REPORT OF THE SUPERINTENDENT

OF THE

COAST AND GEODETIC SURVEY

SHOWING

THE PROGRESS OF THE WORK

FROM

JULY 1, 1902, TO JUNE 30, 1903

WASHINGTON
GOVERNMENT PRINTING OFFICE
1903

National Oceanic and Atmospheric Administration

Annual Report of the Superintendent of the Coast Survey

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LETTER

FROM THE

SUPERINTENDENT OF THE COAST AND GEODETIC SURVEY

SUBMITTING THE

Annual Report for the fiscal year ended June 30, 1903.

COAST AND GEODETIC SURVEY,
Washington, D. C., September 2, 1903.

SIR: In conformity with law and with the regulations of the Treasury Department, 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, 1903. 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.

The Honorable the SECRETARY OF THE TREASURY.

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REPORT OF THE SUPERINTENDENT.

O. H. TITTMANN, *Superintendent.*
FRANK WALLEY PERKINS, *Assistant Superintendent.*

OFFICE OF THE SUPERINTENDENT.

W. B. Chilton, *Clerk.*
H. M. Fitch, *Confidential Clerk.*

THE WORK OF THE YEAR.

Full details of the work of the year are given in the following pages, and they will show that gratifying progress was made in all directions in work devolved on the Survey. This is true of the work along new lines, as well as of the resurveys which are made necessary by the constant changes of the coast line and the depths in rivers, harbors, and ocean bars, the increase in the draft of ships, and by the addition of new features continually added by commercial and other developments. Through the cooperation of the Chief of Engineers, U. S. Army, this Survey is enabled to make full use of the valuable information obtained by the Engineer Corps in their work of river and harbor improvement.

It is the policy of this Bureau to utilize to the fullest extent possible all available sources of information, and thus to avoid duplication of work.

The regions in which work was done are briefly recapitulated as follows:

Astronomic determinations were made in Alaska, Hawaii, Nevada, the Philippine Islands, and Tennessee.

Base lines were measured in the Philippine Islands.

Coast Pilot work was done in Maine, Massachusetts, New Hampshire, Philippine Islands, and Rhode Island.

Gravity was determined in Michigan.

Hydrographic work was done in Alaska, Florida, Massachusetts, Maryland, New York, Philippine Islands, Porto Rico, Virginia, and Washington.

Leveling work was done in Kansas, Louisiana, Nebraska, Oklahoma, Texas, Utah, and Wyoming.

Magnetic observations were made in Alabama, Alaska, Arizona, Arkansas, Atlantic Ocean, Colorado, District of Columbia, Florida, Georgia, Hawaii, Kansas, Louisiana, Maryland, Michigan, Minnesota, Mississippi, Nebraska, New Jersey, New Mexico, Nevada, Ohio, Oklahoma, Pennsylvania, Philippine Islands, Porto Rico, South Carolina, Tennessee, Texas, Virginia, Washington, and Wisconsin.

Reconnaissance work was done in Alaska, Massachusetts, Minnesota, North Carolina, North Dakota, Oregon, and South Dakota.

Tide observations were made in California, Florida, Hawaii, Maryland, New York, Pennsylvania, Philippine Islands, and Washington.

Topographic work was done in Alaska, District of Columbia, Florida, Maryland, Massachusetts, New York, Philippine Islands, Virginia, and Washington.

Triangulation was done in Alaska, Florida, Georgia, Kansas, Maine, Maryland, Massachusetts, Mississippi, New York, North Carolina, Oklahoma, Oregon, Philippine Islands, South Carolina, South Dakota, Texas, Virginia, and Washington.

The field work necessary for the revision of two volumes of the United States Coast Pilot, covering the coast from St. Croix River, Maine, to Point Judith, Rhode Island, was completed.

In Alaska surveys were continued in Icy Straits and Prince William Sound, and the geographic position of points on St. Lawrence and Nunivak islands was determined.

In Porto Rico hydrographic work was continued in the harbors and bays and offshore.

The director of coast surveys in the Philippine Islands, an officer of the Coast and Geodetic Survey (with a detail of assistants), in cooperation with the Insular Government, has continued the important work of charting the imperfectly known waters of the archipelago. The largest vessel belonging to the Survey was also on this duty throughout the year. Detached surveys, based upon astronomic determinations, and including base measure, triangulation, topography, hydrography, and tide observations, were made at various points, and many additional telegraphic longitudes were determined. Magnetic observations were continued. The work of the suboffice of the Survey in Manila was executed with promptness and dispatch. Sixteen new charts were issued during the year, and the following volumes of sailing directions were also issued:

I. North and West Coasts of Luzon.
II. Southwest and South Coast of Luzon and Adjacent Islands.
III. Coasts of Panay, Negros, Cebu, and Adjacent Islands.
IV. Coasts of Samar and Leyte and East Coast of Luzon.
V. Coasts of Mindanao and Adjacent Islands.

Excellent progress was made in the various operations of the magnetic work of the Survey. Magnetic work at sea on board the vessels of the Survey was inaugurated. The determination of the absolute elements of terrestrial magnetism was made in 416 localities, embracing 461 stations, distributed over 31 States and Territories and three foreign countries. Additional details in regard to magnetic work are given under the Office of Inspector of Magnetic Work and in Appendix I to this Report. Magnetic observatories were maintained at Cheltenham, *Maryland;* at Baldwin, *Kansas;* at Sitka, *Alaska*, and at Honolulu, *Hawaii*, and a magnetic observatory was established on Vieques Island, *Porto Rico*. A continuous record of the changes in the earth's magnetism was obtained at these observatories. Special observations were made at the observatories during the year on the 1st and 15th of each month at the formal request of the German Government, in order to cooperate with foreign observatories in international magnetic work during the time of the antarctic expeditions which were sent out from Germany and Great Britain.

Continuous tide observations with self-registering gauges were maintained at eight stations, including one station in Hawaii and one in the Philippine Islands.

The following publications were received from the Public Printer and issued during the year:

Annual Report for 1902; List and Catalogue of Publications 1816–1902; United States Coast Pilot for Chesapeake Bay and Tributaries (revised edition); Catalogue of Charts (revised edition); Tide Tables for 1903 and 1904; United States Declination Tables for 1902. The usual Monthly Notices to Mariners were prepared, published, and issued each month.

In the Office the current work was kept up to date and very satisfactory progress was made in the various branches of its work, including computation, reduction, platting, and discussion of results of field work, and the preparation of results for publication by chart and otherwise. A large amount of special work was also done for other Departments, notably for the State Department for use in the preparation of the United States case for presentation to the Alaska Boundary Tribunal, including special drawings and maps, the photographic reproduction of numerous old maps and their preparation for photolithographing, and the preparation, verification, and general supervision of two atlases.

Satisfactory results were obtained during the year at the latitude observatories maintained under the direction of the Survey at the expense of the International Geodetic Association at Gaithersburg, Md., and Ukiah, Cal., for the purpose of measuring the variations of latitude.

The Superintendent was appointed a member of the commission created to re-mark the boundary line between the United States and Canada from the Rocky Mountains westward, and two officers were detailed for the field work. Two officers were detailed to assist in the preparation of the United States case for presentation to the Alaska Boundary Tribunal, and the Superintendent also aided in this work personally and by preparing material at the office in Washington. One officer continued on duty as a member of the Mississippi River Commission. The two officers appointed by the United States Supreme Court to retrace and mark the boundary line between the States of Virginia and Tennessee completed that duty and joined in making the final report which settled a controversy a century old. The officer assigned to make a resurvey of Mason and Dixon's Line, at the request of the commission created by the States of Maryland and Pennsylvania, continued the work of reestablishing the old monuments. One officer was detailed to the charge of the triangulation of the city of New York, and another to the charge of the preparation of the Coast and Geodetic Survey exhibit for the Louisiana Purchase Exposition. One officer took charge of the survey of the Louisiana oyster beds, in cooperation with the State oyster commission. Five speed trial courses were verified at the request of the Navy Department. A portion of the boundary line between Esmeralda and Nye counties, Nev., was established by astronomic observations at the request of the county authorities, and one officer assisted in laying a cable to the Farallone Islands, off the coast of California.

Details in regard to the field work of the year can be found in Appendix 1 to this Report.

The appropriations for the United States Coast and Geodetic Survey on account of the fiscal year of 1903 amounted to $849 460. Of this amount the sum of $210 245 was

for the pay of officers and men and to man and equip the vessels of the Survey, and $29 000 was for the repairs and maintenance of the vessels of the Survey. The sum of $40 000 was for Office expenses. The remainder of the appropriation was about equally divided between expenses of parties in the field and salaries of the field and office forces.

I. 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 distributed free, and of the sale of the Charts, Coast Pilots, and Tide Tables published by the Survey. All the routine work connected with the above duties was done under his direction by the employees in the Office. Details in regard to all of this work are given in Appendix 2 to this Report by extracts from the report of the Assistant in Charge and by a compilation from the reports of the Chiefs of Divisions.

II. OFFICE OF INSPECTOR OF HYDROGRAPHY AND TOPOGRAPHY.

H. G. OGDEN, *Inspector.*

A.—Inspection.

Personnel.

Name.	Occupation.
D. B. Wainwright	Assistant.
J. H. Roeth	Clerk; July 1 to Aug. 6.
J. M. Griffin	Clerk; Aug. 4 to June 30.
R. D. Chase	Clerk.
B. W. Bembry	Writer; July 7 to 21.

The Inspector visited the field parties engaged in the hydrographic survey of Chesapeake Bay in the fall of 1902 and made numerous trips to inspect the different vessels and supervise the repairs of the vessels while in progress. He also performed such special duties as were assigned to him from time to time. In his absence Assistant Wainwright took his place as Acting Inspector and performed such duties as required immediate attention. Assistant Wainwright devoted the greater portion of his time to special work which was assigned to him. An account of this work is given under his name in Appendix I.

All matters of detail connected with the hydrographic and topographic work in the field and with the vessels of the Survey received attention and the usual routine duties of correspondence and of keeping the record of the ships, including enlistments, discharges, hospital service, ratings, etc., necessary in revising the pay rolls were kept up to date. Orders and instructions to the hydrographic and topographic parties were prepared for issue by the Superintendent.

The work of the Coast Pilot party is under the direction of the Inspector and details are given under the heading, "B.—Coast Pilot party." The Inspector calls attention to the fact that the party while engaged in collecting information in the field for the revision of Coast Pilot volumes, as stated in Appendix I, located 97 rocks and ledges, 50 of which had not been previously reported, and that this information required 29 separate items in the Notices to Mariners to give the necessary information to the public.

Assistant Ogden states in his report that the officers and clerks under his direction rendered most efficient and satisfactory service.

THE VESSELS AND THEIR HYDROGRAPHIC WORK.

THE STEAMER BACHE.

Assistant P. A. Welker, Commanding.

On July 1, 1902, this vessel was at Baltimore, Md., undergoing repairs. On the 16th she sailed for her working grounds at Hyannisport, Mass., arriving there on the 24th, and during the summer was engaged in hydrographic examinations in Nantucket Sound and a resurvey of Pollock Rip Slue. In October a special examination was made at Rockport, Mass., at the request of the Navy Department, and on October 20 field work was closed and the vessel returned to Jersey City, N. J., to outfit for the next season's work in Porto Rico.

On January 13 she sailed for San Juan, P. R., arriving there on the 20th. She was engaged on the hydrography of the west coast of the island in the vicinity of Mayaguez until March 27, when she sailed for Key West, Fla., to make some special examinations in that vicinity requested by the Navy Department. On June 9 she sailed from Key West to Fort Monroe, Va., arriving there on the 14th, having stopped en route at Charleston, S. C., for magnetic observations. On the 19th she sailed for Baltimore, Md., to complete arrangements for repairs, and at the close of the year was still there.

THE STEAMER BLAKE.

Assistant R. L. Faris, Commanding.
Assistant D. B. Wainwright, Commanding.

On July 1, 1902, this vessel was at Baltimore, Md., refitting for work on the New England coast, and on the 20th she sailed for Hyannisport, Mass., arriving there on the 23d. During the summer she was engaged in examinations and resurveys in Nantucket Sound that had been requested by the Navy Department. She continued on this work until September 20, and then proceeded to New Bedford to locate a rock discovered by the U. S. S. *Brooklyn* when leaving that port after the summer maneuvers. She remained at Buzzards Bay making further examinations until October 8, and then

sailed for Baltimore, Md., to undergo extensive repairs before proceeding again to Porto Rico. On January 21 she sailed for San Juan, P. R., arriving there on the 27th. She was engaged during the season in Porto Rico in a survey of Vieques Sound. On May 30 she sailed for Fort Monroe, Va., where she arrived on June 5, and after receiving bids for repairs sailed for Baltimore, Md., on the 9th. She arrived at Baltimore on the 10th, where additional bids for repairs were secured. The repairs having been awarded to a Norfolk firm, she sailed for Norfolk on the 22d, and was placed in the hands of the contractors, where she was at the close of the year.

On the arrival of the ship at Baltimore in October she was extensively repaired to strengthen her for the voyage to Porto Rico. Several of the main-deck beams were renewed and a new main deck was laid. She was also refastened and remetaled.

The hydrographic survey of Vieques Sound was executed with great care and more than ordinary detail. The statistics show an average of 15½ linear miles of sounding lines and over 400 soundings to 1 square mile of area. As an additional precaution in the execution of this work two leadsmen were employed at all times, but the soundings of only one leadsman was recorded, the second leadsman being used as a check upon the first. The limits of the previous season's work seem to have covered the area of the irregular bottom, as Assistant Faris reports that during the last season the average depths were from 12 to 15 fathoms, the only shoal spot having been developed near the center of the Sound with about 7½ fathoms.

On July 15, 1902, Assistant D. B. Wainwright assumed command of the ship during the temporary absence of Assistant Faris. He was relieved on August 13, Assistant Faris having returned to duty.

THE SCHOONER EAGRE.

Assistant J. B. Boutelle, Commanding.

At the opening of the year this vessel was employed upon experimental work in connection with the wireless telegraph in the vicinity of New York, and on July 16, 1902, she sailed for Oxford, Md., to resume the hydrographic survey of the Choptank River. Her operations included the hydrography along the shore of the bay from Poplar Island to Jaynes Point. On the 16th of December she sailed for Baltimore, and was put in ordinary for the winter. She was not put in commission again, as her disposal had been decided upon, and she had been offered to the Navy. The negotiations were still pending at the close of the year.

THE STEAMER ENDEAVOR.

Assistant F. A. Young, Commanding.

On July 1, 1902, this vessel was at work on the Kettle Bottoms, Potomac River, and continued on that survey until December 18, when she sailed for Baltimore, Md., for a general overhauling and repairs. She was laid up at Baltimore during the winter under a reduced crew until May 29, when she sailed for Colonial Beach, Va., to resume work on the Kettle Bottoms, and at the close of the year she was still engaged upon that survey.

THE STEAMER HYDROGRAPHER.

John Ross, Nautical Expert, Commanding.
Assistant H. W. Rhodes, Commanding.
Assistant W. I. Vinal, Commanding.

At the beginning of the year this vessel was at Eastport, Me., engaged upon a field revision of United States Coast Pilots, Parts I–II and III, extending from the eastern boundary to Narragansett Bay. She completed this work and arrived at New York on October 22, and in Washington on November 1. On November 12 Assistant H. W. Rhodes was assigned to the command, and she proceeded on the same date to Chincoteague Inlet, Virginia, for a resurvey of the shoals off Fishing Point. This work was completed on December 18, when she sailed for Norfolk, Va., on her way to Key West, Fla. The necessary repairs were put on the ship while she was at Norfolk, and she sailed on January 31 for Key West, arriving there on February 4.

While at Key West the position of Smith Shoal Bank that had recently been discovered north of Northwest Passage was determined, and the triangulation was extended to redetermine positions on the Keys as far as the Marquesas to facilitate the hydrographic surveys to be undertaken later by the steamers *Bache* and *Hydrographer* jointly.

On the 31st of March Assistant Rhodes was relieved of the command of the vessel by Assistant W. I. Vinal, and from that date until the close of the season the *Hydrographer's* work was continued in conjunction with the steamer *Bache*.

On June 9 the field work was closed and the vessel sailed for Norfolk, arriving there on the 16th, and proceeded to Baltimore on the 19th, where she was at the end of the year, awaiting the award of proposals that had been invited for repairs.

THE SCHOONER MATCHLESS.

Assistant G. L. Flower, Commanding.

At the beginning of the year this vessel was at work in Tangier Sound, and, completing the surveys in that vicinity, sailed for Baltimore on October 23, for a necessary overhauling. On November 19 she proceeded to Elk River, Maryland, and made a further examination of the hydrography near the mouth of that river. She returned to Baltimore on December 14, where repairs previously arranged for were put upon the vessel, and on February 6 she sailed for West River, Maryland, to take up the hydrographic and topographic surveys of the bay southward, to include Herring Bay. She continued on that work until April 17, when she sailed for Annapolis and began a resurvey of the Severn River, upon which work she was engaged at the close of the year.

THE SCHOONER QUICK.

THE SCHOONER SPY.

THE SCHOONER TRANSIT.

These vessels are moored at Madisonville, La., in the charge of a ship keeper.

THE STEAMER GEDNEY.

Assistant E. F. Dickins, Commanding.

This vessel was at Seattle, Wash., on July 1, 1902, having been put in commission on the first of the preceding month. On July 3 she sailed for her working ground

in Icy Strait, and during the summer was engaged in completing the hydrography in that vicinity. On October 15 she closed field work and sailed for Seattle, arriving there on the 24th, where she was supplied with a new propeller, and, on November 9, she sailed for San Francisco and was put out of commission on November 30 at Oakland, Cal.

On June 29 she was put in commission at Oakland, and at the close of the year was outfitting to resume operations in southeast Alaska in the vicinity of Davidson Inlet.

THE STEAMER McARTHUR,

Assistant F. Westdahl, Commanding.

At the beginning of the year this vessel was on her working ground in Prince William Sound, Alaska, and during the season she completed the survey of the entrance, including the determination of the Sea Lion Rocks. On October 2 she sailed for San Francisco, via Juneau and Seattle; arriving at the latter place on the 24th and at San Francisco on November 2, and was placed out of commission on November 30. Since that date she has been laid up in the charge of shipkeepers in Oakland Creek, California.

THE STEAMER PATHFINDER,

Assistant J. J. Gilbert, Commanding.

On July 1 this vessel was engaged in a survey of San Bernardino Strait and vicinity, Philippine Islands. Subsequently surveys were made of San Pedro Bay and the south coast of *Samar* to Sungi Point, and before the close of the season on the southwest coast of *Leyte*, including a search for Carmen Rock, and to define the limits of Danajon Bank. The surveying season closed with March, and the ship proceeded to Hongkong, China, to be overhauled, arriving there April 12, and was still there at the close of the year.

THE STEAMER PATTERSON,

Assistant J. F. Pratt, Commanding.

This ship was at Seattle, Wash., at the beginning of the year, and sailed from there for Dutch Harbor and Bering Sea on July 19, arriving there on the 30th. She was engaged during the season in transporting chronometers between St. Michaels and St. Lawrence and Nunivak Islands and Dutch Harbor. The field work was closed at the end of September, and on October 7 she sailed for Seattle, Wash., arriving there on the 24th. The crew was immediately reduced to a minimum and the ship put in the hands of the contractor to complete certain repairs that had been deferred until a convenient time. On January 24 she was put out of commission, and early in May was again put in commission, and sailed for Sitka on the 17th of June in compliance with instructions to proceed to Controller Bay and Prince William Sound, and incidentally on the outward voyage to run sounding lines Cape Flattery–Sitka and Sitka–Prince William Sound that had been requested by the Chief Signal Officer U. S. Army.

THE STEAMER YUKON.

This vessel was laid up at St. Michael, Alaska, at the close of the season of 1900, and has not been in service since that date, but in the fall of 1902, when the *Patterson* had completed her trips with chronometers in Bering Sea, she was brought down to Dutch Harbor by a crew detailed from the *Patterson* and hauled out at that place and remained there at the close of the fiscal year.

THE STEAMER TAKU.

Assistant H. P. Ritter, Commanding.

This vessel was laid up in the vicinity of Orca, Alaska, during the winter, and was used by Assistant H. P. Ritter in the late spring for the accommodation of his party during the summer months in the surveys of the upper part of Prince William Sound. She was laid up again in the fall when the party was disbanded. In May last, when Assistant Ritter resumed field work, he again took her out for the accommodation of his party, and she was in use by his party at the close of the fiscal year.

B.—Coast Pilot party.

Personnel.

Name.	Occupation.
John Ross	Nautical Expert.
H. C. Graves	Do.
H. L. Ford	Do.
F. H. Ainsworth	Watch Officer; Jan. 1 to 23.
T. O. Pulizzi	Writer.

At the beginning of the fiscal year United States Coast Pilot, Part VI and a supplement to Part VII were in the hands of the printer, and the proof reading of Part VI had been completed. The finished volume of Part VI was received on July 21 and the supplement to Part VII on the 22d. The preparation of the volume of the United States Coast Pilot covering the Pacific coast was continued during the year by Mr. H. L. Ford when not on other duty. A supplement to Part VIII was prepared and sent to the printer on November 21 and was received in printed form on January 7. The revision of Parts I–II, from information obtained and from notes made in the field by the Coast Pilot party early in the fiscal year, was completed, and on February 16 the manuscript was sent to the printer. The proof reading of this volume was completed before June 30. A supplement to Part IV was prepared and sent to the printer on February 21 and a supplement to Part V on February 24. These supplements were received in print on April 2 and 4, respectively. The revision of Part III, from information obtained and from notes made in the field by the Coast Pilot party, was completed.

The usual routine office work of keeping a record of all changes, reported dangers, hydrographic examinations, new information available, and other data necessary for the compilation, revision, and correction of the Coast Pilot volumes was kept up to date. The correction of all Coast Pilot volumes by hand to date of issue from the Office required a considerable portion of the time of the party. The following members of the party were absent on duty in the field for the periods covered by the dates given, and the account of their work in the field is given under the proper headings in Appendix I to the Annual Report.

John Ross, Nautical Expert, July 1 to November 10.
H. C. Graves, Nautical Expert, July 1 to November 10.
H. L. Ford, Nautical Expert, November 12 to December 30.

During the absence of Mr. John Ross in the field, Mr. H. L. Ford had immediate charge of the work in the office. A larger number of Coast Pilot volumes than usual were issued during the year and the demand for them is increasing.

The following table shows the number of volumes of the Coast Pilot corrected for issue during the fiscal year:

Parts.	Vols.	Parts.	Vols.
I–II	14	VII	214
III	67	VIII	261
IV	358	Alaska C. P.	99
V	248		
VI	588	Total	1 849

III. OFFICE OF INSPECTOR OF GEODETIC WORK.

J. F. HAYFORD, *Inspector.*

The duties of the Inspector of Geodetic Work were performed at the Office in Washington and no trips to the field on inspection duty were necessary during the fiscal year. The necessary supervision was exercised continually throughout the year by a careful examination of the correspondence with field parties, by examination of the records sent in from time to time, and by an inspection of the computations and results.

IV. OFFICE INSPECTOR OF MAGNETIC WORK

L. A. BAUER, *Inspector.*

The duties performed by this office involved the inspection of the field work of the magnetic survey of the territory of the United States and the work at the magnetic observatories. The necessary directions and information required by the field and observatory parties were prepared and the records made by them were carefully examined. The Inspector visited the parties at work in Maryland, Pennsylvania, Wisconsin, Minnesota, Nebraska, Kansas, and Texas during September, October, and November, and went to Porto Rico and Florida in February and March.

The entire activity of the Survey in magnetic work during the fiscal year may be summarized as follows:

Magnetic work on land.—The determination of the elements of terrestrial magnetism was made in 416 different localities, embracing 461 stations, distributed over 31 States and Territories (also at stations in three foreign countries), as stated in the table on the following page.

Summary of magnetic survey work executed between July 1, 1902, and June 30, 1903.

State.	Number of localities.	Number of stations.	Old localities reoccupied.	Declination observed.	Dip observed.	Intensity observed.
Alabama	6	6	2	6	6	6
Alaska	5	10	3	10	1	1
Arizona	42	54	2	58	54	53
Arkansas	2	2	..	2	2	2
Colorado	4	5	1	5	5	5
District of Columbia	1	1	1	12	8	11
Florida	25	26	5	27	29	28
Georgia	4	4	1	5	8	7
Hawaiian Islands	1	1	1	1	1	1
Kansas	48	49	5	60	64	64
Louisiana	15	15	2	15	15	18
Maryland	7	8	5	16	13	14
Michigan	7	14	3	14	16	17
Minnesota	1	3	1	3	3	3
Mississippi	6	6	1	6	6	6
Nebraska	19	19	1	20	21	21
Nevada	3	3	..	3	..	..
New Jersey	1	1	..	1	1	1
New Mexico	7	7	1	7	7	7
New York	2	2	..	2	..	..
Ohio	18	19	1	18	19	19
Oklahoma	1	1	..	1	1	1
Pennsylvania	42	52	5	52	42	44
Philippines	9	9	1	9	9	9
Porto Rico	9	9	3	11	7	10
South Carolina	4	4	1	4	8	4
Tennessee	1	1	..	1	..	..
Texas	71	72	8	76	78	79
Virginia	11	12	1	12	12	12
Washington	1	1	1	1	1	1
Wisconsin	1	1	1	1	1	2
Atlantic Ocean	32	32	..	32	..	..
Pacific Ocean	1	1	..	1	..	..
Foreign countries	9	11	..	11	12	13
Total	416	461	57	503	450	459

Special examinations were made in the locally disturbed areas in the vicinity of Mackinac Straits, Michigan, and Duluth, Minn., and the regions around Phoenix and Flagstaff, Ariz., were examined to ascertain whether it was practicable to establish a magnetic observatory near either place.

Magnetic work at sea.—A series of observations to determine the magnetic declination, dip, and intensity was made on board the steamer *Blake* in January, during her voyage from Baltimore to Porto Rico, and on her return trip in May and June, and the ship was "swung" three times on the outward and twice on the return voyage. A series of magnetic observations was made on the steamer *Bache*, with her standard compass, on a voyage from Key West, Fla., to Norfolk, Va., in June, "swinging" the ship three times. Similar observations were made on the steamer *Patterson* on her voyage between Seattle, Wash., and Sitka, Alaska, in June, and the ship was "swung" twice. These surveying vessels belong to the Coast and Geodetic Survey, and all the vessels of the Survey will hereafter aid in this work at sea to the extent permitted by their instrumental outfit and the exigencies of the service upon which they are engaged.

Magnetic observatory work.—Continuous magnetic records were obtained with self-registering instruments throughout the year at the four observatories maintained, at Cheltenham, *Maryland*, Baldwin, *Kansas*, Sitka, *Alaska*, and Honolulu, *Hawaii*, and after March 1 at Fort Isabel, Vieques Island, *Porto Rico*. All of the observatories cooperated, in special observations, with the Antarctic expeditions, and with Professor Birkland in connection with his Norwegian polar light work, to the extent permitted by their instrumental outfit.

The Ziegler North Polar Expedition and the expedition of the Baltimore Geographic Society to the Bahama Islands were supplied with the necessary instruments, the observers were instructed in their use, and a memorandum was prepared for the Superintendent, suggesting directions in detail for the guidance of these two expeditions in their magnetic work, in response to requests made to him by the officers in charge.

V. OFFICE OF THE DISBURSING AGENT.

SCOTT NESBIT, *Disbursing Agent.*

Personnel.

Name.	Occupation.
N. G. Henry	Confidential clerk and cashier.
Ida M. Peck	Typewriter and clerk.
Jennie H. Fitch	Clerk.
Louis C. Ritchie	Captain's clerk (temporarily detailed in connection with the accounts of vessels).

The disbursement of the funds of the Coast and Geodetic Survey is made not only by payments directly from the Disbursing Agent, but also largely through the medium of its Assistants and other officers when acting as chiefs of parties. These officers, on approval of the Superintendent, receive advances of public funds from the Disbursing Agent in lump sums, under authority of an Executive order dated March 26, 1886.

In conformity to this order there are now 56 officers of this Survey bonded in the sum of $2 000 or more each. When acting as chiefs of parties these officers receive from time to time such advances of public funds from the Disbursing Agent as are required to meet the necessary current expenses of the work in hand.

A ledger account is kept in the office of the Disbursing Agent with each chief of party receiving an advance, each one being charged with all advances made to him, and, on the other hand, receiving credit for all proper expenditures made by him when presented on regularly supported vouchers after such accounts have been audited in the office of the Disbursing Agent and found to be correct. All of these accounts, with their supporting vouchers, are then sent to the First Auditor of the Treasury for examination and audit by him.

This system has met the needs of this service, and results, in the main, in economy and good order in its expenditures.

The statement of expenditures in detail will be submitted to Congress as usual in a separate report, and will appear in the Annual Report of the Superintendent for the fiscal year ending June 30, 1904.

VI. OFFICE OF THE EDITOR OF PUBLICATIONS.

ISAAC WINSTON, *Editor.*

Personnel.

Name.	Occupation.
C. J. Hellerstedt.....	Stenographer and typewriter, July 1 to Aug. 18.
A. R. Decker.....	Stenographer and typewriter, Sept. 3 to Apr. 13.
E. C. Hall.....	Stenographer and typewriter, Apr. 14 to June 30.

The compilation of the Annual Report (pp. 1 to 799) covering the progress of the work of the Survey during the fiscal year July 1, 1901, to June 30, 1902, was completed, made ready for printing, and laid before Congress on December 17, 1902. This report was available for issue in the following May. The proof of the United States Declination Tables for 1902 (pp. 1 to 405) and of the List and Catalogue (pp. 1 to 237) of the publications issued by the Survey 1816–1902 was read, and these publications were issued during the year.

Numerous requests for information were referred to the Editor, who compiled the necessary data. The record of all the officers of the Survey who rendered service in the United States Army and Navy during the war of the rebellion was compiled from the Annual Reports and from the Archives of the Survey for the use of the Secretary of War and the Secretary of the Navy. All laws bearing on the Coast and Geodetic Survey, with a statement showing changes made in recent years, were compiled for the use of the Department of Commerce and Labor.

Progress was made in the compilation of the Annual Report covering the operations of the Survey, July 1, 1902, to June 30, 1903.

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

Report of the Superintendent Coast and Geodetic Survey, showing the progress of the work, July 1, 1901, to June 30, 1902, with the following appendices, published also as separates:

No. 3. Triangulation in Kansas.

No. 5. The Magnetic Observatories of the United States Coast and Geodetic Survey, in operation July 1, 1902.

No. 6. Results of Magnetic Dip and Intensity Observations made by the United States Coast and Geodetic Survey between January, 1897, and June 30, 1902.

No. 7. Hawaiian Geographic Names.

No. 9. A Bibliography of Geodesy.

List and Catalogue of the publications issued by the United States Coast and Geodetic Survey, 1816–1902.

United States Declination Tables and Isogonic Charts for 1902, and Principal Facts relating to the Earth's Magnetism.

United States Coast Pilot, Atlantic Coast, Part VI, Chesapeake Bay and Tributaries.

Tide Tables for the year 1903.

Tide Tables for the year 1904.

Twelve Notices to Mariners (one for each month).

The following volumes of sailing directions were prepared and published in Manila, P. I., and issued from the Suboffice at that place.

I. North and West Coast of Luzon.
II. Southwest and South Coast of Luzon and Adjacent Islands.
III. Coasts of Panay, Negros, Cebu, and Adjacent Islands.
IV. Coasts of Samar and Leyte and East Coast of Luzon.
V. Coasts of Mindanao and Adjacent Islands.

NECROLOGY.

The following officers of the Survey died while on active service during the fiscal year:

William C. Willenbucher, one of the most expert hydrographic draftsmen in this country, died of heart disease at Providence Hospital on the 2d of July. Mr. Willenbucher entered the Coast Survey Office as assistant to his father, the then principal hydrographic draftsman, in 1873, and in 1892 succeeded to his position. His long experience, both in field and office, together with a peculiar natural aptitude, had developed a power of interpretation of hydrographic work which has rarely been equaled, and his loss to this Survey is one that will long be felt.

W. E. Gordon, an Extra Observer, in the Philippine service of the Coast and Geodetic Survey, died of cholera at Danao, Island of Negros, Philippine Islands, on November 11, 1902. He was born at Rosedale, Ind., March 9, 1869, and completed his education by a two-years' course at the Missouri State University. After leaving college he entered the service of the United States as a civil engineer on river improvement work under the direction of the Corps of Engineers, U. S. Army, in 1893, and remained until 1894, when the work upon which he was engaged was discontinued. He was then employed as a surveyor by the Mendota Coal and Mining Company of Mendota, Mo., and remained in their service until he entered the Coast and Geodetic Survey, Philippine Service, except for a short time during the Spanish war, when he served four months in 1899 as first-class sergeant, Sixth Company, U. S. Volunteer Signal Corps, until mustered out with his company, and received his discharge with indorsement as follows: "Service honest and faithful. Character excellent. Served in command most satisfactorily." He entered the Coast and Geodetic Survey, Philippine Service, February, 1902, and after reaching the islands received an appointment as Extra Observer, and the Director of Coast Surveys has stated that he rendered "excellent and faithful service."

Charles Albert Thompson, Watch Officer, Coast and Geodetic Survey, was born at Newport, R. I., on September 30, 1850, and died at Providence Hospital, Washington, D. C., on November 17, 1902. He attended St. Johns College, Fordham, N. Y., and the Military School at Middletown, Conn. He graduated in the public schools in New York and at the United States Naval Academy at Annapolis, Md., in 1872. After graduating at the Naval Academy, he served seven years in the United States Navy, and also served in the Spanish war as ensign, United States Navy, July 2, 1898, to February 8, 1899. He entered the service of the Coast and Geodetic Survey as a Watch Officer on July 1, 1899, and remained in the service until he died. He was buried in the national cemetery at Arlington with the honors of the service accorded him by the officers and sailors of the steamer *Endeavor*.

APPENDIX 1.

REPORT 1903.

DETAILS OF FIELD OPERATIONS.

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Georgia.
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Maryland.
Massachusetts.
Michigan.
Mississippi.
New Hampshire.
New Jersey.
New York.
North Carolina.
Ohio.
Pennsylvania.
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Vermont.
Virginia.
West Virginia.
Wisconsin.

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20	Tide observations (continuous).	Florida. Maryland. New York. Pennsylvania.			70
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23	Experimental observations. Wireless telegraphy. Channel and harbor sweep. Quick sounding machine.		Wainwright.		73
24	Magnetic observations.	Alabama. Florida. Georgia. Mississippi. South Carolina.	Wallis.		75
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26	Hydrography. Topography. Triangulation.	Maryland. Virginia.	Young.	Endeavor.	79

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28	Triangulation.	Kansas. Oklahoma. Texas.	Bowie.		81
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58	Astronomic observations. Base measurement. Hydrography. Triangulation.	Philippine Islands.	Bowie.		120
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61	Triangulation.	Philippine Islands.	Fairfield.		128
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EASTERN DIVISION.

MAGNETIC OBSERVATIONS. MARYLAND. MICHIGAN. PENNSYLVANIA. WISCONSIN. L. A. BAUER.

S. A. DEEL, *Magnetic Observer.* July 6–25.
J. H. EGBERT, *Assistant Surgeon.*
G. C. BALLARD, *Assistant Surgeon.*

While engaged on inspection duty in the Eastern Division Assistant Bauer made magnetic observations at the following stations in *Maryland:* Cheltenham, Fort McHenry, Linden, and Upper Marlboro; in *Michigan*, at Harbor Point, Houghton, Mackinac Island, Marquette, Round Island, and Saulte Sainte Marie; in *Pennsylvania*, at Allegheny, Doylestown, and Greensburg; in *Wisconsin*, at Milwaukee. Four stations were occupied on Mackinac Island, and one on Round Island, *Michigan*. He also occupied a station at Fort William, Ontario, Canada. At the stations in *Michigan* and *Wisconsin* the regular observations to determine declination, dip, and horizontal intensity were made with a magnetometer, and dip circle observations were also made with a Lloyd-Creak dip circle, standardized at the Cheltenham Observatory, to determine dip and relative total intensity.

Asst. Surgs. G. C. Ballard and J. H. Egbert were instructed in the use of instruments and methods in the field at Upper Marlboro and Linden, *Maryland*. After receiving the necessary instructions Doctor Egbert made observations at three stations in *Maryland*, Boyds, Dawsonville, and Rockville.

S. A. Deel, magnetic observer, was assigned to extend the magnetic survey in *Pennsylvania* under direction of Assistant Bauer, and made observations at the following stations between July 7 and 25: Bedford, Butler, Kittanning, Somerset, and Waynesburg. He closed work on July 26 and returned to Washington.

HYDROGRAPHY. TRIANGULATION. MARYLAND. J. B. BOUTELLE, Commanding, Schooner *Eagre.*

R. McD. MOSER, *First Watch Officer.*	July 1 to Sept. 19.
G. E. MARCHAND, *Surgeon.*	Nov. 26 to Dec. 16.
SWEPSON EARLE, *Deck Officer.*	July 1 to Oct. 31.
C. M. SPARROW, *Aid.*	
G. A. BERRY, *Deck Officer.*	Oct. 4 to Dec. 16.
F. N. PINNER, *Deck Officer.*	July 1 to July 29.
J. W. YATES, *Deck Officer.*	July 1 to Sept. 3.
L. S. PIQUETT, *Deck Officer.*	July 1 to Dec. 16.
C. E. SKEEN, *Deck Officer.*	July 1 to Dec. 16.

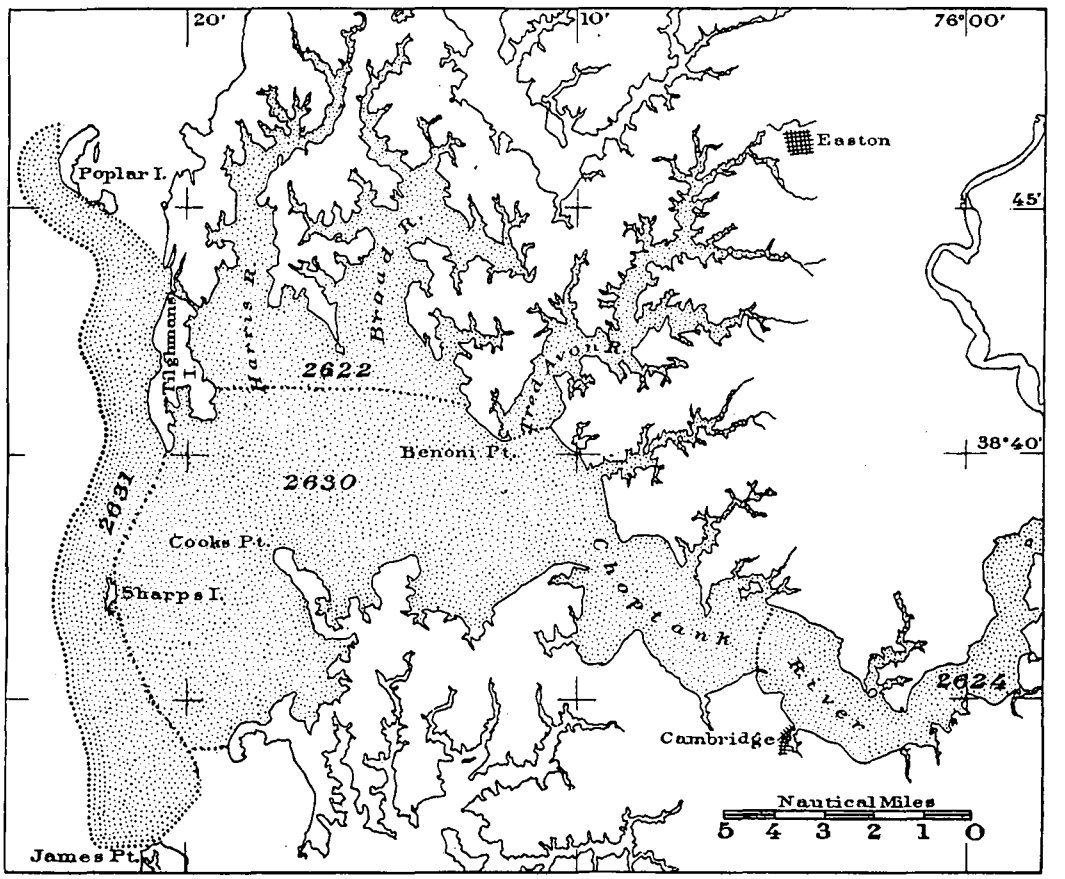
SUMMARY OF RESULTS.

Hydrography:
- 71 square miles area covered by soundings.
- 1 004 miles lines sounded.
- 104 327 soundings made.
- 1 tide station established.
- 2 current stations established.
- 4 hydrographic sheets completed.

Triangulation:
- 7 stations occupied.
- 9 geographic positions determined.

On July 1 the *Eagre*, J. B. Boutelle, Assistant, Coast and Geodetic Survey, commanding, was engaged in making experiments with wireless telegraph apparatus off

No. 1.



Hydrography, Chesapeake Bay.

Long Island, N. Y., under the direction of Assistant D. B. Wainwright, and the account of the work can be found under his name. These experiments were concluded on July 11, and the vessel proceeded to Oxford, Md., via New York.

The *Eagre* reached Oxford on July 20, and took on board the party (five officers and five seamen) landed there during the previous month in charge of Watch Officer Moser to continue the hydrographic work during the absence of the vessel, and resumed the work in the Choptank River and tributary creeks with the full complement of officers and men. On August 11 the vessel was moved to Harris Creek at Tilghmans Island, and from this anchorage the hydrographic work in the creeks named above at the mouth of the Choptank River and on the shoals on the eastern side of Chesapeake Bay between Poplar Island and James Point was completed. A survey was also made of the 15-foot shoal about 3 miles south and west of James Point.

On October 29 the vessel proceeded to Cambridge, Md., and continued the survey of the Choptank River as far as Cabin Creek until December 16, when the work for the season closed and the vessel went to Baltimore.

The weather was favorable until November and the work made good progress, but during that month and in December there was much delay on account of bad weather.

TOPOGRAPHY. MARYLAND. J. W. DONN.
VIRGINIA.

SUMMARY OF RESULTS.

Virginia.—July 1 to November 29.

31 square miles area covered.
49 miles shore line rivers surveyed.
45 miles shore line creeks surveyed.
39 miles railroads surveyed.
135 miles roads surveyed.
3 topographic sheets completed.

Maryland.—May 1 to June 30.

15 square miles area covered.
14 miles river shore line surveyed.
54 miles roads surveyed.
2 topographic sheets completed.

The topographic survey of the Potomac River was in progress on July 1 by a party under the direction of Extra Observer J. W. Donn, and was continued until November 29, when work was suspended for the winter. During this time the survey of the west bank of the river was completed from Accotink Creek to Roslyn, Va., opposite Georgetown, D. C. Advantage was taken of the proximity of this work to Washington to assign several Aids, recently appointed, to the party for instruction in the topographic methods used in the Service, and during July and August four aids, Messrs. Loren, King, Carpenter, and Libby, were ordered to report to Mr. Donn. None of these young men had had any experience in togographic work, but they all had a desire to learn, and Mr. Donn gave them earnest attention. Unfortunately for the purpose in view the exigencies of the Service demanded their assistance elsewhere, and it was necessary to relieve them before any of them had received a month's instruction.

It was impracticable to secure suitable quarters in the vicinity of Mount Vernon, and the party was established at Alexandria. In many respects this place proved to

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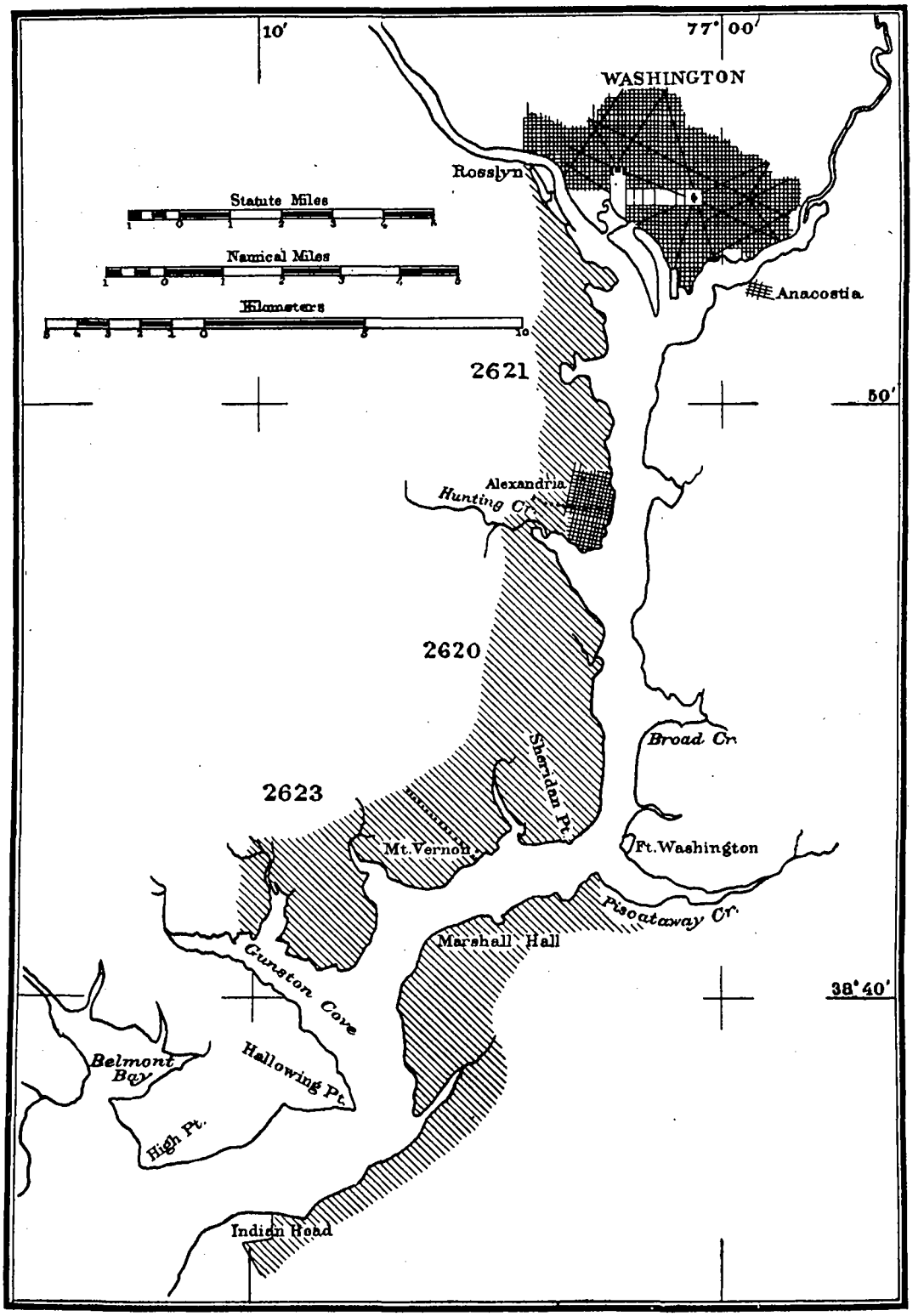


Topography, Potomac River.

be very convenient and the work was easily reached on both sides of the city. The weather conditions were unusually favorable throughout the season, which made it possible to complete the work, very much in detail, within the limits stated.

Topographic work on the Potomac River was resumed by a party under charge of Extra Observer Donn on May 1, and continued during the remainder of the fiscal year. The preliminary arrangements were made previous to that date, and the party was fortunate in securing the use of an unoccupied house where a mess was established. The country is sparsely settled, and it was not possible to secure board within a reasonable distance of the working ground. The party was subsisted with difficulty at this house, but it was conveniently located, and this plan of living was the most feasible that could be adopted under the existing conditions. The few existing roads were in bad condition and the necessity of using them delayed the work considerably. It was necessary to traverse a large portion of the area on foot, which also caused delay.

The area surveyed extends along the Maryland side of the Potomac River from Piscataway Creek to Indian Head. This work was completed by the end of the fiscal year and preparations were in progress to continue the topographic work on the Virginia side of the river after June 30.

TRIANGULATION. GEORGIA. W. B. FAIRFIELD.
SOUTH CAROLINA.

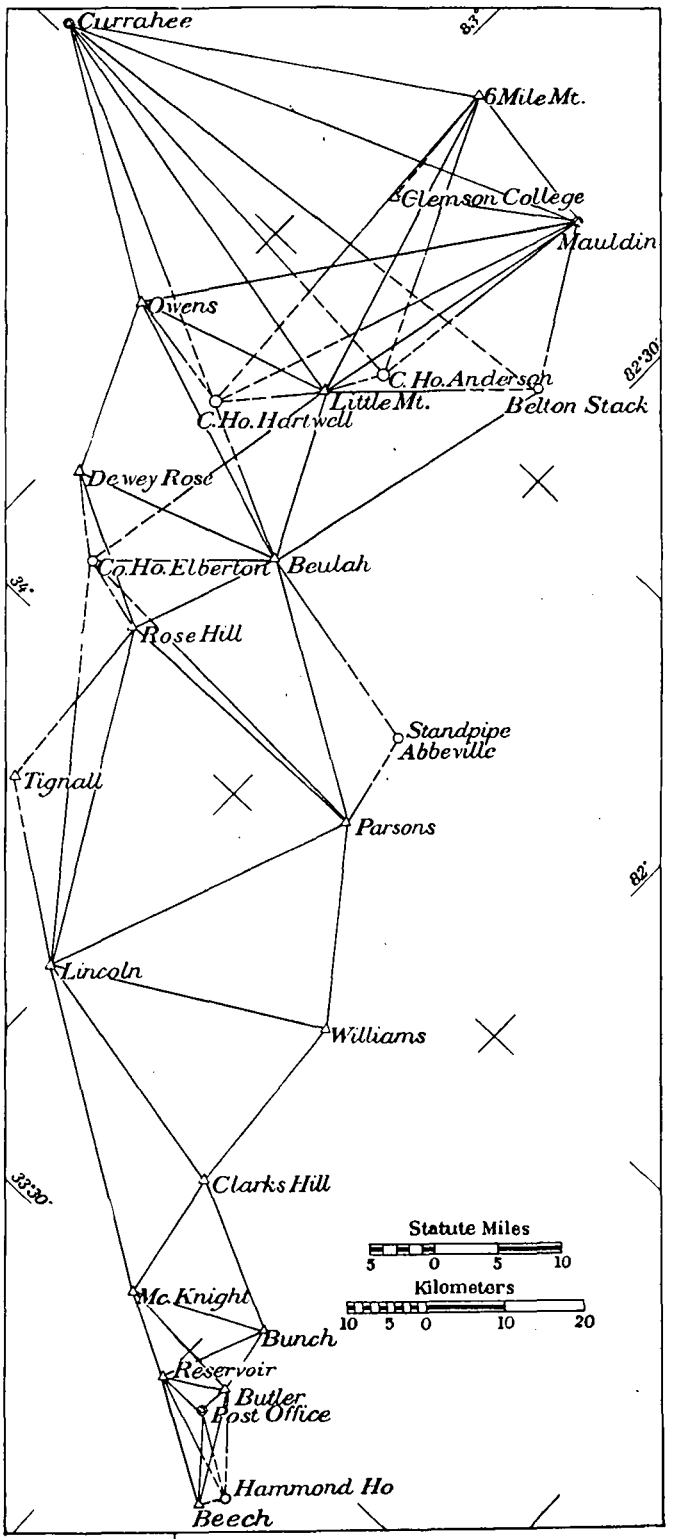
SUMMARY OF RESULTS.

Triangulation:
7 stations occupied.
30 geographic positions determined.

On July 1 the connection of the coast triangulation and the primary triangulation of the Eastern Oblique Arc of the United States along the Blue Ridge Mountains was in progress under the direction of Assistant Fairfield, who was making the necessary observations at the station Dewey Rose. Stations Owens, Beulah, Little Mountain, Mauldin, Six Mile Mountain, and Currahee were then occupied in the order stated. The unfavorable atmospheric conditions prevailing in the region during the greater portion of the season caused serious delay in the work. Thunder storms were of frequent occurrence during the summer, and when there was no rain the haze or smoke was so thick it was impossible to observe on the lights over the longer lines. On these lines two lights were used, one above the other and 15 inches apart, in order to increase the brilliancy, but this plan failed to secure a signal bright enough to be used in observing when the lines were 40 miles long, or longer, except in clear weather. The station at Six Mile Mountain was added to the scheme of triangulation for the purpose of determining the geographic position of Clemson College. It is a sharp peak, heavily wooded and difficult of access, but it is prominent and commands a view in all directions.

The observations were finished at Currahee station on September 30, thus completing the connection between the coast triangulation and the primary triangulation along the Blue Ridge Mountains. All the necessary preparations for closing work in this region were completed, and on October 10 the party was disbanded. The stations Mauldin

No. 3.



Triangulation, Georgia and South Carolina.

and Currahee were re-marked in a substantial manner. The geographic positions of all prominent objects, such as church spires, court-house domes, tall brick chimneys, etc., were determined when it was practicable to do so.

Two acetylene signal lamps, one mounted above the other and 15 inches apart, were used on all lines 40 miles long or longer, and on clear nights they showed as a small bright point, but a very little haze cut them off completely. On lines up to 30 miles in length a single lamp showed very well in fairly clear weather. The vertical angles were generally measured after the observations for horizontal angles were completed, usually from 11 to 12 o'clock at night, and they were measured whenever it was possible to do so.

HYDROGRAPHY. MASSACHUSETTS. R. L. FARIS, Commanding, Steamer *Blake*.

W. F. GLOVER, *First Watch Officer.*	July 1 to Sept. 4.
L. M. FURMAN, *First Watch Officer.*	Sept. 5 to Oct. 11.
J. H. ULLRICH, *Surgeon.*	July — to Aug. 15.
L. M. HOPKINS, *Chief Engineer.*	
W. F. GLOVER, *Second Watch Officer.*	Sept. 5 to Oct. 11.
H. H. JOHNSON, *Assistant Surgeon.*	Oct. 6 to Oct. 11.
THOS. L. JENKINS, *Third Watch Officer.*	
GEORGE OLSEN, *Deck Officer, First Class.*	
A. C. L. ROETH, *Deck Officer, First Class.*	
H. D. KING, *Aid.*	July — to Aug. 16.
W. T. CARPENTER, *Aid.*	

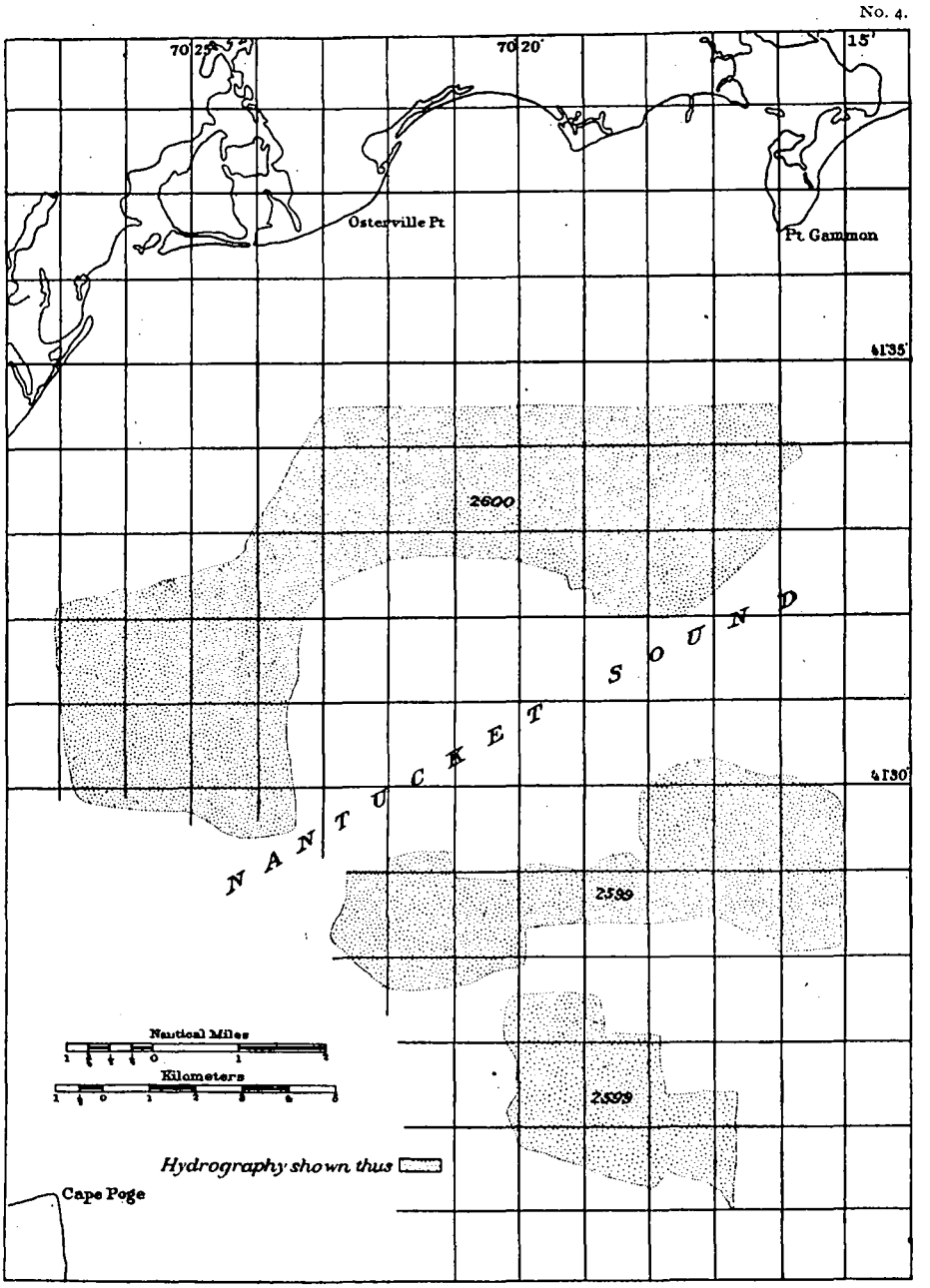
On July 1 the *Blake* was at Baltimore, Md., making preparations to take up hydrographic work in Nantucket Sound, Massachusetts.

These preparations were continued until July 19, when the vessel left Baltimore for Hyannisport, Mass., under the command of Assistant D. B. Wainwright, who was temporarily in command during the absence of Assistant Faris on leave of absence. The *Blake* reached Hyannisport on July 23, and the work of building and locating the signals necessary for the season's work began immediately.

The hydrographic examination of the channel south of Cross Rip light-vessel was taken up and such progress was made as the weather conditions permitted. The incessant foggy weather caused great delay during the latter part of July and the first part of August, but this work was nearly completed by August 13, on which date Assistant Faris relieved Assistant Wainwright of the command of the ship, and continued the examination of Cross Rip channel for three days, when the work was completed. The channel through the middle of the Horseshoe Shoal was examined between August 19 and 25. An examination of the channel on the north and west side of the Horseshoe Shoal, including the development of Eldridge Shoal and the broken ground to the eastward of the Horseshoe, was begun on August 26, and was nearly complete on September 20, when the ship proceeded to New Bedford, Mass., for the purpose of finding, locating, and developing the rock upon which the U. S. S. *Brooklyn* had recently struck in the approaches to New Bedford Harbor.

The search for this rock afforded an excellent opportunity for testing the efficiency of a new channel sweep or drag recently devised and constructed at the Coast and

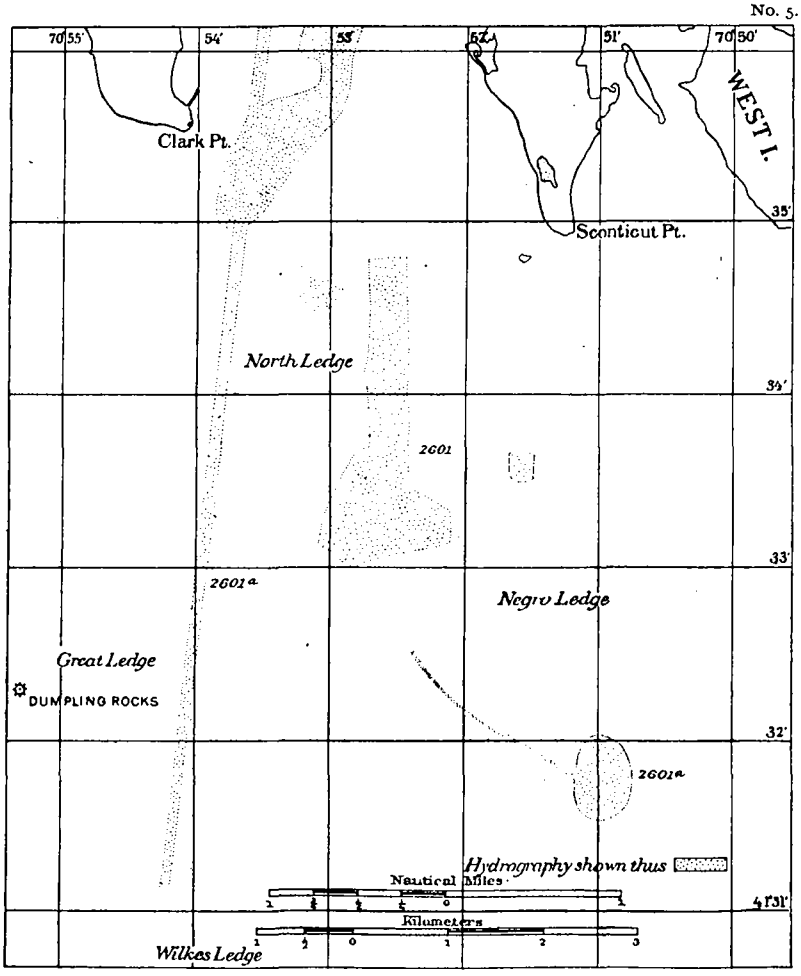
Geodetic Survey Office. Assistant D. B. Wainwright reported on board to superintend the installation and use of the drag in making the search for the rock mentioned above



Hydrography, Nantucket Sound, Mass.

and its use in other tests of the apparatus. The details of the construction of this drag are given in an appendix to the Report of the Superintendent, and details in regard to

its use are given in the statement of work executed by Assistant Wainwright. After the *Brooklyn* rock was found the region about it was closely developed by sounding from a steam launch, and afterwards lines were run over it with the drag set at various depths in order to ascertain the minimum depth of water over it. This work was completed on September 26, and Assistant Wainwright left the ship on that date. The development of certain localities in the approaches to New Bedford Harbor and in Buzzards Bay was begun on September 29, and continued until October 3. Eight



Hydrography, entrance to New Bedford Harbor, Mass.

localities were examined, the drag being used in all cases, set to clear the minimum depth indicated by the latest chart of the locality under examination. This work served to test the efficiency of the drag, and proved its practicability and usefulness in close hydrographic development work. When running at the usual speed the drag retards the vessel's speed about 1 knot per hour.

On October 4 the vessel returned to Nantucket Sound and removed the water signals erected for use during the season, and on October 7 closed work and proceeded

to Baltimore via New Bedford, arriving there on October 11. In all of the hydrographic work with the *Blake* two leads were used, one on each side of the ship, and the record of the soundings was made in such a way that there is no difficulty in determining on which side of the ship any particular sounding was made. In Nantucket Sound it was necessary to erect hydrographic signals out on the sand bars in from 9 to 14 feet of water, and six such signals were used. They consisted of 3-inch gas pipe put together with the ordinary coupling and pumped into the sand 10 or 15 feet, with targets above the top of the pipe. Only one of these signals was carried away by the sea, but all were removed at the close of the season, as they were considered dangerous to sailboat navigation. The work in Buzzards Bay and in the approaches to New Bedford did not require the building or the location of any signals, as the excellent foresight shown in the previous survey by the determination of prominent objects enabled the work to be taken up without the usual delay resulting from building and locating signals.

In concluding his report Assistant Faris expresses his appreciation of the work of his officers, and states that what was accomplished during the season was largely due to their zeal and intelligence.

MAGNETIC OBSERVATIONS. NEW JERSEY. J. A. FLEMING.

PENNSYLVANIA.

Stations occupied.

NEW JERSEY.

BURLINGTON ISLAND.

PENNSYLVANIA.

ALLENTOWN.	EASTERN.	SCRANTON.
BLOOMSBURG.	ELULALIA.	SILVER LAKE.
BROOKVILLE.	FRANKLIN.	SLATE RUN.
CARPENTER.	HONESDALE.	SMETHPORT.
CLARION.	KEATING.	TIONESTA.
COUDERSPORT.	MEADVILLE.	TOWANDA.
CURWENSVILLE.	MERCER.	TUNKHANNOCK.
DANVILLE.	MILFORD.	WARREN.
DOYLESTOWN.	MONTROSE.	WELLSBORO.
EMPORIUM.	NEW CASTLE.	WESTOVER.
EAST MAUCH CHUNK.	RIDGEWAY.	WILKESBARRE.
EAST STROUDSBURG.	SATTERFIELD.	

The extension of the magnetic survey in the States of New Jersey and Pennsylvania was assigned to Aid Fleming and the work in the field began on September 10. The work was continued whenever the weather permitted until November 17, when it was suspended on account of the unfavorable weather conditions. Ten days were lost as the result of bad weather during September and November. During October the weather was generally fair and the observer was able to complete the observations at 19 stations, and also verified several county meridian lines. At Scranton a meridian line was established by request of the Engineer's Club of that city, who provided the marks and placed them in position. All, except two, of the stations occupied were marked in a permanent manner. The declination was also determined at eight county meridian lines, and five county meridian lines were verified.

HYDROGRAPHY.	MARYLAND.	G. L. FLOWER, Commanding, Schooner *Matchless*.
TOPOGRAPHY.		
TRIANGULATION.		
WM. B. PROCTOR, *Watch Officer.*		July 1 to May 23.
W. T. CARPENTER, *Aid.*		Nov. 15 to Dec. 22.
J. C LANDERS, *Aid.*		Jan. 5 to June 30.
J. W. MAUPIN, *Aid.*		May 27 to June 30.
G. C. BALDWIN, *Aid.*		June 5 to June 30.
W. C. SHEPARD, *Temporary Aid.*		July 7 to Sept. 14.
E. L. SCOTT, *Temporary Aid.*		July 7 to Dec. 20.
E. J. MCINTYRE, *Deck Officer.*		July 1 to Oct. 12.
J. W. YATES, *Deck Officer.*		Sept. 12 to Oct. 30. Nov. 18 to Jan. 31.
GILBERT RUDE, *Deck Officer.*		Feb. 3 to June 30.
J. L. AHERN, *Deck Officer.*		Feb. 18 to May 22.
E. V. MILLER, *Junior Captain's Clerk.*		July 1 to Sept. 4.

SUMMARY OF RESULTS.

Hydrography:
- 155 square miles area covered.
- 1 448 miles lines sounded.
- 74 076 soundings made.
- 6 hydrographic sheets completed.
- 17 tide stations occupied.

Topography:
- 13 square miles area covered.
- 97 miles shore line surveyed.
- 13 miles shore line of creeks surveyed.
- 44 miles railways and roads surveyed.

Triangulation:
- 10 square miles area covered.
- 25 stations occupied.
- 27 geographic positions determined.

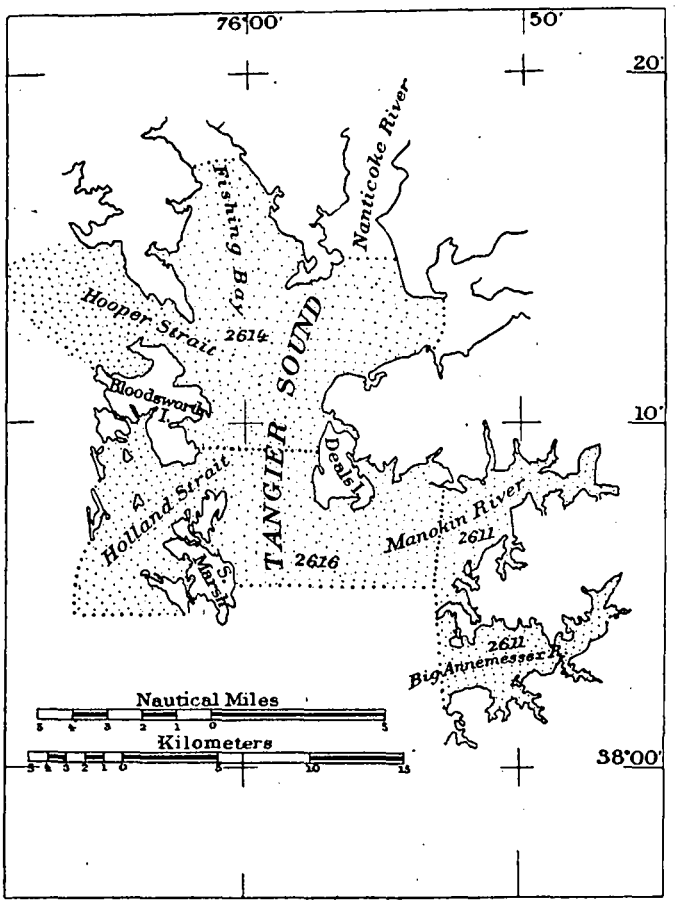
The resurvey of certain portions of Chesapeake Bay was in active progress under the direction of Assistant Flower on July 1, 1902, and the immediate work in hand was a resurvey of Tangier Sound and its tributary waters. The hydrography of Kedge Straits, Holland Straits, and Tangier Sound, between latitude 38° 02′ and 38° 09′, of which about one-half was finished during the previous fiscal year, was completed on July 19; the hydrography of Big Annemessex River was completed on August 4, and of Manokin River on August 19. Work on the hydrographic sheet covering Hoopers Straits, a portion of which had been completed during the previous year, Tangier Sound north of latitude 38° 09′, and a portion of Fishing and Monie bays east to Great Shoals light-house was then taken up and completed on September 18.

From September 19 to October 2 the vessel was in Baltimore being repaired.

The hydrographic examination of Elk River began on October 3. Lines of sounding were run at intervals of about 400 meters normal to the shore and as nearly coincident with the old lines as possible, for purposes of comparison, and two transverse lines were run at right angles to these. Additional lines were run across the bar at the mouth of the river. This work was completed on October 23, when the vessel returned to Baltimore for repairs and remained there until November 18. The vessel returned to Elk

River on November 19, and additional lines of soundings were run between those already established, and the survey of Elk River was completed on December 12. On December 14 the vessel again returned to Baltimore for repairs and remained there until February 6. On that date the *Matchless* proceeded to West River, and the survey of the unfinished portions of the shore line was completed. The hydrography of Herring Bay and of the shoal waters along the bay shore northward to Franklin Point was completed on April 10. The weather was very unfavorable for field work during February, March, and the first week in April. Ice, strong winds, or thick weather prevented field work during at least one-half of this time. Signals were blown down and had to be replaced, and several built near the shore line were washed away with the shore line, and it was necessary to determine new ones. Work in this vicinity proceeded until April 17, when the vessel sailed for Annapolis to take up the resurvey of the Severn River above that place, leaving J. C. Landers, Aid, with a topographic party to complete certain portions of the work in the vicinity of Fairhaven. Two old triangulation stations, Gram 1898 and Greenbury Point light-house, were recovered, and the lines between them formed the base from which the triangulation was extended up the river. Twenty-six triangulation stations were selected and marked and signal poles were erected. Having completed the work assigned him, Mr. J. C. Landers returned to the vessel and began topographic work on the south shore of the river on May 3, and was still engaged on this work at the close of the fiscal year.

No. 6.

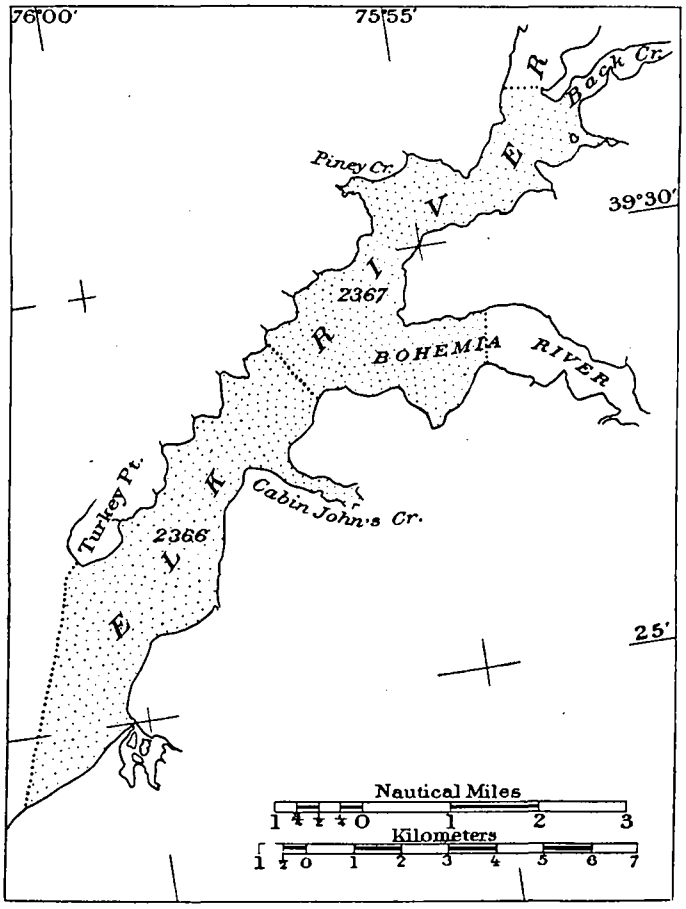


Hydrography. Chesapeake Bay.

On May 7 Assistant Flower began topographic work on the north shore and completed it to Arnolds Point. The hydrography was completed to Arnolds Point on June 4. On the 6th the vessel was moved to Round Bay, and J. W. Maupin, Aid, was instructed in the use of the plane table. On June 15 he was able to continue the topographic work on the north shore without supervision in the field. The accompanying summary

of results and the progress sketches show the amount of work completed to the close of the fiscal year, at which time it was actively in progress.

No. 7.

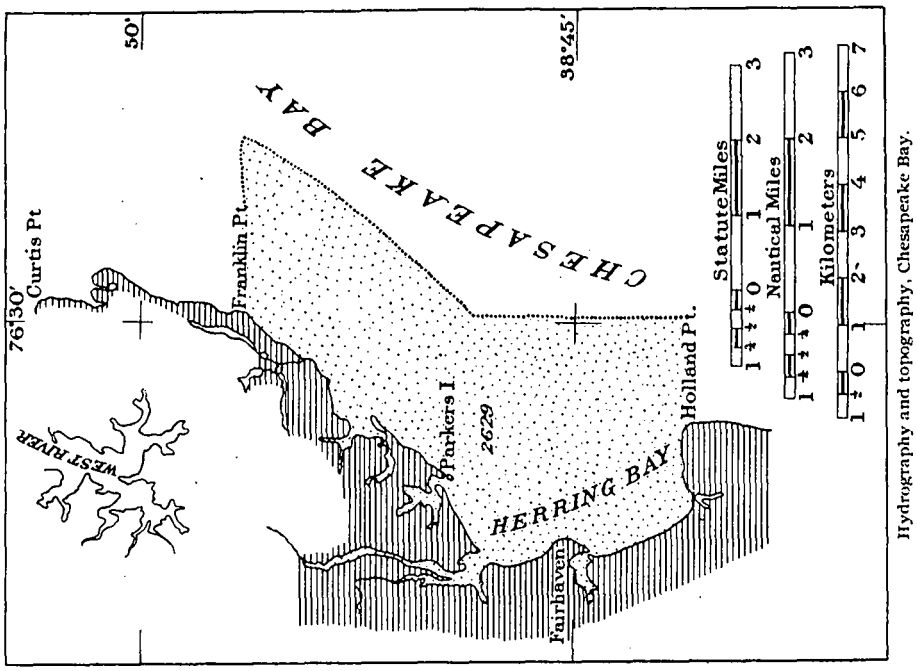


Hydrography, Chesapeake Bay.

The following is quoted from the report of Assistant Flower:

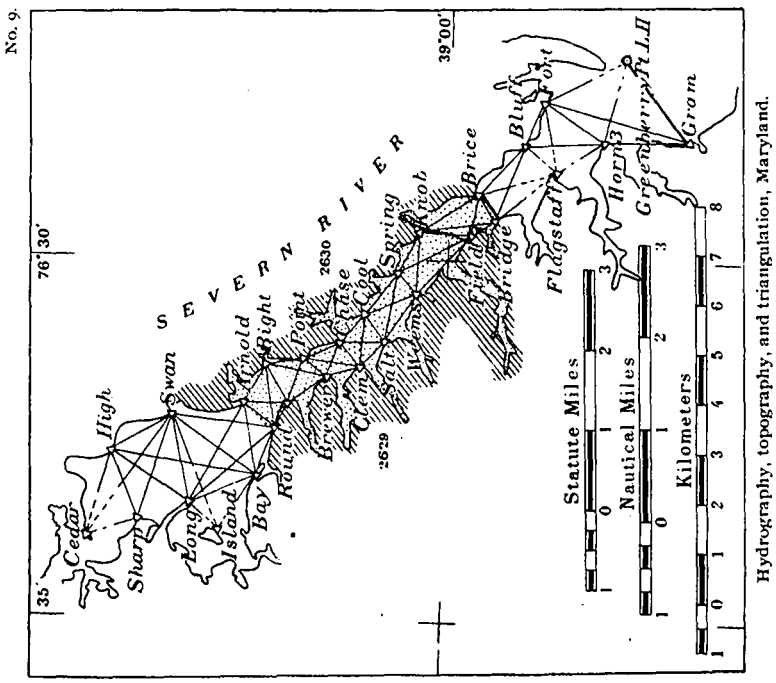
I take pleasure in commending all the officers assigned to my party during the fiscal year for the zeal and industry shown and for the efficient services rendered.

No. 8.



Hydrography and topography, Chesapeake Bay.

No. 9.



Hydrography, topography, and triangulation, Maryland.

TOPOGRAPHY. MARYLAND. S. FORNEY.
VIRGINIA.

SUMMARY OF RESULTS.

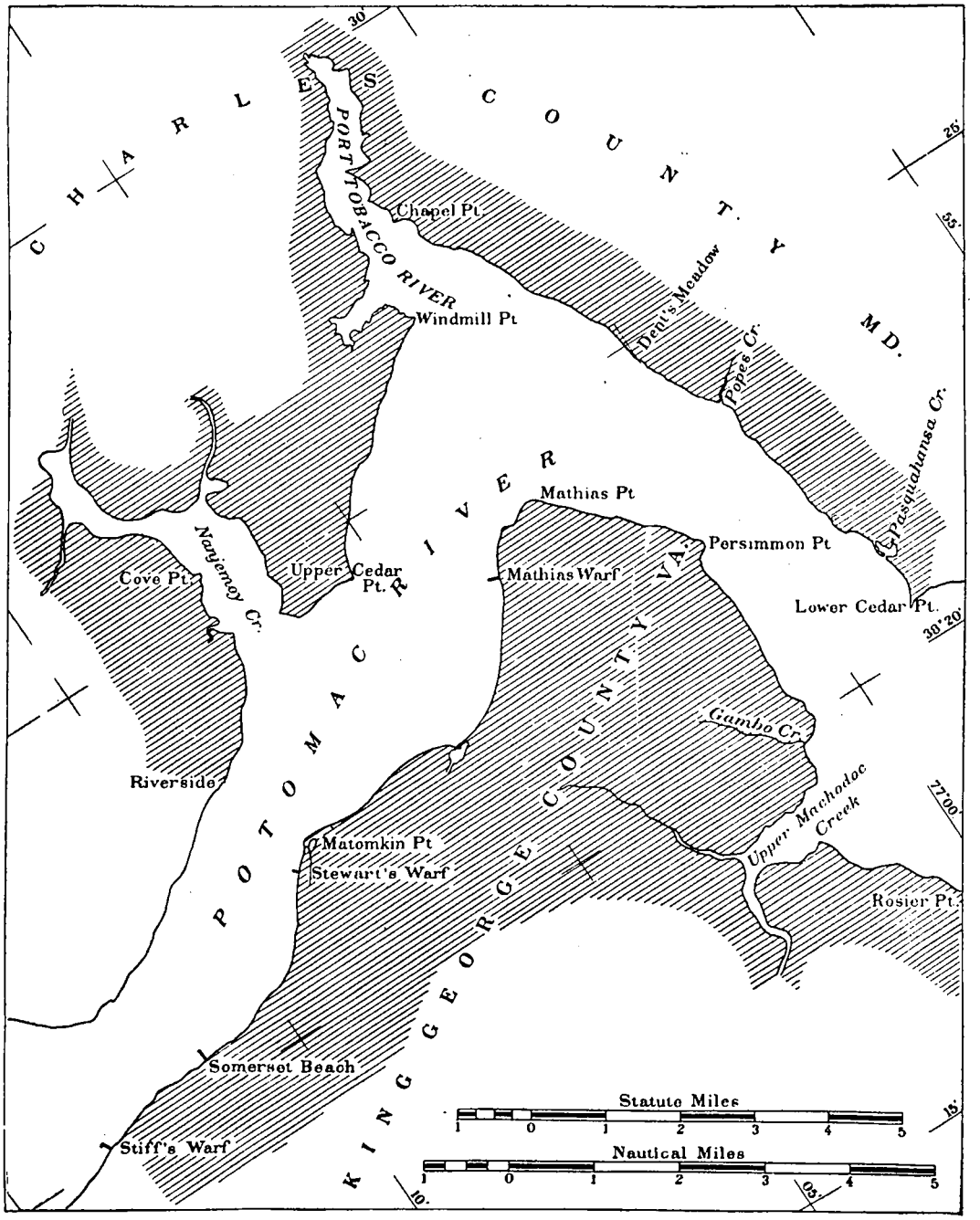
Topography:
62 square miles area covered.
62 miles shore line of rivers surveyed.
55 miles shore line of creeks surveyed.
82 miles of roads surveyed.

A portion of the topographic work in the resurvey of the Potomac River was assigned to Assistant Forney. He transferred his party and outfit from Chesapeake Bay to Chapel Point, Maryland, and began field work on the river on July 11. The work continued from this date to the close of the fiscal year, except during the period December 23 to January 21, when it was temporarily suspended.

The survey of the shore line was completed from Lower Cedar Point to a point 1½ miles below Clifton Beach in Maryland including Port Tobacco River and Nanjemoy Creek, and from Rosier Point to Marlboro triangulation station on Marlboro Point in Virginia, including Upper Machodoc, Gambo, Jotank, Potomac, and Accakeek creeks. The interior topography covering the country back from the river to a distance varying from 1 to 2 miles was completed from Lower Cedar Point to Riverside in Maryland and from Rosier Point to Stiffs Wharf in Virginia. A comparison with the previous survey made forty years ago shows very little change except at prominent projecting points. The work was seriously delayed by unfavorable weather, and on many days no field work could be done. A naptha launch was assigned to the party, but it was out of use, undergoing repairs, a great portion of the time.

Assistant Forney makes special mention in his report of the kindness and courtesy extended to the party by Mr. James A. Arnold, light-house keeper at Lower Cedar Point. In addition to boarding the party at considerable inconvenience to his family, he gave the use of his sailboat and his own service, without charge, during a period of ten days on one occasion when the launch was out of order.

No. 10.

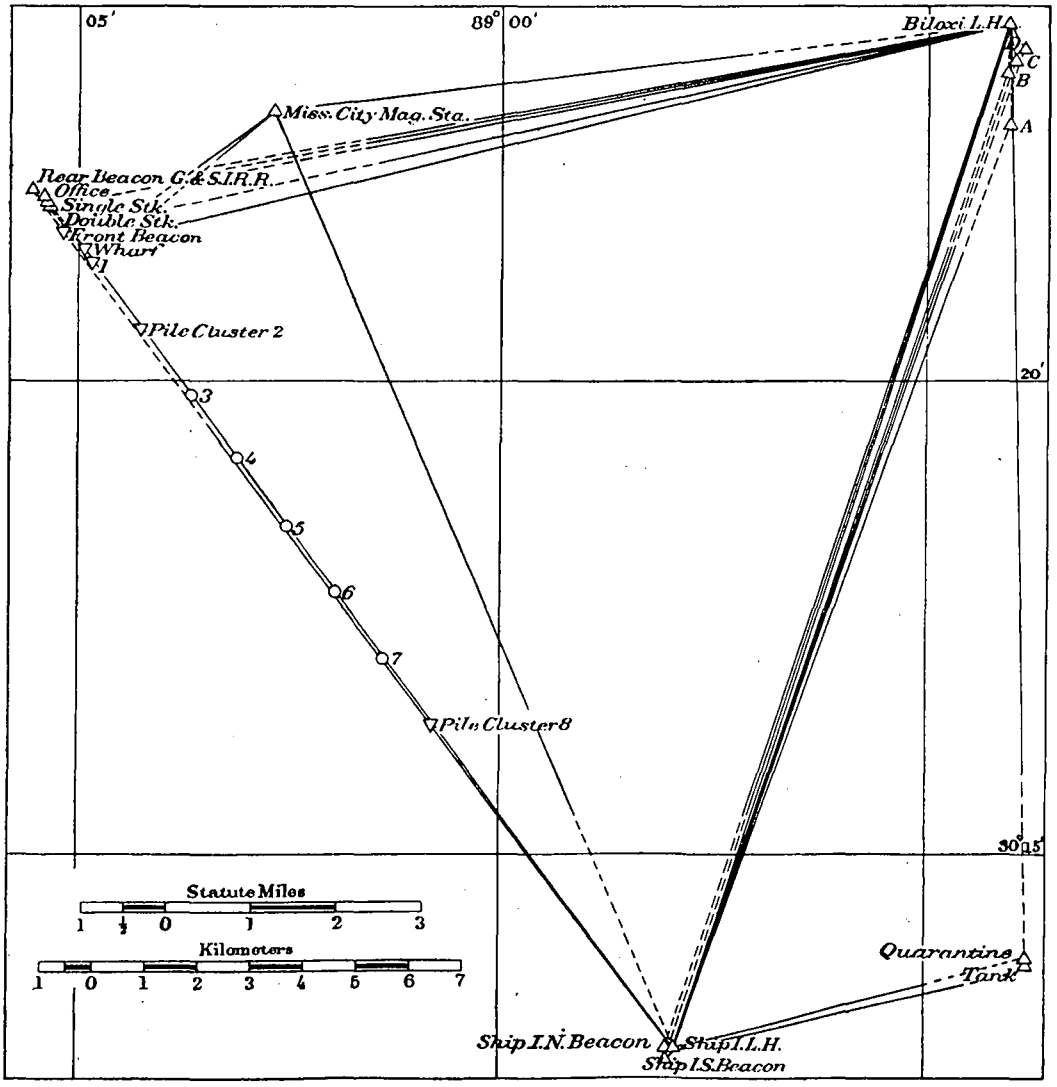


Topography, Potomac River.

MAGNETIC OBSERVATIONS. MISSISSIPPI. O. B. FRENCH.
TRIANGULATION.

In December Assistant French was directed to make the necessary observations to locate a large wharf recently constructed at Gulfport, Miss., on the chart of the locality. He proceeded to Gulfport, and on December 13 began the necessary preparations for the work.

No. 11.



Triangulation, Gulfport, Miss.

Horizontal angles were measured at a number of stations for the purpose of determining the position of various objects in Gulfport and near the wharf, including the pile clusters marking the dredged channel. The line between Biloxi Lighthouse

and Ship Island Lighthouse was used as the base for this work. A complete set of observations for the magnetic elements was made at Ship Island near the light-house, and also at the old station in Mississippi City, and both stations were connected with the triangulation. The work was completed on December 22, and Assistant French returned to Washington.

MAGNETIC OBSERVATIONS. MICHIGAN. O. B. FRENCH.

SUMMARY OF RESULTS.

4 stations occupied.

Advantage was taken of the fact that in February, 1903, the Straits of Mackinac, Michigan, were frozen over with ice thick enough for teams to cross, and magnetic observations were secured at four stations over the water at varying distances from the shore for purposes of comparison with similar observations on shore. This work was assigned to Assistant French, who left Washington on February 22 and arrived at Mackinaw City, Mich., on the 24th. It was desirable to select the positions of the four stations so as to distribute them in a uniform manner over the area included between McGulpin Point, St. Ignace, Mackinac Island, and Bois Blanc Island.

Station A was located about one-third of the way from Mackinaw City to St. Ignace; Station B about 2 miles west of the north end of Bois Blanc Island; Station C at a point about 2 miles east of Mackinaw City, and Station D about 2 miles east of Station C, or 4 miles east of Mackinaw City.

The rough condition of the ice made it necessary to locate the stations at the points indicated as the nearest practicable solution of the question of carrying out the original plan. The large car ferry running between St. Ignace and Mackinaw City prevented the location of any stations between A and B and C. The rough condition of the ice prevented the location of a station farther north toward Mackinac Island by the expense involved in making a road in this direction. The geographic positions of the magnetic stations and the necessary azimuths were determined from the triangulation points established under the direction of the United States Engineers in the survey of the Lakes in this vicinity, through angles measured at the magnetic stations. The instruments were mounted on the usual tripod, the legs being driven into the ice, which was sufficiently stable, as proved by the fact that level did not show any material change while the observations were being made. The tent pins were driven into holes bored in the ice and held very well. The base of the tent was attached to a wooden frame which was fastened to the ice. These precautions were necessary to resist the strong winds which prevailed. A complete set of observations to determine the three magnetic elements was made at each of the four stations and work was completed on March 3, after much delay on account of unfavorable weather.

TRIANGULATION. MAINE. F. D. GRANGER.
MASSACHUSETTS.

SUMMARY OF RESULTS.

Triangulation:
26 stations occupied.
45 geographic positions determined.

The determination of the position of certain lighthouses on the coasts of Maine and Massachusetts was assigned to Assistant Granger. He began work at Bar Harbor, Me., on July 1, and the positions of the following lighthouses in Maine were determined as directed:

Bear Island.
Cape Neddick.
Cuckolds Fog-Signal Station.
Egg Rock.
Goat Island.
Goose Rocks.
Great Duck Island.
Indian Island.
Nash Island.
Portland Breakwater.
Prospect Harbor.
Ram Island.
Rockland Breakwater.
Spring Point Ledge.
Two Bush Island.

Butler Flats Lighthouse, in New Bedford Harbor, Massachusetts, was also determined, and the field work for the season closed September 19.

GRAVITY. MICHIGAN. J. F. HAYFORD.

The Survey was fortunate in securing an opportunity, through the courtesy of Prof. Fred. W. McNair, of Houghton, Mich., of determining the force of gravity at the North Tamarack copper mine, near Calumet, Mich., at the surface of the earth and at points beneath in the mine itself. It was necessary for the Survey to furnish a skilled observer and the instruments required, and to pay a certain portion of the expense involved. This interesting work was assigned to Assistant Hayford, and he left Washington on September 4, after swinging two sets of pendulums at the base station in Washington and making all other necessary preparations. He reached Calumet on September 6, and between that date and September 20, when the work was completed, the pendulums were swung, with the assistance of Professor McNair, for fifteen periods of approximately seven hours each on the surface of the earth at the entrance of the mine, for nine periods of about the same length at a point in the same vertical line as the surface station and about 4 600 feet below it, and for four seven-hour periods at a point a few hundred feet distant from this vertical line and about 1 200 feet below the surface, or at sea level, as the entrance to the mine has an elevation of 1 200 feet above sea level. Whenever a pendulum was swinging beneath the surface in the mine a similar one was swinging at the surface, and the two were being timed by the same chronometer, whose rate was determined by astronomic observations at the surface station. The surface and underground stations were connected by telephone and by complete metallic circuits, so that all observations at the underground stations were recorded on the chronograph at the surface station. Many extraordinary difficulties were encountered and overcome, and the observations were successfully completed.

This success was due to the familiarity of Professor McNair and of his two assistants, Professor Fisher and Mr. Osborne, with the conditions which were encountered in the mine, and to the uniform helpfulness of everyone connected with the mine who could assist in the work. The officers in control at the mine rendered assistance by furnishing men and material, and responded at once to all reasonable requests, even to the extent of stopping certain operations in portions of the mine at considerable inconvenience to themselves. The genial and enthusiastic manner with which the officers of the mine aided this purely scientific undertaking, at considerable cost and inconvenience to themselves, was inspiring.

The final computations have not been made, but the preliminary results indicate that the value of gravity was determined with a high degree of accuracy at all the stations, on the surface and underground. An ideal condition with respect to constancy of temperature existed at the lower underground station, which was far below any other station at which gravity observations have been made, as determined from published results. The results obtained can be fully utilized in connection with the known density of the material in the mine.

TRIANGULATION MASSACHUSETTS. A. T. MOSMAN.

VIRGINIA.

Triangulation:
91 square miles area covered.
20 stations occupied.
40 geographic positions determined.

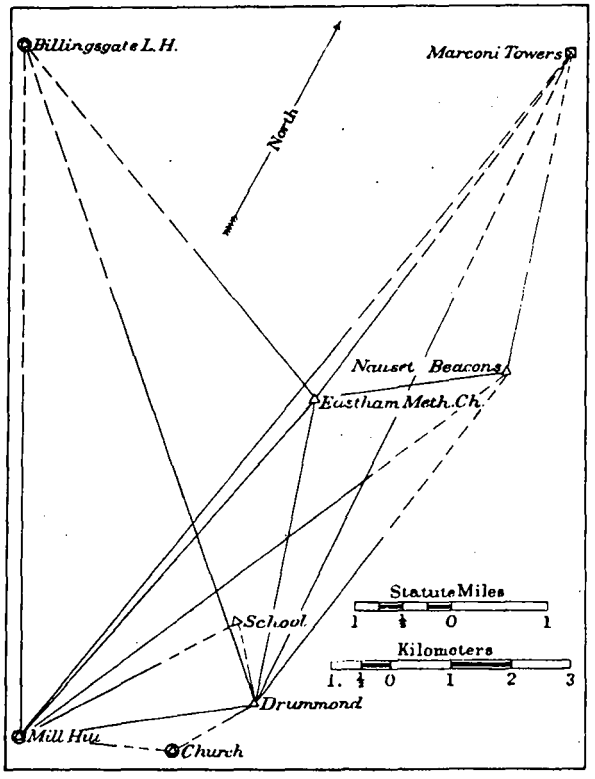
On July 1 the work of determining geographic positions on Chincoteague Island, Virginia, was in progress under the direction of Assistant Mosman, as stated in the report for the preceding year. The work was continued until July 11, on which date the operations in this vicinity were completed, and on the 14th Assistant Mosman, proceeded to Frankford, Del. Mr. E. E. Torrey, foreman, reached this locality several days earlier, and was engaged in searching for the stations of the old triangulation in the vicinity of Fenwick Island Lighthouse. This search was continued until July 20, but no old stations were found. Two days were spent in making a reconnaissance for triangulation south of the mouth of the Delaware River, and field operations then closed for the season.

On July 29 Assistant Mosman reached Gloucester, Mass., under instructions to determine the geographic position of certain lighthouses on the coast of Massachusetts. A sufficient number of stations of the old triangulation in the vicinity of the lighthouses were recovered, and the lines between them were used as bases from which to determine the geographic positions desired. The positions of the following lighthouses were determined: Annisquan Harbor, Deer Island, Eastern Point, Ipswich, Long Island Head, Marblehead, Narrows, Nauset, Straitsmouth, and also the position of the towers of the Marconi wireless telegraph station near South Wellfleet. The Marconi towers are four in number, arranged so as to form a square, with their centers 210 feet apart on the sides of the square. Each tower is 25 feet square at the base, 9 feet square at the top, and 210 feet in height. The observations at the station

Blind Asylum were seriously delayed by smoke from the city, and were not completed until October 31, when the season closed.

Mr. E. E. Torrey, foreman, served during the entire season and performed all duties assigned to him with zeal and intelligence. The thanks of the Survey are due

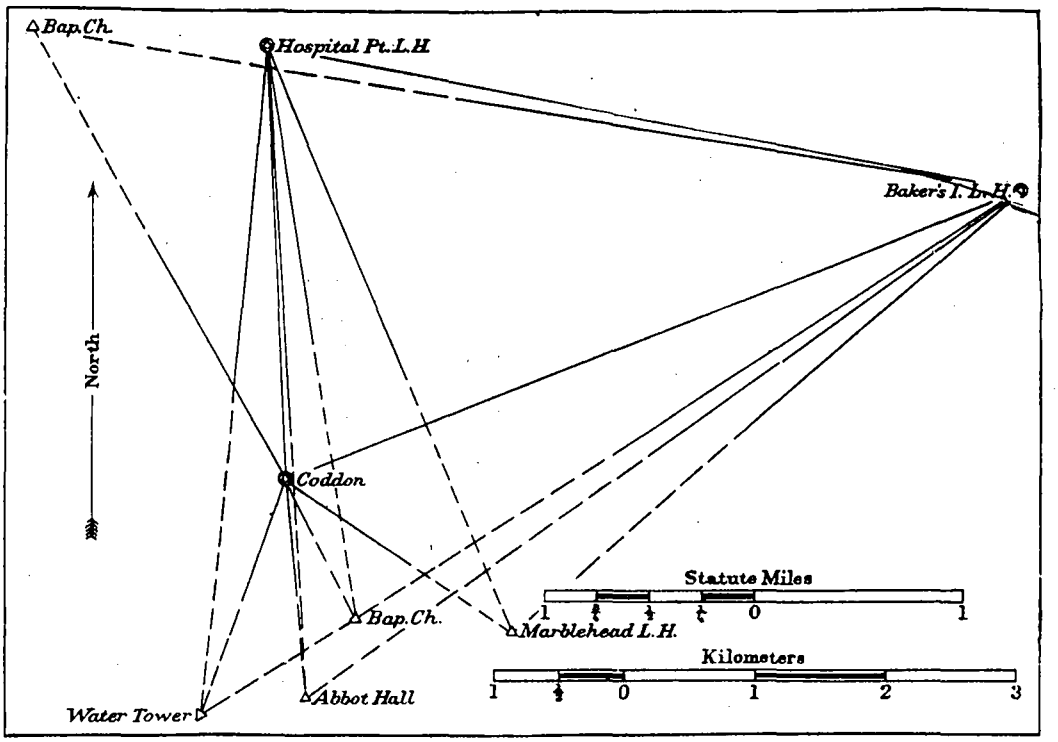
No. 12.



Triangulation, Cape Cod, Mass.

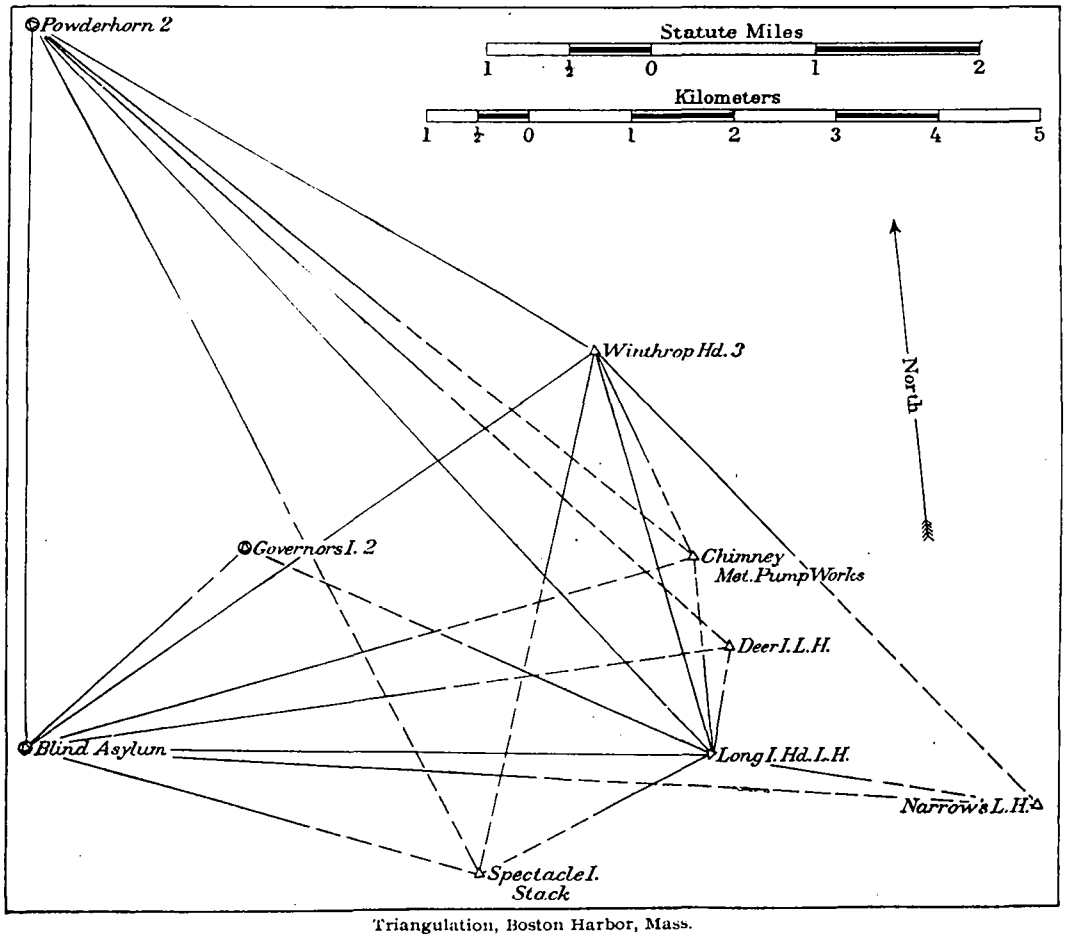
the army Quartermaster at Boston for his courtesy in transporting the party to and from Long Island Head Lighthouse, and to Commander A. P. Nazro, U. S. Navy, Light-House Inspector of the Fourth district, for kindly instructing all light-keepers in his district to render all possible assistance in facilitating the work of the party.

No. 13.



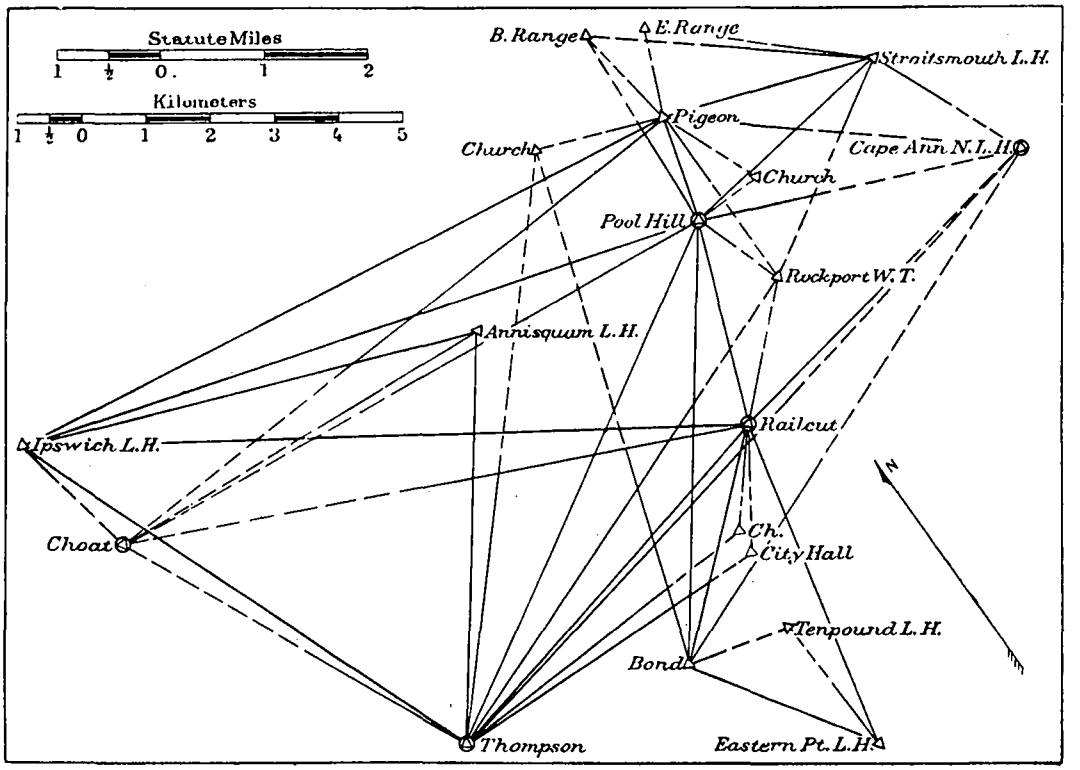
Triangulation, Marblehead, Mass.

No. 14.



Triangulation, Boston Harbor, Mass.

No. 15.



Triangulation, Cape Ann, Mass.

RECONNAISSANCE. MASSACHUSETTS. JOHN NELSON.
TOPOGRAPHY. NEW YORK.
TRIANGULATION. NORTH CAROLINA.

SUMMARY OF RESULTS.

Massachusetts.—July 8 to October 30.

Reconnaissance:
- 75 square miles area covered.
- 25 triangulation stations selected.

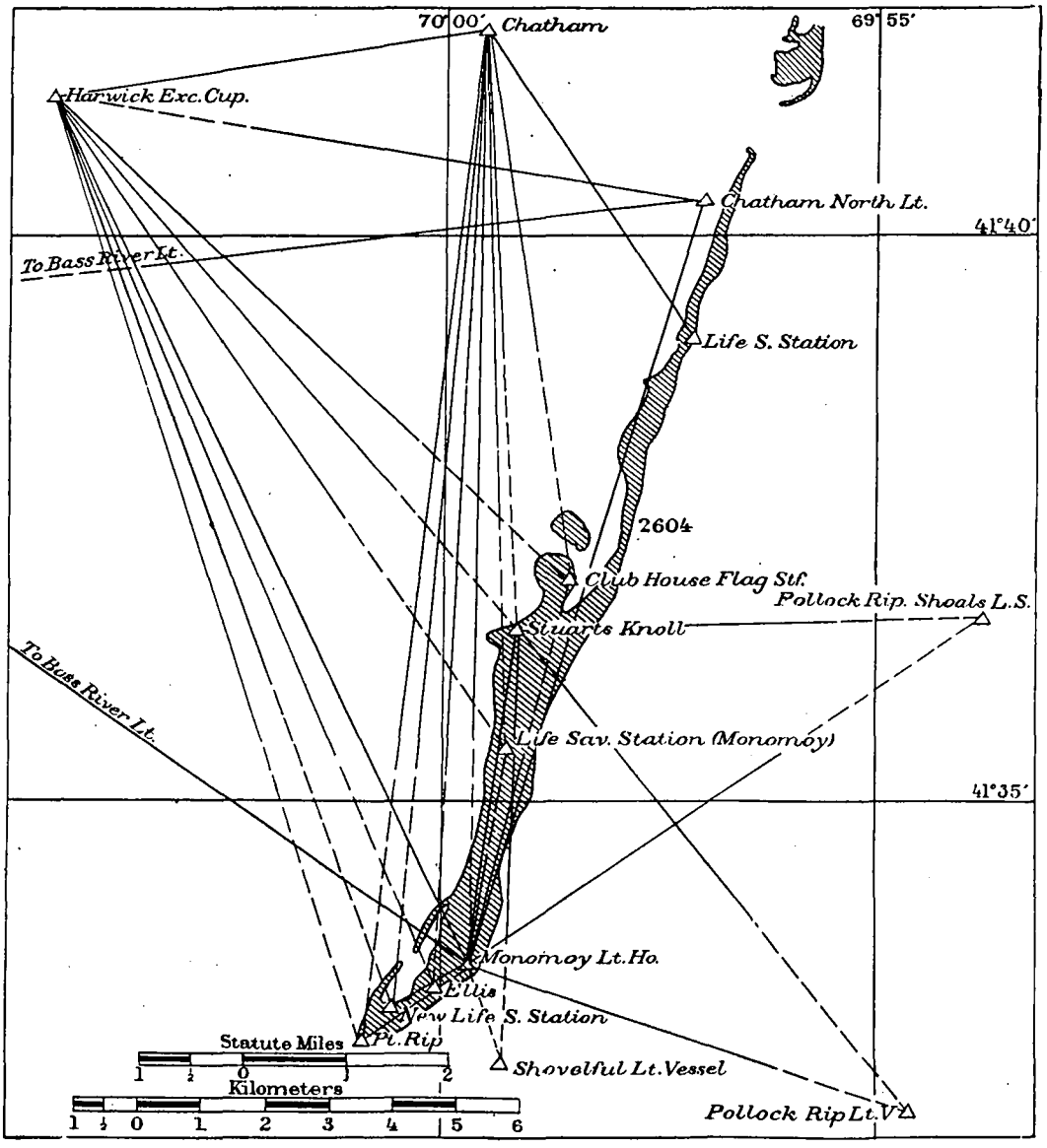
Topography:
- 16 square miles area covered.
- 61 miles general coast line surveyed.
- 67 miles roads and railroads surveyed.
- 4 topographic sheets completed.

Triangulation:
- 50 square miles area covered.
- 15 stations occupied.
- 25 geographic positions determined.

North Carolina.—December 28 to March 7.

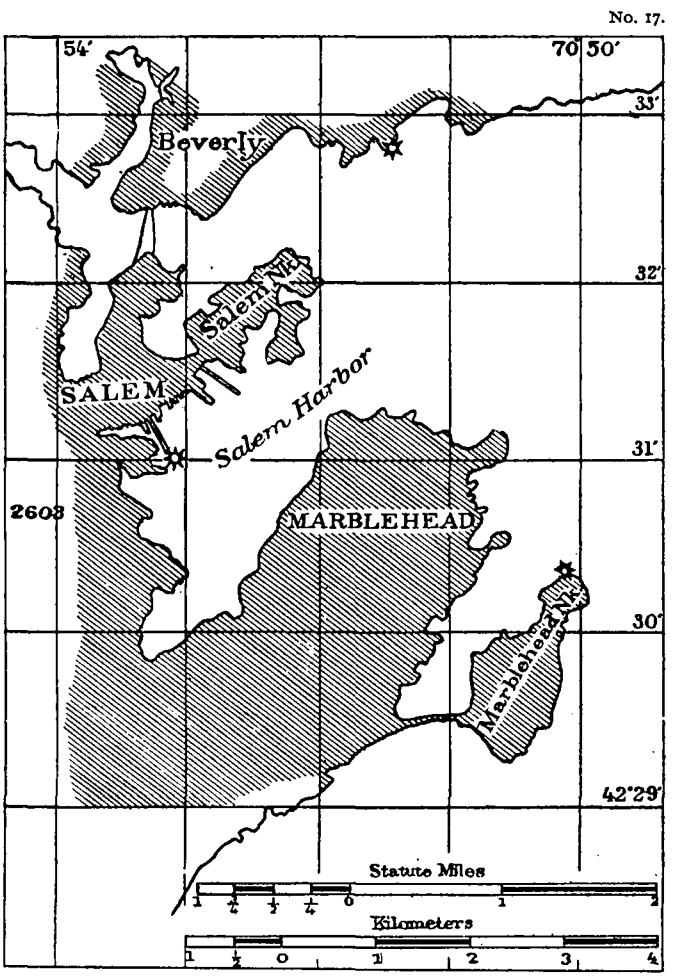
Reconnaissance:
105 square miles area covered.
26 triangulation points selected.
Triangulation:
65 square miles area covered.
9 stations occupied.
19 geographic positions determined.

No. 16.



Topography and triangulation, Monomoy Island, Mass.

Considerable changes in the shore line of the entrance to Sheepshead Bay, Long Island, New York, having been reported to the Office, Assistant Nelson was instructed to proceed to Manhattan Beach, Long Island, and examine the changes and secure the data for making the necessary corrections on the charts. He proceeded to the locality on July 2, and completed a preliminary survey of the entrance on July 7. The resurvey of Monomoy Island, Massachusetts, was then taken up, and Assistant Nelson reached Chatham on July 8. A party was organized and several days were spent in making a reconnaissance, in recovering stations in the former triangulation, and in erecting signals in the vicinity of Chatham and Monomoy Island. Continuous heavy rains, dense fogs, and strong gales of wind caused considerable delay, but the work was completed on August 14.



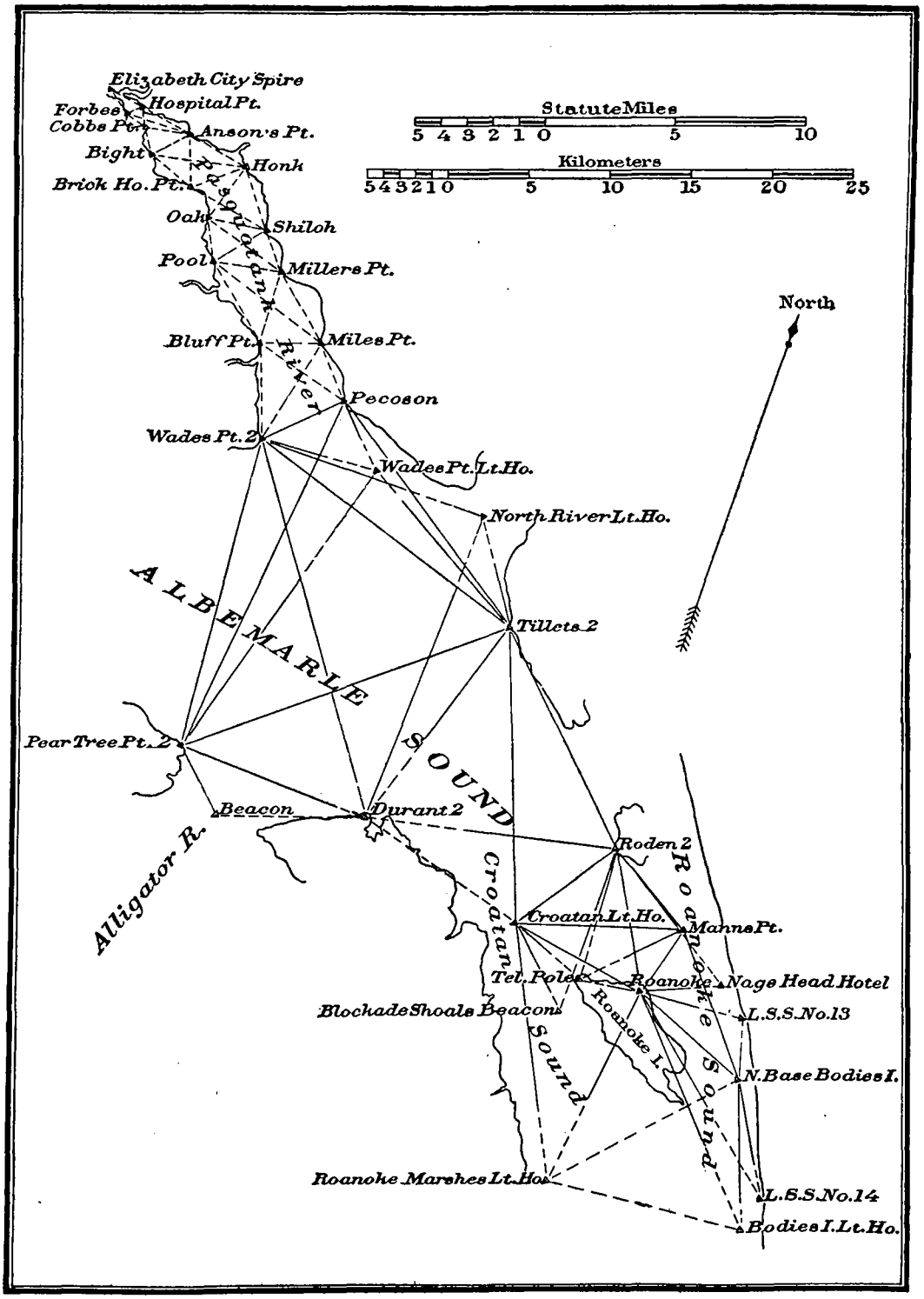
Topography, Massachusetts.

The party then proceeded to Nantucket Island for the purpose of locating the breakwater protecting the harbor and its approach, and of making a resurvey of the shore line of the harbor and of the new cut at the eastern end of Nantucket Bay. This new cut changes during every severe storm. Long sand spits are on each side of the entrance and they are constantly shifting. The work mentioned above was completed and the party proceeded to Marblehead, Mass., on August 20, to take up the topographic resurvey of Marblehead, Marblehead Neck, Salem, and Beverly. This work was continued until October 30, when the field work closed for the season.

Many changes have been made since the previous survey in 1849 and 1850, and a complete topographic survey was made of the town of Marblehead and of Marblehead Neck. Many changes were also noted in the shore line and interior topography in the vicinity of Salem and Beverly. New roads have been opened, railroads have been built, and hundreds of modern houses have been erected.

Assistant Nelson reported for duty at the Office on October 31.

No. 18.



Triangulation, North Carolina.

In December the extension of the triangulation along the Pasquotank River and in Albemarle and Croatan sounds was assigned to Assistant Nelson. He proceeded to Elizabeth City, N. C., and reached that place on December 28. The work of reconnaissance was taken up immediately. Two old triangulation stations, Manns Point and North Base Bodies Island, were recovered and the triangulation was extended from the base furnished by the line between these stations. Launch No. 22, which had been assigned to the party and brought from Baltimore, was found to be unsuitable for use in the rough waters over which the work extended, and a small steamer was chartered and used as quarters for the party and as the means of transportation. In January the reconnaissance was extended from Bodies Island to Elizabeth City and it was necessary to place all except two of the stations on low, marshy ground, which required observing tripods and scaffolds from 10 to 40 feet in height. The lumber used in erecting these signals was towed on a barge as near as possible to the stations and then rafted ashore and landed with much difficulty, as the water near the shore is very shallow. Cypress and juniper swamps cover the shores in this region, which change greatly as the result of wave action during storms. The party was compelled to use Elizabeth City as the base of supplies, and long trips were necessary to secure coal and provisions. In marking the triangulation stations, reference marks were placed in secure positions to guard against the loss of the stations by erosion. The triangulation was continued from February 1 to March 7, when the field work closed.

Wind, rain, and smoke or haze prevailed during the greater portion of the time and seriously delayed the work. Assistant Nelson reports the efficient and valuable service rendered by Signalman J. S. Bilby.

MAGNETIC OBSERVATIONS. DISTRICT OF COLUMBIA. VIRGINIA. E. D. PRESTON.

Stations occupied.

DISTRICT OF COLUMBIA.

WASHINGTON.

VIRGINIA.

BLAND.	JONESVILLE.	SPOTTSYLVANIA.
BOWLING GREEN.	LEBANON.	WISE.
CLINTWOOD.	PULASKI.	WYTHEVILLE.
HANOVER.	SHACKS MILLS.	

A portion of the work of extending the Magnetic Survey in Virginia was assigned to Assistant Preston, and he was making magnetic observations at Wytheville, Va., on July 1, in continuation of his work during the previous fiscal year. He continued this work until July 28, when he closed his work in the field and proceeded to Washington, D. C., and made observations at the base station at the Coast and Geodetic Survey Office. The stations named above were occupied during the period stated, except the stations Bowling Green, Hanover, and Spottsylvania, at which magnetic observations were made between April 25 and May 2, when Assistant Preston was again in the field in Virginia, temporarily. Field work finally closed for the fiscal year on May 2. The work in July was delayed by the difficulties of transportation, away from the railway, where the roads were of the roughest character and the journeys in wagons were long and tedious.

HYDROGRAPHY. NEW YORK. H. W. RHODES.
TOPOGRAPHY.
TRIANGULATION.

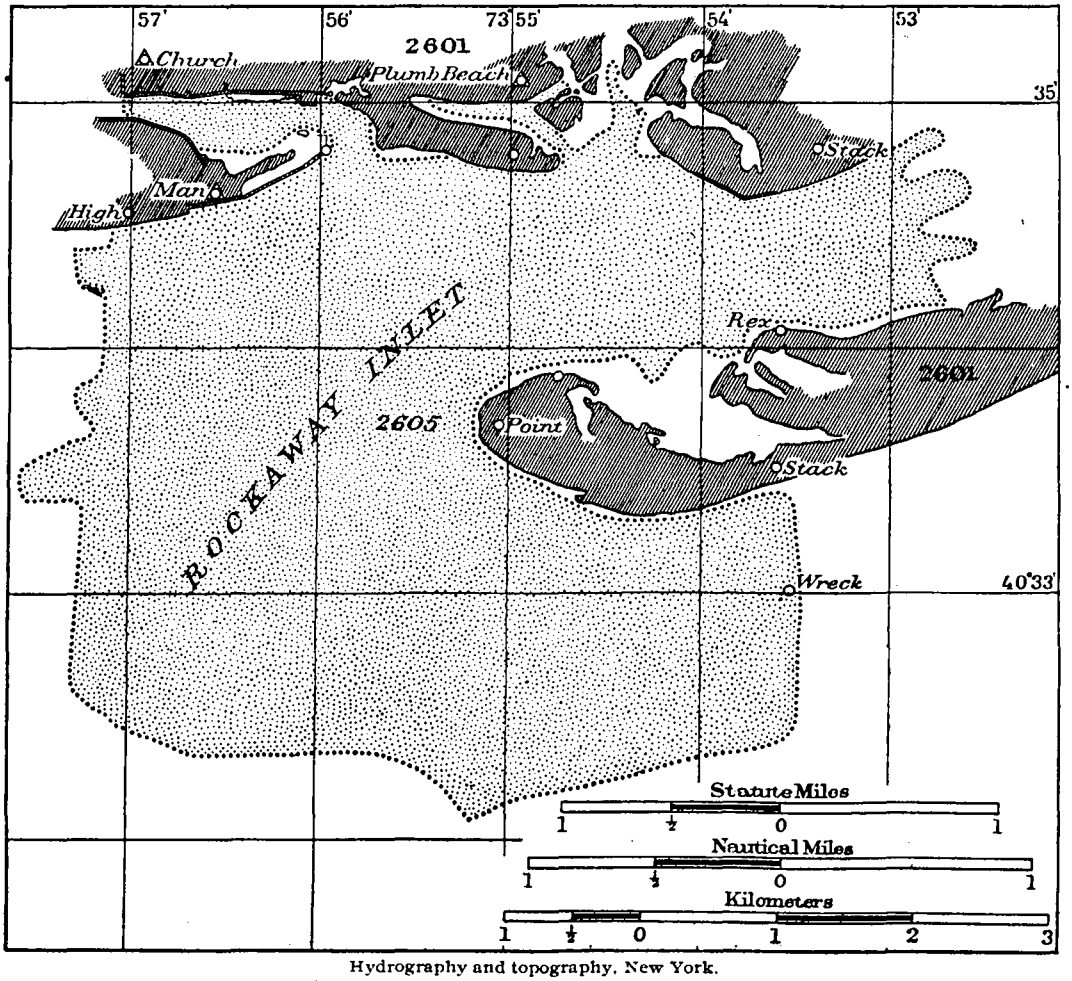
SUMMARY OF RESULTS.

Hydrography:
- 7 square miles area covered.
- 239 miles lines sounded.
- 9 113 soundings made.
- 1 tide station established.
- 1 hydrographic sheet completed.

Topography:
- 3 square miles area covered.
- 17 miles shore line surveyed.
- 9 miles shore line of creeks surveyed.
- 1 topographic sheet completed.

Triangulation:
- 3 stations occupied.
- 9 geographic positions determined.

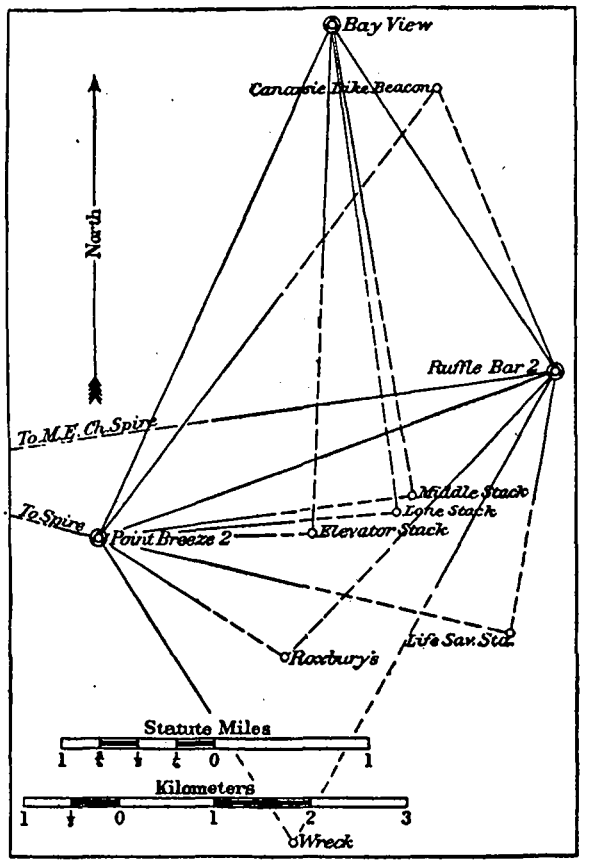
No. 19.



Hydrography and topography, New York.

Extensive changes in the shore line at the entrance to Sheepshead Bay, Long Island, New York, having been reported to the Office, a resurvey in this locality was made under the direction of Assistant Rhodes. He reached Sheepshead Bay on August 18, and field work began on the 20th. Two stations, Bay View and Ruffle Bar 2, of the old triangulation were recovered, after spending considerable time in searching for other stations, and the line between these stations was used as a base from which to determine the geographic positions necessary for the resurvey. The topographic work was extended as rapidly as the weather conditions permitted, but it was delayed by stormy weather and the difficulty of entering Sheepshead Bay at low water.

No. 20.



Triangulation, Rockaway Inlet, New York.

The survey began at the hotels on Manhattan Beach and was extended far enough to the east to show all material changes. Two important changes were developed—a new entrance into Sheepshead Bay opposite the mouth of Hog Creek and the extension of Rockaway Point westward three-quarters of a mile. In September, Mr. C. A. Thompson, watch officer, was assigned to the party to assist in the hydrographic work, and the hydrographic examination of Rockaway Inlet began on the 23d. The weather was unfavorable and delayed the work, which was continued until November 10, when the continued bad weather resulted in closing the work. The hydrographic work covered the Rockaway Shoals and the Inlet proper, with the approaches. The tide gauge established to obtain a plane of reference to which the soundings could be reduced was connected by direct measurements with a bench mark of the department of docks and ferries of New York City and through this bench mark with the plane of reference used by that department. Mr. A. L. Poole served as recorder, and Mr. George Poole as leadsman in the party.

HYDROGRAPHY. FLORIDA. H. W. RHODES, Commanding,
TOPOGRAPHY. VIRGINIA. Steamer *Hydrographer.*
TRIANGULATION.

Virginia—November 21 to December 18.

C. L. GREEN, *First Watch Officer.* November 21 to November 30.
H. L. FORD, *Nautical Expert.*
H. W. PEERCE, *Chief Engineer.*
H. D. KING, *Aid.*

SUMMARY OF RESULTS.

Hydrography:
6 square miles area covered.
131 miles lines sounded.
6 294 soundings made.
1 tide station established.
1 hydrographic sheet completed.
Topography:
2 square miles area covered.
12 miles shore line surveyed.
1 topographic sheet completed.

Florida—February 15 to March 31.

C. L. GREEN, *First Watch Officer.*
H. W. PEERCE, *Chief Engineer.*
H. D. KING, *Aid.*
C. G. QUILLIAN, *Aid.*

SUMMARY OF RESULTS.

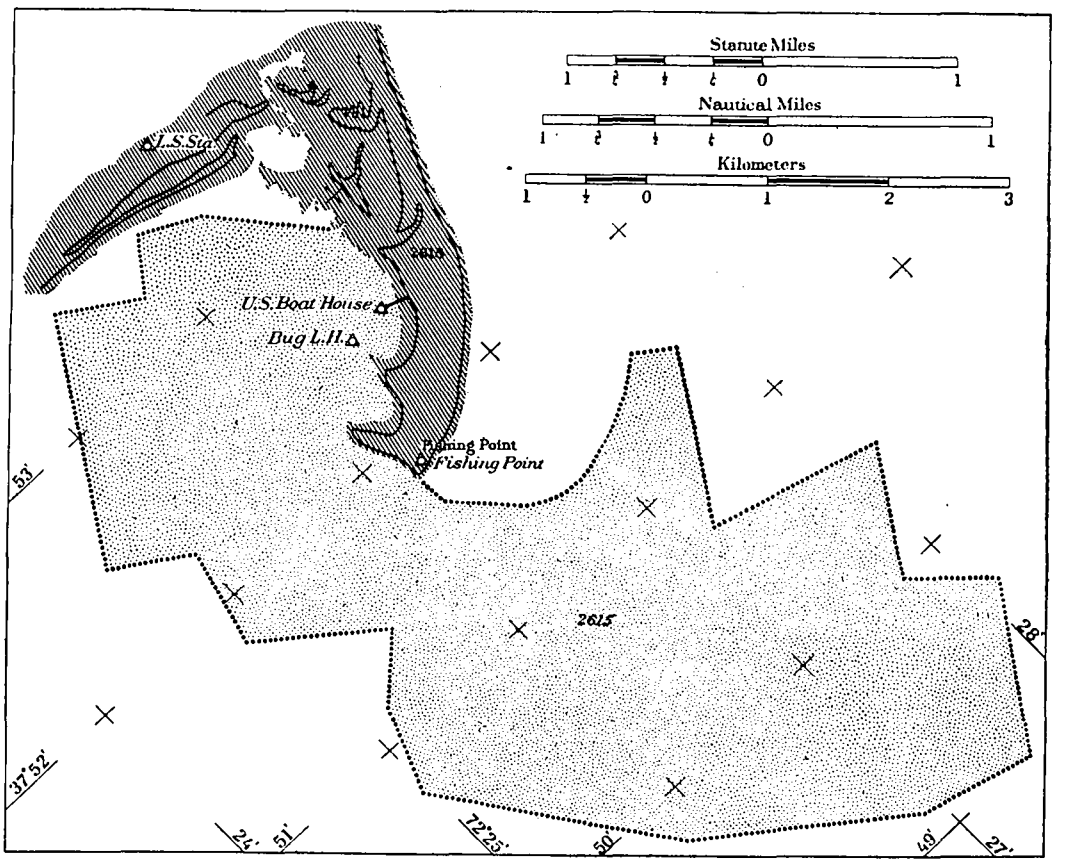
Hydrography:
110 miles lines sounded.
2 tide stations established.
1 hydrographic sheet completed.
Triangulation:
3 stations occupied.
18 geographic positions determined.

The resurvey of the shore line and hydrography at Chincoteague Island, Virginia, for the purpose of determining the changes that had taken place in Fishing Point and Chincoteague Shoals, was assigned to Assistant Rhodes, commanding the steamer *Hydrographer.* He took command of the ship at Washington on November 12, and started the vessel immediately to Chincoteague Island, via Norfolk, for supplies, in charge of First Watch Officer C. L. Green. The ship was delayed several days in Hampton Roads by unfavorable weather, and did not reach Chincoteague Island until November 21. Assistant Rhodes joined the ship on November 24.

The work consisted of a topographic resurvey of Fishing Point, extending as far back as the Assateague Beach Life-Saving Station, the hydrographic development of the anchorage inside the point, and as much work outside on the shoals as it was possible to do before December 18, on which date the work was suspended on account of continued unfavorable weather, and the vessel proceeded to Norfolk, Va. The weather was very stormy, with fresh breezes and gales of wind, and the work was necessarily carried on under unfavorable conditions.

Certain repairs were made to the ship at Norfolk, and during the latter part of January a harbor sweep, with a sweeping bar 32 feet long, was fitted to the ship, and certain experiments were made with a quick sounding machine under the direction of Assistant Wainwright, who had joined the ship for that purpose. On January 31, the ship sailed for Key West, Fla., and reached that place on February 14, after being detained at Charleston one day and at Fernandina three days on account of rough weather. Advantage was taken of the inside passage to avoid rough weather outside and thus expedite the trip.

No. 21.

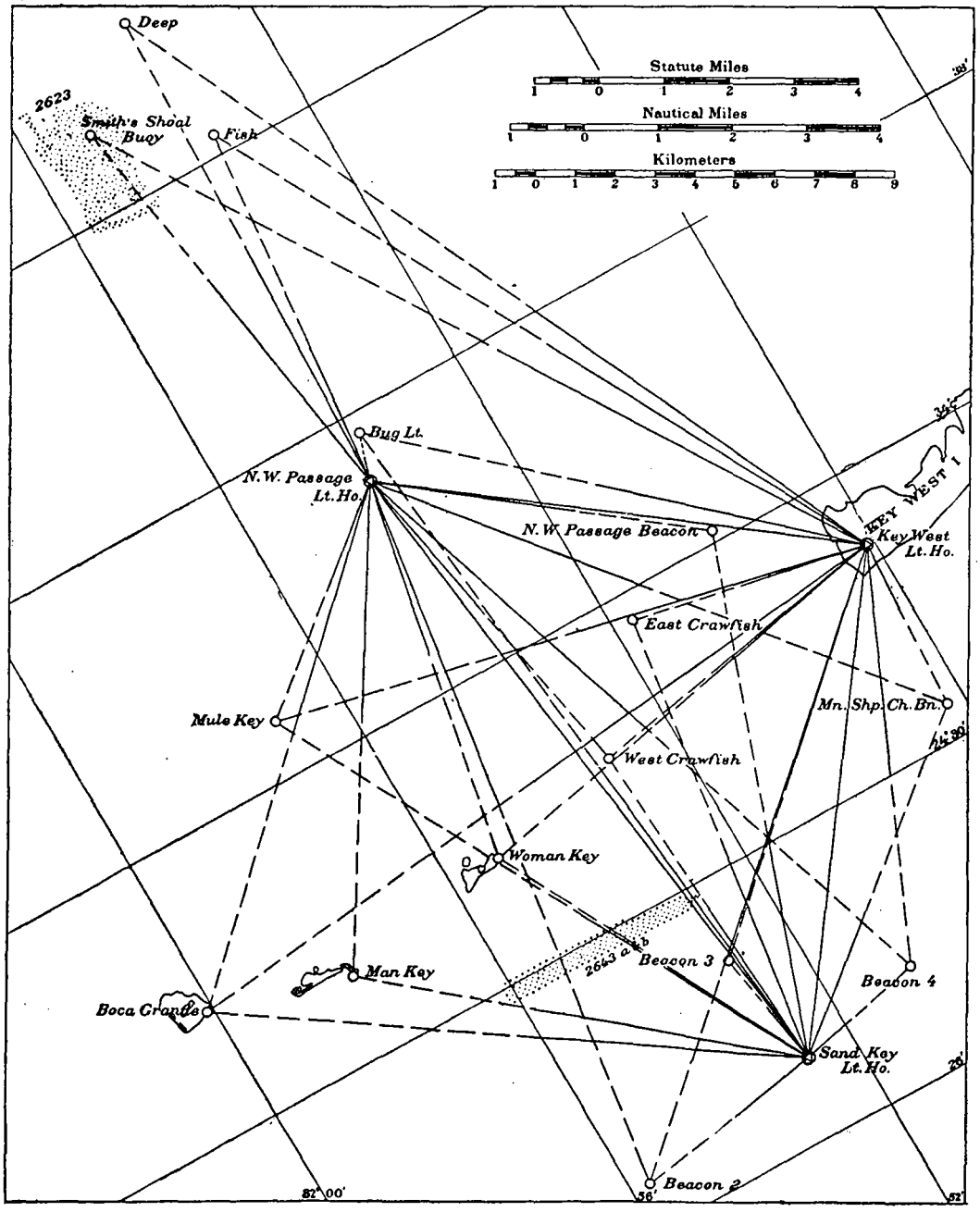


Hydrography and topography, Assateague anchorage, Virginia.

Three old triangulation stations were recovered and occupied, and the positions of points covering the area of the proposed hydrographic resurvey were determined. A self-registering tide gauge was established on the light-house wharf at Key West, and the work progressed as rapidly as the unfavorable weather conditions permitted. A survey was made of Smiths Shoal, northwest of Northwest Passage Lighthouse, and a tide staff was erected at this lighthouse and the observations required in the reduction of soundings were made. A close survey of the proposed anchorage in the Southwest Channel was begun, the lines being run at intervals of 50 meters, and the channel sweep, set at a depth of 5 fathoms, carried continuously. This work was in progress

on March 31, on which date Assistant W. I. Vinal took command of the *Hydrographer*, relieving Assistant Rhodes, who had been ordered to other duty. The details in regard

No. 22.



Hydrography and triangulation, Key West, Fla.

to the continuation of this work to the close of the season are given under the name of Assistant Vinal.

COAST PILOT. HYDROGRAPHY. | MAINE. MASSACHUSETTS. NEW HAMPSHIRE. RHODE ISLAND. | John Ross, Commanding, Steamer *Hydrographer*.

H. C. GRAVES, *Nautical Expert.*
C. L. GREEN, *First Watch Officer.*
H. W. PEERCE, *Chief Engineer.*
JOS. W. OGDEN, *Recorder.*

SUMMARY OF RESULTS.

Hydrography:
33 stations occupied.
20 stations determined.
26 miles lines sounded.
3 181 soundings made.
78 rocks located.
19 ledges developed.
2 tide stations established.
36 buoys located.

The collection of the information necessary for the revision of the Coast Pilot volumes covering the coast from St. Croix River, Maine, to Point Judith, Rhode Island, was in progress on July 1 under the direction of Nautical Expert John Ross. The ports and harbors within the limits stated were visited and inspected. At these places and along the routes followed changes affecting the Coast Pilot were noted, sailing lines were verified, and additional information regarding navigation in these waters was obtained from the captains of steamboats and coasting steamers and from fishermen. Special effort was made to obtain the draft of the largest vessels entering the different ports. Numerous isolated rocks and ledges were located and their positions determined. In a number of cases it was necessary to use a drag in searching for the rocks. The field work for the season closed on October 24, and the vessel proceeded to Washington, D. C.

Mr. Ross reports his appreciation of the assistance rendered by the members of his party, Messrs. Graves, Green, Peerce, and Ogden, and states that the successful prosecution of the work was due to their able and careful cooperation.

MAGNETIC OBSERVATIONS. MARYLAND. L. G. SCHULTZ.

The work at the Magnetic Observatory at Cheltenham, Md., was continued under the direction of L. G. Schultz, Magnetic Observer, and the record of the self-registering instruments for the year is practically unbroken. Two sets of these instruments were in use at the base station and both were in operation almost all the time, and one or the other all the time. Continuous thermogram records were obtained in both the rooms where the self-registering instruments were in operation.

Observations for absolute values were made four or five times each month during the year, and during July, August, and September two sets of instruments were used for absolute observations. Observations were made to determine the constants of the large Edelmann magnetometer No. 26 from July to November, and this instrument was used as the standard intensity instrument after September. The inductor No. 26 was used as the station standard beginning with April.

The regular international term-day observations were made on the 1st and 15th of each month with the Adie eye-reading instruments and with one of the instruments in the observatory for absolute observations. The Eschenhagen magnetograph was run on the two-hour rate during the term hours and from the 2d to 8th in December, January, and February it was run on the two hour rate for two full hours each day in cooperation with the Birkeland Polar Expedition.

Observations to determine atmospheric electricity were made on thirty-one days between October 1 and April 1 and on five of these days the observations were extended over twenty-four or thirty-six successive hours in order to obtain complete daily curves. These observations were the first to show the peculiar conductivity effects about sunrise and sunset, which have since been noted on Mount Vesuvius, Italy. These observations also show in a remarkable manner the intimate relation between the daily variations of temperature and the electrical potential gradient of the air. The daily potential curve deduced from the observations at Cheltenham agrees very closely with the curves obtained from the observations made in Paris, France, at the Eiffel Tower, with the most refined instruments.

MAGNETIC OBSERVATIONS. LOUISIANA. EDWIN SMITH.

Stations occupied.

AMITE.*	DONALDSONVILLE.†	HOUMA.
BATON ROUGE.†	EDGARD.†	NAPOLEONVILLE.†
CLINTON.†	FRANKLIN.†	NEWROADS.†
CONVENT.†	GREENSBURG.†	ST. FRANCISVILLE.†
COVINGTON.	HAHNVILLE.†	THIBODAUX.

Magnetic observations were made in Louisiana at the request of the State geologist, who agreed to pay a portion of the field expenses, and the work was assigned to Assistant Smith. He left Washington on January 1, and proceeded to New Orleans for consultation with the State geologist, and arranged a programme of work with his representative, Dr. W. C. Stubbs, Director of the Louisiana Sugar Experiment Station, and the observations began immediately. The stations named above were occupied, and observations were made to determine the three elements of terrestrial magnetism.

At some of the stations meridian lines were already established. These were verified, and meridian lines were established at all the other stations, except at Amite, where it was impracticable to mark such a line, and at that place an azimuth line was established. Assistant Smith's services were required on other work, and the field work in Louisiana closed on February 19.

TIDE OBSERVATIONS. FLORIDA.
MARYLAND.
NEW YORK.
PENNSYLVANIA.

Self-registering tide gauges were kept in operation throughout the year at the following places: Fernandina, Fla., B. W. Weeks, observer; Baltimore, Md., F. A. Kummell, observer; Fort Hamilton, N. Y., J. G. Spaulding, observer; Philadelphia, Pa., H. E. Olson, observer.

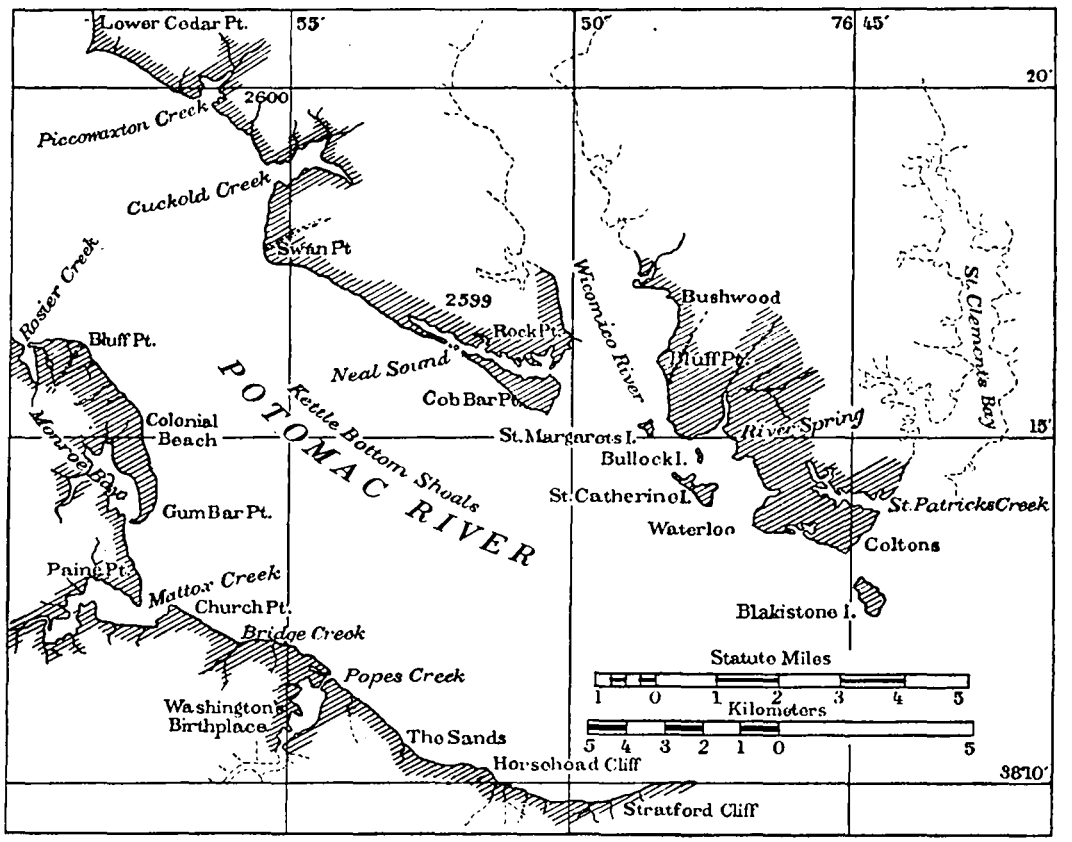
* Azimuth line established. † Meridian line established.

TOPOGRAPHY. MARYLAND. W. I. VINAL.
VIRGINIA.

SUMMARY OF RESULTS.

Topography:
22 square miles area covered.
139 miles shore line rivers and creeks surveyed.
15 miles shore line creeks and ponds surveyed.
49 miles roads surveyed.
1 topographic sheet completed.

No. 23.



Topography, Potomac River.

On July 1 a topographic party under the direction of Assistant Vinal was at work on the Potomac River. The work was continued until November 17, when the field work closed for the winter. The area surveyed lies between Lower Cedar Point and Blakistone Island in Maryland, and between Rosier Creek and Nomini Cliffs in Virginia. The topographic details were surveyed inland for distances varying from one-fourth to three-fourths of a mile. All buoys within the limits of the topographic sheets covering the area surveyed were carefully located on the sheets. Colonial Beach, Va., was the only place in this locality where the party could secure quarters during the summer excursion season, and consequently it was often necessary for the party

to travel long distances to and from work, which resulted in serious delay. As soon as practicable the party moved to River Springs, Md., to be nearer the working ground. The work was also delayed by sickness, which compelled two members of the party to return to their homes. C. A. Thompson, watch officer, was attached to the party from July 10 to September 16. Mr. W. G. Emory served faithfully and showed intelligent interest in the work until October 12, when he left on account of sickness.

HYDROGRAPHY. FLORIDA. W. I. VINAL, Commanding, Steamer *Hydrographer.*

C. L. GREEN, *First Watch Officer.*	
H. W. PEERCE, *Chief Engineer.*	
H. D. KING, *Aid.*	Mar. 31 to Apr. 18.
C. G. QUILLIAN, *Aid.*	
E. V. MILLER, *Acting Second Watch Officer.*	Apr. 18 to June 16.

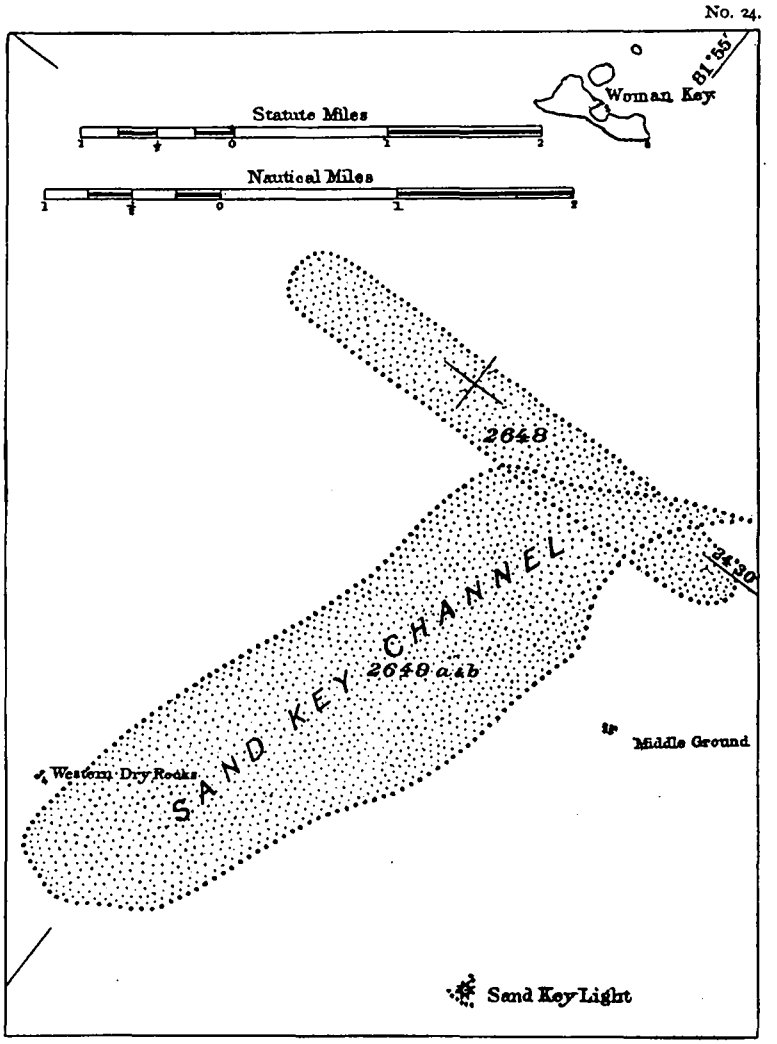
SUMMARY OF RESULTS.

April 1 to June 9.

Hydrography:
- 5 square miles area covered.
- 353 miles lines sounded.
- 15 212 soundings made.
- 3 hydrographic sheets completed.

A hydrographic resurvey of certain localities in the vicinity of Key West, Fla., was in progress on March 31, under the direction of Assistant H. W. Rhodes, commanding the steamer *Hydrographer*, and on that date Assistant Vinal assumed command of the vessel, relieving Assistant Rhodes, whose services were needed elsewhere. On April 1 he reported to Assistant P. A. Welker, commanding the steamer *Bache*, who arrived at Key West on that date with orders to take general direction of the work in the vicinity.

By direction of Assistant Welker, sounding in the anchorage was discontinued and the hydrographic development of the Sand Key Channel was taken up by the party on the *Hydrographer*. Tide observations were made at the Sand Key Lighthouse and on the lighthouse wharf at Key West, to furnish data for the reduction of the soundings. Sounding lines were run at intervals of 35 meters, and a large portion of the lines was also run over with the channel sweep, set to a depth of 5 fathoms. Isolated rocks were buoyed and developed by radial lines of soundings. The weather conditions during the season were fair, but the working ground was at a considerable distance from land, and the character of the survey required light winds and a smooth sea, so that only a portion of the time could be utilized for sounding. The vessel left Key West on June 9, and reached Norfolk on the 16th. Assistant Vinal reports that all the officers of the ship rendered faithful and efficient service, and expresses his appreciation of the aid he received from them.



Hydrography, approaches to Key West, Fla.

EXPERIMENTAL OBSERVATIONS. D. B. WAINWRIGHT.
WIRELESS TELEGRAPHY.
CHANNEL AND HARBOR SWEEP.
QUICK SOUNDING MACHINE.

On July 1 experimental work with wireless telegraph apparatus was in progress under the direction of Assistant Wainwright, for the purpose of ascertaining whether this method of sending signals could be adapted for use in the telegraphic longitude work of the Survey. As stated in the previous Annual Report, the tests were made between the Marconi wireless telegraph station at Sagaponack, on the eastern end of Long Island, New York, and the schooner *Eagre*, at various distances. The plan was to have the *Eagre* establish easy connection with the station on shore and then proceed

away from the station to determine the greatest distance at which it was practicable to exchange signals such as are used in the telegraphic longitude work.

The standing rigging of the vessel consisted of wire rope set up with turn-buckles, which gave a continuous metallic connection from each topmast of almost 125 feet, and the vessel was used in this condition during the first tests, as stated in the previous report, which did not yield satisfactory results. For the next trial, hemp rope was substituted for the wire rope of the standing rigging of the topmasts at the request of the Marconi Wireless Telegraph Company, and at their expense.

The tests were then repeated, other conditions remaining the same. The vessel went to a point about 30 miles west of the Marconi station and established the connection by exchanging signals, and started toward New York, after ascertaining that the conditions were favorable. Signals were exchanged between the vessel and the shore station every half hour as the vessel proceeded westward, and continued for an hour or more after the last intelligible message was received on board, at a distance of 63 miles. On board the schooner a break-circuit chronometer was included in the circuit of the battery and the sparking coil, by use of suitable relays, and in this way each break made by the chronometer was automatically sent as a time signal, which was recorded on the tape of the Morse recorder at the shore station. This method proved to be very satisfactory, and the results indicate that regularly spaced signals sent in this manner can be utilized for longitude determinations at a greater distance than it is possible to use verbal messages by the Morse code. The work closed on July 11.

Later in July, Assistant Wainwright was assigned to the temporary command of the *Blake*, during the absence of Assistant Faris from July 16 to August 11. He took command of the ship at Baltimore on July 16, and sailed on the 19th for Hyannisport, Mass. The *Blake* reached Hyannisport on the 23d, and the hydrographic examination of a portion of Nantucket Sound lying south of Cross Rip light-ship was nearly completed before August 11, the date on which Assistant Faris resumed command, and the details of this work are included in the statement under his name.

On August 12 Assistant Wainwright resumed his duties in the office, and on September 20 proceeded to New Bedford, Mass., and went on board the *Blake* to install and test a channel and harbor sweep which had been devised at the Coast and Geodetic Survey Office. A description of this channel sweep is given in Appendix 6 to this Report. The apparatus was successfully installed and numerous tests were made, which demonstrated that the channel sweep was entirely practicable and satisfactory. The tests were concluded on September 30, and Assistant Wainwright returned to Washington.

From January 18 to 26 he was again in the field in charge of the installation of a channel and harbor sweep on board the steamer *Hydrographer*, and also engaged in testing a navigational sounding machine arranged for quick sounding. After the tests were over the sounding machine was brought back to the Office and some improvements were made, and it was again tested in May (5 to 7) while attached to a naphtha launch. In smooth water and not exceeding 5 fathoms in depth, and where the bottom is moderately regular, 15 soundings can be obtained per minute. The instant of contact of the lead with the bottom can be determined when the speed of the vessel is 5 miles per hour as accurately as when the speed is reduced to 3 miles per hour.

MAGNETIC OBSERVATIONS. ALABAMA. FLORIDA. GEORGIA. MISSISSIPPI. SOUTH CAROLINA. W. F. WALLIS.

L. B. SMITH, *Aid.*

After completing the magnetic observations assigned to him in the Middle Division, Mr. L. B. Smith continued magnetic work, as a member of Mr. W. F. Wallis's party, in the Eastern Division, and occupied the stations named in the following list between January 11 and May 24:

ALABAMA.

EUFAULA.	LIVINGSTON.	SELMA.
GREENSBORO.	OZARK.	TROY.

FLORIDA.

ARCADIA.	KISSIMEE.	ST. PETERSBURG.
BARTOW.	LAKE CITY.	STARKE.
BROOKVILLE.	LIVE OAK.	SUMTERSVILLE.
DADE CITY.	MAYO.	TAMPA.
DELAND.	MIAMI.	TARPON SPRINGS.
EAU GALLIE.	OCALA.	TAVARES.
HOMOSASSA.	ORLANDO.	TITUSVILLE.
INVERNESS.	PUNTA GORDA.	

GEORGIA.

CUTHBERT.	SAVANNAH.	VALDOSTA.
IRWINSVILLE.		

MISSISSIPPI.

CHARLESTON.	HERNANDO.	SARDIS.
GREENWOOD.		

SOUTH CAROLINA.

FLORENCE.	ORANGEBURG.	SUMTER.
HAMPTON.		

The observations necessary to determine the elements of the earth's magnetism were made at all the stations named above, and the positions occupied were all marked in a permanent manner by using stone monuments. Mr. Smith's work in the field closed on May 24, and he reported at the Office in Washington the next day.

HYDROGRAPHY. FLORIDA. MASSACHUSETTS. P. A. WELKER, Commanding Steamer *Bache*.

Massachusetts—July 24 to October 14.

E. B. LATHAM, *Assistant.*	
F. H. AINSWORTH, *First Watch Officer.*	
J. E. SHEPHERD, *Surgeon.*	
M. F. FLANNERY, *Chief Engineer.*	
H. S. SMITH, *Second Watch Officer.*	
A. C. L. ROETH, *Deck Officer.*	July 1 to Aug. 8.
WILLIAM SANGER, *Captain's Clerk.*	
G. BRADFORD, 2D, *Deck Officer.*	Aug. 6 to Oct. 14.
F. RIESENBERG, *Deck Officer.*	

SUMMARY OF RESULTS.

Hydrography:
622 miles lines sounded.
26 801 soundings made.
2 tide stations established.
5 hydrographic sheets completed.

Florida—April 1 to June 6.

E. B. LATHAM, *Assistant.*	
W. M. ATKINSON, *First Watch Officer.*	
G. E. MARCHARD, *Surgeon.*	
M. F. FLANNERY, *Chief Engineer.*	
H. S. SMITH, *Second Watch Officer.*	Apr. 1 to 25.
WILLIAM SANGER, *Captain's Clerk.*	
E. C. SASNETT, *Aid.*	
G. A. BERRY, *Deck Officer.*	
F. B. THOMPSON, *Deck Officer.*	May 1 to June 6.

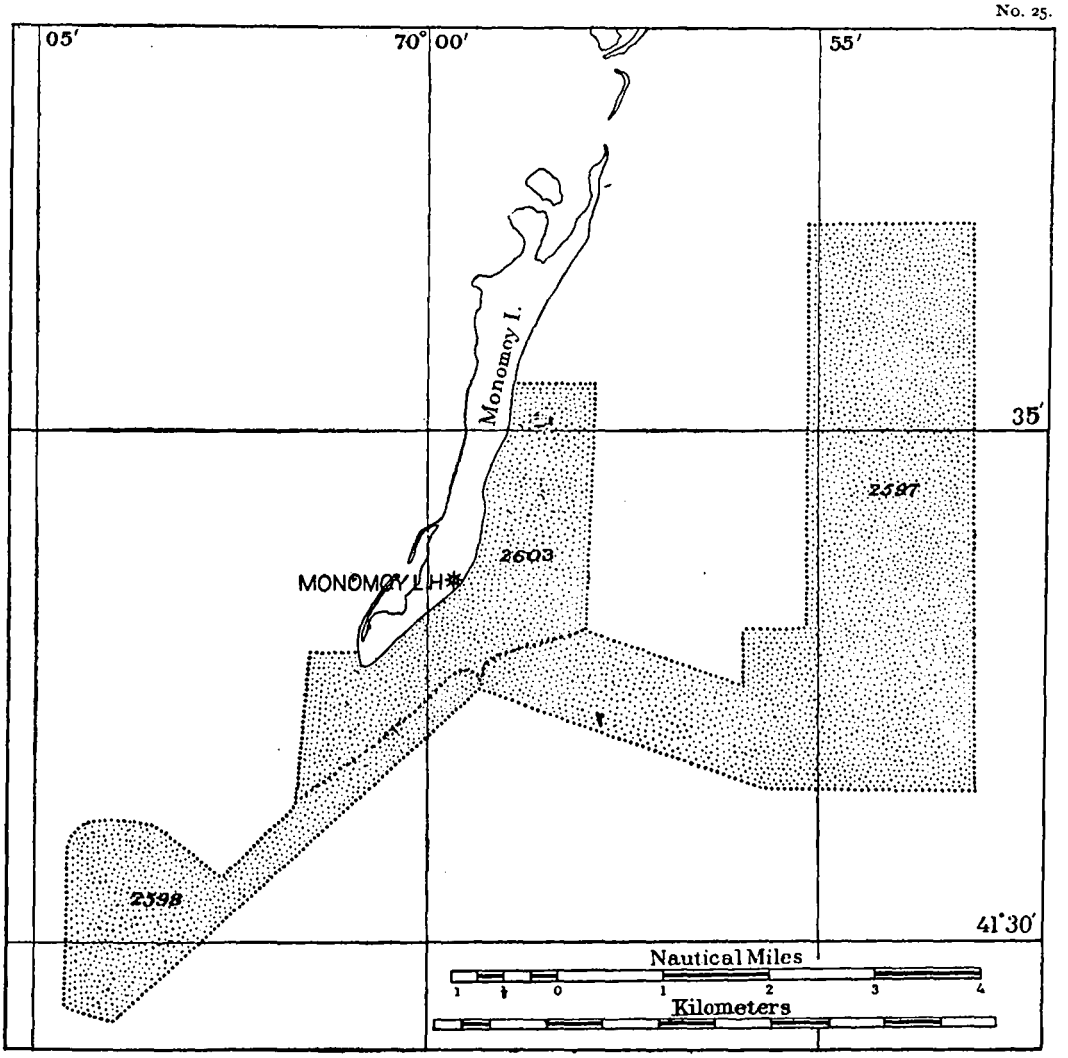
SUMMARY OF RESULTS.

Hydrography:
6 square miles area covered.
486 miles lines sounded.
19 167 soundings made.
1 tide station established.
1 hydrographic sheet completed.

Hydrographic examinations and surveys on the coast of Massachusetts were assigned to Assistant Welker, commanding the steamer *Bache*. The vessel left Baltimore on July 16, with Assistant Latham in command temporarily during the absence of Assistant Welker, and proceeded to Providence, R. I., where Assistant Welker assumed command on July 22. On the 24th the vessel was taken to the working ground and preparations were made for the resurvey of portions of Nantucket Shoals, and work on Pollock Rip Shoal began immediately. Until August 6 the weather was almost continuously foggy and very little was accomplished, but after that date the conditions were favorable, and the survey of this shoal was completed on August 20. The greater portion of this work was done with the steamer, as the rough and choppy sea usually prevailing prevented

the use of the smaller boats except on a few days. The hydrographic survey in the vicinity of Monomoy Slue and Shovelful and Handkerchief shoals was then taken up. On account of the shoal water, breakers, and very strong currents it was necessary to do this work with small boats, and almost calm weather was required for most of it. The work was difficult and the progress slow, but the work was completed on September 17. The water signals used in the work were removed, and on the 18th the vessel proceeded to Boston.

No. 25.

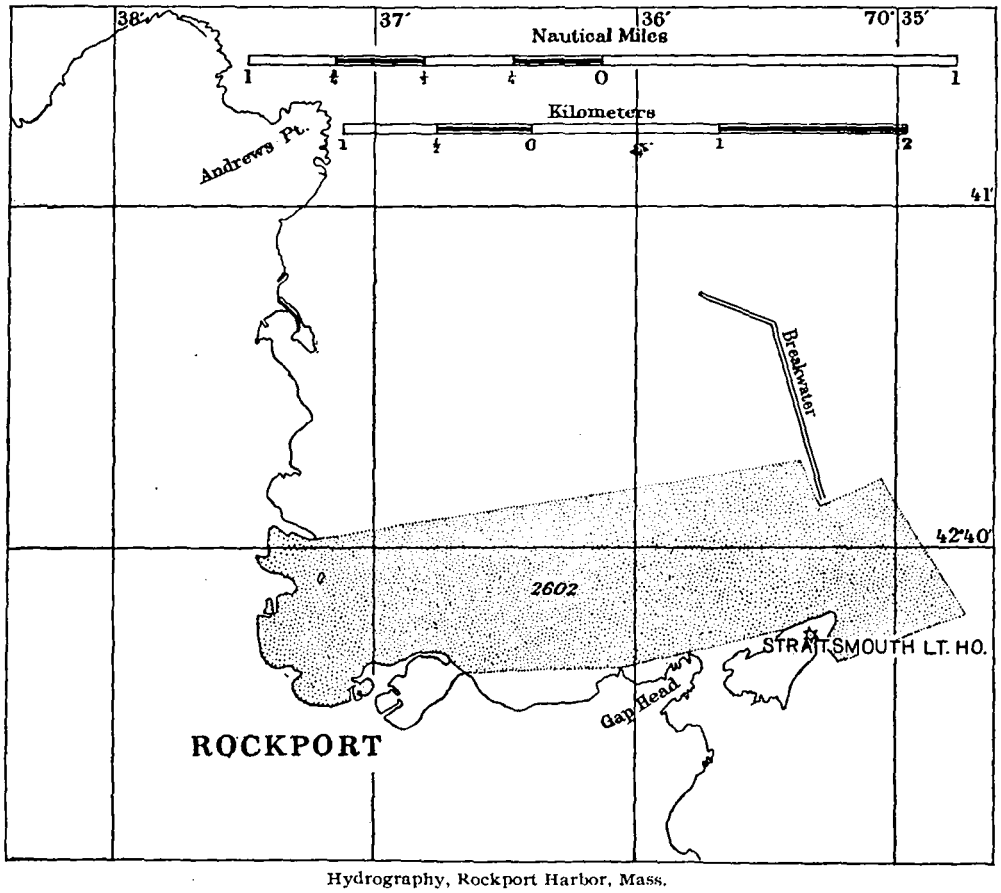


Hydrography, Nantucket Shoals, Massachusetts.

On September 24 the vessel was taken to Rockport, Mass., and a hydrographic survey of the entrance to the harbor and of the anchorage was made. The weather conditions were unfavorable and the work was not completed until October 14, on which date the field work closed for the season and the vessel proceeded to Boston.

The *Bache* left San Juan, P. R., on March 27, under the command of Assistant Welker, and proceeded to Key West, Fla., to make a hydrographic survey in the vicinity. The vessel reached Key West on April 1, and Assistant W. I. Vinal, commanding the steamer *Hydrographer*, already at work in this locality, reported for duty, as Assistant Welker had been instructed to assume the direction of all the work in this region. Assistant Vinal was directed to take up the hydrography in Sand Key Channel, and an account of his work is given under his name. The following refers

No. 26.



Hydrography, Rockport Harbor, Mass.

only to the work executed by the party on the *Bache* in the survey of Southwest Channel. The necessary signals had been erected and their positions were known, so that the hydrographic work began without delay. Sounding lines were run approximately parallel to the axis of the channel and at intervals of 25 to 75 meters. The lines were crossed by other lines approximately at right angles to them, and about the same distance apart. All spots showing indications of shoals or coral heads were afterwards carefully examined and developed. The localities with less than 5 fathoms of water were examined for shoal spots by going over them with a drag. In all of the

work two leadsmen were continuously used, but only the starboard leadsman called out his soundings, except, that in cases where the port leadsman obtained less than 5 fathoms, his soundings were also called out and recorded. During the progress of the work the steamer *Bache* was twice called upon for special service. On May 2 the U. S. S. *Atlanta* grounded in the vicinity of buoy C17, and the commanding officer called for assistance, which was promptly rendered. The *Bache* reached the *Atlanta* at 6 p. m., but the tide was unfavorable and nothing was accomplished before being relieved by the navy tug *Osceola* at 11 p. m.

On May 5 buoy C17 was moved to a new position in response to a request from the Light-House Board. Tide observations were made at the wharf of the Light-House Establishment, Key West, and at Sand Key Lighthouse, where a tide staff was established. The tide staff at the light-house wharf was connected with the United States Engineers' bench mark at Fort Taylor and referred to the one at Sand Key Lighthouse by simultaneous observations, thus reestablishing the old plane of reference for use in reducing the soundings. The field work was closed for the season on June 6, the vessel sailed for Old Point Comfort, Virginia, on the 9th, and reached that place on the 14th.

HYDROGRAPHY. MARYLAND. F. A. YOUNG, Commanding,
TOPOGRAPHY. VIRGINIA. Steamer *Endeavor*.
TRIANGULATION.

July 1 to December 18.

J. A. MCGREGOR, *First Watch Officer.*	
H. G. LOCKE, *Chief Engineer.*	
A. C. L. ROETH, *Deck Officer.*	Oct. 24 to Nov. 29.
E. V. MILLER, *Captain's Clerk.*	Sept. 4 to Dec. 18.
R. J. NEELEY, *Acting Deck Officer.*	July 1 to Aug. 31.
W. K. WEST, *Acting Deck Officer.*	July 1 to Sept. 30.

SUMMARY OF RESULTS.

Hydrography:
964 miles lines sounded.
44 610 soundings made.
3 tide stations established.
Topography:
17 miles shore line surveyed.
Triangulation:
4 stations occupied.

June 4 to June 30.

J. A. MCGREGOR, *First Watch Officer.*	
H. G. LOCKE, *Chief Engineer.*	
E. KRAMER, *Aid.*	June 21 to June 30.
J. H. SIMPSON, *Deck Officer.*	

SUMMARY OF RESULTS.

Hydrography:
33 miles lines sounded.
1 735 soundings made.

The resurvey of Kettle Bottom Shoals was in progress on July 1 under the direction of Assistant F. A. Young, commanding the steamer *Endeavor*. The work continued whenever the weather permitted until December 18, except during the period August 23 to September 2, when necessary repairs were being made, and from September 3 to 5, when the vessel was on other duty. A regular system with lines at intervals of 100 to 150 meters was carried out in making the soundings. All lumps were developed with care and all regions where lumps were shown as the result of former surveys were thoroughly examined. Nearly all these old shoals were found and several new ones were developed on the north side of the river. Soundings were made in a new channel passing close to Neals Point, which was dredged under the direction of the Corps of Engineers, U. S. Army. Tide observations were made at Colonial Beach during the whole season. On October 21 the vessel proceeded to Mattawoman Creek and completed a hydrographic and topographic survey along that creek to a point 6 miles above the mouth on November 21. Tide staffs were established at Stump Neck and at Grinders wharf, where observations were made for use in reducing the soundings. The vessel returned to Colonial Beach on November 21 and closed work for the winter on December 18, on which date the ship sailed for Baltimore.

The *Endeavor* left Baltimore on May 29 and proceeded to Kettle Bottom Shoals to resume work. After stopping at various places on the way, the vessel reached Colonial Beach on June 4. The hydrographic work begun earlier in the fiscal year was continued from June 6 to 30, but the weather was unfavorable and the progress was slow.

The statistics of the work done during this period are given above, and the work was in progress at the close of the fiscal year.

MIDDLE DIVISION.

MAGNETIC OBSERVATIONS. KANSAS. MINNESOTA. NEBRASKA. TEXAS. L. A. BAUER.

While engaged on inspection duty in the Western Division in October Assistant Bauer made magnetic observations at the following stations:

In *Kansas*, at Baldwin, Beloit, Minneapolis, and Winfield; in *Minnesota*, at Duluth; in *Nebraska*, at Tecumseh; in *Texas*, at Hereford, Liberty, and San Antonio. At these stations the regular observations to determine declination, dip, and horizontal intensity were made with a magnetometer and dip circle, and observations were also made with a Lloyd-Creak dip circle, standardized at the Cheltenham Observatory, to determine dip and intensity.

TRIANGULATION. KANSAS. OKLAHOMA. TEXAS. WILLIAM BOWIE. O. W. FERGUSON.

SUMMARY OF RESULTS.

5 861 square miles area covered.
49 stations occupied.
144 geographic positions determined.

On July 1 the triangulation along the ninety-eighth meridian was actively in progress under the direction of Assistant Bowie, with Assistant O. W. Ferguson in charge of the second observing party, and Signalman Jasper S. Bilby in charge of a party engaged in the construction of the necessary observing tripods and scaffolds, which were all built in advance without delaying work of the observers.

The organization of the parties and the instructions under which the work was done were stated in the previous report in connection with the work executed before July 1, and it is not necessary to repeat these details.

On July 1 the observing parties were at work in the vicinity of the El Reno Base in Oklahoma Territory. Rapid progress was made by both observing parties and the stations between the El Reno Base and the Anthony Base, in Kansas, were occupid previous to August 16, on which date the connection with the triangulation north of Anthony Base was completed.

On July 12 the signal building party went south, and the erection of signals between Bowie Base and Lampasas Base began on July 19. All the signals between these points and including the stations of the Lampasas Base net were completed on September 28. The

outfit was placed in storage and on October 3 the building party was disbanded and Signalman Bilby joined the observing parties. This closed a notable performance in the construction of observing tripods and scaffolds for use in triangulation, both in the time involved and the number of signals built. The success attained was made possible by the efficiency of Signalman Bilby and by the continuous employment of a trained party. The observing parties began work south of the Bowie Base net on August 28 and completed the work to the Lampasas Base, including the entire base net, on October 25.

All the necessary preparations were made for closing the field work, and on November 4 the party was disbanded.

During this season, which began in March, as stated in the preceding Annual Report, the two observing parties occupied all the stations necessary to extend the triangulation 640 kilometers along the meridian. This involved the measurement of horizontal and vertical angles at 75 primary stations, and the season's work is remarkable for the distance covered and the small cost per station, a result which reflects great credit upon the two observers.

Horizontal directions and vertical angles were measured during the day and at night between 3 and half past 11 p. m. Heliotropes were used until sunset, and observations on the lamps began about one hour afterwards.

The signal lamp used is a modified acetylene bicycle lamp mounted on a frame capable of being leveled and easily pointed in any desired direction. This lamp was very satisfactory; it can be easily centered and pointed; is so constructed that it can not become overheated; is easily kept in order, and the flame is quite steady and is not materially affected by wind. It requires charging several times each night, which is a disadvantage, but not a serious one. Any necessary instructions were communicated to the light keepers by means of a code of signals. The tripods were not protected against wind during this season and guys were rarely put on the scaffolds. The signals were very rigid even in strong wind, and only a few days were lost as a result of heavy vibration. The tripods were usually in the sunshine, but the observations showed no signs of twisting, and the levels on the instruments did not change materially during the observations. Observations were never discontinued at night on account of the lights being unsteady, but the observations in the afternoon did not begin until the heliotropes were steady enough to insure pointing within a range of two seconds between successive readings of the circle.

The daily programme was to begin observing vertical angles at 3 o'clock in the afternoon on the heliotropes, if showing, or on some part of the signals if they were not visible, and these observations were usually made between 3 and 4 o'clock. As soon as the vertical angle observations were completed the observations of horizontal angles were begun if the atmospheric conditions permitted and were continued until a few minutes before sunset, when work was suspended for an hour and then continued until half-past 10 or 11 o'clock, after which vertical angles were again measured. This usually concluded the work for the day, but occasionally the measurement of horizontal angles was resumed after the vertical angles had been measured.

The following is quoted from the report of Assistant Bowie:

> The success attained during the season is due to the faithful and efficient service rendered by the entire party. Special mention should be made of the ability and cooperation of Assistant Ferguson and Signalman Bilby, who were in charge of the second observing party and the building party,

respectively. The writer also wishes to acknowledge his appreciation of the services of Foreman D. A. Lewis, Recorders C. E. Schurch and H. G. Ferguson, and Light-Keepers Shirley Thomas, W. E. Hodges, W. A. Casey, and L. T. Jagers. Every one of the building party deserves great credit, especially William C. Nohl and Harry Schworer, who were in charge of the subparties under Signalman Bilby.

In concluding the writer wishes to express his appreciation of the cooperation and assistance rendered by those in the office, and especially by Assistant J. F. Hayford, Inspector of Geodetic Work, and Mr. E. G. Fischer, Chief of the Instrument Division.

LEVELING. KANSAS. OKLAHOMA. TEXAS. W. H. BURGER.

SUMMARY OF RESULTS.

508 kilometers of line completed.
78 bench marks established.

As stated in the preceding Annual Report leveling along the ninety-eighth meridian was in progress on June 30 in Oklahoma Territory, near the Kansas line, under the charge of W. H. Burger, aid, Coast and Geodetic Survey. After July 1 the work was extended north from Wakita, Okla., along the Atchison, Topeka and Santa Fe Railroad to Anthony, Kans., where connection was made, on July 12, with bench marks established at this place in a line brought from the north during a previous season.

The party then proceeded to Bowie, Tex., and began work on a line from that place to Shreveport, La. The line began on the bench marks used by the party earlier in the season, during the previous fiscal year, in starting the line north to Anthony, Kans., and was extended along the Fort Worth and Denver City Railway from Bowie to the crossing of the Chicago, Rock Island and Pacific Railway, 9 miles out of Fort Worth, and thence along the latter railway to Fort Worth. From this place the levels were carried over the Texas and Pacific Railway to Dallas; the line was compteted to that place on August 22. From Dallas the levels were carried over the Missouri, Kansas and Texas Railway to Shreveport, La. The distance between these places is longer by this route than over the Texas and Pacific Railway, but the officials of this latter railway refused permission for the party to use velocipede cars on their tracks and the longer route was selected as the velocipede cars greatly facilitate the leveling operations.

Ralph L. Libby, Aid, Coast and Geodetic Survey, was assigned to the party for instruction in the methods of work, and reported for duty on October 1. After this date Mr. Libby made the observations about one-half the time, with Mr. Burger as instructor and recorder, and acted as recorder the rest of the time, while Mr. Burger made the observations.

The line was completed to Shreveport, La., on November 18, when connection was made with the permanent bench marks established at that place under the direction of the Corps of Engineers, U. S. Army, and connected by the U. S. Engineers with the Coast and Geodetic Survey levels at Little Rock, Ark., Vicksburg, Miss., the mouth of Red River, and at other places.

The leveling party then returned to Fort Worth, Tex., for the purpose of extending the line along the Fort Worth and Rio Grande Railway from that place to Granbury, Tex., en route to Comanche Peak, a station in the triangulation along the ninety-eighth meridian. The work was continued until November 30, when 23 kilometers of progress had been made. On this date Mr. Burger was relieved, and Mr. Libby was placed in charge of the party, and the account of the work subsequently executed is given under his name. The line was always leveled in both directions at least once, and such sections as showed more than the allowed discrepancy between the results of the forward and backward lines were leveled more than once.

Permanent bench marks were established at comparatively short intervals, with additional temporary bench marks between them, for the purpose of comparing the results obtained from the forward and backward lines.

Over half the distance from Bowie to Fort Worth, the route was through a rough and heavily wooded section of the country, and the railway has numerous curves and heavy grades. In August, between Fort Worth and Dallas, the temperature was unusually high, and the party suffered a good deal from the lack of water, as the refusal of the railway company to permit the use of velocipede cars prevented the transportation of sufficient water for the use of the party, and the supply in that locality was limited and could not be readily obtained. Between Greenville and Shreveport the grades on the railway were very heavy and made the use of the velocipede cars very laborious.

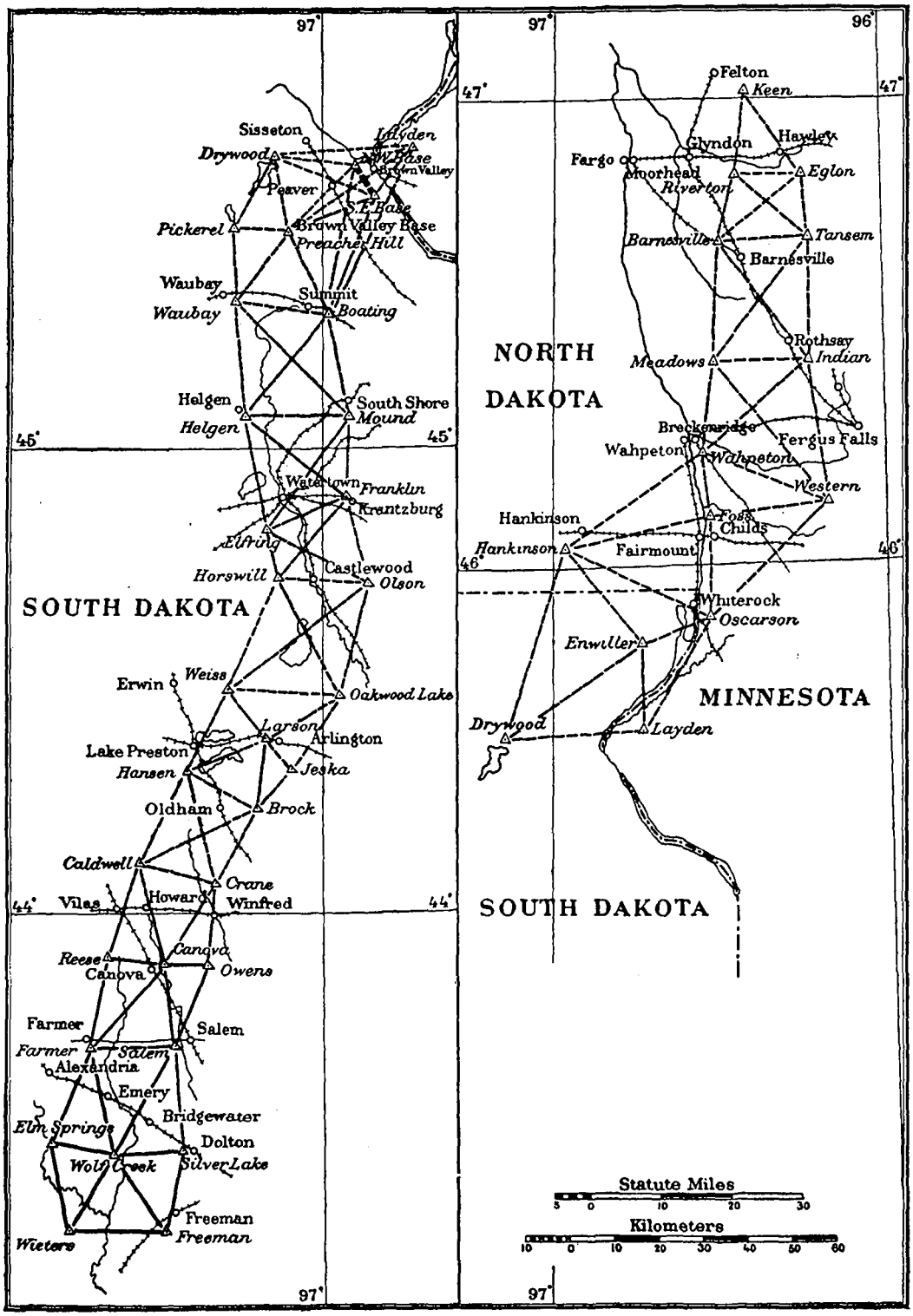
RECONNAISSANCE. NORTH DAKOTA. W. H. BURGER.
SIGNAL BUILDING. SOUTH DAKOTA.

SUMMARY OF RESULTS.

Reconnaissance:
3 900 square miles area covered.
40 triangulation stations selected.
Signal Building:
16 signals erected.

The extension of the reconnaissance along the ninety-eighth meridian northward from the vicinity of Mitchell, S. Dak., was assigned to Aid Burger. After making the necessary preparations at the Office, he proceeded to South Dakota and reached Mitchell on April 13. Signalman J. S. Bilby had been sent to Lampasas, Tex., in time to procure the necessary outfit for the reconnaissance and signal-building parties, stored at that place, and bring it north by rail. He also reached Mitchell on the 13th, and the preparations for active field work were completed. The triangulation stations Freeman and Wieters, established by Assistant F. D. Granger in 1901, were visited and found undisturbed, and the line between them was used as the base from which to extend the reconnaissance northward. After selecting two new stations the party returned to Mitchell, and Signalman Bilby, with Foreman William C. Nohl, began the work of building signals, while Aid Burger continued the work of reconnaissance. Signalman Bilby remained with the building party a short time to train the men, and then joined the reconnaissance party at Canova, S. Dak. The work of the building party proceeded

No. 27.



Reconnaissance and triangulation, Minnesota, North Dakota, and South Dakota.

steadily, and they erected signals at 16 triangulation stations, with an aggregate height of 680 feet before the end of the fiscal year.

In the early part of the season extremely heavy winds constantly prevailed and there was much cold weather. The condition of the roads made traveling difficult and also delayed the work. The scheme of triangulation was gradually swung eastward and carried across the northeast corner of South Dakota and up the east side of Red River. A base line was selected in Brown Valley, near the town of the same name, in South Dakota, and the ends were marked with heavy masonry piers. Forty triangulation stations were selected before June 30, which extended the scheme of triangulation from latitude 43° 30′ north and longitude 97° 30′ west to latitude 47° north and longitude 96° 30′ west. Aid Burger reports the valuable assistance rendered by Signalman Bilby and states that the work accomplished was due to a great extent to his intelligent and unceasing labor. The work of reconnaissance and signal building was in active progress at the close of the fiscal year.

LEVELING. NEBRASKA. W. C. DIBRELL.
WYOMING.

SUMMARY OF RESULTS.

387 kilometers completed line.
42 bench marks established.

On July 1 a leveling party was at work in Nebraska, under charge of Mr. W. C. Dibrell, Aid, Coast and Geodetic Survey, extending a line westward along the Fremont, Elkhorn and Missouri Valley Railroad, from a point 31 kilometers west of Chadron. Rapid progress was made, and on August 4 the line was completed to Orin Junction, Wyo., where a junction was made with the levels brought north from Cheyenne, Wyo., during the previous season. This completed the large circuit Abilene, Kans.; Denver, Colo.; Orin Junction, Wyo., via Cheyenne; Norfolk, Nebr.; Abilene, Kans.

The party then proceeded to Rock River, Wyo., to extend the levels westward from Rockcreek, formerly a station on the Union Pacific Railway, where the leveling work ended in 1899. Since that date the route of the railway has been shifted to straighten the road and improve the grades, and Rockcreek is now 11 kilometers off the railroad. The work began on three bench marks established at Rockcreek in 1899, two of which were found to have retained relative elevations determined when they were established, and the line was carried across the country to Wilcox, a point on the railroad 3 miles west of Rock River, and then continued along the Union Pacific Railway to Red Desert, Wyo., a station 80 kilometers west of Rawlins, where the work for the season was closed. The outfit was stored in the railroad-station building at Creston, Wyo., the only available place within a reasonable distance of Red Desert, through the courtesy of Mr. E. J. Krathmohl, the day telegraph operator at Creston, and the Survey is indebted to him for this favor and many others extended by him to the party.

The party was discharged October 15, except one man, who proceeded with the Chief to Greenriver by rail, for the purpose of setting several stone bench marks which had been distributed along the route as far west as that place. The return trip

to Creston was made on a velocipede car and the work above mentioned was done en route. Eleven stones were placed in position and two bench marks were cut on bridge abutments, and the work closed on October 19. Velocipede cars were used by the party throughout the season, except for a short time after leaving Rockcreek, when there was some delay in securing the necessary authority. The usual method of work was followed and the line was leveled at least once in each direction.

Permanent bench marks were established at comparatively short intervals along the route, and intermediate temporary bench marks were determined for the purpose of comparing the results obtained from the forward and backward lines. The elevation of the top of the rail on the track in front of each railroad station on the route was determined.

It was difficult to maintain the party at its full strength on account of the demand in this region for labor and the prevailing high wages, and after July 1 the party was shorthanded most of the time. Whenever one man was absent it was not practicable to protect the instrument from the wind and sun at the same time, and the instrument was used most of the time exposed to the wind, which was constant and very strong on the line west of Rockcreek. Very rapid progress was made at times during the season, and on one occasion 12.9 kilometers of double line were completed in one day.

Mr. Dibrell reports his appreciation of the service rendered by the members of his party, and makes special mention of George W. Myers, rodman, who remained with the party during the whole season. Mr. King joined the party on September 12 for instructions in the method of work. He served until the close of the season, and used the instrument nearly all the time during October.

TRIANGULATION. NORTH DAKOTA. SOUTH DAKOTA. O. W. FERGUSON.

SUMMARY OF RESULTS.

Triangulation:
- 918 square miles area covered.
- 9 stations occupied.
- 62 geographic positions determined.

The extension of the triangulation northward from the vicinity of Mitchell, S. Dak., was assigned to Assistant Ferguson. The necessary preparations were made at the Office and he started to the field on May 8, reaching Mitchell, S. Dak., on May 11. A party was organized, the preparations for fieldwork were completed, and the party went into camp at triangulation station Elm Springs on May 14. The stations Wolf Creek, Silver Lake, Salem, Farmer, Reese, Canova, Owens, and Crane were then occupied in the order named. The weather conditions were unfavorable for observations in May on account of strong winds and heavy rains. The conditions were much more favorable in June, and more rapid progress was made.

The stations named above were included in two hexagons with central points as shown on illustration 27, and the length of the lines varied between 6 and 18 miles. Mr. E. R. Witman served as recorder, and Mr. E. E. Torrey as foreman in the party.

LEVELING. TEXAS. R. L. LIBBY.

SUMMARY OF RESULTS.

386 kilometers of line completed.
46 bench marks established.

The extension of the standard levels of the Survey in Texas after December 1 was assigned to Aid Libby, who was already engaged on this work under the direction of Aid W. H. Burger. The account of the work of the party previous to that date is given under Mr. Burger's name. On December 1 Mr. Libby relieved Mr. Burger of the charge of the party and continued the line between Fort Worth, Tex., and the triangulation station Comanche near Granburry. Mr. Libby began work at a point 21 kilometers south of Fort Worth, and completed it to Comanche, a distance of 75 kilometers, on December 17. The route followed the Fort Worth and Rio Grande Railway from Fort Worth to Granburry, and then across the country to the triangulation station Comanche. The party then returned to Fort Worth and extended the work southward to Temple, following the Missouri, Kansas and Texas Railway, a distance of 199 kilometers. From Temple a line was leveled along the Gulf, Colorado and Santa Fe Railway to Lampasas, a distance of 86 kilometers, to determine the elevation of Lampasas Base. This line determined the elevation of the triangulation stations Lampasas Northeast Base and Gilmore. The party returned to Temple on March 27 and extended the line south along the Missouri, Kansas and Texas Railway to Holland, Tex., a distance of 26 kilometers, where the work closed on April 9. The line was leveled in both directions, and temporary bench marks were established at short intervals to afford a means of comparing the results obtained on each line.

MAGNETIC OBSERVATIONS. OKLAHOMA. F. M. LITTLE.
TEXAS.

Stations occupied.

OKLAHOMA.

GUYMON.

TEXAS.

AMARILLO.
BOVINA.
CANADIAN.
CANYON CITY.
CHANNING.
CHILDRESS.
CLARENDON.
CLAUDE.
CROWELL.
DALHART.
DIMMITT.
DUMAS.
EMMA.
FLOYADA.
HANSFORD.
HARTLEY.
HEREFORD.
HIGGINS.
LEFORS.
LIPSCOMB.
LUBBOCK.
MATADOR.
MEMPHIS.
MIAMI.
MOBEETIE.
OCHILTREE.
PADUCAH.
PAMPA.
PANHANDLE.
PLAINVIEW.
PLIMONS.
QUANAH.
SILVERTON.
STRATFORD.
TASCOSA.
TEXLINE.
TULIA.
WELLINGTON.

The work of extending the magnetic survey in Oklahoma and Texas was assigned to Assistant Little. He reached Amarillo, Tex., on July 26, and made observations to determine the three elements of the earth's magnetism in Texas and Oklahoma at the stations enumerated above. This work continued until December 25, except during an interval of twenty-three days when work was prevented by illness. At most of the stations a meridian line was established and marked. In nearly all the counties visited the county authorities were anxious to have a meridian line established and willingly furnished the necessary marks and the labor required. Field work in the Middle Division closed on December 24, and was continued in the Western Division.

MAGNETIC OBSERVATIONS. KANSAS. E. D. PRESTON.

Stations occupied.

ANTHONY.	GREENSBURG.	NORTON.
ASHLAND.	HILL CITY.	OBERLIN.
BALDWIN.	HOXIE.	OSBORNE.
BELLEVILLE.	HUGOTON.	PHILLIPSBURG.
BELOIT.	LIBERAL.	SMITH CENTER.
COLBY.	MANKATO.	STOCKTON.
COLDWATER.	MEADE.	SYRACUSE.
COOLIDGE.	MEDICINE LODGE.	WELLINGTON.
GOODLAND.	MINNEAPOLIS.	WINFIELD.

A portion of the work of extending the magnetic survey in Kansas was assigned to Assistant Preston, and he left Washington on September 3, proceeding to Baldwin, Kans., where he tested his instruments by observations at the Magnetic Observatory, the base station to which work in this region is referred.

The work continued until December 10, and during this period the stations named above, except Coolidge and Syracuse, were occupied, and observations were made at each to determine the elements of terrestrial magnetism. At several stations the work was delayed by unfavorable weather. At nearly all the stations a meridian line was established and marked, using stones and labor furnished by the county authorities. At a few places the county surveyor was not a practical surveyor and showed no interest in the work, and at these places a meridian line was not established, but the bearings of all prominent objects in sight were recorded. About the middle of the season the observer visited Baldwin and again tested his instruments at the observatory. Field work in Kansas closed on December 10, and Assistant Preston proceeded to Williams, Ariz., to continue work in the Western Division.

He returned to Kansas on April 8, after completing work for the season in the Western Division, and occupied two stations, Coolidge and Syracuse. He completed the work at the latter place on the 14th, and then proceeded to Washington, D. C., to test his instruments at the Coast and Geodetic Survey base station.

MAGNETIC OBSERVATIONS. ARKANSAS. KANSAS. NEBRASKA. TEXAS. W. F. WALLIS.

S. J. BARNETT, *Magnetic Observer.*	July 1 to Aug. 31.
H. I. WOODS, *Magnetic Observer.*	Aug. 1 to Sept. 1.
J. M. KUEHNE, *Magnetic Observer.*	July 1 to Sept. 29.
L. B. SMITH, *Aid.*	July 1 to May 25.
S. A. DEEL, *Magnetic Observer.*	Sept. 20 to Jan. 23.

The charge of the magnetic observatory at Baldwin, Kans., was assigned to Magnetic Observer Wallis, and he left Washington on July 1 for his station. He reached Baldwin on July 3 and was engaged in instructing Magnetic Observer Barnett and other duties until the 17th, on which date he assumed charge of the observatory, relieving Magnetic Observer W. C. Bauer, who had charge July 1 to 17. The regular observations were continued throughout the year, and an almost continuous record was obtained on the self-registering instruments. Absolute observations were made every week except in August, when these observations were made only on the 4th and 15th, the only days on which the proper instruments were available during that month. Special observations were made on the 1st and 15th of each month and daily between December 2 and 8, January 2 and 8, and February 3 and 9, as a part of the International work undertaken during the absence of the polar expeditions.

L. B. Smith, aid, assisted in the work of the observatory July 1 to January 4, and W. C. Bauer, magnetic observer, assisted in this work July 1 to 31 and at various other times when his services were required for short intervals. In addition to the work at the observatory, the magnetic observers named above were assigned to extend the magnetic survey by making observations under the direction of Mr. Wallis, as members of his party, and the following is a statement of the work performed by them:

Mr. S. J. Barnett began work at Baldwin on July 3, and then occupied the following stations in Kansas:

CENTER.	FREDONIA.	OTTAWA.
EMPORIA.	GIRARD.	PAOLA.
ERIE.	HOWARD.	SEDAN.
EUREKA.	INDEPENDENCE.	WINFIELD.
FORT SCOTT.	MOUND CITY.	YATES.

Magnetic observations were made at each of these stations, and they were marked in a permanent manner by using stone posts for station marks. Mr. Wallis instructed Mr. Barnett in the work at Baldwin, Mound City, Ottawa, and Paola. Mr. Barnett closed field work on August 31.

Mr. J. M. Kuehne began work on July 1, and occupied the following stations in Texas:

ANDERSON.	CAMERON.	HENDERSON.
ATHENS.	CONROE.	HOUSTON.
BELLEVILLE.	FRANKLIN.	JACKSONVILLE.
CALDWELL.	GATESVILLE.	JEFFERSON.
CENTER.	GEORGETOWN.	KAUFMAN.

La Grange.	McKinney.	San Marcos.
Liberty.	Meridian.	Sulphur Springs.
Lindenau.	Mineola.	Trinity.
Livingston.	Mount Pleasant.	Waxahachie.
Lufkin.	Palestine.	Waco.
Madisonville.	Paris.	

The necessary observations to determine the elements of terrestrial magnetism were made at these stations, and they were marked in a permanent manner by using stone monuments. The field work closed on September 29.

Mr. H. I. Woods reported for duty on August 1, and was instructed in the use of the instruments and in the methods of work August 2 to 14. He made observations at Baldwin, and then occupied the following stations in Kansas:

Abilene.	Atchison.	Topeka.
Alma.	Oskaloosa.	Troy.

Observations to determine the magnetic elements were made at these stations, and they were marked in a permanent manner by using stone monuments.

Mr. S. A. Deel was attached to the party from September 20 to January 23. During ten days of this time he was engaged on work at the Baldwin Observatory, and twenty-nine days were spent on leave of absence. He began field work on October 6 by making magnetic observations at Baldwin, and then occupied the stations named below, closing work on December 18 by again making magnetic observations at Baldwin.

KANSAS.

Bird City.

NEBRASKA.

Beatrice.	Hastings.	Lincoln.
Benkelman.	Hayes Center.	North Platte.
Culbertson.	Holdrege.	Ogallala.
Elwood.	Imperial.	Stockville.
Fairburg.	Indianola.	Tecumseh.
Geneva.	Kearney.	Wahoo.
Grant.		

Magnetic observations were made at all the stations named above. From January 1 to 14 Mr. Deel was engaged in instructing L. B. Smith, Aid, in the use of the instruments and the methods employed in making magnetic observations.

Mr. L. B. Smith, Aid, was relieved from the observatory work on January 5 and began field work immediately. He made magnetic observations at Baldwin and then occupied two stations in Arkansas

Hardy. Marion.

and closed work in the Middle Division on January 10. An account of his work during the remainder of the season is given under the name of W. F. Wallis, in the Eastern Division.

HYDROGRAPHY. WASHINGTON. E. F. DICKINS.

A. R. HUNTER, *Watch Officer.*
W. H. STANFORD, *Watch Officer.*
D. R. JEWELL, *Aid.*
R. J. CHRISTMAN, *Draftsman.*

SUMMARY OF RESULTS.

Hydrography:
501 miles lines sounded.
10 252 soundings made.
3 tide stations established.
2 hydrographic sheets completed.

The hydrographic survey of San Juan Channel and Griffin Bay was assigned to Assistant Dickins. He made the necessary preparations and organized a party at San Francisco early in March. On the 7th Aid Jewell was directed to proceed to San Juan Island to obtain necessary local information, and on the 12th Assistant Dickins and his party sailed for Seattle. The steam launch *Fuca* was put in order for the use of the party, and on the 21st the launch *Vixen* was turned over to the party. On March 23 the party left Seattle on the launches *Fuca* and *Vixen*, and reached San Juan Island the next day. The field work began immediately in Griffin Bay. Old triangulation stations were recovered, the necessary signals were erected, and a tide staff was established at Argyle wharf, where observations were made day and night from March 29 to May 9. The hydrographic survey of Griffin Bay was completed on May 4, and the party moved to Richardson, where another tide staff was established and connected with the one at Argyle wharf by making simultaneous observations during three days. Tide observations were made at Richardson day and night between May 5 and 29. Triangulation stations in this vicinity were recovered, the necessary signals were erected, and the hydrographic work began on May 12. The work was continued whenever the weather permitted until May 29, when the field work closed to enable the officers in the party to report for duty elsewhere. On May 30 the party returned to Seattle, and was disbanded on the 31st.

Assistant Dickins reports that special credit is due Watch Officers Hunter and Stanford for the able manner in which the hydrography was done. Aid Jewell acted as recorder in the hydrographic work.

HYDROGRAPHY. OREGON. O. B. FRENCH.
RECONNAISSANCE. WASHINGTON.
TOPOGRAPHY.
TRIANGULATION.

SUMMARY OF RESULTS.

Washington—July 25 to November 20.

Hydrography:
35 square miles area covered.
452 miles lines sounded.
24 499 soundings made.
1 tide station established.
3 hydrographic sheets completed.
Reconnaissance:
50 square miles area covered.
33 triangulation points selected.
Topography:
12 square miles covered.
85 miles general shore line surveyed.
17 miles shore line of creeks surveyed.
2 miles shore line of ponds surveyed.
55 miles roads surveyed.
4 topographic sheets completed.
Triangulation:
50 square miles area covered.
33 stations occupied.
94 geographic positions determined.

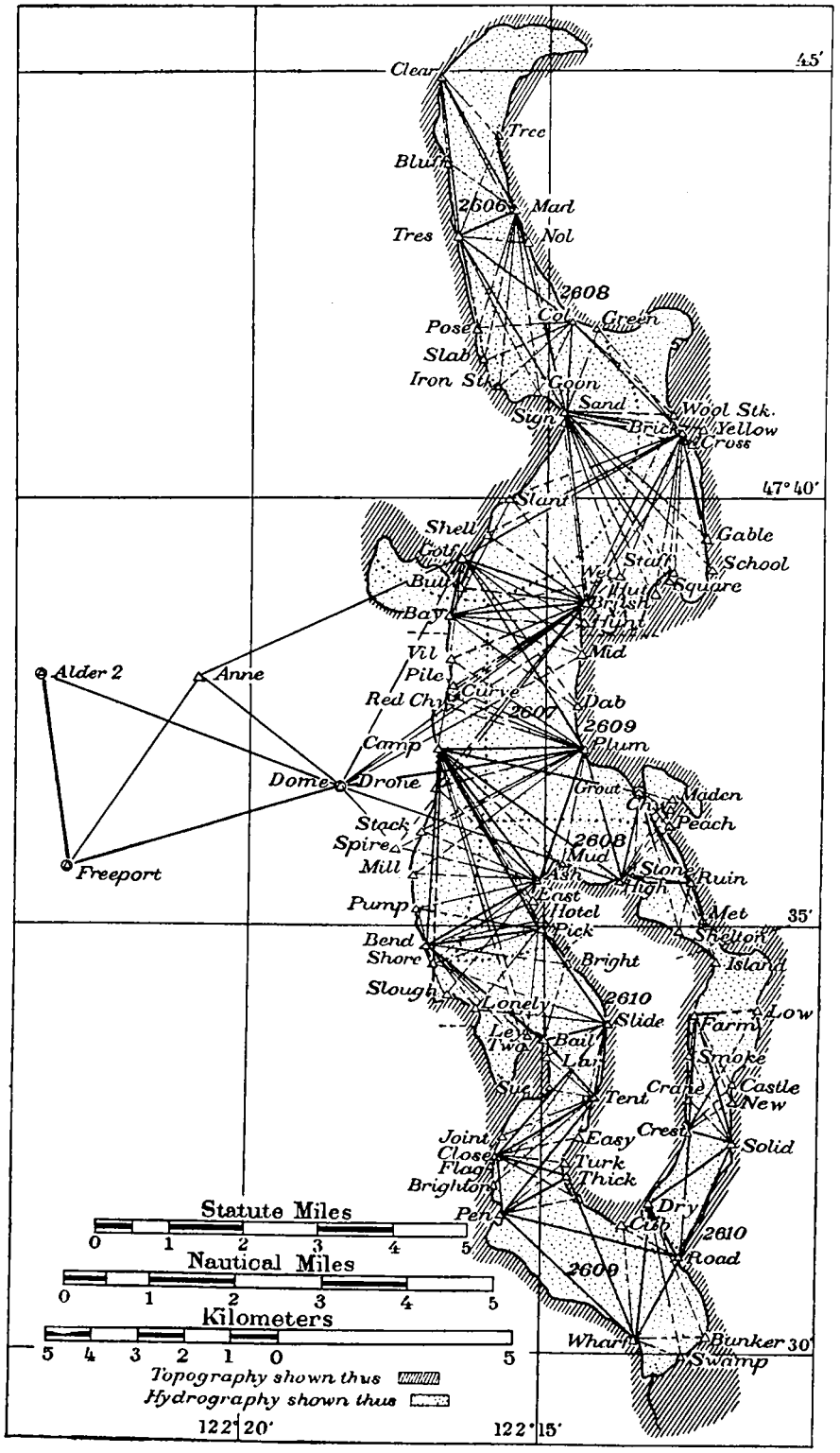
Oregon—April 12 to June 30.

Reconnaissance:
15 triangulation stations selected.
1 base line located.
Triangulation:
1 station occupied.

The survey of Lake Washington, Washington, was assigned to Assistant French, who reached Seattle on July 25 and organized a party immediately. A reconnaissance of the lake was made, and the work of opening the lines and erecting the signals began without delay. The instruments were not received as soon as expected, and no observations were made until August 15, when the chief of the party began observing horizontal angles.

Mr. F. B. Loren, Aid, continued the erection of signals until that work was completed on the 19th, when he began observing, and Assistant French took up the topographic work. The triangulation was extended across the city of Seattle from the line between Freeport and Alder 2, two stations in the Puget Sound triangulation. In extending the work around the lake, single triangles were used, but all the angles were observed. Nearly all the observations in the work covering the southern half of the lake were made by Mr. Loren. The numerous geographic positions determined made the topographic work comparatively simple, but the dense growth of brush, etc., along the shore line made it impracticable to extend the topography far away from the shore

No. 28.



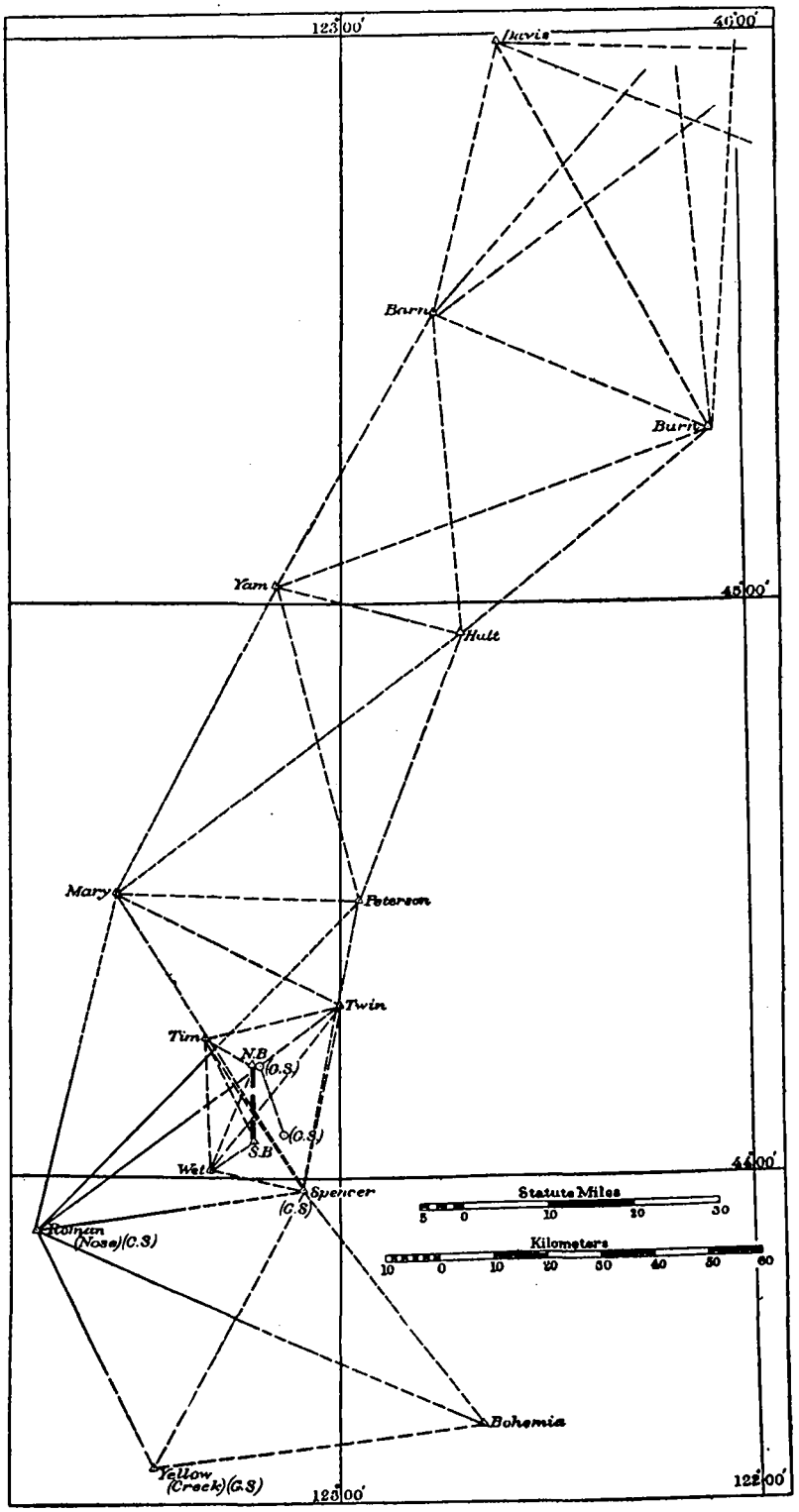
Hydrography, topography, and triangulation, Lake Washington.

line without too great an expenditure of time and money. A width of at least a quarter of a mile was covered around the greater portion of the lake, and the contours were sketched as far back as necessary to develop the elevations up to 100 feet, but the contours are only accurate in a general way, as the woods and brush prevented their precise location without unwarranted expense. All the topographic work was completed between August 19 and September 22, and the work of sounding began on August 25 and was continued as rapidly as practicable until the survey was completed. The lake may be described in a general way as a large basin with steep slopes near the shores, and having a depth, in the main body, of about 200 feet. The bottom is much more smooth than the relief of the surrounding country indicates, and with the exception of a small ridge just west of East Seattle, the bottom of the lake is practically a smooth trough with its sides parallel to the shores of the lake, and with its depth varying with the width of the lake.

A tide staff was erected at Madison Park, and readings were made on it nearly every day from August 13 to November 25 for the purpose of obtaining a plane of reference for the soundings There was a range in the depth of water during this period of about 1 foot, but no effect due to the direction of the wind was observed. The hydrographic work was completed on November 20, the party was disbanded immediately, and Messrs. French and Loren proceeded to Washington, D. C.

The extension of the triangulation northward from the vicinity of Eugene, Oreg., was assigned to Assistant French, who made the necessary preparations and left Washington on April 1, and reached Eugene on the 12th, after stopping at San Francisco long enough to select such outfit as was suitable for his work from the Survey property stored at that place. The preparations for field work were completed and the work of reconnaissance progressed as rapidly as the weather conditions permitted. A preliminary examination was made between Eugene and Portland before the end of April. D. A. Lewis, foreman, joined the party in the latter part of April, and rendered efficient service in the reconnaissance work. Unfavorable weather prevailed during more than two-thirds of the month of May and caused serious delay in the work. A building party began operations on May 21, under charge of foreman Lewis, and visited and prepared seven triangulation stations before the end of June. This party marked the stations, erected stands for instruments and lights, prepared camping ground for the observing party, opened trails or roads to the stations, and collected information to facilitate the work of the observing party. The observing party reached the foot of Saddle Mountain, upon which Station Roman is located, on May 29. A trail 7 miles long was opened in order to reach the station. Owing to the difficulty of procuring extra labor this work delayed the party until June 9, when it was completed. During the remainder of the month fogs and clouds prevailed most of the time, but the necessary observations were obtained and the station was completed. The lack of training and attention to duty on the part of the heliotropers also delayed the work. The work was actively in progress at the close of the fiscal year.

No. 29.



Reconnaissance and triangulation, Oregon.

LEVELING. WYOMING. H. D. KING.

SUMMARY OF RESULTS.

110 kilometers of line completed.
13 bench marks established.

The extension of the standard levels west from Red Desert, Wyo., was assigned to Mr. H. D. King, Aid, and he reached Rawlins, Wyo., on May 16.

A party was organized, the necessary preparations were made, and the field work began at Red Desert on the 20th. The work continued during the remainder of May and during June, with the results shown above, and was in progress on June 30, on which date it was completed to a point 13 miles east of Greenriver, Wyo. The route followed the Union Pacific Railway, and velocipede cars were used as the means of transportation. The line was leveled at least twice, once in each direction. Temporary bench marks were established at short intervals to afford a means of comparing the results of leveling in opposite directions, and these sections of the line were releveled when the discrepancy developed exceeded the allowable amount.

LEVELING. UTAH. R. L. LIBBY.

SUMMARY OF RESULTS.

150 kilometers of line completed.
17 bench marks established.

The extension of the standard levels east from Ogden, Utah, was assigned to Aid Libby. He reached Ogden on April 29, organized a party, and on May 2 began the field work. The route followed the Union Pacific Railway, and on June 30 the line had been completed to a point a few miles from Spring Valley, Wyo. The heavy grades, strong prevailing winds, and four tunnels on the line seriously delayed the work. Two of the tunnels were short enough to carry the line through them by using lanterns and reflectors, but at each of the others it was necessary to carry the line over the mountains, as repairs were being made in one tunnel and the other is nearly 2 kilometers long. The mountains are rough and steep, and the wind on the western slopes was unusually strong, rendering the work very slow and laborious.

MAGNETIC OBSERVATIONS. ARIZONA. F. M. LITTLE.
NEW MEXICO.

Stations occupied.

ARIZONA.

BENSON.	GILABEND.	SAN CARLOS.
BOWIE.	GLOBE.	SENTINEL.
CASAGRANDE.	MARICOPA.	SOLOMONSVILLE.
CRITTENDEN.	MOHAWK SUMMIT.	TOMBSTONE.
COCHISE.	NACO.	TUCSON.
DOUGLAS.	NOGALES.	WELLTON.
FLORENCE.	PHOENIX.	YUMA.
FORT THOMAS.	REDROCK.	

NEW MEXICO.

ARID.	DUNCAN.	RODEO.
CLIFTON.	HACHITA.	SEPAR.
DEMING.	LORDSBURG.	

Magnetic work in the Western Division was assigned to Assistant Little, and on December 25 he started to Phoenix, Ariz., to make special observations in cooperation with Assistant Preston, who had also gone to that place, for the purpose of comparing the instruments in use. These observations and the necessary computations extended over the period January 2 to 12 and the office work continued until January 17. On the 18th Assistant Little went to Yuma and began magnetic observations at the series of stations assigned to him, which are included in the list given above. Work was continued, except during twenty-six days, when he was not well enough to work, and during thirty-eight days when he was engaged on computations. On May 16 magnetic observations began at Lordsburg, N. Mex., and were made at the series of stations named above, and the field work for the season closed at Deming, N. Mex., on May 30.

MAGNETIC OBSERVATIONS. ARIZONA. E. D. PRESTON.
COLORADO.
NEW MEXICO.

Stations occupied.

ARIZONA.

ASHFORK.	HOT SPRINGS JUNCTION.	PEACH SPRINGS.
CONGRESS.	JEROME JUNCTION.	PHOENIX.
FLAGSTAFF.	KINGMAN.	PRESCOTT.
GRAND CANYON.	KIRKLAND.	SELIGMAN.
HACKBERRY.	MAYER.	WILLIAMS.
HOLBROOK.	NAVAJO.	WINSLOW.

COLORADO.

LA JUNTA.	LAS ANIMAS.	THATCHER.

NEW MEXICO.

FOLSOM.	LAGUNA.

A portion of the work of extending the magnetic survey in Arizona, Colorado, and New Mexico was assigned to Assistant Preston, who reached Williams, Ariz., on December 13. Magnetic observations were made at Williams and at Ashfork, and the observer then proceeded to Phoenix. A snow storm at Williams delayed the work at that place. At Phoenix special observations were made in order to compare the instruments used by Assistant Preston with those used by Assistant Little, who was also at Phoenix for that purpose. A special investigation was made to determine the most suitable location for a magnetic observatory in the vicinity of Phoenix. A number of stations were occupied and a desirable location was found. The special observations were concluded on January 13.

A similar investigation was made in the vicinity of Flagstaff between February 24 and March 2, and detailed reports were made giving the results of these investigations. Magnetic work was continued in Arizona until March 16, and the stations named above

were occupied. On the 17th the observer started east and occupied stations in New Mexico and Colorado, as stated, and closed field work in the Western Division on April 8, at Las Animas, Colo., en route to Washington, D. C.

CHARGE OF SUBOFFICE. CALIFORNIA. AUG. F. RODGERS

TIDE OBSERVATIONS.

The suboffice of the Survey in San Francisco was continued under charge of Assistant Rodgers, who attended to numerous duties, many of them matters of routine, as the representative of the Superintendent on the Pacific coast. He purchased and forwarded outfit to the various parties in the field when requested to do so, and arranged for the transportation of men between San Francisco and Manila. Many matters requiring immediate action on the Pacific coast were referred to Assistant Rodgers by telegraph. From December 11 to January 31, Assistant Rodgers was absent on other duty, and Assistant Fremont Morse was in charge of the suboffice. Various officers were attached temporarily to the suboffice during the year and others were on duty there completing records of field work. On October 16 Assistant Rodgers inspected the Bluff Point speed trial course, under telegraphic orders, and reported its condition to Capt. F. W. Dickins, U. S. Navy. On October 27 William J. Diercks, messenger attached to the suboffice, died suddenly, after many years of faithful service in the field and office. H. S. Ballard continued on duty as tide observer at the Presidio Station, and rendered faithful service in securing observations during the year. Mr. John S. Blough, writer, served July 1 to September 27. Information of interest to the Survey was promptly transmitted to the Superintendent.

TIDE OBSERVATIONS. WASHINGTON.

A self-registering tide gauge was kept in operation throughout the year at Seattle, Wash. W. C. Meyer, observer.

DIVISION OF ALASKA.

HYDROGRAPHY. ALASKA. E. F. DICKINS, Commanding,
TOPOGRAPHY. Steamer *Gedney*.
TRIANGULATION.

F. F. WELD, *Assistant.*	
W. M. ATKINSON, *Watch Officer.*	Aug. 9 to Oct. 24.
CHAS. R. PALMER, *Watch Officer.*	July 1 to Aug. 17.
W. E. PARKER, *Aid.*	
C. H. BOWKER, *Assistant Surgeon.*	
W. H. STANFORD, *Deck Officer.*	
E. B. SHAW, *Aid.*	

SUMMARY OF RESULTS.

Hydrography:
- 147 square miles area covered.
- 556 miles lines sounded.
- 4 739 soundings made.
- 5 tide stations established.
- 1 hydrographic sheet completed.

Topography:
- 177 square miles area covered.
- 157 miles shore line surveyed.
- 10 miles shore-line creeks and ponds surveyed.
- 3 topographic sheets completed.

Triangulation:
- 7 stations occupied.
- 2 geographic positions determined.

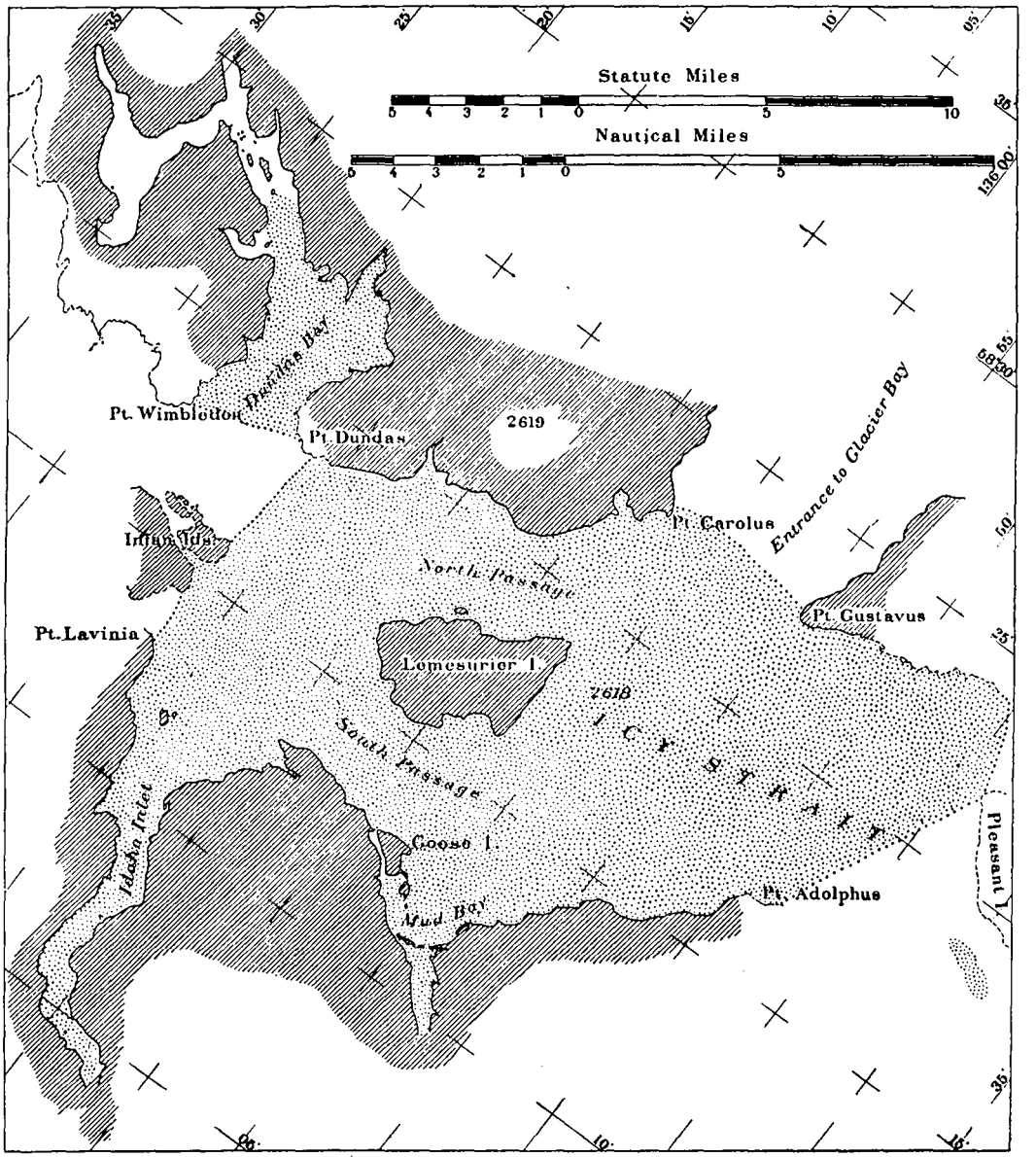
On July 1 the steamer *Gedney*, Assistant Dickins, commanding, was at Seattle, Wash., completing preparations for a season's work in southeastern Alaska.

The *Gedney* left Seattle on July 3 and proceeded to Icy Strait, Alaska, via Victoria and Union Bay, British Columbia, where stores and coal were taken on board.

On July 10 signal lumber was taken on board at Ketchikan, Alaska, and the vessel went to Fanshaw Bay and anchored for the purpose of determining the position of a lighthouse which had been erected on southeast Five Finger Island. After considerable difficulty some of the old triangulation stations in the vicinity were recovered and a base was secured from which the geographic position of the light-house was determined. The vessel continued her journey on the 14th, and about 7 o'clock that evening, while steaming up Stevens Passage, the weather being perfectly clear and no drift logs or floating ice in the strait, a sudden shock was felt, and an examination disclosed the fact that the vessel had lost one blade of her propeller. The vessel proceeded to Juneau with reduced speed and reported the fact by telegraph. While waiting for further

instructions, Assistant Weld was sent to determine the geographic position of the new lighthouse on Sentinel Island. He completed this work and returned to the ship on July 19.

No. 30.



Hydrography and topography, Alaska.

The *Gedney* left for Sitka on the 22d and was detained there until the 30th putting the *Cosmos* and launch No. 117 in working order. The vessel reached Hooniah on August 1, and the work in this vicinity began the next day. A tide staff was erected

at Hooniah, and a reconnaissance was made of the upper part of Port Frederic. An attempt was made to establish a tide staff in Bartlett Bay, but the floating ice prevented. On August 6 the vessel left Bartlett Bay for Inian Cove, and in crossing the entrance to Glacier Bay, where the ice floes were very thick, was caught in a heavy swirl and was struck by a large berg, which smashed in three planks, an iron frame, and one of the cabin portholes. The floating ice was thicker than usual, and caused considerable trouble and delay during the season.

A tide staff was erected in Inian Cove on August 7, and tide observations began. Mr. Weld was left in charge of operations at Inian Cove, and the commanding officer returned on the *Cosmos* to Hooniah and made tide observations for three days in connection with those at Inian Cove. While at Hooniah Mr. Atkinson, watch officer, reported on board the *Cosmos*. The *Cosmos* left Hooniah on August 11, and an examination was made of Willoughby Cove and Mud Bay for the purpose of finding a location for a tide staff and a safe anchorage for the *Gedney*, but the ice was too thick in both places, and the *Cosmos* returned to Inian Cove. Good progress had been made in erecting signals, and hydrographic and topographic work were begun at once. On August 17 Mr. Palmer was relieved from duty and sent to Hooniah, en route to San Francisco. The supply of coal and lumber was nearly exhausted, and on August 30 the vessel proceeded to Juneau for a new supply. On September 1 the vessel was beached near the Douglas Island wharf, and the propeller blade opposite the one that was lost earlier in the season was cut off. The vessel left Juneau on September 5, and returned to the working ground. A tide staff was erected in Mud Bay and connected by simultaneous observations with the tide at Inian Cove. The work was continued in the vicinity of Mud Bay until September 25, when a tide staff was erected in a small cove on the east side of Idaho Inlet and connected by simultaneous observations with the tide at Inian Cove. The hydrography and topography of Idaho Inlet were completed on October 3, and the vessel proceeded to Mud Bay. The tide staff there was verified in position, and another was erected in Flynn Cove and connected with Hooniah and Mud Bay by simultaneous observations. A reexamination of Pleasant Island Reef, which bares at low water, was completed on October 7, and on the following day the tide staff was removed and the work of the season closed.

During the season the geographic positions of the light-houses at Five Finger Island and at Sentinel Island were determined, and the hydrography and topography of Icy Strait from Point Adolphus to the Inian Islands were completed, closing the gap between the surveys made by the *Patterson* and the *Gedney* in 1901. A plane table triangulation of Dundas Bay and Idaho Inlet was made, and the hydrography and topography at these points were completed.

The hydrography was executed by Messrs. Atkinson and Stanford, using steam launch No. 117, which was fitted with a wire sounding reel, the hand lead being used only when approaching the shore in shoal water and in developing reefs and shoals.

The sounding lines were generally about a quarter of a mile apart, and the position of each sounding was determined. In approaching the shore the soundings were taken often enough to develop the dangers thoroughly.

The topographic work was done by Messrs. Weld and Parker. Mr. Weld used the ship's launch and did most of the work in the vicinity of the anchorages, returning to the ship at night; while Mr. Parker lived on board the *Cosmos* and did the work distant from the ship, only returning once a week for coal and supplies.

The shore line was carefully surveyed and many peaks visible from it were located and their heights determined, but the ridges generally rise so abruptly from the shore that the topography was necessarily sketched from the opposite side of the strait. The country as a rule is densely timbered from the shore to an elevation of 1 500 to 2 000 feet, above which the ridges are clear of timber and the mountains are capped with snow.

On October 9 the vessel left Hooniah for Sitka and reached there next day, having left the *Cosmos* at Killisnoo. Launch No. 117 was hauled out and housed, minor repairs were made, and the ship returned to Killisnoo on the 15th. The next morning the *Gedney*, with the *Cosmos* in tow and with the *McArthur* following, sailed for Seattle, and arrived there on October 23.

Assistant Dickins refers to the work done by his officers and reports that he found Mr. Weld "an able assistant and a competent officer;" that Mr. Atkinson "performed all his work and duties in a creditable manner;" that he found Mr. Parker "a competent assistant and officer and that he performed all his duties cheerfully and well;" that Mr. Stanford was "steady and industrious and performed all his duties cheerfully and well." James Mitchell, assistant engineer in charge, the boatswain, master-at-arms, and carpenter all receive favorable mention for the cheerful and creditable manner in which they performed all their duties.

MAGNETIC OBSERVATIONS. ALASKA. H. M. W. EDMONDS.

The magnetic work at the Sitka, Alaska, Magnetic Observatory, was continued under the direction of H. M. W. Edmonds, Magnetic Observer. W. B. Keeling, Magnetic Observer, reported to Mr. Edmonds on July 16, 1902, and assisted in the work after that date.

Necessary improvements were made to the buildings and grounds. The hard-wood caps to the piers on which the instruments were mounted proved to be unsatisfactory and marble was substituted. An astronomic station was established on the reservation near the magnetic station and the station previously used was marked by a concrete block and two brass bolts marking the astronomic and magnetic stations.

The record of the declination and horizontal intensity obtained on the self-registering instruments was practically continuous throughout the year. Observations for declination and horizontal intensity were made twice a week to furnish the data necessary to reduce the relative observations obtained from the record of the self-registering instruments. Observations for dip and for relative total intensity with loaded dip needles were also made twice each week. Special observations were made twice each month in accordance with the plan for international cooperation in magnetic work in connection with the expeditions sent out to the south polar regions. In connection with the magnetic work, time and azimuth observations were made as required, meteorological conditions were noted and maximum and minimum thermometer readings were made every day.

ASTRONOMIC OBSERVATIONS. ALASKA. WILLIAM EIMBECK.
MAGNETIC OBSERVATIONS.

The duty of making the astronomic observations at St. Michaels, Alaska, which were required in connection with the determination of the difference of longitude between that station as a base and stations on St. Lawrence and Nunivak Islands by the chrono-

metric method was assigned to Assistant Eimbeck. He proceeded to Seattle, Wash., and reported on board the *Patterson*, Assistant J. F. Pratt, commanding, on July 10, for duty en route to his station.

The ship reached St. Michaels on August 14, and the necessary material and outfit were landed immediately. A station was selected and a concrete pier and wooden observatory was erected under the direction of Assistant Pratt, this work being completed on August 16, and then Assistant Eimbeck assumed charge of the station as chief of party, under his instructions from the Superintendent. The astronomical transit was placed in position on August 17, and observations for time were made on the same date and chronometer comparisons were made on shore and on the *Patterson*. The observations and comparisons were repeated daily whenever the weather conditions permitted until the 23d, when the concrete pier began to settle unequally, due to heat conducted to the frozen ground on which the pier was built, all ground in this region remaining frozen continuously a short distance below the surface. The necessary changes to secure permanency were made on the morning of the 24th, under Assistant Pratt's direction, and the ship left at noon. After the departure of the *Patterson* to carry the chronometers to the other stations, intercomparisons of the three chronometers at the station were made daily and time observations were made whenever the atmospheric conditions permitted. Four comparisons between the chronometers on shore at St. Michaels and those on the *Patterson* were made during the season, which extended to September 27, when the *Patterson* sailed from St. Michaels. During the equinoxial period the weather was changeable and decidedly unfavorable for astronomic work at night, while the afternoon hours were frequently clear. A star list suitable for observing in daylight was prepared and observations were made whenever the weather conditions permitted day or night, and thus nineteen sets of time observations were secured, the last being made on September 24. The three chronometers at the station were always compared before and after each set of observations for time. The passage of the sun's center over the meridian of the station was also observed a few times by placing a screen over the object glass of the telescope in order to cover all of it, except a quarter inch aperture or slit at the center.

The magnetic declination was determined at one station previously established and at four new stations. These stations were referred to the astronomic station by triangulation and tape measurement.

ASTRONOMIC OBSERVATIONS. ALASKA. FREMONT MORSE.
BASE MEASUREMENT.
TOPOGRAPHY.

SUMMARY OF RESULTS.

Astronomic observations:
1 azimuth determined.
1 latitude determined.
1 longitude determined.
Topography:
60 square miles area covered.
21 miles shore line surveyed.
1 topographic sheet completed.

The duty of making the astronomic observations at Nunivak Island, Alaska, which were required in connection with the determination of the difference in longitude between St. Michael, as the base station, and Cape Mohican, the western point of the island, by the chronometric method, was assigned to Assistant Morse.

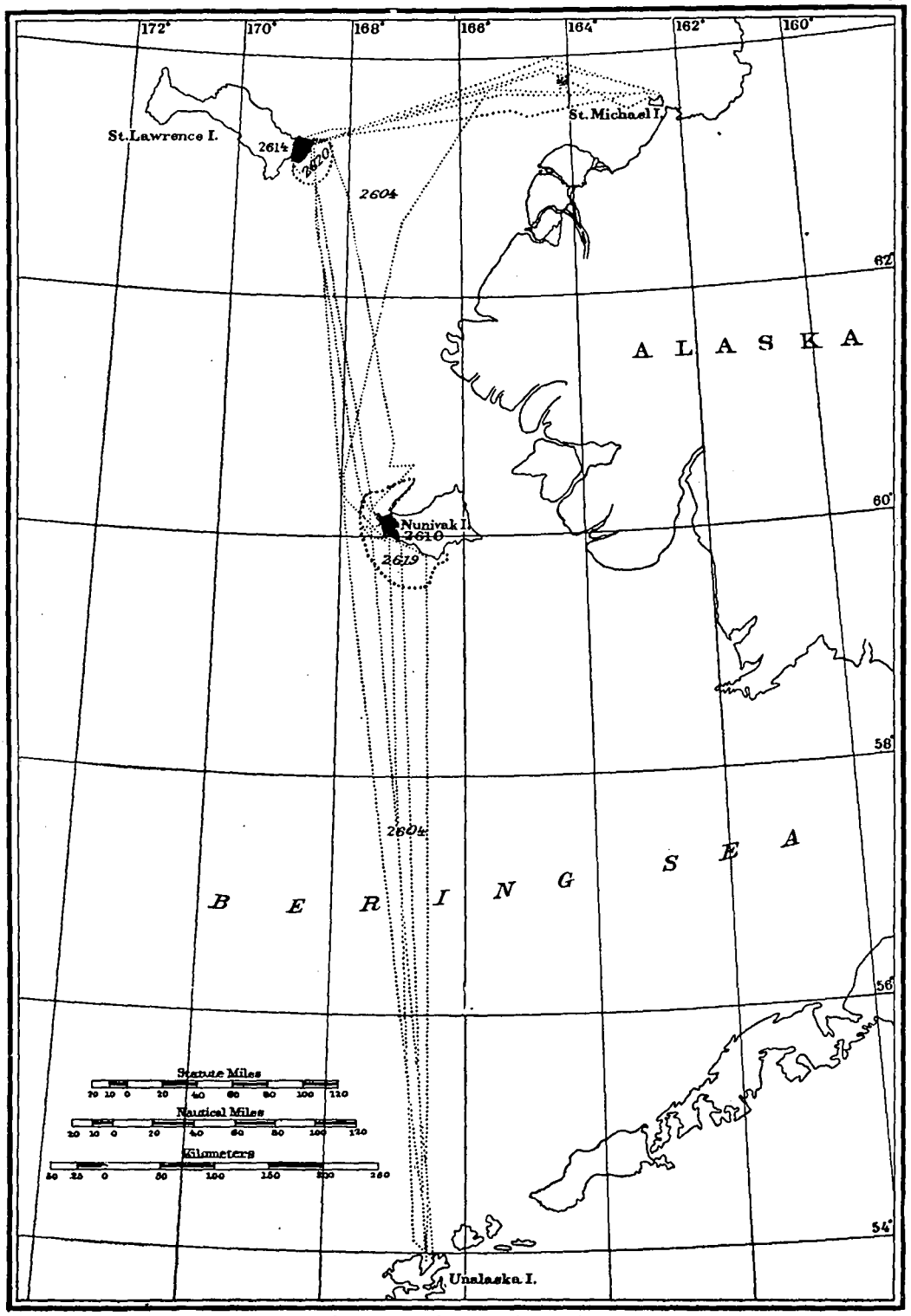
On July 1 he was attached to the steamer *Patterson*, Assistant J. F. Pratt, commanding, for duty en route to his station. On August 6 the ship reached Nunivak Island, and a site for the astronomic station was selected at the nearest landing place to Cape Mohican, about twelve miles to the eastward. A rough building containing a room for the observatory, with concrete pier for the transit, and rooms for the officers and men was immediately erected under Assistant Pratt's direction, and the ship's writer, two men, and the cabin steward were assigned to duty under Assistant Morse to aid in the execution of the work under his charge. Solar observations were made on August 7 for time and latitude, a comparison was made between the chronometers at the station and those on board ship, and the *Patterson* sailed for St. Lawrence Island the following night. Preparations were made immediately to make astronomic observations on every clear night and to connect the station and Cape Mohican by plane table triangulation. A base line was measured and progress was made on every fair day. The necessary signals were erected and their positions and elevations were determined previous to August 24. A survey of the shore within reach of the station was made and as much interior topography was surveyed as the time permitted (see illustration 31). This work was very laborious, as no means of transportation existed, and all material was necessarily carried by the men. Long distances were traversed on foot, and work near Cape Mohican involved walking from ten to twelve hours per day. In spite of all obstacles the desired connection was successfully accomplished. Observations from time were made on every clear night, and observations were also made to determine the latitude and an azimuth. The *Patterson* returned to the island on August 26, September 5, and September 23, and a comparison was made on each occasion between the chronometers at the station and those on board the ship. On September 5, Mr. A. L. Giacomini, deck officer, and a seaman, were also assigned to duty under the direction of Assistant Morse, and aided in the work after that date. On September 23, Assistant Morse and party were taken on board the *Patterson*, and the work at Nunivak Island closed.

HYDROGRAPHY. ALASKA. J. F. PRATT, Commanding,
LONGITUDE (CHRONOMETRIC). Steamer *Patterson*.

WILLIAM EIMBECK, *Assistant.*
EDWIN SMITH, *Assistant.*
FREMONT MORSE, *Assistant.*
H. F. CAUFMAN, *Watch Officer.*
H. S. THROCKMORTON, *Watch Officer.*
G. N. MCLOUGHLIN, *Assistant Surgeon.*
A. L. GIACOMINI, *Deck Officer.*
A. R. HUNTER, *Deck Officer.*
DON R. JEWELL, *Aid.*
H. M. HATHAWAY, *Captain's Clerk.*

The work of determining the longitude of certain points on Nunivak and St. Lawrence islands, from St. Michael, Alaska, by the chronometric method was assigned to

No. 31.



Hydrography and topography, Alaska.

the officers of the steamer *Patterson*, with Assistant Pratt in command. Assistants Eimbeck, Smith, and Morse were instructed to join the ship, reporting to Assistant Pratt for the purpose of performing such duties as were assigned to them while on board, and upon reaching their destination to take station at St. Michael, St. Lawrence Island, and Nunivak Island, respectively, and occupy astronomic stations as chief of parties while on shore. At the end of the season these officers again reported to Assistant Pratt, and served on board the ship on the voyage home. Details of the operations on shore at the three astronomic stations mentioned above are given under the names of the three officers in charge of the stations.

The *Patterson* sailed from Seattle, Wash., on July 19 for Dutch Harbor direct and reached that port on July 30. The voyage was uneventful except that the ship sailed for a portion of one day through floating lava (pumice stone) 200 miles off the Davidson Banks. While the ship was taking on coal and water at Dutch Harbor, time observations were made at the astronomic station at Unalaska. On August 2 the ship sailed for Nunivak Island and arrived there on the 6th. A site for the astronomic station was selected at the nearest landing place to Cape Mohican, about 12 miles to the eastward, and a rough building, containing a room for the observatory and rooms for the officers and men, was immediately erected. The ship's writer, two men, and the cabin steward were assigned to Assistant Morse to aid in the work at this station.

On August 8 the ship proceeded to St. Lawrence Island and reached the Northeast Cape at daybreak the next morning, and the vessel was anchored after making a careful examination of the shores on the north and east sides. A site for the astronomic station was selected about 2½ miles to the southward from the extremity of Northeast Cape and a building similar to the one at Nunivak Island was erected. Don R. Jewell, Aid, two men, and the wardroom cook were assigned to Assistant Smith to aid in the work at this station. The ship started to St. Michael on August 13 and arrived there the following day. The pier at the astronomic station already established at this place was not large enough to mount the transit which had been assigned to the station, and it was necessary to remove the original pier, a cylindrical log of wood erected in 1890 by Assistant Turner, and construct a concrete pier of larger size. An excavation was made down into the ice, a concrete pier with an enlarged base was erected, and a small wooden observatory was constructed around it. Assistant Eimbeck took charge of the station without the detail of any men from the ship. The steamer *Yukon* was launched and put in temporary condition and sent to Dutch Harbor under command of Watch Officer Throckmorton. The ship then proceeded with the work of carrying chronometers between the astronomic stations and the exchanges were made as rapidly as the local conditions permitted, and resulted in the determination of the westerly end of Nunivak Island and of the Northeast Cape of St. Lawrence Island three times from Unalaska and four times from St. Michael. A hydrographic reconnaissance was made along the routes of the ship between the astronomic stations by making 874 soundings on 3 666 miles of route traversed. The soundings were plotted on three hydrographic sheets.

During the night of September 11, with the worst storm of the season prevailing, the rudder stock was carried away. The ship was hove to under sail until daybreak, when a temporary steering geer was constructed and the vessel proceeded to Dutch Harbor for repairs. The weather had become so unfavorable that the vessel started

north on September 20, to pick up the shore parties as soon as possible and return to Seattle. All the men and material (including the remaining outfit which was stored at St. Michael) had been taken on board by September 27, and on that date the vessel started south. At Dutch Harbor five days were spent in laying up the steamer *Yukon* and the launches *Alpha* and *Delta*. On October 7 the vessel sailed for Seattle and reached that port on October 16.

The following extracts are taken from Assistant Pratt's report:

I wish particularly to emphasize the great assistance Mr. Morse rendered me in organizing the party and in equipping the expedition at the outset and in completing the details of office work at the close of the season.

All the work pertaining to the shipping of men devolved upon Deck Officer Giacomini, and he executed it in a most satisfactory manner.

Assistant Surgeon McLoughlin, in addition to his regular professional duties, intercompared the chronometers on shipboard and assisted generally in the office work, and after the ship became short handed he took regular day's duty as acting watch officer. Doctor McLoughlin is professionally unusually well qualified for his position, and, due to his high, stable character and desire to assist whenever he may be useful in the work, is a most desirable adjunct to the service.

Mr. Hathaway, acting captain's clerk, proved to be a most excellent young man and became efficient and perfectly satisfactory.

HYDROGRAPHY. ALASKA. J. F. PRATT, Commanding,
MAGNETIC OBSERVATIONS. Steamer *Patterson*.

H. W. RHODES, *Assistant.*
A. L. GIACOMINI, *Watch Officer.*
A. R. HUNTER, *Assistant Surgeon.*
H. M. HATHAWAY, *Acting Deck Officer*
D. R. JEWELL, *Aid.*
J. W. MILBURN, *Aid.*
H. L. BECK, *Aid.*
C. C. CRAFT, *Aid.*
P. C. WHITNEY, *Aid.*
R. J. CHRISTMAN, *Draftsman.*

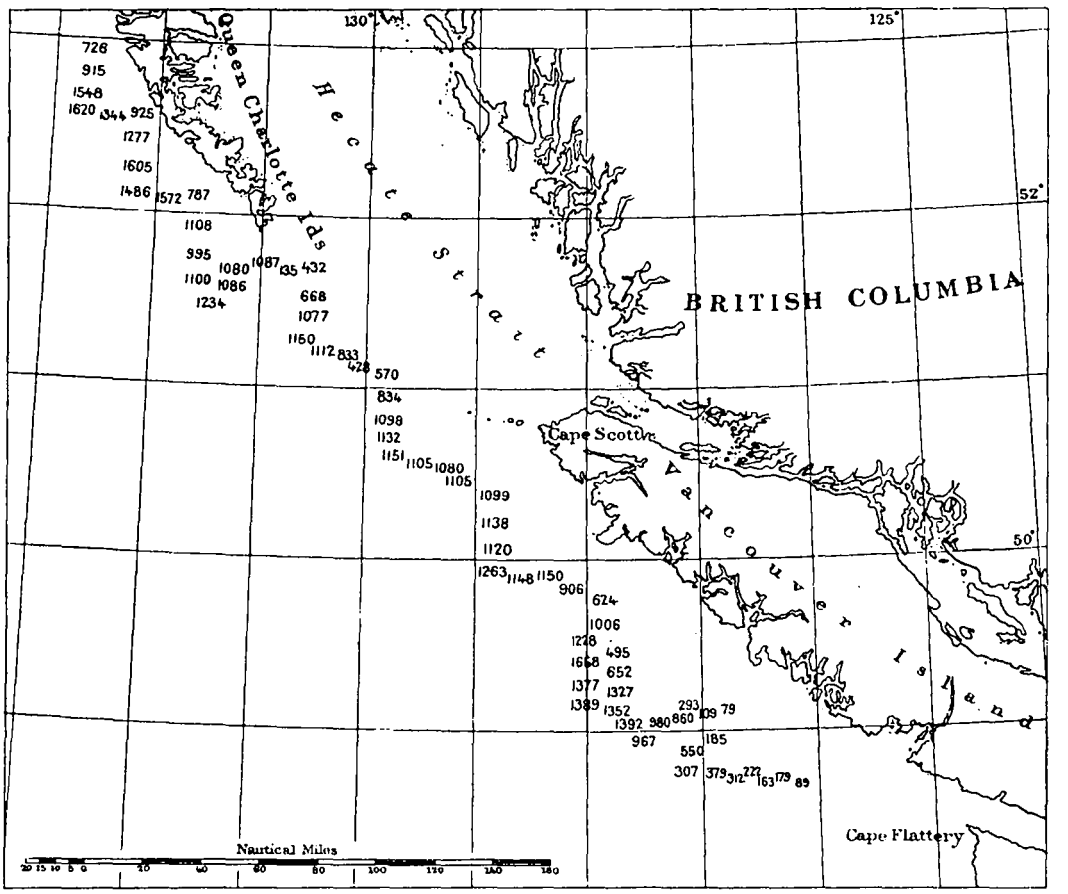
SUMMARY OF RESULTS.

Hydrography:
320 miles of deep-sea soundings.
68 soundings made.
Magnetic observations:
3 stations occupied.

The survey of Controller Bay, Alaska, and of a portion of Prince William Sound was assigned to Assistant Pratt, commanding the steamer *Patterson*. He was also instructed to carry a line of deep-sea soundings from the entrance to Juan de Fuca Strait to Sitka, Alaska, to obtain information desired by Gen. A. W. Greely, Chief Signal Officer, U. S. Army, for use in laying a cable from Seattle to Alaska. All necessary preparations were made, and the *Patterson* sailed from Seattle, Wash., on June 17 via Union Bay and Victoria, British Columbia. The vessel reached Neah Bay on the 22d, and was detained there by unfavorable weather until June 25, on which date the work began. During the latter part of the 26th and first part of the 27th the sea was running too high for sounding, and five hours were lost on the 28th as the

result of a break in the wire; but with these exceptions the work continued regularly day and night until the end of the fiscal year, when the vessel was at sea off the coast of Moresby Island, Queen Charlotte Group, in 726 fathoms of water. The area indicated by the signal officer for the cable bed was covered as well as practicable by a zigzag line, as shown on the accompanying sketch. The weather was very unfavorable for

No. 32.



Hydrographic reconnaissance for United States cable.

the work. Part of the time there was a rough sea and nearly all the time it was cloudy and overcast, so that solar observations were not possible except at irregular and uncertain intervals.

In his report Assistant Pratt calls attention to the satisfactory and successful manner in which Assistant Rhodes performed the duties of executive officer.

HYDROGRAPHY. ALASKA. H. P. RITTER.
TOPOGRAPHY.

July 1 to September 30.

SUMMARY OF RESULTS.

Hydrography:
125 square miles area covered.
406 miles lines sounded.
7 803 soundings made.
7 currents stations occupied.
1 hydrographic sheet completed.
Topography:
20 miles shore line surveyed.

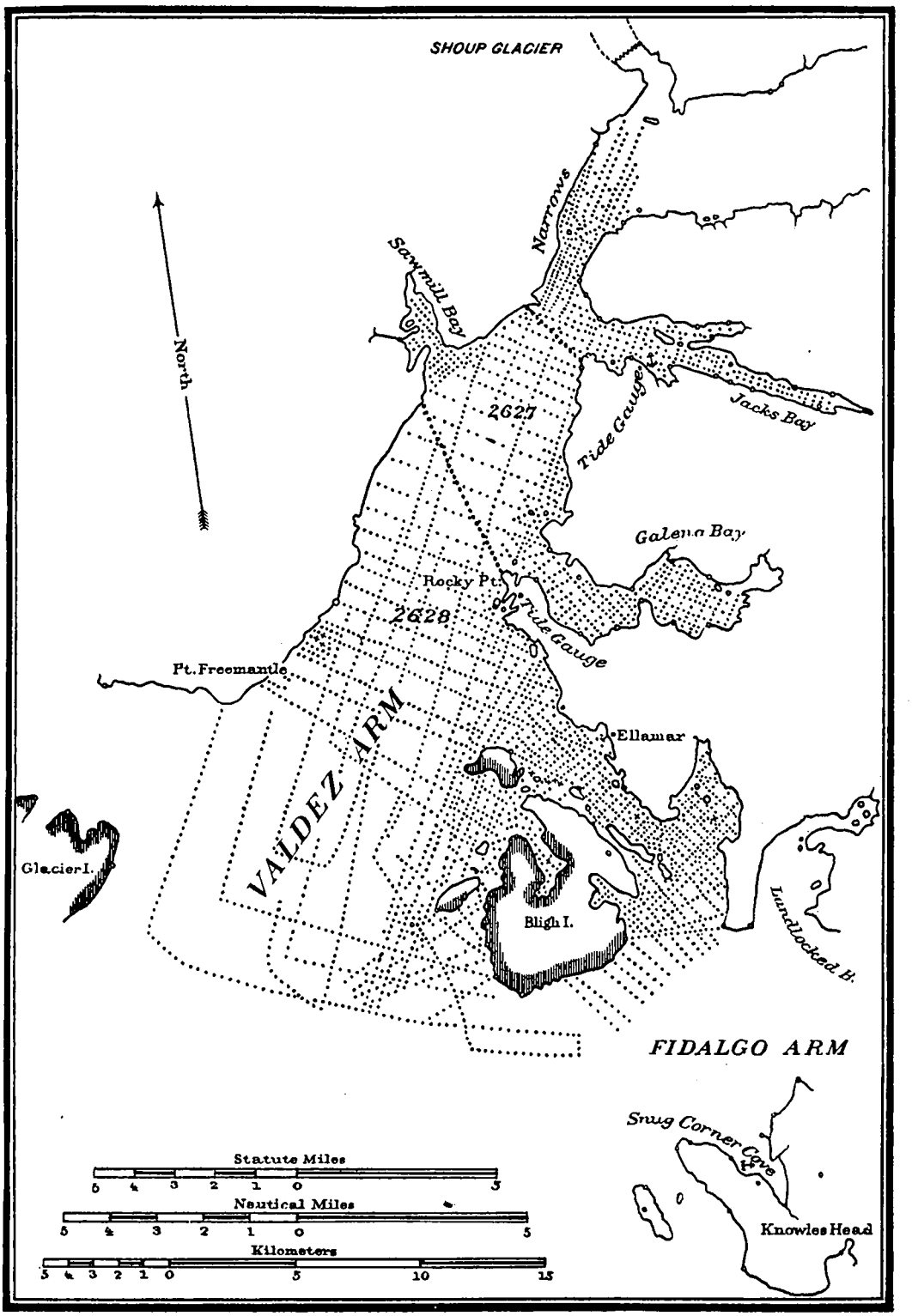
May 3 to June 30.

Hydrography:
30 square miles area covered.
161 miles lines sounded.
3 492 soundings made.
1 tide station established.
Topography:
15 miles shore line surveyed.

The survey of Prince William Sound, Alaska, was in progress on July 1 by a party under the direction of Assistant Ritter, and the following statement applies to the work of the whole season, but the statistics refer to the work executed between July 1 and September 30, when the field work closed. On that date the weather had become stormy, and after some delay on account of unfavorable weather the party returned to Orca on the small steamer *Taku*, which had been used by the party during the season. The outfit was stored and the boats were laid up, the *Taku* being left under the charge of a ship keeper. Assistant Ritter reports that the thanks of the Survey are due to Mr. Walter Storey, the superintendent of Alaska Packers' Association cannery, for his kindness in extending facilities and aid to the party. The party left Orca on October 15 and arrived at Seattle, Wash., on the 24th.

The area sounded covered the western end of Valdes Arm, from a point 2 miles east of the narrows to Point Freemantle, including Jacks Bay, Galena Bay, the two arms extending inland from the southern side of Valdes Arm, and the bay on the north side of the arm, locally known as Sawmill Bay. This portion of Valdes Arm is about 18 miles long. At its western end it is 8 miles wide, and gradually narrows to 1 mile at the narrows. Galena Bay extends inland about 7 miles and is from 1 to 1¾ miles wide. Jacks Bay is 1 mile wide at the entrance and one-half mile wide at its upper end. It extends inland about 7 miles. Sawmill Bay has an average width of about half a mile and extends inland about 2 miles. From the western end of Valdes Arm the soundings were extended in a southerly direction as far as the southern end of Bligh Island. The area covered extends from the western shore of Bligh Island out to deep water and includes the development of the submerged reef and shoal lying to the westward of the island. Soundings were made between Bligh Island and the mainland connecting Valdes and Fidalgo arms and the adjacent bays, called Virgin, Cloudman, and Boulder, and a few lines were extended out from the southern shore of Bligh

No. 33.



Hydrography and topography, Alaska.

Island. Assistant Ritter reports that Messrs. Henry Bernhardt, C. I. Rhodes, and George B. Lorenz assisted in the hydrographic work, and states that much of the success of the season's work was due to their commendable proficiency and cheerful cooperation in meeting the disagreeable conditions frequently met with in executing field work in this section. Tide observations were made for the purpose of reducing the soundings on tide staffs in Jacks Bay and at Rocky Point. A number of observations were made to determine the strength and directions of currents by using a weighted pole, with 18 to 20 feet of its length immersed. This pole was allowed to drift and was followed in a boat to determine its position at intervals of ten minutes. The topographic work consisted of the completion of the shore line along the northern, western, and southern shore of Bligh Island, and on the southeastern end of Glacier Island, by surveying between the isolated portions previously surveyed.

The survey in Prince William Sound and adjacent waters was continued, under the direction of Assistant Ritter, in May, 1903. He left San Francisco with his party on May 1 and reached Orca, Alaska, on the 17th. Necessary repairs were made to the steamer *Taku* and to the launch and boats assigned to the use of the party, and the party went into camp at Snug Corner Cove. Hydrographic work began on May 28 and was in progress at the close of the fiscal year.

ASTRONOMIC OBSERVATIONS. ALASKA. EDWIN SMITH.
BASE MEASUREMENT.
TOPOGRAPHY.

SUMMARY OF RESULTS.

Astronomic observations determined:
1 azimuth.
1 latitude determined.
1 longitude determined.
Topography:
90 square miles area covered.
25 miles shore line surveyed.
100 miles shore line creeks and ponds surveyed.
1 topographic sheet completed.

The duty of making the astronomic observations on St. Lawrence Island, Alaska, which were required in connection with the determination of the difference in longitude between St. Michael as the base station and Northeast Cape, on St. Lawrence Island, by the chronometric method, was assigned to Assistant Smith. He proceeded to Seattle, Wash., and reported on board the steamer *Patterson*, Assistant J. F. Pratt, commanding, on July 11, for duty, en route to his station.

The ship reached St. Lawrence Island on August 8, but the shores were uninviting and no landing could be made until the next day. A station was finally selected well back from the shore and about 2½ miles to the southward from the extremity of Northeast Cape. Lumber, equipage, instruments, stores, etc., were landed, and a rough building, containing a room for the observatory, with concrete pier for the instrument, and rooms for the officers and men, was erected under Assistant Pratt's direction, and Mr. D. R. Jewell, Aid, two men, and the wardroom cook were assigned to duty, under Assistant Smith, to aid in executing the work under his charge. Time observa-

tions were obtained on August 12, and the *Patterson* sailed for St. Michael on August 13. Preparations were made to make a topographic survey of as much of Northeast Cape and vicinity as could be reached from the station (see illustration 31). A base line was measured and the signals necessary for the plane table triangulation were erected. No means of transportation existed and long distances were traveled on foot, which made the work slow and laborious. Mr. Jewell executed part of the topographic work and deserves credit for the energy and ability displayed. Fogs prevailed a portion of the time and delayed the work. Observations for time were made on 18 nights, and for azimuth on 16 nights. The latitude was determined from observations made on four nights.

The *Patterson* visited the station on August 25, September 9, 11, and 24, and a comparison was made on these dates between the chronometers at the station and those on board the ship. On September 24 the work closed and the party and outfit were taken on board the steamer.

HYDROGRAPHY.
MAGNETIC OBSERVATIONS.
RECONNAISSANCE.
TOPOGRAPHY.
TRIANGULATION.

ALASKA.

F. WESTDAHL, Commanding,
Steamer *McArthur*.

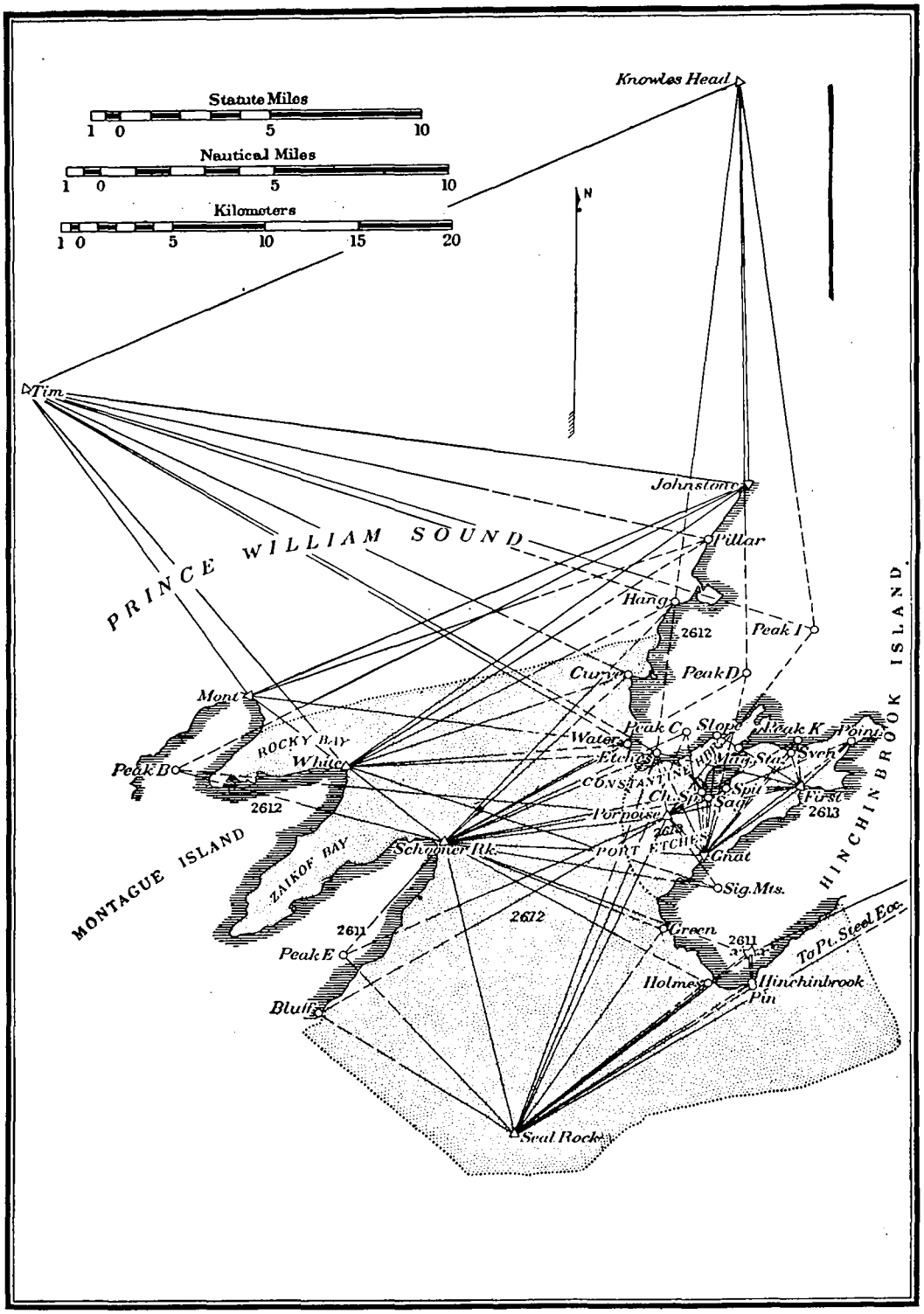
H. F. FLYNN, *Assistant.*
W. G. APPLETON, *First Watch Officer.*
JAMES SULLIVAN, *Chief Engineer.*
J. N. FORCE, *Assistant Surgeon.*
H. H. REES, *Acting Watch Officer.*
R. J. CHRISTMAN, *Draftsman.*

SUMMARY OF RESULTS.

Hydrography:
220 square miles area covered.
580 miles lines sounded.
5 688 soundings made.
2 tide stations established.
2 hydrographic sheets completed.
Magnetic observations:
2 stations occupied.
Reconnaissance:
600 square miles area covered.
37 triangulation stations selected.
Topography:
135 miles shore line surveyed.
3 topographic sheets completed.
Triangulation:
600 square miles area covered.
12 stations occupied.
37 geographic positions determined.

A portion of the work of surveying Prince William Sound, Alaska, was assigned to Assistant Westdahl, and on July 1 he was at Orca with the *McArthur* ready to begin work. A reconnaissance was made and the line between the old triangulation stations

No. 34.



Hydrography, topography, and triangulation, Alaska.

Johnstone and Knowles Head was selected as the base from which to extend the triangulation to the entrance of the sound. A self-registering tide gauge was established on an island in Mosquito Bight on the southeast shore of Port Etches. On July 5 a consultation was held with Assistant Ritter who was already at work in this locality, and all available information concerning the waters with which he was familiar was obtained. On July 12 a sufficient number of triangulation stations had been selected and prepared and on that date the observation of angles began. On July 16 a topographic party under Mr. Christman was organized on board the Schooner *Olga*, which was chartered for the purpose and placed at work in the vicinity of Johnstone Point. On the 22d Assistant Flynn was left in charge of the topographic party while the *McArthur* went to Orca for coal, but resumed work on the triangulation when the ship returned. All branches of the work progressed as rapidly as the weather conditions permitted until September 24, when the field work was closed for the season. Storms and thick weather delayed the work considerably, and on some occasions it was necessary to get up steam and leave an anchorage which had become unsafe from a change in the direction or force of the wind. The results accomplished are shown in the statistics given above and indicated on the accompanying sketch. The ship was ready to sail from Orca on September 28, but a gale caused delay until October 2, when the vessel proceeded to Flynn Cove, Cross Sound, to consult Assistant Dickins, commanding the *Gedney*, who was anchored there. While on the way examinations of reefs were made and information was collected for use in the Coast Pilot. The vessel proceeded to Killisnoo, via Juneau, and on October 16 sailed in company with the *Gedney* for Seattle, via Union Bay and Victoria, and reached that place on October 24.

Assistant Westdahl in his report commends the officers in his party for the faithful performance of the duties assigned to them, and mentions especially the skill and energy displayed by Assistant Flynn in executing the triangulation.

SPECIAL WORK. HAWAIIAN ISLANDS. W. D. ALEXANDER.
TIDE OBSERVATIONS.

The work in the Hawaiian Islands, except the Magnetic Observatory, was continued under the direction of Assistant Alexander. The preparation of the register of the geographic positions determined by the triangulation of the islands, under the direction of the Hawaiian government, before the annexation by the United States, was continued. The portion of the register covering Kauai and Oahu was completed and forwarded to the Office in December. A list of capes, rivers, towns, etc., in the islands was prepared to supplement the list of Hawaiian geographic names already furnished. A table of the magnetic declination at various stations in the islands was compiled from the records of the Territorial survey. The register of geographic positions and elevations on Molokai was completed. The automatic tide gauge at Honolulu was kept in operation.

Assistant Alexander aided in conducting civil-service examinations and in rating examination papers when required, and performed other special temporary duty in addition to his regular work.

ASTRONOMIC OBSERVATIONS. HAWAII. EDWIN SMITH.
FREMONT MORSE.

The completion of the submarine cable between San Francisco, Cal., and Honolulu, Hawaii, furnished the means of adding this important station to the telegraphic longitude system which has been extended over the continental portion of the United States by the Coast and Geodetic Survey. Assistants Smith and Morse were instructed to make the necessary preparations and take station at Honolulu and San Francisco, respectively, to determine the difference in longitude between these places. Permission to use the cable for this purpose was courteously granted to the Survey by Mr. George G. Ward, vice-president and general manager of the Commercial Cable Company, and the thanks of the Survey are due his company for this generous privilege. On a previous occasion, many years ago, Mr. Ward had shown his interest in this important work by doing all in his power to aid the observers in the determination of the trans-Atlantic difference of longitude when he was an operator in the cable office at one end of the line. Assistant Smith visited Mr. Ward in New York and secured much useful information as to the best method of exchanging signals over the cable. Based on this information, an apparatus for automatically recording signals over the cable was devised and two sets were constructed at the Coast and Geodetic Survey Office. Other necessary preparations were made, and Assistant Smith proceeded to San Francisco, where he arrived on March 16, and was joined by Assistant Morse. The preparations for work were completed at this end of the line by connecting the astronomic observ-

atory with the cable office over a wire belonging to the Signal Corps, U. S. Army. This connection was made by direction of Lieut. Col. James Allen, Signal Corps, U. S. Army, who kindly placed the line at the disposal of the observers. The Pacific States Telephone and Telegraph Company generously put telephones in the cable office and the observatory for the use of the party free of expense.

Observations for personal equation were made by Messrs. Smith and Morse, but only two nights' work could be obtained before April 2, when Assistant Smith sailed for Honolulu. He arrived on the 8th and made an examination of the ground before selecting the location of the astronomic station, which was placed in the grounds of the United States naval station, by the permission of the acting commandant, Lieut. Commander Hugh Rodman, U. S. Navy, who facilitated the work in every way in his power. The location of the observatory of the Territorial survey was unsuitable for the purpose in hand, and all other stations at which observations had previously been made were unavailable. The observatory was connected with the telephone system and all other preparations were completed before April 14, but unfavorable weather prevented observations until April 20. On the 29th the necessary observations had been obtained and the observers were ready to exchange stations. Assistant Morse left San Francisco on May 2 and reached Honolulu on the 8th, but it was necessary for Assistant Smith to wait until the 13th for a steamer to San Francisco. During this time the observers succeeded in obtaining observations to determine their personal equation on one night, observations being prevented on other nights by unfavorable weather. Assistant Smith reached San Francisco on May 19, but unfavorable weather prevented observations until June 2. On June 13 the necessary observations were completed and preparations were made to determine the difference in longitude between Honolulu and Guam and between Guam and Manila, P. I., which would soon be possible as the result of the completion of the cable. Assistant Smith sailed for Guam, via Honolulu, on June 21. He reached Honolulu on June 27, and at night the observers made observations for personal equation. Assistant Smith was detained at Honolulu until June 30, but no other observations were possible on account of unfavorable weather. The following is quoted from Assistant Smith's report:

> I wish especially to mention the courtesy we have received from the cable officers in New York, San Francisco, and Honolulu, who have advanced the work in every way in their power. I also wish to state that with the apparatus for the automatic recording of cable signals we can now determine longitudes over cables with as great accuracy as over land lines and with almost as great facility.

MAGNETIC OBSERVATIONS. HAWAII. WILLIAM WEINRICH, Jr.

The magnetic observatory at Honolulu, Hawaii, was assigned to the charge of William Weinrich, jr., Magnetic Observer, on July 1, and continued under his direction until the close of the fiscal year. Differential observations were recorded on every day in the year, and only a very small per cent of magnetograph records were lost. Absolute observations were made every Monday during the year except on one day when the suspension fiber in the magnetometer broke several times and the observations were made on the following day. Special observations were made in accordance with the plan adopted for international cooperation during the absence of the polar expeditions.

The instrumental outfit was the same as during the previous year, except that a

seismograph, loaned to the observatory by Professor Milne, was in operation after April 1. S. A. Deel, magnetic observer, reported for duty on February 5, and assisted in the work after that date. Various improvements in the buildings and grounds were made as they became necessary in the progress of the work.

COMBINED OPERATIONS. PHILIPPINE ISLANDS. G. R. PUTNAM.

The important work of surveying the coasts of the Philippine Islands was continued under the direction of Assistant G. R. Putnam, who remained in charge of the suboffice at Manila, representing the Superintendent of the Coast and Geodetic Survey in all matters of detail requiring immediate decision. In performing this duty he adopted plans for the field operations, issued instructions for field work, compiled all data secured, and prepared and published charts of the waters surveyed. Notices to Mariners and Sailing Directions were prepared and published. He was aided in this work by such advice and instructions issued from Washington as became necessary and the conditions surrounding the work and the necessities of the case required. The work continued under the plan of cooperation between the Philippine Commission and the Coast and Geodetic Survey adopted in 1901 and stated in the Annual Report for 1902. Field parties were at work almost continuously during the fiscal year under the following chiefs of parties:

J. E. McGrath, Assistant (July 1 to June 30); astronomic determinations of base positions; telegraphic longitude work (end of line occupied mention first); Pasacao–Legaspi; Masbate–Calbayoc; Masbate–Carigara; Dumaguete–Iligan; Dumaguete–Cagayan; Dumaguete–Vallehermosa; Dumaguete–Loon; Romblon–Boac; Romblon–Batangas; Ormoc–Surigao. Latitude and magnetic observations were made at Romblon.

W. B. Fairfield, Assistant (January 28 to June 30); triangulation and topography northwest coast of *Luzon* Island from Vigan to San Fernando.

William Bowie, Assistant (February 1 to April 24); triangulation of Manila Bay; April 24 to June 6, hydrography of Lingayen Gulf. Reported to Assistant Denson on June 6.

H. F. Flynn, Assistant (January 28 to June 30); triangulation and topography northwest coast of *Luzon*, from Vigan to Cape Bojeador.

H. C. Denson, Assistant; surveys in vicinity of Aparri, north coast of *Luzon;* hydrographic survey of Lingayen Gulf, with additional triangulation and topography.

R. B. Derickson, Assistant, in command of the steamer *Research;* surveys in Albay Gulf and Rapurapu Strait, east coast of *Luzon;* survey of Puerto Galera and Varadera Bay, *Mindoro;* general survey of vicinity of Mangarin and location of rock in north end of Ilin Strait, south coast of *Mindoro;* hydrographic work at Danao, northeast coast of *Negros*.

H. C. Mitchell, Assistant; astronomic determinations of base positions; longitude work (end of line occupied mentioned first); Catbalogan–Masbate; Calbayoc–Masbate; Tacloban–Carigara; Iligan–Dumaguete; Vallehermosa–Dumaguete. Latitude and magnetic observations were made at Catbalogan, Calbayoc, Iligan, and Vallehermosa. Assistant Mitchell left Manila for Washington on March 28.

C. E. Morford, Aid; triangulation and topography in Sorsogon Bay; triangulation and topography of Danao River entrance, *Negros*. Reported to Assistant Flynn on January 28. Left Manila for San Francisco on April 10.

J. S. Hill, Aid; astronomic determinations of base positions; longitude work (end of line occupied mentioned first); Masbate–Calbalogan; Carigara–Masbate; Carigara–Tacloban; Cagayan–Dumaguete; Loon–Dumaguete; Masbate–Romblon; Calapan–Romblon; Boac–Romblon; Batangas–Romblon; Surigao–Ormoc. Latitude observations were made at Carigara, Cagayan, Loon, Calapan, Boac, and Surigao. Magnetic observations were made at Calapan, Boac, Batangas, and Surigao.

Additional details of the work of each field party are given under the name of its chief.

J. C. Dow, Nautical Expert, was engaged in compiling Sailing Directions and Notices to Mariners from all available sources, in verifying all new information of this character, and in proof reading the Sailing Directions and Notices to Mariners published at Manila. Mr. Dow also went to the field for the purpose of collecting information, in September to Iloilo and in October to twenty-five Philippine ports and to Sandaken, Borneo. He also made five voyages, as follows: To San Bernardino Strait, January 6–13; around *Mindoro*, January 28–February 8; to *Paragua*, March 6–29 and May 5–15; and to northern *Luzon*, June 26–30.

The following pamphlets of Sailing Directions were published during the year:

Section I. North and west coast of *Luzon*.

Section II. Southwest and south coast of *Luzon* and adjacent islands.

Section III. Coasts of *Panay*, *Negros*, *Cebu*, and adjacent islands.

Section IV. Coasts of *Samar* and *Leyte* and east coast of *Luzon*.

Section V. Coasts of *Mindanao* and adjacent islands.

Sections VI and VII were prepared and sent to the printer. The seven sections cover the Philippine Archipelago.

E. R. Frisby, chief Computer, was engaged in the examination of records from the field, in making computations necessary for the construction of charts, and the preparation of the data to be retained in Manila when the original records are forwarded to Washington. Mr. F. F. Pangan, junior Computer, assisted in this work after October, and also took care of the self-registering tide gauge at Manila.

P. B. Castles, chief Draftsman, has continued in charge of the preparation of charts. The force of junior draftsmen (Filipinos) numbered 8 in January, and was increased to 10 before the close of the fiscal year. These men are efficient, painstaking, and industrious, and are interested in their work.

Fourteen charts were published in Manila by lithography during the year, as follows:

4253. Tabaco Bay.
4254. Subig Bay and Port Silanguin.
4255. Manila Bay and approaches.
4256. San Bernardino Strait.
4258. Matnog Bay, Ticlin Strait, and Port Gubat.
4259. Rapurapu Strait.
4260. Aparri anchorage.
4261. Legaspi anchorage.
4342. Halsey Harbor.
4446. Ports (7) on coast of *Samar*.
4447. Cebu Harbor and approaches.
4448. Iloilo Strait and Harbor.
4449. Port Palapag and Laguan Bay.
4542. *Jolo* Island and vicinity.

Eleven charts were in preparation at the close of the fiscal year, some of which were nearly completed. On June 30, 1903, the force at the Manila suboffice consisted of 17 persons, as follows: Assistant in charge, 1 chief computer, 1 nautical expert, 1 chief draftsman, 1 clerk, 10 junior draftsmen, 1 junior computer, and 1 messenger. Various members of the field force were on duty at the suboffice for short intervals. The steamer *Research* was laid up from April 10 to June 22 having a new boiler installed, the machinery overhauled, and repairs made. The Coast and Geodetic Survey steamer *Pathfinder*, with Assistant Gilbert in command, reporting direct to Washington, continued at work until April 9, when she sailed for Hongkong to have repairs made. Assistant Gilbert completed very important work off the south coast of *Samar* and the southwest coast of *Leyte*, and details of this work are given under his name. All possible assistance was given to this vessel. At the request of the Director of the Philippine Census assistance was given to his office, and a list of the islands in the Archipelago, showing the area of each, was prepared for his use.

Those whom the work affects are becoming more interested in the Survey, and much information was sent to the suboffice by the Engineer Officers of the Army, the officers of the Division of Military Information, the Bureau of Coast Guard and Transportation (including Light-House Service), Census Office, Customs Service, Army Transport Service, Masters of merchant steamers, and others. Information was supplied by the suboffice in response to numerous official and private requests.

ASTRONOMIC OBSERVATIONS. PHILIPPINE ISLANDS. WM. BOWIE.
BASE MEASUREMENT.
HYDROGRAPHY.
TRIANGULATION.

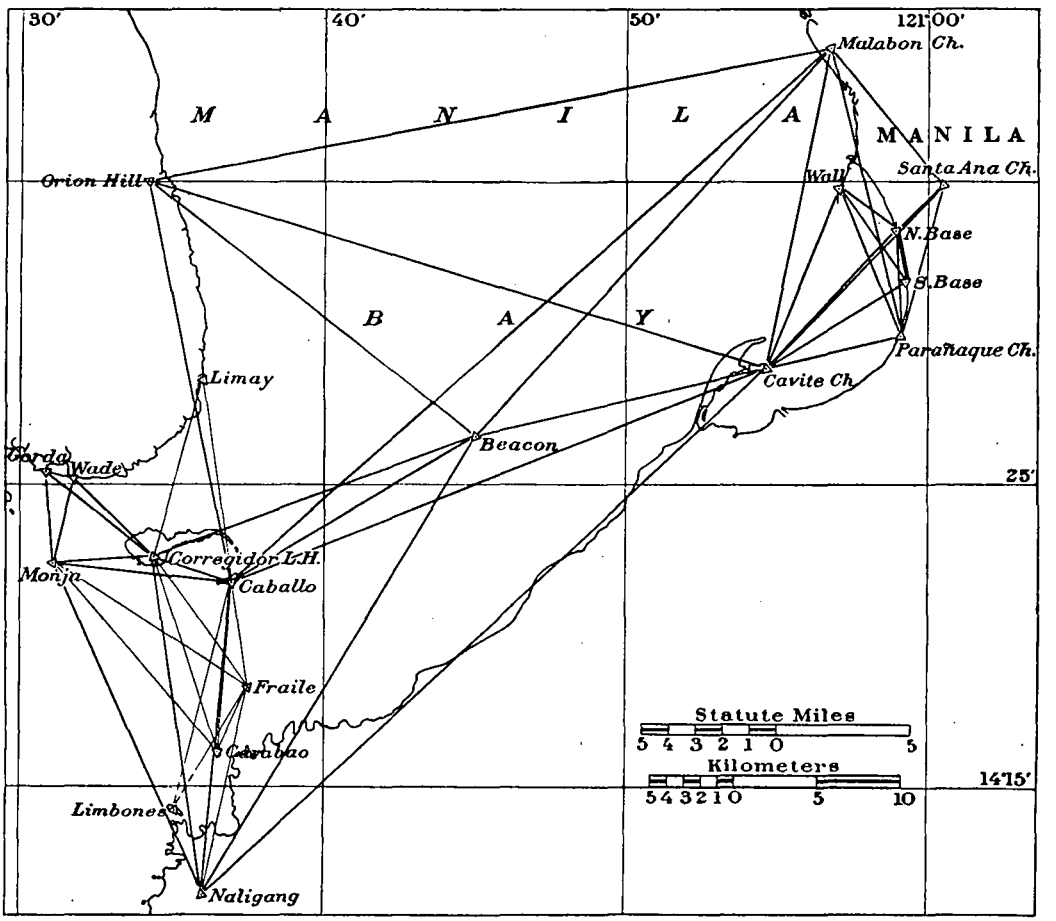
SUMMARY OF RESULTS.

Astronomic observations:
1 azimuth established.
Base measurement:
1 base line measured.
Hydrography:
425 square miles area covered.
709 miles lines sounded.
4 171 soundings made.
Triangulation:
19 stations occupied.
70 geographic positions determined.

The triangulation in the vicinity of Manila Bay was assigned to Assistant Bowie and the work in the field began on February 3. A base line was located and measured on the beach south of Manila and from this the triangulation was extended across and down the bay, including the islands at the entrance. All prominent objects, such as church spires, mountain peaks, etc., were observed upon from two or more stations. Vertical angles were measured on the mountain peaks to determine their elevation. Observations to determine an azimuth were made at the northern end of the base line. Except when working in the immediate vicinity of Manila a chartered steam launch was used and the party lived on board. The work was completed on April 13. Prepa-

rations for hydrographic work in Lingayen Gulf were then made and on April 24 field work was begun at Dagupan. The party consisted of the chief, Observer Malcolm Elliott, Recorder A. J. Godfrey, and three hands. A launch was chartered and the party lived on board. Soundings began on April 29 and continued until June 5

No. 35.



Triangulation, Luzon, P. I.

(except for four days, May 12 to 16), when the field work assigned to the party was completed. The work is shown within the heavy dotted line on sketch 36. The weather was favorable and soundings were only prevented on one day during the season. On June 6 the party was disbanded and Assistant Bowie reported to Assistant Denson for duty in the party under his charge.

ASTRONOMIC OBSERVATIONS. PHILIPPINE ISLANDS. H. C. DENSON
BASE MEASUREMENT.
HYDROGRAPHY.
TOPOGRAPHY.
TRIANGULATION.

WM. BOWIE, *Assistant.* June 6 to June 30.

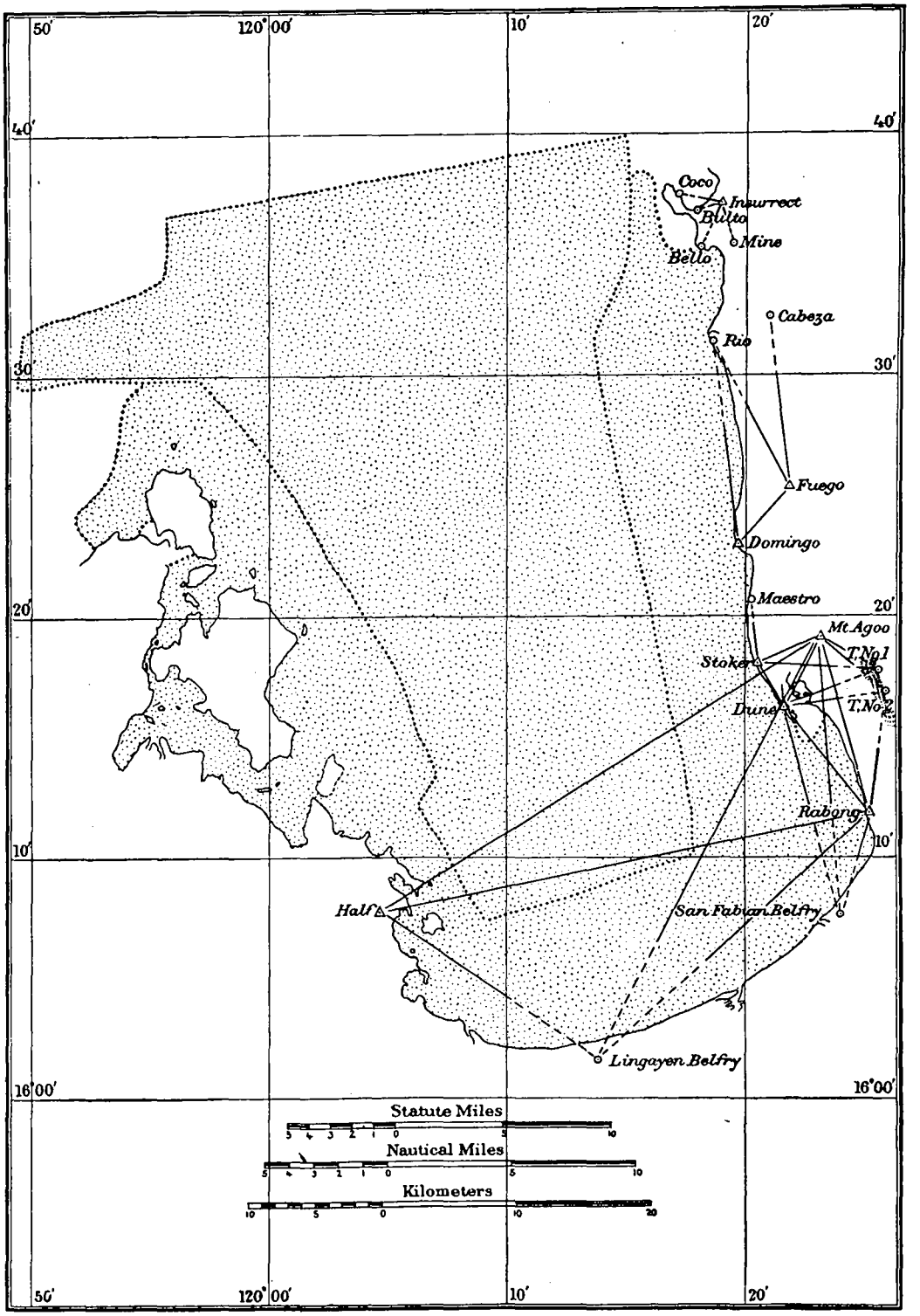
SUMMARY OF RESULTS.

Astronomic observations:
1 azimuth established.
Base measurement:
1 base line measured.
Hydrography:
482 square miles area covered.
1 526 miles lines sounded.
39 321 soundings made.
4 tide stations established.
6 hydrographic sheets completed.
Topography:
19 miles shore line surveyed.
1 topographic sheet completed.
Triangulation:
15 stations occupied.
50 geographic positions determined.

The survey of the entrance to Cagayan River at Aparri, northern *Luzon*, was in progress on July 1 by a party under charge of Assistant Denson. The work continued until August 25, when it was completed, after much delay resulting from unfavorable weather conditions and from sickness in the party.

On November 1 the hydrography of Lingayen Gulf was taken up by Assistant Denson and was in progress at the close of the fiscal year. The party lived on shore in tents, or houses when available, and the work was done with a steam launch. During December, January, and February the prevailing winds in Lingayen Gulf are from the northeast, and as the gulf opens to the north, there were many days during this period when work was prevented in the open gulf. Unfavorable weather conditions prevailed from November to March, but much progress was made by taking advantage of the shelter afforded by the numerous islands along the west coast where work was done when it would not have been practicable to work elsewhere. After the middle of March the weather was favorable for the hydrographic work except on a few days when a strong northerly wind prevailed and heavy seas rolled into the gulf.

No. 36.



Hydrography, Lingayen Gulf, Luzon, P. I.

ASTRONOMIC OBSERVATIONS. PHILIPPINE ISLANDS. R. B. DERICKSON, Commanding, Steamer *Research*.
BASE MEASUREMENT.
HYDROGRAPHY.
MAGNETIC OBSERVATIONS.
TOPOGRAPHY.
TRIANGULATION.

N. G. GRAYSON, *First Watch Officer.*	
H. M. DAVIE, *First Watch Officer.*	July and August.
W. W. MARKOE, *Surgeon.*	
E. E. ALLEN, *Chief Engineer.*	July to October.
OWEN DUFFY, *Chief Engineer.*	November to June.
H. O. PIXLEY, *Observer.*	July to August.
MALCOLM ELLIOTT, *Observer.*	November to April.

SUMMARY OF RESULTS.

Astronomic observations:
3 azimuths established.
Base measurement:
2 base lines measured.
Hydrography:
729 miles lines sounded.
21 021 soundings made.
4 tide stations established.
8 current stations occupied.
Magnetic observations:
2 stations occupied.
Topography:
50 square miles area covered.
93 miles shore line surveyed.
Triangulation:
132 square miles area covered.
37 stations occupied.

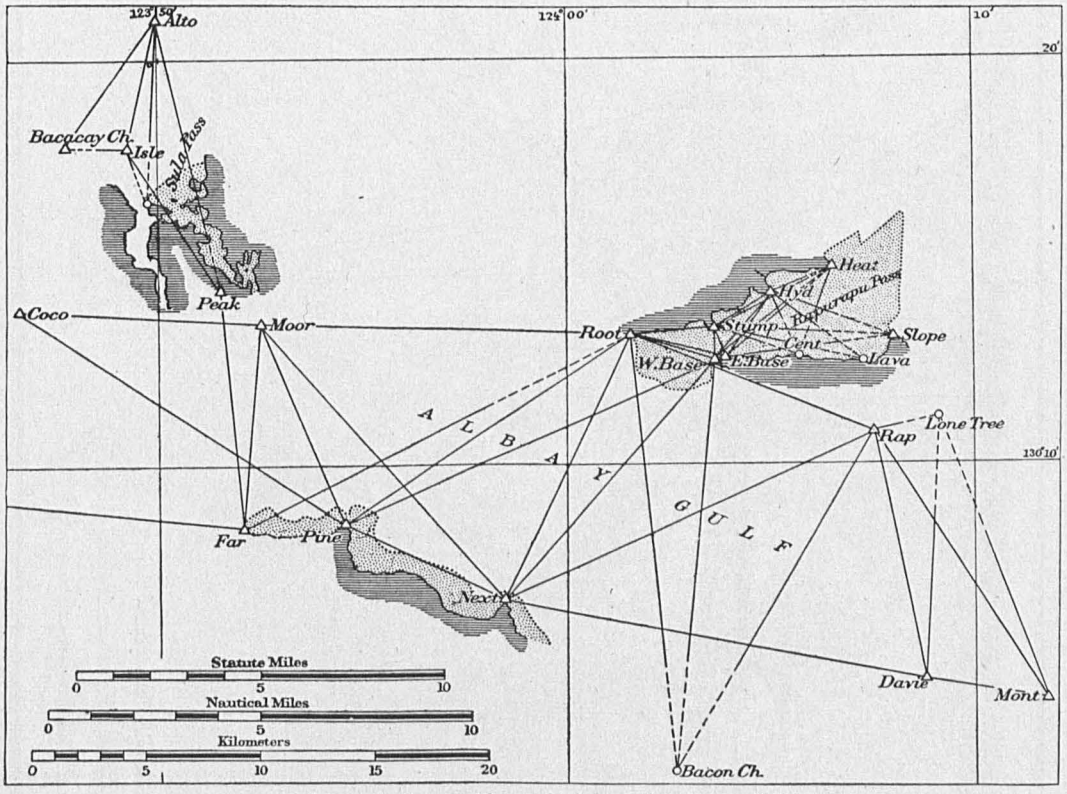
Surveys in various localities in the Philippine Islands were assigned to Assistant Derickson, commanding the steamer *Research*, furnished by the Philippine Commission for use in the work. The work of the party, stated in the order of execution, may be briefly summarized as follows:

Triangulation was extended on the shores of Albay Gulf and south end of Tabaco Bay. A topographic survey was made of a portion of the shore line of Sula Pass and the south shore of Albay Gulf. Hydrographic work was done in Sula Pass and Albay Gulf, including tide and current observations. The magnetic declination was determined on the shore of Albay Gulf. Between November 20 and February 5 a survey was made of Puerto Galera, including base measurement, triangulation, azimuth observations, topography, and hydrography (including tide observations). The triangulation of this survey was connected with the church spire at Batangas, *Luzon*, and the flagstaff at Calapan, *Mindoro*, two stations whose latitude and longitude had been determined. The topography was extended along the south coast of the promontory and around Varadero Bay. The inshore hydrography of Puerto Galera and around Point Escarceo and Varadero Bay was done with the whaleboat and alco-vapor launch under charge of Messrs. Grayson and Elliott. The offshore hydrography was done

with the *Research* under charge of the commanding officer, sounding with lead out to 20 fathoms and in deeper water with the sounding machine. The work was delayed by strong wind. The northeast monsoon is drawn down by the high range of mountains to the westward and sweeps the promontory with great violence.

On February 12 the survey of Mangarin Bay and Ilin Pass, *Mindoro*, was taken up and included base measurement, azimuth observations, magnetic observations, triangulation, topography, and hydrography (including tide observations with a self-registering

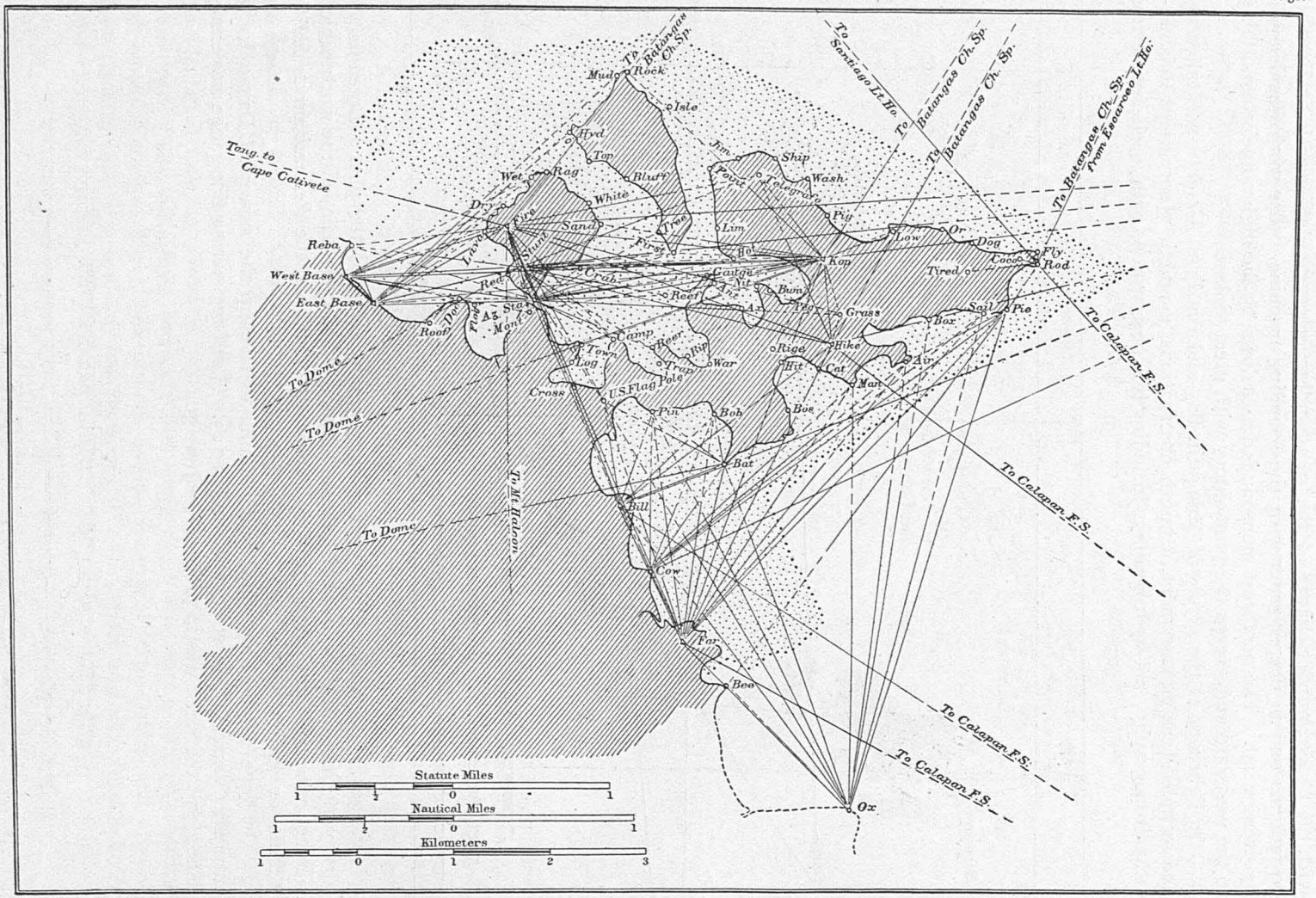
No. 37.



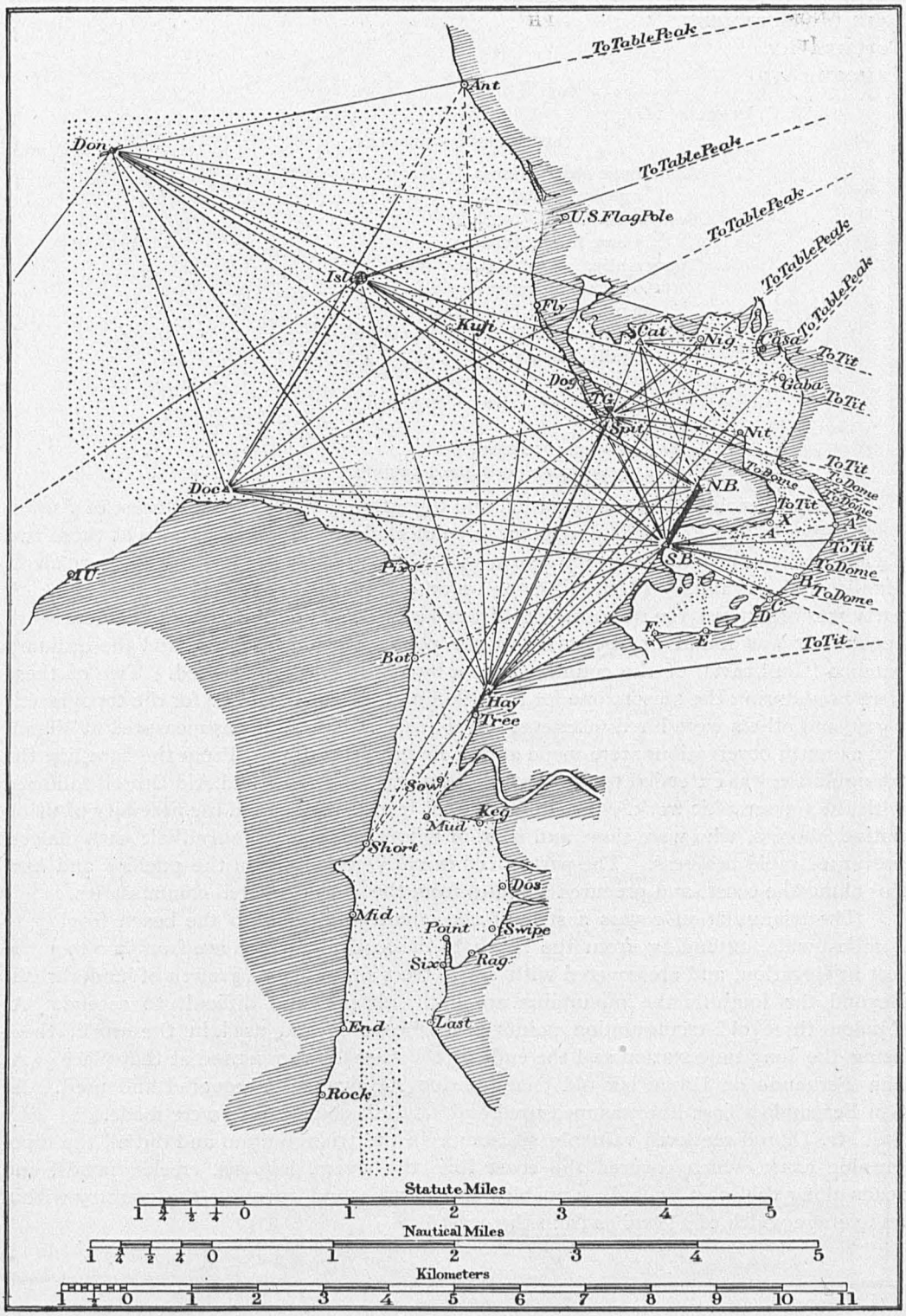
Hydrography, topography, and triangulation, Luzon, P. I.

tide gauge). The inshore and offshore hydrography followed the plan adopted in the survey of Puerto Galera, as stated above. Heavy wind again delayed the work, which was not completed until April 7, when field work closed and the *Research* proceeded to Manila for repairs.

On June 21 the ship sailed from Manila to take up the survey of Danao River entrance, *Negros*. The work began on June 23. A self-registering tide gauge was established, and the work was in progress on June 30.



Hydrography, topography, and triangulation, Puerto Galera, Mindoro, P. I.



Hydrography, topography, and triangulation, Mangarin, Mindoro, P. I.

ASTRONOMIC OBSERVATIONS. PHILIPPINE ISLANDS. W. B. FAIRFIELD.
BASE MEASUREMENT.
TOPOGRAPHY.
TRIANGULATION.

W. C. DIBRELL, *Aid.*

SUMMARY OF RESULTS.

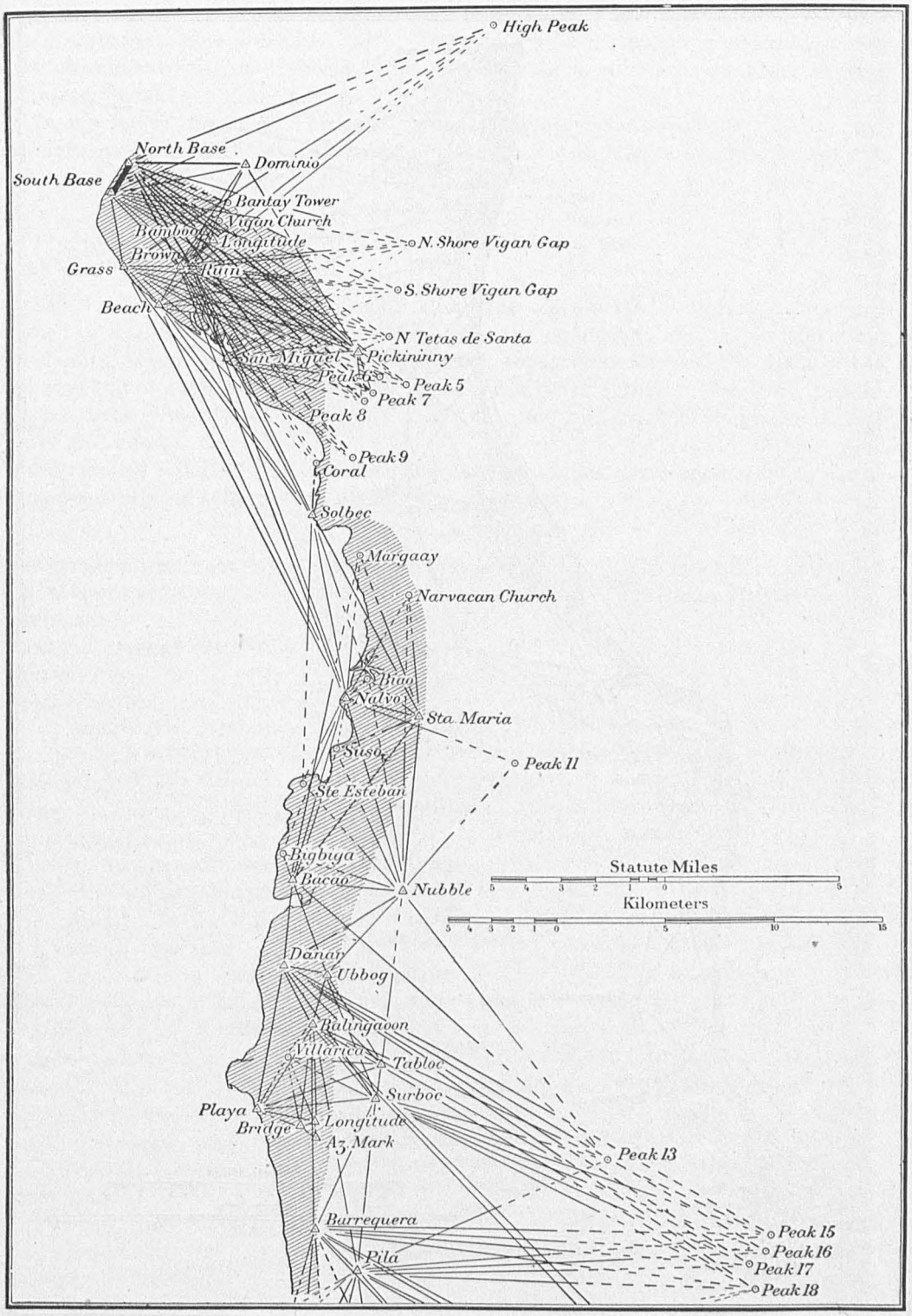
Astronomic observations:
1 azimuth established.
Base measurement:
2 base lines measured.
Topography:
160 square miles area covered.
80 miles shore line surveyed.
243 miles shore line lagoons and rivers surveyed.
80 miles roads surveyed.
50 miles streets surveyed.
6 topographic sheets completed.
Triangulation:
54 stations occupied.
141 geographic positions determined.

The extension of the triangulation and topography along the west coast of *Luzon*, from Vigan to San Fernando de Union, to connect the astronomic stations at those two places was assigned to Assistant Fairfield. The necessary preparations were made at Manila, and on January 28 he sailed for Vigan and reached that place on the 30th. A party was organized, the necessary outfit was secured, and on February 4 the field work began. It was found impracticable to use ponies as pack animals, and the ordinary bamboo "bull cart" of the country, drawn by a bull, was substituted. Two of these were used during the season, one for the triangulation party and one for the topographic party, and others were hired whenever necessary. A base line was measured at Vigan, and azimuth observations were made at the longitude station. From the base line the triangulation was extended to the south by Assistant Fairfield, and Aid Dibrell followed with the topographic work. The difficulties of transportation and the necessity of using native laborers, who were slow, and most of whom understood only their own dialect, prevented rapid progress. The party lived in native buildings in the pueblos and barrios along the coast, and procured supplies from the army and civil commissaries.

The triangulation covers a strip of the country adjacent to the beach from 2 to 4 miles wide, extending from the beach to the foothills, which are from 400 to 1 300 feet in elevation, and are covered with small trees and a dense growth of underbrush. Beyond the foothills the mountains are high, abrupt, and difficult to ascend. At Candon three old triangulation points were recovered and used in the work, these being the longitude station and the ends of the base line measured at that place. At San Fernando de Union six old triangulation stations were recovered and used. At San Fernando a base line was measured and azimuth observations were made.

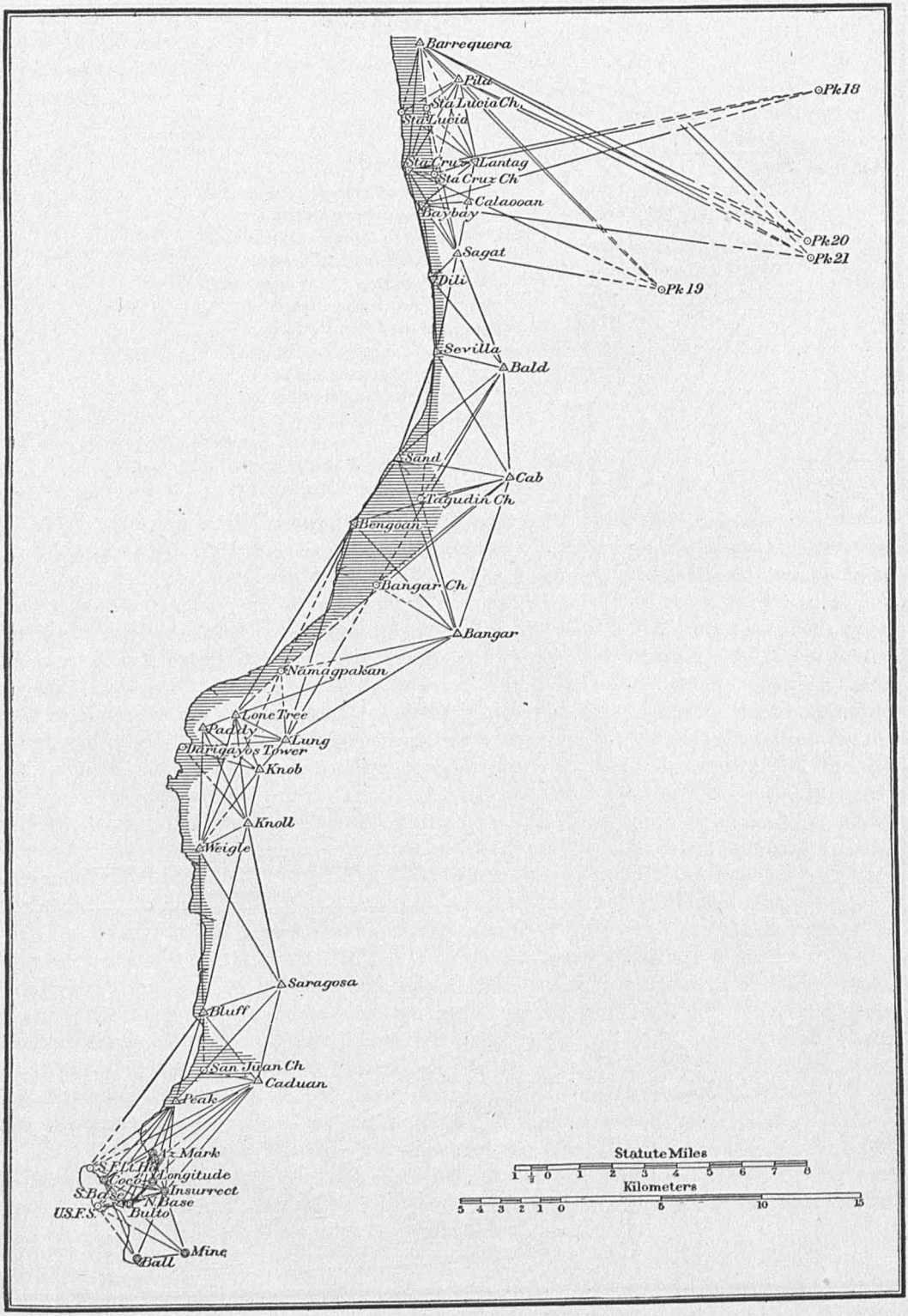
Mr. Dibrell rendered valuable assistance in the triangulation and did all the topographic work, which covered the coast line, the rivers, lagoons, creeks, ponds, and roads along the coast, including pueblos and barrios, and covering the country within an average width of 2½ miles from the coast line.

No. 40.



Triangulation, west coast, Luzon, P. I.

No. 41.



Triangulation, west coast, Luzon, P. I.

The weather was favorable and there was little delay on this account. On two days observations were prevented during three hours in the morning and three hours in the afternoon by flights of locust, which filled the air to such an extent that objects 300 meters distant could not be seen.

In his report Assistant Fairfield expresses his appreciation of the rapidity and thoroughness with which Mr. Dibrell performed the duties assigned to him and of the interest and efficiency shown by the recorder, Mr. Weigle.

TOPOGRAPHY. PHILIPPINE ISLANDS. H. F. FLYNN.
TRIANGULATION.

The extension of the triangulation along the coast north of Vigan, *Luzon*, was assigned to Assistant Flynn. He reached Vigan on January 30 and began field work immediately. As the triangulation progressed a topographic survey was made of the shore line and of a narrow strip of land in its immediate vicinity. The work was in progress at the close of the fiscal year and at that time had reached Bangui, northeast of Cape Bojeador.

No detailed report of this work had been received when this Report went to press, and consequently no statistics are given.

ASTRONOMIC OBSERVATIONS. PHILIPPINE ISLANDS. J. J. GILBERT, Commanding,
BASE MEASUREMENT. Steamer *Pathfinder*.
HYDROGRAPHY.
MAGNETIC OBSERVATIONS.
TOPOGRAPHY.
TRIANGULATION.

C. C. YATES, *Assistant*.
J. T. GOLDSBOROUGH, *Chief Engineer*.
B. A. BAIRD, *Aid*.
C. W. FITZGERALD, *Second Watch Officer*.
R. H. HAWKES, *Assistant Surgeon*.
E. S. DANIELS, *Third Watch Officer*.
L. H. WESTDAHL, *Deck Officer, First Class*.
C. F. DEICHMAN, *Captain's Clerk*.
J. F. PFAU, *Draftsman*. July 1 to Oct. 13.

SUMMARY OF RESULTS.

Astronomic observations:
2 azimuth stations occupied.
Base measurement:
2 base lines measured.
Hydrography:
1 356 square miles area covered.
3 834 miles lines sounded.
60 210 soundings made.
8 tide stations established.
4 current stations occupied.
8 hydrographic sheets completed.
Magnetic observations:
4 stations occupied.

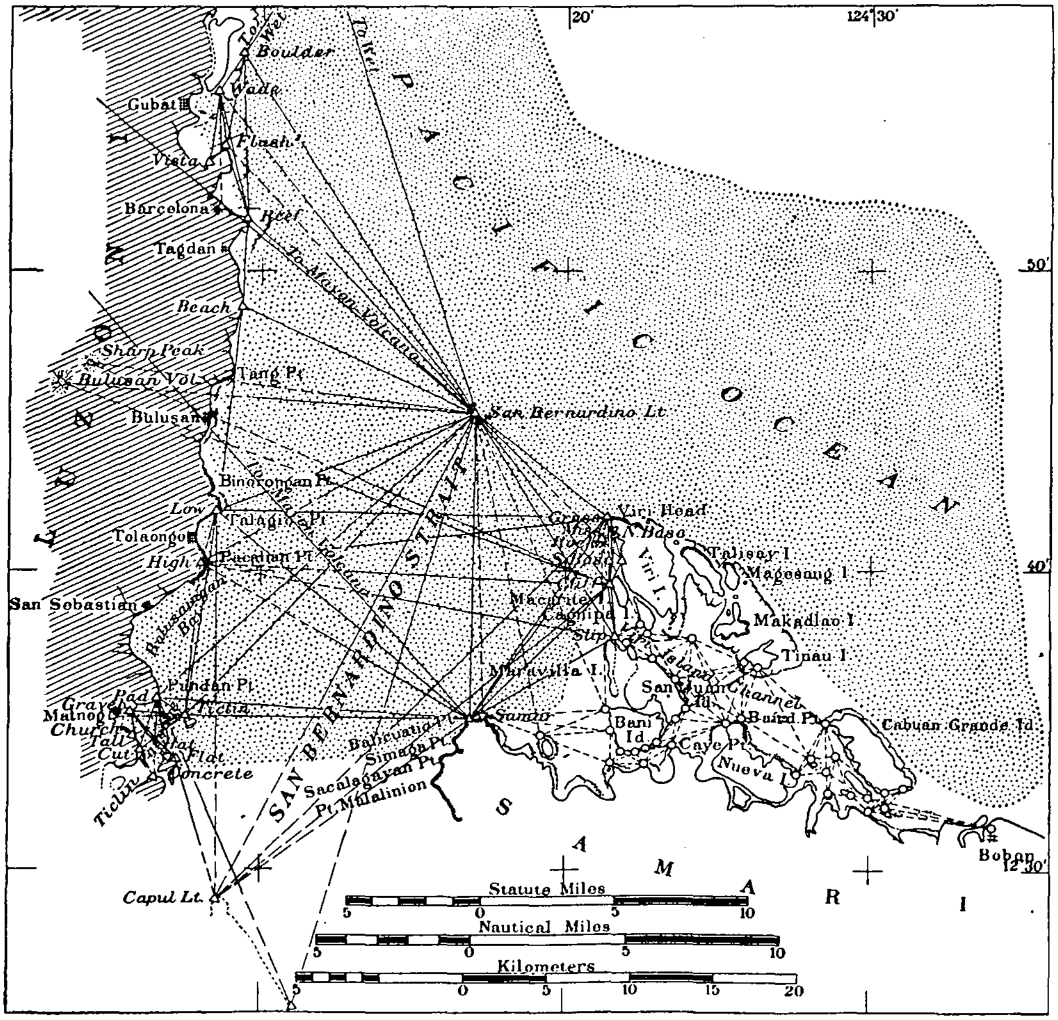
Topography:

264 square miles area covered.
397 miles coast line surveyed.
39 miles of roads surveyed.
13 topographic sheets completed.

Triangulation:

908 square miles area covered.
79 stations occupied.
140 geographic positions determined.

No. 42.

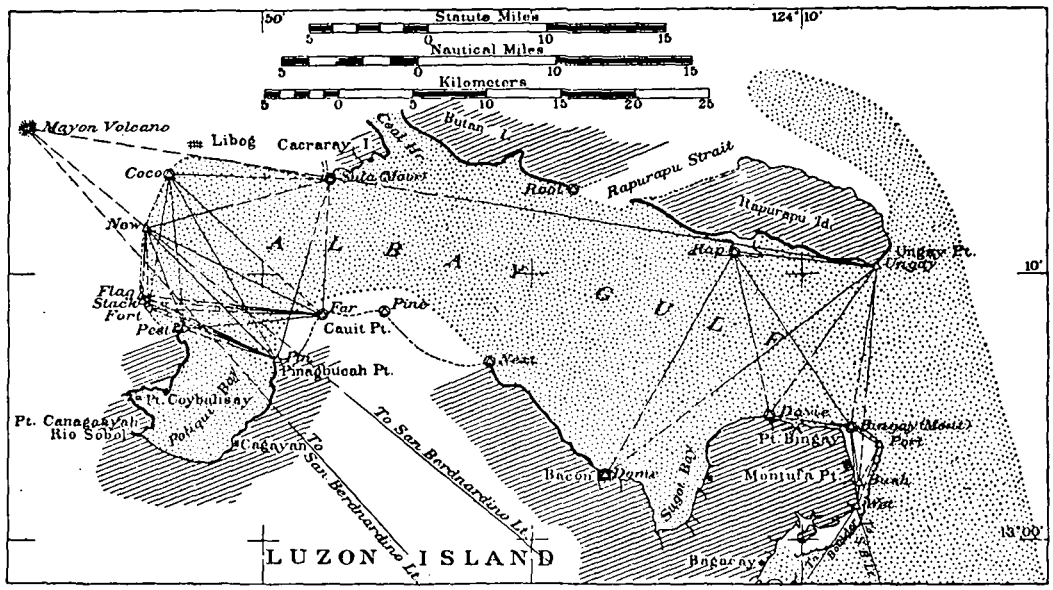


Hydrography, topography, and triangulation, Philippine Islands.

On July 1 the steamer *Pathfinder*, Assistant Gilbert commanding, was at work on the survey of San Bernardino Strait, and had gone to Masbate for coal and supplies. Coal was obtained, but it was necessary to go from there to Cebu for provisions. Unfortunately cholera had recently appeared at Cebu, and this caused delay in getting

supplies. The vessel returned to San Bernardino Strait on the 18th and resumed field work. The survey was completed on August 9 as far north as Bingay Point, at the entrance to Albay Gulf, and south to a junction with the Spanish surveys. After consulting with Assistant Derickson, commanding the *Research*, the survey of the southern shore of Albay Gulf was taken up by both vessels and completed on August 15. The *Pathfinder* then proceeded to Matnog, and a survey of that port was made. On August 21 the vessel proceeded to Cebu for coal and supplies. Cholera still prevailed and a strict quarantine was established on board the ship, which caused delay. The self-registering tide gauge at Cebu had become disabled, and it was dismounted and taken on board. Coal and provisions were on board by September 1, and the ship sailed that day, returning to Albay Gulf. On September 3 one of the whaleboats was wrecked in an attempt to land on the rocky shore of Rapurapu Island. The topography

No. 43.

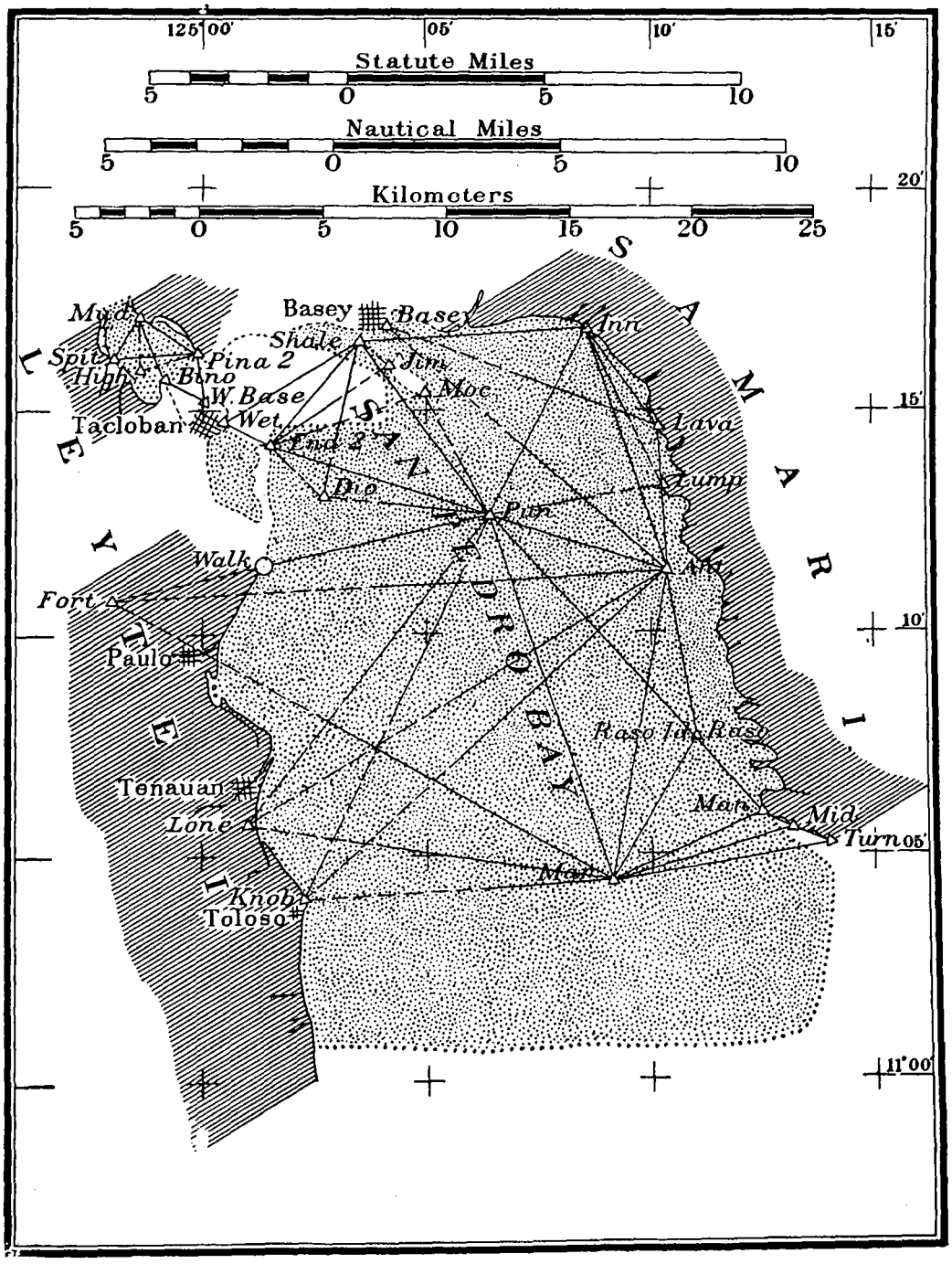


Hydrography, topography, and triangulation, Philippine Islands.

of Rapurapu Island, and on the south shores of Batan and Cacraray islands, and the inshore and offshore hydrography of Albay Gulf as far as Port Sulat was completed on September 16, and the survey of Poliqui Bay was completed on September 25. On the 26th the vessel proceeded to Manila and remained there until November 13, when she proceeded to Tacloban, Leyte Island. A self-registering tide gauge was established and two triangulation stations of the harbor survey were recovered and the line between them used as a base from which to extend the triangulation around San Pedro Bay. The survey of this bay was completed and a survey of a small area at the south entrance to San Juanico Strait was also made. Some hydrographic work was also done in Cancabato Bay.

On December 31 the triangulation under charge of Assistant Yates covered the work in San Bernardino Strait, a portion of Albay Gulf, San Pedro Bay, and a small

No. 44.

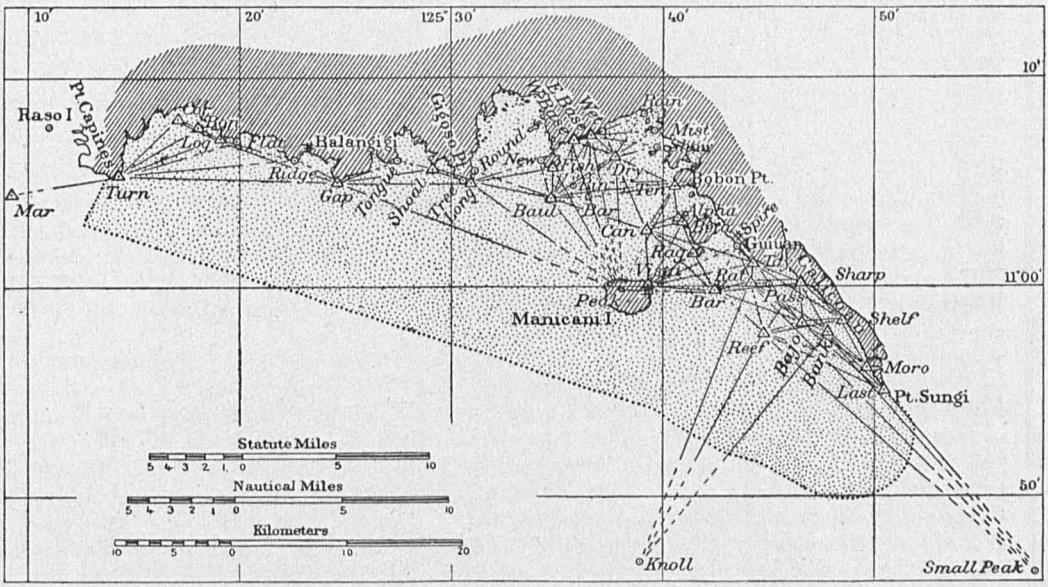


Hydrography, topography, and triangulation, Philippine Islands.

area at the entrance to San Juanico Strait. The topography covered all the coast of Luzon Island from Matnog Bay to a junction with the work previously completed in Albay Gulf; all of Poliqui Bay; the south coasts of Cacraray and Butan islands; all the shore of Rapurapu Island, except that portion along Rapurapu Pass; all of the shores of Samar and Leyte islands bordering on San Pedro Bay, and a few miles of the shore line at the entrance of San Juanico Strait.

After January 1 the survey was extended along the coast of Samar Island east of Point Capines. The hydrography with the launch had been under charge of Watch Officer Fitzgerald, but his health had become seriously impaired, and this work was assigned to Deck Officer Westdahl. Assistant Yates continued in charge of the triangulation and base measurement, and the commanding officer personally executed the topography and the hydrography with the ship. The topography was very difficult

No. 45.



Hydrography, topography, and triangulation, south coast of Samar, P. I.

work on account of the number of mangoe swamps encountered, and it was necessary to do a great deal of the work while standing in the water.

As a result of the numerous bays, bends, and small islands, the distance of 30 miles between Point Capines and Point Sungi includes 150 miles of shore line. The hydrography, on account of the numerous reefs, was nearly all done from the launches, and much of it was done in a rough sea. Observations for azimuth were made at Raton Island by Assistant Yates, who also made observations with the compass declinometer at several stations. A self-registering tide gauge was maintained at Tacloban from November 18 to March 9, and staff gauges were established at Binabasian and Raton islands, and the hydrographic work in the vicinity was based on the plane of reference deduced from observations at these places. The work proceeded without interruption, except on two occasions, when brief visits were made to Tacloban

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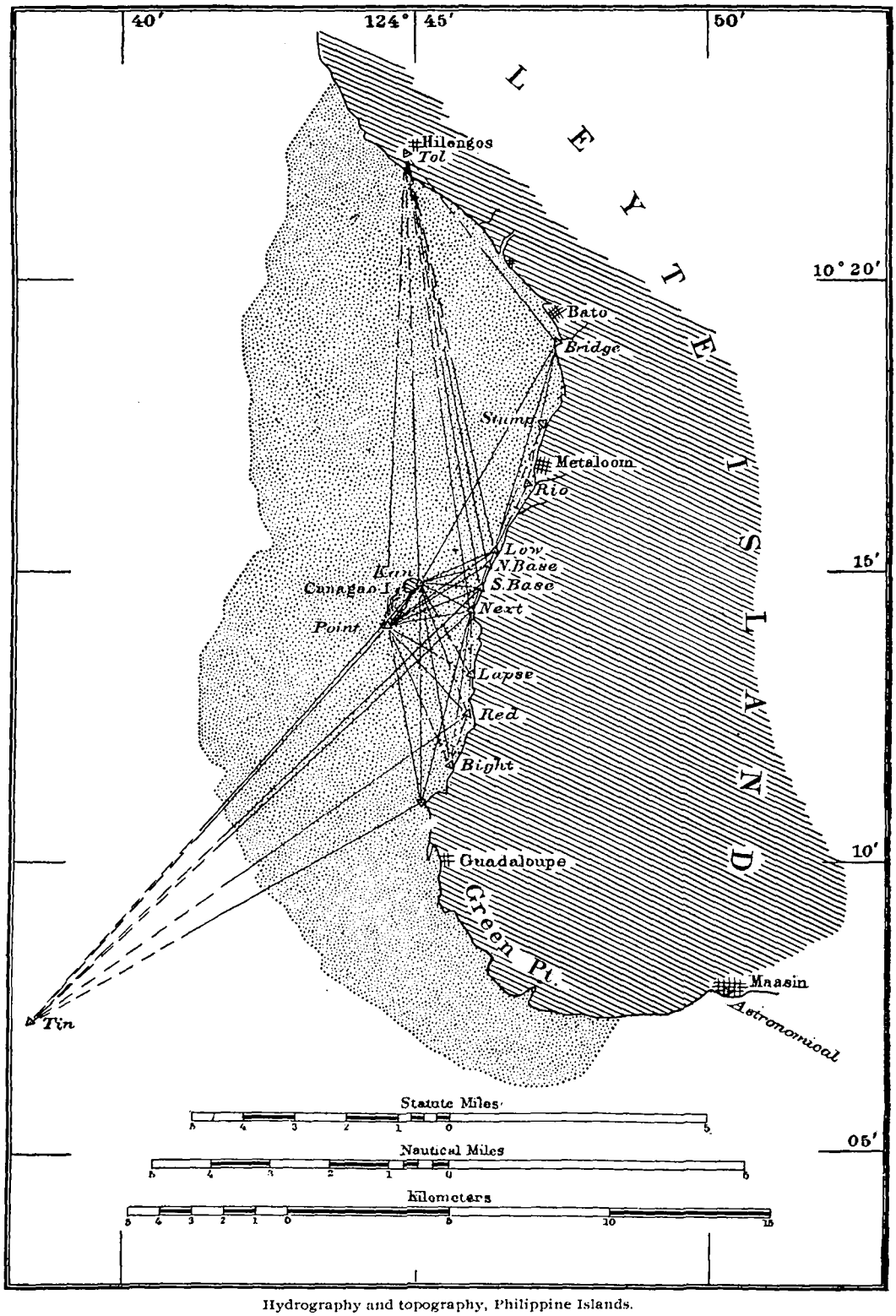

Hydrography and topography, Philippine Islands.

for coal and provisions. Heavy seas breaking against the cliffs prevented the survey of the outside coast of Calicoan Island. The work undertaken by the party was completed on March 7 and the vessel returned to Tacloban. The self-registering tide gauge was dismounted, and on the 9th the vessel proceeded to Cebu for coal and provisions, and while there established the self-registering tide gauge, and on the 13th proceeded to make a hydrographic examination of some reefs and shoals in Cebu Strait and a survey on the west coast of Leyte Island. The vessel was anchored close to Canagoa Island, a tide staff was established, and tide observations were made every day and during three nights. A base line was measured on Leyte Island, from which the triangulation was extended in both directions, and reached a point within 6 miles of Maasin. Observations for azimuth and magnetic observations were also made on Canagoa Island. The topographic survey was extended from Iilegos to the astronomic station at Maasin. The hydrographic work was extended from Iilegos to a point within 3 miles of Maasin. A careful search for Carmen Shoal failed to develop any indications of it in the position where it had been reported. Careful search was also made for a reef reported near Metalom, but it could not be found. The field work closed on March 28, and on that date the vessel started to Manila, via Ormoc, and reached that port on April 1.

The following is quoted from Assistant Gilbert's report:

I have only praise for all the officers associated with me during the past year.

Mr. Yates has attended to the triangulation, measured two base lines, occupied two azimuth stations, taken observations with the compass declinometer, and assisted in the hydrography. With some assistance he has made all field computations and inked and duplicated his records.

Mr. Baird, except when assisting in the base measurement and in the hydrographic work on a few occasions when it was done with the ship, has been constantly engaged in plotting the hydrographic sheets.

Mr. Fitzgerald, Watch Officer and Executive Officer, had the direction of the hydrographic work with the launches previous to January 1, when the condition of his health became alarming and he was excused from field work on the advice of the surgeon. He continued to attend to all other duties until the middle of April, when he was relieved from all duty, and left for the United States on April 25. Mr. Fitzgerald had been a most satisfactory officer and I was very sorry to part with him.

Mr. Daniels has proved to be an efficient and valuable officer. Since the first of the year he has been taking one angle and recording in the starboard launch, has generally had charge of the sounding machine when sounding with the ship, and has taken current observations when practicable.

Chief Engineer Goldsborough has kept everything in his department in excellent condition, with the result that we have required but few repairs.

Dr. Hawkes has been most commendably attentive to his duties. He has also responded most cheerfully to every call for other service, whether to take sextant angles or to assist in the office work. I believe him to be thoroughly competent, and that he studies and he keeps up to date in his profession.

Mr. Deichman, besides carefully and efficiently attending to his especial duties, has recorded and taken one angle in launch and ship hydrography a large portion of the time, and is very efficient in this work.

Mr. Westdahl has been in charge of the launch hydrography since the 1st of January and always assisted Mr. Fitzgerald before that time. Since Mr. Fitzgerald was relieved about the middle of April he has been acting executive officer of the *Pathfinder*, and has performed the duties of that important office in a most intelligent and satisfactory manner.

ASTRONOMIC OBSERVATIONS. PHILIPPINE ISLANDS. J. E. MCGRATH.
MAGNETIC OBSERVATIONS. H. C. MITCHELL.
J. S. HILL.

SUMMARY OF RESULTS.

Astronomic observations:
12 azimuths established
14 latitudes determined.
14 longitudes determined.
Magnetic observations:
8 stations occupied.

The determination of astronomic base positions was assigned to Assistant McGrath and Aids Mitchell and Hill. This work was in progress on July 1, with these officers in charge of cooperating parties. The longitude of the following places was determined during the fiscal year:

Batangas, *Luzon;* base station Romblon.
Boac, *Marinduque;* base station Romblon.
Cagayan, *Mindanao;* base station Dumaguete.
Calapan, *Mindoro;* base station Romblon.
Calbayoc, *Samar;* base station Masbate.
Carigara, *Leyte;* base station Masbate.
Catbalogan, *Samar;* base station Masbate.
Iligan, *Mindanao;* base station Dumaguete.
Loon, *Bohol;* base station Dumaguete.
Pasacao, *Luzon;* base station Legaspi.
Romblon, *Romblon;* base station Masbate.
Sorsogon, *Luzon;* base station Legaspi.
Surigao, *Mindanao;* base station Ormoc.
Tacloban, *Leyte;* base station Ormoc.
Vallehermosa, *Negros;* base station Dumaguete.

On July 1 Assistant McGrath was at Pasacao, *Luzon*, determining the longitude of this station. The place is situated at the mouth of a narrow gorge, which extends inland about north and south, and the southerly monsoon drew into this funnel-shaped opening with terrific force during July and August and unfavorable weather was almost continuous. The observations to determine the longitude were completed on August 3, and after waiting until September 1 without being able to make any observations to determine the latitude the station was abandoned, and the observer sailed for Masbate September 2 on the quartermaster's launch *Bangor*, through the courtesy of Maj. Arthur Williams, Twenty-sixth Infantry, U. S. Army. He arrived at Masbate on September 3 and remained there until October 18. During this period observations for personal equation between Messrs. McGrath and Hill were made and signals were exchanged with Calbayoc and Carigara. After serious delay, on account of unfavorable weather, the necessary exchanges of signals with the two stations named were completed on October 14 and the observer proceeded to Manila on October 18. Assistant McGrath arrived at Dumaguete on November 12 and was tendered the hospitality of the army officers' quarters and mess. His report expressed his appreciation of the kindness extended to him by Captain Paine, U. S. Army, and the officers under his command, and Reverend Mr. Hibbard, his wife, and Doctor Langheim, officials of Silliman's Institute, a local educational insti-

tution. The work was delayed by unfavorable weather and by a break in the cable, and the exchanges of longitude signals with Iligan were not completed until December 5. After more delay on account of unsatisfactory conditions on the cable lines the necessary exchanges of time signals with Cagayan and Vallehermosa were made on December 30. The weather in January was very unfavorable, and the exchanges of time signals with Loon were not completed until January 29. On February 28 Assistant McGrath reached Romblon and determined the latitude and longitude, established an azimuth, and made magnetic observations. He remained at Romblon until May 21, and during this period the necessary time signals were exchanged with Calapan, Batangas, and Boac. On June 16 he reached Ormoc and remained there until the close of the fiscal year. The necessary exchanges of time signals were completed on June 27.

From July 1 to August 12, Aid Mitchell was at Legaspi, Luzon, occupying this base station and exchanging time signals with the observers at Pasacao and Sorsogon. He then occupied the following stations and exchanged the necessary time signals with other observers between the dates specified and with the base stations named in the list of stations determined:

Catbalogan, August 13 to September 18.
Calbayoc, September 18 to October 19.
Tacloban, October 21 to November 2. (Reoccupied to close a loop.)
Iligan, November 6 to December 9.
Vallehermosa, December 20 to January 14.

An azimuth was established at Catbalogan and Calbayoc and latitude and magnetic observations were made at Catbalogan, Calbayoc, Iligan, and Vallehermosa. Aid Mitchell closed field work in the Philippine Islands on January 14.

Aid Hill reached Sorsogon on July 11, and after that date occupied the following stations and made the necessary exchanges of time signals, between the dates stated, with the base stations named in the list of longitudes determined:

Sorsogon, July 11 to August 3.
Masbate (base station), August 15 to September 2.
Carigara, September 24 to October 27. (Used as a base station October 14 to 27).
Cagayan, December 15 to January 3.
Loon, January 10 to February 3.
Masbate (base station), March 2 to March 23.
Calapan, March 25 to April 7.
Batangas, April 9 to April 24.
Boac, May 9 to May 18.
Surigao, June 13 to June 29.

Latitude and azimuth observations were also made at Sorsogon, Carigara, Cagayan, Loon, Calapan, Batangas, Boac, and Surigao. Magnetic observations were made at Calapan, Batangas, Boac, and Surigao. Observations to determine the personal equation between Messrs. Hill and Mitchell were made at Iligan, November 7 to 17. The unfavorable weather conditions and the absence of direct and rapid transportation between the stations caused serious delay at all the stations.

ASTRONOMIC OBSERVATIONS. PHILIPPINE ISLANDS. C. E. MORFORD.
BASE MEASUREMENT.
HYDROGRAPHY.
MAGNETIC OBSERVATIONS.
TOPOGRAPHY.
TRIANGULATION.

SUMMARY OF RESULTS.

Astronomic observations:
1 azimuth established.
1 latitude determined.
1 longitude (chronometric) determined.
Base measurement:
2 base lines measured.
Hydrography:
1 square mile area covered.
12 miles lines sounded.
514 soundings made.
1 tide station established.
1 hydrographic sheet completed.
Magnetic observations:
3 stations occupied.
Topography:
15 square miles area covered.
31 miles coast line surveyed.
4 miles shore line of creeks surveyed.
8 miles of roads surveyed.
1 topographic sheet completed.
Triangulation:
40 square miles area covered.
38 stations occupied.

The survey of Port Gubat, *Luzon*, was in progress on July 1, under charge of Aid Morford. The work was almost completed during the previous fiscal year, and it only remained to run a few miles of sounding lines and to reoccupy four triangulation stations to connect the work with the San Bernardino Lighthouse, a station in the triangulation of San Bernardino Strait. Unfavorable weather prevented observations to establish an azimuth.

On July 14 the party proceeded to Sorsogon to make a survey at that place. It was difficult to secure laborers and boats, and the weather was so unfavorable that very little progress was made in July. Considerable progress was made in August, and the work was continued until August 30, on which date Mr. John Bach, recorder, who had been assisting in the work, was placed in immediate charge of the party, and Mr. Morford proceeded to Manila. Mr. Malcolm Elliott also assisted in the work as recorder. On November 8, Mr. Morford, assisted by Mr. W. E. Gordon, Recorder, resumed field work in Danao River, *Negros*, and made a survey which included observations for azimuth, latitude and longitude (chronometric), magnetic observations, triangulation, and topography. Unfortunately, Mr. W. E. Gordon, Recorder, died, as the result of an attack of cholera, on November 11, 1902, three days after the work began. It was impracticable to do any hydrographic work, as the necessary assistance could not be obtained. Field work closed at Danao on December 9, and Mr. Morford returned to Manila.

MAGNETIC OBSERVATIONS. PORTO RICO. L. A. BAUER.

R. F. SOPER, *Magnetic Observer.* Dec. 19 to June 30.

The duty of inaugurating magnetic observations at sea on board the vessels of the Coast and Geodetic Survey was assigned to Assistant L. A. Bauer. He made the necessary preparations for this work and to establish a magnetic observatory in Porto Rico, and on January 19 reported on board the steamer *Blake*, Assistant Faris, commanding, with his assistant, R. F. Soper, and the necessary outfit for the work. Assistant Faris was instructed to transport the party and outfit en route to Porto Rico, and to afford Assistant Bauer all necessary assistance in carrying out the work assigned to him. The *Blake* sailed from Baltimore on January 21, and arrived at San Juan, P. R., on the 27th, and at Fajardo Roads on the 30th. The vessel was swung three times, in order to obtain the necessary deviation corrections due to the ship's magnetism, in Chesapeake Bay on January 21, at sea on January 24, and in Fajardo Roads on January 30. While the *Blake* was at anchor in Fajardo Harbor, the necessary magnetic observations on land were made on Obispo Cayo on January 31, and on February 1 the magnetic declination was determined on the main island at Cueva, on the west side of the harbor. The vessel proceeded to Port Mulas, Vieques Island, on February 1, and landed the party and outfit for the magnetic observatory at Isabel Segunda.

Hon. W. H. Hunt, governor of Porto Rico, courteously assigned to the Survey the quarters necessary for the establishment of the magnetic observatory on the ground floor of Fort Isabel, on Vieques Island. The work was facilitated by the commander of the insular police, the mayor of the town, and by the corporal in charge of the fort, and by others who were able to render assistance. During the period February 2–18, the quarters were adapted for observatory purposes, the instruments were installed, the necessary adjustments were made, the instruments were compared, and the constants were determined. Under the direction of Assistant Bauer, the observatory was placed in charge of Mr. R. F. Soper on February 19, and from that date to June 30 a continuous record was obtained with the self-registering instruments. Observations for absolute values were made once a week, and the regular international term day observations were made on the 1st and 15th of each month. Special observations were also made in cooperation with the expeditions sent out by foreign governments to the polar regions. Assistant Bauer left Vieques Island on February 19 and made magnetic observations at Aibonita, Caguas, and Mayaguez for the purpose of investigating the conditions on the main island with the view of determining the final site for the magnetic observatory. On February 25 he left San Juan and proceeded to do some special work outside the United States.

HYDROGRAPHY. PORTO RICO. R. L. FARIS, Commanding,
MAGNETIC OBSERVATIONS. Steamer *Blake*.

L. M. FURMAN, *First Watch Officer.*
L. M. HOPKINS, *Chief Engineer.*
THOMAS L. JENKINS, *Second Watch Officer.*
R. A. WARNER, *Assistant Surgeon.*
W. F. GLOVER, *Third Watch Officer.*
GEORGE OLSEN, *Fourth Watch Officer.*
F. B. LOREN, *Aid.*
W. T. CARPENTER, *Aid.*

SUMMARY OF RESULTS.

Hydrography:
148 square miles area covered.
2 294 miles lines sounded.
2 tide stations established.
6 hydrographic sheets completed.
Magnetic observations:
5 stations occupied.

The continuation of hydrographic surveys and examinations in Vieques Sound, Porto Rico, was assigned to Assistant Faris. After making necessary repairs and preparations at Baltimore, he sailed for San Juan, P. R., on January 21, in command of the steamer *Blake*.

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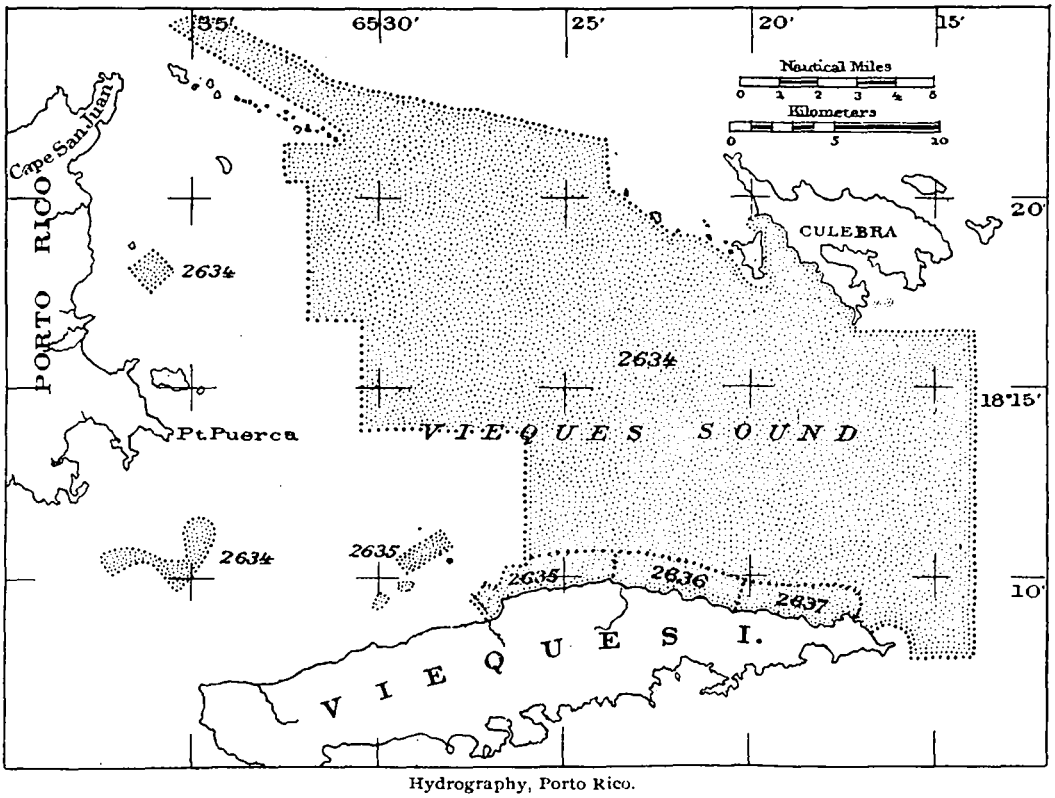

Hydrography, Porto Rico.

Assistant L. A. Bauer, Inspector of Magnetic Work, and R. F. Soper, a member of his party, were taken on board with instruments and outfit for making magnetic observations at sea en route, and for establishing a temporary magnetic observatory in Porto Rico. An account of the magnetic work executed on board the ship under the direction of Assistant Bauer is given under his name, and it is sufficient in this place to say that all necessary assistance was rendered to Assistant Bauer by Assistant Faris and the officers under his command.

The *Blake* reached San Juan on January 27, and sailed for Fajardo Roads on the 30th, to complete the magnetic observations by swinging ship at that place. Assistant Bauer's party and outfit were landed at Port Mulas on February 2. On the same day hydrographic signals were erected and a self-registering tide gauge was established at Port Mulas.

A continuous tide record was obtained at this station from February 3 to May 25. Simultaneous staff readings of the tide were made at this station and at Target Bay on several days during the season, but no material change was noted in the time and range of the tide at the two stations.

Unfavorable weather retarded the progress of the work during the earlier part of the season, when the weather was frequently too rough to permit sounding. The shoals in Port Mulas Harbor were resurveyed and the 18-foot spot immediately to the southward of Corona Reef was examined. The area covered by the season's work included all the unsurveyed portion of Vieques Sound to Grampus Shoal, Barilles, and Harmanos Passage on the east, and to the north to a line along the reefs and islands forming the north side of the sound. A number of special surveys of verification were made in the vicinity of Target Bay at the entrance to Great Harbor; on Blake and Hodgkins shoals; at Point Arenas bell buoy; at Mosquito Reef, and at Port Mulas. Especial care was taken in the examination of Blake and Hodgkins shoals. In this work two leads were used as usual and the channel sweep was also used. The sounding lines were run very close together with ~~the ship of~~ the lowest speed which the necessity of controlling the ship permitted. The passage between Culebra Island and Southwest Cay was also carefully examined with the channel sweep.

Magnetic observations were made in several places about Vieques Sound during the season and the three magnetic elements were determined at each station occupied. On May 24 magnetic observations were made at a shore station and on the ship on the 25th for compass errors. The hydrographic work closed on May 25, and the ship sailed from San Juan for Old Point Comfort, Va., on the 30th, and arrived at that place on June 5. On the trip from San Juan to Norfolk complete sets of magnetic observations were made every day, and the ship was swung at sea about midway between San Juan, P. R., and Cape Henry, Virginia. The result of the work was the determination of the magnetic declination in nineteen different places between the points named above. The compass observations were made by Watch Officers Furman and Jenkins, who performed the work with much care and interest.

In his report, Assistant Faris expresses his hearty appreciation of the manner in which the officers under his command cooperated with him in executing the work assigned to the party, and makes special mention of the kindness and courtesy extended to him by Capt. Andrew Dunlap, U. S. Navy, commandant of the San Juan naval station.

HYDROGRAPHY. PORTO RICO. W. E. PARKER.

SUMMARY OF RESULTS.

Hydrography:
40 square miles area covered.
657 miles lines sounded.
22 687 soundings made.
1 tide station established.
1 hydrographic sheet completed.

The extension of the hydrographic work on the south coast of Porto Rico was assigned to Aid W. E. Parker, and Aid C. M. Sparrow was detailed to assist him in the work. They proceeded to Porto Rico, and reached Ponce on January 11. Various preparations were completed and the working ground was inspected. On January 27 five members of the party arrived at Mayaguez on the steamer *Bache*, and Mr. Parker went there immediately, leaving Mr. Sparrow to bring the outfit from Ponce to Parguera. The steam launch *Rudy* was taken from storage and put in order, and the party started in the launch to Parguera on February 2, reaching there next day after being delayed all night at Cape Roja by rough weather. Mr. Sparrow joined the party at Parguera with the outfit brought from Ponce, and a camp was established. Old triangulation stations were recovered, and from these additional hydrographic stations were determined when necessary. A tide staff was established and observations began at once.

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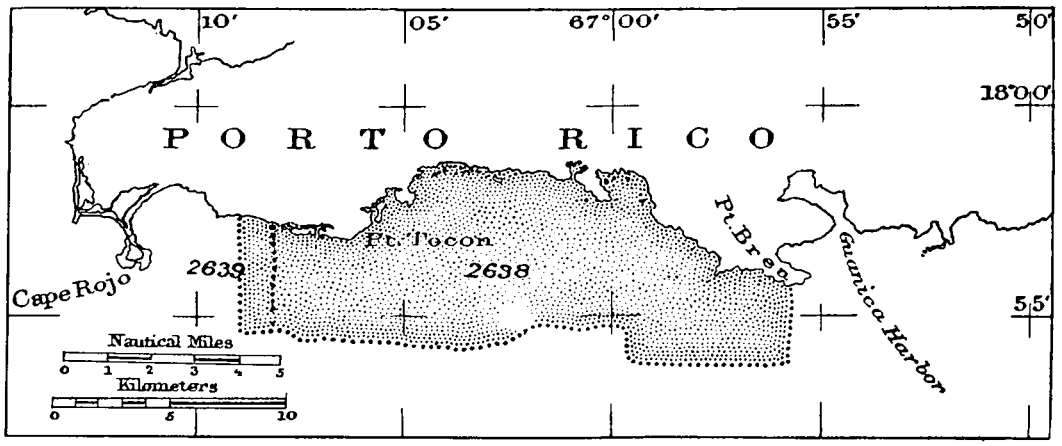

Hydrography, south coast of Porto Rico.

Soundings were made February 12 to March 6, except during one week, when the engineer was disabled as the result of accidental injury received in line of duty. On March 6 the boiler gave out and was repaired, but after two days' use it failed again, on the 12th, and an examination showed that a large portion of the tubes had burned out. New tubes were received from New York on April 16, but proper tools were lacking, and the launch was not ready for use until April 25. From that date until May 23, when the field work closed, the launch was in use continuously and did

good service. While the launch was laid up the party used a whaleboat, manned by native oarsmen, and during this period the work progressed very slowly on account of the strong trade winds which prevailed. The hydrography from the limit of the work previously completed by Assistant Flower off the entrance to Guanica Harbor to the western end of Margarita Reef was well developed out to the 10-fathom curve, except over a 5-fathom patch 4 miles south of the town of Parguera, over which lines of soundings were run 200 meters apart in one direction, but no cross lines were run, because comparatively calm weather was needed for such work in a small boat, and there was not enough of such weather available. North and south lines were run from Margarita Reef 1 mile to the westward, but these lines had no lines run across them. In closing his report Aid Parker expresses his appreciation of the faithful service rendered by all the members of the party, and calls attention to the intelligence and zeal displayed by C. M. Sparrow, Aid.

HYDROGRAPHY. PORTO RICO. P. A. WELKER, Commanding, Steamer *Bache*.

E. B. LATHAM, *Assistant*.
W. M. ATKINSON, *First Watch Officer*.
G. E. MARCHAND, *Surgeon*.
M. F. FLANNERY, *Chief Engineer*.
H. S. SMITH, *Second Watch Officer*.
WILLIAM SANGER, *Captain's Clerk*.
E. C. SASNETT, *Aid*.
G. A. BERRY, *Deck Officer*.

SUMMARY OF RESULTS.

Hydrography:
145 square miles area covered.
895 miles sounded.
18 924 soundings made.
3 hydrographic sheets completed.

Hydrographic work on the west coast of Porto Rico was assigned to Assistant Welker, commanding the steamer *Bache*, and he sailed from New York on January 13. He reached San Juan on January 20, took on coal and supplies, and proceeded to Mayaguez on January 26. The field work began immediately, and hydrographic signals were erected and the positions determined whenever necessary. Work was continued until March 20, on which date the hydrography was completed. It reaches from Mayaguez Harbor to Point Jiguero and extends about 10 nautical miles offshore. Tourmaline Reef was developed, and also the region about a spot marked as possibly dangerous to the northwestward of the reef. The region was thoroughly sounded and dragged and no dangerous rock was found, but there is an extensive bank at this point which rises out of deep water to a depth of 13 fathoms, the least depth developed. There were no indications of shoals in the immediate vicinity of the spots marked "Guadeloupe Bank" and "Peregrina Reef," though shoals were found within 1 or 2 miles of these places. Special examinations were also made whenever required. The sounding lines were run at varying distances apart, in accordance with any necessity

indicated by the soundings. These distances varied from 25 meters for close work to 1 600 meters in deep water (100 to 400 fathoms). The shoals in this region rise very abruptly, and great care should be exercised in navigating these waters. It is not unusual to have the depth change suddenly from 100 to 5 fathoms.

During the season the weather was almost continuously fair, but on account of the strong trade winds which prevailed there were very few days available for close develop-

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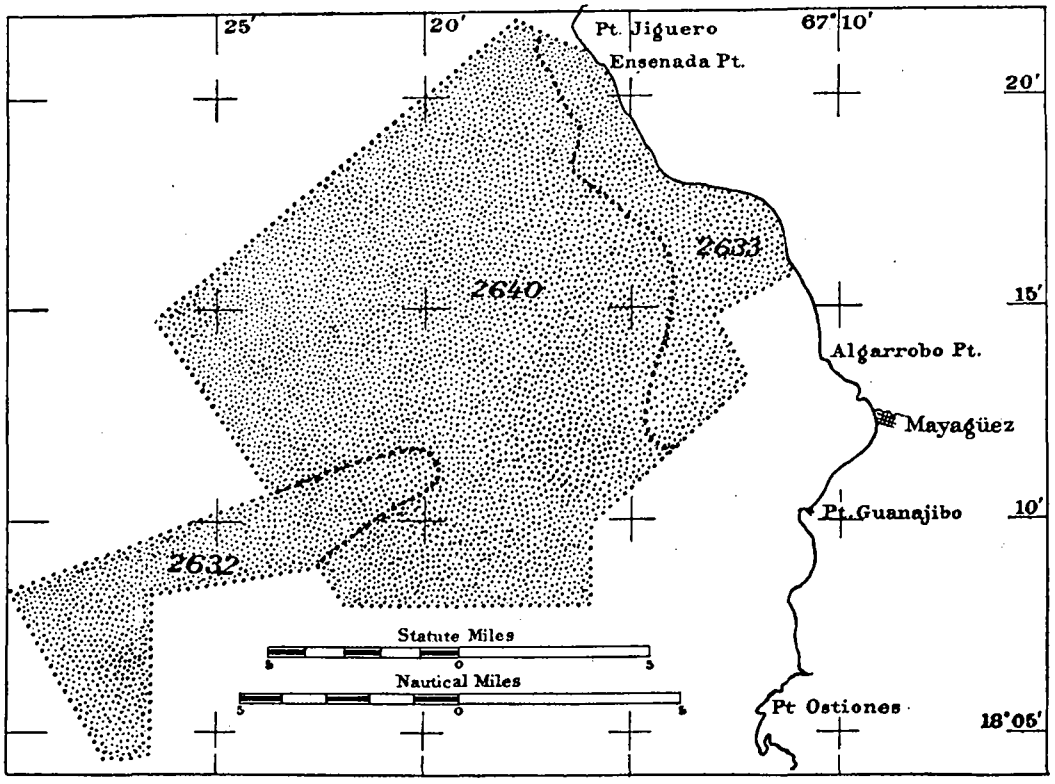

Hydrography, west coast of Porto Rico.

ment of shoals, which required work with the launch and great accuracy. The steamer was engaged nearly every day and the two launches were used whenever the weather permitted. The field work closed on March 20, and on the 23d the steamer proceeded to San Juan. Assistant Welker in his report expresses his appreciation of the faithful and intelligent manner in which the officers and men under his command performed their duties, and states that much of the success of the season's work was due to their efforts.

SPECIAL DUTY.

MAGNETIC OBSERVATIONS. L. A. BAUER.

Advantage was taken by Assistant Bauer of his presence on duty in Porto Rico to return by way of San Domingo and Cuba, to secure magnetic observations in those countries. He determined the elements of terrestrial magnetism in *San Domingo* at San Pedro de Macoris and at San Domingo City, and in *Cuba* at Baracoa, Gibara, Habana (two stations), and Santiago de Cuba. His report expresses his appreciation of the courtesy extended to him by Father Gangoiti, who did all in his power to facilitate the work.

SURVEY OF LOUISIANA OYSTER BEDS. J. B. BAYLOR.

In response to a request for the survey of the natural oyster beds and reefs in the State of Louisiana, made by the United States Commissioner of Fish and Fisheries, Assistant Baylor was assigned to execute the necessary work in the field in cooperation with the Louisiana Oyster Commission, recently created by the State legislature. All available material bearing on the work was collected at the Office, and on February 15 Assistant Baylor proceeded to New Orleans for consultation with the State Commission. He made an examination of the region to be surveyed and returned to Washington on March 2. On March 24 he went to Louisiana to begin the field work of the survey. A small vessel and steam launch was provided by the Commission, and the necessary men and outfit were provided by the Coast and Geodetic Survey. Extensive changes have been made along the coast of Louisiana by wind and water since the former survey, and most of the old triangulation points have been washed away. It was necessary to use the line between Ship Island Lighthouse and Biloxi Island Lighthouse as a base from which to extend the triangulation required in the work in hand. The new positions of Cat Island Lighthouse, Murrell Shell Bank Lighthouse, Lake Borgne Lighthouse, and St. Joseph beacon were determined, changes in the position of these lights having been made when they were rebuilt. Eight new triangulation stations were established and securely marked along the shores of Mississippi Sound and in the Louisiana marshes. The positions of these points were determined and the work progressed until June 12, when it was suspended for the summer.

SURVEY IN GROUNDS OF AGRICULTURAL DEPARTMENT. O. W. FERGUSON.

In accordance with the request of the Supervising Architect of the Treasury, a survey was made of the southern portion of the grounds of the Agricultural Department upon which the new departmental building will be erected. This work was

placed in charge of Assistant Ferguson, who began the field work on March 21 and completed it by the end of the month.

The survey covers the portion lying between Twelfth and Fourteenth streets and between B street and a line 500 feet to the north. This space was divided into squares by a system of lines 50 feet apart, and the various buildings, etc., within the area were located from fixed points on these lines. The elevation of a number of points within the area was determined with a spirit level. After completing the field work a report and a topographic sketch were prepared and forwarded to the Supervising Architect.

RESURVEY OF MASON AND DIXON'S LINE. W. C. HODGKINS.

The resurvey of Mason and Dixon's Line, the boundary line between the States of Maryland and Pennsylvania, was in progress on July 1 under the direction of Assistant Hodgkins who had been detailed for this duty in response to a request from the joint commission established by the States named for an officer of the Survey to direct the work which is done at the expense of the States.

The work during July and August included the survey of the boundary strip from the summit of North Mountain to Sideling Hill Creek, a distance of about nineteen miles, and the monuments were set as far west as the summit of Ragged Mountain. The plan of placing monuments of cut stone at regular intervals of 1 mile was abandoned by Mason and Dixon at the eastern foot of Sideling Hill, 132 miles west of the northeastern corner of Maryland, on account of the impossibility of taking wagons across the mountains without building roads. A considerable number of stone monuments which had been transported to the locality, now Washington County, Md., were also abandoned. These stones were utilized by many of the farmers as door steps and window sills, and some of them were broken in pieces for other purposes. A number of them, still in fair condition, were secured and used as originally intended. Mounds of earth or stone, placed at irregular intervals and generally upon the summits of the high transverse ridges, were the only marks used on the line from the summit of Sideling Hill westward to the end. Whenever the evidence established the authentic character of a mound a monument was placed at its center and the mound was restored. As these mounds were placed at intervals of 2 to 5 miles, it was necessary to establish additional monuments between them, and these new monuments were located with reference to the adjacent mounds on each side, on a line between them, with the curvature prescribed by Mason and Dixon. The new monuments were placed at the most suitable points without any attempt to make the intervals between them exactly equal, though these intervals were made as nearly equal to 1 mile as the topography and other conditions permitted. In November and December the work was greatly delayed by unfavorable weather conditions and all work was suspended from December 20 to 31. On January 1 the party resumed work at Hagerstown, Md., and preparations were made to complete the work from the Blue Ridge to North Mountain, across the Cumberland Valley. The weather was unusually severe during January and February and considerable delay resulted. The work progressed as rapidly as the weather conditions permitted until February 18, when Assistant Hodgkins was ordered to other special duty and the work was again suspended until early in March, when it was resumed by Messrs. R. H. Blain, transitman, and E. R. Martin, foreman, working under instruc-

tions from Assistant Hodgkins in his absence. Both of these men had previously assisted in the work and had shown considerable interest in performing the duties assigned to them. The work was continued until the end of May, when operations were suspended until the end of June. Assistant Hodgkins was absent on duty connected with marking the Virginia and Tennessee boundary July 13 to August 31, and after February 18 on special duty, except for a short time, April 27 to May 4. During his absence he directed the work by correspondence.

MARKING THE VIRGINIA AND TENNESSEE BOUNDARY.

W. C. HODGKINS.
J. B. BAYLOR.

The work of remarking the Virginia and Tennessee boundary, under an order of the United States Supreme Court, was in active progress at the close of the previous fiscal year, as stated in the Report for that year. Assistants Hodgkins and Baylor continued the work as members of the Commission created by the court for that purpose and good progress was made until September 16, when the field work of the Commission was completed.

The work proceeded from Clinch River westward to Cumberland Mountain, on the sharp summit of which the monument marking the extreme western end of the line was placed in position in the latter part of August, and on Monday, August 25, the working party was disbanded and Assistant Hodgkins started to Washington. Assistant Baylor remained in the field until September 16, engaged in placing monuments on the line and in inspecting monuments already in position. Cut-stone monuments weighing over 500 pounds and lettered "T V" were placed on the line on all public roads and at many other important points along the entire length of the line. Ninety-nine of these monuments were used in addition to the distinctive marks cut on numerous trees adjacent to the line throughout its length. The boundary line was referred to the following triangulation stations, previously established by the Coast and Geodetic Survey: "Damacus," on Holston Mountain; "Dunn," vicinity of Bristol; "Cloud," on Holston River; "Wildcat," on Clinch Mountain; "Powell," on Powell Mountain, and "Minter."

It is interesting to note that the Commission was able to find trees marked a century before, which enabled them to reestablish the line beyond question. In many instances the marks were found imbedded several inches inside the body of the tree, with only faint indications of the original marks on the outside bark. The date when the marks were made was verified by the Bureau of Forestry, Department of Agriculture, and the marks were of the greatest importance in fixing the position of the "Diamond" line as originally traced upon the ground.

After conclusion of the field work the necessary records and maps were prepared and the final report of the Commission was filed in the Supreme Court on January 5, 1903. This report was confirmed by the court on June 1, 1903.

Assistant Hodgkins was absent from the party in the field July 1 to 12, and August 25 to September 16 engaged upon other duty.

CAPE COD SPEED TRIAL COURSE. H. L. MARINDIN.

The work of verifying the length of the trial course off Cape Cod, Massachusetts, was in progress at the close of the previous fiscal year under the direction of Assistant Marindin. The necessary range marks had been placed in position by the civil engineers of the Fore River Ship and Engine Company, and it was found to be impracticable to make a direct measurement of the distances between the range lines. A base line was selected and measured, and the length of the trial course was determined by triangulation from this base line. The marks at both ends of the course were shifted to new positions for the purpose of increasing the facility and accuracy of their use. This

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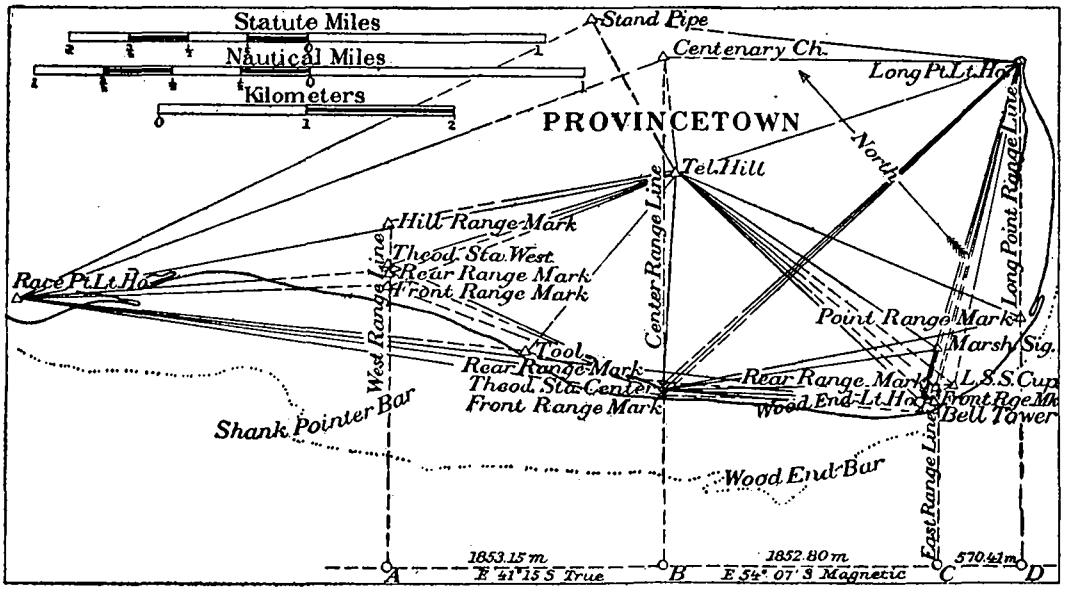


Cape Cod Speed Trial Course, Massachusetts.

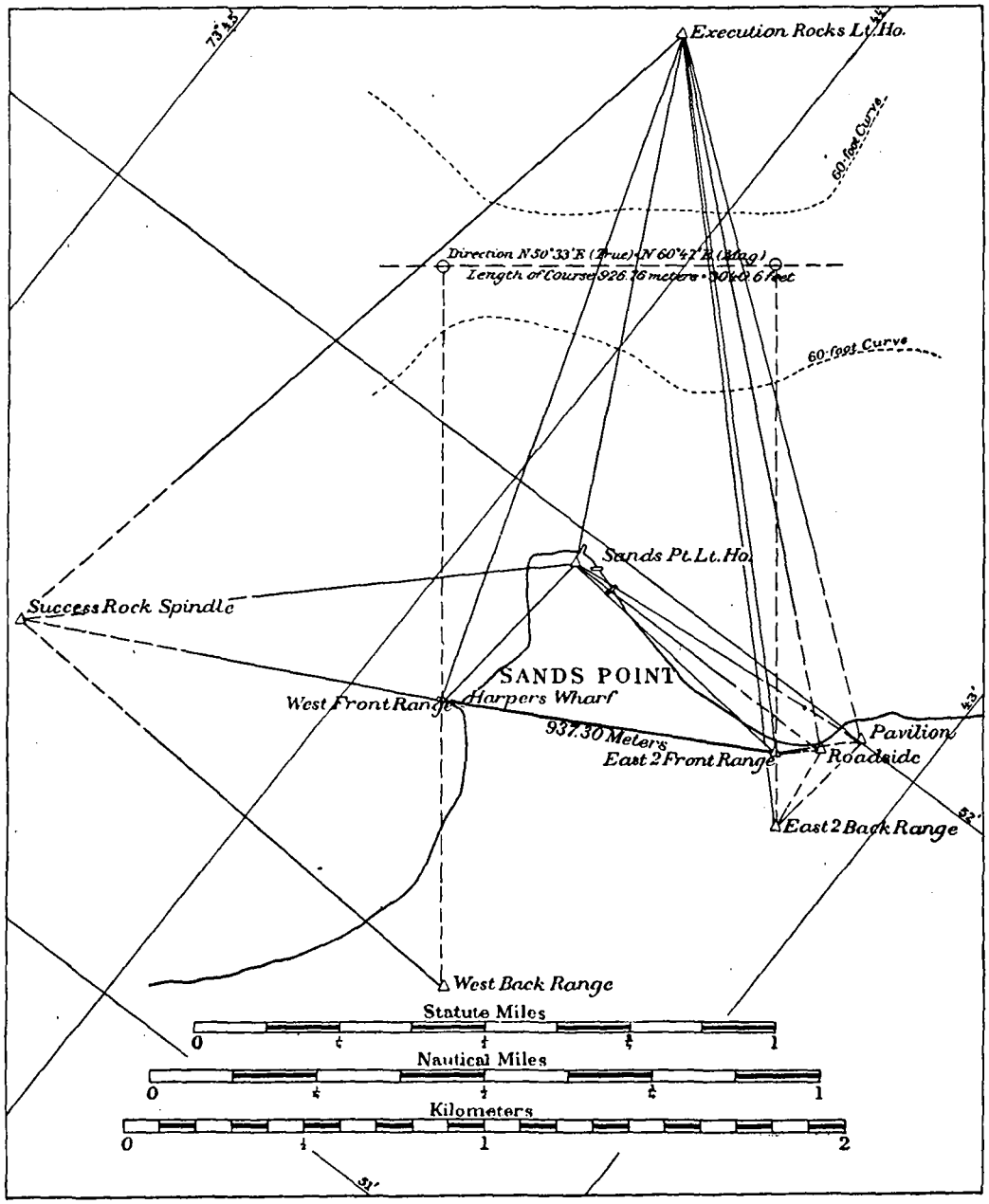
work improved the conditions at both ends of the trial course, but materially increased the time estimated for the verification and the work was not completed until August 6.

Mr. Gershom Bradford, 2d, and G. S. Peterson, quartermaster from the steamer *Blake*, served in the party, and Assistant Marindin expresses his appreciation of their service.

In the latter part of September Assistant Marindin again visited the trial course, this time at the request of the Navy Department, in company with Capt. C. J. Train, U. S. Navy, President of the Board of Inspection and Survey, to make certain changes desired by the Department. This duty was performed, and he returned to the Office on October 3.

SANDS POINT SPEED TRIAL COURSE. H. L. MARINDIN.

No. 51



Sands Point Speed Trial Course.

At the request of the Crescent Ship Yard Company, of Quincy, Mass., Assistant Marindin was directed to establish a speed trial course in deep water in Long Island Sound. A location was selected in the vicinity of Sands Point, Long Island, New

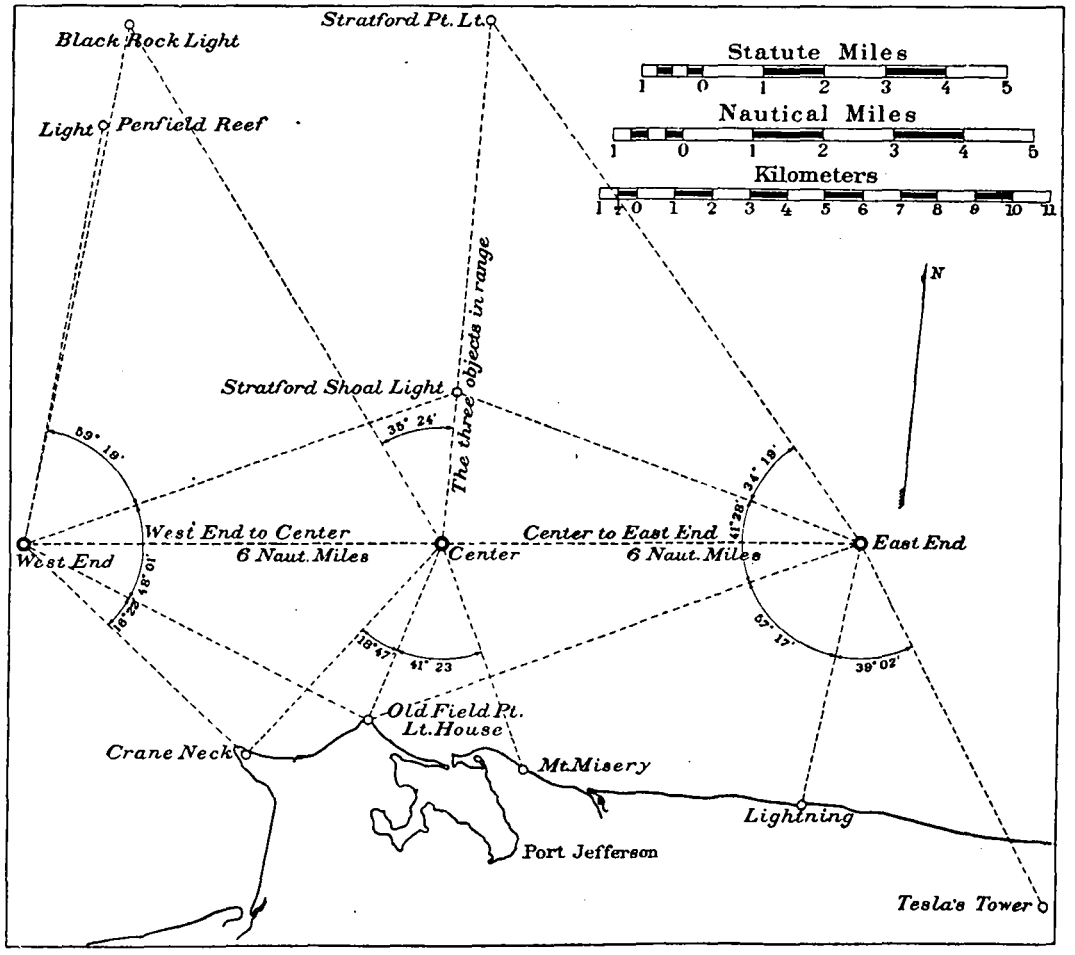
York, and on October 15 he proceeded to the vicinity and inspected the location in company with the president of the corporation, returning to the Office on October 18.

The trial course was then established and marked as requested, between October 20 and November 4, and Assistant Marindin returned to the Office on the latter date.

He reports the able assistance rendered him by Quartermaster S. L. Jensen, of the steamer *Blake*, who was temporarily assigned to his party.

PORT JEFFERSON SPEED TRIAL COURSE. H. L. MARINDIN.

No. 52.



Port Jefferson Speed Trial Course, New York.

In response to a request from the Navy Department for the establishment of a deep-water speed trial course in Long Island Sound, in the vicinity of Bridgeport, Conn., Assistant Marindin was detailed to execute the necessary work in the field, under the direction of the Board of Inspection and Survey.

After making the necessary preparations and consulting with Capt. C. J. Train, U. S. Navy, President of the Board, he left Washington on February 23 and proceeded

to Bridgeport, where he boarded a navy tugboat, and after some delay, caused by thick weather, made an examination of the waters between Stratford Shoal (Middle Ground) and the northern shore of Long Island Sound. It was evident that the position of buoys placed on the course could be determined in clear weather by using the triangulation stations along the northern shore of Long Island, but from an examination of the shore in this vicinity it was also evident that the unfavorable topographic features made it impracticable to establish range lines on that shore. It was necessary to have a number of signals determined on high points from which the trial course could be located, and the Tesla tower, erected for use in wireless telegraph experiments, was used as one of these. It is the most prominent object to be seen from the Sound in this locality. Field Point Lighthouse was also used and four other points were selected. These stations furnished the basis from which the position of the buoys on the trial course were determined by sextant angles measured at the buoys.

Three buoys, one at each end and one in the center of the course, were established and their positions determined. On account of unfavorable weather conditions and the desire to use the trial course without delay, it was necessary to determine the position of the buoys, marking the center and the east end by observations at night on the lights in this vicinity. The work was completed on March 18.

MEMBER OF MISSISSIPPI RIVER COMMISSION. H. L. MARINDIN.

Assistant Marindin continued his service as a member of the Commission and performed such duties during the year as were necessary.

On November 6 he left Washington and proceeded to St. Louis, where he attended a meeting of the Commission, which was followed by a low water inspection trip down the river to New Orleans. He returned to the Office on November 19. March 21 to April 3 he was absent attending a meeting of the Commission at St. Louis and on a tour of inspection of the improvements on the river between Cairo, Ill., and the Head of the Passes. A considerable amount of time during the year was devoted to work incident to membership in the Commission whenever other assignments to duty permitted.

POTRERO POINT SPEED TRIAL COURSE. FREMONT MORSE.

The work of establishing a speed trial course off Potrero Point, San Francisco Bay, California, was assigned to Assistant Morse. This trial course was established to comply with a request from the Holland Torpedo Boat Company to the Secretary of the Navy, and referred by him to the Secretary of the Treasury.

This course is located off the shore of the bay opposite the southern section of San Francisco, and extends from a point about half a mile off Potrero Point southeasterly to a point about the same distance off Hunters Point. It is 2 miles long, and the quarter and half mile points of the first mile from the northern end were indicated by marks. Three stations of the bay triangulation were recovered and the lines between them were used as bases from which to determine the points on the trial course. The ranges were marked by rows of piles driven in the shallow water of the bay out to the 3-fathom course, as requested by the resident superintendent of the Holland Torpedo Boat Company.

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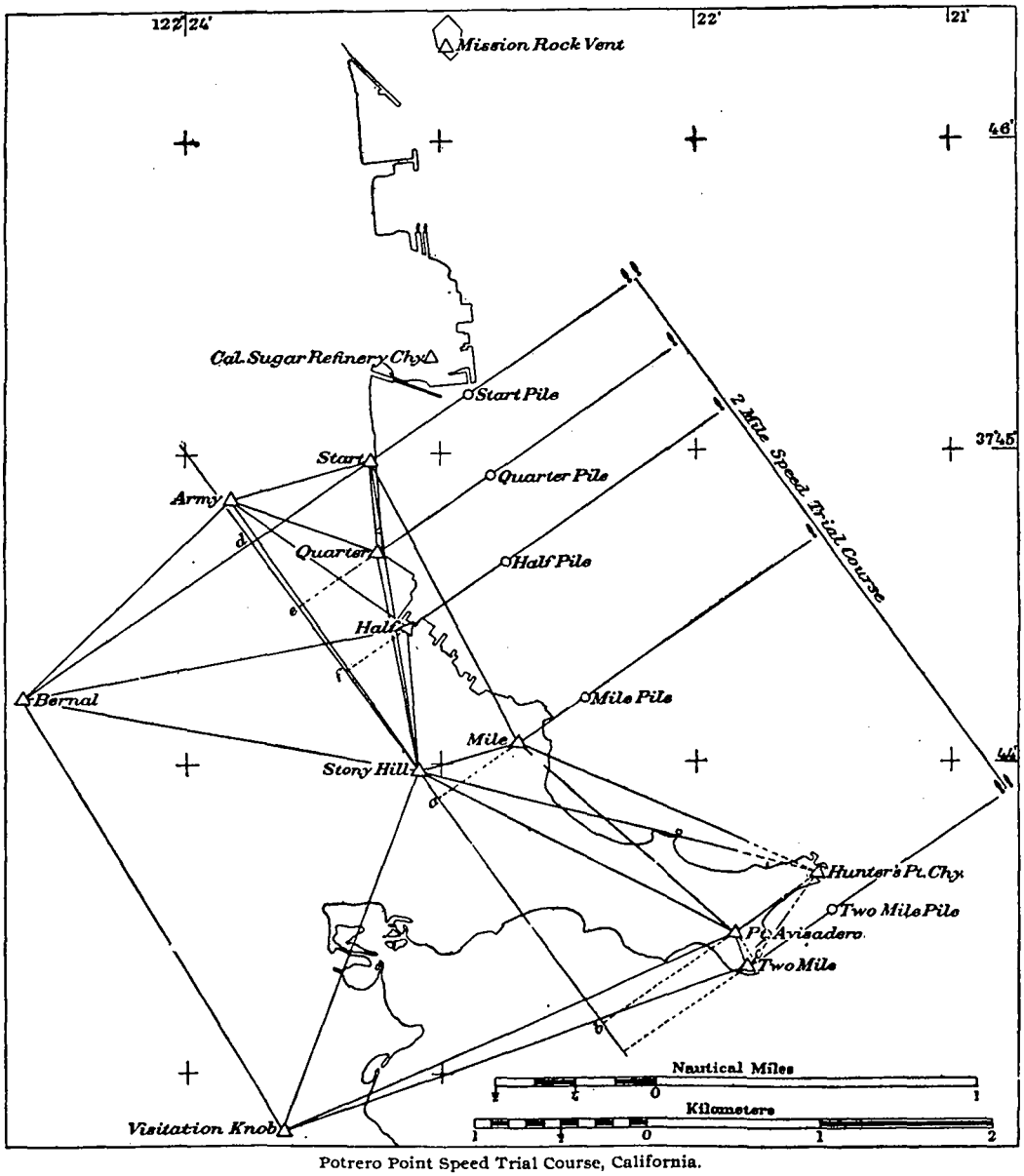


Potrero Point Speed Trial Course, California.

TRIANGULATION OF THE CITY OF NEW YORK. A. T. MOSMAN.

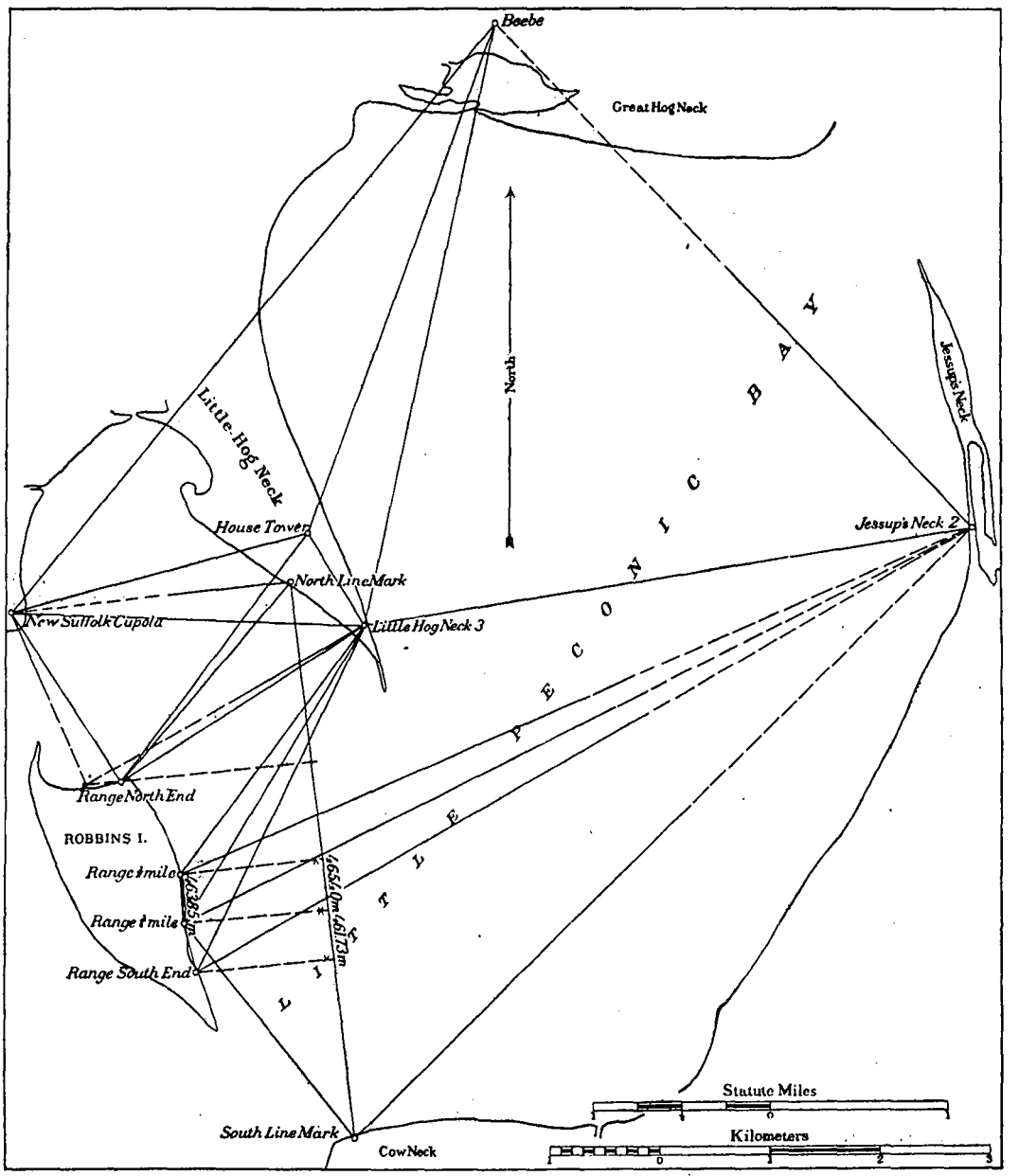
In response to a request from Mr. Nelson P. Lewis, chief engineer of the board of estimate and apportionment of the city of New York, as the representative of the board, for the cooperation of the Coast and Geodetic Survey in completing the triangulation of the city, Assistant Mosman was detailed to take charge of this work. The city agreed to pay all the field expenses incurred in making the necessary observations to complete this work, based upon the triangulation of the Coast and Geodetic Survey, and

to follow the method prescribed for the work of the Survey. The city also agreed to pay the expense of making the necessary computations and reductions under the direction of the Office in Washington.

This work when completed will add numerous standard geographic positions to the registers of the Survey, and duplicates of such records of the work as may be necessary will be furnished for the use of the Survey.

PECONIC BAY SPEED TRIAL COURSE. JOHN NELSON.

No. 54.



Peconic Bay Speed Trial Course, New York.

A speed trial course in Peconic Bay, off New Suffolk, Long Island, New York, was verified at the request of the Holland Submarine Torpedo Boat Company. This work was assigned to Assistant Nelson, and he left Washington for New Suffolk on November 3. Many of the principal triangulation points in this region could not be recovered and proper transportation was not furnished, consequently the work required much more time than was anticipated. The work of verification was completed on November 20, and Assistant Nelson returned to the Office on the 22d.

PECONIC BAY SPEED TRIAL COURSE. H. G. OGDEN.

In response to a request from the Navy Department for the determination of the length of a new section which had been added to the Peconic Bay speed trial course off New Suffolk, Long Island, Assistant Ogden was directed to execute the necessary work in the field. He reached New Suffolk on May 17, and on the 22d had secured the information desired by Capt. C. J. Train, U. S. Navy, President of the Board of Inspection and Survey.

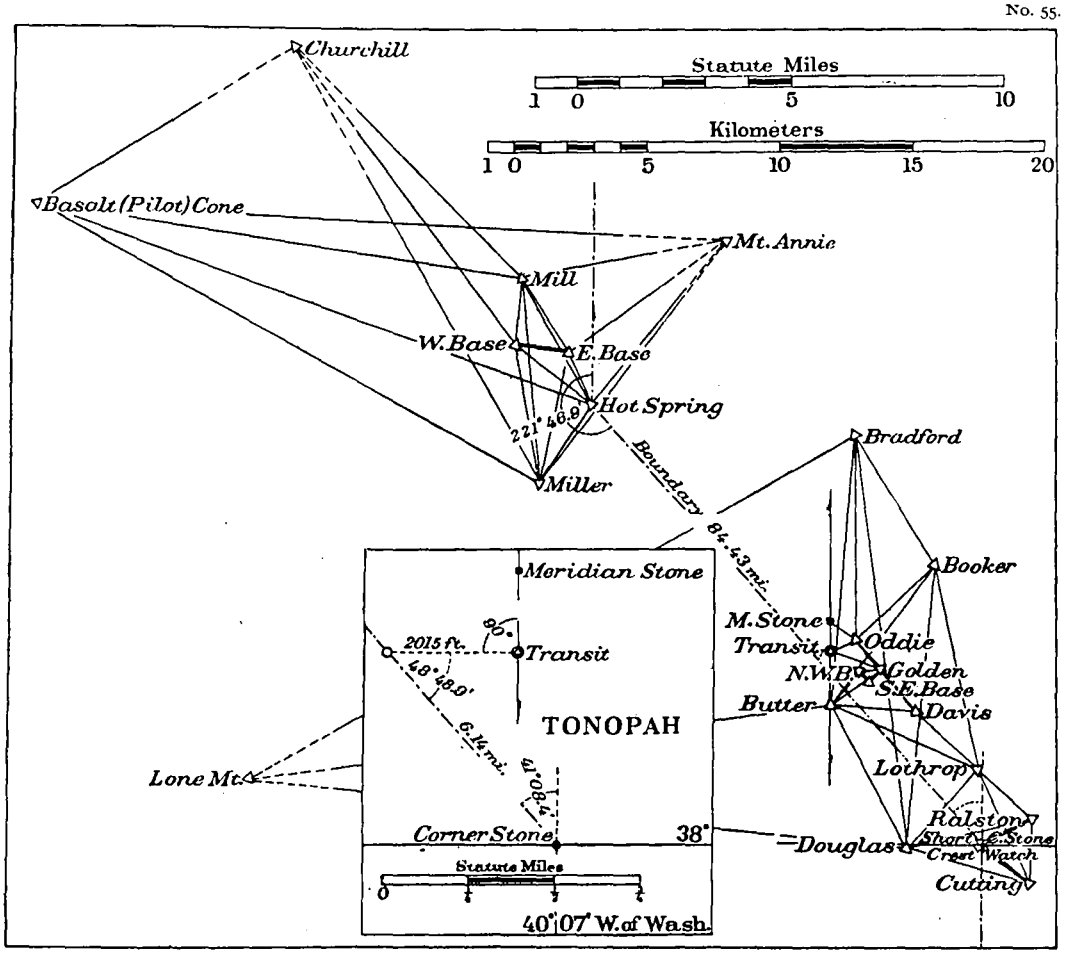
BOUNDARY LINE BETWEEN ESMERALDA AND NYE COUNTIES, NEV. C. H. SINCLAIR.

In response to a request from the county authorities of Esmeralda County, Nev., for the determination of a certain portion of the boundary line between that county and the adjoining county of Nye, Assistant Sinclair was instructed to proceed to the locality and execute the necessary field work at the expense of Esmeralda County.

He left Washington on August 1 and proceeded to Tonopah, Nev., via San Francisco, Cal., to procure an outfit, and Carson City, Nev., where observations were made to determine personal equation with Mr. C. W. Friend, who kindly cooperated with him in determining the longitude of Tonopah from the observatory at Carson City. The telephone line from Candelaria was connected with that from Sodaville, and a metallic circuit was thus secured over which signals were exchanged between Tonopah and Carson City. The latitude of the station was determined by observations made on four nights. A base line was then selected and a scheme of triangulation developed to locate on the ground the intersection of the parallel of 38° north latitude with the meridian in longitude 40° 07′ west from Washington, which point locates one end of the oblique boundary line between the two counties named, and is about 6 miles southeast of the astronomic station. Lone Mountain station of the transcontinental triangulation was connected with the local triangulation for the purpose of comparing the astronomic position of the astronomic station with its geodetic position. Between September 10 and October 6 a base was measured and observations were made at the 18 stations of the triangulation. Lone Mountain station was visited and recovered, but it was not occupied for observations, as the trail up the mountain was found to be impossible for pack animals without extensive repairs. The geographic position of the northwest terminus of the boundary at Hot Spring was determined by connecting it through triangulation with Basalt (Pilot) Cone, a peak connected with the transcontinental triangulation. The azimuth of the boundary line was then computed and the line was traced in the vicinity of the town of Tonopah, thus completing the work

requested by the authorities of Esmeralda County. Magnetic observations were made at Tonopah, Hot Springs, and Esmeralda Mill. The field operations were completed on October 28, and Assistant Sinclair returned to Washington and reported at the Office on November 7.

No. 55.



Boundary between Esmeralda and Nye counties, Nevada.

KENTUCKY–TENNESSEE BOUNDARY. C. H. SINCLAIR.

In December, 1902, while on leave of absence, Assistant Sinclair made observations to determine the latitude of a point near the Kentucky–Tennessee Boundary, in the vicinity of Dover, Tennessee, for the purpose of definitely locating the bounding line of some timber property which was in dispute. The work was done at the request of the Bank of Commerce of Cleveland, Ohio, and the expenses of the work were paid by that corporation.

NORTHWEST BOUNDARY. O. H. TITTMANN.

C. H. SINCLAIR, *Assistant.*

The necessity of remarking that portion of the boundary line between the United States and Canada lying west of the summit of the Rocky Mountains having become apparent, the Secretary of State of the United States was authorized by Congress to take part in this work, and a Joint Commission was appointed by Great Britain and the United States to have charge of the necessary work in the field. Mr. W. F. King, Chief Astronomer of the Canadian department of the interior, was appointed Commissioner to represent the British Government, and Messrs. O. H. Tittmann, Superintendent United States Coast and Geodetic Survey, and C. D. Walcott, Director of the United States Geological Survey, were appointed Commissioners to represent the United States.

The Commissioners each assigned certain officers of their Bureaus to have charge of the necessary work in the field. Assistant Sinclair was detailed for this purpose from the Coast and Geodetic Survey, and Assistant John Nelson was assigned to duty in his party. Numerous preparations, including the purchase of instruments and outfit, were made before leaving Washington, and on May 27 Assistant Sinclair started with Assistant Nelson to Seattle to complete the outfit and to organize the party. Gateway, Mont., is the nearest railway supply point to the field of work, and at that place horses were purchased and men engaged to complete the party. High water in the Kootenai River flooded the railway and delayed the arrival of men and outfit. As there was no ferry over the Kootenai River near Gateway, it was necessary to carry all the supplies across in a small boat and then transport them by pack train to the westward more than 20 miles over a mountain trail. On June 30 two parties were at work on the line, one on the west side of the Kootenai, opening a line across the summits along the chord joining monuments Nos. 11 and 12, 16.5 miles apart, and the other opening the line across the summits along the chord joining monuments Nos. 7 and 8, 13 miles apart (in the Wigwam Valley).

More details in regard to this work will be given in the next Annual Report.

ALASKA BOUNDARY. O. H. TITTMANN.
W. C. HODGKINS.
A. L. BALDWIN.

In response to a request from the State Department, the Secretary of the Treasury detailed Superintendent Tittmann, Assistant Hodgkins, and Computer Baldwin to report to the State Department for duty in connection with the preparation of the United States case for presentation to the Alaska Boundary Tribunal, and a large portion of the time of these officers during the last half of the fiscal year was devoted to the performance of duties assigned to them in Washington and elsewhere. As these officers aided in making the survey of southeastern Alaska in the vicinity of the boundary in 1893, 1894–95, in cooperation with the Canadian parties and under the direction of international commissioners, they were especially qualified to perform the service required.

LOUISIANA PURCHASE EXPOSITION. D. B. WAINWRIGHT.

The preparation of plans and material for the exhibit of the Coast and Geodetic Survey at the Louisiana Purchase Exposition at St. Louis, Mo., in 1904, was assigned to Assistant Wainwright, and he devoted such time as was necessary to this work at intervals when his other duties permitted.

CABLE TO FARALLON ISLANDS. F. WESTDAHL.

In response to a request from the Weather Bureau for an officer to accompany the cable ship while laying a cable from Point Reyes, Cal., to the Farallon Islands, Assistant Westdahl was assigned to this duty and instructed to render all possible assistance in the work. He went on board the steamer *Argo* at San Francisco on April 10, and navigated the ship while the cable was being laid, and afterwards plotted the position of the cable, as laid, on a chart and furnished a copy of it to Prof. A. G. McAdie, the representative of the Weather Bureau in charge of the work. The work was successfully completed and Assistant Westdahl returned to San Francisco on April 14. Prof. Willis L. Moore, Chief of the Weather Bureau, has expressed officially his appreciation of the service rendered by Assistant Westdahl.

CABLE TO ALASKA. F. WESTDAHL.

In response to a request from Gen. A. W. Greeley, Chief Signal Officer, U. S. Army, for an officer to accompany the cable ship while laying a cable between Seattle, Washington, and Sitka, Alaska, Assistant Westdahl was assigned to this duty and instructed to render all possible aid in the work. He made the necessary preparations and sailed from San Francisco on June 20, under orders to join the cable ship *Burnside* at Sitka, Alaska, on July 1. On June 30 he was en route to his destination.

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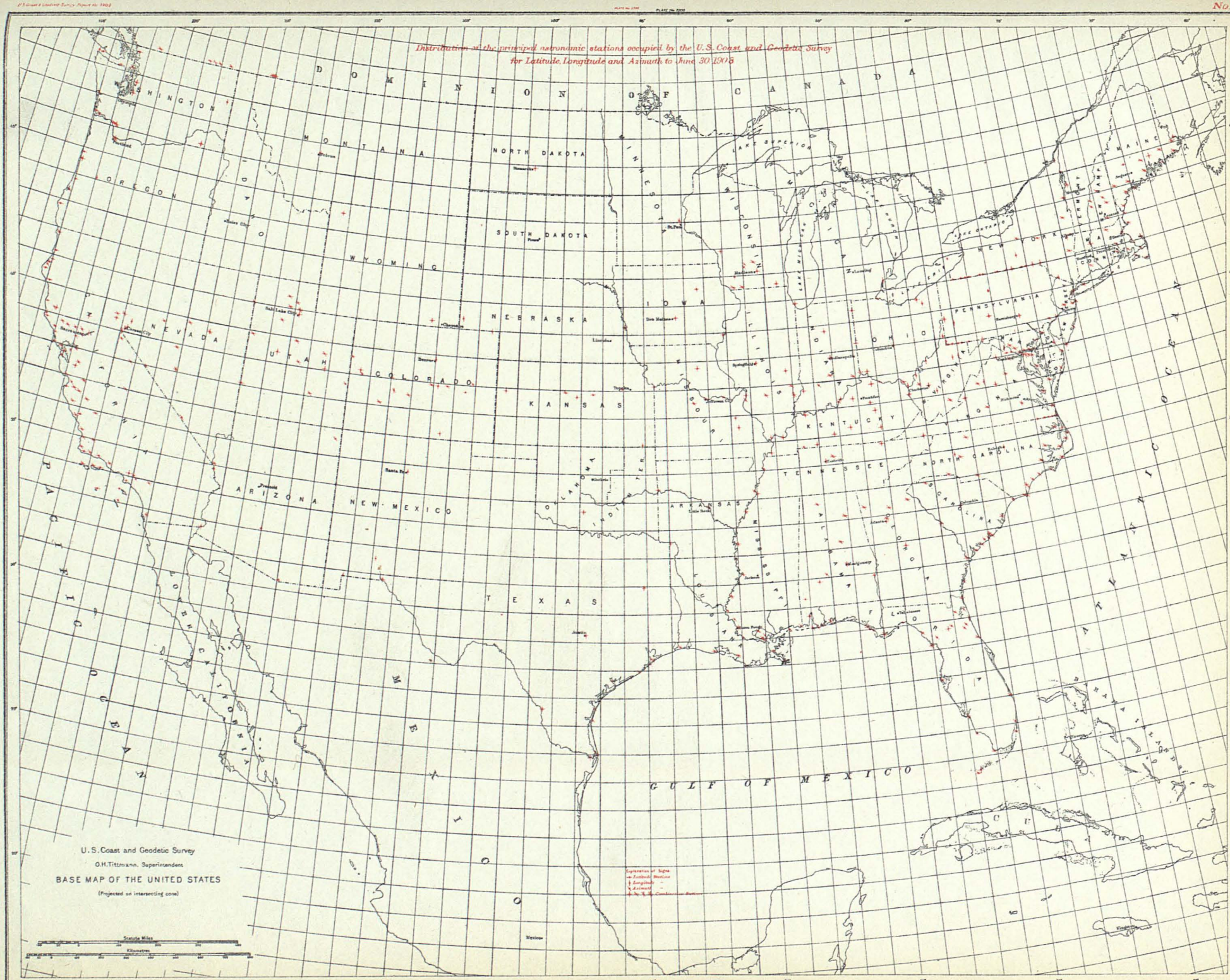
Distribution of the principal astronomic stations occupied by the U.S. Coast and Geodetic Survey for Latitude, Longitude and Azimuth to June 30, 1905



U.S. Coast and Geodetic Survey

O.H. Tittmann, Superintendent

BASE MAP OF THE UNITED STATES

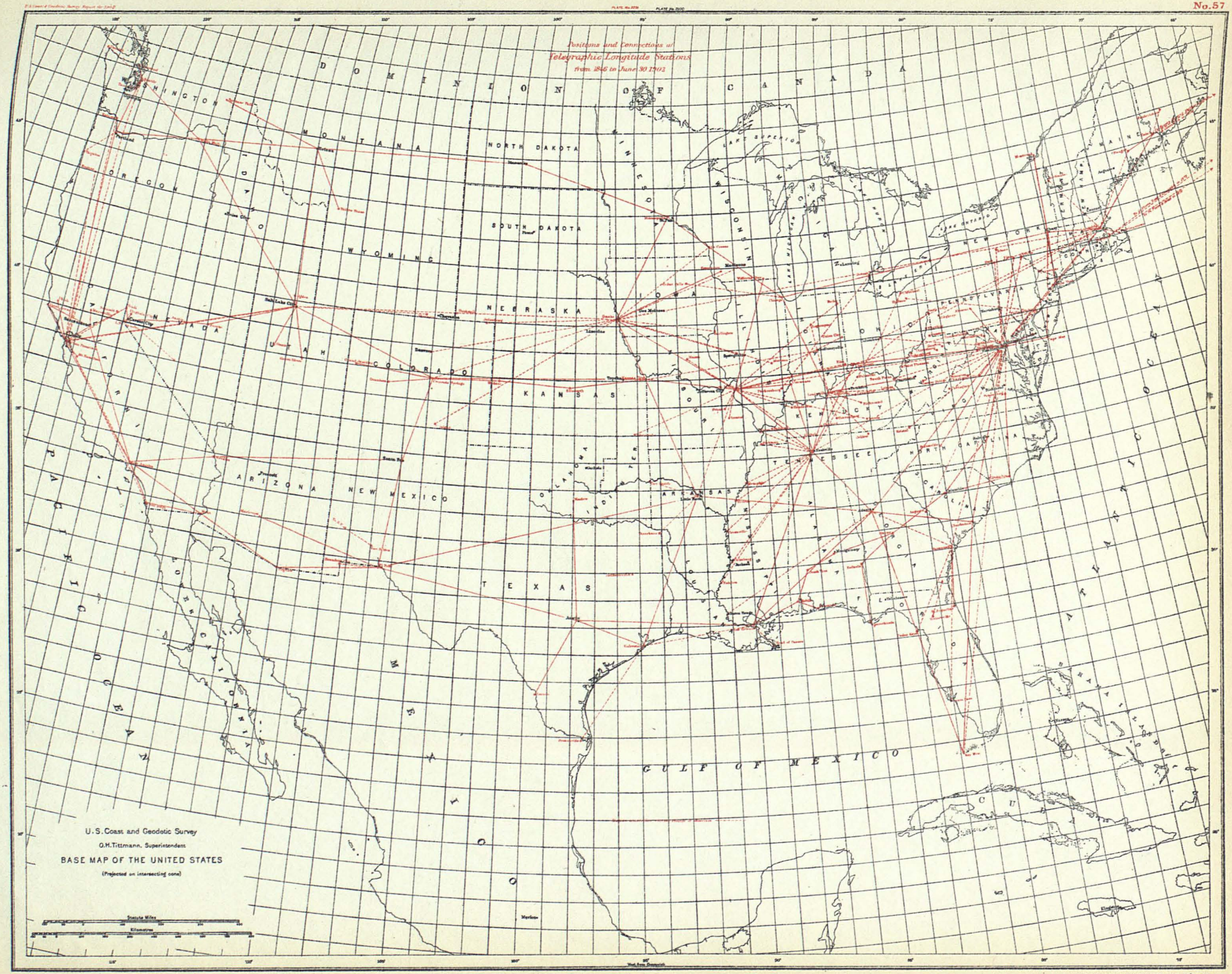
(Projected on intersecting cone)

Statute Miles

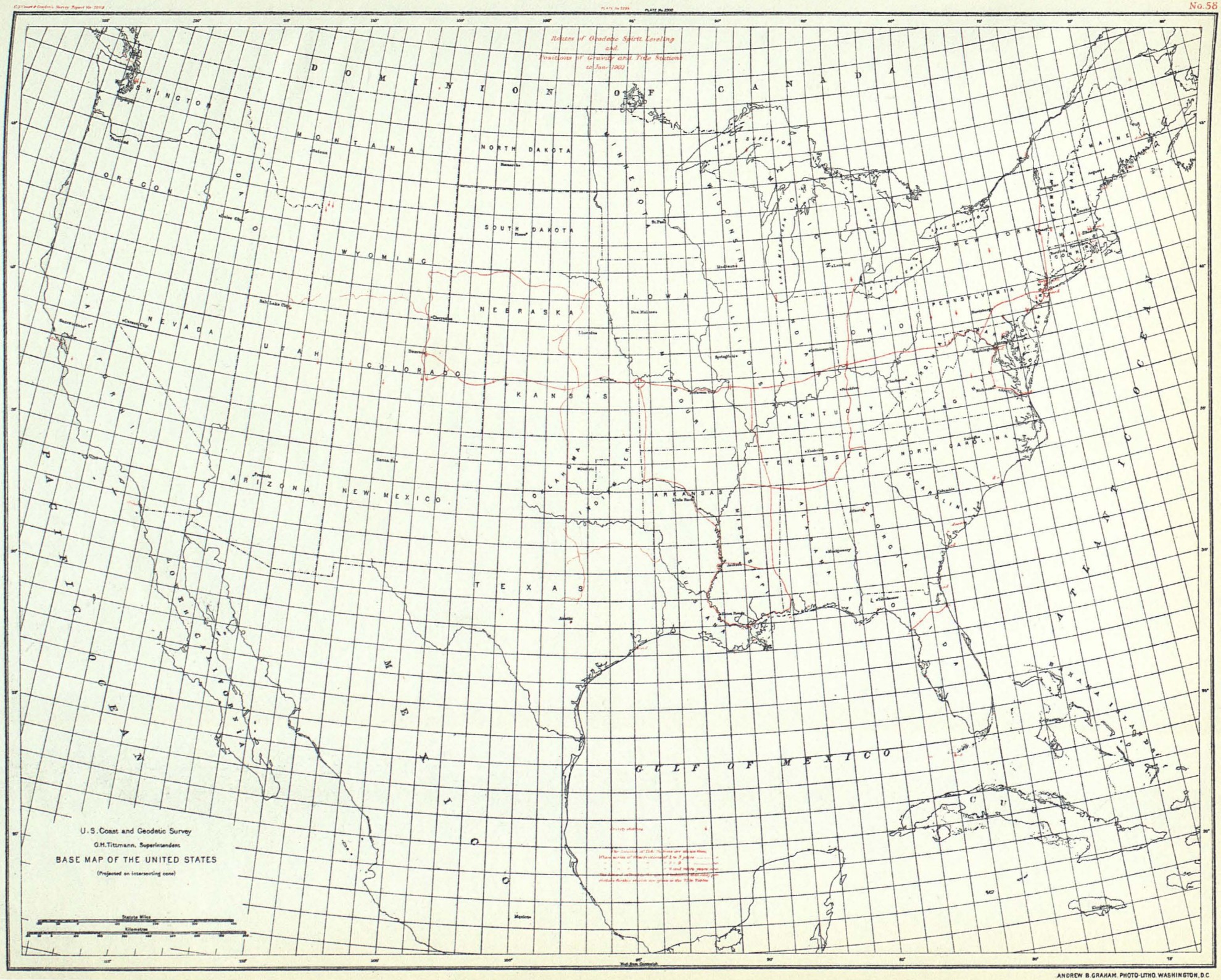
Kilometres

Explanation of Signs
Zenithal Stations
Longitude "
Azimuth "
Combination Stations

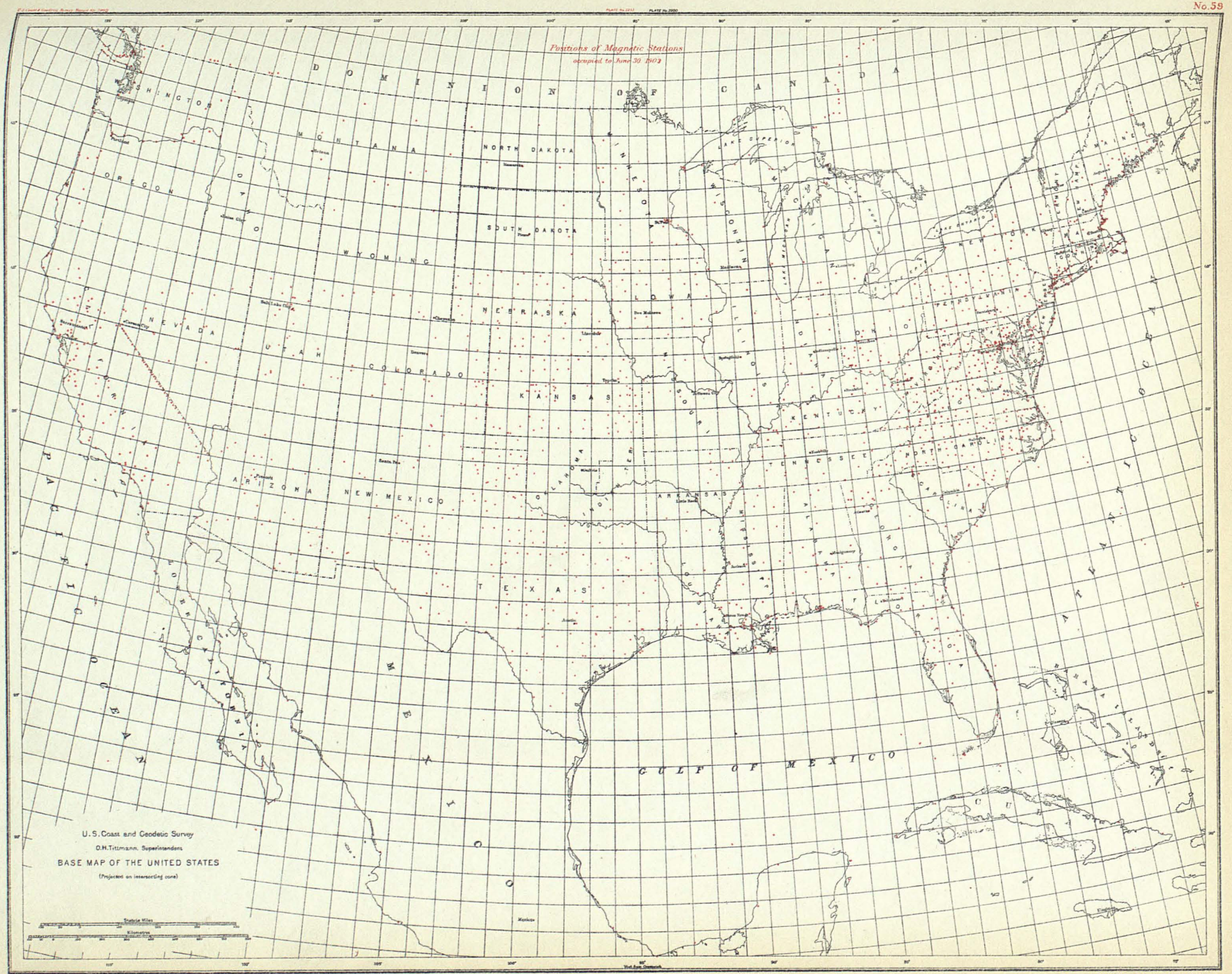
ANDREW B. GRAHAM, PHOTO-LITHO, WASHINGTON, D.C.



ANDREW B. GRAHAM, PHOTO-LITHO. WASHINGTON, D.C.



ANDREW B. GRAHAM, PHOTO-LITHO. WASHINGTON, D.C.



U.S. Coast and Geodetic Survey

O.H. Tittmann, Superintendent

BASE MAP OF THE UNITED STATES

(Projected on intersecting cone)

ANDREW B. GRAHAM, PHOTO-LITHO, WASHINGTON, D.C.

APPENDIX No. 2.

REPORT 1903.

DETAILS OF OFFICE OPERATIONS.

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CONTENTS.

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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 following persons were employed under his immediate direction:

Name.	Occupation.
George A. Fairfield	Clerk.
A. B. Simons	Do.
E. B. Wills	Do.
Miss Kate Lawn	Do.
John S. Collins	Stenographer and typewriter (Jan. 13 to June 30).

The Miscellaneous Section is a part of the immediate office of the Assistant in Charge, and the manifold and arduous duties pertaining to it were performed by Messrs. H. C. Allen and C. W. Jones. The details of the work in this section are given under the heading "Miscellaneous Section" in this Appendix. The duties of the other members of the personnel mentioned above were of the usual routine character.

The following extracts are taken from the report of the Assistant in Charge:

I have the honor to submit the annual report of the office for the fiscal year ended June 30, 1903, accompanied by the annual reports of the various divisions, namely: Computing Division, Division of Terrestrial Magnetism, Tidal Division, Drawing and Engraving Division, Chart Division, Instrument Division, Library and Archives Division, and Miscellaneous Section.

The Computing Division continued under the charge of Assistant J. F. Hayford, whose report shows a large amount of work accomplished during the year, as follows:

1. The completion for publication of the reduction of the Lake Survey triangulation to the United States Standard Datum.

2. A new adjustment of the precise level net.

3. The computation of all the triangulation in California south of Point Conception and its reduction to the United States Standard Datum was nearly completed.

4. A new investigation of the form of the geoid in the United States.

5. The computation of the triangulation along the ninety-eighth meridian.

The routine work of the Division has received due attention, and the demand upon it in regard to geographic positions and for copies of descriptions of stations, although smaller than during the previous year, was quite heavy.

The Division of Terrestrial Magnetism continued under the charge of Assistant L. A. Bauer, who, as Inspector of Magnetic Work, is also charged with the supervision of the field parties engaged on magnetic work. Much of his time while in the office was necessarily occupied with his duties in the latter capacity. The correspondence and routine work and the distribution of magnetic information have received prompt attention.

Among other works accomplished by the Division may be mentioned the discussion of the international magnetic observations made during the solar eclipse of May, 1901, the preliminary discussion of magnetic observations made on the *Blake* on her trip from Baltimore to Porto Rico, and the making of observations to standardize various instruments, as occasion required.

The Tidal Division remained under the charge of Mr. L. P. Shidy, and his report gives full information as to the work accomplished during the year. Mr. R. A. Harris has been engaged in the study of tidal phenomena and has constructed a cotidal chart for the northern Indian Ocean. Similar work is in progress for other regions, and a preliminary cotidal chart has been completed for the Eastern coast of the United States.

The Drawing and Engraving Division continued under the charge of Assistant W. W. Duffield, and his report shows in detail the work accomplished in each of the five sections of the Division, and gives the usual statistical information. I may here mention that a complete and thorough examination of all charts of various scales of the coast of Maine was made in view of the proposed naval maneuvers on that coast. In the Drawing Section, under the immediate direction of Chief Draftsman E. H. Fowler, a large amount of work has been accomplished during the year. The illustrations for the Superintendent's Annual Report also received due attention. It may be mentioned also that a large amount of work was performed for the Alaska Boundary Tribunal, including the preparation of two atlases and numerous special drawings and maps.

In the Printing Section, under the immediate direction of Foreman D. N. Hoover, the usual large amount of work has been accomplished, over 80 000 impressions being the product for the year.

The demands upon the Photographing Section during the year have been very great and its capacity has been taxed to the utmost.

In the Electrotyping Section the output has not been quite as large as during the previous year, owing to the fact that for nearly three months work was suspended during the installation of the new plant. The new plant is now working very satisfactorily, and the time lost during the installation will soon be made up by the more rapid output that is now possible.

The Drawing and Engraving Division has also supplied information in response to a large number of calls involving areas, shore lines, distances, tracings from original sheets, maps of obsolete and canceled charts, and miscellaneous blue prints, etc.

The Chart Division, constituted by the Chart and Hydrographic sections, has remained under the charge of Assistant Gershom Bradford, Inspector of Charts. The issue of charts for the year 1903 has been considerably larger than in any previous year. In the Hydrographic Section the work of indicating chart corrections, preparing the monthly Notice to Mariners, etc., was attended to in a very satisfactory manner. The Section sustained a severe loss by the death on July 2, 1902, of Mr. W. C. Willenbucher, the chief hydrographic draftsman. His successor, Mr. J. T. Watkins, has attended to the work in a very satisfactory and thorough manner. The Section has had the assistance from time to time of field draftsmen when they were not engaged upon field work.

The Instrument Division continued under the charge of Mr. E. G. Fischer, the chief mechanician, and the usual amount of work has been accomplished, which consists mainly of repairs to instruments, the construction of such new instruments as are not obtainable in the market, the issue of instruments, camp outfit, and general property to field parties, miscellaneous correspondence relating thereto, keeping the necessary accounts relating to the distribution of instruments and general property, etc. Among the special items mentioned in Mr. Fischer's report are the construction of 12 new plane table alidades, the reconstruction of 2 Gambey theodolites, the regraduation of a 10-inch Gambey theodolite, the construction of 9 "Harbor and channel sweeps" for discovering shoals, rocks, etc., in harbors, and the construction of 12 pairs of telemeters with metallic (magnalium) backs. Valuable assistance was also rendered the Electrotyping Section during the installation of the new electrotyping plant.

The Library and Archives Division has continued under the charge of Mr. E. L. Burchard. Good progress has been made in the indexing of the library and special attention has been given to

the arrangement, classification, and cataloguing of our valuable collection of foreign charts. The compilation and preparation for publication of the "List and Catalogue of Publications of the Survey, 1816-1902" was completed, and progress made on the manuscript on bibliography of the Mason and Dixon line.

The Miscellaneous Section, under the immediate direction of Mr. H. C. Allen, attended to the purchase and distribution of supplies required for the Office, the making of requisitions for printing and binding, the issue of stationery to field parties and office divisions, the custody of the publications of the Survey, and the keeping of the records relative to their disposition.

Computing Division.

Personnel.

Name.	Occupation.
J. H. Hayford	Chief of Division.
M. H. Doolittle	Computer.
A. L. Baldwin	Do.
Miss Lilian Pike	Do.
C. R. Duvall	Do.
W. H. Dennis	Do.
O. M. Leland	Computer (July 1 to May 18).
F. H. Brundage	Computer (July 1 to Mar. 4).
Miss L. J. Harvie	Computer (Aug. 18 to June 30).
R. Y. Ferner	Computer (Aug. 21 to June 30).
H. C. Mitchell	Computer (May 4 to June 30).
C. E. Everett	Computer (Apr. 3 to June 15).
Miss Sarah Beall	Computer (June 20 to June 30).
J. H. Milsaps	Writer.
DETAILED TEMPORARILY.	
Miss H. S. Poole	Computer.
Mrs. L. J. Arbuckle	Do.
El Bie K. Foltz	Writer.
R. S. Decker	Do.

Temporary details from field force.

Assistants.

O. W. Ferguson.
Wm. Bowie.

Aids.

Jose Vano Reyes.
C. G. Quillian.
Paul C. Whitney.
H. D. King.
E. W. Kramer.
W. H. Burger.
G. C. Baldwin.
B. D. Barker.
E. C. Sasnett.
John C. Landers.
H. L. Beck.
J. W. Milburn.
H. M. Trueblood.
C. C. Craft.
J. B. Miller.

Temporary aids.

E. L. Scott.
L. A. Richards.
F. W. Gladding.
S. H. Graves.
W. H. Sligh, jr.
N. Harontun.
M. W. Hawkins.
M. J. Wall.
W. G. Randall.
W. R. Johnson.
R. F. Rohrer.
E. B. Shaw.
C. E. Foster.

Watch officers.

R. Mc.D Moser. T. L. Jenkins.

Deck officers.

J. W. Yates. J. H. Wood, jr.

Signalman.

J. S. Bilby.

The average effective force of the Computing Division during the year was 17. This force varied between the extremes of 11 in January and 21 in December, and was about 50 per cent larger than during the preceding fiscal year. The work of the Division shows a corresponding increase in amount in spite of the fact that a considerable portion of the increase in force consisted of aids holding temporary appointments and of others who were assigned to the Division to acquire practical knowledge of the methods in use.

The more important computations upon which the Computing Division has been engaged during the year are as follows:

First. The completion for publication of the reduction of the Lake Survey Triangulation to the United States Standard Datum. This work was completed in September, 1902.

Second. A new adjustment of the precise level net. The first adjustment was completed in 1900. Since that time so much new leveling has been done that the new net, as now adjusted, contains over 30 per cent of new leveling.

Third. The computation of all the triangulation in California and its reduction to the United States Standard Datum. This was begun in August, 1902, and at the end of the fiscal year it was nearly completed from the Mexican boundary northward to the vicinity of Point Conception, near the west end of Santa Barbara Channel.

Fourth. On October 23, 1902, the work of making a new investigation of the form of the geoid within the United States was commenced and good progress was made before the end of the fiscal year.

Fifth. The triangulation along the ninety-eighth meridian in 1902, including the occupation of 75 primary stations, covered about 6½° in length in latitude, or 444 miles. The field work was completed in October. The computations, including all secondary and tertiary points, as well as all computations of elevations, were completed in June, less than eight months from the date of the last field work. This computation is equivalent to about one-fourth the computations required in connection with the whole Transcontinental Triangulation, and this makes a record of which the Computing Division may be justly proud.

The routine work of furnishing information to the officers in the field and to persons outside the Survey in response to requests for information was very heavy, and is constantly increasing.

During the year the manuscript was prepared and the proof was read of Appendix 3 of the Report for 1902, "Triangulation in Kansas," which puts in printed form all the information available in regard to the triangulation in Kansas. The manuscript of two more appendices was nearly completed at the end of the year, namely, an appendix on precise leveling, and an appendix on the ninety-eighth meridian triangulation in 1902, both of which are printed as appendices to this Report.

The following extracts are taken from Mr. Hayford's report:

During the first three months of the year Mr. T. Russell, assistant engineer, Mrs. M. E. C. Walker, Miss B. M. Chase, and Miss K. R. Macqueen were engaged for various periods in finishing the computations of the Lake Survey Triangulation, these being persons who were paid by the Survey of the Northern and Northwestern Lakes, and who were doing the work under my direction in the Computing Division.

Mr. A. L. Baldwin acted as Chief of the Division during my absence therefrom, September 4–30, December 14–18, December 22–January 3, March 11–14, and March 26–April 8. He was engaged during the last half of April, more than half of May, and all of June on special work. This was a serious loss to the Computing Division, as the Chief of the Division depends upon him as his first assistant, he being the only person in the Division having the necessary training and experience in both office and fieldwork to make him fully capable of taking charge during the absence of the chief, or of sharing in all parts of the chief's work when the chief is present.

Of the members of the Computing Division, individually and as a group, I may reiterate with all sincerity what was said in my last annual report, namely, that with a "great deal of pleasure, and perhaps with some pride, I may state that on the whole each member of the Division has rendered zealous, efficient, and interested service throughout the year."

Mr. M. H. Doolittle, the oldest computer in the Division, in rapidity of computation and especially in rapidity and accuracy in making complicated and difficult least square adjustments, is still unexcelled by any of the younger computers.

Miss Lilian Pike supervised all computations during the year connected with precise leveling and the adjustment of the precise level net, and has also done much in the way of editing and proof reading. In both of these lines of work, and especially in the latter, she has shown marked ability, and has saved the Chief of the Division from a great deal of the attention to detail which would otherwise have been necessary.

During the last two and a half months of the fiscal year, while Mr. Baldwin was available for computing duty but a small portion of the time, Mr. C. R. Duvall has been depended upon as my first assistant, to have direct supervision over various computations in progress in the hands of the computers. He has shown steady improvement in ability in that direction, which is making him of great value to the Division.

Miss Lelia J. Harvie, appointed August 18, 1902, has been given a rather unusual opportunity, for a new computer, to learn the methods of complicated least-square adjustments during the first year of her service. During the greater part of this year she has been working under the immediate direction of Mr. Doolittle, in cooperation with him on least-square adjustment. She has risen to the opportunity and has become an adept in making such computations.

Division of Terrestrial Magnetism.

Personnel.

Name	Occupation.
L. A. Bauer	Chief of Division.
D. L. Hazard	Computer.
C. J. Houston	Do.
Miss J. E. Haslup	Writer.
Temporarily detailed.	
S. A. Deel	Magnetic observer (July 1 to July 5; July 26 to Sept. 15).
H. I. Woods	Magnetic observer (July 7 to July 26).
G. B. Pegram	Magnetic observer (July 15 to Aug. 1).
G. E. King	Computer (July 1 to July 31).
J. A. Fleming	Aid (Aug. 11 to Sept. 8).
R. W. Walker	Aid (July 1 to Oct. 26; Nov. 13 to Jan. 4).
W. T. Carpenter	Aid (Dec. 22 to Jan. 9).
R. E. Nyswander	Aid (Jan. 17 to Mar. 31).
J. W. Milburn	Aid (May 4 to May 19).
L. B. Smith	Aid (May 25 to June 30).
José Vañó Reyes	Aid (June 8 to June 26).
T. L. Jenkins	Watch officer (Dec. 22 to Jan. 9).
A. H. Wise	Assistant surgeon (Jan. 28 to June 30).
J. H. Egbert	Assistant surgeon (Jan. 30 to June 13).
G. C. Ballard	Assistant surgeon (Feb. 24 to May 6).

The revision of the computation of the magnetic observations made by the field parties was kept nearly up to date and was practically completed at the close of the fiscal year. Two appendixes, "The Magnetic Observatories of the United States Coast and Geodetic Survey, in operation July 1, 1902," and "Results of Dip and Intensity Observations" (1897–1902) were prepared for publication in the Annual Report for 1902, and the proof of the United States Declination Tables for 1902 was read.

A discussion of the magnetic observations made by several nations during the solar eclipse of May 17–18, 1901, was completed and the results published; also, a preliminary discussion of the magnetic observations made at sea on board the Coast and Geodetic Survey steamer *Blake* between Baltimore and Porto Rico was completed. The Division prepared compass data to be used on 87 charts and for 20 places on the coast of Maine and 12 places on the coast of Massachusetts, to be used in the preparation of the Coast Pilot. The routine correspondence work of the Division was 20 per cent larger than during the preceding fiscal year. Mr. L. A. Bauer was absent on field duty during the greater portion of July, from September 15 to November 13, and from January 19 to April 16. A large portion of his time while in the Office was occupied by the duties assigned to him as Inspector of Magnetic Work.

During the absence of the Chief, his duties were performed by Mr. D. L. Hazard, computer. Mr. C. J. Houston, computer, was absent on field duty from April 19 to June 30. Numerous temporary assignments to the Division were made, usually for the instruction of the persons assigned in the use of instruments and in the methods of computation, so that they did not materially advance the progress of the work in hand.

Tidal Division.

Personnel.

Name.	Occupation.
L. P. Shidy	Chief of Division.
R. A. Harris	Computer.
J. C. Hoyt	Computer (July 1 to Sept. 3).
Artemas Martin	Computer.
Miss C. C. Barnum	Do.
John M. Brooks	Computer (Aug. 26 to May 31).
Maurice J. Wall	Computer (Oct. 6 to June 30).
Paul Schureman	Computer (June 15 to June 30).
Miss A. G. Reville	Clerk.
Miss V. E. Campbell	Writer.
Luke A. Cole	Writer (Sept. 20 to June 30).
Temporarily detailed.	
B. W. Bembry	Writer (July 1 to July 7).
Miss M. L. Handlan	Writer (July 1 to July 23).
T. C. Bradley	Writer (at intervals from July 1 to Oct. 9).
Parke Hutchinson	Computer (July 14 to Aug. 12).
I. W. Thompson	Aid (July 7 to Aug. 5).
W. C. Shephard	Aid (July 1 to July 5).
J. W. Hart	Aid (Aug. 11 to Sept. 9).
E. H. Henderson	Aid (Dec. 26 to Jan. 24).
E. B. Shaw	Aid (Jan. 31 to Feb. 14).

Harmonic analyses were completed for a year each of hourly heights at 4 stations, and also for ten shorter series. This work, together with that in progress at the close of the fiscal year, is equivalent to the complete harmonic analyses of eight years of continuous record. Nonharmonic reductions were made for 82 stations, at one of which six years were reduced, and four years at another, while the other series ranged from two years down to half a month. This work is equivalent to first reductions for twenty-six years of continuous high and low waters.

The plane of reference for the reduction of soundings was determined for 69 stations. About twenty-eight years of self-registering tide-gauge records were tabulated as high and low waters, and also as hourly heights of the sea. Tide notes were prepared for 236 stations upon 56 charts and 68 original hydrographic sheets. Tidal information was furnished to the field parties and in response to requests from individuals not connected with the Survey in 297 instances, involving the preparation of descriptions of 563 bench marks, tidal data for 1 588 stations, and current data for 21 stations.

There were received, examined, and registered an aggregate of about nineteen years of record from self-registering tide gauges at 16 stations, together with about five years of record from box and staff gauges, consisting of 104 original and 59 duplicate volumes of tide observations made by 34 hydrographic parties at 71 stations.

Tidal records from outside sources were received as follows: July 1 to March 31, with self-registering tide gauge at Reedy Island, Delaware, maintained by the Philadelphia Maritime Exchange; six years' records of observations at the entrance to St. Johns River, Florida, were loaned to the Survey by the Corps of Engineers, U. S. Army,

and one month's record of observations on Culebra Island, Porto Rico, by the Navy Department.

Copies of the predicted tides for Wellington and Port Russell, New Zealand, with tidal differences for 80 subordinate ports, were prepared and furnished in response to a request from the Secretary of the Marine Department of New Zealand.

Some questions connected with the flow of water under the action of gravity were studied by Mr. R. A. Harris. These relate chiefly to the velocities of tidal streams over their entire cross sections at various depths from the surface and at different distances from the center of the stream. He also constructed a cotidal chart for the northern part of the Indian Ocean. His studies of this region show that the tides there are primarily due to local oscillations. Waves progressing at nearly the rate due to depth occur in most of the shallow arms of this ocean. Such is the case in the Persian Gulf, in the Gulf of Kutch, in Palk Strait and Bay, in the Gulf of Cambay, in the Gulf of Martaban, in the western part of Malacca Strait, in most of the gulfs and bays along the northern coast of Australia, and in Sharks Bay.

Similar work is in progress for other oceans, and a preliminary cotidal chart for the eastern coast of the United States was completed.

The Tide Tables for the year 1904 were prepared for printing, and the proof was read, before the close of the fiscal year. These tables contain current diagrams for Boston Harbor, Nantucket and Vineyard sounds, Delaware Bay and Chesapeake Bay, in addition to those for New York Harbor which were given last year. The sunrise and sunset table was recomputed and arranged according to the sun's declination, with the approximate corresponding date as a rough argument when desired.

Drawing and Engraving Division.

Personnel.

Name.	Occupation.
W. W. Duffield	Chief of Division.
James M. Griffin	Clerk (July 1 to Aug. 2).
E. Meads	Clerk.
Edwin H. Fowler	Chief Draftsman.
Harlow Bacon	Draftsman.
J. N. Baker	Draftsman (July 1 to 6).
R. S. Baker	Draftsman (Dec. 18 to June 27).
Chas. H. Deetz	Draftsman.
F. C. Donn	Do.
E. P. Ellis	Do.
P. Von Erichson	Do.
F. B. Essex	Draftsman (Oct. 3 to Mar. 17).
C. M. Hahn	Draftsman.
R. Hansen	Draftsman (July 28 to Sept. 15).
D. M. Hildreth	Draftsman.
Jas. P. Keleher	Draftsman (July 1 to June 26).
A. Lindenkohl	Draftsman.
H. Lindenkohl	Do.
J. W. McGuire	Do.
C. F. McKenney	Draftsman (Dec. 22 to June 30).
S. B. Maize	Draftsman.
H. L. Simmons	Draftsman (Apr. 18 to June 30).
E. J. Sommer	Draftsman.
T. J. Walsh	Draftsman (Nov. 13 to Dec. 12).
D. C. Crain	Engraver (Sept. 29 to Oct. 28).

Drawing and Engraving Division—Continued.

Personnel—Continued.

Name.	Occupation.
W. H. Davis	Engraver.
H. E. Franke	Do.
R. H. Ford	Engraver (Oct. 14 to June 30).
P. H. Geddes	Engraver.
F. Geoghegan	Do.
Geo. Hergesheimer	Do.
W. H. Holmes	Do.
H. M. Knight	Do.
Wm. Mackenzie	Do.
W. F. Peabody	Do.
A. H. Sefton	Do.
E. H. Sipe	Do.
H. L. Thompson	Do.
J. W. Thompson	Do.
W. A. Van Doren	Do.
Theo. Wasserbach	Do.
F. G. Wurdemann	Do.
D. N. Hoover	Foreman of printing.
E. F. Campbell	Plate printer.
R. J. Fondren	Do.
Eberhard Fordan	Do.
C. J. Harlow	Do.
C. J. Locraft	Do.
R. V. H. Jama	Printer's helper.
W. W. Kirby	Do.
E. M. Kline	Do.
R. F. Le Mat	Printer's helper (July 1 to Dec. 17).
W. B. Mehler	Printer's helper.
V. E. Torney	Printer's helper (Feb. 2 to June 30).
C. F. Blacklidge	Photographer and electrotyper.
L. P. Keyser	Assistant photographer.
Roy Thomas	Assistant electrotyper.
George Newman	Messenger.
J. W. Brown	Laborer (Nov. 8 to June 30).
C. W. Hawkins	Laborer (absent Nov. 5 to Apr. 27).
H. Murray	Laborer.
Frank Thomas	Do.
I. E. Williamson	Laborer (Apr. 1 to 26).
A. A. Meredith	Extra laborer.
Temporarily assigned.	
G. C. Ballard	Assistant surgeon (May 6 to June 3).
P. Betts	Aid (Oct. 15 to 27).
J. H. Simpson	Deck officer (Apr. 21 to May 15).
F. B. Thompson	Deck officer (Apr. 4 to 14).
P. C. Whitney	Aid (Oct. 20 to Jan. 26).

This Division is divided into five sections—the Drawing, the Engraving, the Printing, the Photographing, and the Electrotyping sections. Each section executed the work indicated by its title, and the combined result is shown by the charts published and issued by the Survey.

During the year 332 requests for information were received and answered in the Division. These involved the measurement of areas and shore line and distances between various points, the preparation of tracings from original topographic and hydrographic sheets, copies of old and canceled charts, and the construction of special maps.

Two of the new charts published, those of San Francisco Bay, are intended as examples of the method used in producing them. They were made up from engraved plates showing the hydrography, contour curves of the bottom, soundings, etc., and the topography was added by photolithography from drawings made on a larger scale and reduced to fit the chart. Color was used on the charts published by lithography to a greater extent than ever before, and extended in many instances to the water areas to distinguish areas of the same depth. The preparation of plates by the heliogravure process was continued and five plates were completed. From May 1 until June 20, Mr. E. H. Fowler served as Acting Chief of the Division during the absence of the Chief.

Drawing Section.

During the year the following drawings were completed for photolithographing or engraving:

Chart No.	Title.	Scale.
112	Vineyard Sound and Buzzards Bay	1–80 000
901	Mona Island to Mayaguez	1–100 000
902	Guanica Light to Point Tuna Light	1–100 000
903	North coast of Porto Rico	1–100 000
914	Culebra Island and Approaches	1–20 000
915	Target Bay and Vicinity	1–10 000
916	Port Mulas and Approaches	1–10 000
929	Guanica Harbor	1–10 000
931	Mayaguez Bay and Approaches	1–15 000
4711	Northern Part of Luzon Island	Mercator.
4712	West Coast of Luzon Island	Mercator.
4713	East Coast of Luzon Island	Mercator.
4716	Paragua Island, P. I	Mercator.
4717	Cuyos and Cagayanes Islands	Mercator.
4720	Straits of Balabac and Approaches	Mercator.
4721	Jolo Sea, P. I	Mercator.
5531	San Francisco Bay, southern part	1–40 000
5532	San Francisco Entrance	1–40 000
5534	Suisun Bay, Cal	1–40 000
6443	Port Orchard, Wash	1–20 000
8094	Tongass River and Hassler Harbor	1–20 000
8105	Behm Canal, Alaska	Varying.
8285	Killisnoo Harbor, Alaska	1–10 000
9382	Golofnin Bay, Alaska	1–40 000
9385	Port Clarence and Grantley Harbor	1–80 000

In addition to the foregoing 514 charts were revised (including second and third revisions of the same chart), corrected and verified for new editions or new prints. Twenty-one projections for topographic sheets and 35 for hydrographic sheets were constructed for the use of the field parties or in the Office. Three hundred and fifty-four topographic and hydrographic sheets were inked, lettered, plotted, revised, or made ready for the approval of the Office.

A large number of illustrations (more than 100) were prepared for publication in the Annual Report of the Superintendent for 1902, and 40 illustrations were prepared for the Report for 1903.

A great deal of work was done at the request of the State Department in aiding in the preparation of the United States' case for presentation to the Alaska Boundary

Tribunal. This work included the preparation, verification of the maps in two atlases, and general supervision over the publication of the same, one of which contained 25 sheets and the other 30. In addition to the large maps, numerous special drawings and maps were prepared, including four bromide enlargements (4 by 10 feet). The work of the Drawing Section was under the immediate direction of Mr. E. H. Fowler, Chief Draftsman, who deserves great credit for the efficient manner in which the work has been carried on and the introduction of time and labor saving methods. The Chief of the Division reports that the men of this section have shown steady improvement in their work, and, being faithful and attentive, deserve credit for the high standard maintained and the amount of work completed.

Engraving Section.

The following original plates were completed:

Chart No.	Title.	Scale.
252	New Bedford Harbor and Approaches	1–20 000
518	Calcasieu Pass (heliogravure)	1–20 000
903	North Coast of Porto Rico	1–100 000
921	Fajardo Harbor and Approaches	1–10 000
1000	Cape Sable to Cape Hatteras	Mercator.
1001	Chesapeake Bay to Straits of Florida	Mercator.
5651	Fort Ross Cove (heliogravure)	1–6 000
5773	Shelter Cove, Cal. (heliogravure)	1–15 000
9381	Port Safety, Alaska (heliogravure)	1–15 000

The following plates were corrected for new editions of charts:

Chart No.	Title.	Scale.
S	San Francisco to Bering Sea	1–3 600 000
111	Nantucket Sound and Eastern Approaches	1–80 000
120	New York Bay and Harbor	1–80 000
124	Delaware Entrance	1–80 000
170	Key West to Rebecca Shoals	1–80 000
184	St. Josephs and St. Andrews Bays	1–80 000
320	Rockland Harbor	1–20 000
345	Robinsons Hole and Quicks Hole	1–10 000
346	Edgartown Harbor, Marthas Vineyard	1–30 000
359	New London Harbor and Approaches	1–20 000
369	New York Bay and Harbor	1–40 000
400	Hampton Roads to Norfolk	1–20 000
453	Fernandina Entrance	1–20 000
5106	San Diego Bay, Cal	1–40 000
5523	San Pablo Bay, Cal	1–50 000
5524	Petaluma and Napa Creeks	1–30 000
6140	Columbia River. Entrance to Upper Astoria	1–40 000
8800	Alaska Peninsula	1–1 200 000

The following miscellaneous plates were completed:

Plate No.	
2792.	Charleston Exhibition plate of Calais, Me.
2793.	Standard letters, transfer plate.
2794.	Field Sheet Notes, transfer plate.
2801.	Plate of squares, centimeter graduations.
2810.	Alphabet plate, slanting letters.
2814.	Notes for hydrographic sheets, transfer plate.
2820.	Bureau of Immigration plate.
2822.	Alphabet plate, upright letters.
2823.	Alphabet plate, upright letters.
2824.	Alphabet plate, slanting letters.

Recapitulation.

Recapitulation of the work done in the Engraving Section:

	Number.
Original plates commenced	5
Original plates completed	9
Original plates unfinished	23
New editions commenced	13
New editions completed	18
New editions unfinished	12
Miscellaneous plates finished	10
Plates corrected for printing	797

During the year there was a considerable increase in the number of new charts engraved as compared with the preceding year. A large portion of the time of the engravers was used in making extensive corrections to the printing plates, and, while the number of plates corrected for printing is not so large as during the previous year, the corrections have generally been more extensive. On all the plates for new editions of charts the form of the notes was changed to accord with the standard in use at present, and this involved a great deal of work. The continued use of the standard alphabet plates insured uniformity in all titles.

Printing Section.

	Number.
Impressions made for the Chart Section	75 518
Impressions made for proofs	4 197
Impressions made for standards	341
Impressions made for transfers (lithographs)	193
Impressions made for transfers (Drawing Section)	193
Impressions made on bond	266
Total impressions	80 708

Of the charts printed for the Chart Section, 1 365, namely, Nos. 369, 380, and 381, required two impressions, and 38 District of Columbia charts required four impressions, leaving 74 039 charts delivered to the Chart Section. The file of bond proofs was kept up to date.

In addition to the number of charts printed in the Printing Section, the following charts have been published by photolithography and sent to the Chart Section for distribution:

New charts.

Chart No.	Title.	Scale.
902	South Coast of Porto Rico	1–100 000
915	Target Bay and Vicinity	1–10 000
916	Port Mulas and Approaches	1–10 000
931	Mayaguez Harbor and Approaches	1–15 000
4711	Northern part of Luzon Island	Mercator.
4712	West Coast of Luzon Island	Mercator.
4713	East Coast of Luzon Island	Mercator.
4716	Paragua Island, Philippine Islands	Mercator.
4717	Cuyos and Cagayanes Islands	Mercator.
4721	Jolo Sea, Philippine Islands	Mercator.
5532	San Francisco Entrance	1–40 000
5534	Suisun Bay, Cal	1–40 000
8094	Tongass River and Hassler Harbor	Varying.
8285	Killisnoo Harbor, Alaska	1–20 000
9385	Port Clarence and Grantley Harbor	1–80 000

New editions.

Chart No.	Title.	Scale.
T.	General Chart of Alaska	1–3 600 000
109	Boston Bay and Approaches	1–80 000
244	Salem Harbor	1–20 000
249	Buzzards Bay, Mass	1–40 000
274	Harlem River	1–10 000
356	Block Island	1–10 000
577	Fernandina to Jacksonville	1–40 000
904	Virgin Passage to Vieques Sound	1–100 000
908	San Juan Harbor, P. R	1–10 000
920	Porto Rico	Mercator.
928	Guayanilla Harbor, P. R	1–10 000
4100	Hawaiian Islands	1–600 000
4202	Guam Island	1–80 000
8050	Dixon Entrance to Head of Lynn Canal	1–600 000
8302	Lynn Canal, Entrance to Port Sherman	1–80 000
9380	Norton Sound, Alaska	1–400 000
9381	Entrance to Port Safety	1–15 000

New prints.

Chart No.	Title.	Scale.
79	Chesapeake Bay	1–200 000
79	Chesapeake Bay	1–200 000
79	Chesapeake Bay	1–200 000
109	Boston Bay and Approaches	1–80 000
249	Buzzards Bay, Mass	1–40 000
293	New Bedford Harbor and Naval Station	1–10 000
297	Cuttyhunk Harbor	1–10 000
376	Delaware and Chesapeake Bays	1–400 000
413	Pensacola Bay Entrance	1–10 000
549	Baltimore Harbor	1–40 000
571	Port Royal Sound	1–40 000
911	Ponce Harbor, P. R	1–20 000
920	Porto Rico	Mercator.
922	Ensenada Honda, P. R	1–10 000
1000	Cape Sable to Cape Hatteras	Mercator.
1002	Straits of Florida and Approaches	Mercator.
1007	Gulf of Mexico	Mercator.
4243	Manila and Cavite Anchorages	1–30 000
4246	San Fernando Harbor, P. I	1–15 000
4251	Port Bolinao, Luzon Island	1–20 000
4252	Santa Cruz Harbor, Luzon Island	1–30 000
4441	Tacloban Harbor, P. I	1–20 000
5002	San Diego to Port St. George	Mercator.
6400	Seacoast and Interior Waters of Washington	1–300 000
6445	Seattle Harbor, Washington	1–20 000
8050	Dixon Entrance to Head of Lynn Canal	1–600 000
8521	Port Valdez, Prince Williams Sound	1–40 000
8860	Unimak and Akutan Passes	Mercator.

The total number of impressions made in the Printing Section was nearly 12 000 more than during the previous year, and over 16 000 more charts were printed as the result of completing the bond proof file for office use.

Photographic Section.

	Number.
Glass negatives made	304
Paper negatives made	62
Velox prints made	1 952
Vandyke prints made	228
Bromide prints made	89
Blue prints made	592
Silver prints made	10
Lantern slides made	40
Transparencies made	1
Negatives developed	482
Prints mounted	513

The output of this section was much larger than during the previous fiscal year and the details of the work are stated in the table given above.

Electrotyping Section.

	Number.
Kilograms of copper deposited	696
Square decimeters on which deposited	4 757
Alto plates made	39
Basso plates made	22

The work completed in this section is less than during the previous year, the result of three months enforced idleness of the plant while new machinery was being installed and repairs were being made. The plant is an excellent one and the facilities for work have been largely increased.

Chart Division.

Personnel.

Name.	Occupation.
Gershom Bradford	Inspector of Charts and Chief of Division.
Miss L. A. Mapes	Chief of Chart Section.
W. C. Willenbucher	Draftsman (July 1 to July 2).
J. T. Watkins	Draftsman.
E. H. Wyvill	Chart corrector.
H. R. Garland	Do.
J. B. Quinlan	Clerk.
A. B. Simpson	Buoy colorist.
Miss C. Willenbucher	Buoy colorist (July 12 to Sept. 11; Sept. 24 to Oct. 23).
John G. Allee	Buoy colorist (Apr. 27 to June 30; July 21 to June 30).
Miss Irine Roeth	Buoy colorist (Aug. 18 to Oct. 17).
Lucien White	Buoy colorist (Aug. 26 to Aug. 30).
Edward Sasnett	Buoy colorist (Aug. 26 to Aug. 27).
S. A. Reynolds	Buoy colorist (Oct. 9 to Apr. 22).
A. P. Breeden	Buoy colorist (July 1 to Nov. 7).
Archie Upperman	Map mounter.
J. H. Mason	Messenger.
Temporarily detailed.	
Swepson Earle	Draftsman (Nov. 10 to June 30).
Reinert Hanssen	Draftsman (Sept. 16 to May 25).
Williams Welch	Draftsman (July 1 to July 7).
J. C. Landers	Aid (Dec. 23 to Jan. 3).
G. T. Rude	Deck officer (Jan. 20 to Feb. 3).
F. B. Thompson	Deck officer (Apr. 14 to Apr. 27).

The Chief of Division supervised the two sections into which the Division is divided, gave personal attention to the inspection of new charts and new editions of charts in their various stages of progress, and prepared a new edition of the chart catalogue for publication.

Chart Section.

In this section all letters relating to the sale of charts and tide tables were prepared, the accounts with the sales agents were kept, the buoys on the charts were colored, and other routine work was done.

A few changes in the list agencies for the sale of charts were made and 10 additional agencies were established, bringing the total number in existence on June 30 up to 190.

Editions of 16 new charts, printed by photolithography, were issued during the year. Thirty-four new editions of charts, 19 printed from copperplate and 15 by photolithography, were also issued. Charts were received as follows:

From Drawing and Engraving Division	74 039
From lithographers	23 089
From Manila suboffice	4 165

The following table contains a list of charts which were prepared, published, and issued from the suboffice of the Survey at Manila, P. I., copies of which were received for issue at the Washington Office during the year:

Date of receipt.	Catalogue No.	Title.
1902.		
Aug. 6	4444	Ormoc Bay.
Aug. 6	4341	Paluan Bay.
Aug. 6	4445	San Juanica Strait.
Aug. 28	4446	Ports on the Coast of Samar.
Oct. 23	4342	Halsey Harbor.
Nov. 7	4253	Tabaco Bay.
Nov. 7	4254	Subig Bay.
Dec. 6	4447	Cebu Harbor and Approaches.
1903.		
Jan. 16	4255	Manila Bay and Coast of Luzon to Capones Island.
Feb. 3	4448	Iloilo Strait and Harbor (Subsketch Iloilo River).
Apr. 9	4258	Matnog Bay and Ticlin Strait; Port Gubat.
May 5	4256	San Bernardino Strait and Approaches.
June 1	4259	Rapurapu Strait.
June 1	4260	Aparri Anchorage and Part of Cagayan River.

Charts were issued as follows:

Sales agents	39 350
Sales by Office and Chart Section	1 526
Congressional account	3 766
Hydrographic Office, United States Navy	30 109
Light-House Board	3 235
Coast and Geodetic Survey Office	6 746
Coast and Geodetic Survey suboffice, Manila	3 100
Executive Departments	7 730
Foreign Governments	500
Libraries	546
Miscellaneous	1 101
Total	97 709

A comparison of the total issue of charts for the fiscal year with the issue in previous years, except for the years 1898 and 1899, when the issue for governmental purposes was abnormal, shows the total to be much larger than that of any other year, or 54 per cent larger than the average annual issue, and 32 per cent larger than the issue for the previous fiscal year. The above statement does not include the charts published and issued at the suboffice in Manila, except those sent to Washington for distribution.

Hydrographic Section.

The work of indicating the chart corrections and preparing the monthly Notices to Mariners was performed with marked ability by Mr. Wyvill. Mr. Watkins was employed in plotting and verifying field sheets, in the revision and verification of proofs, charts, and drawings, and on other miscellaneous work, which included the supervision of the work of various draftsmen temporarily detailed to duty in the Division.

Statistics of work.

Original sheets plotted	4
Soundings plotted	53 495
Angles protracted	15 025
Sheets verified and inked	9
Sheets verified	4
Soundings verified and inked	69 019
Soundings verified	93 892
Angles, protraction verified	50 893
Charts, corrections verified	125
Projections made	3

On July 2, 1902, the Division was deprived, by death, of the services of the chief hydrographic draftsman, Mr. W. C. Willenbucher, who entered the service in 1873, and rendered faithful and efficient service until death closed his useful and honorable career.

Instrument Division.

Personnel.

Name.	Occupation.
E. G. Fischer	Chief of Division.
W. C. Maupin	Clerk.
Otto Storm	Instrument maker.
C. Jacomini	Do.
W. R. Whitman	Do.
M. Lauxman	Do.
C. F. Zimmisch	Instrument maker (Sept. 20 to June 30).
H. G. Fischer	Instrument maker.
H. O. French	Carpenter.
G. W. Clarvoe	Do.
C. N. Darnall	Do.
Jere Hawkins	Messenger.

The energy of the Instrument Division during the year was largely devoted to repairing the numerous instruments in use by the field parties of the Survey. During the year 1 024 instruments were cleaned, adjusted, and sent to the field. Work on new instruments was done whenever more pressing duties permitted and the 12 new plane-table alidades begun during the previous fiscal year were completed.

Twelve pairs of telemeters were made, using a joint piece of improved design, made of magnalium, an alloy of aluminum and magnesium. Telemeters, with metallic backs, made in this way are as light as those made of wood and are sufficiently strong and rigid to resist very rough usage in the field without losing their usefulness. The difficulties arising from the oxidation and corrosion of the silver films on sextant mirrors, as the result of their use in the hydrographic work, was overcome by coating the mirrors sent to the Office for repairs with a mercury-tin amalgam. Various instruments were remodeled and repaired. A working design for a channel and harbor sweep, based on suggestions made to the Chief of the Division by officers of the Survey, was made and 9 of the sweeps were constructed for use on the vessels of the Survey. A description of this apparatus is given in Appendix 6 to this Report. The preparation of a design for a quick-sounding machine was undertaken in accordance with suggestions from officers of the Survey, and good progress was made in perfecting such a machine. A

considerable amount of work was done in repairing and improving the magnetic instruments of the Survey. Considerable progress was made in the construction of a new tide-predicting machine.

The usual routine work, including the verification of property returns and inventories of instruments and general property, was kept up to date.

The Chief of the Division was assigned to special duty on several occasions. In July he took part in the experiments with wireless telegraph apparatus, made for the purpose of testing the availability of the Marconi system for use in the longitude work of the Survey, as described in Appendix 1 to this Report, under the name of Assistant Wainwright. He made the arrangements necessary for the installation of an electrical tide indicator in the office of the Maritime Association of New York; examined an 8-inch alt-azimuth instrument belonging to the Trigonometrical Survey of Trinidad, British West Indies, at the request of the officer in charge, after extensive repairs had been made; supervised the construction of a leveling instrument of the same design as that used in the Survey, at the request of the Baltimore and Ohio Railway Company, and arranged for placing a contract for the construction of a tape base apparatus for the Brazilian Government, at the request of the authorities of that country. The continued applications made to the Superintendent for the service of experts to supervise the construction and repair of instruments of precision in this country, belonging to foreign governments, are gratifying evidences of the feeling of high esteem with which the Coast and Geodetic Survey is regarded abroad and of the confidence felt in the officers and methods of the organization. In closing his report Mr. Fischer states that—

> The conduct of the employees of the Division, whose work is of a much higher class than that given to employees in the same class of work in private establishments, is worthy of praise. They have shown zeal and conscientious interest in the performance of the duties assigned to them.

Library and Archives.

Personnel.

Name.	Occupation.
Edw. L. Burchard	Librarian.
A. F. Zust	Writer.
E. K. Foltz	Writer (July 1 to Aug. 6).
Mrs. M. A. Grant	Writer.
J. G. Maupin	Writer (absent five months).
Miss M. L. Handlan	Writer.
S. B. Little	Writer (July 16 to Aug. 9).
L. H. White	Writer (Sept. 26 to June 30).
W. H. Butler	Messenger.

The routine work in the library was kept up to date. The records of observations made in the field were indexed as they were received. The Chief of the Division completed the compilation of the "List and catalogue of the publications of the Survey, 1816–1902," and read the proof of this publication. He was detailed to the Department of Commerce and Labor on June 10 for the purpose of organizing the Department library. In his absence Mr. A. F. Zust performed his duties as acting librarian.

Accessions.

Items.	Purchased.	Donated.	Exchanged.	Total.
Books	121	60	172	353
Pamphlets	17	105	208	330
Serials	149	201	771	1 121
Maps and charts	122	227	2 622	2 971

Issued for temporary use.

Books and pamphlets	2 244
Serials	720
Records	4 779
Original sheets	3 722
Maps and charts	2 406

The following list shows the original records received:

Subject.	Volumes.	Cahiers.	Sheets.
Astronomy	46	.....	.....
Geodesy	108	.....	.....
Hydrography	303	.....	47
Hypsometry	134	.....	.....
Magnetism	90	947	.....
Tides	90	3	.....
Topography	.....	63	29
Total	771	1 013	76
Photographs:			
Prints	12	.....	.....
Negatives	104	.....	.....

Miscellaneous Section.

Personnel.

Name.	Occupation.
H. C. Allen	Clerk and Chief of Section.
C. W. Jones	Clerk.
Thomas McGoines	Messenger.

The routine work of this section was kept up to date and was larger in amount than during the previous fiscal year. The money available for the Office expenses was larger than usual and a greater number of publications were received and issued, as shown in the following lists. The issue of the monthly Notice to Mariners, involving 1 600 addresses, was assigned to this section on July 1, and they were mailed promptly as soon as received from the printer. The use of an addressograph, purchased for the purpose, greatly facilitated the work of mailing the publications of the Survey and rendered it possible to accomplish the large amount of work performed by those engaged upon it.

In reporting upon the work of the section Mr. Allen states his pleasure in commending Mr. C. W. Jones, Clerk, and Thomas McGoines, Messenger, for their faithfulness and attention to duty.

The following publications were received from the Public Printer:

Report of the Superintendent of the Coast and Geodetic Survey, showing the progress of the work from July 1, 1901, to June 30, 1902	2 000
List and Catalogue of the Publications issued by the United States Coast and Geodetic Survey, 1816–1902	3 006
United States Declination Tables and Isogonic Charts for 1902 and Principal Facts Relating to the Earth's Magnetism	4 000
United States Coast Pilot, Atlantic Coast, Part VI, Chesapeake Bay and Tributaries. Second Edition	1 011
Cotalogue of Charts, Coast Pilots, and Tide Tables, 1902	2 039
Tide Tables for the Year 1903	1 525
Tide Tables for the Year 1904	1 400
Tide Tables for the Atlantic Coast of the United States, including Canada and the West Indies. Reprinted from Tide Tables for 1903	1 000
Tide Tables for the Pacific Coast of the United States, together with a number of foreign ports in the Pacific Ocean. Reprinted from Tide Tables for 1903	7 060
Geodesy. Triangulation in Kansas. Appendix No. 3, Report for 1902	500
Terrestrial Magnetism. Magnetic Observatories of the United States Coast and Geodetic Survey in Operation July 1, 1902. Appendix No. 5, Report for 1902.	500
Terrestrial Magnetism. Magnetic Dip and Intensity Observations, January, 1897, to June 30, 1902. Appendix No. 6, Report for 1902	1 050
Geography. Hawaiian Geographic Names. Appendix No. 7, Report for 1902	100
Geodesy. A Bibliography of Geodesy. Second edition. Appendix No. 8, Report for 1902 (paper bound)	700
Geodesy. A Bibliography of Geodesy. Second edition. Appendix No. 8, Report for 1902 (cloth bound)	99
Supplement to the Third Edition. United States Coast Pilot, Atlantic Coast, Part IV. From Point Judith to New York. March 26, 1903	700
Supplement to the Reprint of Second Edition. United States Coast Pilot, Atlantic Coast, Part V. From New York to Chesapeake Bay Entrance. March 28, 1903	400
Supplement to Second Edition. United States Coast Pilot, Atlantic Coast, Part VII. From Chesapeake Bay Entrance to Key West. July 15, 1902	500
Supplement to Second Edition. United States Coast Pilot, Atlantic Coast, Part VIII. Gulf of Mexico, from Key West to the Rio Grande. December 23, 1902	500
Notice to Mariners, Nos. 286 to 298, inclusive, June, 1902, to May, 1903, including one Index, 4 500 each number	58 500

The following publications were received from Manila, P. I.:

Bulletin: Philippine Islands. Sailing Directions for the North and West Coasts of Luzon, from Cape Enango to Manila Bay	120
Bulletin: Philippine Islands. Section II. Sailing Directions for the Southwest and South Coasts of Luzon and Adjacent Islands	200
Bulletin: Philippine Islands. Section III. Sailing Directions for the Coasts of Panay, Negros, Cebu, and Adjacent Islands	200
Bulletin: Philippine Islands. Section IV. Sailing Directions for the Coasts of Samar and Leyte and the East Coast of Luzon	200
Bulletin: Philippine Islands. Section V. Sailing Directions for the Coasts of Mindanao and Adjacent Islands	200

Catalogue of Charts, Sailing Directions, and Tide Tables of the Philippine Islands	99
Philippine Islands Notice to Mariners, No. 1	100
Philippine Islands Notice to Mariners, No. 2	101
Philippine Islands Notice to Mariners, No. 3	100
Philippine Islands Notice to Mariners, No. 4	102
Philippine Islands Notice to Mariners, No. 5	100

The following publications were undelivered and returned to the Office:

Reports of the Superintendent between the years 1848 and 1902, inclusive	147
List and Catalogue of Publications issued by the United States Coast and Geodetic Survey, 1816–1902	8
United States Declination Tables and Isogonic Charts for 1902 and Principal Facts Relating to the Earth's Magnetism	11
Bulletin No. 40. Fourth Edition—with additions and changes. Alaska. Coast Pilot Notes on the Fox Islands Passes, Unalaska Bay, Bering Sea, and Arctic Ocean, as far as Point Barrow	51
Special Publication No. 2. Bibliography. Descriptive catalogue of publications relating to the Coast and Geodetic Survey	1
Special Publication No. 3. The Philippine Atlas. (Furnished from the Treasury Department.)	180
Special Publication No. 7. Geodesy. The Eastern Oblique Arc of the United States and Osculating Spheroid	5
United States Coast Pilot, Atlantic Coast, Part IV. From Point Judith to New York. Third edition	5
United States Coast Pilot, Atlantic Coast, Part V. From New York to Chesapeake Bay Entrance. Second edition (reprint, with supplement)	3
United States Coast Pilot, Atlantic Coast, Part VI. Chesapeake Bay and Tributaries. First edition (obsolete)	1
United States Coast Pilot, Atlantic Coast, Part VIII. Gulf of Mexico, from Key West to the Rio Grande. First edition (obsolete)	1
Pacific Coast. Coast Pilot of California, Oregon, and Washington. Fourth edition (entirely rewritten), 1889	1
Geodesy. A Bibilography of Geodesy. Second edition. Appendix No. 8. Report for 1902 (paper bound)	6
United States Coast Pilot, Atlantic Coast, Part VII. From Chesapeake Bay Entrance to Key West. Second edition	2

The following publications were issued by the Office:

Annual Reports (covering the years 1851 to 1902):		
Domestic distribution—		
Individuals	1 987	
Institutions	1 416	
Foreign distribution—		
Individuals	341	
Institutions	577	
		4 321
Appendices to Annual Reports		2 400
Bulletins		469
Tide Tables, Complete, one each for 1892, 1898, 1899		3
Tide Tables, Complete, two for 1900		2
Tide Tables, Complete, 1901		4
Tide Tables, Complete, 1902		63
Tide Tables, Complete, 1903		1 167
Tide Tables, Complete, 1904		114

Tide Tables, Atlantic Coast, 1895	2
Tide Tables, Atlantic Coast, 1901	3
Tide Tables, Atlantic Coast, 1902	119
Tide Tables, Atlantic Coast, 1903	780
Tide Tables, Pacific Coast, 1895	1
Tide Tables, Pacific Coast, 1901	2
Tide Tables, Pacific Coast, 1902	175
Tide Tables, Pacific Coast, 1903	6 495
United States Coast Pilot, Atlantic Coast, Parts I–II	14
United States Coast Pilot, Atlantic Coast, Part III	67
United States Coast Pilot, Atlantic Coast, Part IV	359
United States Coast Pilot, Atlantic Coast, Part V	248
United States Coast Pilot, Atlantic Coast, Part VI, first edition	2
United States Coast Pilot, Atlantic Coast, Part VI, second edition	586
United States Coast Pilot, Atlantic Coast, Part VII	214
United States Coast Pilot, Atlantic Coast, Part VIII	261
Pacific Coast Pilot, California, Oregon, and Washington	69
United States Coast Pilot, Pacific Coast, Alaska, Part I, edition of 1869	2
United States Coast Pilot, Pacific Coast, Alaska, Part I, edition of 1883	1
United States Coast Pilot, Pacific Coast, Alaska, Part I, fourth edition	101
Supplement to United States Coast Pilot, Atlantic Coast, Parts I–II, III, VI, VIII, February, 1900	54
Supplement to First Edition United States Coast Pilot, Atlantic Coast, Parts I–II, February 12, 1900	15
Supplement to First Edition United States Coast Pilot, Atlantic Coast, Part III, September 22, 1899	69
Supplement to First Edition United States Coast Pilot, Part IV, March 26, 1903	128
Supplement to the reprint of Second Edition United States Coast Pilot, Atlantic Coast, Part V, December 19, 1900	182
Supplement to the reprint of Second Edition United States Coast Pilot, Atlantic Coast, Part V, March 28, 1903	97
Supplement to First Edition United States Coast Pilot, Atlantic Coast, Part VI, February 13, 1900	2
Supplement to Second Edition United States Coast Pilot, Atlantic Coast, Part VII, July 15, 1902	221
Supplement to Second Edition United States Coast Pilot, Atlantic Coast, Part VIII, December 23, 1902	159
Catalogue of Charts, Coast Pilots, and Tide Tables, 1902	1 864
Special Publication No. 1. California, Bay of San Francisco. Magnetic Ranges for Determining the Deviation of the Compass, with Short Explanations of How to Find the Deviation and Error of the Compass	13
Special Publication No. 2. Bibliography. Descriptive Catalogue of Publications Relating to the United States Coast and Geodetic Survey, 1807 to 1896, and the United States Standard Weights and Measures, 1790 to 1896	4
Special Publication No. 3. The Philippine Atlas	42
Special Publication No. 4. The Transcontinental Triangulation and the American Arc of the Parallel	56
Special Publication No. 5. Geodesy. Tables for a Polyconic Projection of Maps, Based on Clarke's Reference Spheroid of 1866, second edition	72
Special Publication No. 6. Notes Relative to the Use of Charts	50
Special Publication No. 7. Geodesy. The Eastern Oblique Arc of the United States and Osculating Spheroid	1 610
List and Catalogue of Publications of the Coast and Geodetic Survey, 1816–1901	2 076
United States Declination Tables, 1902	3 993
Notices to Mariners, printed at Washington	54 952

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APPENDIX No. 3.

REPORT 1903.

PRECISE LEVELING IN THE UNITED STATES, 1900-03, WITH A READJUSTMENT OF THE LEVEL NET AND RESULTING ELEVATIONS.

By JOHN F. HAYFORD,
Inspector of Geodetic Work,
Assistant, Coast and Geodetic Survey.

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ILLUSTRATIONS.

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PRECISE LEVELING IN THE UNITED STATES, 1900–1903, WITH A READJUSTMENT OF THE LEVEL NET AND RESULTING ELEVATIONS.

By JOHN F. HAYFORD, *Inspector of Geodetic Work; Assistant, Coast and Geodetic Survey.*

GENERAL STATEMENT.

This appendix is a supplement to Appendix No. 8 of the Report for 1899, entitled "Precise Leveling in the United States." The purpose of that appendix was, as stated in its introduction, "To bring the publication in detail of the results of precise leveling by the Coast and Geodetic Survey as nearly as possible up to date; to set forth the methods employed in making a general adjustment of the precise level net covering the eastern half of the United States and involving leveling by other organizations as well as by the Coast and Geodetic Survey; to put into print in convenient form for ready reference a concise compilation of the corrected elevations resulting from this general adjustment; and, finally, to make available in form for general use, examination, and criticism the more important items of information and opinions in regard to precise leveling which have been acquired during the course of a long and careful investigation of the problem of making such an adjustment and of securing the highest degree of accuracy in future precise level observations consistent with a reasonable degree of economy and rapidity." The purpose of the present appendix is to furnish such additions and corrections as will bring the information in regard to precise leveling in the United States up to 1903.

Four new lines were run by the Coast and Geodetic Survey in 1900, with an aggregate length of 1 525 kilometers (948 miles). One of these lines extends from Cincinnati southward through Kentucky, Tennessee, and Alabama to Birmingham. It connects at Knoxville, Tenn., with the thousand-mile loop of precise levels which had been run in 1896–1898 by the United States Geological Survey from Morehead City, N. C., to Brunswick, Ga., via Raleigh, Asheville, Knoxville, and Atlanta. It also connects at Decatur and at Birmingham with the lines Corinth to Decatur and Meridian to Birmingham, respectively, which are shown in Appendix No. 8 of the Report for 1899. This line, together with the Geological Survey line with which it connects, serves then to break up the single large circuit, Washington—Hagerstown—Odin—Biloxi—Washington, of the precise level net of 1900 (see sketch opposite page 424, Report for 1899) into five smaller circuits, and to furnish accurate elevations for the southeastern group of States. A second line was run in 1900 from Norfolk, Nebr., to

Sioux City, Iowa. It served to add a new circuit, Kansas City—Sioux City—Norfolk—Abilene—Kansas City, to the precise level net of 1900. The two other lines run during 1900 by the Coast and Geodetic Survey were from Norfolk, Nebr., to Page, Nebr., to connect with the Page Base, and from Solomon, Kans., to Anthony, Kans., to connect with the Anthony Base.

Three new lines were run by the Coast and Geodetic Survey in 1901 with an aggregate length of 851 kilometers (529 miles). Two of these lines, namely, from the Page Base westward to Chadron, Nebr., and from Cheyenne, Wyo., to Orin Junction, Wyo., served to bring a new circuit of the level net nearly to completion. The third line was from Decatur, Ala., to Corinth, Miss. After the level line of 1900 had been run from Cincinnati, Ohio, to Birmingham, Ala., by way of Decatur, it became evident that there was a large error of 0.7 meter or more in some one of the level lines in Alabama and Mississippi. The evidence indicated that the error was probably in the line Corinth to Decatur, which had been run under the direction of the Corps of Engineers in 1895. It was determined, therefore, to relevel this line, even though it was run originally with great care by an excellent method and with good instruments. The releveling of this line developed a discrepancy of 1 meter near the western end of the line, as set forth later in this publication.

Four new lines were completed by the Coast and Geodetic Survey in 1902. The aggregate length of these lines is 2 000 kilometers (1 243 miles). The line from Dobbs Ferry, N. Y., to Greenbush, N. Y. (now Rensselaer), as used in the adjustment of the level net in 1899, was known to be of an inferior degree of accuracy. In view of the facts that a large amount of new water leveling and precise leveling was being done in the region of the Great Lakes by the United States Lake Survey, that the officers of that Survey were very desirous of securing as high a degree of accuracy as possible in the determinations of the absolute elevations of the Lakes, and that any uncertainty in the elevation at Greenbush affected directly all of the assigned elevations throughout the Great Lakes, it was determined to rerun the line Dobbs Ferry to Greenbush and supersede the old line, and this was done early in the summer of 1902.

The second line of 1902 was from Chadron, Nebr., westward to Orin Junction, Wyo. It served to complete the great circuit, Abilene, Kans.–Norfolk, Nebr.–Orin Junction, Wyo.–Cheyenne, Wyo.–Denver, Colo.–Abilene, Kans., and thus to secure fully checked accurate elevations connected with the net as far westward as Cheyenne and Denver.

The third line of 1902 (finished in 1903) reaches from the Anthony Base in southern Kansas southward to Bowie, Tex., and eastward to Shreveport, La., with spur lines to Bowie Base and by way of Temple to Lampasas Base and to Holland, Tex. This line is connected with the ninety-eighth meridian triangulation at various points between Anthony, Kans., and Lampasas, Tex., in addition to those named. The portion of the line from Anthony, Kans., to Shreveport, La., by way of Bowie, Tex., and Fort Worth, Tex., forms the west side of a great circuit, Monroe, La.–Little Rock, Ark.–Harrisonville, Mo.–Holliday, Kans.–Abilene, Kans.–Shreveport, La.–Monroe, La.

The fourth line of 1902 was from Rockreek, Wyo., the former western terminus of the precise leveling, to Red Desert, Wyo. It is proposed to continue this line

westward, via Ogden, to Seattle, where it will connect with sea level on the Pacific Coast.

Besides the above new lines by the Coast and Geodetic Survey, the following lines run by other organizations have been added to the precise level net:

First. The loop of precise levels run by the United States Geological Survey from Morehead City, N. C., to Brunswick, Ga., via Raleigh, Asheville, Knoxville, and Atlanta, 1 674 kilometers (1 040 miles), has been already referred to in connection with the Coast and Geodetic Survey line in 1900 from Cincinnati to Birmingham, with which it is connected at Knoxville by a Coast and Geodetic Survey spur line.

A line by the United States Geological Survey from Cleveland, Tenn., to Chattanooga, Tenn., connects the loop again with the Cincinnati-Birmingham line at Chattanooga. Ten lines of the Geological Survey in New York, Pennsylvania, and Ohio, with an aggregate length of 1 128 kilometers (701 miles), were also added.

Second. The line from Biloxi, Miss., to Fort Adams, Miss., via New Orleans and Baton Rouge, 407 kilometers (253 miles), was run under the direction of the Mississippi River Commission in 1897–98 and 1900. This line enters directly into the level net, superseding the lines between those points formerly run by the Coast and Geodetic Survey and the Mississippi River Commission. There can be little doubt that the earlier leveling should be superseded, partly because the later leveling is probably of a higher degree of accuracy and partly because there are good reasons for supposing that the elevations of many of the intermediate bench marks have changed since the earlier leveling.

Third. The line Pittsburg, Pa., to Lawrenceburg, Ind., 791 kilometers (491 miles), was run under the direction of the Corps of Engineers in 1896–97 and 1899–1900 in connection with surveys of the Ohio River. This line is continued westward beyond Lawrenceburg to Petersburg, Ky. The line Pittsburg to Lawrenceburg crosses and is connected with the line Grafton to Cincinnati, at Belpre, Ohio, and it therefore adds two new circuits to the level net.

Fourth. The lines Brainerd to Lake Itasca, 205 kilometers (127 miles), and Cass Lake to Grand Rapids, 98 kilometers (61 miles), both in Minnesota, run under the direction of the Corps of Engineers, were added to the net as spurs.

Fifth. The line Lima to Monaca in Ohio, 380 kilometers (236 miles), run by the Pennsylvania Railroad Company, was furnished for incorporation in the net by the United States Geological Survey. It divides one circuit of the former net into two. The line Harrisburg to Williamsport, by the Pennsylvania Railroad Company, was also incorporated into the net from their bench mark book.

Sixth. The new line of levels run by the Baltimore and Ohio Railroad in 1902 with instruments and methods similar to those now in use by the Coast and Geodetic Survey, from Washington, D. C., to Foley, Pa., 283 kilometers (176 miles), was incorporated in the net. It is connected with the leveling formerly used in the net at Hancock, W. Va., and Cumberland, Md., as well as at Washington, D. C.

Seventh. The United States Lake Survey made the most important addition to the level net received from outside the Coast and Geodetic Survey. It furnished a new line of precise levels from Greenbush, N. Y., to Oswego, N. Y., 313 kilometers (194 miles), several short lines between the Great Lakes, and a series of new or revised water levels covering the whole region of the Great Lakes. The water levels are in part a revision

of old observations and in part new observations, and supersede all the water leveling on the Great Lakes formerly used in the level net. The Greenbush-Oswego line supersedes all former lines between those points in so far as the adjustment of the level net is concerned. This contribution by the Lake Survey of 4 275 kilometers (2 656 miles) of water leveling, and of 564 kilometers (350 miles) of land leveling lines, nearly all of the highest degree of accuracy, serves to strengthen greatly all that portion of the level net between Greenbush, N. Y., and Tibbetts Point, N. Y., on the eastern, and Chicago and Duluth on the western portion of the net.

Eighth. Certain lines run by the Board on Deep Waterways and by the New York State Barge Canal Survey in New York, which were connected at both ends with lines of the level net, have been used to furnish the elevations of certain permanent bench marks established along them. They have not, however, been used in the adjustment of the level net. The proper corrections have been applied to make them fit the net, and the corrected elevations have been introduced into the list of published elevations. In each case the lines used in the level net between the same end points are of a much higher degree of accuracy than these levels.

There has thus been added to the level net since it was adjusted in 1899, 4 300 kilometers (about 2 700 miles) of precise leveling by the Coast and Geodetic Survey and 3 200 kilometers (about 2 000 miles) of leveling by other organizations. Of these lines only the last two in Minnesota are on spurs from the net. All the other lines form links or parts of links of the net and are therefore concerned in the adjustment.

When there is added to such a level net as that which was fully and carefully adjusted in 1899, so much new and accurate leveling as is indicated above, it is not easy to decide upon the best course of procedure. It is a great convenience to have fixed assigned elevations for bench marks—standard elevations, so to speak—to which all other elevations in surrounding regions shall be referred. Every change in the assigned elevations of the principal bench marks is apt to cause inconvenience by making extensive changes necessary in computations based upon these assigned elevations. On the other hand, however desirable it may be to have fixed values for the elevations of the principal bench marks, it does not seem possible to decide upon a final standard elevation for any bench mark, unless it is known positively that no more precise leveling connected with the net is to be done, or else that, if done, it will not be utilized to improve existing assigned elevations. If all new leveling is to be utilized to the fullest extent in securing elevations of the highest degree of accuracy in every part of the net, then whenever new leveling forming links in the net is secured the whole net must be readjusted and the old adjusted elevations must be completely superseded by the new.

A conservative procedure intermediate between the two radical plans indicated above—namely, that of holding all old elevations without change and merely fitting new leveling to the old, and that of superseding all old elevations by new ones—seems to be best and has been followed in this appendix. Whenever a new adjustment of a net is made on account of the introduction of new lines of levels the changes in the old elevations and differences of elevations are necessarily greater in the vicinity of the new leveling than in regions more remote. At any junction point in the net for which the change in the assigned elevation required by the new adjustment is very small, or, in other words, for which the elevations from the old and new adjustments agree closely, it seems best to hold the old assigned elevation. Especially does it seem certain that

whenever the change called for by the new adjustment is considerably smaller than the uncertainties in the new adjusted elevations no change should be made. So also when for any link of the net the new adjustment gives a difference of elevation for its two ends which agrees with the old adjusted difference of elevation within the limits of uncertainty of the new adjusted difference it seems that the old difference of elevation should be held without change, even though a constant correction to the elevations along the line be found necessary.

It happens that the new leveling introduced into the net in the 1903 adjustment supersedes the two most important connections with mean sea level—namely, at New York from the northward and at Biloxi from the westward—and that in each case the effect is to increase the assigned elevations of points in the interior. Hence, it was found in applying the above principles to the adjustment of 1903, that very few of the elevations could be held without change. It was found, however, that some of the differences of elevations could be kept unchanged, or, in other words, that there was a group of lines for which simply a constant change in the elevations was required to bring them sufficiently near to the theoretically best values.

The composition of the level net as adjusted in 1903, including all spurs, but excluding all superseded lines, is as follows:

	Kilometers.	Miles.
Leveling by the Coast and Geodetic Survey previous to 1899	7 154	4 445
Leveling by the Coast and Geodetic Survey in 1899 and later	5 549	3 448
Leveling by the Corps of Engineers with Kern levels, excluding Lake Survey leveling	7 006	4 354
Leveling by the United States Lake Survey, of which 4 275 kilometers is water leveling	5 284	3 283
Miscellaneous lines of leveling, of which 103 kilometers is water leveling	6 796	4 223
Total	31 789	19 753

The new leveling added since the adjustment of 1899 was made constitutes more than 30 per cent of the net as now adjusted.

The adjustment of 1899 fixed the elevations of 4 200 bench marks. The 1903 adjustment fixes the elevations of 6 900 bench marks, all published in this appendix.

The complete list of elevations as adopted for the present is published in this appendix. It is believed that these adopted elevations are substantially as good as any that can be deduced from the leveling available at this Office up to date (July, 1903).

Descriptions are published in this appendix for all bench marks introduced into the net for the first time, and revised descriptions or additional notes to descriptions are introduced as a result of information acquired since the last publication, or to correct mistakes in that publication.

Aside from acknowledgments made at other points in this publication, the author feels that he should acknowledge here his indebtedness to Miss Lilian Pike, Computer, for her supervision of the computations of the leveling for 1901 and 1902 of the Coast and Geodetic Survey and of the preparation of the new list of elevations of the bench marks for the whole net, for a portion of the work of adjustment, and for much verbal assistance in preparing this text; to Mr. O. M. Leland, Computer, for aid in the adjustment of the level net, and to Mr. W. H. Burger, Aid, for supervision of the computations of the Coast and Geodetic Survey level lines of 1900, and assistance in gathering some of the material for this text.

THE NEW PRECISE LEVEL.

Commencing with the summer of 1900 a new type of precise level was put into use in the Coast and Geodetic Survey, and a method of observation was adopted which has remained unchanged except in unimportant details since that time. Three seasons of leveling have furnished a thorough test of the instrument and method. The train of events leading up to the change is of little importance now. The justification of the present instrument and method must be found in the accuracy, rapidity, and cheapness of the recent leveling. Hence, in this appendix, the first official publication in which the results of these three seasons of leveling appear, it is appropriate that detailed information in regard to the degree of success attained in the leveling since the change was made should be fully set forth.

The following description* of the new instrument is reproduced, with a few and unimportant changes, from a description written by Mr. E. G. Fischer, Chief of the Instrument Division, Coast and Geodetic Survey, and the designer of the instrument.

When it became necessary to provide additional instruments for carrying out the geodetic leveling planned for the season of 1900, opportunity arose to embody in a new design the fruits of the deliberations of the committee on precise leveling of 1898–99,† whose conclusions had been tried and proven with the three geodetic levels Nos. 1, 5, and 6, remodeled in the instrument shop of the Survey in the spring of 1899 and used in the field during the whole of that season. A careful study of the results obtained with these instruments proved conclusively that the use of the new alloy of iron and nickel, which was first applied in their reconstruction, and the reduction of the distance between the level and the line of collimation were decided improvements and practically eliminated errors due to temperature effects.

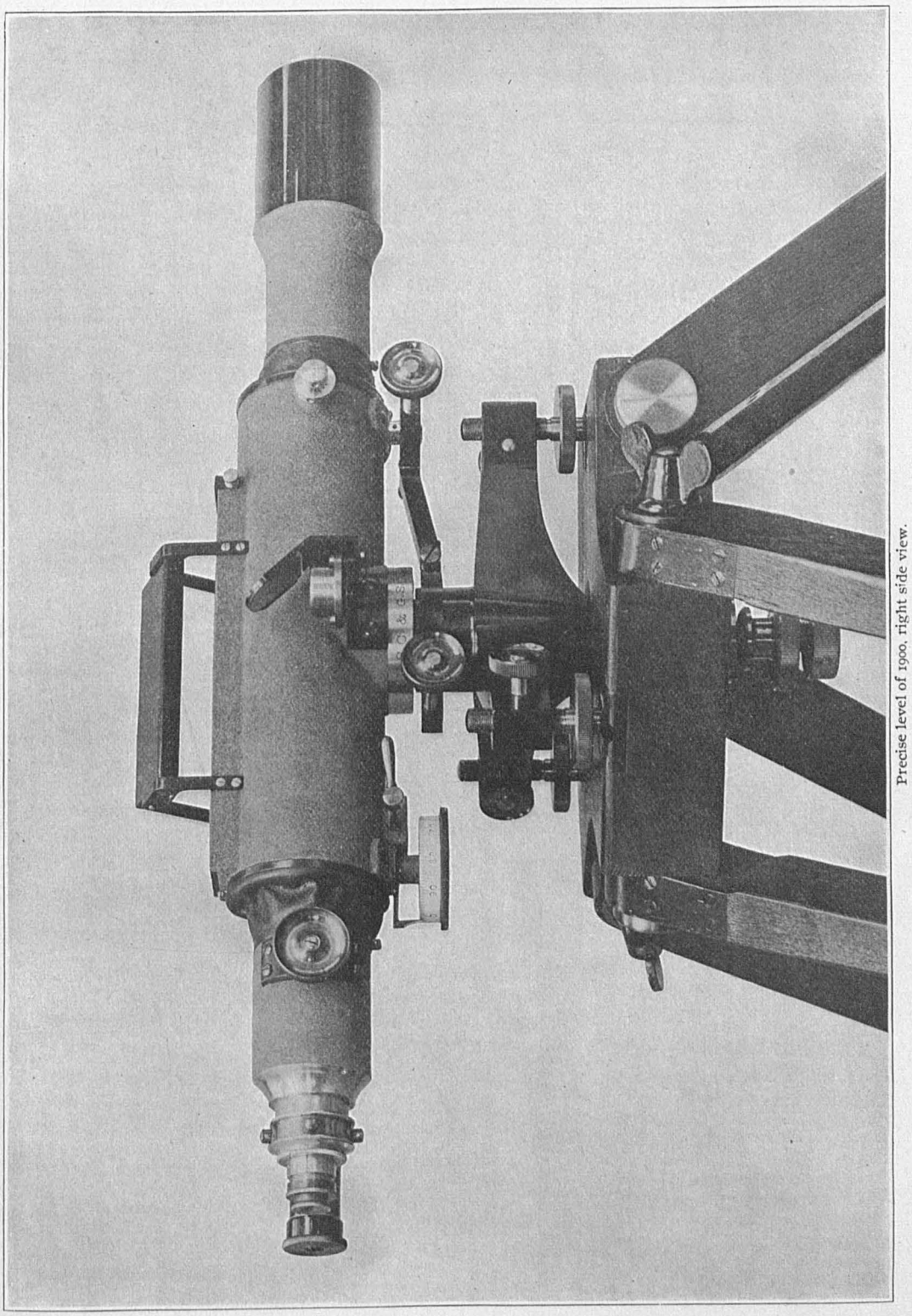
These facts were kept in view in designing the new instruments. As the newly adopted method of observation obviated the use of the reversible stride level and the rotating telescope, the distance between the level and the line of collimation could be reduced to a minimum by placing the former in an opening cut into the telescope and the latter could be placed within a tube-shaped support, at one end of which two pivot screws provide a horizontal axis around which the telescope can be rotated and the line of collimation put into the horizon by means of a fine motion or micrometer screw mounted at the other end. By making the support for the telescope tubular, it was not only given the strongest and lightest form, but it could be made to serve at the same time as a protection to the level mounted in the telescope. The level-reading device, in principle the same as that used in the reconstruction of levels Nos. 1, 5, and 6, being mounted at the side of the telescope at binocular distance from it, offers, with the exception of a small mirror, which is almost horizontal and fastened neither to the level nor the telescope, no additional surface to wind pressure and enables the observer to stand with head and body erect while observing the rod with one eye and the level with the other.

As has been done in designs of other instruments made for the Survey, the legs of the instrument were put as high up on the center bearing as possible and the lower part

* This description was originally published as Appendix 6 of the Report for 1900, but is now (July, 1903) out of print as a separate appendix.

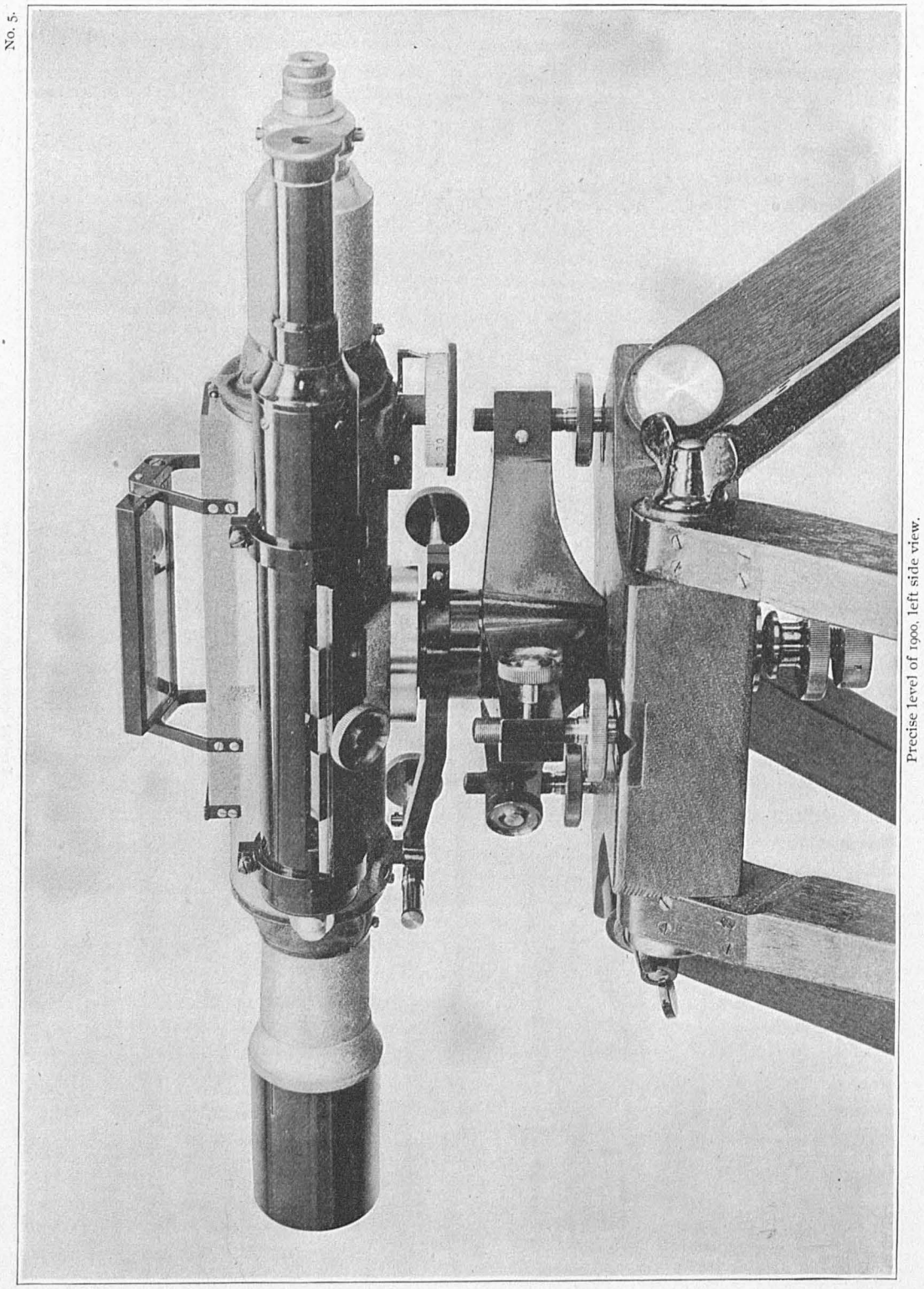
† See page 352 of Appendix 8 of the Report of 1899.

No. 4.



Precise level of 1900, right side view.

No. 5.



Precise level of 1900, left side view.

of the latter disposed of within the head of the tripod; thus not only affording room for an unusually long and therefore more durable and rigid center, but also bringing the center of gravity of the instrument much nearer to the plane of support.

THE MATERIAL IN THE NEW LEVEL.

For all those parts upon which depend the constancy of the relation between the line of collimation and the level—the telescope, the tube incasing the level vial, the draw-tube, reticle ring, and the supporting cylinder—the material selected is the same as that used in the reconstruction of geodetic levels Nos. 1, 5, and 6 in the spring of 1899.

The nickel-steel alloys brought out by Dr. Ch. Ed. Guillaume,* of the International Bureau of Standard Weights and Measures, had attracted considerable attention by reason of their low expansion coefficients (down to 0.000001 per degree centigrade). Inquiry established the fact that tubing and castings, almost indispensable in the construction of instruments, could not be obtained, because attempts to produce them had not yet been successful. Mr. George T. Ennis, of Washinton, D. C., who furnishes the brass castings required in the shops of the Survey, was persuaded to undertake a series of trials in 1899 of alloying various kinds of steel and iron with nickel. A quantity of what in the trade is called "machinery steel" and commercially pure nickel was weighed off in the proportion of 64 of steel to 36 of nickel, the same from which Dr. Guillaume obtains a coefficient of less than one-millionth per degree centigrade. The furnaces of brass founders being supplied with air only by natural draft, it was with considerable difficulty that sufficient heat could be developed to melt the steel, and when mixture with the nickel was finally accomplished the temperature was still too low to allow impurities to rise freely to the surface and leave the casting sound and solid. In another attempt steel turnings from the large gun forgings being assembled at the Washington ordnance yard were used, but the trial castings also proved porous.

The coefficients of these specimens, as determined from the temperatures of 0° and about 60° C., were, however, quite low, namely, three-millionths, nearly. The melting point of cast iron being much lower than that of wrought iron or steel, a trial was made with it, using the same proportion. But while the castings were now sound and free from pores the coefficient had increased to nearly five-millionths. The results of Dr. Guillaume's investigations showing that but a slight variation from the above given proportion caused a change of several units in the sixth place of the coefficient, it was thought likely that a loss of one or the other of the two metals by oxidation during the melting and mixing was the cause of this increase. For this reason a number of alloys were made of different proportions, of which one of 66⅔ parts of a medium-grained cast iron, furnished by the Brown & Sharpe Manufacturing Company, of Providence, R. I., and 33⅓ parts of which is called "grain nickel" was finally adopted. It can be cast free from sand and blowholes, and has a coefficient of 0.000004.

No thorough tests as to strength, etc., were made of this alloy, but so far as shop practice reveals its physical properties it can be said to be rather brittle, easily worked in the lathe and with the file, entirely unmalleable, and behaving practically like the better and softer grades of cast iron.† It can readily be brazed and soldered, and,

* These alloys are protected by patents.

† As soon as nickel-steel tubing can be obtained the instruments may be considerably improved by its use. Such material will not be brittle, like the material here described, and moreover will probably have a much lower coefficient of expansion.

unlike cast iron, very easily takes an exceptionally fine polish, resembling that of nickel. The smoothness with which it wears against itself, even under considerable pressure, should be particularly mentioned. For instance, the nickel-iron drawtubes of the three remodeled instruments of 1899, though moving in bearings of the same metal, do not show the slightest wear or looseness, though they were used in running 200, 300, and 600 miles of leveling line, respectively.

None of the acids except aqua regia will readily attack it. A rectangular piece submerged in water for twelve days showed formation of what resembled iron oxide, but only along the sharp corners and without pitting, while the surfaces remained bright. A rough test proved the specific gravity of the alloy to be between that of iron and of nickel, but below that theoretically deduced from their proportions. The nickel used in these experiments was purchased at a cost of 42 cents and the iron at 6 cents a pound, making the cost of the two-to-one alloy 18 cents per pound, which is 2 cents less than that of good brass.

The pointed screws pivoting the telescope, the screws holding in place the level tube and by which the level is adjusted, the screws holding and adjusting the reticle ring, and the fine-motion micrometer screw, upon all of which depends the constancy of the relation between the line of sight and the plane tangent to the middle point of the level vial, and which require to be of a material much harder than the casting above described, are made of nickel steel, with a coefficient of 0.000001, obtained from the Société Anonyme de Commentry-Fourchambault, 26 Place Vendôme, Paris. This alloy is well adapted for screws of all kinds, and should now entirely replace steel in the manufacture of all measuring screws, such as micrometer screws for astronomic and surveying instruments, micrometer calipers, gauges, etc., used in mechanical engineering, provided, of course, that the nuts into which such screws are threaded are made of the same material, for it is obvious that a screw with a coefficient of 0.000001 could be made to fit closely in a nut of brass whose coefficient is 0.000018 only at one certain temperature.

The material used in the construction of other portions of the instrument will be named in the description of those parts.

The Tripod of the New Level.

The tripod is of the usual form. The three legs, separating some distance above the feet into two rectangular rods, pivot in the head by means of bolts about 1^{cm} diameter at points forming a regular hexagon. The feet consist of pointed hollow sockets about 14^{cm} long and $3\frac{1}{2}^{cm}$ diameter at the top, fitted and fastened by screws to the legs. They are made of 10 per cent aluminum bronze, an alloy but little inferior to steel in hardness and toughness. The two rods forming the leg are made of black walnut, 2^{cm} by $3\frac{1}{2}^{cm}$, and fastened together at two points by walnut braces which are screwed between them. The tops of the legs are brass bound to guard against the splitting out of the bolt holes. In obtaining the length of the legs, which should be made to suit the observer's height, their normal angle with the ground was taken to be 60°, the vertical distance between the bolt holes in the head of the stand and the line of collimation begin 13^{cm}. The head of the stand, also of black walnut, is $4\frac{1}{2}^{cm}$ thick and carries sunk into its upper surface the three V-grooved plates forming the supports for the foot screws of the instrument. In a circular recess in the lower surface is held by a ring-shaped plate marked *a* in fig. 1, a washer, *b*, shaped so as to form a seat for the convex shoulder of

Longitudinal Section

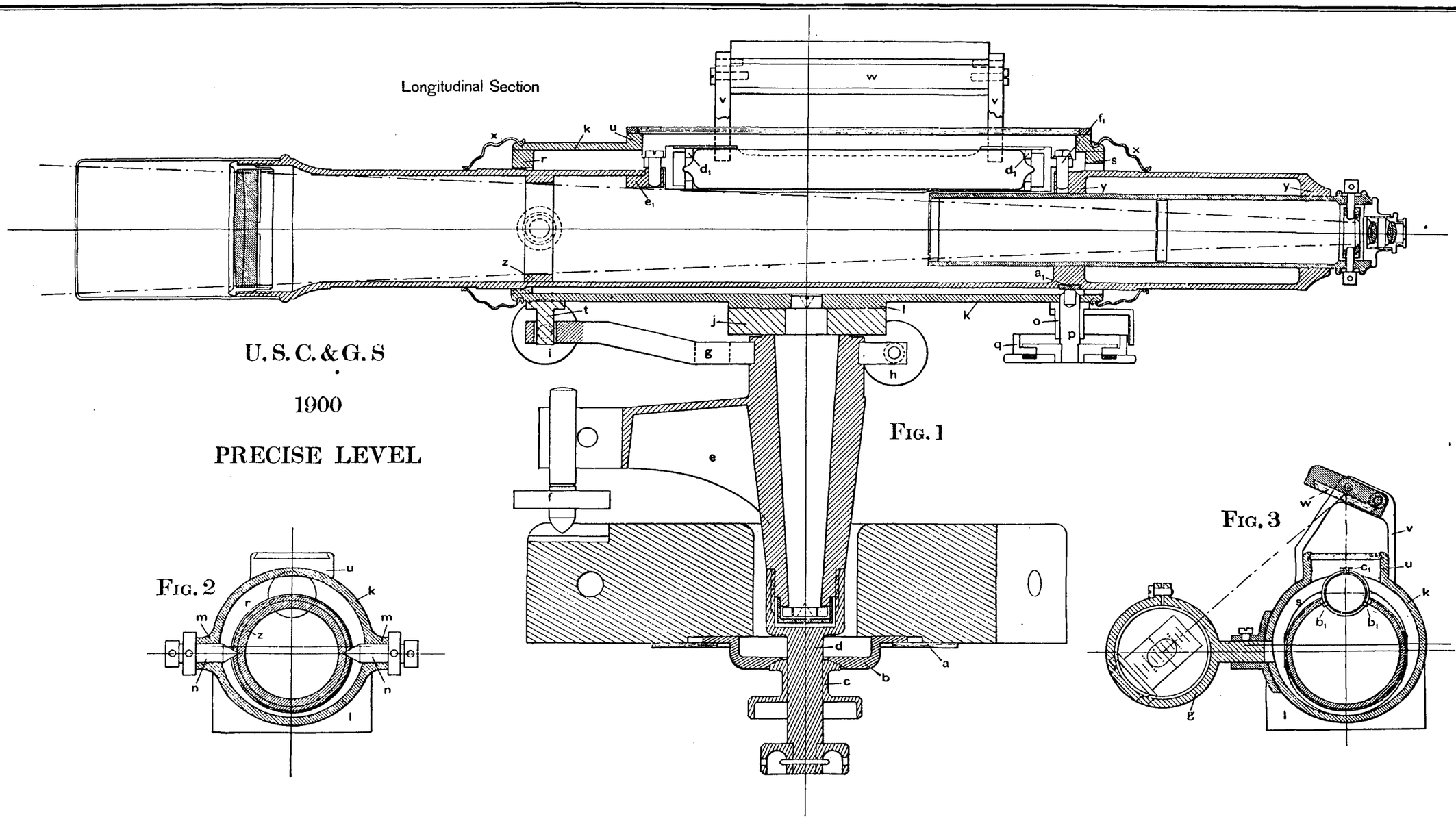


FIG. 1

U. S. C. & G. S.

1900

PRECISE LEVEL

FIG. 2

FIG. 3

Faces page 205.

the nut *c*, which is threaded on the screw *d*. This screw, $1^{cm}.3$ in diameter and of a pitch of 8 threads per centimeter, enlarges at its upper end to a cup-shaped nut, which can be screwed upon the lower end of the center socket of the instrument. The washer *b* is not confined in its recess so closely but what it can move laterally and adapt itself to any position the vertical axis may assume in relation so the head of the stand. When the instrument is set upon the stand the lower end of the center socket will come to rest upon the cup-shaped nut before the foot screws can touch their supports, thus leaving it in an unstable position and making it practically impossible for the observer to forget to secure the instrument to the stand before it is carried to the place of work. The nut *c* is loosened before observing, and tightened only when the instrument and stand are to be carried from station to station.

The Instrument Base and Center.

The instrument base, designated by *e* on the diagram, is a single piece of hard and fine-grained cast iron, furnished by the Brown & Sharpe Manufacturing Company. In its three legs, at a radial distance of 9^{cm}, are threaded the foot screws *f*, of $9\frac{1}{2}^{mm}$ diameter and 15 threads per centimeter, and having a bearing of $2^{cm}.3$. The screws are of such length as to permit a motion of 6^{mm} above and below the normal position, thus allowing the instrument to be leveled even under unusual inclination of the head of the tripod. No position of the foot screws can prevent the fine-motion or micrometer screw from freely passing over them. The ends of the legs are split in the usual manner and provided with milled-head screws for clamping the foot screws. The clamp arm *g*, with its clamp screw *h*, is fitted into a groove near the top of the center socket, and carries at the outer end the fine-motion screw *i* for moving the telescope horizontally in azimuth. The central portion of the instrument base is bored out conically and affords a bearing throughout its length for the unusually long center (10^{cm}), which is made of the hardest grade of tool steel, Sanderson's No. 6. It is secured against being withdrawn by a small nut screwed to its lower end. Upon its upper end is fastened permanently, by screwing and riveting, a disk or flange *j*, of $5^{cm}.8$ diameter, made of hard cast iron, which forms the base of the supporting cylinder.

The Supporting Cylinder of the Telescope.

This, indicated in figs. 1, 2, and 3 by *k*, is a nickel-iron casting, as stated above. Its length is $21^{cm}.6$, its outer diameter $5^{cm}.9$, its inner diameter $5^{cm}.4$, leaving a thickness of wall of $2^{mm}.5$. At its middle point is a cylindrical boss or hub (*l* in figs. 1, 2, and 3), of the same diameter as the flange of the center, to which it is firmly fastened by four steel screws. Two lugs, *m* in fig. 2, are threaded to receive the pivoting screws *n*, which are made of nickel steel, and, with their points $2^{mm}.6$ below the center of the supporting cylinder, form a horizontal axis for the telescope. At a distance of $1^{cm}.2$ from the rear end and below is fastened, by two screws, the nut *o* (fig. 1), made of nickel iron, which carries the fine-motion or micrometer screw *p*. This latter, of 39 threads per centimeter nearly (100 per inch) and 7^{mm} diameter, is provided at its upper end with a small tip of glass hard steel, and carries, below, an adjustable micrometer head of white zylonite *q*, which is $4^{cm}.1$ in diameter and is divided into 100 parts. A hard rubber disk with milled edge, projecting beyond the micrometer head, not only protects the graduation from the fingers, but, by reason of its large diameter, facilitates

the setting of the sensitive level. An index for reading the micrometer head is provided.

The supporting cylinder carries a removable eccentric ring *r* inserted into its forward end (figs. 1 and 2), of which the inner diameter is such as to permit the telescope pivoted between the screws *n* to rotate slightly without touching. A similar ring *s* (figs. 1 and 3) at the rear end, however, is cut out so as to permit the telescope to move up and down, above and below the normal or horizontal position, by about 2^{mm}, while the sides of the ring permit of no lateral play, but form a guide for that amount of vertical motion.

Directly in front of the micrometer screw is fastened to the supporting cylinder a small case holding an eccentric which can be rotated by a lever handle at the right side of the instrument. When the lever handle is turned up the eccentric pushes against the telescope, lifts its weight off the micrometer screw, and presses it gently against a spring sunk into the upper part of the ring *s*. In this position the instrument can be carried without the risk of jarring the telescope and thereby disturbing the level adjustment. This device is not shown in the diagrams but can be seen in the photographic view (fig. 4).

Against the hub *l*, on the right side of the instrument, is fastened a bracket carrying a small universal level, which is easily observed from the eye end of the telescope by means of a mirror mounted above it at an angle of 45° (see fig. 4).

At the forward end of the supporting cylinder and below is mounted a post *t* (fig. 1), reaching downward between the horizontal pointing screw *i* and the spring case of the clamp arm *g*.

The upper part of the supporting cylinder has cast into it a rectangular opening with a framing *u* surrounding it. A piece of plate glass, fitted into this framing by dovetail grooves, closes the opening against dust or air currents, but can quickly be moved forward for the purpose of adjusting the level by loosening a small milled head screw (see fig. 4), and turning up a hinged locking piece. Over this opening and against the sides of the framing is mounted by brass arms *v* the glass mirror *w*, arranged so as to permit of a small rotary adjustment for the purpose of adapting the level reading device to individual observers. It may be stated here that the opening in the supporting cylinder was placed as near as possible to its rear end and away from the middle of the instrument, because the level could at that place be put closer to the line of collimation without entering the cone formed by the apertures of the objective and the reticle ring.

Small grooves around the ends of the supporting cylinder afford the means of fastening, by wire rings or narrow metal bands, the leather cones *x* (fig. 1). They are fastened to the telescope in a similar manner, and effectively shut out dust and air currents without in the slightest degree preventing the telescope from assuming the position determined by the pivoting screws at one end and the micrometer screw at the other end of the supporting cylinder.

The Telescope of the New Level.

The tube with the objective head and drawtube bearings, forming the telescope, is cast of nickel iron in one piece and bored and turned in the lathe. Its outer diameter being $4^{cm}.37$ and the inner $4^{cm}.05$, gives a thickness of wall of $1^{mm}.6$. Immediately at

the eye end and at a distance of 9^{cm} from it are two constrictions forming the bearings y for the drawtube. A ring z is fitted and soldered into the telescope at the place where the 60° points of the pivoting screws n are bored into it ($28^{cm}.9$ from the eye end) for the purpose of strengthening it to resist strains caused by undue tightening of these screws.

The drawtube, cast solid of nickel iron and bored out, is fitted closely into its bearings, and carries within an enlargement at its outer end, by means of four nickel-steel screws, the nickel-iron reticle ring. Great care was taken to fit the threads of these screws very tightly to insure, as much as possible, invariability of the position of the reticle. One vertical and three horizontal spider threads of the finest grade obtainable are mounted upon the reticle ring. The horizontal threads are equidistant and the upper and lower embrace a space of 30^{cm} at a distance of 100^{m}. Two Steinheil eyepieces, of $12^{mm}.5$ and $9^{mm}.5$ (one-half inch and three-eighths inch), equivalent focus, to suit different weather conditions, are supplied. The objective lens is mounted in a cell cast of nickel iron. It is held in place by a spring ring, fastened with three small screws, in such manner as to hold it firmly in position, without restraining it from expanding and contracting with changes of temperature. It has a clear aperture of $4^{cm}.2$ and a focal length of 41^{cm}, giving a magnifying power of 32 diameters with the $12^{mm}.5$ and of 43 diameters with the $9^{mm}.5$ eyepiece. The drawtube is moved into focal distance in the usual way, by means of a rack and pinion, and has sufficient range to enable the observer to point on an object as near as 3.5 meters.

Just within or under the leather cones x the telescope carries two enlargements or collars, which are turned to equal diameters, and serve the purpose of placing the pointing line into the geometric axis of the telescope. This adjustment is made in the shop permanently. It is done by laying the telescope, with these collars, upon two metal wye supports provided with leveling foot screws. Pointing on an object and rotating the telescope in the wyes reveals any want of parallelism between the axis of the two collars and the line connecting the intersection of the vertical and middle horizontal threads and the optical center of the objective. This is corrected by means of the four screws holding the reticle ring. Since the spider threads move with the drawtube, it also must move in a line parallel to the axis of the collars, in order to preserve true collimation in any position required by focusing upon the rod at different distances. To insure this parallelism, great care was taken in making the telescopes. The objectives were centered with special care, and the collars were turned true at the same chucking under which the drawtube bearings were bored. Inasmuch as any error of collimation enters into the result of leveling only to the small amount due to differences between back and fore sights, it may be said that these instruments, as far as collimation error is concerned, are practically faultless.

In the same wye supports above mentioned, the level attached to the telescope is adjusted so that its axis is parallel to the vertical plane containing the line of collimation. This adjustment eliminates what is commonly called the "wind" of the level, and can not readily be made in the field.

The position of the forward drawtube bearing and that of the micrometer screw were selected with the view to sufficient rigidity of that part of the telescope which rests upon the micrometer screw. The point of contact with the hardened tip of the screw is a small hardened steel plate a_1, fastened into the telescope at the forward drawtube

bearing. The distance between the axis of the micrometer screw and the axis of rotation formed by the pivoting screws n is $19^{cm}.15$ nearly, which, with the screw pitch of 39 threads per centimeter, gives a value of about 2".6 per division of micrometer head. The distance between the axis of rotation of the telescope and the vertical center is $9^{cm}.8$.

THE LEVEL VIAL OF THE NEW INSTRUMENT.

The level vial was made by A. Pessler, and is of the chambered type. It is $11^{cm}.5$ long, $1^{cm}.5$ in diameter, and carries a graduation 8^{cm} long in 2^{mm} spaces. The length of the bubble used is about 25 div., or $5^{cm}.0$. The value of a division of the level vial is 1".94 for level No. 7 and 1".86 for No. 8. The mounting of the vial has been attended to with special care, with the aim of securing the greatest possible constancy of adjustment. The glass vial rests within a tube of nickel iron upon the ends of four small screws b_1, piercing the tube, two at each end of the vial, 120° apart. A small tip c_1, at the end of a flat spring fastened to the tube and also piercing it, presses with sufficient force upon the vial at each end, exactly over the supporting screws, to hold it firmly in place and yet permit it to expand and contract independently of the tube. Longitudinally the vial is confined by two cork rings d_1, one at each end, which, however, leave a small clearance, so that the vial is free also in that direction. This is the manner in which all level vials, excepting only the smaller ones, have been mounted in the shops of the Survey for the past thirteen years. The level tube, with the vial thus supported, is secured to the telescope, sunk through an oblong opening close to the cone formed by the apertures of the objective and reticle ring. At the forward end it is held by a screw holding it down to a rounded support e_1, screwed to the telescope, upon which it can be moved laterally by two opposing screws for adjusting the "wind." The other end is made adjustable in the vertical for the purpose of keeping the level parallel to the line of collimation. This is the only adjustment required on the part of the observer in the field. A square-headed vertical screw f_1, of about 27 threads per centimeter and fitting closely in the level tube end, is threaded tightly into that part of the telescope forming the forward drawtube bearing. Two strong helical steel springs, one on each side, press the level tube tightly upward against the shoulder of the screw f_1. A socket wrench, with a lever arm $7^{cm}.5$ long, permits of applying rotary force to the screw without exerting any other pressure against the instrument and thereby displacing the pointing of the telescope, as is the case when using a screw-driver or capstan bar, so that this delicate adjustment is made quickly and with ease, and seldom requires to be repeated.

As already stated, the adjustment of the reticle is made permanently in the shop, the observer having no means of testing it in the field. It is of great importance, therefore, that the reticle ring should not be disturbed, but that, when necessary, the level be moved into parallelism with the pointing line.

In the instruments as originally constructed the heads of the four screws holding the reticle ring were exposed in the ordinary manner, as shown in illustration 4. Now (1903) the design has been so improved that the heads of these screws are completely inclosed in a protecting case and are inaccessible to the observer in the field.

The observer, carrying the instrument from station to station, readily learns to hold it in such position as to prevent any change of the length of the bubble by establishing communication between the chamber and the interior of the vial. In the vials used for these instruments the openings in the chambers are not at the bottom, but slightly to the side.

The first of the new instruments to be used in the field was put in adjustment at Washington and sent by express to a point in Kentucky. The observer there, on beginning work with it, found it still in adjustment and continued to use it for one and one-half months, during which time the angle between the tangent to level vial at its middle point and the line of sight defined by the three horizontal lines never exceeded 3″. At the end of that time the angle suddenly became 9″ and the instrument was adjusted. After constant use for nearly one and one-half months more the record showed the greatest value of this angle to be 3″.6. The mean algebraic value of the angle during this time was a little more than 1″. This behavior in the matter of holding adjustment has been frequently approached in later work with instruments of this type. The constancy with which these instruments retain their adjustment testifies to the fine work put upon them, for which credit is due to Mr. C. Jacomini and O. Storm, instrument makers.

The Level-Reading Device.

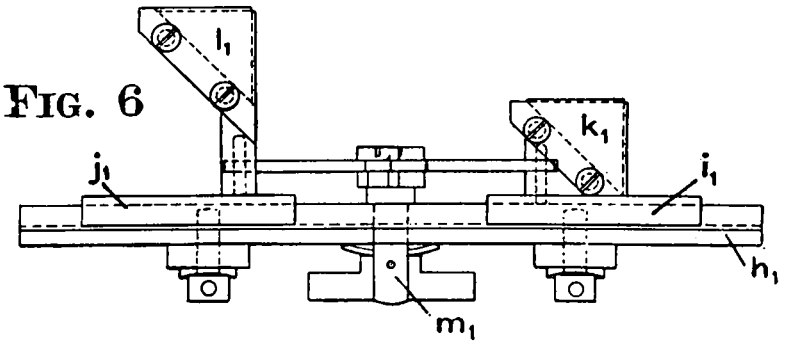
The operation of reading the position of three fine lines, the spider threads, projected upon the graduation of the level rod, is a trying one under the best conditions, and subjects the observer, when the air is hazy or unsteady, to severe strains. As it is of the highest importance that these readings be taken only at the instant when the level indicates horizontality of the line of sight, the instrument should be designed particularly with a view to the observer's comfort, so as to enable him to observe the rod and the level as nearly as possible simultaneously. It is thought that the level-reading device provided for these instruments fulfills all requirements, since only the time required for transferring mental attention from one object to another need elapse between the two observations. It is a modification of that used by Berthélemy, of Paris, in his precise level,* which consists of two adjustable prisms mounted upon the stride level and three prisms mounted in a casing fastened to the wye support of the telescope, with a short tube immediately on the side of the latter reaching as far as the eyepiece. Besides the objectionable feature of the overloaded stride level, the design has the fault of requiring the observer to shift his head between observations upon the rod and the level.

The modified form here described was applied in the spring of 1899, when precise levels Nos. 1, 5, and 6 were remodeled, and it was amply tested in the field during the season of that year. In designing an entirely new instrument it was possible to improve greatly upon the manner of its application. Two clamp rings g_1, fig. 3, support an aluminum tube with an eye end reaching back to a point even with the eyepiece of the telescope when focused for an average distance. Against this tube is screwed a dovetail bar h_1 (illustrations 6 and 7) upon which move, within the tube, two slides i_1 and j_1 carrying the prisms k_1 and l_1. These slides are connected by arms with a lever mounted upon a stem with a milled head m_1, the rotation of which moves the prisms equally toward or away from a central point between them. This motion is provided to adjust the distance of the prisms accurately to the length of the bubble, which, during the day's work, may vary by reason of temperature changes. Those faces of the prisms which are directed toward the eye are ground to such curvatures

*See page 423 and illustration opposite, in Appendix No. 8, Report for 1899, Precise Leveling in the United States.

as, with the aid of a lens mounted between them and the eye end, to reduce to that of distinct vision of the normal eye the distance from the end of the bubble to the eye, by way of the mirror w, the reflecting faces of the prisms k_1 and l_1 and the lens. For the benefit of the observer required to use glasses the eye cap of the level-reading tube is arranged to hold such a lens as he may require to enable him to observe without spectacles.

FIG. 6

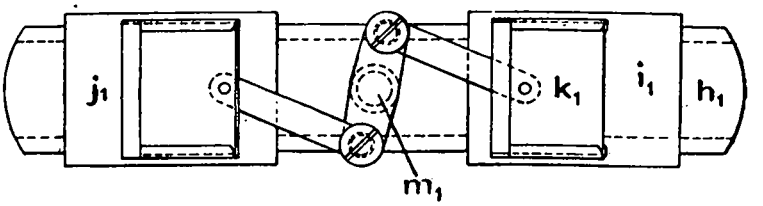


Prisms of level reading device; vertical section.

The distance between the level-reading tube and the telescope can be changed to suit each individual observer, and provision is made for the rotary adjustment of the prisms and the mirror necessary in consequence of any such change, as can be seen in fig. 3. The appearance of the field of view of the level-reading device is also shown in fig. 3. The prisms are put in such position by means of the milled head m_1, that the ends of the bubble and the graduation marks above them are brought into view, appear-

Prisms of Level Reading Device

FIG. 7



Prisms of level reading device; horizontal section.

ing as if the bubble were very short. The lines forming the graduation upon the level vial are marked by small dots in such manner that symmetrical lines, or lines equidistant from the center of the graduation, are readily distinguishable, thus relieving the observer of any strain in guarding against mistakes.

THE FINISH AND WEIGHT OF THE NEW LEVELS.

The telescope throughout its length—with the exception of the eye end of the draw tube and the two collars turned to equal diameters—the supporting cylinder, and the level tube were covered with a heavy coating of cloth dust of a bluish-gray color. This coating is put on by painting the parts with a mixture of Japan varnish, turpentine, and

linseed oil, which is colored with white lead, lampblack, and ultramarine blue, to the same shade as that of the cloth dust; the latter is sifted over the freshly varnished pieces through a hair screen and pressed in with the hand. After allowing it to dry for two days and brushing off all loose cloth dust, a coating of a dilute solution of bleached shellac in alcohol is applied. The finish has the appearance of a fine quality of cloth, and affords considerable protection against sudden and temporary changes of temperature.

Other parts of the instrument, as the instrument base, mirror frame, level-reading tube, etc., are finished in black enamel of the kind introduced so extensively through the bicycle industry. It is heavy, hard though elastic, and surpasses in appearance and durability any of the black lacquers heretofore used in the art of instrument making.

The weight of the instrument is $5^{kg}.2$. No doubt this can be considerably reduced when tubing made of nickel steel is obtainable in the market. The thickness of the cast tubing—about twice as great as would be necessary if wrought metal could be substituted—is considered as small as is safe to use in view of the loose texture of the alloy.

The weight of the tripod, $7^{kg}.2$, is somewhat greater than that of stands formerly used for the same class of instruments. This is due to the much greater length required in order to enable the observer to stand erect, which is considered of sufficient advantage to warrant a small sacrifice in the matter of weight.

RODS AND ROD SUPPORTS.

The rods and footplates need not be described in detail here, as they are the same that were formerly in use and have already been described.*

The only important change made with reference to rod supports has been that hardened steel pins having a broad head carrying a spherical cavity similar to that in the old footplates have been put into use,† and have steadily gained in favor. During the season just ended the footplates were used but little by Coast and Geodetic Survey leveling parties. The cross section of one of these pins is shown in illustration 8. Some of the first pins were made of tool steel and turned down to shape. The more recent ones were made of machinery steel and tool steel, as indicated in the illustration. The pins are driven with a wooden mallet.

INSTRUCTIONS FOR PRECISE LEVELING.

The general instructions issued to the leveling parties in 1902 are given below. Those issued in 1900 and 1901 differ from these only in minor matters and in not being so complete.

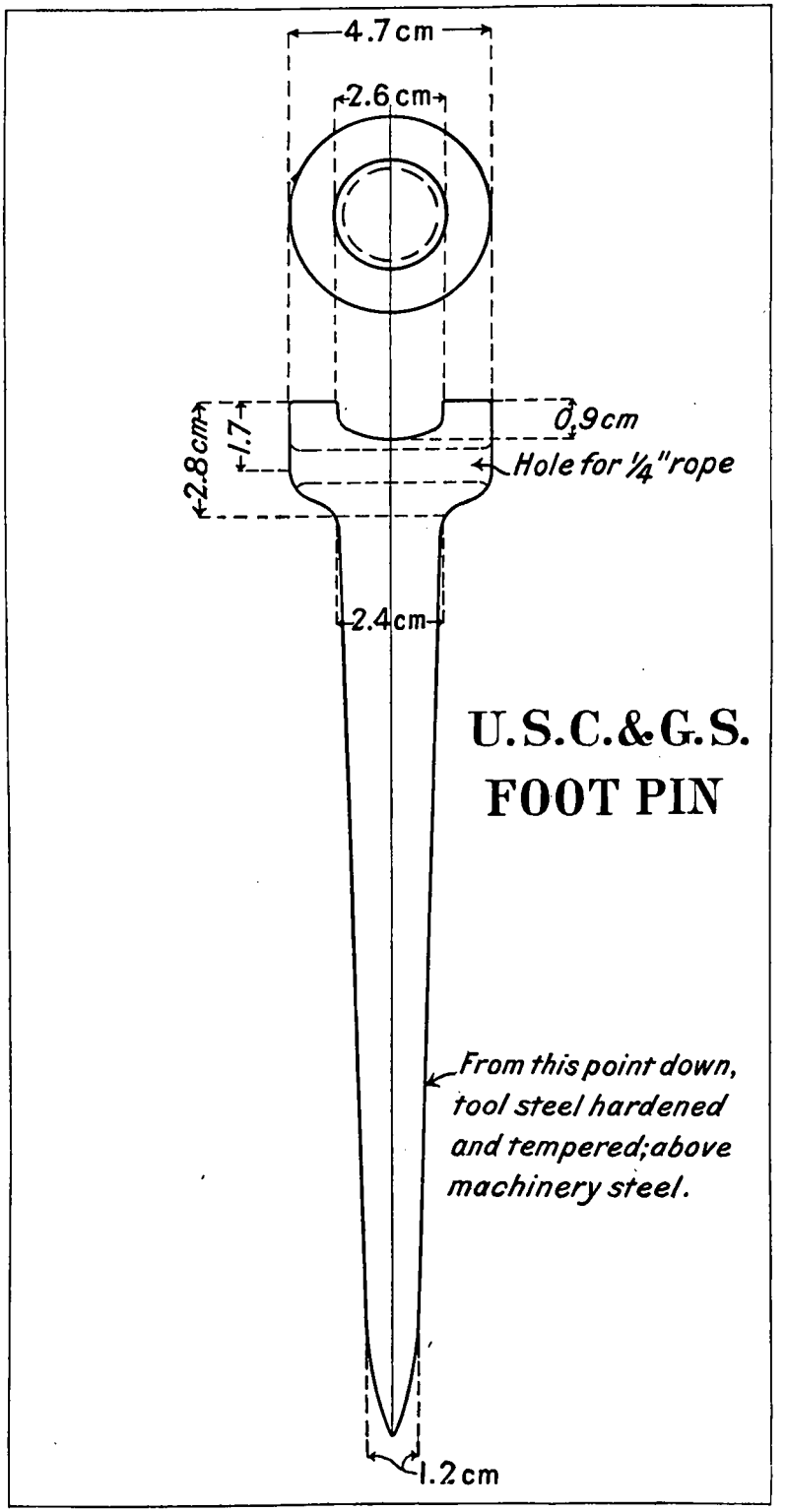
In order that the reader may comprehend fully the spirit of the general instructions shown below, it may be well to call special attention here to three main points in regard to the new instrument:

First. The instrument is irreversible and as simple as possible. The telescope is supported directly on trunnions between the objective and the middle of the telescope and on the point of a micrometer screw near the eye end. It is therefore not capable

* See Appendix 8 of the Report for 1899, Precise Leveling in the United States, pp. 418–419; and Transactions of the American Society of Civil Engineers, Vol. XLV, June, 1901, pp. 133–134.

† These pins were introduced into use in the Coast and Geodetic Survey by Assistant O. W. Ferguson.

No. 8.


4.7 cm
2.6 cm
0.9 cm
Hole for 1/4" rope
2.8 cm
1.7
2.4 cm
U.S.C.&G.S.
FOOT PIN
From this point down, tool steel hardened and tempered; above machinery steel.
1.2 cm

of being rotated about its axis of figure. The level vial is fixed relatively to the telescope, except that the small range necessary for adjustment is provided. This makes it necessary to test the adjustment by a modification of the well-known peg method, as indicated later in the instructions. The simple instrument is used, as will be seen later, with an extremely simple programme of observation.

Second. A device for reading the bubble has been supplied which enables the observer to stand erect at all times and see the bubble and the rod alternately in quick succession without moving the eye and without even refocusing the eyes, the only change required being a mere shifting of the attention from one eye to the other.

Third. Great care has been taken in all the features in the design of the instrument to prevent errors in observation due to changes in the relative temperature of different parts of the instrument.

General Instructions for Precise Leveling.

1. Except when specific instructions are given to proceed otherwise, all lines are to be leveled independently in both the forward and the backward direction.

2. The distance between successive bench marks shall nowhere exceed 15 kilometers. The line of levels is to be broken up by temporary bench marks into sections from 1 to 2 kilometers long, except where special conditions make shorter sections advisable.

3. It is desirable that the backward measurement on each section should be made under different atmospheric conditions from those which occurred on the forward measurement. It is especially desirable to make the backward measurement in the afternoon if the forward measurement was made in the forenoon, and vice versa. The observer is to secure as much difference of conditions between the forward and backward measurements as is possible without materially delaying the work for that purpose.

4. On all sections upon which the forward and backward measures differ by more than $4^{mm}.0\sqrt{K}$ (in which K is the distance leveled between adjacent bench marks in kilometers), both the forward and backward measures are to be repeated until two such measures fall within the limit.

5. If any measure over a section gives a result differing by more than 6 millimeters from the mean of all the measures over that section, this measure shall be rejected. No rejection shall be made on account of a residual smaller than 6 millimeters, unless there is some other good reason for suspecting an error in this particular measure, and in such cases the reason for rejection must be fully stated in the record.

6. Whenever a blunder, such as a misreading of 1 decimeter or of 1 meter, or an interchange of sights (the backsight being recorded as a foresight) is discovered in any measure after its completion, and the necessary correction applied, such measure may be retained, provided there are at least two other measures over the same section which are not subject to any such uncertainty.

7. The programme of observation at each station is to be as follows:

Set up and level the instrument. Read the three lines of the diaphragm as seen projected against the front (or rear) rod, each reading being taken to the nearest millimeter (estimated), and bubble being held continuously in the middle of the tube (i. e., both ends reading the same). As soon as possible thereafter read the three lines of the

diaphragm, as seen projected against the rear (or front) rod, estimating to millimeters as before, and holding the bubble continuously in the middle of the tube.

8. At each rod station the rod thermometer is to be read to the nearest centigrade degree and the temperature recorded.

9. At stations of odd numbers the backsight is to be taken before the foresight, and at even stations the foresight is to be taken before the backsight.

10. The maximum difference in length between a foresight and the corresponding backsight is to be 10 meters. The actual difference is to be made as small on each pair of sights as is feasible by the use of good judgment, without any expenditure of time for this particular purpose.

11. The recorder shall keep a record of the rod intervals subtended by the extreme lines of the diaphragm on each backsight, together with their continuous sum between bench marks. A similar record shall be kept for the foresights. The two continuous sums shall be kept as nearly equal as is feasible, without the expenditure of extra time for that purpose, by setting the instrument beyond (or short of) the middle point between the back and front rods. The two continuous sums shall not be allowed to differ by more than a quantity corresponding to a distance of 20 meters.

12. Once during each day of observation the error of the level should be determined in the regular course of the leveling and recorded in a separate opening of the record book, as follows: The ordinary observations at an instrument station being completed, transcribe the last foresight reading as part of the error determination, call up the back rod and have it placed about 10 meters back of the instrument, read the rod, move the instrument to a position about 10 meters behind the front rod, read the front rod, and then the back rod. The rod readings must be taken with the bubble in the middle of its tube. The required constant C to be determined, namely, the ratio of the required correction to any rod reading to the corresponding subtended interval, is

$$C = \frac{(\text{sum of near rod readings}) - (\text{sum of distant rod readings})}{(\text{sum of distant rod intervals}) - (\text{sum of near rod intervals})}.$$

The level should not be adjusted if C is less than 0.005. If C is between 0.005 and 0.010 the observer is advised not to adjust the level, but if C exceeds 0.010 the adjustment must be made. If a new adjustment of the level is made, C should at once be redetermined. It is desirable to have the determinations of level error made under the ordinary conditions as to length of sight, character of ground, elevation of line of sight above the ground, etc.

13. Notes for future use in studying leveling errors shall be inserted in the record; indicating the time of beginning and ending of the work for each section, the weather conditions especially as to cloudiness and wind, and whether each section of the line is run toward or away from the sun; and such other notes as may be of value in studying errors.

14. The instrument shall be shaded from the direct rays of the sun, both during the observations and the movement from station to station.

15. The maximum length of sight shall be 150 meters, and the maximum is to be attained only under the most favorable circumstances.

16. At the beginning and end of the season, and at least twice each month during the progress of the leveling, the three-meter interval between metallic plugs on the

face of each level rod shall be measured carefully with a steel tape, which shall be continuously kept in the party throughout the season for that purpose. The rod temperature at the time of each of these measures must be recorded. The purpose of these measures is to detect changes in the lengths of the rods rather than to determine the absolute lengths. The absolute lengths are determined at the Office between field seasons.

17. The field computations and abstracts are to be kept up as the work progresses. As soon as each book of original record is out of use it is to be sent to the Office by registered mail, and the corresponding abstracts are to be retained in the field until the observer is informed of the receipt of the original record. No duplicates of the original record are to be made, except of the descriptions of bench marks, of which the duplicate is to be kept in a separate volume.

It should be added, in justice to the observers, that in verbal discussions of the manner in which precise leveling should be done they were urged to keep the length of sight great enough to make it necessary to do a moderate amount of re-running. The accidental errors seem to increase rapidly as the length of sight is increased, under given conditions, beyond that at which the apparent vibration of the graduation on the rod becomes sufficient to make accurate estimation to millimeters difficult. If an observer is extremely cautious and confines all his observations to sufficiently short sights to insure easy reading of the rod, it is possible to work month after month almost without re-running, but the progress will be slow. On the other hand, it is certain that an attempt to take sights of the limiting length, 150 meters, at all times would lead to a very large amount of re-running and the progress would not be rapid. The writer's opinion, frequently expressed to the observers, is that the maximum speed consistent with the required degree of accuracy will be secured by continually keeping the length of sight such that the percentage of re-running will be from 5 to 15, and that an extremely small percentage of re-running is sufficient evidence of excess of caution on the part of the observer. The occurrence of a moderate amount of re-running on each line is due, therefore, to an attempt on the part of the observer to attain the maximum speed consistent with the required degree of accuracy, and not to inability to secure such observations that little or no re-running would be necessary.

The observers have found a convenient rule in fixing the length of sight to be to shorten sights whenever the upper and lower thread intervals subtended on the rod are found to differ frequently by more than a selected limit. Each observer fixes the limit from his own experience by noting the relation between such a provisional limit and the amount of re-running found to be necessary while using it. Such a rule is based upon the idea that the additional errors which are encountered when the length of sight is increased are in the main those due to increased accidental errors in reading the rods.

It should also be noted that although there is no limit placed in the instructions on the rate of divergence between forward and backward lines, the writer has urged the observers to watch the rate of such divergence continually, and to make an effort to keep it small. It has been the opinion of the writer, and many of the observers, that a large steady rate of divergence is in general due to a systematic rising or settling of rod supports, either foot plates or pins. This opinion has been frequently expressed to all the observers. The usual practice has been for the observer, when he noticed a steady tendency for his lines to diverge rapidly, to study the manner in which the foot plates or

pins were handled, and to make tentative changes until the tendency to rapid divergence disappeared. Sometimes the change from foot plates to pins produced the desired effect, or from placing the rod supports between the railroad rails to placing them at the edge of the ballast, or even out on the undisturbed ground beyond the ballast. In one case it was found that as soon as a certain rodman was relieved and another put in his place the tendency to divergence promptly disappeared. For observations with the present methods and instrument the writer has been unable to find any explanation of a steady divergence between forward and backward lines which is quantitatively sufficient, except that indicated above, based upon the supposition that foot plates or pins have a systematic tendency to rise or settle, according to the manner in which they are handled and the character of the ground on which they are placed. The writer has noted that of the observers who have come under his observation those who have acted upon this theory most consistently have had the greatest success in preventing rapid divergence.

EXAMPLES OF RECORD AND COMPUTATION.

A specimen* of the determination of C as actually made in the field in accordance with paragraph 12 of the General Instructions is given below, together with suggestions which were furnished to the observers.

Determination of C, 8.20 a. m., August 28, 1900.

Left-hand page.

Number of station.	Thread reading, backsight.	Mean.	Thread interval.
	1515		13
A	1528	1528.3	14
	1542		27
	2252		105
B	2357	2357.0	105
	2462		210
		0461.7	419
		2818.7	52
Cor. for curv. and ref.		−0.8	367
		2817.9	

Right-hand page.

Rod.	Thread reading, foresight.	Mean.	Thread interval.
	0357		105
W	0462	0461.7	104
	0566		209
	1276		12
W	1288	1288.3	13
	1301		25
		1528.3	
		2816.6	
		2817.9	

$367)\ -1.3\ (-0.004 = C$

Only the distant rod readings need be corrected for curvature and refraction, and the two corrections for the two distant rods may be combined as indicated.

Note that if the transfers of figures across from page to page are made as indicated all subtractions are made right side up.

Do not carry C to more than three decimal places.

When the instrument must be adjusted, due to too large a value for C, do it by raising or lowering one end of the level vial and *not by moving the reticle.*

The adjustment is made as follows: Point to a distant rod with the bubble in the middle of its tube, and read. Move the telescope so as to raise the middle line by an amount equal to C times the rod interval. While holding the telescope in this position bring the bubble to the middle of the tube by raising or lowering one end of the level vial. If C is negative the middle line must of course be lowered on the rod.

The following examples of the record and computation will serve to explain the method of observation still further:

* The unit of length used in this specimen is the millimeter.

Left-hand page. SPIRIT LEVELING. Right-hand page.

Date: August 29, 1900. Forward—~~Backward~~. (Strike out one word.) From B. M.: 68 To B. M.: G.
Sun: C. Wind: S. T.

No. of station.	Thread reading backsight.	Mean.	Thread interval.	Sum of intervals.	Rod and temp.	Thread reading foresight.	Mean.	Thread interval.	Sum of intervals.
43	0674		99		V	2683		99	
	0773	0773.0	99		38	2782	2782.3	100	
	0872		198			2882		199	
44	0925		106		W	2415		103	
	1031	1030.3	104		35	2518	2518.0	103	
	1135		210	408		2621		206	405
45	0484		98		V	2510		96	
	0582	0582.3	99		35	2606	2606.0	96	
	0681		197	605		2702		192	597
46	0398		97		W	2859		96	
	0495	0495.0	97		34	2955	2954.7	95	
	0592		194	799		3050		191	788
47	1027		26		V	1006		29	
	1053	1053.3	27		34	1035	1034.7	28	
	1080		53	852		1063		57	845
		3933.9					11895.7		
							−7961.8		
								2:25 p. m.	

The explanation of the symbols used after the words "Sun" and "Wind" is printed on the bottom of the computation form shown later. The unit in the record is the millimeter. The instrument stations (not turning points) are numbered consecutively throughout the day. A rod once placed at a point stays there, both for the foresight and backsight, each rodman thus being front and rear rodman alternately. To carry out the requirement of the general directions, that at stations of odd numbers the backsight is to be taken before the foresight, and at even stations the foresight is to be taken first, it is only necessary to remember that this is equivalent to the statement that one particular rodman must always show his rod first after each placing of the instrument. The position of the rod is indicated in the record on the foresight only. The temperature is read by the rear rodman just before he moves forward, and is called out to the recorder when the rodman passes.

The columns headed "Thread interval" show the intervals between the lower and middle threads as seen projected on the rod, and the middle and the upper, and finally the total interval. The columns headed "Sum of intervals" show the continuous sum of the total intervals, and as these values are proportional to the sums of the backsight distances and foresight distances, respectively, they enable the observer to keep these two sums nearly equal at all times, as required by the instructions, for the purpose of eliminating instrumental errors.

Such portions of the computation as are shown as forming a part of the record are kept up by the recorder as the work progresses. The instrument is not moved forward from any station until the recorder announces that the readings at that station check properly. The recorder uses, as a short method of computing the mean of the three thread readings, the fact that the difference of the upper and lower intervals divided by

three is the correction to be applied with the proper sign to the middle thread reading to give the mean of the three.

But little explanation is needed in connection with the computation form shown below. The forward line from B. M. 68 to B. M. G. on this form is that for which the record is given.

The fifth column on the left-hand page is derived from the fourth by using the sufficiently exact relation that 287 millimeters subtended on the rod corresponds to 100 meters along the line, regardless of the lengths of the separate sights.

The corrections for curvature and refraction shown in the first column of the right-hand page are those due to the slight differences of corresponding foresights and backsights, no correction being necessary when the corresponding sights are exactly equal. The correction is usually inappreciable and seldom exceeds 0.1 millimeter under actual conditions. It may be applied very quickly by the use of properly prepared tables and a rapid inspection of the record books. It is important to note that this is in the main a correction for curvature, a quantity which is not uncertain, the uncertain refraction being upon an average about one-eighth as great as the curvature.

The level correction shown in the second column of the right-hand page is equal to the constant C (defined in the general directions for leveling) times the value in the sixth column of the left-hand page. Its sign is fixed by the signs of the two factors. This correction will very seldom exceed 0.3 millimeter under actual conditions, and will not sensibly differ from zero on most sections, since the instructions require (paragraph 11) that the sum of the foresight rod intervals on any section shall be nearly equal to the sum of the backsight rod intervals.

The third column gives the correction due to the excess of length of the rod at zero degrees, this particular rod being 0.28 millimeter too long on each meter. The examinations of the rods made at the Office show that the error of graduation is, with sufficient accuracy, proportional to the distance along the rod. The next column gives the correction due to the expansion of the rod from zero to the temperature of observation, computed with the known coefficient of expansion of the rods, namely, 0.000004 per degree Centigrade. The sum of the quantities in the third and fourth columns in any line gives the correction due to the excess of length of the rod at the temperature of observation. For these particular rods, which are long, even at zero, the correction in each of these columns will always have the same sign as the measured difference of elevation.

The last four columns on this form are for use whenever special studies are to be made to determine if possible the sources of the principal errors of leveling. It should be noted that the times of the backward and forward runnings of any section, as indicated in the last column, have no fixed relation to each other. The two runnings are sometimes made on the same day, sometimes on different days, and in some instances they both occur in the forenoon, at other times both in the afternoon, and frequently they occur in opposite halves of the day. Any long portion of the line will show corresponding forward and backward measurements having all possible relations to each other as to the time of day.

In the comparatively rare cases in which it is necessary to apply an index correction, to take account of the fact that the zero of graduation and the foot of the rod are not exactly coincident, it should be entered in the second column of the right-hand page of the computation, no separate column having been provided for it.

Left-hand page.

Right-hand page.

COMPUTATION OF PRECISE LEVELS.

Line: Somerset, Ky., to Knoxville, Tenn.

Observer: W. H. B. Year: 1900.

Bench marks.	Forward or backward.	Number of stations.	Sum of rod intervals.	Distance in kilometers.	Rod intervals ΣB-ΣF.	Mean rod readings. ΣB	Mean rod readings. ΣF	Approximate difference of elevation.	Mean temperature of rods.	Corrections. Curvature and refraction.	Corrections. Level.	Corrections. Length of rod.	Corrections. Temperature of rod.	Difference of elevation. Each line.	Difference of elevation. Mean.	Divergence B-F.	Toward or from sun.	Sunshine or cloudy.	Wind.	Date and hour.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
			mm.		*mm.*	*m.*	*m.*	*m.*		*mm.*	*mm.*	*mm.*	*mm.*	*m.*	*m.*	*mm.*				
65–66	F	9	3669	1.279	+ 5	10.6532	19.0087	− 8.3555	37			−2.4	−1.2	− 8.3591	− 8.3593	−0.4	L.	S	C	8/28– 9:15
	B	7	3675		+ 9	15.1650	6.8087	+ 8.3563	26	+0.1	−0.1	+2.4	+0.8	+ 8.3595				C	C	8/29– 9:00
66–67	F	8	3738	1.302	+12	17.6667	10.4370	+ 7.2297	32		−0.1	+2.1	+0.9	+ 7.2326	+ 7.2332	+1.2		C	C	8/29–11:05
	B	7	3739		−23	7.8223	15.0537	− 7.2314	23	+0.1	+0.2	−2.1	−0.6	− 7.2338				C	C	8/29– 7:45
67–68	F	13	4198	1.464	+ 4	15.5276	31.8222	−16.2946	33			−4.6	−2.1	−16.3013	−16.3008	+1.0	T.	S & C	C	8/29– 1:30
	B	8	4206		−24	21.5524	5.2587	+16.2937	28	+0.1	+0.1	+4.6	+1.8	+16.3003				C	C	8/28– 5:00
68–G	F	5	1697	0.590	+ 7	3.9339	11.8957	− 7.9618	35		−0.1	−2.3	−1.1	− 7.9653	− 7.9647	+1.2		C	S	8/29– 2:15
	B	6	1691		− 5	12.5587	4.5979	+ 7.9608	31			+2.3	+1.0	+ 7.9641				C	C	8/31– 9:10
G–69	F	11	5126	1.785	− 2	28.4990	5.8171	+22.6819	30			+6.5	+2.7	+22.6911	+22.6910	−0.3	R.	S & C	T S	8/29– 3:15
	B	11	5120		+14	6.3550	29.0368	−22.6818	27			−6.5	−2.5	−22.6908				C	F M	8/31– 8:30
69–70	F	12	4589	1.602	−23	17.7855	22.7719	− 4.9864	22	+0.1	−0.1	−1.4	−0.4	− 4.9882	− 4.9901	−3.8		C	C	8/30– 7:15
	B	9	4607		− 9	17.5312	12.5410	+ 4.9902	22			+1.4	+0.4	+ 4.9920				C	C	8/30– 4:30
70–71	F	10	5000	1.740	+ 6	6.9331	27.1772	−20.2441	25			−5.8	−2.0	−20.2519	−20.2530	−2.2		C	C	8/30– 8:15
	B	10	4987		− 5	26.9183	6.6720	+20.2463	24	+0.1		+5.8	+1.9	+20.2541				C	C	8/30– 3:30
71–72	F	10	4076	1.420	+ 2	10.5955	26.0830	−15.4875	33			−4.4	−2.0	−15.4939	−15.4932	+1.4	L.	S	C	8/30– 9:15
	B	8	4073		+ 3	21.0375	5.5510	+15.4865	26			+4.4	+1.6	+15.4925				C	C	8/30– 2:40

Abbreviations: S=sunshine. C=cloudy. S & C=alternate sunshine and shade.
Abbreviations, strength of wind: S=strong. M=moderate. C=calm.

Abbreviations, direction of progress relative to sun:
$\frac{T}{F}$=within 45° of directly $\frac{\text{toward}}{\text{from}}$ sun. $\frac{Tr}{Fr}$=$\frac{\text{toward}}{\text{from}}$ sun, but at an angle of more than 45° to right. $\frac{Tl}{Fl}$=ditto with sum to left.

$\frac{R}{L}$=sun to $\frac{\text{right}}{\text{left}}$ and nearly at right angles to line. The same abbreviations also apply to the direction of progress relative to the wind.

The following abstract of results is the form actually used in collecting the results of the computation indicated above. It is essentially a summary and combination of the values derived on the computation form. The computation is discontinuous, showing results from separate sections, while this abstract is continuous, and is substantially the form in which the results are published:

Left-hand page. Right-hand page.

ABSTRACT OF SPIRIT-LEVEL RESULTS.

State: Tennessee. Instrument: Level No. 8. Rods: V. & W. Observer: W. H. B. Computers: W. H. D. W. H. B.

Date.	From B. M. to B. M.	Distance in kilometers.	Difference of elevation. Forward line.	Difference of elevation. Backward line.	Difference of elevation. Mean.	Discrepancy. Partial.	Discrepancy. Total accumulated.	No. of B. M.	Distance from B. M. A_5 at Ludlow, Ky.	Elevation above mean sea level.	Locality.
			m.	*m.*	*m.*	*mm.*	*mm.*		*km.*	*m.*	
Aug. 28–29	65–66	1.279	− 8.3591	+ 8.3595	− 8.3593	−0.4	+108.7	66	365.848	424.5262	
29	66–67	1.302	+ 7.2326	− 7.2338	+ 7.2332	+1.2	+109.9	67	367.150	431.7594	
28–29	67–68	1.464	−16.3013	+16.3003	−16.3008	+1.0	+110.9	68	368.614	415.4586	
29–31	68–G	0.590	− 7.9653	+ 7.9641	− 7.9647	+1.2	+112.1	G	369.204	407.4939	Stone post at Sunbright, Morgan County, Tenn.
29–31	G–69	1.785	+22.6911	−22.6908	+22.6910	−0.3	+111.8	69	370.989	430.1849	
30	69–70	1.602	− 4.9882	+ 4.9920	− 4.9901	−3.8	+108.0	70	372.591	425.1948	
30	70–71	1.740	−20.2519	+20.2541	−20.2530	−2.2	+105.8	71	374.331	404.9418	
30	71–72	1.420	−15.4939	+15.4925	−15.4932	+1.4	+107.2	72	375.751	389.4486	

CORRECTION TABLES.

For convenience there are inserted here three tables which are useful in making the foregoing computations.

The table of total correction for curvature and refraction is for use in computing C, in making river crossings, and in general wherever the total correction is required. In computing this table the refraction was assumed to be equal to one-eighth the curvature.

Total correction for curvature and refraction.

Distance.	Correction to rod reading.	Distance.	Correction to rod reading.
m. *m.*	*mm.*	*m.*	*mm.*
0 to 27	0.0	160	−1.8
28 to 47	−0.1	170	−2.1
48 to 60	−0.2	180	−2.3
61 to 72	−0.3	190	−2.6
73 to 81	−0.4	200	−2.8
82 to 90	−0.5	210	−3.0
91 to 98	−0.6	220	−3.3
99 to 105	−0.7	230	−3.7
106 to 112	−0.8	240	−4.0
113 to 118	−0.9	250	−4.3
119 to 124	−1.0	260	−4.7
125 to 130	−1.1	270	−5.0
131 to 136	−1.2	280	−5.4
137 to 141	−1.3	290	−5.8
142 to 146	−1.4	300	−6.2
147 to 150	−1.5		

The table for the differential correction for curvature and refraction is for use in deriving the corrections shown in the first column of the right-hand page of the com-

putation indicated on page 219. The table was computed upon the assumption that the refraction is one-eighth of the curvature, and that the stadia interval for the instrument is such that the distance from the instrument to the rod in meters is one-third of the interval subtended on the rod in millimeters. An inspection of the table will show that it is sufficiently accurate for use even though the stadia interval differs from that stated by 10 per cent or more.

Differential correction for curvature and refraction.

Length of sight in rod interval in millimeters.	Difference of sights in rod interval in millimeters.																												
	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58
10	.0	.0	.0	.0	.0																								
20	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0																			
30	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0														
40	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0									
50	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0				
60	.0	0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	1	1
70	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	1	1	1	1	1	1
80	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	1	1	1	1	1	1	1	1	1
90	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	1	1	1	1	1	1	1	1	1	1	1
100	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	1	1	1	1	1	1	1	1	1	1	1	1	1
110	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
120	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
130	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
140	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
150	.0	.0	.0	.0	.0	.0	.0	.0	.0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
160	.0	.0	.0	.0	.0	.0	.0	.0	.0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
170	.0	.0	.0	.0	.0	.0	.0	.0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2
180	.0	.0	.0	.0	.0	.0	.0	.0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2
190	.0	.0	.0	.0	.0	.0	.0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2
200	.0	.0	.0	.0	.0	.0	.0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
210	.0	.0	.0	.0	.0	.0	.0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
220	.0	.0	.0	.0	.0	.0	.0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2
230	.0	.0	.0	.0	.0	.0	.0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2
240	.0	.0	.0	.0	.0	.0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2
250	.0	.0	.0	.0	.0	.0	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2
260	.0	.0	.0	.0	.0	.0	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2
270	.0	.0	.0	.0	.0	.0	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2
280	.0	.0	.0	.0	.0	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2
290	.0	.0	.0	.0	.0	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	3	3
300	.0	.0	.0	.0	.0	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	3	3	3
310	.0	.0	.0	.0	.0	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	3	3	3	3
320	.0	.0	.0	.0	.0	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3
330	.0	.0	.0	.0	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3
340	.0	.0	.0	.0	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3
350	.0	.0	.0	.0	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3
360	.0	.0	.0	.0	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3
400	.0	.0	.0	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	4
440	.0	.0	.0	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	4	4	4	4
480	.0	.0	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	4	4	4	4	4	4	4
520	.0	.0	1	1	1	1	1	1	1	2	2	2	2	2	2	3	3	3	3	3	3	3	4	4	4	4	4	4	4

The table of temperature corrections is for use in deriving the values shown in fourth column of the right-hand page of the computation indicated on page 219, the length of the rod at zero degrees Centigrade having been used in deriving the third column. The table is computed upon the assumption that the coefficient of expansion

of the rod is four parts in a million per degree Centigrade. The sign of the correction is always the same as the sign of the measured difference of elevation unless the temperature is below the Centigrade zero.

Correction for temperature (in millimeters).

Temp. C.	Difference of elevation in meters.													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1
2	.0	.0	.0	.0	.0	.0	.1	.1	.1	.1	.1	.1	.1	.1
3	.0	.0	.0	.0	.1	.1	.1	.1	.1	.1	.1	.1	.2	.2
4	.0	.0	.0	.1	.1	.1	.1	.1	.1	.2	.2	.2	.2	.2
5	.0	.0	.1	.1	.1	.1	.1	.2	.2	.2	.2	.2	.3	.3
6	.0	.0	.1	.1	.1	.1	.2	.2	.2	.2	.3	.3	.3	.3
7	.0	.1	.1	.1	.1	.2	.2	.2	.2	.3	.3	.3	.4	.4
8	.0	.1	.1	.1	.2	.2	.2	.3	.3	.3	.4	.4	.4	.4
9	.0	.1	.1	.1	.2	.2	.2	.3	.3	.4	.4	.4	.5	.5
10	.0	.1	.1	.2	.2	.2	.3	.3	.4	.4	.4	.5	.5	.6
11	.0	.1	.1	.2	.2	.3	.3	.4	.4	.4	.5	.5	.6	.6
12	.0	.1	.1	.2	.2	.3	.3	.4	.4	.5	.5	.6	.6	.7
13	.0	.1	.2	.2	.3	.3	.4	.4	.5	.5	.6	.6	.7	.7
14	.1	.1	.2	.2	.3	.3	.4	.4	.5	.6	.6	.7	.7	.8
15	.1	.1	.2	.2	.3	.4	.4	.5	.5	.6	.7	.7	.8	.8
16	.1	.1	.2	.3	.3	.4	.4	.5	.6	.6	.7	.8	.8	.9
17	.1	.1	.2	.3	.3	.4	.5	.5	.6	.7	.8	.8	.9	.9
18	.1	.1	.2	.3	.4	.4	.5	.6	.6	.7	.8	.9	.9	1.0
19	.1	.2	.2	.3	.4	.5	.5	.6	.7	.8	.8	.9	1.0	1.1
20	.1	.2	.2	.3	.4	.5	.6	.6	.7	.8	.9	1.0	1.0	1.1
21	.1	.2	.2	.3	.4	.5	.6	.7	.8	.8	.9	1.0	1.1	1.2
22	.1	.2	.3	.4	.4	.5	.6	.7	.8	.9	1.0	1.1	1.1	1.2
23	.1	.2	.3	.4	.5	.6	.6	.7	.8	.9	1.0	1.1	1.2	1.3
24	.1	.2	.3	.4	.5	.6	.7	.8	.9	1.0	1.1	1.2	1.2	1.3
25	.1	.2	.3	.4	.5	.6	.7	.8	.9	1.0	1.1	1.2	1.3	1.4
26	.1	.2	.3	.4	.5	.6	.7	.8	.9	1.0	1.1	1.2	1.3	1.5
27	.1	.2	.3	.4	.5	.6	.8	.9	1.0	1.1	1.2	1.3	1.4	1.5
28	.1	.2	.3	.4	.6	.7	.8	.9	1.0	1.1	1.2	1.3	1.4	1.6
29	.1	.2	.4	.5	.6	.7	.8	.9	1.0	1.2	1.3	1.4	1.5	1.6
30	.1	.2	.4	.5	.6	.7	.8	1.0	1.1	1.2	1.3	1.4	1.6	1.7
31	.1	.2	.4	.5	.6	.7	.9	1.0	1.1	1.2	1.4	1.5	1.6	1.7
32	.1	.3	.4	.5	.6	.8	.9	1.0	1.2	1.3	1.4	1.5	1.7	1.8
33	.1	.3	.4	.5	.7	.8	.9	1.1	1.2	1.3	1.4	1.6	1.7	1.8
34	.1	.3	.4	.5	.7	.8	1.0	1.1	1.2	1.4	1.5	1.6	1.8	1.9
35	.1	.3	.4	.6	.7	.8	1.0	1.1	1.3	1.4	1.5	1.7	1.8	2.0
36	.1	.3	.4	.6	.7	.9	1.0	1.2	1.3	1.4	1.6	1.7	1.9	2.0
37	.1	.3	.4	.6	.7	.9	1.0	1.2	1.3	1.5	1.6	1.8	1.9	2.1
38	.1	.3	.5	.6	.8	.9	1.1	1.2	1.4	1.5	1.7	1.8	2.0	2.1
39	.2	.3	.5	.6	.8	.9	1.1	1.2	1.4	1.6	1.7	1.9	2.0	2.2
40	.2	.3	.5	.6	.8	1.0	1.1	1.3	1.4	1.6	1.8	1.9	2.1	2.2
41	.2	.3	.5	.7	.8	1.0	1.1	1.3	1.5	1.6	1.8	2.0	2.1	2.3
42	.2	.3	.5	.7	.8	1.0	1.2	1.3	1.5	1.7	1.8	2.0	2.2	2.3
43	.2	.3	.5	.7	.9	1.0	1.2	1.4	1.5	1.7	1.9	2.1	2.2	2.4
44	.2	.3	.5	.7	.9	1.1	1.2	1.4	1.6	1.8	1.9	2.1	2.3	2.5
45	.2	.3	.5	.7	.9	1.1	1.3	1.4	1.6	1.8	2.0	2.2	2.3	2.5

STATISTICS OF NEW COAST AND GEODETIC SURVEY LEVEL LINES.

The principal items of information in regard to the Coast and Geodetic Survey level lines are given in tables below, which have been arranged in such a manner as to be conducive to comparisons between the lines. The details in regard to the lines will be given later.

Instruments Nos. 7, 8, and 9 are of the new type; instruments Nos. 1 and 6 are the modified instruments which were the immediate predecessors of the new type, and which involve many of the essential features of the new instruments. The method of observing was substantially the same with these instruments as with the new instruments. For a description of these instruments and the method of observing used with them, see Appendices 5, 6, and 7 of the Report for 1899.

The rods used in the leveling of 1900–1903 are all alike and are of the type referred to on page 211.

The number of permanent bench marks includes all with which the leveling was directly connected, regardless of whether they are new bench marks or bench marks previously established by some other party or organization.

The average distance between bench marks was obtained by dividing the total length of the main line by the number of bench marks.

The speed has been obtained by dividing the total length of the lines run by the interval in months from the date of the first leveling to the date of the last, inclusive.

The divergence in millimeters per kilometer was obtained by dividing the total divergence on the main line by the length of the main line in kilometers.

The probable error of the mean result for a section was computed by the formula

$$r'' = 0.674\sqrt{\frac{\Sigma d^2}{4s}}$$

in which d is the discrepancy between the forward and backward leveling over a section, and s the number of sections. The probable error for 1 kilometer, r_1, was derived by assuming that the average length of a section is to 1 kilometer as $(r'')^2$ is to r_1^2.

	Cincinnati, Ohio, to Somerset, Ky.	Somerset, Ky., to Knoxville, Tenn.	Harriman Junction, Tenn., to Woodville, Ala.	Woodville, Ala., to Birmingham, Ala.	Norfolk, Nebr., to Sioux City, Iowa.	Norfolk, Nebr., to Page, Nebr.	Solomon, Kans., to Anthony, Kans.
Observer	O. W. F.	W. H. B.	O. W. F.	W. H. B.	B. E. T.	B. E. T.	B. E. T.
Instrument	1 and 7	8	7	8	6	6	6
Rods	T & U	V & W	T & U	W & V	R_2 & S	R_2 & S	R_2 & S
Date of first leveling	June 6, 1900	July 23, 1900	Sept. 4, 1900	Nov. 7, 1900	May 8, 1900	June 22, 1900	July 31, 1900
Date of last leveling	Aug. 31, 1900	Nov. 3, 1900	Dec. 3, 1900	Jan. 9, 1901	June 20, 1900	July 27, 1900	Oct. 12, 1900
Length of main line, km.	263	*260	†262	219	132	107	241
Length of side lines, km.	7	27	4	2	2	1	7
Total length, km	270	287	266	221	134	108	248
Total length, miles	168	178	165	137	83	67	154
Number permanent bench marks.	65	41	66	43	19	14	42
Average distance between permanent B. Ms., in km.	4.0	6.3	4.0	5.1	6.9	7.6	5.7
Speed, km. per month.	94	84	89	105	93	90	102
Speed, miles per month.	59	52	55	65	58	56	63
Percentage run more than twice.	8	8	4	9	25	18	18
Discrepancy (B—F), total, mm.	+58.8	+100.9	+30.7	+161.4	+37.4	+50.3	+96.9
Discrepancy (B—F), in mm. per km.	+0.23	+0.42	+0.12	+0.74	+0.28	+0.47	+0.39
Probable error for 1 km., in mm.	±0.5	±0.8	±0.8	±0.8	±0.7	±0.8	±0.7
Velocipede cars used.	No.	No.	No.	No.	Yes.	On one-half.	Yes.

*Includes the line to Melton triangulation station, 20 km., the length of the main line between Somerset and Knoxville being 240 km.

†Includes the line to Gunter triangulation station, 15 km., the length of the main line from Harriman Junction to Woodville being 247 km.

	Page, Nebr., to Chadron, Nebr.	Cheyenne, Wyo., to Orin Junction, Wyo.	Decatur, Ala., to Corinth, Miss.	Dobbs Ferry, N.Y., to Greenbush, N.Y.	Chadron, Nebr., to Orin Junction, Wyo.	Bowie, Tex., to Anthony, Kans.
Observer	O. E. C. & G. E. S.	W. C. D.	W. C. D.	W. C. D.	W. C. D.	W. H. B.
Instrument	8 & 6	7	7	7	7	8
Rods	V & W	R_2, S. & T.	R_2 & T	R_2 & S	R_2 & S	V & W
Date of first leveling	July 13, 1901	July 31, 1901	Oct. 24, 1901	Apr. 16, 1902	June 24, 1902	Apr. 3, 1902
Date of last leveling	Nov. 23, 1901	Oct. 15, 1901	Dec. 9, 1901	June 13, 1902	Aug. 1, 1902	July 11, 1902
Length of main line, km	426	245	169	215	203	*449
Length of side lines, km	8	3	0	4	2	36
Total length, km	434	248	169	219	205	485
Total length, miles	270	154	105	136	127	301
Number permanent B. Ms	46	26	40	86	24	94
Average distance between permanent B. Ms. in km	9.3	9.4	4.2	2.5	8.5	4.8
Speed, km. per month	99	98	†110	111	158	147
Speed, miles per month	62	61	†68	69	98	91
Percentage run more than twice	20	14	‡16	6	14	11
Discrepancy (B—F), total, mm	+42.4	−32.9	‡+13.3	+67.1	−5.4	−46.9
Discrepancy (B—F), mm. per km	+0.10	−0.13	‡+0.18	+0.31	−0.03	−0.11
Probable error for 1 km in mm	±0.7	±0.6	†±0.6	±0.7	±0.7	±0.7
Velocipede cars used	Yes.	Yes.	No.	No.	Yes.	Yes.

	Bowie, Tex., to Shreveport, La.	Ft. Worth, Tex., to Comanche △, Tex.	Ft. Worth, Tex., to Lampasas, Tex.	Temple, Tex., to Holland, Tex.	Rock Creek, Wyo., to Red Desert, Wyo.
Observer	W. H. B.	R. L. L.	R. L. L.	R. L. L.	W. C. D.
Instrument	8 & 9	9	9	9	7
Rods	V & W	V & W	V & W	V & W	R_2 & S
Date of first leveling	July 14, 1902	Nov. 22, 1902	Dec. 20, 1902	Mar. 27, 1903	Aug. 11, 1902
Date of last leveling	Nov. 18, 1902	Dec. 18, 1902	Mar. 25, 1903	Apr. 9, 1903	Oct. 13, 1902
Length of main line, km	533	75	287	26	212
Length of side lines, km	14	3	4	2	2
Total length, km	547	78	291	28	214
Total length, miles	340	48	181	17	133
Number permanent B. Ms	72	11	35	7	30
Average distance between permanent B. Ms. in km	7.4	6.8	8.2	3.7	7.1
Speed, km. per month	131	87	91	60	102
Speed, miles per month	81	54	57	37	63
Percentage run more than twice	10	8	13	34	14
Discrepancy (B—F), total, mm	−84.2	−23.2	−48.5	−8.4	+37.5
Discrepancy (B—F), mm. per km	−0.16	−0.31	−0.17	−0.32	+0.18
Probable error for 1 km in mm	±0.7	±0.7	±0.7	±0.9	±0.7
Velocipede cars used	Yes.	Yes.	Yes.	Yes.	Yes.

*Includes the line to Bowie Northwest Base, 16 km., the length of the main line between Anthony and Bowie being 433 km.

†It should be noted that of 169 km. on this line but 103 km. was double line, the remaining 66 being single line. The total length is therefore equivalent to 136 km. $\left(=103+\frac{66}{2}\right)$ of double line, and the speed per month in terms of double line is 89 km., or 55 miles.

‡Computed from the portion Decatur to Tuscumbia, the portion Tuscumbia to Corinth being as a rule a single line. The length of the line Decatur to Tuscumbia is 72 km.

CINCINNATI–SOMERSET LINE.

This line of levels was run by Assistant O. W. Ferguson, between June 6 and August 31, 1900. Level No. 1, one of the modified levels which immediately preceded the present type of level, was used up to July 23, after which level No. 7, one of the new type, was used to the end of the season. This line forms the first section of the line from Cincinnati to Birmingham, the purpose of which was to strengthen the southeastern portion of the level net. It connected with the triangulation of the eastern oblique arc and with the thousand-mile loop of precise leveling in North Carolina, Tennessee, and Georgia by the U. S. Geological Survey, and entered the large area in the southeastern group of States in which there was no precise leveling by the Coast and Geodetic Survey. The line runs over the Queen and Crescent road, as indicated in the illustration opposite. It starts from bench marks Y_4, Z_4 and A_5, in Cincinnati, Ohio, and Ludlow, Ky., which had been fixed by the leveling from Gibraltar to Cincinnati in 1899. It connects at Somerset, Ky., with the next section of the line which was run by Aid W. H. Burger in 1900. The velocipede cars were not used during this leveling.

Rods T and U were used by Assistant Ferguson and rods V and W by Aid W. H. Burger on the lines between Cincinnati and Birmingham throughout the season of 1900.

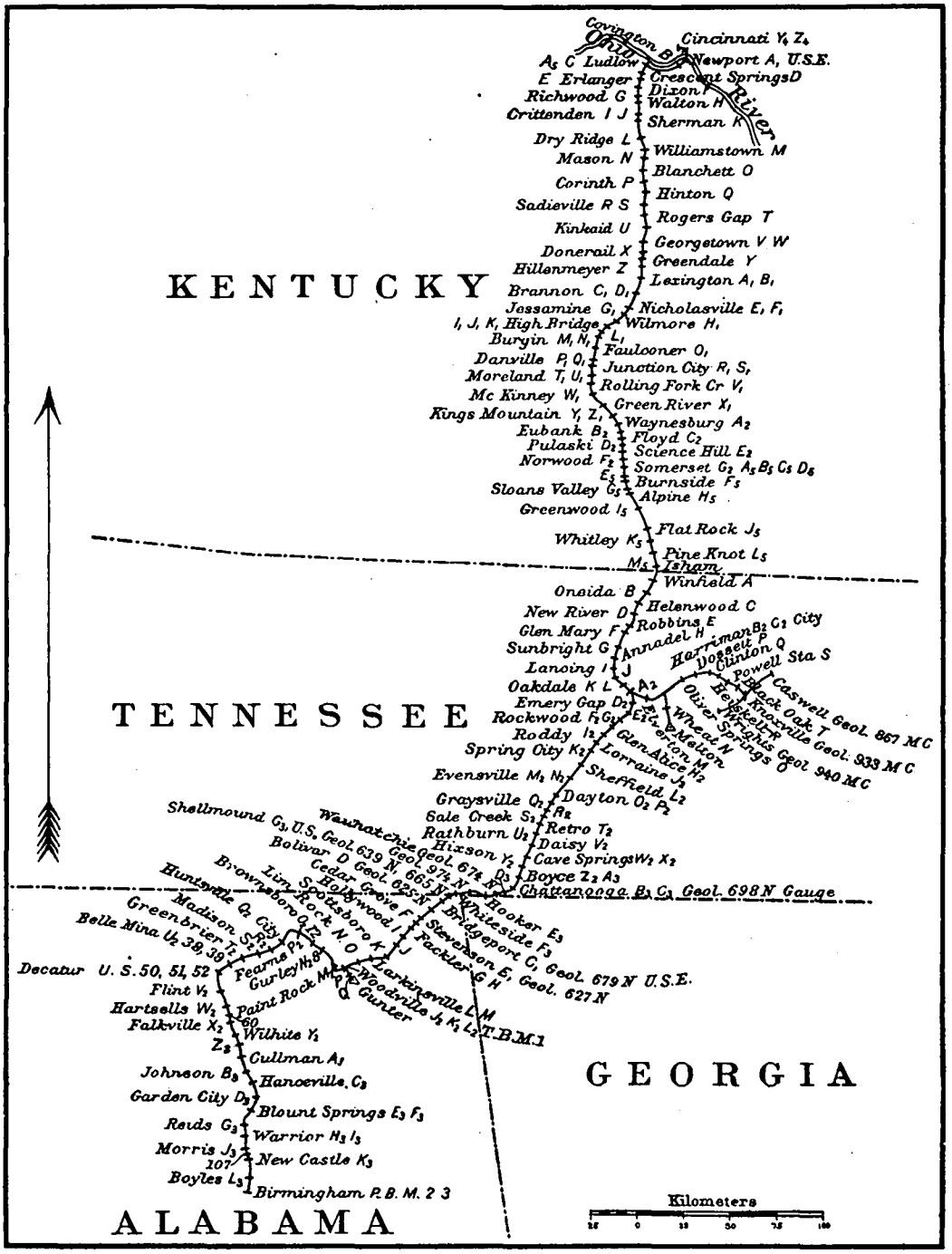
The index corrections of the rods T and U at the close of the season of 1899 were −0.3 millimeter for T and −0.4 millimeter for U, the zero of the graduation being below the bottom of the rod. At the end of the season of 1900 these rods each had a correction of −0.5 millimeter. The average correction for rod T was therefore −0.4 millimeter and for rod U −0.45 millimeter. Thus the correction for index error is practically zero and was not applied except in the cases where a reading was taken on a bench mark without the use of the rod. In these cases a correction of 0.4 millimeter was applied in such a way as to affect only the height of the one bench mark. Another reason for not applying these very small corrections is that they are largely compensating in character and would change the final elevations very little. No separate column is provided for the index correction on the computation form shown on page 219, as it seldom needs to be applied. When it must be applied it should be entered in the second column of the right-hand page of the computation.

The index correction for rod V at the beginning of the season was zero and at the end of the season was −0.1 millimeter, with an average of −0.05 millimeter. For rod W the same values respectively were zero and −0.2 millimeter, with an average of −0.1 millimeter. As these corrections were very small they were not applied at all in the office revision of the work.

While in the field the rods were measured by means of a steel tape, graduated to millimeters, used direct and reversed, and read with the aid of a pocket reading glass. The temperature of the rod thermometer was always noted in connection with these measures. Care was taken that the rods and tape should be at the temperature of the atmosphere so that reliable comparisons could be made. These measurements were made in order to detect, if possible, any change in the length of the rods during the season.

The results of these measures are given in the accompanying table. The part of the rod measured was between the fine lines on the silver plugs at the first and thirty-

No. 9.



Leveling route, Cincinnati, Ohio, to Birmingham, Ala.

first decimeter graduations. These measurements are made comparable by reducing the lengths as observed to 20° C., both the coefficient of expansion of the tape and that of the rod being taken into account when reducing.

Field measurements of rods.

Reduced to 20° C.

Date.		Rod T.	Rod U.
1900.		*m.*	*m.*
June 9		3.0010	3.0007
26		3.0011	3.0009
July 23		3.0012	3.0010
Aug. 8		3.0011	3.0008
Sept. 6		3.0012	3.0011
27		3.0011	3.0009
Oct. 16		3.0010	3.0009
29		3.0009	3.0006
Nov. 23		3.0010	3.0010
Dec. 4		3.0008	3.0008
	Mean	3.0010	3.0009

Date.		Rod V.	Rod W.
1900.		*m.*	*m.*
July 12		3.0006	3.0009
23		3.0007	3.0009
24		3.0006	3.0010
26	First group	3.0005	3.0008
30		3.0008	3.0011
Aug. 9		3.0007	3.0010
22		3.0007	3.0009
	Mean	3.0007	3.0009
Sept. 10		3.0009	3.0012
27		3.0010	3.0015
Oct. 12		3.0010	3.0015
23	Second group	3.0009	3.0014
Nov. 5		3.0007	3.0011
13		3.0009	3.0013
	Mean	3.0009	3.0013
Nov. 22		3.0013	3.0017
Dec. 6		3.0012	3.0016
19		3.0014	3.0021
1901.	Third group		
Jan. 3		3.0010	3.0016
16		3.0012	3.0016
	Mean	3.0012	3.0017

The values given in the table are relative only, as the correction to the tape was not applied.

As far as rods T and U are concerned no change in length is noticed, the measurements at no time differing by more than 0.2 millimeter from the mean, with 0.4 millimeter as a maximum range.

Rods V and W show apparently a very decided change in length, a maximum range of 0.9 millimeter in the former and 1.3 millimeters in the latter. Furthermore, the change seems to have been a gradual change throughout the season, the rods becoming longer. At the periods August 22 and November 22, there appear slight jumps in the series. These two breaks divide the total series into three parts and for computation purposes, namely, correction for length of rod, a corresponding division was made.

The total absolute changes in the lengths of the rods, as indicated by the measurements in the Office of Standard Weights and Measures before and after the season of leveling, are shown in the following table.

The coefficient of expansion used in the reduction to 0° C. was 0.000004 per Centigrade degree.

Measurements of rods in Office of Standard Weights and Measures.

Date.	Rod T.	Rod U.	Temp.	Lengths at 0.0° C. Rod T.	Rod U.
	m.	*m.*	°	*m.*	*m.*
Dec. 22, 1899	3.001774	3.001545	25.50 C.	3.001504	3.001275
Jan. 21, 1901	3.001644	3.001461	25.25	3.001361	3.001158
				3.001432	3.001216

Date.	Rod V.	Rod W.	Temp.	Lengths at 0.0° C. Rod T.	Rod U.
	m.	*m.*	°	*m.*	*m.*
June 16, 1900	3.001073	3.001254	V—25.8	3.000763	3.000944
Jan. 22, 1901	3.001840	3.002233	V—23.25 W—22.38	3.001561	3.001963
				3.001162	3.001454

Rod T shows a shortening of 0.143 millimeter and rod U of 0.117 millimeter between December 22, 1899, and January 21, 1901. This shortening is very slight. In making the corrections for length of rod a mean value for the two rods of 3.001324 was taken. Therefore the correction applied was 0.441 millimeter per meter of difference of elevation and numerically increased the difference of elevation between bench marks in every case.

Both rods V and W show an increase in absolute length by the measurements of the Office of Standard Weights and Measures, a confirmation of the results of measurements by tape in the field; and as these field measurements seemed to show the change to have been gradual, with but the two above-mentioned breaks, it was decided to use for computation purposes a mean of the June values for the period up to the first break in the series, or from July 23 to September 1, to use a mean of the January values for the period from November 20 to January 9, and a mean of the two means for the middle period. These values are, respectively, 3.000854, 3.001762, and 3.001308. Expressed as corrections for length of rod, they are +0.285, +0.587, and +0.436 millimeter per meter of difference of elevation between bench marks.

This slight increase in the length of rods V and W during their first season of use is in accordance with previous experience with paraffined rods on this Survey. The general tendency is for the rods to increase slightly in length during the first season and to preserve nearly a constant length thereafter.

The elevations in the following tabulation are based upon the elevations published in Appendix 8, Report for 1899, for bench marks A_5 and Z_4, as indicated in detail in the note at the foot of the first page of the tabulation:

Results of precise leveling from Cincinnati, Ohio, to Somerset, Ky., 1900.

Bench marks.		Distance between successive bench marks.	Distance from bench mark A_5 at Ludlow, Ky.	Difference of elevation.			Discrepancy, B—F.		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
	A_5		0.000					0.0	*162.3489
A_5	C	0.258	0.258	— 0.3667	+ 0.3658	— 0.3662	+0.9	+ 0.9	†161.9827
	Y_4		‡(0.000)					0.0	*168.4273
Y_4	Z_4	1.084	‡(1.084)	—18.9783	+18.9782	—18.9782	+0.1	+ 0.1	149.4491
	Z_4								*149.4506
Z_4	A	0.834	‡(1.918)	+ 6.5926	— 6.5916	+ 6.5921	—1.0	— 0.9	†156.0427
A	U. S. E.	0.322	‡(2.240)	— 3.6590		— 3.6590			†152.3837
A	2	1.310	‡(3.228)	— 5.6953	+ 5.6975	— 5.6964	—2.2	— 3.1	150.3463
2	B	0.689	‡(3.917)	+ 6.0549	— 6.0546	+ 6.0548	—0.3	— 3.4	†156.4011
B	3	1.106	‡(5.023)	— 7.8386§	+ 7.8493	— 7.8497	+0.8	— 2.6	148.5514
				— 7.8501					
3	4	1.400	‡(6.423)	+ 1.6319	— 1.6281	+ 1.6300	—3.8	— 6.4	150.1814
4	C	0.806	‡(7.229)	+11.8120	—11.8113	+11.8116	—0.7	— 7.1	†161.9930
	C		0.258					+ 0.9	†161.9831
C	1	1.709	1.967	+16.1745	—16.1801	+16.1760	+4.8	+ 5.7	178.1591
				+16.1728	—16.1766				
1	5	2.072	4.039	+23.6272	—23.6264	+23.6268	—0.8	+ 4.9	201.7859
5	6	1.052	5.091	+12.6126	—12.6153	+12.6140	+2.7	+ 7.6	214.3999
6	D	1.966	7.057	+22.9235	—22.9238	+22.9236	+0.3	+ 7.9	237.3235
D	7	2.074	9.131	+19.8958	—19.8995	+19.8976	+3.7	+11.6	257.2211
7	E	2.360	11.491	+21.6426	—21.6433	+21.6430	+0.7	+12.3	278.8641
E	8	1.394	12.885	—10.1143	+10.1169	—10.1156	—2.6	+ 9.7	268.7485
8	9	1.018	13.903	— 4.4933	+ 4.4965	— 4.4949	—3.2	+ 6.5	264.2536
9	10	1.387	15.290	+ 7.8821	— 7.8821	+ 7.8821	0.0	+ 6.5	272.1357
10	F	1.924	17.214	+ 9.7179	— 9.7159	+ 9.7169	—2.0	+ 4.5	281.8526
F	11	2.145	19.359	+ 4.2321	— 4.2315	+ 4.2318	—0.6	+ 3.9	286.0844
11	12	2.317	21.676	— 0.4773	+ 0.4743	— 0.4758	+3.0	+ 6.9	285.6086
12	13	1.643	23.319	— 5.7671	+ 5.7669	— 5.7670	+0.2	+ 7.1	279.8416
13	G	0.424	23.743	+ 6.1567	— 6.1565	+ 6.1566	—0.2	+ 6.9	285.9982
13	14	2.374	25.693	+ 3.1866	— 3.1864	+ 3.1865	—0.2	+ 6.9	283.0281
14	15	1.312	27.005	+ 5.7290	— 5.7303	+ 5.7296	+1.3	+ 8.2	288.7577
15	16	1.707	28.712	— 8.4138	+ 8.4124	— 8.4131	+1.4	+ 9.6	280.3446
16	H	0.608	29.320	— 1.9637	+ 1.9644	— 1.9640	—0.7	+ 8.9	278.3806
H	17	1.142	30.462	— 4.9801	+ 4.9787	— 4.9794	+1.4	+10.3	273.4012
17	18	1.162	31.624	+ 3.2312	— 3.2229	+ 3.2262	—4.8	+ 5.5	276.6274
				+ 3.2261	— 3.2248				
18	19	0.894	32.518	+ 2.2746	— 2.2737	+ 2.2742	—0.9	+ 4.6	278.9016
19	20	2.161	34.679	+ 4.1595	— 4.1574	+ 4.1584	—2.1	+ 2.5	283.0600
20	21	2.294	36.973	— 3.0819	+ 3.0918	— 3.0861	—5.0	— 2.5	279.9739
				— 3.0852	+ 3.0854				

*These values are from p. 492, Appendix 8, Report for 1899.

† The two values for the elevation of C, derived from A_5 and Z_4, respectively, differ by 10.3 millimeters. This difference was distributed proportionally to the distance along the line between Z_4 and A_5. Bench marks A, U. S. E., B, and C received corrections of −1.3, −1.3, −4.6, and −9.9 millimeters, respectively, giving for their adjusted elevations 156.0414, 152.3824, 156.3965, and 161.9831, respectively.

‡ The distances in parentheses are reckoned from Y_4.

§ Rejected.

Results of precise leveling from Cincinnati, Ohio, to Somerset, Ky., 1900—Continued.

Bench marks.		Distance between successive bench marks.	Distance from bench mark A_5 at Ludlow, Ky.	Difference of elevation.			Discrepancy, B—F.		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
21	I	0.513	37.486	− 7.0874	+ 7.0880	− 7.0877	−0.6	− 3.1	272.8862
21	22	1.807	38.780	− 0.4695	+ 0.4697	− 0.4696	−0.2	− 2.7	279.5043
22	23	1.091	39.871	− 0.3816	+ 0.3814	− 0.3815	+0.2	− 2.5	279.1228
23	J	0.148	40.019	+ 2.2900	− 2.2902	+ 2.2901	+0.2	− 2.3	281.4129
23	24	1.636	41.507	+ 2.3107	− 2.3153	+ 2.3130	+4.6	+ 2.1	281.4358
24	25	1.954	43.461	− 1.4955	+ 1.4986	− 1.4970	−3.1	− 1.0	279.9388
25	K	1.736	45.197	+ 4.7994	− 4.7987	+ 4.7990	−0.7	− 1.7	284.7378
K	26	2.469	47.666	+ 2.9048	− 2.8985	+ 2.9016	−6.3	− 8.0	287.6394
26	27	2.370	50.036	+ 0.9571	− 0.9531	+ 0.9551	−4.0	−12.0	288.5945
27	L	0.952	50.988	+ 3.2621	− 3.2647	+ 3.2634	+2.6	− 9.4	291.8579
L	28	1.846	52.834	+ 0.4647	− 0.4651	+ 0.4649	+0.4	− 9.0	292.3228
28	29	1.656	54.490	− 0.0829	+ 0.0814	− 0.0822	+0.5	− 8.5	292.2406
29	M	2.186	56.676	+ 4.6726	− 4.6689	+ 4.6708	−3.7	−12.2	296.9114
M	30	2.472	59.148	−11.8938	+11.8932	−11.8935	+0.6	−11.6	285.0179
30	31	1.847	60.995	+ 3.2728	− 3.2745	+ 3.2736	+1.7	− 9.9	288.2915
31	32	2.213	63.208	− 4.7562	+ 4.7561	− 4.7562	+0.1	− 9.8	283.5353
32	N	1.068	64.276	− 4.7804	+ 4.7804	− 4.7804	0.0	− 9.8	278.7549
N	33	1.772	66.048	+ 4.7362	− 4.7344	+ 4.7353	−1.8	−11.6	283.4902
33	34	1.958	68.006	+ 1.9139	− 1.9118	+ 1.9128	−2.1	−13.7	285.4030
34	O	1.964	69.970	+ 1.4158	− 1.4142	+ 1.4150	−1.6	−15.3	286.8180
O	35	0.905	70.875	+ 3.2854	− 3.2840	+ 3.2847	−1.4	−16.7	290.1027
35	36	0.936	71.811	+ 2.1491	− 2.1450	+ 2.1466	−1.6	−18.3	292.2493
				+ 2.1457	− 2.1467				
36	37	1.198	73.009	− 0.4721	+ 0.4739	− 0.4730	−1.8	−20.1	291.7763
37	38	1.464	74.473	+ 0.4023	− 0.4041	+ 0.4032	+1.8	−18.3	292.1795
38	P	0.091	74.564	− 0.0616	+ 0.0617	− 0.0616	−0.1	−18.4	292.1179
38	39	1.514	75.987	− 2.5254	+ 2.5250	− 2.5252	+0.4	−17.9	289.6543
39	40	1.766	77.753	+ 1.8937	− 1.8930	+ 1.8934	−0.7	−18.6	291.5477
40	Q	2.174	79.927	− 1.0971	+ 1.0932	− 1.0952	+3.9	−14.7	290.4525
Q	41	1.591	81.518	− 6.8868	+ 6.8853	− 6.8860	+1.5	−13.2	283.5665
41	42	1.780	83.298	− 9.8170	+ 9.8165	− 9.8168	+0.5	−12.7	273.7497
42	43	2.352	85.650	−11.0966	+11.1008	−11.0987	−4.2	−16.9	262.6510
43	R	2.215	87.865	− 1.1027	+ 1.1071	− 1.1049	−4.4	−21.3	261.5461
R	44	1.532	89.397	+ 8.6332	− 8.6350	+ 8.6341	+1.8	−19.5	270.1802
44	45	1.997	91.394	+ 6.1896	− 6.1906	+ 6.1901	+1.0	−18.5	276.3703
45	46	1.948	93.342	− 1.4467	+ 1.4473	− 1.4470	−0.6	−19.1	274.9233
46	S	0.358	93.700	−11.2330	+11.2353	−11.2342	−2.3	−21.4	263.6891
46	47	1.592	94.934	+ 2.0429	− 2.0435	+ 2.0432	+0.6	−18.5	276.9665
47	48	1.665	96.599	− 3.7351	+ 3.7320	− 3.7336	+3.1	−15.4	273.2329
48	49	1.401	98.000	+ 6.9059	− 6.9081	+ 6.9070	+2.2	−13.2	280.1399
49	T	0.275	98.275	− 4.8965	+ 4.8966	− 4.8966	−0.1	−13.3	275.2433
49	50	2.416	100.416	−11.5665	+11.5672	−11.5668	−0.7	−13.9	268.5731
50	U	2.475	102.891	−13.6569	+13.6581	−13.6575	−1.2	−15.1	254.9156
U	51	1.092	103.983	− 2.4090	+ 2.4098	− 2.4094	−0.8	−15.9	252.5062
51	52	1.768	105.751	+ 5.0594	− 5.0517	+ 5.0568	−1.5	−17.4	257.5630
				+ 5.0559	− 5.0605				

Results of precise leveling from Cincinnati, Ohio, to Somerset, Ky., 1900—Continued.

Bench marks.		Distance between successive bench marks.	Distance from bench mark A_5 at Ludlow, Ky.	Difference of elevation.			Discrepancy, B—F.		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
52	V	2.276	108.027	+ 3.1308	− 3.1302	+ 3.1305	−0.6	−18.0	260.6935
V	W	1.110	109.137	+ 6.4777	− 6.4764	+ 6.4770	−1.3	−19.3	267.1705
W	53	1.077	110.214	+ 3.3309	− 3.3335	+ 3.3322	+2.6	−16.7	270.5027
53	54	1.164	111.378	− 0.5279	+ 0.5255	− 0.5267	+2.4	−14.3	269.9760
54	55	1.011	112.389	− 4.3852	+ 4.3819	− 4.3836	+3.3	−11.0	265.5924
55	56	2.103	114.492	+ 0.6231	− 0.6277	+ 0.6254	+4.6	− 6.4	266.2178
56	X	0.714	115.206	− 0.9697	+ 0.9704	− 0.9700	−0.7	− 7.1	265.2478
X	57	1.167	116.373	+ 7.0192	− 7.0232	+ 7.0212	+4.0	− 3.1	272.2690
57	58	2.468	118.841	+12.5980	−12.6011	+12.5996	+3.1	0.0	284.8686
58	59	1.694	120.535	+ 1.7124	− 1.7086	+ 1.7105	−3.8	− 3.8	286.5791
59	Y	0.349	120.884	− 1.4849	+ 1.4861	− 1.4855	−1.2	− 5.0	285.0936
59	60	2.048	122.583	+ 2.0635	− 2.0607	+ 2.0621	−2.8	− 6.6	288.6412
60	Z	0.353	122.936	− 2.4426	+ 2.4427	− 2.4426	−0.1	− 6.7	286.1986
Z	61	1.098	124.034	+ 2.6449	− 2.6454	+ 2.6452	+0.5	− 6.2	288.8438
61	62	1.842	125.876	− 0.7602	+ 0.7618	− 0.7610	−1.6	− 7.8	288.0828
62	63	2.086	127.962	+ 5.7999	− 5.8065	+ 5.8036	+3.7	− 4.1	293.8864
				+ 5.8036	− 5.8045				
63	A_1	0.748	128.710	+ 4.5258	− 4.5271	+ 4.5264	+1.3	− 2.8	298.4128
63	64	2.134	130.096	+ 3.3035	− 3.3001	+ 3.3018	−3.4	− 7.5	297.1882
64	65	2.110	132.206	+14.7786	−14.7780	+14.7783	−0.6	− 8.1	311.9665
65	B_1	1.920	134.126	− 3.9562	+ 3.9547	− 3.9554	+1.5	− 6.6	308.0111
B_1	66	1.984	136.110	+ 3.6513	− 3.6580	+ 3.6536	+1.2	− 5.4	311.6647
				+ 3.6548	− 3.6503				
66	67	1.547	137.657	+ 3.7714	− 3.7725	+ 3.7720	+1.1	− 4.3	315.4367
67	C_1	0.470	138.127	− 2.0653	+ 2.0654	− 2.0654	−0.1	− 4.4	313.3713
C_1	68	0.800	138.927	− 3.2993	+ 3.2979	− 3.2986	+1.4	− 3.0	310.0727
68	D_1	1.929	140.856	−13.0332	+13.0299	−13.0316	+3.3	+ 0.3	297.0411
D_1	69	0.724	141.580	+ 7.4010	− 7.4008	+ 7.4009	−0.2	+ 0.1	304.4420
69	70	2.175	143.755	− 1.1674	+ 1.1651	− 1.1662	+2.3	+ 2.4	303.2758
70	71	1.283	145.038	− 8.5223	+ 8.5198	− 8.5210	+2.5	+ 4.9	294.7548
71	E_1	1.304	146.342	− 4.9939	+ 4.9929	− 4.9934	+1.0	+ 5.9	289.7614
E_1	F_1	0.862	147.204	− 1.2639	+ 1.2610	− 1.2624	+2.9	+ 8.8	288.4990
E_1	72	1.808	148.450	−11.3602	+11.3604	−11.3603	−0.2	+ 5.7	278.4011
72	73	1.686	149.836	−12.1789	+12.1843	−12.1816	−5.4	+ 0.3	266.2195
73	G_1	0.598	150.434	+ 3.5583	− 3.5593	+ 3.5588	+1.0	+ 1.3	269.7783
G_1	74	1.698	152.132	+ 2.4539	− 2.4550	+ 2.4544	+1.1	+ 2.4	272.2327
74	75	1.518	153.650	− 4.4768	+ 4.4724	− 4.4746	+4.4	+ 6.8	267.7581
75	H_1	1.121	154.771	− 0.2429	+ 0.2448	− 0.2438	−1.9	+ 4.9	267.5143
H_1	76	1.630	156.401	+ 1.9512	− 1.9525	+ 1.9518	+1.3	+ 6.2	269.4661
76	I_1	1.835	158.236	+ 3.8029	− 3.7989	+ 3.8009	−4.0	+ 2.2	273.2670
I_1	77	0.964	159.200	− 9.6477	+ 9.6508	− 9.6492	−3.1	− 0.9	263.6178
77	78	1.634	160.834	−17.3218	+17.3179	−17.3198	+3.9	+ 3.0	246.2980
78	J_1	1.636	162.470	−13.6231	+13.6185	−13.6208	+4.6	+ 7.6	232.6772
J_1	K_1	0.414	162.884	+ 1.8507	− 1.8539	+ 1.8524	+1.1	+ 8.7	234.5296
				+ 1.8530	− 1.8519				
K_1	79	1.201	164.085	+ 9.2466	− 9.2456	+ 9.2461	−1.0	+ 7.7	243.7757
79	80	1.750	165.835	+16.3095	−16.3100	+16.3098	+0.5	+ 8.2	260.0855
80	81	2.018	167.853	+16.8019	−16.7994	+16.8006	−2.5	+ 5.7	276.8861

Results of precise leveling from Cincinnati, Ohio, to Somerset, Ky., 1900—Continued.

Bench marks.		Distance between successive bench marks.	Distance from bench mark A_5 at Ludlow, Ky.	Difference of elevation.			Discrepancy, B—F.		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
80	L_1	1.304	167.139	+ 4.7461		+ 4.7461			264.8316
81	L_1	0.759	168.612	−12.0558		−12.0558			264.8303
81	82	1.654	169.507	+ 6.1030	− 6.1074	+ 6.1052	+4.4	+10.1	282.9913
82	M_1	2.146	171.653	− 8.4712	+ 8.4710	− 8.4711	+0.2	+10.3	274.5202
M_1	N_1	0.264	171.917	− 1.1690	+ 1.1687	− 1.1688	+0.3	+10.6	273.3514
M_1	83	2.107	173.760	+ 2.5021	− 2.5040	+ 2.5030	+1.9	+12.2	277.0232
83	84	1.587	175.347	+ 2.8474	− 2.8529	+ 2.8492	+2.8	+15.0	279.8724
				+ 2.8482	− 2.8483				
84	O_1	1.716	177.063	− 8.8121	+ 8.8143	− 8.8132	−2.2	+12.8	271.0592
O_1	85	1.920	178.983	+ 3.0111	− 3.0124	+ 3.0118	+1.3	+14.1	274.0710
85	P_1	1.251	180.234	+ 6.6444	− 6.6446	+ 6.6445	+0.2	+14.3	280.7155
P_1	86	2.068	182.302	+ 7.2741	− 7.2770	+ 7.2756	+2.9	+17.2	287.9911
86	87	1.629	183.931	+ 2.6912	− 2.6959	+ 2.6936	+4.7	+21.9	290.6847
87	Q_1	0.268	184.199	+10.4437	−10.4439	+10.4438	+0.2	+22.1	301.1285
87	88	1.502	185.433	−10.8040	+10.8029	−10.8034	+1.1	+23.0	279.8813
88	89	1.410	186.843	+13.8154	−13.8179	+13.8166	+2.5	+25.5	293.6979
89	90	1.502	188.345	+ 8.6920	− 8.6901	+ 8.6910	−1.9	+23.6	302.3889
90	R_1	1.178	189.523	+10.7768	−10.7752	+10.7760	−1.6	+22.0	313.1649
R_1	91	1.472	190.995	−14.1806	+14.1791	−14.1798	+1.5	+23.5	298.9851
91	S_1	1.872	192.867	− 9.6025	+ 9.6035	− 9.6030	−1.0	+22.5	289.3821
S_1	92	1.548	194.415	+ 8.9893	− 8.9911	+ 8.9902	+1.8	+24.3	298.5723
92	T_1	1.644	196.059	+ 4.5228	− 4.5235	+ 4.5232	+0.7	+25.0	302.8955
T_1	93	0.815	196.874	+ 4.6610	− 4.6627	+ 4.6618	+1.7	+26.7	307.5573
93	94	1.596	198.470	+14.5667	−14.5621	+14.5644	−4.6	+22.1	322.1217
94	U_1	1.931	200.401	+11.2178*	−11.2099	+11.2088	+4.1	+26.2	333.3305
				+11.2067	−11.2116				
U_1	95	1.754	202.155	−16.5960	+16.5972	−16.5966	−1.2	+25.0	316.7339
95	96	1.534	203.689	−14.8535	+14.8558	−14.8546	−2.3	+22.7	301.8793
96	V_1	1.069	204.758	− 9.9538	+ 9.9530	− 9.9534	+0.8	+23.5	291.9259
V_1	97	2.356	207.114	+ 8.7914	− 8.7886	+ 8.7900	−2.8	+20.7	300.7159
97	W_1	1.214	208.328	+ 7.3973	− 7.3977	+ 7.3975	+0.4	+21.1	308.1134
W_1	98	1.609	209.937	−17.8586	+17.8547	−17.8566	+3.9	+25.0	290.2568
98	X_1	1.648	211.585	−11.9867	+11.9857	−11.9862	+1.0	+26.0	278.2706
X_1	99	1.620	213.205	+ 8.8857	− 8.8881	+ 8.8869	+2.4	+28.4	287.1575
99	100	1.560	214.765	+12.1113	−12.1125	+12.1119	+1.2	+29.6	299.2694
100	Y_1	0.636	215.401	+ 5.6098	− 5.6116	+ 5.6107	+1.8	+31.4	304.8801
Y_1	101	1.490	216.891	+16.6775	−16.6769	+16.6772	−0.6	+30.8	321.5573
101	102	1.583	218.474	+16.2792	−16.2756	+16.2774	−3.6	+27.2	337.8347
102	Z_1	1.456	219.930	+15.3123	−15.3132	+15.3128	+0.9	+28.1	353.1475
Z_1	103	1.540	221.470	+ 5.3111	− 5.3112	+ 5.3112	+0.1	+28.2	358.4587
103	104	1.642	223.112	+ 9.9415	− 9.9448	+ 9.9432	+3.3	+31.5	368.4019
104	105	1.689	224.801	+ 5.1844	− 5.1858	+ 5.1851	+1.4	+32.9	373.5870
105	A_2	0.741	225.542	− 4.2321	+ 4.2312	− 4.2316	+0.9	+33.8	369.3554
A_2	106	1.800	227.342	+ 3.4978	− 3.4958	+ 3.4968	−2.0	+31.8	372.8522
106	107	1.650	228.992	− 1.5509	+ 1.5529	− 1.5519	−2.0	+29.8	371.3003
107	B_2	1.647	230.639	−15.3291*	+15.3196	−15.3214	+2.1	+31.9	355.9789
				−15.3224	+15.3210				

*Rejected.

Results of precise leveling from Cincinnati, Ohio, to Somerset, Ky., 1900—Continued.

Bench marks.		Distance between successive bench marks.	Distance from bench mark A_5 at Ludlow, Ky.	Difference of elevation.			Discrepancy, B—F.		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
B_2	108	1.340	231.979	— 1.4938	+ 1.4876	— 1.4896	+4.0	+35.9	354.4893
				— 1.4893					
108	109	2.518	234.497	— 6.2561	+ 6.2549	— 6.2555	+1.2	+37.1	348.2338
109	C_2	0.463	234.960	— 7.9946	+ 7.9944	— 7.9945	+0.2	+37.3	340.2393
C_2	110	1.395	236.355	+ 2.0523	— 2.0520	+ 2.0522	−0.3	+37.0	342.2915
110	111	1.392	237.747	+10.1696	−10.1707	+10.1702	+1.1	+38.1	352.4617
111	112	1.390	239.137	−11.8328	+11.8316	−11.8322	+1.2	+39.3	340.6295
112	D_2	0.296	239.433	— 0.2218	+ 0.2217	— 0.2218	+0.1	+39.4	340.4077
112	113	0.933	240.070	+ 2.4498	— 2.4529	+ 2.4514	+3.1	+42.4	343.0809
113	114	1.772	241.842	+ 1.1019	— 1.1027	+ 1.1023	+0.8	+43.2	344.1832
114	115	1.565	243.407	— 4.0210	+ 4.0184	— 4.0197	+2.6	+45.8	340.1635
115	E_2	0.190	243.597	+ 2.5810	— 2.5817	+ 2.5814	+0.7	+46.5	342.7449
115	116	1.622	245.029	+ 8.3698	— 8.3698	+ 8.3698	0.0	+45.8	348.5333
116	F_2	3.098	248.127	−21.7423	+21.7404	−21.7414	+1.9	+47.7	326.7919
F_2	117	1.314	249.441	— 9.8859	+ 9.8807	— 9.8834	+3.1	+50.8	316.9085
				— 9.8839	+ 9.8830				
117	118	1.277	250.718	−12.2401	+12.2394	−12.2398	+0.7	+51.5	304.6687
118	G_2	1.332	252.050	−12.5859	+12.5872	−12.5866	−1.3	+50.2	292.0821
G_2	119	1.166	253.216	−13.0453	+13.0417	−13.0435	+3.6	+53.8	279.0386
119	A_5	1.563	254.779	−17.1761	+17.1713	−17.1736	+4.5	+58.3	261.8650
				−17.1754					
A_5	B_5	0.384	255.163	+ 5.9804	— 5.9809	+ 5.9806	+0.5	+58.8	267.8456

The following elevations are for the top of rail in front of the railroad station named unless otherwise stated. They are part of the preceding tabulation, and each one is subject to the correction that is finally applied to the bench mark from which it is determined:

From bench mark.	Station.	Difference of elevation.	Elevation.
		m.	*m.*
C	Ludlow	+ 1.58	163.56
D	Crescent Springs	+ 1.87	239.19
E	Erlanger*	— 3.21	275.65
F	Dixon	+ 0.35	282.20
12	Richwood	— 2.51	283.10
15	Crossing of Queen and Crescent and Louisville and Nashville railroads †	+ 0.23	288.99
16	Walton	— 0.22	280.12
20	Bracht	— 0.39	282.67
23	Crittenden	— 0.14	278.98
K	Sherman	— 1.60	283.13
L	Dry Ridge	— 1.10	290.76
30	Williamstown	+ 4.08	289.10

*West rail. †On rail of the Queen and Crescent Railroad.

From bench mark.	Station.	Difference of elevation.	Elevation.
		m.	*m.*
N	Mason	+ 4.50	283.25
35	Blanchett	+ 1.09	291.19
38	Corinth	− 0.04	292.14
Q	Hinton *	− 1.63	288.82
R	Sadieville	+ 1.01	262.56
49	Rogers Gap	− 0.58	279.56
50	Kinkaid	− 4.64	263.93
W	Georgetown	− 1.29	265.88
57	Donerail	− 2.31	269.96
59	Greendale	+ 1.36	287.94
63	Lexington	− 0.03	293.86
E_1	Nicholasville †	+ 0.79	290.55
E_1	Nicholasville	− 0.60	289.16
67	Brannon	− 0.10	315.33
H_1	Wilmore	− 0.74	266.77
J_1	High Bridge	+ 0.59	233.27
87	Danville	+ 1.19	291.87
91	Junction City ‡	+ 1.09	300.07
U_1	Moreland	− 1.62	331.71
W_1	McKinney	− 0.56	307.55
Y_1	Trestle over South Fork §	+ 1.45	306.33
Z_1	Kings Mountain	+ 3.22	356.36
105	Waynesburg	− 2.66	370.93
109	Floyd	− 1.87	346.36
B_2	Eubank	+ 1.31	357.29
112	Pulaski	+ 0.99	341.62
115	Science Hill	− 0.06	340.10
F_2	Norwood	+15.38	342.17
B_5	Somerset	− 3.27	264.57

* Presumably on rail in front of station.
† At intersection of south rail of Louisville and Atlantic Railroad and east rail of the Queen and Crescent Railroad.
‡ At railroad crossing, on top of east rail of Queen and Crescent Railroad, in center of Louisville and Nashville Railroad track.
§ Top of rail opposite P. B. M. Y_1 on south end of trestle.

SOMERSET–KNOXVILLE LINE.

This line was run by Aid W. H. Burger between July 23 and November 3, 1900, using instrument No. 8, one of the new type. The portion Somerset to Harriman Junction, of this line, is the second section of the line from Cincinnati to Birmingham, of which the purpose is indicated under the heading "Cincinnati-Somerset Line." The portion from Harriman Junction to Knoxville was run for the purpose of connecting with the Geological Survey loop in the vicinity of Knoxville. The route of the levels is over the Queen and Crescent to Harriman Junction, and thence over the Southern Railroad to Knoxville, as indicated on illustration 9, page 227. A side line about 20 kilometers long was run from the vicinity of Elverton, Tenn., to Melton triangulation station for the purpose of controlling the elevations determined by measurements of vertical angles along the eastern oblique arc triangulation. This side line was run over ordinary roads and across country, and some very steep grades were encountered. The velocipede cars were not used on any portion of the line from Somerset to Knoxville.

The lengths and index corrections of rods V and W, used on this line, have already been given on pages 229, in connection with the line Cincinnati to Somerset.

The line from Cincinnati to Birmingham ran through very mountainous sections of Kentucky, Tennessee, and Alabama, over railroads with many high trestles, heavy grades, and sharp curves. An interesting feature of the work was the fact that of the 28 tunnels encountered on the line, 24 of them were in the section of 98 miles from Somerset to Harriman Junction. In general, the topography of the surrounding country was such as to render it impracticable to carry the levels around, and so the line was run through all tunnels but one, this one being considered too dangerous to permit working through it. The problem of illuminating the rods in the tunnels, many of which were long and dark, gave the observers some trouble. Several methods were tried, such as lighting by lamps, candles, and lanterns, but the best results were obtained by using an acetylene bicycle lamp. On clear days, and when the form of the tunnel permitted this, very satisfactory results were had by placing a mirror at the end of the tunnel and throwing a beam of sunlight upon the rod. With the latter method the rods could be accurately read at a distance of 120 meters.

The elevations given in the tabulation which follows are in continuation of those shown in the Cincinnati-Somerset line, and are therefore based upon the elevations printed in Appendix 8 of 1899 for bench marks A_5 and Z_4, in the vicinity of Cincinnati.

The two short side lines, 10 kilometers each, at the end of the tabulation, viz, from Knoxville to Caswell and from Knoxville to Wright, were run for the purpose of securing checks on the connection at Knoxville with the Geological Survey line.

Results of precise leveling from Somerset, Ky., to Knoxville, Tenn., 1900.

Bench marks.		Distance between successive bench marks.	Distance from bench mark A_5 at Ludlow, Ky.	Difference of elevation.			Discrepancy (B.–F.)		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
	A_5		254.779						261.8650*
	B_5		255.163						267.8456*
B_5	C_5	0.340	255.503	+ 4.1044	− 4.1025	+ 4.1034	−1.9	+56.2	271.9490
A_5	1	0.291		+ 4.3997	− 4.4019	+ 4.4008	+2.2		266.2658
B_5	1	0.069	255.232	− 1.5767	+ 1.5774	− 1.5770	−0.7	+58.1	266.2686
	1								
								Mean=	266.2672
1	D_5	1.170	256.402	+ 1.9357	− 1.9375	+ 1.9366	+1.8	+59.9	268.2038
D_5	2	1.673	258.075	− 6.2510	+ 6.2460	− 6.2485	+5.0	+64.9	261.9553
2	3	1.462	259.537	−10.4462	+10.4449	−10.4456	+1.3	+66.2	251.5097
3	4	2.089	261.626	+ 4.8689	− 4.8630	+ 4.8660	−5.9	+60.3	256.3757
4	5	1.215	262.841	− 1.8832	+ 1.8798	− 1.8815	+3.4	+63.7	254.4942
5	E_5	0.854	263.695	− 5.4779	+ 5.4750	− 5.4764	+2.9	+66.6	249.0178
E_5	6	0.767	264.462	− 8.2731	+ 8.2676	− 8.2688	+1.6	+68.2	240.7490
				− 8.2661	+ 8.2684				
6	6a	0.736	265.198	− 9.2086	+ 9.2065	− 9.2076	+2.1	+70.3	231.5414
6a	7	0.958	266.156	− 6.3340	+ 6.3334	− 6.3337	+0.6	+70.9	225.2077
7	F_5	0.901	267.057	+ 9.9638	− 8.7592†	+ 9.9651	+1.2	+72.1	235.1728
				+ 9.9652	− 9.9657				
F_5	8	0.613	267.670	+ 6.4604	− 6.4595	+ 6.4593	+1.4	+73.5	241.6321
				+ 6.4569	− 6.4604				
8	9	1.894	269.564	+20.1236	−20.1263	+20.1250	+2.7	+76.2	261.7571

*These elevations are from the line Cincinnati to Somerset, 1900. †Rejected.

Results of precise leveling from Somerset, Ky., to Knoxville, Tenn., 1900—Continued.

Bench marks.		Distance between successive bench marks.	Distance from bench mark A_6 at Ludlow, Ky.	Difference of elevation.			Discrepancy (B.—F.)		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
9	10	1.109	270.673	+ 6.3461	− 6.3462	+ 6.3462	+0.1	+ 76.3	268.1033
10	11	1.935	272.608	+19.4609	−19.4631	+19.4620	+2.2	+ 78.5	287.5653
11	G_5	1.749	274.357	− 7.2861	+ 7.2853	− 7.2857	+0.8	+ 79.3	280.2796
G_5	12	2.037	276.394	− 4.4973	+ 4.4970	− 4.4972	+0.3	+ 79.6	275.7824
12	H_6	1.274	277.668	+14.1154	−14.1164	+14.1159	+1.0	+ 80.6	289.8983
H_6	15	1.115	278.783	+12.2681	−12.2652	+12.2666	−2.9	+ 77.7	302.1649
15	16	0.889	279.672	+10.5182	−10.5223	+10.5185	+0.2	+ 77.9	312.6834
				+10.5186	−10.5150				
16	17	0.688	280.360	+ 8.3052	− 8.3112	+ 8.3066	+4.0	+ 81.9	320.9900
				+ 8.3041	− 8.3059				
17	18	1.241	281.601	+14.3945	−14.3972	+14.3958	+2.7	+ 84.6	335.3858
18	19a	0.405	282.006	+ 4.3746	− 4.3757	+ 4.3752	+1.1	+ 85.7	339.7610
19a	19b	0.687	282.693	+ 8.2465*	− 8.2359	+ 8.2343	+1.8	+ 87.5	347.9953
				+ 8.2334	− 8.2346				
19b	I_5	1.432	284.125	+15.3584	−15.3604	+15.3594	+2.0	+ 89.5	363.3547
I_5	20	1.589	285.714	+17.9299	−17.9399	+17.9355	+3.4	+ 92.9	381.2902
				+17.9376	−17.9346				
20	21	1.881	287.595	−13.7561	+13.7596	−13.7578	−3.5	+ 89.4	367.5324
21	22	0.929	288.524	+ 7.7039	− 7.7053	+ 7.7046	+1.4	+ 90.8	375.2370
22	22a	1.201	289.725	+ 2.6693	− 2.6694	+ 2.6694	+0.1	+ 90.9	377.9064
22a	23	1.021	290.746	− 9.5228	+ 9.5219	− 9.5224	+0.9	+ 91.8	368.3840
23	24	1.302	292.048	+14.8797	−14.8810	+14.8804	+1.3	+ 93.1	383.2644
24	25	2.080	294.128	+12.6309	−12.6327	+12.6318	+1.8	+ 94.9	395.8962
25	J_5	0.602	294.730	− 2.5057	+ 2.5052	− 2.5054	+0.5	+ 95.4	393.3908
J_5	26	1.577	296.307	− 3.0155	+ 3.0155	− 3.0155	0.0	+ 95.4	390.3753
26	27	1.690	297.997	− 1.5309	+ 1.5353	− 1.5331	−4.4	+ 91.0	388.8422
27	28	1.085	299.082	− 1.7128	+ 1.7114	− 1.7121	+1.4	+ 92.4	387.1301
28	29	1.535	300.617	+15.2289	−15.2278	+15.2284	−1.1	+ 91.3	402.3585
29	30	1.528	302.145	+ 1.4736	− 1.4741	+ 1.4738	+0.5	+ 91.8	403.8323
30	K_5	0.397	302.542	− 2.4477	+ 2.4460	− 2.4468	+1.7	+ 93.5	401.3855
K_5	31	1.159	303.701	+ 3.9066	− 3.9102	+ 3.9084	+3.6	+ 97.1	405.2939
31	32	1.773	305.474	+ 0.3255	− 0.3262	+ 0.3258	+0.7	+ 97.8	405.6197
32	33	2.133	307.607	+ 2.1436	− 2.1380	+ 2.1408	−5.6	+ 92.2	407.7605
33	34	1.697	309.304	+ 9.7980	− 9.7975	+ 9.7978	−0.5	+ 91.7	417.5583
34	35	1.775	311.079	+ 8.5565	− 8.5616	+ 8.5590	+5.1	+ 96.8	426.1173
35	L_5	1.674	312.753	+ 3.9304	− 3.9317	+ 3.9310	+1.3	+ 98.1	430.0483
L_5	36	1.220	313.973	− 4.3447	+ 4.3429	− 4.3438	+1.8	+ 99.9	425.7045
36	37	2.348	316.321	− 4.6092	+ 4.6044	− 4.6068	+4.8	+104.7	421.0977
37	38	1.149	317.470	+ 8.7235	− 8.7265	+ 8.7250	+3.0	+107.7	430.8227
38	M_5	1.224	318.694	−14.6754	+14.6773	−14.6764	−1.9	+105.8	415.1463
M_5	39	1.070	319.764	− 9.2893	+ 9.2928	− 9.2910	−3.5	+102.3	405.8553
39	40	1.594	321.358	− 1.2731	+ 1.2739	− 1.2735	−0.8	+101.5	404.5818
40	At†	1.665	323.023	− 8.4932	+ 8.4937	− 8.4934	−0.5	+101.0	396.0884
A	41	1.995	325.018	+14.5091	−14.5097	+14.5094	+0.6	+101.6	410.5978
41	42	1.757	326.775	+20.2455	−20.2412	+20.2434	−4.3	+ 97.3	430.8412
42	43	1.864	328.639	+10.3076	−10.3053	+10.3064	−2.3	+ 95.0	441.1476
43	44	1.793	330.432	+17.6088	−17.6089	+17.6088	+0.1	+ 95.1	458.7564
44	45	1.618	332.050	−14.1541	+14.1496	−14.1518	+4.5	+ 99.6	444.6046
45	46	1.416	333.466	− 5.6863	+ 5.6807	− 5.6840	+3.9	+103.5	438.9206
				− 5.6857	+ 5.6835				
46	B	0.101	333.567	− 0.4996	+ 0.4986	− 0.4988	+0.3	+103.8	438.4218
				− 0.4982	+ 0.4985				

*Rejected.

†First bench mark established in Tennessee. The permanent bench marks established by the Survey are now designated in each State by the letters of the alphabet, repeating the letters with numerical subscripts when necessary.

Results of precise leveling from Somerset, Ky., to Knoxville, Tenn., 1900—Continued.

Bench marks.		Distance between successive bench marks.	Distance from bench mark A, at Ludlow, Ky.	Difference of elevation.			Discrepancy (B. – F.)		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
46	47	0.462	333.928	— 2.0067	+ 2.0065	— 2.0066	+0.2	+103.7	436.9140
47	48	2.018	335.946	+17.2674	—17.2647	+17.2660	—2.7	+101.0	454.1800
48	49	1.589	337.535	+ 6.5534	— 6.5516	+ 6.5525	—1.8	+ 99.2	460.7325
49	50	1.485	339.020	—13.9256	+13.9273	—13.9264	—1.7	+ 97.5	446.8061
50	51	1.827	340.847	—17.8369	+17.8404	—17.8386	—3.5	+ 94.0	428.9675
51	C	1.605	342.452	— 6.2027	+ 6.2000	— 6.2014	+2.7	+ 96.7	422.7661
C	52	0.474	342.946	+ 2.3626	— 2.3630	+ 2.3628	+0.4	+ 97.1	425.1289
52	53	1.069	343.995	—11.9424	+11.9453	—11.9430	—4.5	+ 92.6	413.1859
				—11.9392					
53	54	1.193	345.188	—12.5559	+12.5517	—12.5538	+4.2	+ 96.8	400.6321
54	55	1.109	346.297	—13.2091	+13.2116	—13.2104	—2.5	+ 94.3	387.4217
55	D	2.048	348.345	—20.5070	+20.5084	—20.5077	—1.4	+ 92.9	366.9140
D	56	0.607	348.952	+ 5.7494	— 5.7487	+ 5.7490	—0.7	+ 92.2	372.6630
56	57	1.670	350.622	+19.4300	—19.4299	+19.4300	—0.1	+ 92.1	392.0930
57	58	0.683	351.305	+ 7.3900	— 7.3915	+ 7.3908	+1.5	+ 93.6	399.4838
58	59	1.475	352.780	+16.7887	—16.7927	+16.7907	+4.0	+ 97.6	416.2745
59	60	0.851	353.631	+ 0.8877	— 0.8851	+ 0.8855	—0.8	+ 96.8	417.1600
				+ 0.8841					
60	E	1.630	355.261	+ 2.1144	— 2.1139	+ 2.1142	—0.5	+ 96.3	419.2742
E	61	1.622	356.883	+ 1.6684	— 1.6708	+ 1.6696	+2.4	+ 98.7	420.9438
61	62	1.657	358.540	—18.6508	+18.6489	—18.6498	+1.9	+100.6	402.2940
62	F	1.699	360.239	—13.3179	+13.3139	—13.3152	+2.5	+103.1	388.9788
				—13.3148					
F	63	1.134	361.373	+ 9.1013	— 9.1010	+ 9.1012	—0.3	+102.8	398.0800
63	64	1.933	363.306	+22.9007	—22.9047	+22.9027	+4.0	+106.8	420.9827
64	65	1.263	364.569	+11.9016	—11.9039	+11.9028	+2.3	+109.1	432.8855
65	66	1.279	365.848	— 8.3591	+ 8.3595	— 8.3593	—0.4	+108.7	424.5262
66	67	1.302	367.150	+ 7.2326	— 7.2338	+ 7.2332	+1.2	+109.9	431.7594
67	68	1.464	368.614	—16.3013	+16.3003	—16.3008	+1.0	+110.9	415.4586
68	G	0.590	369.204	— 7.9653	+ 7.9641	— 7.9647	+1.2	+112.1	407.4939
G	69	1.785	370.989	+22.6911	—22.6908	+22.6910	—0.3	+111.8	430.1849
69	70	1.602	372.591	— 4.9882	+ 4.9920	— 4.9901	—3.8	+108.0	425.1948
70	71	1.740	374.331	—20.2519	+20.2541	—20.2530	—2.2	+105.8	404.9418
71	72	1.420	375.751	—15.4939	+15.4925	—15.4932	+1.4	+107.2	389.4486
72	H	1.227	376.978	—14.1127	+14.1114	—14.1120	+1.3	+108.5	375.3366
H	73a	1.662	378.640	+ 5.4510	— 5.4527	+ 5.4518	+1.7	+110.2	380.7884
73a	73b	1.221	379.861	+ 7.3264	— 7.3249	+ 7.3256	—1.5	+108.7	388.1140
73b	74	0.893	380.754	— 9.7027	+ 9.7013	— 9.7020	+1.4	+110.1	378.4120
74	75	1.089	381.843	—12.8003	+12.7978	—12.7990	+2.5	+112.6	365.6130
75	76	1.840	383.683	— 0.6586	+ 0.6550	— 0.6568	+3.6	+116.2	364.9562
76	I	0.780	384.463	— 5.1989	+ 5.1974	— 5.1982	+1.5	+117.7	359.7580
I	77	0.772	385.235	— 8.0787	+ 8.0759	— 8.0773	+2.8	+120.5	351.6807
77	78	1.987	387.222	—23.0552	+23.0538	—23.0545	+1.4	+121.9	328.6262
78	79	1.772	388.994	—20.2762	+20.2819	—20.2790	—5.7	+116.2	308.3472
79	80	1.155	390.149	—13.3620	+13.3606	—13.3613	+1.4	+117.6	294.9859
80	81	1.519	391.668	—15.1371	+15.1320	—15.1349	+3.0	+120.6	279.8510
				—15.1358	+15.1349				
81	82	0.644	392.312	— 2.2491	+ 2.2481	— 2.2486	+1.0	+121.6	277.6024
82	83	1.515	393.827	— 7.9116	+ 7.9098	— 7.9107	+1.8	+123.4	269.6917
83	84	1.261	395.088	— 6.2533	+ 6.2538	— 6.2536	—0.5	+122.9	263.4381
84	85	0.869	395.957	— 4.4295	+ 4.4264	— 4.4280	+3.1	+126.0	259.0101
85	J	1.322	397.279	— 4.1745	+ 4.1737	— 4.1741	+0.8	+126.8	254.8360
J	86	1.923	399.202	— 1.1188	+ 1.1295	— 1.1236	—6.0	+120.8	253.7124
				— 1.1223	+ 1.1238				
86	87	1.683	400.885	— 5.0475	+ 5.0506	— 5.0490	—3.1	+117.7	248.6634
87	88	1.580	402.465	— 1.5664	+ 1.5642	— 1.5653	+2.2	+119.9	247.0981

Results of precise leveling from Somerset, Ky., to Knoxville, Tenn., 1900—Continued.

Bench marks.		Distance between successive bench marks.	Distance from bench mark A_5 at Ludlow, Ky.	Difference of elevation.			Discrepancy (B.—F.)		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
88	89	1.488	403.953	— 4.0724	+ 4.0709	— 4.0716	+1.5	+121.4	243.0265
89	K	1.785	405.738	— 1.8356	+ 1.8391	— 1.8374	−3.5	+117.9	241.1891
K	L	0.199	405.937	+ 0.6620	— 0.6617	+ 0.6618	−0.3	+117.6	241.8509
89	L	1.955	405.908	— 1.1806		— 1.1806			241.8459
	L							Mean=	241.8484
L	90	1.713	407.650	+ 0.6456	— 0.6470	+ 0.6463	+1.4	+119.0	242.4947
90	91	0.933	408.583	— 4.7913	+ 4.7920	— 4.7916	−0.7	+118.3	237.7031
91	92	1.937	410.520	— 1.8334	+ 1.8379	— 1.8356	−4.5	+113.8	235.8675
92	93	1.484	412.004	+ 4.3178	— 4.3168	+ 4.3173	−1.0	+112.8	240.1848
93	A_2	0.171	412.175	— 6.0091	+ 6.0080	— 6.0086	+1.1	+113.9	234.1762
93	94	1.577	413.581	— 2.4914	+ 2.4935	— 2.4924	−2.1	+110.7	237.6924
94	B_2	0.145	413.726	+ 4.2360	— 4.2366	+ 4.2363	+0.6	+111.3	241.9287
B_2	C_2	0.326	414.052	— 0.6056	+ 0.6057	— 0.6056	−0.1	+111.2	241.3231
C_2	City	0.064	414.116	— 1.9161	+ 1.9165	— 1.9163	−0.4	+110.8	239.4068
94	95	2.097	415.678	— 9.3097	+ 9.3122	— 9.3108	−2.3	+108.4	228.3816
				— 9.3215*	+ 9.3119				
95	96	1.846	417.524	+ 14.8865	— 14.8973*	+ 14.8881	+1.6	+110.0	243.2697
				+ 14.8881	— 14.8889				
96	97	0.840	418.364	— 9.9726	+ 9.9699	— 9.9712	+2.7	+112.7	233.2985
97	98	1.757	420.121	+ 3.5349	— 3.5352	+ 3.5350	+0.3	+113.0	236.8335
98	99a	1.024	421.145	+ 4.6049	— 4.6073	+ 4.6061	+2.4	+115.4	241.4396
99a	99b	1.839	422.984	— 9.9581	+ 9.9582	— 9.9582	−0.1	+115.3	231.4814
99b	M	1.861	424.845	+ 17.2965	— 17.2939	+ 17.2952	−2.6	+112.7	248.7766
M	100	1.299	426.144	+ 9.2988	— 9.2968	+ 9.2978	−2.0	+110.7	258.0744
100	101	1.674	427.818	+ 3.1471	— 3.1539	+ 3.1488	+5.9	+116.6	261.2232
				+ 3.1447	— 3.1498				
Beginning of line to Melton triangulation station.									
101	102	1.628	429.446	— 17.2405	+ 17.2366	— 17.2386	+3.9	+120.5	243.9846
102	103	1.619	431.065	— 16.0949	+ 16.0926	— 16.0938	+2.3	+122.8	227.8908
103	104	0.831	431.896	+ 11.5804	— 11.5824	+ 11.5814	+2.0	+124.8	239.4722
104	105	1.464	433.360	— 7.9346	+ 7.9372	— 7.9359	−2.6	+122.2	231.5363
105	106	2.032	435.392	+ 10.7844	— 10.7837	+ 10.7840	−0.7	+121.5	242.3203
106	107	1.252	436.644	+ 23.7426	— 23.7415	+ 23.7420	−1.1	+120.4	266.0623
107	N	0.556	437.200	+ 6.4795	— 6.4780	+ 6.4788	−1.5	+118.9	272.5411
107	108	1.718	438.362	— 7.9525	+ 7.9532	— 7.9528	−0.7	+119.7	258.1095
108	108a	0.791	439.153	+ 30.9731	— 30.9681	+ 30.9702	−2.7	+117.0	289.0797
				+ 30.9701	— 30.9697				
108a	109	0.856	440.009	— 39.8366	+ 39.8391	— 39.8379	−2.5	+114.5	249.2418
109	110	1.584	441.593	+ 2.1167	— 2.1193	+ 2.1180	+2.6	+117.1	251.3598
110	111	1.583	443.176	— 2.5555	+ 2.5555	— 2.5555	0.0	+117.1	248.8043
111	112	1.801	444.977	— 0.7069	+ 0.7072	— 0.7070	−0.3	+116.8	248.0973
112	113	1.332	446.309	+ 0.7423	— 0.7426	+ 0.7424	+0.3	+117.1	248.8397
113	Melton. △	1.286	447.595	+164.1049	−164.1010	+164.1030	−3.9	+113.2	412.9427
End of line to Melton triangulation station.									
101	114	1.574	429.392	+ 2.1726	— 2.1719	+ 2.1722	−0.7	+115.9	263.3954
114	115	2.028	431.420	— 7.7548	+ 7.7567	— 7.7558	−1.9	+114.0	255.6396

*Rejected.

Results of precise leveling from Somerset, Ky., to Knoxville, Tenn., 1900—Continued.

Bench marks.		Distance between successive bench marks.	Distance from bench mark A_5 at Ludlow, Ky.	Difference of elevation.			Discrepancy (B.—F.)		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
115	116	1.685	433.105	+ 9.9747	− 9.9750	+ 9.9748	+0.3	+114.3	265.6144
116	117	2.074	435.179	−15.2783	+15.2749	−15.2766	+3.4	+117.7	250.3378
117	118	1.846	437.025	−12.3639	+12.3596	−12.3618	+4.3	+122.0	237.9760
118	O	0.122	437.147	+ 0.8097	− 0.8097	+ 0.8097	0.0	+122.0	238.7857
118	119	1.151	438.176	+ 9.4590	− 9.4597	+ 9.4594	+0.7	+122.7	247.4354
119	120	0.927	439.103	+10.4804	−10.4838	+10.4821	+3.4	+126.1	257.9175
120	121	1.210	440.313	− 7.7249	+ 7.7224	− 7.7236	+2.5	+128.6	250.1939
121	122	1.100	441.413	+ 5.6548	− 5.6542	+ 5.6545	−0.6	+128.0	255.8484
122	123	2.055	443.468	+ 1.6480	− 1.6509	+ 1.6494	+2.9	+130.9	257.4978
123	124	1.513	444.981	+17.0741	−17.0741	+17.0741	0.0	+130.9	274.5719
124	125	1.346	446.327	+ 2.4253	− 2.4260	+ 2.4256	+0.7	+131.6	276.9975
125	126	1.658	447.985	−19.3206	+19.3128	−19.3170	+5.7	+137.3	257.6805
				−19.3192	+19.3156				
126	127	1.705	449.690	+ 2.1695	− 2.1700	+ 2.1698	+0.5	+137.8	259.8503
127	P	1.241	450.931	+15.7749	−15.7715	+15.7732	−3.4	+134.4	275.6235
P	128	1.850	452.781	+23.8157	−23.8202	+23.8180	+4.5	+138.9	299.4415
128	129	1.524	454.305	+ 5.2988	− 5.3011	+ 5.3000	+2.3	+141.2	304.7415
129	130	1.553	455.858	− 4.0417	+ 4.0401	− 4.0409	+1.6	+142.8	300.7006
130	131	1.646	457.504	− 5.5953	+ 5.5909	− 5.5931	+4.4	+147.2	295.1075
131	132	1.572	459.076	−17.8900	+17.8905	−17.8902	−0.5	+146.7	277.2173
132	133	1.573	460.649	−19.8940	+19.8949	−19.8944	−0.9	+145.8	257.3229
133	Q	0.489	461.138	− 3.9849	+ 3.9849	− 3.9849	0.0	+145.8	253.3380
Q	134	1.307	462.445	+ 1.6236	− 1.6224	+ 1.6230	−1.2	+144.6	254.9610
134	135	1.668	464.113	+ 4.6619	− 4.6542	+ 4.6568	−2.5	+142.1	259.6178
				+ 4.6543	− 4.6570				
135	136	1.523	465.636	+16.7028	−16.7076	+16.7052	+4.8	+146.9	276.3230
136	137	1.685	467.321	+10.4530	−10.4566	+10.4548	+3.6	+150.5	286.7778
137	138	1.096	468.417	+13.5959	−13.5963	+13.5961	+0.4	+150.9	300.3739
138	139	1.778	470.195	+13.4941	−13.4927	+13.4930	−2.1	+148.8	313.8669
					−13.4914				
139	140	2.049	472.244	−25.7965	+25.7984	−25.7974	−1.9	+146.9	288.0695
140	R	0.739	472.983	−13.4124	+13.4180	−13.4145	−3.0	+143.9	274.6550
				−13.4136	+13.4140				
R	141	0.860	473.843	−12.0372	+12.0378	−12.0375	−0.6	+143.3	262.6175
141	142	1.392	475.235	+ 9.1874	− 9.1886	+ 9.1880	+1.2	+144.5	271.8055
142	143	1.981	477.216	+31.1166	−31.1209	+31.1188	+4.3	+148.8	302.9243
143	144	1.118	478.334	+20.8437	−20.8412	+20.8424	−2.5	+146.3	323.7667
144	145	1.808	480.142	− 6.4068	+ 6.4059	− 6.4064	+0.9	+147.2	317.3603
145	S	1.146	481.288	−14.5485	+14.5501	−14.5493	−1.6	+145.6	302.8110
S	146	0.771	482.059	− 3.6538	+ 3.6536	− 3.6537	+0.2	+145.8	299.1573
146	147	1.552	483.611	+ 7.8580	− 7.8631	+ 7.8606	+5.1	+150.9	307.0179
147	148	1.391	485.002	+ 7.5615	− 7.5635	+ 7.5625	+2.0	+152.9	314.5804
148	149	1.379	486.381	+18.5445	−18.5454	+18.5450	+0.9	+153.8	333.1254
149	T	0.534	486.915	+ 2.7881	− 2.7904	+ 2.7892	+2.3	+156.1	335.9146
T	150	1.325	488.240	−15.2601	+15.2590	−15.2596	+1.1	+157.2	320.6550
150	151	1.945	490.185	−17.8393	+17.8411	−17.8402	−1.8	+155.4	302.8148
151	152	1.468	491.653	−17.8809	+17.8810	−17.8810	−0.1	+155.3	284.9338
152	153	1.364	493.017	−16.0957	+16.0944	−16.0950	+1.3	+156.6	268.8388
153	154	1.252	494.269	+ 2.3934	− 2.3941	+ 2.3938	+0.7	+157.3	271.2326
154	933 MC	1.093	495.362	+12.6842	−12.6859	+12.6850	+1.7	+159.0	283.9176
				Side line, Knoxville to Caswell.					
154	155	1.691	495.960	+ 1.0918	− 1.0938	+ 1.0928	+2.0	+159.3	272.3254
155	156	1.756	497.716	+14.0333	−14.0376	+14.0354	+4.3	+163.6	286.3608

Results of precise leveling from Somerset, Ky., to Knoxville, Tenn, 1900—Continued.

Bench marks.		Distance between successive bench marks.	Distance from bench mark A_5 at Ludlow, Ky.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
156	157	1.566	499.282	+ 0.4042	− 0.4064	+ 0.4053	+2.2	+165.8	286.7661
157	158	1.532	500.814	− 4.3214	+ 4.3246	− 4.3230	−3.2	+162.6	282.4431
158	159	1.598	502.412	−13.6955	+13.6944	−13.6950	+1.1	+163.7	268.7481
159	160	1.747	504.159	+ 5.1889	− 5.1850	+ 5.1870	−3.9	+159.8	273.9351
160	867 MC	1.245	505.404	−10.0946	+10.0957	−10.0952	−1.1	+158.7	263.8399
Side line, Knoxville to Wright.									
154	161	1.835	496.104	− 4.5996	+ 4.5996	− 4.5996	0.0	+157.3	266.6330
161	162	1.812	497.916	− 7.1475	+ 7.1450	− 7.1462	+2.5	+159.8	259.4868
162	163	1.722	499.638	+10.4056	−10.4037	+10.4046	−1.9	+157.9	269.8914
163	164	1.388	501.026	+ 6.4194	− 6.4183	+ 6.4188	−1.1	+156.8	276.3102
164	165	1.596	502.622	− 8.1433	+ 8.1434	− 8.1434	−0.1	+156.7	268.1668
165	166	1.677	504.299	+10.8553	−10.8574	+10.8564	+2.1	+158.8	279.0232
166	940 MC	1.598	505.897	+ 7.0601	− 7.0613	+ 7.0607	+1.2	+160.0	286.0839

The following elevations are for the top of rail in front of the railroad stations at the stations named unless otherwise stated. They are part of the preceding tabulation, and each is subject to the correction that is finally applied to the bench mark from which it is determined:

From bench mark.	Station.	Difference of elevation.	Elevation.
1	Somerset	− 1.69	264.58
F_5	Burnside	− 1.12	234.05
10	Tateville	− 2.33	265.77
G_5	Sloans Valley	− 2.83	277.45
I_5	Greenwood	+ 1.34	364.69
22a	Cumberland Falls	+ 1.77	379.68
J_5	Flat Rock	+ 1.23	394.62
L_5	Pine Knot	+ 0.68	430.73
39	Isham	+ 2.01	407.87
A	Winfield	+ 5.78	401.87
44	Flat Gap *	+ 1.32	460.08
46	Oneida	+ 0.08	439.00
49	Mile post "Cin. 209" †	+ 1.05	461.78
D	New River	− 0.67	366.24
60	Robbins	+ 0.31	417.47
F	Glen Mary	− 0.13	388.85
61	Rugby Road	+ 2.96	423.90
G	Sunbright	+ 2.62	410.11
H	Annadel	+ 0.97	376.31
I	Lancing	+ 1.29	361.05
L	Oakdale	+ 2.20	244.05
93	Harriman Junction ‡	− 0.20	239.98
93	Harriman Junction §	− 0.32	239.86
94	Harriman	+ 1.04	238.73
98	De Armond	+ 2.11	238.94
M	Elverton	+ 0.79	249.57
115	Scandlyn	+ 1.66	257.30

* Top of rail at highest point in Flat Gap, near Oneida.
† On rail at milepost; said to be highest point on Queen and Crescent Railroad.
‡ Southern Railroad.
§ Queen and Crescent Railroad.

From bench mark.	Station.	Difference of elevation.	Elevation.
118	Oliver Springs	+ 0.61	238.59
122	Donovan	— 3.85	252.00
Q	Clinton	+ 2.60	255.94
127	Ivy	— 1.62	258.23
P	Dossett	+ 0.63	276.25
129	Laurel*	— 5.66	299.08
137	Peak*	— 2.31	284.47
141	Heiskell	+12.38	276.00
146	Powell	+ 2.85	302.01
148	Dante	+ 2.77	317.35
154	Knoxville	+ 0.24	271.47
160	Caswell	— 4.19	269.75

HARRIMAN JUNCTION–WOODVILLE LINE.

This line, which forms the third section of the line from Cincinnati to Birmingham, the purpose of which is explained on page 226, was run by Assistant O. W. Ferguson between September 4 and December 3, 1900, using level No. 7, one of the new type. The leveling followed the Queen and Crescent Railroad from Harriman Junction to Chattanooga, and thence over the Nashville, Chattanooga and St. Louis and Southern railroads to Woodville, Ala. (See illustration 9, p. 227.) A side line from Woodville to Gunter triangulation station, about 15 kilometers long, shown at the end of the tabulation, was run to control the elevations determined by measurements of vertical angles along the triangulation of the eastern oblique arc. Velocipede cars were not used on any portion of this leveling.

The lengths and index corrections of rods T and U used on this line have already been given on page 226 in connection with the line Cincinnati to Somerset.

The elevations in the following tabulation are based upon the elevations of A_2, B_2, and C_2 at Harriman Junction, as determined by Mr. Burger on the Somerset–Knoxville line, and therefore depend upon the elevations published in Appendix 8 for bench marks in the vicinity of Cincinnati.

Results of precise leveling from Harriman Junction, Tenn., to Woodville, Ala., 1900.

Bench marks.		Distance between successive bench marks.	Distance from bench mark A_6 at Ludlow, Ky.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
	A_2		412.175					+113.9	†234.1762
A_2	B_2	1.831	414.006	+ 7.7571	— 7.7578	+ 7.7574	+0.7	+114.6	241.9336
	B_2								†241.9287
	B_2							Mean=	241.9312
B_2	C_2	0.336	414.342	— 0.6077	+ 0.6074	— 0.6076	+0.3	+114.9	241.3260
	C_2								†241.3231
	C_2							Mean=	241.3246
C_2	1	0.802	415.144	— 6.5895	+ 6.5878	— 6.5886	+1.7	+116.6	234.7360

* On rail at siding.
† See abstract of Somerset to Knoxville, 1900.

Results of precise leveling from Harriman Junction, Tenn., to Woodville, Ala., 1900—Continued.

Bench marks.		Distance between successive bench marks.	Distance from bench mark A 5 at Ludlow, Ky.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
1	2	1.115	416.259	+37.1148	−37.1269*	+37.1190	−2.1	+114.5	271.8550
				+37.1213	−37.1201				
2	D_2	1.455	417.714	−17.2236	+17.2300	−17.2278	−0.1	+114.4	254.6272
				−17.2318	+17.2255				
D_2	3	1.110	418.824	− 7.8590	+ 7.8580	− 7.8585	+1.0	+115.4	246.7687
3	4	1.600	420.424	−11.5048	+11.4961	−11.4992	+6.4	+121.8	235.2695
				−11.5000	+11.4960				
4	5	1.701	422.125	+ 3.4831	− 3.4791	+ 3.4811	−4.0	+117.8	238.7506
5	6	1.583	423.708	+ 2.3228	− 3.3252	+ 3.3240	+2.4	+120.2	241.0746
6	E_2	0.268	423.976	+ 0.6692	− 0.6684	+ 0.6688	−0.8	+119.4	241.7434
E_2	7	1.300	425.276	+10.3016	−10.3059	+10.3038	+4.3	+123.7	252.0472
7	8	1.321	426.597	+ 9.6273	− 9.6280	+ 9.6276	+0.7	+124.4	261.6748
8	9	1.555	428.152	+12.2895	−12.2892	+12.2894	−0.3	+124.1	273.9642
9	10	1.615	429.767	− 8.0370	+ 8.0351	− 8.0360	+1.9	+126.0	265.9282
10	F_2	0.370	430.137	+ 1.6346	− 1.6348	+ 1.6347	+0.2	+126.2	267.5629
10	G_2	0.376	430.143	+ 2.1440	− 2.1442	+ 2.1441	+0.2	+126.2	268.0723
10	11	1.416	431.183	− 3.9517	+ 3.9555	− 3.9536	−3.8	+122.2	261.9746
11	12	1.508	432.691	− 1.8486	+ 1.8541	− 1.8518	−2.5	+119.7	260.1228
				− 1.8525	+ 1.8521				
12	13	1.254	433.945	− 9.9171	+ 9.9199	− 9.9185	−2.8	+116.9	250.2043
13	14	1.226	435.171	− 4.7036	+ 4.7011	− 4.7024	+2.5	+119.4	245.5019
14	15	1.238	436.409	− 0.9680	+ 0.9639	− 0.9660	+4.1	+123.5	244.5359
15	H_2	1.738	438.147	− 2.0606	+ 2.0612	− 2.0609	−0.6	+122.9	242.4750
H_2	16	1.788	439.935	− 3.1186	+ 3.1190	− 3.1188	−0.4	+122.5	239.3562
16	17	1.324	441.259	− 1.8556	+ 1.8519	− 1.8538	+3.7	+126.2	237.5024
17	18	1.362	442.621	− 4.6944	+ 4.6899	− 4.6922	+4.5	+130.7	232.8102
18	I_2	1.049	443.670	+ 2.2951	− 2.2949	+ 2.2950	−0.2	+130.5	235.1052
I_2	19	1.634	445.304	+ 6.6884	− 6.6894	+ 6.6889	+1.0	+131.5	241.7941
19	20	1.478	446.782	+ 8.3141	− 8.3138	+ 8.3140	−0.3	+131.2	250.1081
20	21	1.545	448.327	+ 8.5589	− 8.5616	+ 8.5602	+2.7	+133.9	258.6683
21	J_2	1.500	449.827	−14.0944	+14.0895	−14.0920	+4.9	+138.8	244.5763
J_2	22	1.409	451.236	− 5.4453	+ 5.4478	− 5.4466	−2.5	+136.3	239.1297
22	23	1.377	452.613	− 2.8073	+ 2.8037	− 2.8055	+3.6	+139.9	236.3242
23	K_2	1.386	453.999	− 3.0783	+ 3.0764	− 3.0774	+1.9	+141.8	233.2468
K_2	24	1.745	455.744	+ 0.1575	− 0.1636	+ 0.1602	+1.3	+143.1	233.4070
				+ 0.1617	− 0.1582				
24	25	1.303	457.047	+ 1.8140	− 1.8155	+ 1.8148	+1.5	+144.6	235.2218
25	26	1.822	458.869	+ 6.3128	− 6.3140	+ 6.3134	+1.2	+145.8	241.5352
26	27	1.767	460.636	+ 8.0525	− 8.0592	+ 8.0565	+2.6	+148.4	249.5917
				+ 8.0578	− 8.0564				
27	L_2	1.966	462.602	− 1.7823	+ 1.7830	− 1.7826	−0.7	+147.7	247.8091
L_2	28	1.678	464.280	−10.0228	+10.0260	−10.0244	−3.2	+144.5	237.7847
28	29	1.995	466.275	+ 2.0792	− 2.0782	+ 2.0787	−1.0	+143.5	239.8634
29	30	1.268	467.543	+ 9.2033	− 9.2039	+ 9.2036	+0.6	+144.1	249.0670
30	31	1.320	468.863	−11.0440	+11.0433	−11.0436	+0.7	+144.8	238.0234
31	M_2	1.287	470.150	− 6.8751	+ 6.8731	− 6.8741	+2.0	+146.8	231.1493
M_2	32	1.282	471.432	− 1.9626	+ 1.9619	− 1.9622	+0.7	+147.5	229.1871
32	N_2	1.338	472.770	− 2.9077	+ 2.9070	− 2.9074	+0.7	+148.2	226.2797
N_2	33	1.714	474.484	− 0.6569	+ 0.6544	− 0.6556	+2.5	+150.7	225.6241
33	34	2.121	476.605	− 7.1971	+ 7.1955	− 7.1963	+1.6	+152.3	218.4278
34	35	1.576	478.181	− 2.4164	+ 2.4157	− 2.4160	+0.7	+153.0	216.0118
35	36	1.454	479.635	+ 1.0714	− 1.0734	+ 1.0724	+2.0	+155.0	217.0842
36	37	1.860	481.495	− 3.1705	+ 3.1732	− 3.1718	−2.7	+152.3	213.9124

*Rejected.

Results of precise leveling from Harriman Junction, Tenn., to Woodville, Ala., 1900—Continued.

Bench marks.		Distance between successive bench marks.	Distance from bench mark A_6 at Ludlow, Ky.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
37	O_2	0.616	482.111	+ 1.3541	− 1.3529	+ 1.3535	−1.2	+151.1	215.2659
37	P_2	0.410	481.905	+ 0.0146	− 0.0139	+ 0.0142	−0.7	+151.6	213.9266
37	38	1.596	483.091	+ 7.0680	− 7.0683	+ 7.0682	+0.3	+152.6	220.9806
38	39	1.554	484.645	+11.7877	−11.7882	+11.7880	+0.5	+153.1	232.7686
39	40	1.896	486.541	+11.9056	−11.9050	+11.9053	−0.6	+152.5	244.6739
40	Q_2	1.002	487.543	−12.1375	+12.1369	−12.1372	+0.6	+153.1	232.5367
Q_2	41	0.700	488.243	− 0.5362	+ 0.5337	− 0.5350	+2.5	+155.6	232.0017
41	42	1.610	489.853	−11.1434	+11.1458	−11.1446	−2.4	+153.2	220.8571
42	R_2	1.221	491.074	− 5.1080	+ 5.1099	− 5.1090	−1.9	+151.3	215.7481
R_2	43	1.318	492.392	+ 2.0449	− 2.0448	+ 2.0448	−0.1	+151.2	217.7929
43	44	1.590	493.982	− 5.7507	+ 5.7526	− 5.7516	−1.9	+149.3	212.0413
44	45	1.580	495.562	+ 3.2613 + 3.2580	− 3.2559	+ 3.2578	−3.7	+145.6	215.2991
45	S_2	1.390	496.952	+ 8.0810	− 8.0802	+ 8.0806	−0.8	+144.8	223.3797
S_2	46	1.664	498.616	+ 7.5091	− 7.5126	+ 7.5108	+3.5	+148.3	230.8905
46	47	1.661	500.277	− 0.5664	+ 0.5640	− 0.5652	+2.4	+150.7	230.3253
47	48	1.736	502.013	− 7.2477	+ 7.2476	− 7.2476	+0.1	+150.8	223.0777
48	T_2	1.208	503.221	− 1.1940	+ 1.1953	− 1.1946	−1.3	+149.5	221.8831
T_2	49	1.959	505.180	+16.7497	−16.7502	+16.7500	+0.5	+150.0	238.6331
49	50	1.128	506.308	− 0.9369	+ 0.9333	− 0.9351	+3.6	+153.6	237.6980
50	51	1.308	507.616	− 7.7581	+ 7.7625	− 7.7603	−4.4	+149.2	229.9377
51	U_2	1.240	508.856	+ 5.1791	− 5.1754	+ 5.1772	−3.7	+145.5	235.1149
U_2	52	1.644	510.500	+ 5.7799	− 5.7790	+ 5.7794	−0.9	+144.6	240.8943
52	53	1.374	511.874	− 6.4848	+ 6.4881	− 6.4864	−3.3	+141.3	234.4079
53	V_2	1.990	513.864	−14.8854	+14.8859	−14.8856	−0.5	+140.8	219.5223
V_2	54	1.455	515.319	− 7.7905	+ 7.7895	− 7.7900	+1.0	+141.8	211.7323
54	55	1.554	516.873	− 2.2372	+ 2.2339	− 2.2356	+3.3	+145.1	209.4967
55	56	1.166	518.039	+ 0.7945	− 0.7949	+ 0.7947	+0.4	+145.5	210.2914
56	W_2	1.068	519.107	− 3.8382	+ 3.8340	− 3.8361	+4.2	+149.7	206.4553
W_2	57	2.014	521.121	+ 1.4284	− 1.4253	+ 1.4268	−3.1	+146.6	207.8821
57	58	1.296	522.417	− 0.3286	+ 0.3285	− 0.3286	+0.1	+146.7	207.5535
58	X_2	0.959	523.376	− 0.6309	+ 0.6320	− 0.6314	−1.1	+145.6	206.9221
X_2	59	0.876	524.252	+ 1.9781	− 1.9760	+ 1.9770	−2.1	+143.5	208.8991
59	60	1.152	525.404	− 0.7861	+ 0.7870	− 0.7866	−0.9	+142.6	208.1125
60	61	1.330	526.734	− 2.2483	+ 2.2485	− 2.2484	−0.2	+142.4	205.8641
61	Y_2	1.340	528.074	+ 1.3075	− 1.3063	+ 1.3069	−1.2	+141.2	207.1710
Y_2	62	2.468	530.542	− 2.5047	+ 2.5078	− 2.5062	−3.1	+138.1	204.6648
62	Z_2	1.236	531.778	+ 5.1576	− 5.1597	+ 5.1586	+2.1	+140.2	209.8234
Z_2	A_3	0.574	532.352	− 0.0272	+ 0.0269	− 0.0270	+0.3	+140.5	209.7964
A_3	63	1.864	534.216	− 2.9947	+ 2.9932	− 2.9940	+1.5	+142.0	206.8024
63	64	1.761	535.977	+ 0.3822	− 0.3864	+ 0.3843	+4.2	+146.2	207.1867
64	65	0.740	536.717	− 5.3289	+ 5.3279	− 5.3284	+1.0	+147.2	201.8583
65	B_3	1.843	538.560	+ 1.8623	− 1.8628	+ 1.8626	+0.5	+147.7	203.7209
B_3	66	1.552	540.112	+ 4.8638	− 4.8673	+ 4.8656	+3.5	+151.2	208.5865
66	67	1.310	541.422	+ 6.2467	− 6.2489	+ 6.2478	+2.2	+153.4	214.8343
67	68	1.178	542.600	−10.6526	+10.6524	−10.6525	+0.2	+153.6	204.1818
68	698 N	0.747	543.347	+ 6.8196	− 6.8230	+ 6.8213	+3.4	+157.0	211.0031
68	C_3	1.034	543.634	+ 1.9100	− 1.9085	+ 1.9092	−1.5	+152.1	206.0910
C_3	Gauge	0.375	544.009	− 0.7722	+ 0.7722	− 0.7722	0.0	+152.1	205.3188
68	69	1.320	543.920	− 1.2118	+ 1.2110	− 1.2114	+0.8	+154.4	202.9704

Results of precise leveling from Harriman Junction, Tenn., to Woodville, Ala., 1900—Continued.

Bench marks.		Distance between successive bench marks.	Distance from bench mark A_5 at Ludlow, Ky.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
69	70	1.405	545.325	— 0.0583	+ 0.0592	— 0.0558	—0.9	+153.5	202.9116
70	D_3	0.780	546.105	— 1.6700	+ 1.6708	— 1.6704	—0.8	+152.7	201.2412
D_3	71	1.081	547.186	+ 1.2802	— 1.2787	+ 1.2794	—1.5	+151.2	202.5206
71	72	1.428	548.614	+ 0.4874	— 0.4908	+ 0.4892	+3.4	+154.6	203.0098
72	73	1.427	550.041	— 0.1129	+ 0.1123	— 0.1126	+0.6	+155.2	202.8972
73	674 N	1.649	551.690	+ 0.7214	— 0.7202	+ 0.7208	—1.2	+154.0	203.6180
674 N	74	1.302	552.992	+12.0634	−12.0604	+12.0619	—3.0	+151.0	215.6799
74	75	1.306	554.298	+13.3425	−13.3384	+13.3404	—4.1	+146.9	229.0203
75	76	1.464	555.762	+11.7557	−11.7537	+11.7547	—2.0	+144.9	240.7750
76	77	1.393	557.155	+11.2465	−11.2484	+11.2474	+1.9	+146.8	252.0224
77	E_3	1.138	558.293	+ 8.9784	— 8.9786	+ 8.9785	+0.2	+147.0	261.0009
E_3	78	0.872	559.165	+ 9.8074	— 9.8087	+ 9.8080	+1.3	+148.3	270.8089
78	79	1.401	560.566	+12.7789	−12.7775	+12.7782	—1.4	+146.9	283.5871
79	974 N	1.472	562.038	+12.0979	−12.0972	+12.0976	—0.7	+146.2	295.6847
974 N	80	1.606	563.644	−15.7844	+15.7853	−15.7848	—0.9	+145.3	279.8999
80	F_3	1.452	565.096	−17.5133	+17.5148	−17.5140	—1.5	+143.8	262.3859
F_3	81	1.354	566.450	— 7.0735	+ 7.0708	— 7.0722	+2.7	+146.5	255.3137
81	82	0.880	567.330	— 7.1357	+ 7.1357	— 7.1357	0.0	+146.5	248.1780
82	83	1.350	568.680	−11.8644	+11.8664	−11.8654	—2.0	+144.5	236.3126
83	84	1.372	570.052	−13.3324	+13.3367	−13.3346	—4.3	+140.2	222.9780
84	85	1.310	571.362	−10.8481	+10.8509	−10.8495	—2.8	+137.4	212.1285
85	86	0.559	571.921	— 4.8586	+ 4.8597	— 4.8592	—1.1	+136.3	207.2693
86	639 N	1.314	573.235	−13.4864	+13.4823	−13.4844	+4.1	+140.4	193.7849
639 N	87	0.972	574.207	— 2.9601	+ 2.9602	— 2.9602	—0.1	+140.3	190.8247
87	88	1.112	575.319	— 0.1722	+ 0.1735	— 0.1728	—1.3	+139.0	190.6519
88	89	1.256	576.575	— 0.1275	+ 0.1279	— 0.1277	—0.4	+138.6	190.5242
89	U. S.	0.939	577.514	— 0.7732	+ 0.7734	— 0.7733	—0.2	+138.4	189.7509
U. S.	G_3	0.553	578.067	— 0.7397	+ 0.7396	— 0.7396	+0.1	+138.5	189.0113
G_3	90	1.250	579.317	+ 1.5944	— 1.5918	+ 1.5931	—2.6	+135.9	190.6044
90	91	1.262	580.579	+ 5.2480	— 5.2452	+ 5.2466	—2.8	+133.1	195.8510
91	92	1.220	581.799	+ 6.4996	— 6.4972	+ 6.4984	—2.4	+130.7	202.3494
92	665 N	0.108	581.907	— 0.7763	+ 0.7760	— 0.7762	+0.3	+131.0	201.5732
665 N	93	2.552	584.459	— 3.3877	+ 3.3883	— 3.3880	—0.6	+130.4	198.1852
93	94	1.368	585.827	— 9.5937	+ 9.5949	— 9.5943	—1.2	+129.2	188.5909
94	C	1.510	587.337	+ 0.6702	— 0.6721	+ 0.6712	+1.9	+131.1	189.2621
C	679 N	2.223	589.560	+16.4366	−16.4404	+16.4385	+3.8	+134.9	205.7006
C	U. S. E.	0.021	587.358	+ 0.0033	— 0.0034	+ 0.0034	+0.1	+131.2	189.2655
679 N	95	1.221	590.781	+ 5.9805	— 5.9811	+ 5.9808	+0.6	+135.5	211.6814
95	96	2.447	593.228	+ 4.0577	— 4.0573	+ 4.0575	—0.4	+135.1	215.7389
96	D	2.872	596.100	−27.9903	+27.9913	−27.9908	—1.0	+134.1	187.7481
D	625 N	1.374	597.474	+ 1.5008	— 1.5019	+ 1.5014	+1.1	+135.2	189.2495
625 N	97	1.492	598.966	+ 0.2536	— 0.2550	+ 0.2543	+1.4	+136.6	189.5038
97	98	1.432	600.398	+ 4.1351	— 4.1354	+ 4.1352	+0.3	+136.9	193.6390
98	99	1.440	601.838	— 6.7233	+ 6.7198	— 6.7216	+3.5	+140.4	186.9174
99	100	1.275	603.113	+ 7.8032	— 7.8015	+ 7.8024	—1.7	+138.7	194.7198
100	627 N	1.223	604.336	— 4.6605	+ 4.6636	— 4.6620	—3.1	+135.6	190.0578
627 N	E	1.676	606.012	— 5.6523	+ 5.6553	— 5.6538	—3.0	+132.6	184.4040
E	101	1.913	607.925	+ 0.5224	— 0.5203	+ 0.5214	—2.1	+130.5	184.9254
101	F	1.576	609.501	+ 0.1842	— 0.1830	+ 0.1836	—1.2	+129.3	185.1090
F	102	2.128	611.629	+ 7.8308	— 7.8300	+ 7.8304	—0.8	+128.5	192.9394
102	103	1.876	613.505	— 7.5347	+ 7.5334	— 7.5340	+1.3	+129.8	185.4054
103	104	1.604	615.109	+ 0.4031	— 0.4028	+ 0.4030	—0.3	+129.5	185.8084
104	G	1.120	616.229	— 2.6339	+ 2.6316	— 2.6328	+2.3	+131.8	183.1756
G	H	1.757	617.986	+ 0.9931	— 0.9955	+ 0.9943	+2.4	+134.2	184.1699

Results of precise leveling from Harriman Junction, Tenn., to Woodville, Ala., 1900—Continued.

Bench marks.		Distance between successive bench marks.	Distance from bench mark A5 at Ludlow, Ky.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
H	105	1.422	619.408	— 0.0711	+ 0.0718	— 0.0714	—0.7	+133.5	184.0985
105	106	1.290	620.698	+ 4.5419	— 4.5427	+ 4.5423	+0.8	+134.3	188.6408
106	107	1.447	622.145	+10.0519	—10.0529	+10.0524	+1.0	+135.3	198.6932
107	108	1.239	623.384	— 1.8451	+ 1.8454	— 1.8452	—0.3	+135.0	196.8480
108	I	1.196	624.580	— 1.8561	+ 1.8544	— 1.8552	+1.7	+136.7	194.9928
I	109	1.569	626.149	— 3.0855	+ 3.0833	— 3.0844	+2.2	+138.9	191.9084
109	110	1.169	627.318	— 3.5721	+ 3.5705	— 3.5713	+1.6	+140.5	188.3371
110	111	1.117	628.435	+ 3.3794	— 3.3803	+ 3.3798	+0.9	+141.4	191.7169
111	J	1.020	629.455	+ 0.1886	— 0.1892	+ 0.1889	+0.6	+142.0	191.9058
J	112	1.002	630.457	+ 3.8585	— 3.8585	+ 3.8585	0.0	+142.0	195.7643
112	113	1.159	631.616	+ 5.5824	— 5.5842	+ 5.5833	+1.8	+143.8	201.3476
113	114	1.447	633.063	— 2.8972	+ 2.8970	— 2.8971	+0.2	+144.0	198.4505
114	K	0.342	633.405	+ 0.0677	— 0.0675	+ 0.0676	—0.2	+143.8	198.5181
114	115	1.782	634.845	— 6.1539	+ 6.1548	— 6.1544	—0.9	+143.1	192.2961
115	116	0.973	635.818	— 3.7274	+ 3.7271	— 3.7272	+0.3	+143.4	188.5689
116	117	1.188	637.006	— 0.2287	+ 0.2229	— 0.2234	+3.9	+147.3	188.3455
				— 0.2221	+ 0.2201				
117	118	1.324	638.330	+ 1.7483	— 1.7536	+ 1.7512	+2.0	+149.3	190.0967
				+ 1.7520	— 1.7507				
118	L	1.481	639.811	+ 8.0786	— 8.0801	+ 8.0794	+1.5	+150.8	198.1761
L	119	1.077	640.888	— 5.5175	+ 5.5179	— 5.5177	—0.4	+150.4	192.6584
119	120	1.033	641.921	— 3.3518	+ 3.3552	— 3.3535	—3.4	+147.0	189.3049
120	M	1.038	642.959	— 2.0376	+ 2.0361	— 2.0368	+1.5	+148.5	187.2681
M	121	0.811	643.770	— 0.7739	+ 0.7754	— 0.7746	—1.5	+147.0	186.4935
121	122	1.617	645.387	— 2.3955	+ 2.3994	— 2.3974	—3.9	+143.1	184.0961
122	123	1.647	647.034	+ 1.5617	— 1.5634	+ 1.5626	+1.7	+144.8	185.6587
123	N	2.096	649.130	+ 1.5281	— 1.5226	+ 1.5254	—5.5	+139.3	187.1841
N	124	1.645	650.775	+ 6.4879	— 6.4891	+ 6.4885	+1.2	+140.5	193.6726
124	O	0.744	651.519	+ 9.2785	— 9.2789	+ 9.2787	+0.4	+140.9	202.9513
O	125	1.684	653.203	— 6.1534	+ 6.1513	— 6.1524	+2.1	+143.0	196.7989
125	126	1.452	654.655	— 8.0900	+ 8.0904	— 8.0902	—0.4	+142.6	188.7087
126	127	1.424	656.079	— 2.2261	+ 2.2245	— 2.2253	+1.6	+144.2	186.4834
127	128	1.287	657.366	— 2.9383	+ 2.9379	— 2.9381	+0.4	+144.6	183.5453
128	J_2	1.281	658.647	+ 3.6277	— 3.6274	+ 3.6276	—0.3	+144.3	187.1729
J_2	K_2	0.193	658.840	+ 1.3678	— 1.3681	+ 1.3680	+0.3	+144.6	188.5409
Side line to triangulation station on Gunters Mountain.									
J_2	129	2.146	660.793	+ 5.2494	— 5.2482	+ 5.2488	—1.2	+143.1	192.4217
129	130	0.888	661.681	— 1.4266	+ 1.4244	— 1.4255	+2.2	+145.3	190.9962
130	131	1.381	663.062	+ 2.4603	— 2.4630	+ 2.4616	+2.7	+148.0	193.4578
131	132	0.984	664.046	+ 5.6731	— 5.6701	+ 5.6716	—3.0	+145.0	199.1294
132	133	0.880	664.926	—16.1625	+16.1660	—16.1642	—3.5	+141.5	182.9652
133	134	0.922	665.848	+45.4095	—45.4132	+45.4114	+3.7	+145.2	228.3766
134	135	1.210	667.058	—15.7056	+15.7088	—15.7072	—3.2	+142.0	212.6694
135	P	1.147	668.205	+ 6.6271	— 6.6224	+ 6.6243	—4.2	+137.8	219.2937
				+ 6.6257	— 6.6219				
P	136	0.371	668.576	+38.6441	—38.6457	+38.6449	+1.6	+139.4	257.9386
136	137	0.272	668.848	+39.3576	—39.3586	+39.3581	+1.0	+140.4	297.2967
137	138	0.321	669.169	+38.1407	—38.1411	+38.1409	+0.4	+140.8	335.4376
138	139	0.538	669.707	+30.7132	—30.7161	+30.7151	+0.6	+141.4	366.1527
				+30.7165	—30.7147				
139	140	0.942	670.649	+33.1555	—33.1582	+33.1568	+2.7	+144.1	399.3095
140	Q	1.113	671.762	+14.3936	—14.3952	+14.3944	+1.6	+145.7	413.7039

Results of precise leveling from Harriman Junction, Tenn., to Woodville, Ala., 1900—Continued.

Bench marks.		Distance between successive bench marks.	Distance from bench mark A_5 at Ludlow, Ky.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
Q	141	1.011	672.773	+4.2290	+4.2293	−4.2292	+0.3	+146.0	417.9331
141	Gunter △	0.854	673.627	−5.8284	+5.8293	−5.8288	−0.9	+145.1	412.1043
Gunter △	Gunter N		673.629	+0.1598					412.2641
Gunter △	Gunter S		673.629	+0.0958					412.2001
Gunter △	Gunter E		673.629	+0.1028					412.2071
Gunter △	Gunter W		673.629	+0.0980					412.2023

The following elevations are for the top of rail in front of the railroad stations named unless otherwise stated. They are part of the preceding tabulation, and each is subject to the correction that is finally applied to the bench mark from which it is determined:

From bench mark.	Station.	Difference of elevation.	Elevation.
		m.	*m.*
A_2	Harriman Junction	+5.96	240.14
B_2	Harriman	−3.29	238.64
D_2	Emory Gap	−2.82	251.81
6	Cardiff	+0.04	241.11
10	Rockwood	+0.06	265.99
H_2	Glen Alice	+4.86	247.34
18	Roddy	+1.57	234.38
J_2	Lorraine*	−1.06	243.52
K_2	Spring City	+0.28	233.53
27	Sheffield	+5.79	255.38
32	Evensville	−0.08	229.11
37	Dayton	−0.53	213.38
42	Graysville	0.00	220.86
44	Coulterville	+0.39	212.43
S_2	Sale Creek	+2.17	225.55
U_2	Rathburn, or Soddy	+0.86	235.97
48	Retro	+0.29	223.37
V_2	Daisy	−0.52	219.00
Y_2	Hixon	−0.73	206.44
B_3	Citico Junction	+3.35	207.07
64	Boyce	+0.27	207.46
68	Chattanooga†	−0.27	203.91
E_3	Hooker, Ga.	+1.93	262.93
674N	Wauhatchie	+2.10	205.72
F_3	Whiteside	+3.47	265.86
679N	Bridgeport	−3.88	201.82
D	Bolivar	+0.94	188.69
627N	Stevenson	−1.14	188.92
104	Fackler	+0.27	186.07
I	Hollywood	−0.63	194.36
114	Scottsboro	+0.33	198.78
120	Larkinsville	+0.36	189.66
N	Lim Rock	+0.59	187.77
J_2	Woodville	+0.67	187.84

* Top of rail in front of mail crane. † On west rail of first track east of Central Depot.

WOODVILLE–BIRMINGHAM LINE.

The line forming the last section of the line Cincinnati–Birmingham, of which the purpose is explained on page 226, was run by Aid W. H. Burger between November 7, 1900, and January 9, 1901, using level No. 8, one of the new type. The line followed the Southern Railroad from Woodville to Decatur and the Louisville and Nashville from Decatur to Birmingham. (See illustration 9, page 227.) It is connected at Decatur with the line Corinth–Decatur, run under the direction of the Corps of Engineers in 1895, and at Birmingham with the line Meridian–York–Birmingham, run under the direction of the Corps of Engineers in 1897–98. Both of these lines have already been published.*

The lengths and index corrections of rods V and W, used on this line, have already been given on pp. 229 in connection with the line Cincinnati to Somerset.

The elevations in the following tabulation are based upon those determined at Woodville by the preceding sections of the Cincinnati–Birmingham line, and therefore depend upon the elevations published in Appendix 8, Report for 1899, for bench marks in the vicinity of Cincinnati.

Results of precise leveling from Woodville to Birmingham, Ala., 1900.

Bench marks.		Distance between successive bench marks.	Distance from bench mark J_2 at Woodville, Ala.	Difference of elevation.			Discrepancy (B–F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
	J_2		0.000						187.1729†
J_2	K_2	0.193	0.193	+ 1.3685	− 1.3673	+ 1.3679	−1.2	− 1.2	188.5408‡
K_2	L_2	1.221	1.414	− 0.9779	+ 0.9792	− 0.9786	−1.3	− 2.5	187.5622
L_2	T. B. M. 1	1.672	3.086	− 3.7294	+ 3.7289	− 3.7292	+0.5	− 2.0	183.8330
T. B. M. 1	2	1.161	4.247	− 2.8615	+ 2.8660	− 2.8638	−4.5	− 6.5	180.9692
2	3	1.552	5.799	+ 5.3583	− 5.3538	+ 5.3560	−4.5	−11.0	186.3252
3	M_2	1.835	7.634	− 4.4309	+ 4.4318	− 4.4314	−0.9	−11.9	181.8938
M_2	4	1.587	9.221	+ 1.0349	− 1.0357	+ 1.0353	+0.8	−11.1	182.9291
4	5	1.912	11.133	+ 0.4870	− 0.4822	+ 0.4846	−4.8	−15.9	183.4137
5	6	1.456	12.589	+11.0414	−11.0390	+11.0402	−2.4	−18.3	194.4539
6	N_2	1.834	14.423	+ 1.5042	− 1.5043	+ 1.5042	+0.1	−18.2	195.9581
N_2	7	1.223	15.646	− 6.8473	+ 6.8486	− 6.8480	−1.3	−19.5	189.1101
7	T. B. M. 8	1.360	17.006	− 1.4651	+ 1.4638	− 1.4644	+1.3	−18.2	187.6457
T. B. M. 8	9	1.675	18.681	− 0.9522	+ 0.9539	− 0.9530	−1.7	−19.9	186.6927
9	10	1.772	20.453	+ 9.9357	− 9.9372	+ 9.9364	+1.5	−18.4	196.6291
10	11	1.817	22.270	− 5.0014	+ 5.0043	− 5.0028	−2.9	−21.3	191.6263
11	11a	0.658	22.928	+ 1.3367	− 1.3341	+ 1.3354	−2.6	−23.9	192.9617
11a	O_2	0.040	22.968	− 0.3049	+ 0.3048	− 0.3048	+0.1	−23.8	192.6569
11a	T.B.M.12	0.809	23.737	+ 4.0615	− 4.0621	+ 4.0618	+0.6	−23.3	197.0235
T.B.M.12	13	1.478	25.215	+12.8879	−12.8926	+12.8901	+2.6	−20.7	209.9136
				+12.8896	−12.8902				
13	14	0.976	26.191	− 0.4153	+ 0.4163	− 0.4158	−1.0	−21.7	209.4978
14	15	1.695	27.886	+ 4.2086	− 4.2068	+ 4.2077	−1.8	−23.5	213.7055
15	16	1.842	29.728	− 7.3781	+ 7.3829	− 7.3805	−4.8	−28.3	206.3250

*Chief of Engineers' Report, 1899, Part 2, pages 1770–1781, and Appendix 8 of the Coast and Geodetic Survey Report for 1899.

† From abstract of Harriman Junction to Woodville, 1900.

‡ The elevation of B. M. K_2, as determined on line Harriman Junction to Woodville, was 188.5409 meters.

Results of precise leveling from Woodville to Birmingham, Ala., 1900—Continued.

Bench marks.		Distance between successive bench marks.	Distance from bench mark J_2 at Woodville, Ala.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
16	17	1.898	31.626	+15.3217	−15.3183	+15.3200	−3.4	−31.7	221.6450
17	18	1.306	32.932	+10.7180	−10.7239	+10.7197	+2.4	−29.3	232.3647
				+10.7190	−10.7179				
18	P_2	1.820	34.752	+12.0370	−12.0360	+12.0365	−1.0	−30.3	244 4012
P_2	19	1.667	36.419	−17.7626	+17.7587	−17.7606	+3.9	−26.4	226.6406
19	20	1.369	37.788	−10.9079	+10.9029	−10.9054	+5.0	−21.4	215.7352
20	21	1.893	39.681	−18.9224	+18.9179	−18.9202	+4.5	−16.9	196.8150
21	22	1.347	41.028	− 7.8281	+ 7.8276	− 7.8278	+0.5	−16.4	188.9872
22	Q_2	0.666	41.694	+ 5.5836	− 5.5817	+ 5.5826	−1.9	− 18.3	194.5698
Q_2	City			− 0.9370					193.6328
22	23	1.754	42.782	+ 0.5949	− 0.5943	+ 0.5946	−0.6	−17.0	189.5818
23	24	2.033	44.815	+10.2948	−10.2956	+10.2952	+0.8	−16.2	199.8770
24	25	1.799	46.614	− 7.0871	+ 7.0878	− 7.0874	−0.7	−16.9	192.7896
25	26	1.283	47.897	+ 4.9238	− 4.9257	+ 4.9248	+1.9	−15.0	197.7144
26	27	1.488	49.385	+ 1.6219	− 1.6206	+ 1.6212	−1.3	−16.3	199.3356
27	R_2	2.761	52.146	−10.6119	+10.6074	−10.6096	+4.5	−11.8	188.7260
R_2	28	0.803	52.949	+ 4.0805	− 4.0802	+ 4.0804	−0.3	−12.1	192.8064
28	29	1.536	54.485	+12.7295	−12.7298	+12.7296	+0.3	−11.8	205.5360
29	30	1.121	55.606	+ 4.3472	− 4.3471	+ 4.3472	−0.1	−11.9	209.8832
30	31	0.980	56.586	− 4.4867	+ 4.4868	− 4.4868	−0.1	−12.0	205.3964
31	32	0.921	57.507	− 3.0558	+ 3.0533	− 3.0546	+2.5	− 9.5	202.3418
31	S_2	0.038	56.624	− 0.1709*					205.2255
32	S_2	0.883		+ 2.8849*					205.2267
	S_2							Mean=	205.2261
32	33	1.171	58.678	− 4.3214	+ 4.3209	− 4.3212	+0.5	− 9.0	198.0206
33	34	1.927	60.605	+ 7.6048	− 7.6064	+ 7.6056	+1.6	− 7.4	205.6262
34	35	1.465	62.070	−13.6716	+13.6708	−13.6712	+0.8	− 6.6	191.9550
35	T_2	1.720	63.790	−13.6227	+13.6236	−13.6232	−0.9	− 7.5	178.3318
T_2	36	1.683	65.473	+ 6.9379	− 6.9367	+ 6.9373	−1.2	− 8.7	185.2691
36	37	1.648	67.121	− 3.4141	+ 3.4147	− 3.4144	−0.6	− 9.3	181.8547
37	T.B.M. 38	1.305	68.426	− 3.6438	+ 3.6443	− 3.6440	−0.5	− 9.8	178.2107
T.B.M. 38	U_2	0.913	69.339	+ 4.6799	− 4.6772	+ 4.6786	−2.7	−12.5	182.8893
U_2	T.M.B. 39	1.374	70.713	− 8.4107	+ 8.4066	− 8.4086	+4.1	− 8.4	174.4807
T.B.M. 39	40	1.177	71.890	+ 7.8632	− 7.8640	+ 7.8636	+0.8	− 7.6	182.3443
40	41	1.813	73.703	− 1.3710	+ 1.3713	− 1.3712	−0.3	− 7.9	180.9731
41	42	1.303	75.006	+ 0.5976	− 0.5934	+ 0.5955	−4.2	−12.1	181.5686
42	43	1.405	76.411	− 6.0885	+ 6.0842	− 6.0864	+4.3	− 7.8	175.4822
43	44	1.736	78.147	− 3.5210	+ 3.5160	− 3.5185	+5.0	− 2.8	171.9637
44	P.B.M. 52	1.097	79.244	+ 1.0597	− 1.0622	+ 1.0610	+2.5	− 0.3	173.0247
P.B.M. 52	P.B.M. 51	0.447	79.691	− 0.7791	+ 0.7808	− 0.7800	−1.7	− 2.0	172.2447
P.B.M. 51	U. S.					+ 0.6164			172.8611
P.B.M. 51	45	0.140	79.831	+ 2.0911	− 2.0912	+ 2.0912	+0.1	− 1.9	174.3359
45	P.B.M. 50	0.128	79.959	− 4.9085	+ 4.9091	− 4.9088	−0.6	− 2.5	169.4271
45	46	1.440	81.271	+ 0.6699	− 0.6713	+ 0.6706	+1.4	− 0.5	175.0065

* S_2 was a rod station of bench 31–32, and was not touched upon in the backward running. The two readings to S_2 combined make −3.0558, the forward measure of 31–32.

Results of precise leveling from Woodville to Birmingham, Ala., 1900—Continued.

Bench marks.		Distance between successive bench marks.	Distance from bench mark J_2 at Woodville, Ala.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
46	47	2.429	83.700	— 0.1555	+ 0.1525	— 0.1540	+3.0	+ 2.5	174.8525
47	48	1.854	85.554	+ 0.5507	— 0.5563	+ 0.5535	+5.6	+ 8.1	175.4060
48	49	1.597	87.151	+ 0.2507	— 0.2531	+ 0.2519	+2.4	+10.5	175.6579
49	50	1.567	88.718	— 3.3308*	+ 3.3193	— 3.3222	+2.3	+12.8	172.3357
				— 3.3233	+ 3.3227				
50	51	1.634	90.352	+ 0.8794	— 0.8850	+ 0.8836	+2.8	+15.6	173.2193
				+ 0.8849					
51	51a	1.214	91.566	+ 1.6525	— 1.6516	+ 1.6520	−0.9	+14.7	174.8713
51a	V_2	1.271	92.837	— 1.9351	+ 1.9347	— 1.9349	+0.4	+15.1	172.9364
V_2	52	0.837	93.674	— 0.6187	+ 0.6166	— 0.6176	+2.1	+17.2	172.3188
52	53	1.539	95.213	+ 0.2204	— 0.2224	+ 0.2214	+2.0	+19.2	172.5402
53	54	1.618	96.831	+ 6.5444	— 6.5499	+ 6.5456	+2.9	+22.1	179.0858
				+ 6.5441	— 6.5443				
54	55	1.447	98.278	+19.4881	−19.4976*	+19.4908	+5.7	+27.8	198.5766
				+19.4843*	−19.4930				
				+19.4877	−19.4943				
55	56	1.321	99.599	+11.1088	−11.1107	+11.1098	+1.9	+29.7	209.6864
56	57	1.129	100.728	— 5.1063	+ 5.1042	— 5.1052	+2.1	+31.8	204.5812
57	W_2	0.313	101.041	— 3.5689	+ 3.5669	— 3.5679	+2.0	+33.8	201.0133
W_2	58	1.410	102.451	— 2.1380	+ 2.1352	— 2.1366	+2.8	+36.6	198.8767
58	59	1.651	104.102	— 8.5163	+ 8.5149	— 8.5156	+1.4	+38.0	190.3611
59	T. B. M. 60	2.000	106.102	— 9.4687	+ 9.4650	— 9.4668	+3.7	+41.7	180.8943
T.B.M. 60	61	1.393	107.495	+ 1.6309	— 1.6383	+ 1.6363	+3.6	+45.3	182.5306
				+ 1.6381	— 1.6379				
61	62	1.397	108.892	— 1.7252	+ 1.7226	— 1.7239	+2.6	+47.9	180.8067
62	X_2	2.399	111.291	+ 2.2504	— 2.2523	+ 2.2514	+1.9	+49.8	183.0581
X_2	63	1.746	113.037	+ 0.4514	— 0.4540	+ 0.4527	+2.6	+52.4	183.5108
63	64	1.548	114.585	+ 2.6669	— 2.6710	+ 2.6690	+4.1	+56.5	186.1798
64	65	1.514	116.099	+ 2.5858	— 2.5867	+ 2.5862	+0.9	+57.4	188.7660
65	Y_2	2.339	118.438	+16.8416	−16.8482	+16.8449	+6.6	+64.0	205.6109
Y_2	66	1.545	119.983	+18.2170	−18.2206	+18.2188	+3.6	+67.6	223.8297
66	67	1.154	121.137	+15.4258	−15.4295	+15.4276	+3.7	+71.3	239.2573
67	68	1.419	122.556	+17.1587	−17.1580	+17.1584	−0.7	+70.6	256.4157
68	69	1.340	123.896	+12.8686	−12.8710	+12.8698	+2.4	+73.0	269.2855
69	70	1.598	125.494	+ 1.0840	— 1.0832	+ 1.0836	−0.8	+72.2	270.3691
70	Z_2	2.105	127.599	— 9.1698	+ 9.1644	— 9.1671	+5.4	+77.6	261.2020
Z_2	71	1.469	129.068	— 7.9392	+ 7.9402	— 7.9397	−1.0	+76.6	253.2623
71	72	1.344	130.412	— 1.2744	+ 1.2707	— 1.2726	+3.7	+80.3	251.9897
72	73	1.601	132.013	— 7.9379	+ 7.9318	— 7.9352	+4.9	+85.2	244.0545
				— 7.9373	+ 7.9336				
73	A_3	0.852	132.865	+ 0.4298	— 0.4336	+ 0.4317	+3.8	+89.0	244.4862
A_3	74	1.457	134.322	−15.2608	+15.2513	−15.2575	+4.4	+93.4	229.2287
				−15.2607	+15.2543				
				−15.2576	+15.2602				
74	75	1.069	135.391	−10.0822	+10.0818	−10.0820	+0.4	+93.8	219.1467
75	76	1.616	137.007	— 4.4586	+ 4.4553	— 4.4570	+3.3	+97.1	214.6897
76	77	1.820	138.827	+ 3.9259	— 3.9306	+ 3.9282	+4.7	+101.8	218.6179
77	78	1.500	140.327	−13.8956	+13.8938	−13.8947	+1.8	+103.6	204.7232
78	79	1.475	141.802	+ 9.5317	— 9.5361	+ 9.5339	+4.4	+108.0	214.2571
79	B_3	1.737	143.539	−16.1664	+16.1694	−16.1679	−3.0	+105.0	198.0892
B_3	80	1.390	144.929	— 3.0053	+ 3.0006	— 3.0030	+4.7	+109.7	195.0862
80	81	1.465	146.394	−15.7606	+15.7595	−15.7600	+1.1	+110.8	179.3262
81	82	1.469	147.863	−14.8052	+14.8025	−14.8038	+2.7	+113.5	164.5224
82	83	1.307	149.170	+ 5.5133	— 5.5141	+ 5.5137	+0.8	+114.3	170.0361
83	C_3	1.397	150.567	— 8.5058	+ 8.5034	— 8.5053	+3.8	+118.1	161.5308
				— 8.5085					

* Rejected.

Results of precise leveling from Woodville to Birmingham, Ala., 1900—Continued.

Bench marks.		Distance between successive bench marks.	Distance from bench mark J_3 at Woodville, Ala.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
C_3	84	1.047	151.614	+ 5.2108	— 5.2112	+ 5.2110	+0.4	+118.5	166.7418
84	85	1.562	153.176	—15.5228	+15.5225	—15.5226	+0.3	+118.8	151.2192
85	86	1.589	154.765	—15.7750	+15.7734	—15.7742	+1.6	+120.4	135.4450
86	D_3	0.526	155.291	— 5.5006	+ 5.5013	— 5.5010	—0.7	+119.7	129.9440
D_3	87	1.053	156.344	+12.6039	—12.6073	+12.6056	+3.4	+123.1	142.5496
87	88	1.664	158.008	+ 0.5053	— 0.5093	+ 0.5073	+4.0	+127.1	143.0569
88	89	1.612	159.620	+15.9386	—15.9441	+15.9436	+5.1	+132.2	159.0005
				+15.9434	—15.9481				
89	90	1.276	160.896	+ 5.2320	— 5.2356	+ 5.2338	+3.6	+135.8	164.2343
90	E_3	2.126	163.022	—25.6392	+25.6389	—25.6390	+0.3	+136.1	138.5953
E_3	91	1.799	164.821	—10.5588	+10.5637	—10.5612	—4.9	+131.2	128.0341
91	F_3	0.820	165.641	— 3.9560	+ 3.9556	— 3.9558	+0.4	+131.6	124.0783
F_3	92	1.831	167.472	+ 9.5485	— 9.5448	+ 9.5466	—3.7	+127.9	133.6249
92	93	1.770	169.242	+11.2091	—11.2090	+11.2090	—0.1	+127.8	144.8339
93	94	1.620	170.862	+19.1480	—19.1454	+19.1467	—2.6	+125.2	163.9806
94	G_3	1.652	172.514	+15.1385	—15.1387	+15.1386	+0.2	+125.4	179.1192
G_3	95	1.474	173.988	+14.4010	—14.4037	+14.4024	+2.7	+128.1	193.5216
95	96	1.749	175.737	—21.1089	+21.1073	—21.1081	+1.6	+129.7	172.4135
96	97	1.594	177.331	—20.3391	+20.3331	—20.3360	+4.7	+134.4	152.0775
				—20.3378	+20.3343				
97	98	1.885	179.216	— 0.3524	+ 0.3516	— 0.3520	+0.8	+135.2	151.7255
98	99	1.726	180.942	+14.7181	—14.7212	+14.7196	+3.1	+138.3	166.4451
99	H_3	0.096	181.038	+ 0.3282	— 0.3282	+ 0.3282	0.0	+138.3	166.7733
99	100	1.648	182.590	—14.5221	+14.5215	—14.5218	+0.6	+138.9	151.9233
100	101	1.286	183.876	—16.3339	+16.3341	—16.3340	—0.2	+138.7	135.5893
101	I_3	1.023	184.899	— 9.9792	+ 9.9760	— 9.9776	+3.2	+141.9	125.6117
I_3	102	1.378	186.277	+10.7790	—10.7798	+10.7794	+0.8	+142.7	136.3911
102	103	1.188	187.465	— 0.1504	+ 0.1485	— 0.1494	+1.9	+144.6	136.2417
103	J_3	1.570	189.035	—10.3394	+10.3377	—10.3386	+1.7	+146.3	125.9031
J_3	104	1.679	190.714	—11.0274	+11.0276	—11.0275	—0.2	+146.1	114.8756
104	105	1.362	192.076	+ 0.0832	— 0.0869	+ 0.0850	+3.7	+149.8	114.9606
105	106	1.328	193.404	— 0.2618	+ 0.2611	— 0.2614	+0.7	+150.5	114.6992
106	T.B.M.107	1.654	195.058	+ 5.8139	— 5.8132	+ 5.8136	—0.7	+149.8	120.5128
T.B.M.107	108	1.572	196.630	+ 2.6082	— 2.6102	+ 2.6092	+2.0	+151.8	123.1220
108	109	1.947	198.577	+10.0152	—10.0108	+10.0130	—4.4	+147.4	133.1350
109	110	1.851	200.428	+11.8043	—11.8058	+11.8050	+1.5	+148.9	144.9400
110	K_3	2.019	202.447	+12.4942	—12.4943	+12.4942	+0.1	+149.0	157.4342
K_3	111	1.047	203.494	+ 4.5838	— 4.5836	+ 4.5837	—0.2	+148.8	162.0179
111	112	1.653	205.147	+ 8.5305	— 8.5308	+ 8.5306	+0.3	+149.1	170.5485
112	113	0.974	206.121	— 1.4518	+ 1.4491	— 1.4504	+2.7	+151.8	169.0981
113	114	1.981	208.102	+13.7542	—13.7531	+13.7536	—1.1	+150.7	182.8517
114	115	1.547	209.649	—16.9490	+16.9497	—16.9494	—0.7	+150.0	165.9023
115	116	1.446	211.095	— 4.3824	+ 4.3789	— 4.3806	+3.5	+153.5	161.5217
116	117	1.299	212.394	+11.3142	—11.3179	+11.3160	+3.7	+157.2	172.8377
117	118	1.626	214.020	+ 4.7195	— 4.7257	+ 4.7246	+7.0	+164.2	177.5623
				+ 4.7228	— 4.7306				
118	I_3	0.052	214.072	+ 0.3730	— 0.3721	+ 0.3726	—0.9	+163.3	177.9349
118	119	1.656	215.676	— 0.1278	+ 0.1288	— 0.1283	—1.0	+163.2	177.4340
119	120	2.010	217.686	+10.7474	—10.7483	+10.7478	+0.9	+164.1	188.1818
120	P. B. M. 2	1.318	219.004	— 6.8293	+ 6.8316	— 6.8304	—2.3	+161.8	181.3514
P.B.M. 2	P. B. M. 3	0.257	219.261	— 1.1000	+ 1.1004	— 1.1002	—0.4	+161.4	180.2512

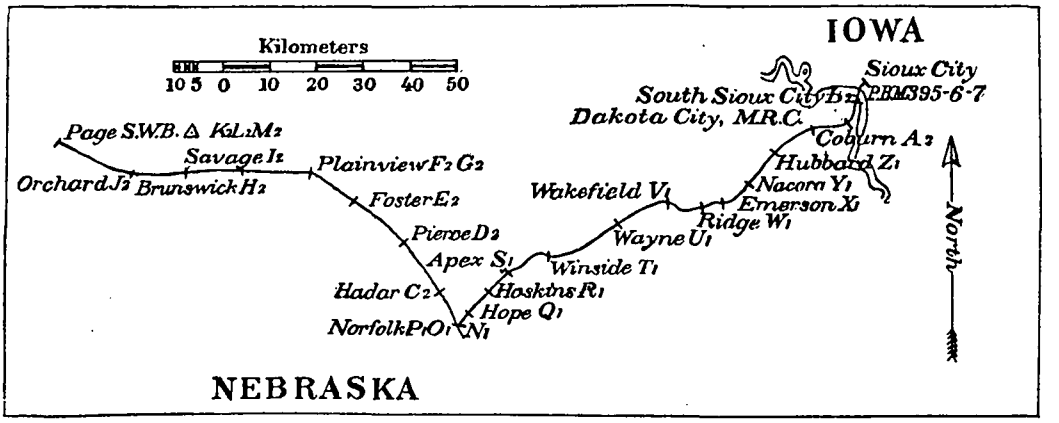
The following elevations are for top of rail in front of the railroad stations named, unless otherwise stated. They are part of the preceding tabulation, and each one is subject to the correction that is finally applied to the bench mark from which it is determined.

From bench mark—	Station.	Difference of elevation.	Elevation.
		m.	
J_2	Woodville	+0.64	187.81
M_2	Paintrock	+0.55	182.44
N_2	Gurley	+1.22	197.18
11a	Brownsboro	+0.18	193.14
P_2	Fearns	−2.64	241.76
22	Huntsville	+0.02	189.01
S_2	Madison	+0.02	205.25
36	Greenbrier	+1.59	186.86
U_2	Bellemina	+0.12	183.01
45	Decatur	+1.35	175.69
46	New Decatur	−1.01	173.99
51	Flint	+0.76	173.98
57	Hartselle	+0.17	204.75
60	Leesdale	+5.05	185.94
62	Falkville	+2.79	183.60
63	Lacon	+0.08	183.59
70	Holmes Gap	+8.54	278.91
A_3	Cullman	−0.23	244.26
B_3	Johnson	+0.23	198.32
82	Hanceville	+0.28	164.80
85	Garden City	−2.02	149.20
91	Blount Springs	+1.86	129.89
88	Bangor	−0.42	142.64
99	Warrior	+0.78	167.23
102	Jefferson	−0.64	135.75
J_3	Morris	−0.67	125.23
109	Cunningham	+0.10	133.24
K_3	Newcastle	−0.19	157.24
118	Boyles	−0.17	177.39

NORFOLK–SIOUX CITY LINE.

This line was run by Aid B. E. Tilton between May 8 and June 20, 1900, using level No. 6, one of the intermediate type. The purpose of this line was to complete

No. 10.



Leveling route, Norfolk, Nebr., to Sioux City, Iowa, and Page, Nebr.

the circuit Norfolk–Abilene–Kansas City–Sioux City–Norfolk. The line was run over the Chicago, St. Paul, Minneapolis and Omaha Railroad. Velocipede cars were used.

Rods R_2 and S were used. Their lengths at zero degrees centigrade, before and after the leveling, as determined at the Office of Standard Weights and Measures, were as follows:

	Rod R_2.	Rod S.
	m. mm.	*m. mm.*
October, 1899	3+1.09	3+1.53
November, 1900	3+1.22	3+1.57

The mean of all is $3^m + 1^{mm}.35$, or an excess of length of $0^{mm}.45$ per meter.

The lengths of the 3-meter intervals on the rod as measured in the field were as follows:

Date.	Length of R_2 reduced to 25° C.	Length of S reduced to 25° C.
1900.	*m.*	*m.*
May 9	3.0009	3.0014
24	3.0005	3.0008
June 12	3.0008	3.0009
26	3.0006	3.0009
July 10	3.0008	3.0009
25	3.0008	3.0009
Aug. 7	3.0008	3.0013
21	3.0008	3.0010
Sept. 6	3.0007	3.0010
19	3.0010	3.0014
Oct. 4	3.0010	3.0015
12	3.0009	3.0013

These field measurements are made merely to determine whether the rods change in length. They are not directly comparable with the Office measures, made with great care to determine the absolute lengths.

These measurements show that the rods retained so nearly a constant length throughout the season that it was decided to use the mean of the rod lengths, as measured at the Office of Standard Weights and Measures, in making the computation, the correction for length being therefore $0^{mm}.45$ per meter.

The index corrections to the rods in November, 1899, were: For R_2, 0.0 millimeter; for S, −0.2 millimeter; and in January, 1901, for R_2, −0.2 millimeter; for S, −0.6 millimeter.

The elevations given in the tabulation are based upon those printed in Appendix 8, Report for 1899, for the bench marks N_1, O_1, and P_1 at Norfolk, of the line Abilene–Norfolk, run by A. L. Baldwin and B. E. Tilton in 1899. (See Appendix 6, Report for 1899.) The line connects at Sioux City with bench marks established on the line St. Joseph–Sioux City, which was run under the direction of the Corps of Engineers in 1892.

The elevations in the tabulation for stations marked thus: (Sta.-Norfolk), refer to the top of rail in front of the railroad station named.

Results of precise leveling from Norfolk, Nebr., to Sioux City, Iowa, 1900.

Bench marks.		Distance between successive bench marks.	Distance from bench mark B_1 at Abilene, Kans.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
	N_1		467.122					+242.7*	464.3781†
N_1	1	1.587	468.709	+ 1.0204		+ 1.0204			465.3985
1	2	1.191	469.900	— 1.8375		— 1.8375			463.5610
	O_1								465.5346†
O_1	2	0.512		— 1.9667		— 1.9667			463.5679
	P_1								464.7704†
P_1	2	0.638		— 1.2047		— 1.2047			463.5657
	2							Mean	463.5649
2	Sta. Norfolk			+ 0.18					463.74
2	3	1.606	471.506	+ 1.4946	— 1.4939	+ 1.4942	—0.7	+242.0	465.0591
3	Q_1	2.222	473.728	+ 9.0005	— 8.9996	+ 9.0000	—0.9	+241.1	474.0591
Q_1	4	1.627	475.355	+ 4.1033	— 4.1040	+ 4.1036	+0.7	+241.8	478.1627
4	5	1.616	476.971	+ 6.2804	— 6.2871	+ 6.2829	+4.2	+246.0	484.4456
				+ 6.2812	— 6.2828				
5	6	1.624	478.595	+ 5.6364	— 5.6388	+ 5.6376	+2.4	+248.4	490.0832
6	7	1.023	479.618	+ 5.4831	— 5.4863	+ 5.4847	+3.2	+251.6	495.5679
7	8	1.590	481.208	+ 4.5776	— 4.5793	+ 4.5784	+1.7	+253.3	500.1463
8	R_1	2.005	483.213	+ 8.4007	— 8.4106	+ 8.4048	+7.9	+261.2	508.5511
				+ 8.3989	— 8.4068				
				+ 8.4027					
R_1	Sta. Haskins			— 0.71					507.84
R_1	9	1.571	484.784	+ 4.1820	— 4.1823	+ 4.1822	+0.3	+261.5	512.7333
9	10	1.605	486.389	+ 4.5636	— 4.5617	+ 4.5628	—2.2	+259.3	517.2961
				+ 4.5642					
10	11	1.856	488.245	+13.3143	—13.3173	+13.3158	+3.0	+262.3	530.6119
11	S_1	1.407	489.652	+13.9049	—13.9001	+13.9025	—4.8	+257.5	544.5144
S_1	12	1.680	491.332	—18.2392	+18.2430	—18.2411	—3.8	+253.7	526.2733
12	13	1.594	492.926	—19.7987	+19.8018	—19.7994	+3.7	+257.4	506.4739
				—19.8039	+19.7935				
13	14	1.715	494.641	—14.3530	+14.3542	—14.3536	—1.2	+256.2	492.1203
14	15	1.677	496.318	— 9.1586	+ 9.1597	— 9.1583	+3.4	+259.6	482.9620
				— 9.1613	+ 9.1535				
15	16	1.598	497.916	— 4.5677	+ 4.5679	— 4.5678	+2.8	+262.4	478.3942
				— 4.5706	+ 4.5650				
16	T_1	1.593	499.509	— 1.2444	+ 1.2433	— 1.2448	+3.0	+265.4	477.1494
				— 1.2482					
T_1	Sta. Winside			+ 0.19					477.34
T_1	17	1.577	501.086	— 5.8300‡	+ 5.8412	— 5.8414	+0.3	+265.7	471.3080
				— 5.8415					
17	18	1.630	502.716	— 4.4544	+ 4.4518	— 4.4531	+2.6	+268.3	466.8549
18	19	1.584	504.300	— 4.2964	+ 4.2929	— 4.2946	+3.5	+271.8	462.5603
19	20	1.606	505.906	— 1.7326	+ 1.7359	— 1.7342	—3.3	+268.5	460.8261
20	21	1.893	507.799	— 5.7471	+ 5.7509	— 5.7468	—1.5	+267.0	455.0793
				— 5.7537‡	+ 5.7345‡				
				— 5.7450	+ 5.7441				

* From B_1 at Abilene. † From Appendix 8, Report for 1899, page 490. ‡ Rejected.

Results of precise leveling from Norfolk, Nebr., to Sioux City, Iowa, 1900—Continued.

Bench marks.		Distance between successive bench marks.	Distance from bench mark B_1 at Abilene, Kans.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
21	22	1.645	509.444	— 3.8998	+ 3.9012	— 3.9005	—1.4	+265.6	451.1788
22	23	1.535	510.979	— 3.7377	+ 3.7380	— 3.7378	—0.3	+265.3	447.4410
23	24	1.797	512.776	— 3.3385	+ 3.3344	— 3.3364	+4.1	+269.4	444.1046
24	25	1.801	514.577	— 1.9028	+ 1.9022	— 1.9025	+0.6	+270.0	442.2021
25	Sta. Wayne			+ 1.36					443.56
25	U_1	0.493	515.070	+ 2.9095	— 2.9106	+ 2.9100	+1.1	+271.1	445.1121
25	26	1.597	516.174	— 1.2713	+ 1.2762	— 1.2738	—4.9	+265.1	440.9283
26	27	1.658	517.832	— 4.6622	+ 4.6630	— 4.6626	—0.8	+264.3	436.2657
27	28	2.027	519.859	— 2.8788	+ 2.8812	— 2.8786	—4.8	+259.5	433.3871
				— 2.8735	+ 2.8808				
28	29	1.534	521.393	— 1.4136	+ 1.4119	— 1.4128	+1.7	+261.2	431.9743
29	30	1.716	523.109	— 2.3825	+ 2 3863	— 2.3848	+2.0	+263.2	429.5895
				— 2.3891	+ 2.3813				
30	31	1.571	524.680	— 2.7200	+ 2.7249	— 2.7224	—4.9	+258.3	426.8671
31	32	1.598	526.278	— 1.9273	+ 1.9244	— 1.9258	+2.9	+261.2	424.9413
32	33	1.610	527.888	— 2.0989	+ 2.1015	— 2.1004	—2.1	+259.1	422.8409
				— 2.0998	+ 2.0917*				
33	34	1.669	529.557	+ 0.1477	— 0.1454	+ 0.1466	+2.4	+261.5	422.9875
				+ 0.1430	— 0.1502				
34	Sta. Wakefield.			+ 0.14					423.13
34	V_1	0.191	529.748	+ 8.3780	— 8.3788	+ 8.3784	+0.8	+262.3	431.3659
34	35	1.524	531.081	— 1.2055	+ 1.2015	— 1.2035	+4.0	+265.5	421.7840
35	36	1.607	532.688	— 2.7269	+ 2.7234	— 2.7252	+3.5	+269.0	419.0588
36	37	1.661	534.349	— 0.1498	— 0.1496	+ 0.1497	—0.2	+268.8	419.2085
37	38	1.660	536.009	+ 6.8194	— 6.8179	+ 6.8186	—1.5	+267.3	426.0271
38	39	1.640	537.649	+11.2532	—11.2572	+11.2552	+4.0	+271.3	437.2823
39	40	1.638	539.287	+15.0314	—15.0319	+15.0316	+0.5	+271.8	452.3139
40	W_1	0.896	540.183	+11.0030	—11.0048	+11.0039	+1.8	+273.6	463.3178
W_1	Sta. Ridge			— 1.07					462.25
W_1	41	1.674	541.857	—18.5508	+18.5527	—18.5508	+2.3	+275.9	444.7670
				—18.5531	+18.5467				
41	42	1.604	543.461	—11.3721	+11.3740	—11.3730	—1.9	+274.0	433.3940
42	X_1	1.111	544.572	+ 1.6000	— 1.6020	+ 1.6010	+2.0	+276.0	434.9950
X_1	Sta. Emerson			— 0.34					434.66
X_1	43	1.623	546.195	+14.1393	—14.1410	+14.1402	+1.7	+277.7	449.1352
43	44	1.692	547.887	—18.8273	+18.8277	—18.8276	—0.7	+277.0	430.3076
				—18.8367*	+18.8283				
44	45	1.653	549.540	—14.5657	+14.5650	—14.5654	+0.7	+277.7	415.7422
45	46	1.638	551.178	— 8.1552	+ 8.1530	— 8.1541	+2.2	+279.9	407.5881
46	47	1.637	552.815	+15.3163	—15.3130	+15.3146	—3.3	+276.6	422.9027
47	Y_1	0.534	553.349	+ 6.6388	— 6.6388	+ 6.6388	0.0	+276.6	429.5415
Y_1	48	1.579	554.928	—13.0430	+13.0428	—13.0429	+0.2	+276.8	416.4986

*Rejected.

Results of precise leveling from Norfolk, Nebr., to Sioux City, Iowa, 1900—Continued.

Bench marks.		Distance between successive bench marks.	Distance from bench mark B_1 at Abilene, Kans.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
48	49	1.646	556.574	−17.7012	+17.7008	−17.7010	+0.4	+277.2	398.7976
49	50	1.723	558.297	−13.1893	+13.1890	−13.1892	+0.3	+277.5	385.6084
50	51	1.712	560.009	− 9.3334	+ 9.3376	− 9.3355	−4.2	+273.3	376.2729
51	52	1.647	561.656	− 9.9186	+ 9.9168	− 9.9177	+1.8	+275.1	366.3552
52	53	1.707	563.363	− 6.7094	+ 6.7055	− 6.7074	+3.9	+279.0	359.6478
53	Z_1	1.647	565.010	− 6.6624	+ 6.6601	− 6.6612	+2.3	+281.3	352.9866
Z_1	Sta. Hubbard			− 0.23					352.76
Z_1	54	1.678	566.688	− 6.5802	+ 6.5806	− 6.5804	−0.4	+280.9	346.4062
54	55	1.771	568.459	− 6.9857	+ 6.9844	− 6.9850	+1.3	+282.2	339.4212
55	56	1.727	570.186	− 2.4409	+ 2.4378	− 2.4414	−1.2	+281.0	336.9798
				− 2.4407	+ 2.4463				
56	57	1.106	571.292	− 0.2502	+ 0.2540	− 0.2521	−3.8	+277.2	336.7277
57	A_2	0.896	572.188	+ 0.0808	− 0.0769	+ 0.0788	−3.9	+273.3	336.8065
A_2	Sta. Coburn			+ 0.23					337.04
A_2	58	1.628	573.816	− 0.3549	+ 0.3551	− 0.3550	−0.2	+273.1	336.4515
58	59	1.752	575.568	− 0.0828	+ 0.0822	− 0.0825	+0.6	+273.7	336.3690
59	60	1.632	577.200	− 1.1067	+ 1.1109	− 1.1057	0.0	+273.7	335.2633
				− 1.1085	+ 1.1018				
				− 1.1020	+ 1.1043				
60	61	1.993	579.193	− 0.3952*	+ 0.3905	− 0.3888	−1.3	+272.4	334.8745
				− 0.3769*	+ 0.3885				
				− 0.3881	+ 0.3893				
61	Sta. Dakota City			+ 1.08					335.95
61	M. R. C.	1.319	580.512	+ 0.2370	− 0.2379	+ 0.2374	+0.9	+273.3	335.1119
M. R. C.	62	1.647	582.159	+ 0.4708	− 0.4708	+ 0.4708	0.0	+273.3	335.5827
62	63	1.746	583.905	+ 1.1178	− 1.1181	+ 1.1180	+0.3	+273.6	336.7007
63	64	1.501	585.406	− 0.1313	+ 0.1316	− 0.1314	−0.3	+273.3	336.5693
64	B_2	0.736	586.142	− 0.0891	+ 0.0870	− 0.0880	+2.1	+275.4	336.4813
B_2	65	2.091	588.233	+10.5907	−10.5927	+10.5917	+2.0	+277.4	347.0730
65	66	0.730	588.963	+ 1.9727	− 1.9729	+ 1.9740	+0.6	+278.0	349.0470
				+ 1.9756	− 1.9760				
				+ 1.9727	− 1.9739				
66	P.B.M.395†	0.521	589.484	−14.9489	+14.9461	−14.9475	+2.8	+280.8	334.0995
66	67	1.594	590.557	−12.9271	+12.9280	−12.9261	−0.6	+277.4	336.1209
				−12.9244	+12.9247				
67	68	0.986	591.543	+ 0.3023	− 0.3019	+ 0.3021	−0.4	+277.0	336.4230
68	P.B.M.396†	1.387	592.930	+ 2.6015	− 2.6049	+ 2.6032	+3.4	+280.4	339.0262
P.B.M. 396†	69	1.473	594.403	+ 1.7052	− 1.7062	+ 1.7057	+1.0	+281.4	340.7319
69	70	1.706	596.109	+10.9676	−10.9641	+10.9658	−3.5	+277.9	351.6977
70	71	1.546	597.655	−11.0686	+11.0676	−11.0681	+1.0	+278.9	340.6296
71	P.B.M.397†	1.332	598.987	− 3.4104	+ 3.4092	− 3.4098	+1.2	+280.1	337.2198

*Rejected. †Top of cap.

NORFOLK–PAGE LINE.

This line was run by Aid B. E. Tilton between June 22 and July 27, 1900, using instrument No. 6, one of the intermediate type. The purpose of this line was to connect the Page Base with the precise level net and ultimately to form a part of the great circuit Abilene, Kans.–Norfolk, Nebr.–Page, Nebr.–Chadron, Nebr.–Orin Junction, Wyo.–Cheyenne, Wyo.–Denver, Colo.–Abilene, Kans. The leveling followed the Fremont, Elkhorn and Missouri Valley Railway from Norfolk to Plainview, and the Pacific Short Line to Page. Velocipede cars were used between Plainview and Page, but not between Norfolk and Plainview. The necessary information as to the index corrections and length of rods is given in the account of the preceding line, Norfolk–Sioux City.

The elevations given in the following tabulation are based upon those printed for bench marks O_1 and P_1 at Norfolk in Appendix 8, Report for 1899. The elevations given in the tabulation for stations marked thus, (Sta. Hadar), refer to the top of rail in front of the railroad station named.

Results of precise leveling from Norfolk to Page, Nebr., 1900.

Bench marks.		Distance between successive bench marks.	Distance from P. B. M. O_1 at Norfolk.	Difference of elevation.			Discrepancy (B–F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
	P_1								464.7704*
P_1	O_1	0.790		+0.7636		+0.7636			465.5340
	O_1		0.000						465.5346*
O_1	72	0.250	0.250	−0.9473		−0.9473			464.5873
P_1	72	0.898		−0.1846		−0.1846			464.5858
	72							Mean=	464.5866
72	73	1.694	1.944	+2.3900	−2.3946	+2.3923	+4.6	+ 4.6	466.9789
73	74	1.923	3.867	+3.7696	−3.7723	+3.7710	+2.7	+ 7.3	470.7499
74	75	1.913	5.780	−1.1806	+1.1784	−1.1795	+2.2	+ 9.5	469.5704
75	76	1.604	7.384	+2.6712	−2.6671	+2.6692	−4.1	+ 5.4	472.2396
76	C_2	1.587	8.971	+2.7592	−2.7588	+2.7590	−0.4	+ 5.0	474.9986
C_2	Sta. Hadar			−0.19					474.81
C_2	77	1.792	10.763	−1.2011	+1.2014	−1.2012	−0.3	+ 4.7	473.7974
77	78	1.607	12.370	+1.8084	−1.8115	+1.8100	+3.1	+ 7.8	475.6074
78	79	1.680	14.050	−0.0456	+0.0440	−0.0448	+1.6	+ 9.4	475.5626
79	80	1.793	15.843	+4.1730	−4.1745	+4.1738	+1.5	+10.9	479.7364
80	81	1.605	17.448	+2.4581	−2.4565	+2.4573	−1.6	+ 9.3	482.1937
81	82	1.723	19.171	−1.6321	+1.6298	−1.6310	+2.3	+11.6	480.5627
82	83	1.660	20.831	+1.5249	−1.5253	+1.5251	+0.4	+12.0	482.0878
83	Sta. Pierce			+0.33					482.42
83	D_2	0.387	21.218	+3.5547	−3.5547	+3.5547	0.0	+12.0	485.6425
D_2	84	0.872	22.090	−2.9385	+2.9380	−2.9382	+0.5	+12.5	482.7043

*See Appendix 8, Report for 1899, page 490.

Results of precise leveling from Norfolk to Page, Nebr., 1900—Continued.

Bench marks.		Distance between successive bench marks.	Distance from P. B. M. O1 at Norfolk.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
84	85	1.644	23.734	+2.9185	—2.9184	+2.9184	—0.1	+12.4	485.6227
85	86	1.699	25.433	+6.0323	—6.0276	+6.0300	—4.7	+ 7.7	491.6527
86	87	1.793	27.226	+0.6514	—0.6519	+0.6507	—2.6	+ 5.1	492.3034
				+0.6527	—0.6469				
87	88	1.614	28.840	+2.0858	—2.0814	+2.0836	—4.4	+ 0.7	494.3870
88	89	1.630	30.470	+1.6766	—1.6762	+1.6764	—0.4	+ 0.3	496.0634
89	90	1.606	32.076	+1.5253	—1.5268	+1.5260	+1.5	+ 1.8	497.5894
90	91	1.734	33.810	+0.3938	—0.3927	+0.3932	—1.1	+ 0.7	497.9826
91	E_2	1.435	35.245	+2.0491	—2.0492	+2.0505	+3.8	+ 4.5	500.0331
				+2.0482	—2.0557				
E_2	Sta. Foster			+ 0.74					500.77
E_2	92	1.459	36.704	+1.9320	—1.9324	+1.9322	+0.4	+ 4.9	501.9653
92	93	1.718	38.422	+2.3571	—2.3543	+2.3556	+2.0	+ 6.9	504.3209
				+2.3522	—2.3588				
93	94	1.680	40.102	+0.4488	—0.4501	+0.4494	+1.3	+ 8.2	504.7703
94	95	2.013	42.115	+1.9585	—1.9633	+1.9609	+4.8	+13.0	506.7312
95	96	1.744	43.859	+1.3678	—1.3745	+1.3702	+4.7	+17.7	508.1014
				+1.3677	—1.3748				
					—1.3681				
96	97	1.661	45.520	+0.9129	—0.9160	+0.9144	+3.1	+20.8	509.0158
97	98	1.626	47.146	+1.3804	—1.3836	+1.3820	+3.2	+24.0	510.3978
98	99	1.668	48.814	+2.4795	—2.4812	+2.4804	+1.7	+25.7	512.8782
99	Sta. Plainview			+ 0.14					513.02
99	F_2	0.225	49.039	+ 5.0818	— 5.0829	+ 5.0834	+1.5	+27.2	517.9616
				+ 5.0835	— 5.0853				
F_2	G_2	0.050	49.089	+ 0.0168	— 0.0174	+ 0.0171	+0.6	+27.8	517.9787
99	100	1.662	50.476	+ 5.9081	— 5.9070	+ 5.9076	—1.1	+24.6	518.7858
100	101	1.710	52.186	+12.8757	—12.8783	+12.8770	+2.6	+27.2	531.6628
101	102	1.637	53.823	+12.3507	—12.3465	+12.3503	—5.0	+22.2	544.0131
				+12.3550	—12.3492				
102	103	1.746	55.569	+ 9.6216	— 9.6183	+ 9.6204	—2.4	+19.8	553.6335
				+ 9.6300*	— 9.6201				
103	104	1.659	57.228	+ 2.9087	— 2.9105	+ 2.9096	+1.8	+21.6	556.5431
104	105	1.740	58.968	— 9.0057	+ 9.0057	— 9.0057	0.0	+21.6	547.5374
105	106	1.635	60.603	+ 5.1263	— 5.1326	+ 5.1301	+5.0	+26.6	552.6675
				+ 5.1290					
106	107	1.670	62.273	+ 9.9164	— 9.9204	+ 9.9184	+4.0	+30.6	562.5859
107	H_2	1.735	64.008	+ 3.1365	— 3.1369	+ 3.1367	+0.4	+31.0	565.7226
H_2	Sta. Brunswick			+ 0.97					566.69
H_2	108	1.637	65.645	— 2.5769	+ 2.5715	— 2.5742	+5.4	+36.4	563.1484
108	109	0.777	66.422	— 4.1786	+ 4.1805	— 4.1796	—1.9	+34.5	558.9688
109	110	1.790	68.212	— 1.6036	+ 1.6046	— 1.6041	—1.0	+33.5	557.3647
110	111	1.644	69.856	+ 1.9992	— 2.0005	+ 1.9998	+1.3	+34.8	559.3645
111	112	1.660	71.516	— 0.7729	+ 0.7723	— 0.7708	+4.4	+39.2	558.5937
				— 0.7730	+ 0.7650				

*Rejected.

Results of precise leveling from Norfolk to Page, Nebr., 1900—Continued.

Bench marks.		Distance between successive bench marks.	Distance from P. B. M. O1 at Norfolk.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
112	113	1.762	73.278	— 5.5142 — 5.5150	+ 5.5174 + 5.5051*	— 5.5160	—2.8	+36.4	553.0777
113	114	1.718	74.996	+ 1.2833	— 1.2868	+ 1.2850	+3.5	+39.9	554.3627
114	I_2	2.012	77.008	+15.5858	—15.5893	+15.5876	+3.5	+43.4	569.9503
I_2	Sta. Savage			+ 0.12					570.07
I_2	115	1.457	78.465	+ 5.2240	— 5.2212	+ 5.2226	—2.8	+40.6	575.1729
115	116	1.265	79.730	+ 6.5718	— 6.5729	+ 6.5724	+1.1	+41.7	581.7453
116	117	1.595	81.325	+ 5.5961	— 5.5926	+ 5.5944	—3.5	+38.2	587.3397
117	118	1.665	82.990	+ 1.4987	— 1.5035 — 1.5032	+ 1.5010	+4.7	+42.9	588.8407
118	119	1.714	84.704	+ 1.5819	— 1.5842	+ 1.5830	+2.3	+45.2	590.4237
119	J_2	1.642	86.346	+ 1.8680	— 1.8704	+ 1.8692	+2.4	+47.6	592.2929
J_2	Sta. Orchard			+ 0.54					592.83
J_2	120	2.271	88.617	+ 6.8292	— 6.8313	+ 6.8302	+2.1	+49.7	599.1231
120	121	1.642	90.259	— 4.5805	+ 4.5831	— 4.5818	—2.6	+47.1	594.5413
121	122	1.685	91.944	+ 4.4155	— 4.4131	+ 4.4143	—2.4	+44.7	598.9556
122	123	1.668	93.612	+ 5.2475	— 5.2497	+ 5.2486	+2.2	+46.9	604.2042
123	124	1.668	95.280	— 2.5000	+ 2.5053	— 2.5026	—5.3	+41.6	601.7016
124	125	1.632	96.912	+ 4.8210	— 4.8233	+ 4.8222	+2.3	+43.9	606.5238
125	126	1.595	98.507	— 5.9212	+ 5.9218	— 5.9215	—0.6	+43.3	600.6023
126	127	1.638	100.145	— 1.5873	+ 1.5824	— 1.5848	+4.9	+48.2	599.0175
127	128	1.506	101.651	— 1.6814	+ 1.6840	— 1.6827	—2.6	+45.6	597.3348
128	K_2	1.249	102.900	— 0.5700	+ 0.5677	— 0.5688	+2.3	+47.9	596.7660
K_2	129	1.186	104.086	+ 4.0521	— 4.0543	+ 4.0532	+2.2	+50.1	600.8192
129	L_2	1.522	105.608	+10.9565 +10.9576	—10.9532 —10.9521	+10.9548	—4.4	+45.7	611.7740
L_2	M_2	1.1119	106.727	+14.4229 +14.4173	—14.4252 —14.4225	+14.4220	+3.7	+49.4	626.1960
† M_2	Page S.W.B. △	0.082	106.809	+ 0.5247	— 0.5256	+ 0.5252	+0.9	+50.3	626.7212

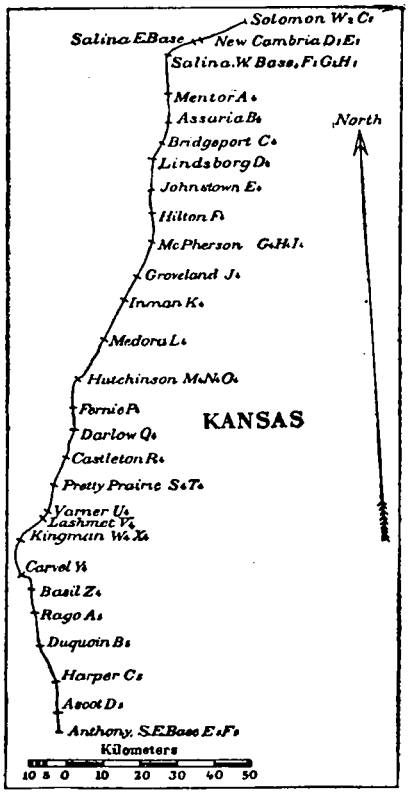
* Rejected.

† August 22–24, 1900, by O. M. Leland.

SOLOMON–ANTHONY LINE.

This line was run by Aid B. E. Tilton between July 31 and October 12, 1900, using level No. 6, one of the intermediate type. The primary purpose of this line was to connect the Anthony Base with the precise level net and to control the elevations determined by the measurement of vertical angles along the ninety-eighth meridian triangulation. Connections were made with the triangulation stations Kingman and Pretty Prairie. The line forms a part of the great circuit Abilene, Kans.–Anthony, Kans.–Bowie, Tex.–Shreveport, La.–Monroe, La.–Little Rock, Ark.–Harrisonville, Mo.–Holliday, Kans.–Abilene, Kans. The leveling followed the Union Pacific Rail-

No. 11.



Leveling route, Solomon to Anthony, Kans.

way from Solomon, Kans., to McPherson, Kans., the Chicago, Rock Island and Pacific to Hutchinson, and the Santa Fe to Anthony. The velocipede cars were used over the whole line. The necessary information in regard to the index corrections and lengths of rods is given under the line Norfolk–Sioux City.

The elevations in the following tabulation are based upon those printed for bench marks C_1 and W_2, at Solomon, in Appendix 8 Report for 1899. The elevations in the following tabulation for stations marked thus: (Sta. Solomon) refer to the top of the rail in front of the station named.

Results of precise leveling from Solomon to Anthony, Kans., 1900.

Bench marks.		Distance between successive bench marks.	Distance from bench mark B_1 at Abilene, Kans.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.*	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
	C_1								358.8322†
C_1	Sta. Solomon			—1.12					357.71
C_1	1	1.006		—2.0762	+2.0766	—2.0776	—0.3		356.7546
				—2.0788	+2.0790				
	W_2		14.118						356.3944†
W_2		1.202	15.320	+0.3556	—0.3558	+0.3557	+0.2	—12.8	356.7501
	1							Mean=	356.7524
1	2	1.726	17.046	+1.0701	—1.0695	+1.0698	—0.6	—13.4	357.8222
2	3	1.657	18.703	+0.4631	—0.4611	+0.4621	—2.0	—15.4	358.2843
3	4	1.713	20.416	+1.0093	—1.0090	+1.0083	—3.0	—18.4	359.2926
				+1.0103	—1.0046				
4	5	1.656	22.072	+0.5921	—0.5889	+0.5905	—3.2	—21.6	359.8831
5	6	1.636	23.708	+0.8407	—0.8405	+0.8406	—0.2	—21.8	360.7237
6	7	1.656	25.364	+1.9065	—1.9061	+1.9063	—0.4	—22.2	362.6300
7	D_1	1.882	27.246	+3.5534	—3.5531	+3.5532	—0.3	—22.5	366.1832
D_1	Sta. New Cambria			—0.30					365.88
D_1	E_1	1.216	28.462	—0.3434	+0.3449	—0.3442	—1.5	—24.0	365.8390
E_1	Salina E. B. △	0.906	29.368	+0.3919	—0.3916	+0.3918	—0.3	—24.3	366.2308
Salina E. B. △	8	1.636	31.004	+1.8373	—1.8387	+1.8380	+1.4	—22.9	368.0688
8	9	1.895	32.899	+2.3609	—2.3599	+2.3602	—1.3	—24.2	370.4290
					—2.3592				
9	10	1.825	34.724	+1.4003	—1.4041	+1.4022	+3.8	—20.4	371.8312
10	Salina W.B. △	1.186	35.910	+0.4913	—0.4946	+0.4930	+3.3	—17.1	372.3242
Salina W.B. △	F_1	0.900	36.810	+1.3708	—1.3710	+1.3709	+0.2	—16.9	373.6951
F_1	H_1	0.339	37.149	+0.4466		+0.4466			374.1417
H_1	G_1	0.172	37.321	—0.0438		—0.0438			374.0979
G_1	F_1	0.307	37.628	—0.4027		—0.4027			373.6952
F_1	11	1.795	38.605	+0.4044	—0.4057	+0.4050	+1.3	—15.6	374.1002
11	12	1.618	40.223	+1.5099	—1.5099	+1.5099	0.0	—15.6	375.6101
12	13	1.659	41.882	+0.7450	—0.7470	+0.7460	+2.0	—13.6	376.3561
13	14	1.660	43.542	+2.2816	—2.2861	+2.2838	+4.5	— 9.1	378.6399
14	15	1.672	45.214	+1.5591	—1.5591	+1.5591	0.0	— 9.1	380.1990
15	16	1.599	46.813	+1.6219	—1.6227	+1.6223	+0.8	— 8.3	381.8213
16	17	1.148	47.961	+2.5112	—2.5115	+2.5114	+0.3	— 8.0	384.3327
17	A_4	1.181	49.142	+1.8360	—1.8345	+1.8352	—1.5	— 9.5	386.1679
A_4	18	1.651	50.793	+1.8439	—1.8440	+1.8433	+3.0	— 6.5	388.0112
				+1.8397	—1.8456				
18	19	1.692	52.485	+2.0242	—2.0293	+2.0268	+5.1	— 1.4	390.0380
19	20	1.750	54.235	—0.2292	+0.2310	—0.2301	—1.8	— 3.2	389.8079
20	B_4	1.502	55.737	+1.4391	—1.4401	+1.4396	+1.0	— 2.2	391.2475
B_4	Sta. Assaria			+0.47					391.72
B_4	21	1.670	57.407	+1.3344	—1.3358	+1.3351	+1.4	— 0.8	392.5826
21	22	1.608	59.015	+1.1599	—1.1623	+1.1611	+2.4	+ 1.6	393.7437
22	23	1.476	60.491	+1.5777	—1.5760	+1.5768	—1.7	— 0.1	395.3205

* From B_1 at Abilene.

† From Appendix 8, Report for 1899, pages 477-489.

Results of precise leveling from Solomon to Anthony, Kans., 1900—Continued.

Bench marks.		Distance between successive bench marks.	Distance from bench mark B1 at Abilene, Kans.	Difference of elevation.			Discrepancy (B—F.)		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
23	C_4	1.132	61.623	+ 1.8303	— 1.8295	+ 1.8299	—0.8	— 0.9	397.1504
C_4	24	1.734	63.357	+ 1.4372	— 1.4348	+ 1.4360	—2.4	— 3.3	398.5864
24	25	1.653	65.010	+ 1.2540	— 1.2535	+ 1.2538	—0.5	— 3.8	399.8402
25	26	1.632	66.642	+ 0.8872	— 0.8844	+ 0.8858	—2.8	— 6.6	400.7260
26	27	1.642	68.284	+ 3.2508	— 3.2500	+ 3.2510	—3.2	— 9.8	403.9770
				+ 3.2545	— 3.2489				
27	D_4	1.641	69.925	+ 3.7298	— 3.7279	+ 3.7288	—1.9	—11.7	407.7058
D_4	Sta. Lindsborg			— 1.69					406.02
D_4	28	1.590	71.515	+ 0.7419	— 0.7379	+ 0.7399	—4.0	—15.7	408.4457
28	29	1.649	73.164	+ 4.6463	— 4.6426	+ 4.6444	—3.7	—19.4	413.0901
29	30	1.728	74.892	— 2.3240	+ 2.3251	— 2.3246	—1.1	—20.5	410.7655
30	31	1.642	76.534	+ 4.9451	— 4.9446	+ 4.9448	—0.5	—21.0	415.7130
31	32	1.370	77.904	+ 3.2804	— 3.2812	+ 3.2808	+0.8	—20.2	418.9911
32	E_4	1.150	79.054	+ 5.7957	— 5.7965	+ 5.7964	—2.1	—22.3	424.7875
				+ 5.7992	— 5.7941				
E_4	33	1.640	80.694	+12.5334	—12.5347	+12.5340	+1.3	—21.0	437.3215
33	34	1.202	81.896	+11.1066	—11.1066	+11.1066	0.0	—21.0	448.4281
34	35	1.726	83.622	+10.8650	—10.8653	+10.8652	+0.3	—20.7	459.2933
35	F_4	1.143	84.765	+ 3.9919	— 3.9936	+ 3.9928	+1.7	—19.0	463.2861
F_4	Sta. Hilton			+ 0.30					463.59
F_4	36	1.137	85.902	— 2.1866	+ 2.1819	— 2.1842	+4.7	—14.3	461.1019
				— 2.1867					
36	37	2.036	87.938	— 0.7654	+ 0.7637	— 0.7646	+1.7	—12.6	460.3373
37	38	1.644	89.582	— 0.5391	+ 0.5451	— 0.5421	—6.0	—18.6	459.7952
38	39	1.638	91.220	— 2.5881	+ 2.5925	— 2.5903	—4.4	—23.0	457.2049
39	G_4	1.702	92.922	— 0.8377	+ 0.8367	— 0.8372	+1.0	—22.0	456.3677
G_4	Sta. McPherson*			— 0.56					455.81
G_4	H_4	0.669	93.591	+ 0.3379	— 0.3377	+ 0.3378	—0.2	—22.2	456.7055
H_4	40	0.484	94.075	— 1.5057	+ 1.5047	— 1.5052	+1.0	—21.2	455.2003
40	Sta. McPherson†			+ 0.35					455.55
40	41	1.599	95.674	— 3.7847	+ 3.7806	— 3.7826	+4.1	—17.1	451.4177
41	I_4	0.764	96.438	+ 2.9478	— 2.9508	+ 2.9493	+3.0	—14.1	454.3670
I_4	42	1.616	98.054	+ 0.4142	— 0.4199	+ 0.4162	—0.3	—14.4	454.7832
				+ 0.4184	— 0.4121				
42	43	1.695	99.749	+ 0.4273	— 0.4277	+ 0.4254	+3.5	—10.9	455.2086
				+ 0.4200	— 0.4265				
43	44	1.642	101.391	— 1.3712	+ 1.3640	— 1.3700	+7.1	— 3.8	453.8386
				— 1.3758	+ 1.3687				
44	45	1.679	103.070	— 1.2015	+ 1.2052	— 1.2044	+3.5	— 0.3	452.6342
				— 1.2119‡	+ 1.2032				
				— 1.2108	+ 1.1996				
45	J_4	1.478	104.548	— 0.4300	+ 0.4309	— 0.4300	+2.1	+ 1.8	452.2042
				— 0.4319	+ 0.4269				

*Union Pacific Railroad.
†Chicago, Rock Island and Pacific Railroad.
‡Rejected.

Results of precise leveling from Solomon to Anthony, Kans., 1900—Continued.

Bench marks.		Distance between successive bench marks.	Distance from bench mark B_1 at Abilene, Kans.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
J_4	Sta. Groveland			+ 0.35					452.55
J_4	46	1.760	106.308	− 5.6368	+ 5.6362	− 5.6365	+0.6	+ 2.4	446.5677
46	47	1.750	108.058	− 0.6154	+ 0.6196	− 0.6175	−4.2	− 1.8	445.9502
47	48	1.730	109.788	+ 6.1606	− 6.1650	+ 6.1632	−0.7	− 2.5	452.1134
				+ 6.1664	− 6.1607				
48	49	1.693	111.481	+ 6.0762	− 6.0758	+ 6.0760	−0.4	− 2.9	458.1894
49	K_4	1.321	112.802	+ 5.1174	− 5.1199	+ 5.1178	+4.1	+ 1.2	463.3072
				+ 5.1143					
K_4	Sta. Inman			+ 0.57					463.88
K_4	50	1.829	114.631	− 6.3300	+ 6.3297	− 6.3298	+0.3	+ 1.5	456.9774
50	51	1.586	116.217	+ 2.6679	− 2.6722	+ 2.6700	+4.3	+ 5.8	459.6474
51	52	0.984	117.201	− 2.1961	+ 2.1924	− 2.1942	+3.7	+ 9.5	457.4532
52	53	1.676	118.877	+11.1943	−11.1982	+11.1962	+3.9	+13.4	468.6494
53	54	1.661	120.538	− 7.2025	+ 7.2019	− 7.1993	+0.6	+14.0	461.4501
				− 7.1967	+ 7.1962				
54	55	1.202	121.740	− 6.0297	+ 6.0328	− 6.0312	−3.1	+10.9	455.4189
55	L_4	1.092	122.832	− 4.7764	+ 4.7769	− 4.7766	−0.5	+10.4	450.6423
L_4	56	1.687	124.519	+ 6.4484	− 6.4513	+ 6.4498	+2.9	+13.3	457.0921
56	57	1.693	126.212	+13.6650	−13.6610	+13.6630	−4.0	+ 9.3	470.7551
57	58	1.643	127.855	+13.0761	−13.0757	+13.0770	−2.6	+ 6.7	483.8321
				+13.0805	−13.0938*				
58	59	1.498	129.353	+ 9.2940	− 9.2945	+ 9.2942	+0.5	+ 7.2	493.1263
59	60	1.625	130.978	−12.1444	+12.1418	−12.1431	+2.6	+ 9.8	480.9832
60	61	1.686	132.664	−13.5227	+13.5272	−13.5250	−4.5	+ 5.3	467.4582
61	62	1.530	134.194	− 1.6887	+ 1.6858	− 1.6872	+2.9	+ 8.2	465.7710
62	63	1.266	135.460	− 0.4501	+ 0.4484	− 0.4492	+1.7	+ 9.9	465.3218
63	M_4	1.687	137.147	+ 2.8193	− 2.8240	+ 2.8216	+4.7	+14.6	468.1434
M_4	64	1.822	138.969	− 2.0300	+ 2.0307	− 2.0318	+3.6	+18.2	466.1116
				− 2.0372	+ 2.0294				
64	N_4	0.704	139.673	+ 1.4045	− 1.4035	+ 1.4040	−1.0	+17.2	467.5156
N_4	O_4	0.558	140.231	− 0.9415	+ 0.9420	− 0.9418	−0.5	+16.7	466.5738
O_4	65	1.702	141.933	+ 2.2888	− 2.2868	+ 2.2878	−2.0	+14.7	468.8616
65	66	1.859	143.792	− 1.8690	+ 1.8704	− 1.8698	−1.6	+13.1	466.9918
					+ 1.8709				
66	67	1.704	145.496	+ 2.4530	− 2.4544	+ 2.4520	+4.4	+17.5	469.4438
				+ 2.4466	− 2.4540				
67	68	1.660	147.156	+ 0.9511	− 0.9478	+ 0.9494	−3.3	+14.2	470.3932
68	69	1.476	148.632	+ 1.0134	− 1.0171	+ 1.0146	+2.3	+16.5	471.4078
				+ 0.7804*	− 1.0143				
69	P_4	1.082	149.714	+ 0.8528	− 0.8499	+ 0.8514	−2.9	+13.6	472.2592
P_4	Sta. Fernie			+ 0.42					472.68
P_4	70	1.710	151.424	− 0.7688	+ 0.7651	− 0.7670	+3.7	+17.3	471.4922
70	71	1.586	153.010	+ 0.8865	− 0.8887	+ 0.8876	+2.2	+19.5	472.3798
71	Q_4	1.274	154.284	+ 2.5425	− 2.5423	+ 2.5424	−0.2	+19.3	474.9222
Q_4	Sta. Darlow			− 0.05					474.87
Q_4	72	1.691	155.975	+ 3.5222	− 3.5263	+ 3.5230	+5.1	+24.4	478.4452
				+ 3.5188	− 3.5248				

*Rejected.

Results of precise leveling from Solomon to Anthony, Kans., 1900—Continued.

Bench marks.		Distance between successive bench marks.	Distance from bench mark B_1 at Abilene, Kans.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
72	73	1.660	157.635	− 4.3967	+ 4.3943	− 4.3965	+4.0	+28.4	474.0487
				− 4.4003	+ 4.3947				
73	74	1.604	159.239	−10.9779	+10.9770	−10.9774	+0.9	+29.3	463.0713
74	75	1.768	161.007	−10.3318	+10.3312	−10.3315	+0.6	+29.9	452.7398
75	R_4	1.819	162.826	− 5.4674	+ 5.4670	− 5.4672	+0.4	+30.3	447.2726
R_4	Sta. Castleton			+ 0.33					447.60
R_4	76	1.180	164.006	− 0.5351	+ 0.5345	− 0.5348	+0.6	+30.9	446.7378
76	77	1.477	165.483	+10.6096	−10.6136	+10.6110	−1.2	+29.7	457.3488
				+10.6137	−10.6072				
77	78	1.644	167.127	+12.0155	−12.0190	+12.0172	+3.5	+33.2	469.3660
78	79	1.679	168.806	+ 3.8865	− 3.8886	+ 3.8876	+2.1	+35.3	473.2536
79	80	1.750	170.556	+ 4.8616	− 4.8623	+ 4.8620	+0.7	+36.0	478.1156
80	81	1.606	172.162	+ 2.2082	− 2.2053	+ 2.2068	−2.9	+33.1	480.3224
81	S_4	1.620	173.782	+ 0.1117	− 0.1097	+ 0.1107	−2.0	+31.1	480.4331
S_4	Sta. Pretty Prairie			− 0.62					479.81
S_4	T_4	1.109	174.891	+ 1.0945	− 1.0954	+ 1.0968	−2.5	+28.6	481.5299
				+ 1.1009	− 1.0964				
				+ 1.0985	− 1.0948				
S_4	82	1.730	175.512	− 8.1684	+ 8.1658	− 8.1671	+2.6	+33.7	472.2660
82	83	1.658	177.170	− 2.8365	+ 2.8341	− 2.8353	+2.4	+36.1	469.4307
83	84	1.609	178.779	− 3.2948	+ 3.2943	− 3.2946	+0.5	+36.6	466.1361
84	85	1.096	179.875	− 2.9049	+ 2.9027	− 2.9038	+2.2	+38.8	463.2323
85	U_4	0.943	180.818	+ 0.4554	− 0.4564	+ 0.4559	+1.0	+39.8	463.6882
U_4	Sta. Varner			+ 0.61					464.30
U_4	V_4	2.632	183.450	− 2.3953	+ 2.3998	− 2.3976	−4.5	+35.3	461.2906
V_4	Sta. Lashmet			+ 0.09					461.39
V_4	86	1.694	185.144	+14.6342	−14.6351	+14.6346	+0.9	+36.2	475.9252
86	87	1.666	186.810	+ 5.9267	− 5.9257	+ 5.9262	−1.0	+35.2	481.8514
87	88	1.682	188.492	+ 3.5136	− 3.5128	+ 3.5132	−0.8	+34.4	485.3646
88	89	1.610	190.102	− 9.6015	+ 9.5993	− 9.6004	+2.2	+36.6	475.7642
89	90	1.644	191.746	−10.9239	+10.9256	−10.9248	−1.7	+34.9	464.8394
90	91	1.480	193.226	− 5.9553	+ 5.9552	− 5.9552	+0.1	+35.0	458.8842
91	Sta. Kingman			+ 0.15					459.03
91	W_4	0.209	193.435	+ 1.8196	− 1.8207	+ 1.8202	+1.1	+36.1	460.7044
91	92	1.642	194.868	+ 2.1606	− 2.1606	+ 2.1606	0.0	+35.0	461.0448
92	93	1.716	196.584	+10.6227	−10.6260	+10.6244	+3.3	+38.3	471.6692
93	94	1.715	198.299	+16.8219	−16.8225	+16.8222	+0.6	+38.9	488.4914
94	95	1.669	199.968	+12.4665	−12.4688	+12.4676	+2.3	+41.2	500.9590

Results of precise leveling from Solomon to Anthony, Kans., 1900—Continued.

Bench marks.		Distance between successive bench marks.	Distance from bench mark B1 at Abilene, Kans.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
95	X_4	2.179	202.147	+ 4.4931	− 4.4897	+ 4.4914	−3.4	+37.8	505.4504
95	96	1.663	201.631	−12.2053	+12.2021	−12.2037	+3.2	+44.4	488.7553
96	97	1.668	203.299	+ 1.5870	− 1.5888	+ 1.5879	+1.8	+46.2	490.3432
97	Y_4	1.297	204.596	+ 6.4391	− 6.4382	+ 6.4386	−0.9	+45.3	496.7818
Y_4	Sta. Carvel			+ 0.53					497.31
Y_4	98	1.658	206.254	− 4.2314	+ 4.2323	− 4.2318	−0.9	+44.4	492.5500
98	99	1.605	207.859	+ 0.6827	− 0.6841	+ 0.6834	+1.4	+45.8	493.2334
99	100	1.603	209.462	+ 1.4348	− 1.4374	+ 1.4361	+2.6	+48.4	494.6695
100	101	1.204	210.666	− 3.8452 − 3.8460	+ 3.8445	− 3.8450	+1.1	+49.5	490.8245
101	Z_4	1.268	211.934	− 3.0593	+ 3.0619	− 3.0606	−2.6	+46.9	487.7639
Z_4	Sta. Basil			− 0.94					486.82
Z_4	102	1.636	213.570	−16.2257	+16.2245	−16.2251	+1.2	+48.1	471.5388
102	103	1.644	215.214	− 6.0152	+ 6.0129	− 6.0140	+2.3	+50.4	465.5248
103	104	1.660	216.874	−11.7472	+11.7453	−11.7462	+1.9	+52.3	453.7786
104	105	1.150	218.024	− 6.2784	+ 6.2774	− 6.2779	+1.0	+53.3	447.5007
105	A_5	1.430	219.454	− 6.1275 − 6.1234	+ 6.1244 + 6.1285	− 6.1259	−1.0	+52.3	441.3748
A_5	Sta. Rago			+ 0.40					441.77
A_5	106	1.676	221.130	+ 1.3061	− 1.3057	+ 1.3059	−0.4	+51.9	442.6807
106	107	1.642	222.772	+15.4358	−15.4396	+15.4377	+3.8	+55.7	458.1184
107	108	1.643	224.415	+15.9304	−15.9350	+15.9327	+4.6	+60.3	474.0511
108	109	1.641	226.056	+11.0094	−11.0136	+11.0115	+4.2	+64.5	485.0626
109	B_5	0.860	226.916	− 1.8557	+ 1.8549	− 1.8553	+0.8	+65.3	483.2073
B_5	Sta. Duquoin			− 0.72					482.49
B_5	110	1.662	228.578	− 3.0489	+ 3.0467	− 3.0478	+2.2	+67.5	480.1595
110	111	1.755	230.333	+ 0.0217	− 0.0264	+ 0.0240	+4.7	+72.2	480.1835
111	112	1.900	232.233	− 9.5813	+ 9.5839	− 9.5826	−2.6	+69.6	470.6009
112	113	1.646	233.879	−14.7973	+14.7954	−14.7964	+1.9	+71.5	455.8045
113	114	1.610	235.489	− 9.2944	+ 9.2914	− 9.2929	+3.0	+74.5	446.5116
114	115	1.754	237.243	− 7.9499	+ 7.9499	− 7.9499	0.0	+74.5	438.5617
115	116	0.790	238.033	− 2.6231	+ 2.6214	− 2.6222	+1.7	+76.2	435.9395
116	C_5	1.256	239.289	− 2.2174	+ 2.2148	− 2.2161	+2.6	+78.8	433.7234
116	117	1.792	239.825	− 1.4139	+ 1.4166	− 1.4152	−2.7	+73.5	434.5243
117	118	1.716	241.541	+ 2.4386	− 2.4389	+ 2.4388	+0.3	+73.8	436.9631
118	119	1.766	243.307	+ 0.3296	− 0.3318	+ 0.3307	+2.2	+76.0	437.2938
119	120	1.624	244.931	− 3.1504	+ 3.1531	− 3.1518	−2.7	+73.3	434.1420
120	D_5	1.001	245.932	− 1.0119	+ 1.0102	− 1.0110	+1.7	+75.0	433.1310
D_5	Sta. Ascot			+ 0.09					433.22
D_5	121	1.622	247.554	− 6.7292 − 6.7330	+ 6.7264 + 6.7258	− 6.7286	+5.0	+80.0	426.4024

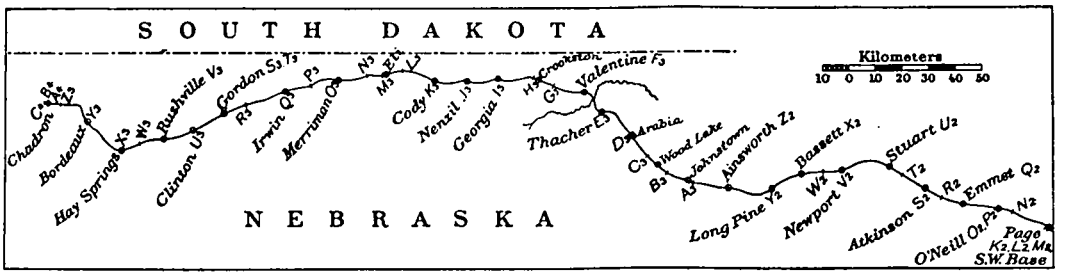
Results of precise leveling from Solomon to Anthony, Kans., 1900—Continued.

Bench marks.		Distance between successive bench marks.	Distance from bench mark B1 at Abilene, Kans.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
121	122	1.696	249.250	−6.5707 −6.5733	+6.5709 +6.5654	−6.5701	+3.8	+83.8	419.8323
122	123	1.440	250.690	+1.4199	−1.4192	+1.4196	−0.7	+83.1	421.2519
123	E_5	0.660	251.350	+1.3297 +1.3254	−1.3283 −1.3299	+1.3284	+1.5	+84.6	422.5803
E_5	Anthony S. E. B. △	1.009	252.359	−2.6456	+2.6444 +2.6473	−2.6457	−0.2	+84.4	419.9346
Anthony S. E. B. △	124	1.557	253.916	−6.9734	+6.9719	−6.9726	+1.5	+85.9	412.9620
124	125	0.860	254.776	−3.8708	+3.8725	−3.8716	−1.7	+84.2	409.0904
125	Sta. Anthony			+0.31					409.40
125	F_5	0.141	254.917	+1.0120 +1.0131	−1.0123	+1.0124	−0.3	+83.9	410.1028

PAGE–CHADRON LINE.

This line was run by O. E. Carr, Observer, and Aid G. E. Selby between July 13 and November 23, 1901. Level No. 8, one of the new type, was used, except for a few days during which it was sent to the Office at Washington, and new lines were placed in its diaphragm, the old ones having been accidentally broken. Level No. 6, one of the intermediate type, was used during these few days. This line forms a part of the

No. 12.



Leveling route, Page to Chadron, Nebr.

great circuit already named in connection with the line Norfolk–Page, of which the principal points are Norfolk, Orin Junction, Denver, Abilene, and Norfolk, and which will serve to carry completely checked elevations, depending upon the best grade of leveling as far west as Orin Junction, Cheyenne, and Denver. The leveling followed the line of the Fremont, Elkhorn and Missouri Valley Railroad, and velocipede cars were used over the whole line.

Rods V and W were used. Their lengths at 0° C., before and after the leveling, as determined at the Office of Standard Weights and Measures and National Bureau of Standards, respectively, were as follows:

	Rod V.	Rod W.
	m. mm.	*m. mm.*
January, 1901	3+1.56	3+1.96
March, 1902	3+1.18	3+1.63

The mean of all is $3^{m}+1^{mm}.58$, or an excess of length+0.53 millimeter per meter.

Field measurements of rods.

[Reduced to 20° C.]

Date.	Rod V.	Rod W.
1901.	*m.*	*m.*
July 13	3.0011	3.0020
Aug. 19	3.0009	3.0015
Sept. 3	3.0009	3.0012
20	3.0010	3.0017
30	3.0005	3.0008
Oct. 14	3.0008	3.0010
24	3.0008	3.0011
Nov. 8	3.0009	3.0012
18	3.0009	3.0013
23	3.0009	3.0012
1902.		
Mar. 18	3.0012	3.0017

The office measurements of the rods indicated that rod V shortened 0.38 millimeter, and rod W 0.33 millimeter, on the 3-meter interval, or an average of one-eighth millimeter per meter. The field measurements of the rods show a confused indication of this change. As the field measurements do not give sufficiently clear indication to decide upon the time of shortening, or whether it occurred slowly or suddenly, it was decided to use the mean of the four determinations of the rod lengths in computing the elevations, viz, an excess of length of 0.53 millimeter per meter. If the length of the rods in the interval between the two office determinations of their length never varied outside the range given by the two office measurements, the mean length used in the computation must have been correct at all times during the field season within one-sixteenth millimeter per meter. As the total range of elevation encountered during the season was from 600 to 1 180 meters (viz, 580 meters), the uncertainty in the elevations due to rod length is probably much less than 36 millimeters, this being the correction at the rate of one-sixteenth millimeter per meter on 580 meters. As it is probable that the rod changed in length gradually during the season, the uncertainty in the elevations is much less than 36 millimeters. The index corrections to the rods at the beginning of the season were, for rod V, —0.1 millimeter, and for rod W, —0.2 millimeter; in January, 1902, for rod V, —0.2 millimeter, and for rod W, —0.2 millimeter.

The elevations given in the tabulations are based upon those given by the line Norfolk–Page, which in turn are based upon the elevations for bench marks O_1 and P_1, at Norfolk, as printed in Appendix 8, Report for 1899. The elevations given in the tabulation for stations marked thus (Sta. Page) refer to the top of the rail in front of the station named.

Results of precise leveling from Page to Chadron, Nebr., 1901.

Bench marks.		Distance between successive bench marks.	Distance from T. B. M. 2. at Page.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
	Page S. W. B. △								626.7212*
Page S. W. B. △	M_2	0.080		— 0.5321	+ 0.5311	— 0.5316	—1.0		626.1896†
				—14.4198	+14.4193	—14.4196	+0.5		611.7700†
M_2	L_2	1.112							
Page S. W. B. △	1	0.824		— 4.7588	+ 4.7610 + 4.7595	— 4.7598	—1.4		621.9614
1	2	1.416		—13.4681	+13.4698 +13.4649‡	—13.4690	—1.7		608.4924
	K_2								596.7660*
K_2	Sta. Page	0.096		+ 0.50					597.27
K_2	2	1.663		+11.7227	—11.7245	+11.7236	+1.8		608.4896
	2		0.000					Mean =	608.4910
2	3	1.302	1.302	— 0.7435	+ 0.7462	— 0.7448	—2.7	— 2.7	607.7462
3	4	1.639	2.941	— 3.3788‡ — 3.3684	+ 3.3706 + 3.3698	— 3.3696	—1.8	— 4.5	604.3766
4	5	1.591	4.532	— 1.0937	+ 1.0984	— 1.0960	—4.7	— 9.2	603.2806
5	6	1.601	6.133	— 4.7109 — 4.7125	+ 4.7168 + 4.7184	— 4.7146	—5.9	—15.1	598.5660
6	7	1.816	7.949	— 3.1127 — 3.1023	+ 3.1092 + 3.0876‡	— 3.1081	—1.7	—16.8	595.4579
7	8	1.764	9.713	+ 0.0768 + 0.0796	— 0.0835 — 0.0767	+ 0.0792	+1.9	—14.9	595.5371
8	9	1.517	11.230	+ 0.8809	— 0.8821	+ 0.8815	+1.2	—13.7	596.4186
9	N_2	0.188	11.418	— 0.2685 — 0.2664	+ 0.2664 + 0.2678	— 0.2673	+0.3	—13.4	596.1513
9	10	1.609	12.839	+ 1.5482	— 1.5523	+ 1.5502	+4.1	— 9.6	597.9688
10	11	1.702	14.541	+ 0.2256 + 0.2280	— 0.2341 — 0.2310	+ 0.2297	+5.8	— 3.8	598.1985
11	12	1.994	16.535	+ 4.1669 + 4.1608	— 4.1594 — 4.1584	+ 4.1614	—4.9	— 8.7	602.3599
12	13	1.696	18.231	+ 0.0405	— 0.0397	+ 0.0401	—0.8	— 9.5	602.4000
12	Sta. O'Neill⁂	1.686	18.221	+ 0.59					602.95
13	O_2	0.450	18.681	+ 3.8808	— 3.8811	+ 3.8810	+0.3	— 9.2	606.2810

* From Norfolk to Page, 1900.
† Elevations from Norfolk to Page, 1900: $M_2 = 626.1960$; $L_2 = 611.7740$.
‡ Rejected.
⁂ Depot, Great Northern Railroad.

Results of precise leveling from Page to Chadron, Nebr., 1901—Continued.

Bench marks.		Distance between successive bench marks.	Distance from T. B. M. 2. at Page.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
O_2	P_2	0.182	18.863	+3.9658	−3.9675	+3.9666	+1.7	− 7.5	610.2476
13	14	1.153	19.384	+2.2434	−2.2444	+2.2439	+1.0	− 8.5	604.6439
14	Sta. O'Neill*	1.132	20.516	−2.17					602.47
14	15	1.652	21.036	+0.1901	−0.1901	+0.1901	0.0	− 8.5	604.8340
15	16	1.690	22.726	+2.8706	−2.8707	+2.8706	+0.1	− 8.4	607.7046
16	17	1.486	24.212	+2.0260	−2.0243	+2.0252	−1.7	−10.1	609.7298
17	18	1.664	25.876	+1.6720	−1.6749	+1.6734	+2.9	− 7.2	611.4032
18	19	1.664	27.540	+2.4311	−2.4331	+2.4321	+2.0	− 5.2	613.8353
19	20	1.558	29.098	+0.7910‡	−0.8050‡	+0.7988	−0.1	− 5.3	614.6341
				+0.7989	−0.7988				
20	21	1.299	30.397	+1.6779	−1.6857	+1.6827	+4.5	− 0.8	616.3168
				+1.6799	−1.6865				
				+1.6836	−1.6827				
21	Q_2	1.032	31.429	+0.5556	−0.5567	+0.5562	+1.1	+ 0.3	616.8730
Q_2	22	1.470	32.899	+1.2917	−1.2884	+1.2900	−3.3	− 3.0	618.1630
22	23	1.619	34.518	+1.8786	−1.8735	+1.8760	−5.1	− 8.1	620.0390
22	Sta. Emmet	1.331	34.230	−1.07					617.09
23	24	1.460	35.978	+2.4239	−2.4268	+2.4254	+2.9	− 5.2	622.4644
24	25	1.202	37.180	+3.1544	−3.1538	+3.1541	−0.6	− 5.8	625.6185
25	26	1.507	38.687	+2.1960	−2.1914	+2.1937	−4.6	−10.4	627.8122
26	27	1.187	39.874	+2.2857	−2.2821	+2.2839	−3.6	−14.0	630.0961
27	R_2	1.034	40.908	+0.1688	−0.1638	+0.1680	−3.3	−17.3	630.2641
				+0.1706	−0.1690				
R_2	28	1.733	42.641	+3.7299	−3.7374	+3.7341	+6.2	−11.1	633.9982
				+3.7322	−3.7369				
28	29	1.672	44.313	+4.9492	−4.9516	+4.9504	+2.4	− 8.7	638.9486
29	30	1.670	45.983	+2.8566	−2.8604	+2.8585	+3.8	− 4.9	641.8071
30	S_2	1.760	47.743	+1.7880	−1.7932	+1.7906	+5.2	+ 0.3	643.5977
30	Sta. Atkinson	1.815	47.798	+1.37					643.18
S_2	31	1.779	49.522	+1.4733	−1.4737	+1.4735	+0.4	+ 0.7	645.0712
31	32	1.541	51.063	+0.9322	−0.9260	+0.9302	−0.9	− 0.2	646.0014
				+0.9292	−0.9335				
32	33	1.666	52.729	−0.2621	+0.2689†	−0.2607	+1.4	+ 1.2	645.7407
				−0.2602	+0.2598				
33	34	1.614	54.343	+1.9368	−1.9337	+1.9352	−3.1	− 1.9	647.6759
34	35	1.722	56.065	+3.2738	−3.2726	+3.2732	−1.2	− 3.1	650.9491
35	36	1.486	57.551	+0.9709	−0.9669	+0.9689	−4.0	− 7.1	651.9180
36	T_2	1.421	58.972	+0.8970	−0.9001	+0.8986	+3.1	− 4.0	652.8166
T_2	37	1.637	60.609	+1.5975	−1.5991	+1.5983	+1.6	− 2.4	654.4149
37	38	1.481	62.090	+0.9180	−0.9228	+0.9204	+4.8	+ 2.4	655.3353
38	U_2	1.445	63.535	+2.3448	−2.3507	+2.3464	+1.4	+ 3.8	657.6817
				+2.3465	−2.3434				
U_2	39	1.548	65.083	+0.9020	−0.9063	+0.9042	+4.3	+ 8.1	658.5859
U_2	Sta. Stuart	0.455	63.990	−0.36					657.32
39	40	1.290	66.373	+1.8909†	−1.8653	+1.8671	−2.5	+ 5.6	660.4530
				+1.8688	−1.8673				

* Depot, Fremont, Elkhorn and Missouri Valley Railroad. † Rejected.

Results of precise leveling from Page to Chadron, Nebr., 1901—Continued.

Bench marks.		Distance between successive bench marks.	Distance from T. B. M. 2. at Page.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
40	41	1.612	67.985	+ 1.5486	— 1.5464	+ 1.5475	—2.2	+ 3.4	662.0005
41	42	1.617	69.602	+ 2.5897	— 2.5857	+ 2.5877	—4.0	+ 0.6	664.5882
42	43	1.648	71.250	+ 2.0997	— 2.0916	+ 2.0969	—4.6	— 5.2	666.6851
				+ 2.0987	— 2.0975				
43	44	1.723	72.973	+ 2.3423	— 2.3439	+ 2.3431	+1.6	— 3.6	669.0282
44	45	1.706	74.679	+ 3.3979	— 3.3976	+ 3.3978	—0.3	— 3.9	672.4260
45	46	1.572	76.251	+ 2.5481	— 2.5496	+ 2.5488	+1.5	— 2.4	674.9748
46	47	1.646	77.897	+ 2.7370	— 2.7355	+ 2.7362	—1.5	— 3.9	677.7110
47	48	1.532	79.429	+ 3.0190	— 3.0150	+ 3.0170	—4.0	— 7.9	680.7280
48	V_2	0.064	79.493	— 0.1167	+ 0.1174	— 0.1170	—0.7	— 8.6	680.6110
V_2	Sta. Newport	0.050	79.543	+ 0.42					681.03
V_2	49	1.587	81.080	+ 2.1160	— 2.1157	+ 2.1158	—0.3	— 8.9	682.7268
49	50	1.650	82.730	+ 6.9466	— 6.9417	+ 6.9442	—4.9	—13.8	689.6710
50	51	1.647	84.377	+ 2.1871	— 2.1917	+ 2.1894	+4.6	— 9.2	691.8604
51	52	1.591	85.968	+ 0.3818	— 0.3829	+ 0.3824	+1.1	— 8.1	692.2428
52	W_2	1.478	87.446	+ 1.7633	— 1.7657	+ 1.7645	+2.4	— 5.7	694.0073
W_2	53	1.841	89.287	+ 1.0091	— 1.0099	+ 1.0095	+0.8	— 4.9	695.0168
53	54	1.469	90.756	+ 1.9922	— 1.9962	+ 1.9942	+4.0	— 0.9	697.0110
54	55	1.469	92.225	+ 2.4671	— 2.4666	+ 2.4668	—0.5	— 1.4	699.4778
55	56	1.653	93.878	+ 2.4328	— 2.4346	+ 2.4337	+1.8	+ 0.4	701.9115
56	57	1.635	95.513	+ 2.0079	— 2.0080	+ 2.0080	+0.1	+ 0.5	703.9195
57	58	1.654	97.167	+ 4.3077	— 4.3122	+ 4.3080	+2.4	+ 2.9	708.2275
				+ 4.3059	— 4.3062				
58	X_2	0.248	97.415	+ 1.5143	— 1.5144	+ 1.5144	+0.1	+ 3.0	709.7419
58	59	1.653	98.820	+ 0.4243	— 0.4262	+ 0.4252	+1.9	+ 4.8	708.6527
59	Sta. Bassett	1.401	100.221	+ 0.28					708.93
59	60	1.672	100.492	+ 6.3412	— 6.3418	+ 6.3415	+0.6	+ 5.4	714.9942
60	61	1.653	102.145	+ 4.0114	— 4.0180	+ 4.0174	+3.5	+ 8.9	719.0116
				+ 4.0200	— 4.0203				
61	62	1.469	103.614	— 1.2948	+ 1.2952	— 1.2950	—0.4	+ 8.5	717.7166
62	63	1.653	105.267	+ 4.9332	— 4.9330	+ 4.9331	—0.2	+ 8.3	722.6497
63	64	1.671	106.938	+ 1.1003	— 1.0995	+ 1.0999	—0.8	+ 7.5	723.7496
64	65	1.462	108.400	+ 4.1351	— 4.1340	+ 4.1346	—1.1	+ 6.4	727.8842
65	66	1.707	110.107	+ 3.2288	— 3.2277	+ 3.2282	—1.1	+ 5.3	731.1124
66	67	0.881	110.988	— 0.6805	+ 0.6799	— 0.6802	+0.6	+ 5.9	730.4322
67	Y_2	1.208	112.196	+ 2.5379	— 2.5383	+ 2.5381	+0.4	+ 6.3	732.9703
Y_2	Sta. Long Pine.	0.050	112.246	— 0.59					732.38
Y_2	68	1.773	113.969	— 2.9932	+ 2.9975	— 2.9954	—4.3	+ 2.0	729.9749
68	69	1.579	115.548	+ 6.8431	— 6.8425	+ 6.8428	—0.6	+ 1.4	736.8177
69	70	1.542	117.090	+ 1.0795	— 1.0821	+ 1.0788	+2.4	+ 3.8	737.8965
				+ 1.0757	— 1.0780				
70	71	1.536	118.626	+ 2.4484	— 2.4473	+ 2.4478	—1.1	+ 2.7	740.3443
71	72	1.487	120.113	+ 3.5103	— 3.5075	+ 3.5089	—2.8	— 0.1	743.8532
72	73	1.633	121.746	+ 6.0362	— 6.0351	+ 6.0356	—1.1	— 1.2	749.8888
73	74	1.652	123.398	+10.4364	—10.4378	+10.4371	+1.4	+ 0.2	760.3259
74	75	1.652	125.050	+ 7.7585	— 7.7605	+ 7.7595	+2.0	+ 2.2	768.0854

Results of precise leveling from Page to Chadron, Nebr., 1901—Continued.

Bench marks.		Distance between successive bench marks.	Distance from T. B. M. 2. at Page.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
75	76	1.469	126.519	+0.3362	−0.3323	+0.3342	−3.9	−1.7	768.4196
76	77	1.082	127.601	+0.6285	−0.6291	+0.6287	+0.6	−1.1	769.0483
				+0.6285					
77	Z_2	0.052	127.653	+0.6385	−0.6369	+0.6384	−0.8	−1.9	769.6867
				+0.6391	−0.6391				
77	Sta. Ainsworth.	0.272	127.873	+0.46					769.51
77	78	1.823	129.424	+1.8775	−1.8762	+1.8768	−1.3	−2.4	770.9251
78	79	1.463	130.887	+7.6716	−7.6747	+7.6732	+3.1	+0.7	778.5983
79	80	1.651	132.538	+0.7812	−0.7846	+0.7829	+3.4	+4.1	779.3812
80	81	1.634	134.172	+3.8216	−3.8204	+3.8210	−1.2	+2.9	783.2022
81	82	1.654	135.826	+2.2005	−2.1989	+2.1997	−1.6	+1.3	785.4019
82	83	1.636	137.462	−1.6778	+1.6782	−1.6780	−0.4	+0.9	783.7239
83	84	1.619	139.081	+3.3852	−3.3836	+3.3844	−1.6	−0.7	787.1083
84	85	1.403	140.484	+2.6443	−2.6448	+2.6446	+0.5	−0.2	789.7529
85	A_3	0.039	140.523	+0.0832	−0.0835	+0.0834	+0.3	+0.1	789.8363
85	86	1.536	142.020	+0.1937	−0.1915	+0.1926	−2.2	−2.4	789.9455
86	87	1.868	143.888	+3.9848	−3.9875	+3.9862	+2.7	+0.3	793.9317
87	Sta. Johnstown.	0.135	144.023	−0.10					793.83
87	88	1.087	144.975	−5.0243	+5.0244	−5.0244	−0.1	+0.2	788.9073
88	89	1.652	146.627	+4.0331	−4.0346	+4.0338	+1.5	+1.7	792.9411
89	90	1.567	148.194	−1.4183	+1.4201	−1.4192	−1.8	−0.1	791.5219
90	91	1.653	149.847	+7.7328	−7.7291	+7.7310	−3.7	−3.8	799.2529
91	92	1.647	151.494	−4.9688	+4.9658	−4.9673	+3.0	−0.8	794.2856
92	93	1.645	153.139	+2.6520	−2.6475	+2.6498	−4.5	−5.3	796.9354
93	94	1.783	154.922	+9.2709	−9.2722	+9.2716	+1.3	−4.0	806.2070
94	B_3	1.597	156.519	+4.2473	−4.2435	+4.2454	−3.8	−7.8	810.4524
B_3	95	1.580	158.099	+4.6334	−4.6364	+4.6349	+3.0	−4.8	815.0873
95	96	1.706	159.805	+3.1428	−3.1450	+3.1439	+2.2	−2.6	818.2312
96	97	1.542	161.347	+1.2121	−1.2154	+1.2138	+3.3	+0.7	819.4450
97	Sta. Woodlake	0.197	161.544	+0.54					819.98
97	98	1.616	162.963	+0.8653	−0.8661	+0.8657	+0.8	+1.5	820.3107
98	99	1.704	164.667	+2.2378	−2.2359	+2.2368	−1.9	−0.4	822.5475
99	C_3	1.556	166.223	+1.6422	−1.6420	+1.6421	−0.2	−0.6	824.1896
C_3	100	1.576	167.799	+3.3464	−3.3475	+3.3470	+1.1	+0.5	827.5366
100	101	1.470	169.269	+0.1304	−0.1294	+0.1299	−1.0	−0.5	827.6665
101	102	1.668	170.937	+0.4446	−0.4441	+0.4444	−0.5	−1.0	828.1109
102	103	1.659	172.596	+0.6075	−0.6043	+0.6059	−3.2	−4.2	828.7168
103	104	1.670	174.266	+0.9941	−0.9943	+0.9942	+0.2	−4.0	829.7110
104	105	1.632	175.898	+0.6564	−0.6564	+0.6564	0.0	−4.0	830.3674
105	106	1.535	177.433	+1.1987	−1.2026	+1.2006	+3.9	−0.1	831.5680
106	Sta. Arabia.	0.863	178.296	−2.01					829.56
106	D_3	0.148	177.581	+0.3202	−0.3198	+0.3200	−0.4	−0.5	831.8880
106	107	1.773	179.206	−6.9342	+6.9309	−6.9326	+3.3	+3.2	824.6354

Results of precise leveling from Page to Chadron, Nebr., 1901—Continued.

Bench marks.		Distance between successive bench marks.	Distance from T. B. M. 2. at Page.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
107	108	1.463	180.669	— 0.2708	+ 0.2709	— 0.2708	—0.1	+ 3.1	824.3646
108	109	1.599	182.268	— 4.6037	+ 4.6081	— 4.6059	—4.4	— 1.3	819.7587
109	110	1.655	183.923	— 1.6862	+ 1.6846	— 1.6854	+1.6	+ 0.3	818.0733
110	111	1.651	185.574	— 3.4469	+ 3.4405	— 3.4433	+4.6	+ 4.9	814.6300
				— 3.4442	+ 3.4416				
111	112	1.469	187.043	— 3.0746	+ 3.0707	— 3.0726	+3.9	+ 8.8	811.5574
112	113	1.651	188.694	— 1.5483	+ 1.5407	— 1.5444	+4.5	+13.3	810.0130
				— 1.5449	+ 1.5435				
113	114	1.652	190.346	+ 1.9198	— 1.9181	+ 1.9190	—1.7	+11.6	811.9320
114	115	1.538	191.884	— 0.9562	+ 0.9532	— 0.9547	+3.0	+14.6	810.9773
115	E_3	0.450	192.334	— 1.3881	+ 1.3874	— 1.3878	+0.7	+15.3	809.5895
E_3	*Sta. Thacher	0.163	192.497	— 0.18					809.41
E_3	116	1.632	193.966	—13.1318	+13.1349	—13.1334	—3.1	+12.2	796.4561
116	117	1.536	195.502	—16.2667	+16.2721	—16.2692	—2.8	+ 9.4	780.1869
				—16.2659	+16.2740				
				—16.2707	+16.2656				
117	118	1.674	197.176	—20.3091	+20.3106	—20.3098	—1.5	+ 7.9	759.8771
118	119	1.266	189.442	— 0.3412	+ 0.3405	— 0.3408	+0.7	+ 8.6	759.5363
119	120	1.474	199.916	+17.3541†	—17.3450	+17.3459	+1.7	+10.3	776.8822
				+17.3448	— 17.3480				
120	121	1.292	201.208	+ 8.9813	— 8.9809	+ 8.9811	—0.4	+ 9.9	785.8633
121	122	1.250	202.458	+ 1.7969	— 1.7983	+ 1.7976	+1.4	+11.3	787.6609
122	Sta. Valentine	0.114	202.572	+ 0.05					787.71
122	F_3	0.526	202.984	+ 1.0030	— 1.0033	+ 1.0032	+0.3	+11.6	788.6641
122	123	1.632	204.090	+ 4.0476	— 4.0408	+ 4.0440	—1.2	+10.1	791.7049
				+ 4.0415	— 4.0461				
123	124	1.653	205.743	+ 3.4642	— 3.4687	+ 3.4664	+4.5	+14.6	795.1713
124	125	1.653	207.396	+ 5.4289	— 5.4369	+ 5.4337	+4.6	+19.2	800.6050
				+ 5.4340	— 5.4351				
125	126	1.653	209.049	+ 3.3903	— 3.3975	+ 3.3942	+2.2	+21.4	803.9992
				+ 3.3959	— 3.3931				
126	127	1.502	210.551	— 5.0568	+ 5.0659†	— 5.0563	+1.5	+22.9	798.9429
				— 5.0568	+ 5.0553				
127	128	1.303	211.854	— 7.0806	+ 7.0807	— 7.0806	—0.1	+22.8	791.8623
128	129	1.740	213.594	+ 3.2109	— 3.2052	+ 3.2052	—2.8	+20.0	795.0675
				+ 3.2022	— 3.2023				
129	G_3	0.888	214.482	+ 1.4788	— 1.4773	+ 1.4780	—1.5	+18.5	796.5455
G_3	130	1.543	216.025	+ 7.2512	— 7.2499	+ 7.2506	—1.3	+17.2	803.7961
130	131	1.620	217.645	+ 2.6021	— 2.5966	+ 2.5990	—2.4	+14.8	806.3951
				+ 2.5983	— 2.5989				
131	132	1.611	219.256	+ 5.9029†	— 5.8905	+ 5.8922	+0.8	+15.6	812.2873
				+ 5.8917	— 5.8945				
132	Sta. Crookston	1.583	220.839	+ 3.60					815.89
132	133	1.622	220.878	+ 3.8828	— 3.8841	+ 3.8834	+1.3	+16.9	816.1707
133	134	1.782	222.660	+ 8.8900	— 8.8942	+ 8.8921	+4.2	+21.1	825.0628
134	H_3	1.602	224.262	+ 5.4370	— 5.4364	+ 5.4367	—0.6	+20.5	830.4995

*In front of sign. †Rejected.

Results of precise leveling from Page to Chadron, Nebr., 1901—Continued.

Bench marks.		Distance between successive bench marks.	Distance from T. B. M. 2. at Page.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
H_3	135	1.618	225.880	+12.7599	−12.7630	+12.7614	+3.1	+23.6	843.2609
135	136	1.745	227.625	+ 8.6508	− 8.6468	+ 8.6488	−4.0	+19.6	851.9097
136	137	1.469	229.094	+ 9.8944	− 9.8940	+ 9.8942	−0.4	+19.2	861.8039
137	138	1.469	230.563	+ 6.6903	− 6.6871	+ 6.6887	−3.2	+16.0	868.4926
138	139	1.655	232.218	+ 9.0649	− 9.0683	+ 9.0666	+3.4	+19.4	877.5592
139	140	1.618	233.836	+ 0.4039	− 0.4075	+ 0.4057	+3.6	+23.0	877.9649
140	141	1.690	235.526	+ 5.6583	− 5.6570	+ 5.6576	−1.3	+21.7	883.6225
141	142	1.615	237.141	+ 3.6461	− 3.6475	+ 3.6468	+1.4	+23.1	887.2693
142	I_3	0.883	238.024	+ 1.9611	− 1.9587	+ 1.9599	−2.4	+20.7	889.2292
I_3	143	1.881	239.905	+14.8965	−14.9069*	+14.8964	−0.3	+20.4	904.1256
				+14.8805*	−14.8962				
143	Sta. Georgia†	1.530	241.435	−14.64					889.49
143	144	1.764	241.669	+ 8.8132	− 8.8091	+ 8.8112	−4.1	+16.3	912.9368
144	145	1.561	243.230	+10.2298	−10.2307	+10.2302	+0.9	+17.2	923.1670
145	146	1.614	244.844	+ 3.7006	− 3.7012	+ 3.7009	+0.6	+17.8	926.8679
146	147	1.615	246.459	+10.5549	−10.5606	+10.5567	+4.1	+21.9	937.4246
				+10.5544	−10.5568				
147	148	1.615	248.074	+15.8198	−15.8153	+15.8176	−4.5	+17.4	953.2422
148	149	1.818	249.892	− 2.4421	+ 2.4461	− 2.4441	−4.0	+13.4	950.7981
149	Sta. Nenzil	1.404	251.296	− 1.83					948.97
149	J_3	1.437	251.329	− 2.1009	+ 2.1004	− 2.1006	+0.5	+13.9	948.6975
J_3	150	1.393	252.722	+ 1.0213	− 1.0155	+ 1.0185	−3.3	+10.6	949.7160
				+ 1.0190	− 1.0183				
150	151	1.593	254.315	+ 8.8568	− 8.8586	+ 8.8577	+1.8	+12.4	958.5737
151	152	1.488	255.803	− 2.0900	+ 2.0859	− 2.0880	+4.1	+16.5	956.4857
152	153	1.524	257.327	− 2.3433	+ 2.3434	− 2.3434	−0.1	+16.4	954.1423
153	154	1.468	258.795	− 1.6504	+ 1.6491	− 1.6498	+1.3	+17.7	952.4925
154	155	1.763	260.558	+ 0.8135	− 0.8165	+ 0.8150	+3.0	+20.7	953.3075
155	156	1.544	262.102	− 6.1002	+ 6.0974	− 6.0988	+2.8	+23.5	947.2087
156	K_3	1.544	263.646	− 2.0183	+ 2.0129	− 2.0154	+4.0	+27.5	945.1933
				− 2.0166	+ 2.0139				
K_3	Sta. Cody	0.142	263.788	− 0.05					945.14
K_3	157	1.640	265.286	+ 0.3561	− 0.3589	+ 0.3575	+2.8	+30.3	945.5508
157	158	1.652	266.938	+ 3.9938	− 4.0008	+ 3.9988	+3.9	+34.2	949.5496
				+ 4.0000	− 4.0008				
158	159	1.597	268.535	+10.3714	−10.3706	+10.3710	−0.8	+33.4	959.9206
159	160	1.614	270.149	− 3.0897	+ 3.0844*	− 3.0908	+3.0	+36.4	956.8298
				− 3.0989*	+ 3.0919				
				− 3.0948	+ 3.0866				
160	161	1.669	271.818	+ 0.7270	− 0.7274	+ 0.7272	+0.4	+36.8	957.5570
161	162	1.616	273.434	− 0.3825	+ 0.3868	− 0.3846	−4.3	+32.5	957.1724
162	L_3	1.042	274.476	− 0.4238	+ 0.4269	− 0.4254	−3.1	+29.4	956.7470
L_3	163	1.566	276.042	+ 8.3424	− 8.3432	+ 8.3428	+0.8	+30.2	965.0898
163	164	1.653	277.695	− 0.0812	+ 0.0857	− 0.0834	−4.5	+25.7	965.0064
164	165	1.322	279.017	+ 5.6633	− 5.6635	+ 5.6622	−3.6	+22.1	970.6686
				+ 5.6647	− 5.6572				
165	166	1.780	280.797	+11.5530	−11.5558	+11.5544	+2.8	+24.9	982.2230

* Rejected. † In front of sign.

Results of precise leveling from Page to Chadron, Nebr., 1901—Continued.

Bench marks.		Distance between successive bench marks.	Distance from T. B. M. 2. at Page.	Difference of elevation			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
166	167	1.614	282.411	+ 1.9628	— 1.9650	+ 1.9639	+2.2	+27.1	984.1869
167	168	1.427	283.838	— 8.6095	+ 8.6071	— 8.6083	+2.4	+29.5	975.5786
168	169	1.607	285.445	— 2.4739	+ 2.4682	— 2.4725	+2.8	+32.3	973.1061
				— 2.4739	+ 2.4740				
169	Sta. Eli	0.108	285.553	+ 0.31					973.42
169	M_3	1.562	287.007	+ 8.6743	— 8.6729	+ 8.6736	—1.4	+30.9	981.7797
M_3	170	1.855	288.862	— 6.2916	+ 6.2876	— 6.2896	+4.0	+34.9	975.4901
170	171	1.617	290.479	— 7.8310	+ 7.8318	— 7.8314	—0.8	+34.1	967.6587
171	172	1.616	292.095	+ 2.7320	— 2.7309	+ 2.7314	—1.1	+33.0	970.3901
172	N_3	1.637	293.732	+ 3.5449	— 3.5430	+ 3.5440	—1.9	+31.1	973.9341
N_3	173	1.545	295.277	+ 3.7394	— 3.7369	+ 3.7382	—2.5	+28.6	977.6723
173	174	1.675	296.952	+ 2.7642	— 2.7663	+ 2.7652	+2.1	+30.7	980.4375
174	175	1.653	298.605	+ 2.9456	— 2.9454	+ 2.9455	—0.2	+30.5	983.3830
175	176	1.632	300.237	+ 4.2536	— 4.2492	+ 4.2514	—4.4	+26.1	987.6344
176	177	1.563	301.800	+ 0.6961	— 0.6960	+ 0.6960	—0.1	+26.0	988.3304
177	O_3	0.527	302.327	+ 0.7955	— 0.7968	+ 0.7962	+1.3	+27.3	989.1266
177	Sta. Merriman	1.855	303.655	+ 4.85					993.18
177	178	1.872	303.672	+ 4.4628	— 4.4663	+ 4.4646	+3.5	+29.5	992.7950
178	179	1.517	305.189	+ 4.4726	— 4.4771	+ 4.4748	+4.5	+34.0	997.2698
179	180	1.623	306.812	+ 4.4680	— 4.4727	+ 4.4704	+4.7	+38.7	1001.7402
180	181	1.622	308.434	+ 5.1877	— 5.1850	+ 5.1864	—2.7	+36.0	1006.9266
181	182	1.642	310.076	+ 7.0662	— 7.0710	+ 7.0686	+4.8	+40.8	1013.9952
182	183	1.611	311.687	+ 1.0986	— 1.1006	+ 1.0996	+2.0	+42.8	1015.0948
183	P_3	1.543	313.230	+ 1.0759	— 1.0753	+ 1.0756	—0.6	+42.2	1016.1704
P_3	184	1.708	314.938	+ 7.9301	— 7.9305	+ 7.9303	+0.4	+42.6	1024.1007
184	185	1.600	316.538	+ 1.3628	— 1.3615	+ 1.3622	—1.3	+41.3	1025.4629
185	186	1.654	318.192	+ 4.7209	— 4.7163	+ 4.7186	—4.6	+36.7	1030.1815
186	187	1.286	319.478	+ 5.1311	— 5.1361	+ 5.1320	+2.8	+39.5	1035.3135
				+ 5.1302	— 5.1306				
187	188	1.836	321.314	+ 6.0456	— 6.0510	+ 6.0483	+5.4	+44.9	1041.3618
188	189	1.653	322.967	+ 0.7605	— 0.7542	+ 0.7556	—2.2	+42.7	1042.1174
				+ 0.7530	— 0.7549				
189	190	1.818	324.785	— 1.6395	+ 1.6429	— 1.6412	—3.4	+39.3	1040.4762
190	Q_3	1.489	326.274	+ 8.2749	— 8.2707	+ 8.2728	—4.2	+35.1	1048.7490
Q_3	191	1.545	327.819	+ 4.7773	— 4.7824	+ 4.7797	+4.0	+39.1	1053.5287
				+ 4.7795	— 4.7707*				
191	Sta. Irwin	1.528	329.347	— 4.82					1048.71
191	192	1.554	329.373	+10.0202	—10.0236	+10.0219	+3.4	+42.5	1063.5506
192	193	1.616	330.989	+10.8777	—10.8829	+10.8802	+2.7	+45.2	1074.4308
				+10.8799	—10.8801				
193	194	1.615	332.604	+ 9.3247	— 9.3273	+ 9.3260	+2.6	+47.8	1083.7568
194	195	1.616	334.220	+ 6.1773	— 6.1755	+ 6.1764	—1.8	+46.0	1089.9332
195	196	1.544	335.764	— 3.7383	+ 3.7330	— 3.7364	+3.2	+49.2	1086.1968
				— 3.7377	+ 3.7367				
196	197	1.616	337.380	+ 9.3721	— 9.3721	+ 9.3721	0.0	+49.2	1095.5689
197	198	1.544	338.924	— 7.3144	+ 7.3066	— 7.3112	+4.4	+53.6	1088.2577
				— 7.3123	+ 7.3113				

*Rejected.

Results of precise leveling from Page to Chadron, Nebr., 1901—Continued.

Bench marks.		Distance between successive bench marks.	Distance from T. B. M. 2, at Page.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
198	R_3	1.307	340.231	— 7.1168	+ 7.1134	— 7.1151	+3.4	+57.0	1081.1426
R_3	199	0.474	340.705	+ 3.7247	— 3.7234	+ 3 7240	—1.3	+55.7	1084.8666
199	200	1.472	342.177	— 3.3393	+ 3.3414	— 3.3404	—2.1	+53.6	1081.5262
200	201	1.653	343.830	+ 3.6212	— 3.6265	+ 3.6209	+0.6	+54.2	1085.1471
				+ 3.6200	— 3.6160				
201	202	1.634	345.464	— 0.2590	+ 0.2595	— 0.2592	—0.5	+53.7	1084.8879
202	203	1.489	346.953	— 2.2579	+ 2.2581	— 2.2580	—0.2	+53.5	1082.6299
203	Sta. Gordon	1.648	348.601	+ 1.20					1083.83
203	S_3	1.619	348.572	+ 1.3407	— 1.3415	+ 1.3411	+0.8	+54.3	1083.9710
S_3	T_3	0.222.	348.794	+ 0.7660	— 0.7674	+ 0.7667	+1.4	+55.7	1084.7377
S_3	204	1.700	350.272	+ 7.9308	— 7.9317	+ 7.9312	+0.9	+55.2	1091.9022
204	205	1.655	351.927	+ 6.1269	— 6.1284	+ 6.1276	+1.5	+56.7	1098.0298
205	206	1.599	353.526	+ 9.7041	— 9.7080	+ 9.7060	+3.9	+60.6	1107.7358
206	207	1.544	355.070	+ 6.7673	— 6.7623	+ 6.7650	—0.1	+60.5	1114.5008
				+ 6.7628	— 6.7675				
207	208	1.544	356.614	+ 6.8961	— 6.8937	+ 6.8949	—2.4	+58.1	1121.3957
208	209	1.545	358.159	— 1.7438	+ 1.7473	— 1.7456	—3.5	+54.6	1119.6501
209	210	1.690	359.849	+ 8.3814	— 8.3774	+ 8.3794	—4.0	+50.6	1128.0295
210	U_3	0.517	360.366	+ 1.9301	— 1.9309	+ 1.9305	+0.8	+51.4	1129.9600
U_3	211	1.543	361.909	+ 9.0673	— 9.0684	+ 9.0678	+1.1	+52.5	1139.0278
211	Sta. Clinton	0.149	362.058	+ 0.38					1139.41
211	212	1.656	363.565	+10.1280	—10.1267	+10.1274	—1.3	+51.2	1149.1552
212	213	1.663	365.228	+ 4.0892	— 4.0881	+ 4.0889	—0.5	+50.7	1153.2441
					— 4.0893				
213	214	1.549	366.777	+ 4.9872*	— 4.9929*	+ 4.9778	+0.3	+51.0	1158.2219
				+ 4.9776	— 4.9779				
214	215	1.614	368.391	— 5.2395	+ 5.2426	— 5.2408	—2.2	+48.8	1152.9811
				— 5.2399	+ 5.2412				
215	216	1.544	369.935	— 7.1370	+ 7.1369	— 7.1370	+0.1	+48.9	1145.8441
216	217	1.544	371.479	— 3.9040	+ 3.9037	— 3.9038	+0.3	+49.2	1141.9403
217	V_3	1.115	372.594	— 1.4547	+ 1.4512	— 1.4530	+3.5	+52.7	1140.4873
V_3	Sta. Rushville	0.041	372.635	— 0.17					1140.32
V_3	218	1.558	374.152	— 2.7160	+ 2.7181	— 2.7170	—2.1	+50.6	1137.7703
218	219	1.663	375.815	— 5.4473†	+ 5.4562	— 5.4560	+0.6	+51.2	1132.3143
				— 5.4564	+ 5.4555				
219	220	1.217	377.032	+ 6.0018	— 6.0037	+ 6.0028	+1.9	+53.1	1138.3171
220	221	1.650	378.682	+ 3.9133	— 3.9154	+ 3.9144	+2.1	+55.2	1142.2315
221	222	1.555	380.237	+ 4.9826	— 4.9815	+ 4.9820	—1.1	+54.1	1147.2135
222	W_3	0.746	380.983	— 1.4777	+ 1.4795	— 1.4786	—1.8	+52.3	1145.7349
W_3	223	1.662	382.645	+ 9.5596	— 9.5557	+ 9.5576	—3.9	+48.4	1155.2925
223	224	1.566	384.211	+ 2.4751	— 2.4753	+ 2.4752	+0.2	+48.6	1157.7677
224	225	1.567	385.778	+ 6.7417	— 6.7443	+ 6.7430	+2.6	+51.2	1164.5107
225	226	1.629	387.407	— 1.6840	+ 1.6818	— 1.6829	+2.2	+53.4	1162.8278

*Rejected. ¦The rerunnings, agreeing with each other within the limit ($4^{mm}.0\sqrt{K}$) are accepted, being later and probably more reliable than the first two measures.

†Rejected.

Results of precise leveling from Page to Chadron, Nebr., 1901—Continued.

Bench marks.		Distance between successive bench marks.	Distance from T. B. M. 2. at Page.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
226	227	1.630	389.037	+ 1.6275	− 1.6246	+ 1.6260	−2.9	+50.5	1164.4538
227	228	1.630	390.667	+ 0.0783	− 0.0791	+ 0.0787	+0.8	+51.3	1164.5325
228	229	0.853	391.520	+ 1.7983	− 1.7959	+ 1.7971	−2.4	+48.9	1166.3296
229	X_3	0.560	392.080	+ 1.2338	− 1.2318	+ 1.2328	−2.0	+46.9	1167.5624
X_3	Sta. Hay Springs	0.030	392.110	+ 0.22					1167.78
X_3	230	1.665	393.745	+ 5.4277	− 5.4312	+ 5.4294	+3.5	+50.4	1172.9918
230	231	1.556	395.301	+14.8141	−14.8172	+14.8156	+3.1	+53.5	1187.8074
231	232	1.557	396.858	− 4.9340	+ 4.9382	− 4.9361	−4.2	+49.3	1182.8713
232	233	1.630	398.488	− 5.1257	+ 5.1275	− 5.1266	−1.8	+47.5	1177.7447
233	234	1.556	400.044	− 8.1858	+ 8.1894	− 8.1876	−3.6	+43.9	1169.5571
234	235	1.557	401.601	− 5.7754	+ 5.7742	− 5.7748	+1.2	+45.1	1163.7823
235	236	1.557	403.158	−11.0140	+11.0160	−11.0150	−2.0	+43.1	1152.7673
236	Y_3	1.824	404.982	−14.6569	+14.6624	−14.6596	−5.5	+37.6	1138.1077
Y_3	Sta. Bordeaux*	1.754	406.736	−11.79					1126.32
Y_3	237	1.632	406.614	−11.9883	+11.9891	−11.9887	−0.8	+36.8	1126.1190
237	238	1.557	408.171	−10.5788	+10.5798	−10.5793	−1.0	+35.8	1115.5397
238	239	1.555	409.726	− 9.7502	+ 9.7532	− 9.7517	−3.0	+32.8	1105.7880
239	240	1.557	411.283	−14.9212	+14.9136	−14.9161	+0.6	+33.4	1090.8719
				−14.9117	+14.9180				
240	241	1.630	412.913	−13.1569	+13.1606	−13.1588	−3.7	+29.7	1077.7131
241	242	1.556	414.469	−14.4441	+14.4448	−14.4444	−0.7	+29.0	1063.2687
242	243	1.533	416.002	− 9.4447	+ 9.4369	− 9.4410	+2.5	+31.5	1053.8277
				− 9.4399	+ 9.4427				
243	244	1.557	417.559	−10.1124	+10.1068	−10.1120	+3.7	+35.2	1043.7157
				−10.1154	+10.1135				
244	Z_3	1.909	419.468	− 9.8731	+ 9.8732	− 9.8732	−0.1	+35.1	1033.8425
Z_3	245	1.780	421.248	− 2.5605	+ 2.5563	− 2.5584	+4.2	+39.3	1031.2841
245	246	1.228	422.476	− 3.8854†	+ 3.8749	− 3.8748	−1.4	+37.9	1027.4093
				− 3.8738	+ 3.8756				
246	Sta. Chadron	1.822	424.298	+ 0.02					1027.43
246	A_4	1.763	424.239	+ 0.2678	− 0.2714	+ 0.2696	+3.6	+41.5	1027.6789
A_4	B_4	0.672	424.911	+ 6.9288	− 6.9287	+ 6.9285	+0.3	+41.8	1034.6074
				+ 6.9281					
A_4	C_4	1.516	425.755	− 9.7983	+ 9.7974	− 9.7978	+0.9	+42.4	1017.8811

* In front of sign. † Rejected.

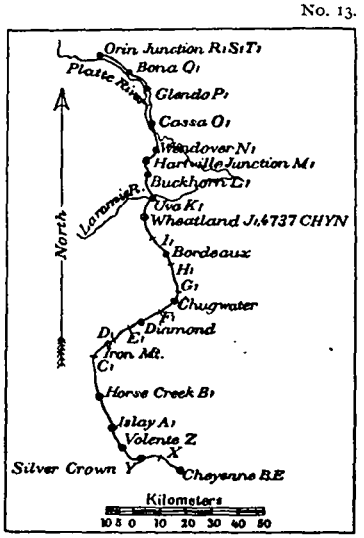
CHEYENNE–ORIN JUNCTION LINE.

This line of levels was run by Aid W. C. Dibrell, between July 31 and October 15, 1901, with level No. 7, one of the new type. This line forms a part of the great circuit already named in connection with the line Norfolk–Page, and of which the principal points are Norfolk, Orin Junction, Denver, Abilene, and Norfolk. The line follows the Colorado and Southern Railroad. Velocipede cars were used over the whole line. The party lived in tents, but secured their meals elsewhere. Rods R_2 and S were used until August 21. On that date rod T was substituted for rod S, the graduation upon rod S having become indistinct.

The lengths of the rods at 0° C. before and after leveling, as determined at the Office of Standard Weights and Measures, were as follows:

	Rod R_2.	Rod S.	Rod T.
	m. mm.	*m. mm.*	*m. mm.*
January 22, 1901	3 +0.99	3 +1.36	3 +1.36
March 26, 1902	3 +0.86	3 +1.39	3 +1.24

No. 13.



Leveling route, Cheyenne to Orin Junction, Wyo.

The mean of the four measures of rods R_2 and S is $3^m+1^{mm}.15$, or an excess of length of 0.38 millimeter per meter. The mean of the four measures of rods R_2 and T is $3^m+1^{mm}.11$, or an excess of length of 0.37 millimeter per meter.

The lengths of the 3-meter interval on the rods as measured in the field are shown below. The measurements made on and after October 24 were made in Alabama and Mississippi, on the Corinth–Decatur line, with the same tape that had been used in Wyoming.

Field measurements of rods.

Reduced to 20° C.

Date.	Rod R_2.	Date.	Rod S.	Date.	Rod T.
1901.	*m.*	1901.	*m.*	1901.	*m.*
July 30	3.0011	July 30	3.0017	Aug. 22	3.0022
Aug. 13	3.0011	Aug. 13	3.0017	Sept. 12	3.0016
Sept. 12	3.0009			30	3.0012
30	3.0005	1902.		Oct. 7	3.0013
Oct. 7	3.0009	Jan. 6	3.0020	14	3.0016
14	3.0012			15	3.0015
15	3.0012			24	3.0017
24	3.0013			28	3.0015
28	3.0010			Nov. 2	3.0015
Nov. 2	3.0013			12	3.0017
12	3.0013			18	3.0014
18	3.0009			24	3.0013
24	3.0010			Dec. 3	3.0016
Dec. 3	3.0012			10	3.0016
10	3.0009				
1902.				1902.	
Jan. 6	3.0014			Jan. 6	3.0018

The office measurements of the rods show but slight changes in lengths. The field measurements show no variations except those which may be accounted for as errors of measurement, with the possible exception of the measurement of rod T on August 22. This measurement was apparently subject to some large error. The evidence as a whole, therefore, indicates that the rods held a constant length with sufficient accuracy throughout the season. In making the computation the mean of the four measurements of R_2 and S was used up to and including August 21, viz, $3^m+1^{mm}.15$, or 0.38 millimeter excess of length per meter. During the remainder of the field season the mean of the four measures of R_2 and T, $3^m+1^{mm}.11$, an excess of length of 0.37 millimeter per meter, was used. This latter correction was also used in computing the line Decatur–Corinth, run immediately after the completion of the line Cheyenne–Orin Junction.

The index corrections to the rods in January, 1901, were: For rod R_2, —0.2 millimeter; for rod T, —0.5 millimeter; for rod S, —0.6 millimeter; and in January, 1902, for rod R_2, —0.2 millimeter; for rod S, —0.6 millimeter, and for rod T, —0.6 millimeter.

The elevations given in the following tabulation are based upon those printed for bench marks B and E at Cheyenne, in Appendix 8 of 1899. The elevations given in the tabulations for stations marked thus: (Sta. Silver Crown) refer to the top of rail in front of the railroad station named.

Results of precise leveling from Cheyenne to Orin Junction, Wyo., 1901.

Bench marks.		Distance between successive bench marks.	Distance from T. B. M. 1. at Cheyenne.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
	B								*1847.7840
	E								*1859.1694
B	1	1.832		+ 6.0900	— 6.0920	+ 6.0910	+2.0		1853.8750
E	1	0.860		— 5.2972	+ 5.2969	— 5.2970	+0.3		1853.8724
	1		0.000					Mean=	1853.8737
1	2	1.611	1.611	+ 7.1638	— 7.1649	+ 7.1662	—0.8	— 0.8	1861.0399
				+ 7.1693	— 7.1667				
				+ 7.1574†					
2	3	1.656	3.267	+12.7542	—12.7544	+12.7543	+0.2	— 0.6	1873.7942
3	4	1.552	4.819	+10.7340	—10.7350	+10.7345	+1.0	+ 0.4	1884.5287
4	5	1.587	6.406	+ 8.4747	— 8.4733	+ 8.4740	—1.4	— 1.0	1893.0027
5	6	1.582	7.988	+ 9.6675	— 9.6664	+ 9.6670	—1.1	— 2.1	1902.6697
6	7	1.613	9.601	+ 9.7346	— 9.7304	+ 9.7325	—4.2	— 6.3	1912.4022
7	8	1.702	11.303	+ 8.7765	— 8.7781	+ 8.7773	+1.6	— 4.7	1921.1795
8	X	1.043	12.346	— 5.0007	+ 5.0053	— 5.0018	—4.9	— 9.6	1916.1777
				— 4.9979	+ 5.0032				
X	9	0.572	12.918	— 2.4312	+ 2.4341	— 2.4318	—3.6	—13.2	1913.7459
				— 2.4287	+ 2.4331				
9	10	1.576	14.494	+ 6.3920	— 6.3939	+ 6.3934	—2.5	—15.7	1920.1393
				+ 6.3971	— 6.3903				

*See Appendix 8, Report for 1899, pages 488 and 489. †Rejected.

Results of precise leveling from Cheyenne to Orin Junction, Wyo., 1901—Continued.

Bench marks.		Distance between successive bench marks.	Distance from T. B. M. 1. at Cheyenne.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
10	11	1.490	15.984	+ 8.4751	— 8.4740	+ 8.4746	—1.1	—16.8	1928.6139
11	12	1.637	17.621	+ 9.7504	— 9.7528	+ 9.7516	+2.4	—14.4	1938.3655
12	Y	1.787	19.408	+13.6488	—13.6472	+13.6480	—1.6	—16.0	1952.0135
Y	Sta. Silver Crown	0.106	19.514	— 1.14					1950.87
Y	13	1.412	20.820	+ 8.6299	— 8.6303	+ 8.6301	+0.4	—15.6	1960.6436
13	14	1.594	22.414	+14.2651	—14.2637	+14.2644	—1.4	—17.0	1974.9080
14	15	1.599	24.013	+16.4679	—16.4654	+16.4666	—2.5	—19.5	1991.3746
15	16	1.592	25.605	+15.2707	—15.2708	+15.2708	+0.1	—19.4	2006.6454
16	17	1.608	27.213	+12.7203	—12.7235	+12.7219	+3.2	—16.2	2019.3673
17	18	1.600	28.813	+14.1223	—14.1197	+14.1210	—2.6	—18.8	2033.4883
18	19	1.600	30.413	+14.2792	—14.2786	+14.2789	—0.6	—19.4	2047.7672
19	Z	1.606	32.019	+10.2027	—10.2073	+10.2050	+4.6	—14.8	2057.9722
Z	20	1.598	33.617	+11.4185	—11.4162	+11.4174	—2.3	—17.1	2069.3896
20	21	1.600	35.217	—11.6932	+11.6948	—11.6940	—1.6	—18.7	2057.6956
21	22	1.630	36.847	— 7.5326	+ 7.5324	— 7.5325	+0.2	—18.5	2050.1631
22	23	1.590	38.437	— 3.7514	+ 3.7537	— 3.7526	—2.3	—20.8	2046.4105
23	A_1	0.854	39.291	— 2.0149	+ 2.0138	— 2.0144	+1.1	—19.7	2044.3961
A_1	24	0.754	40.045	+ 0.7405	— 0.7360	+ 0.7371	—3.8	—23.5	2045.1332
				+'0.7374	— 0.7345.				
24	Sta. Islay	0.385	40.430	— 0.09					2045.04
24	25	1.614	41.659	— 0.9899	+ 0.9889	— 0.9894	+1.0	—22.5	2044.1438
25	26	1.566	43.225	+12.4209	—12.4192	+12.4200	—1.7	—24.2	2056.5638
26	27	1.626	44.851	— 5.6528	+ 5.6525	— 5.6526	+0.3	—23.9	2050.9112
27	28	1.600	46.451	—14.7179	+14.7106	—14.7130	+4.7	—19.2	2036.1982
				—14.7127	+14.7106				
28	29	1.572	48.023	—14.5804	+14.5774	—14.5789	+3.0	—16.2	2021.6193
29	30	1.610	49.633	—14.3225	+14.3196	—14.3210	+2.9	—13.3	2007.2983
30	31	1.600	51.233	—16.0931	+16.1039	—16.0983	—4.0	—17.3	1991.2000
				—16.0995	+16.0967				
31	Sta. Horse Creek	0.851	52.084	— 3.50					1987.70
31	B_1	1.714	52.947	— 5.2465	+ 5.2517	— 5.2489	—3.0	—20.3	1985.9511
				— 5.2483	+ 5.2492				
B_1	32	1.448	54.395	+ 7.4410	— 7.4425	+ 7.4418	+1.5	—18.8	1993.3929
32	33	1.616	56.011	+13.3907	—13.3888	+13.3898	—1.9	—20.7	2006.7827
33	34	1.614	57.625	+13.7809	—13.7835	+13.7822	+2.6	—18.1	2020.5649
34	35	1.618	59.243	+13.2973	—13.2926	+13.2950	—4.7	—22.8	2033.8599
35	36	1.597	60.840	+14.0069	—14.0045	+14.0057	—2.4	—25.2	2047.8656
36	Sta. Altus	0.088	60.928	+1.28					2049.15
36	37	1.600	62.440	—12.9529	+12.9556	—12.9542	—2.7	—27.9	2034.9114
37	38	1.598	64.038	—24.6440	+24.6380	—24.6434	+1.6	—26.3	2010.2680
				—24.6445	+24.6472				
38	C_1	1.588	65.626	—25.7300	+25.7242	—25.7283	—0.2	—26.5	1984.5397
				—25.7265	+25.7325				
C_1	39	1.548	67.174	—23.6362	+23.6311	—23.6336	+5.1	—21.4	1960.9061
39	40	1.656	68.830	—26.3247	+26.3256	—26.3252	—0.9	—22.3	1934.5809

Results of precise leveling from Cheyenne to Orin Junction, Wyo., 1901—Continued.

Bench marks.		Distance between successive bench marks.	Distance from T. B. M. 1. at Cheyenne.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
40	41	1.581	70.411	−16.8729 −16.8742	+16.8778 +16.8718	−16.8742	−1.2	−23.5	1917.7067
41	Sta. Iron Mountain	1.256	71.667	−9.61					1908.10
41	42	1.628	72.039	−14.3664	+14.3715	−14.3690	−5.1	−28.6	1903.3377
42	43	1.556	73.595	−12.4150	+12.4176	−12.4163	−2.6	−31.2	1890.9214
43	D_1	1.948	75.543	−18.2890 −18.2938	+18.2968 +18.2896	−18.2923	−1.8	−33.0	1872.6291
D_1	44	1.310	76.853	−12.4973 −12.5040	+12.5058 +12.5060	−12.5033	−5.3	−38.3	1860.1258
44	45	1.629	78.482	−15.6439	+15.6460	−15.6450	−2.1	−40.4	1844.4808
45	46	1.554	80.036	−13.9522	+13.9551	−13.9536	−2.9	−43.3	1830.5272
46	Sta. Shultz Spur	0.999	81.035	−5.44					1825.09
46	47	1.608	81.644	−10.6538	+10.6542	−10.6540	−0.4	−43.7	1819.8732
47	48	1.600	83.244	−12.4348	+12.4345	−12.4346	+0.3	−43.4	1807.4386
48	49	1.628	84.872	−10.4564	+10.4541	−10.4552	+2.3	−41.1	1796.9834
49	50	1.600	86.472	−11.5592	+11.5647	−11.5620	−5.5	−46.6	1785.4214
50	51	1.607	88.079	−12.7850	+12.7861	−12.7856	−1.1	−47.7	1772.6358
51	E_1	1.088	89.167	−8.1363 −8.1345	+8.1307 +8.1312	−8.1332	+4.4	−43.3	1764.5026
E_1	52	2.130	91.297	−18.0544	+18.0546	−18.0545	−0.2	−43.5	1746.4481
52	53	1.548	92.845	−12.2887	+12.2918	−12.2902	−3.1	−46.6	1734.1579
53	Sta. Diamond	1.346	94.191	−6.75					1727.41
53	54	1.610	94.455	−9.3074	+9.3112	−9.3093	−3.8	−50.4	1724.8486
54	55	1.620	96.075	−11.1286	+11.1284	−11.1285	+0.2	−50.2	1713.7201
55	56	1.638	97.713	−11.2053	+11.2064	−11.2058	−1.1	−51.3	1702.5143
56	57	1.575	99.288	−12.5450	+12.5475	−12.5462	−2.5	−53.8	1689.9681
57	58	1.599	100.887	−11.6712	+11.6757	−11.6734	−4.5	−58.3	1678.2947
58	F_1	1.555	102.442	−9.4700	+9.4715	−9.4708	−1.5	−59.8	1668.8239
F_1	59	1.607	104.049	−13.5980	+13.5963	−13.5972	+1.7	−58.1	1655.2267
59	60	1.592	105.641	−8.8309	+8.8301	−8.8305	+0.8	−57.3	1646.3962
60	61	1.566	107.207	−10.4104	+10.4125	−10.4114	−2.1	−59.4	1635.9848
61	62	1.612	108.819	−11.6945	+11.6927	−11.6936	+1.8	−57.6	1624.2912
62	63	1.612	110.431	−8.5055	+8.5024	−8.5040	+3.1	−54.5	1615.7872
63	Sta. Chugwater	0.960	111.391	−3.37					1612.42
63	64	1.598	112.029	−7.5840	+7.5850	−7.5845	−1.0	−55.5	1608.2027
64	65	1.617	113.646	−10.7244 −10.7236	+10.7312 +10.7257	−10.7262	−4.4	−59.9	1597.4765
65	G_1	1.593	115.239	−11.1145 −11.1169	+11.1193 +11.1177	−11.1171	−2.8	−62.7	1586.3594
G_1	66	1.594	116.833	−11.7617	+11.7647	−11.7632	−3.0	−65.7	1574.5962
66	67	1.580	118.413	−8.1282	+8.1307	−8.1294	−2.5	−68.2	1566.4668
67	68	1.616	120.029	−11.3347 −11.3350	+11.3417 +11.3338	−11.3363	−3.0	−71.2	1555.1305
68	69	1.600	121.629	−8.7414	+8.7417	−8.7416	−0.3	−71.5	1546.3889
69	70	1.628	123.257	−9.5083	+9.5036	−9.5060	+4.7	−66.8	1536.8829

Results of precise leveling from Cheyenne to Orin Junction, Wyo., 1901—Continued.

Bench marks.		Distance between successive bench marks.	Distance from T. B. M. 1. at Cheyenne.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
70	71	1.578	124.835	−10.2481	+10.2508	−10.2494	−2.7	−69.5	1526.6335
71	72	1.550	126.385	− 7.4754	+ 7.4785	− 7.4770	−3.1	−72.6	1519.1565
72	H_1	2.013	128.398	−10.4499	+10.4467	−10.4483	+3.2	−69.4	1508.7082
H_1	73	1.234	129.632	− 8.5999	+ 8.5991	− 8.5995	+0.8	−68.6	1500.1087
73	74	1.592	131.224	− 7.4612	+ 7.4598	− 7.4605	+1.4	−67.2	1492.6482
74	75	1.610	132.834	− 8.1163	+ 8.1143	− 8.1153	+2.0	−65.2	1484.5329
75	Sta. Bordeaux	0.547	133.381	− 2.05					1482.48
75	76	1.571	134.405	− 9.8818	+ 9.8858	− 9.8838	−4.0	−69.2	1474.6491
76	77	1.645	136.050	− 6.1058	+ 6.1079	− 6.1068	−2.1	−71.3	1468.5423
77	78	1.513	137.563	− 6.2326	+ 6.2391	− 6.2343	−5.4	−76.7	1462.3080
				− 6.2305	+ 6.2349				
78	79	1.668	139.231	−12.2669	+12.2725	−12.2695	−3.3	−80.0	1450.0385
				−12.2688	+12.2697				
79	I_1	1.649	140.880	− 9.5057	+ 9.5011	− 9.5034	+4.6	−75.4	1440.5351
I_1	80	1.592	142.472	+ 0.1288	− 0.1324	+ 0.1306	+3.6	−71.8	1440.6657
80	81	1.569	144.041	+14.9364	−14.9327	+14.9346	−3.7	−75.5	1455.6003
81	82	1.618	145.659	+14.1223	−14.1248	+14.1236	+2.5	−73.0	1469.7239
82	83	1.582	147.241	+ 8.5918	− 8.5956	+ 8.5937	+3.8	−69.2	1478.3176
83	84	1.596	148.837	−11.6881	+11.6834	−11.6858	+4.7	−64.5	1466.6318
84	85	1.644	150.481	−13.8319	+13.8311	−13.8315	+0.8	−63.7	1452.8003
85	Sta. Wheatland	1.376	151.857	− 8.47					1444.33
85	4737 Chyn	1.386	151.867	− 9.3773	+ 9.3746	− 9.3760	+2.7	−61.0	1443.4243
4737 Chyn	J_1	0.112	151.979	+ 1.8397	− 1.8391	+ 1.8394	−0.6	−61.6	1445.2637
J_1	86	0.114	152.093	− 2.7903	+ 2.7904	− 2.7904	−0.1	−61.7	1442.4733
86	87	1.548	153.641	−12.8195	+12.8188	−12.8192	+0.7	−61.0	1429.6541
87	88	1.636	155.277	−12.4252	+12.4271	−12.4262	−1.9	−62.9	1417.2279
88	89	1.634	156.911	−14.4801	+14.4824	−14.4812	−2.3	−65.2	1402.7467
89	90	1.546	158.457	−12.9398	+12.9420	−12.9409	−2.2	−67.4	1389.8058
90	91	1.681	160.138	−13.5349	+13.5360	−13.5354	−1.1	−68.5	1376.2704
91	92	1.486	161.624	−13.0432	+13.0410	−13.0421	+2.2	−66.3	1363.2283
92	K_1	1.680	163.304	− 0.5369	+ 0.5346	− 0.5358	+2.3	−64.0	1362.6925
K_1	Sta. Ura	0.046	163.350	− 0.10					1362.59
K_1	93	1.548	164.852	+ 4.1541	− 4.1541	+ 4.1541	0.0	−64.0	1366.8466
93	94	1.702	166.554	+ 9.8660	− 9.8715	+ 9.8688	+5.5	−58.5	1376.7154
94	95	1.556	168.110	+ 7.8045	− 7.8124	+ 7.8078	+6.4	−52.1	1384.5232
				+ 7.8048	− 7.8095				
95	96	1.484	169.594	+10.7772	−10.7789	+10.7780	+1.7	−50.4	1395.3012
96	97	1.636	171.230	+12.8432*	−12.8530	+12.8531	−0.4	−50.8	1408.1543
				+12.8534	−12.8530				
97	98	1.632	172.862	+ 9.9186	− 9.9192	+ 9.9189	+0.6	−50.2	1418.0732
98	99	1.572	174.434	+13.7558	−13.7554	+13.7556	−0.4	−50.6	1431.8288
99	L_1	1.124	175.558	+14.4811	−14.4814	+14.4812	+0.3	−50.3	1446.3100
L_1	99a	0.088	175.646	+ 0.1570	− 0.1570	+ 0.1570	0.0	−50.3	1446.4670
99a	100	1.496	177.142	+14.8236	−14.8259	+14.8248	+2.3	−48.0	1461.2918
100	Sta. Buckhorn	1.408	178.550	+12.09					1473.38
100	101	1.589	178.731	+11.8493	−11.8480	+11.8486	−1.3	−49.3	1473.1404

*Rejected.

Results of precise leveling from Cheyenne to Orin Junction, Wyo., 1901—Continued.

Bench marks.		Distance between successive bench marks.	Distance from T. B. M. 1. at Cheyenne.	Difference of elevation.			Discrepancy. (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
101	102	1.598	180.329	−14.5793	+14.5777	−14.5785	+1.6	−47.7	1458.5619
102	103	1.649	181.978	−15.3718	+15.3721	−15.3720	−0.3	−48.0	1443.1899
103	104	1.529	183.507	−14.9559	+14.9563	−14.9561	−0.4	−48.4	1428.2338
104	105	1.655	185.162	−13.4265	+13.4262	−13.4264	+0.3	−48.1	1414.8074
105	106	1.508	186.670	−11.4666	+11.4640	−11.4653	+2.6	−45.5	1403.3421
106	Sta. Hartville Junction	1.063	187.733	− 7.16					1396.18
106	M_1	1.472	188.142	− 9.1935	+ 9.1951	− 9.1943	−1.6	−47.1	1394.1478
M_1	107	1.720	189.862	−15.3394	+15.3324	−15.3359	+7.0	−40.1	1378.8119
107	108	1.666	191.528	−10.2291	+10.2301	−10.2296	−1.0	−41.1	1368.5823
108	Sta. Badger	0.646	192.174	− 4.14					1364.44
108	N_1	2.032	193.560	−13.0116	+13.0103	−13.0110	+1.3	−39.8	1355.5713
N_1	Sta. Wendover	0.223	193.783	− 1.16					1354.41
N_1	109	1.156	194.716	− 1.9361	+ 1.9380	− 1.9370	−1.9	−41.7	1353.6343
109	110	1.586	196.302	+ 0.7575	− 0.7543	+ 0.7559	−3.2	−44.9	1354.3902
110	111	1.684	197.986	+ 2.7769	− 2.7815	+ 2.7792	+4.6	−40.3	1357.1694
111	112	1.528	199.514	+ 2.2158	− 2.2116	+ 2.2137	−4.2	−44.5	1359.3831
112	113	1.670	201.184	+ 2.1694	− 2.1727	+ 2.1710	+3.3	−41.2	1361.5541
113	114	1.494	202.678	+ 2.4398	− 2.4389*	+ 2.4395	−0.6	−41.8	1363.9936
					− 2.4392				
114	115	1.629	204.307	+ 2.6015	− 2.5989	+ 2.6002	−2.6	−44.4	1366.5938
115	116	1.595	205.902	+ 4.0632	− 4.0636	+ 4.0634	+0.4	−44.0	1370.6572
116	O_1	1.667	207.569	− 2.1605	+ 2.1596	− 2.1600	+0.9	−43.1	1368.4972
O_1	Sta. Cassa	0.135	207.704	+ 0.83					1369.33
O_1	117	1.548	209.117	+ 5.9566	− 5.9559	+ 5.9562	−0.7	−43.8	1374.4534
117	118	1.611	210.728	+ 3.2434	− 3.2404	+ 3.2419	−3.0	−46.8	1377.6953
118	119	1.672	212.400	+ 4.0550	− 4.0591	+ 4.0570	+4.1	−42.7	1381.7523
119	120	1.528	213.928	+11.0683	−11.0698	+11.0690	+1.5	−41.2	1392.8213
120	121	1.608	215.536	+12.0198	−12.0148	+12.0173	−5.0	−46.2	1404.8386
121	122	1.538	217.074	+11.2712	−11.2703	+11.2708	−0.9	−47.1	1416.1094
122	123	1.610	218.684	+12.7139	−12.7149	+12.7144	+1.0	−46.1	1428.8238
123	P_1	1.003	219.687	+ 3.8267	− 3.8280	+ 3.8274	+1.3	−44.8	1432.6512
P_1	124	0.665	220.352	+ 4.8785	− 4.8800	+ 4.8792	+1.5	−43.3	1437.5304
124	Sta. Glendo	0.090	220.442	+ 0.71					1438.24
124	125	1.590	221.942	− 7.1661	+ 7.1661	− 7.1661	0.0	−43.3	1430.3643
125	126	1.594	223.536	−10.5656	+10.5605	−10.5630	+5.1	−38.2	1419.8013
126	127	1.366	224.902	+ 6.4006	− 6.4037	+ 6.4022	+3.1	−35.1	1426.2035
127	128	1.845	226.747	− 4.1419	+ 4.1442	− 4.1430	−2.3	−37.4	1422.0605
128	129	1.627	228.374	− 0.0943	+ 0.0972	− 0.0958	−2.9	−40.3	1421.9647
129	130	1.617	229.991	+ 2.1069	− 2.1081	+ 2.1075	+1.2	−39.1	1424.0722
130	131	1.595	231.586	+10.8701	−10.8730	+10.8716	+2.9	−36.2	1434.9438
131	Q_1	1.397	232.983	− 1.1483	+ 1.1466	− 1.1474	+1.7	−34.5	1433.7964
Q_1	132	1.807	234.790	− 9.5003	+ 9.5000	− 9.5002	+0.3	−34.2	1224.2962

*Rejected. Result obtained by correcting apparent interchange of sights.

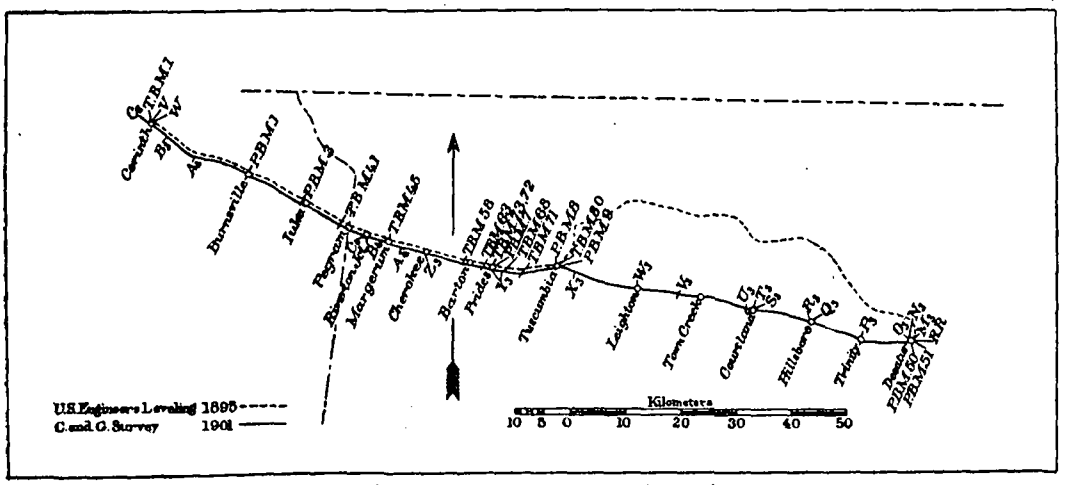
Results of precise leveling from Cheyenne to Orin Junction, Wyo., 1901—Continued.

Bench marks.		Distance between successive bench marks.	Distance from T. B. M. 1. at Cheyenne.	Difference of elevation.			Discrepancy. (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
132	Sta. Bona	0.078	234.868	+0.23					1424.53
132	133	1.659	236.449	−5.1949	+5.1943	−5.1946	+0.6	−33.6	1419.1016
133	134	1.549	237.998	−0.1423	+0.1443	−0.1433	−2.0	−35.6	1418.9583
134	135	1.603	239.601	+0.9332	−0.9299	+0.9316	−3.3	−38.9	1419.8899
135	136	1.626	241.227	+3.5593	−3.5615	+3.5604	+2.2	−36.7	1423.4503
136	R_1	1.584	242.811	+1.8184	−1.8235	+1.8201	+1.8	−34.9	1425.2704
				+1.8200	−1.8185				
R_1	S_1	1.391	244.202	+9.6181	−9.6216	+9.6198	+3.5	−31.4	1434.8902
S_1	Sta. Orin Jct.	0.042	244.244	−0.29					1434.60
S_1	T_1	0.961	245.163	−4.2640	+4.2655	−4.2648	−1.5	−32.9	1430.6254

DECATUR–CORINTH LINE.

This line was run by Aid W. C. Dibrell between October 24 and December 9, 1901, using level No. 7, one of the new type. The purpose of this line was to locate a large error of 0.7 meter or more which it seemed certain must exist somewhere in the leveling in Alabama and Mississippi. An examination of the leveling in that vicinity, after the

No. 14.



Leveling route, Decatur, Ala., to Corinth, Miss.

completion of the line of 1900 from Cincinnati, Ohio, to Birmingham, Ala., indicated that an error probably existed in the line Corinth–Decatur, which had been run under the direction of the Corps of Engineers in 1895. The determination to rerun the Corinth–Decatur line was based upon the evidence furnished by this examination, though

it was known to have been run originally with great care by an excellent method and with good instruments. The rerunning developed an error of 1 meter near the western end of the line, as shown in the comparison between the old and new lines following the tabulation of the new line.

The new line of levels followed the Southern Railway from Decatur to Corinth. The old line of levels also followed that railroad between Corinth and Tuscumbia, and there are frequent bench marks between these points common to the two lines. The old line, however, from Tuscumbia toward Decatur, followed the railroad to Florence, and from that point ran along the Tennessee River and the Muscle Shoals Canal to Decatur. The old and new lines, therefore, form a circuit, Decatur–Tuscumbia–Florence–Decatur. The agreement between old and new lines is indicated in the table following the tabulation of the results of the new work.

The length and index corrections of the rods R_2 and T, which were used on this line, are given in connection with the preceding line, Cheyenne–Orin Junction.

The tabulation is given in two parts, Decatur–Tuscumbia, a double line, and Tuscumbia–Corinth, which is a single line as a rule. All the elevations in the tabulation are based upon that of P. B. M. 50, in Appendix 8, Report for 1899. The elevations given in the tabulation for stations marked thus: (Sta. Decatur) refer to the top of rail in front of the railroad station named.

Results of precise leveling from Decatur to Tuscumbia, Ala., 1901.

Bench marks.		Distance between successive bench marks.	Distance from P. B. M. 50. at Decatur.	Difference of elevation.			Discrepancy (B−F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
	P. B. M. 51								171. 4946*
P.B.M. 51	P. B. M. 50	0. 330		−2. 8129	+2. 8127	−2. 8128	+0. 2		168. 6818
	P. B. M. 50		0. 000						168. 6796*
P.B.M. 50	Old R. R.	0. 256	0. 256	+3. 2854	−3. 2879	+3. 2865	+2. 2	+2. 2	171. 9661
				+3. 2854	−3. 2872				
Old R. R.	M_3	0. 214	0. 470	+3. 3126	−3. 3116	+3. 3121	−1. 0	+1. 2	175. 2782
M_3	Sta. Decatur	0. 371	0. 841		+0. 61				174. 67
M_3	N_3	0. 500	0. 970	+6. 0820	−6. 0837	+6. 0828	+1. 7	+2. 9	181. 3610
N_3	O_3	1. 124	2. 094	−2. 1916	+2. 1878	−2. 1892	+3. 1	+6. 0	179. 1718
				−2. 1899	+2. 1876				
O_3	1	1. 049	3. 143	−5. 9653	+5. 9631	−5. 9642	+2. 2	+8. 2	173. 2076
1	2	0. 692	3. 835	−0. 7768	+0. 7787	−0. 7778	−1. 9	+6. 3	172. 4298
2	3	1. 772	5. 607	+1. 1788	−1. 1730	+1. 1755	−4. 3	+2. 0	173. 6053
				+1. 1765	−1. 1736				
3	4	1. 524	7. 131	+6. 2857	−6. 2868	+6. 2862	+1. 1	+3. 1	179. 8915
4	5	1. 531	8. 662	−1. 3520	+1. 3506	−1. 3513	+1. 4	+4. 5	178. 5402
5	6	1. 768	10. 430	+7. 2691	−7. 2672	+7. 2682	−1. 9	+2. 6	185. 8084
6	7	1. 442	11. 872	+6. 8569	−6. 8566	+6. 8568	−0. 3	+2. 3	192. 6652

*From App. 8, Rept. for 1899, p. 501.

Results of precise leveling from Decatur to Tuscumbia, Ala., 1901—Continued.

Bench marks.		Distance between successive bench marks.	Distance from P. B. M. 50. at Decatur.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
7	P_3	0.696	12.568	−0.3638 −0.3642	+0.3590 +0.3643	−0.3628	+2.4	+ 4.7	192.3024
P_3	Sta. Trinity	0.040	12.608	+0.19					192.49
P_3	8	0.869	13.437	−2.7261 −2.7229	+2.7246 +2.7302	−2.7260	−2.9	+ 1.8	189.5764
8	9	1.708	15.145	−6.7462	+6.7457	−6.7460	+0.5	+ 2.3	182.8304
9	10	1.518	16.663	−2.9831	+2.9805	−2.9818	+2.6	+ 4.9	179.8486
10	11	1.572	18.235	+2.2112	−2.2144	+2.2128	+3.2	+ 8.1	182.0614
11	12	1.602	19.837	−0.4068	+0.4024	−0.4046	+4.4	+12.5	181.6568
12	13	1.786	21.623	−0.1855	+0.1896 +0.1850*	−0.1876	−4.1	+ 8.4	181.4692
13	Q_3	1.254	22.877	−0.0329	+0.0307	−0.0318	+2.2	+10.6	181.4374
Q_3	R_3	0.029	22.906	+0.8382	−0.8386	+0.8384	+0.4	+11.0	182.2758
R_3	Sta. Hillsboro	0.104	23.010	−1.32					180.96
R_3	14	0.101	23.007	−1.4221	+1.4224	−1.4222	−0.3	+10.7	180.8536
14	15	1.885	24.892	−1.4275	+1.4256	−1.4266	+1.9	+12.6	179.4270
15	16	1.509	26.401	+3.1162 +3.1177	−3.1234 −3.1174	+3.1187	+3.4	+16.0	182.5457
16	17	1.636	28.037	−0.4892	+0.4922	−0.4907	−3.0	+13.0	182.0550
17	Sta. Wheeler	0.518	28.555	−1.50					180.56
17	18	1.618	29.655	−0.4805	+0.4798	−0.4802	+0.7	+13.7	181.5748
18	19	1.491	31.146	−2.2909	+2.2923	−2.2916	−1.4	+12.3	179.2832
19	20	1.563	32.709	−3.3087	+3.3072	−3.3080	+1.5	+13.8	175.9752
20	21	1.486	34.195	−4.7703	+4.7701	−4.7702	+0.2	+14.0	171.2050
21	Sta. Courtland	0.106	34.201	−0.25					170.95
21	S_3	0.101	34.296	+0.8632	−0.8629	+0.8630	−0.3	+13.7	172.0680
S_3	T_3	0.090	34.386	−0.3250	+0.3258	−0.3254	−0.8	+12.9	171.7426
T_3	U_3	1.102	35.488	−5.0663	+5.0668	−5.0666	−0.5	+12.4	166.6760
U_3	22	0.804	36.292	+5.5507	−5.5498	+5.5502	−0.9	+11.5	172.2262
22	23	1.480	37.772	+4.7122	−4.7109	+4.7116	−1.3	+10.2	176.9378
23	24	1.758	39.530	+1.4325	−1.4330	+1.4328	+0.5	+10.7	178.3706
24	25	1.736	41.266	+0.9567	−0.9574	+0.9570	+0.7	+11.4	179.3276
25	26	1.461	42.727	−6.6090	+6.6090	−6.6090	0.0	+11.4	172.7186
26	27	0.738	43.465	−1.6589	+1.6598	−1.6594	−0.9	+10.5	171.0592
27	28	0.828	44.293	−2.4425	+2.4417	−2.4421	+0.8	+11.3	168.6171
28	Sta. Town Creek.	0.647	44.940	−2.52					166.10
28	29	1.666	45.959	+4.8489	−4.8510	+4.8500	+2.1	+13.4	173.4671
29	30	1.586	47.545	−9.1793	+9.1803	−9.1798	−1.0	+12.4	164.2873
30	V_3	0.636	48.181	−0.1050	+0.1039	−0.1044	+1.1	+13.5	164.1829
V_3	31	1.076	49.257	+6.5108	−6.5129	+6.5118	+2.1	+15.6	170.6947
31	32	1.396	50.653	+1.1932	−1.1918	+1.1925	−1.4	+14.2	171.8872

*Rejected. Result obtained by correcting apparent interchange of sights.

Results of precise leveling from Decatur to Tuscumbia, Ala., 1901—Continued.

Bench marks.		Distance between successive bench marks.	Distance from P. B. M. 50. at Decatur.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
32	33	1.694	52.347	+4.5164	−4.5179	+4.5172	+1.5	+15.7	176.4044
33	34	1.708	54.055	+2.2430	−2.2419	+2.2424	−1.1	+14.6	178.6468
34	35	0.990	55.045	−2.9097	+2.9107	−2.9102	−1.0	+13.6	175.7366
35	Sta. Leighton	0.347	55.392	−2.08					173.66
35	W_3	0.404	55.449	−2.1728	+2.1743	−2.1736	−1.5	+12.1	173.5630
W_3	36	0.188	55.637	−2.2144	+2.2131	−2.2138	+1.3	+13.4	171.3492
36	37	1.604	57.241	−6.7228	+6.7247	−6.7238	−1.9	+11.5	164.6254
37	38	1.675	58.916	−2.2849	+2.2908	−2.2878	−1.8	+9.7	162.3376
				−2.2889	+2.2866				
38	39	1.564	60.480	−1.6002	+1.5990	−1.5996	+1.2	+10.9	160.7380
39	40	1.575	62.055	−5.9521	+5.9539	−5.9530	−1.8	+9.1	154.7850
40	41	1.570	63.625	+3.0520	−3.0491	+3.0506	−2.9	+6.2	157.8356
41	42	1.991	65.616	−3.2766	+3.2695	−3.2707	+7.0	+13.2	154.5649
				−3.2718	+3.2650				
42	X_3	0.098	65.714	+0.2504	−0.2497	+0.2500	−0.7		154.8149
42	43	1.244	66.860	+0.7332	−0.7341	+0.7336	+0.9	+14.1	155.2985
43	44	1.566	68.426	−0.5625	+0.5609	−0.5617	+1.6	+15.7	154.7368
44	45	1.694	70.120	−3.3110	+3.3111	−3.3110	−0.1	+15.6	151.4258
45	P. B. M. 9	2.020	72.140	−9.1611	+9.1639	−9.1625	−2.8	+12.8	142.2633
P. B. M. 9	T. B. M. 80	0.140	72.280	−0.4179	+0.4179	−0.4179	0.0	+12.8	141.8454
T.B.M. 80	Sta. Tuscumbia	0.087	72.367	+0.20					142.05
T.B.M. 80	P. B. M. 8	0.197	72.477	+3.5867	−3.5872	+3.5870	+0.5	+13.3	145.4324

Results of precise leveling from Tuscumbia, Ala., to Corinth, Miss., 1901.

Bench marks.		Distance between successive bench marks.	Distance from P. B. M. 8. at Tuscumbia.	Difference of elevation.			Discrepancy B—F.		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
	P. B. M. 8		0.000					0.0	145.4324
P. B. M. 8	1	1.264	1.264	−9.3410	+9.3396	−9.3403	+1.4	+1.4	136.0921
1	2	1.636	2.900	+18.9284	−18.9287	+18.9286	+0.3	+1.7	155.0207
2	3	1.422	4.322	−2.4642	+2.4656	−2.4649	−1.4	+0.3	152.5558
3	T. B. M. 71	1.446	5.768	−15.4689	+15.4707	−15.4698	−1.8	−1.5	137.0860
T.B.M. 71	4	1.852	7.620	+10.1402	−10.1467	+10.1412	+5.7	+4.2	147.2272
				+10.1364	−10.1414				
4	T. B. M. 68	1.012	8.632	+0.6175	−0.6193	+0.6184	+1.8	+6.0	147.8456
T.B.M. 68	5	0.615	9.247	−4.9893		−4.9893			142.8563
5	6	1.629	10.876	−5.2725		−5.2725			137.5838
6	7	1.139	12.015	+1.6993		+1.6993			139.2831
7	Sta. Prides	0.096	12.786	+1.76					131.70
7	T. B. M. 72	0.675	12.690	−9.3411		−9.3411			129.9420

Results of precise leveling from Tuscumbia, Ala., to Corinth, Miss., 1901—Continued.

Bench marks.		Distance between successive bench marks.	Distance from P. B. M. 8. at Tuscumbia.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
T. B. M. 72	T. B. M. 73	0.503	13.193	− 3.1177		− 3.1177			126.8243
T. B. M. 73	P. B. M. 7	0.010	13.203	+ 1.0400	− 1.0392	+ 1.0397	−0.2	−0.2	127.8640
				+ 1.0396	− 1.0399				
P. B. M. 7	8	1.134	13.337	+12.5439		+12.5439			140.4079
8	9	1.715	15.052	− 4.7016		− 4.7016			135.7063
9	T. B. M. 63	0.671	15.723	− 5.3624		− 5.3624			130.3439
T. B. M. 63	10	1.138	16.861	+ 8.2443		+ 8.2443			138.5882
10	Y_3	0.577	17.438	− 4.8925		− 4.8925			133.6957
Y_3	11	0.967	18.405	+ 6.3351		+ 6.3351			140.0308
11	Sta. Barton	1.478	19.883	+ 6.51					146.54
11	12	1.637	20.042	+ 6.4227		+ 6.4227			146.4535
12	T. B. M. 58	0.738	20.780		− 3.6536	+ 3.6536			150.1071
T. B. M. 58	13	0.759	21.539		− 3.4803	+ 3.4803			153.5874
13	14	1.520	23.059		+ 5.6851	− 5.6851			147.9023
14	15	1.665	24.724		− 6.6127	+ 6.6127			154.5150
15	16	1.513	26.237		− 9.5202	+ 9.5202			164.0352
16	17	1.341	28.578		+ 8.2036	− 8.2036			155.8316
17	Sta. Cherokee	0.113	28.691	+ 0.93					156.76
17	Z_3	0.922	29.500	+ 7.3368		+ 7.3368			163.1684
Z_3	18	0.869	30.369	− 4.7719		− 4.7719			158.3965
18	Sta. Dickson	1.434	31.803	− 3.33					155.07
18	19	1.756	32.125	− 6.4036		− 6.4036			151.9929
19	20	1.764	33.889	− 9.2854		− 9.2854			142.7075
20	A_4	1.333	35.222	− 9.4904		− 9.4904			133.2171
A_4	21	1.285	36.507	+ 0.6332		+ 0.6332			133.8503
21	T. B. M. 45	0.798	37.305	− 1.6137		− 1.6137			132.2366
T. B. M. 45	Sta. Margerum	0.159	37.464	+ 0.10					132.34
T. B. M. 45	Sta. Riverton Jct.	1.116	38.580	− 4.77					127.47
T. B. M. 45	22	1.421	38.726	− 6.6136		− 6.6136			125.6230
22	23	1.437	40.163	− 1.3116		− 1.3116			124.3114
23	B_4	0.274	40.437	+ 1.1994		+ 1.1994			125.5108
B_4	C_4	1.429	41.866		− 5.6413	+ 5.6413			131.1521
C_4	T. B. M. 41	0.456	42.322		+ 0.0015	− 0.0015			131.1506
T. B. M. 41	24	1.309	43.631		− 4.5696	+ 4.5696			135.7202
24	25	1.601	45.232		−11.3163	+11.3163			147.0365
25	26	1.640	46.872		−12.5856	+12.5856			159.6221
26	27	1.361	48.233		−16.4412	+16.4412			176.0633
27	28	2.001	50.234		+ 6.9663	− 6.9663			169.0970
28	P. M. B. 3	1.433	51.667		− 2.1402	+ 2.1402			171.2372
P. B. M. 3	Sta. Iuka	0.712	52.379	− 2.28					168.96
P. B. M. 3	29	1.784	53.451	+ 8.7053	− 8.7037	+ 8.7045	−1.6	−1.6	179.9417
29	30	1.480	54.931	−13.9394	+13.9424	−13.9409	−3.0	−4.6	166.0008

Results of precise leveling from Tuscumbia, Ala., to Corinth, Miss., 1901—Continued.

Bench marks.		Distance between successive bench marks.	Distance from P. B. M. 8. at Tuscumbia.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
30	31	1.639	56.570	−14.8099	+14.8090	−14.8094	+0.9	−3.7	151.1914
31	32	1.574	58.144	− 7.4423	− 7.4420	− 7.4422	+0.3	−3.4	143.7492
32	33	1.538	59.682	− 6.8669	+ 6.8616	− 6.8642	+5.3	+1.9	136.8850
33	34	1.706	61.338	− 2.1693	+ 2.1658	− 2.1676	+3.5	+5.4	134.7174
34	Sta. Walker Switch	0.841	62.229	+ 3.41					138.13
34	P. B. M. 1	1.821	63.209	+ 7.6186	− 7.6219	+ 7.6202	+3.3	+8.7	142.3376
P. B. M. 1	Sta. Burnsville	0.148	63.357	− 1.33					141.01
P. B. M. 1	35	1.470	64.679		− 7.3978	+ 7.3978			149.7354
35	36	1.722	66.401	− 9.6190		− 9.6190			140.1164
36	37	1.585	67.986	+ 7.8301		+ 7.8301			147.9465
37	38	1.488	69.474	− 8.0225		− 8.0225			139.9240
38	39	1.713	71.187	+ 5.3549		+ 5.3549			145.2789
39	40	1.545	72.732	+ 0.9335		+ 0.9335			146.2124
40	Sta. Glens	1.086	73.818	+ 4.26					150.47
40	41	1.589	74.321	+ 4.7686		+ 4.7686			150.9810
41	42	1.120	75.441		− 4.5162	+ 4.5162			155.4972
42	A_3	1.919	77.360		+ 7.7582	+ 7.7582			163.2554
A_3	43	0.641	78.001		+ 2.5709	− 2.5709			160.6845
43	B_3	1.893	79.894		+14.9620	−14.9620			145.7225
B_3	44	1.055	80.949		− 1.4352	+ 1.4352			147.1577
44	45	1.551	82.500		+ 4.9905	− 4.9905			142.1672
45	46	1.498	83.998		+11.5762	−11.5762			130.5910
46	47	1.611	85.609		−10.6549	+10.6549			141.2459
47	V	1.372	86.981		+ 4.5485	− 4.5485			136.6974
V	T. B. M. 1	0.038	87.019	− 0.6153	+ 0.6160	− 0.6156	−0.7	−0.7	136.0818
T. B. M. 1	W	0.035	87.054	+ 0.6703	− 0.6703	+ 0.6703	0.0	−0.7	136.7521
W	C_3	0.152	87.206	− 1.0006	+ 0.9998	− 1.0002	+0.8	+0.1	135.7519

In the following comparison of elevations of bench marks between Decatur and Corinth the values in the column headed "Elevation 1901" are from the preceding tabulation, which is based on the elevation 168^m.6796, for P. B. M. 50 at Decatur. The values in the column headed "Elevation 1895" are taken directly from the Chief of Engineer's Report for 1896, part 3, pages 1961–1998.

Place.	Bench mark.	Elevation 1901.	Elevation 1895.	Elevation 1901 − 1895.
		m.	*m.*	*m.*
Decatur	P. B. M. 50	168.6796	168.3550	+0.3246
Tuscumbia	P. B. M. 9	142.2633	141.9452*	+0.3181
Tuscumbia	T. B. M. 80	141.8454	141.5319	+0.3135
Tuscumbia	P. B. M. 8	145.4324	145.1156	+0.3168
Near Prides	T. B. M. 71	137.0860	136.7884	+0.2976†
Near Prides	T. B. M. 68	147.8456	147.5322	+0.3134
Prides	T. B. M. 72	129.9420	129.6293	+0.3127
Prides	T. B. M. 73	126.8243	126.5102	+0.3141
Prides	P. B. M. 7	127.8640	127.5518	+0.3122
Bear River	T. B. M. 63	130.3439	130.0290	+0.3149
Near Barton	T. B. M. 58	150.1071	149.7938	+0.3133
Margerum	T. B. M. 45	132.2366	131.9177	+0.3189
Near Pegram	T. B. M. 41	131.1506	130.8366	+0.3140
Iuka	P. B. M. 3	171.2372	170.9300	+0.3072
Burnsville	P. B. M. 1	142.3376	143.0301	−0.6925
Corinth	V	136.6974	137.3805	−0.6831
Corinth	T. B. M. 1	136.0818	136.9606	−0.8788‡
Corinth	W	136.7521	137.4377	−0.6856

The very close agreement of the old and new lines from Decatur to Iuka, 124 kilometers over the new line, the difference, 1901–1895, being over this whole distance always within 9 millimeters of 0.3160, indicates both level lines to have been of an extremely high degree of accuracy. In view of the abrupt change in the difference, 1901–1895, between Iuka and Burnsville, of almost exactly an even meter, and of the fact that an error of that sign and approximately that magnitude had been indicated by external evidence before the line of 1901 was run, there seems to be no good reason to doubt that an error of one meter was made in the older work.

In the formation of the difference of elevation, Tuscumbia 9—Corinth V, for line 151, page 355, a mean was taken of the two determinations for Tuscumbia 9—Iuka, 3; for Iuka 3—Burnsville 1, the Coast Survey line only was used and a mean was taken again for Burnsville 1—Corinth V.

DOBBS FERRY–GREENBUSH LINE.

This line was run by Aid W. C. Dibrell, between April 16 and June 13, 1902, with level No. 7, one of the new type of instruments. The line from Dobbs Ferry to Greenbush used in the level net adjustment of 1899 was known to be of an inferior degree of accuracy. In view of the importance of an accurate determination of the elevation of the Greenbush bench mark, as set forth on page 196, it was decided to supersede this line by leveling of as high degree of accuracy as possible. The line follows the New York Central and Hudson River Railroad along the east bank of the Hudson River. It connects at Dobbs Ferry with the old line from Sandy Hook and New York, run in 1886–87 by Subassistant J. E. McGrath and others. At Greenbush it connects with the Gristmill bench mark and therefore with the old Engineer line of levels of 1875 to Oswego; with the two Deep Waterways Board lines to Oswego direct and by way of Lake

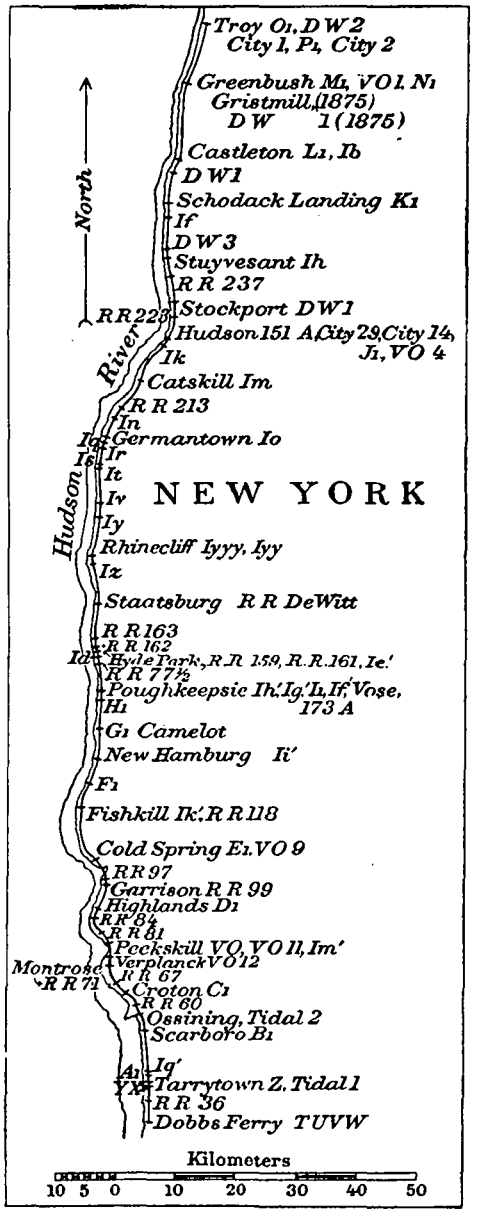
*This elevation is erroneously printed 141.9252 on page 1982 of Ch. of Eng. Rep., 1896, part 3, as may be seen by checking the additions of the difference P. B. M. 8–T. B. M 80 to the elevation on the preceding page for T. B. M. 80.

†Apparently this bench mark has changed in elevation.

‡The observer in 1901 believed this bench mark to have settled.

Champlain, and with the Geological Survey line to Dunkirk, N. Y. Connections were also made on Geological Survey bench marks at Poughkeepsie and Hudson, and with bench marks of the Deep Waterways Board at Greenbush and Hudson, and at Troy, and with various bench marks of the New York Central and Hudson River Railroad between Dobbs Ferry and Greenbush. No velocipede cars were used upon this leveling on account of the frequent trains. The interference of the trains with the work also had a tendency to make progress unusually slow.

No. 15.



Leveling route, Dobbs Ferry to Greenbush, N. Y.

Rods R_2 and S were used. Their lengths at 0° C., as determined by the National Bureau of Standards in May, 1902, were, for rod R_2, $3^m+0^{mm}.86$, and for rod S, $3^m+1^{mm}.39$. The mean of these two lengths is $3^m+1^{mm}.12$, or an excess of length of 0.37 millimeter per meter.

The lengths of the 3-meter intervals of the two rods, as measured in the field along the Dobbs Ferry–Greenbush line between April 15 and June 14, and on the Chadron–Orin Junction line between June 24 and August 4, are as follows:

Field measurements of rods.

Reduced to 20° C.

Date.	Rod S.	Rod R_2.
1902.	*m.*	*m.*
Apr. 15	3.0011	3.0007
21	3.0014	3.0010
28	3.0012	3.0011
May 10	3.0013	3.0010
14	3.0015	3.0012
24	3.0016	3.0011
30	3.0012	3.0009
June 9	3.0014	3.0008
14	3.0016	3.0012
24	3.0015	3.0010
July 1	3.0017	3.0013
9	3.0013	3.0011
15	3.0014	3.0009
22	3.0013	3.0009
29	3.0012	3.0008
Aug. 4	3.0013	3.0007

At the time the computations were made the rods were still in the field, in use on another line, from Rock Creek to Red Desert, Wyo. As the above field measures showed that if any change had occurred in the lengths of the rods it must be very small, the lengths measured at the beginning of the

season were used in making the computation; that is, a correction of 0.37 millimeter per meter was applied. This assumption that the rods held a constant length is reasonably safe, since past experience shows that rods ordinarily hold a constant length with considerable accuracy during each season after the first. Both of these rods had been used for many months during preceding seasons. The index corrections of the rods were in January, 1902, for rod R_2,—0.2 millimeter, and for rod S, —0.6 millimeter. These index corrections were used throughout the season on both the Dobbs Ferry–Greenbush line and the Chadron–Orin Junction line.

The elevations in the following tabulation are based upon the elevation of bench mark V at Dobbs Ferry, printed in Appendix 8, Report for 1899. The elevations given in the following tabulation for stations marked thus: (Sta. Ardsley), refer to the top of the rail in front of the railroad station named.

Results of precise leveling from Dobbs Ferry to Greenbush, N. Y., 1902.

Bench mark.		Distance between successive bench marks.	Distance from bench mark V at Dobbs Ferry.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
	V		0.000						*2.9357
V	T	0.162	0.162	+1.2928	−1.2941	+1.2930	+0.5	+ 0.5	4.2287
				+1.2927	−1.2925				
T	U	0.089	0.251	+0.3099	−0.3081	+0.3088	−0.9	− 0.4	4.5375
				+0.3085	−0.3085				
U	W	0.546	0.797	−1.7209	+1.7193	−1.7201	+1.6	+ 1.2	2.8174
W	1	0.252	1.049	−0.6072	+0.6069	−0.6070	+0.3	+ 1.5	2.2104
1	Sta. Ardsley	1.031	2.080	+0.50					2.71
1	R. R. 36	1.542	2.591	−0.3123	+0.3067	−0.3078	+4.8	+ 6.3	1.9026
				−0.3082	+0.3041				
R. R. 36	2	0.058	2.649	+0.3107	−0.3110	+0.3108	+0.3	+ 6.6	2.2134
2	Sta. Irvington	0.937	3.586	+0.49					2.70
2	3	1.582	4.231	+0.1500	−0.1500	+0.1500	0.0	+ 6.6	2.3634
3	4	1.614	5.845	−0.1115	+0.1089	−0.1102	+2.6	+ 9.2	2.2532
4	X	1.029	6.874	+1.2433	−1.2461	+1.2447	+2.8	+12.0	3.4979
X	Y	0.102	6.976	−0.8880	+0.8879	−0.8880	+0.1	+12.1	2.6099
Y	5	0.482	7.458	−0.3341	+0.3334	−0.3338	+0.7	+12.8	2.2761
5	Tidal 1 Tarrytown	0.511	7.969	+0.9972	−0.9949	+0.9960	−2.3		3.2721
5	Sta. Tarrytown	0.303	7.761	+0.16					2.44
5	Z	0.942	8.400	+3.9741	−3.9728	+3.9734	−1.3	+11.5	6.2495
Z	6	0.716	9.116	−3.4794	+3.4792	−3.4793	+0.2	+11.7	2.7702
6	7	1.555	10.671	−0.4892	+0.4904	−0.4898	−1.2	+10.5	2.2804
7	A_1	0.210	10.881	+0.3420	−0.3384	+0.3390	−1.2	+ 9.3	2.6194
				+0.3371	−0.3384				
A_1	Iq′	0.488	11.369	+0.6096	−0.6084	+0.6090	−1.2	+ 8.1	3.2284

*Appendix 8, Report for 1899, p. 473.

Results of precise leveling from Dobbs Ferry to Greenbush, N. Y., 1902—Continued.

Bench mark.		Distance between successive bench marks.	Distance from bench mark V at Dobbs Ferry.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
Iq′	8	0.962	12.331	−0.7426	+0.7449	−0.7438	−2.3	+5.8	2.4846
8	9	1.566	13.897	+1.5721	−1.5676	+1.5698	−4.5	+1.3	4.0544
9	Sta. Scarboro.	0.702	14.599	−1.19					2.86
9	B_1	0.888	14.785	−2.0137	+2.0141	−2.0139	−0.4	+0.9	2.0405
B_1	10	0.781	15.566	+0.3545	−0.3525	+0.3535	−2.0	−1.1	2.3940
10	Sta. Ossining	1.530		+0.10					2.49
10	Tidal 2 Ossining	1.700	17.266	+0.2464	−0.2472	+0.2468	+0.8	−0.3	2.6408
Tidal 2 Ossining	11	0.100	17.366	−0.7034	+0.7044	−0.7039	−1.0	−1.3	1.9369
11	12	1.627	18.993	+0.2354*	−0.2297	+0.2272	+3.8	+2.5	2.1641
				+0.2247	−0.2273				
12	R. R. 60	1.024	20.017	+0.1235					2.2876
12	13	1.633	20.626	+0.2694	−0.2715	+0.2704	+2.1	+4.6	2.4345
13	14	1.594	22.220	+2.4294	−2.4303	+2.4298	+0.9	+5.5	4.8643
14	Sta. Croton	0.807	23.027	−2.25					2.61
14	15	1.608	23.828	−2.5545	+2.5571	−2.5558	−2.6	+2.9	2.3085
15	C_1	0.182	21.010	+0.4339	−0.4349	+0.4344	+1.0	+3.9	2.7429
C_1	16	1.434	25.444	−0.5988	+0.5998	−0.5993	−1.0	+2.9	2.1436
16	Sta. Oscawana	0.514	25.958	+0.63					2.77
16	R. R. 67	0.684	26.128	+0.9774	−0.9802	+0.9788	+2.8	+5.7	3.1224
R. R. 67	17	0.899	27.027	+1.7582	−1.7590	+1.7586	+0.8	+6.5	4.8810
17	Sta. Crugers	0.486	27.513	+1.88					6.76
17	18	1.636	28.663	+6.6511	−6.6508	+6.6510	−0.3	+6.2	11.5320
18	R. R. 71	1.030	29.693	−0.1200	+0.1210	−0.1205	−1.0	+5.2	11.4115
R. R. 71	Sta. Montrose	0.181	29.874	+0.52					11.93
R. R. 71	19	0.615	30.308	+0.4951	−0.5005	+0.5003	+0.4	+5.6	11.9118
19	V. O. 12	0.957	31.265	−2.8174	+2.8195	−2.8184	−2.1	+3.5	9.0934
V. O. 12	20	0.657	31.922	−2.1678	+2.1704	−2.1691	−2.6	+0.9	6.9243
20	21	1.676	33.598	−3.8514	+3.8471	−3.8492	+4.3	+5.2	3.0751
21	Im′	0.074	33.672	+1.2343	−1.2362	+1.2360	+0.7	+5.9	4.3111
				+1.2370	−1.2364				
Im′	V. O.	0.201	33.873	−1.0974	+1.0985	−1.0980	−1.1	+4.8	3.2131
V. O.	Sta. Peekskill	0.025	33.898	−0.29					2.92
V. O.	22	1.201	35.074	−0.8941	+0.8946	−0.8944	−0.6	+4.2	2.3187
22	V. O. 11	0.109	35.183	−0.2484	+0.2495	−0.2490	−1.1	+3.1	2.0697

* Rejected.

Results of precise leveling from Dobbs Ferry to Greenbush, N. Y., 1902—Continued.

Bench mark.		Distance between successive bench marks.	Distance from bench mark V at Dobbs Ferry.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
V. O. 11	R. R. 81	1.357	36.540	+0.8646	−0.8670	+0.8658	+1.8	+ 4.9	2.9355
				+0.8658					
R. R. 81	23	0.279	36.819	−1.0277	+1.0293	−1.0285	−1.6	+ 3.3	1.9070
23	24	1.402	38.221	+0.0136	−0.0182	+0.0159	+4.6	+ 7.9	1.9229
24	R. R. 84	0.258	39.479	+0.4766					2.3995
24	25	1.954	40.175	+0.5949	−0.5905	+0.5927	− 4.4	+ 3.5	2.5156
25	D_2	0.793	40.968	−0.1152	+0.1139	−0.1146	+1.3	+ 4.8	2.4010
D_2	26	0.769	41.737	−0.1591	+0.1594	−0.1592	−0.3	+ 4.5	2.2418
26	Sta. Highlands	0.226	41.963	+0.27					2.51
26	27	1.732	43.469	+0.3585	−0.3618	+0.3602	+3.3	+ 7.8	2.6020
27	28	1.860	45.329	−0.2253	+0.2219	−0.2236	+3.4	+11.2	2.3784
28	29	1.123	46.452	+0.0146	−0.0173	+0.0160	+2.7	+13.9	2.3944
29	R. R. 97	0.089	46.541	+0.8568	−0.8550	+0.8559	−1.8	+12.1	3.2503
R. R. 97	Sta. Garrison	1.336	47.877	+2.07					5.32
R. R. 97	30	1.345	47.886	+2.3535	−2.3528	+2.3532	−0.7	+11.4	5.6035
30	R. R. 99	0.058	47.944	+0.6880	−0.6874	+0.6877	−0.6	+10.8	6.2902
R. R. 99	30a	0.578	48.522	−1.5783	+1.5790	−1.5786	−0.7	+10.1	4.7126
30a	31	1.357	49.879	−3.0473	+3.0511	−3.0492	−3.8	+ 6.3	1.6634
31	32	1.613	51.492	+0.2933	−0.2901	+0.2917	−3.2	+ 3.1	1.9551
32	Sta. Coldspring	0.721	52.213	+2.11					4.07
32	V. O. 9	0.766	52.258	+2.3236	−2.3229	+2.3232	−0.7	+ 2.4	4.2783
V. O. 9	E_1	0.212	52.470	−0.3040	+0.3045	−0.3042	−0.5	+ 1.9	3.9741
E_1	33	1.064	53.534	−1.6323	+1.6331	−1.6327	−0.8	+ 1.1	2.3414
33	34	1.612	55.146	−0.4848	+0.4811	−0.4830	+3.7	+ 4.8	1.8584
34	Sta. Storm King	0.801	55.947	+0.99					2.85
34	35	1.609	56.755	+0.9754	−0.9757	+0.9776	+1.7	+ 6.5	2.8360
				+0.9780	−0.9812				
35	36	1.632	58.387	−0.3631	+0.3620	−0.3626	+1.1	+ 7.6	2.4734
36	37	1.630	60.017	+0.5094	−0.5112	+0.5103	+1.8	+ 9.4	2.9837
37	Sta. Dutchess Jct.	0.269	60.286	−0.03					2.95
37	38	1.672	61.689	+1.3145	−1.3176	+1.3160	+3.1	+12.5	4.2997
38	Ik′	1.025	62.714	−0.9041	+0.9036	−0.9038	+0.5	+13.0	3.3959
Ik′	Sta. Fishkill	0.382	63.096	−0.94					2.46
Ik′	39	0.593	63.307	−0.8045	+0.8027	−0.8036	+1.8	+14.8	2.5923
39	R. R. 118	0.194	63.501	−0.0767	+0.0770	−0.0768	−0.3	+14.5	2.5155
R. R. 118	40	1.405	64.906	+0.2073	−0.2063	+0.2068	−1.0	+13.5	2.7223

Results of precise leveling from Dobbs Ferry to Greenbush, N. Y., 1902—Continued.

Bench mark.		Distance between successive bench marks.	Distance from bench mark V at Dobbs Ferry.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
40	41	1.616	66.522	— 0.2774	+ 0.2771	— 0.2772	+0.3	+13.8	2.4451
41	42	1.615	68.137	+ 1.4619	— 1.4594	+ 1.4606	−2.5	+11.3	3.9057
42	Sta. Chelsea	0.694	68.831	— 0.73					3.18
42	43	1.622	69.759	— 1.1938	+ 1.1929	— 1.1934	+0.9	+12.2	2.7123
43	F_1	1.386	71.145	— 1.0939	+ 1.0922	— 1.0930	+1.7	+13.9	1.6193
F_1	44	1.818	72.963	+ 2.3183	— 2.3229	+ 2.3206	+4.6	+18.5	3.9399
44	Sta. New Hamburg.	0.053	73.016	+ 0.12					4.06
44	Ii′	0.073	73.036	+ 0.4954	— 0.4952	+ 0.4953	−0.2	+18.3	4.4352
Ii′	45	1.572	74.608	— 1.0836	+ 1.0882	— 1.0852	−1.2	+17.1	3.3500
				— 1.0856	+ 1.0834				
45	46	1.614	76.222	— 1.4793	+ 1.4803	— 1.4798	−1.0	+16.1	1.8702
46	47	1.619	77.841	+ 0.3208	— 0.3205	+ 0.3206	−0.3	+15.8	2.1908
47	G_1	0.295	78.136	— 0.4265	+ 0.4261	— 0.4263	+0.4	+16.2	1.7645
G_1	Sta. Camelot	0.133	78.269	+ 1.04					2.80
G_1	48	1.421	79.557	+ 0.7513	— 0.7574	+ 0.7558	+3.5	+19.7	2.5203
				+ 0.7567	— 0.7576				
48	49	1.629	81.186	— 0.0619	+ 0.0612	— 0.0616	+0.7	+20.4	2.4587
49	50	1.607	82.793	+ 0.3597	— 0.3574	+ 0.3586	−2.3	+18.1	2.8173
50	H_1	1.221	84.014	+ 6.8398	— 6.8406	+ 6.8402	+0.8	+18.9	9.6575
H_1	51	0.460	84.474	— 2.5309	+ 2.5296	— 2.5302	+1.3	+20.2	7.1273
51	Ih′	1.573	86.047	+ 4.6513	— 4.6542	+ 4.6528	+2.9	+23.1	11.7801
Ih′	52	0.034	86.081	— 1.0603	+ 1.0596	— 1.0600	+0.7	+23.8	10.7201
52	173 A	0.896	86.977	+42.0074	−42.0088	+42.0081	+1.4	+25.2	52.7282
173 A	Ig′	1.082	88.059	−39.5377	+39.5332	−39.5354	+4.5	+29.7	13.1928
Ig′	Vose	0.013	88.072	— 1.0163	+ 1.0161	— 1.0162	+0.2	+29.9	12.1766
Ig′	Sta. Poughkeepsie.	0.019	88.078	— 1.44					11.75
Ig′	I_1	0.059	88.118	— 0.9959	+ 0.9963	— 0.9961	−0.4	+29.3	12.1967
I_1	53	0.975	89.093	— 1.7125	+ 1.7108	— 1.7116	+1.7	+31.0	10.4851
53	54	1.625	90.718	— 3.0214	+ 3.0210	— 3.0212	+0.4	+31.4	7.4639
54	If′	0.556	91.274	— 1.2782	+ 1.2746	— 1.2758	+2.0	+33.4	6.1881
				— 1.2755	+ 1.2751				
If′	55	1.053	92.327	— 2.2452	+ 2.2458	— 2.2455	−0.6	+32.8	3.9426
55	56	1.608	93.935	— 2.0497	+ 2.0489	— 2.0493	+0.8	+33.6	1.8933
56	R. R. 77½	0.713	94.648	+ 1.0999	— 1.0960	+ 1.0992	−2.7	+30.9	2.9925
				+ 1.1013	— 1.0998				
R. R. 77½	Ie′	0.640	95.288	— 0.9277	+ 0.9275	— 0.9276	+0.2	+31.1	2.0649
Ie′	57	0.264	95.552	— 0.0909	+ 0.0920	— 0.0914	−1.1	+30.0	1.9735
57	R. R. 159	0.751	96.303	+ 0.5919	— 0.5888	+ 0.5904	−3.1	+26.9	2.5639
R. R. 159	58	0.879	97.182	+ 0.0230	— 0.0240	+ 0.0235	+1.0	+27.9	2.5874
58	Sta. Hyde Park	0.326	97.508	+ 0.03					2.62
58	R. R. 161	0.354	97.536	— 0.3132	+ 0.3113	— 0.3122	+1.9	+29.8	2.2752
R. R. 161	R. R. 162	1.195	98.731	+ 0.2886	— 0.2923	+ 0.2904	+3.7	+33.5	2.5656

Results of precise leveling from Dobbs Ferry to Greenbush, N. Y., 1902—Continued.

Bench mark.		Distance between successive bench marks.	Distance from bench mark V at Dobbs Ferry.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
R. R. 162	59	0.043	98.774	−0.2035	+0.2039	−0.2037	−0.4	+33.1	2.3619
59	R. R. 163	0.989	99.763	−0.3886	+0.3874	−0.3880	+1.2	+34.3	1.9739
R. R. 163	60	0.617	100.380	+0.3401	−0.3388	+0.3394	−1.3	+33.0	2.3133
60	61	1.608	101.988	+1.2446	−1.2395	+1.2420	−5.1	+27.9	3.5553
61	R.R. DeWitt	1.529	103.517	+3.7841					7.3394
61	62	1.612	103.600	+4.6206	−4.6229	+4.6218	+2.3	+30.2	8.1771
62	63	0.965	104.565	+0.8369	−0.8380	+0.8374	+1.1	+31.3	9.0145
63	64	0.622	105.187	+1.3312	−1.3332	+1.3322	+2.0	+33.3	10.3467
64	65	1.621	106.808	−5.2537	+5.2516	−5.2526	+2.1	+35.4	5.0941
65	66	1.616	108.424	−2.6552	+2.6536	−2.6544	+1.6	+37.0	2.4397
66	67	1.598	110.022	+0.4262	−0.4283	+0.4272	+2.1	+39.1	2.8669
67	Iz	1.237	111.259	−1.7032	+1.7026	−1.7029	+0.6	+39.7	1.1640
Iz	68	0.376	111.635	+1.2055	−1.2047	+1.2051	+0.8	+40.5	2.3691
68	Sta. Rhinecliff	1.560	113.195	+0.85					3.22
68	Iyyy	1.554	113.189	+1.5967	−1.5978	+1.5972	+1.1	+41.6	3.9663
Iyyy	Iyy	0.031	113.220	+0.7585	−0.7577	+0.7583	+0.5	+41.1	4.7246
				+0.7585	−0.7584				
Iyy	69	0.069	113.289	−1.1565	+1.1555	−1.1560	+1.0	+42.1	3.5686
69	70	1.608	114.897	−1.2626	+1.2612	−1.2619	+1.4	+43.5	2.3067
70	71	1.610	116.507	−0.2008	+0.1994	−0.2001	+1.4	+44.9	2.1066
71	72	1.609	118.116	+1.1065	−1.1094	+1.1080	+2.9	+47.8	3.2146
72	73	1.607	119.723	−0.6836	+0.6855	−0.6846	−1.9	+45.9	2.5300
73	Iy	0.439	120.162	+0.6023	−0.6026	+0.6024	+0.3	+46.2	3.1324
Iy	74	1.175	121.337	+0.1772	−0.1758	+0.1765	−1.4	+44.8	3.3089
74	Sta. Barrytown	0.953	122.290	+1.49					4.80
74	75	1.620	122.957	+1.3158	−1.3171	+1.3164	+1.3	+46.1	4.6253
75	76	1.615	124.572	−1.9931	+1.9912	−1.9922	+1.9	+48.0	2.6331
76	Iv	0.237	124.809	−1.9344	+1.9338	−1.9341	+0.6	+48.6	0.6990
Iv	77	1.380	126.189	+1.2996	−1.3007	+1.3002	+1.1	+49.7	1.9992
77	78	1.616	127.805	+0.5755	−0.5767	+0.5761	+1.2	+50.9	2.5753
78	Sta. Tivoli	1.510	129.315	+0.36					2.94
78	79	1.613	129.418	+0.4610	−0.4611	+0.4610	+0.1	+51.0	3.0363
79	80	1.627	131.045	−0.6350	+0.6344	−0.6347	+0.6	+51.6	2.4016
80	It	0.109	131.154	−0.1675	+0.1682	−0.1678	−0.7	+50.9	2.2338
It	Is	0.993	132.147	+0.1291	−0.1266	+0.1278	−2.5	+48.4	2.3616
Is	81	0.506	132.653	+0.6300	−0.6300	+0.6300	0.0	+48.4	2.9916
81	Ir	1.671	134.324	−0.2438	+0.2437	−0.2438	+0.1	+48.5	2.7478
Ir	Iq	0.908	135.232	−0.0678	+0.0664	−0.0671	+1.4	+49.9	2.6807
Iq	82	0.675	135.907	+0.4327	−0.4339	+0.4333	+1.2	+51.1	3.1140
82	83	1.603	137.510	−0.0309	+0.0269	−0.0289	+4.0	+55.1	3.0851
83	Sta. Germantown.	0.510	138.020	+0.06					3.15
83	84	1.599	139.109	−0.3155	+0.3137	−0.3146	+1.8	+56.9	2.7705
84	Io	1.125	140.234	+0.2346	−0.2330	+0.2338	−1.6	+55.3	3.0043

Results of precise leveling from Dobbs Ferry to Greenbush, N. Y., 1902—Continued.

Bench mark.		Distance between successive bench marks.	Distance from bench mark V at Dobbs Ferry.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
Io	85	0.501	140.735	— 0.0260	+ 0.0248	— 0.0254	+1.2	+56.5	2.9789
85	86	1.592	142.327	— 0.3835	+ 0.3827	— 0.3831	+0.8	+57.3	2.5958
86	In	1.135	143.462	— 0.1695	+ 0.1696	— 0.1696	—0.1	+57.2	2.4262
In	87	0.471	143.933	+ 0.8318	— 0.8337	+ 0.8328	+1.9	+59.1	3.2590
87	Sta. Linlithgo	0.312	144.245	+ 0.10					3.36
87	R. R. 213	1.482	145.415	— 0.4713	+ 0.4738	— 0.4726	—2.5	+56.6	2.7864
R.R. 213	88	0.178	145.593	+ 0.0996	— 0.0989	+ 0.0992	—0.7	+55.9	2.8856
88	89	1.578	147.171	+ 0.0743	— 0.0708	+ 0.0726	—3.5	+52.4	2.9582
89	Im	0.075	147.246	+ 1.5420	— 1.5420	+ 1.5420	0.0	+52.4	4.5002
Im	Sta. Catskill	0.035	147.281	— 0.96					3.54
Im	90	1.551	148.797	— 2.1375	+ 2.1393	— 2.1384	—1.8	+50.6	2.3618
90	Ik	1.368	150.165	— 0.0004	— 0.0022	+ 0.0009	+2.6	+53.2	2.3627
Ik	91	0.236	150.401	— 0.1624	+ 0.1627	— 0.1626	—0.3	+52.9	2.2001
91	92	1.608	152.009	+ 1.0025	— 1.0022	+ 1.0024	—0.3	+52.6	3.2025
92	93	1.608	153.617	— 0.7706 — 0.7697	+ 0.7652 + 0.7659	— 0.7678	+4.6	+57.2	2.4347
93	94	1.136	154.753	+16.2523	—16.2497	+16.2510	—2.6	+54.6	18.6857
94	151 A	1.135	155.888	+27.5053	—27.5046	+27.5050	—0.7	+53.9	46.1907
151 A	City 14	0.249	156.137	+ 0.0782	— 0.0776	+ 0.0779	—0.6	+53.3	46.2686
City 14	City 29	0.717	156.854	—17.0829	+17.0826	—17.0828	+0.3	+53.6	29.1858
City 29	J1	0.090	156.944	+ 1.6621	— 1.6621	+ 1.6621	0.0	+53.6	30.8479
J1	Sta. Hudson	1.125	158.069	—27.74					3.11
J1	V. O. 4	1.180	158.124	—27.5943 —27.5915	+27.5859 +27.5903	—27.5905	+4.8	+58.4	3.2574
V. O. 4	95	0.951	159.075	— 0.9222	+ 0.9197	— 0.9210	+2.5	+60.9	2.3364
95	96	1.610	160.685	+ 0.0627	— 0.0638	+ 0.0632	+1.1	+62.0	2.3996
96	R. R. 223	0.780	161.465	+ 0.3085	— 0.3094	+ 0.3090	+0.9	+62.9	2.7086
R.R. 223	97	0.828	162.293	— 0.1939	+ 0.1941	— 0.1940	—0.2	+62.7	2.5146
97	98	1.605	163.898	+ 0.2484	— 0.2496	+ 0.2490	+1.2	+63.9	2.7636
98	98a	0.711	164.609	— 0.6281	+ 0.6283	— 0.6282	—0.2	+63.7	2.1354
98a	D. W. 1	0.164	164.773	— 0.0826	+ 0.0840	— 0.0833	—1.4		2.0521
98a	Sta. Stockport	0.307	164.916	+ 1.32					3.46
98a	99	0.894	165.503	+ 0.3947	— 0.3952	+ 0.3950	+0.5	+64.2	2.5304
99	100a	1.505	167.008	+ 0.6756	— 0.6771	+ 0.6764	+1.5	+65.7	3.2068
100a	101	1.703	168.711	— 0.5376	+ 0.5365	— 0.5370	+1.1	+66.8	2.6698
101	Sta. Coxsackie	1.137	169.848	+ 0.25					2.92
101	102	1.608	170.319	— 0.7407	+ 0.7400	— 0.7404	+0.7	+67.5	1.9294
102	R. R. 237	0.455	170.774	+ 0.1367	— 0.1367	+ 0.1367	0.0	+67.5	2.0661
R.R. 237	103	1.150	171.924	+ 0.5059	— 0.5023	+ 0.5041	—3.6	+63.9	2.5702
103	104	1.597	173.521	+ 0.4249	— 0.4208	+ 0.4228	—4.1	+59.8	2.9930
104	Ih	0.323	173.844	+ 1.0700	— 1.0716	+ 1.0708	+1.6	+61.4	4.0638

Results of precise leveling from Dobbs Ferry to Greenbush, N. Y., 1902—Continued.

Bench mark.		Distance between successive bench marks.	Distance from bench mark V at Dobbs Ferry.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
Ih	Sta. Stuyvesant	0.187	174.031	−0.43					3.63
Ih	105	1.347	175.191	−1.3951	+1.3922	−1.3936	+2.9	+64.3	2.6702
105	D.W. 3	1.413	176.604	+0.0979	−0.0980	+0.0980	+0.1	+64.4	2.7682
D.W. 3	106	0.398	177.002	−0.2148	+0.2141	−0.2144	+0.7	+65.1	2.5538
106	107	1.755	178.757	+0.0747	−0.0731	+0.0739	−1.6	+63.5	2.6277
107	108	1.594	180.351	+0.2435	−0.2450	+0.2442	+1.5	+65.0	2.8719
108	108a	0.061	180.412	+0.4182	−0.4183	+0.4182	+0.1	+65.1	3.2901
108a	If	0.802	181.214	−1.4869	+1.4866	−1.4868	+0.3	+65.4	1.8033
If	K_1	0.648	181.862	+1.4702	−1.4677	+1.4690	−2.5	+62.9	3.2723
K_1	109	0.174	182.036	+0.6226	−0.6215	+0.6220	−1.1	+61.8	3.8943
109	110	1.534	183.570	−0.8607	+0.8564	−0.8586	+4.3	−66.1	3.0357
110	Sta. Schodack	0.432	184.002	+0.38					3.42
110	111	1.491	185.061	+0.4686	−0.4708	+0.4697	+2.2	+68.3	3.5054
111	D. W. 1	1.248	186.309	+0.9406	−0.9365	+0.9386	−4.1	+64.2	4.4440
D. W. 1	112	0.450	186.759	−1.4432	+1.4424	−1.4428	+0.8	+65.0	3.0012
112	113	2.013	188.772	+0.4285	−0.4318	+0.4302	+3.3	+68.3	3.4314
113	L_1	1.400	190.172	+2.2332	−2.2365	+2.2348	+3.3	+71.6	5.6662
L_1	Ib	0.186	190.358	−0.5121	+0.5103	−0.5112	+1.8	+73.4	5.1550
Ib	Sta. Castleton	0.019	190.377	−0.57					4.59
Ib	114	1.312	191.670	−1.1869	+1.1870	−1.1870	−0.1	+73.3	3.9680
114	115	1.605	193.275	+0.7452	−0.7487	+0.7470	+3.5	+76.8	4.7150
115	116	1.551	194.826	−0.3073	+0.3095	−0.3084	−2.2	+74.6	4.4066
116	117	1.660	196.486	+0.1970	−0.1911	+0.1940	−5.9	+68.7	4.6006
117	118	1.607	198.093	+0.0897	−0.0892	+0.0894	−0.5	+68.2	4.6900
118	119	1.607	199.700	+0.1787	−0.1781	+0.1784	−0.6	+67.6	4.8684
119	M_1	1.840	201.540	+3.3260	−3.3219	+3.3240	−4.1	+63.5	8.1924
M_1	V. O. 1	0.107	201.647	−1.4888	+1.4895	−1.4892	−0.7	+62.8	6.7032
V. O. 1	N_1	0.411	202.058	−1.3361	+1.3355	−1.3358	+0.6	+63.4	5.3674
N_1	Gristmill	0.731	202.789	−1.1421	+1.1418	−1.1420	+0.3	+63.7	4.2254
Gristmill	(1875)	0.716	203.505	+0.0466	−0.0473	+0.0470	+0.7	+64.4	4.2724
(1875)	D. W.	1.140	204.645	+2.2281	−2.2302	+2.2292	+2.1	+66.5	6.5016
D. W.	Sta. Rensselaer	0.184	204.829	+1.23					7.73
D. W.	1 (1875)	0.919	205.564	+1.5059	−1.5061	+1.5060	+0.2	+66.7	8.0076
1 (1875)	Sta. Forbes Ave.	0.644	206.208	−1.80					6.21
1 (1875)	120	0.925	206.489	−1.9260	+1.9234	−1.9247	+2.6	+69.3	6.0829
120	121	1.608	208.097	+0.6313	−0.6328	+0.6320	+1.5	+70.8	6.7149
121	122	1.608	209.705	+0.7455	−0.7439	+0.7447	−1.6	+69.2	7.4596
122	123	1.608	211.313	−0.2028	+0.2034	−0.2031	−0.6	+68.6	7.2565
123	Sta. Iron Works.	1.116	212.429	+0.35					7.61
123	124	1.608	212.921	−0.2939	+0.2957	−0.2948	−1.8	+66.8	6.9617
124	O_1	0.772	213.693	+1.2085	−1.2089	+1.2087	+0.4	+67.2	8.1704

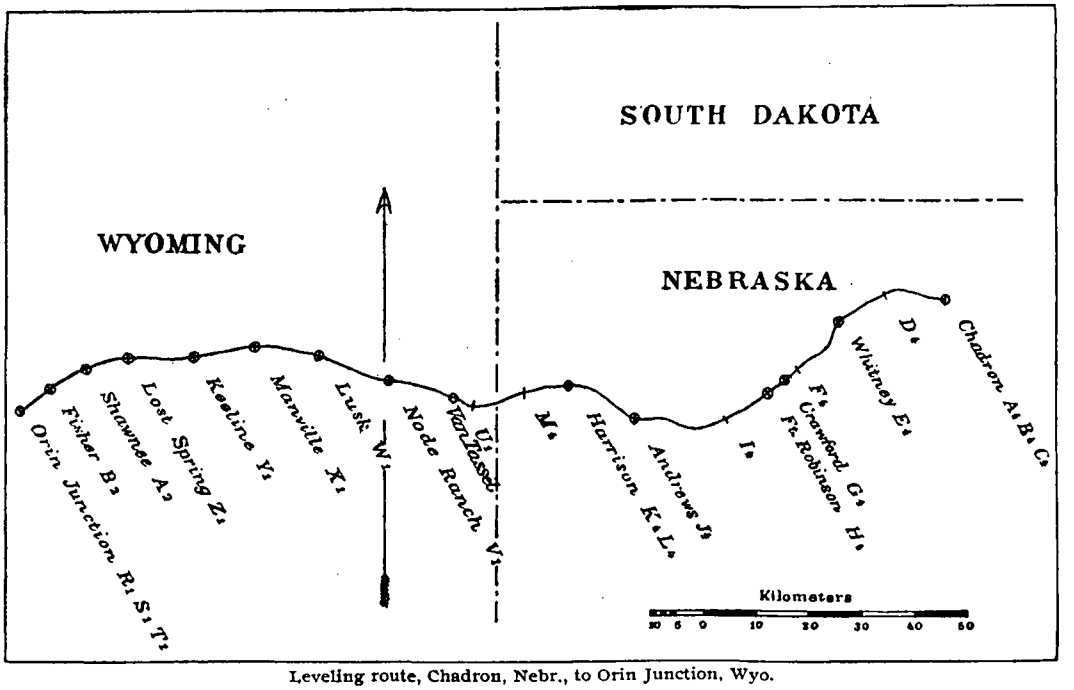
Results of precise leveling from Dobbs Ferry to Greenbush, N. Y., 1902—Continued.

Bench mark.		Distance between successive bench marks.	Distance from bench mark V at Dobbs Ferry.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
O_1	D. W. 2	0.205	213.898	−0.9282 −0.9286	+0.9298 +0.9285	−0.9288	−0.8	+66.4	7.2416
D. W. 2	City 1	0.135	214.033	−0.2145	+0.2149	−0.2147	−0.4		7.0269
D. W. 2	P_1	0.695	214.593	+1.0429	−1.0439	+1.0434	+1.0	+67.4	8.2850
P_1	City 2	0.056	214.649	−0.0610	+0.0613	−0.0612	−0.3	+67.1	8.2238

CHADRON–ORIN JUNCTION LINE.

This line was run by Aid W. C. Dibrell between June 24 and August 1, 1902, with level No. 7, one of the new type. It completed the circuit already referred to in connection with the line Norfolk–Page, and of which the principal points are Norfolk,

No. 16.



Leveling route, Chadron, Nebr., to Orin Junction, Wyo.

Orin Junction, Denver, Abilene, and Norfolk. The leveling followed the Fremont, Elkhorn and Missouri Valley Railroad. Velocipede cars were used. The heavy grades encountered over a considerable portion of the line made the work of pulling the cars

wearisome, but in spite of this the work was done with unusual rapidity, the whole line being run at the average rate of 98 miles per month.

Rods R_2 and S were used. Their lengths and index corrections are given in the text in connection with the line Dobbs Ferry–Greenbush, which precedes this line.

The elevations in the tabulation are based upon the elevation of bench mark C_4 at Chadron, as fixed by the Page–Chadron line, and depend therefore upon the elevations printed in Appendix 8, Report for 1899 for bench marks O_1 and P_1 at Norfolk. The elevations given in the tabulation for stations marked thus, (Sta. Whitney), refer to the top of rail in front of the railroad station named.

Results of precise leveling from Chadron, Nebr., to Orin Junction, Wyo., 1902.

Bench mark.		Distance between successive bench marks.	Distance from bench mark C_4 at Chadron.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
	B_4								1034.6074*
B_4	A_4	0.652		— 6.9260	+ 6.9279	— 6.9270	—1.9		1027.6804
	A_4								1027.6789*
A_4	C_4	1.495		— 9.7987	+ 9.8029	— 9.8008	—4.2		1017.8781
	C_4		0.000						1017.8811*
C_4	1	1.321	1.321	— 3.5530	+ 3.5549	— 3.5540	—1.9	— 1.9	1014.3271
1	2	1.418	2.739	— 7.1469	+ 7.1469	— 7.1469	0.0	— 1.9	1007.1802
2	3	1.626	4.365	— 8.2766	+ 8.2796	— 8.2781	—3.0	— 4.9	998.9021
3	4	1.627	5.992	— 5.1920	+ 5.1923	— 5.1922	—0.3	— 5.2	993.7099
4	5	1.549	7.541	+ 0.0777	— 0.0803	+ 0.0790	+2.6	— 2.6	993.7889
5	6	1.639	9.180	+11.3326	—11.3337	+11.3332	+1.1	— 1.5	1005.1221
6	7	1.606	10.786	— 0.0347	+ 0.0311	— 0.0329	+3.6	+ 2.1	1005.0892
7	D_4	0.156	10.942	+ 1.2404	— 1.2408	+ 1.2406	+0.4	+ 2.5	1006.3298
D_4	8	0.041	10.983	— 0.9305	+ 0.9306	— 0.9306	—0.1	+ 2.4	1005.3992
8	9	1.413	12.396	+ 3.7668	— 3.7681	+ 3.7674	+1.3	+ 3.7	1009.1666
9	10	1.590	13.986	+ 6.8002	— 6.7987	+ 6.7994	—1.5	+ 2.2	1015.9660
10	11	1.613	15.599	+ 6.1374	— 6.1381	+ 6.1378	+0.7	+ 2.9	1022.1038
11	12	1.608	17.207	— 1.6637	+ 1.6628	— 1.6632	+0.9	+ 3.8	1020.4406
12	13	1.560	18.767	+ 2.5527	— 2.5564	+ 2.5546	+3.7	+ 7.5	1022.9952
13	14	1.624	20.391	+10.5636	—10.5653	+10.5644	+1.7	+ 9.2	1033.5596
14	15	1.604	21.995	+ 3.3067	— 3.3092	+ 3.3080	+2.5	+11.7	1036.8676
15	Sta. Whitney	1.266	23.261	+ 2.87					1039.74
15	E_4	1.372	23.367	+ 3.0632	— 3.0616	+ 3.0624	—1.6	+10.1	1039.9300
E_4	16	1.868	25.235	+ 7.4995	— 7.5040	+ 7.5018	+4.5	+14.6	1047.4318
16	17	1.481	26.716	+ 8.7574	— 8.7625	+ 8.7617	+4.1	+18.7	1056.1935
				+ 8.7619	— 8.7649				
17	18	1.728	28.444	+ 8.9973	— 8.9980	+ 8.9976	+0.7	+19.4	1065.1911
18	19	1.610	30.054	— 0.8509	+ 0.8533	— 0.8521	—2.4	+17.0	1064.3390
19	20	1.641	31.695	+ 5.9047	— 5.8968†	+ 5.9054	+2.4	+19.4	1070.2444
				+ 5.9044	— 5.9070				
20	21	1.439	33.134	+10.1770	—10.1731	+10.1750	—3.9	+15.5	1080.4194
21	F_4	1.747	34.881	+16.0977†	—16.0922	+16.0897	+0.6	+17.1	1096.5091
				+16.0886	—16.0883				
F_4	22	1.609	36.490	— 1.2361	+ 1.2351	— 1.2356	+1.0	+18.1	1095.2735
22	23	1.599	38.089	+ 8.1375	— 8.1355	+ 8.1365	—2.0	+16.1	1103.4100
23	24	1.612	39.701	+ 9.9704	— 9.9664	+ 9.9684	—4.0	+12.1	1113.3784
24	G_4	1.081	40.782	+ 8.4593	— 8.4602	+ 8.4598	+0.9	+13.0	1121.8382
G_4	25	0.857	41.639	+ 3.7001	— 3.7014	+ 3.7008	+1.3	+14.3	1125.5390

*As determined by the line Page to Chadron, 1900. †Rejected.

Results of precise leveling from Chadron, Nebr., to Orin Junction, Wyo., 1902—Continued.

Bench mark.		Distance between successive bench marks.	Distance from bench mark C_4 at Chadron.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
25	Sta. Crawford	0.680	42.319	− 3.67					1121.87
25	26	1.606	43.245	+10.3880	−10.3881	+10.3880	+0.1	+14.4	1135.9270
26	27	1.612	44.857	+ 7.5120	− 7.5152	+ 7.5136	+3.2	+17.6	1143.4406
27	H_4	0.935	45.792	+10.6543	−10.6572	+10.6558	+2.9	+20.5	1154.0964
H_4	Sta. Robinson	0.194	45.986	− 0.79					1153.31
H_4	28	0.671	46.463	− 0.6860	+ 0.6831	− 0.6839	+1.1	+21.6	1153.4125
				− 0.6824					
28	29	1.610	48.073	+12.4763	−12.4787	+12.4784	+3.1	+24.7	1165.8909
					−12.4802				
29	30	1.606	49.679	+ 5.6065	− 5.6104	+ 5.6089	+2.2	+26.9	1171.4998
				+ 5.6098					
30	31	1.588	51.267	+10.5549	−10.5570	+10.5560	+2.1	+29.0	1182.0558
31	32	1.628	52.895	+ 7.9589	− 7.9614	+ 7.9602	+2.5	+31.5	1190.0160
32	33	1.593	54.488	+13.5468	−13.5472	+13.5470	+0.4	+31.9	1203.5630
33	34	1.612	56.100	+11.6277	−11.6266	+11.6272	−1.1	+30.8	1215.1902
34	I_4	0.623	56.723	+ 6.6224	− 6.6219	+ 6.6222	−0.5	+30.3	1221.8124
I_4	35	0.993	57.716	+ 9.9829	− 9.9826	+ 9.9828	−0.3	+30.0	1231.7952
35	36	1.579	59.295	+13.8154	−13.8107	+13.8130	−4.7	+25.3	1245.6082
36	37	1.598	60.893	+16.0054	−16.0039	+16.0046	−1.5	+23.8	1261.6128
37	38	1.599	62.492	+15.3854	−15.3876	+15.3865	+2.2	+26.0	1276.9993
38	39	1.605	64.097	+12.4116	−12.4099	+12.4108	−1.7	+24.3	1289.4101
39	40	1.600	65.697	+14.3127	−14.3174	+14.3146	+3.8	+28.1	1303.7247
				+14.3126	−14.3155				
40	41	1.604	67.301	+14.3994	−14.4052	+14.4023	+4.5	+32.6	1318.1270
				+14.4007	−14.4038				
41	42	1.459	68.760	+14.0627	−14.0637	+14.0632	+1.0	+33.6	1332.1902
42	43	1.460	70.220	+14.8977	−14.8997	+14.8987	+2.0	+35.6	1347.0889
43	J_4	0.013	70.233	− 0.2755	+ 0.2755	− 0.2755	0.0	+35.6	1346.8134
J_4	Sta. Andrews	1.065	71.298	+ 3.43					1350.24
J_4	44	1.887	72.120	+10.9873	−10.9840	+10.9856	−3.3	+32.3	1357.7990
44	45	1.602	73.722	+17.6270	−17.6225	+17.6248	−4.5	+27.8	1375.4238
45	46	1.604	75.326	+16.1461	−16.1424	+16.1433	−4.3	+23.5	1391.5671
					−16.1413				
46	47	1.607	76.933	+20.0561	−20.0439	+20.0458	+2.2	+25.7	1411.6129
				+20.0444	−20.0492				
47	48	1.588	78.521	+20.0902	−20.0929	+20.0916	+2.7	+28.4	1431.7045
48	49	1.605	80.126	+20.1031	−20.1026	+20.1028	−0.5	+27.9	1451.8073
49	50	1.599	81.725	+19.8027	−19.8043	+19.8035	+1.6	+29.5	1471.6108
50	K_4	1.593	83.318	+11.5362	−11.5361	+11.5362	−0.1	+29.4	1483.1470
K_4	51	1.627	84.945	− 7.0245	+ 7.0246	− 7.0246	−0.1	+29.3	1476.1224
51	L_4	1.015	85.960	+11.4338	−11.4340	+11.4339	+0.2	+29.5	1487.5563
L_4	52	1.290	87.250	− 8.3557	+ 8.3571	− 8.3564	−1.4	+28.1	1479.1999
52	Sta. Harrison	0.954	88.204	+ 1.14					1480.34
52	53	1.607	88.857	+ 2.1145	− 2.1143	+ 2.1144	−0.2	+27.9	1481.3143
53	54	1.629	90.486	+13.1634	−13.1625	+13.1630	−0.9	+27.0	1494.4773
54	55	1.606	92.092	+ 5.9288	− 5.9238	+ 5.9263	−5.0	+22.0	1500.4036
55	56	1.605	93.697	−15.4447	+15.4477	−15.4462	−3.0	+19.0	1484.9574
56	57	1.604	95.301	−12.2656	+12.2670	−12.2663	−1.4	+17.6	1472.6911
57	M_4	1.605	96.906	− 8.8026	+ 8.8030	− 8.8028	−0.4	+17.2	1463.8883

Results of precise leveling from Chadron, Nebr., to Orin Junction, Wyo., 1902—Continued.

Bench mark.		Distance between successive bench marks.	Distance from bench mark C_4 at Chadron.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
M_4	58	1.614	98.520	−13.8262	+13.8300	−13.8281	−3.8	+13.4	1450.0602
58	59	1.600	100.120	− 0.7705	+ 0.7753	− 0.7738	−3.7	+ 9.7	1449.2864
				− 0.7734	+ 0.7761				
59	60	1.609	101.729	−13.7959	+13.8031	−13.7994	−6.3	+ 3.4	1435.4870
				−13.7967	+13.8021				
60	61	1.600	103.329	+ 6.4558	− 6.4523	+ 6.4538	−2.9	+ 0.5	1441.9408
				+ 6.4552					
61	Sta. Van Tassell	0.243	103.572	+ 1.65					1443.59
61	62	1.608	104.937	+ 0.9652	− 0.9623	+ 0.9638	−2.9	− 2.4	1442.9046
62	63	1.604	106.541	+ 6.5453	− 6.5478	+ 6.5466	+2.5	+ 0.1	1449.4512
63	U_1	1.500	108.041	+ 3.5819	− 3.5818	+ 3.5818	−0.1	0.0	1453.0330
U_1	64	1.705	109.746	+ 2.6421*	− 2.8352	+ 2.8356	−0.7	− 0.7	1455.8686
				+ 2.8359					
64	65	1.530	111.276	+ 4.8872	− 4.8868	+ 4.8870	−0.4	− 1.1	1460.7556
65	66	1.680	112.956	+ 8.1799	− 8.1787	+ 8.1793	−1.2	− 2.3	1468.9349
66	67	1.602	114.558	+16.2523	−16.2517	+16.2520	−0.6	− 2.9	1485.1869
67	68	1.608	116.166	+ 1.9770	− 1.9775	+ 1.9772	+0.5	− 2.4	1487.1641
68	69	1.609	117.775	+ 6.0591	− 6.0596	+ 6.0594	+0.5	− 1.9	1493.2235
69	70	1.593	119.368	+11.3189	−11.3155	+11.3172	−3.4	− 5.3	1504.5407
70	71	1.605	120.973	+ 0.9695	− 0.9688	+ 0.9692	−0.7	− 6.0	1505.5099
71	V_1	0.970	121.943	− 0.1085	+ 0.1066	− 0.1076	+1.9	− 4.1	1505.4023
V_1	Sta. Node Ranch.	0.140	122.083	− 0.70					1504.70
V_1	72	0.635	122.578	− 2.3259	+ 2.3243	− 2.3251	+1.6	− 2.5	1503.0772
72	73	1.605	124.183	− 1.0039	+ 1.0048	− 1.0056	+1.2	− 1.3	1502.0716
				− 1.0082	+ 1.0249*				
73	74	1.597	125.780	+ 3.9789	− 3.9827	+ 3.9808	+3.8	+ 2.5	1506.0524
74	75	1.606	127.386	+ 3.0825	− 3.0821	+ 3.0823	+0.4	+ 2.9	1502.9701
75	76	1.603	128.989	+ 2.2505	− 2.2505	+ 2.2505	0.0	+ 2.9	1505.2206
76	77	1.605	130.594	+ 3.5188	− 3.5188	+ 3.5188	0.0	+ 2.9	1508.7394
77	78	1.598	132.192	+ 3.6797	− 3.6810	+ 3.6804	+1.3	+ 4.2	1512.4198
78	79	1.604	133.796	+ 8.1327	− 8.1323	+ 8.1325	−0.4	+ 3.8	1520.5523
79	W_1	1.993	135.789	+ 8.7477	− 8.7461	+ 8.7469	−1.6	+ 2.2	1529.2992
W_1	Sta. Lusk	0.327	136.116	+ 0.02					1529.32
W_1	80	1.234	137.023	+ 8.9255	− 8.9249	+ 8.9252	−0.6	+ 1.6	1538.2244
80	81	1.600	138.623	+10.1143	−10.1166	+10.1154	+2.3	+ 3.9	1548.3398
81	82	1.612	140.235	+12.0820	−12.0830	+12.0825	+1.0	+ 4.9	1560.4223
82	83	1.601	141.836	+12.0467	−12.0495	+12.0481	+2.8	+ 7.7	1572.4704
83	84	1.608	143.444	+ 6.2373	− 6.2377	+ 6.2375	+0.4	+ 8.1	1578.7079
84	85	1.607	145.051	+ 5.8844	− 5.8835	+ 5.8840	−0.9	+ 7.2	1584.5919
85	86	1.605	146.656	+ 4.6219	− 4.6208	+ 4.6214	−1.1	+ 6.1	1589.2133
86	87	1.595	148.251	+ 9.9888	− 9.9864	+ 9.9876	−2.4	+ 3.7	1599.2009
87	Sta. Manville	1.464	149.715	+ 0.50					1599.70
87	88	1.578	149.829	+ 0.6608	− 0.6604	+ 0.6606	−0.4	+ 3.3	1599.8615
88	X	0.044	149.873	− 0.3129	+ 0.3132	− 0.3130	−0.3	+ 3.0	1599.5485

*Rejected.

Results of precise leveling from Chadron, Nebr., to Orin Junction, Wyo., 1902—Continued.

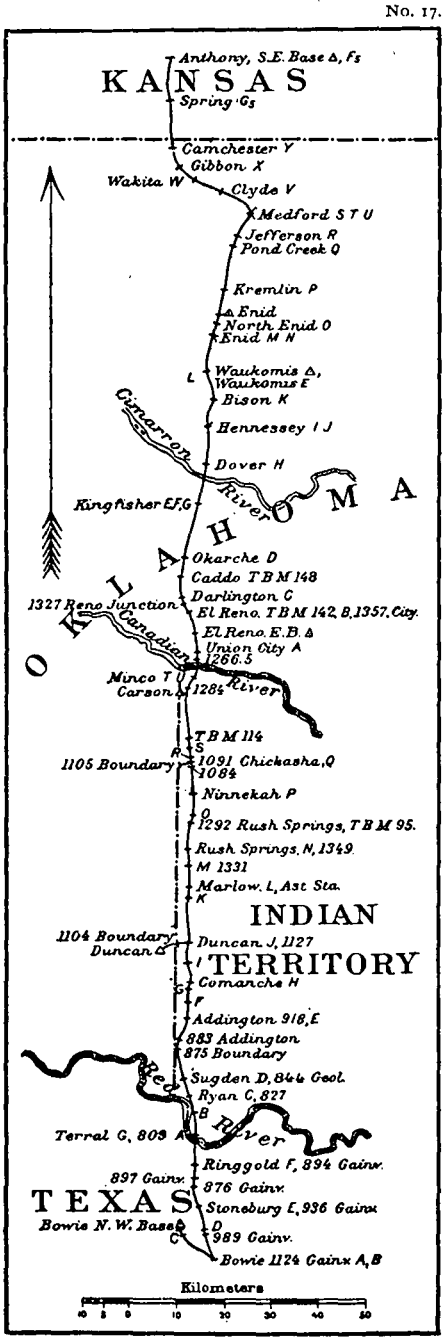
Bench mark.		Distance between successive bench marks.	Distance from bench mark C_4 at Chadron.	Difference of elevation.			Discrepancy (B−F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
X_1	89	1.600	151.473	+ 9.7649	− 9.7636	+ 9.7642	−1.3	+1.7	1609.3127
89	90	1.608	153.081	+ 3.3459	− 3.3456	+ 3.3458	−0.3	+1.4	1612.6585
90	91	1.603	154.684	+ 7.3692	− 7.3668	+ 7.3680	−2.4	−1.0	1620.0265
91	92	1.554	156.238	+ 8.3584	− 8.3601	+ 8.3592	+1.7	+0.7	1628.3857
92	93	1.601	157.839	− 0.5219	+ 0.5173	− 0.5196	+4.6	+5.3	1627.8661
93	94	1.636	159.475	− 3.6970	+ 3.7002	− 3.6986	−3.2	+2.1	1624.1675
94	95	1.599	161.074	− 9.7972	+ 9.8076*	− 9.7991	+0.2	+2.3	1614.3684
				− 9.8012	+ 9.7990				
95	Y_1	0.729	161.803	− 1.7534	+ 1.7547	− 1.7540	−1.3	+1.0	1612.6144
Y_1	Sta. Keeline	0.169	161.972	− 0.64					1611.97
Y_1	96	0.918	162.721	+ 3.9370	− 3.9366	+ 3.9368	−0.4	+0.6	1616.5512
96	97	1.608	164.329	+ 6.3722	− 6.3657	+ 6.3688	−3.1	−2.5	1622.9200
				+ 6.3686	− 6.3689				
97	98	1.607	165.936	− 9.1300	+ 9.1333	− 9.1316	−3.3	−5.8	1613.7884
98	99	1.603	167.539	−14.1034	+14.1029	−14.1032	+0.5	−5.3	1599.6852
99	100	1.596	169.135	−12.9084	+12.9035	−12.9061	+3.4	−1.9	1586.7791
				−12.9073	+12.9053				
100	101	1.607	170.742	−15.8479	+15.8487	−15.8483	−0.8	−2.7	1570.9308
101	102	1.593	172.335	−16.0726	+16.0735	−16.0730	−0.9	−3.6	1554.8578
102	103	1.618	173.953	−16.3092	+16.3099	−16.3096	−0.7	−4.3	1538.5482
103	104	1.631	175.584	−14.3783	+14.3787	−14.3785	−0.4	−4.7	1524.1697
104	Z_1	0.452	176.036	− 1.0307	+ 1.0303	− 1.0305	+0.4	−4.3	1523.1392
Z_1	Sta. Lost Spring.	0.148	176.184	+ 0.34					1523.48
Z_1	105	1.155	177.191	+ 4.4503	− 4.4538	+ 4.4520	+3.5	−0.8	1527.5912
105	106	1.602	178.793	− 1.8280	+ 1.8268	− 1.8274	+1.2	+0.4	1525.7638
106	107	1.599	180.392	+ 6.7709	− 6.7729	+ 6.7719	+2.0	+2.4	1532.5357
107	108	1.608	182.000	+ 1.3244	− 1.3257	+ 1.3250	+1.3	+3.7	1533.8607
108	109	1.608	183.608	+ 6.8193	− 6.8145	+ 6.8169	−4.8	−1.1	1540.6776
109	A_2	1.187	184.795	− 8.5351	+ 8.5344	− 8.5348	+0.7	−0.4	1532.1428
A_2	Sta. Shawnee	0.050	184.845	− 1.22					1530.92
A_2	110	0.404	185.199	− 4.7820	+ 4.7821	− 4.7820	−0.1	−0.5	1527.3608
110	111	1.609	186.808	−16.5951	+16.5946	−16.5948	+0.5	0.0	1510.7660
111	112	1.604	188.412	−15.8301	+15.8262	−15.8282	+3.9	+3.9	1494.9378
112	113	1.599	190.011	−15.7481	+15.7493	−15.7487	−1.2	+2.7	1479.1891
113	114	1.609	191.620	−12.7437	+12.7475	−12.7456	−3.8	−1.1	1466.4435
114	115	1.608	193.228	−10.2021	+10.2024	−10.2022	−0.3	−1.4	1456.2413
115	B_2	1.393	194.621	− 4.4328	+ 4.4333	− 4.4330	−0.5	−1.9	1451.8083
B_2	Sta. Fisher	0.147	194.768	− 0.05					1451.86
B_2	116	1.818	196.439	− 5.6072	+ 5.6080	− 5.6076	−0.8	−2.7	1446.2007
116	117	1.606	198.045	− 2.8631	+ 2.8622	− 2.8626	+0.9	−1.8	1443.3381
117	118	1.610	199.655	− 9.5153	+ 9.5146	− 9.5150	+0.7	−1.1	1433.8231
118	T_1	0.883	200.538	− 3.2240	+ 3.2229	− 3.2234	+1.1	0.0	1430.5997
T_1	S_1	0.960	201.498	+ 4.2651	− 4.2636	+ 4.2644	−1.5	−1.5	1434.8641
S_1	R_1	1.393	202.891	− 9.6173	+ 9.6212	− 9.6192	−3.9	−5.4	1425.2449

*Rejected.

BOWIE–ANTHONY LINE.

This line was run by Aid W. H. Burger between April 3 and July 11, 1902, with level No. 8, one of the new type. The line forms a part of the circuit Abilene, Kans.–Anthony, Kans.–Bowie, Tex.–Shreveport, La.–Monroe, La.–Little Rock, Ark.–Harrisonville, Mo.–Holliday, Kans.–Abilene, Kans. The line follows the Chicago, Rock Island and Pacific Railroad from Bowie, Tex., to Medford, Okla., and the Santa Fe Railroad from that point to Anthony, Kans. It is connected with Bowie Northwest Base, near Bellevue, Tex., by a branch line, and with the following triangulation stations along the ninety-eighth meridian by other short branch lines: Duncan, Carson, Elreno East Base, Waukomis, and Enid. The line ends at Anthony Southeast Base, which was also connected with the line Solomon–Anthony, 1900. The line serves therefore to control the elevations determined by measurements of vertical angles along the ninety-eighth meridian triangulation from Kansas to northern Texas, and to fix the heights of two base lines. Various connections were also made with bench marks which had been established by the United States Geological Survey in Indian Territory and Texas.

No. 17.



Leveling route, Bowie, Tex., to Anthony, Kans.

Velocipede cars were used over the whole length of the line and the conditions as to grades were very favorable. The leveling was done with unusual rapidity, 105 miles of line being completed during the month of June, and the average speed for the whole line being 91 miles per month.

Rods V and W were used. Their lengths at 0° C. in March, 1902, as determined by the National Bureau of Standards, were, for V, $3^{m}+1^{mm}.18$, and for W, $3^{m}+1^{mm}.63$. The mean of these is $3^{m}+1^{mm}.40$, or an excess of length of 0.47 millimeter per meter. As these rods had already been used in the field as early as 1900, and therefore were presumably holding a constant length, and as the following measures of the 3-meter interval on the rods showed no variations greater than can be accounted for as errors of observation, the lengths as determined at the Office at the beginning of the season and given above were used in making the computation.

Field measurements of rods.

Date.	Rod V.	Rod W.
1902.	*m.*	*m.*
Mar. 18	3.0012	3.0017
Apr. 3	3.0013	3.0016
14	3.0010	3.0015
May 5	3.0010	3.0016
13	3.0010	3.0017
June 2	3.0015	3.0022
18	3.0012	3.0017
30	3.0013	3.0015
July 12	3.0012	3.0017

The index corrections of rods V and W, as measured in January, 1902, were each 0.2 millimeter.

The elevations in the following tabulation are based upon that published for bench mark 1124 Gainv. by the United States Geological Survey (21st Annual Report, pt. 1, p. 485), this being one of their bench marks. The elevations given in the tabulation for stations marked thus (Sta. Bowie), refer to the top of rail in front of the railroad station named.

Results of precise leveling from Bowie, Tex., to Anthony, Kans., 1902.

Bench mark.		Distance between successive bench marks.	Distance from 1124 Gainv.	Difference of elevation.			Discrepancy (B−F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
	1124 Gainv.		0.000						342.3715
1124 Gainv.	A	0.959	0.959	−13.2989	+13.2966	−13.2978	+2.3	+2.3	329.0737
A	Sta. Bowie*			+3.13					332.20
1124 Gainv.	B	0.410	1.369	+6.4938	−6.4961	+6.4950	+2.3	+4.6	348.8665
A	1	0.479	1.438	+2.1076	−2.1101	+2.1088	+2.5	+4.8	331.1825
1	Bowie†			−0.17					331.01
				Beginning of line to Bellevue.					
1	2	2.934	4.372	−6.0322	+6.0305	−6.0314	+1.7	+6.5	325.1511
2	3	1.519	5.891	−6.4319	+6.4334	−6.4326	−1.5	+5.0	318.7185
3	4	1.719	7.610	+4.0985	−4.1063	+4.1036	+1.1	+6.1	322.8221
				+4.1075	−4.1019				
4	5	1.775	9.385	−19.4111	+19.4058	−19.4084	+5.3	+11.4	303.4137
5	6	1.757	11.142	−2.9428	+2.9419	−2.9424	+0.9	+12.3	300.4713
6	C	0.933	12.075	−10.8796	+10.8832	−10.8814	−3.6	+8.7	289.5899
C	7	1.505	13.580	+2.9047	−2.9070	+2.9058	+2.3	+11.0	292.4957
7	8	1.666	15.246	+17.1756	−17.1760	+17.1758	+0.4	+11.4	309.6715

*On rail at station of Chicago, Rock Island and Texas Pacific Railroad.
†Intersection of north rail of Fort Worth and Denver City Railroad and west rail of Chicago, Rock Island and Texas Railroad.

Results of precise leveling from Bowie, Tex., to Anthony, Kans., 1902—Continued.

Bench mark.		Distance between successive bench marks.	Distance from 1124 Gainv.	Difference of elevation.			Discrepancy (B−F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
8	9	1.594	16.840	+ 2.1900	− 2.1888	+ 2.1894	−1.2	+10.2	311.8609
9	Bowie N.W. Base △	1.048	17.888	+15.3335	−15.3332	+15.3334	−0.3	+ 9.9	327.1943
				End of line to Bellevue.					
1	12	0.562	2.000	− 3.4298	+ 3.4309	− 3.4304	−1.1	+ 3.7	327.7521
12	13	0.776	2.776	− 6.7449	+ 6.7446	− 6.7448	+0.3	+ 4.0	321.0073
13	14	0.838	3.614	− 0.6986	+ 0.6950	− 0.6968	+3.6	+ 7.6	320.3105
14	15	1.614	5.228	−11.1560	+11.1553	−11.1556	+0.7	+ 8.3	309.1549
15	989 Gainv.	1.562	6.790	− 7.7802	+ 7.7824	− 7.7813	−2.2	+ 6.1	301.3736
989 Gainv.	D	1.239	8.029	− 8.9867	+ 8.9888	− 8.9878	−2.1	+ 4.0	292.3858
D	16	2.058	10.087	− 0.1719	+ 0.1734	− 0.1726	−1.5	+ 2.5	292.2132
16	17	1.618	11.705	− 7.3593	+ 7.3571	− 7.3582	+2.2	+ 4.7	284.8550
17	18	1.556	13.261	+ 1.6704	− 1.6710	+ 1.6720	+2.4	+ 7.1	286.5270
					− 1.6747				
18	E	0.867	14.128	− 1.6804	+ 1.6772	− 1.6788	+3.2	+10.3	284.8482
E	Sta. Stoneburg			− 0.06					284.79
E	936 Gainv.	0.152	14.280	+ 0.3328	− 0.3329	+ 0.3328	+0.1	+10.4	285.1810
936 Gainv.	19	2.295	16.575	−10.5407	+10.5430	−10.5418	−2.3	+ 8.1	274.6392
19	20	1.618	18.193	−10.0343	+10.0361	−10.0352	−1.8	+ 6.3	264.6040
20	21	1.619	19.812	− 1.6147	+ 1.6141	− 1.6144	+0.6	+ 6.9	262.9896
21	876 Gainv.	1.618	21.430	+ 3.8434	− 3.8445	+ 3.8440	+1.1	+ 8.0	266.8336
876 Gainv.	22	1.620	23.050	− 3.1725	+ 3.1716	− 3.1720	+0.9	+ 8.9	263.6616
22	23	1.616	24.666	+ 1.1601	− 1.1620	+ 1.1610	−1.9	+10.8	264.8226
23	F	0.991	25.657	+ 3.7917	− 3.7928	+ 3.7922	+1.1	+11.9	268.6148
F	897 Gainv.	0.955	26.612	+ 4.4460	− 4.4490	+ 4.4475	+3.0	+14.9	273.0623
897 Gainv.	24	1.364	27.976	+ 8.6381	− 8.6364	+ 8.6372	−1.7	+13.2	281.6995
24	25	1.619	29.595	+ 0.7525	− 0.7538	+ 0.7527	+1.6	+14.8	282.4522
				+ 0.7518					
25	26	1.619	31.214	− 7.4265	+ 7.4236	− 7.4250	+2.9	+17.7	275.0272
26	27	1.017	32.231	− 3.6106	+ 3.6085	− 3.6096	+2.1	+19.8	271.4176
27	Sta. Ringgold			− 0.59					270.83
27	894 Gainv.	1.105	33.336	+ 1.0066	− 1.0078	+ 1.0072	+1.2	+21.0	272.4248
27	28	0.600	32.831	− 3.0563	+ 3.0560	− 3.0562	+0.3	+20.1	268.3614
28	29	1.617	34.448	− 8.6248	+ 8.6224	− 8.6236	+2.4	+22.5	259.7378
29	30	1.617	36.065	− 8.3075	+ 8.3028	− 8.3052	+4.7	+27.2	251.4326
30	G	2.212	38.277	− 3.0332	+ 3.0259	− 3.0290	+4.3	+31.5	248.4036
				− 3.0290	+ 3.0277				
G	809 Terral	0.490	38.767	− 1.9474	+ 1.9457	− 1.9466	+1.7	+33.2	246.4570
809 Terral	A*	1.682	40.449	+11.4733	−11.4819	+11.4776	+6.9	+40.1	257.9346
				+11.4738	−11.4821				
				+11.4754	−11.4794				
A	Sta. Terral			− 0.30					257.63
A	31	1.330	41.779	+ 0.0138	− 0.0112	+ 0.0125	−2.6	+37.5	257.9471
31	32	0.767	42.546	+ 0.1247	− 0.1217	+ 0.1232	−3.0	+34.5	258.0703
32	33	1.615	44.161	+ 0.8240	− 0.8218	+ 0.8229	−2.2	+32.3	258.8932

*Indian Territory.

Results of precise leveling from Bowie, Tex., to Anthony, Kans., 1902—Continued.

Bench mark.		Distance between successive bench marks.	Distance from 1124 Gainv.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
33	34	1.642	45.803	+0.3525	−0.3530	+0.3528	+0.5	+32.8	259.2460
34	35	1.591	47.394	+1.2654	−1.2714	+1.2661	−0.5	+32.3	260.5121
				+1.2673	−1.2604				
35	B	1.256	48.650	−7.3911	+7.3860	−7.3890	+2.9	+35.2	253.1231
				−7.3899	+7.3891				
B	36	1.977	50.627	+2.8644	−2.8663	+2.8654	+1.9	+37.1	255.9885
36	37	1.615	52.242	−3.6617	+3.6590	−3.6604	+2.7	+39.8	252.3281
37	38	1.616	53.858	−0.3301	+0.3272	−0.3286	+2.9	+42.7	251.9995
38	Sta. Ryan			−4.54					247.46
38	C	1.543	55.401	−0.1113	+0.1031	−0.1056	+3.3	+46.0	251.8939
				−0.1032	+0.1047				
C	827 Ryan	0.103	55.504	+0.1601	−0.1598	+0.1600	−0.3	+45.7	252.0539
C	39	1.695	57.096	+1.4969	−1.4972	+1.4970	+0.3	+46.3	253.3909
39	40	1.596	58.692	+3.6664	−3.6673	+3.6668	+0.9	+47.2	257.0577
40	41	1.637	60.329	−0.3492*	+0.3454	−0.3458	+0.9	+48.1	256.7119
				−0.3463					
41	U.S.G.S.	0.531	60.860	+0.5059	−0.5035	+0.5047	−2.4	+45.7	257.2166
U.S.G.S.	844 Sugden	0.345	61.205	−0.0330	+0.0337	−0.0334	−0.7	+45.0	257.1832
U.S.G.S.	42	1.176	62.036	+1.6116	−1.6159	+1.6138	+4.3	+50.0	258.8304
42	D	0.164	62.200	−0.5939	+0.5949	−0.5944	−1.0	+49.0	258.2360
42	Sta. Sugden			−0.69					258.14
42	43	1.616	63.652	+1.1684	−1.1730	+1.1707	+4.6	+54.6	260.0011
43	44	1.615	65.267	+1.8784	−1.8757	+1.8770	−2.7	+51.9	261.8781
44	45	1.617	66.884	+2.7004	−2.6972	+2.6988	−3.2	+48.7	264.5769
45	46	1.618	68.502	+0.1380	−0.1358	+0.1369	−2.2	+46.5	264.7138
46	47	1.618	70.120	+1.3228	−1.3180	+1.3204	−4.8	+41.7	266.0342
47	875 Bndy.	1.199	71.319	+0.4586	−0.4581	+0.4584	−0.5	+41.2	266.4926
875 Bndy.	48	0.724	72.043	+1.0706	−1.0679	+1.0692	−2.7	+38.5	267.5618
48	883 Add.	1.960	74.003	+1.5914	−1.5896	+1.5905	−1.8	+36.7	269.1523
883 Add.	49	1.275	75.278	+1.9214	−1.9225	+1.9220	+1.1	+37.8	271.0743
49	50	1.615	76.893	+1.8334	−1.8358	+1.8346	+2.4	+40.2	272.9089
50	51	1.614	78.507	+2.7721	−2.7741	+2.7731	+2.0	+42.2	275.6820
51	52	1.617	80.124	+1.8685	−1.8719	+1.8702	+3.4	+45.6	277.5522
52	53	1.616	81.740	+0.5917	−0.5898	+0.5908	−1.9	+43.7	278.1430
53	E	0.099	81.839	−0.9568	+0.9568	−0.9568	0.0	+43.7	277.1862
53	918 Add.	0.526	82.266	+1.4780	−1.4766	+1.4773	−1.4	+42.3	279.6203
918 Add.	Sta. Addington			−0.52					279.10
918 Add.	54	1.089	83.355	−0.0527	+0.0504	−0.0516	+2.3	+44.6	279.5687
54	55	1.619	84.974	+1.3235	−1.3274	+1.3254	+3.9	+48.5	280.8941

* Rejected. Result obtained by correcting apparent interchange of sights.

Results of precise leveling from Bowie, Tex., to Anthony, Kans., 1902—Continued.

Bench mark.		Distance between successive bench marks.	Distance from 1124 Gainv.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
55	56	1.619	86.593	+ 2.0305	— 2.0283	+ 2.0294	— 2.2	+46.3	282.9235
56	F	1.193	87.786	+ 0.5199	— 0.5233	+ 0.5216	+3.4	+49.7	283.4451
F	57	2.035	89.821	+ 5.3868	— 5.3852	+ 5.3860	—1.6	+48.1	288.8311
57	58	1.606	91.427	— 0.0422	+ 0.0414	— 0.0418	+0.8	+48.9	288.7893
58	59	1.645	93.072	+ 2.4878	— 2.4885	+ 2.4882	+0.7	+49.6	291.2775
59	M. Pole 487*	0.111	93.183	+ 0.8062	— 0.8058	+ 0.8060	—0.4	+49.2	292.0835
59	G	1.173	94.245	+ 3.5548	— 3.5533	+ 3.5540	—1.5	+48.1	294.8315
G	60	2.044	96.289	+ 3.1920	— 3.1902	+ 3.1911	—1.8	+46.3	298.0226
60	H	0.292	96.581	+ 2.5771	— 2.5771	+ 2.5771	0.0	+46.3	300.5997
60	Sta. Comanche			+ 0.90					298.92
60	61	1.646	97.935	+ 3.8191	— 3.8182	+ 3.8186	—0.9	+45.4	301.8412
61	62	1.573	99.508	+ 6.1333	— 6.1307	+ 6.1320	—2.6	+42.8	307.9732
62	63	1.615	101.123	+ 2.2279	— 2.2263	+ 2.2271	—1.6	+41.2	310.2003
63	64	1.752	102.875	+ 1.0415	— 1.0406	+ 1.0410	—0.9	+40.3	311.2413
64	I	0.268	103.143	— 1.5588	+ 1.5578	— 1.5583	+1.0	+41.3	309.6830
64	65	1.491	104.366	+ 2.8633	— 2.8604	+ 2.8618	—2.9	+37.4	314.1031
65	66	1.586	105.952	+ 4.0019	— 3.9945	+ 3.9994	—3.9	+33.5	318.1025
				+ 4.0007	— 4.0004				
66	67	1.655	107.607	+10.7085	—10.7017	+10.7056	—4.4	+29.1	328.8081
				+10.7071	—10.7051				
67	68	1.618	109.225	+ 4.2045	— 4.1994	+ 4.2020	—5.1	+24.0	333.0101
68	69	1.618	110.843	+ 6.1641	— 6.1605	+ 6.1623	—3.6	+20.4	339.1724
69	69a	1.392	112.235	— 1.0321	+ 1.0302	— 1.0312	+1.9	+22.3	338.1412
69a	69b	1.522	113.757	— 1.1048	+ 1.1107	— 1.1075	—4.2	+18.1	337.0337
				— 1.1060	+ 1.1084				
69b	1104 Bndy.	1.498	115.255	— 0.6757	+ 0.6755	— 0.6756	+0.2	+18.3	336.3581
1104 Boundary	69c	1.729	116.984	+20.1484	—20.1497	+20.1490	+1.3	+19.6	356.5071
69c	69d	1.712	118.696	+13.8581	—13.8539	+13.8560	—4.2	+15.4	370.3631
69d	Duncan △	1.686	120.382	+ 2.6615	— 2.6631	+ 2.6623	+1.6	+17.0	373.0254
69	J	0.752	111.595	+ 4.0043	— 4.0036	+ 4.0040	—0.7	+19.7	343.1764
J	Sta. Duncan			— 0.05					343.13
J	1127 Duncan	0.601	112.196	+ 0.3599	— 0.3629	+ 0.3614	+3.0	+22.7	343.5378
J	70	0.867	112.462	+ 3.3655	— 3.3631	+ 3.3643	—2.4	+17.3	346.5407
70	71	1.621	114.083	+12.9506	—12.9461	+12.9484	—4.5	+12.8	359.4891
71	72	1.770	115.853	+12.3250	—12.3227	+12.3238	—2.3	+10.5	371.8129
72	73	1.474	117.327	+10.8893	—10.8873	+10.8883	—2.0	+ 8.5	382.7012
73	74	1.617	118.944	+ 7.7904	— 7.7901	+ 7.7902	—0.3	+ 8.2	390.4914
74	75	1.619	120.563	+ 2.1459	— 2.1499	+ 2.1479	+4.0	+12.2	392.6339

*Spike in pole.

Results of precise leveling from Bowie, Tex., to Anthony, Kans., 1902—Continued.

Bench mark.		Distance between successive bench marks.	Distance from 1124 Gainv.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
75	76	1.618	122.181	+ 5.5710	— 5.5696	+ 5.5703	—1.4	+10.8	398.2096
76	77	1.618	123.799	+ 0.5684	— 0.5670	+ 0.5677	—1.4	+ 9.4	398.7773
77	K	0.056	123.855	— 3.2942	+ 3.2952	— 3.2947	—1.0	+ 8.4	395.4826
77	78	1.617	125.416	— 5.1144	+ 5.1128	— 5.1136	+1.6	+11.0	393.6637
78	79	1.615	127.031	— 3.0974	+ 3.0950	— 3.0962	+2.4	+13.4	390.5675
79	80	0.990	128.021	+ 2.2053	— 2.2057	+ 2.2055	+0.4	+13.8	392.7730
80	Sta. Marlow			+ 0.40					393.17
80	L	0.531	128.552	+ 7.5272	— 7.5260	+ 7.5266	—1.2	+12.6	400.2996
L	Marlow Ast. Sta.	0.311	128.863	— 0.4321	+ 0.4320	— 0.4320	+0.1	+12.7	399.8676
80	81	0.625	128.646	+ 0.5106	— 0.5096	+ 0.5101	—1.0	+12.8	393.2831
81	82	1.595	130.241	+10.8574	—10.8559	+10.8566	—1.5	+11.3	404.1397
82	1331 Marlow	1.428	131.669	+ 1.6888	— 1.6900	+ 1.6894	+1.2	+12.5	405.8291
1331 Marlow	83	1.831	133.500	— 7.6088	+ 7.6046	— 7.6067	+4.2	+16.7	398.2224
83	M	1.084	134.584	—11.5991	+11.5999	—11.5995	—0.8	+15.9	386.6229
M	84	0.930	135.514	+ 5.5816	— 5.5781	+ 5.5798	—3.5	+12.4	392.2027
84	85	1.220	136.734	+10.3362	—10.3370	+10.3366	+0.8	+13.2	402.5393
85	86	1.619	138.353	— 3.9462	+ 3.9484	— 3.9473	—2.2	+11.0	398.5920
86	87	1.618	139.971	+ 4.8585	— 4.8564	+ 4.8574	—2.1	+ 8.9	403.4494
87	88	1.616	141.587	— 2.4822	+ 2.4838	— 2.4830	—1.6	+ 7.3	400.9664
88	N	1.791	143.378	— 7.2912	+ 7.2904	— 7.2908	+0.8	+ 8.1	393.6756
N	Sta. Rush Springs.			— 0.46					393.22
N	1349 R.Spr.	0.453	143.831	+17.6162	—17.6156	+17.6159	—0.6	+ 7.5	411.2915
N	89	1.448	144.825	+ 6.9241	— 6.9185	+ 6.9230	—3.2	+ 4.9	400.5986
				+ 6.9251	— 6.9243				
89	90	1.655	146.481	+11.6462	—11.6412	+11.6437	—5.0	— 0.1	412.2423
90	91	1.578	148.059	+12.7058	—12.7114	+12.7094	+2.4	+ 2.3	424.9517
				+12.7106	—12.7097				
91	92	1.615	149.674	—10.9037	+10.9043	—10.9040	—0.6	+ 1.7	414.0477
92	93	1.672	151.346	—13.4403	+13.4366	—13.4384	—3.7	+ 5.4	400.6093
93	1292 R.Spr.	0.986	152.332	— 6.8121	+ 6.8149	— 6.8135	—2.8	+ 2.6	393.7958
1292 Rush Springs	94	0.578	152.990	— 3.6808	+ 3.6794	— 3.6801	+1.4	+ 4.0	390.1157
94	95	1.617	154.527	— 6.7503	+ 6.7566	— 6.7544	—3.5	+ 0.5	383.3613
				— 6.7549	+ 6.7556				
95	Mile Pole 449*			+ 0.58					383.94
95	96	1.619	156.146	— 0.7387	+ 0.7426	— 0.7406	—3.9	— 3.4	382.6207
96	O	0.965	157.171	— 9.3830	+ 9.3879	— 9.3866	—0.9	— 4.3	373.2341
				— 9.3892	+ 9.3862				
O	97	0.652	157.763	— 3.2582	+ 3.2581	— 3.2582	+0.1	— 4.2	369.9759

*Spike in pole.

Results of precise leveling from Bowie, Tex., to Anthony, Kans., 1902—Continued.

Bench mark.		Distance between successive bench marks.	Distance from 1124 Gainv.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
97	98	1.618	159.381	−11.9350	+11.9367	−11.9358	−1.7	− 5.9	358.0401
98	99	1.617	160.998	−12.5846	+12.5844	−12.5845	+0.2	− 5.7	345.4556
99	100	1.623	162.621	−10.5922	+10.5939	−10.5930	−1.7	− 7.4	334.8626
100	Sta. Ninnekah			− 6.44					328.42
100	P	1.741	164.362	− 6.9232	+ 6.9232	− 6.9232	0.0	− 7.4	327.9394
P	101	1.498	165.860	+ 7.9691	− 7.9716	+ 7.9704	−2.5	− 4.9	335.9098
101	102	1.621	167.481	+11.3729	−11.3734	+11.3732	+0.5	− 4.4	347.2830
102	103	1.616	169.097	+ 7.5719	− 7.5699	+ 7.5709	−2.0	− 6.4	354.8539
103	104	1.617	170.714	−10.7426	+10.7449	−10.7438	−2.3	− 8.7	344.1101
104	105	1.608	172.322	−11.1554	+11.1553	−11.1554	+0.1	− 8.6	332.9547
105	106	1.734	174.056	− 2.1001	+ 2.0989	− 2.0995	+1.2	− 7.4	330.8552
105	1084 Chick.				+ 2.4500	− 2.4500			330.5047
106	1084 Chick.			− 0.3510		− 0.3510			330.5042
								Mean	330.5044
106	107	1.761	175.817	+ 1.1019	− 1.1072	+ 1.1046	−5.3	− 2.1	331.9598
107	Sta. Chickasha.*			− 0.04					331.92
107	1091 Chick.	0.596	176.413	+ 0.6325	− 0.6325	+ 0.6325	0.0	− 2.1	332.5923
1091 Chick.	Q	0.206	176.619	+ 0.3183	− 0.3188	+ 0.3186	+0.5	− 1.6	382.9109
107	R	0.347	176.164	+ 0.1311	− 0.1305	− 0.1308	−0.6	− 2.7	332.0906
R	108	1.210	177.374	+ 0.7259	− 0.7249	− 0.7254	−1.0	− 3.7	332.8160
108	109	1.449	178.823	+ 1.1098	− 1.1104	− 1.1101	+0.6	− 3.1	333.9261
109	110	1.619	180.442	+ 2.1817	− 2.1772	+ 2.1794	−4.5	− 7.6	336.1055
110	1105 Bndy.	2.022	182.464	+ 0.7099	− 0.7087	− 0.7093	−1.2	− 8.8	336.8148
R	111	1.865	178.029	+ 0.1698	− 0.1697	− 0.1698	−0.1	− 2.8	332.2604
111	112	0.878	178.907	+ 0.9640	− 0.9639	+ 0.9640	−0.1	− 2.9	333.2244
112	S	0.925	179.832	− 1.4216	+ 1.4205	− 1.4210	+1.1	− 1.8	331.8034
S	113	0.693	180.525	+ 1.5596	− 1.5586	+ 1.5591	−1.0	− 2.8	333.3625
113	114	1.621	182.146	+ 2.1872	− 2.1870	+ 2.1871	−0.2	− 3.0	335.5496
114	115	1.617	183.763	+ 3.5080 + 3.5087	− 3.5161 − 3.5086	+ 3.5104	+4.0	+ 1.0	339.0600
115	116	1.595	185.358	+ 2.2237	− 2.2192	+ 2.2214	−4.5	− 3.5	341.2814
116	117	1.698	187.056	+10.1539 +10.1517	−10.1486 −10.1521	+10.1516	−2.4	− 5.9	351.4330
117	118	1.586	188.642	+ 5.9206	− 5.9182	+ 5.9194	−2.4	− 8.3	357.3524
118	119	1.555	190.197	+ 0.9700	− 0.9698	+ 0.9699	−0.2	− 8.5	358.3223
119	120	1.674	191.871	+ 5.3207 + 5.3186	− 5.3128 − 5.3178	+ 5.3175	−4.3	−12.8	363.6398
120	Sta. Windale			+ 1.36					365.00
120	121	1.525	193.396	+ 3.5930 + 3.5900	− 3.5865 − 3.5894	+ 3.5897	−3.5	−16.3	367.2295

*Ground in front of depot.

Results of precise leveling from Bowie, Tex., to Anthony, Kans., 1902—Continued.

Bench mark.		Distance between successive bench marks.	Distance from 1124 Gainv.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
121	122	1.684	195.080	+ 5.0082	— 5.0047	+ 5.0064	—3.5	—19.8	372.2359
122	123	1.606	196.686	+ 7.5219	— 7.5208	+ 7.5214	—1.1	—20.9	379.7573
123	124	1.633	198.319	+ 9.2991	— 9.2974	+ 9.2982	—1.7	—22.6	389.0555
124	125	1.780	200.099	+11.7197	—11.7207	+11.7202	+1.0	—21.6	400.7757
125	Carson △	1.112	201.211	+34.7775	—34.7767	+34.7771	—0.8	—22.4	435.5528
125	126	1.261	201.360	+ 0.2668	— 0.2672	+ 0.2670	+0.4	—21.2	401.0427
126	1284 Minco	1.140	202.500	— 9.5619	+ 9.5635	— 9.5627	—1.6	—22.8	391.4800
1248 Minco	127	0.797	203.297	— 3.0791	+ 3.0814	— 3.0802	—2.3	—25.1	388.3998
127	T	1.791	205.088	+ 6.7851	— 6.7836	+ 6.7844	—1.5	—26.6	395.1842
T	Sta. Minco			— 0.65					394.53
T	U	0.235	205.323	+ 1.1731	— 1.1723	+ 1.1727	—0.8	—27.4	396.3569
T	128	1.572	206.660	— 0.6277 — 0.6311	+ 0.6335 + 0.6316	— 0.6310	—3.2	—29.8	394.5532
128	129	1.503	208.163	— 7.1927	+ 7.1939	— 7.1933	—1.2	—31.0	387.3599
129	130	1.422	209.585	— 6.2017	+ 6.2064	— 6.2040	—4.7	—35.7	381.1559
130	131	1.032	210.617	+ 1.6408	— 1.6423	+ 1.6416	+1.5	—34.2	382.7975
131	1266.5 Union	0.935	211.552	+ 3.4762 + 3.4755	— 3.4815 — 3.4776	+ 3.4777	+3.8	—30.4	386.2752
1266.5 Union	132	1.620	213.172	+10.4109	—10.4136	+10.4122	+2.7	—27.7	396.6874
132	133	1.618	214.790	+ 9.4105	— 9.4099	+ 9.4102	—0.6	—28.3	406.0976
133	Sta. Union			— 0.59					405.51
133	A*	0.084	214.874	+ 0.6316	— 0.6308	+ 0.6312	—0.8	—29.1	406.7288
133	134	1.567	216.357	+ 5.1334	— 5.1336	+ 5.1335	+0.2	—28.1	411.2311
134	135	1.655	218.012	+ 4.0339	— 4.0291	+ 4.0315	—4.8	—32.9	415.2626
135	136	1.596	219.608	+ 5.0430	— 5.0399	+ 5.0414	—3.1	—36.0	420.3040
136	137	1.295	220.903	+ 3.0243	— 3.0226	+ 3.0234	—1.7	—37.7	423.3274
137	Elreno E. B. △	1.263	222.166	+16.5778 +16.5753	—16.5839 —16.5757	+16.5782	+3.2	—34.5	439.9056
137	138	1.800	222.703	— 9.7504 — 9.7521	+ 9.7555 + 9.7528	— 9.7527	—3.0	—40.7	413.5747
138	139	2.027	224.730	+ 4.2741	— 4.2696	+ 4.2718	—4.5	—45.2	417.8465
139	140	1.373	226.103	+ 1.7913	— 1.7898	+ 1.7906	—1.5	—46.7	419.6371
140	141	1.608	227.701	— 2.9392	+ 2.9420	— 2.9406	—2.8	—49.5	416.6965
141	142	1.629	229.340	— 0.6582	+ 0.6605	— 0.6594	—2.3	—51.8	416.0371
142	Sta. Elreno			— 0.38					415.66
142	B	0.601	229.941	— 1.5896	+ 1.5904	— 1.5900	—0.8	—52.6	414.4471
B	1357 Elreno	0.710	230.651	— 0.3786	+ 0.3803	— 0.3794	—1.7	—54.3	414.0677
1357 Elreno	City	0.065	230.716	— 0.4136	+ 0.4123	— 0.4130	+1.3	—53.0	413.6547

*Oklahoma Territory.

Results of precise leveling from Bowie, Tex., to Anthony, Kans., 1902—Continued.

Bench mark.		Distance between successive bench marks.	Distance from 1124 Gainv.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
142	143	1.621	230.961	— 9.3509	+ 9.3497	— 9.3503	+1.2	—50.6	406.6868
143	1327 Reno Junct.	1.932	232.893	— 1.7649	+ 1.7622	— 1.7636	+2.7	—47.9	404.9232
1327 Reno Junct.	Reno Junct.*			+ 1.19					406.11
1327 Reno Junct.	144	1.312	234.205	+ 0.7025	— 0.7004	+ 0.7014	—2.1	—50.0	405.6246
144	145	1.619	235.824	+ 0.0643	— 0.0633† — 0.0644	+ 0.0644	—0.5	—50.5	405.6890
145	• C	1.065	236.889	+ 1.5208	— 1.5193	+ 1.5200	—1.5	—52.0	407.2090
C	Sta. Darlington			— 0.54					406.67
C	146	0.609	237.498	+ 1.5569	— 1.5592	+ 1.5580	+2.3	—49.7	408.7670
146	147	1.570	239.068	+10.9521	—10.9476	+10.9498	—4.5	—54.2	419.7168
147	148	1.650	240.718	— 3.4467	+ 3.4436	— 3.4452	+3.1	—51.1	416.2716
148	Highest Pt.‡			+ 6.78					423.05
148	149	1.573	242.291	—11.7963	+11.7976	—11.7970	—1.3	—52.4	404.4746
149	150	1.504	243.795	—10.9416	+10.9387	—10.9402	+2.9	—49.5	393.5344
150	151	1.643	245.438	—11.2982	+11.3002	—11.2992	—2.0	—51.5	382.2352
151	152	1.682	247.120	+ 0.5828	— 0.5817	+ 0.5822	—1.1	—52.6	382.8174
152	153	1.605	248.725	— 3.4488	+ 3.4496	— 3.4492	—0.8	—53.4	379.3682
153	154	1.660	250.385	— 1.3968	+ 1.3932	— 1.3950	+3.6	—49.8	377.9732
154	155	1.572	251.957	— 0.2130	+ 0.2122	— 0.2126	+0.8	—49.0	377.7606
155	156	1.280	253.237	— 0.8501	+ 0.8515	— 0.8508	—1.4	—50.4	376.9098
156	Sta. Okarche			— 0.41					376.50
156	D	0.182	253.419	+ 0.6945	— 0.6954	+ 0.6950	+0.9	—49.5	377.6048
156	157	1.950	255.187	—12.3897	+12.3895	—12.3896	+0.2	—50.2	364.5202
157	158	1.696	256.883	— 5.8429	+ 5.8419	— 5.8424	+1.0	—49.2	358.6778
158	159	1.664	258.547	— 5.9165	+ 5.9140	— 5.9152	+2.5	—46.7	352.7626
159	160	1.579	260.126	— 6.9972	+ 6.9975	— 6.9974	—0.3	—47.0	345.7652
160	161	1.522	261.648	— 5.2218	+ 5.2236	— 5.2227	—1.8	—48.8	340.5425
161	162	1.603	263.251	— 5.6608	+ 5.6606	— 5.6607	+0.2	—48.6	334.8818
162	163	1.755	265.006	— 3.0465	+ 3.0413	— 3.0439	+5.2	—43.4	331.8379
163	164	1.597	266.603	— 7.3592	+ 7.3564	— 7.3578	+2.8	—40.6	324.4801
164	165	1.571	268.174	— 3.6838	+ 3.6824	— 3.6831	+1.4	—39.2	320.7970
165	E	0.716	268.890	+ 0.0380	— 0.0412	+ 0.0396	+3.2	—36.0	320.8366
E	Sta. Kingfisher			— 0.45					320.39
E	F	0.499	269.389	+ 1.3240	— 1.3240	+ 1.3240	0.0	—36.0	322.1606
F	G	0.246	269.635	— 0.2984	+ 0.2984	— 0.2984	0.0	—36.0	321.8622

*Northeast intersection of Chicago, Rock Island and Pacific and Choctaw, Oklahoma and Gulf railways.
†Rejected. Result obtained by correcting apparent interchange of sights.
‡Supposed highest point on Chicago, Rock Island and Pacific Railroad between Topeka and Fort Worth.

Results of precise leveling from Bowie, Tex., to Anthony, Kans., 1902—Continued.

Bench mark.		Distance between successive bench marks.	Distance from 1124 Gainv.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
E	166	1.046	269.936	— 4.3839	+ 4.3819	— 4.3829	+2.0	—34.0	316.4537
166	167	1.454	271.390	— 1.6016	+ 1.6000	— 1.6008	+1.6	—32.4	314.8529
167	168	1.617	273.007	— 0.1147	+ 0.1136	— 0.1142	+1.1	—31.3	314.7387
168	169	1.572	274.579	+ 7.5242	— 7.5308	+ 7.5291	+3.0	—28.3	322.2678
				+ 7.5311	— 7.5303				
169	170	1.719	276.298	+ 6.1522	— 6.1499	+ 6.1510	—2.3	—30.6	328.4188
170	171	1.493	277.791	— 9.1767	+ 9.1776	— 9.1772	—0.9	—31.5	319.2416
171	172	1.845	279.636	— 7.1000	+ 7.0997	— 7.0998	+0.3	—31.2	312.1418
172	173	1.586	281.222	+ 0.7082	— 0.7058	+ 0.7070	—2.4	—33.6	312.8488
173	Sta. Dover			+ 2.34					315.19
173	H	1.232	282.454	+ 2.1649	— 2.1640	+ 2.1644	—0.9	—34.5	315.0132
173	174	1.615	282.837	+ 3.6150	— 3.6125	+ 3.6138	—2.5	—37.0	316.4626
174	175	1.819	284.656	+12.9343	—12.9335	+12.9339	—0.8	—37.8	329.3965
175	175a	1.360	286.016	+ 1.7764	— 1.7728	+ 1.7746	—3.6	—41.4	331.1711
175a	176	1.580	287.596	+ 2.9619	— 2.9643*	+ 2.9638	+3.9	—37.5	334.1349
					— 2.9658				
176	177	1.781	289.377	— 1.2623	+ 1.2648	— 1.2636	—2.5	—40.0	332.8713
177	178	1.452	290.829	+ 3.1379	— 3.1319	+ 3.1349	—6.0	—46.0	336.0062
178	179	1.702	292.531	+ 1.9322	— 1.9318	+ 1.9320	—0.4	—46.4	337.9382
179	180	1.682	294.213	+11.3087	—11.3088	+11.3088	+0.1	—46.3	349.2470
180	181	1.359	295.572	— 0.1539	+ 0.1543	— 0.1541	—0.4	—46.7	349.0929
181	I	1.157	296.729	+ 5.0239	— 5.0289	+ 5.0270	+0.8	—45.9	354.1199
				+ 5.0293	— 5.0259				
I	Sta. Hennessey			— 0.28					353.84
I	J	0.282	297.011	+ 0.1235	— 0.1215	+ 0.1225	—2.0	—47.9	354.2424
I	182	1.269	297.998	+ 1.2100	— 1.2102	+ 1.2101	+0.2	—45.7	355.3300
182	183	1.175	299.173	+ 1.4052	— 1.4040	+ 1.4046	—1.2	—46.9	356.7346
183	184	1.560	300.733	+ 2.4698	— 2.4725	+ 2.4712	+2.7	—44.2	359.2058
184	185	1.565	302.298	+ 2.6179	— 2.6173	+ 2.6176	—0.6	—44.8	361.8234
185	186	1.579	303.877	+ 5.5508	— 5.5519	+ 5.5514	+1.1	—43.7	367.3748
186	187	1.655	305.532	+ 7.7570	— 7.7556	+ 7.7563	—1.4	—45.1	375.1311
187	K	1.337	306.869	+ 2.7541	— 2.7592	+ 2.7573	+3.0	—42.1	377.8884
				+ 2.7574	— 2.7584				
K	Sta. Bison			+ 0.43					378.32
K	188	1.860	308.729	— 9.2533	+ 9.2552	— 9.2542	—1.9	—44.0	368.6342
188	189	1.533	310.262	+ 6.9443	— 6.9429	+ 6.9436	—1.4	—45.4	375.5778
189	190	1.726	311.988	+ 0.8802	— 0.8777	+ 0.8790	—2.5	—47.9	376.4568
190	191	1.562	313.550	— 1.4539	+ 1.4513	— 1.4526	+2.6	—45.3	375.0042
191	192	1.616	315.166	+ 2.6128	— 2.6100	+ 2.6114	—2.8	—48.1	377.6156
192	193	0.968	316.134	- 0.4506	+ 0.4496	— 0.4501	+1.0	—47.1	377.1655
193	193a	0.328	316.462	+ 3.7877	— 3.7884	+ 3.7880	+0.7	—46.4	380.9535
193a	L	0.368	316.830	+ 4.2569	— 4.2580	+ 4.2574	+1.1	—45.3	385.2109

*Rejected. Result obtained by correcting apparent interchange of sights.

Results of precise leveling from Bowie, Tex., to Anthony, Kans., 1902—Continued.

Bench mark.		Distance between successive bench marks.	Distance from 1124 Gainv.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
193a	Waukomis △	1.228	317.690	+ 7.6561	— 7.6586	+ 7.6574	+ 2.5	— 43.9	388.6109
Waukomis △	Waukomis E			— 4.1166					384.4943
193	194	1.136	317.270	— 5.0602	+ 5.0626	— 5.0614	— 2.4	— 49.5	372.1041
194	195	1.359	318.629	— 7.2197	+ 7.2212	— 7.2204	— 1.5	— 51.0	364.8837
195	196	1.525	320.154	+ 9.1701	— 9.1730	+ 9.1716	+ 2.9	— 48.1	374.0553
196	197	1.919	322.073	— 12.7803	— 12.7811	+ 12.7807	+ 0.8	— 47.3	386.8360
197	198	1.886	323.959	— 1.6680	+ 1.6712	— 1.6696	— 3.2	— 50.5	385.1664
198	199	1.341	325.300	— 1.9607	+ 1.9628	— 1.9618	— 2.1	— 52.6	383.2046
199	200	1.415	326.715	— 5.6337	+ 5.6324	— 5.6330	+ 1.3	— 51.3	377.5716
200	M	2.366	329.081	— 0.5100	— 0.5056	— 0.5078	+ 4.4	— 46.9	377.0638
M	Sta. Enid			+ 2.21					379.27
M	N	0.540	329.621	— 2.9709	— 2.9696	— 2.9702	— 1.3	— 48.2	380.0340
M	201	0.748	329.829	+ 1.1985	— 1.1960	— 1.1972	— 2.5	— 49.4	378.2610
201	202	1.892	331.721	+ 2.8079	— 2.8090	+ 2.8084	+ 1.1	— 48.3	381.0694
202	203	1.066	332.787	+ 0.9148	— 0.9113	+ 0.9130	— 3.5	— 51.8	381.9824
203	O	0.893	333.680	— 1.1107	+ 1.1092	— 1.1100	+ 1.5	— 50.3	380.8724
O	Sta. N. Enid			+ 0.31					381.18
O	204	0.960	334.640	— 1.9656	— 1.9664	— 1.9660	+ 0.8	— 49.5	382.8384
204	205	1.775	336.415	+ 1.7068	— 1.7105	+ 1.7086	+ 3.7	— 45.8	384.5470
205	205a	2.309	338.724	+ 0.3778	— 0.3754	+ 0.3766	— 2.4	— 48.2	384.9236
205a	Enid △	1.553	340.277	— 0.0434	— 0.0463	+ 0.0448	+ 2.9	— 45.3	384.9684
205	206	1.785	338.200	— 1.9691	+ 1.9688	— 1.9690	+ 0.3	— 45.5	382.5780
206	207	1.475	339.675	— 10.1326	+ 10.1382	— 10.1348	— 2.8	— 48.3	372.4432
				— 10.1343	+ 10.1341				
207	208	1.655	341.330	— 11.5424	+ 11.5391	— 11.5408	+ 3.3	— 45.0	360.9024
208	209	1.396	342.726	— 7.6572	+ 7.6556	— 7.6564	+ 1.6	— 43.4	353.2460
209	210	1.790	344.516	— 9.6691	+ 9.6686	— 9.6688	+ 0.5	— 42.9	343.5772
210	211	1.292	345.808	+ 0.8288	— 0.8302	+ 0.8295	+ 1.4	— 41.5	344.4067
211	212	0.698	346.506	— 2.6188	+ 2.6179	— 2.6184	+ 0.9	— 40.6	341.7883
212	Sta. Kremlin			+ 0.42					342.21
212	P	0.173	346.679	— 0.2235	+ 0.2251	— 0.2243	— 1.6	— 42.2	341.5640
212	213	1.143	347.649	— 6.4777	+ 6.4793	— 6.4785	— 1.6	— 42.2	335.3098
213	214	1.631	349.280	— 5.0051	+ 5.0053	— 5.0052	— 0.2	— 42.4	330.3046
214	215	1.645	350.925	+ 2.2107	— 2.2083	+ 2.2095	— 2.4	— 44.8	332.5141
215	216	1.780	352.705	— 8.9051	+ 8.9103	— 8.9077	— 5.2	— 50.0	323.6064
216	217	1.488	354.193	— 1.0772	+ 1.0796	— 1.0784	— 2.4	— 52.4	322.5280
217	218	1.588	355.781	+ 1.1067	— 1.1088	+ 1.1078	+ 2.1	— 50.3	323.6358
218	219	1.653	357.434	+ 1.9088	— 1.9123	+ 1.9106	+ 3.5	— 46.8	325.5464
219	220	1.531	358.965	— 2.4058	+ 2.4067	— 2.4062	— 0.9	— 47.7	323.1402
220	221	1.449	360.414	— 4.4672	+ 4.4667	— 4.4670	+ 0.5	— 47.2	318.6732

Results of precise leveling from Bowie, Tex., to Anthony, Kans., 1902—Continued.

Bench mark.		Distance between successive bench marks.	Distance from 1124 Gainv.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
221	Sta. Pond Creek			+ 0.69					319.36
221	Q	0.363	360.777	+ 1.3869	— 1.3860	+ 1.3864	—0.9	—48.1	320.0596
221	222	1.269	361.683	— 1.2701	+ 1.2708	— 1.2704	—0.7	—47.9	317.4028
222	223	1.817	363.500	— 1.0712	+ 1.0697	— 1.0704	+1.5	—46.4	316.3324
223	R	1.504	365.004	+ 2.9704	— 2.9721	+ 2.9712	+1.7	—44.7	319.3036
R	Sta. Jefferson			— 0.61					318.69
R	224	2.233	367.237	+ 2.9226	— 2.9227	+ 2.9226	+0.1	—44.6	322.2262
224	225	1.625	368.862	+ 3.5897	— 3.5913	+ 3.5905	+1.6	—43.0	325.8167
225	226	1.465	370.327	+ 3.3931	— 3.3917	+ 3.3924	—1.4	—44.4	329.2091
226	227	1.599	371.926	— 1.8621	+ 1.8651	— 1.8636	—3.0	—47.4	327.3455
227	228	1.626	373.552	+ 2.0633	— 2.0624	+ 2.0628	—0.9	—48.3	329.4083
228	229	1.565	375.117	— 0.2885	+ 0.2911	— 0.2898	—2.6	—50.9	329.1185
229	230	1.708	376.825	+ 3.0881	— 3.0885	+ 3.0883	+0.4	—50.5	332.2068
230	Sta. Medford*			+ 0.44					332.65
230	S	0.577	377.402	— 0.9014	+ 0.9005	— 0.9010	+0.9	—49.6	331.3058
S	T	0.503	377.905	+ 3.6723	— 3.6712	+ 3.6718	—1.1	—50.7	334.9776
230	U	1.249	378.074	+ 2.7261	— 2.7246	+ 2.7254	—1.5	—52.0	334.9322
U	Sta. Medford†			— 0.11					334.82
U	Medford‡			— 2.76					332.17
U	231	2.074	380.148	— 0.2199	+ 0.2217	— 0.2208	—1.8	—53.8	334.7114
231	232	1.741	381.889	— 1.2714	+ 1.2716	— 1.2715	—0.2	—54.0	333.4399
232	233	1.530	383.419	— 4.9998	+ 5.0019	— 5.0008	—2.1	—56.1	328.4391
233	234	1.437	384.856	+ 6.4306	— 6.4320	+ 6.4313	+1.4	—54.7	334.8704
234	235	1.495	386.351	+ 4.2997	— 4.2990	+ 4.2994	—0.7	—55.4	339.1698
235	Sta. Clyde			+ 0.18					339.35
235	V	0.034	386.385	+ 0.0581	— 0.0577	+ 0.0579	—0.4	—55.8	339.2277
235	236	1.647	387.998	— 6.1067	+ 6.1057	— 6.1062	+1.0	—54.4	333.0636
236	237	1.758	389.756	+ 1.8179	— 1.8169	+ 1.8174	—1.0	—55.4	334.8810
237	238	1.630	391.386	+ 4.1229	— 4.1221	+ 4.1225	—0.8	—56.2	339.0035
238	239	1.663	393.049	+ 1.7780	— 1.7824	+ 1.7802	+4.4	—51.8	340.7837
239	240	1.547	394.596	+ 3.4763	— 3.4776	+ 3.4770	+1.3	—50.5	344.2607
240	241	1.708	396.304	+14.0685	—14.0651	+14.0668	—3.4	—53.9	358.3275
241	Sta. Wakika			— 0.58					357.75
241	W	0.205	396.509	+ 1.8455	— 1.8460	+ 1.8458	+0.5	—53.4	360.1733
241	242	1.761	398.065	— 7.4381 — 7.4425	+ 7.4440 + 7.4401	— 7.4412	—1.7	—55.6	350.8863

* Sta. Medford, C., R. I. & P. Ry.
† Sta. Medford, A., T. & S. F. Ry.
‡ Intersection of C., R. I. & P. Ry. and A., T. & S. F. Ry.

Results of precise leveling from Bowie, Tex., to Anthony, Kans., 1902—Continued.

Bench mark.		Distance between successive bench marks.	Distance from 1124 Gainv.	Difference of elevation.			Discrepancy. (B − F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
242	243	1.470	399.535	+ 2.1219	− 2.1189	+ 2.1204	−3.0	−58.6	353.0067
243	244	1.635	401.170	− 1.1360	+ 1.1308	− 1.1331	+4.1	−54.5	351.8736
				− 1.1343	+ 1.1314				
244	245	1.604	402.774	+ 0.9119	− 0.9084	+ 0.9102	−3.5	−58.0	352.7838
245	246	1.695	404.469	+ 8.5687	− 8.5726	+ 8.5706	+3.9	−54.1	361.3544
246	Sta. Gibbon			+ 0.44					361.79
246	X	0.030	404.499	− 0.8458	+ 0.8462	− 0.8460	−0.4	−54.5	360.5084
246	247	1.443	405.912	− 2.6087	+ 2.6099	− 2.6093	−1.2	−55.3	358.7451
247	248	1.749	407.661	+ 4.8530	− 4.8478	+ 4.8504	−5.2	−60.5	363.5955
248	249	1.509	409.170	+ 6.7970	− 6.7952	+ 6.7961	−1.8	−62.3	370.3916
249	250	1.641	410.811	+ 8.7178	− 8.7169	+ 8.7174	−0.9	−63.2	379.1090
250	251	1.640	412.451	+13.3502	−13.3541	+13.3522	+3.9	−59.3	392.4612
251	Sta. Camchester			+ 1.06					393.52
251	Y	0.275	412.726	+ 0.1948	− 0.1948	+ 0.1948	0.0	−59.3	392.6560
251	252	1.546	413.997	+ 5.3928	− 5.3951	+ 5.3940	+2.3	−57.0	397.8552
252	253	1.707	415.704	+10.9922	−10.9939	+10.9930	+1.7	−55.3	408.8482
253	254	1.734	417.438	+ 5.0355	− 5.0351	+ 5.0353	−0.4	−55.7	413.8835
254	255	1.433	418.871	+ 2.8123	− 2.8060	+ 2.8094	−3.7	−59.4	416.6929
				+ 2.8103	− 2.8091				
255	256	1.670	420.541	+ 8.1759	− 8.1810	+ 8.1784	+5.1	−54.3	424.8713
256	G_5*	1.148	421.689	− 8.1163	+ 8.1100	− 8.1138	+2.7	−51.6	416.7575
				− 8.1141	− 8.1150				
G_5	257	1.998	423.687	−10.2860	+10.2844	−10.2852	+1.6	−50.0	406.4723
257	258	1.635	425.322	−12.3214	+12.3199	−12.3206	+1.5	−48.5	394.1517
258	259	1.719	427.041	− 2.4873	+ 2.4849	− 2.4861	+2.4	−46.1	391.6656
259	260	1.578	428.619	+ 2.8910	− 2.8912	+ 2.8911	+0.2	−45.9	394.5567
260	F_5	2.100	430.719	+15.0787	−15.0736	+15.0762	−5.1	−51.0	409.6329
F_5	261	1.825	432.544	+ 7.5405	− 7.5460	+ 7.5432	+5.5	−45.5	417.1761
261	Anthony S. E. B. △	0.780	433.324	+ 2.2909	− 2.2895	+ 2.2902	−1.4	−46.9	419.4663

* Kansas.

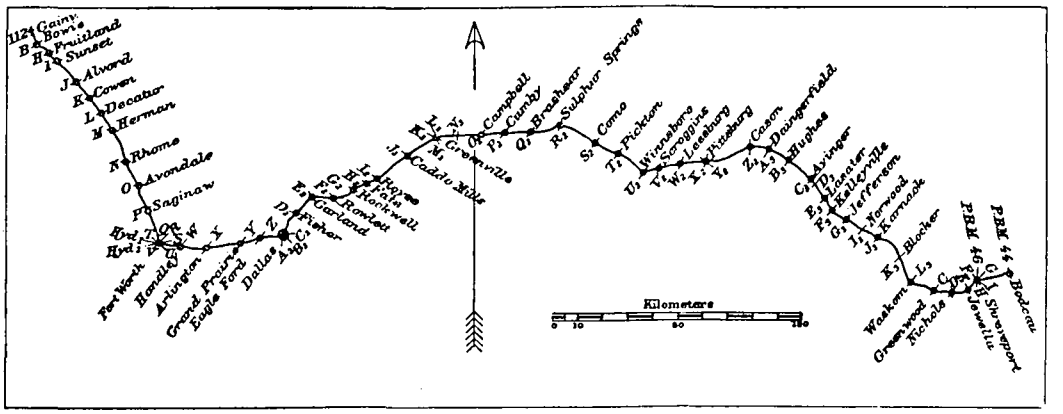
BOWIE–SHREVEPORT LINE.

This line was run by W. H. Burger, Aid, between July 14 and November 18, 1902, with levels Nos. 8 and 9, both of the new type. The change of instruments was made on account of the breakage in the field of the spider lines in the telescope of level No. 8. During the last few weeks of the leveling, R. L. Libby, Aid, was with the party preparing to take charge of it, and alternating with Mr. Burger in observing. This line served to close the circuit Shreveport, La.–Monroe, La.–Little Rock, Ark.–Harrisonville, Mo.–Holliday, Kans.–Abilene, Kans.–Bowie, Tex.–Shreveport, La. The line followed the Chicago, Rock Island and Texas Railroad from Bowie to Fort

Worth, thence the Texas and Pacific Railroad to Dallas, and the Missouri, Kansas and Texas Railroad to Shreveport. At Shreveport and Bodcau, La., the line connects with two permanent bench marks established in connection with the leveling by the United States Engineers from Monroe and Smithland, La., to Shreveport, La.

Velocipede cars were used over nearly the whole length of the line. Many heavy grades were encountered, and during a considerable portion of the time the weather was hot, the thermometers in the rods reading at times as high as 53° C. (127° F.). In spite of these two disadvantages the leveling was done with unusual rapidity, namely. at an average speed of 81 completed miles per month.

No. 18.



Leveling route, Bowie, Tex., to Shreveport, La.

Rods V and W were used. The field measures of length showed no appreciable change, and their corrections were assumed to be the same as during the leveling between Bowie and Anthony, Kans. (See p. 303.) The index corrections were also assumed to be unchanged.

The elevations in the following tabulation were based upon the assumed value, 342.8141 meters for bench mark 1124 Gainv. at Bowie, that being as close an approximation to the final adjusted elevation of that bench mark as could be made at the time the computation was commenced. The elevations given in the tabulation for stations marked thus (Sta. Bowie) refer to the top of the rail in front of the railroad station named.

Results of precise leveling from Bowie, Tex., to Shreveport, La.

Bench mark.		Distance between successive bench marks.	Distance from bench mark 1124 Gainv.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
	1124 Gainv.		0.000						342.8141*
1124 Gainv.	B	0.399		+ 6.4941	— 6.4940	+ 6.4940	—0.1		349.3081
	B								349.3091*
1124 Gainv.	Sta. Bowie†	0.108	0.108	+ 0.08					342.89
1124 Gainv.	1	1.605	1.605	— 6.2257	+ 6.2289	— 6.2273	—3.2	— 3.2	336.5868
1	2	1.570	3.175	— 5.3404	+ 5.3477	— 5.3435	—5.4	— 8.6	331.2433
				— 5.3412	+ 5.3448				
2	3	1.760	4.935	— 3.4043	+ 3.4013	— 3.4028	+3.0	— 5.6	327.8405
3	4	1.626	6.561	— 1.8238	+ 1.8224	— 1.8230	+1.4	— 4.2	326.0175
4	5	1.617	8.178	— 5.6971	+ 5.6964	— 5.6968	+0.7	— 3.5	320.3207
5	H	0.080	8.258	+ 1.1356	— 1.1352	+ 1.1354	—0.4	— 3.9	321.4561
5	Sta. Fruitland	0.089	8.267	— 0.20					320.12
5	6	1.617	9.795	— 8.7868	+ 8.7892	— 8.7880	—2.4	— 5.9	311.5327
6	7	1.666	11.461	— 4.6373	+ 4.6384	— 4.6378	—1.1	— 7.0	306.8949
7	8	1.625	13.086	— 9.6350	+ 9.6364	— 9.6357	—1.4	— 8.4	297.2592
8	9	1.361	14.447	+ 3.7263	— 3.7218	+ 3.7240	—4.5	—12.9	300.9832
9	Sta. Sunset	0.133	14.580	+ 1.61					302.59
9	I	0.186	14.633	+ 3.9948	— 3.9922	+ 3.9933	—1.8	—14.7	304.9765
				+ 3.9936	— 3.9927				
9	10	2.082	16.529	— 7.0458	+ 7.0461	— 7.0460	—0.3	—13.2	293.9372
10	11	1.620	18.149	— 6.7021	+ 6.7033	— 6.7027	—1.2	—14.4	287.2345
11	12	1.716	19.865	—10.3294	+10.3240	—10.3267	+5.4	— 9.0	276.9078
12	13	1.702	21.567	— 5.0929	+ 5.0930	— 5.0930	—0.1	— 9.1	271.8148
13	14	1.680	23.247	—18.1762	+18.1808	—18.1785	—4.6	—13.7	253.6363
14	15	1.922	25.169	+ 6.7530	— 6.7543	+ 6.7536	+1.3	—12.4	260.3899
15	16	1.949	27.118	+ 7.9598	— 7.9601	+ 7.9600	+0.3	—12.1	268.3499
16	Sta. Alvord	0.064	27.182	0.00					268.35
16	J	0.124	27.242	+ 1.8891	— 1.8887	+ 1.8889	—0.4	—12.5	270.2388
16	17	0.989	28.107	+ 8.1138	— 8.1152	+ 8.1145	+1.4	—10.7	276.4644
17	18	1.437	29.544	— 4.3870	+ 4.3830	— 4.3850	+4.0	— 6.7	272.0794
18	19	1.634	31.178	— 7.7430	+ 7.7402	— 7.7416	+2.8	— 3.9	264.3378
19	20	1.595	32.773	— 0.6230	+ 0.6229	— 0.6230	+0.1	— 3.8	263.7148
20	21	1.410	34.183	+15.2034	—15.2080	+15.2057	+4.6	+ 0.8	278.9205
21	22	2.033	36.216	—13.8531	+13.8549	—13.8540	—1.8	— 1.0	265.0665
22	K	0.469	36.685	+ 1.2333	— 1.2276	+ 1.2300	—2.4	— 3.4	266.2965
				+ 1.2292	— 1.2299				
22	Sta. Cowen	0.417	36.633	+ 1.05					266.12
22	23	1.524	37.740	+11.3100	—11.3114	+11.3107	+1.4	+ 0.4	276.3772

* From line, Bowie to Anthony, 1902, as corrected by the adjustment of 1902.
† Fort Worth and Denver Railroad.

Results of precise leveling from Bowie, Tex., to Shreveport, La.—Continued.

Bench mark.		Distance between successive bench marks.	Distance from bench mark 1124 Gainv.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
23	24	0.976	38.716	+ 6.5338	— 6.5325	+ 6.5332	—1.3	— 0.9	282.9104
24	25	1.829	40.545	— 4.3729	+ 4.3741	— 4.3735	—1.2	— 2.1	278.5369
25	26	1.530	42.075	+14.8877	—14.8912	+14.8894	+3.5	+ 1.4	293.4263
26	27	1.827	43.902	+23.0863	—23.0935	+23.0916	+2.4	+ 3.8	316.5179
				+23.0945	—23.0920				
27	28	1.631	45.533	+ 5.8233	— 5.8241	+ 5.8237	+0.8	+ 4.6	322.3416
28	L	0.658	46.191	+12.1329	—12.1331	+12.1330	+0.2	+ 4.8	334.4746
28	Sta. Decatur	0.101	45.634	+ 0.31					322.65
28	29	1.437	46.970	+ 0.8091	— 0.8078	+ 0.8084	—1.3	+ 3.3	323.1500
29	30	1.772	48.742	— 9.6855	+ 9.6905	— 9.6880	—5.0	— 1.7	313.4620
30	31	1.653	50.395	—13.5550	+13.5554	—13.5552	—0.4	— 2.1	299.9068
31	32	1.654	52.049	— 3.8984	+ 3.8911	— 3.8946	+2.9	+ 0.8	296.0122
				— 3.8937	+ 3.8951				
32	33	1.286	53.335	— 8.4448	+ 8.4451	— 8.4450	—0.3	+ 0.5	287.5672
33	M	1.230	54.565	— 4.6551	+ 4.6561	— 4.6556	—1.0	— 0.5	282.9116
M	Sta. Herman*	0.176	54.741	+ 1.68					284.59
M	34	2.170	56.735	+ 1.8218	— 1.8196	+ 1.8207	—2.2	— 2.7	284.7323
34	35	1.762	58.497	— 6.0441	+ 6.0477	— 6.0459	—3.6	— 6.3	278.6864
35	36	1.630	60.127	+ 5.6886	— 5.6871	+ 5.6878	—1.5	— 7.8	284.3742
36	37	1.800	61.927	+ 7.9301	— 7.9264	+ 7.9282	—3.7	—11.5	292.3024
37	38	1.642	63.569	+ 1.4984	— 1.4957	+ 1.4970	—2.7	—14.2	293.7994
38	39	1.345	64.914	— 4.4660	+ 4.4625	— 4.4642	+3.5	—10.7	289.3352
39	40	1.617	66.531	— 0.6477	+ 0.6491	— 0.6484	—1.4	—12.1	288.6868
40	41	1.304	67.835	+ 5.2627	— 5.2636	+ 5.2632	+0.9	—11.2	293.9500
41	42	1.880	69.715	—10.2995	+10.2994	—10.2994	+0.1	—11.1	283.6506
42	N	0.212	69.927	+ 2.5287	— 2.5269	+ 2.5278	—1.8	—12.9	286.1784
42	Sta. Rhone	0.086	69.801	+ 1.16					284.81
42	43	1.332	71.047	— 4.2174	+ 4.2202	— 4.2188	—2.8	—13.9	279.4318
43	44	1.425	72.472	— 3.2863	+ 3.2850	— 3.2856	+1.3	—12.6	276.1462
44	45	1.635	74.107	— 3.0609	+ 3.0593	— 3.0601	+1.6	—11.0	273.0861
45	46	1.510	75.617	— 5.0711	+ 5.0711	— 5.0711	0.0	—11.0	268.0150
46	47	1.763	77.380	— 0.3619	+ 0.3593	— 0.3606	+2.6	— 8.4	267.6544
47	48	1.652	79.032	— 9.2082	+ 9.2026	— 9.2042	+3.7	— 4.7	258.4502
				— 9.2040	+ 9.2021				
48	49	1.470	80.502	— 1.0724	+ 1.0726	— 1.0725	—0.2	— 4.9	257.3777
49	Sta. Avondale	0.904	81.406	+ 0.07					257.45
49	O	1.017	81.519	— 0.7175	+ 0.7132	— 0.7154	+2.4	— 2.5	256.6623
				— 0.7157	+ 0.7153				
O	50	1.929	83.448	+ 4.4248	— 4.4181	+ 4.4222	—2.4	— 4.9	261.0845
				+ 4.4219	— 4.4238				
50	51	1.957	85.405	— 1.5137	+ 1.5129	— 1.5133	+0.8	— 4.1	259.5712
51	52	1.526	86.931	— 3.9622	+ 3.9668	— 3.9645	—4.6	— 8.7	255.6067

*In front of station sign.

Results of precise leveling from Bowie, Tex., to Shreveport, La.—Continued.

Bench mark.		Distance between successive bench marks.	Distance from bench mark 1124 Gainv.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
52	Sta. Caleb*	0.231	87.162	— 0.45					255.16
52	53	1.846	88.777	— 5.5899	+ 5.5900	— 5.5900	—0.1	— 8.8	250.0167
53	54	1.691	90.468	— 6.3992†	+ 6.4072	— 6.4056	—3.3	—12.1	243.6111
				— 6.4039	+ 6.4117†				
54	55	1.697	92.165	— 4.3405	+ 4.3416	— 4.3410	—1.1	—13.2	239.2701
55	P	1.484	93.649	—10.0245	+10.0231	—10.0238	+1.4	—11.8	229.2463
P	56	1.615	95.264	— 7.2854	+ 7.2893	— 7.2874	—3.9	—15.7	221.9589
56	Sta. Saginaw‡	0.407	95.671	— 1.07					220.89
56	Sta. Saginaw§	0.539	95.803	— 0.99					220.97
56	Sta. Saginaw‖	0.124	95.388	+ 0.08					222.04
56	57	1.324	96.588	— 3.7947	+ 3.7936	— 3.7942	+1.1	—14.6	218.1647
57	58	1.541	98.129	— 2.1114	+ 2.1106	— 2.1110	+0.8	—13.8	216.0537
58	59	1.452	99.581	— 8.8674	+ 8.8677	— 8.8676	—0.3	—14.1	207.1861
59	Q	1.580	101.161	—15.4746	+15.4756	—15.4751	—1.0	—15.1	191.7110
Q	60	0.809	101.970	— 6.6407	+ 6.6375	— 6.6391	+3.2	—11.9	185.0719
60	61	1.582	103.552	—14.8703	+14.8742	—14.8722	—3.9	—15.8	170.1997
61	R	0.801	104.353	— 6.0818	+ 6.0813	— 6.0816	+0.5	—15.3	164.1181
R	S	2.151	106.504	— 2.2132	+ 2.2128	— 2.2130	+0.4	—14.9	161.9051
S	T	1.558	108.062	+11.9154	—11.9138	+11.9146	—1.6	—16.5	173.8197
T	U	1.337	109.399	+11.0921	—11.0951	+11.0936	+3.0	—13.5	184.9133
U	Hyd. 1	0.139	109.538	+ 1.0577	— 1.0570	+ 1.0574	—0.7	—14.2	185.9707
U	Fountain	0.496	109.895	+ 3.2613	— 3.2586	+ 3.2600	—2.7	—16.2	188.1733
Fountain	Sta. Fort Worth¶	0.255	110.150	— 0.90					187.27
Fountain	Hyd. 2	0.662	110.557	— 0.3597	+ 0.3593	— 0.3595	+0.4	—15.8	187.8138
Hyd. 2	V	0.050	110.607	+ 1.1804	— 1.1813	+ 1.1808	+0.9	—14.9	188.9946
U	62	1.418	110.817	—11.7520	+11.7529	—11.7524	—0.9	—14.4	173.1609
62	63	1.556	112.373	— 2.8958	+ 2.8916	— 2.8937	+4.2	—10.2	170.2672
63	64	1.642	114.015	+14.9561	—14.9594	+14.9578	+3.3	— 6.9	185.2250
64	65	1.545	115.560	+16.1612	—16.1662	+16.1637	+5.0	— 1.9	201.3887
65	66	1.664	117.224	— 8.4085	+ 8.4069	— 8.4077	+1.6	— 0.3	192.9810
66	67	1.659	118.883	— 9.0487	+ 9.0492	— 9.0490	—0.5	— 0.8	183.9320
67	68	0.916	119.799	— 6.0466	+ 6.0475	— 6.0470	—0.9	— 1.7	177.8850
68	Sta. Handley	0.275	120.074	+ 2.10					179.98
68	W	0.537	120.336	— 1.3471	+ 1.3497	— 1.3484	—2.6	— 4.3	176.5376
68	69	2.092	121.891	—19.9786	+19.9787	—19.9786	—0.1	— 1.8	157.9064
69	70	1.755	123.646	— 6.0286	+ 6.0335	— 6.0310	—4.9	— 6.7	151.8754

* In front of station sign.
† Rejected.
‡ Rail at intersection of Fort Worth and Denver City and Gulf, Colorado and Santa Fe Railroad. Intersection nearest station.
§ Rail at intersection nearest station of Chicago, Rock Island and Pacific and Gulf, Colorado and Santa Fe Railroads.
‖ Rail in front of station of Chicago, Rock Island and Pacific Railway.
¶ On rail at Texas and Pacific station on main through track in line with south side of building.

Results of precise leveling from Bowie, Tex., to Shreveport, La.—Continued.

Bench mark.		Distance between successive bench marks.	Distance from bench mark 1124 Gainv.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
70	71	1.644	125.290	+10.3828	−10.3823	+10.3826	−0.5	−7.2	162.2580
71	72	1.744	127.034	+16.1686	−16.1715	−16.1700	+2.9	−4.3	178.4280
72	73	1.532	128.566	+15.1606	−15.1541	−15.1558	−2.2	−6.5	193.5838
				+15.1532	−15.1553				
73	74	1.698	130.264	− 6.0552	+ 6.0621	− 6.0606	−5.0	−11.5	187.5232
				− 6.0609	+ 6.0640				
74	X	0.125	130.389	+ 1.0651	− 1.0660	+ 1.0656	+0.9	−10.6	188.5888
74	Sta. Arlington	0.060	130.324	+ 0.41					187.93
74	75	1.571	131.835	−15.8132	+15.8173	−15.8152	−4.1	−15.6	171.7080
75	76	1.584	133.419	+10.4625	−10.4630	+10.4628	+0.5	−15.1	182.1708
76	77	1.534	134.953	− 1.9144	+ 1.9110	− 1.9127	+3.4	−11.7	180.2581
77	78	1.647	136.600	− 4.2428	+ 4.2422	− 4.2425	+0.6	−11.1	176.0156
78	79	1.931	138.531	− 9.6192	+ 9.6234	− 9.6213	−4.2	−15.3	166.3943
79	80	1.819	140.350	− 5.9895	+ 5.9910	− 5.9902	−1.5	−16.8	160.4041
80	Y	0.147	140.497	− 0.2254	+ 0.2251	− 0.2252	+0.3	−16.5	160.1789
80	Sta. Grand Prairie.	0.081	140.431	+ 0.73					161.13
80	81	1.468	141.818	− 6.9922	+ 6.9977	− 6.9958	−3.6	−20.4	153.4083
				− 6.9957	+ 6.9974				
81	82	1.211	143.029	− 2.0509	+ 2.0502	− 2.0506	+0.7	−19.7	151.3577
82	83	1.861	144.890	−11.9491	+11.9534	−11.9512	−4.3	−24.0	139.4065
83	84	1.625	146.515	− 7.9585	+ 7.9635	− 7.9610	−5.0	−29.0	131.4455
84	85	1.920	148.435	− 0.4651	+ 0.4630	− 0.4640	+2.1	−26.9	130.9815
85	Z	1.915	150.350	+ 3.6499	− 3.6488	+ 3.6494	−1.1	−28.0	134.6309
Z	Sta. Eagle Ford	0.096	150.446	− 0.07					134.56
Z	86	0.900	151.250	− 4.0312	+ 4.0338	− 4.0325	−2.6	−30.6	130.5984
86	87	1.548	152.798	+ 0.8656	− 0.8617	+ 0.8636	−3.9	−34.5	131.4620
87	88	1.625	154.423	− 0.4442	+ 0.4433	− 0.4438	+0.9	−33.6	131.0182
88	89	1.454	155.877	− 1.3820	+ 1.3832	− 1.3826	−1.2	−34.8	129.6356
89	90	1.239	157.116	− 1.2643	+ 1.2627	− 1.2635	+1.6	−33.2	128.3721
90	91	1.081	158.197	+ 0.1832	− 0.1818	+ 0.1825	−1.4	−34.6	128.5546
91	92	1.142	159.339	+ 2.0366	− 2.0382	+ 2.0374	+1.6	−33.0	130.5920
92	A_2	0.260	159.599	+ 1.9197	− 1.9200	+ 1.9198	+0.3	−32.7	132.5118
92	Trinity River Bridge*	0.113	159.452	− 0.37					130.22
92	Sta. Dallas†	0.208	159.547	+ 0.46					131.05
92	Sta. Dallas‡	0.482	159.821	+ 0.76					131.35
92	93	1.111	160.450	+ 6.6243	− 6.6270	+ 6.6256	+2.7	−30.3	137.2176

*Texas and Pacific Railroad bridge, near center; top of rail. †Missouri, Kansas and Texas R.R.
‡Texas and Pacific R. R.

Results of precise leveling from Bowie, Tex., to Shreveport, La.—Continued.

Bench mark.		Distance between successive bench marks.	Distance from bench mark 1124 Gainv.	Difference of elevation.			Discrepancy (B−F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
93	B_2	0.217	160.667	− 0.5781	+ 0.5766	− 0.5774	+1.5	−28.8	136.6402
B_2	C_2	0.347	161.014	− 3.6411	+ 3.6422	− 3.6416	−1.1	−29.9	132.9986
92	94	1.616	160.955	− 0.9364	+ 0.9400	− 0.9382	−3.6	−36.6	129.6538
94	95	1.530	162.485	+ 6.1805	− 6.1830	+ 6.1818	+2.5	−34.1	135.8356
95	96	1.577	164.062	+15.3583	−15.3636	+15.3625	+3.4	−30.7	151.1981
				+15.3633	−15.3649				
96	97	1.606	165.668	+15.1103	−15.1165	+15.1117	+2.2	−28.5	166.3098
				+15.1108	−15.1090				
97	98	1.620	167.288	+12.3270	−12.3353	+12.3308	+4.1	−24.4	178.6406
				+12.3304	−12.3303				
98	99	1.632	168.920	− 3.9653	+ 3.9740	− 3.9696	−8.7	−33.1	174.6710
99	100	1.551	170.471	−12.5293	+12.5358	−12.5329	−2.1	−35.2	162.1381
				−12.5345	+12.5321				
100	D_2	0.024	170.495	− 0.8052	+ 0.8055	− 0.8054	−0.3	−35.5	161.3327
100	Sta. Fisher	0.105	170.576	− 0.15					161.99
100	101	1.696	172.167	−13.3780	+13.3790	−13.3785	−1.0	−36.2	148.7596
101	102	1.636	173.803	− 3.6707	+ 3.6715	− 3.6711	−0.8	−37.0	145.0885
102	103	1.574	175.377	+14.1149	−14.1132	+14.1140	−1.7	−38.7	159.2025
103	104	1.625	177.002	+15.1554	−15.1570	+15.1562	+1.6	−37.1	174.3587
104	105	1.631	178.633	+12.8898	−12.8896	+12.8897	−0.2	−37.3	187.2484
105	106	1.530	180.163	+ 4.7468	− 4.7477	+ 4.7472	+0.9	−36.4	191.9956
106	107	1.498	181.661	− 7.1156	+ 7.1205	− 7.1180	−4.9	−41.3	184.8776
107	108	1.790	183.451	−17.6007	+17.5917	−17.5964	+3.7	−37.6	167.2812
				−17.5957	+17.5973				
108	109	1.589	185.040	− 1.8911	+ 1.8892	− 1.8902	+1.9	−35.7	165.3910
109	E_2	0.384	185.424	+ 2.7675	− 2.7672	+ 2.7674	−0.3	−36.0	168.1584
109	Sta. Garland	0.107	185.147	− 0.35					165.04
109	110	1.585	186.625	− 9.1620	+ 9.1611	− 9.1616	+0.9	−34.8	156.2294
110	111	1.551	188.176	−10.3056	+10.3029	−10.3042	+2.7	−32.1	145.9252
111	112	1.680	189.856	− 6.7497	+ 6.7515	− 6.7506	−1.8	−33.9	139.1746
112	113	1.344	191.200	+11.2475	−11.2496	+11.2486	+2.1	−31.8	150.4232
113	F_2	1.062	192.262	+ 3.6828	− 3.6828	+ 3.6828	0.0	−31.8	154.1060
113	Sta. Rowlett	1.002	192.202	+ 4.70					155.12
113	114	1.590	192.790	− 1.3675	+ 1.3664	− 1.3670	+1.1	−30.7	149.0562
114	115	1.545	194.335	−14.2094	+14.2061	−14.2078	+3.3	−27.4	134.8484
115	116	1.711	196.046	+ 7.8512	− 7.8537	+ 7.8524	+2.5	−24.9	142.7008
116	117	1.520	197.566	− 7.4595	+ 7.4607	− 7.4601	−1.2	−26.1	135.2407
117	118	1.649	199.215	− 8.4289	+ 8.4348	− 8.4314	−3.3	−29.4	126.8093
				− 8.4306	+ 8.4314				
118	Sta. Harry*	0.466	199.681	+ 1.08					127.89
118	119	1.703	200.918	+ 8.0039	− 8.0009	+ 8.0024	−3.0	−32.4	134.8117

*In front of sign.

Results of precise leveling from Bowie, Tex., to Shreveport, La.—Continued.

Bench mark.		Distance between successive bench marks.	Distance from bench mark 1124 Gainv.	Difference of elevation.			Discrepancy (B−F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
119	120	1.564	202.482	+15.9494	−15.9445	+15.9470	−4.9	−37.3	150.7587
120	121	1.943	204.425	+17.1368	−17.1324	+17.1346	−4.4	−41.7	167.8933
121	G_2	1.485	205.910	+13.8752	−13.8756	+13.8754	+0.4	−41.3	181.7687
121	Sta. Rockwall	0.101	204.526	+ 0.89					168.78
121	122	1.402	205.827	+ 7.1881	− 7.1835	+ 7.1858	−4.6	−46.3	175.0791
122	123	1.470	207.297	+ 4.8638	− 4.8591	+ 4.8614	−4.7	−51.0	179.9405
123	124	1.583	208.880	+ 2.3222	− 2.3228	+ 2.3225	+0.6	−50.4	182.2630
124	125	1.656	210.536	− 3.5438	+ 3.5428	− 3.5433	+1.0	−49.4	178.7197
125	Sta. Fate	1.503	212.039	− 0.67					178.05
125	H_2	1.766	212.302	+ 1.5767	− 1.5743	+ 1.5755	−2.4	−51.8	180.2952
H_2	126	1.617	213.919	−11.7334	+11.7358	−11.7346	−2.4	−54.2	168.5606
126	127	1.656	215.575	− 0.3732	+ 0.3710	− 0.3721	+1.2	−53.0	168.1885
127	128	1.288	216.863	+ 3.7576	− 3.7555	+ 3.7566	−2.1	−55.1	171.9451
128	129	1.557	218.420	− 3.8556	+ 3.8570	− 3.8563	−1.4	−56.5	168.0888
129	I_2	0.213	218.633	+ 2.9912	− 2.9906	+ 2.9909	−0.6	−57.1	171.0797
129	Sta. Royse	0.098	218.518	+ 0.80					168.89
129	130	1.653	220.073	− 4.8414	+ 4.8384	− 4.8399	+3.0	−53.5	163.2489
130	131	1.657	221.730	+ 6.2357	− 6.2354	+ 6.2356	−0.3	−53.8	169.4845
131	132	1.841	223.571	+ 7.0761	− 7.0826	+ 7.0787	+5.3	−48.5	176.5632
				+ 7.0760	− 7.0800				
132	133	1.654	225.225	−11.1475	+11.1462	−11.1468	+1.3	−47.2	165.4164
133	134	1.841	227.066	− 7.1173	+ 7.1194	− 7.1184	−2.1	−49.3	158.2980
134	135	1.681	228.747	+ 5.7787	− 5.7767	+ 5.7777	−2.0	−51.3	164.0757
135	136	1.512	230.259	+ 1.2877	− 1.2854	+ 1.2866	−2.3	−53.6	165.3623
136	137	1.397	231.656	− 6.6941	+ 6.6951	− 6.6946	−1.0	−54.6	158.6677
137	J_2	1.057	232.713	+ 3.2474	− 3.2451	+ 3.2462	−2.3	−56.9	161.9139
J_2	Sta. Caddo Mills.	0.084	232.797	+ 0.59					162.50
J_2	138	0.963	233.676	+ 6.0291	− 6.0275	+ 6.0283	−1.6	−58.5	167.9422
138	139	1.585	235.261	− 1.4161	+ 1.4138	− 1.4150	+2.3	−56.2	166.5272
139	140	1.611	236.872	+ 3.7153	− 3.7167	+ 3.7160	+1.4	−54.8	170.2432
140	141	1.542	238.414	− 7.8974	+ 7.8984	− 7.8979	−1.0	−55.8	162.3453
141	142	1.634	240.048	+ 1.0987*	− 1.1054	+ 1.1070	+0.1	−55.7	163.4523
				+ 1.1069	− 1.1087				
142	143	1.630	241.678	+10.0164	−10.0198	+10.0181	+3.4	−52.3	173.4704
143	144	1.638	243.316	+ 3.0036	− 3.0045	− 3.0040	+0.9	−51.4	176.4744
144	145	1.653	244.969	− 4.1472	+ 4.1491	− 4.1482	−1.9	−53.3	172.3262
145	146	1.683	246.652	−11.3954	+11.3987	−11.3970	−3.3	−56.6	160.9292
146	K_2	0.134	246.786	+ 4.1752	− 4.1760	+ 4.1756	+0.8	−55.8	165.1048
K_2	L_2	0.456	247.242	+ 4.0521					169.1569

*Rejected.

Results of precise leveling from Bowie, Tex., to Shreveport, La.—Continued.

Bench mark.		Distance between successive bench marks.	Distance from bench mark 1124 Gainv.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
L_2	M_2	0.339	247.581	— 1.7846					167.3723
M_2	K_2	0.547	248.128	— 2.2661					165.1062
146	147	1.483	248.135	— 6.4665	+ 6.4677	— 6.4671	—1.2	—57.8	154.4621
147	Sta. Greenville	0.309	248.444	+ 1.41					155.87
147	148	1.573	249.708	+ 3.8712	— 3.8720	+ 3.8716	+0.8	—57.0	158.3337
148	149	1.628	251.336	— 2.3745	+ 2.3740	— 2.3742	+0.5	—56.5	155.9595
149	150	1.773	253.109	+ 8.6827	— 8.6757	+ 8.6812	—1.9	—58.4	164.6407
				+ 8.6815	— 8.6847				
150	151	1.419	254.528	+ 8.5971	— 8.5926	+ 8.5948	—4.5	—62.9	173.2355
151	N_2	0.129	254.657	+ 0.2650	— 0.2651	+ 0.2650	+0.1	—62.8	173.5005
151	152	1.638	256.166	— 5.1742	+ 5.1741	— 5.1742	+0.1	—62.8	168.0613
152	153	1.556	257.722	+12.9998	—12.9973	+12.9986	—2.5	—65.3	181.0599
153	154	2.215	259.937	+ 3.0344	— 3.0351	+ 3.0348	+0.7	—64.6	184.0947
154	O_2	1.945	261.882	— 5.3384	+ 5.3361	— 5.3372	+2.3	—62.3	178.7575
O_2	Sta. Campbell	0.212	262.094	— 0.44					178.32
O_2	155	0.969	262.851	—10.2848	+10.2815	—10.2832	+3.3	—59.0	168.4743
155	156	1.490	264.341	— 2.3218	+ 2.3235	— 2.3226	—1.7	—60.7	166.1517
156	157	1.573	265.914	+ 6.7291	— 6.7307	+ 6.7299	+1.6	—59.1	172.8816
157	158	1.508	267.422	+10.3225	—10.3252	+10.3238	+2.7	—56.4	183.2054
158	159	1.869	269.291	— 1.6482	+ 1.6430	— 1.6456	+5.2	—51.2	181.5598
159	160	1.637	270.928	+ 4.2055	— 4.2046	+ 4.2050	—0.9	—52.1	185.7648
160	161	1.807	272.735	+ 7.2370	— 7.2385	+ 7.2378	+1.5	—50.6	193.0026
161	P_2	0.397	273.132	+ 5.0722	— 5.0712	+ 5.0717	—1.0	—51.6	198.0743
161	Sta. Cumby	0.132	272.867	+ 0.55					193.55
161	162	1.372	274.107	—12.3313	+12.3343	—12.3328	—3.0	—53.6	180.6698
162	163	1.497	275.604	— 1.6530	+ 1.6491	— 1.6510	+3.9	—49.7	179.0188
163	164	1.630	277.234	+ 2.0551	— 2.0527	+ 2.0539	—2.4	—52.1	181.0727
164	165	1.675	278.909	— 9.2967	+ 9.2949	— 9.2958	+1.8	—50.3	171.7769
165	166	1.633	280.542	— 9.4422	+ 9.4431	— 9.4426	—0.9	—51.2	162.3343
166	167	1.600	282.142	— 4.7988	+ 4.7983	— 4.7986	+0.5	—50.7	157.5357
167	Q_2	0.540	282.682	— 0.3387	+ 0.3378	— 0.3382	+0.9	—49.8	157.1975
Q_2	Sta. Brashaw	0.113	282.795	— 0.77					156.43
Q_2	168	1.040	283.722	— 4.9455	+ 4.9476	— 4.9466	—2.1	—51.9	152.2509
168	169	1.647	285.369	+ 0.7187	— 0.7195	+ 0.7191	+0.8	—51.1	152.9700
169	170	1.568	286.937	+ 0.8569	— 0.8552	+ 0.8560	—1.7	—52.8	153.8260
170	171	1.629	288.566	— 3.5720	+ 3.5777	— 3.5729	—2.1	—54.9	150.2531
				— 3.5717	+ 3.5701				
171	172	1.648	290.214	+ 6.1099	— 6.1082	+ 6.1090	—1.7	—56.6	156.3621
172	173	1.644	291.858	— 4.8734	+ 4.8753	— 4.8744	—1.9	—58.5	151.4877

Results of precise leveling from Bowie, Tex., to Shreveport, La.—Continued.

Bench mark.		Distance between successive bench marks.	Distance from bench mark 1124 Gainv.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
173	174	1.466	293.324	+ 2.9087	— 2.9081	+ 2.9084	—0.6	—59.1	154.3961
174	175	2.058	295.382	— 4.2435	+ 4.2446	— 4.2440	—1.1	—60.2	150.1521
175	R_2	0.584	295.966	+ 3.5708	— 3.5727	+ 3.5718	+1.9	—58.3	153.7239
175	Sta. Sulphur Springs	0.123	295.505	+ 0.48					150.63
175	176	1.458	296.840	+ 3.3481	— 3.3497	+ 3.3489	+1.6	—58.6	153.5010
176	177	1.426	298.266	— 8.8740	+ 8.8745	— 8.8742	—0.5	—59.1	144.6268
177	178	1.703	299.969	— 9.7017	+ 9.6999	— 9.7008	+1.8	—57.3	134.9260
178	179	1.554	301.523	+ 2.6308	— 2.6288	+ 2.6298	—2.0	—59.3	137.5558
179	180	1.590	303.113	+12.0021	—12.0047	+12.0034	+2.6	—56.7	149.5592
180	181	1.575	304.688	+ 4.7626	— 4.7614	+ 4.7620	—1.2	—57.9	154.3212
181	182	1.728	306.416	+10.3093	—10.3108	+10.3100	+1.5	—56.4	164.6312
182	183	1.650	308.066	— 3.7793	+ 3.7796	— 3.7794	—0.3	—56.7	160.8518
183	184	1.489	309.555	— 1.4938	+ 1.4984	— 1.4961	—4.6	—61.3	159.3557
184	S_2	1.036	310.591	+ 3.0968	— 3.0964	+ 3.0966	—0.4	—61.7	162.4523
S_2	Sta. Como	0.079	310.670	— 0.23					162.22
S_2	185	0.835	311.426	+ 3.9547	— 3.9529 — 3.9533	+ 3.9536	—1.6	—63.3	166.4059
185	186	1.492	312.918	— 3.2760	+ 3.2790	— 3.2775	—3.0	—66.3	163.1284
186	187	1.661	314.579	+ 6.1027 + 6.1023	— 6.0891* — 6.1039	+ 6.1030	+1.4	—64.9	169.2314
187	188	1.422	316.001	— 6.2430	+ 6.2400	— 6.2415	+3.0	—61.9	162.9899
188	189	1.534	317.535	— 5.8891	+ 5.8901	— 5.8896	—1.0	—62.9	157.1003
189	T_2	1.560	319.095	+ 6.7542	— 6.7544	+ 6.7543	+0.2	—62.7	163.8546
T_2	Sta. Pickton	0.102	319.197	— 0.39					163.46
T_2	190	1.945	321.040	—13.7989	+13.7960	—13.7974	+2.9	—59.8	150.0572
190	191	1.634	322.674	+ 6.5521	— 6.5574	+ 6.5548	+5.3	—54.5	156.6120
191	192	1.468	324.142	+ 0.2481	— 0.2520	+ 0.2500	+3.9	—50.6	156.8620
192	193	1.811	325.953	— 0.5233	+ 0.5247	— 0.5240	—1.4	—52.0	156.3380
193	194	1.476	327.429	— 1.1934	+ 1.1937	— 1.1936	—0.3	—52.3	155.1444
194	195	1.727	329.156	— 2.9805	+ 2.9830	— 2.9818	—2.5	—54.8	152.1626
195	196	1.453	330.609	— 0.9272	+ 0.9272	— 0.9272	0.0	—54.8	151.2354
196	197	1.568	332.177	+ 8.1658	— 8.1706	+ 8.1682	+4.8	—50.0	159.4036
197	U_2	0.226	332.403	+ 3.3859	— 3.3843	+ 3.3851	—1.6	—51.6	162.7887
197	Sta. Winnsboro	0.099	332.276	— 0.11					159.29
197	198	1.661	333.838	— 4.4790	+ 4.4809	— 4.4800	—1.9	—51.9	154.9236
198	199	1.810	335.648	— 9.5593	+ 9.5542	— 9.5568	+5.1	—46.8	145.3668
199	200	1.621	337.269	— 1.3797	+ 1.3818	— 1.3808	—2.1	—48.9	143.9860
200	201	1.612	338.881	— 9.1724	+ 9.1715	— 9.1720	+0.9	—48.0	134.8140
201	202	1.593	340.474	—10.8540	+10.8582	—10.8561	—4.2	—52.2	123.9579
202	203	1.674	342.148	—13.8506	+13.8479	—13.8492	+2.7	—49.5	110.1087
203	V_2	0.697	342.845	— 1.4374	+ 1.4331	— 1.4352	+4.3	—45.2	108.6735

* Rejected.

Results of precise leveling from Bowie, Tex., to Shreveport, La.—Continued.

Bench mark.		Distance between successive bench marks.	Distance from bench mark 1124 Gainv.	Difference of elevation.			Discrepancy (B−F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
203	Sta. Scroggins	0.397	342.545	− 0.68					109.43
V_2	204	0.824	343.669	+ 2.4447	− 2.4447	+ 2.4447	0.0	−45.2	111.1182
204	205	1.659	345.328	+ 8.0057	− 8.0027	+ 8.0042	−3.0	−48.2	119.1224
205	206	1.644	346.972	+18.8230	−18.8243	+18.8236	+1.3	−46.9	137.9460
206	207	1.555	348.527	− 0.7378	+ 0.7433	− 0.7421	−3.0	−49.9	137.2039
				− 0.7433	+ 0.7439				
207	208	1.602	350.129	− 5.6930	+ 5.6916	− 5.6923	+1.4	−48.5	131.5116
208	209	1.478	351.607	− 7.2975	+ 7.2953	− 7.2964	+2.2	−46.3	124.2152
209	W_2	1.109	352.716	− 4.8708	+ 4.8673	− 4.8700	+1.2	−45.1	119.3452
					+ 4.8720				
W_2	Sta. Leesburg	0.064	352.780	+ 0.81					120.16
W_2	210	0.966	353.682	+ 1.9387	− 1.9352	+ 1.9370	−3.5	−48.6	121.2822
210	211	1.387	355.069	+ 1.9474	− 1.9476	+ 1.9475	+0.2	−48.4	123.2297
211	212	1.472	356.541	− 2.0068	+ 2.0066	− 2.0067	+0.2	−48.2	121.2230
212	213	1.573	358.114	+ 4.9522	− 4.9475	+ 4.9498	−4.7	−52.9	126.1728
213	214	1.675	359.789	+ 0.4308	− 0.4298	+ 0.4303	−1.0	−53.9	126.6031
214	215	1.484	361.273	− 1.9458	+ 1.9488	− 1.9473	−3.0	−56.9	124.6558
215	X_2	1.741	363.014	− 6.6272	+ 6.6212	− 6.6255	+2.1	−54.8	118.0303
				− 6.6259	+ 6.6278				
X_2	216	0.489	363.503	+ 1.2781	− 1.2779	+ 1.2780	−0.2	−55.0	119.3083
216	Y_2	0.355	363.858	+ 2.1788	− 2.1798	+ 2.1793	−1.0	−54.0	121.4876
216	Sta. Pittsburg	0.125	363.628	+ 0.32					119.63
216	217	1.116	364.619	− 7.7732	+ 7.7713	− 7.7722	+1.9	−53.1	111.5361
217	218	1.642	366.261	+ 0.8905	− 0.8957	+ 0.8931	+5.2	−47.9	112.4292
218	219	1.537	367.798	− 2.9725	+ 2.9716	− 2.9720	+0.9	−47.0	109.4572
219	220	1.721	369.519	− 7.1833	+ 7.1873	− 7.1853	−4.0	−51.0	102.2719
220	221	1.579	371.098	−17.5754	+17.5776	−17.5765	−2.2	−53.2	84.6954
221	Sta. Faker	1.065	372.163	+12.58					97.28
221	222	1.739	372.837	− 1.7824	+ 1.7845	− 1.7834	−2.1	−55.3	82.9120
222	223	1.518	374.355	+12.2533	−12.2561	+12.2547	+2.8	−52.5	95.1667
223	224	1.603	375.958	+ 1.4150	− 1.4106	+ 1.4128	−4.4	−56.9	96.5795
224	225	1.721	377.679	− 0.5411	+ 0.5424	− 0.5418	−1.3	−58.2	96.0377
225	Z_2	1.145	378.824	+ 3.5459	− 3.5463	+ 3.5461	+0.4	−57.8	99.5838
Z_2	Sta. Cason	0.417	379.241	+ 3.22					102.80
Z_2	227	1.860	380.684	−11.4594	+11.4632	−11.4613	−3.8	−61.6	88.1225
227	228	1.756	382.440	− 4.8214	+ 4.8224	− 4.8219	−1.0	−62.6	83.3006
228	229	1.490	383.930	+ 4.9120	− 4.9051	+ 4.9082	−3.6	−66.2	88.2088
				+ 4.9079	− 4.9078				
229	230	1.733	385.663	+ 9.5525	− 9.5465	+ 9.5506	−2.0	−68.2	97.7594
				+ 9.5506	− 9.5528				
230	231	1.397	387.060	+14.8738	−14.8791	+14.8783	−1.0	−67.2	112.6377
				+14.8819	−14.8784				
231	232	1.588	388.648	+ 8.6082	− 8.6028	+ 8.6038	−3.2	−70.4	121.2415
				+ 8.6027	− 8.6017				

Results of precise leveling from Bowie, Tex., to Shreveport, La.—Continued.

Bench mark.		Distance between successive bench marks.	Distance from bench mark 1124 Gainv.	Difference of elevation.			Discrepancy (B−F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
232	A_3	0.139	388.787	+ 1.7298	− 1.7296	+ 1.7297	−0.2	−70.6	122.9712
232	Sta. Daingerfield	0.138	388.786	− 0.39					120.85
232	233	1.595	390.243	−19.0994	+19.1057*	−19.0983	+5.7	−64.7	102.1432
				−19.0992	+19.0940				
				−19.1031	+19.0958				
233	234	1.775	392.018	+ 6.9493	− 6.9461	+ 6.9477	−3.2	−67.9	109.0909
234	235	1.772	393.790	+26.9343	−26.9463*	+26.9346	+3.4	−64.5	136.0255
				+26.9327	−26.9369				
235	236	1.594	395.384	+ 7.4197	− 7.4251	+ 7.4205	+1.4	−63.1	143.4460
				+ 7.4198	− 7.4173				
236	237	1.611	396.995	−15.1060	+15.1059	−15.1060	+0.1	−63.0	128.3400
237	238	1.960	398.955	−14.6276	+14.6305	−14.6290	−2.9	−65.9	113.7110
238	B_3	0.071	399.026	+ 1.7660	− 1.7653	+ 1.7656	−0.7	−66.6	115.4766
238	Sta. Hughes	0.132	399.087	+ 0.22					113.93
238	239	1.319	400.274	− 8.1075	+ 8.1080	− 8.1078	−0.5	−66.4	105.6032
239	240	1.586	401.860	− 9.8914	+ 9.8903	− 9.8908	+1.1	−65.3	95.7124
240	241	1.627	403.487	− 6.6104	+ 6.6097	− 6.6100	+0.7	−64.6	89.1024
241	242	1.613	405.100	− 4.8623	+ 4.8588	− 4.8606	+3.5	−61.1	84.2418
242	243	1.617	406.717	− 4.9374	+ 4.9387	− 4.9380	−1.3	−62.4	79.3038
243	244	1.346	408.063	− 2.1783	+ 2.1788	− 2.1786	−0.5	−62.9	77.1252
244	245	1.781	409.844	+ 8.1605	− 8.1641	+ 8.1623	+3.6	−59.3	85.2875
245	246	1.782	411.626	+14.8021	−14.8023	+14.8022	+0.2	−59.1	100.0897
246	247	1.402	413.028	+20.8955	−20.8966	+20.8960	+1.1	−58.0	120.9857
247	C_3	0.058	413.086	− 0.3294	+ 0.3292	− 0.3293	+0.2	−57.8	120.6564
247	D_3	1.497	414.525	+ 1.0060	− 1.0030	+ 1.0045	−3.0	−61.0	121.9902
247	Sta. Avinger	0.069	413.097	+ 0.01					121.00
D_3	249	1.697	416.222	− 0.2380	+ 0.2347	− 0.2364	+3.3	−57.7	121.7538
249	250	1.586	417.808	− 3.6303	+ 3.6286	− 3.6294	+1.7	−56.0	118.1244
250	251	1.626	419.434	+ 7.3714	− 7.3699	+ 7.3706	−1.5	−57.5	125.4950
251	252	1.551	420.985	− 7.7855	+ 7.7869	− 7.7862	−1.4	−58.9	117.7088
252	253	1.631	422.616	− 9.4105	+ 9.4093	− 9.4099	+1.2	−57.7	108.2989
253	E_3	0.816	423.432	− 6.1070	+ 6.1082	− 6.1076	−1.2	−58.9	102.1913
E_3	Sta. Lasater	0.248	423.680	− 0.20					101.99
E_3	254	0.970	424.402	− 2.6383	+ 2.6383	− 2.6383	−0.0	−58.9	99.5530
254	255	1.998	426.400	− 5.6627	+ 5.6589	− 5.6608	+3.8	−55.1	93.8922
255	256	1.464	427.864	+ 0.2689	− 0.2666	+ 0.2678	−2.3	−57.4	94.1600
256	257	1.290	429.154	+ 4.8094	− 4.8082	+ 4.8088	−1.2	−58.6	98.9688
257	258	1.618	430.772	− 2.3712	+ 2.3732	− 2.3722	−2.0	−60.6	96.5966
258	259	1.455	432.227	− 5.6231	+ 5.6216	− 5.6224	+1.5	−59.1	90.9742
259	260	1.636	433.863	− 0.7674	+ 0.7692	− 0.7683	−1.8	−60.9	90.2059

*Rejected.

Results of precise leveling from Bowie, Tex., to Shreveport, La.—Continued.

Bench mark.		Distance between successive bench marks.	Distance from bench mark 1124 Gainv.	Difference of elevation.			Discrepancy (B-F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
260	F_3	0.127	433.990	− 0.5783	+ 0.5776	− 0.5780	+0.7	−60.2	89.6279
260	261	1.638	435.501	−14.9569	+14.9593	−14.9581	−2.4	−63.3	75.2478
261	262	1.645	437.146	−10.7226	+10.7217	−10.7222	+0.9	−62.4	64.5256
262	263	1.418	438.564	+ 2.2353	− 2.2360	+ 2.2356	+0.7	−61.7	66.7612
263	264	1.618	440.182	+ 0.8450	− 0.8468	+ 0.8459	+1.8	−59.9	67.6071
264	265	1.366	441.548	− 3.6565	+ 3.6551	− 3.6558	+1.4	−58.5	63.9513
265	G_3	0.907	442.455	− 6.0140	+ 6.0141	− 6.0140	−0.1	−58.6	57.9373
G_3	Sta. Jefferson	0.239	442.694	+ 0.38					58.32
G_3	266	0.966	443.421	− 0.8889	+ 0.8910	− 0.8900	−2.1	−60.7	57.0473
266	267	1.664	445.085	+ 3.1712	− 3.1682	+ 3.1697	−3.0	−63.7	60.2170
267	268	1.677	446.762	+ 3.4956*	− 4.5060	+ 4.5013	+2.9	−60.8	64.7183
				+ 4.4994	− 4.4986				
268	269	1.546	448.308	− 7.5277	+ 7.5287	− 7.5282	−1.0	−61.8	57.1901
269	270	1.513	449.821	− 0.4080	+ 0.4108	− 0.4094	−2.8	−64.6	56.7807
270	271	1.673	451.494	+ 4.3835	− 4.3828	+ 4.3832	−0.7	−65.3	61.1639
271	272	1.475	452.969	+ 0.2567	− 0.2612	+ 0.2590	+4.5	−60.8	61.4229
272	I_3	1.893	454.862	+ 1.8653	− 1.8663	+ 1.8658	+1.0	−59.8	63.2887
I_3	274	1.562	456.424	− 4.3337	+ 4.3348	− 4.3342	−1.1	−60.9	58.9545
274	275	1.631	458.055	+ 3.9231	− 3.9234	+ 3.9232	+0.3	−60.6	62.8777
275	276	1.591	459.646	+ 6.1783	− 6.1846	+ 6.1810	+1.2	−59.4	69.0587
				+ 6.1826	− 6.1787				
276	277	1.495	461.141	+14.1501	−14.1550	+14.1516	+3.2	−56.2	83.2103
				+14.1498	−14.1513				
277	J_3	1.575	462.716	−12.5363	+12.5354	−12.5358	+0.9	−55.3	70.6745
J_3	Sta. Karnack	0.149	462.865	+ 1.60					72.27
J_3	279	1.804	464.520	− 1.3242	+ 1.3220	− 1.3231	+2.2	−53.1	69.3514
279	280	1.615	466.135	− 3.9790	+ 3.9823	− 3.9806	−3.3	−56.4	65.3708
280	281	1.579	467.714	− 5.0454	+ 5.0470	− 5.0462	−1.6	−58.0	60.3246
281	282	1.675	469.389	+ 6.6790	− 6.6791	+ 6.6790	+0.1	−57.9	67.0036
282	283	1.484	470.873	+ 4.4569	− 4.4538	+ 4.4554	−3.1	−61.0	71.4590
283	284	1.788	472.661	+ 8.2296	− 8.2272	+ 8.2284	−2.4	−63.4	79.6874
284	285	1.827	474.488	+14.6752	−14.6728	+14.6740	−2.4	−65.8	94.3614
285	286	1.343	475.831	− 9.2233	+ 9.2230	− 9.2232	+0.3	−65.5	85.1382
286	K_3	1.013	476.844	− 4.2203	+ 4.2196	− 4.2200	+0.7	−64.8	80.9182
K_3	Sta. Blocker	0.186	477.030	+ 0.12					81.04
K_3	287	0.798	477.642	− 2.1104	+ 2.1110	− 2.1107	−0.6	−65.4	78.8075
287	288	1.516	479.158	− 6.3832	+ 6.3869	− 6.3850	−3.7	−69.1	72.4225
288	289	1.675	480.833	− 5.6188	+ 5.6201	− 5.6194	−1.3	−70.4	66.8031
289	290	1.448	482.281	+ 2.3142	− 2.3154	+ 2.3148	+1.2	−69.2	69.1179
290	291	1.605	483.886	+ 3.7148	− 3.7185	+ 3.7166	+3.7	−65.5	72.8345
291	292	1.477	485.363	+14.7847	−14.7817	+14.7832	−3.0	−68.5	87.6177
292	L_3	0.659	486.022	+ 3.7796	− 3.7789	+ 3.7792	−0.7	−69.2	91.3969
L_3	Sta. Waskom	0.092	486.114	− 0.72					90.68
L_3	293	1.238	487.260	− 6.6955	+ 6.6940	− 6.6948	+1.5	−67.7	84.7021
293	294	1.559	488.819	−11.8028	+11.8057	−11.8042	−2.9	−70.6	72.8979

*Rejected.

Results of precise leveling from Bowie, Tex., to Shreveport, La.—Continued.

Bench mark.		Distance between successive bench marks.	Distance from bench mark 1124 Gainv.	Difference of elevation.			Discrepancy (B−F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
294	295	1.460	490.279	− 1.5723	+ 1.5702	− 1.5712	+2.1	−68.5	71.3267
295	296	1.712	491.991	− 2.9795	+ 2.9734	− 2.9764	+2.8	−65.7	68.3503
				− 2.9761	+ 2.9766				
296	297	1.466	493.457	+ 7.8740	− 7.8776	+ 7.8758	+3.6	−62.1	76.2261
297	298	1.788	495.245	− 7.7085	+ 7.7078	− 7.7082	+0.7	−61.4	68.5179
298	C*	0.376	495.621	− 1.3854	+ 1.3860	− 1.3857	−0.6	−62.0	67.1322
298	Sta. Greenwood	0.046	495.291	+ 1.00					69.52
298	299	1.443	496.688	+ 8.1896	− 8.1881	+ 8.1888	−1.5	−62.9	76.7067
299	300	1.627	498.315	+10.0764	−10.0815	+10.0790	+5.1	−57.8	86.7857
300	301	1.504	499.819	+ 1.0909	− 1.0859	+ 1.0884	−5.0	−62.8	87.8741
301	302	1.606	501.425	− 3.9514	+ 3.9538	− 3.9526	−2.4	−65.2	83.9215
302	303	1.650	503.075	− 4.6622	+ 4.6669	− 4.6646	−4.7	−69.9	79.2569
303	304	1.480	504.555	+ 4.0717	− 4.0666	+ 4.0692	−5.1	−75.0	83.3261
304	D	0.041	504.596	+ 0.7875	− 0.7868	+ 0.7872	−0.7	−75.7	84.1133
304	305	1.644	506.199	− 1.4057	+ 1.4097	− 1.4077	−4.0	−79.0	81.9184
305	306	1.638	507.837	+ 0.7324	− 0.7378	+ 0.7356	+0.4	−78.6	82.6540
				+ 0.7384	− 0.7337				
306	307	1.798	509.635	−11.1305	+11.1325	−11.1315	−2.0	−80.6	71.5225
307	308	1.553	511.188	+ 1.7521	− 1.7493	+ 1.7507	−2.8	−83.4	73.2732
308	E	1.387	512.575	+ 1.3756	− 1.3723	+ 1.3740	−3.3	−86.7	74.6472
E	Sta. Jewella	0.218	512.793	− 0.06					74.59
E	310	1.708	514.283	− 0.8354	+ 0.8355	− 0.8354	−0.1	−86.8	73.8118
310	311	1.625	515.908	− 2.4403	+ 2.4424	− 2.4414	−2.1	−88.9	71.3704
311	312	1.360	517.268	+ 3.3119	− 3.3140	+ 3.3130	+2.1	−86.8	74.6834
312	313	1.538	518.806	−14.3071	+14.3091	−14.3081	−2.0	−88.8	60.3753
313	F	0.017	518.823	− 2.5788	+ 2.5784	− 2.5786	+0.4	−88.4	57.7967
F	G	0.336	519.159	+ 4.6529	− 4.6521	+ 4.6525	−0.8	−89.2	62.4492
G	P. B. M. 46	0.170	519.329	− 2.5313	+ 2.5295	− 2.5304	+1.8	−87.4	59.9188
F	H	0.621	519.444	− 2.1953	+ 2.1963	− 2.1958	−1.0	−89.4	55.6009
H	Red River Bridge†	0.018	519.462	+ 1.93					57.53
H	I	0.205	519.649	+ 0.5703	− 0.5707	+ 0.5705	+0.4	−89.0	56.1714
I	314	1.660	521.309	− 3.7148	+ 3.7146	− 3.7147	+0.2	−88.8	52.4567
314	315	1.456	522.765	− 0.2526	+ 0.2535	− 0.2530	−0.9	−89.7	52.2037
315	316	1.446	524.211	− 0.4879	+ 0.4843	− 0.4861	+3.6	−86.1	51.7176
316	317	1.568	525.779	+ 0.0538	− 0.0486	+ 0.0512	−5.2	−91.3	51.7688
317	318	1.563	527.342	− 0.4364	+ 0.4382	− 0.4373	−1.8	−93.1	51.3315
318	319	1.605	528.947	− 0.0362	+ 0.0358	− 0.0360	+0.4	−92.7	51.2955
319	320	1.605	530.552	+ 0.0748	− 0.0770	+ 0.0759	+2.2	−90.5	51.3714
320	321	1.523	532.075	+ 0.8844	− 0.8852	+ 0.8848	+0.8	−89.7	52.2562
321	P. B. M. 44	1.322	533.397	+10.1003	−10.1004	+10.1004	+0.1	−89.6	62.3566

*Louisiana. †On rail.

FORT WORTH—COMANCHE LINE.

This line was run by Ralph L. Libby, Aid, between November 22 and December 18, 1902, with level No. 9, one of the new type. It is a spur from the level net. It starts at Fort Worth from bench marks of the Bowie–Shreveport line, and ends at Station Comanche of the ninety-eighth meridian triangulation, fixing its height, and through trigonometrical leveling the height of the Stephenville base line, which is in sight from Comanche. The line follows the Fort Worth and Rio Grande Railroad. (See illustration 19.)

Velocipede cars were used. The rods V and W still showed no change of length, and the same correction for length and for index errors were used as on the Bowie–Anthony line (see p. 303).

In the following tabulation the final elevations obtained from the adjustment of 1903 are given.

Results of precise leveling from Fort Worth to Comanche, Tex., 1902.

Bench mark.		Distance between successive bench marks.	Distance from bench mark U at Fort Worth.	Difference of elevation.			Discrepancy (B−F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
	T								173.6345*
T	U	1.329		+11.0966	−11.0956	+11.0961	−1.0		184.7306
	U		0.000						184.7280*
U	1	0.441	0.441	+ 2.8898	− 2.8875	+ 2.8886	−2.3	−2.3	187.6166
1	M_3	0.424	0.865	+ 1.0404	− 1.0372	+ 1.0382	−1.9	−4.2	188.6548
				+ 1.0378	− 1.0373				
M_3	2	1.790	2.655	− 0.9237	+ 0.9263	− 0.9250	−2.6	−6.8	187.7298
2	3	1.720	4.375	+ 2.5863	− 2.5891	+ 2.5877	+2.8	−4.0	190.3175
3	4	1.804	6.179	+11.2704†	−11.2837	+11.2823	+3.1	−0.9	201.5998
				+11.2803	−11.2830				
4	N_3	0.212	6.391	− 1.9327	+ 1.9310	− 1.9318	+1.7	+0.8	199.6680
4	5	1.626	7.805	+ 3.2181	− 3.2163	+ 3.2172	−1.8	−2.7	204.8170
5	6	1.484	9.289	+ 4.8706	− 4.8712	+ 4.8709	+0.6	−2.1	209.6879
6	7	1.599	10.888	− 2.1212	+ 2.1229	− 2.1220	−1.7	−3.8	207.5659
7	8	1.502	12.390	+13.5647	−13.5641	+13.5644	−0.6	−4.4	221.1303
8	9	1.567	13.957	+ 3.4262	− 3.4313	+ 3.4302	+5.9	+1.5	224.5605
				+ 3.4284	− 3.4350				
9	10	1.640	15.597	+ 7.9185	− 7.9228	+ 7.9206	+4.3	+5.8	232.4811
10	11	1.643	17.240	− 3.0464	+ 3.0441	− 3.0452	+2.3	+8.1	229.4359
11	12	1.731	18.971	+ 3.8210	− 3.8214	+ 3.8212	+0.4	+8.5	233.2571
12	‡Sta. Primrose	0.773	19.744	+ 2.51					235.77
12	13	1.086	20.057	+ 1.7611	− 1.7613	+ 1.7612	+0.2	+8.7	235.0183
13	O_3	0.025	20.082	− 0.0283	+ 0.0284	− 0.0284	−0.1	+8.6	234.9899
13	14	1.970	22.027	−15.1903	+15.1933	−15.1918	−3.0	+5.7	219.8265
14	15	1.495	23.522	− 8.5354	+ 8.5386	− 8.5370	−3.2	+2.5	211.2895

* Adjusted elevations of 1903. † Rejected. ‡ On rail at station sign.

Results of precise leveling from Fort Worth to Comanche, Tex., 1902—Continued.

Bench mark.		Distance between successive bench marks.	Distance from bench mark U at Fort Worth.	Difference of elevation.			Discrepancy (B−F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
15	16	1.661	25.183	+ 4.4041	− 4.4045	+ 4.4043	+0.4	+ 2.9	215.6938
16	17	1.648	26.831	+ 8.2474	− 8.2429	+ 8.2452	−4.5	− 1.6	223.9390
17	18	1.569	28.400	+10.8665	−10.8636	+10.8650	−2.9	− 4.5	234.8040
18	19	1.623	30.023	+19.3337	−19.3296	+19.3316	−4.1	− 8.6	254.1356
19	20	1.491	31.514	+13.1598	−13.1599	+13.1598	+0.1	− 8.5	267.2954
20	21	1.638	33.152	+10.3162	−10.3151	+10.3156	−1.1	− 9.6	277.6110
21	P_3	0.888	34.040	+10.3565	−10.3567	+10.3566	+0.2	− 9.4	287.9676
P_3	22	1.195	35.235	+ 2.4667	− 2.4647	+ 2.4657	−2.0	−11.4	290.4333
22	23	1.608	36.843	+13.2564	−13.2527	+13.2546	−3.7	−15.1	303.6879
23	24	1.254	38.097	+ 3.6768	− 3.6771	+ 3.6770	+0.3	−14.8	307.3649
24	25	1.641	39.738	+ 6.5224	− 6.5215	+ 6.5220	−0.9	−15.7	313.8869
25	26	1.536	41.274	+ 5.7972	− 5.8027	+ 5.8018	+4.8	−10.9	319.6887
				+ 5.8017	− 5.8056				
26	Q_3	0.029	41.303	− 1.0825	+ 1.0825	− 1.0825	0.0	−10.9	318.6062
26	27	1.621	42.895	+ 6.3682	− 6.3723	+ 6.3702	+4.1	− 6.8	326.0589
27	28	1.633	44.528	+ 5.2883	− 5.2851	+ 5.2867	−3.2	−10.0	331.3456
28	29	1.597	46.125	+ 7.2101	− 7.2118	+ 7.2110	+1.7	− 8.3	338.5566
29	30	1.652	47.777	− 3.7953	+ 3.7933	− 3.7943	+2.0	− 6.3	334.7623
30	31	1.773	49.550	− 9.5662	+ 9.5667	− 9.5664	−0.5	− 6.8	325.1959
31	32	1.460	51.010	−17.5895	+17.5901	−17.5898	−0.6	− 7.4	307.6061
32	33	1.609	52.619	−18.4622	+18.4650	−18.4636	−2.8	−10.2	289.1425
33	34	1.461	54.080	−16.6646	+16.6634	−16.6640	+1.2	− 9.0	272.4785
34	R_3	1.440	55.520	−15.9667	+15.9699	−15.9683	−3.2	−12.2	256.5102
R_3	36	1.740	57.260	− 9.9877	+ 9.9898	− 9.9888	−2.1	−14.3	246.5214
36	37	1.638	58.898	−19.3710	+19.3698	−19.3704	+1.2	−13.1	227.1510
37	38	1.634	60.532	+ 1.4152	− 1.4142	+ 1.4147	−1.0	−14.1	228.5657
38	39	1.479	62.011	− 1.5546	+ 1.5522	− 1.5534	+2.4	−11.7	227.0123
39	40	1.635	63.646	−12.8273	+12.8305	−12.8289	−3.2	−14.9	214.1834
40	41	1.150	64.796	+ 1.1430	− 1.1395	+ 1.1412	−3.5	−18.4	215.3246
41	S_3	0.637	65.433	+ 5.7177	− 5.7182	+ 5.7180	+0.5	−17.9	221.0426
41	42	1.701	66.497	+ 9.0027	− 9.0001	+ 9.0014	−2.6	−21.0	224.3260
42	43	1.095	67.592	+16.5076	−16.5079	+16.5078	+0.3	−20.7	240.8338
43	44	1.629	69.221	+ 5.7842	− 5.7836	+ 5.7839	−0.6	−21.3	246.6177
44	45	0.644	69.865	− 3.4067	+ 3.4033	− 3.4050	+3.4	−17.9	243.2127
45	46	1.663	71.728	+20.8980	−20.8965	+20.8972	−1.5	−19.4	264.1099
46	47	0.735	72.263	+ 8.6563	− 8.6560	+ 8.6562	−0.3	−19.7	272.7661
47	48	1.060	73.323	+ 9.3444	− 9.3447	+ 9.3446	+0.3	−19.4	282.1107
48	49	1.011	74.334	+46.2055	−46.2023	+46.2041	−2.7	−22.1	328.3148
				+46.2046	−47.2010*				
49	Comanche △	0.934	75.268	+46.3949	−46.3992	+46.3953	+3.0	−19.1	374.7101
				+46.3927	−46.3945				
Comanche △	Ref. mark.	0.053	75.321	− 0.6942	+ 0.6936	− 0.6939	+0.6	−18.5	374.0162

*Rejected.

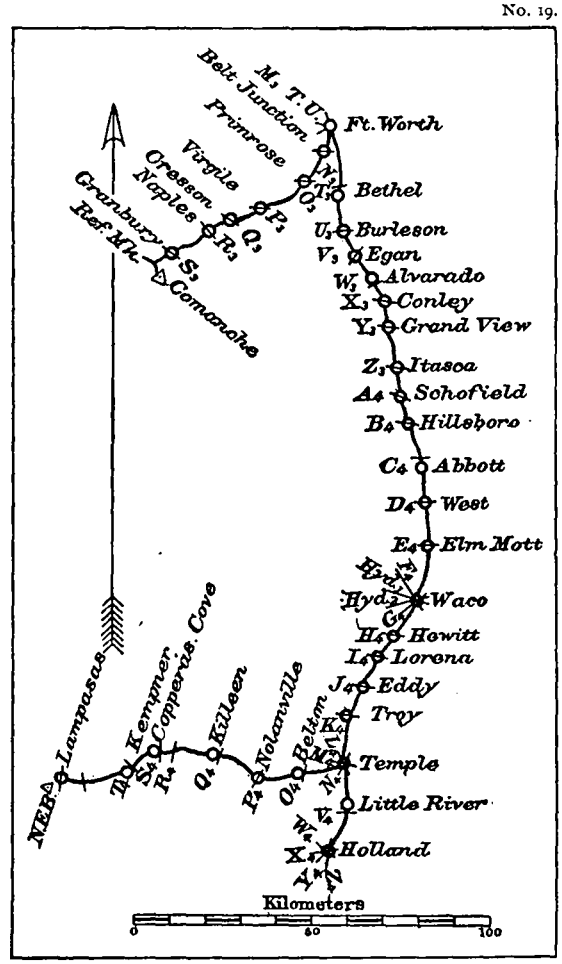
FORT WORTH–LAMPASAS LINE.

This line was run by Ralph L. Libby, Aid, between December 20, 1902, and March 25, 1903, with level No. 9, one of the new type. This line starts from bench marks at Fort Worth of the Bowie–Shreveport line and ends at the Lampasas Base of the ninety-eighth meridian triangulation, of which it fixes the elevation accurately. It also connects with and fixes accurately the elevation of Gilmore triangulation station, near the Lampasas Base. These connections, together with those made by precise levels at Bowie Base, and at Comanche triangulation station near the Stephenville Base, already referred to, serve to fix the elevations of the stations along the ninety-eighth meridian triangulation from Bowie Base to Lampasas Base.

The line follows the Missouri, Kansas and Texas Railroad from Fort Worth southward to Temple, Tex., and then westward over the Gulf, Colorado and Santa Fe Railroad to Lampasas.

Velocipede cars were used. Unfavorable weather delayed the leveling considerably. Rods V and W were used as of the same length as on the Bowie–Anthony line (see p. 303), the field measures having shown no change. The index errors were assumed to be the same as on that line.

No. 19.



Leveling route, Fort Worth to Holland, Tex.

In the following tabulation the elevations as fixed by the adjustment of 1903 are given. The elevations given in the tabulation for stations marked thus (Sta. Alvarado) refer to the top of rail in front of the railroad station named.

Results of precise leveling from Fort Worth to Temple, Tex., 1903.

Bench mark.		Distance between successive bench marks.	Distance from bench mark U at Fort Worth.	Difference of elevation.			Discrepancy (B−F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
	T								173.6345*
T	U	1.327		+11.0944	−11.0967	+11.0956	+2.3	0.0	184.7301
U			0.000						184.7280*
U	1	1.593	1.593	+ 7.4968	− 7.4960	+ 7.4964	−0.8	− 0.8	192.2244
1	2	1.479	3.072	+ 9.9855	− 9.9861	+ 9.9858	+0.6	− 0.2	202.2102
2	3	1.772	4.844	+ 2.7161	− 2.7181	+ 2.7171	+2.0	+ 1.8	204.9273
3	4	1.459	6.303	+ 2.8843	− 2.8838	+ 2.8840	−0.5	+ 1.3	207.8113
4	5	1.807	8.110	+ 1.2231	− 1.2233	+ 1.2232	+0.2	+ 1.5	209.0345
5	6	1.606	9.716	− 5.6384	+ 5.6373	− 5.6378	+1.1	+ 2.6	203.3967
6	7	1.601	11.317	+ 4.5876	− 4.5884	+ 4.5880	+0.8	+ 3.4	207.9847
7	T_3	0.040	11.357	+ 0.0463	− 0.0467	+ 0.0465	+0.4	+ 3.8	208.0312
7	8	1.578	12.895	+ 9.3754	− 9.3702	+ 9.3708	−2.3	+ 1.1	217.3555
				+ 9.3685	− 9.3692				
8	9	1.550	14.445	+10.6207	−10.6122	+10.6158	−6.4	− 5.3	227.9713
				+10.6173	−10.6131				
9	10	1.646	16.091	− 6.0881	+ 6.0852	− 6.0866	+2.9	− 2.4	221.8847
10	11	1.647	17.738	− 7.6906	+ 7.6824	− 7.6882	+5.0	+ 2.6	214.1965
				− 7.6908	+ 7.6891				
11	12	1.568	19.306	+ 6.1074	− 6.1079	+ 6.1076	+0.5	+ 3.1	220.3041
12	13	1.584	20.890	− 4.3351	+ 4.3291	− 4.3318	+5.3	+ 8.4	215.9723
				− 4.3338	+ 4.3292				
13	14	1.717	22.607	− 0.3905	+ 0.3875	− 0.3894	−1.5	+ 6.9	215.5829
				− 0.3868	+ 0.3928				
14	U_3	0.179	22.786	+ 2.4241	− 2.4237	+ 2.4239	−0.4	+ 6.5	218.0068
14	15	1.615	24.222	− 2.5817	+ 2.5806	− 2.5812	+1.1	+ 8.0	213.0017
15	16	1.595	25.817	+11.8492	−11.8511	+11.8502	+1.9	+ 9.9	224.8519
16	17	1.315	27.132	+ 2.1409	− 2.1402	+ 2.1406	−0.7	+ 9.2	226.9925
17	18	1.607	28.739	+15.4111†	−15.4234	+15.4204	+3.0	+12.2	242.4129
				+15.4184	−15.4194				
18	19	1.831	30.570	− 8.2050	+ 8.2091	− 8.2070	−4.1	+ 8.1	234.2059
19	20	1.633	32.203	+16.3429	−16.3436	+16.3432	+0.7	+ 8.8	250.5491
20	21	1.042	33.245	+ 3.6570	− 3.6562	+ 3.6566	−0.8	+ 8.0	254.2057
21	V_3	0.064	33.309	− 1.9897	+ 1.9901	− 1.9899	−0.4	+ 7.6	253.2158
21	22	1.933	35.178	− 9.6792	+ 9.6740	− 9.6766	+5.2	+13.2	244.5291
22	23	1.727	36.905	−11.4354	+11.4399	−11.4376	−4.5	+ 8.7	233.0915
23	24	1.630	38.535	− 8.2299	+ 8.2351	− 8.2326	−3.0	+ 5.7	224.8589
				− 8.2323	+ 8.2330				
24	25	1.810	40.345	− 6.1097	+ 6.1152	− 6.1123	−0.3	+ 5.4	218.7466
				− 6.1146	+ 6.1097				
25	26	1.793	42.138	− 7.8583	+ 7.8560	− 7.8572	+2.3	+ 7.7	210.8894
26	27	1.825	43.963	− 3.0172	+ 3.0136	− 3.0154	+3.6	+11.3	207.8740
27	W_3	0.042	44.005	− 1.0951	+ 1.0946	− 1.0948	+0.5	+11.8	206.7792
27	Sta. Alvarado			+ 3.49					211.36
27	28	1.297	45.260	+ 6.9402	− 6.9390	+ 6.9396	−1.2	+10.1	214.8136

* Adjusted elevations of 1903. † Rejected.

Results of precise leveling from Fort Worth to Temple, Tex., 1903—Continued.

Bench mark.		Distance between successive bench marks.	Distance from bench mark U at Fort Worth.	Difference of elevation.			Discrepancy (B−F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
28	29	1.478	46.738	−12.9524	+12.9492	−12.9508	+3.2	+13.3	201.8628
29	30	1.314	48.052	+10.5956	−10.5981	+10.5968	+2.5	+15.8	212.4596
30	31	1.520	49.572	+15.3981	−15.4009	+15.3995	+2.8	+18.6	227.8591
31	X_3	0.525	50.097	− 0.5500	+ 0.5512	− 0.5506	−1.2	+17.4	227.3085
X_3	32	1.367	51.464	− 6.8759	+ 6.8787	− 6.8773	−2.8	+14.6	220.4312
32	33	1.658	53.122	−14.5653	+14.5668	−14.5660	−1.5	+13.1	205.8652
33	34	1.660	54.782	− 8.9806	+ 8.9855	− 8.9830	−4.9	+ 8.2	196.8822
34	35	1.780	56.562	+ 0.9954	− 0.9955	+ 0.9954	+0.1	+ 8.3	197.8776
35	36	1.727	58.289	+13.9115	−13.9080	+13.9098	−3.5	+ 4.8	211.7874
36	Y_3	0.090	58.379	+ 1.3687	− 1.3683	+ 1.3685	−0.4	+ 4.4	213.1559
36	Sta. Grand View			+ 0.25					212.03
36	37	1.244	59.533	− 4.2609	+ 4.2584	− 4.2596	+2.5	+ 7.3	207.5278
37	38	1.605	61.138	− 7.6361	+ 7.6349	− 7.6355	+1.2	+ 8.5	199.8923
38	39	1.690	62.828	− 3.0114	+ 3.0109	− 3.0112	+0.5	+ 9.0	196.8811
39	40	1.369	64.197	− 1.4897	+ 1.4881	− 1.4889	+1.6	+10.6	195.3922
40	41	1.780	65.977	+13.5477	−13.5508	+13.5492	−3.1	+13.7	208.9414
41	42	1.533	67.510	− 3.0650	+ 3.0635	− 3.0642	+1.5	+15.2	205.8772
42	43	1.526	69.036	+ 1.5534	− 1.5610	+ 1.5573	+4.6	+19.8	207.4345
				+ 1.5566	− 1.5582				
43	44	1.799	70.835	+ 5.9612	− 5.9583	+ 5.9598	−2.9	+16.9	213.3943
44	Z_3	0.389	71.224	+ 2.6145	− 2.6155	+ 2.6150	+1.0	+17.9	216.0093
44	45	1.720	72.555	− 4.2839	+ 4.2875	− 4.2857	−3.6	+13.3	209.1086
45	46	1.694	74.249	− 6.2548	+ 6.2541	− 6.2544	+0.7	+14.0	202.8542
46	47	1.610	75.859	+ 8.6300	− 8.6302	+ 8.6301	+0.2	+14.2	211.4843
47	48	1.589	77.448	−11.7042	+11.7106	−11.7084	−1.9	+12.3	199.7759
				−11.7106	+11.7080				
48	49	1.189	78.637	− 1.5437	+ 1.5412	− 1.5424	+2.5	+14.8	198.2335
49	A_4	0.122	78.759	+ 1.8920	− 1.8910	+ 1.8915	−1.0	+13.8	200.1250
49	50	1.609	80.246	+ 0.4549	− 0.4492	+ 0.4510	−2.9	+11.9	198.6845
				+ 0.4501	− 0.4500				
50	51	1.408	81.654	+ 1.9084*	− 1.9016	+ 1.9002	+1.9	+13.8	200.5847
				+ 1.8989	− 1.9000				
51	52	1.409	83.063	−11.7109	+11.7090	−11.7100	+1.9	+15.7	188.8747
52	53	1.794	84.857	+ 4.8109	− 4.8109	+ 4.8109	0.0	+15.7	193.6856
53	54	1.409	86.266	−10.1861	+10.1824	−10.1842	+3.7	+19.4	183.5014
54	55	1.713	87.979	+ 4.6189	− 4.6168	+ 4.6178	−2.1	+17.3	188.1192
55	B_4	0.324	88.303	+ 5.0920	− 5.0925	+ 5.0922	+0.5	+17.8	193.2114
55	Sta. Hillsboro			+ 1.10					189.22
55	56	1.921	89.900	− 4.5044	+ 4.5036	− 4.5040	+0.8	+18.1	183.6152
56	57	1.797	91.697	+ 1.9030	− 1.8997	+ 1.9014	−3.3	+14.8	185.5166
57	58	1.832	93.529	+ 1.7676	− 1.7706	+ 1.7691	+3.0	+17.8	187.2857
58	59	1.641	95.170	+ 8.0866	− 8.0884	+ 8.0875	+1.8	+19.6	195.3732
59	60	1.394	96.564	+ 5.1751	− 5.1729	+ 5.1740	−2.2	+17.4	200.5472

Results of precise leveling from Fort Worth to Temple, Tex., 1903—Continued.

Bench mark.		Distance between successive bench marks.	Distance from bench mark U at Fort Worth.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
60	61	1.639	98.203	−10.9161	+10.9136	−10.9148	+2.5	+19.9	189.6324
61	62	1.619	99.822	+ 5.9306	− 5.9254	+ 5.9276	−1.8	+18.1	195.5600
				+ 5.9264	− 5.9279				
62	63	1.464	101.286	+11.3474	−11.3427	+11.3450	−4.7	+13.4	206.9050
63	C_4	1.005	102.291	+ 4.7666	− 4.7672	+ 4.7669	+0.6	+14.0	211.6719
C_4	65	1.777	104.068	+ 1.6425	− 1.6443	+ 1.6434	+1.8	+15.8	213.3153
65	Sta. Abbott			+ 3.98					217.29
65	66	1.991	106.059	−12.0010	+12.0016	−12.0013	−0.6	+15.2	201.3140
66	67	1.643	107.702	− 7.8057	+ 7.8065	− 7.8061	−0.8	+14.4	193.5079
67	68	1.645	109.347	+ 1.7588	− 1.7611	+ 1.7600	+2.3	+16.7	195.2679
68	69	1.643	110.990	+ 1.7692	− 1.7676	+ 1.7684	−1.6	+15.1	197.0363
69	70	1.971	112.961	+ 1.1917	− 1.1889	+ 1.1903	−2.8	+12.3	198.2266
70	D_4	0.037	112.998	+ 1.6159	− 1.6157	+ 1.6158	−0.2	+12.1	199.8424
70	Sta. West			− 0.65					197.58
70	71	0.887	113.848	− 6.9620	+ 6.9614	− 6.9617	+0.6	+12.9	191.2649
71	72	1.789	115.637	− 1.0612	+ 1.0643	− 1.0628	−3.1	+ 9.8	190.2021
72	73	1.798	117.435	−15.9784	+15.9810	−15.9797	−2.6	+ 7.2	174.2224
73	74	1.334	118.769	− 6.3892	+ 6.3878	− 6.3885	+1.4	+ 8.6	167.8339
74	75	1.788	120.557	+ 2.0702	− 2.0758	2.0751	+5.8	+14.4	169.9090
				+ 2.0741	− 2.0802				
75	76	1.806	122.363	− 9.4997	+ 9.4960	− 9.4978	+3.7	+18.1	160.4112
76	77	1.425	123.788	+ 3.0300	− 3.0304	+ 3.0302	+0.4	+18.5	163.4414
77	78	1.641	125.429	+ 3.5979	− 3.5959	+ 3.5969	−2.0	+16.5	167.0383
78	79	1.358	126.787	− 7.3350	+ 7.3329	− 7.3340	+2.1	+18.6	159.7043
79	F_4	0.899	127.686	− 2.7640	+ 2.7605	− 2.7622	+3.5	+22.1	156.9421
E_4	Sta. Elmmott			+ 0.96					157.90
E_4	80	0.914	128.600	− 0.8893	+ 0.8873	− 0.8883	+2.0	+24.1	156.0538
80	81	1.630	130.230	− 4.4204	+ 4.4191	− 4.4198	+1.3	+25.4	151.6340
81	82	1.606	131.836	− 1.6734	+ 1.6691	− 1.6712	+4.3	+29.7	149.9628
82	83	1.463	133.299	− 3.4176	+ 3.4219	− 3.4198	−4.3	+25.4	146.5430
83	84	1.742	135.041	− 9.3778	+ 9.3750	− 9.3764	+2.8	+28.2	137.1666
84	85	1.457	136.498	− 4.3204	+ 4.3157	− 4.3180	+4.7	+32.9	132.8486
85	86	1.642	138.140	− 7.5581	+ 7.5556	− 7.5568	+2.5	+35.4	125.2918
86	87	1.634	139.774	− 1.0858	+ 1.0852	− 1.0855	+0.6	+36.0	124.2063
87	Hyd. 1	1.571	141.345	− 1.3716	+ 1.3711	− 1.3714	+0.5	+36.5	122.8349
Hyd. 1	Sta. Waco			+ 3.58					126.41
Hyd. 1	F_4	0.272	141.617	+ 3.1032	− 3.1038	+ 3.1035	+0.6	+37.1	125.9384
F_4	G_4	0.302	141.919	+ 0.3947	− 0.3958	+ 0.3952	+1.1	+38.2	126.3336
Hyd. 1	Hyd. 2	1.515	142.860	+ 7.2216	− 7.2282	+ 7.2236	+5.7	+42.2	130.0585
				+ 7.2200	− 7.2248				
Hyd. 2	90	1.839	144.699	+10.7841	−10.7842	+10.7842	+0.1	+42.3	140.8427
90	91	1.463	146.162	+14.1520	−14.1526	+14.1523	+0.6	+42.9	154.9950
91	92	1.587	147.749	+12.1679	−12.1710	+12.1694	+3.1	+46.0	167.1644
92	93	1.658	149.407	+ 8.4345	− 8.4351	+ 8.4348	+0.6	+46.6	175.5992

Results of precise leveling from Fort Worth to Temple, Tex., 1903—Continued.

Bench mark.		Distance between successive bench marks.	Distance from bench mark U at Fort Worth.	Difference of elevation.			Discrepancy (B−F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
93	94	1.804	151.211	+ 8.2981	− 8.2990	+ 8.2986	+0.9	+47.5	183.8978
94	95	1.404	152.615	+ 2.2099	− 2.2068	+ 2.2084	−3.1	+44.4	186.1062
95	H_4	1.794	154.409	+13.6078	−13.6048	+13.6063	−3.0	+41.4	199.7125
H_4	97	1.545	155.954	− 2.8635	+ 2.8604	− 2.8620	+3.1	+44.5	196.8505
97	98	1.461	157.415	+ 2.1061	− 2.1062	+ 2.1062	+0.1	+44.6	198.9567
98	99	1.645	159.060	−16.5029	+16.4942	−16.4982	+4.6	+49.2	182.4585
				−16.4982	+16.4977				
99	100	1.633	160.693	+14.3735	−14.3721	+14.3728	−1.4	+47.8	196.8313
100	101	1.418	162.111	− 9.2055	+ 9.2016	− 9.2036	+3.9	+51.7	187.6277
101	I_4	1.217	163.328	− 8.0019	+ 8.0018	− 8.0018	+0.1	+51.8	179.6259
I_4	Sta. Lorena			+ 1.14					180.77
I_4	102	0.494	163.822	− 4.6831	+ 4.6824	− 4.6828	+0.7	+52.5	174.9431
102	103	1.824	165.646	+ 0.5929	− 0.5899	+ 0.5914	−3.0	+49.5	175.5345
103	104	1.294	166.940	+ 5.2274	− 5.2269	+ 5.2272	−0.5	+49.0	180.7617
104	105	1.607	168.547	−14.3400	+14.3435	−14.3418	−3.5	+45.5	166.4199
105	106	1.640	170.187	+10.9306	−10.9304	+10.9305	−0.2	+45.3	177.3504
106	Sta. Bruceville			+ 3.04					180.39
106	107	1.786	171.973	+17.2010	−17.1980	+17.1995	−3.0	+42.3	194.5499
107	J_4	1.758	173.731	+ 9.9880	− 9.9848	+ 9.9864	−3.2	+39.1	204.5363
J_4	Sta. Eddy			+ 0.40					204.94
J_4	109	1.553	175.284	+ 7.7955	− 7.7964	+ 7.7960	+0.9	+40.0	212.3323
109	110	1.412	176.696	− 8.8941	+ 8.8983	− 8.8962	−4.2	+35.8	203.4361
110	111	1.645	178.341	− 0.0222	+ 0.0262	− 0.0242	−4.0	+31.8	203.4119
111	112	1.579	179.920	+ 3.9103	− 3.9128	+ 3.9116	+2.5	+34.3	207.3235
112	113	1.657	181.577	−11.0378	+11.0415	−11.0396	−3.7	+30.6	196 2839
113	114	1.855	183.432	− 1.4734	+ 1.4788	− 1.4761	−5.4	+25.2	194.8078
114	115	1.485	184.917	+12.0360	−12.0355	+12.0358	−0.5	+24.7	206.8436
115	Sta. Troy			+ 0.44					207.28
115	K_4	0.025	184.942	− 0.1359	+ 0.1366	− 0.1362	−0.6	+24.1	206.7074
				− 0.1360	+ 0.1365				
K_4	116	1.108	186.050	+ 7.9389	− 7.9354	+ 7.9372	−3.5	+20.6	214.6446
116	117	1.639	187.689	+12.6089	−12.6089	+12.6089	0.0	+20.6	227.2535
117	118	1.825	189.514	− 5.7795	+ 5.7827	− 5.7811	−3.2	+17.4	221.4724
118	119	1.623	191.137	− 9.0592	+ 9.0631	− 9.0612	−3.9	+13.5	212.4112
119	120	1.591	192.728	−11.3694	+11.3625	−11.3636	+2.4	+15.9	201.0476
				−11.3601	+11.3623				
120	121	1.854	194.582	+ 7.9428	− 7.9474	+ 7.9451	+4.6	+20.5	208.9927
121	122	1.148	195.730	− 3.1048	+ 3.1034	− 3.1041	+1.4	+21.9	205 8886
122	N_4	1.347	197.077	+ 3.6746	− 3.6723	+ 3.6734	−2.3	+19.6	209.5620
N_4	123	0.446	197.523	+ 0.4616	− 0.4589	+ 0.4608	−2.0	+17.6	210.0228
123	Sta. Temple			+ 0.64					210.66
123	I_4	1.067	198.590	− 4.7489	+ 4.7521	− 4.7505	−3.2	+14.4	205.2723
L_4	M_4	1.063	199.653	+ 8.9459	− 8.9427	+ 8.9443	−3.2	+11.2	214.2166

Results of precise leveling from Temple to Lampasas, Tex., 1903.

Bench mark.		Distance between successive bench marks.	Distance from bench mark U at Fort Worth.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
	M_4		199.653					+11.2	214.2166
M_4	125	1.299	200.952	+ 5.2403	− 5.2429	+ 5.2416	+2.6	+13.8	219.4582
125	126	1.991	202.943	−25.0294	+25.0312	−25.0303	−1.8	+12.0	194.4279
126	127	1.947	204.890	− 9.2893	+ 9.2929	− 9.2911	−3.6	+ 8.4	185.1368
127	128	1.653	206.543	−18.1680	+18.1685	−18.1681	−0.2	+ 8.2	166.9687
128	129	1.686	208.229	− 5.6306	+ 5.6285	− 5.6296	+2.1	+10.3	161.3391
129	130	1.259	209.488	− 8.4907	+ 8.4940	− 8.4924	−3.3	+ 7.0	152.8467
130	O_4	1.247	210.735	+ 2.1729	− 2.1747	+ 2.1738	+1.8	+ 8.8	155.0205
O_4	131	0.915	211.650	+11.5810	−11.5814	+11.5812	+0.4	+ 9.2	166.6017
131	132	1.442	213.092	+14.4207	−14.4193	+14.4200	−1.4	+ 7.8	181.0217
132	133	1.788	214.880	+ 7.6172	− 7.6171	+ 7.6172	−0.1	+ 7.7	188.6389
133	134	1.660	216.540	−10.6557	+10.6572	−10.6564	−1.5	+ 6.2	177.9825
134	135	1.642	218.182	+ 5.2405	− 5.2381	+ 5.2393	−2.4	+ 3.8	183.2218
135	136	1.644	219.826	+ 1.1810	− 1.1765	+ 1.1788	−4.5	− 0.7	184.4006
136	137	1.840	221.666	+ 3.3713	− 3.3701	+ 3.3707	−1.2	− 1.9	187.7713
137	138	0.851	222.517	+ 0.7964	− 0.7958	+ 0.7961	−0.6	− 2.5	188.5674
138	P_4	1.820	224.337	+14.5483	−14.5445	+14.5464	−3.8	− 6.3	203.1138
P_4	140	1.549	225.886	+ 6.1758	− 6.1762	+ 6.1760	+0.4	− 5.9	209.2898
140	141	1.617	227.503	+ 3.1032	− 3.1025	+ 3.1028	−0.7	− 6.6	212.3926
141	Sta. Nolanville			− 0.54					211.85
141	143	1.516	229.019	+ 2.4691	− 2.4678	+ 2.4684	−1.3	− 7.9	214.8610
143	144	1.938	230.957	+ 2.0962	− 2.0958	+ 2.0960	−0.4	− 8.3	216.9570
144	145	1.952	232.909	+ 4.8169	− 4.8117	+ 4.8143	−5.2	−13.5	221.7713
145	146	1.965	234.874	+ 8.0710	− 8.0716	+ 8.0713	+0.6	−12.9	229.8426
146	147	1.987	236.861	+ 9.2184	− 9.2183	+ 9.2184	−0.1	−13.0	239.0610
147	Q_4	0.122	236.983	+ 0.9325	− 0.9325	+ 0.9325	0.0	−13.0	239.9935
147	148	1.948	238.809	+ 5.2532	− 5.2523	+ 5.2528	−0.9	−13.9	244.3138
148	149	1.649	240.458	+ 8.8348	− 8.8353	+ 8.8350	+0.5	−13.4	253.1488
149	Sta. Killeen			+ 0.54					253.69
149	150	1.980	242.438	+ 5.1797	− 5.1753	+ 5.1775	−4.4	−17.8	258.3263
150	151	1.443	243.881	+18.1444	−18.1488	+18.1466	+4.4	−13.4	276.4729
151	152	1.483	245.364	+14.3495	−14.3527	+14.3511	+3.2	−10.2	290.8240
152	153	1.473	246.837	+ 1.6836	− 1.6826	+ 1.6831	−1.0	−11.2	292.5071
153	154	1.363	248.200	−18.1084	+18.1085	−18.1084	−0.1	−11.3	274.3987
154	155	1.967	250.167	− 5.4438	+ 5.4460	− 5.4449	−2.2	−13.5	268.9538
155	156	1.434	251.601	+16.1048	−16.1052	+16.1050	+0.4	−13.1	285.0588
156	R_4	0.061	251.662	+ 1.4510	− 1.4509	+ 1.4510	−0.1	−13.2	286.5098
156	157	1.477	253.078	+13.9576	−13.9579	+13.9578	+0.3	−12.8	299.0166
157	158	1.475	254.553	+11.5710	−11.5714	+11.5712	+0.4	−12.4	310.5878
158	159	1.456	256.009	+11.4605	−11.4587	+11.4596	−1.8	−14.2	322.0474
159	S_4	0.655	256.664	+ 4.8281	− 4.8292	+ 4.8286	+1.1	−13.1	326.8760

Results of precise leveling from Temple to Lampasas, Tex., 1903—Continued.

Bench marks.		Distance between successive bench marks.	Distance from bench mark U at Fort Worth.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
S_4	Sta. Copperas Cove.			+ 4.23					331.11
S_4	159½	1.479	258.143	+ 1.4185	− 1.4194	+ 1.4190	+0.9	−12.2	328.2950
159½	160	0.425	258.568	− 4.7333	+ 4.7338	− 4.7336	−0.5	−12.7	323.5614
160	161	1.399	259.967	+25.0798	−25.0851	+25.0824	+5.3	− 7.4	348.6438
161	Gilmore △	1.663	261.630	+43.5092	−43.5021	+43.5044	+0.2	− 7.2	392.1482
				+43.4993	−43.5069				
Gilmore △	Ref. mark	0.090	261.720	− 1.4761	+ 1.4756	− 1.4758	+0.5	− 6.7	390.6724
160	162	1.759	260.327	+ 8.7495	− 8.7477	+ 8.7486	−1.8	−14.5	332.3100
162	163	0.984	261.311	− 1.9182	+ 1.9169	− 1.9176	+1.3	−13.2	330.3924
163	164	1.625	262.936	+ 5.9683	− 5.9620	+ 5.9652	−3.9	−17.1	336.3576
				+ 5.9660	− 5.9645				
164	165	1.504	264.440	−19.6330	+19.6347	−19.6338	−1.7	−18.8	316.7238
165	166	1.613	266.053	−17.5888	+17.5932	−17.5910	−4.4	−23.2	299.1328
166	167	1.571	267.624	−11.6838	+11.6937	−11.6884	−5.4	−28.6	287.4444
				−11.6875	+11.6885				
167	168	1.604	269.228	−13.4808	+13.4833	−13.4820	−2.5	−31.1	273.9624
168	169	1.629	270.857	− 1.3643	+ 1.3664	− 1.3654	−2.1	−33.2	272.5970
169	T_4	0.078	270.935	− 0.0650	+ 0.0649	− 0.0650	+0.1	−33.1	272.5320
T_4	170	1.252	272.187	− 9.8105	+ 9.8165	− 9.8126	−3.7	−36.8	262.7194
				− 9.8109	+ 9.8123				
170	Sta. Kempner			+ 4.23					266.95
170	171	1.768	273.955	+ 1.9064	− 1.9066	+ 1.9065	+0.2	−36.6	264.6259
171	172	1.661	275.616	+ 3.8035	− 3.7995	+ 3.8015	−4.0	−40.6	268.4274
172	173	1.456	277.072	+ 4.6105	− 4.6099	+ 4.6102	−0.6	−41.2	273.0376
173	174	1.501	278.573	+ 8.3392	− 8.3368	+ 8.3380	−2.4	−43.6	281.3756
174	175	1.677	280.250	+ 5.6679	− 5.6734	+ 5.6720	+1.2	−42.4	287.0476
				+ 5.6749	− 5.6718				
175	176	1.809	282.059	+11.2911	−11.2900	+11.2906	−1.1	−43.5	298.3382
176	177	1.644	283.703	+ 3.5155	− 3.5117	+ 3.5136	−3.8	−47.3	301.8518
177	U_4	1.821	285.524	− 2.9292	+ 2.9307	− 2.9300	−1.5	−48.8	298.9218
U_4	178	0.383	285.907	− 1.1357	+ 1.1374	− 1.1366	−1.7	−50.5	297.7852
178	179	0.872	286.779	− 2.0920	+ 2.0851	− 2.0878	+3.1	−47.4	295.6974
				− 2.0868	+ 2.0875				
179	Lampasas N.E.B. △	0.619	287.398	+19.7548	−19.7537	+19.7542	−1.1	−48.5	315.4516

TEMPLE–HOLLAND LINE.

This line was run by R. L. Libby, Aid, between March 27 and April 9, 1903, with level No. 9, one of the new type. It is the beginning of a line southward from Temple to control the elevations on the southern portion of the ninety-eighth meridian triangulation and to furnish a new connection with sea level at some point on the Texas coast. The line follows the Missouri, Kansas and Texas Railroad.

The remarks as to the velocipede cars, weather, and length and index corrections of rods made in connection with the Fort Worth-Lampasas line apply to this line also.

In the following tabulation the elevations shown depend on the adjustment of 1903.

Results of precise leveling from Temple to Holland, Tex.

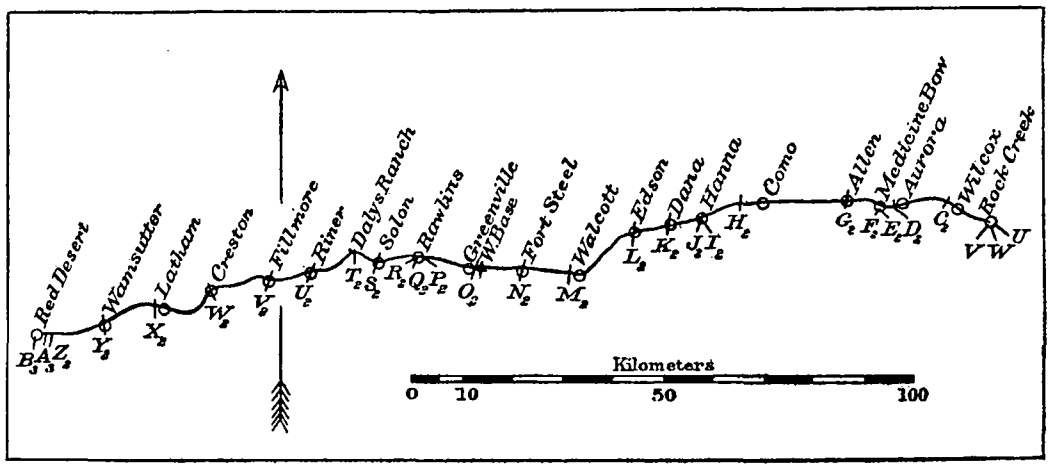
Bench marks.		Distance between successive bench marks.	Distance from bench mark I_4 at Temple.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
	N_4								209.5620*
N_4	I_4	1.499		— 4.2917	+ 4.2900	— 4.2908	+1.7		205.2712
	I_4		0.000						205.2723*
I_4	181	1.648	1.648	— 1.0429	+ 1.0473	— 1.0451	−4.4	— 4.4	204.2272
181	182	1.834	3.482	— 6.5461	+ 6.5468	— 6.5477	+1.4	— 3.0	197.6795
				— 6.5502					
182	183	1.802	5.284	−12.0721	+12.0731	−12.0726	−1.0	— 4.0	185.6069
183	184	1.970	7.254	— 9.2218†	+ 9.2334	— 9.2330	−2.7	— 6.7	176.3739
				— 9.2312	+ 9.2344				
184	185	1.641	8.895	−14.4425	+14.4495	−14.4456	−5.5	−12.2	161.9283
				−14.4432	+14.4472				
185	186	1.314	10.209	— 6.2759	+ 6.2834	— 6.2803	−4.2	−16.4	155.6480
				— 6.2805	+ 6.2814				
186	187	1.507	11.716	— 6.1900	+ 6.1912	— 6.1906	−1.2	−17.6	149.4574
187	V_4	0.028	11.744	+ 0.7125	— 0.7124	+ 0.7124	−0.1	−17.7	150.1698
187	Sta. Little River‡	0.692	12.408	+ 4.05					153.51
187	189	1.617	13.333	−14.0885	+14.0832	−14.0861	+2.5	−15.1	135.3713
				−14.0862	+14.0866				
189	190	1.662	14.995	+ 1.7942	— 1.7987	+ 1.7964	+4.5	−10.6	137.1677
190	191	1.592	16.587	+ 6.3263	— 6.3266	+ 6.3264	+0.3	−10.3	143.4941
191	192	1.626	18.213	— 2.2983	+ 2.3036	— 2.3028	−3.2	−13.5	141.1913
				— 2.3040	+ 2.3053				
192	193	1.638	19.851	+ 7.4283	— 7.4361	+ 7.4324	+4.2	— 9.3	148.6237
				+ 7.4323	— 7.4330				
193	194	1.967	21.818	+16.7505	−16.7466	+16.7486	−3.9	−13.2	165.3723
194	195	1.970	23.788	— 0.7222	+ 0.7192	— 0.7207	+3.0	−10.2	164.6516
195	196	0.412	24.200	+ 3.6362	— 3.6352	+ 3.6357	−1.0	−11.2	168.2873
196	Z_4	1.432	25.632	— 7.6980	+ 7.6946	— 7.6963	+3.4	— 7.8	160.5910
Z_4	W_4	0.946	26.578	— 5.8928	+ 5.8936	— 5.8932	−0.8	— 8.6	154.6978
Z_4	Sta. Holland‡	0.434	26.066	— 1.20					159.39
Z_4	X_4	0.228	25.860	+ 0.3644	— 0.3651	+ 0.3648	+0.7	— 7.1	160.9558
X_4	Y_4	0.081	25.941	+ 0.1671	— 0.1655	+ 0.1664	−1.3	— 8.4	161.1222
				+ 0.1670	— 0.1660				

*Elevation fixed by the line Fort Worth to Lampasas. †Rejected. ‡On rail in front of station.

ROCK CREEK–RED DESERT LINE.

This line was run by W. C. Dibrell, Aid, between August 11 and October 13, 1902, with level No. 7, one of the new type. It extends the leveling westward from the former western terminus of the precise leveling at Rock Creek, Wyo., toward the Pacific. It forms a part of the line from Rock Creek via Ogden to Seattle, Wash., at which point a connection with mean sea level will be obtained. The line follows the Union Pacific Railroad, and velocipede cars were used. Very steep and long grades were encountered.

No. 20.



Leveling route, Rock Creek to Red Desert, Wyo.

Rods R_2 and S were used. Their lengths at 0° C., as determined by the National Bureau of Standards, were, in March, 1902, $R_2 = 3^m + 0^{mm}.86$ and $S = 3^m + 1^{mm}.39$, and in December, 1902, $R_2 = 3^m + 0^{mm}.80$ and $S = 3^m + 1^{mm}.34$ There had evidently been no change in length during the season, and the mean of the four measures, or an excess of length of 0.37 millimeters per meter, was used.

The elevations given in the following tabulation are nearly correct. To make them correspond to the 1903 adjustment, −0.0926 meter should be applied to the tabular elevations. The elevations given in the tabulation for stations marked thus (Sta. Aurora) refer to top of rail in front of railroad station named.

Results of precise leveling from Rock Creek to Red Desert, Wyoming, 1902.

Bench marks.		Distance between successive bench marks.	Distance from bench mark U at Rock Creek.	Difference of elevation.			Discrepancy. (B—F)		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
	V								2043.3002*
V	W	0.022		+ 0.0601	— 0.0607	+ 0.0603	+0.6		2043.3605
				+ 0.0600	— 0.0604				
	U								2043.4926*
U	W	1.221		— 0.1334	+ 0.1343	— 0.1338	+0.9		2043.3588
	W								2043.3643*
	W							Mean=	2043.3596†
	U		0.000						2043.4926*
U	1	1.688	1.688	+ 9.9343	— 9.9372	+ 9.9358	+2.9	+ 2.9	2053.4284
1	2	1.624	3.312	+ 0.9323	— 0.9350	+ 0.9336	+2.7	+ 5.6	2054.3620
2	3	1.730	5.042	— 3.9645	+ 3.9657	— 3.9651	—1.2	+ 4.4	2050.3969
3	4	0.886	5.928	+ 4.4262	— 4.4306	+ 4.4274	+4.0	+ 8.4	2054.8243
				+ 4.4245	— 4.4283				
4	5	1.608	7.536	+11.9111	—11.9113	+11.9112	+0.2	+ 8.6	2066.7355
5	6	1.583	9.119	+20.5713	—20.5693	+20.5703	+2.0	+ 6.6	2087.3058
6	7	0.248	9.367	+ 6.0797	— 6.0814	+ 6.0806	+1.7	+ 8.3	2093.3864
7	8	1.616	10.983	+27.8917	—27.8939	+27.8928	+2.2	+10.5	2121.2792
8	9	1.605	12.588	+ 1.4501	— 1.4486	+ 1.4494	—1.5	+ 9.0	2122.7286
9	C_2	1.562	14.150	—12.6570	+12.6578	—12.6574	—0.8	+ 8.2	2110.0712
C_2	10	0.320	14.470	— 2.1993	+ 2.1995	— 2.1994	—0.2	+ 8.0	2107.8718
10	11	1.614	16.084	—13.1621	+13.1574	—13.1598	+4.7	+12.7	2094.7120
11	Sta. Aurora	1.237	17.321	— 9.67					2085.04
11	12	1.619	17.703	—12.9987	+12.9968	—12.9978	+1.9	—14.6	2081.7142
12	13	1.602	19.305	—13.1877	+13.1886	—13.1882	—0.9	+13.7	2068.5260
13	D_2	1.586	20.891	—12.6770	+12.6805	—12.6788	—3.5	+10.2	2055.8472
D_2	14	1.152	22.043	— 9.7196	+ 9.7212	— 9.7204	—1.6	+ 8.6	2046.1268
14	Sta. Ridge	1.039	23.082	— 5.30					2040.83
14	15	1.655	23.698	— 7.4520	+ 7.4487	— 7.4504	+3.3	+11.9	2038.6764
15	16	1.596	25.294	— 4.8787	+ 4.8795	— 4.8791	—0.8	+11.1	2033.7973
16	17	1.608	26.902	—13.2610	+13.2549	—13.2582	+3.0	+14.1	2020.5391
				—13.2584	+13.2585				
17	18	1.550	28.452	—10.9694	+10.9701	—10.9698	—0.7	+13.4	2009.5693
18	19	1.608	30.060	+ 6.9853	— 6.9898	+ 6.9876	+4.5	+17.9	2016.5569
19	20	1.607	31.667	—11.9664	+11.9653	—11.9658	+1.1	+19.0	2004.5911
20	21	1.623	33.290	— 3.6404	+ 3.6378	— 3.6391	+2.6	+21.6	2000.9520
21	E_2	0.028	33.318	+ 0.0006	— 0.0006	+ 0.0006	0.0	+21.6	2000.9526
E_2	Sta. Medicine Bow	0.118	33.436	— 0.37					2000.58
E_2	F_2	0.309	33.627	— 1.6025	+ 1.6021	— 1.6023	+0.4	+22.0	1999.3503
F_2	22	0.034	33.661	— 0.3706	+ 0.3705	— 0.3706	+0.1	+22.1	1998.9797
22	23	1.103	34.764	— 0.5973	+ 0.5988	— 0.5980	—1.5	+20.6	1998.3817
23	24	1.603	36.367	+ 4.4951	— 4.4922	+ 4.4936	—2.9	+17.7	2002.8753
24	25	1.601	37.968	+ 2.7321	— 2.7302	+ 2.7312	—1.9	+15.8	2005.6065

*Adjusted elevations of 1902.

†Bench mark W has evidently settled since the earlier determination, and the mean of the two values from this line is adopted.

Results of precise leveling from Rock Creek to Red Desert, Wyoming, 1902—Continued.

Bench marks.		Distance between successive bench marks.	Distance from bench mark U at Rock Creek.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
25	26	1.612	39.580	+ 5.8216	— 5.8206	+ 5.8211	—1.0	+14.8	2011.4276
26	G_2	0.451	40.031	+ 4.1020	— 4.1031	+ 4.1026	+1.1	+15.9	2015.5302
G_2	Sta. Allen	0.095	40.126	— 1.15					2014.38
G_2	27	1.629	41.660	+ 7.9159	— 7.9157	+ 7.9158	—0.2	+15.7	2023.4460
27	28	1.597	43.257	+ 5.5948	— 5.5991	+ 5.5970	+4.3	+20.0	2029.0430
28	29	1.608	44.865	+ 3.8447	— 3.8478	+ 3.8462	+3.1	+23.1	2032.8892
29	30	1.608	46.473	+ 8.4841	— 8.4849	+ 8.4845	+0.8	+23.9	2041.3737
30	31	1.615	48.088	+ 3.3387	— 3.3346	+ 3.3366	—4.1	+19.8	2044.7103
31	Sta. Como	0.669	48.757	+ 0.66					2045.37
31	32	1.617	49.705	+ 2.4969	— 2.4998	+ 2.4984	+2.9	+22.7	2047.2087
32	33	1.614	51.319	+ 6.4853	— 6.4891	+ 6.4872	+3.8	+26.5	2053.6959
33	34	1.605	52.924	+10.4384	—10.4346	+10.4365	—3.8	+22.7	2064.1324
34	H_2	0.069	52.993	— 1.1741	+ 1.1747	— 1.1744	—0.6	+22.1	2062.9580
H_2	35	1.611	54.604	+12.4000	—12.4036	+12.4018	+3.6	+25.7	2075.3598
35	36	1.626	56.230	+11.6295	—11.6284	+11.6290	—1.1	+24.6	2086.9888
36	37	1.608	57.838	+11.3928	—11.3933	+11.3930	+0.5	+25.1	2098.3818
37	Sta. Ramsey	1.310	59.148	+ 2.60					2100.98
37	38	1.604	59.442	— 0.5388	+ 0.5409	— 0.5398	—2.1	+23.0	2097.8420
38	39	0.985	60.427	— 4.9593	+ 4.9575	— 4.9584	+1.8	+24.8	2092.8836
39	40	1.630	62.057	—11.0050	+11.0036	—11.0043	+1.4	+26.2	2081.8793
40	41	1.609	63.666	— 9.5339	+ 9.5324	— 9.5332	+1.5	+27.7	2072.3461
41	I_2	1.623	65.289	— 6.2879	+ 6.2921	— 6.2900	—4.2	+23.5	2066.0561
I_2	J_2	0.870	66.159	— 0.9735	+ 0.9760	— 0.9748	—2.5	+21.0	2065.0813
J_2	Sta. Hanna	0.079	66.238	— 0.41					2064.67
J_2	42	1.627	67.786	+ 7.2527	— 7.2563	+ 7.2545	+3.6	+24.6	2072.3358
42	43	1.609	69.395	+13.3714	—13.3692	+13.3703	—2.2	+22.4	2085.7061
43	44	1.618	71.013	+13.1705 +13.1796	—13.1766 —13.1738	+13.1751	+0.2	+22.6	2098.8812
44	45	1.610	72.623	+12.8808	—12.8836	+12.8822	+2.8	+25.4	2111.7634
45	46	1.616	74.239	+ 1.4966	— 1.4922	+ 1.4944	—4.4	+21.0	2113.2578
46	Sta. Percy	0.149	74.388	+ 0.20					2113.46
46	47	1.610	75.849	—12.9479	+12.9476	—12.9478	+0.3	+21.3	2100.3100
47	48	1.609	77.458	—12.9137	+12.9150	—12.9144	—1.3	+20.0	2087.3956
48	49	1.607	79.065	—12.6483	+12.6477	—12.6480	+0.6	+20.6	2074.7476
49	K_2	0.737	79.802	— 4.7898	+ 4.7874	— 4.7886	+2.4	+23.0	2069.9590
K_2	Sta. Dana	0.135	79.937	+ 0.32					2070.28
K_2	50	0.460	80.262	— 1.7030	+ 1.7045	— 1.7038	—1.5	+21.5	2068.2552
50	51	1.612	81.874	— 4.5231	+ 4.5270	— 4.5250	—3.9	+17.6	2063.7302
51	52	1.608	83.482	— 2.5532	+ 2.5538	— 2.5535	—0.6	+17.0	2061.1767
52	Sta. Edson	0.354	83.836	+ 0.02					2061.20
52	L_2	0.707	84.189	+ 0.1390	— 0.1393	+ 0.1392	+0.3	+17.3	2061.3159

Results of precise leveling from Rock Creek to Red Desert, Wyoming, 1902—Continued.

Bench marks.		Distance between successive bench marks.	Distance from bench mark U at Rock Creek.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
L_2	53	0.993	85.182	− 3.9566	+ 3.9569	− 3.9568	−0.3	+17.0	2057.3591
53	54	1.556	86.738	+ 0.0483	− 0.0490	+ 0.0486	+0.7	+17.7	2057.4077
54	55	1.649	88.387	− 9.3466	+ 9.3465	− 9.3466	+0.1	+17.8	2048.0611
55	56	1.665	90.052	− 4.0683	+ 4.0670	− 4.0676	+1.3	+19.1	2043.9935
56	57	1.493	91.545	−10.3303	+10.3312	−10.3308	−0.9	+18.2	2033.6627
57	58	0.944	92.489	− 3.2839	+ 3.2827	− 3.2833	+1.2	+19.4	2030.3794
58	59	0.656	93.145	+ 0.5913	− 0.5895	+ 0.5904	−1.8	+17.6	2030.9698
59	60	1.610	94.755	− 7.9634	+ 7.9653	− 7.9644	−1.9	+15.7	2023.0054
60	61	1.605	96.360	− 4.7603	+ 4.7549	− 4.7569	+2.6	+18.3	2018.2485
				− 4.7562	+ 4.7563				
61	Sta. Walcott	0.122	96.482	+ 0.47					2018.72
61	M_2	1.107	97.467	− 5.3436	+ 5.3412	− 5.3424	+2.4	+20.7	2012.9061
M_2	62	0.505	97.972	− 1.8011	+ 1.8011	− 1.8011	0.0	+20.7	2011.1050
62	63	1.599	99.571	− 5.5153	+ 5.5176	− 5.5164	−2.3	+18.4	2005.5886
63	64	1.601	101.172	− 6.9359	+ 6.9363	− 6.9361	−0.4	+18.0	1998.6525
64	65	1.611	102.783	− 9.0522	+ 9.0465	− 9.0491	+1.0	+19.0	1989.6034
				− 9.0469	+ 9.0508				
65	66	1.563	104.346	− 7.7015	+ 7.6999	− 7.7007	+1.6	+20.6	1981.9027
66	Sta. Fort Steele	1.641	105.987	+ 2.42					1984.32
66	N_2	1.671	106.017	+ 3.4188	− 3.4224	+ 3.4206	+3.6	+24.2	1985.3233
N_2	67	1.552	107.569	+10.5762	−10.5763	+10.5762	+0.1	+24.3	1995.8995
67	68	1.609	109.178	+ 4.7394	− 4.7388	+ 4.7391	−0.6	+23.7	2000.6386
68	69	1.608	110.786	− 5.8290	+ 5.8301	− 5.8296	−1.1	+22.6	1994.8090
69	70	1.607	112.393	− 3.3435	+ 3.3378	− 3.3402	+0.1	+22.7	1991.4688
				− 3.3371	+ 3.3425				
70	71	1.608	114.001	+ 1.0874	− 1.0863	+ 1.0868	−1.1	+21.6	1992.5556
71	72	1.606	115.607	+ 6.7969	− 6.8024	+ 6.7965	+1.4	+23.0	1999.3521
				+ 6.7947	− 6.7921				
72	73	1.612	117.219	+ 4.1319	− 4.1378	+ 4.1328	+2.5	+25.5	2003.4849
				+ 4.1311	− 4.1302				
73	Geol. W. B.	0.615	117.834	+ 2.8490	− 2.8515	+ 2.8502	+2.5	+28.0	2006.3351
73	R. R. B. M.	0.510	117.729	+ 1.80					2005.28
73	O_2	1.234	118.453	+ 3.2284	− 3.2298	+ 3.2291	+1.4	+26.9	2006.7140
O_2	74	0.383	118.836	− 1.1389	+ 1.1383	− 1.1386	+0.6	+27.5	2005.5754
74	Sta. Greenville	0.252	119.088	+ 1.36					2006.94
74	75	1.611	120.447	+ 3.7793	− 3.7795	+ 3.7794	+0.2	+27.7	2009.3548
75	76	1.640	122.087	+ 3.1293	− 3.1300	+ 3.1296	+0.7	+28.4	2012.4844
76	77	1.574	123.661	+ 6.6052	− 6.6033	+ 6.6042	−1.9	+26.5	2019.0886
77	Sta. Seminole	0.534	124.195	+ 0.79					2019.88
77	78	1.610	125.271	+ 4.9740	− 4.9814	+ 4.9767	+6.2	+32.7	2024.0653
				+ 4.9732	− 4.9781				

Results of precise leveling from Rock Creek to Red Desert, Wyoming, 1902—Continued.

Bench marks.		Distance between successive bench marks.	Distance from bench mark U at Rock Creek.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
78	79	1.608	126.879	+13.3389 +13.3394 +13.3389	−13.3507* −13.3452 −13.3370	+13.3399	+2.0	+34.7	2037.4052
79	80	0.661	127.540	+ 4.4563	− 4.4557	+ 4.4560	−0.6	+34.1	2041.8612
80	81	1.952	129.492	+10.3719	−10.3739	+10.3729	+2.0	+36.1	2052.2341
81	P_2	0.786	130.278	+ 4.4009	− 4.3982	+ 4.3996	−2.7	+33.4	2056.6337
P_2	Sta. Rawlins	0.257	130.535	− 0.71					2055.92
P_2	Q_2	0.399	130.677	+ 1.8371	− 1.8384	+ 1.8378	+1.3	+34.7	2058.4715
Q_2	R_2	0.311	130.988	+10.0181	−10.0175	+10.0178	−0.6	+34.1	2068.4893
R_2	82	0.757	131.745	−12.8714	+12.8696	−12.8705	+1.8	+35.9	2055.6188
82	83	1.413	133.158	+11.9794	−11.9773	+11.9784	−2.1	+33.8	2067.5972
83	84	1.364	134.522	+10.4064	−10.4067	+10.4066	+0.3	+34.1	2078.0038
84	Sta. Ferris	1.883	136.405	+15.49					2093.49
84	85	1.889	136.411	+16.4955	−16.4970	+16.4962	+1.5	+35.6	2094.5000
85	86	1.905	138.316	+11.4226	−11.4248	+11.4237	+2.2	+37.8	2105.9237
86	87	0.579	138.895	− 0.2004	+ 0.2018	− 0.2011	−1.4	+36.4	2105.7226
87	88	1.608	140.503	− 0.9361	+ 0.9368	− 0.9364	−0.7	+35.7	2104.7862
88	89	1.246	141.749	+ 5.8941	− 5.8965	+ 5.8953	+2.4	+38.1	2110.6815
89	Sta. Solon	0.354	142.103	+ 0.95					2111.63
89	S_2	0.389	142.138	− 0.3995	+ 0.3981	− 0.3988	+1.4	+39.5	2110.2827
S_2	90	1.598	143.736	− 7.0126	+ 7.0119	− 7.0122	+0.7	+40.2	2103.2705
90	91	1.526	145.262	− 8.7295	+ 8.7341	− 8.7318	−4.6	+35.6	2094.5387
91	92	1.609	146.871	−12.6611* −12.6705	+12.6694 +12.6706	−12.6702	+0.5	+36.1	2081.8685
92	Sta. Knobs	0.560	147.431	− 4.18					2077.69
92	93	1.607	148.478	−12.6016	+12.6033	−12.6024	−1.7	+34.4	2069.2661
93	94	1.605	150.083	−13.0488	+13 0497	−13.0492	−0.9	+33.5	2056.2169
94	95	1.736	151 819	−13.9676	+13.9733	−13.9704	−5.7	+27.8	2042.2465
95	T_2	0.962	152.781	− 6.9444	+ 6.9438	− 6.9441	+0.6	+28.4	2035.3024
T_2	96	1.517	154.298	+ 3.8179	− 3.8203	+ 3.8191	+2.4	+30.8	2039.1215
96	Sta. Daleys Ranch	0.292	154.590	− 0.68					2038.44
96	97	1.510	155.808	+10.3400 +10.3444	−10.3458 −10.3402	+10.3426	+0.8	+31.6	2049.4641
97	98	0.813	156.621	+ 5.0657	− 5.0642	+ 5.0650	−1.5	+30.1	2054.5291
98	99	1.627	158.248	− 0.1480 − 0.1508	+ 0.1568 + 0.1526	− 0.1520	−5.3	+24.8	2054.3771
99	100	1.738	159.986	+ 3.9363	− 3.9393	+ 3.9378	+3.0	+27.8	2058.3149
100	Sta. Riner	0.364	160.350	+ 1.07					2059.38
100	U_2	0.556	160.542	+ 0.9652	− 0.9666	+ 0.9659	+1.4	+29.2	2059.2808
U_2	101	1.588	162.130	− 4.5182	+ 4.5170	− 4.5176	+1.2	+30.4	2054.7632

*Rejected.

Results of precise leveling from Rock Creek to Red Desert, Wyoming, 1902—Continued.

Bench marks.		Distance between successive bench marks.	Distance from bench mark U at Rock Creek.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
101	R. R. B. M.	0.461	162.591	— 0.67					2054.09
101	102	1.700	163.830	+ 5.3646	— 5.3642	+ 5.3644	—0.4	+30.0	2060.1276
102	103	1.129	164.959	+ 6.2002	— 6.1970	+ 6.1986	—3.2	+26.8	2066.3262
103	104	1.626	166.585	+ 9.9284	— 9.9268	+ 9.9276	—1.6	+25.2	2076.2538
104	Sta. Cherokee	1.167	167.752	+ 6.20					2082.45
104	105	1.570	168.155	+10.0447*	—10.0606*	+10.0558	+1.7	+26.9	2086.3096
				+10.0549	—10.0566				
105	106	1.923	170.078	+13.7853	—13.7850	+13.7852	—0.3	+26.6	2100.0948
106	107	1.662	171.740	+13.7672	—13.7721	+13.7696	+4.9	+31.5	2113.8644
107	V_2	1.547	173.287	+12.6122*	—12.6336	+12.6293	+4.6	+36.1	2126.4937
				+12.6262	—12.6280				
V_2	Sta. Fillmore	0.132	173.419	+ 0.34					2126.83
V_2	108	1.242	174.529	+ 9.1797	— 9.1772	+ 9.1784	—2.5	+33.6	2135.6721
108	109	0.402	174.931	+ 3.8277	— 3.8284	+ 3.8280	+0.7	+34.3	2139.5001
109	110	1.653	176.584	+13.5978*	—13.6186*	+13.6048	—4.1	+30.2	2153.1049
				+13.6069	—13.6028				
110	Sta. Creston	1.557	178.141	+12.85					2165.95
110	W_2	1.614	178.198	+13.7118	—13.7217*	+13.7108	—1.1	+29.1	2166.8157
					—13.7110				
				+13.7108	—13.7095				
W_2	Divide†	0.124	178.322	— 0.72					2166.10
W_2	111	1.537	179.735	— 9.4976	+ 9.5099*	— 9.4998	+1.2	+30.3	2157.3159
				— 9.5028	+ 9.4990				
111	112	1.604	181.339	—12.4834	+12.4830	—12.4832	+0.4	+30.7	2144.8327
112	113	1.603	182.942	—13.0289*	+13.0428	—13.0413	—0.7	+30.0	2131.7914
				—13.0409	+13.0403				
113	114	1.570	184.512	—12.5220	+12.5041*	—12.5229	+2.1	+32.1	2119.2685
				—12.5253	+12.5215				
114	Sta. Latham	0.461	184.973	— 1.30					2117.97
114	X_2	1.245	185.757	— 7.7288	+ 7.7324	— 7.7306	—3.6	+28.5	2111.5379
X_2	115	1.240	186.997	— 8.9681	+ 8.9700	— 8.9690	—1.9	+26.6	2102.5689
115	116	1.574	188.571	—12.6764	+12.6736	—12.6750	+2.8	+29.4	2089.8939
116	117	1.632	190.203	—13.0615	+13.0629	—13.0622	—1.4	+28.0	2076.8317
117	118	1.577	191.780	—12.6249	+12.6194	—12.6275	—0.1	+27.9	2064.2042
				—12.6301	+12.6276				
118	Sta. Joshua	1.751	193.531	—11.19					2053.01
118	119	1.756	193.536	—11.5650	+11.5544*	—11.5636	+3.1	+31.0	2052.6406
				—11.5643	+11.5615				
119	120	1.609	195.145	— 2.5311	+ 2.5325	— 2.5318	—1.4	+29.6	2050.1088

*Rejected. †On rail in front of post marked "Divide of the continent."

Results of precise leveling from Rock Creek to Red Desert, Wyoming, 1902—Continued.

Bench marks.		Distance between successive bench marks.	Distance from bench mark U at Rock Creek.	Difference of elevation.			Discrepancy (B—F).		Elevation above mean sea level.
From	To			Forward line.	Backward line.	Mean.	Partial.	Total.	
		km.	*km.*	*m.*	*m.*	*m.*	*mm.*	*mm.*	*m.*
120	121	1.611	196.756	−3.1258	+3.1258	−3.1258	0.0	+29.6	2046.9830
121	Y_2	1.123	197.879	−2.3857	+2.3854	−2.3856	+0.3	+29.9	2044.5974
Y_2	Sta. Wamsutter	0.196	198.075	−0.26					2044.34
Y_2	122	0.484	198.363	−1.1670	+1.1677	−1.1674	−0.7	+29.2	2043.4300
122	123	1.609	199.972	+2.2347	−2.2387	+2.2367	+4.0	+33.2	2045.6667
123	124	1.833	201.805	−9.0026	+9.0070	−9.0048	−4.4	+28.8	2036.6619
124	R.R.B.M.	0.146	201.951	−0.23					2036.43
124	125	1.391	203.196	−3.7283	+3.7260	−3.7272	+2.3	+31.1	2032.9347
125	126	1.611	204.807	+2.3308	−2.3268	+2.3288	−4.0	+27.1	2035.2635
126	Sta. Frewen	1.056	205.863	+3.97					2039.23
126	127	1.614	206.421	+5.6757	−5.6786	+5.6772	+2.9	+30.0	2040.9407
127	128	1.610	208.031	+4.0759	−4.0795	+4.0777	+3.6	+33.6	2045.0184
128	129	1.611	209.642	+2.4219	−2.4184	+2.4202	−3.5	+30.1	2047.4386
129	Z_2	1.031	210.673	+3.5685	−3.5672	+3.5678	−1.3	+28.8	2051.0064
Z_2	A_3	0.445	211.118	−2.0064	+2.0038	−2.0051	+2.6	+31.4	2049.0013
A_3	B_3	0.516	211.634	−1.2329	+1.2322	−1.2326	+0.7	+32.1	2047.7687
B_3	Sta. Red Desert	0.124	211.758	+1.05					2048.82

MOREHEAD CITY–BRUNSWICK LINE.

The details in regard to this line, run by the United States Geological Survey, may be found in the annual reports of that Survey, Eighteenth Annual, Part 1, pages 295–301; Nineteenth Annual, pages 247–251; Twentieth Annual, pages 370–384, and in the Transactions of the American Society of Civil Engineers, Volume XXXIX, June, 1898, pages 366–375. The observing was done by Messrs. W. Carvel Hall and E. L. McNair in 1896–1898. The type of instrument used is illustrated in Appendix 8 of the Coast and Geodetic Survey Report for 1899, page 394, illustration No. 5, and in the article in the Transactions of the American Society of Civil Engineers referred to above. The instrument was made by Buff and Berger and is of the type ordinarily known as the Van Orden level. The rods used were nonextensible target rods about 10 feet in length, with a T-shaped cross section, made of pine treated with paraffin. The target readings were taken to thousandths of a foot. The leveling was done by the double simultaneous method continuously in one direction. The micrometer screw was used simply as a quick leveling device, the target being placed in the horizon of the instrument. The method, instrument, and rods used on this line were similar to those used on lines 138, 140, and 142* in New York and Pennsylvania by the United States Geological Survey.

* See Appendix 8, Report for 1899, p. 421.

The line connected with mean sea level at Morehead City and at Brunswick, and is now connected with recent leveling by the Coast and Geodetic Survey at Knoxville (see illustration 9).

A short line, run by approximately the same method by the United States Geological Survey in 1902 from Cleveland to Chattanooga, Tenn., connected this line a second time at Chattanooga with the Coast and Geodetic Survey line from Cincinnati to Birmingham.

OTHER UNITED STATES GEOLOGICAL SURVEY LINES.

Nine other level lines in New York, Pennsylvania, and Ohio run with methods and instruments similar to those used on the Morehead City–Brunswick line, were also furnished by the United States Geological Survey for incorporation in the level net. These lines are: Canton to Cleveland, Ohio; Buffalo to Dunkirk, N. Y.; Leboeuf to Irvineton, Pa.; Salamanca, N. Y., to Irvineton, Pa.; Hornellsville to Charlotte, N. Y.; Elmira, N. Y., to Williamsport, Pa.; Utica to Bainbridge, N. Y.; Hancock to Sidney, N. Y., and Hancock to Poughkeepsie, N. Y.

The United States Geological Survey also furnished, in manuscript, the results of leveling by the Pittsburg, Fort Wayne and Chicago Railroad, of the Pennsylvania system, from Monaca, Pa., to Lima, Ohio, with a connection with the Canton–Cleveland line of the Geological Survey at Canton.

These lines furnish many new circuits and well-determined elevations in the three States named.

BILOXI–FORT ADAMS LINE.

Full particulars in regard to this line, run under the direction of the Mississippi River Commission, may be found in the Chief of Engineers' Report for 1900, part 7, pages 4622–4740. The field work was done under the direction of W. S. Williams in 1897–98 and 1900, the observers being W. S. Williams, E. J. Thomas, and E. L. Harman. Kern levels and rods were used and the methods of observation are the well-known methods which have been used for many years by the Mississippi River Commission, and are known to give results of the highest degree of accuracy. Some minor improvements have been made in these methods in recent years. In the Chief of Engineers' Report for 1899, page 3649, will be found a statement of the present method as improved. This line supersedes the old Coast and Geodetic Survey lines between Biloxi and Carrollton, Carrollton and Smithland, and from Smithland toward Vidalia as far as Fort Adams, and also supersedes the old line run under the direction of the Chief of Engineers between Biloxi and Carrollton. There were good reasons for supposing that the bench marks between Fort Adams and Biloxi had probably settled since the old leveling had been done, the settling being in part due to a probable general movement of the Lower Mississippi delta region. Results of the leveling show that such settling took place. The new line should therefore supersede the old lines, both because of its undoubtedly higher degree of accuracy and because of the settling of intermediate bench marks, and it has been so used to supersede the old lines in every respect in this publication.

A branch line has also been run, under the direction of the Mississippi River Commission, in 1897–98 from New Orleans to the mouth of the South Pass. This line has

not been incorporated in this Appendix because it is upon especially unstable ground, on which the bench marks are likely to settle, and because the connection with sea level by tidal observations at the end of this line is not of the same high degree of accuracy as the sea-level connection at Biloxi, and has not been utilized fully as a mean sea-level connection by the Mississippi River Commission. It should be noted that although the line from Biloxi to Fort Adams is also over unstable ground it begins on ground at Biloxi which the evidence indicates to be stable, and it ends on presumably stable ground at Fort Adams. The elevations as carried from Biloxi to Fort Adams are therefore subject only to the uncertainties due to possible changes in the elevations of the bench marks during the comparatively short interval from 1897 to 1900, during which the leveling was in progress.

PITTSBURG–BELPRE AND BELPRE–LAWRENCEBURG LINES.

These lines form a part of the line of precise levels from Pittsburg, Pa., to Petersburg, Ky., run along the Ohio River under the direction of the Chief of Engineers. The details in regard to this line have not yet been published. The Chief of Engineers kindly furnished to the Superintendent of the Coast Survey, in manuscript, a short report upon this line by Mr. R. R. Jones, chief assistant engineer, under whose supervision the leveling was done. The portion from Pittsburg, Pa., to Marietta, Ohio, was run in 1896–97 and the remainder in 1899–1900. The line starts at P. R. R. B. M. 100 in Pittsburg, connects with the Coast and Geodetic Survey line between Grafton and Cincinnati on bench mark XL at Belpre, Ohio, and connects again with the Coast and Geodetic Survey line between Cincinnati and Odin on bench mark U at Lawrenceburg, Ind. It thus adds two new circuits to the precise level net. (See illustration 22, opposite p. 372.)

The instrument used is that referred to above in connection with the Morehead City–Brunswick line, which is described in Appendix 8, page 394, illustration No. 5, and in the Transactions of the American Society of Civil Engineers, Volume XXXIX, 1898, pages 356–358. The level was made by Buff & Berger and is ordinarily known as the Van Orden level. Target rods were used. The precise leveling was restricted to hours between 9 a. m. and 3 p. m., all of it being thus done during the middle of the day. The instrument was carefully shaded from the direct rays of the sun. Each mile was run both in the forward and in the backward direction. A failure to agree within 0.01 foot per mile caused the entire mile's work to be thrown out and rerun. The agreement was usually within 0.005 foot per mile. The level rods were provided with universal levels, and two sets of readings were taken each time, as follows: First, a foresight; second, a backsight; third, a foresight; fourth, a backsight. Both sets of readings had to agree or the sets were repeated until they did.

BRAINERD–LAKE ITASCA AND CASS LAKE–GRAND RAPIDS LINES.

The details in regard to these lines, run under the direction of the Mississippi River Commission, will be found in the Report of the Chief of Engineers for 1901 in the supplement, which is a report of the Mississippi River Commission and the Missouri River Commission, pages 69–125. The observers were Messrs. W. S. Williams and E. L. Harman, and the work was under the general direction of Mr. Williams. Both

lines were run in 1900, using Kern instruments and rods and the well-known methods of the Mississippi River Commission, which have uniformly furnished results of the highest degree of accuracy. The details in regard to the present method of leveling by the Mississippi River Commission as used on these lines will be found in the Report of the Chief of Engineers for 1899, page 3469. The line from Brainerd to Lake Itasca starts from a bench mark in Brainerd, on the line from St. Paul to Aitkin, which has already been published. The line from Cass Lake to Grand Rapids is a branch line which leaves the Brainerd–Lake Itasca line at Cass Lake. (See illustration 22, opposite p. 372.)

THE BALTIMORE AND OHIO LINE, WASHINGTON, D. C., TO FOLEY, PA.

This line was run for the Baltimore and Ohio Railroad in 1902 by O. E. Carr, who formerly had considerable experience as recorder and observer on Coast and Geodetic Survey leveling parties. The results were kindly furnished to the Coast and Geodetic Survey, for incorporation in the level net, by Mr. J. M. Graham, chief engineer of the Baltimore and Ohio Railroad. The instrument used in this leveling is a copy of the new type of Coast and Geodetic Survey precise level. From Washington, D. C., to Hancock, W. Va., Coast and Geodetic Survey rods T and U were used. Beyond that point Molitor self-reading precise level rods, graduated to hundredths of feet, were used. The method of observation was substantially that followed at present by the Coast and Geodetic Survey. Foot pins were used for rod supports.

The accumulated discrepancy between the forward and backward line (B–F) was at the end of the line +0.1865 foot, or $+56.8^{mm}$ on 282^{km}, or $+0.20^{mm}$ per kilometer. The line connects at Washington, Hancock, and Cumberland with Coast and Geodetic Survey leveling. The route is shown on illustration 21.

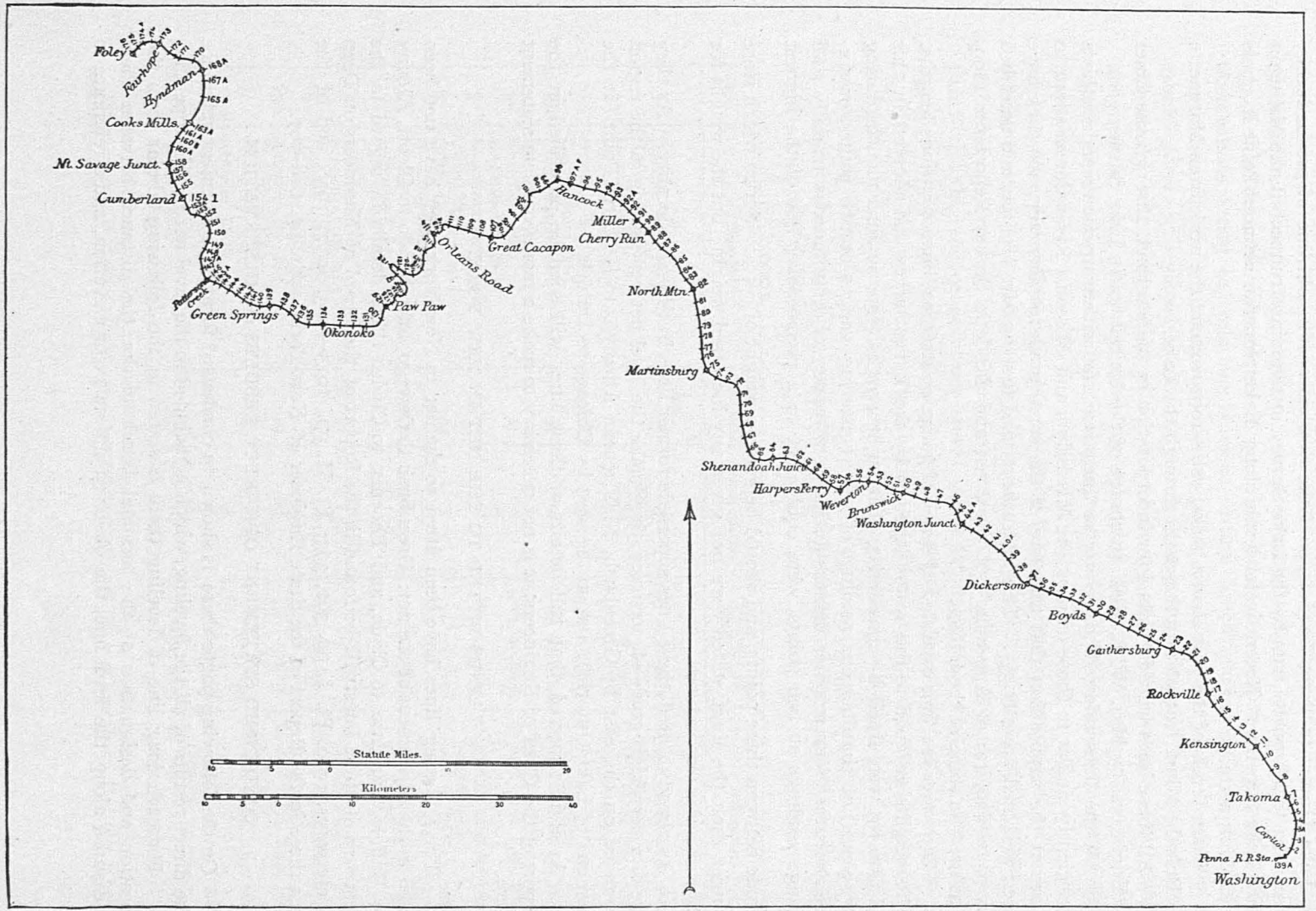
THE LAKE SURVEY LINES.

The following general statement indicates the extent and location of the lines furnished by the United States Lake Survey. They commence with a line of precise levels from Greenbush, N. Y. (now Rensselaer), to Oswego, N. Y., connecting with nearly all of the old bench marks along the line run by the Lake Survey in 1875, and also with those of the Board of Engineers on Deep Waterways and of the State engineers of New York, along this route. Oswego is connected with Olcott to the westward and with Tibbetts Point, at the eastern end of Lake Ontario, by water levels on Lake Ontario during the summer months of 1899 to 1902, inclusive. At Tibbetts Point a connection is made with the line of precise levels down the St. Lawrence River.

From Olcott, N. Y., a line of precise levels, run in 1901, extends the chain to Buffalo, N. Y. Water levels on Lake Erie for the four summer seasons of 1899–1902, inclusive, extend the chain to Erie, Pa., Cleveland, Ohio, and Amherstburg, Ontario.

A short line of checked Wye levels extends from Amherstburg, Ontario, to Trenton, Mich., on the Gibraltar–Lexington precise level line run in 1898–99 and 1901. Recent water levels combined with old water levels on Lake Huron and Lake Michigan connect Lexington, Sand Beach, Mackinaw, Detour, and Escanaba, Mich., Milwaukee, Wis., and Chicago, Ill.

A precise level line run in 1901 extends along the St. Marys River from Detour,



Leveling route, Washington, D. C., to Foley, Pa.

on Lake Huron, to Point Iroquois, on Lake Superior. The old line of precise levels, Escanaba to Marquette, run by the Lake Survey in 1876, also connects Lake Michigan with Lake Superior. Recent water levels along Lake Superior connect Point Iroquois with Marquette.

Water levels of the past eleven years, 1892–1902, extend the work from Marquette to Duluth, Minn., completing the chain through the Lakes.

All these lines were furnished for incorporation in the level net, through the Chief of Engineers, by Maj. W. L. Fisk, in charge of the United States Lake Survey.

All the lines referred to as precise lines were run with instruments and methods sufficiently similar to those used on the Mississippi and Missouri River Commissions to warrant the supposition that they are of the same grade of accuracy, and they have been weighted accordingly. The instrument used first by Mr. Molitor, and described on pages 420, 421 of Appendix 8 of the Coast and Geodetic Survey Report for 1899, was used on some of these lines.

The water leveling consisted of series of gauge or staff readings of various lengths. The weights assigned to this water leveling by the Lake Survey and adopted in this adjustment were fixed by considering that eight months (four summer months during two years) of simultaneous readings of self registering gauges at two points, or sixteen months (four summer months during four years) of simultaneous tri-daily staff gauge readings at two points, were equivalent to a precise level line of the highest grade between these points, and should be given a weight of $\frac{1000}{L}$. Series which were longer than the limit stated were not given any increased weight; but the weight for shorter series was reduced.

As already stated, these lines supersede former lines in the same locality. As they are of a very high grade of accuracy, they make the level net very strong in the region bounded on the east by Greenbush, N. Y. (near Albany), to Tibbetts Point (at the east end of Lake Ontario), and on the west by Chicago to Duluth.

As it is expected that full details of these lines will soon be published in the report of the Chief of Engineers, it is not necessary to make a more complete statement here.

LINES FITTED TO THE NET IN NEW YORK.

The following lines have been fitted to the net in New York, but have not been used in the adjustment of the net: Greenbush to Oswego, and Buffalo to Olcott, Albany to Buffalo, Syracuse to Clyde, and Phoenix to Clyde. The details in regard to the first two of these lines will be found in the Report of the Board of Engineers on Deep Waterways, 1900, Pt. I, pp, 392, 393; Pt. II, pp. 1015–1023, 1037, 1038, and of the last three in the Report of the State Engineer of New York, 1901, pp. 619–707.

CONDENSED STATEMENT OF DIRECT RESULTS OF OBSERVATION.

On the following pages there is shown in condensed form for convenient reference the direct results of all the leveling, which is included in the level net in this appendix.

For each long line of leveling there is stated in the following tabular form the location and designation of the terminal bench marks, the distance between them measured along the level line, the observed difference of elevation, and a reference to

the authority from which these facts are obtained. The sign affixed to the difference of elevation indicates the elevation of the first named referred to the other.

As the desirable information in regard to tidal observations and in regard to the observations fixing the relations between certain bench marks which are common to two or more level lines at their junction points can not conveniently be put in this tabular form, it is placed immediately after it in paragraphs, which are numbered to correspond with the relation which they bear to the tabular matter. The numbers assigned in the tabulation and the following paragraphs serve also to indicate approximately the order in which the corrected elevations and descriptions of bench marks are given.

Another distinction may also be made between the paragraphic matter and the tabular matter. All elevations or relative elevations which are stated in the paragraphic matter are determined by the observations with so high a degree of accuracy, as compared with the relative elevations stated in the tabular matter, that they are treated as fixed quantities in the adjustment, or, in other words, are assigned infinite weight.

In the following tabular form all lines introduced into the net since the preparation of Appendix 8, Report for 1899, in which the preceding adjustment was set forth, are indicated by italics.

The numbering of lines has been retained unchanged from Appendix 8, Report for 1899, as far as possible.

No.	Places.	Distance.	Bench marks.	Difference of elevation.	Reference.
		km.		*m.*	
2	Raritan Bay, N. J. Harrisburg, Pa.	267	F XXIX	−106. 3911	C. and G. S. Rep. 1882, pp. 525–528.
3	Harrisburg, Pa. Hagerstown, Md.	119	XXIX A	− 59. 5851	C. and G. S. Rep. 1882, pp. 528–529.
4A	Grafton, W. Va. Cumberland, Md.	164	M I	+113. 7589	C. and G. S. Rep. 1882, pp. 535–537.
4B	Cumberland, Md. Hancock, Md.	94	I F	+ 61. 8102	C. and G. S. Rep. 1882, pp. 533–535.
4C	Hancock, Md. Hagerstown, Md.	50	F A	− 40. 0451	C. and G. S. Rep. 1882, p. 533.
7	Lawrenceburg, Ind. Odin, Ill.	414	U V	− 13. 0744	C. and G. S. Rep. 1882, pp. 547–552.
8	Odin, Ill. St. Louis, Mo.	104	V K_8	+ 34. 4398	C. and G. S. Rep. 1882, pp. 552–554.
9	St. Louis, Mo.* Jefferson City, Mo.	205	K_8 90 (85)	− 43. 6058	C. and G. S. Rep. 1893, pp. 23–32; Rep. 1896, p. 268.
11	Jefferson City, Mo. Pleasant Hill, Mo.	198	XXVIII LI	− 69. 6683	C. and G. S. Rep. 1896, pp. 268–273.
13	Kansas City, Mo. Pleasant Hill, Mo.	45	LVIII LII	− 32. 0065	C. and G. S. Rep. 1896, pp. 273–275.
15A	Kansas City, Mo. Holliday, Kans.	23	244 LXII	− 2. 9290	C. and G. S. Rep. 1896, p. 275.
16	Holliday, Kans. Abilene, Kans.	239	LXIII B_1	−120. 1134	C. and G. S. Rep. 1897, pp. 273, 278.
20	Salina, Kans. Ellis, Kans.	188	H_1 A_2	−272. 6940	C. and G. S. Rep. 1897–98, p. 190.
22	Ellis, Kans. Hugo, Colo.	372	B_2 K	−891. 8633	C. and G. S. Rep. 1897–98, pp. 201–209.

*This includes a local adjustment of two runnings between M_8 and XIV near New Haven, Mo. (See C. and G. S. Rep. 1893, pp. 25, 28.)

No.	Places.	Distance.	Bench marks.	Difference of elevation.	Reference.
		km.		*m.*	
23	Hugo, Colo. Limon, Colo.	25	K N	− 93.8534	C. and G. S. Rep. 1897–98, p. 221.
25	Limon, Colo. Colorado Springs, Colo.	123	P Z	−214.1380	C. and G. S. Rep. 1897–98, pp. 221–224.
26	Colorado Springs, Colo. Denver, Colo.	121	Z Z_1	+267.8229	C. and G. S. Rep. 1899, pp. 385–388.
28	Limon, Colo. Denver, Colo.	141	N Z_1	+ 46.4068	C. and G. S. Rep. 1899, pp. 389–392.
30	Mobile, Ala. Biloxi, Miss.	93	A E_1	− 1.0250	C. and G. S. Rep. 1887, pp. 188–190.
31	Meridian, Miss. Mobile, Ala.	219	C A	+101.1643	C. and G. S. Rep. 1888, pp. 411–417.
32	Corinth, Miss. Meridian, Miss.	314	V C	+ 32.3287	C. and G. S. Rep. 1888, pp. 418–422; Rep. 1892, pp. 165–169.
34	Cairo, Ill. Corinth, Miss.	265	I W	− 41.1591	C. and G. S. Rep. 1892, pp. 168–181.
36	Odin, Ill. Cairo, Ill.	194 /	V 2	+ 63.0832	C. and G. S. Rep. 1892, pp. 180–189.
42	Vicksburg, Miss. Vidalia, La.	138	215 LXIV	+ 8.1504	C. and G. S. Rep. 1888, pp. 437–443.
44	Greenville, Miss. Vicksburg, Miss.	185	I 211	+ 12.1193	C. and G. S. Rep. 1888, pp. 443–450.
46	Little Rock, Ark. Arkansas City, Ark.	181	3 (or I) F	+ 38.0703	C. and G. S. Rep. 1888, pp. 457–461.
48	Van Buren, Ark. Little Rock, Ark.	261	XXXVIII 3 (or I)	+ 46.1848	C. and G. S. Rep. 1888, pp. 461–462; Rep. 1899, pp. 362–368.
50	Van Buren, Ark. Fort Smith, Ark.	9	XXXIX XLI	− 10.1563	C. and G. S. Rep. 1899, p. 368.
51	Chester, Ark. Van Buren, Ark.	40	XLVIII XXXIX	+131.2299	C. and G. S. Rep. 1899, p. 369.
53	Boston, Mo. Chester, Ark.	252	XCVII XLIX	+ 27.5842	C. and G. S. Rep. 1899, pp. 377–382.
55	Harrisonville, Mo. Boston, Mo.	145	43 XCVI	+ 25.8493	C. and G. S. Rep. 1899, pp. 373–376.
56	Pleasant Hill, Mo. Harrisonville, Mo.	13	LI 43	− 48.3294	C. and G. S. Rep. 1899, p. 372.
57A	Holliday, Kans. Harrisonville, Mo.	75	LXII 43	− 76.4558	C. and G. S. Rep. 1899, pp. 370–372.
59A	Hagerstown, Md. Georgetown, D. C.	129	A XI	+158.4543	C. and G. S. Rep. 1896, pp. 257, 262–263.
59B	Georgetown, D. C. Washington, D. C.	8	XI Capitol	− 18.0040	C. and G. S. Rep. 1899, p. 251.
61A	Georgetown, D. C. Richmond, Va.	185	XI O	− 49.1571 in 1884 − 48.7652 in 1895	C. and G. S. Rep. 1896, pp. 248–255.
63	Richmond, Va. Old Point Comfort, Va.	140	O U	+ 55.4865 in 1884 + 55.5318 in 1891–92	C. and G. S. Rep. 1896, pp. 239–244.
64	St. Augustine, Fla. Cedar Keys, Fla.	216	Sea level Sea level	− 0.2585	C. and G. S. Rep. 1899, p. 397.
65	Meridian, Miss. Vicksburg, Miss.	224	C Cistern	+ 45.5885	C. and G. S. Rep. 1899, pp. 354–360.
66	Corinth, Miss. Memphis, Tenn.	151	W Memphis	+ 57.2388	C. and G. S. Rep. 1892, pp. 207–219.
68	Annapolis, Md. Washington, D. C.	63	a Capitol	− 26.3500	C. and G. S. Rep. 1889, p. 463.
70A	Norfolk, Nebr. Abilene, Kans.	466	N_1 Y_2	+113.4466	C. and G. S. Rep. 1899, pp. 306–319.

No.	Places.	Distance.	Bench marks.	Difference of elevation.	Reference.
		km.		*m.*	
72A	Gibraltar, Mich. Lima, Ohio.	177	1 (1898) U_1	— 88.8262	C. and G. S. Rep. 1899, p. 340.
72B	Lima, Ohio. Cincinnati, Ohio	219	U_1 T	+101.3727	C. and G. S. Rep. 1899, pp. 340–342.
74A	Monroe, La. Bodcau, La.	140	27 P. B. M. 44	— 38.3101	Vicksburg tabulation; Ch. of Eng. Rep. 1893, Pt. 3, pp. 1952–1953.
74C	Shreveport, La. Smithland, La.	382	P. B. M. 46 XLV	+ 44.8399	Vicksburg tabulation; Ch. of Eng. Rep. 1893, Pt. 3, pp. 1953–1954.
76	Monroe, La. Rayville, La.	34	24 17	— 4.9980	Vicksburg tabulation; Ch. of Eng. Rep. 1893, Pt. 3, pp. 1945–1946.
78	Rayville, La. Vicksburg, Miss.	79	16 S. W. Base	— 2.1750	Vicksburg tabulation; Ch. of Eng. Rep. 1893, Pt. 3, p. 1945.
79	Concordia, La. Vidalia, La.	11	9 LXIV	— 0.1609	Vicksburg tabulation.
80	Monroe, La. Concordia, La.	168	27 9	+ 4.1753	Vicksburg tabulation.
81	Rayville, La. Concordia, La.	110	17 9	+ 7.2458	Vicksburg tabulation.
83	Jonesville, La. Mouth of Black River	54	P. B. M. 5 P. B. M. 12a	+ 1.4377	Vicksburg tabulation.
84	Shreveport, La. Jeters Landing, La.	44	P. B. M. 46 P. B. M. 4	— 0.4581	Vicksburg tabulation.
86	Parkeville, La. Monroe, La.	34	Parkeville 24	+ 1.7471	Vicksburg tabulation.
87	Glendora, La. Farmerville, La.	42	P. R. P. Glendora P. B. M. Stein	— 4.7268	Vicksburg tabulation.
88	Little Rock, Ark. Parkeville, La.	338	3 (or I) Parkeville.	+ 56.8075	Vicksburg tabulation.
89	Wilkersons Landing, Miss. Parkeville, La.	163	84 74	+ 17.4850	Vicksburg tabulation.
90	Greenville, Miss. Wilkersons Landing, Miss.	32	1 84	— 2.3115	Ch. of Eng. Rep. 1883, Pt. 3, p. 2179.
91	Greenville, Miss. Wilkersons Landing, Miss.	33	1 84	— 2.3033	Vicksburg tabulation.
92	Vicksburg, Miss. Greenville, Miss.	269	P. B. M. 2 1	— 10.5820	Vicksburg tabulation; Ch. of Eng. Rep. 1894, Pt. 3, pp. 1497–1499.
93	Wilkersons Landing, Miss. Friar Point, Miss.	153	84 II	— 12.8985	Ch. of Eng. Rep. 1883, Pt. 3, pp. 2174–2183.
94	Friar Point, Miss. Clarksdale, Miss.	32	II III	+ 2.5630	Vicksburg tabulation.
96	Friar Point, Miss. Memphis, Tenn.	134	II Memphis.	— 25.3792	Ch. of Eng. Rep. 1879, Pt. 3, p. 1944; 1878, Pt. 3, p. 1392.
99	Riverton Junction, Ala. Pittsburg Landing, Tenn.	63	T. B. M. 44 P. B. M. 61	— 1.1236	Ch. of Eng. Rep. 1896, Pt. 3, pp. 1999–2011.
100	Meridian, Miss. York, Ala.	42	C P. B. M. 26	+ 57.4130	Ch. of Eng. Rep. 1899, Pt. 2, pp. 1779–1781.
101	York, Ala. Birmingham, Ala.	207	P. B. M. 26 P. B. M. 1	—138.5920	Ch. of Eng. Rep. 1899, Pt. 2, pp. 1770–1779.
102	York, Ala. Demopolis, Ala.	46	P. B. M. 26 P. B. M. 6	+ 8.7319	Ch. of Eng. Rep. 1899, Pt. 2, pp. 1781–1783.
103	Memphis, Tenn. Cairo, Ill.	330	Memphis P. B. M. 2	— 16.7198	Miss. Riv. Com. Rep. 1881, pp. 52, 63; Ch. of Eng. Rep. 1883, Pt. 3, pp. 2187–2188.
104	Cairo, Ill. St. Louis, Mo.	275	P. B. M. 1 K_3	— 29.2737	Ch. of Eng. Rep. 1884, Pt. 4, pp. 2480–2499.

No.	Places.	Distance.	Bench marks.	Difference of elevation.	Reference.
		km.		*m.*	
105	St. Louis, Mo. 12 miles above St. Louis, Mo.	21	K_3 P. B. M. 12	— 13.3804	Ch. of Eng. Rep. 1884, Pt. 4, pp. 2479–2480; Rep. 1888, Pt. 4, p. 2328. (Mean of these two measures used.)
106	12 miles above St. Louis, Mo. Albany, Ill.	552	P. B. M. 12 P. B. M. 53	— 42.9398	Ch. of Eng. Rep. 1884, Pt. 4, pp. 2476–2534.
108	Albany, Ill. Fulton, Ill.	6	P. B. M. 53 P. B. M. 56	+ 4.9232	Ch. of Eng. Rep. 1884, Pt. 4, p. 2534; Rep. 1885, Pt. 4, p. 2652. (Mean of these two measures used.)
110	Fulton, Ill. Savanna, Ill.	31	P. B. M. 56 P. B. M. 62	— 2.9032	Ch. of Eng. Rep. 1885, Pt. 4, pp. 2652–2654.
112	Savanna, Ill. Chicago, Ill.	224	P. B. M. 62 P. B. M. 99	+ 0.2105	Ch. of Eng. Rep. 1885, Pt. 4, pp. 2654–2669.
113	Savanna, Ill. St. Paul, Minn.	478	P. B. M. 62 P. B. M. 68	— 33.8437	Ch. of Eng. Rep. 1892, Pt. 4, pp. 2958–3037.
116	St. Paul, Minn. Duluth, Minn.	250	P. B. M. 68 1	+ 23.1902	Ch. of Eng. Rep. 1892, Pt. 4, pp. 3074–3098.
118	Marquette, Mich. Escanaba, Mich.	105	1 1	+ 5.1567	Professional Papers No. 24 (U. S. Lake Survey Rep.), pp. 603–604.
120	12 miles above St. Louis, Mo. Jefferson City, Mo.	214	P. B. M. 12 XXVIII (Capitol)	— 52.1251	Ch. of Eng. Rep. 1888, Pt. 4, p. 2328; 1893, Pt. 6, pp. 4046–4082.
121	Jefferson City, Mo. Kansas City, Mo.	306	90 (85) LVIII	— 58.2482	Ch. of Eng. Rep. 1893, Pt. 6, pp. 3988–4045.
122	Kansas City, Mo. St. Joseph, Mo.	113	244 P. B. M. 287	— 19.0180	Ch. of Eng. Rep. 1893, Pt. 6, pp. 3964–3988.
124	St. Joseph, Mo. Sioux City, Iowa.	366	P. B. M. 290 P. B. M. 399	— 85.1170	Ch. of Eng. Rep. 1893, Pt. 6, pp. 4138–4208.
133A	*Greenbush, N. Y.* *Troy, N. Y.*	11	Gristmill D. W. Troy 2	— 3.0162	See pp. 297, 298 of this Report.
133C	Troy, N. Y. Whitehall, N. Y.	106 (66 mi.)	N. Y. 12 U. S. C. S. 36	— 25.1211* (— 82.418 ft.)	Report on Deep Waterways 1900, Pt. II, pp. 1017, 1023, 1025. N. Y. State Eng. Rep. 1901, pp. 653, 671, 675.
133D	Whitehall, N. Y. Crown Point, N. Y.	60 (37.2 mi.)	U. S. C. S. 36 L. H.	— 8.0071 (— 26.27 ft.)	Report on Deep Waterways 1900, Pt. II, pp. 1025–1026.
133E	Crown Point, N. Y. Cooperville, N. Y.	103 (63.9 mi.)	L. H. D. W. Cooperville	+ 8.4674 (+ 27.78 ft.)	Report on Deep Waterways 1900, Pt. I, pp. 393–398, Pt. II, p. 1026.
133F	Cooperville, N. Y. Hogansburg, N. Y.	126 (78.5 mi.)	D. W. Cooperville U. S. P.	— 23.2380 (— 76.24 ft.)	Report on Deep Waterways 1900, Pt. II, pp. 1026–1029.
133G	Hogansburg, N. Y. Tibbetts Pt.	193	U. S. P. P. B. M. 35	— 26.0919†	Manuscript furnished by Ch. of Eng. March, 1900.

*In combining, the D. W. leveling was given twice as much weight as the New York State leveling. The weight assigned to the portion of the line Oswego–Greenbush is $\frac{750}{L}$, as it consists of three runnings instead of two. See page 628 of the State Engineer's Report.

† The difference of elevation, —26.0940 meters, obtained by converting 85.61 feet from the tabulation of this line in the Report of the Deep Waterways 1900, Part II, pages 1029–1036, was used by mistake in establishing the equations. The difference is due to the conversion of the original meters into feet and keeping the hundredths only, and then the conversion of the approximate feet into meters again. The mistake was not discovered until too late to correct the equations, but the true value was used in distributing the correction on the line and in forming the circuit closure.

No.	Places.	Distance.	Bench marks.	Difference of elevation.	Reference.
		km.		*m.*	
133H	Oswego, N. Y. Tibbetts Point, N. Y	73	A P. B. M. 35	— 3.6430	Manuscript furnished by Ch. of Eng. Mar., 1903.
135	Greenbush, N. Y. Boston, Mass.	320	Gristmill Sea level	+ 4.2898 (+ 14.074 ft.)	Rep. Topographical Survey Mass., 1893.
138A	Dunkirk, N. Y. Salamanca, N. Y.	76	598 D 1391 D	—241.4932	Manuscript furnished by U. S. Geological Survey, Feb., 1903.
138B	Salamanca, N. Y. Hornellsville, N. Y.	131	1391 D 1141 D	+ 75.9076	Manuscript furnished by U. S. Geological Survey, Feb., 1903.
138C	Hornellsville, N. Y. Elmira, N. Y.	94	1141 D 857 A	+ 86.5039	Manuscript furnished by U. S. Geological Survey, Feb., 1903.
138D	Elmira, N. Y. Binghamton, N. Y.	94	857 A 867 A	— 2.2659	Manuscript furnished by U. S. Geological Survey, Feb., 1903.
138E	Binghamton, N. Y. Bainbridge, N. Y.	60	867 A 989 A	— 37.7005	Manuscript furnished by U. S. Geological Survey, Feb., 1903.
138F	Bainbridge, N. Y. Vischers Ferry, N. Y.	168 (104.6 mi.)	989 A L. S. 18	+243.4220	Manuscript furnished by U. S. Geological Survey, Feb., 1903.
140B	Leboeuf, Pa. Erie, Pa.	36	1193 P L. H.	+188.0081	Manuscript furnished by U. S. Geological Survey, Feb., 1903.
140C	Franklin, Pa. Leboeuf, Pa.	86	987 P 1193 P	— 62.8310	Manuscript furnished by U. S. Geological Survey, Feb., 1903.
140D	West Penn Junction, Pa. Franklin, Pa.	150	P. R. R. 26 987 P	— 60.6127	Manuscript furnished by U. S. Geological Survey, Feb., 1903.
142A	Braddock, Pa. Grafton, W. Va.	225	P. R. R. 88 M	— 51.2087*	Manuscript furnished by U. S. Geological Survey, Feb., 1903.
143A	Braddock, Pa. Blairsville Intersec., Pa.	70 (43 mi.)	P. R. R. 88 P. R. R. 47	— 88.7061	Pennsylvania R. R. Bench Mark Book, pp. 71–74.
143B	West Penn Junction, Pa. Blairsville Intersec., Pa.	68 (42 mi.)	P. R. R. 26 P. R. R. 47	—100.9072	Pennsylvania R. R. Bench Mark Book, pp. 77–80.
143C	Blairsville Intersec., Pa. Harrisburg, Pa.	314 (195mi.)	P. R. R. 47 P. R. R. 2	+238.6040	Pennsylvania R. R. Bench Mark Book, pp. 46–71.
144	*New Orleans, La.* *Biloxi, Miss.*	135	Halfw'y House E,	— 3.1523	Ch. of Eng. Rep. 1900, Pt. 7, pp. 4631–4645.
145	*Baton Rouge, La.* *New Orleans, La.*	144	XXXII Halfw'y House	+ 6.9856	Ch. of Eng. Rep. 1900, Pt. 7, pp. 4682–4708.
146	*Smithland, La.* *Baton Rouge, La.*	104	XLV XXXII	+ 6.1987	Ch. of Eng. Rep. 1900, Pt. 7, pp. 4709–4721.
147	*Fort Adams, Miss.* *Smithland, La.*	24	XLIX XLV	+ 6.0760	Ch. of Eng. Rep. 1900, Pt. 7, pp. 4721–4725.
148	Vidalia, La. Fort Adams, Miss.	85	LXI XLIX	— 2.0819	C. and G. S. Rep. 1888, pp. 436–438.
150	*Decatur, Ala.* *Birmingham, Ala.*	139	P. B. M. 50 P. B. M. 2	— 11.9243	Pp. 249–251 of this Report.
151	*Tuscumbia, Ala.* *Corinth, Miss.*	86	P. B. M. 9 V	+ 5.5652	Pp. 286–289 of this Report, and Ch. of Eng. Rep. 1891, Pt. 3, pp. 1982–1998.

* Results revised.

No.	Places.	Distance.	Bench marks.	Difference of elevation.	Reference.
		km.		*m.*	
152	Decatur, Ala. Tuscumbia, Ala.	86	P. B. M. 50 P. B. M. 9	+ 26.4098	Ch. of Eng. Rep. 1896, Pt. 3, pp. 1982–1998.
153	*Decatur, Ala.* *Tuscumbia, Ala.*	72	P. B. M. 50 P. B. M. 9	+ 26.4163	Pp. 284–286 of this Report.
155	*Sioux City, Iowa.* *Norfolk, Nebr.*	116	B_2 2	−127.0836	Pp. 252–256 of this Report.
157A	*Decatur, Ala.* *Chattanooga, Tenn.*	196	P. B. M. 50 698 N	− 41.5760	Pp. 244–249 of this Report.
157B	*Chattanooga, Tenn.* *Harriman Junction, Tenn.*	128	698 N C_2	− 30.3215	Pp. 242–244 of this Report.
159	*Cincinnati, Ohio.* *Harriman Junction, Tenn.*	412	C A_2	− 72.1931	Pp. 230–239 of this Report.
160	*Knoxville, Tenn.* *Harriman Junction, Tenn.*	81	933 M C C_2	+ 42.5945	Pp. 239–240 of this Report.
162	*Morehead City, N. C.* *Caswell, Tenn.*	863	7 M C 867 M C	−262.0148 m. (−859.627 ft.)	U. S. Geol. Survey, 20th Ann. Rep., Pt. 1, pp. 376–378.
164A	*Wright, Tenn.* *Cleveland, Tenn.*	120	940 M C 875 M C	+ 20.0138 (+ 65.662 ft.)	U. S. Geol. Survey, 20th Ann. Rep., Pt. 1, p. 378.
164B	*Cleveland, Tenn.* *Brunswick, Ga.*	671	875 M C 10 M C	+263.4319	U. S. Geol. Survey, 20th Ann. Rep., Pt. 1, pp. 378–380.
166	Belpre, Ohio. Cincinnati, Ohio.	316	XL T	+ 22.7452	C. and G. S. Rep. 1882, pp. 542–546.
167	*Belpre, Ohio.* *Lawrenceburg, Ohio.*	495	XL U	+ 41.1523 (+135.014 ft).	Letter Ch. of Eng., June 18, 1902, and inclosed manuscript.
168	Grafton, W. Va. Belpre, Ohio.	170	M XL	+114.4023	C. and G. S. Rep. 1882, pp. 540–542.
169A	*Monaca, Pa.* *Pittsburg, Pa.*	40 (25 mi.)	25 C P. R. R. 100	− 17.5190 (− 57.477 ft.)	Manuscript furnished by the Ch. of Eng. and by the U. S. Geol. Survey.
169B	*Belpre, Ohio.* *Monaca, Pa.*	256	XL 25 C	− 19.8431 (− 65.102 ft.)	Manuscript furnished by the Ch. of Eng. and by the U. S. Geol. Survey.
170A	*Dobbs Ferry, N. Y.* *Poughkeepsie, N. Y.*	87	V 173 A	− 49.7925	Pp. 291–294 of this Report.
170B	*Poughkeepsie, N. Y.* *Greenbush, N. Y.*	116	173 A Gristmill.	+ 48.5028	Pp. 294–297 of this Report.
171	*Page, Nebr.* *Norfolk, Nebr.*	103	K_2 O_1	+131.2314	Pp. 257–259 of this Report.
172	*Chadron, Nebr.* *Page, Nebr.*	427	C_4 K_2	+421.1151	Pp. 268–276 of this Report.
173	*Orin Junction, Wyo.* *Chadron, Nebr.*	201	T_1 C_4	+412.7186	Pp. 299–302 of this Report.
174	*Cheyenne, Wyo.* *Orin Junction, Wyo.*	247	B T_1	+417.1586	Pp. 278–283 of this Report.
175	Denver, Colo. Cheyenne, Wyo.	169	A_2 B	−262.6197	C. and G. S. Rep. 1899, pp. 289–293.
176	Cheyenne, Wyo. Rock Creek, Wyo.	172	B U	−195.7608	C. and G. S. Rep. 1899, pp. 293–297.
178	*Anthony, Kans.* *Salina, Kans.*	215	SE. B. △ H_1	+ 45.7929	Pp. 261–266 of this Report.
180	*Bowie, Tex.* *Anthony, Kans.*	431	1124 Gainv F_5	− 67.2614	Pp. 304–315 of this Report.
181	St. Paul, Minn. Brainerd, Minn.	247	P. B. M. 68 N. B. △	−152.7073	Ch. of Eng. Rep. 1899, Pt. 5, pp. 3420–3457.
182	Brainerd, Minn. Aitkin, Minn.	68	N. B. △ P. B. M. Courthouse	3.6394	Ch. of Eng. Rep. 1899, Pt. 5, pp. 3457–3468.

No.	Places.	Distance.	Bench marks.	Difference of elevation.	Reference.
		km.		*m.*	
183	*Cass Lake, Minn.* *Brainerd, Minn.*	129	T. B. M. 92 N. B. △	+ 40.0053	Ch. of Eng. Rep. 1901, Supplement, Miss. and Mo. River Com., pp. 71–85.
184	*Lake Itasca, Minn.* *Cass Lake, Minn.*	76	Park House T. B. M. 92	+ 46.8957	Ch. of Eng. Rep. 1901, Supplement, Miss. and Mo. River Com. Reps., pp. 85–96.
185	*Grand Rapids, Minn.* *Cass Lake, Minn.*	98	Blackberry T. B. M. 92	— 10.7692	Ch. of Eng. Rep. 1901, Supplement, Miss. and Mo. River Com. Reps., 97–111.
186	*Shreveport, La.* *Fort Worth, Tex.*	410	P. B. M. 46 U	—124.9945	Pp. 319–328 of this Report.
187	*Fort Worth, Tex.* *Bowie, Tex.*	109	U 1124 Gainv	—157.9008	Pp. 317–319 of this Report.
188	*Fort Worth, Tex.* *Comanche, Tex.*	75	U Comanche △	+ 89.9821	Pp. 329–330 of this Report.
189	*Cleveland, Tenn.* *Chattanooga, Tenn.*	50	875 M C 698 N	+ 55.1436	Manuscript furnished by the U. S. Geol. Survey, Feb., 1903.
190	*Canton, Ohio.* *Monaca, Pa.*	124 (77 mi.)	Bridge 77 25 C	+104.3094	Leveling of Pittsburg, Fort Wayne and Chicago R. R., submitted by the U. S. Geol. Survey.
191	*Lima, Ohio.* *Canton, Ohio.*	256 (159mi.)	U_1 Bridge 77	— 45.9353	Leveling of Pittsburg, Fort Wayne and Chicago R. R., submitted by the U. S. Geol. Survey.
192	*Canton, Ohio.* *Cleveland, Ohio.*	96	Bridge 77 U. S. E. 2	+137.6233	Manuscript furnished by U. S. Geol. Survey, Feb., 1903.
194	*Duluth, Minn.* *Marquette, Mich.*	470	No. 1 No. 1	+ 5.0841	Manuscript furnished Mar., 1903, by Ch. of Eng. from U. S. Lake Survey.
195	*Escanaba, Mich.* *Sand Beach, Mich.*	500	No. 1 E	+ 3.1775*	Manuscript furnished Mar. 2, 1903, by Ch. of Eng. from U. S. Lake Survey.
196	*Milwaukee, Wis.* *Sand Beach, Mich.*	720	No. 1 E	+ 3.0279	Manuscript furnished Mar. 2, 1903, by Ch. of Eng. from U. S. Lake Survey.
197	*Chicago, Ill.* *Milwaukee, Wis.*	130	99 No. 1	— 0.4404	Manuscript furnished Mar. 2, 1903, by Ch. of Eng. from U. S. Lake Survey.
198	*Marquette, Mich.* *Iroquois, Mich.*	240	No. 1 Iroquois	+ 0.6770	Manuscript furnished Mar. 2, 1903, by Ch. of Eng. from U. S. Lake Survey.
199	*Iroquois, Mich.* *Detour, Mich.*	126	Iroquois Goetz	+ 1.7274	Manuscript furnished Mar. 2, 1903, by Ch. of Eng. from U. S. Lake Survey.

*This value is the result of the Lake Survey adjustment of the figure Escanaba-Mackinaw-Detour-Sand Beach. The unadjusted value is: +3.1790.

No.	Places.	Distance.	Bench marks.	Difference of elevation.	Reference.
		km.		*m.*	
200	*Mackinaw, Mich.* *Escanaba, Mich.*	210	No. 1 No. 1	— 0.8284*	Manuscript furnished Mar. 2, 1903, by Ch. of Eng. from U. S. Lake Survey.
201	*Detour, Mich,* *Mackinaw, Mich.*	72	Goetz No. 1	+ 3.4869*	Manuscript furnished Mar. 2, 1903, by Ch. of Eng. from U. S. Lake Survey.
202	*Detour, Mich.* *Sand Beach, Mich.*	260	Goetz E	+ 5.8360*	Manuscript furnished Mar. 2, 1903, by Ch. of Eng. from U. S. Lake Survey.
203	*Sand Beach, Mich.* *Lexington, Mich.*	48	E No. 4	— 9.0267	Manuscript furnished Mar. 2, 1903, by Ch. of Eng. from U. S. Lake Survey.
204	*Lexington, Mich.* *Trenton, Mich.*	185	No. 4 1877	+ 2.8581	Manuscript furnished Mar. 2, 1903, by Ch. of Eng. from U. S. Lake Survey.
205	Gibraltar, Mich. Trenton, Mich.	7	(1877) 1877	— 6.3912	Manuscript furnished by Ch. of Eng. Mar. 2, 1903, from U. S. Lake Survey.
206	*Trenton, Mich.* *Amherstburg, Can.*	12	1877 Gage	+ 7.4113	Manuscript furnished Mar. 2, 1903, by Ch. of Eng. from U. S. Lake Survey.
207	*Amherstburg, Can.* *Buffalo, N. Y.*	418	Gage L. H.	— 3.3370	Manuscript furnished Mar. 2, 1903, by Ch. of Eng. from U. S. Lake Survey.
208	*Cleveland, Ohio.* *Buffalo, N. Y.*	288	No. 1 L. H.	— 2.6478†	Manuscript furnished Mar. 2, 1903, by Ch. of Eng. from U. S. Lake Survey.
209	*Buffalo, N. Y.* *Olcott, N. Y.*	80	L. H. No. 4	+100.8456	Manuscript furnished Mar. 2, 1903, by Ch. of Eng. from U. S. Lake Survey.
210	*Olcott, N. Y.* *Oswego, N. Y.*	180	No. 4 A	+ 2.2409	Manuscript furnished Mar. 2, 1903, by Ch. of Eng. from U. S. Lake Survey.
211	*Oswego, N. Y.* *Utica, N. Y.*	131	A L. S. 92	— 54.4108	Manuscript furnished Mar. 2, 1903, by Ch. of Eng. from U. S. Lake Survey.
212	*Utica, N. Y.* *Vischers Ferry, N. Y.*	148	L. S. 92 L. S. 18	+ 73.0104	Manuscript furnished by Ch. of Eng. Mar. 2, 1903, from U. S. Lake Survey.
213	*Vischers Ferry, N. Y.* *Greenbush, N. Y.*	34	L. S. 18 Gristmill	+ 53.9514	Manuscript furnished by Ch. of Eng. Mar. 2, 1903, from U. S. Lake Survey.

*These values are the result of the Lake Survey adjustment of the figure Escanaba-Mackinaw-Detour-Sand Beach. The unadjusted values are:

200..... −0.8230
201..... +3.4860
202..... +5.8372

†This value is the result of the Lake Survey adjustment of the circuit Cleveland-Buffalo-Erie-Cleveland. The unadjusted value is −2.6441.

No.	Places.	Distance.	Bench marks.	Difference of elevation.	Reference.
		km.		*m.*	
214	*Erie, Pa.* *Buffalo, N. Y.*	130	1 (1873) L. H.	− 4.4781*	Manuscript furnished by Ch. of Eng. Mar. 2, 1903, from U. S. Lake Survey.
215	*Buffalo, N. Y.* *Dunkirk, N. Y.*	66	L. H. 598 D	− 2.6277	Manuscript furnished by U. S. Geol. Survey Feb., 1903.
216	*Hornellsville, N. Y.* *Charlotte, N. Y.*	142	1141 D 1 (1874)	+261.9448	Manuscript furnished Feb., 1903, by U. S. Geol. Survey.
217	*Charlotte, N. Y.* *Oswego, N. Y.*	91	1 (1874) A	+ 9.5418	Manuscript furnished by Ch. of Eng. Mar. 14, 1903.
218	*Sidney, N. Y.* *Utica, N. Y.*	99 (61.4 mi.)	Tel. Pole 991 L. S. 92	+170.8679	Manuscript furnished Feb., 1903, by U. S. Geol. Survey.
220	*Irvineton, Pa.* *Le Boeuff, Pa.*	62 (39 mi.)	1167 D 1193 P	− 7.9602	Manuscript furnished Feb., 1903, by U. S. Geol. Survey.
221	*Franklin, Pa.* *Irvineton, Pa.*	93	987 P 1167 D	− 54.9415	Manuscript furnished Feb., 1903, by U. S. Geol. Survey.
222	*Salamanca, N. Y.* *Irvineton, Pa.*	78	1391 D 1167 D	+ 68.1732†	Manuscript furnished Feb., 1903, by U. S. Geol. Survey.
223	*Elmira, N. Y.* *Williamsport, Pa.*	121	857 A P. R. R. 46	+101.6296	Manuscript furnished Feb., 1903, by U. S. Geol. Survey.
224	*Harrisburg, Pa.* *Williamsport, Pa.*	150 (93 mi.)	P. R. R. 2 P. R. R. 46	− 57.2873	P. R. R. Bench Mark Book pp. 46, 110–113, 96–99.
225	*Hancock, Md.* *Washington, D. C.*	158 (98 mi.)	F Capitol	+100.6856	Manuscript furnished by the B. and O. R. R.
226	*Cumberland, Md.* *Hancock, Md.*	90 (56 mi.)	I F	+ 61.9468	Manuscript furnished by the B. and O. R. R.
227	*Cumberland, Md.* *Foley, Pa.*	35 (22 mi.)	I B. & O. 176	−275.0180	Manuscript furnished by the B. and O. R. R.
228	*Sidney, N. Y.* *Hancock, N. Y.*	71	Tel. Pole 991 924 A	+ 20.2617	Manuscript furnished Feb., 1903, by U. S. Geol. Survey.
229	*Hancock, N. Y.* *Poughkeepsie, N. Y.*	222	924 A 173 A	+229.2567	Manuscript furnished Feb., 1903, by U. S. Geol. Survey.
230	*Binghamton, N. Y.* *Hancock, N. Y.*	78	867 A 924 A	− 17.8684	Manuscript furnished Feb., 1903, by U. S. Geol. Survey.
231	*Fort Worth, Tex.* *Temple, Tex.*	200	U L_4	− 20.5443	Pp. 332–335 of this Report.
232	*Temple, Tex.* *Lampasas, Tex.*	89	L_4 NE. Base △	−110.1793	Pp. 336–337 of this Report.
233	*Temple, Tex.* *Holland, Tex.*	26	L_4 Y_4	+ 44.1501	P. 338 of this Report.
234	*Rock Creek, Wyo.* *Red Desert, Wyo.*	212	U B_3	− 4.2761	Pp. 340–345 of this Report.
235	*Mackinaw, Mich.* *Sand Beach, Mich.*	290	No. 1 E	+ 2.3491‡	Manuscript furnished Mar. 2, 1903, by Ch. of Eng. from U. S. Lake Survey.
236	*Cleveland, Ohio.* *Erie, Pa.*	155	No. 1 1 (1873)	+ 1.8303§	Manuscript furnished Mar. 2, 1903, by Ch. of Eng. from U. S. Lake Survey.

*This value is the result of the Lake Survey adjustment of the circuit Cleveland-Buffalo-Erie-Cleveland. The unadjusted value is, −4.4818. †This line was run twice. ‡This is the adjusted value. See note on p. 357. The unadjusted value is +2.3424. §This is the adjusted value. The unadjusted value is +1.8294.

The statements of the local relative elevations which were held fixed in the adjustment of 1899 are here repeated in abbreviated form for convenience of reference, together with new matter of the same kind. The complete statements may be found on the pages of Appendix 8, Report for 1899, referred to in the separate paragraphs.

No. 1.—VICINITY OF NEW YORK CITY.

The differences of elevation which are fixed, see pages 402–404 of Appendix 8, Report for 1899, are—

Raritan Bay, F—Sea level at Sandy Hook $= +2^{m}.3640$; distance 55 kilometers.

Dobbs Ferry, V—Sea level at Sandy Hook $= +2^{m}.9357$; distance 144 kilometers.

No. 6A.—CINCINNATI, OHIO, TO LAWRENCEBURG, IND., AND COVINGTON, KY.

B. M. T (City B. M. No. 1) was connected with B. M. U on the court-house at Lawrenceburg, Ind., by the transcontinental line of levels in 1879. These two bench marks were connected again by the line of levels between Gibraltar, Mich., and Cincinnati, Ohio, in 1899. The difference of elevation, T—U, as determined in 1879 was +18.4435 meters, and in 1899 +18.4825 meters. The mean of these two, giving the leveling of 1899 double weight, was adopted. The distribution of the corrections through the lines between these bench marks fixed the differences between T and O_4, and T and A_5. The bench marks T and A_5 were connected again by leveling from Y_4 to A_5 in the line from Cincinnati southward in 1900. The discrepancy thus developed was distributed over the new line only.

The differences fixed as indicated above are—

Cincinnati, T—Lawrenceburg, U $= +18^{m}.4695$; distance 37 kilometers.

Cincinnati, T—Cincinnati, $O_4 = +16^{m}.7277$.

Cincinnati, T—Covington, $A_5 = +4^{m}.0849$.

Cincinnati, T—Ludlow, C $= +4^{m}.4507$; distance 8 kilometers.

No. 10.—JEFFERSON CITY, MO.

The differences of elevation fixed as indicated on page 405 of Appendix 8, Report for 1899, are—

90 (85)—XXVII $= -14^{m}.8684$; distance 0.5 kilometer.

XXVII—XXVIII $= -6^{m}.8101$; distance 0.2 kilometer.

No. 12.—PLEASANT HILL, MO.

The difference of elevation fixed as indicated on page 405 of Appendix 8, Report for 1899, is—

LI—LII $= +1^{m}.2130$; distance 1.2 kilometers.

No. 14.—KANSAS CITY, MO.

The difference of elevation fixed as indicated on page 405 of Appendix 8, Report for 1899, is—

LVIII—P. B. M. 244 $= -1^{m}.9810$; distance 8.3 kilometers.

No. 15B.—HOLLIDAY, KANS.

The difference of elevation LXIII–LXII as determined by the leveling between Jefferson City and Holliday in 1899 (see p. 275 of the Coast and Geodetic Survey Report for 1896) will be considered as fixed, namely:

$LXIII - LXII = +0^m.0206$

No. 17A.—ABILENE, SOLOMON, AND SALINA, KANS.

The differences of elevation fixed as indicated in Appendix 8, Report for 1899, on pages 405–406, are—

Abilene, B_1—Solomon, $C_1 = -5^m.6278$; distance 14 kilometers.

Abilene, B_1—Abilene, $Y_2 = +2^m.2729$; distance 2 kilometers.

The leveling from Solomon to Anthony, Kans., in 1900, see page 261 of this report, gives the following difference of elevation which is adopted as fixed:

Solomon, C_1—Salina, $H_1 = -15^m.3095$; distance 23 kilometers.

No. 21.—ELLIS, KANS.

The difference of elevation fixed as indicated on page 406 of Appendix 8, Report for 1899, is $A_2 - B_2 = +0^m.1163$.

No. 24.—LIMON, COLO.

The difference of elevation fixed as indicated on page 406 of Appendix 8, Report for 1899, is—

$N - P = -6^m.9860$.

No. 27.—DENVER, COLO.

The differences of elevation fixed as indicated on page 406 of Appendix 8, Report for 1899, are $Z_1 - B_2 = +0^m.6844$ and $B_2 - A_2 = +0^m.0360$.

No. 29A.—BILOXI, MISS.

The details in regard to the levels of the group of bench marks at this point are shown on page 407 of Appendix 8, Report for 1899. Since that was published, however, part 7 of the Chief of Engineers Report for 1900 has appeared, and on pages 4629–4631 are shown the elevations as fixed by new leveling in 1898, and a new discussion of the tidal observations. For B. M. E_1 the new elevation differs but 0.1 mm. from that adopted in Appendix 8, Report for 1899, which is therefore retained unchanged; hence,

E_1—Sea level at Biloxi $= +4^m.7915$.

No. 33.—CORINTH, MISS.

The difference of elevation fixed as indicated on pages 407–408 of Appendix 8, Report for 1899, is—

$W - V = +0^m.0569$.

No. 35.—CAIRO, ILL.

The difference of elevation fixed as indicated on page 408 of Appendix 8, Report for 1899, is—

P. B. M. 2—P. B. M. $1 = +0^m.4031$.

No. 41.—VIDALIA, LA.

The difference of elevation fixed as indicated on page 408 of Appendix 8, Report for 1899, is—

Palo Alto, LXIV—Vidalia, LXI = $-0^m.9880$; distance, 5.8 kilometers.

No. 43.—VICKSBURG, MISS.

The differences of elevations fixed as indicated on pages 408–409 of Appendix 8, Report for 1899, are—

Delta, 211—Delta, 215 = $-0^m.1143$; distance, 3.6 kilometers.
Delta, 211—Vicksburg, Cistern = $-31^m.1994$.
Delta, 211—Delta, S. W. Base = $+1^m.1314$; distance, 2.6 kilometers.
Delta, 211—Vicksburg, P. B. M. 2 = $-1^m.6679$.

No. 45.—WILKERSONS LANDING, MISS.—ARKANSAS CITY, ARK.

The difference of elevation fixed as indicated on page 410 of Appendix 8, Report for 1899, is—

Arkansas City, F—Wilkersons Landing, 84 = $-0^m.0564$; distance, 2 kilometers.

No. 49.—VAN BUREN, ARK.

The difference of elevation fixed as indicated on page 410 of Appendix 8, Report for 1899, is—

XXXIX—XXXVIII = $-0^m.0072$.

No. 52.—CHESTER, ARK.

The difference of elevation fixed as indicated on page 410 of Appendix 8, Report for 1899, is—

XLIX—XLVIII = $-1^m.1358$.

No. 54.—BOSTON, MO.

The difference of elevation fixed as indicated on page 410 of Appendix 8, Report for 1899, is—

XCVI—XCVII = $-0^m.0008$.

No. 58.—WASHINGTON, D. C.

The elevation given on page 410 of Appendix 8, Report for 1899, for the Capitol bench mark depends upon five years of tidal observations at the navy-yard. Additional tidal observations are now available. The elevation here given and used in the adjustment of 1903 depends upon ten years, 1892–1901, of hourly heights on the water surface of the Potomac River, obtained from self-registering tide gauges located, first, at the navy-yard, later at the Seventh street wharf, and finally at Easbys Point. These gauges were all connected with each other and with the Capitol bench mark by spirit leveling. The total range of the 10 annual means all referred to one point is 0.4565 foot = 0.1391 meter, and the probable error of the mean is 0.0297 foot or 0.0091 meter. According to these tidal observations the Capitol bench mark is 90.3966 feet = 27.5529 meters above the mean river level. Retaining as before the assumption that the total fall

of the Potomac from Washington to the open sea is 88 millimeters (see page 256 of the Coast and Geodetic Survey Report of 1896), the fixed elevation adopted for the Capitol bench mark is—

Washington, Capitol—Sea level = +27^{m}.6409.

Various other bench marks in Washington are fixed in elevation by the various level lines which connect the Capitol bench mark with the three gauges. The elevations and description of these bench marks are given in the regular list.

No. 60.—RICHMOND, VA.

The elevation of O fixed as indicated on page 411 of Appendix 8, Report for 1899, is—

O — Sea level = +58^{m}.1957.

No. 62.—OLD POINT COMFORT, VA.

The elevation of U fixed as indicated on page 411 of Appendix 8, Report for 1899, is—

U — Sea level = +2^{m}.6875.

No. 67.—ANNAPOLIS, MD.

The elevation of the Perkins B. M. fixed as indicated on page 411 of Appendix 8, Report for 1899, is—

a, or Perkins Tidal B. M. — Sea level = + 1^{m}.268.

No. 71—GIBRALTAR, MICH.

The difference of elevation fixed as indicated on page 411 of Appendix 8, Report for 1899, is—

1 (of 1898) — (1877) = +1^{m}.5488.

No. 74B.—SHREVEPORT LA.—BODCAU, LA.

The bench marks P. B. M. 44 at Bodcau and P. B. M. 46 at Shreveport were connected by the U. S. Engineers (Chief of Engineers Report, 1893, pt. 3, p. 1953) and by the Coast and Geodetic Survey on the line Bowie to Shreveport in 1903, with the results—

P. B. M. 44—P. B. M. 46 = + 2^{m}.4292 and +2^{m}.4378, respectively.

The mean is adopted as a fixed difference of elevation, namely—

Bodcau, P. B. M. 44—Shreveport, P. B. M. 46 = +2^{m}.4335; distance, 15 kilometers.

No. 75.—MONROE, LA.

The difference of elevation fixed as indicated on page 411 of Appendix 8, Report for 1899, is—

P. B. M. 24—P. B. M. 27 = −1^{m}.9772.

No. 77.—RAYVILLE, LA.

The difference of elevation fixed as indicated on page 412 of Appendix 8, Report for 1899, is—

P. B. M. 17—P. B. M. 16 = +2^{m}.3294.

No. 82.—JONESVILLE, LA.

The relation between certain bench marks at this point is shown on page 412 of Appendix 8, Report for 1899.

No. 85.—PARKEVILLE, LA.

The difference of elevation fixed as indicated on page 412 of Appendix 8, Report for 1899, is—

T. B. M. 74—Parkeville = $+1^{m}.2220$.

Nos. 95, 107, 109, 111, 114.—AUSTIN, MISS.; GRAFTON, ILL.; KEOKUK, IOWA; SAVANNA, ILL.; ST. PAUL, MINN.

The fixed relations between bench marks at the above-named points are shown on pages 412–413 of Appendix 8, Rep. for 1899.

No. 123.—ST. JOSEPH, MO.

The difference of elevation fixed as indicated on page 413 of Appendix 8, Report for 1899, is

P. B. M. 287—P. B. M. 290 = $-0^{m}.9892$.

No. 133 B.—TROY, N. Y.

The difference of elevation of two bench marks in Troy, as determined by the Board of Engineers on Deep Waterways, is adopted as fixed, namely:

D. W. Troy 2—D. W. Troy 1 (or N. Y. 12) = $+0^{m}.7925$ = +2.60 feet.

No. 140 A.—ERIE, PA.

According to information furnished to the United States Coast and Geodetic Survey by the engineer in charge at Erie, B. M. 1 (1873) is 2.200 feet lower than the United States Engineers' bench mark on the light-house; hence,

L. H.—1 (1873) = $+0^{m}.6706$.

No. 141 A.—PITTSBURG, PA.

The following differences of elevation, as determined by the United States Geological Survey lines from Erie to Pittsburg and Grafton to Pittsburg, are adopted as fixed:

Braddock, P. R. R. 88—Pittsburg, Penn avenue curb = $+28^{m}.0770$; distance, 7.6 kilometers.

West Penn Junction, P. R. R. 26—Pittsburg, Penn avenue curb = $+15^{m}.8292$; distance, 27.3 kilometers.

Pittsburg, P. R. R. 99—Pittsburg, Penn avenue curb = $+2^{m}.1766$; distance, 1.4 kilometers.

And from the P. R. R. bench mark book is adopted as fixed:

P. R. R. 99—P. R. R. 100 = $-0^{m}.0518$.

No. 143 D.—HARRISBURG, PA.

The elevations reported by the United States Geological Survey give the following differences of elevation, which are adopted as fixed. From their determination alone,

P. R. R. 1—XXIX = $-11^{m}.2227$.

And from a mean of their determination and a determination by the Pennsylvania Railroad Company,

P. R. R. 2 − P. R. R. 1 = $+5^{m}.2160$.

No. 149.—BIRMINGHAM, ALA.

The following difference of elevation, as determined by the U. S. Engineers on line from York to Birmingham, is considered fixed:

P. B. M. 1 − P. B. M. 2 = $+4^{m}.5173$.

No. 154.—SIOUX CITY, IOWA.

To get a connection between the line St. Joseph–Sioux City by the U. S. Engineers, and Norfolk–Sioux City by the Coast and Geodetic Survey, two values were obtained for the difference P. B. M. 399 − B_2, as follows, it being assumed in deriving the first difference that the top of the cap of P. B. M. 395 had remained stable during the years intervening between the first and second of these two lines of levels, and in deriving the second value that the top of cap of P. B. M. 397 remained stable during the interval.

	Meters.
From Norfolk–Sioux City line, No. 155, top of cap of 395 − B_2	= −2.3818
From St. Joseph–Sioux City line, No. 124, P. B. M. 399—top of cap of 395	= +1.3022
P. B. M. 399 − B_2	= −1.0796
From line Norfolk–Sioux City, top of cap of 397 − B_2	= +0.7385
From line St. Joseph–Sioux City, P. B. M. 399—top of cap of 397	= −1.8231
P. B. M. 399 − B_2	= −1.0846

The mean, P. B. M. 399 − B_2 = −1.0821, is adopted as fixed. (Distance, 16 kilometers.)

No. 156.—NORFOLK, NEBR.

From the line Norfolk–Sioux City, No. 155, the following mean difference is considered fixed:

T. B. M. 2 − N_1 = $-0^{m}.8132$.

From the line Abilene–Norfolk, No. 70A, the following difference is considered fixed:

$O_1 - N_1 = +1^{m}.1565$.

No. 158.—HARRIMAN JUNCTION, TENN.

The difference $A_2 - C_2$, as determined on the lines Harriman Junction–Decatur, No. 157, and Knoxville–Harriman Junction, No. 160, was $-7^{m}.1469$ and $-7^{m}.1498$, respectively. The following mean is adopted as fixed:

$A_2 - C_2 = -7^{m}.1484$.

No. 161.—MOREHEAD CITY, N. C.

According to the Twentieth Annual Report of the United States Geological Survey, Part I, pp. 370–371, the elevation above mean sea level of 7 M C is +6.951 feet. This is considered fixed. Hence 7 M C − Sea level = $+2^{m}.1186$.

No. 163.—KNOXVILLE, TENN.

The difference, 867 M C (at Caswell) −933 M C (at Knoxville) as determined by the United States Geological Survey (see Twentieth Annual Report, Part I, p. 378), is −65.909 feet = −20.0890 meters. The same difference as determined on the line Somerset–Knoxville by the Coast and Geodetic Survey in 1900 is −20.0777 meters. The mean is adopted as fixed:

Caswell, 867 M C −Knoxville, 993 M C = $-20^{m}.0834$. Distance, about 10 kilometers.

The difference, 933 M C (at Knoxville) −940 M C (at Wright), as determined by the United States Geological Survey, Twentieth Annual Report, Part I, p. 378, is −7.083 feet = −2.1590 meters. The same difference as determined by the Coast and Geodetic Survey is −2.1663 meters. The following mean is adopted as fixed:

Knoxville, 933 M C −Wright, 940 M C = $-2^{m}.1626$. Distance, about 10 kilometers.

No. 165.—BRUNSWICK, GA.

According to the Twentieth Annual Report of the United States Geological Survey, Part I, pp. 380–383, the elevation above mean sea level of 10 M C is +10.688 feet. This is considered fixed as follows:

10 M C −Sea level = $+3^{m}.2577$.

No. 179.—ANTHONY, KANS.

The difference, Southeast Base−F_5, as determined on the line Salina–Anthony, No. 178, in 1901, is +9.8318 meters. The same difference, as determined on the line Bowie–Anthony, No. 180, in 1902, is +9.8334 meters. The following mean between these two values is adopted as fixed:

Anthony S. E. B.−F_5= $+9^{m}.8326$. Distance, approximately, 3 kilometers.

No. 193.—CLEVELAND, OHIO.

The difference of elevation of two bench marks at Cleveland, as given on page 615 of Professional Papers No. 24 of the Corps of Engineers, is adopted as fixed, namely:

U. S. E. 2 −U. S. E. 1 = $-1^{m}.1186$.

No. 219.—BAINBRIDGE AND SIDNEY, N. Y.

The following difference of elevation, as determined by the United States Geological Survey line Utica to Bainbridge, is adopted as fixed:

Bainbridge, 989A−Sidney, Tel. Pole 991 = $-0^{m}.4401$; distance 2 kilometers.

TESTS OF THE ADJUSTMENT OF 1899.

As the net now to be adjusted is the same as that adjusted in 1899 with a few additions, and as the same method of adjustment is to be used, it will be interesting to note at the outset how well the differences of elevations given by the new lines agree with the same differences as determined by the adjustment of 1899, and with the differences as given by the most direct connections between the same points by old lines before any adjustment whatever had been made, and even before the correction for systematic error as set forth on pages 441–444, 446 of Appendix 8, Report for

1899, had been applied. Such tests will serve to indicate whether the corrections applied in the 1899 adjustment improved the results.

The difference of elevation, Cincinnati, T—Birmingham, P. B. M. 2, as given by the new lines via Somerset, Harriman Junction, Woodville, and Decatur,* is −14.9176 meters. The most direct route by the old leveling is by way of Odin, Cairo, Corinth, and Meridian,† and according to this the difference, Cincinnati, T—Birmingham, P. B. M. 2, is −16.5538 meters. If from the old leveling Birmingham and Cincinnati be considered fixed in elevation by the best lines connecting these two points with sea level, and the difference then taken, the result will be as follows: Birmingham, P. B. M. 2, as fixed from the sea-level connection at Biloxi by the lines via Mobile and Meridian,‡ has an elevation of +181.5925; Cincinnati, T, as fixed from the sea-level connection at Sandy Hook by the lines via Harrisburg, Hagerstown, Grafton, and Belpre,§ has an elevation of +166.7167; Cincinnati, T, as fixed from the sea-level connection at Washington by the lines via Hagerstown, Grafton, and Belpre,‖ has an elevation of +166.5268 meters. From these two elevations for Cincinnati and the elevation of Birmingham as fixed from Biloxi result the differences, Cincinnati, T—Birmingham, P. B. M. 2= −14.8758 and −15.0657, respectively. The difference of elevation, Cincinnati, T—Birmingham, P. B. M. 2, as adjusted in 1899,¶ is −15.0858, which, it will be noted, agrees more closely with the new observed difference than any of the old observed differences except the last.

The difference of elevation, Cincinnati, T—Corinth, V, from the new lines via Somerset, Harriman Junction, Woodville, Decatur, and Tuscumbia,** is +28.9882. The same difference derived from the old line via Odin and Cairo†† is +27.7792 meters. The elevation of Corinth, V, as derived from mean sea level at Biloxi via Mobile and Meridian,‡‡ is +137.2595 meters. Combining this with the two values for Cincinnati, T, derived from Sandy Hook and Washington as indicated above, there are obtained the differences, Cincinnati, T—Corinth, V=+29.4572 meters and +29.2673 meters, respectively. The difference, Cincinnati, T—Corinth, V, as adjusted in 1899,§§ is +28.7285 meters, which agrees more closely with the new observed difference than do any of the other unadjusted differences cited above.

The difference of elevation, Corinth, V—Birmingham, P. B. M. 2, from the new lines via Tuscumbia and Decatur,‖‖ is −43.9058 meters. The same difference as derived from the old lines via Meridian¶¶ is −44.3330 meters. The difference, as adjusted in 1899,¶ is −43.8143 meters, agreeing very closely with the new line.

In the computations of the two preceding paragraphs the old line between Corinth and Decatur (lines 97 and 98, App. 8) has been ignored on account of the 1-meter error which has lately been discovered in it. If, however, it had been taken into account after being corrected 1 meter, the comparison would stand substantially as shown, since after correction it agrees very closely within $7^{mm}.7$ with the new line between the same points.

* Lines 150, 157A, 157B, 158, 159, 6A, of this appendix and Appendix 8, Report for 1899.

† Lines 149, 101, 100, 32, 33, 34, 35, 36, 7, and 6A.

‡ Lines 29A, 30, 31, 100, 101, 149.

§ Lines 1, 2, 3, 4A, 4B, 4C, 168, 166.

‖ Lines 58, 59A, 59B, 4A, 4B, 4C, 168, 166.

¶ Appendix 8, Report for 1899, pp. 449, 501.

** Lines 151, 153, 157A, 157B, 158, 159, 6A.

†† Lines 33, 34, 35, 36, 7, 6A.

‡‡ Lines 29A, 30, 31, 32.

§§ Appendix 8, Report for 1899, p. 449.

‖‖ Lines 150, 153, 151.

¶¶ Lines 149, 101, 100, 32.

The difference of elevation, Sioux City, P. B. M. 399—Norfolk, N_1, as determined by the new line,* is —128.9789 meters. The same difference from the old lines via Kansas City and Abilene† is —129.1125 meters. The difference, as adjusted in 1899,‡ is —129.0661 meters, the adjustments having applied such corrections as to bring the adjusted difference of elevation nearer to the difference of elevation as observed later.

The difference, Solomon, C_1—Salina, H_1, as observed in 1900 on the line Solomon–Anthony (p. 261), was —15.3095 meters. The same difference as observed on the old line, Holliday–Salina,§ was —15.3359 meters. The difference as adjusted in 1899‖ was —15.3322 meters, the adjusted difference thus being slightly nearer to the new difference observed later than the old observed difference.

The difference, Norfolk, N_1—Cheyenne, B, from the new lines via Page, Chadron, and Orin Junction,¶ is —1 383.3802 meters. The same difference from the shortest of the old lines between the same points, viz, via Abilene, Solomon, Salina, and Denver,** is —1383.5769. The difference as adjusted in 1899†† is —1383.4059 meters, an extremely close agreement with the new observations. If for the line between Solomon, C_1, and Salina, H_1, as adjusted in 1899, there is substituted the new line run between these points, 17A, run since the adjustment of 1899 was made, and the adjustment of 1899 as otherwise left unchanged, the difference Norfolk, N_1—Cheyenne, B, becomes —1383.3832, agreeing within 3 millimeters with the new lines from Norfolk to Cheyenne via Orin Junction.

The difference, Greenbush, Gristmill—Dobbs Ferry, V, as observed in 1902‡‡ is +1.2897. The same difference by the old direct line§§ between those points is +1.1249 meters. The difference as adjusted in 1899‖‖ is +1.2027 meters. The effect of the adjustment was, therefore, to correct the old line in the right direction but by an insufficient amount.

The elevation of Smithland, XLV, as brought from mean sea level at Biloxi by the new lines through New Orleans and Baton Rouge¶¶ is +14.8235. This same elevation as brought from Biloxi over the old lines is +14.6001 meters if the Engineer line is used between Biloxi and Carrollton,*** and +14.6474 meters if the Coast and Geodetic Survey line is used between those points.††† The elevation of Smithland, XLV, as adjusted in 1899‡‡‡ is +14.7917. In other words, the adjustment of 1899 corrected the observed differences of elevation in such a way as to bring them nearly into agreement, within 31.8 millimeters, with the observed difference of elevation, which was not known at this Office at the time the adjustment was made.

The difference of elevation, Fort Adams, XLIX—Smithland, XLV, from the new line (line 147), is +6.0760 meters. This same difference, as determined by the old line between Smithland and Vidalia, line 40, is +6.0439 meters. The adjustment of 1899§§§ gave Fort Adams, XLIX—Smithland, XLV, as +6.0402. The very small

* Lines 154, 155, 156.
† Lines 70A, 17, 16, 15B, 15A, 122, 123, 124.
‡ Appendix 8, Report for 1899, pp. 490, 539.
§ Lines 18 and 19, Appendix 8.
‖ Appendix 8, Report for 1899, p. 477.
¶ Lines 174, 173, 172, 171, 156.
** Lines 70A, 175, 27, 28, 23, 22, 21, 20, of this appendix and 19, 18, 17, of Appendix 8.
†† Appendix 8, Report for 1899, pp. 488, 490.
‡‡ Lines 170A, 170B.
§§ Line 136 of Appendix 8.
‖‖ Appendix 8, Report for 1899, pp. 473, 540.
¶¶ Lines 29A, 144, 145, 146.
*** Lines 29A and 73, 39, of Appendix 8.
††† Lines 29A and 37, 39, of Appendix 8.
‡‡‡ Appendix 8, Report for 1899, p. 449.
§§§ Appendix 8, Report for 1899, p. 482.

correction applied by the adjustment to the old observations in this case was apparently in the wrong direction.

The difference of elevation, Braddock, 88—Belpre, XL, from the new lines* is +63.2107 meters. The same difference by the old lines, by way of Grafton,† is +63.2110 meters. The adjustment of 1899‡ gave the difference, Braddock, 88—Belpre, XL, +63.3424 meters, farther from the new observed difference than is the old observed difference.

The difference of elevation, Belpre, XL—Lawrenceburg, U, from the new line,§ by way of the Ohio River, is +41.1523 meters. The same difference by the old line direct between these points‖ is +41.2147 meters. The difference as adjusted in 1899¶ was +41.4041 meters, the adjustment having again apparently corrected the old observations in the wrong direction.

The difference of elevation, Abilene, Y_2—Shreveport, 46, from the new lines,** by way of Bowie, Tex., is +290.9862 meters. The same difference by the old lines,†† by way of Holliday, Kans., and Little Rock, Ark., was +291.8105 meters. The adjustment of 1899 gave +291.2892, much nearer to the new difference than is the old determination.

The difference of elevation, Oswego, A—Greenbush, Gristmill, from the new lines,‡‡ by the Lake Survey, is +72.5510 meters. The same difference from the old lines§§ was +72.5800. The adjustment of 1899 gave +72.5632. The correction applied in the adjustment was therefore of such a sign and magnitude as to make the adjusted difference nearer to the new difference than is the old difference.

The difference, Washington, Capitol—Hancock, F, from the new Baltimore and Ohio line (line 225) is −100.6856 meters. By the old leveling (lines 58A, 59A, 59B, 4C) this difference was −100.4882. The adjustment of 1899 gave −100.5393, the correction applied being therefore of the right sign to force the adjusted result toward that given by the new leveling.

The difference, Cumberland, I—Hancock, F, from the new Baltimore and Ohio line (line 226) is +61.9468 meters. This difference from the old leveling (line 4B) was +61.8102. The adjustment of 1899 gave +61.8334, the correction again being of the right sign to force the adjusted result toward that given by the new leveling.

In the above comparisons many new lines which have been introduced into the net in Ohio, Pennsylvania, and the south of New York have not been considered, as they are of such little weight that the new direct determinations of the differences of elevation of their end points is of little if any greater reliability than the old indirect determinations. Such lines serve the purposes of fixing the elevations of intermediate bench marks along the lines rather than of fixing the differences of elevation of the end bench marks. The new Lake Survey lines are in part revisions of old lines and it is very difficult to get from them comparisons of value similar to those made above.

The other new lines do not connect such points that comparisons similar to the above may be made. Many additional comparisons between old and new lines and the

* Lines 169A, 169B, 141A.
† Lines 142, 168.
‡ Appendix 8, Report for 1899, pp. 449, 474.
§ Line 167.
‖ Lines 166, 6A.
¶ Appendix 8, Report for 1899, pp. 474-475.
** Lines 17A, 178, 179, 180, 187, 186.
†† Lines 17A, 16, 15B, 57A, 55, 54, 53, 52, 51, 49, 48, 88, 86, 75, 74A, 74B.
‡‡ Lines 211, 212, 213.
§§ Lines 132, 134.

adjustment of 1899 could be made if such comparisons were not limited to the most direct of the old lines between the points in question. Such a limitation is, however, evidently proper. It will be noted that if two of the comparisons made above, viz, on the lines Braddock–Belpre and Belpre–Lawrenceburg be omitted, in the remaining eighteen comparisons the difference of elevation from the adjustment of 1899 was found to be nearer to the difference as observed later than were the old observed differences upon which the adjustment was based, in sixteen out of eighteen cases. The two exceptional lines, Braddock–Belpre and Belpre–Lawrenceburg, on which the adjustment apparently had the wrong effect, are the only new lines which are not either Kern leveling by the Engineers or leveling since 1899 by the Coast and Geodetic Survey, the two classes of leveling to which it is now certain that the greatest weight should be assigned.

Taking the comparisons as a whole they indicate that the adjustment of 1899 had anticipated the effects of later leveling to a considerable extent by making the adjusted elevations agree closely with results which were yet to be obtained by such later leveling. To have accomplished such a feat is a triumph for the adjustment. It is also a remarkably satisfactory proof that the theories upon which the adjustment was based are in the main correct, for the best possible proof that a theory is correct is an agreement, such as that noted above, between prediction and subsequent observation.

These tests of the adjustment and other tests made from different points of view led to the decision to make the adjustment of 1903 by the same methods as the adjustment of 1899.

The above decision carries with it the application of the systematic corrections to the Coast and Geodetic Survey leveling previous to 1899 as applied in the adjustment of 1899, the comparisons made above being between the old differences of elevation without systematic correction, the adjusted differences of elevation involving systematic corrections, and the differences of elevation from the new leveling. It is especially interesting to note that on the long line from Abilene westward to Denver, which was a portion of a spur from the level net when the adjustment of 1899 was made, the correction +64.0 millimeters which was applied for systematic error,* was of the right sign and amount to produce an almost exact agreement with the later leveling, as indicated in the preceding comparisons.

THE CIRCUIT CLOSURES.

The 50 circuit closures are reproduced below in a table for convenient reference. The circuits are arranged in the order of the magnitude of the closures expressed in millimeters per kilometer, the best closure being placed first. Only simple circuits are used; i. e., there are no circuits given in the table which are divided by cross lines into smaller circuits. The last column shows the character of the lines forming the circuits, the different grades of lines being mentioned in decreasing order of the number of kilometers entering into the circuit. The symbols 1899— and 1899+ in the last column refer, respectively, to leveling by Coast and Geodetic Survey previous to 1899, and leveling by the Coast and Geodetic Survey in 1899 and later. The leveling referred to by the word "Engineers" was done under the direction of the Corps of Engineers, mainly by the Mississippi and Missouri River Commissions, with Kern instruments and the corresponding methods.

* See page 451 of Appendix 8, Report for 1899.

Closing errors of circuits.

[The circumferences given for circuits of which tide water forms one side do not include tide-water distances.]

Serial No.	Circuit.	Circuit closure.	Circumference of circuit.	Circuit closure per kilometer.	Character of lines.
		mm.	*km.*	*mm.*	
1	Savanna-Sand Beach-Escanaba-Marquette-Duluth-Savanna.	− 34.7	2 877	−0.012	Water, Engineers
2	Sand Beach-Mackinaw-Escanaba-Sand Beach	− 13.6	1 000	−0.014	Water.
3	Sand Beach-Detour-Mackinaw-Sand Beach	+ 8.8	622	+0.014	Water.
4	Cleveland-Erie-Buffalo-Cleveland	+ 8.3	573	+0.014	Water.
5	Oswego-Greenbush-Cooperville-Oswego	+ 20.4	985	+0.021	Engineers, Wye, water.
6	Grafton-Pittsburg-Belpre-Grafton	− 17.1	701	−0.024	Pittsburg-Belpre+, Geological, 1899−.
7	Biloxi-Meridian-Vicksburg-Biloxi	+ 43.5	1 174	+0.037	1899−, Engineers.
8	Utica-Bainbridge-Vischers Ferry-Utica	+ 16.2	417	+0.039	Geological, Engineers.
9	Decatur-Tuscumbia-Decatur	+ 6.5	158	+0.041	Engineers, 1899+.
10	Smithland-Vidalia-Monroe-Shreveport-Smithland.	+ 37.5	826	+0.045	Engineers, 1899−.
11	Hancock-Bainbridge-Binghamton-Hancock	− 10.5	211	−0.050	Geological.
12	Hagerstown-Harrisburg-Pittsburg*-Grafton-Hagerstown.†	− 54.2	1 043	−0.052	Penna. R. R., 1899−, Geological, B. and O. R. R.
13	Harrisburg-Elmira-Salamanca-Franklin-Pittsburg*-Harrisburg.	− 72.4	1 227	−0.059	Geological, Penna. R. R.
14	Abilene-Norfolk-Orin Junction-Denver-Abilene	−170.3	2 446	−0.070	1899+, 1899−.
15	Vidalia-Vicksburg-Rayville-Concordia-Vidalia	− 25.8	338	−0.076	Engineers, 1899−.
16	Old Point Comfort-Washington-Grafton†-Cincinnati-Harriman Junction-Morehead City.	−254.1	2 821	−0.090	1899−, Geological, 1899+, Belpre-Lawrenceburg,‡ B. and O. R. R.
17	Boston-Greenbush-Dobbs Ferry-Sandy Hook	+ 64.4	667	+0.097	Van Orden, 1899+, 1899−.
18	Vicksburg-Wilkersons Landing-Monroe-Vicksburg	− 52.4	531	−0.099	Engineers, 1899−.
19	Kansas City-Sioux City-Norfolk-Abilene-Kansas City.	−133.6	1 325	−0.10	1899+, Engineers, 1899−.
20	Canton-Cleveland-Buffalo-Amherstburg-Trenton-Lima-Canton.	+132.8	1 254	+0.11	Water, Penna. R. R., 1899+, Geological, Wye, Engineers.
21	Escanaba-Mackinaw-Detour-Iroquois-Marquette-Escanaba.	− 89.3	753	−0.12	Water, Engineers.
22	Pittsburg-Erie-Cleveland-Canton-Pittsburg	− 90.5	717	−0.13	Geological, water, Penna. R.R., Pittsburg-Monaca.‡
23	Parkeville-Wilkersons Landing-Little Rock-Parkeville.	− 86.6	684	−0.13	Engineers, 1899−.
24	Utica-Oswego-Charlotte-Hornellsville-Bainbridge-Utica.	+110.5	711	+0.16	Geological, Engineers, water.
25	St. Louis-Cincinnati-Sand Beach-Chicago-Savanna-St. Louis.	−447.0	2 872	−0.16	1899−, Engineers, water, 1899+.
26	Concordia-Rayville-Monroe-Concordia	+ 49.7	312	+0.16	Engineers.
27	Raritan Bay-Poughkeepsie-Hancock-Binghamton-Elmira-Harrisburg-Raritan Bay.	+185.3	1 108	+0.17	Geological, 1899−, 1899+.
28	Brunswick-Cleveland-Chattanooga-Decatur-Meridian-Biloxi.	+301.8	1 617	+0.19	Geological, 1899+, 1899−, Engineers.
29	Morehead City-Knoxville-Cleveland-Brunswick	−324.0	1 674	−0.19	Geological, 1899+.
30	Knoxville-Harriman Junction-Chattanooga-Cleveland-Knoxville.	+ 78.8	389	+0.20	1899+, Geological.
31	Wilkersons Landing-St. Louis-Harrisonville-Vanburen-Wilkersons Landing.	−457.6	2 219	−0.21	1899 −, Engineers
32	Jefferson City-Kansas City-Pleasant Hill-Jefferson City.	+120.9	549	+0.22	Engineers, 1899−.
33	Oswego-Olcott-Dunkirk-Hornellsville-Charlotte-Oswego.	−186.8	766	−0.24	Geological, water, Engineers.
34	Vicksburg-Greenwood-Greenville-Vicksburg	+130.6	472	+0.28	Engineers, 1899−.
35	Irvineton-Leboeuf-Franklin-Irvineton	+ 70.7	241	+0.29	Geological.
36	Monroe-Little Rock-Harrisonville-Abilene-Bowie-Shreveport-Monroe.	+824.3	2 745	+0.30	1899+, 1899−, Engineers.
37	Corinth-Cairo-Memphis-Corinth	−237.0	746	−0.32	1899−, Engineers.
38	Greenbush-Bainbridge-Hancock-Poughkeepsie-Greenbush.	+207.7	613	+0.34	Geological, 1899+, Engineers.
39	Canton-Lima-Cincinnati-Belpre-Monaca-Canton	−410.3	1 171	−0.35	1899−, Penna. R. R., Belpre-Monaca,‡ 1899+.
40	Cairo-Odin-St. Louis-Cairo	−227.2	573	−0.40	1899−, Engineers.
41	Sandy Hook-Harrisburg-Hagerstown-Washington-Annapolis.	+271.9	641	+0.42	1899−.
42	Decatur-Corinth-Meridian-Birmingham-Decatur	+427.2	860	+0.50	1899−, 1899+, Engineers.
43	Irvineton-Salamanca-Dunkirk-Buffalo-Erie-Leboeuf-Irvineton.	+292.7	448	+0.65	Geological, water.

*Between Pittsburg and Blairsville Intersection the mean of two determinations, via Braddock and via West Penn Junction, was used.

†A mean has been taken between Hancock and Cumberland of two determinations, by the Coast and Geodetic Survey and by the Baltimore and Ohio Railroad.

‡The leveling between these points forms a portion of the line between Pittsburg and Lawrenceburg. The method used is described on p 347.

Closing errors of circuits—Continued.

Serial No.	Circuit.	Circuit closure.	Circumference of circuit.	Circuit closure per kilometer.	Character of lines.
		mm.	*km.*	*mm.*	
44	Harriman Junction-Cincinnati-Odin-Corinth-Decatur-Harriman Junction.	+1 202.5	1 826	+0.66	1899−, 1899+, Engineers.
45	Meridian-Corinth-Memphis-Greenwood-Vicksburg-Meridian.	− 900.3	1 284	−0.70	1899−, Engineers.
46	Limon-Denver-Roswell-Limon	+ 292.1	385	+0.76	1899−.
47	Washington-Hagerstown-Hancock-Washington	− 280.4	345	−0.81	1899−, B. and O. R. R.
48	Annapolis-Washington-Old Point Comfort	+ 378.5	398	+0.96	1899−.
49	Pleasant Hill-Kansas City-Holliday-Harrisonville-Pleasant Hill.	− 183.1	165	−1.11	1899−.
50	Cedar Keys-St. Augustine*	+ 258.5	216	+1.20	1899−, Van Orden.

THE LEVEL NET ADJUSTMENT OF 1903.

The relative positions of the various lines forming the level net to be adjusted are shown on the illustration here inserted. The lines have been drawn nearly in their true location, but the drawing has necessarily been somewhat generalized, and in a few cases it has been necessary to exaggerate distances between points in order to make them show as separate points.

Inside each circuit formed by several level lines there is printed the closing error in millimeters and the total circumference of the circuit in kilometers. A plus sign on the closing error indicates that the elevation as carried around the circuit in a counter-clockwise direction is too great. On all circuits of which the Atlantic, the Gulf of Mexico, or Chesapeake Bay form one side it is assumed that the mean sea surface is everywhere at the same level on the Atlantic, Gulf, and the Chesapeake.

It is evident that in these closing errors there is information of the highest value as to the actual errors of the leveling. The concrete problem in hand is to adjust this net by distributing the closing errors in such a way as to obtain as close an approximation as possible to the truth.

Illustration No. 22 shows the net used in the adjustment of 1903. It should be noted, however, that the line St. Augustine–Cedar Keys, across Florida, does not enter the equations of the adjustment, as it does not connect with any other line; that the lines Old Point Comfort–Richmond–Washington and Annapolis–Washington do not enter the equations for the reason that they are tied to sea level at each end.

Before beginning the adjustment, the question of what relative weights should be assigned to the different classes of leveling was again carefully considered. The same criterion for determining these relative weights that had been used in 1899 was again used, viz, that after the adjustment is made the mean value of pv^2 for each of the five groups into which the leveling is divided with respect to assigned weights should be as nearly as possible the same. As even a large change in relative weights produces but small changes in the computed elevations, it is not advisable to change the weight assigned to any class of leveling unless the evidence is clear that a change of at least 25 per cent should be made. It was found necessary to make a large reduction in the weights assigned to each class of leveling except the first, namely, the class including Engineer lines, Coast and Geodetic Survey lines in 1899 and later, and water leveling.

*The tidal series at each end of this line extends over one year only, and at each end the local conditions are such that the tide observations may be subject to considerable wind effect. See Appendix 8, Report for 1899, p. 396.

PRECISE LEVEL NET OF 1903

Old Coast and Geodetic Survey

Coast and Geodetic Survey 1899 or later

Engineers Precise on water

Engineers Wye

Geological Survey and Van Orden

Pennsylvania Railroad

Closing errors are reckoned in the counter-clockwise direction.

B. & O. Railroad also

ANDREW B. GRAHAM, PHOTO-LITHO WASHINGTON D.C.

The new line from Pittsburg, Pa., to Lawrenceburg, Ind., was classed with the Wye levels run under the direction of the Corps of Engineers and the Board on Deep Waterways, and was therefore assigned a weight of $\frac{300}{L}$. The use of target rods and a method of observing which extended the observations at a given station over a considerably longer interval of time than is necessary with the Kern leveling or the later Coast and Geodetic Survey leveling, made it certain that this line should not be assigned to the class having the greatest weight. The care with which the work seems to have been done and the fact that each portion of the line was run in both the forward and backward directions, each indicated that it should not be assigned to a lower group in the scale of weights.

The weights used in the adjustment of 1903* are as follows, L being the length of the line in kilometers:

No.	Lines.	Weight p.
1	Engineer lines with Kern instrument; Coast and Geodetic Survey of 1899 and later; water leveling on lakes, except short series of observations †, and Baltimore and Ohio Railroad	$\frac{1000}{L}$
2	Wye levels run under the direction of the Engineers and Deep Waterways Board; and the lines Pittsburg–Belpre and Belpre–Lawrenceburg	$\frac{300}{L}$
3	Geological Survey and Van Orden leveling	$\frac{24}{L}$
4	Leveling by the Pennsylvania Railroad Company	$\frac{15}{L}$
5	Coast and Geodetic Survey previous to 1899	$\frac{1600}{L^2}$

The net is connected strongly with mean sea level at Sandy Hook and at Biloxi, and there are weak connections with mean sea level at Washington, D. C., Morehead City, N. C., and Brunswick, Ga. At Washington the adjustment is based upon the assumption that the mean level of the Potomac at Washington is 88 millimeters higher than mean sea level. (See p. 362.)

The net of 1903 involves 106 links and 48 circuits, including those of which water levels along the Gulf and Atlantic form one side. The adjustment of 1899 involved 54 links and 25 such circuits.

Before making the least square adjustment, all of the Coast and Geodetic Survey leveling previous to 1899 was corrected for systematic error according to the formula derived in 1899 (see pp. 442–444, 446, Appendix 8, Report for 1899), and the corrected values are given in the column headed "Observed differences" in the following table.

*It may be of interest to note that the pv^2 from the adjustment of 1903 were examined after the adjustment was completed to determine whether these weights seemed to be correct. The test indicated that groups 1, 3, and 5 have been assigned the proper relative weights, and groups 2 and 4 weights which are probably somewhat too large. The evidence was not sufficiently decisive, however, to warrant any changes in weights.

† If a series of simultaneous self-registering gauge readings at two points was less than eight months long (four summer months during each of two years), or a series of simultaneous try-daily staff gauge readings less than sixteen months (four summer months during four years), the weight assigned to the line joining these points was reduced below $\frac{1000}{L}$.

An examination of the evidence afforded by the new lines added to the net since 1899 indicates that a new computation of the constants of this formula would give values agreeing closely with the old values. For convenience of reference, the systematic corrections are shown in the tables on pages 382 to 386.

Observation equations, 1903.

No. of equation or link.	Observed difference.			Weight p.	Adjusted difference.		Correction v.	pv^2.
			m.			*m.*	*mm.*	*mm.*
1A	Smithland, XLV—Sea level at Biloxi	= +	14.8235	2.6	+	14.8406	+ 17.1	760
4A	Vidalia, LXIV — Smithland, XLV	= +	5.0506	0.22	+	4.9458	—104.8	2 416
5A	Shreveport, 46 — Smithland, XLV	= +	44.8399	2.6	+	44.8658	+ 25.9	1 744
5B	Monroe, 27—Shreveport, 46	= —	35.8766	7.1	—	35.8774	— 0.8	5
6	Monroe, 27—Vidalia, LXIV	= +	4.0144	5.6	+	4.0426	+ 28.2	4 453
7	Rayville, 16—Vidalia, LXIV	= +	4.7555	8.3	+	4.7350	— 20.5	3 488
8	Vicksburg, 211—Vidalia, LXIV	= +	8.1564	0.083	+	8.0306	—125.8	1 314
9	Wilkersons Landing, 84—Monroe, 27	= +	18.4769	5.1	+	18.5010	+ 24.1	2 962
10	Rayville, 16—Monroe, 27	= +	0.6914	29.0	+	0.6924	+ 1.0	29
11	Vicksburg, 211—Rayville, 16	= +	3.3064	13.0	+	3.2956	— 10.8	1 516
12	Wilkersons Landing, 84—Vicksburg, 211	= +	14.5648*	0.046	+	14.5130	— 51.8	123
13	Wilkersons Landing, 84—Vicksburg, 211	= +	14.5573†	3.5	+	14.5130	— 44.3	6 869
14	Meridian, C—Vicksburg, 211	= +	76.8463	0.032	+	77.0417	+195.4	1 222
15	Meridian, C—Sea level at Biloxi	= +	105.2009	0.016	+	104.8587	—342.2	1 874
16	Corinth, V—Meridian, C	= +	32.6807	0.016	+	32.7600	+ 79.3	101
16A	Decatur, 50—Meridian, C	= +	64.7374	2.6	+	64.7372	— 0.2	0
16B	Tuscumbia, 9—Corinth, V	= +	5.5652	20.0	+	5.5645	— 0.7	10
16C	Decatur, 50—Tuscumbia, 9	= +	26.4098†	12.0	+	26.4127	+ 2.9	101
16D	Decatur, 50—Tuscumbia, 9	= +	26.4163*	14.0	+	26.4127	— 3.6	181
17	Little Rock, I or 3—Wilkersons Landing, 84	= +	38.1423	0.048	+	38.0765	— 65.8	208
18	Little Rock, I or 3—Monroe, 27	= +	56.5774	2.7	+	56.5775	+ 0.1	0
19	Memphis, "Memphis"—Wilkersons Landing, 84	= +	38.2777	3.5	+	38.2687	— 9.0	284
20	Harrisonville, 43 — Little Rock, I or 3	= +	230.1734	0.0033	+	229.2547	—918.7	2 785
21	Pleasant Hill, LI—Harrisonville, 43	= —	48.3114	9.6	—	48.3081	+ 3.3	105
22A	Kansas City, 244 — Holliday, LXIII	= —	2.9338	3.0	—	2.9442	— 10.4	324
22B	Holliday, LXIII — Harrisonville, 43	= —	76.3982	0.28	—	76.5226	—124.4	4 333
22D	Norfolk, N_1—Kansas City, 244	= +	234.1031	1.7	+	234.0625	— 40.6	2 802
22E	Abilene, Y_2—Norfolk, N_1	= —	113.4466	2.1	—	113.4796	— 33.0	2 287
22F	Abilene, Y_2—Holliday, LXIII	= +	117.7702	0.028	+	117.6387	—132.0	488
22G	Abilene, Y_2—Shreveport, 46	= +	290.9862	0.86	+	291.0709	+ 84.7	6 170
22H	Limon, N—Abilene, Y_2	= + 1	281.4225	0.0047	+ 1	281.4009	— 21.6	2
22I	Denver, A_2—Limon, N	= —	47.0880‡	0.083	—	47.1607	— 72.7	439
22J	Denver, A_2—Limon, N	= —	47.3801ǂ	0.027	—	47.1607	+219.4	1 300
22K	Denver, A_2—Norfolk, N_1	= + 1	120.7605	0.87	+ 1	120.7606	+ 0.1	0
23	Kansas City, 244 — Pleasant Hill, LI	= —	31.2026	0.77	—	31.1587	+ 43.9	1 484
24	Jefferson City, 90 — Pleasant Hill, LI	= —	91.3198	0.042	—	91.3662	— 46.4	90

* Coast and Geodetic Survey. † United States Engineers. ‡ Direct. ǂ Via Colorado Springs.

Observation equations, 1903—Continued.

No. of equation or link.	Observed difference.		Weight p.	Adjusted difference.	Correction v.	pv^2.
		m.		*m.*	*mm.*	*mm.*
25	Kansas City, 244—Jefferson City, 90	=+ 60.2292	3.3	+ 60.2075	— 21.7	1 554
26	St. Louis. K_3—Jefferson City, 90	=— 43.5512*	0.038	— 43.8093	—258.1	2 531
27	St. Louis, K_3—Jefferson City, 90	=— 43.8270†	4.5	— 43.8093	+ 17.7	1 410
28	Cairo, 2—Memphis, "Memphis"	=+ 16.7198	3.0	+ 16.7133	— 6.5	127
29	Corinth, V—Memphis, "Memphis"	=+ 57.1960	0.070	+ 57.0200	—176.0	2 168
30	Cairo, 2—Corinth, V	=— 40.4428	0.022	— 40.3067	+136.1	408
31	St. Louis, K_3—Cairo, 2	=+ 28.8706	3.6	+ 28.8656	— 5.0	90
32	Odin, V—Cairo, 2	=+ 63.3052	0.044	+ 63.3435	+ 38.3	65
33	Savanna, 62—St. Louis, K_3	=+ 54.3002	1.7	+ 54.3295	+ 29.3	1 459
34	Odin, V—St. Louis, K_3	=+ 34.4651	0.15	+ 34.4779	+ 12.8	25
35	Cincinnati, T—Odin, V	=+ 5.5540	0.0096	+ 5.9294	+375.4	1 353
35A	Trenton, 1877—Lima, U_1	=— 83.9838	5.4	— 83.9956	— 11.8	752
35B	Lima, U_1—Cincinnati, T	=+101.3727	4.6	+101.3564	— 16.3	1 222
36B	Cincinnati, T—Harriman Junction, C_2	=— 74.8908	2.4	— 74.9039	— 13.1	412
36C	Knoxville, 933MC—Harriman Junction, C_2	=+ 42.5945	12.0	+ 42.5960	+ 1.5	27
36D	Morehead City, Sea level,—Knoxville, 933MC	=—284.2168	0.027	—284.0848	+132.0	470
36F	Knoxville, 933MC—Cleveland, 875MC	=+ 17.8512	0.19	+ 17.7748	— 76.4	1 109
36G	Cleveland, 875MC—Brunswick, Sea level	=+266.6896	0.035	+266.3100	—379.6	5 043
36H	Harriman Junction, C_2—Chattanooga, 698N	=+ 30.3215	7.8	+ 30.3198	— 1.7	23
36I	Chattanooga, 698N—Decatur, 50	=+ 41.5760	5.1	+ 41.5731	— 2.9	43
36J	Chattanooga, 698N—Cleveland, 875MC	=— 55.1436	0.48	— 55.1410	+ 2.6	3
37A	Belpre, XL—Cincinnati, T	=+ 22.8420*	0.016	+ 22.7635	— 78.5	99
37B	Belpre, XL—Cincinnati, T	=+ 22.6828‡	0.60	+ 22.7635	+ 80.7	3 907
37C	Grafton, M—Belpre, XL	=+114.4429	0.056	+114.4938	+ 50.9	145
37E	Pittsburg, 99—Monaca, 25C	=+ 17.4672	7.2	+ 17.4708	+ 3.6	93
37F	Monaca, 25C—Belpre, XL	=+ 19.8431	1.2	+ 19.8800	+ 36.9	1 634
37G	Monaca, 25C—Canton, Br. 77	=—104.3094	0.12	—104.4602	—150.8	2 729
37H	Lima, U_1—Canton, Br. 77	=— 45.9353	0.058	— 45.7473	+188.0	20
37I	Canton, Br. 77—Buffalo, L. H	=+133.8569	0.23	+133.8256	— 31.3	225
38A	Marquette, 1—Savanna, 62	=+ 5.5694	0.83	+ 5.5703	+ 0.9	1
38B	Escanaba, 1—Marquette, 1	=— 5.1567	4.8	— 5.1454	+ 11.3	613
39A	Escanaba, 1—Sand Beach, E.	=+ 3.1775	2.0	+ 3.1700	— 7.5	112
39B	Sand Beach, E—Savanna, 62.	=— 2.7980	0.93	— 2.7451	+ 52.9	2 603
40A	Marquette, 1—Detour, Goetz.	=+ 2.4044	0.75	+ 2.4757	+ 71.3	3 813
40B	Escanaba, 1—Detour, Goetz	=— 2.6585	3.5	— 2.6697	— 11.2	439
40C	Detour, Goetz—Sand Beach, E	=+ 5.8360	3.8	+ 5.8397	+ 3.7	52
40D	Sand Beach, E—Trenton, 1877	=— 6.1686	3.3	— 6.1837	— 15.1	752
41A	Trenton, 1877—Buffalo, L. H.	=+ 4.0743	1.7	+ 4.0827	+ 8.4	120
42A	Buffalo, L. H.—Oswego, A	=+103.0865	3.8	+103.0842	— 2.3	20
43A	Salamanca, 1391 D—Buffalo, L. H	=+244.1209	0.18	+244.2626	+141.7	3 614
43B	Hornellsville, 1141 D—Salamanca, 1391 D	=— 75.9076	0.18	— 75.8968	+ 10.8	21
43C	Oswego, A—Hornellsville, 1141 D	=—271.4866	0.16	—271.4500	+ 36.6	214

* Coast and Geodetic Survey. † United States Engineers. ‡ New line by Engineers.

Observation equations, 1903—Continued.

No. of equation or link.	Observed difference.		Weight p.	Adjusted difference.	Correction v.	pv^2.
		m.		*m.*	*mm.*	*mm.*
43D	Elmira, 857 A—Hornellsville, 1141 D	=— 86.5039	0.26	— 86.5190	— 15.1	59
43E	Bainbridge, 989 A—Elmira, 857 A	=+ 39.9664	0.16	+ 39.9433	— 23.1	85
43F	Utica, L. S. 92—Bainbridge, 989 A	=— 170.4278	0.24	—170.4638	— 36.0	311
43G	Greenbush, Gristmill—Bainbridge, 989 A	=— 297.3734	0.14	—297.4276	— 54.2	411
44A	Leboeuf, 1193P—Buffalo, L. H	=+ 184.2006	0.61	+184.1330	— 67.6	2 788
44B	Franklin, 987P—Leboeuf, 1193 P	=— 62.8310	0.27	— 62.9210	— 90.0	2 187
44C	Irvineton, 1167D—Leboeuf, 1193 P	=— 7.9602	0.38	— 8.0049	— 44.7	759
44D	Irvineton, 1167D—Franklin, 987 P	=+ 54.9415	0.26	+ 54.9161	— 25.4	168
44E	Salamanca, 1391D—Irvineton, 1167D	=+ 68.1732	0.61	+ 68.1345	— 38.7	1 359
44F	Pittsburg, 99—Franklin, 987 P	=— 74.2653	0.16	— 74.3758	—110.5	1 954
45A	Harrisburg, XXIX—Pittsburg, 99	=— 118.0141	0.043	—117.9032	+110.9	529
45B	Elmira, 857A—Harrisburg, XXIX	=+ 152.9102	0.066	+152.9138	+ 3.6	1
46A	Pittsburg, 99—Grafton, M	=— 77.1091	0.11	— 77.1430	— 33.9	126
47A	Cumberland, I—Grafton, M	=— 113.6854	0.060	—113.5763	+109.1	714
47B	Hancock, F—Cumberland, I.	=— 61.7904*	0.18	— 61.9437	—153.3	423
47C	Hagerstown, H—Hancock, F	=+ 40.0497	0.64	+ 40.0173	— 32.4	672
47D	Hancock, F—Cumberland, I.	=— 61.9468†	11.0	— 61.9437	+ 3.1	106
47E	Washington, Sea level—Hancock, F	=— 128.3265†	6.3	—128.3222	+ 4.3	116
48	Harrisburg, XXIX—Hagerstown, H	=— 59.4816	0.12	— 59.5435	— 61.9	460
49A	Hagerstown, H—Washington, Sea level	=+ 168.1788	0.083	+168.3395	+160.7	2 143
50	Sea level at Sandy Hook—Harrisburg, XXIX	=— 108.6643	0.022	—108.7960	—131.7	382
51A	Utica, L. S. 92—Oswego, A	=+ 54.4108	7.6	+ 54.4105	— 0.3	1
51B	Greenbush, Gristmill—Utica, L. S. 92	=— 126.9618	5.5	—126.9638	— 2.0	22
52A	Oswego, A—Greenbush, Gristmill	=+ 72.5735‡	0.82	+ 72.5533	— 20.2	335
53	Sea level at Boston—Greenbush, Gristmill	=— 4.2898	0.072	— 4.2255	+ 64.3	298
54B	Greenbush, Gristmill—Poughkeepsie, 173A	=— 48.5028	8.6	— 48.5021	+ 0.7	4
54C	Poughkeepsie, 173A—Sea level at Sandy Hook	=+ 52.7282	11.5	+ 52.7276	— 0.6	4
55	Bainbridge, 989A—Poughkeepsie, 173A	=+ 249.0783	0.082	+248.9255	—152.8	1 915

*Coast and Geodetic Survey. †Baltimore and Ohio Railroad. ‡Via Lake Champlain.

In this table the numbers of the lines, as shown on pages 351 to 366, used in making up each link of the net or equation in the adjustment are indicated.

Link or equation.	References.	Link or equation.	References.
1A	29A, 144, 145, 146.	36J	189.
4A	147, 148, 41.	37A	166.
5A	74C.	37B	167, 6A.
5B	74A, 74B.	37C	168.
6	80, 79.	37E	169A.
7	77, 81, 79.	37F	169B.
8	43, 42.	37G	190.
9	89, 85, 86, 75.	37H	191.
10	77, 76, 75.	37I	192, 193, 208.
11	43, 78.	38A	194, 116, 113.
12	90, 91, 44.	38B	118.
13	90, 91, 92, 43.	39A	195.
14	65, 43.	39B	196, 197, 112.
15	29A, 30, 31.	40A	198, 199.
16	32.	40B	200, 201.
16A	100, 101, 149, 150.	40C	202.
16B	151.	40D	203, 204.
16C	152.	41A	206, 207.
16D	153.	42A	209, 210.
17	46, 45.	43A	138A, 215.
18	88, 86, 75.	43B	138B.
19	96, 93.	43C	217, 216.
20	55, 54, 53, 52, 51, 49, 48.	43D	138C.
21	56.	43E	138D, 138E.
22A	15A, 15B.	43F	218, 219.
22B	57A, 15B.	43G	138F, 213.
22D	122, 123, 124, 154, 155, 156.	44A	140B, 140A, 214.
22E	70A.	44B	140C.
22F	16, 17A.	44C	220.
22G	17A, 178, 179, 180, 187, 186.	44D	221.
22H	23, 22, 21, 20, 17A.	44E	222.
22I	27, 28.	44F	140D, 141A.
22J	27, 26, 25, 24.	45A	141A, 143A, 143B, 143C, 143D, the mean being taken at Blairsville Intersection of 141A and 143A, and 141A and 143B.
22K	175, 174, 173, 172, 171, 156.		
23	14, 13, 12.		
24	10, 11.		
25	14, 121.		
26	9.	45B	223, 224.
27	105, 120, 10.	46A	141A, 142A.
28	103.	47A	4A.
29	33, 66.	47B	4B.
30	35, 34, 33.	47C	4C.
31	104, 35.	47D	226.
32	36.	47E	58A, 225.
33	110, 109, 108, 107, 106, 105.	48	3.
34	8.	49A	58A, 59A, 59B.
35	6A, 7.	50	1, 2.
35A	205, 71, 72A.	51A	211.
35B	72B.	51B	213, 212.
36B	158, 159, 6A.	52A	133A, 133B, 133C, 133D, 133E, 133F, 133G, 133H.
36C	160.		
36D	161, 162, 163.	53	135.
36F	163, 164A.	54B	170B.
36G	164B, 165.	54C	170A, 1.
36H	157B.	55	219, 228, 229.
36I	157A.		

The formation of normal equations from the observation equations by the method of least squares, and their solution, gave the new adjusted elevations shown in the

following table. For the purpose of showing clearly the effects of the new lines the elevations as adjusted in 1899 are also placed in the table, and the differences (1903–1899) are shown.

Junction point.	Bench mark.	Adjusted elevation, 1899.	Adjusted elevation, 1903.	Correction to elevation, 1899.
		m.	*m.*	*mm.*
Smithland	XLV	14.7917	14.8406	+ 48.9
Vidalia	LXIV	19.7233	19.7864	+ 63.1
Monroe	27	23.7658	23.8290	+ 63.2
Shreveport	46	59.6423	59.7064	+ 64.1
Rayville	16	24.4587	24.5214	+ 62.7
Vicksburg	211	27.7556	27.8170	+ 61.4
Meridian	C	104.8579	104.8587	+ 00.8
Decatur	50	168.6796	169.5959	+916.3
Tuscumbia	9	142.2698	143.1832	+913.4
Harriman Junction	C_2		241.4888	
Chattanooga	698 N		211.1690	
Knoxville	933 M C		284.0848	
Cleveland	875 M C		266.3100	
Wilkersons Landing	84	42.2704	42.3300	+ 59.6
Little Rock	I or 3	80.3434	80.4065	+ 63.1
Harrisonville	43	309.6687	309.6612	— 7.5
Pleasant Hill	LI	261.3595	261.3531	— 6.4
Holliday	LXIII	233.1608	233.1386	— 22.2
Kansas City	244	230.1885	230.1944	+ 5.9
Norfolk	N_1	464.3781	464.2569	—121.2
Denver	A_2	1585.1643	1585.0175	—146.8
Limon	N	1632.3593	1632 1782	—181.1
Abilene	Y_2	350.9315	350.7773	—154.2
Jefferson City	90	169.9596	169.9869	+ 27.3
Memphis	"Memphis"	80.5465	80.5987	+ 52.2
Corinth	V	137.7053	137.6187	— 86.6
Cairo	2	97.2658	97.3120	+ 46.2
St. Louis	K_3	126.1353	126.1776	+ 42.3
Odin	V	160.6075	160.6555	+ 48.0
Cincinnati	T	166.4338	166.5849	+151.1
Belpre	XL	189.3684	189.3484	— 20.0
Savanna	62	180.4298	180.5071	+ 77.3
Marquette	1	185.9353	186.0774	+142.1
Escanaba	1	180.7760	180.9320	+156.0
Detour	Goetz		183.6017	
Sand Beach	E		177.7620	
Trenton	1877	183.8237	183.9457	+122.0
Lima	U_1	267.8069	267.9413	+134.4
Canton	Br. 77		313.6886	
Monaca	25C		209.2284	
Leboeuf	1193P	363.9825	363.9960	+ 13.5
Franklin	987P	301.1287	301.0750	— 53.7
Irvineton	1167D		355.9911	
Pittsburg	99	226.8012	226.6992	—102.0
Grafton	M	303.8721	303.8422	— 29.9
Hancock	F	128.2393	128.3222	+ 82.9
Cumberland	I	190.0727	190.2659	+193.2
Hagerstown	A	168.2720	168.3395	+ 67.5
Harrisburg	XXIX	108.7880	108.7960	+ 8.0
Elmira	857A	261.5010	261.7098	+208.8
Hornellsville	1141D	348.0154	348.2288	+213.4
Salamanca	1391D	423.9382	424.1256	+187.4
Buffalo	L. H.		179.8630	
Bainbridge	989A		301.6531	
Poughkeepsie	173A		52.7276	
Utica	L. S. 92		131.1893	
Oswego	A	76.7016	76.7788	+ 77.2
Greenbush	Gristmill	4.1384	4.2255	+ 87.1

The probable error of an observation of unit weight, i. e., of the observed difference of elevation on the two ends of a line of such a length as to be assigned unit weight, was found to be ± 32.8 millimeters. In the adjustment of 1899 this quantity was found to be ± 32.9 millimeters. The probable error of unit weight, ± 32.8 millimeters, corresponds to a probable error of ± 1.04 millimeters for a single kilometer of leveling assigned to Group 1 in the scale of weights (p. 373), i. e., for either Kern leveling by the Corps of Engineers, or leveling in 1899 or later by the Coast and Geodetic Survey.

The probable error of the elevation of bench mark K_3 at St. Louis is found from the 1903 adjustment to be ± 32 millimeters. The probable error of this elevation computed from the 1899 adjustment was ± 65 millimeters. The contrast between these values expresses forcibly the great increase in the strength of the level net due to the added leveling. It is an even chance that the elevation computed from the adjustment of 1903 will not be changed more than 32 millimeters by any amount of new leveling, and it is almost certain that it will not be changed by as much as 0.15 meter or 6 inches.

ADOPTED ELEVATIONS OF JUNCTION POINTS.

Having thus secured the theoretically most accurate elevations for the junction points, the question of adopting as standard elevations for present use such values as will produce the minimum disturbance in past publications, and the minimum inconvenience in the revision of past computations, now arises. This question has already been touched upon in the general statement at the beginning of this appendix (see p. 198).

It is desirable to make as few changes as is allowable in the elevations and differences of elevations already published in Appendix 8, Report for 1899. The following decision is based upon the supposition that an arbitrary decision to hold old elevations unchanged or to correct a group of them by a constant which is an integral number of centimeters is allowable, *Provided*, 1. That by so doing a considerable number of old elevations or differences of elevation are retained unchanged; 2. That every assigned elevation agrees with the elevation derived from the latest adjustment within the probable error of said elevation derived from the latest adjustment; 3. That every assigned difference of elevation between junction points agrees with the value of that difference derived from the latest adjustment within the probable error of observation of said difference.

It was decided in accordance with these principles to add 60 millimeters to the elevations printed in Appendix 8, Report for 1899, at Smithland, La.; Vidalia, La.; Shreveport, La.; Monroe, La.; Rayville, La.; Vicksburg, Miss.; Wilkersons Landing, Miss.; Little Rock, Ark.; Memphis, Tenn.; Cairo, Ill., and Odin, Ill., and to the elevations of all bench marks on the direct lines joining these points. The differences of elevation therefore on all these lines remain unchanged. For all other junction points in the net the elevations given by the 1903 adjustment were adopted.

Junction point.	Adopted elevation.	Theoretical elevation (from adjustment) minus adopted elevation.
	m.	*mm.*
Smithland, XLV	14.8517	—11.1
Vidalia, LXIV	19.7833	+ 3.1
Monroe, 27	23.8258	+ 3.2
Shreveport, 46	59.7023	+ 4.1
Rayville, 16	24.5187	— 2.7
Vicksburg, 211	27.8156	+ 1.4
Wilkersons Landing, 84	42.3304	— 0.4
Little Rock, I or 3	80.4034	+ 3.1
Memphis, "Memphis"	80.6065	— 7.8
Cairo, 2	97.3258	—13.8
Odin, V	160.6675	—12.0

CORRECTIONS APPLIED IN THE 1903 ADJUSTMENT.

The three tables which follow have been prepared in order to exhibit fully the facts as to the corrections applied to the lines used in the 1903 net.

Table 1 gives the observed and corrected difference of elevation of the end bench marks of each link corresponding to the equations given on pages 374 to 376.

TABLE 1.—*Differences of elevation.*

Links.	Observed.	Corrected for systematic error.	Adjusted 1903.	Adopted 1903.*
	m.	*m.*	*m.*	*m.*
1A	+ 14.8235	.....	+ 14.8406	+ 14.8517
4A	+ 4.9821	+ 5.0506	+ 4.9458	+ 4.9316
5A	+ 44.8399	.....	+ 44.8658	+ 44.8506
5B	— 35.8766	.....	— 35.8774	— 35.8765
6	+ 4.0144	.....	+ 4.0426	+ 4.0425
7	+ 4.7555	.....	+ 4.7350	+ 4.7354
8	+ 8.0361	+ 8.1564	+ 8.0306	+ 8.0323
9	+ 18.4769	.....	+ 18.5010	+ 18.5046
10	+ 0.6914	.....	+ 0.6924	+ 0.6929
11	+ 3.3064	.....	+ 3.2956	+ 3.2969
12	+ 14.4267	+ 14.5648	+ 14.5130	+ 14.5148
13	+ 14.5573	.....	+ 14.5130	+ 14.5148
14	+ 76.7879	+ 76.8463	+ 77.0417	+ 77.0431
15	+104.9308	+105.2009	+104.8587	.....
16	+ 32.3287	+ 32.6807	+ 32.7600	.....
16A	+ 64.7374	.....	+ 64.7372	.....
16B	+ 5.5652	.....	+ 5.5645	.....
16C	+ 26.4098	.....	+ 26.4127	.....
16D	+ 26.4163	.....	+ 26.4127	.....
17	+ 38.0139	+ 38.1423	+ 38.0765	+ 38.0730
18	+ 56.5774	.....	+ 56.5775	+ 56.5776
19	+ 38.2777	.....	+ 38.2687	+ 38.2761
20	+229.7044	+230.1734	+229.2547	+229.2578
21	— 48.3294	— 48.3114	— 48.3081	.....
22A	— 2.9496	— 2.9338	— 2.9442	.....
22B	— 76.4352	— 76.3982	— 76.5226	.....
22D	+234.1031	.....	+234.0625	.....

* If no entry is made in this column the adopted value is the same as the adjusted.

TABLE 1.—*Differences of elevation*—Continued.

Links.	Observed.	Corrected for systematic error.	Adjusted 1903.	Adopted 1903.
	m.	*m.*	*m.*	*m.*
22E	— 113.4466	.....	— 113.4796	.....
22F	+ 117.8405	+ 117.7707	+ 117.6387	.....
22G	+ 290.9862	.....	+ 291.0709	+ 291.0750
22H	+1281.5046	+1281.4225	+1281.4009	.....
22I	— 47.1272	— 47.0880	— 47.1607	.....
22J	— 47.4193	— 47.3801	— 47.1607	.....
22K	+1120.7605	.....	+1120.7606	.....
23	— 31.2385	— 31.2026	— 31.1587	.....
24	— 91.3468	— 91.3198	91.3662	.....
25	+ 60.2292	.....	60.2075	.....
26	— 43.6058	— 43.5512	— 43.8093	.....
27	— 43.8270	.....	— 43.8093	.....
28	+ 16.7198	.....	+ 16.7133	+ 16.7193
29	+ 57.1819	+ 57.1960	+ 57.0200	+ 57.0122
30	— 40.6991	— 40.4428	— 40.3067	— 40.2929
31	+ 28.8706	.....	+ 28.8656	+ 28.8518
32	+ 63.0832	+ 63.3052	+ 63.3435	+ 63.3417
33	+ 54.3002	.....	+ 54.3295	.....
34	+ 34.4398	+ 34.4651	+ 34.4779	+ 34.4899
35	+ 5.3951	+ 5.5540	+ 5.9294	+ 5.9174
35A	— 83.9838	.....	— 83.9956	.....
35B	+ 101.3727	.....	+ 101.3564	.....
36B	— 74.8908	.....	— 74.9039	.....
36C	+ 42.5945	.....	+ 42.5960	.....
36D	— 284.2168	.....	— 284.0848	.....
36F	+ 17.8512	.....	+ 17.7748	.....
36G	+ 266.6896	.....	+ 266.3100	.....
36H	+ 30.3215	.....	+ 30.3198	.....
36I	+ 41.5760	.....	+ 41.5731	.....
36J	— 55.1436	.....	— 55.1410	.....
37A	+ 22.7452	+ 22.8420	+ 22.7635	.....
37B	+ 22.6828	.....	+ 22.7635	.....
37C	+ 114.4023	+ 114.4429	+ 114.4938	.....
37E	+ 17.4672	.....	+ 17.4708	.....
37F	+ 19.8431	.....	+ 19.8800	.....
37G	— 104.3094	.....	— 104.4602	.....
37H	— 45.9353	.....	— 45.7473	.....
37I	+ 133.8569	.....	+ 133.8256	.....
38A	+ 5.5694	.....	+ 5.5703	.....
38B	— 5.1567	.....	— 5.1454	.....
39A	+ 3.1775	.....	+ 3.1700	.....
39B	— 2.7980	.....	— 2.7451	.....
40A	+ 2.4044	.....	+ 2.4757	.....
40B	— 2.6585	.....	— 2.6697	.....
40C	+ 5.8360	.....	+ 5.8397	.....
40D	— 6.1686	.....	— 6.1837	.....
41A	+ 4.0743	.....	+ 4.0827	.....
42A	+ 103.0865	.....	+ 103.0842	.....
43A	+ 244.1209	.....	+ 244.2626	.....
43B	— 75.9076	.....	— 75.8968	.....
43C	— 271.4866	.....	— 271.4500	.....
43D	— 86.5039	.....	— 86.5190	.....
43E	+ 39.9664	.....	+ 39.9433	.....
43F	— 170.4278	.....	— 170.4638	.....
43G	— 297.3734	.....	— 297.4276	.....
44A	+ 184.2006	.....	+ 184.1330	.....
44B	— 62.8310	.....	— 62.9210	.....
44C	— 7.9602	.....	— 8.0049	.....
44D	+ 54.9415	.....	+ 54.9161	.....

TABLE 1.—*Differences of elevation*—Continued.

Links.	Observed.	Corrected for systematic error.	Adjusted 1903.	Adopted 1903.
	m.	*m.*	*m.*	*m.*
44E	+ 68.1732	.....	+ 68.1345	.....
44F	— 74.2653	.....	— 74.3758	.....
45A	— 118.0141	.....	— 117.9032	.....
45B	+ 152.9102	.....	+ 152.9138	.....
46A	— 77.1091	.....	— 77.1430	.....
47A	— 113.7589	— 113.6854	— 113.5763	.....
47B	— 61.8102	— 61.7904	— 61.9437	.....
47C	+ 40.0451	+ 40.0497	+ 40.0173	.....
47D	— 61.9468	.....	— 61.9437	.....
47E	— 128.3265	.....	— 128.3222	.....
48	— 59.5851	— 59.4816	— 59.5435	.....
49A	+ 168.0912	+ 168.1788	+ 168.3395	.....
50	— 108.7551	— 108.6643	— 108.7960	.....
51A	+ 54.4108	.....	+ 54.4105	.....
51B	— 126.9618	.....	— 126.9638	.....
52A	+ 72.5735	.....	+ 72.5533	.....
53	— 4.2898	.....	— 4.2255	.....
54B	— 48.5028	.....	— 48.5021	.....
54C	+ 52.7282	.....	+ 52.7276	.....
55	+ 249.0783	.....	+ 248.9255	.....

Table 2 gives for each link the weight, the various corrections applied, and in the last column the probable error of the observed differences except in cases when a correction for systematic error was applied. In these cases the probable error of the corrected difference is given, and the systematic correction is shown in the third column.

TABLE 2.—*Corrections to differences of elevation.*

Links.	Weight. p.	Systematic correction.	Additional correction adjustment of 1903.	Total correction adjustment of 1903.	Total correction adopted 1903.	Probable error. $\frac{32.8}{\sqrt{p}}$
		mm.	*mm.*	*mm.*	*mm.*	*mm.*
1A	2.6	.....	+ 17.1	+ 17.1	+ 28.2	± 20.3
4A	0.22	+ 68.5	—104.8	— 36.3	— 50.5	70.0
5A	2.6	.....	+ 25.9	+ 25.9	+ 10.7	20.3
5B	7.1	.....	— 0.8	— 0.8	+ 0.1	12.3
6	5.6	.....	+ 28.2	+ 28.2	+ 28.1	13.8
7	8.3	.....	— 20.5	— 20.5	— 20.1	11.4
8	0.083	+120.3	—125.8	— 5.5	— 3.8	113.8
9	5.1	.....	+ 24.1	+ 24.1	+ 27.7	14.5
10	29.0	.....	+ 1.0	+ 1.0	+ 1.5	6.1
11	13.0	.....	— 10.8	— 10.8	— 9.5	9.1
12	0.046	+138.1	— 51.8	+ 86.3	+ 88.1	150.9
13	3.5	.....	— 44.3	— 44.3	— 42.5	17.5
14	0.032	+ 58.4	+195.4	+253.8	+265.2	183.4
15	0.016	+270.1	—342.2	— 72.1	.....	259.3
16	0.016	+352.0	+ 79.3	+431.3	.....	259.3
16A	2.6	.....	— 0.2	— 0.2	.....	20.3
16B	20.0	.....	— 0.7	— 0.7	.....	7.3
16C	12.0	.....	+ 2.9	+ 2.9	.....	9.5
16D	14.0	.....	— 3.6	— 3.6	.....	8.8

TABLE 2.—*Corrections to differences of elevation*—Continued.

Links.	Weight. p.	Systematic correction.	Additional correction adjustment of 1903.	Total correction adjustment of 1903.	Total correction adopted 1903.	Probable error. $\frac{32.8}{\sqrt{p}}$
		mm.	*mm.*	*mm.*	*mm.*	*mm.*
17	0.048	+128.4	− 65.8	+ 62.6	+ 59.1	149.7
18	2.7	.....	+ 0.1	+ 0.1	+ 0.2	20.0
19	3.5	.....	− 9.0	− 9.0	− 1.6	17.5
20	0.0033	+469.0	−918.7	−449.7	−446.6	571.4
21	9.6	+ 18.0	+ 3.3	+ 21.3	.....	10.6
22A	3.0	+ 15.8	− 10.4	+ 5.4	.....	19.0
22B	0.28	+ 37.0	−124.4	− 87.4	.....	62.0
22D	1.7	.....	− 40.6	− 40.6	.....	25.2
22E	2.1	.....	− 33.0	− 33.0	.....	22.6
22F	0.028	− 69.8	−132.0	−201.8	.....	196.4
22G	0.86	.....	+ 84.7	+ 84.7	+ 88.8	35.4
22H	0.0047	− 82.1	− 21.6	−103.7	.....	478.4
22I	0.083	+ 39.2	− 72.7	− 33.5	.....	114.0
22J	0.027	+ 39.2	+219.4	+258.6	.....	200.0
22K	0.87	.....	+ 0.1	+ 0.1	.....	35.1
23	0.77	+ 35.9	+ 43.9	+ 79.8	.....	37.5
24	0.042	+ 27.0	− 46.4	− 19.4	.....	160.0
25	3.3	.....	− 21.7	− 21.7	.....	18.0
26	0.038	+ 54.6	−258.1	−203.5	.....	168.2
27	4.5	.....	+ 17.7	+ 17.7	.....	15.5
28	3.0	.....	− 6.5	− 6.5	− 0.5	19.0
29	0.070	+ 14.1	−176.0	−161.9	−169.7	123.7
30	0.022	+256.3	+136.1	+392.4	+406.2	221.1
31	3.6	.....	− 5.0	− 5.0	− 18.8	17.3
32	0.044	+222.0	+ 38.3	+260.3	+258.5	156.2
33	1.7	.....	+ 29.3	+ 29.3	.....	25.2
34	0.15	+ 25.3	+ 12.8	+ 38.1	+ 50.1	84.8
35	0.0096	+158.9	+375.4	+534.3	+522.3	334.7
35A	5.4	.....	− 11.8	− 11.8	.....	14.1
35B	4.6	.....	− 16.3	− 16.3	.....	15.3
36B	2.4	.....	− 13.1	− 13.1	.....	21.2
36C	12.0	.....	+ 1.5	+ 1.5	.....	9.5
36D	0.027	.....	+132.0	+132.0	.....	200.0
36F	0.19	.....	− 76.4	− 76.4	.....	75.2
36G	0.035	.....	−379.6	−379.6	.....	175.4
36H	7.8	.....	− 1.7	− 1.7	.....	11.8
36I	5.1	.....	− 2.9	− 2.9	.....	14.5
36J	0.48	.....	+ 2.6	+ 2.6	.....	47.4
37A	0.016	+ 96.8	− 78.5	+ 18.3	.....	259.3
37B	0.60	.....	+ 80.7	+ 80.7	.....	42.3
37C	0.056	+ 40.6	+ 50.9	+ 91.5	.....	138.6
37E	7.2	.....	+ 3.6	+ 3.6	.....	12.2
37F	1.2	.....	+ 36.9	+ 36.9	.....	29.8
37G	0.12	.....	−150.8	−150.8	.....	94.8
37H	0.058	.....	+188.0	+188.0	.....	136.1
37I	0.23	.....	− 31.3	− 31.3	.....	68.4
38A	0.83	.....	+ 0.9	+ 0.9	.....	36.1
38B	4.8	.....	+ 11.3	+ 11.3	.....	15.0
39A	2.0	.....	− 7.5	− 7.5	.....	23.3
39B	0.93	.....	+ 52.9	+ 52.9	.....	34.1
40A	0.75	.....	+ 71.3	+ 71.3	.....	37.9
40B	3.5	.....	− 11.2	− 11.2	.....	17.5
40C	3.8	.....	+ 3.7	+ 3.7	.....	16.8
40D	3.3	.....	− 15.1	− 15.1	.....	18.0
41A	1.7	.....	+ 8.4	+ 8.4	.....	25.2
42A	3.8	.....	− 2.3	− 2.3	.....	16.8
43A	0.18	.....	+141.7	+141.7	.....	77.4
43B	0.18	.....	+ 10.8	+ 10.8	.....	77.4
43C	0.16	.....	+ 36.6	+ 36.6	.....	82.0

TABLE 2.—*Corrections to differences of elevation*—Continued.

Links.	Weight. p.	Systematic correction.	Additional correction adjustment of 1903.	Total correction adjustment of 1903.	Total correction adopted 1903.	Probable error. $32.8\sqrt{p}$
		mm.	*mm.*	*mm.*	*mm.*	*mm.*
43D	0.26	.....	— 15.1	— 15.1	.....	64.3
43E	0.16	.....	— 23.1	— 23.1	.....	82.0
43F	0.24	.....	— 36.0	— 36.0	.....	66.9
43G	0.14	.....	— 54.2	— 54.2	.....	87.7
44A	0.61	.....	— 67.6	— 67.6	.....	42.1
44B	0.27	.....	— 90.0	— 90.0	.....	63.1
44C	0.38	.....	— 44.7	— 44.7	.....	53.3
44D	0.26	.....	— 25.4	— 25.4	.....	64.3
44E	0.61	.....	— 38.7	— 38.7	.....	42.1
44F	0.16	.....	—110.5	—110.5	.....	82.0
45A	0.043	.....	+110.9	+110.9	.....	158.2
45B	0.066	.....	+ 3.6	+ 3.6	.....	127.6
46A	0.11	.....	— 33.9	+ 33.9	.....	98.8
47A	0.060	+ 73.5	+109.1	+182.6	.....	133.9
47B	0.18	+ 19.8	—153.3	—133.5	.....	77.4
47C	0.64	+ 4.6	— 32.4	— 27.8	.....	41.0
47D	11.0	.....	+ 3.1	+ 3.1	.....	9.9
47E	6.3	.....	+ 4.3	+ 4.3	.....	13.1
48	0.12	+103.5	— 61.9	+ 41.6	.....	94.8
49A	0.083	+ 87.6	+160.7	+248.3	.....	113.9
50	0.022	+ 90.8	—131.7	+ 40.9	.....	221.1
51A	7.6	.....	— 0.3	— 0.3	.....	11.9
51B	5.5	.....	— 2.0	— 2.0	.....	14.0
52A	0.82	.....	— 20.2	— 20.2	.....	36.2
53	0.072	.....	+ 64.3	+ 64.3	.....	122.4
54B	8.6	.....	+ 0.7	+ 0.7	.....	11.2
54C	11.5	.....	— 0.6	— 0.6	.....	9.7
55	0.082	.....	—152.8	—152.8	.....	114.7

Table 3 shows the same corrections as Table 2, expressed in millimeters per kilometer. The different links have been rearranged and placed in Table 3 in the order of magnitude of the total correction in the adjustment of 1903 in millimeters per kilometer, and serial numbers on this basis have been assigned. The table serves to place the links in order of accuracy as shown by this standard, the most accurate line being placed first. In the column headed "Character of line" a single entry indicates that practically the whole link was of that character. If there are two or more entries, the link is a composite one, in which the character of the longer portion is mentioned first. The symbols 1899+ and 1899— refer to leveling by the Coast and Geodetic Survey in 1899 and later, and before 1899, respectively.

TABLE 3.—*Corrections to differences of elevation.*

Serial No.	Link.	Length.	Systematic correction per kilometer.	Additional correction adjustment of 1903, per kilometer.	Total correction adjustment of 1903, per kilometer.	Total correction adopted 1903, per kilometer.*	Character of line.
		km.	*mm.*	*mm.*	*mm.*	*mm.*	
1	22K	1 147	.....	+0.000	+0.000	.....	1899+.
2	18	372	.....	+0.000	+0.000	+0.001	Engineers.
3	16A	388	.....	—0.000	—0.000	.....	Engineers, 1899+.
4	38A	1 198	.....	+0.001	+0.001	.....	Engineers, water.
5	51A	131	.....	—0.002	—0.002	.....	Engineers.

*If no entry is made in this column the adopted value is the same as the adjusted.

TABLE 3.—*Corrections to differences of elevation*—Continued.

Serial No.	Link.	Length.	Systematic correction per kilometer.	Additional correction adjustment of 1993, per kilometer.	Total correction adjustment of 1903, per kilometer.	Total correction adopted 1903, per kilometer.	Character of line.
		km.	*mm.*	*mm.*	*mm.*	*mm.*	
6	5B	140	.....	−0.006	−0.006	+0.001	Engineers.
7	54B	116	.....	+0.006	+0.006	.....	1899+.
8	54C	87	.....	−0.007	−0.007	.....	1899+.
9	16B	86	.....	−0.008	−0.008	.....	Engineers, 1899+.
10	42A	260	.....	−0.009	−0.009	.....	Water, Engineers.
11	51B	182	.....	−0.011	−0.011	.....	Engineers.
12	45B	271	.....	+0.013	+0.013	.....	P. R. R., Geological.
13	36H	128	.....	−0.013	−0.013	.....	1899+.
14	40	260	.....	+0.014	+0.014	.....	Water.
15	36I	196	.....	−0.015	−0.015	.....	1899+.
16	39A	500	.....	−0.015	−0.015	.....	Water.
17	31	275	.....	−0.018	−0.018	−0.068	Engineers.
18	36C	81	.....	+0.019	+0.019	.....	1899+.
19	41A	430	.....	+0.020	+0.020	.....	Water, Wye.
20	28	330	.....	−0.020	−0.020	−0.002	Engineers.
21	47E	158	.....	+0.027	+0.027	.....	Baltimore and Ohio R. R.
22	10	34	.....	+0.029	+0.029	+0.044	Engineers.
23	52A	672	.....	−0.030	−0.030	.....	Wye, water, Engineers.
24	19	287	.....	−0.031	−0.031	−0.006	Engineers.
25	36B	412	.....	−0.032	−0.032	.....	1899+.
26	16C	86	.....	+0.034	+0.034	.....	Engineers.
27	47D	90	.....	+0.034	+0.034	.....	Baltimore and Ohio R. R.
28	8	138	+0.87	−0.91	−0.039	−0.028	1899−.
29	40B	282	.....	−0.040	−0.040	.....	Water.
30	1A	383	.....	+0.045	+0.045	+0.074	Engineers.
31	33	610	.....	+0.048	+0.048	.....	Engineers.
32	39B	1 074	.....	+0.049	+0.049	.....	Water, Engineers.
33	16D	72	.....	−0.050	−0.050	.....	1899+.
34	36J	50	.....	+0.052	+0.052	.....	Geological.
35	37A	316	+0.31	−0.25	+0.058	.....	1899−.
36	35A	184	.....	−0.064	−0.064	.....	1899+, Engineers.
37	40D	233	.....	−0.065	−0.065	.....	Engineers, water.
38	5A	382	.....	+0.068	+0.068	+0.028	Engineers.
39	22D	595	.....	−0.068	−0.068	.....	Engineers, 1899+.
40	22E	466	.....	−0.071	−0.071	.....	1899+.
41	25	306	.....	−0.071	−0.071	.....	Engineers.
42	22G	1 165	.....	+0.073	+0.073	+0.076	1899+.
43	35B	219	.....	−0.074	−0.074	.....	1899+.
44	27	235	.....	+0.075	+0.075	.....	Engineers.
45	37I	384	.....	−0.082	−0.082	.....	Water, Geological.
46	43B	131	.....	+0.082	+0.082	.....	Geological.
47	37E	40	.....	+0.090	+0.090	.....	Pittsburg–Belpre line.
48	24	198	+0.14	−0.23	−0.098	.....	1899−.
49	38B	105	.....	+0.11	+0.11	.....	Engineers.
50	9	197	.....	+0.12	+0.12	+0.14	Engineers.
51	11	79	.....	−0.14	−0.14	−0.12	Engineers.
52	37F	256	.....	+0.14	+0.14	.....	Pittsburg–Belpre line.
53	43E	154	.....	−0.15	−0.15	.....	Geological.
54	46A	225	.....	−0.15	−0.15	.....	Geological.
55	36D	863	.....	+0.15	+0.15	.....	Geological.
56	50	267	+0.34	−0.49	−0.15	.....	1899−.
57	43C	233	.....	+0.16	+0.16	.....	Geological, water.
58	6	179	.....	+0.16	+0.16	+0.16	Engineers.
59	43D	94	.....	−0.16	−0.16	.....	Geological.
60	7	121	.....	−0.17	−0.17	−0.17	Engineers.
61	37B	495	.....	+0.16	+0.16	.....	Belpre–Cincinnati line.
62	22H	585	−0.14	−0.037	−0.18	.....	1899−, 1899+.
63	40A	366	.....	+0.19	+0.19	.....	Water, Engineers.
64	53	320	.....	+0.20	+0.20	.....	Van Orden.

TABLE 3.—*Corrections to differences of elevation*—Continued.

Serial No.	Link.	Length.	Systematic correction per kilometer.	Additional correction adjustment of 1903, per kilometer.	Total correction adjustment of 1903, per kilometer.	Total correction adopted 1903, per kilometer.	Character of line.
		km.	*mm.*	*mm.*	*mm.*	*mm.*	
65	13	218	.....	—0.20	—0.20	—0.19	Engineers.
66	15	312	+0.87	—1.1	—0.23	.....	1899—.
67	22A	23	+0.69	—0.45	+0.24	.....	1899—.
68	22I	141	+0.28	—0.52	—0.24	.....	1899—.
69	43G	202	.....	—0.27	—0.27	.....	Geological, Engineers.
70	44D	93	.....	—0.27	—0.27	.....	Geological.
71	45A	383	.....	+0.29	+0.29	.....	Pennsylvania R. R.
72	4A	(85)109	+0.81*	—0.96	—0.33	—0.46	1899—, Engineers.
73	17	181	+0.71	—0.36	+0.35	+0.33	1899—.
74	48	119	+0.87	—0.52	+0.35	.....	1899—.
75	43F	99	.....	—0.36	—0.36	.....	Geological.
76	34	104	+0.24	+0.12	+0.37	+0.48	1899—.
77	12	(185)217	+0.75*	—0.24	+0.40	+0.41	1899—, Engineers.
78	44A	166	.....	—0.41	—0.41	.....	Water, Geological.
79	44E	78	.....	—0.50	—0.50	.....	Geological.
80	55	293	.....	—0.52	—0.52	.....	Geological.
81	37C	170	+0.24	+0.30	+0.54	.....	1899—.
82	47C	50	+0.092	—0.65	—0.56	.....	1899—.
83	36G	671	.....	—0.57	—0.57	.....	Geological.
84	36F	120	.....	—0.64	—0.64	.....	Geological.
85	20	698	+0.67	—1.3	—0.64	—0.64	1899—.
86	44C	62	.....	—0.72	—0.72	.....	Geological.
87	37H	256	.....	+0.73	+0.73	.....	Pennsylvania R. R.
88	44F	150	.....	—0.74	—0.74	.....	Geological.
89	22F	239	—0.29	—0.55	—0.84	.....	1899—.
90	26	205	+0.27	—1.3	—0.99	.....	1899—.
91	43A	142	.....	+1.0	+1.0	.....	Geological.
92	44B	86	.....	—1.0	—1.0	.....	Geological.
93	22J	244	+0.16	+0.90	—1.1	.....	1899—.
94	29	151	+0.093	—1.2	—1.1	—1.1	1899—.
95	47A	164	+0.045	+0.67	—1.1	.....	1899—.
96	14	224	+0.26	+0.87	+1.1	+1.2	1899—.
97	22B	75	+0.49	—1.7	—1.2	.....	1899—.
98	37G	124	.....	—1.2	—1.2	.....	Pennsylvania R. R.
99	35	414	+0.38	+0.91	+1.3	+1.3	1899—.
100	32	194	+1.2	+0.20	+1.4	+1.3	1899—.
101	16	314	+1.1	+0.25	+1.4	.....	1899—.
102	47B	94	+0.21	—1.6	—1.4	.....	1899—.
103	30	265	+0.97	+0.51	+1.5	+1.5	1899—.
104	21	13	+1.4	+0.25	+1.6	.....	1899—.
105	23	45	+0.80	+0.98	+1.8	.....	1899—.
106	49A	137	+0.64	+1.2	+1.8	.....	1899—.

COMPARISON OF VARIOUS ADJUSTMENTS.

In the table given below the elevations for the junction points resulting from various adjustments are placed side by side for comparison. The four adjustments shown in columns 1 to 4 depend upon the data which were available in 1899. The adjustment corresponding to column 5 depends upon the data which were available in 1902 at the time that adjustment was made. Column 6 shows the values resulting from the adjustment of 1903. The differences between elevations in columns 5 and 6 and those in columns 1 to 4 are therefore due in part to the utilization of additional information.

*On link 4A the systematic correction was applied only upon the 85 kilometers of leveling by the C. and G. S. previous to 1899. Similarly on link 12 the whole systematic correction was applied on the 185 kilometers by the C. and G. S. previous to 1899.

The close agreements between columns 1 to 4 among themselves and between columns 5 and 6 indicate to what a slight extent the derived elevations are dependent on the judgment of the computer in fixing the relative weights and the form of the computation.

The various adjusted values for any one junction point furnish an indication of the probable accuracy of the elevation of that point derived from the last adjustment.

The explanations of the six adjustments corresponding to the six separate columns are given after the table.

The integral number of meters for each junction point is given but once in the table, and the decimal part only given in the remaining columns.

Junction point.	Whole meters.	Preliminary adjustment, C. and G. Survey lines only, 1899.	Preliminary adjustment, Engineers' lines only, 1899.	Preliminary general adjustment, 1899.	Final general adjustment adopted, 1899.	Adjustment of 1902.	Adjustment of 1903.
Smithland, XLV	14	.8491	.6165	.7774	.7917	.8267	.8406
Vidalia, LXIV	19	.8481	.5641	.6982	.7233	.7687	.7864
Monroe, 27	23	.....	.6060	.7413	.7658	.8102	.8290
Shreveport, 46	59	.....	.....	.....	.6423	.....	.7064
Rayville, 16	24	.....	.2993	.4340	.4587	.5033	.5214
Vicksburg, 211	27	.9487	.5954	.7307	.7556	.8003	.8170
Meridian, C	104	.9531	.....	.8780	.8579	.8481	.8587
Decatur, 50	169	.....	.....	.....	.....	.5855	.5959
Tuscumbia, 9	143	.....	.....	.....	.....	.1731	.1832
Harriman Junction, C_2	241	.....	.....	.....	.....	.4752	.4888
Chattanooga, 698 N	211	.....	.....	.....	.....	.....	.1690
Knoxville, 933 M C	284	.....	.....	.....	.....	.0706	.0848
Cleveland, 875 M C	266	.....	.....	.....	.....	.....	.3100
Wilkersons Landing, 84	42	.2750	.1155	.2457	.2704	.3159	.3300
Little Rock, I or 3	80	.....	.....	.3155	.3434	.3879	.4065
Harrisonville, 43	309	.5543	.....	.6726	.6687	.7183	.6612
Pleasant Hill, LI	261	.2342	.....	.3533	.3595	.4102	.3531
Holliday, LXIII	233	.....	.....	.....	.1608	.1974	.1386
Kansas City, 244	230	.0504	.0741	.1662	.1885	.2526	.1944
Norfolk, N	464	.....	.....	.....	.....	.....	.2569
Denver, A_2	1585	.....	.....	.....	.1643	.....	.0175
Limon, N	1632	.....	.....	.....	.3593	.....	.1782
Abilene, Y_2	350	.....	.....	.....	.9315	.....	.7773
Jefferson City, 90	169	.7894	.8449	.9365	.9596	1.0234	.9869
Memphis, "Memphis"	80	.....	.....	.5218	.5465	.5943	.5987
Corinth, V	137	.....	.....	.6515	.7053	.6091	.6187
Cairo, 2	97	.1854	.1355	.2409	.2658	.3216	.3120
St. Louis, K_3	126	.0823	.0175	.1108	.1353	.1991	.1776
Odin, V	160	.4706	.....	.5481	.6075	.6729	.6555
Cincinnati, T	166	.....	.....	.4116	.4338	.5696	.5849
Belpre, XL	189	.....	.....	.....	.3684	.2764	.3484
Savanna, 62	180	.....	.3401	.4065	.4298	.5102	.5071
Marquette, 1	185	.....	.....	.....	.9353	.....	1.0774
Escanaba, 1	180	.....	.7072	.7535	.7760	.8688	.9320
Detour, Goetz	183	.....	.....	.....	.....	.....	.6017
Sand Beach, E	177	.....	.....	.....	.....	.....	.7620
Trenton, 1877	183	.....	.....	.....	.8237	.....	.9457
Lima, U	267	.....	.....	.....	.8069	.....	.9413
Canton, Br. 77	313	.....	.....	.....	.....	.....	.6886
Monaca, 25 C	209	.....	.....	.....	.....	.....	.2284
Leboeuf, 1193 P	363	.....	.....	.....	.9825	.....	.9960
Franklin, 987 P	301	.....	.....	.....	.1287	.....	.0750
Irvineton, 1167 D	355	.....	.....	.....	.....	.....	.9911
Pittsburg, 99	226	.....	.....	.....	.8012	.....	.6992

Junction point.	Whole meters.	Preliminary adjustment, C. and G. Survey lines only, 1899.	Preliminary adjustment, Engineers' lines only, 1899.	Preliminary general adjustment, 1899.	Final general adjustment adopted, 1899.	Adjustment of 1902.	Adjustment of 1903.
Grafton, M	303	.....	.....	.8582	.8721	.6987	.8422
Hancock, F	128	.....	.....	.....	.2393	.....	.3222
Cumberland, I	190	.....	.....	.....	.0727	.....	.2659
Hagerstown, A	168	.1451	.....	.2638	.2720	.2023	.3395
Harrisburg, XXIX	108	.....	.....	.7503	.7880	.6842	.7960
Elmira, 857 A	261	.....	.....	.....	.5010	.....	.7098
Hornellsville, 1141 D	348	.....	.....	.....	.0154	.....	.2288
Salamanca, 1391 D	423	.....	.....	.....	.9382	.....	1.1256
Buffalo, L. H	179	.....	.....	.....	.....	.....	.8630
Bainbridge, 989 A	301	.....	.....	.....	.4496	.....	.6531
Poughkeepsie, 173 A	52	.....	.....	.....	.....	.....	.7276
Utica, L. S. 92	131	.....	.....	.....	.....	.....	.1893
Oswego, A	76	.....	.6913	.6857	.7016	.8014	.7788
Greenbush, Gristmill	4	.....	.1389	.1270	.1384	.2292	.2255

The adjustment of which the results are shown in column 1 is published on pages 431–433 of Appendix 8, Report for 1899. The net adjusted was composed entirely of Coast and Geodetic Survey leveling previous to 1899, with the minor exception that 33 kilometers of Kern leveling by the Engineers between Greenville and Wilkersons Landing in Mississippi was used. The net involved 11 links, forming 5 circuits. The weights assigned to each line were equal to $\frac{1000}{L}$. The probable error corresponding to unit weight was found to be ± 450 millimeters.

The adjustment of which the results are shown in column 2 is published on pages 434–437 of Appendix 8, Report for 1899. The net was made up of 17 links forming 7 circuits. The net was composed in the main of Kern leveling by the Engineers and water leveling along the Great Lakes. In order to form a net suitable for adjustment it was necessary to supplement such leveling by introducing a few other lines presumed to be of a lesser degree of accuracy and assigned smaller weights. The weights assigned to lines of Kern leveling by the Engineers and of water leveling along the Great Lakes (with one exception) were equal to $\frac{1000}{L}$. The probable error corresponding to unit weight was found to be ± 73 millimeters.

The adjustment of which the results are shown in column 3 is published on pages 437–441 of Appendix 8, Report for 1899. This adjustment dealt with all the available leveling connected with the net up to and including 1899 and, therefore, involved observations of various grades of accuracy. The net was composed of 54 links forming 25 circuits. The lines of Kern leveling by the Engineers, of water leveling along the Great Lakes (with one exception), of Coast and Geodetic Survey leveling in 1899 and later, were assigned weights equal to $\frac{1000}{L}$ and the remaining lines were assigned much smaller weights (see p. 438, Appendix 8, Report for 1899).

The adjustment of which the results are shown in column 4 is published on pages 439–441, 447–450, of Appendix 8, Report for 1899. The same leveling was used in this as in the preliminary general adjustment indicated in column 3. The difference between

the two adjustments is that the weights were greatly changed for all Coast and Geodetic Survey lines run previous to 1899 and for the Geological Survey and Van Orden lines,* and that corrections for systematic error were applied to all Coast and Geodetic Survey leveling previous to 1899 before the adjustment was made. Weights equal to $\frac{1000}{L}$ were still retained for the leveling of the highest grade of accuracy. The probable error corresponding to unit weight was found to be ± 32.9 millimeters.

The adjustment of which the results are shown in column 5 was made in 1902. It included all of the available leveling connected with the net up to the date of the adjustment in the fall of 1902,† and the net was composed of 66 links, forming 31 circuits. The weights assigned to the five classes indicated on page 373 were $\frac{1000}{L}$, $\frac{500}{L}$, $\frac{15}{L}$, $\frac{38}{L}$, $\frac{2500}{L^2}$, respectively. The probable error corresponding to unit weight was found to be ± 33.4 millimeters.

As already stated, the adjustment of which the results are shown in column 6, is that made in 1903 and for which the details are shown on pages 372 to 379. It involved much new material, being composed of 106 links and 48 circuits as contrasted with 66 links and 31 circuits in the adjustment of 1902.

A comparison of the results of adjustments of 1902 and of 1903 is especially interesting, as showing how little change in the elevations of 1902 was made by the large amount of new material added in 1903 and the large changes in relative weights then introduced.

An adjustment was also made in which all leveling was weighted in inverse proportion to the length of line only, that is: $p = \frac{1000}{L}$, without regard to the class in which it belongs. This adjustment was based on the same data as the adjustment of 1902, except that the 1899—leveling was not corrected for systematic error. The resulting elevations differed from those derived from the 1902 adjustment from 1 to 30 centimeters, but the test for weights, namely, that the average pv^2 for each class of leveling should be approximately the same, showed that the weighting used, $\frac{1000}{L}$ for all, was not correct, and that the different classes should be assigned weights which differ greatly, and are in the same order as those used in the 1903 adjustment. The further test by the comparison of the corrections on the links in millimeters per kilometers, similar to table 3, page 384, showed the same relative positions for the different classes of leveling and indicated conclusively that the corrections can not be forced away from this relative order by any change in the weighting.

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*Compare the tables of weights on pp. 438 and 448 of Appendix 8, Report for 1899.

†This did not include the new and revised Lake Survey lines nor the eleven new lines by the U. S. Geological Survey in New York, Pennsylvania, and Ohio, which are referred to on pages 346 and 348 as having been introduced into the 1903 adjustment.

SPEED, COST, AND ACCURACY OF LEVELING WITH THE NEW INSTRUMENT.

The average rate of progress of a party with the new instrument for a whole line has varied from 52 to 98 miles per month,* the time being counted without any deductions from the first to the last day of leveling. The rate of progress has seldom fallen below 50 miles per month even for a single month. The average rate of progress on all the lines here published run with the new instruments has been 66 miles (106 kilometers) of completed line per month (2 440 miles in 36.9 months). Every mile of progress represents a mile leveled at least twice, once in the forward and once in the backward direction. If the first two results on any section did not check within the specified narrow limits the section was releveled in each direction, except as indicated in paragraph 6 of the instructions, p. 213.

The following instances of rapid leveling occurred in the ordinary course of the field work. In every case except that given in the following paragraph similar examples closely approaching it can readily be found by examining the records.

Between April 3 and November 18, 1902, Mr. W. H. Burger, Aid, ran 640 completed miles of leveling between Anthony, Kans., and Shreveport, La., his average rate of progress being 85 miles per month. This period included two months of very hot weather, during which many miles were run with the thermometer buried in the wooden rods reading more than 40° C. (104° F.). For comparison with other leveling of the same grade of accuracy it may be noted that recent leveling under the Mississippi River Commission was done at a rate of 38 completed miles per month,† and under the Lake Survey at about 40 miles per month.

During the month of June, on the line from Anthony to Shreveport, by Mr. Burger, 105 miles were completed, the leveling proceeding on twenty-five days during the month, and the total length of single line was 223 miles, or an average of 8.9 miles of single line per observing day. This feat was not accomplished by extra long hours. Making no allowances whatever for any delays or interruptions except the stop in the middle of the day for lunch, the average number of hours of leveling was 7¼ per day, and the average speed was therefore for a whole month 1.2 miles of single line per hour during the progress of the surveying. The average length of sight during this month was 274 feet (83 meters).

The party under Mr. W. C. Dibrell, Aid, ran 103 completed miles during the month of July, 1902, a remarkable record when it is considered that the party encountered many heavy grades on this work in Wyoming.

On July 29, 1902, Mr. Dibrell ran 15.8 miles of single line, none of which was afterwards found to need rerunning. The observing was done in 9 hours and 40 minutes, making no deduction for delays except dinner, or at an average rate of 1.6 miles per hour. The total number of instrument stations on this day was 147. Assuming that the observer moved from station to station on the velocipede cars at an average rate of 6 miles per hour, the time actually spent at the stations was 7 hours 2 minutes, or 2.9 minutes per station. This includes the time of leveling the instrument and

*The very short line, Temple to Holland, Tex., 17 miles, at the rate of 37 miles per month, is excluded from this statement.

†See Transactions of the American Society of Civil Engineers, XLV, June, 1901, pp. 174, 175, 179, 187, 188.

making other manipulations as well as the observing, being the interval from the instant the instrument struck the ground until it was back upon the car.

Similarly, the same observer, a few miles east of Rawlins, Wyo., ran 4 miles of levels, none of which required rerunning, in 1 hour 53 minutes, or at the rate of 2.1 miles per hour.

The cost per completed mile for certain of the lines run with the new instrument for which the facts are now obtainable are as follows:

Cincinnati to Somerset and Harriman Junction to Woodville, $10.60 per mile. Somerset to Knoxville and Woodville to Birmingham, $9.50 per mile; Page to Chadron, Nebr., $8.80 per mile; Cheyenne to Orin Junction, Wyo., and Decatur, Ala., to Corinth, Miss., $10.30 per mile; Anthony, Kans., to Shreveport, La., $6.70 per mile. The average cost per completed mile for all these lines is $8.70 ($5.40 per kilometer). The variation in cost between the above lines is due to various causes; to the weather conditions, whether boarding places were near together and near to the work, whether velocipede cars were used, whether heavy grades were encountered, and, finally, to the difference between observers. The above figures represent the actual cost of the leveling, including the establishment of the bench marks, with the exception of the cost of instruments and stationery. It includes the transportation to and from the field paid by the Government, and all wages and salaries, including the chief of party and recorder. The salary of each member of the permanent force is charged to the leveling for the whole period during which he was engaged upon work incidental to the leveling, including the time spent in travel to and from the field, the time spent in preparing for the field, and of completing field reports and records and computations at the end of the season. One-eleventh has been added to the salary actually paid each officer during the time he was connected with the leveling, to take account of the fact that the Government pays its permanent employees twelve months' salary for eleven months' work upon an average.

Various comparisons with the cost of other leveling might be made. Perhaps the most interesting comparison is with some of the most recent leveling under the Mississippi River Commission of which the costs are available to the writer, namely, the line New Orleans, La., to Biloxi, Miss., 85 miles, cost $16 per mile; St. Paul to Aitkin, Minn., 222 miles, $13.85 per mile; Brainerd to Lake Itasca and Cass Lake to Grand Rapids, Minn., 204 miles, $16.73 per mile.*

Other leveling of as high a degree of accuracy as this and the recent Coast and Geodetic Survey leveling has in general cost more than $16 per mile, and in some cases has cost double that amount. (See p. 187, preceding reference.) As to accuracy, it should be noted at the outset that the instructions under which the observers on Coast and Geodetic Survey leveling have worked since 1899 (see pp. 211) are such as to cause the accidental errors discoverable by the discrepancies on each section between the forward and backward lines to be of the magnitude measured by probable error of about $\pm 0^{mm}.7$ or $\pm 0^{mm}.8$. It is true that the instructions contain no reference to this probable error, but the $4^{mm}\sqrt{K}$ limit of divergence between the forward and the backward lines on any section, coupled with the verbal injunction to the observer (see p. 215) not to be so cautious and slow as to have no rerunning, has practically the effect of preventing the probable error from departing far from these values in either direction (see pp. 224–225).

* See Transactions of the American Society of Civil Engineers, XLV, June, 1901, p. 179.

The real test of the accuracy, however, is the most severe test, namely, the corrections which are found necessary when the lines are adjusted as part of a net, these being the corrections which must be made in order to close all circuits. The whole group to which this leveling done with the new instrument has been assigned has been found to be of the degree of accuracy measured by the probable error of $\pm 1^{mm}.04$ for a completed line 1 kilometer long or $\pm 32^{mm}.8$ for a completed line 1 000 kilometers long. In comparing this value with the value $\pm 0^{mm}.7$ or $\pm 0^{mm}.8$, calculated in the preceding paragraph, it must be noted that the value, $\pm 1^{mm}.04$, computed from the adjustment of the net includes all systematic errors which become evident when a line is incorporated in the net as well as the purely accidental errors which become evident from the rerunning of short sections.

The leveling with the new instruments has been classed with the levels run under the Corps of Engineers with the Kern instruments and with accurate water leveling through the Great Lakes (see weight table on p. 373). The probable error of $\pm 1^{mm}.04$ applies to the whole group. The attempt was deliberately made in fixing the methods used since 1899 to make the new leveling of the same grade of accuracy as the leveling under the Corps of Engineers, and to reduce the time and cost as much as possible rather than to increase the accuracy. Is the leveling which has actually been done with the new instruments as accurate as the leveling under the Corps of Engineers? The writer believes it to be of at least the same degree of accuracy. The two best tests available to settle this question are furnished by the tables on pages 371 and 384.

According to the latter table, the 1899+ links range from 1 to 43 in the serial numbers assigned in the order of magnitude of the corrections in millimeters per kilometers, whereas the Engineer leveling ranges from 2 to 65. For the 1899+ links the maximum rate of correction is 0.074 millimeter per kilometer, and for the Engineer links 0.20 millimeter per kilometer. This test indicates that the 1899+ leveling is of a higher degree of accuracy than the Engineer leveling.

In the equations on pages 374 to 376 both the 1899+ leveling and the Engineer leveling have been weighted on the same scale, namely, weight $=\frac{1000}{L}$; hence, if the two kinds of leveling are of the same grade of accuracy, the average pv^2 for the 1899+ links should be the same as for the Engineer links. The average pv^2 for the 1899+ links is 756 and for the Engineer links is 1233. This difference is a strong indication that the new leveling by the Coast and Geodetic Survey is more accurate than the Engineer leveling.

Taking all the evidence set forth in this Appendix into account, and much more voluminous evidence not set forth for lack of space, which corroborates fully the following conclusions, it may be confidently stated that the leveling done in the Coast and Geodetic Survey with the new instruments since 1899 is fully up to the highest standard yet attained in precise leveling in the United States, and that the cost per mile with the new instruments has been from 25 to 80 per cent of the cost of leveling of approximately the same grade of accuracy with other instruments and methods.

Index to elevations and descriptions of bench marks.

[Alphabetical under each State and the States arranged in alphabetical order.]

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Syracuse	460		572
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Teteseau Bend	509		818
Tipton	460		572
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Bowie to Anthony, Kans	572, 573	774–781	
Bowie to Fort Worth	573, 574	782	
Brashear	574	785	
Burleson	575	788	
Caddo Mills	574	784	
Campbell	574	784	
Cason	574	785	
Como	574	785	
Conley	575	789	
Copperas Cove	575	790, 791	
Cowen	573	782	
Cresson	574	788	
Cumby	574	785	
Dallas	574	783	
Daingerfield	574	785	
Decatur	573	782	
Eagle Ford	574	783	
Eddy	575	790	
Egan	575	788	
Elinmott	575	789	
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Handley	574	783	
Herman	573	782	
Hewitt	575	790	
Hillsboro	575	789	
Holland	575	791, 792	
Holland to Temple	575	791, 792	
Hughes	574	785	
Itasca	575	789	
Jefferson	574	786	
Karnack	574	786	
Kelleyville	574	786	
Kempner	575	791	
Killeen	575	790	
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Lasater	574	786	
Leesburg	574	785	
Little River	575	791	
Lorena	575	790	
Nolandville	575	790	
Norwood	574	786	
Pickton	574	785	
Pittsburg	574	785	
Primrose	574	787	
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Rockwall	574	784	
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Saginaw	573	782	
Scofield	575	789	
Scroggins	574	785	
Stoneburg	572	775	
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Temple to Holland	575	791, 792	
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Ashland	468		628
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Laurel	468		628
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Milford	468		628
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Baird	557	735	
Benton Ferry	560		866
Bridgeport	458		562
Cairo	458		563
Catawba	560		866
Cherry Run	551	733	
Cornwall	458		563
Cranberry Summit	458		562
Dans Run	558	736	
Doe Gully	557	735	
Duffields	556	732	
Engle	556	731	
Fairmont	560		866
French	558	736	
Grafton	458		562
Grafton to Belpre, Ohio	458		562, 563
Grafton to Braddock, Pa	560, 561		866–868
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Little Cacapan	558	735	
Little Falls	560		866
Magnolia	557	735	
Martinsburg	557	732	
Miller	557	733	
Morgantown	560		866
North Mountain	557	733	
Okonoko	558	735	
Opequan	557	732	
Orleans Road	557	734	
Parkersburg	458		563
Patterson Creek	558	736	
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Paw Paw	557, 558	735	
Petroleum	458		563
Powells	560		866
Rockwells Run	557	734	
Round Top	577	734	
Rowlesburg	458		562
Shenandoah Junction	556	732	
Sir Johns Run	557	734	
Sleepy Creek	557	733	
Tabb	557	732, 733	
Uffington	560		866
Valley Falls	560		866
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Van Vorhis	560		866
West Union	458		563
Woodmont	557	734	

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Charme	488		759, 760
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Island No. 69	486		750
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Athol	579	.....	645
Aurora	579	803	.....
Bona	578	802	.....
Bordeaux	578	801	.....
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Cassa	578	802	.....
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Como	579	803	.....
Coopers Lake	579	.....	646
Creston	579	805	.....
Dale Creek	579	.....	646
Daleys Ranch	579	804	.....
Dana	579	804	.....
Diamond	578	801	.....
Edson	579	804	.....
Fillmore	579	805	.....
Fisher	578	800	.....
Fort Steele	579	804	.....
Glendo	578	802	.....
Granite Canyon	579	.....	646
Greenville	579	804	.....
Hanna	579	803	.....
Harper	579	.....	647
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Horse Creek	578	801	.....
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ELEVATIONS.

In deriving the adopted elevations of the following list the same methods have been followed as were set forth on page 451 of Appendix 8, Report for 1899. The local differences of elevation as adopted, as shown on pages 360 to 366 of this appendix, have been preserved unchanged. The adopted elevations of the junction points are shown on page 378, and in general the adoption of an elevation for each junction point fixes the elevations for a group of bench marks around it in accordance with the preceding sentence.

The elevations being thus fixed at each end of each line which forms a link in the level net, for intermediate points the corrections to the observed elevations have been interpolated between end points on the supposition that the correction varies at a uniform rate in millimeters per kilometer along the line except in two classes of cases, viz, first, if a line is composed of two classes of leveling which have been weighted differently as indicated on page 373, the corrections have been supposed to vary on each part of the line at different rates in accordance with the assigned weights; second, if a

bench mark is common to two or more lines between fixed points—as, for example, certain bench marks between Washington and Richmond which were connected with both the line of 1883–84 and of 1895—a mean or weighted mean of the two corrected elevations is taken as the adopted elevation. Such bench marks common to two lines serve to break each of them into sections, each of which, if it contains any intermediate bench marks, is treated as a link having fixed ends in deriving the elevations of these bench marks.

On each line which is a spur from the level net, or, in other words, is connected with it at one end only, a constant correction has been applied to the observed elevations equal to the correction applied at the origin of the spur.

The elevations are given in the following list to tenths of millimeters. This does not imply that the tenths are known. For bench marks not more than 2 kilometers apart the difference of elevation is uncertain in the millimeters and tenths; for those which are from 2 to 200 kilometers apart the centimeters are also uncertain, and for greater distances there may be in some cases an uncertainty in the decimeters. Similarly, the uncertainty in the absolute elevations varies with the distance from the nearest tidal connection.

For the convenience of those who may wish to compare the elevations here given with others which are expressed in feet, or vice versa, 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

Corrected elevations of permanent bench marks.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Sandy Hook, N. J.	T. H.	3. 4881
At Sandy Hook, N. J.	A	3. 4751
At Sandy Hook, N. J.	B	2. 8630
At Sandy Hook, N. J.	C	5. 9531
Near Highlands, N. J.	No. II.	2. 3210
Near Branchport, N. J.	No. V.	1. 0597
At Red Bank, N. J.	E	11. 7284
At Sandy Hook, N. J.	T of 1886.	3. 2802
At Sandy Hook, N. J.	U of 1886.	1. 8770

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Port Monmouth, N. J.	S	3.5559
At Port Monmouth, N. J.	Port Monmouth tidal.	3.5765
At Keyport, N. J.	R	6.9828
At Conaskonk Point, N. J.	Conaskonk Point tidal.	3.9603
At Matawan, N. J.	No. VI.	* 16.8599
At South Amboy, N. J.	Tidal, South Amboy.	2.1885
Near South Amboy, N. J.	No. VIII.	4.4368
At Raritan, N. J.	F	2.3640
At Perth Amboy, N. J.	State Geological Survey.	18.5763
Near Gifford, N. Y.	N	21.6607
At Great Kills, N. Y.	O	1.7203
At Great Kills, N. Y.	Great Kills tidal.	2.0008
At Fort Wadsworth, N. Y.	M	12.1584
At Quarantine Dock, N. Y.	Quarantine Dock.	2.5504
At Constables Hook, N. J.	Constables Hook.	2.7324
At Constables Hook, N. J.	P	2.9530
At Bergen, N. J.	Q	4.0705
At Elm Park, N. Y.	Elm Park tidal.	3.3748
At Elizabeth, N. J.	Elizabeth tidal.	3.7910
At Fort Hamilton, N. Y.	L	11.0842
At Bath Beach, N. Y.	Locust Grove tidal.	2.8038
At Bath Beach, N. Y.	K	8.3289
At Bay Ridge, N. Y.	No. 25.	26.5994
At Bay Ridge, N. Y.	Bay Ridge tidal.	1.9460
At Bay Ridge, N. Y.	J	13.3000
At Brooklyn, N. Y.	A	20.0484
At Brooklyn, N. Y.	G	2.8963
At Governors Island, N. Y.	Hydrographic marks. {B. M. 1	3.6951
	{B. M. 2	8.4710
At Governors Island, N. Y.	H	2.4439
At Governors Island, N. Y.	I	2.6313
At Brooklyn, N. Y.	C	17.0737
At Brooklyn, N. Y.	D	4.1137
At Brooklyn, N. Y.	F	3.1708
At New York, N. Y.	E	4.0819
At Corlears Hook, N. Y.	Tidal, Corlears Hook.	2.3390
At Hunters Point, N. Y.	Tidal, Hunters Point (No. 8).	1.8172
At Hunters Point, N. Y.	B	2.4207
At Ravenswood, N. Y.	No. 7.	3.0352
At Astoria, N. Y.	No. 6.	3.6297
Near Astoria Dock, N. Y.	No. 4.	1.7992
At Pot Cove, N. Y.	No. 1.	2.9208
At Pot Cove, N. Y.	No. 2.	4.1874
At Polhemus Dock, N. Y.	No. 4a.	2.0778
At New York, N. Y.	No. 5.	2.2991
At New York, N. Y.	Tidal, foot of Forty-second street.	{† 3.0794
		{‡ 4.5927
At Dobbs Ferry, N. Y.	Tidal, Dobbs Ferry.	⁂ 3.0049
At Dobbs Ferry, N. Y.	V	2.9357
At Long Island City, N. Y.	No. 9.	3.9512
At Flushing, N. Y.	No. 10.	2.5809
At College Point, N. Y.	No. 11.	12.5611
At College Point, N. Y.	Tidal, Station No. 68.	2.9225
At College Point, N. Y.	No. 12.	10.4801
At Willets Point, N. Y.	No. 105.	3.0681
At Willets Point, N. Y.	Tidal, U. S. Engineers.	4.3083
At Sandy Hook, N. J.	No. I.	4.7198
At Navesink Highlands, N. J.	No. III.	61.7145

* This elevation for VI at Matawan is derived from the 1886–87 line alone. The elevation given by the 1881 line is 16.7885. † 1885. ‡ 1886. ⁂ Reported in 1902 to have been destroyed.

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Navesink Highlands, N. J.	D	63.2741
At Seabright, N. J.	No. IV.	2.8224
At Morgan, N. J.	No. VII.	1.7050
Near Metuchen, N. J.	No. IX.	25.4933
At South Plainfield, N. J.	No. X.	19.4639
Near Bound Brook, N. J.	No. XI.	9.9030
Near New Market, N. J.	No. XII.	14.9902
At Bound Brook, N. J.	No. XIII.	10.8969
At Somerville, N. J.	No. XIV.	24.9405
At Somerville, N. J.	G	27.8305
At North Branch, N. J.	No. XV.	25.8806
Near Annandale, N. J.	No. XVI.	108.2553
Near Bloomsbury, N. J.	No. XVII.	99.4605
Near Phillipsburg, N. J.	No. XVIII.	80.1902
At Easton, Pa.	No. XIX.	65.3790
At Easton, Pa.	No. XX.	108.9076
At Easton, Pa.	H	110.8291
At Allentown, Pa.	I	97.9306
Near Allentown, Pa.	No. XXI.	90.2157
Near Macungie, Pa.	No. XXII.	116.9892
Near Shamrock, Pa.	No. XXIII.	129.3637
At Reading, Pa.	J	80.5056
Near Robesonia, Pa.	No. XXIV.	131.9242
Near Womelsdorf, Pa.	No. XXV.	147.3661
At Lebanon, Pa.	No. XXVI.	144.6983
At Lebanon, Pa.	K	142.0093
Near Annville, Pa.	No. XXVII.	123.5577
Near Beaver, Pa.	No. XXVIII.	112.1158
At Harrisburg, Pa.	No. XXIX.	108.7960
At Harrisburg, Pa.	L	112.0898
At Carlisle, Pa.	M	144.2646
At Shippensburg, Pa.	No. XXX.	199.3384
At Chambersburg, Pa.	N	189.1777
At Greencastle, Pa.	No. XXXI.	179.4218
At Hagerstown, Md.	A	168.3395
Near Hagerstown, Md.	No. I.	171.8583
Near Hagerstown, Md.	No. II.	177.0214
Near Williamsport, Md.	No. IV.	150.8069
Near Williamsport, Md.	No. V.	136.3976
At Williamsport, Md.	B	109.1237
Near Williamsport, Md.	C	113.3561
Near Williamsport, Md.	No. VI.	113.2736
Near Williamsport, Md.	D	123.2968
Near Cherry Run, Md.	No. VII.	123.6737
Near Hancock, Md.	E	123.4153
Near Hancock, Md.	No. VIII.	127.5629
At Hancock, Md.	F	128.3222
Near Hancock, Md.	No. IX.	130.2658
Near Hancock, Md.	G	135.3711
Near Hancock, Md.	No. X.	137.7526
Near Little Orleans, Md.	No. XI.	139.7419
At Little Orleans, Md.	No. XII.	140.2159
Near Little Orleans, Md.	No. XIII.	142.6317
Near Little Orleans, Md.	H	150.1707
Near Little Orleans, Md.	No. XIV.	162.3793
Near Oldtown, Md.	No. XV.	164.8346
Near Cumberland, Md.	No. XVI.	179.2590
At Cumberland, Md,	I	190.2659
Near Cumberland, Md.	No. XVII.	197.4682
Near Cumberland, Md.	No. XVIII.	211.6723

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Keyser, W. Va.	J	244.8459
At Bloomington, Md.	No. XX.	307.5368
Near Bloomington, Md.	No. XXV.	693.4527
Near Deer Park, Md.	No. XXIII.	748.7263
Near Oakland, Md.	No. XXII.	732.9886
Near Oakland, Md.	No. XXI.	725.0767
Near Oakland, Md.	K	724.2090
Near Hutton, Md.	No. XXIV.	742.1398
Near Cranberry Summit, W. Va.	No. XXVI.	756.3099
Near Cranberry Summit, W. Va.	No. XXVII.	747.7053
Near Rowlesburg, W. Va.	L	495.0461
At Rowlesburg, W. Va.	No. XXVIII.	426.9767
Near Rowlesburg, W. Va.	No. XXIX.	523.4851
Near Grafton, W. Va.	No. XXX.	312.1230
At Grafton, W. Va.	M	303.8422
Near Grafton, W. Va.	No. XXXI.	329.9840
Near Bridgeport, W. Va.	No. XXXII.	298.5913
Near West Union, W. Va.	No. XXXIII.	243.8972
At West Union, W. Va.	N	245.3222
Near West Union W. Va.	No. XXXIV.	244.6991
At Cornwall, W. Va.	No. XXXV.	211.4909
Near Cairo, W. Va.	No. XXXVI.	209.0791
At Petroleum, W. Va.	No. XXXVII.	212.4257
Near Petroleum, W. Va.	No. XXXVIII.	211.2789
Near Parkersburg, W. Va.	No. XXXIX.	185.1524
At Parkersburg, W. Va.	O	187.6979
At Belpre, Ohio.	No XL.	189.3484
At Little Hocking, Ohio.	No. XLI.	190.0699
Near Coolville, Ohio	No. XLII.	193.0793
Near Coolville, Ohio.	No. XLIII.	184.8133
Near Stewart, Ohio.	No. XLVIII.	187.6155
Near Stewart, Ohio.	No. XLVII.	187.9424
Near Guysville, Ohio.	No. XLIV.	188.2242
Near Guysville, Ohio.	No. XLV.	189.6093
Near Canaanville, Ohio	No. XLVI.	190.1818
Near Canaanville, Ohio.	No. XLIX.	192.1805
At Athens, Ohio.	No. L.	197.9239
At Athens, Ohio.	P	200.0380
At Moonville, Ohio.	No. LI.	217.1233
Near Zaleski, Ohio.	No. LII.	217.7765
Near Hamden, Ohio.	No. LIII.	215.3051
Near Londonderry, Ohio.	No. LIV.	183.1300
Near Schooley, Ohio.	No. LV.	200.4837
At Chillicothe, Ohio.	Q	194.5181
Near Musselmans Junction, Ohio.	No. LVI.	213.3025
Near Musselmans Junction, Ohio.	No. LVII.	217.1237
Near Lyndon, Ohio.	No. LVIII.	277.9218
At Martinsville, Ohio.	No. LIX.	322.0829
Near Clinton Valley, Ohio.	No. LX.	301.7918
Near Loveland, Ohio.	No. LXI.	211.2187
At Loveland, Ohio.	R	177.3712
Near Remington, Ohio.	No. LXII.	180.1050
Near Cumminsville, Ohio.	No. LXIII.	154.3606
At Cincinnati, Ohio.	No. LXIV.	150.8207
At Cincinnati, Ohio.	S	150.7180
At Cincinnati, Ohio.	T or City B. M. No. 1.	166.5849
Near Delhi, Ohio.	No. LXV.	Destroyed.
Near Lawrenceburg, Ind.	No. LXVI.	147.0438
At Lawrenceburg, Ind.	U	148.1154
Near Cochran, Ind.	No. LXVII.	150.4322

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Delaware, Ind.	No. LXVIII.	282.8283
Near North Vernon, Ind.	No. LXIX.	208.7158
Near Medora, Ind.	V	162.7097
Near Fort Ritner, Ind.	No. LXX.	158.9552
Near Scottsville, Ind.	W	157.0006
At Mitchell, Ind.	X	209.3086
At West Shoals, Ind.	Y	159.0514
At Washington, Ind.	Z	155.1155
At Vincennes, Ind.	A_3	132.1142
At Vincennes, Ind.	No. I.	130.9191
At Olney, Ill.	B_3	147.9296
At Olney, Ill.	No. II.	146.1898
Near Clay City, Ill.	No. III.	130.4358
At Flora, Ill.	C_3	149.0919
Near Iuka, Ill.	No. IV.	143.4550
At Salem, Ill.	D_3	165.7412
At Odin, Ill.	No. V.	160.6675
Near Sandoval, Ill.	No. VI.	148.7942
Near Collins, Ill.	No. VII.	136.0553
Near Carlyle, Ill.	E_3	133.6782
At Carlyle, Ill.	F_3	142.6999
Near Aviston, Ill.	No. VIII.	137.8896
At Lebanon, Ill.	G_3	139.3856
Near Caseyville, Ill.	No. IX.	137.0736
Near East St. Louis, Ill.	H_3	158.9757
At East St. Louis, Ill.	I_3	126.1770
At St. Louis, Mo.	J_3	126.1804
At St. Louis, Mo.	*K_3	126.1776
At St. Paul, Mo.	No. X.	132.0763
At Allenton, Mo.	No. XI.	146.3698
Near South Point, Mo.	No. XII.	149.5358
At Washington, Mo.	L_3	166.4514
At New Haven, Mo.	M_3	155.3997
Near New Haven, Mo.	No. XIII.	154.5107
Near Etlah, Mo.	No. XIV.	155.3287
At Berger, Mo.	No. XV.	156.0768
At Hermann, Mo.	N_3	158.4822
Near Gasconade, Mo.	No. XVI.	159.5216
At Gasconade, Mo.	No. XVII.	159.7658
At Gasconade, Mo.	No. XVIII.	160.7009
At Morrison, Mo.	No. XIX.	160.8352
At Chamois, Mo.	O_3	163.5460
At St. Aubert, Mo.	No. XX.	164.3188
Near St. Aubert, Mo.	No. XXI.	164.1505
At Isbell, Mo.	No. XXII.	164.6479
At Bonnots Mill, Mo.	P_3	168.4122
At Osage, Mo.	No. XXIII.	167.1569
At Osage, Mo.	No. XXIV.	166.7609
Near Osage, Mo.	No. XXV.	169.9341
At Jefferson City, Mo.	Old B. M. 90 (85).	169.9869
At Jefferson City, Mo.	No. XXVII.	184.8553
At Jefferson City, Mo.	No. XXVIII.	191.6654
Near Cole, Mo.	No. XXIX.	169.8093
At Scott, Mo.	No. XXX.	177.1324
At Elston, Mo.	No. XXXI.	213.1978
At Centertown, Mo.	No. XXXII.	261.2229
At Centertown, Mo.	M. P. R. R. No. 114.	259.0255
At California, Mo.	No. XXXIII.	267.1737
At California, Mo.	M. P. R. R. No. 122.	271.1830

* Known also as St. Louis Directrix.

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Clarksburg, Mo.	No. XXXIV.	275.8140
At Tipton, Mo.	No. XXXV.	282.1353
At Fortuna, Mo.	No. 14.	295.7911
Near Versailles, Mo.	Versailles North Base △	322.4181
Near Versailles, Mo.	Hunter △.	319.5921
Near Syracuse, Mo.	No. XXXVI.	281.7887
Near Otterville, Mo.	No. XXXVII.	223.5956
Near Otterville, Mo.	M. P. R. R. No. 143.	219.3508
Near Smithton, Mo.	No. XXXVIII.	269.3415
Near Sedalia, Mo.	M. P. R. R. No. 152.	276.6698
At Sedalia, Mo.	No. XXXIX.	277.5051
Near Sedalia, Mo.	No. XL.	226.3938
At Lamonte, Mo.	No. XLI.	264.5183
At Knobnoster, Mo.	No. XLII.	247.0230
Near Knobnoster, Mo.	M. P. R. R. No. 169.	226.9546
At Montserrat, Mo.	No. XLIII or M.P.R.R.No.171.	243.5284
At Warrensburg, Mo.	No. XLIV or Normal △.	267.9222
At Warrensburg, Mo.	No. XLV.	269.7086
At Center View, Mo.	No. XLVI.	266.1333
At Holden, Mo.	No. XLVII.	260.4810
Near Holden, Mo.	No. XLVIII or M.P.R.R.No.188.	244.5296
At Kingsville, Mo.	No. XLIX.	279.9554
Near Strasburg, Mo.	No. L.	255.5925
At Pleasant Hill, Mo.	No. LI.	261.3531
Near Pleasant Hill, Mo.	M. P. R. R. No. 201.	260.7751
Near Pleasant Hill, Mo.	No. LII.	260.1401
Near Greenwood, Mo.	M. P. R. R. No. 206.	280.3763
Near Greenwood, Mo.	No. LIII.	280.3701
At Lees Summit, Mo.	No. LIV.	315.8726
Near Little Blue, Mo.	No. LV.	240.2736
Near Independence, Mo.	No. LVI.	310.2267
At Independence, Mo.	No. LVII.	320.6775
At Independence, Mo.	Independence City Directrix.	320.1615
Near Big Blue River, Mo.	No. LVIII.	228.2134
At Kansas City, Mo.	Old M. R. C. B. M. 241.	228.3028
At Kansas City, Mo.	Old M. R. C. B. M. 243.	230.3539
At Kansas City, Mo.	Old M. R. C. B. M. 244.	230.1944
At Kansas City, Mo.	M. R. C. $\frac{7}{8}$, Top of Cap.	*228.8449
At Kansas City, Mo.	Old M. R. C. B. M. 245.	227.5733
At Kansas City, Kans.	No. LIX.	228.4242
At Argentine, Kans.	No. LX.	229.3276
Near Holliday, Kans.	No. LXI.	231.9340
Near Holliday, Kans.	No. LXII.	233.1180
Near Holliday, Kans.	No. LXIII.	233.1386
Near Cedar Junction, Kans.	A	238.5557
Near Desoto, Kans.	B	241.0436
At Desoto, Kans.	C	243.4843
Near Weaver, Kans.	D	243.9603
Near Eudora, Kans.	E	247.3941
At Lawrence, Kans.	F	252.0649
At Lawrence, Kans.	G	249.3473
Near Club House, Kans.	H	252.9847
Near Lecompton, Kans.	I	257.2410
Near Lecompton, Kans.	J	258.1719
Near Grover, Kans.	K	261.6018
Near Tecumseh, Kans.	L	264.1467
At Topeka, Kans.	M	270.9720
At Topeka, Kans.	B. M. Jennings.	283.2724
At Topeka, Kans.	O	284.6148

*This elevation has been destroyed. For present elevation see page 511.

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Topeka, Kans.	N	269.3689
At Silver Lake, Kans.	P	279.0815
Near Rossville, Kans.	Q	283.5777
At St. Marys, Kans.	R	294.5704
Near Belvue, Kans.	S	293.2885
At Wamego, Kans.	T	302.3469
At St. George, Kans.	U	306.1219
At Manhattan, Kans.	V	307.0617
At Ogden, Kans.	W	322.8991
At Fort Riley, Kans.	X	326.4203
At Junction City, Kans.	Y	329.5656
Near Chapman, Kans.	Z	337.7078
At Chapman, Kans.	A_1	341.2223
At Abilene, Kans.	B_1	353.0502
At Salina, Kans.	H_1	373.9875
At Bavaria, Kans.	I_1	388.8300
At Brookville, Kans.	J_1	414.5987
Near Terra Cotta, Kans.	K_1	441.1989
At Kanopolis, Kans.	L_1	483.5231
At Ellsworth, Kans.	M_1	469.7855
At Ellsworth, Kans.	N_1	469.6850
At Ellsworth, Kans.	Water gauge B. M.	464.8343
At Wilson, Kans.	O_1	515.3693
At Wilson, Kans.	P_1	515.7317
At Dorrance, Kans.	Q_1	528.1191
At Bunker Hill, Kans.	R_1	569.0936
At Bunker Hill, Kans.	S_1 or Bunker Hill△.	570.3099
Near Homer, Kans.	T_1 or Russell Southeast Base△.	573.3685
At Russell, Kans.	U_1	559.0067
At Gorham, Kans.	V_1	584.5379
At Walker, Kans.	W_1	593.7622
At Victoria, Kans.	X_1	587.8138
At Hays, Kans.	Y_1	609.3236
At Ellis, Kans.	Z_1	647.5417
At Ellis, Kans.	A_2	646.6495
At Ellis, Kans.	B_2	646.5332
At Ogallah, Kans.	C_2	724.7930
At Wakeeney, Kans.	D_2	751.4734
At Collyer, Kans.	E_2	787.3494
At Quinter, Kans.	F_2	816.9841
At Buffalo Park, Kans.	G_2	838.6685
At Grainfield, Kans.	H_2	858.0206
At Grinnell, Kans.	I_2	887.5542
At Oakley, Kans.	J_2	930.5519
At Monument, Kans.	K_2	967.2942
Near Page City, Kans.	L_2	983.8193
At Winona, Kans.	M_2	1013.6773
At McAllaster, Kans.	N_2	962.0431
At Turkey Creek, Kans.	O_2	985.1984
At Wallace, Kans.	P_2	1010.3921
Near Wallace, Kans.	Q_2	1018.1703
At Sharon Springs, Kans.	R_2	1053.1146
At Monotony, Kans.	S_2	1152.3280
At Weskan, Kans.	T_2	1167.4148
Near Weskan, Kans.	U_2	1181.5880
At Arapahoe, Colo.	A	1223.4922
At Cheyenne Wells, Colo.	B	1305.2417
At First View, Colo.	C	1395.9762

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Kit Carson, Colo.	D	1307.0440
Near Wildhorse, Colo.	E	1351.9509
At Aroya, Colo.	F	1390.9931
At Boyero, Colo.	G	1445.0257
At Mirage, Colo.	H	1484.5112
At Hugo, Colo.	I	1537.9653
At Hugo, Colo.	J	1538.3321
At Hugo, Colo.	K	1538.3293
Near Lake, Colo.	L	1596.5977
At Lake, Colo.	M	1616.1025
At Limon, Colo.	N	1632.1782
At Limon, Colo.	O	1639.1772
At Limon, Colo.	P	1639.1642
At Resolis, Colo.	Q	1700.1151
At Mattison, Colo.	R	1764.9641
At Ramah, Colo.	S	1856.8867
At Calhan, Colo.	T	1984.3115
At Peyton, Colo.	U	2074.0476
At Falcon, Colo.	V	2084.1973
At Falcon, Colo.	W	2076.6049
At Elsmere, Colo.	X	1957.3158
Near Roswell, Colo.	Y	1864.2396
At Roswell, Colo.	Z	1853.4323
At Colorado Springs, Colo.	A_1	1825.2553
At Colorado Springs, Colo.	B_1	1823.1794
At Colorado Springs, Colo.	City B. M.	1822.8431
At Colorado Springs, Colo.	North Mast B. M.	1823.494
At Colorado Springs, Colo.	South Mast B. M.	1823.181
At Colorado Springs, Colo.	Nail B. M.	1822.622
At Colorado Springs, Colo.	Reference B. M.	1823.719
At Colorado Springs, Colo.	V. C. Post B. M.	1822.226
Near Pike View, Colo.	C_1	1895.0394
At Edgerton, Colo.	D_1	1947.3348
Near Husted, Colo.	E_1	1986.6042
At Husted, Colo.	F_1	2007.3415
At Monument, Colo.	G_1	2121.3968
At Palmer Lake, Colo.	H_1	2202.4636
Near Palmer Lake, Colo.	I_1	2154.2820
At Greenland, Colo.	J_1	2101.1298
At Larkspur, Colo.	K_1	2035.8097
Near Douglas, Colo.	L_1	1923.3866
At Castle Rock, Colo.	M_1	1890.7103
At Plateau, Colo.	N_1	1832.9613
At Sedalia, Colo.	O_1	1780.1758
At Toluca, Colo.	P_1	1711.1186
Near Acequia, Colo.	Q_1	1677.7913
At Wolhurst, Colo.	R_1	1647.8754
At Littleton, Colo.	S_1	1634.6834
At Petersburg, Colo.	T_1	1609.9761
At Denver, Colo.	U_1	1609.1048
At Denver, Colo.	V_1	1608.8574
At Denver, Colo.	W_1	1609.1534
At Denver, Colo.	X_1	1581.2148
At Denver, Colo.	Y_1	1580.5966
At River Bend, Colo.	N_2	1675.2478
At Godfrey, Colo.	M_2	1705.3334
At Agate, Colo.	L_2	1664.4756
At Lowland, Colo.	K_2	1621.3353
At Deer Trail, Colo.	J_2	1580.0418

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Byers, Colo.	I_2	1585.4926
At Bennett, Colo.	H_2	1671.6316
At Watkins, Colo.	G_2	1681.4653
Near Magnolia, Colo.	F_2	1672.6899
Near Magnolia, Colo.	E_2	1647.0475
At Magnolia, Colo.	D_2	1626.6550
Near Denver, Colo.	C_2	1608.9941
At Denver, Colo.	Z_1	1585.7379
At Jersey, Colo.	A_2	1585.0175
At Jersey, Colo.	B_2	1585.0535
At Biloxi, Miss.	I_1 or P. B. M. 18.	6.7175
Near Biloxi, Miss.	H_1 or P. B. M. 19.	1.7849
Near Biloxi, Miss.	G_1 or P. B. M. 20.	2.1149
Near Biloxi, Miss.	F_1 or P. B. M. 21.	0.3270
Near Ocean Springs, Miss.	E_1	4.7915
At Ocean Springs, Miss.	D_1	7.5369
At Scranton, Miss.	C_1	5.1685
At Grand Bay, Ala.	B_1	32.5402
At St. Elmo, Ala.	A_1	40.4660
At Mobile, Ala.	A	3.7450
At Mobile, Ala.	Astronomical station.	4.6662
At Citronelle, Ala.	B	100.8205
Near Citronelle, Ala.	E_2	71.7504
At Deer Park, Ala.	F_2	46.9318
At Escatawpa, Ala.	G_2	53.6082
Near Escatawpa, Ala.	H_2	65.6541
Near Bucatunna, Miss.	I_2	80.7478
At Bucatunna, Miss.	J_2	46.1253
At Winchester, Miss.	K_2	51.2270
At Waynesboro, Miss.	L_2	58.8034
Near Waynesboro, Miss.	M_2	54.1358
At Shubuta, Miss.	N_2	61.3038
At De Soto, Miss.	O_2	63.3709
At Quitman, Miss.	D_2	70.0589
At Quitman, Miss.	C_2	70.8580
At Enterprise, Miss.	B_2	74.7541
At Meridian, Miss.	C	104.8587
At Meridian, Miss.	D	105.1442
At Scooba, Miss.	E	58.9888
Near Macon, Miss.	F	53.6206
At Macon, Miss.	No 96.	54.9851
At Artesia, Miss.	G	71.4508
At West Point, Miss.	H	72.5715
At West Point, Miss.	I	74.1169
At Okolona, Miss.	L	93.2964
At Okolona, Miss.	K	94.8540
Near Shannon, Miss.	M	76.2624
At Shannon, Miss.	N	77.3497
At Verona, Miss.	O	96.3788
At Tupelo, Miss.	P	85.1858
At Saltillo, Miss.	Q	95.7652
At Guntown, Miss.	R	121.7474
At Baldwyn, Miss.	S	114.5250
At Booneville, Miss.	T	162.7583
At Rienzi, Miss.	U	138.9281
At Corinth, Miss.	V	137.6187
At Corinth, Miss.	W	137.6756
At Ramer, Tenn.	X	126.4404
At Falcon, Tenn.	Y	131.7390

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Bethel Springs, Tenn.	Z	142.7314
At McNairy, Tenn.	No. XXVII.	139.5406
At Henderson, Tenn.	No. XXVI.	131.4543
At Pinson, Tenn.	No. XXV.	117.9963
Near Jackson Tenn.	No. XXIV.	107.6732
At Jackson, Tenn.	No. XXIII.	120.7693
At Jackson, Tenn.	No. XXII.	119.7927
At Oakfield, Tenn.	No. XXI.	134.9743
At Medina, Tenn.	No. XX.	153.9197
At Milan, Tenn.	No. XIX.	131.2353
At Milan, Tenn.	No. XVIII.	129.4373
At Bradford, Tenn.	No. XVII.	112.1441
At Greenfield, Tenn.	No. XV.	133.4065
At Sharon, Tenn.	No. XIV.	127.3602
At Martin, Tenn.	No. XIII.	127.3092
At McConnell, Tenn.	No. XII.	108.8645
At Fulton, Ky.	No. XI.	109.8640
At Alexander, Ky.	No. X.	112.9309
At Clinton, Ky.	No. IX.	119.2750
At Arlington, Ky.	No. VIII.	111.4268
At Bardwell, Ky.	No. VII.	119.7317
Near Bardwell, Ky.	No. VI.	97.4172
At Fort Jefferson, Ky.	No. V.	98.6678
At Wickliffe, Ky.	No. IV.	101.9826
At East Cairo, Ky.	No. III.	99.0529
At Cairo, Ill.	P. B. M. 3.	99.7361
At Cairo, Ill.	P. B. M. 2.	97.3258
At Cairo, Ill.	P. B. M. 1.	96.9227
Near Mound City Junction, Ill.	No. II.	99.7203
At Mound City Junction, Ill.	No. I.	98.1617
At Villa Ridge, Ill.	Z_3	117.6086
At Villa Ridge, Ill.	Y_3	115.9286
Near Villa Ridge, Ill.	No. XII_a.	104.5763
Near Ullin, Ill.	No. 139.	102.3731
Near Ullin, Ill.	X_3.	102.8619
At Anna, Ill.	W_3	191.7996
Near Makanda, Ill.	V_3	131.4222
At Carbondale, Ill.	T_3	126.6159
Near De Soto, Ill.	U_3	117.4716
At Duquoin, Ill.	R_3	140.8608
Near Radom, Ill.	S_3	152.2177
Near Ashley, Ill.	Q_3	170.1791
Near Richview, Ill.	P_3	165.7331
At Centralia, Ill.	N_3	150.6035
Near Centralia, Ill.	O_3	143.4946
At Odin, Ill.	M_3	161.0278
On Ballamagan Plantation, La.	No. LII.	17.2841
At Black Hawk, La.	No. LIII.	16.0186
Near Bougére, La.	No. LIV.	17.4423
Near Fairview, La.	No. LV.	17.1910
Near Fairview, La.	No. LVI.	18.9385
On Deer Park Plantation, La.	No. LVII.	18.1003
On Ashley Plantation, La.	No. LVIII.	16.5543
On Moro Plantation, La.	No. LIX.	19.2982
On Moro Plantation, La.	No. LX.	19.6123
Near Vidalia, La.	No. LXI.	18.7953
At Vidalia, La.	No. LXII.	19.3466
At Vidalia, La.	No. LXIII.	* 18.6801
At Palo Alto, La.	No. LXIV.	19.7833

* This elevation is from the Engineer line of 1894.

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Vidalia, La.	No. LXV.	20.8646
On Bullitt Bayou Plantation, La.	No. LXVI.	19.6826
At Gibsons Landing, La.	No. LXVII.	20.1669
Near L'Argent Landing, La.	No. LXVIII.	21.1772
Near L'Argent, La.	No. LXIX.	21.8888
Near Waterproof, La.	No. LXX.	20.7264
At Waterproof, La.	No. LXXI.	20.5435
At Kemps Landing, La.	No. LXXII.	22.1494
On Villa Clara Plantation, La.	No. LXXIII or No. 297.	21.6924
On Duck Pond Plantation, La.	No. 291.	23.2356
On Panola Plantation, La.	No. 286.	24.9597
On Waveland Plantation, La.	No. 280.	23.9013
On Hard Times Plantation, La.	No. 272.	24.1678
On Riverside Plantation, La.	No. 262.	25.4578
On Point Pleasant Plantation, La.	No. 258.	26.8150
On Sargents Point Plantation, La.	No. 246.	26.1796
At Kelloggs Landing, La.	No. 243.	26.9637
On Crystal Springs Plantation, La.	No. 232.	26.7662
On Point Place Plantation, La.	No. 225.	27.7668
At Delta, La.	No. 215.	27.9299
Near Delta, La.	No. 211.	27.8156
On Elcho Plantation, La.	No. 207.	29.8286
On Duck Port Plantation, La.	No. 197.	29.6875
On Cabin Teele Plantation, La.	No. 188.	30.1260
On River View Plantation, La.	No. 184.	28.8317
Near Millikens Bend, La.	No. 179.	29.7825
Near Omega, La.	No. 171.	29.4885
Near Hendersons Landing, La.	No. 162.	31.0947
Near Hendersons Landing, La.	No. 161.	30.2868
Near Ingomar, Miss.	No. 153.	31.8864
Near Ingomar, Miss.	No. 150.	32.2209
On Shiloh Plantation, Miss.	No. 140.	33.8753
Near Hays, Miss.	No. 137.	32.3513
Near Tallulah Landing, Miss.	No. 128.	32.4674
Near Tallulah Landing, Miss.	No. 124.	31.8727
On Ben Lomond Plantation, Miss.	No. 112.	33.3351
On Reserve Plantation, Miss.	No. 105.	33.1262
Near Mayersville, Miss.	No. 95.	34.1915
Near Mayersville, Miss.	No. 90.	33.9090
On Riverdale Plantation, Miss.	No. 83.	34.5728
On Palmetto Plantation, Miss.	No. 70.	34.8324
Near Leota, Miss.	No. 65.	36.8141
Near Leota, Miss.	No. 62.	36.6590
Near Lake Washington Landing, Miss.	No. 56.	36.0049
On Longwood Plantation, Miss.	No. 46.	36.6125
On Glenora Plantation, Miss.	No. 42.	36.7164
On Auburn Plantation, Miss.	No. 39.	36.2366
Near Lake See, Miss.	No. 33.	37.1035
At Refuge, Miss.	No. 22.	39.6737
On Refuge Plantation, Miss.	No. 19.	39.9310
At Warfield Point, Miss.	No. 11.	39.4960
Near Warfield Point, Miss.	No. 8.	39.9540
Near Greenville, Miss.	No. 5.	39.2404
Near Greenville, Miss.	No. 2.	40.5169
At Greenville, Miss.	Greenville No. 1.	40.0230
At Wilkersons Landing, Miss.	P. B. M. No. 84.	42.3304
At Arkansas City, Ark.	F	42.2740

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At McGehee, Ark.	G	*45.6604
At Tillar, Ark.	H	46.6098
At Walnut Lake, Ark.	I	49.8812
At Varner, Ark.	J	54.6207
At Noble Lake, Ark.	K	61.7372
At Pine Bluff, Ark.	N	68.3962
At Pine Bluff, Ark.	L	71.4210
Near Pine Bluff, Ark.	E	103.7009
At Redfield, Ark.	D	93.7874
At Wrightsville, Ark.	C	78.6342
Near Wrightsville. Ark.	No. II.	81.1898
At Little Rock, Ark.	No. I or 3.	80.4034
At Little Rock, Ark.	A	91.1372
At Little Rock, Ark.	B	90.7344
At Little Rock, Ark.	O	87.8488
At Argenta, Ark.	West Base.	78.0943
Near Little Rock, Ark.	No. I.	96.2065
At Marche, Ark.	No. II.	81.8974
At Palarm, Ark.	No. III.	82.2633
At May Flower, Ark.	No. IV.	87.5319
At Preston, Ark.	No. V.	84.0357
At Conway, Ark.	No. VI.	97 6492
Near Conway, Ark.	No. VII.	100.7292
Near Menifee, Ark.	No. VIII.	86.4456
At Menifee, Ark.	No. IX.	87.2142
At Plumerville, Ark.	No. X.	89.1513
At Morrillton, Ark.	No. XI.	118.3199
At Germantown, Ark.	No. XII.	93.5200
At Blackville, Ark.	No. XIII.	99.3027
At Atkins, Ark..	No. XIV.	108.5935
At Galla Creek, Ark.	No. XV.	113.2731
At Russellville, Ark.	No. XVI.	106.8688
At Onita, Ark.	No. XVII.	108.5656
Near Onita, Ark.	No. XVIII.	99.9535
Near Mill Creek, Ark.	No. XIX.	99.3694
At London, Ark.	No. XX.	115.8842
Near Berlin, Ark.	No. XXI.	103.1522
At Knoxville, Ark.	No. XXII.	120.6216
At Lamar, Ark.	No. XXIII.	125.2954
Near Clarksville, Ark.	No. XXIV.	114.6456
At Clarksville. Ark.	No. XXV.	112.7103
At Clarksville, Ark.	No. XXVI.	112.3293
At Spadra, Ark.	No. XXVII.	115.2522
At Hartman, Ark.	No. XXVIII.	123.9446
At Coal Hill, Ark.	No. XXIX.	144.6506
At Altus, Ark.	No. XXX.	165.5051
At Ozark, Ark.	No. XXXI.	122.0089
At Poepping, Ark.	No. XXXII.	116.8772
At White Oak Ark.	No. XXXIII.	120.9327
Near Mulberry, Ark.	No. XXXIV.	117.3604
At Dyer, Ark.	No. XXXV.	130.9404
At Alma, Ark.	No. XXXVI.	132.7331
At Van Buren, Ark.	No. XXXVII.	125.3643
At Van Buren, Ark.	No. XXXVIII.	126.4213
At Van Buren, Ark.	No. XXXIX.	126.4141
At Van Buren, Ark.	No. XL.	126.3707
At Fort Smith, Ark.	No. XLI.	136.5704
At Fort Smith Ark.	No. XLII.	130.7790

*This elevation is from the Engineer line between Wilkersons Landing and Parkeville in 1897. The description of the bench made at that time indicates that the bench mark had been disturbed.

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Lillie, Ark.	No. XLIII.	141.1429
Near Rudy, Ark.	No. XLIV.	163.6263
Near Lancaster, Ark.	No. XLV.	185.4820
Near Mountainburg, Ark.	No. XLVI.	211.6714
Near Chester, Ark.	No. XLVII.	249.8495
At Chester, Ark.	No. XLVIII.	257.6184
At Chester, Ark.	No. XLIX.	256.4826
At Porter, Ark.	No. CXXVIII.	331.0415
Near Winslow, Ark.	No. CXXVII.	572.0450
Near Winslow, Ark.	No. CXXVI.	531.3082
At Brentwood, Ark.	No. CXXV.	454.3994
Near Woolseys, Ark.	No. CXXIV.	419.6759
At West Fork, Ark.	No. CXXIII.	411.9327
At Greenland, Ark.	No. CXXII.	380.7650
At Fayetteville, Ark.	No. CXXI.	443.2296
At Johnson, Ark.	No. CXX.	364.1136
At Springdale, Ark.	No. CXIX.	405.2610
At Lowell, Ark.	No. CXVIII.	409.5382
At Rogers, Ark.	No. CXVII.	421.6200
At Avoca, Ark.	No. CXVI.	415.1398
At Brightwater, Ark.	No. CXV.	386.0484
At Garfield, Ark.	No. CXIV.	463.6734
At Seligman, Mo.	No. CXIII.	470.2536
At Washburn, Mo.	No. CXII.	449.5641
At Exeter, Mo.	No. CXI.	475.7929
At Purdy, Mo.	No. CX.	453.1402
At Monett, Mo.	No. CIX.	397.0064
At Pierce City, Mo.	No. CVII.	366.5611
At Wentworth, Mo.	No. CVI.	373.6792
At Sarcoxie, Mo.	No. CV.	332.1224
At Reeds, Mo.	No. CIV.	343.8119
At Carthage, Mo.	No. CIII.	287.1406
Near Carthage, Mo.	No. CII.	288.6596
Near Carthage, Mo.	No. CI.	294.4024
Near Carthage, Mo.	No. C.	280.8584
At Jasper, Mo.	No. XCIX.	289.2562
At Boston, Mo.	No. XCVIII.	287.8555
Near Boston, Mo.	No. XCVII.	283.9055
Near Boston, Mo.	No. XCVI.	283.9047
At Lamar, Mo.	No. XCV.	298.7907
Near Lamar, Mo.	No. XCIV.	288.3787
At Irwin, Mo.	No. XCIII.	296.9779
At Sheldon, Mo.	No. XCII.	281.9542
At Milo, Mo.	No. XCI.	268.1341
At Nevada, Mo.	No. XC.	262.9306
Near Horton, Mo.	No. LXXXIX.	228.2052
At Horton, Mo.	No. LXXXVIII.	236.7610
Near Arthur, Mo.	No. LXXXVII.	228.8899
At Rich Hill, Mo.	No. LXXXVI.	245.7105
At Rich Hill, Mo.	No. LXXXV.	245.7044
Near Rich Hill, Mo.	No. LXXXIV.	231.8420
Near Butler, Mo.	No. LXXXIII.	231.6761
At Butler, Mo.	No. LXXXII.	264.0520
At Passaic, Mo.	No. LXXXI.	263.9254
At Adrian, Mo.	No. LXXX.	264.7006
Near Archie, Mo.	No. LXXIX.	243.0942
At Archie, Mo.	No. LXXVIII.	255.3755
Near Archie, Mo.	No. LXXVII.	243.8442
At Lone Tree, Mo.	No. LXXVI.	268.1902
At Harrisonville, Mo.	No. LXXV.	275.6250

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Harrisonville, Mo.	No. LXXIV.	280.2422
Near Harrisonville, Mo.	No. 43.*	309.6612
Near Pleasant Hill, Mo.	Big Creek.	260.3638
At Kimpton, Mo.	No. LXXIII.	309.1773
At Coleman, Mo.	No. LXXII.	310.4541
At Raymore, Mo.	No. LXXI.	337.0301
At Belton, Mo.	No. LXX.	337.4798
Near Newington, Kans.	No. LXIX.	265.4517
At Morse, Kans.	No. LXVIII.	333.7044
At Olathe, Kans.	No. LXVII.	315.7988
At Olathe, Kans.	No. LXVI.	315.9223
At Olathe, Kans.	No. LXV.	Destroyed.
Near Holliday, Kans.	No. LXIV.	237.9564
At Washington, D. C.	Navy-Yard B. M. C. or 12.	2.8774
At Washington, D. C.	Capitol B. M.	27.6409
At Washington, D. C.	Monument B. M.	12.3245
At Washington, D. C.	National Museum B. M.	9.0589
At Georgetown, D. C.	No. XI.	9.6508
At Great Falls, Md.	F	50.7941
At Seneca, Md.	E	60.4945
At Whites Ferry, Md.	No. V.	63.2054
At Point of Rocks, Md.	D	†68.3582
At Weverton, Md.	C	†76.8728
Near Keedysvile, Md.	B	119.4174
At Richmond, Va.	O	58.1957
At Laurel, Va.	N_1	66.8653
At Ashland, Va.	N	67.4127
Near Doswell, Va.	M	44.6731
At Rutherglen, Va.	K_3	62.5229
At Penola, Va.	K_2	29.7129
At Milford, Va.	K_1	31.1880
Near Guinea, Va.	I_2	38.6751
Near Summit, Va.	I_1	60.8218
At Fredericksburg, Va.	I	21.0509
At Fredericksburg, Va.	H	13.1288
Near Potomac Run, Va.	G_8	25.9060
At Brooke, Va.	G_7	17.9587
Near Widewater, Va.	G_6	2.2472
At Quantico, Va.	G_5	10.7357
Near Woodbridge, Va.	G_4	20.9538
At Pohick Creek, Va.	G_3	19.4547
Near Accotink, Va.	G_2	25.0320
At Cameron Run, Va.	G_1	15.6859
At Alexandria, Va.	G	14.2473
At Old Point Comfort, Va.	Old Tidal B. M.	2.9352
At Old Point Comfort, Va.	U	2.6875
At Fort Monroe, Va.	Fort B. M.	3.3678
At Newport News, Va.	S	6.8144
At Morrison, Va.	R_3	9.8730
At Lee Hall, Va.	R_2	19.4833
At Williamsburg, Va.	R	27.0919
At Toano, Va.	Q_4	30.8285
At Diascond, Va.	Q_3	13.5427
Near Lanexa, Va.	Q_2	2.3397

*No description is furnished for No. 43, as it was only a temporary bench mark, but its elevation is necessary as a junction point.

†Destroyed. Reported 1903.

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Providence Forge, Va.	Q	9.7976
At Roxbury, Va.	P_5	13.0545
Near Richmond, Va.	P_4	34.2610
At Richmond, Va.	P_3	5.9818
At Richmond, Va.	P_2	6.7256
At Richmond, Va.	New City Hall B. M.	50.0431
At Richmond, Va.	P	62.7532
At Richmond, Va.	City B. M.	7.7678
At St. Augustine, Fla.	B. M. Fairfield.	2.2115
At St. Augustine, Fla.	B. M. Hitchcock.	0.3983
At St. Augustine, Fla.	Tidal Bench Mark.	0.2659
At St. Augustine, Fla.	A	2.1475
At St. Augustine, Fla.	B	2.0388
At St. Augustine, Fla.	C	2.4067
At St. Augustine, Fla.	D	2.4035
At Tocoi Junction, Fla.	E	10.8458
At Middleton, Fla.	F	10.5431
At Hastings, Fla.	G	2.2941
At Buena Vista, Fla.	H	4.4872
At East Palatka, Fla.	I	5.1346
At Palatka, Fla.	J	3.8728
At Francis, Fla.	B. M. Francis.	21.1522
At Hollister, Fla.	K	24.4657
At Interlachen, Fla.	L	32.1355
At McMeekin, Fla.	M	36.6462
At Hawthorn, Fla.	N	44.2419
At Hawthorn, Fla.	O	44.7570
At Grove Park, Fla.	P	30.6452
At Rochelle, Fla.	Q	25.3489
At Gainesville, Fla.	R	53.9473
At Gainesville, Fla.	S	54.0136
At Gainesville, Fla.	T	54.4760
At Arredonda, Fla.	U	27.0717
At Palmer, Fla.	V	23.2710
At Archer, Fla.	B. M. Archer.	25.9293
At Albion, Fla.	B. M. Albion.	26.9986
At Bronson, Fla.	W	21.9725
At Otter Creek, Fla.	B. M. Otter Creek.	9.8707
At Ellzey, Fla.	X	7.7666
At Rosewood, Fla.	B. M. Rosewood.	4.4408
At Cedar Keys, Fla.	Tidal Bench Mark.	0.9299
At Cedar Keys, Fla.	B. M. Perkins.	3.5713
At Cedar Keys, Fla.	Y	4.0021
At Cedar Keys, Fla.	Z	4.0540
At Cedar Keys, Fla.	B. M. Transit.	3.8859
At Delta, La.	S. W. Base.	26.6842
At Delta, La.	N. E. Base.	27.9179
Near Vicksburg, Miss.	B	30.0196
At Kleinston, Miss.	M. R. C. Stone Line[191].	26.8694
At Kleinston, Miss.	A	28.6396
At Vicksburg, Miss.	B. M. Cistern.	59.0150
At Vicksburg, Miss.	C	62.7646
At Vicksburg, Miss.	D	60.2664
Near Vicksburg, Miss.	E	75.9564
Near Vicksburg, Miss.	F	80.1231
At Newmans, Miss.	G	100.8797
At Bovina, Miss.	H	75.3278
Near Bovina, Miss.	I	46.4763

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Bovina, Miss.	J	32. 1401
At Smiths, Miss.	K	41. 0372
At Edwards, Miss.	L	68. 8843
Near Edwards, Miss.	M	52. 7175
Near Bolton, Miss.	N	62. 1962
Near Clinton, Miss.	O	101. 2438
At Jackson, Miss.	P	90. 6949
At Jackson, Miss.	Q	83. 9815
Near Pearsons, Miss.	R	85. 5221
At Greenfield, Miss.	S	94. 8254
At Brandon, Miss.	T	120. 9858
At Rankin, Miss.	U	128. 8227
At Pelahatchie, Miss.	W	109. 3794
Near Clarksburg, Miss.	X	113. 2882
At Morton, Miss.	Y	138. 5505
At Forest, Miss.	Z	146. 6773
At Lake, Miss.	A_1	137. 6840
At Newton, Miss.	B_1	129. 3670
At Hickory, Miss.	C_1	99. 3764
At Chunkey, Miss.	D_1	95. 0556
Near Chunkey, Miss.	E_1	90. 8332
At Graham, Miss.	F_1	94. 3497
Near Meridian, Miss.	G_1	118. 6850
At Chewalla, Tenn.	L	125. 9508
At Cypress Creek, Tenn.	M	117. 1995
At Pocahontas, Tenn.	N	122. 0934
At Middleton, Tenn.	O	125. 2635
At Saulsbury, Tenn.	P	165. 5206
At Grand Junction, Tenn.	R	177. 4250
At La Grange, Tenn.	I	162. 6261
At La Grange, Tenn.	K	162. 6582
At Moscow, Tenn.	H	107. 9048
At Wolf River, Tenn.	G	103. 0481
At Rossville, Tenn.	F	94. 4994
At Collierville, Tenn.	E	117. 9229
At Bailey, Tenn.	D	108. 9914
At Germantown, Tenn.	C	115. 6222
At White, Tenn.	B	95. 8981
At Buntyn, Tenn.	A	91. 6869
At Memphis, Tenn.	P. B. M. Memphis.	80. 6065
At Annapolis, Md.	a	*1. 2680
At Annapolis, Md.	Wood's.	*1. 1100
At Annapolis, Md.	b	1. 1510
At Annapolis, Md.	5 S. R.	2. 8680
At Annapolis, Md.	1 S. R.	5. 2710
At Annapolis, Md.	Obs.	7. 0140
At Annapolis, Md.	Hern.	8. 8990
At Annapolis, Md.	Taylor.	28. 9660
At Annapolis, Md.	No. XIII.	12. 6124
At Annapolis, Md.	No. XII.	13. 0615
At Bowie, Md.	No. VII.	45. 2917
At Wilson, Md.	No. IV.	17. 9206
Near Washington, D. C.	Hill.	84. 0706
At Washington, D. C.	No. II.	2. 3325
At Washington, D. C.	No. I or 5.	11. 9210
At Washington, D. C.	New C. S. Office.	23. 7464

*Settled. Reported by U. S. Geological Survey, 1903.

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Washington, D. C.	No. 8 or E.	1. 6305
At Washington, D. C.	No. 14 or Ordnance.	4. 9982
At Washington, D. C.	No. 16 or 24.	14. 4831
At Washington, D. C.	No. 22.	9. 5948
At Washington, D. C.	No. 25.	3. 6030
At Washington, D. C.	No. 30.	7. 4756
At Washington, D. C.	No. 36.	6. 1705
At Washington, D. C.	No. 41.	5. 4474
At Washington, D. C.	No. 47 or Brewery.	4. 1478
At Washington, D. C.	No. 79.	9. 8424
At Washington, D. C.	No. 80.	9. 9909
At Washington, D. C.	No. 82.	9. 0573
At Washington, D. C.	No. 84 or Smithsonian	9. 5964
At Washington, D. C.	No. 88.	8. 9719
At Washington, D. C.	No. 92.	11. 2501
At Washington, D. C.	No. 93.	12. 3643
At Washington, D. C.	No. 95.	12. 0615
At Washington, D. C.	No. 96.	12. 0036
At Washington, D. C.	No. 97.	12. 0398
At Washington, D. C.	No. 98.	12. 0498
At Washington, D. C.	No. 101.	6. 7509
At Washington, D. C.	No. 102.	10. 1044
At Washington, D. C.	No. 103.	1. 3864
At Monroe, La.	P. B. M. 24.	21. 8486
At Monroe, La.	P. B. M. 25.	24. 6608
At Monroe, La.	P. B. M. 26.	24. 7096
At Monroe, La.	P. B. M. 27.	23. 8258
At West Monroe, La.	P. B. M. 28.	23. 0790
At Chênière, La.	P. B. M. 29.	27. 3553
At Calhoun, La.	P. B. M. 30.	50. 4875
At Choudrant, La.	P. B. M. 32.	46. 4574
At Ruston, La.	P. B. M. 33.	95. 8903
At Allen Green, La.	P. B. M. 34.	100. 6780
At Simsboro, La.	P. B. M. 35.	97. 6737
At Arcadia, La.	P. B. M. 36.	112. 5090
At Gibsland, La.	P. B. M. 37.	73. 7846
At Taylor, La.	P. B. M. 38.	66. 5699
At Dubberly, La.	P. B. M. 39.	78. 0526
At Sibley, La.	P. B. M. 40.	57. 6418
At Bayou Dorcheat, La.	P. B. M. 41.	42. 9904
At Doyle, La.	P. B. M. 42.	68. 0794
At Haughton, La.	P. B. M. 43.	72. 2046
At Bodcau, La.	P. B. M. 44.	62. 1320
Near Shreveport, La.	P. B. M. 45.	52. 2279
At Shreveport, La.	P. B. M. 46.	59. 7023
Near Shreveport, La.	P. B. M. 47.	49. 9954
At Lotus Landing, La.	P. B. M. 48.	48. 0872
On Cash Plantation, La.	P. B. M. 49.	46. 4555
At Caspiana Landing, La.	P. B. M. 50.	45. 1918
On Campo Bello Plantation, La.	P. B. M. 51.	44. 6724
On Bonner's Plantation, La.	P. B. M. 52.	43. 9334
Near Howard, La.	P. B. M. 53.	43. 1290
Near Loggy Bayou, La.	P. B. M. 54.	43. 8614
At Eastpoint, La,	P. B. M. 55.	43. 2464
On Crichton's Plantation, La.	P. B. M. 56.	42. 0194
At Coushatta, La.	P. B. M. 57.	40. 3444
At Coushatta, La.	P. B. M. 58.	40. 7685
On Upper Brownsville Plantation, La.	P. B. M. 59.	38. 5729

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Old River, La.	P. B. M. 60.	36.9663
Near Campti, La.	P. B. M. 61.	36.2389
Near Willow, La.	P. B. M. 62.	36.3143
Near Tiger Island, La.	P. B. M. 63.	34.4153
At St. Maurice, La.	P. B. M. 64.	32.8584
Near Dunns Landing, La.	P. B. M. 65.	31.9625
Near Montgomery, La.	P. B. M. 66.	30.2654
At Buxtons Landing, La.	P. B. M. 67.	28.1498
Near Colfax, La.	P. B. M. 68.	26.4282
At Colfax, La.	P. B. M. 69.	29.3506
Near Fairmount, La.	P. B. M. 70.	28.8532
At Boyce, La.	P. B. M. 71.	26.1993
Near Rapides, La.	P. B. M. 72.	23.9421
At Alexandria, La.	P. B. M. 73.	22.4931
At Alexandria, La.	P. B. M. 74.	21.6457
Near Alexandria, La.	P. B. M. 75.	22.1244
Near Grand Bend, La.	P. B. M. 76.	21.6966
Near Jones Quarter Landing, La.	P. B. M. 77.	20.2381
Near Poland, La.	P. B. M. 78.	18.5772
At Egg Bend Landing, La.	P. B. M. 79.	18.7739
At David Ferry, La.	P. B. M. 80.	20.2553
At Normands Landing, La.	P. B. M. 81.	18.7855
At Normands Landing, La.	P. B. M. 82.	18.8670
At Marksville, La.	P. B. M. 83.	26.7049
At Mansura, La.	P. B. M. 84.	23.3236
At Mansura, La.	P. B. M. 85.	24.3183
At Moreauville, La.	P. B. M. 86.	18.7005
At Hamburg, La.	P. B. M. 87.	17.0055
Near Simmesport, La.	P. B. M. 88.	15.4261
At Simmesport, La.	P. B. M. 89.	12.8190
Near Water Valley Landing, La.	P. B. M. 90.	13.0474
Near Merrick, La.	P. B. M. 91.	13.6127
Near Barbre Landing, La.	P. B. M. 92.	13.6939
Near Barbre Landing, La.	P. B. M. 93.	15.1982
Near Barbre Landing, La.	P. B. M. 94.	15.3986
Near Torras Landing, La.	M. R. C. B. M. $\frac{149}{3}$.	15.9751
At Rayville, La.	P. B. M. 16.	24.5187
At Rayville, La.	P. B. M. 17.	26.8481
Near Rayville, La.	P. B. M. 18.	24.4287
At Girard, La.	P. B. M. 19.	24.1770
At Girard, La.	P. B. M. 20.	26.3190
At Crew Lake, La.	P. B. M. 21.	20.2984
At Gordon, La.	P. B. M. 23.	19.6420
At Mound, La.	P. B. M. 2.	25.3701
At California, La.	P. B. M. 3.	26.9186
At Barnes, La.	P. B. M. 4.	24.7286
At Tallulah, La.	P. B. M. 5.	28.0129
At Tallulah, La.	P. B. M. 6.	27.6170
Near Lake One, La.	P. B. M. 7.	23.5938
At Quebec, La.	P. B. M. 8.	22.9150
Near Quebec, La.	P. B. M. 9.	23.8479
At Dallas, La.	P. B. M. 10.	23.2614
At Waverly, La.	P. B. M. 11.	23.9707
Near Bayou Maçon, La.	P. B. M. 12.	22.6545
At Delhi, La.	P. B. M. 13.	28.7801
At Carpenter, La.	P. B. M. 14.	26.3682
At Holly Ridge, La.	P. B. M. 15.	25.9442

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Vidalia, La.	M. R. C. Stone $\frac{132}{3}$.	18. 1373
At Vidalia, La.	M. R. C. Stone $\frac{132}{4}$.	17. 7023
At Vidalia, La.	B. M. 1858.	19. 5978
At Vidalia, La.	B. M. Court-house Pedestal.	20. 2561
At Natchez, Miss.	B. M. Polk 1.	23. 3998
At Natchez, Miss.	B. M. Polk 2.	25. 0546
At Natchez, Miss.	B. M. Polk 3.	12. 3114
At Natchez, Miss.	B. M. cor. of State and Broadway sts.	59. 3567
At Natchez, Miss.	P. B. M. 1.	59. 5198
At Natchez, Miss.	B. M. No. 7 (Melvin, 1879).	65. 7814
At Natchez, Miss.	B. M. (Babbitt, 1874), No. 3.	24. 5173
At Natchez, Miss.	B. M. N (Ewens, 1886).	21. 6365
At Monroe, La.	B. M. C (Burrows, 1883).	24. 7012
At Monroe, La.	B. M. D (Burrows, 1883).	24. 5678
At Logtown, La.	P. B. M. 9.	21. 7081
At Blankston, La.	P. B. M. 10.	19. 6249
Near Waverly, La.	T. B. M. 125.	21. 6463
Near Riverton, La.	P. B. M. 11.	19. 2834
Near Riverton, La.	Gauge B. M. B	23. 4475
At Riverton, La.	Gauge B. M. A	17. 1862
At Columbia, La.	P. B. M. 12.	18. 7333
At Gibsons Landing, La.	P. R. P. Gibson.	18. 7039
At Coles Landing, La.	P. B. M. 13.	18. 4938
At Cottingham Landing, La.	P. B. M. 14.	17. 6672
At Danville, La.	B. M. B	18. 3856
Near Danville, La.	B. M. A	18. 2954
At Stafford, La.	P. B. M. 8.	17. 2077
At Catahoula Shoals, La.	P. B. M. 7.	17. 4585
At Harrisonburg, La.	T. B. M. H	18. 4042
At Harrisonburg, La.	B. M. V	20. 5615
At Harrisonburg, La.	P. B. M. 6.	24. 1273
At Trinity, La.	P. B. M. 5.	*16. 3915
At Jonesville, La.	P. B. M. 4.	16. 4856
At Black River, La.	P. B. M. 3.	15. 6307
At Frogmore, La.	P. B. M. 2.	17. 2220
At Concordia, La.	T. B. M. 9.	19. 6224
At Burke, La.	P. B. M. Burke.	23. 0943
At Archibald, La.	P. B. M. Archibald.	23. 4706
At Mangham, La.	P. B. M. Mangham.	22. 7886
At Big Creek, La.	P. B. M. Big Creek.	22. 7165
At Baskin, La.	P. B. M. Baskin.	22. 5224
At Steeles Switch, La.	P. B. M. Steele.	22. 0622
At Winnsboro, La.	P. B. M. Winnsboro.	22. 0338
At Eden, La.	P. B. M. Eden.	21. 8899
At Gilbert, La.	P. B. M. Gilbert.	23. 7449
At Wisner, La.	P. B. M. Wisner.	22. 8314
At Elam, La.	P. B. M. Elam.	22. 0592
At Peck, La.	P. B. M. Peck.	22. 8471
Near Peck, La.	P. B. M. Newman.	21. 8144
Near Florence, La.	P. B. M. Chisum.	21. 9172
At Florence, La.	P. B. M. Florence.	22. 1108
At Copeland, La.	P. B. M. Copeland.	19. 5778
At Kirks Ferry, La.	P. B. M. Kirk.	19. 8518

* Line of 1894 only used in deriving this elevation.

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Greenville, La.	P. B. M. Tensas.	19.7084
At Lee Bayou, La.	P. B. M. Lee Bayou.	19.3762
At Clayton, La.	P. B. M. Clayton.	18.7510
At Cypress City, La.	P. B. M. Cypress.	17.8088
At Helena, La.	P. B. M. Helena.	18.4662
At Concordia, La.	P. B. M. Concordia.	18.4458
At Concordia, La.	B. M. 384.	20.8340
At Jones Bayou, La.	P. B. M. 5 a.	* 17.9831
At McClures Landing, La.	P. B. M. 6 a.	17.0194
At Eva, La.	P. B. M. 7 a.	16.3578
At Hardscramble Landing, La.	P. B. M. 8 a.	16.5562
At Lums, La.	P. B. M. 9 a.	15.9597
At New Era, La.	P. B. M. 10 a.	15.8715
At Acme, La.	P. B. M. 11 a.	15.3316
Near Acme, La.	Discharge Jar.	15.4928
Near Acme, La.	P. B. M. 12 a.	14.9538
At Albany Pt., La.	P. B. M. 1.	67.9701
At Hendersons Mill, La.	P. B. M. 2.	74.5181
At Mooringsport, La.	P. B. M. 3.	55.8591
At Jeters Landing, La.	P. B. M. 4.	60.1604
Near Bayou Siord, La.	P. R. P. Pargoud.	31.5377
At Bank Smith Place, La.	P. R. P. Zeph.	24.1176
At Rock Row Shoals, La.	P. R. P. Rock Row.	23.3890
Near Glendora, La.	P. R. P. Glendora.	24.7663
At Glendora, La.	T. B. M. 79.	† 26.0925
At Parkeville, La.	P. R. P. Parkeville.	23.5981
At Parkeville, La.	T. B. M. 74.	24.8201
At Port Union Landing, La.	P. B. M. Port Union.	25.8315
Near Point Pleasant, La.	P. B. M. Hay.	41.2558
Near Farmerville, La.	P. B. M. White.	54.6285
Near Farmerville, La.	P. B. M. Rogers.	53.5082
At Farmerville, La.	P. B. M. Farmerville.	54.7544
At Scotts Bluff, La.	P. B. M. Scott.	23.1730
At Steins Bluff, La.	P. B. M. Stein.	29.4931
Near Bayou D'Arbonne, La.	P. B. M. Cox Ferry.	21.5688
Near Mill Bayou, La.	P. R. P. Cashill.	21.8094
Near Fishtrap Shoals, La.	P. R. P. Fishtrap.	21.2363
At Alabama Landing, La.	P. R. P. Alabama.	21.2262
At Frank Pierre Creek, La.	P. R. P. Frank Pierre.	17.0652
Near Shiloh Shoals, La.	P. R. P. Shiloh.	17.3146
Near Lake Landing, Ark.	P. R. P. Lake.	18.0296
Near Bayou Lapile, Ark.	P. R. P. Lapile.	18.7510
Near Ouachita Belle Landing, Ark.	P. R. P. Belle Point.	19.6314
Near Belle Point Landing, Ark.	T. B. M. 39.	20.7272
Near Eutaw Shoals, Ark.	P. R. P. Eutaw.	22.0996
Near Jacks Island, Ark.	P. R. P. Jacks Island.	23.8016
At Careyville Landing, Ark.	P. R. P. Careyville.	25.0381
At Pigeon Hill Landing, Ark.	P. R. P. Pigeon Hill.	27.8372
Near Fletchers Landing, Ark.	P. R. P. Fletcher.	25.7413
Near Franklin Bayou, Ark.	P. R. P. Franklin.	22.6681
Near Champagnolle, Ark.	P. R. P. Bell Field.	24.6890
At Champagnolle Landing, Ark.	P. R. P. Champagnolle.	29.7342
At El Dorado Landing, Ark.	P. R. P. El Dorado.	26.8470
Near Smackover Creek, Ark.	P. R. P. Smackover.	26.4071

* Mean derived from P. B. M. 3 and P. B. M. 4 of line of 1894.

† From line of 1897–98.

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Leppards Camp, Ark.	P. R. P. Leppard.	27.6074
Near Little Bay, Ark.	P. R. P. Little Bay.	27.6084
Near Beech Hill, Ark.	P. R. P. Beech Hill.	28.3803
Near Walnut Hill, Ark.	P. R. P. Walnut Hill.	27.5633
Near Walnut Hill, Ark.	T. B. M. 5.	31.6798
At Frenchport, Ark.	P. R. P. Frenchport II.	37.5363
At Frenchport, Ark.	P. R. P. Frenchport I.	34.7957
At Elliott, Ark.	P. R. P. Elliott.	77.4801
At Camden, Ark.	Gauge B. M. A (Ewens, 1890).	40.7403
Near Camden, Ark.	P. B. M. Camden IV.	35.1142
At Camden, Ark.	P. B. M. Camden III.	32.8635
At Camden, Ark.	P. B. M. Camden II.	60.7998
At Camden, Ark.	P. B. M. Camden I.	42.2677
At Lester, Ark.	P. B. M. Lester.	34.7234
At Chidester, Ark.	P. B. M. Chidester.	70.2630
At Little Missouri River, Ark.	P. B. M. Little Missouri.	50.5812
At Whelen, Ark.	P. B. M. Whelen.	76.9675
At Gurdon, Ark.	P. B. M. Gurdon II.	63.5514
At Gurdon, Ark.	P. B. M. Gurdon I.	63.7028
Near Smithton, Ark.	P. B. M. Smithton.	62.9111
At Curtis, Ark.	P. B. M. Curtis.	56.4703
At Gum Springs, Ark.	P. B. M. Gum Springs.	65.2486
At Arkadelphia, Ark.	P. B. M. Arkadelphia II.	65.9479
At Arkadelphia, Ark.	P. B. M. Arkadelphia I.	57.4547
Near Arkadelphia, Ark.	Gauge B. M. B (Ewens, 189–).	56.8013
Near Arkadelphia, Ark.	P. B. M. Ouachita River.	59.4567
At Daleville, Ark.	P. B. M. Daleville.	57.0531
At Donaldson, Ark.	P. B. M. Donaldson.	69.6781
At Malvern, Ark.	P. B. M. Malvern.	82.5696
At Traskwood, Ark.	P. B. M. Traskwood.	89.0353
At Saline River, Ark.	P. B. M. Saline River.	86.1158
At Benton, Ark.	P. B. M. Benton.	91.0042
At Alexander, Ark.	P. B. M. Alexander.	99.5019
At Mabelvale Ark.	P. B. M. Mabelvale.	94.5646
At Ensign, Ark.	P. B. M. Ensign.	89.4570
At Little Rock, Ark.	B. M. Whittemore.	80.3914
At Little Rock, Ark.	B. M. Abert.	75.1891
At Little Rock, Ark.	B. M. Merrill.	78.0255
At Little Rock, Ark.	S. S. Gauge, B. M.	75.8886
At Little Rock, Ark.	B. M. State House Steps.	87.8300
At Little Rock, Ark.	Gauge B. M. A (Ewens).	73.7994
At Little Rock, Ark.	B. M. I (Ewens, 1887).	72.0337
At Little Rock, Ark.	No. 6 (Gauge B. M.).	80.1275
On Bayou Bartholomew, La.	P. B. M. Sandidge.	27.2116
On Bayou Bartholomew, La.	P. B. M. Myers.	27.6967
On Bayou Bartholomew, La.	P. B. M. Williams.	26.4595
On Bayou Bartholomew, La.	P. B. M. Anderson.	27.5528
On Bayou Bartholomew, La.	P. B. M. Bonner.	28.0270
On Bayou Bartholomew, La.	P. B. M. Davis, No. 2.	29.2239
At Wards Ferry, La.	P. B. M. Ward.	29.6491
Near Bayou Bartholomew, La.	P. B. M. Wells.	30.5095
At Mound Landing, La.	P. B. M. Mound.	31.2358
At Lindgrove Landing, La.	P. B. M. Lindgrove.	32.2548
At Bonita, La.	P. B. M. Bonita.	32.4611
At Jones, La.	P. B. M. Jones.	32.5844
Near Jones, La.	P. B. M. Louisiana-Arkansas.	32.6968
At Wilmot, Ark.	P. B. M. Wilmot.	34.9204
On Bayou Bartholomew, Ark.	P. B. M. Noble.	34.7382
At Parkdale, Ark.	P. B. M. Parkdale.	35.5469

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Sunshine, Ark.	P. B. M. Sunshine.	36.0205
At Portland, Ark.	P. B. M. Portland.	38.9113
At Kidds Spur, Ark.	P. B. M. Kidd.	37.9335
At Morrell, Ark.	P. B. M. Morrell.	39.7223
At Hudspeth, Ark.	P. B. M. Hudspeth.	40.5874
At Dermott, Ark.	P. B. M. Dermott.	42.7390
At Baxter, Ark.	P. B. M. Baxter.	43.2725
At McGehee, Ark.	P. B. M. McGehee.	45.3383
At Trippe Junction, Ark.	P. B. M. Trippe.	44.1230
At Trippe Junction, Ark.	T. B. M. 117=Levee B. M.	44.1386
Near Arkansas City, Ark.	M. R. C. Stone $\frac{63}{3}$.	41.5335
Near Arkansas City, Ark.	M. R. C. Stone $\frac{63}{2}$.	44.2153
Near Port Anderson, Miss.	T. B. M. 121 = Levee Board B. M.	44.1407
At Millers Bend, Miss.	P. B. M. Millers Bend.	38.7361
At Greenville, Miss.	B. M. O.	38.1663
At Vicksburg, Miss.	P. B. M. 1.	31.4125
Near Vicksburg, Miss.	P. B. M. 2.	29.4835
On Blakely Plantation, Miss.	P. B. M. 3.	34.4727
At Yazoo River, Miss.	P. B. M. 4.	28.7539
At Yazoo River, Miss.	P. B. M. 5.	32.1771
On Belle Isle Plantation, Miss.	P. B. M. 6.	28.4409
At Calmar, Miss.	P. B. M. 7.	31.0905
Near L'Argent, Miss.	P. B. M. 8.	28.8489
At L'Argent, Miss.	P. B. M. 9.	26.9074
At Satartia, Miss.	P. B. M. 10.	29.6799
At Enola, Miss.	P. B. M. 11.	30.3336
At Yazoo City, Miss.	P. B. M. 12.	35.8025
At Yazoo City, Miss.	P. B. M. 13.	31.2599
At Bee Lake, Miss.	P. B. M. 29.	32.8619
At Tchula, Miss.	P. B. M. 28.	36.0064
At Tchula, Miss.	P. B. M. 27.	34.8443
At Sidon, Miss.	P. B. M. 26.	37.2813
At Greenwood, Miss.	P. B. M. 25.	38.1527
At Greenwood, Miss.	P. B. M. 24.	39.3490
At Fort Loring, Miss.	P. B. M. 23.	40.9617
At Fort Loring, Miss.	P. B. M. 22.	39.1035
At Itta Bena, Miss.	P. B. M. 21.	38.0913
Near Baird, Miss.	P. B. M. 20.	35.7069
Near Baird, Miss.	P. B. M. 19.	34.9794
Near Baird, Miss.	P. B. M. 18.	38.5243
At Indianola, Miss.	P. B. M. 17.	35.7913
At Heathman, Miss.	P. B. M. 16.	36.9994
At The Bogue, Miss.	P. B. M. 15.	34.9913
At Stoneville, Miss.	P. B. M. 14.	37.2799
At Greenville, Miss.	Greenville North Base △.	38.4125
Near Argyle, Miss.	P. B. M. 88.	38.1649
At Millers Bend, Miss.	P. B. M. 87.	39.4603
Near Offutts Landing, Miss.	P. B. M. 86.	41.2070
At Port Anderson, Miss.	P. B. M. 85.	41.6882
Near Wilkersons Landing, Miss.	P. B. M. 83.	42.3734
At Mound Place, Miss.	P. B. M. 82.	42.3054
At Childers, Miss.	P. B. M. 81.	42.7513
At Content, Miss.	P. B. M. 80.	43.6178
At Buck Ridge, Miss.	P. B. M. 79.	43.1813

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Bolivar, Miss.	P. B. M. 78.	42.9336
At Stormville, Miss.	P. B. M. 77.	43.3020
At Nebletts Landing, Miss.	P. B. M. 76.	44.2824
Near Prentiss, Miss.	P. B. M. 75.	45.3268
Near Prentiss, Miss.	P. B. M. 74.	45.2121
Near Prentiss, Miss.	P. B. M. 73.	44.7197
Near Clarks Landing, Miss.	P. B. M. 72.	45.2109
Near Beulah, Miss.	P. B. M. 71.	44.5488
At Riverton, Miss.	P. B. M. 70.	45.8253
At Rosedale, Miss.	P. B. M. 69.	46.1809
At Rosedale, Miss.	P. B. M. 68.	44.7763
Near Terrene, Miss.	P. B. M. 67.	47.2570
Near Concordia, Miss.	P. B. M. 66.	47.2131
At Concordia, Miss.	P. B. M. 65.	48.2240
At Carsons, Miss.	P. B. M. 64.	49.1567
Near Australia, Miss.	P. B. M. 63.	49.3939
At Lake Charles Landing, Miss.	P. B. M. 62.	50.4931
At Robinsonville, Miss.	P. B. M. 61.	49.3510
Near Sunflower Landing, Miss.	P. B. M. 60.	51.3442
Near Hughes Landing, Miss.	P. B. M. 59.	53.0277
Near Hughes Landing, Miss.	P. B. M. 58.	52.3345
Near Friar Point, Miss.	P. B. M. 57.	52.2394
At Friar Point, Miss.	P. B. M. Friar Point II.	55.2280
At Friar Point, Miss.	P. B. M. Friar Point III.	53.7734
At Coahoma, Miss.	P. B. M. Coahoma.	54.1990
Near Clover Hill, Miss.	P. B. M. Clover Hill.	52.8131
At Lyon, Miss.	P. B. M. Lyon.	52.9758
At Clarksdale, Miss.	P. B. M. Clarksdale I.	52.9284
At Clarksdale, Miss.	P. B. M. Clarksdale II.	52.5497
Near Clarksdale, Miss.	P. B. M. Clarksdale III.	52.6651
Near Friar Point, Miss.	B. M. Delta.	54.7301
At Friar Point, Miss.	B. M. Friar Point I.	55.8570
At Glendale, Miss.	B. M. Glendale.	56.2899
At Helena, Ark.	B. M. Helena I.	58.5692
At Helena, Ark.	B. M. Helena II.	58.5757
Near Austin, Miss.	B. M. Trotters Landing.	56.4015
At Austin, Miss.	B. M. Austin I.	59.9594
At Austin, Miss.	B. M. Austin II.	59.2868
At Mhoons Landing, Miss.	B. M. Mhoons Landing.	59.2901
At Commerce, Miss.	B. M. Commerce.	60.0088
At Star Landing, Miss.	B. M. Star Landing.	63.0804
At Horn Lake Creek, Miss.	B. M. Horn Lake Creek.	67.2001
At Birmingham, Ala.	P. B. M. 1.	186.0376
At Birmingham, Ala.	T. B. M. 1.	184.8005
At Birmingham, Ala.	P. B. M. 2.	181.5203
At Birmingham, Ala.	P. B. M. 3.	180.4194
At Birmingham, Ala.	T. B. M. 2.	176.1231
At Elyton, Ala.	T. B. M. 3.	174.0557
Near West End, Ala.	T. B. M. 7.	166.0019
Near Powderly, Ala.	P. B. M. 4.	160.3524
At Powderly, Ala.	T. B. M. 8.	157.2705
Near Powderly, Ala.	T. B. M. 9.	159.8494
Near Hillman, Ala.	T. B. M. 10.	159.0087
Near Hillman, Ala.	T. B. M. 11.	156.2253
At Turpin, Ala.	T. B. M. 13.	157.8734
At Bessemer, Ala.	T. B. M. 14.	159.0121
At Bessemer, Ala.	T. B. M. 15.	157.0456

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Bessemer, Ala.	P. B. M. 5.	156. 4021
At Jonesboro, Ala.	T. B. M. 18.	154. 8965
Near McCalla, Ala.	T. B. M. 24.	150. 4976
Near Baylor, Ala.	T. B. M. 27.	151. 9374
At Kimbrel, Ala.	P. B. M. 6.	149. 6724
Near Standiford, Ala.	T. B. M. 32.	147. 3469
Near Woodstock, Ala.	T. B. M. 39.	151. 5154
Near Bibbville, Ala.	T. B. M. 42.	151. 0621
Near Vance, Ala.	P. B. M. 7.	147. 5327
Near Vance, Ala.	T. B. M. 47.	143. 8140
Near Coaling Station, Ala.	P. B. M. 8.	113. 2591
Near Johnson, Ala.	T. B. M. 60.	98. 9934
Near Olmstead, Ala.	T. B. M. 63.	90. 8203
Near Cottondale, Ala.	P. B. M. 9.	74. 8194
Near Cottondale, Ala.	T. B. M. 69.	106. 7086
Near Cottondale, Ala.	T. B. M. 70.	110. 1588
Near Tuscaloosa, Ala.	T. B. M. 75.	65. 2328
At Tuscaloosa, Ala.	P. B. M. 11.	67. 8710
Near Tuscaloosa, Ala.	Old B. M. 3.	44. 7209
At Tuscaloosa, Ala.	P. B. M. 12.	34. 2781
Near Tuscaloosa, Ala.	Old B. M. 4.	34. 2719
Near Tuscaloosa, Ala.	Old B. M. 5.	28. 0424
Near Tuscaloosa, Ala.	P. B. M. 13.	38. 5740
At Tuscaloosa, Ala.	P. B. M. 10.	50. 8448
Near Tuscaloosa, Ala.	T. B. M. 78.	51. 6965
Near Tuscaloosa, Ala.	T. B. M. 80.	41. 9990
At Englewood, Ala.	T. B. M. 88.	42. 1897
At Hull, Ala.	T. B. M. 94.	39. 1656
At Hull, Ala.	P. B. M. 14.	39. 4383
At Moundville, Ala.	T. B. M. 100.	49. 8928
At Moundville, Ala.	P. B. M. 15.	49. 9038
At Powers, Ala.	P. B. M. 16.	41. 7122
At Akron, Ala.	P. B. M. 17.	39. 6832
At Warrior River, Ala.	P. B. M. 18.	36. 2043
At Warrior River, Ala.	T. B. M. 122.	38. 6019
Near Eutaw, Ala.	T. B. M. 123.	35. 7348
Near Eutaw, Ala.	T. B. M. 124.	36. 0581
At Eutaw, Ala.	P. B. M. 19.	53. 0659
At Eutaw, Ala.	P. B. M. 20.	65. 8573
Near Hairston, Ala.	T. B. M. 132.	49. 7256
Near Hairston, Ala.	T. B. M. 138.	40. 3276
Near Boligee, Ala.	T. B. M. 139.	37. 3852
Near Boligee, Ala.	P. B. M. 21.	37. 3855
Near Miller, Ala.	T. B. M. 150.	33. 9106
Near Epes, Ala.	P. B. M. 22.	29. 7082
At Epes, Ala.	P. B. M. 23.	34. 8127
At Epes, Ala.	T. B. M. 152.	42. 7721
Near Epes, Ala.	T. B. M. 153.	49. 1810
Near Parker, Ala.	T. B. M. 156.	72. 9170
At Parker, Ala.	T. B. M. 157.	81. 4361
Near Livingston, Ala.	T. B. M. 160.	71. 8289
Near Livingston, Ala.	T. B. M. 162.	55. 5670
At Livingston, Ala.	P. B. M. 24.	48. 9316
Near Livingston, Ala.	P. B. M. 25.	37. 2046
Near York, Ala.	T. B. M. 172.	42. 7225
Near York, Ala.	T. B. M. 175.	48. 9445
At York, Ala.	P. B. M. 26.	47. 4457
Near York, Ala.	T. B. M. 179.	48. 6415
Near York, Ala.	T. B. M. 182.	50. 8840
At Cuba, Ala.	P. B. M. 27.	65. 4285

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Cuba, Ala.	T. B. M. 188.	72.8614
At Toomsuba, Miss.	P. B. M. 28.	88.6154
Near Russell, Miss.	T. B. M. 207.	125.9200
At Meridian, Miss.	T. B. M. 217.	101.8682
At Meridian, Miss.	P. B. M. 29.	103.8826
At Coatopa, Ala.	P. B. M. 1.	38.4712
At McDowell, Ala.	P. B. M. 2.	29.0458
Near McDowell, Ala.	P. B. M. 3.	28.1370
Near McDowell, Ala.	P. B. M. 4.	28.1295
At Demopolis, Ala.	Old B. M.	36.6318
At Demopolis, Ala.	P. B. M. 5.	38.4055
At Demopolis. Ala.	P. B. M. 6.	38.7138
At Cairo, Ill.	P. B. M. 4.	95.1581
At Cairo, Ill.	P. B. M. 5.	95.7927
At Fort Jefferson, Ky.	P. B. M. 6.	97.9399
At Columbus, Ky.	P. B. M. 7.	96.0503
At Columbus, Ky.	P. B. M. 8.	93.8418
At Columbus, Ky.	P. B. M. 9.	94.3798
At Columbus, Ky.	P. B. M. 10.	137.8562
Near Worshams Landing, Ky.	P. B. M. 11.	93.4802
Near Worshams Landing, Ky.	P. B. M. 12.	92.3238
Near Hickman, Ky.	P. B. M. 13.	91.8880
At Hickman, Ky.	P. B. M. 14.	109.7892
At Hickman, Ky.	P. B. M. 15.	94.4950
Near Hickman, Ky.	P. B. M. 16.	91.7317
Near Hickman, Ky.	P. B. M. 17.	90.6526
Near Hickman, Ky.	P. B. M. 18.	89.9362
Near Hickman, Ky.	P. B. M. 19.	90.2692
Near Lesters Landing, Tenn.	P. B. M. 20.	89.7502
Near Lesters Landing, Tenn.	P. B. M. 21.	89.4146
At Tiptonville, Tenn.	P. B. M. 22.	88.4217
At Tiptonville, Tenn.	P. B. M. 23.	90.1271
Near Tiptonville, Tenn.	P. B. M. 24.	85.3623
Near Tiptonville, Tenn.	P. B. M. 25.	85.5993
Near Reelfoot Landing, Tenn.	P. B. M. 26.	84.7907
At Mott Landing, Tenn.	P. B. M. 27.	82.4453
Near Booths Point Landing, Tenn.	P. B. M. 28.	82.3355
Near Booths Point, Tenn.	P. B. M. 29.	80.3120
Near Booths Point, Tenn.	P. B. M. 30.	80.2108
Near Booths Point, Tenn.	P. B. M. 31.	80.4334
Near Hales Point, Tenn.	P. B. M. 32.	79.3952
Near Hales Point, Tenn.	P. B. M. 33.	79.1360
Near Hales Point, Tenn.	P. B. M. 34.	77.6995
Near Forked Deer Island, Tenn.	P. B. M. 35.	77.9174
Near Ashport, Tenn.	P. B. M. 36.	77.6122
Near Ashport, Tenn.	P. B. M. 37.	77.5365
Near Ashport, Tenn.	P. B. M. 38.	76.5516
Near Plum Point, Tenn.	P. B. M. 39.	76.0384
Near Plum Point, Tenn.	P. B. M. 40.	75.3851
Near Fort Pillow Landing, Tenn.	P. B. M. 41.	77.4152
Near Fulton, Tenn.	P. B. M. 42.	90.9775
Near Fulton, Tenn.	P. B. M. 43.	75.2555
Near Randolph, Tenn.	P. B. M. 44.	74.2394
Near Randolph, Tenn.	P. B. M. 45.	73.9970
At Randolph, Tenn.	P. B. M. 46.	104.2680
Near Randolph, Tenn.	P. B. M. 47.	119.6661
Near Richardsons Landing, Tenn.	P. B. M. 48.	73.3933
Near Richardsons Landing, Tenn.	P. B. M. 49.	72.2602

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Paynes Landing, Tenn.	P. B. M. 50.	72.0445
Near Thomas Landing, Tenn.	P. B. M. 51.	72.0731
Near Thomas Landing, Tenn.	P. B. M. 52.	70.7236
Near Brinkleys Landing, Tenn.	P. B. M. 53.	69.0674
Near Island No. 40, Tenn.	P. B. M. 54.	68.3088
Near Island No. 40, Tenn.	P. B. M. 55.	67.4878
Near Memphis, Tenn.	P. B. M. 56.	67.4342
Near Grafton, Ill.	P. B. M. 1.	128.4059
Near Grafton, Ill.	P. B. M. 2.	130.2623
At Grafton, Ill.	P. B. M. 3.	133.2104
At Grafton, Ill.	P. B. M. 4.	135.9706
At Grafton, Ill.	P. B. M. 5.	135.3289
At Jersey Landing, Ill.	P. B. M. 6.	128.9321
Near Piasa Creek, Ill.	P. B. M. 7.	137.6159
At Alton, Ill.	P. B. M. 8.	130.8444
At Alton, Ill.	P. B. M. 9.	148.3587
Near Alton, Ill.	P. B. M. 10.	129.9429
Near Alton, Ill.	P. B. M. 11.	126.1282
Near Wilsons Island No. 5, Ill.	P. B. M. 12.	139.5576
Near St. Louis, Mo.	P. B. M. 13.	131.5370
At St. Louis, Mo.	P. B. M. 14.	130.0167
At St. Louis, Mo.	P. B. M. 15.	126.9946
At St. Louis, Mo.	P. B. M. 16.	153.2500
At Carondelet, Mo.	P. B. M. 17.	132.5862
At Jefferson Barracks, Mo.	P. B. M. 18.	150.8037
At Cliff Cave, Mo.	P. B. M. 19.	120.0998
Near Cliff Cave, Mo.	P. B. M. 20.	125.0020
Near Jefferson Station, Mo.	P. B. M. 21.	123.9525
At Kimmswick, Mo.	P. B. M. 22.	124.5959
At Sulphur Springs, Mo.	P. B. M. 23.	123.2163
At Illinois, Mo.	P. B. M. 24.	125.6589
At Platin Rock Creek, Mo.	P. B. M. 25.	117.5461
Near Rush Tower, Mo.	P. B. M. 26.	118.5652
At Rush Tower, Mo.	P. B. M. 27.	120.5865
Near Cliff, Mo.	P. B. M. 28.	115.4569
Near Cliff, Mo.	P. B. M. 29.	124.9460
Near White Sand Depot Landing, Mo.	P. B. M. 30.	118.5960
Near Ste. Genevieve, Mo.	P. B. M. 31.	122.8136
At Ste. Genevieve, Mo.	P. B. M. 32.	119.0639
At Ste. Genevieve, Mo.	P. B. M. 33.	122.2247
At Quarrytown, Mo.	P. B. M. 34.	117.1643
At Ste. Marys, Mo.	P. B. M. 35.	118.5722
At Ste. Marys, Mo.	P. B. M. 36.	120.6892
Near Ste. Marys, Mo	P. B. M. 37.	112.0234
At Chester, Ill.	P. B. M. 38.	116.0020
Near Chester, Ill.	P. B. M. 39.	116.1786
Near Chester, Ill.	P. B. M. 40.	111.9637
At Bois Brulé, Mo.	P. B. M. 41.	110.4882
Near Grand Eddy, Mo.	P. B. M. 42.	113.3386
Near Grand Eddy, Mo.	P. B. M. 43.	112.6849
Near Wittenberg, Mo.	P. B. M. 44.	112.4654
At Wittenberg, Mo.	P. B. M. 45.	110.5109
Near Wittenberg, Mo.	P. B. M. 46.	110.3861
Near Tower Rock, Mo.	P. B. M. 47.	104.9178
At Birmingham Point, Mo.	P. B. M. 48.	103.9468
In Cape Girardeau County, Mo.	P. B. M. 49.	104.1165
In Cape Girardeau County, Mo.	P. B. M. 50.	104.1416
Near Bainbridge Creek, Mo.	P. B. M. 51.	103.0504
Near Cape Rock, Mo.	P. B. M. 52.	104.4910
Near Cape Rock, Mo.	P. B. M. 53.	102.6812

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Cape Girardeau, Mo.	P. B. M. 54.	105.6669
At Cape Girardeau, Mo.	P. B. M. 55.	108.6905
At Cape Girardeau, Mo.	P. B. M. 56.	101.0422
At Grays Point, Mo.	P. B. M. 57.	104.8236
Near Commerce, Mo.	P. B. M. 58.	104.5958
At Commerce, Mo.	P. B. M. 59.	112.6728
At Commerce, Mo.	P. B. M. 60.	104.4220
At Commerce, Mo.	P. B. M. 61.	110.5495
Near Cairo, Ill.	P. B. M. 62.	98.5266
Near Cairo, Ill.	P. B. M. 63.	102.7155
Near Cairo, Ill.	P. B. M. 64.	101.4609
Near Cairo, Ill.	P. B. M. 65.	97.3807
Near Cairo, Ill.	P. B. M. 66.	95.3985
At Keokuk, Iowa	P. B. M. 1 (1881).	150.4482
At Keokuk, Iowa	P. B. M. 2.	150.6632
At Keokuk, Iowa	P. B. M. 3.	155.3010
Near Keokuk, Iowa	P. B. M. 4.	152.3353
At Alexandria, Mo.	P. B. M. 5.	151.9195
At Gregorys Landing, Mo.	P. B. M. 6.	148.6792
Near Gregorys Landing, Mo.	P. B. M. 7.	151.1447
At Canton, Mo.	P. B. M. 8.	150.6950
At Canton, Mo.	P. B. M. 9.	150.4943
Near Lagrange, Mo.	P. B. M. 10.	147.5209
At Lagrange, Mo.	P. B. M. 11.	147.4881
At West Quincy, Mo.	P. B. M. 12.	145.6268
At Fabius River, Mo.	P. B. M. 13.	145.8224
Near Hilton Station, Mo.	P. B. M. 14.	144.7141
Near Hilton Station, Mo.	P. B. M. 15.	143.6579
At Hannibal, Mo.	P. B. M. 16.	149.1719
Near Hannibal, Mo.	P. B. M. 17.	141.7074
At Saverton, Mo.	P. B. M. 18.	141.2861
Near Ashburn, Mo.	P. B. M. 19.	145.6554
Near Ashburn, Mo.	P. B. M. 20.	144.4816
Near Ashburn, Mo.	P. B. M. 21.	139.1105
Near Louisiana, Mo.	P. B. M. 22.	142.8850
At Louisiana, Mo.	P. B. M. 23.	142.8764
At Louisiana, Mo.	P. B. M. 24.	142.5951
At Louisiana, Mo.	P. B. M. 25.	141.1869
Near Clarksville, Mo.	P. B. M. 26.	140.5512
At Clarksville, Mo.	P. B. M. 27.	141.9220
At Clarksville, Mo.	P. B. M. 28.	140.4647
In Illinois, opposite Clarksville, Mo.	P. B. M. 29.	136.7880
In Illinois, opposite Clarksville, Mo.	P. B. M. 30.	136.7715
In Illinois, opposite Clarksville, Mo.	P. B. M. 31.	135.9132
Near Hamburg, Ill.	P. B. M. 32.	142.5028
Near Hamburg, Ill.	P. B. M. 33.	156.9398
Near Hamburg, Ill.	P. B. M. 34.	135.5934
Near Hamburg, Ill.	P. B. M. 35.	133.8172
Near Reds Landing, Ill.	P. B. M. 36.	133.5623
Near Sterling Island, Ill.	P. B. M. 37.	133.4705
Near Hogville Landing, Ill.	P. B. M. 38.	132.6083
At Turners Landing, Ill.	P. B. M. 39.	133.4760
Near Turners Landing, Ill.	P. B. M. 40.	132.5362
At West Point, Ill.	P. B. M. 41.	135.8659
Near Hastings Landing, Ill.	P. B. M. 42.	134.9869
Near Martins Landing, Ill.	P. B. M. 43.	132.8006
Near Millers Landing, Ill.	P. B. M. 44.	132.6757
At Thomas Landing, Ill.	P. B. M. 45.	130.9148
Near Dixons Landing, Ill.	P. B. M. 46.	138.5713

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Point Landing, Ill.	P. B. M. 47.	131.7351
Near Keokuk, Iowa	P. B. M. 1 (1882).	152.8651
At Nashville, Iowa	P. B. M. 2.	154.8011
At Montrose, Iowa	P. B. M. 3.	161.6613
Near Viele Station, Iowa	P. B. M. 4.	165.5806
Near Viele Station, Iowa	P. B. M. 5.	163.7730
Near Viele Station, Iowa	P. B. M. 6.	165.2841
At Fort Madison, Iowa	P. B. M. 7.	162.9042
At Fort Madison, Iowa	P. B. M. 8.	164.4760
Near Fort Madison, Iowa	P. B. M. 9.	166.4044
Near Fort Madison, Iowa	P. B. M. 10.	167.0380
Near Burlington, Iowa	P. B. M. 11.	164.6233
At Burlington, Iowa	P. B. M. 12.	162.0802
At Burlington, Iowa	P. B. M. 13.	165.3114
At Burlington, Iowa	P. B. M. 14.	165.3499
At Burlington, Iowa	P. B. M. 15.	161.5912
At Burlington, Iowa	P. B. M. 16.	162.0787
At Oquawka, Ill.	P. B. M. 17.	163.4420
At Oquawka, Ill.	P. B. M. 18.	167.0525
At Keithsburg, Ill.	P. B. M. 19.	164.5420
At Keithsburg, Ill.	P. B. M. 20.	167.5656
Near New Boston, Ill.	P. B. M. 21.	169.1795
At New Boston, Ill.	P. B. M. 22.	166.1815
At New Boston, Ill.	P. B. M. 23.	173.9293
At Port Louisa, Iowa	P. B. M. 24.	166.2256
Near Muscatine, Iowa	P. B. M. 25.	165.9199
Near Muscatine, Iowa	P. B. M. 26.	167.1733
At Muscatine, Iowa	P. B. M. 27.	167.7565
At Muscatine, Iowa	P. B. M. 28.	168.2164
At Muscatine, Iowa	P. B. M. 29.	168.3545
Near Muscatine, Iowa	P. B. M. 30.	168.7132
Near Muscatine, Iowa	P. B. M. 31.	168.4747
Near Muscatine, Iowa	P. B. M. 32.	171.1081
At Fairport, Iowa	P. B. M. 33.	169.3092
Near Montpelier, Iowa	P. B. M 34.	169.0202
Near Montpelier, Iowa	P. B. M. 35.	172.1316
Near Montpelier, Iowa	P. B. M. 35a.	169.8439
At Buffalo, Iowa	P. B. M. 36.	172.3216
Near Buffalo, Iowa	P. B. M. 37.	173.3880
At West Davenport, Iowa	P. B. M. 38.	172.9507
Near West Davenport, Iowa	P. B. M. 39.	174.7967
On Arsenal Island, Ill.	P. B. M. 40.	176.0357
At Rock Island, Ill.	P. B. M. 41.	177.2272
Near Moline, Ill.	P. B. M. 42.	173.4929
At Watertown, Ill.	P. B. M. 43.	175.3508
At Hampton, Ill.	P. B. M. 44.	176.9214
At Hampton, Ill.	P. B. M. 45.	173.8663
At Rapids City, Ill.	P. B. M. 46.	175.7645
Near Port Byron, Ill.	P. B. M. 47.	176.8743
At Port Byron, Ill.	P. B. M. 48.	177.3244
At Port Byron, Ill.	P. B. M. 49.	179.1264
At Cordova, Ill.	P. B. M. 50.	174.9780
At Cordova, Ill.	P. B. M. 51.	181.4380
At Albany, Ill.	P. B. M. 52.	181.6234
Near Albany, Ill.	P. B. M. 53.	182.5254
Near Albany, Ill.	P. B. M. 54.	176.2240
Near Fulton, Ill.	P. B. M. 55.	177.2180
Near Fulton, Ill.	P. B. M. 56.	177.6024
At Fulton, Ill.	P. B. M. 57.	182.1154

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Fulton, Ill.	P. B. M. 58.	177.6781
At Fulton, Ill.	B. M. 35.	178.7067
Near Fulton, Ill.	P. B. M. 59.	179.7555
At Thomson, Ill.	P. B. M. 60.	184.7882
Near Savanna, Ill.	P. B. M. 61.	178.9327
At Savanna, Ill.	P. B. M. 62.	180.5071
At Savanna, Ill.	Captain McKenzie's B. M. 34.	180.5081
At Savanna, Ill.	P. B. M. 63.	182.7830
At Savanna. Ill.	P. B. M. 64.	181.0140
Near Hickory Grove, Ill.	P. B. M. 65.	205.4322
At Mount Carroll, Ill.	P. B. M. 66.	249.0428
Near Lanark, Ill.	P. B. M. 67.	240.4425
At Lanark, Ill.	P. B. M. 68.	269.2147
Near Lanark, Ill.	P. B. M. 69.	256.1154
Near Lanark Junction, Ill.	P. B. M. 70.	288.7707
At Forreston Junction, Ill.	P. B. M. 71.	267.3297
At Adeline, Ill.	P. B. M. 72.	228.8629
At Leaf River, Ill.	P. B. M. 73.	216.1271
At Byron, Ill.	P. B. M. 74.	222.3274
Near Byron, Ill.	P. B. M. 75.	211.3481
At Stillman Valley, Ill.	P. B. M. 76.	215.4429
Near Davis Junction, Ill.	P. B. M. 77.	246.4491
At Monroe, Ill.	P. B. M. 78.	256.9261
At Fielding, Ill.	P. B. M. 79.	239.5515
At Kirkland, Ill.	P. B. M. 80.	236.1510
At Kingston, Ill.	P. B. M. 81.	245.3451
At Genoa, Ill.	P. B. M. 82.	255.6219
At Hampshire, Ill.	P. B. M. 83.	274.4159
At Pingree Grove, Ill.	P. B. M. 84.	279.7464
Near Dumser, Ill.	P. B. M. 85.	259.2934
At West Elgin, Ill.	P. B. M. 86.	218.6837
At West Elgin, Ill.	P. B. M. 87.	218.0633
At East Elgin, Ill.	B. M. Newcomb.	227.3392
Near Elgin, Ill.	P. B. M. 88.	220.0164
At Bartlett, Ill.	P. B. M. 89.	245.0703
At Roselle, Ill.	P. B. M. 90.	235.3477
At Itasca, Ill.	P. B. M. 91.	213.0822
At Bensenville, Ill.	P. B. M. 92.	207.6131
At Manheim, Ill.	P. B. M. 93.	198.4461
At Cragin, Ill.	P. B. M. 94.	188.3859
At Chicago, Ill.	P. B. M. 95.	180.3837
At Chicago, Ill.	P. B. M. 96.	182.3783
At Chicago, Ill.	P. B M. 97.	181.6065
At Chicago, Ill.	P. B. M. 98.	182.4300
At Chicago, Ill.	P. B. M. 99.	180.3077
In Lake Michigan, Ill.	P. B. M. 100.	179.2116
At Chicago, Ill.	B. M. I.	181.5427
At Chicago, Ill.	B. M. II.	181.0552
At Chicago, Ill.	B. M. III.	179.7930
At Chicago, Ill.	B. M. IV.	180.9759
At Chicago, Ill.	B. M. VI.	181.4351
At Chicago, Ill.	B. M. VII.	181.5621
At Chicago, Ill.	B. M. VIII.	180.7963
At Chicago, Ill.	B. M. IX.	180.8971
At Chicago, Ill.	B. M. XIII.	179.5749
At St. Paul, Minn.	P. B. M. 66.	218.9943
At St. Paul, Minn.	T. B. M. 1.	218.4547
At St. Paul, Minn.	P. B. M. 65.	217.7745
At St. Paul, Minn.	P. B. M. 67.	215.9947

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At St. Paul, Minn.	P. B. M. 68.	214.3512
At St. Paul, Minn.	Old U. S. B. M. A.	215.5678
At St. Paul, Minn.	Old U. S. B. M. 2½.	211.9094
At St. Paul, Minn.	P. B. M. 70.	214.8002
At St. Paul, Minn.	P. B. M. 71.	216.0221
At St. Paul, Minn.	P. B. M. 72.	237.8303
At St. Paul, Minn.	P. B. M. 73.	213.4163
At St. Paul, Minn.	P. B. M. 74.	214.6358
At Daytons Bluff, Minn.	P. B. M. 75.	212.8678
At Daytons Bluff, Minn.	P. B. M. 76.	214.0853
Near Highwood, Minn.	T. B. M. 8.	215.8077
Near Highwood, Minn.	T. B. M. 9.	212.8019
Near Highwood, Minn.	T. B. M. 10.	216.9043
Near Highwood, Minn.	P. B. M. 77.	215.3045
Near Highwood, Minn.	P. B. M. 78.	216.5231
Near Red Rock, Minn.	T. B. M. 11.	221.3983
At Newport, Minn.	T. B. M. 12.	226.7953
At Newport, Minn.	P. B. M. 79.	225.6243
At Newport, Minn.	P. B. M. 80.	226.8431
At Newport Landing, Minn.	Old U. S. B. M. 12.	211.3178
At St. Paul Park, Minn.	P. B. M. 81.	227.3143
Near St. Paul Park, Minn.	T. B. M. 14.	229.4748
Near St. Paul Park, Minn.	P. B. M. 83.	228.8512
Near St. Paul Park, Minn.	P. B. M. 84.	230.0678
Near Pullman, Minn.	T. B. M. 17.	227.3660
Near head of Nininger Slough, Minn.	P. B. M. 85.	211.5843
Near head of Nininger Slough, Minn.	P. B. M. 86.	212.8082
Near Island 18, Minn.	T. B. M. 22.	211.3581
At foot of Nininger Slough, Minn.	P. B. M. 87.	210.8357
Near mouth of Nininger Slough, Minn.	Old U. S. B. M. 23.	211.7235
Near Hastings, Minn.	T. B. M. 23.	211.5894
Near Hastings, Minn.	P. B. M. 88.	210.8910
Near Hastings, Minn.	P. B. M. 89.	212.1125
Near Hastings, Minn.	P. B. M. 96.	210.7211
At Hastings, Minn.	P. B. M. 97.	211.8398
At Point Douglas, Minn.	T. B. M. 26.	216.0961
At Point Douglas, Minn.	P. B. M. 90.	217.1713
At Prescott, Wis.	T. B. M. 27.	212.8535
At Prescott, Wis.	P. B. M. 91.	211.9307
At Prescott, Wis.	T. B. M. 28.	213.8111
Near Prescott, Wis.	T. B. M. 30.	209.0485
Near Prescott, Wis.	P. B. M. 92.	209.5459
Near Prescott, Wis.	P. B. M. 93.	210.7633
Near Prescott, Wis.	P. B. M. 94.	207.2827
Near Prescott, Wis.	P. B. M. 95.	208.5012
Near Smiths Bar, Wis.	T. B. M. 35.	208.4572
At Smiths Landing, Wis.	P. B. M. 98.	207.5656
At Smiths Landing, Wis.	P. B. M. 99.	208.7843
At Smiths Landing, Wis.	T. B. M. 37.	207.1946
Near Smiths Landing, Wis.	T. B. M. 38.	208.3854
Near Morgans Coulee, Wis.	T. B. M. 39.	209.7104
Near Diamond Bluff, Wis.	T. B. M. 40.	212.0515
Near Diamond Bluff, Wis.	T. B. M. 47.	207.1905
Near Diamond Bluff, Wis.	P. B. M. 100.	208.5647
Near Diamond Bluff, Wis.	P. B. M. 101.	209.7816
At Diamond Bluff, Wis.	T. B. M. 45.	220.4858
At Diamond Bluff, Wis.	P. B. M. 102.	220.2763
At Diamond Bluff, Wis.	P. B. M. 103.	221.4922
Near Diamond Bluff, Wis.	T. B. M. 46.	221.1198
Near Diamond Bluff, Wis.	P. B. M. 104.	219.6186

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Diamond Bluff, Wis.	P. B. M. 105.	220. 8409
Near Diamond Bluff, Wis.	T. B. M. 48.	220. 3340
At Trenton, Wis.	T. B. M. 50.	233. 2230
At Trenton Landing, Wis.	T. B. M. 51.	206. 0268
At Trenton Landing, Wis.	P. B. M. 106.	205. 7034
At Trenton Landing, Wis.	P. B. M. 107.	206. 9268
Near Island 24, Wis.	T. B. M. 52.	206. 4716
Near Pucketville, Wis.	T. B. M. 53.	206. 3687
Near Pucketville, Wis.	P. B. M. 108.	205. 5469
Near Pucketville, Wis.	P. B. M. 109.	206, 7634
At Pucketville, Wis.	P. B. M. 110.	205. 3829
At Pucketville, Wis.	P. B. M. 111.	206. 5927
At Red Wing, Minn.	P. B. M. 112.	209. 7713
At Red Wing, Minn.	P. B. M. 113.	206. 5856
Near Red Wing, Minn.	T. B. M. 57.	209. 7666
Near Red Wing, Minn.	T. B. M. 58.	215. 8130
Near Red Wing, Minn.	P. B. M. 114.	212. 5862
Near Red Wing, Minn.	P. B. M. 115.	213. 8014
Near Red Wing, Minn.	T. B. M. 59.	205. 0005
Near Red Wing, Minn.	T. B. M. 60.	205. 0279
Near Red Wing, Minn.	T. B. M. 61.	204. 7289
Near Wacouta, Minn.	P. B. M. 116.	206. 2467
Near Wacouta, Minn.	P. B. M. 117.	207. 4631
At Wacouta, Minn.	P. B. M. 118.	206. 2097
At Wacouta, Minn.	P. B. M. 119.	207. 4289
Near Lake Side, Minn.	P. B. M. 120.	205. 6752
Near Lake Side, Minn.	P. B. M. 121.	206. 8949
Near Lake Side, Minn.	T. B. M. 66.	205. 0034
Near Lake Side, Minn.	T. B. M. 67.	204. 7713
Near Lake Side, Minn.	T. B. M. 69.	204. 3930
Near Lake Side, Minn.	T. B. M. 70.	204. 0150
At Lake Side, Minn.	P. B. M. 122.	205. 8058
At Lake Side, Minn.	P. B. M. 123.	207. 0216
At Florence, Minn.	T. B. M. 76.	209. 0104
At Florence, Minn.	P. B. M. 124.	207. 2448
At Florence, Minn.	P. B. M. 125.	208. 4643
Near Florence, Minn.	T. B. M. 77.	205. 0869
At Central Point, Minn.	P. B. M. 126.	206. 0247
At Central Point, Minn.	P. B. M. 127.	207. 2396
At Lake City, Minn.	P. B. M. 128.	210. 3118
At Lake City, Minn.	P. B. M. 129.	210. 3399
At Lake City, Minn.	Old U. S. B. M.	205. 8872
Near Lake City, Minn.	P. B. M. 130.	211. 0482
Near Lake City, Minn.	P. B. M. 131.	212. 2693
Near Lake City, Minn.	T. B. M. 84.	208. 6948
Near Kings Coulee, Minn.	T. B. M. 86.	207. 3408
At Keplers Coulee, Minn.	P. B. M. 132.	207. 6109
At Kings Coulee, Minn.	T. B. M. 87.	207. 5215
Near Kings Coulee, Minn.	P. B. M. 133.	208. 2338
Near Kings Coulee, Minn.	P. B. M. 134.	209. 4562
At Dutchmans Coulee, Minn.	T. B. M. 88.	207. 1160
Near Kings Coulee, Minn.	T. B. M. 89.	208. 5461
Near Reeds Landing, Minn.	T. B. M. 90.	207. 7821
Near Reeds Landing, Minn.	P. B. M. 135.	208. 9405
Near Reeds Landing, Minn.	P. B. M. 136.	210. 1591
Near Roscoes Coulee, Minn.	T. B. M. 91.	208. 5949
At Reeds Landing, Minn.	P. B. M 137.	209. 2140
At Reeds Landing, Minn.	T. B. M. 93.	208. 4183
At Reeds Landing, Minn.	Old U. S. B. M. A.	210. 4420
At Reeds Landing, Minn.	P. B M. 138.	208. 9537

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Reeds Landing, Minn.	P. B. M. 139.	210.1695
At Wabasha, Minn.	P. B. M. 140.	210.5889
At Wabasha, Minn.	Old U. S. B. M. 62¼.	206.5796
At Wabasha, Minn.	Old U. S. B. M. E.	210.5521
At Wabasha, Minn.	P. B. M. 141.	206.8767
At Wabasha, Minn.	P. B. M. 142.	208.0872
At Teepeeota Point, Minn.	P. B. M. 143.	205.2429
At Teepeeota Point, Minn.	P. B. M. 144.	206.4569
Near Alma, Wis.	P. B. M. 145.	202.4398
Near Alma, Wis.	P. B. M. 146.	203.6568
At Alma, Wis.	T. B. M. 104.	205.5330
At Alma, Wis.	P. B. M. 147.	205.5340
At Alma, Wis.	Old U. S. B. M. 1.	207.4898
At Alma, Wis.	Old U. S. B. M. 3.	208.0858
At Alma, Wis.	P. B. M. 148.	209.6077
At Alma, Wis.	Old U. S. B. M. 4.	207.3581
Near Alma, Wis.	T. B. M. 105.	206.8222
Near Alma, Wis.	P. B. M. 149.	206.0474
Near Alma, Wis.	P. B. M. 150.	207.2595
Near Alma, Wis.	T. B. M. 107.	205.4986
Near Alma, Wis.	P. B. M. 151.	203.7806
Near Alma, Wis.	P. B. M. 152.	204.9972
Near Cochrane, Wis.	P. B. M. 153.	204.2874
Near Cochrane, Wis.	P. B. M. 154.	205.5089
Near Fountain City, Wis.	T. B. M. 117.	203.7254
Near Fountain City, Wis.	P. B. M. 155.	200.4803
Near Fountain City, Wis.	P. B. M. 156.	201.6981
Near Fountain City, Wis.	T. B. M. 121.	201.4075
Near Fountain City, Wis.	P. B. M. 157.	199.7190
Near Fountain City, Wis.	P. B. M. 158.	200.9388
At Fountain City, Wis.	T. B. M. 122.	203.1176
At Fountain City, Wis.	Old U. S. B. M. 1 H. W. G.	200.9660
At Fountain City, Wis.	Old U. S. B. M. A.	204.9895
At Fountain City. Wis.	P. B. M. 159.	205.9382
Near Fountain City, Wis.	T. B. M. 123.	202.5674
Near Fountain City, Wis.	P. B. M. 160.	204.0388
Near Fountain City, Wis.	P. B. M. 161.	205.2577
Near Island 65, Wis.	T. B. M. 124.	203.5292
At Island 69, Wis.	T. B. M. 125.	202.0093
At Island 69, Wis.	P. B. M. 162.	201.3258
At Island 69, Wis.	P. B. M. 163.	202.0435
Near Island 69, Wis.	T. B. M. 126.	202.8346
Opposite Winona, Minn., in Wis.	T. B. M. 127.	203.8693
Opposite Winona, Minn., in Wis.	P. B. M. 164.	197.4417
Opposite Winona, Minn., in Wis.	P. B. M. 165.	198.6547
At Winona, Minn.	Old U. S. B. M. XVII.	200.8984
At Winona, Minn.	P. B. M. 166.	200.6544
At Winona, Minn.	P. B. M. 167.	201.8061
At Winona, Minn.	New Gauge at Winona.	195.1990
At Winona, Minn.	Old U. S. B. M. b.	201.0207
At Winona, Minn.	Winona City B. M.	200.6954
At Winona, Minn.	Old U. S. B. M.	200.9260
At Winona, Minn.	P. B. M. 168.	203.1911
At Winona, Minn.	Old U. S. B. M. B.	200.5607
At Winona, Minn.	Old U. S. B. M. on Liberty and Second streets.	201.5901
At Winona, Minn.	Old U. S. B. M. on Keys's barn.	203.6133
At Winona, Minn.	P. B. M. 169.	202.4406
At Minneopa, Minn.	P. B. M. 170.	198.2989
At Minneopa, Minn.	P. B. M. 171.	199.5157

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Winona, Minn.	T. B. M. 130.	200.0315
Near Homer, Minn.	T. B. M. 131.	201.3948
Near Homer, Minn.	P. B. M. 172.	200.6513
Near Homer, Minn.	P. B. M. 173.	201.8678
Near Homer, Minn.	T. B. M. 132.	200.6853
Near Homer, Minn.	T. B. M. 133.	201.4018
Near Homer, Minn.	P. B. M. 174.	203.9733
Near Homer, Minn.	P. B. M. 175.	205.1930
Near Lamoille, Minn.	T. B. M. 135.	200.1514
At Lamoille, Minn.	P. B. M. 176.	199.4898
At Lamoille, Minn.	P. B. M. 177.	200.7052
Near Richmond, Minn.	T. B. M. 142.	204.3120
At Richmond, Minn.	P. B. M. 178.	199.8959
At Richmond, Minn.	P. B. M. 179.	201.1157
At Richmond, Minn.	T. B. M. 144.	199.9687
Near Dakota, Minn.	T. B. M. 146.	204.6712
Near Richmond, Minn.	P. B. M. 180.	202.1492
Near Richmond, Minn.	P. B. M. 181.	203.3711
At Dakota, Minn.	P. B. M. 182.	202.1010
At Dakota, Minn.	P. B. M. 183.	203.3200
At Dakota, Minn.	Old U. S. B. M. 131.	199.0408
At Dresbach, Minn.	Old U. S. B. M. 130½.	197.6636
At Dresbach, Minn.	P. B. M. 184.	210.2806
Near Dresbach, Minn.	T. B. M. 151.	201.2065
Near Dresbach, Minn.	P. B. M. 185.	200.1199
Near Dresbach, Minn.	P. B. M. 186.	201.3421
Near Dresbach, Minn.	T. B. M. 153.	202.2582
Near River Junction, Minn.	T. B. M. 154.	201.3395
Near La Crescent, Minn.	P. B. M. 187.	199.0429
Near La Crescent, Minn.	P. B. M. 188.	200.2678
Near La Crescent, Minn.	T. B. M. 155.	196.3554
Near La Crosse, Wis.	Old U. S. B. M. 139.	198.6562
Near La Crosse Wis.	P. B. M. 189.	199.1640
Near La Crosse, Wis.	P. B. M. 190.	199.1871
At North La Crosse, Wis.	T. B. M. 157.	197.9963
At North La Crosse, Wis.	P. B. M. 191.	197.2823
At North La Crosse, Wis.	T. B. M. 158.	196.9455
At La Crosse, Wis.	City B. M. (Front street).	198.6474
At La Crosse, Wis.	P. B. M. 192.	207.2291
At La Crosse, Wis.	T. B. M. 160.	200.5062
At La Crosse, Wis.	City B. M. (near bridge).	195.4616
At La Crosse, Wis.	P. B. M. 193.	196.3674
At La Crosse, Wis.	T. B. M. 161.	201.3831
At La Crosse, Wis.	T. B. M. 162.	205.5880
At La Crosse, Wis.	P. B. M. 194.	198.0975
At La Crosse, Wis.	P. B. M. 195.	199.3152
Near Stoddard, Wis.	P. B. M. 196.	196.1654
Near Stoddard, Wis.	P. B. M. 197.	197.3790
Near Stoddard, Wis.	T. B. M. 170.	196.0505
Near Stoddard, Wis.	T. B. M. 172.	195.4727
At Stoddard, Wis.	P. B. M. 198.	196.8498
At Warners Landing, Wis.	P. B. M. 199.	194.1799
At Warners Landing, Wis.	P. B. M. 200.	195.3985
At Britts Landing, Wis	T. B. M. 175.	196.2897
Near Genoa, Wis.	P. B. M. 201.	194.6521
Near Geona, Wis.	P. B. M. 202.	195.8757
Near Geona, Wis.	T. B. M. 177.	195.2188
Near Genoa, Wis.	T. B. M. 178.	195.7950
Near Genoa, Wis.	P. B. M. 203.	200.2671
At Genoa, Wis.	Old U. S. B. M. i.	195.1542

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Genoa, Wis.	T. B. M. 180.	195.7053
Near Genoa, Wis.	P. B. M. 204.	193.4521
Near Genoa, Wis.	P. B. M. 205.	194.6710
At Tippets Landing, Wis.	T. B. M. 186.	195.4616
At Tippets Landing, Wis.	P. B. M. 206.	195.9673
At Tippets Landing, Wis.	P. B. M. 207.	197.1896
At Victory, Wis.	P. B. M. 208.	195.2660
Near Victory, Wis.	T. B. M. 188.	194.6660
Near De Soto, Wis.	P. B. M. 209.	193.0983
Near De Soto, Wis.	P. B. M. 210.	194.3199
Near De Soto, Wis.	T. B. M. 192.	194.5396
At De Soto, Wis.	T. B. M. 193.	195.7950
At De Soto, Wis.	P. B. M. 211.	191.0355
At De Soto, Wis.	P. B. M. 212.	194.0753
Near De Soto, Wis.	T. B. M. 195.	194.0858
Near De Soto, Wis.	P. B. M. 213.	192.6015
Near De Soto, Wis.	P. B. M. 214.	193.8107
Near De Soto, Wis.	T. B. M. 196.	193.8195
Near Rush Creek, Wis.	T. B. M. 197.	194.0447
Near Ferryville, Wis.	T. B. M. 198.	193.1631
Near Ferryville, Wis.	P. B. M. 215.	192.7731
Near Ferryville, Wis.	P. B. M. 216.	193.9937
Near Ferryville, Wis.	T. B. M. 200.	192.9585
At Ferryville, Wis.	P. B. M. 217.	191.7393
At Ferryville, Wis.	P. B. M. 218.	192.9608
Near Ferryville, Wis.	T. B. M. 202.	193.7196
Near Ferryville, Wis.	T. B. M. 204.	192.0252
Near Ferryville, Wis.	P. B. M. 219.	190.4046
Near Ferryville, Wis.	P. B. M. 220.	191.6230
Near Lynxville, Wis.	P. B. M. 221.	191.9805
Near Lynxville, Wis.	P. B. M. 222.	193.2006
Near Lynxville, Wis.	T. B. M. 206.	192.9046
At Lynxville, Wis.	T. B. M. 207.	193.6276
At Lynxville, Wis.	Old U. S. B. M.	194.4788
At Lynxville, Wis.	P. B. M. 223.	194.6620
Near Lynxville, Wis.	T. B. M. 209.	192.8855
At Viola, Wis.	T. B. M. 211.	192.8354
At Viola, Wis.	P. B. M. 224.	192.0671
At Viola, Wis.	P. B. M. 225.	193.2855
Near Viola, Wis.	T. B. M. 212.	193.5464
Near Viola, Wis.	T. B. M. 213.	193.7018
Near Charme, Wis.	T. B. M. 215.	191.8058
Near Charme, Wis.	P. B. M. 226.	192.2958
Near Charme, Wis.	P. B. M. 227.	193.5156
Near Charme, Wis.	P. B. M. 228.	193.7195
At Charme, Wis.	T. B. M. 216.	193.2087
Near Charme, Wis.	T. B. M. 218.	192.6508
Near Charme, Wis.	P. B. M. 229.	192.1992
Near Charme, Wis.	P. B. M. 230.	193.4176
At Prairie du Chien, Wis.	T. B. M. 225.	194.8645
At Prairie du Chien, Wis.	P. B. M. 231.	196.1599
At Prairie du Chien, Wis.	P. B. M. 232.	192.3807
At Prairie du Chien, Wis.	Old U. S. B. M. a.	192.3809
At Prairie du Chien, Wis.	T. B. M. 226.	190.8411
At North McGregor, Iowa	T. B. M. 227.	189.2287
At North McGregor, Iowa	P. B. M. 233.	192.4485
At South McGregor, Iowa	T. B. M. 228.	191.7001
At South McGregor, Iowa	P. B. M. 234.	192.5589
At South McGregor, Iowa	P. B. M. 235.	192.9091
Near South McGregor, Iowa	T. B. M. 230.	192.7131

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near South McGregor, Iowa	P. B. M. 236.	191.3735
Near South McGregor, Iowa	P. B. M. 237.	192.5932
Near South McGregor, Iowa	P. B. M. 238.	193.8411
Near South McGregor, Iowa	T. B. M. 231.	191.3085
Near Island 176, Iowa	T. B. M. 232.	190.4724
Near Sny McGill, Iowa	P. B. M. 239.	190.3849
Near Sny McGill, Iowa	P. B. M. 240.	191.5026
At Clayton, Iowa	Old U. S. B. M. b.	189.7739
At Clayton, Iowa	Old U. S. B. M.	190.8700
At Clayton, Iowa	P. B. M. 241.	198.2367
Near Clayton, Iowa	T. B. M. 239.	192.6729
Near Clayton, Iowa	P. B. M. 242.	192.2514
Near Clayton, Iowa	T. B. M. 241.	191.5301
Near Eckard, Iowa	P. B. M. 243.	188.9991
Near Eckard, Iowa	P. B. M. 244.	190.2199
Near Eckard, Iowa	T. B. M. 245.	189.9144
Near Guttenberg, Iowa	P. B. M. 245.	188.2437
Near Guttenberg, Iowa	P. B. M. 246.	189.4610
At Guttenberg, Iowa	P. B. M. 247.	192.5269
At Guttenberg, Iowa	P. B. M. 248.	194.5407
At Guttenberg, Iowa	T. B. M. 250.	187.8654
Near Guttenberg, Iowa	T. B. M. 252.	189.9025
Near Guttenberg, Iowa	P. B. M. 249.	188.0296
Near Guttenberg, Iowa	P. B. M. 250.	189.2475
Near Guttenberg, Iowa	T. B. M. 253.	189.6677
Near Guttenberg, Iowa	T. B. M. 254.	192.2496
Near Turkey River Junction, Iowa	T. B. M. 256.	190.4160
At Turkey River Junction, Iowa	P. B. M. 251.	190.9406
At Turkey River Junction, Iowa	T. B. M. 257.	187.9182
At Turkey River Junction, Iowa	P. B. M. 252.	187.9218
Near Turkey River Junction, Iowa	T. B. M. 258.	189.9400
Near Buena Vista, Iowa	P. B. M. 253.	188.1083
Near Buena Vista, Iowa	P. B. M. 254.	189.3275
Near Buena Vista, Iowa	T. B. M. 262.	190.7192
At Buena Vista, Iowa	T. B. M. 264.	191.1802
At Buena Vista, Iowa	P. B. M. 255.	191.2775
Near Buena Vista, Iowa	T. B. M. 265.	191.4742
Near Buena Vista, Iowa	T. B. M. 267.	191.3309
Near Waupeton, Iowa	P. B. M. 256.	190.1381
Near Waupeton, Iowa	P. B. M. 257.	191.3572
Near Waupeton, Iowa	T. B. M. 269.	191.8613
Near Waupeton, Iowa	T. B. M. 270.	190.9051
Near Waupeton, Iowa	P. B. M. 258.	187.7169
Near Waupeton, Iowa	P. B. M. 259.	188.9326
Near Waupeton, Iowa	T. B. M. 273.	190.9485
At Finley Landing, Iowa	P. B. M. 260.	188.6382
At Finley Landing, Iowa	P. B. M. 261.	189.8579
Near Island 207, Iowa	P. B. M. 262.	187.6476
At Frenchtown Landing, Iowa	T. B. M. 277.	187.1521
At Frenchtown Landing, Iowa	P. B. M. 263.	186.2006
At Frenchtown Landing, Iowa	P. B. M. 264.	187.4199
At Specht Ferry, Iowa	Old P. B. M. No. 30.	187.5944
At Specht Ferry, Iowa	Old U. S. B. M. a.	187.7394
At Specht Ferry, Iowa	P. B. M. 265.	186.3623
At Specht Ferry, Iowa	P. B. M. 266.	187.5809
At Specht Ferry, Iowa	T. B. M. 279.	188.3402
Near Specht Ferry, Iowa	T. B. M. 280.	188.5422
Near Specht Ferry, Iowa	P. B. M. 267.	185.8009
Near Specht Ferry, Iowa	P. B. M. 268.	187.0239
2¼ miles above Little Maquoketa River, Iowa	P. B. M. 269.	188.3971

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
2¼ miles above Little Maquoketa River, Iowa	P. B. M. 270.	189.6240
1½ miles above Little Maquoketa River, Iowa	T. B. M. 283.	187.9389
¾ miles above Edmore, Iowa	P. B. M. 271.	186.6329
¾ miles above Edmore, Iowa	P. B. M. 272.	187.8518
2.3 miles above Eagle Point, Iowa	T. B. M. 287.	186.3568
2.3 miles above Eagle Point, Iowa	P. B. M. 273.	185.4053
2.3 miles above Eagle Point, Iowa	P. B. M. 274.	186.6228
Near Eagle Point, Iowa	T. B. M. 289.	188.4719
At Eagle Point, Iowa	T. B. M. 291.	185.5797
At Dubuque, Iowa	P. B. M. 275.	184.6691
At Dubuque, Iowa	P. B. M. 276.	185.3217
At Dubuque, Iowa	P. B. M. 277.	186.5392
At Eagle Point, Iowa	Old U. S. B. M. 23.	181.2104
At Dubuque, Iowa	T. B. M. 293.	186.2558
At Dubuque, Iowa	T. B. M. 294.	185.7720
At Dubuque, Iowa	P. B. M. 278.	185.8106
At Dubuque, Iowa	T. B. M. 295.	185.1773
At Dubuque, Iowa	P. B. M. 279.	196.5431
At Dubuque, Iowa	P. B. M. 280.	188.3956
At East Dubuque, Ill.	Old U. S. B. M. a.	187.5211
At East Dubuque, Ill.	Old U. S. B. M. b.	187.2979
At Dubuque, Iowa	T. B. M. 296.	185.4344
At Dubuque, Iowa	City B. M. Julien House.	186.7249
At Dubuque, Iowa	City B. M. Jess's store.	185.6121
At Dubuque, Iowa	T. B. M. 297.	185.4090
At Dubuque, Iowa	Old U. S. B. M. a.	185.1468
At Dubuque, Iowa	Old U. S. B. M. b.	184.8002
At Dubuque, Iowa	P. B. M. 281.	186.6747
Near Dubuque, Iowa	T. B. M. 299.	186.1614
Near Dubuque, Iowa	P. B. M. 282.	185.9348
Near Dubuque, Iowa	P. B. M. 283.	187.1538
Near Cattese, Iowa	T. B. M. 301.	187.9965
Near Cattese, Iowa	P. B. M. 284.	186.8452
Near Cattese, Iowa	P. B. M. 285.	188.0644
At Cattese, Iowa	T. B. M. 302.	188.1243
Near Cattese, Iowa	T. B. M. 303.	187.4623
Near Cattese, Iowa	T. B. M. 304.	185.1020
Near Cattese, Iowa	Old U. S. B. M. 24.	180.1420
At Shawondasee Club Grounds, Iowa	P. B. M. 286.	183.7172
At Shawondasee Club Grounds, Iowa	P. B. M. 287.	184.9364
Near Massey, Iowa	T. B. M. 307.	185.8253
Near Massey, Iowa	T. B. M. 308.	185.0301
Near Nine Mile Island, Iowa	P. B. M. 288.	184.0205
Near Nine Mile Island, Iowa	P. B. M. 289.	185.2395
Near Nine Mile Island, Iowa	T. B. M. 311.	186.3917
Near Snyders, Iowa	T. B. M. 312.	186.3717
Near Gordons Ferry, Iowa	P. B. M. 290.	184.2151
Near Gordons Ferry, Iowa	P. B. M. 291.	185.4352
Near Gordons Ferry, Iowa	T. B. M. 314.	182.6209
Near Gordons Ferry, Iowa	P. B. M. 292.	183.0841
Near Gordons Ferry, Iowa	P. B. M. 293.	184.3043
Near Gordons Ferry, Iowa	T. B. M. 315.	186.5511
At Gordons Ferry, Iowa	P. B. M. 294.	187.2327
At Gordons Ferry, Iowa	P. B. M. 295.	188.4470
Near Gordons Ferry, Iowa	T. B. M. 318.	186.2747
Near Gordons Ferry, Iowa	P. B. M. 296.	185.0627
Near Gordons Ferry, Iowa	P. B. M. 297.	186.2854
Near Smiths Station, Iowa	T. B. M. 321.	185.1845
Near Smiths Station, Iowa	P. B. M. 298.	183.5200
Near Smiths Station, Iowa	P. B. M. 299.	184.7340

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Smiths Station, Iowa	T. B. M. 323.	185. 5457
Near Smiths Station, Iowa	P. B. M. 300.	184. 7548
Near Smiths Station, Iowa	P. B. M. 301.	185. 9664
Near North Bellevue, Iowa	P. B. M. 302.	190. 9473
Near North Bellevue, Iowa	P. B. M. 303.	180. 3521
Near North Bellevue, Iowa	P. B. M. 304.	181. 5631
At Bellevue, Iowa	P. B. M. 305.	188. 6234
At Bellevue, Iowa	P. B. M. 306.	189. 8415
At Bellevue, Iowa	P. B. M. 307.	188. 7438
At Bellevue, Iowa	Old U. S. B. M.	181. 9580
At Bellevue, Iowa	T. B. M. 326.	185. 4088
At Bellevue, Iowa	P. B. M. 308.	186. 1715
Near Bellevue, Iowa	P. B. M. 309.	184. 4357
Near Bellevue, Iowa	P. B. M. 310.	185. 6483
Near Bellevue, Iowa	T. B. M. 329.	184. 6039
Near Bellevue, Iowa	T. B. M. 331.	182. 9860
Near Bellevue, Iowa	P. B. M. 311.	181. 5299
Near Bellevue, Iowa	P. B. M. 312.	182. 7467
Near Bellevue, Iowa	P. B. M. 313.	179. 5064
Near Bellevue, Iowa	P. B. M. 314.	180. 7167
Near Bellevue, Iowa	P. B. M. 315.	179. 1158
Near Bellevue, Iowa	P. B. M. 316.	180. 3242
At Harris Landing, Ill.	P. B. M. 317.	186. 2298
At Harris Landing, Ill.	P. B. M. 318.	187. 4388
At Harris Landing, Ill.	P. B. M. 319	186. 5740
At Harris Landing, Ill.	P. B. M. 320.	187. 7925
Near Harris Landing, Ill.	P. B. M. 321.	188. 9503
Near Harris Landing, Ill.	P. B. M. 322.	190. 1694
Opposite foot of Island 256.	P. B. M. 323.	190. 2244
Opposite foot of Island 256.	P. B. M. 324.	191. 4427
Near Arnold Landing, Ill.	P. B. M. 325.	178. 6927
Near Arnold Landing, Ill.	P. B. M. 326.	179. 9097
At Arnold Landing, Ill.	P. B. M. 327.	186. 3680
Near Arnold Landing, Ill.	P. B. M. 328.	181. 0491
Near Arnold Landing, Ill.	P. B. M. 329.	182. 2582
Near Marcus, Ill.	P. B. M. 330.	178. 0566
Near Marcus, Ill.	P. B. M. 331.	179. 2778
Near Savanna, Ill.	P. B. M. 332.	179. 7544
Near Savanna, Ill.	P. B. M. 333.	180. 9768
Near Savanna, Ill.	P. B. M. 334.	180. 4309
Near Savanna, Ill.	P. B. M. 335.	181. 6477
At Savanna, Ill.	Old U. S. B. M. 18.	176. 8279
At Savanna, Ill.	P. B. M. 336.	182. 5421
At Savanna, Ill.	P. B. M. 337.	178. 5852
At Savanna, Ill.	P. B. M. 338.	179. 8020
At St. Paul, Minn.	T. B. M. 23.	248. 6238
At St. Paul, Minn.	T. B. M. 22.	252. 4829
At St. Paul, Minn.	P. B. M. Macalester.	284. 4081
	Top of cap over same.	285. 6176
At St. Paul, Minn.	T. B. M. 18.	277. 0893
At St. Paul, Minn.	T. B. M. 16.	265. 0537
At Minneapolis, Minn.	T. B. M. 13.	256. 2363
At Minneapolis, Minn.	P. B. M. University Campus.	256. 9384
At Minneapolis, Minn.	P. B. M. Pillsbury Hall.	258. 5928
At Minneapolis, Minn.	T. B. M. 12.	252. 5704
At Minneapolis, Minn.	P. B. M. $\frac{265}{2}$.	242. 1768
	Top of cap over same.	243. 3898
At Minneapolis, Minn.	P. B. M. Great Northern.	258. 5333

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Minneapolis, Minn.	P. B. M. Brewery.	248.9152
At Minneapolis, Minn.	T. B. M. 11.	252.3826
At Minneapolis, Minn.	P. B. M. Gluck.	253.4953
At Minneapolis, Minn.	P. B. M. $\frac{266}{2}$.	253.1427
	Top of cap over same.	254.3562
At Minneapolis, Minn.	T. B. M. 3.	254.0610
Near Minneapolis, Minn.	T. B. M. $\frac{267}{2}$.	253.5892
	Top of cap over same.	254.7963
Near Fridley, Minn.	P. B. M. $\frac{268}{2}$.	258.3517
	Top of cap over same.	259.5637
Near Anoka, Minn.	T. B. M. 27.	270.6683
Near Anoka, Minn.	P. B. M. △ Dunn.	267.4760
	Top of cap over same.	268.6906
Near Anoka, Minn.	T. B. M. 29.	260.8575
Near Anoka, Minn.	P. B. M. $\frac{269}{2}$.	254.7077
	Top of cap over same.	255.9131
Near Anoka, Minn.	P. B. M. △ Powell.	264.5011
	Top of cap over same.	265.7161
Near Anoka, Minn.	P. B. M. $\frac{270}{2}$.	261.1281
	Top of cap over same.	262.3363
At Anoka, Minn.	P. B. M. Anoka.	259.0206
At Anoka, Minn.	P. B. M. $\frac{271}{2}$.	256.8388
	Top of cap over same.	258.0520
Near Anoka, Minn.	P. B. M. $\frac{272}{2}$.	261.4221
	Top of cap over same.	262.6301
Near Itasca, Minn.	P. B. M. $\frac{273}{2}$.	268.3932
	Top of cap over same.	269.6036
Near Elk River, Minn.	P. B. M. $\frac{274}{2}$.	270.1547
	Top of cap over same.	271.3611
At Elk River, Minn.	P. B. M. $\frac{275}{2}$.	271.8692
	Top of cap over same.	273.0743
At Elk River, Minn.	P. B. M. Elk River.	266.3809
Near Otsego, Minn.	P. B. M. $\frac{276}{2}$.	273.7810
	Top of cap over same.	274.9871
Near Monticello, Minn.	P. B. M. $\frac{277}{2}$.	271.8520
	Top of cap over same.	273.0557
Near Monticello, Minn.	P. B. M. $\frac{278}{2}$.	282.4265
	Top of cap over same.	283.6174
Near Monticello, Minn.	P. B. M. △ East Base.	284.0285
	Top of cap over same.	285.2426
Near Monticello, Minn.	P. B. M. △ West Base.	283.9131
	Top of cap over same.	285.1205
At Monticello, Minn.	P. B. M. $\frac{279}{2}$.	284.6691

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
	Top of cap over same.	285.8759
At Monticello, Minn.	T. B. M. 70.	278.4519
Near Monticello, Minn.	P. B. M. $\frac{280}{2}$.	289.6215
	Top of cap over same.	290.8298
Near Monticello, Minn.	P. B. M. $\frac{281}{2}$.	289.1566
	Top of cap over same.	290.3680
Near Bear Island, Minn.	P. B. M. $\frac{282}{2}$.	294.4385
	Top of cap over same.	295.6434
Near Bear Island, Minn.	P. B. M. $\frac{283}{1}$.	295.8937
	Top of cap over same.	297.1016
Near Clearwater, Minn.	P. B. M. $\frac{284}{1}$	298.8800
	Top of cap over same.	300.0907
Near Clearwater, Minn.	P. B. M. $\frac{285}{2}$.	291.2079
	Top of cap over same.	292.4163
Near Clearwater, Minn.	P. B. M. $\frac{286}{2}$.	305.0384
	Top of cap over same.	306.2451
Near St. Augusta, Minn.	P. B. M. $\frac{287}{1}$.	307.8869
	Top of cap over same.	309.0911
Near St. Cloud, Minn.	P. B. M. $\frac{288}{2}$.	312.7657
	Top of cap over same.	313.9718
At East St. Cloud, Minn.	P. B. M. $\frac{289}{2}$.	308.5800
	Top of cap over same.	309.7886
At St. Cloud, Minn.	P. B. M. St. Cloud.	314.8890
Near St. Cloud, Minn.	T. B. M. 110.	306.2834
Near Sauk Rapids, Minn.	P. B. M. $\frac{290}{2}$.	305.4440
	Top of cap over same.	306.6516
Near Sauk Rapids, Minn.	T. B. M. 112.	307.0044
Near Sauk Rapids, Minn.	P. M. B. $\frac{291}{2}$.	312.8131
	Top of cap over same.	314.0236
Near Little Rock, Minn.	P. B. M. $\frac{292}{2}$.	312.2019
	Top of cap over same.	313.4096
Near Rice, Minn.	P. B. M. $\frac{293}{2}$.	314.3579
	Top of cap over same.	315.5687
Near Rice, Minn.	P. B. M. △ Back Base.	321.9742
	Top of cap over same.	323.1869
Near Rice, Minn.	P. B. M. △ River Base.	320.8781
	Top of cap over same.	322.0910
Near Rice, Minn.	P. B. M. $\frac{294}{2}$.	321.4877
	Top of cap over same.	322.6997
Near Rice, Minn.	P. B. M. $\frac{295}{2}$.	321.0663
	Top of cap over same.	322.2768

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near North Prairie, Minn.	P. B. M. $\frac{296}{2}$.	318.6321
	Top of cap over same.	319.8402
Near North Prairie, Minn.	P. B. M. $\frac{297}{2}$.	324.8890
	Top of cap over same.	326.1016
Near Royalton, Minn.	P. B. M. $\frac{298}{2}$.	331.5878
	Top of cap over same.	332.7995
Near Royalton, Minn.	P. B. M. $\frac{299}{2}$.	333.0175
	Top of cap over same.	334.2176
Near Little Falls, Minn.	P. B. M. $\frac{300}{2}$.	336.3328
	Top of cap over same.	337.5357
Near Little Falls, Minn.	P. B. M. $\frac{301}{2}$.	339.1905
	Top of cap over same.	340.4009
At Little Falls, Minn.	T. B. M. 152	339.6261
Near Little Falls, Minn.	P. B. M. $\frac{302}{2}$.	341.0355
	Top of cap over same.	342.2323
At Belle Prairie, Minn.	P. B. M. $\frac{303}{2}$.	344.0121
	Top of cap over same.	345.2244
Near Belle Prairie, Minn.	P. B. M. $\frac{304}{2}$.	346.3309
	Top of cap over same.	347.5413
Near Fort Ripley, Minn.	P. B. M. $\frac{305}{2}$.	348.3810
	Top of cap over same.	349.5957
Near Fort Ripley, Minn.	P. B. M. $\frac{306}{2}$.	350.9119
	Top of cap over same.	352.1289
Near Fort Ripley, Minn.	P. B. M. $\frac{307}{2}$.	353.9003
	Top of cap over same.	355.1149
Near Old Fort Ripley, Minn.	P. B. M. $\frac{308}{2}$.	353.7137
	Top of cap over same.	354.9244
Near Island No. 22, Minn.	P. B. M. $\frac{309}{2}$.	360.9154
	Top of cap over same.	362.1257
Near Old Crow Wing Ferry, Minn.	P. B. M. $\frac{310}{2}$.	361.9335
	Top of cap over same.	363.1442
Near Old Crow Wing Ferry, Minn.	P. B. M. $\frac{311}{2}$.	358.9243
	Top of cap over same.	360.1343
Near Brainerd, Minn.	P. B. M. $\frac{312}{2}$.	363.4452
	Top of cap over same.	364.6538
Near Brainerd, Minn.	T. B. M. 195.	377.4929
Near Brainerd, Minn.	T. B. M. 196.	372.5673
At Brainerd, Minn.	P. B. M. $\frac{313}{2}$.	370.7269

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
	Top of cap over same.	371.9362
At Brainerd, Minn.	P. B. M. Sanitarium.	368.4842
	Top of cap over same.	369.7272
At Brainerd, Minn.	P. B. M. △ South Base.	369.7582
	Top of cap over same.	370.9703
At Brainerd, Minn.	P. B. M. △ North Base.	367.0584
	Top of cap over same.	368.2722
At Brainerd, Minn.	P. B. M. $\frac{314}{2}$.	367.5627
	Top of cap over same.	368.7709
Near Brainerd, Minn.	P. B. M. $\frac{315}{2}$.	370.6583
	Top of cap over same.	371.8716
Near mouth of Rabbit River, Minn.	P. B. M. $\frac{317}{2}$.	368.5774
	Top of cap over same.	369.7832
Near mouth of Rabbit River, Minn.	P. B. M. $\frac{318}{2}$.	377.9913
	Top of cap over same.	379.1982
Near Old Indian Mission, Minn.	P. B. M. $\frac{319}{2}$.	359.4656
	Top of cap over same.	360.6743
Near mouth of Pine River, Minn.	P. B. M. $\frac{320}{2}$.	364.5705
	Top of cap over same.	365.7801
Near Island Lake, Minn.	P. B. M. $\frac{321}{2}$.	362.4728
	Top of cap over same.	363.6767
Near Towhead Rapids, Minn.	P. B. M. $\frac{322}{2}$.	364.2584
	Top of cap over same.	365.4693
Near Island No. 1, Minn.	P. B. M. $\frac{323}{2}$.	367.7566
	Top of cap over same.	368.9680
Near Dean Brook, Minn.	P. B. M. $\frac{324}{2}$.	369.3894
	Top of cap over same.	370.5996
Near mouth of Hay Creek, Minn.	P. B. M. $\frac{325}{2}$.	367.5533
	Top of cap over same.	368.7626
Near mouth of Cedar Brook, Minn.	P. B. M. $\frac{326}{2}$.	365.1470
	Top of cap over same.	366.3579
Near Aitkin, Minn.	P. B. M. $\frac{327}{2}$.	365.2849
	Top of cap over same.	366.4910
At Aitkin, Minn.	P. B. M. Court-house.	370.6978
At Aitkin, Minn.	P. B. M. $\frac{328}{2}$.	365.2282
	Top of cap over same.	366.4392
At Aitkin, Minn.	P. B. M. △ Lower Base.	365.2950
	Top of cap over same.	366.5084
At Brainerd, Minn.	T. B. M. 201.	367.7607
Near Leaks, Minn.	T. B. M. 3.	371.8875

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Leaks, Minn.	T. B. M. 5.	372. 6007
Near Merrifield, Minn.	T. B. M. 6.	372. 5701
At Merrifield, Minn.	P. B. M. Merrifield.	370. 8259
	Top of cap over same.	372. 0387
Near Merrifield, Minn.	T. B. M. 10.	371. 7429
Near Hubert, Minn.	T. B. M. 13.	372. 1151
Near Hubert, Minn.	T. B. M. 14.	372. 3066
At Hubert, Minn.	T. B. M. 16.	367. 4420
Near Hubert, Minn.	T. B. M. 18.	373. 8351
Near Pequot, Minn.	T. B. M. 20.	367. 1417
Near Pequot, Minn.	T. B. M. 21.	372. 5019
Near Pequot, Minn.	T. B. M. 22.	378. 7495
Near Pequot, Minn.	T. B. M. 23.	389. 1779
At Pequot, Minn.	T. B. M. 24.	391. 1081
At Pequot, Minn.	P. B. M. Pequot.	389. 6961
	Top of cap over same.	390. 9052
Near Pequot, Minn.	T. B. M. 26.	388. 2915
At Jenkins, Minn.	T. B. M. 28.	386. 5732
Near Pine River, Minn.	T. B. M. 30.	388. 9453
Near Pine River, Minn.	T. B. M. 31.	388. 3806
Near Pine River, Minn.	T. B. M. 32.	390. 5220
Near Pine River, Minn.	T. B. M. 33.	392. 9625
At Pine River, Minn.	T. B. M. 35.	395. 8229
At Pine River, Minn.	P. B. M. Pine River.	394. 9006
	Top of cap over same.	396. 1052
Near Pine River, Minn.	T. B. M. 37.	399. 7464
Near Mildred, Minn.	T. B. M. 39.	409. 3018
Near Mildred, Minn.	T. B. M. 41.	406. 7379
Near Backus, Minn.	T. B. M. 43.	411. 3729
At Backus, Minn.	P. B. M. Backus.	407. 3677
	Top of cap over same.	408. 5771
Near Island Lake, Minn.	T. B. M. 46.	410. 1797
Near Island Lake, Minn.	T. B. M. 48.	404. 9546
Near Island Lake, Minn.	T. B. M. 49.	407. 4366
Near Hackensack, Minn.	T. B. M. 50.	412. 0479
Near Hackensack, Minn.	T. B. M. 52.	422. 8487
At Hackensack, Minn.	P. B. M. Hackensack.	422. 8194
	Top of cap over same.	424. 0336
At Hackensack, Minn.	T. B. M. 53.	423. 1722
Near Hackensack, Minn.	T. B. M. 54.	431. 2947
Near Hackensack, Minn.	T. B. M. 55.	433. 8099
Near Hackensack, Minn.	T. B. M. 56.	426. 7256
At Lothrop, Minn.	T. B. M. 57.	425. 6382
Near Hunters, Minn.	P. B. M. Portage Lake.	423. 7257
	Top of cap over same.	424. 9391
At Hunters, Minn.	T. B. M. 60.	423. 2033
Near Hunters, Minn.	T. B. M. 62.	409. 0940
Near Walker Minn.	T. B. M. 63.	400. 6338
Near Walker, Minn.	T. B. M. 64.	397. 8213
Near Walker, Minn.	T. B. M. 65.	399. 2592
At Walker, Minn.	P. B. M. Walker.	402. 8554
	Top of cap over same.	404. 0611
At Walker, Minn.	P. B. M. Cole.	402. 3070
At Walker, Minn.	P. B. M. Water Tank.	414. 0389
Near Walker, Minn.	T. B. M. 69.	404. 3263
Near Walker, Minn.	T. B. M. 71.	399. 2854
Near Walker, Minn.	T. B. M. 72.	398. 0158
Near Walker, Minn.	R. R. B. M.	397. 0735

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Leech Lake, Minn.	T. B. M. 73.	405.5457
At Leech Lake, Minn.	P. B. M. Leech Lake.	406.2821
	Top of cap over same.	407.4864
Near Leech Lake, Minn.	T. B. M. 77.	400.8294
Near Wilkinson, Minn.	T. B. M. 78.	399.4837
Near Wilkinson, Minn.	T. B. M. 79.	397.2677
Near Wilkinson, Minn.	T. B. M. 80.	397.8217
Near Wilkinson, Minn.	T. B. M. 81.	401.2636
Near Wilkinson, Minn.	T. B. M. 82.	396.7368
Near Wilkinson, Minn.	T. B. M. 83.	398.1431
Near Wilkinson, Minn.	P. B. M. Steamboat Lake.	398.1146
	Top of cap over same.	399.3211
Near Wilkinson, Minn.	T. B. M. 85.	400.4152
Near Wilkinson, Minn.	T. B. M. 86.	407.4342
Near Cass Lake, Minn.	T. B. M. 87.	408.0480
Near Cass Lake, Minn.	T. B. M. 89.	409.0780
Near Cass Lake, Minn.	T. B. M. 90.	406.0634
At Cass Lake, Minn.	P. B. M. Wye.	405.9658
	Top of cap over same.	407.1803
Near Cass Lake, Minn.	T. B. M. 93.	402.4725
Near Farris, Minn.	T. B. M. 94.	409.9503
Near Farris, Minn.	T. B. M. 97.	413.1718
Near Farris, Minn.	P. B. M. Midge Lake.	404.8624
	Top of cap over same.	406.0716
Near Farris, Minn.	T. B. M. 101.	404.8745
Near Rosby, Minn.	T. B. M. 102.	406.1966
Near Rosby, Minn.	T. B. M. 103.	408.2886
Near South Bemidji, Minn.	T. B. M. 105.	411.4269
Near South Bemidji, Minn.	T. B. M. 107.	414.4819
Near South Bemidji, Minn.	T. B. M. 108.	414.9305
Near Bemidji, Minn.	◬ Bemidji.	415.5727
	Top of cap over same.	416.7857
At Bemidji, Minn.	T. B. M. 111.	411.4840
At Bemidji, Minn.	P. B. M. Willets.	414.1789
	Top of cap over same.	415.3886
At Bemidji, Minn.	P. B. M. Bemidji Tank.	415.2226
Near Bemidji, Minn.	T. B. M. 114.	416.6267
Near Bemidji, Minn.	P. B. M. Dorman.	419.3510
	Top of cap over same.	420.5621
Near Bemidji, Minn.	P. B. M. Collette.	415.4469
	Top of cap over same.	416.6605
Near Maltby, Minn.	◬ County line.	447.6681
	Top of cap over same.	448.8837
Near mouth of Hennepin River, Minn.	P. B. M. Hennepin.	421.7069
	Top of cap over same.	422.9188
Near "The Rapids," Minn.	P. B. M. Rapids.	425.9667
	Top of cap over same.	427.1765
Near mouth of La Salle River, Minn.	P. B. M. La Salle.	431.2362
	Top of cap over same.	432.4475
On Prospect Hill, Minn.	◬ Prospect Hill.	512.3079
	Top of cap over same.	513.5246
Near Lake Itasca, Minn.	P. B. M. Sherratt.	453.5801
	Top of cap over same.	454.7983
Near Lake Itasca, Minn.	P. B. M. Park Line.	451.6067
	Top of cap over same.	452.8180
Near Lake Itasca, Minn.	◬ Itasca.	466.9317
	Top of cap over same.	468.1469
At Lake Itasca, Minn.	P. B. M. Park House.	454.9594
	Top of cap over same.	455.1706

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Cass Lake, Minn.	P. B. M. Roundhouse.	404.0747
At Cass Lake, Minn.	U. S. E. B. M. 347.	405.2161
	Top of cap over same.	406.4150
Near Cass Lake, Minn.	U. S. E. B. M. 342.	401.0262
	Top of cap over same.	402.2231
Near Lomond, Minn.	T. B. M. 169.	403.3638
At Lomond, Minn.	P. B. M. Lomond Spur.	399.3257
	Top of cap over same.	400.5364
Near Lomond, Minn.	U. S. E. B. M. 337.	.....
	Top of cap over same.	398.2827
At Cuba, Minn.	T. B. M. 170.	410.3813
Near Cuba, Minn.	T. B. M. 172.	408.6941
Near Schley, Minn.	T. B. M. 174.	399.9329
Near Schley, Minn.	T. B. M. 175.	402.6617
Near Schley, Minn.	T. B. M. 176.	405.5397
Near Schley, Minn.	T. B. M. 177.	403.9657
Near Schley, Minn.	T. B. M. 179.	402.0394
Near Bena, Minn.	T. B. M. 181.	401.5067
Near Bena, Minn.	T. B. M. 183.	400.4738
Near Bena, Minn.	⧋ Bigosh.	401.9622
	Top of cap over same.	403.1763
At Bena, Minn.	⧋ Bena.	401.5610
	Top of cap over same.	402.7730
At Bena, Minn.	R. R. B. M.	399.3452
Near Bena, Minn.	⧋ Norway Grove.	402.9420
	Top of cap over same.	404.1494
Near Bena, Minn.	T. B. M. 188.	402.4681
Near Bena, Minn.	R. R. B. M.	402.2620
Near Nushka, Minn.	T. B. M. 189.	399.4457
At Nushka, Minn.	T. B. M. 191.	399.5486
Near Nushka, Minn.	T. B M. 192.	403.0003
Near Nushka, Minn.	⧋ Divide	402.5417
	Top of cap over same.	403.7459
Near Nushka, Minn.	B. M. Mississipp.	397.9350
	Top of cap over same.	399.1416
Near Ball Club, Minn.	U. S. E. B. M. 304.	394.3402
	Top of cap over same.	395.5360
Near Ball Club, Minn.	B. M. Tomahawk.	397.1478
	Top of cap over same.	398.3506
Near Ball Club, Minn.	B. M. Wigwam.	392.9171
	Top of cap over same.	394.1314
Near Ball Club, Minn.	T. B. M. 15 C.	391.6648
Near Starke, Minn.	⧋ Starke.	391.8866
	Top of cap over same.	393.0993
At Starke, Minn.	T. B. M. 200.	393.7730
Near Starke, Minn.	T. B. M. 202.	397.0389
Near Deer River, Minn.	T. B. M. 203.	397.1647
Near Deer River, Minn.	⧋ Old Road.	394.2056
	Top of cap over same.	395.4137
At Deer River, Minn.	T. B. M. 206.	394.2814
At Deer River, Minn.	⧋ Deer River.	395.6107
	Top of cap over same.	396.8301
At Deer River, Minn.	B. M. Roundhouse.	393.3415
	Top of cap over same.	394.5395
Near Deer River, Minn.	U. S. E. B. M. 192.	391.5453
	Top of cap over same.	392.7422
Near Deer River, Minn.	U. S. Engineer gauge.	390.6485

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Deer River, Minn.	T. B. M. 208.	391.0111
Near Hull, Minn.	T. B. M. 210.	392.2483
Near Hull, Minn.	T. B. M. 212.	400.7662
Near Hull, Minn.	T. B. M. 213.	391.0106
Near Cohasset, Minn.	B. M. Cohasset.	390.3671
	Top of cap over same.	391.5754
At Cohasset, Minn.	T. B. M. 215.	390.9562
At Cohasset, Minn.	U. S. E. B. M. 166.	389.7868
	Top of cap over same.	390.9814
Near Cohasset, Minn.	B. M. Dam.	392.9763
	Top of cap over same.	394.1872
Near Pokegama Dam, Minn.	Old U. S. B. M.	390.3591
At Pokegama Dam, Minn.	P. B. M. Pokegama Falls.	392.4141
Near Pokegama Dam, Minn.	U. S. E. B. M. 167.	390.0389
	Top of cap over same.	391.2382
At Pokegama Dam, Minn.	U. S. Engineer gauge.	390.1542
At Pokegama Dam, Minn.	U. S. Engineer gauge.	388.3241
At Pokegama Dam, Minn.	U. S. Engineer gauge.	388.3314
Near Grand Rapids, Minn.	ⓐ Grand Rapids.	389.3580
	Top of cap over same.	390.5689
Near Grand Rapids, Minn.	T. B. M. 220.	392.8958
At Grand Rapids, Minn.	P. B. M. Balustrade.	393.3090
Near Grand Rapids, Minn.	ⓐ Race track.	389.3605
	Top of cap over same.	390.5705
Near Grand Rapids, Minn.	B. M. Grand Rapids.	390.7721
	Top of cap over same.	391.9825
Near La Prairie, Minn.	P. B. M. Prairie River.	391.4158
Near La Prairie, Minn.	ⓐ La Prairie.	.....
	Top of cap over same.	391.4370
Near La Prairie, Minn.	T. B. M. 226.	395.2573
At Blackberry, Minn.	T. B. M. 229.	397.3345
At Blackberry, Minn.	T. B. M. 230.	397.1213
At Blackberry, Minn.	B. M. Blackberry.	396.2945
	Top of cap over same.	397.5056
At Duluth, Minn.	B. M. 1 of U. S. Engineers.	191.1611
At Duluth, Minn.	B. M. 19 of U. S. Engineers.	185.2348
At Duluth, Minn.	B. M. 23 of U. S. Engineers.	185.8113
At West Duluth, Minn.	B. M. Iron Bay Iron Works.	191.7048
Near Duluth, Minn.	P. B. M. 1.	193.6004
Near Duluth, Minn.	P. B. M. 1A.	194.8127
At Smithville, Minn.	P. B. M. 2.	214.3014
At Smithville, Minn.	P. B. M. 2A.	215.5147
At Short Line Park, Minn.	P. B. M. 3.	291.4035
At Short Line Park, Minn.	P. B. M. 3A.	292.6212
At Thomson, Minn.	P. B. M. 4.	326.3612
At Thomson, Minn.	P. B. M. 4A.	327.5732
At Carlton, Minn.	P. B. M. 5.	332.2082
Near Carlton, Minn.	P. B. M. 6.	339.4365
Near Carlton, Minn.	P. B. M. 6A.	340.6504
Near Barnum, Minn.	P. B. M. 7.	332.6105
Near Barnum, Minn.	P. B. M. 7A.	333.8289
Near Barnum, Minn.	P. B. M. 8.	355.3516
Near Barnum, Minn.	P. B. M. 8A.	356.5616
Near Barnum, Minn.	P. B. M. 9.	360.2556
Near Barnum, Minn.	P. B. M. 9A.	361.4786
At Moose Lake, Minn.	P. B. M. 10.	323.1195
At Moose Lake, Minn.	P. B. M. 10A.	324.3358
At Sturgeon Lake, Minn.	P. B. M. 11.	325.5331
At Sturgeon Lake, Minn.	P. B. M. 11A.	326.7564

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Willow River, Minn.	P. B. M. 12.	313. 2107
At Willow River, Minn.	P. B. M. 12A.	314. 4252
At Kettle River, Minn.	P. B. M. 13.	314. 1735
At Kettle River, Minn.	P. B. M. 13A.	315. 3886
At Miller, Minn.	P. B. M. 14.	344. 4136
At Miller, Minn.	P. B. M. 14A.	345. 6257
At Sandstone Junction, Minn.	P. B. M. 15.	341. 2012
At Sandstone Junction, Minn.	P. B. M. 15A.	342. 4202
At Hinckley, Minn.	P. B. M. 16.	313. 8461
At Hinckley, Minn.	P. B. M. 17.	314. 1345
At Hinckley, Minn.	P. B. M. 17A.	315. 3544
At Mission Creek, Minn.	P. B. M. 18.	300. 7501
At Mission Creek, Minn.	P. B. M. 18A.	301. 9704
At Browns Hill, Minn.	P. B. M. 19.	296. 8034
At Browns Hill, Minn.	P. B. M. 19A.	298. 0222
At Pine City, Minn.	P. B. M. 20.	289. 2646
At Pine City, Minn.	P. B. M. 21.	288. 4818
At Pine City, Minn.	P. B. M. 21A.	289. 7026
At Brock Creek, Minn.	P. B. M. 22.	284. 8631
At Brock Creek, Minn.	P. B. M. 22A.	286. 0830
At Rush City, Minn.	P. B. M. 23.	279. 2276
At Rush City, Minn.	P. B. M. 23A.	280. 4439
At Rush City, Minn.	P. B. M. 24.	280. 3016
At Harris, Minn.	P. B. M. 25.	273. 7385
At Harris, Minn.	P. B. M. 25A.	274. 9498
At North Branch, Minn.	P. B. M. 26.	272. 6967
At North Branch, Minn.	P. B. M. 27.	272. 2158
At North Branch, Minn.	P. B. M. 27A.	273. 4343
At Stacy, Minn.	P. B. M. 28.	271. 7287
At Stacy, Minn.	P. B. M. 28A.	272. 9430
At Wyoming, Minn.	P. B. M. 29.	270. 6341
At Wyoming, Minn.	P. B. M. 29A.	271. 8509
At Forest Lake, Minn.	P. B. M. 30.	279. 0471
At Forest Lake, Minn.	P. B. M. 31.	277. 4693
At Forest Lake, Minn.	P. B. M. 31A.	278. 6929
At Forest Lake, Minn.	P. B. M. 32.	277. 4186
At Forest Lake, Minn.	P. B. M. 32A.	278. 6345
At Centerville, Minn.	P. B. M. 33.	284. 1463
At Centerville, Minn.	P. B. M. 33A.	285. 3640
At Bald Eagle Junction, Minn.	P. B. M. 34.	283. 0555
At Bald Eagle Junction, Minn.	P. B. M. 34A.	284. 2686
At White Bear, Minn.	P. B. M. 35.	286. 2172
At White Bear, Minn.	P. B. M. 36.	285. 2353
At White Bear, Minn.	P. B. M. 36A.	286. 4536
At White Bear, Minn.	P. B. M. 37.	285. 1781
At White Bear, Minn.	P. B. M. 37A.	286. 3939
Near White Bear, Minn.	P. B. M. 38.	282. 2852
Near White Bear, Minn.	P. B. M. 38A.	283. 5042
Near White Bear, Minn.	T. B. M. 185.	275. 4423
At Gladstone, Minn.	P. B. M. 39.	273. 2908
At Gladstone, Minn.	P. B. M. 39A.	274. 5077
At Gladstone, Minn.	P. B. M. 40.	272. 8662
At Gladstone, Minn.	P. B. M. 40A.	274. 0758
At St. Paul, Minn.	T. B. M. 193.	216. 9441
Near Columbia Bottom, Mo.	P. B. M. $2=\frac{1}{1}$.	129. 9811
	Top of cap over same.	131. 2205
At Columbia Bottom, Mo.	P. B. M. 3.	131. 1791
At Columbia Bottom, Mo.	T. B. M. 2.	130. 9689

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Fort Bellefontaine, Mo.	P. B. M. $4=\frac{2}{1}$.	131.1819
	Top of cap over same.	132.4205
Near Mouth of Cold Water Creek, Mo.	P. B. M. 5.	131.3615
At Jamestown Landing, Mo.	P. B. M. 6.	128.4747
Near Jamestown Landing, Mo.	P. B. M. 7.	132.1523
	Top of cap over same.	133.3862
Near Jamestown Landing, Mo.	P. B. M. 8.	127.4661
Near Jamestown Landing, Mo.	P. B. M. $9=\frac{3}{1}$.	134.5714
	Top of cap over same.	135.8111
Near Musics Ferry, Mo.	P. B. M. 10.	138.9520
Near Musics Ferry, Mo.	P. B. M. 11.	132.2031
	Top of cap over same.	133.4426
Near Musics Ferry, Mo.	P. B. M. 12; old P. B. M. 11, 1887.	133.8290
At Musics Ferry, Mo.	P. B. M. 13.	137.0612
At Musics Ferry, Mo.	P. B. M. $14=\frac{4}{1}$.	134.3576
	Top of cap over same.	135.5957
Near Musics Ferry, Mo.	P. B. M. 15.	135.7480
	Top of cap over same.	136.9853
At Charbonnier Point, Mo.	P. B. M. $16=\frac{5}{1}$.	132.6223
	Top of cap over same.	133.8589
Near St. Charles, Mo.	P. B. M. 17.	133.3921
	Top of cap over same.	134.6286
Near St. Charles, Mo.	P. B. M. 18.	132.7399
	Top of cap over same.	133.9713
At St. Charles, Mo.	P. B. M. 19.	139.1235
At St. Charles, Mo.	P. B. M. 20; old B. M. 17.	135.3881
At St. Charles, Mo.	T. B. M. 23.	137.1491
At St. Charles, Mo.	T. B. M. 24=gauge B. M.	136.4226
At St. Charles, Mo.	P. B. M. $21=\frac{6}{2}$.	135.7744
	Top of cap over same.	137.0105
At St. Charles, Mo.	T. B. M. 25. City B. M.	139.0707
Near St. Charles, Mo.	T. B. M. 32.	138.8525
Near St. Charles, Mo.	P. B. M. $22=\frac{6}{1}$.	146.3956
	Top of cap over same.	147.6338
Near St. Charles, Mo.	P. B. M. 23.	136.3205
	Top of cap over same.	137.5620
Near Creve Cœur Lake, Mo.	P. B. M. $24=\frac{7}{2}$.	137.1280
	Top of cap over same.	138.3677
Near Creve Cœur Lake, Mo.	P. B. M. 25.	136.2360
	Top of cap over same.	137.4750
Near Creve Cœur Lake, Mo.	P. B. M. 26.	139.0799
Near Mona, Mo.	T. B. M. 45.	138.1865
At Mona, Mo.	P. B. M. $27=\frac{8}{1}$.	137.4753
	Top of cap over same.	138.7137
At Drew, Mo.	P. B. M. 28.	141.1441
	Top of cap over same.	142.3800
At Drew, Mo.	T. B. M. 51.	140.5433
At Gumbo, Mo.	P. B. M. $29=\frac{9}{1}$.	141.4574
	Top of cap over same.	142.6925

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Stevens, Mo.	P. B. M. 30.	140.3427
	Top of cap over same.	141.5809
At Bon Homme, Mo.	P. B. M. $31=\frac{10}{1}$.	140.3448
	Top of cap over same.	141.5826
At Bon Homme, Mo.	P. B. M. 32.	144.3904
At Bon Homme, Mo.	T. B. M. 56.	140.8829
At Centaur, Mo.	P. B. M. 33.	140.3082
	Top of cap over same.	141.5430
Near Centaur, Mo.	P. B. M. 34.	143.3414
Near Port Royal, Mo.	T. B. M. 61.	144.0102
At Port Royal, Mo.	P. B. M. $35=\frac{11}{1}$.	144.6812
	Top of cap over same.	145.9233
At Port Royal, Mo.	T. B. M. 62.	144.2339
Near Port Royal, Mo.	T. B. M. 63.	145.7100
Near Port Royal, Mo.	P. B. M. 36.	146.0773
	Top of cap over same.	147.3156
Near Port Royal, Mo.	P. B. M. 37.	154.0991
At St. Albans, Mo.	P. B. M. $38=\frac{12}{1}$.	146.1001
	Top of cap over same.	147.3365
Near Becker, Mo.	T. B. M. 69.	149.8823
Near Becker, Mo.	P. B. M. 39.	147.0176
	Top of cap over same.	148.2569
Near Becker, Mo.	P. B. M. 40.	145.8187
Near Becker, Mo.	P. B. M. 41.	142.0607
	Top of cap over same.	143.2981
Near Labaddie, Mo.	P. B. M. 42.	149.5412
Near Boles, Mo.	P. B. M. $43=\frac{13}{1}$.	142.8405
	Top of cap over same.	144.0767
Near Boles, Mo.	T. B. M. 78.	149.0311
Near Boles, Mo.	P. B. M. 44.	148.0797
Near Boles, Mo.	T. B. M. 80.	147.5854
At Boles, Mo.	T. B. M. 81.	148.1313
Near Boles, Mo.	P. B. M. 45.	144.5480
	Top of cap over same.	145.7795
Near Boles, Mo.	T. B. M. 83.	148.8533
Near South Point, Mo.	T. B. M. 84.	148.6614
Near South Point, Mo.	T. B. M. 85.	147.0490
Near South Point, Mo.	P. B. M. $46=\frac{14}{1}$.	147.7466
	Top of cap over same.	148.9813
Near South Point, Mo.	T. B. M. 86.	148.1300
Near South Point, Mo.	P. B. M. 47.	150.2677
Near South Point, Mo.	T. B. M. 87.	148.3491
Near South Point, Mo.	T. B. M. 88.	147.2642
At South Point, Mo.	P. B. M. 48.	147.6384
	Top of cap over same.	148.8776
At South Point, Mo.	T. B. M. 89.	149.0149
Near Washington, Mo.	T. B. M. 90.	149.1546
At Washington, Mo.	P. B. M. 50.	150.5337
At Washington, Mo.	T. B. M. 92.	149.7290
At Washington, Mo.	T. B. M. 94=Old B. M. 75, 1879.	151.7660
At Washington, Mo.	T. B. M. 95.	151.9729
At Washington, Mo.	P. B. M. $51=\frac{15}{1}$.	151.1832
	Top of cap over same.	152.4202

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Washington, Mo.	T. B. M. 96=Old B. M. 42a.	149.5541
Near Washington, Mo.	T. B. M. 97.	150.0395
Near Washington, Mo.	P. B. M. 52.	152.8743
Near Washington, Mo.	T. B. M. 98.	151.5473
Near Washington, Mo.	P. B. M. 53.	148.8165
	Top of cap over same.	150.0513
Near Washington, Mo.	T. B. M. 99=Old B. M. 43a.	150.1005
Near Washington, Mo.	T. B. M. 100.	152.0662
Near Dundee, Mo.	P. B. M. 54=$\frac{16}{1}$.	151.3824
	Top of cap over same.	152.6195
Near Dundee, Mo.	T. B. M. 105.	151.5674
Near Dundee, Mo.	P. B. M. 55.	152.0589
	Top of cap over same.	153.2919
Near Dundee, Mo.	T. B. M. 106.	152.9978
Near Dundee, Mo.	P. B. M. 56.	154.1524
At Dundee, Mo.	P. B. M. 57=$\frac{17}{1}$.	147.3516
	Top of cap over same.	148.5912
At Dundee, Mo.	T. B. M. 108=Old B. M. 46 (b).	151.0884
At Dundee, Mo.	T. B. M. 107=Old R. R. B. M.	152.9423
At Dundee, Mo.	T. B. M. 109=Old B. M. 46a.	152.9613
At Kent, Mo.	T. B. M. 110.	152.8664
Near Kent, Mo.	T. B. M. 111=Old B. M. 47.	152.7984
Near Kent, Mo.	T. B. M. 112.	153.6328
Near New Haven, Mo.	P. B. M. 58.	154.0974
	Top of cap over same.	155.3357
Near New Haven, Mo.	T. B. M. 113.	153.6822
Near New Haven, Mo.	P. B. M. 59.	155.2997
Near New Haven, Mo.	T. B. M. 114.	154.6822
At New Haven, Mo.	P. B. M. 60=$\frac{18}{1}$.	153.7714
	Top of cap over same.	155.0120
At New Haven, Mo.	T. B. M. 115.	155.3786
At New Haven, Mo.	T. B. M. 116.	154.2343
Near New Haven, Mo.	P. B. M. 61.	156.4618
Near Etlah, Mo.	T. B. M. 118.	154.9573
Near Etlah, Mo.	P. B. M. 62.	154.3644
	Top of cap over same.	155.6043
Near Etlah, Mo.	T. B. M. 119.	155.1534
Near Etlah, Mo.	T. B. M. 120.	155.1111
At Etlah, Mo.	P. B. M. 63=$\frac{19}{1}$.	155.9631
	Top of cap over same.	157.2052
Near Etlah, Mo.	T. B. M. 122.	155.7017
Near Etlah, Mo.	T. B. M. 123=Old R. R. B. M.	154.5619
Near Berger, Mo.	T. B. M. 125.	155.9705
Near Berger, Mo.	P. B. M. 64.	156.8294
	Top of cap over same.	158.0614
Near Berger, Mo.	T. B. M. 126.	155.2670
Near Berger, Mo.	P. B. M. 65.	157.0400
At Berger, Mo.	P. B. M. 66=$\frac{20}{1}$.	154.9083
	Top of cap over same.	156.1450
Near Berger, Mo.	T. B. M. 128.	155.8666
Near Hermann, Mo.	P. B. M. 67.	154.7852
	Top of cap over same.	156.0245
Near Hermann, Mo.	T. B. M. 129.	156.0193
Near Hermann, Mo.	T. B. M. 130.	157.0783

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Hermann, Mo.	P. B. M. 68.	155.8768
	Top of cap over same.	157.1121
Near Hermann, Mo.	T. B. M. 132.	156.1376
Near Hermann, Mo.	P. B. M. 69.	158.2283
Near Hermann, Mo.	T. B. M. 133.	156.9683
At Hermann, Mo.	P. B. M. 70=$\frac{21}{1}$.	155.8311
	Top of cap over same.	156.0650
At Hermann, Mo.	P. B. M. 71.	155.7764
At Hermann, Mo.	T. B. M. 135.	158.2463
At Hermann, Mo.	P. B. M. 72=Old B. M. 59.	157.7603
Near Hermann, Mo.	P. B. M. 73.	159.5405
	Top of cap over same.	160.7801
Near Hermann, Mo.	T. B. M. 136.	157.7182
Near Hermann, Mo.	T. B. M. 137.	159.2252
Near Hermann, Mo.	P. B. M. 74.	157.6181
Near Gasconade, Mo.	T. B. M. 139.	160.2640
Near Gasconade, Mo.	P. B. M. 75=$\frac{22}{1}$.	159.7231
	Top of cap over same.	160.9609
Near Gasconade, Mo.	T. B. M. 140.	157.6151
Near Gasconade, Mo.	T. B. M. 141.	159.7058
Near Gasconade, Mo.	P. B. M. 76.	158.8505
	Top of cap over same.	160.0863
Near Gasconade, Mo.	T. B. M. 142=Old R. R. B. M.	158.1269
Near Gasconade, Mo.	T. B. M. 143.	160.4910
At Gasconade, Mo.	T. B. M. 144, Gasconade Survey. B. M. 1879.	159.7374
At Gasconade, Mo.	P. B. M. 77.	159.7339
Near Gasconade, Mo.	T. B. M. 145.	160.4978
Near Gasconade, Mo.	T. B. M. 146.	157.8627
Near Gasconade, Mo.	P. B. M. 78=$\frac{23}{1}$.	160.7142
	Top of cap over same.	161.9517
Near Gasconade, Mo.	P. B. M. 79.	159.7044
Near Morrison, Mo.	T. B. M. 148.	159.5942
Near Morrison, Mo.	T. B. M. 149=Old R. R. B. M.	160.1649
At Morrison, Mo.	P. B. M. 80.	160.8635
	Top of cap over same.	161.1014
At Morrison, Mo.	P. B. M. 81.	162.2613
At Morrison, Mo.	T. B. M. 150.	161.1581
Near Morrison, Mo.	T. B. M. 151.	160.2526
Near Morrison, Mo.	P. B. M. 82.	162.7392
Near Morrison, Mo.	P. B. M. 83=$\frac{24}{1}$.	162.4792
	Top of cap over same.	163.7160
Near Morrison, Mo.	T. B. M. 153.	162.5864
Near Chamois, Mo.	T. B. M. 154.	161.3659
Near Chamois, Mo.	T. B. M. 155.	161.6840
Near Chamois, Mo.	P. B. M. 84.	160.9812
	Top of cap over same.	162.2192
Near Chamois, Mo.	T. B. M. 157.	164.5693
Near Chamois, Mo.	T. B. M. 158.	162.3338
At Chamois, Mo.	P. B. M. 85.	164.0468
At Chamois, Mo.	P. B. M. 86=$\frac{25}{1}$.	161.7350
	Top of cap over same.	162.9779
Near Chamois, Mo.	T. B. M. 160=Old R. R. B. M.	163.2030

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Deer Creek, Mo.	P. B. M. 87.	163. 6917
	Top of cap over same.	164. 9356
Near Deer Creek, Mo.	T. B. M. 161.	165. 1547
Near Deer Creek, Mo.	P. B. M. 88.	162. 4042
Near St. Aubert, Mo.	P. B. M. 89=Old B. M. 74.	161. 5812
Near St. Aubert, Mo.	T. B. M. 163.	162. 6091
Near St. Aubert, Mo.	T. B. M. 164.	164. 7692
At St. Aubert, Mo.	P. B. M. 90=$\frac{26}{1}$.	164. 8013
	Top of cap over same.	166. 0432
At Shipley Landing, Mo.	P. B. M. 91.	164. 1500
	Top of cap over same.	165. 3886
At Shipley Landing, Mo.	T. B. M. 167.	165. 6755
Near Loose Creek, Mo.	T. B. M. 168.	166. 7609
At Isbell, Mo.	P. B. M. 92=$\frac{27}{1}$.	161. 9658
	Top of cap over same.	163. 1993
At Isbell, Mo.	P. B. M. 93.	167. 3084
At Isbell, Mo.	T. B. M. 169.	166. 5096
Near Isbell, Mo.	T. B. M. 170.	167. 9911
Near Bonnots Mill, Mo.	T. B. M. 171=Old R. R. B. M.	165. 2672
Near Bonnots Mill, Mo.	P. B. M. 94.	163. 2706
	Top of cap over same.	164. 5060
Near Bonnots Mill, Mo.	T. B. M. 172.	164. 3821
Near Bonnots Mill, Mo.	T. B. M. 173.	166. 3183
At Bonnots Mill, Mo.	T. B. M. 174.	166. 5591
At Bonnots Mill, Mo.	T. B. M. 175=Old R. R. B. M.	165. 9817
At Bonnots Mill, Mo.	P. B. M. 95=$\frac{28}{1}$.	162. 3457
	Top of cap over same.	163. 5847
Near Osage, Mo.	T. B. M. 178=Old B. M. 81.	166. 0237
Near Osage, Mo.	T. B. M. 177=Old B. M. 80.	166. 0475
Near Bonnots Mill, Mo.	P. B. M. 96.	167. 2934
Near Osage, Mo.	T. B. M. 179.	165. 4037
Near Osage City, Mo.	P. B. M. 97.	164. 4237
	Top of cap over same.	165. 6654
Near Osage City, Mo.	T. B. M. 180=Old R. R. B. M.	165. 8595
At Osage City, Mo.	P. B. M. 98.	166. 7048
At Osage City, Mo.	T. B. M. 182=Old R. R. B. M.	166. 7102
At Osage City, Mo.	P. B. M. 99.	167. 1126
	Top of cap over same.	168. 3517
At Osage City, Mo.	T. B. M. 183.	168. 6127
Near Osage City, Mo.	T. B. M. 184=Old R. R. B. M.	170. 3372
At Ewings Landing, Mo.	P. B. M. 100=$\frac{29}{1}$.	165. 2942
	Top of cap over same.	166. 5384
Near Jefferson City, Mo.	P. B. M. 101.	177. 2047
Near Jefferson City, Mo.	P. B. M. 102.	174. 1346
	Top of cap over same.	175. 3717
Near Jefferson City, Mo.	T. B. M. 190.	174. 2142
Near Jefferson City, Mo.	T. B. M. 191.	169. 6994
Near Jefferson City, Mo.	T. B. M. 192.	169. 7039
Near Jefferson City, Mo.	P. B. M. 103.	167. 0679
	Top of cap over same.	168. 3058
At Jefferson City, Mo.	T. B. M. 193=Old B. M. 88.	169. 7604
Near Jefferson City, Mo.	P. B. M. 104.	170. 4624
Near Jefferson City, Mo.	T. B. M. 194.	169. 5713
At Jefferson City, Mo.	T. B. M. 195.	169. 3193
At Jefferson City, Mo.	T. B. M. 196. Gauge B. M. 1st.	169. 4575

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Jefferson City, Mo.	City B. M.	194.3466
At Jefferson City, Mo.	T. B. M. 197.	191.4757
At Jefferson City, Mo.	P. B. M. 105.	170.7503
At Jefferson City, Mo.	T. B. M. 199.	169.2442
At Jefferson City, Mo.	T. B. M. 198=Old B. M. 90_n (c)	165.2668
At Jefferson City, Mo.	T. B. M. 200.	170.0640
At Jefferson City, Mo.	T. B. M. 201=Old B. M. 90 (b)	166.3068
At Jefferson City, Mo.	P. B. M. 107=$\frac{30}{1}$.	168.7797
	Top of cap over same.	170.0175
Near Jefferson City, Mo.	T. B. M. 202.	170.8891
Near Jefferson City, Mo.	P. B. M. 108.	168.6075
	Top of cap over same.	169.8463
Near Jefferson City, Mo.	T. B. M. 203=Old B. M.	169.1289
Near Jefferson City, Mo.	T. B. M. 204.	169.6433
Near Grays Creek, Mo.	P. B. M. 109.	171.8307
Near Grays Creek, Mo.	T. B. M. 205.	170.9068
Near Grays Creek, Mo.	T. B. M. 206.	171.0144
At Grays Creek, Mo.	T. B. M. 207=Old R. R. B. M.	169.8574
At Grays Creek, Mo.	P. B. M. 110=$\frac{31}{1}$.	171.9447
	Top of cap over same.	173.1875
Near Grays Creek, Mo.	T. B. M. 209.	165.0497
Near Claysville, Mo.	T. B. M. 213.	164.6480
Near Claysville, Mo.	P. B. M. 111.	169.3683
Near Claysville, Mo.	P. B. M. 112.	167.7727
	Top of cap over same.	169.0102
Near Claysville, Mo.	P. B. M. 113=$\frac{32}{1}$.	171.7234
	Top of cap over same.	172.9622
Near Stanleys Landing, Mo.	T. B. M. 218.	169.1299
At Sugar Loaf Rock, Mo.	P. B. M. 114.	173.6854
Near Marion, Mo.	P. B. M. 115.	169.2369
	Top of cap over same.	170.4741
Near Marion, Mo.	T. B. M. 220.	170.8789
Near Bull Rock, Mo.	T. B. M. 223.	167.3197
At Bull Rock, Mo.	P. B. M. 116.	169.0860
At Bull Rock, Mo.	P. B. M. 117.	174.4331
	Top of cap over same.	175.6705
Near Marion, Mo.	T. B. M. 224.	168.2719
Near Marion, Mo.	T. B. M. 225.	167.3183
Near Marion, Mo.	T. B. M. 226.	169.8831
At Marion, Mo.	P. B. M. 118=$\frac{33}{1}$.	175.0535
	Top of cap over same.	176.2942
At Marion, Mo.	P. B. M. 119.	170.9983
At Marion, Mo.	T. B. M. 230.	166.5718
Near Marion, Mo.	T. B. M. 232.	171.0063
At Moniteau Creek, Mo.	P. B. M. 120.	172.5594
	Top of cap over same.	173.8003
Near Sandy Hook Landing, Mo.	T. B. M. 236.	172.0484
Near Sandy Hook Landing, Mo.	P. B. M. 121.	171.0483
At Sandy Hook Landing, Mo.	P. B. M. 122=$\frac{34}{1}$.	177.2397
	Top of cap over same.	178.4806
Near Sandy Hook Landing, Mo.	P. B. M. 123.	172.8424
Near Sandy Hook Landing, Mo.	T. B. M. 240.	171.5277
Near Geigers Landing, Mo.	T. B. M. 241.	169.9822

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Geigers Landing, Mo.	P. B. M. 124.	177. 2754
	Top of cap over same.	178. 5126
At Geigers Landing, Mo.	P. B. M. 125.	175. 4953
At Geigers Landing, Mo.	T. B. M. 242.	173. 7936
Near Geigers Landing, Mo.	T. B. M. 243.	174. 3249
Near Wolf Point, Mo.	P. B. M. 126=$\frac{35}{1}$.	176. 5424
	Top of cap over same.	177. 7818
At Wolf Point, Mo.	P. B. M. 127=$\frac{36}{1}$.	179. 0471
	Top of cap over same.	180. 2876
At Wolf Point, Mo.	T. B. M. 250.	177. 1918
At Wolf Point, Mo.	P. B. M. 128.	184. 7765
At Mount Vernon Landing, Mo.	P. B. M. 129.	179. 2384
	Top of cap over same.	180. 4746
At Mount Vernon Landing, Mo.	T. B. M. 253.	172. 2734
At Mount Vernon Landing, Mo.	P. B. M. 130.	175. 7116
Near Terrapin Island, Mo.	P. B. M. 131=$\frac{37}{1}$.	177. 7511
	Top of cap over same.	178. 9931
Near Rocheport, Mo.	P. B. M. 132.	175. 9555
	Top of cap over same.	177. 1928
Near Overton, Mo.	P. B. M. 133=$\frac{38}{1}$.	180. 8661
	Top of cap over same.	182. 1087
Near Boonville, Mo.	P. B. M. 134.	179. 7388
Near Elliots Landing, Mo.	P. B. M. 135.	179. 1753
	Top of cap over same.	180. 4127
At Elliots Landing, Mo.	P. B. M. 136.	181. 3981
At Elliots Landing, Mo.	P. B. M. 137=$\frac{39}{1}$.	182. 3639
	Top of cap over same.	183. 6014
Near Franklin Island, Mo.	T. B. M. 271.	176. 0095
Near Boonville, Mo.	P. B. M. 138.	178. 4812
Near Boonville, Mo.	P. B. M. 139.	177. 4438
	Top of cap over same.	178. 6869
Near Boonville, Mo.	T. B. M. 276.	178. 5105
Near Boonville, Mo.	P. B. M. 140=$\frac{40}{1}$.	179. 2117
	Top of cap over same.	180. 4481
At Boonville, Mo.	T. B. M. 279.	182. 8401
At Boonville, Mo.	Highwater mark, 1844 (Main street).	182. 6621
At Boonville, Mo.	P. B. M. 144=Old B. M. 121.	178. 9546
At Boonville, Mo.	U. S. Signal Service gauge.	172. 5902
At Boonville, Mo.	Highwater mark, 1844 (Bridge).	182. 5990
At Boonville, Mo.	P. B. M. 141.	181. 9042
At Boonville, Mo.	P. B. M. 142=40½, Boonville.	181. 6992
	Top of cap over same.	182. 9406
At Boonville, Mo.	T. B. M. 280.	186. 2912
At Boonville, Mo.	P. B. M. 143.	186. 2925
At Boonville, Mo.	P. B. M. 145.	185. 4253
Near Franklin, Mo.	P. B. M. 146.	180. 9975
	Top of cap over same.	182. 2397
Near Boonville, Mo.	P. B. M. 147=$\frac{41}{3}$ (new position).	181. 9369
	Top of cap over same.	183. 1727
Near Boonville, Mo.	T. B. M. 286.	183. 9898

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Boonville, Mo.	P. B. M. 148.	183. 1285
	Top of cap over same.	184. 3676
Near Lisbon, Mo.	P. B. M. 149.	184. 3967
	Top of cap over same.	185. 6340
Near Lisbon, Mo.	P. B. M. 150.	183. 6914
Near Lisbon, Mo.	P. B. M. 151=$\frac{43}{3}$.	189. 0366
	Top of cap over same.	190. 2755
Near Lisbon, Mo.	T. B. M. 295.	183. 7419
Near Lisbon, Mo.	P. B. M. 152=$\frac{44}{3}$.	187. 3399
	Top of cap over same.	188. 5797
Near Lisbon, Mo.	T. B. M. 297.	188. 6217
Near Lisbon, Mo.	P. B. M. 153.	185. 1285
Near Lisbon, Mo.	T. B. M. 300.	184. 5488
Near Lisbon, Mo.	P. B. M. 154=$\frac{45}{3}$.	183. 1115
	Top of cap over same.	184. 3354
Near Lisbon, Mo.	T. B. M. 301.	184. 5327
Near Lisbon, Mo.	T. B. M. 302.	185. 2889
Near Lisbon, Mo.	T. B. M. 303.	187. 6834
Near Bluffport, Mo.	T. B. M. 304.	186. 4750
Near Richland Creek, Mo.	P. B. M. 155.	186. 5500
	Top of cap over same.	187. 7885
Near Bluffport, Mo.	P. B. M. 156.	189. 0491
Near Richland Creek, Mo.	T. B. M. 305.	188. 6679
Near Glasgow, Mo.	P. B. M. 157=$\frac{46}{2}$.	186. 2316
	Top of cap over same.	187. 4699
Near Glasgow, Mo.	T. B. M. 309.	186. 1839
At Glasgow, Mo.	P. B. M. 159=$\frac{47}{3}$.	188. 3960
	Top of cap over same.	189. 6323
At Glasgow, Mo.	P. B. M. 160.	194. 4131
At Glasgow, Mo.	T. B. M. 314.	192. 0459
At Glasgow, Mo.	T. B. M. 315=Old B. M. 141(a).	187. 2425
Near Glasgow, Mo.	P. B. M. 161.	202. 3681
Near Glasgow, Mo.	P. B. M. 158=$\frac{47}{2}$.	188. 5957
	Top of cap over same.	189. 8339
Near Cambridge, Mo.	P. B. M. 162.	190. 7075
	Top of cap over same.	191. 9477
At Cambridge, Mo.	P. B. M. 163.	194. 4995
At Cambridge, Mo.	T. B. M. 325.	193. 8609
At Cambridge, Mo.	P. B. M. 164=$\frac{48}{1}$.	191. 4158
	Top of cap over same.	192. 6517
At Cambridge, Mo.	T. B. M. 326.	192. 5418
Near Salt Creek, Mo.	P. B. M. 165.	188. 8987
	Top of cap over same.	190. 1359
At New Frankfort, Mo.	P. B. M. 166=$\frac{49}{1}$.	191. 0345
	Top of cap over same.	192. 2773
Near New Frankfort, Mo.	P. B. M. 167.	191. 0966
	Top of cap over same.	192. 3328
Near Buckhorn Point, Mo.	P. B. M. 168=$\frac{50}{1}$.	192. 1437
	Top of cap over same.	193. 3850

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Cromwell Point, Mo.	P. B. M. 169.	193.0603
	Top of cap over same.	194.3001
Near Grand River, Mo.	P. B. M. 170=$\frac{51}{1}$.	193.6842
	Top of cap over same.	194.9235
Near Dewitt, Mo.	P. B. M. 171=$\frac{52}{1}$.	193.9349
	Top of cap over same.	195.1710
Near Miami, Mo.	P. B. M. 172.	194.7355
	Top of cap over same.	195.9770
Near Miami, Mo.	P. B. M. 173.	195.8527
Near Miami, Mo.	T. B. M. 357=B. M. C. of 1878.	197.0122
At Miami, Mo.	P. B. M. 175=$\frac{53}{1}$.	196.5825
	Top of cap over same.	197.8260
At Miami, Mo.	T. B. M. 358.	197.7454
Near Miami, Mo.	P. B. M. 176.	195.3822
Near Miami, Mo.	T. B. M. 359.	194.6231
Near Miami, Mo.	T. B. M. 360.	198.4105
Near Miami, Mo.	P. B. M. 177=$\frac{54}{1}$.	196.1957
	Top of cap over same.	197.4386
Near Teteseau Bend, Mo.	P. B. M. 178.	197.3832
	Top of cap over same.	198.6149
Near Laynesville, Mo.	P. B. M. 179=$\frac{55}{2}$.	198.6579
	Top of cap over same.	199.8985
At Malta Bend Landing, Mo.	P. B. M. 180.	198.9041
	Top of cap over same.	200.1445
Near Malta Bend Landing, Mo.	P. B. M. 181.	199.6099
	Top of cap over same.	200.8486
Near Waverly, Mo.	P. B. M. 182=$\frac{56}{1}$.	200.9320
	Top of cap over same.	202.1756
Near Waverly, Mo.	P. B. M. 183.	205.5326
	Top of cap over same.	206.7723
Near Waverly, Mo.	T. B. M. 389.	204.9645
Near Waverly, Mo.	P. B. M. 184=$\frac{57}{1}$.	201.0831
	Top of cap over same.	202.3242
Near Waverly, Mo.	T. B. M. 392.	207.2083
At Waverly, Mo.	P. B. M. 185=$\frac{58}{1}$.	208.8101
	Top of cap over same.	210.0575
Near Waverly, Mo.	P. B. M. 186.	205.1035
Near Waverly, Mo.	T. B. M. 396.	206.5193
Near Waverly, Mo.	P. B. M. 187.	205.9789
Near Waverly, Mo.	T. B. M. 397.	206.5230
Near Waverly, Mo.	P. B. M. 188.	205.7950
	Top of cap over same.	207.0303
Near Waverly, Mo.	P. B. M. 189=$\frac{59}{1}$.	212.7595
	Top of cap over same.	213.9992
Near Edwards, Mo.	P. B. M. 190.	209.5622
Near Edwards, Mo.	T. B. M. 402.	209.0280
At Edwards, Mo.	P. B. M. 191.	208.3472
At Edwards, Mo.	P. B. M. 192.	205.7138
	Top of cap over same.	206.9571

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Edwards, Mo.	T. B. M. 403.	206.9221
Near Dover, Mo.	P. B. M. 193=$\frac{60}{1}$.	207.6897
	Top of cap over same.	208.9293
Near Dover, Mo.	T. B. M. 407.	207.7071
Near Dover, Mo.	T. B. M. 408.	208.3631
At Dover, Mo.	P. B. M. 194.	206.5974
	Top of cap over same.	207.8374
At Berlin, Mo.	P. B. M. 195=$\frac{61}{1}$.	208.1730
	Top of cap over same.	209.4086
At Berlin, Mo.	P. B. M. 196.	208.9419
At Berlin, Mo.	T. B. M. 411.	209.5686
Near Northrup, Mo.	P. B. M. 197.	208.0371
Near Northrup, Mo.	T. B. M. 412.	208.2984
At Northrup, Mo.	P. B. M. 198.	210.1521
	Top of cap over same.	211.3878
Near Northrup, Mo.	T. B. M. 415.	210.9786
Near Lexington, Mo.	P. B. M. 199=$\frac{62}{1}$.	206.3290
	Top of cap over same.	207.5738
Near Lexington, Mo.	T. B. M. 419.	212.0408
Near Lexington, Mo.	P. B. M. 200.	212.4372
Near Lexington, Mo.	T. B. M. 420.	214.9081
Near Lexington, Mo.	P. B. M. 201.	213.2198
	Top of cap over same.	214.4605
Near Lexington, Mo.	P. B. M. 202.	212.2294
Near Lexington, Mo.	T. B. M. 422.	210.6480
At Lexington, Mo.	P. B. M. 203=$\frac{63}{1}$.	209.8666
	Top of cap over same.	211.1066
At Lexington, Mo.	T. B. M. 423.	211.2467
At Lexington, Mo.	P. B. M. 204.	209.8095
At Lexington, Mo.	T. B. M. 424.	209.5565
At Lexington, Mo.	P. B. M. 205=old B. M. 190.	219.5859
Near Lexington, Mo.	T. B. M. 425=old B. M. 191.	212.4364
Near Lexington, Mo.	P. B. M. 206.	211.5931
Near Lexington, Mo.	P. B. M. 207.	211.2517
	Top of cap over same.	212.4924
Near Wellington, Mo.	P. B. M. 208.	212.5597
	Top of cap over same.	213.7925
Near Wellington, Mo.	T. B. M. 429=old B. M. 194.	212.4703
Near Wellington, Mo.	P. B. M. 209=$\frac{64}{1}$.	214.5907
	Top of cap over same.	215.8343
At Wellington, Mo.	P. B. M. 210.	218.5357
At Wellington, Mo.	T. B. M. 431.	219.3633
Near Waterloo, Mo.	P. B. M. 211.	212.2349
	Top of cap over same.	213.4706
At Napoleon, Mo.	P. B. M. 212=$\frac{66}{1}$.	215.6153
	Top of cap over same.	216.8560
Near Napoleon, Mo.	T. B. M. 436.	219.7124
Near Napoleon, Mo.	P. B. M. 213.	215.5513
	Top of cap over same.	216.7884
Near Sibley Bridge, Mo.	P. B. M. 214=$\frac{67}{1}$.	216.8314
	Top of cap over same.	218.0717
At Matthews Landing, Mo.	T. B. M. 445=Old B. M. 210.	218.8281

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Sibley, Mo.	P. B. M. 215.	218. 1465
	Top of cap over same.	219. 3818
At Sibley, Mo.	P. B. M. 216.	227. 6228
Near Sibley, Mo.	P. B. M. 217=cap over $\frac{68}{1}$.	216. 1364
Near New Sibley, Mo.	P. B. M. 218.	217. 5411
	Top of cap over same.	218. 7742
Near New Sibley, Mo.	T. B. M. 457.	223. 1702
At Little Blue River, Mo.	T. B. M. 458.	223. 8137
Near Missouri City, Mo.	P. B. M. 219=$\frac{69}{1}$.	218. 5681
	Top of cap over same.	219. 8110
At Atherton, Mo.	P. B. M. 220.	222. 4203
	Top of cap over same.	223. 6573
Near Atherton, Mo.	P. B. M. 221.	224. 7730
	Top of cap over same.	226. 0058
At Blue Mills Landing, Mo.	T. B. M. 465.	227. 9842
At Blue Mills Landing, Mo.	T. B. M. 466=Old B. M. 33 of 1878.	223. 4554
At Blue Mills Landing, Mo.	T. B. M. 467=Old B. M. 228.	220. 9566
At Courtney, Mo.	P. B. M. 222.	223. 5004
	Top of cap over same.	224. 7320
Near Courtney, Mo.	T. B. M. 470.	226. 3271
Near Independence, Mo.	T. B. M. 471.	229. 9400
Near Independence, Mo.	P. B. M. 223=$\frac{71}{1}$.	223. 4850
	Top of cap over same.	224. 7263
At Wayne, Mo.	P. B. M. 224.	227. 6383
Near Wayne, Mo.	P. B. M. 225.	228. 2618
	Top of cap over same.	229. 4979
Near Independence, Mo.	P. B. M. 226.	226. 7268
At Big Blue River, Mo.	P. B. M. 227.	224. 1164
	Top of cap over same.	225. 3538
Near Kansas City, Mo.	P. B. M. 228=$\frac{72}{1}$.	224. 0295
	Top of cap over same.	225. 2701
At Kansas City, Mo.	T. B. M. 478=Old B. M. 240.	226. 3488
At Kansas City, Mo.	T. B. M. 479.	228. 2836
At Kansas City, Mo.	P. B. M. 229.	228. 4499
At Kansas City, Mo.	T. B. M. 480=Old B. M. 242.	233. 7614
At Kansas City, Mo.	P. B. M. 230=$\frac{73}{1}$.	227. 5983
	Top of cap over same.	*228. 8429
At Kansas City, Mo.	T. B. M. 481.	229. 5741
At Kansas City, Mo.	P. B. M. 233.	228. 9478
At Kansas City, Mo.	T. B. M. 482.	228. 0809
At Kansas City, Kans.	P. B. M. 234.	229. 7505
At Kansas City, Kans.	T. B. M. 483.	228. 4847
At Kansas City, Kans.	P. B. M. 235.	226. 2202
At Kansas City, Kans.	T. B. M. 484.	225. 6888
At Kansas City, Kans.	T. B. M. 485=Old B. M. 248.	237. 1943
At Kansas City, Kans.	T. B. M. 486=City B. M.	237. 4590
At Kansas City, Kans.	T. B. M. 487.	232. 6173
At Kansas City, Kans.	P. B. M. 236.	228. 6262
	Top of cap over same.	229. 8645
At Kansas City, Kans.	P. B. M. 237.	229. 4898
Near Quindaro, Kans.	P. B. M. 238=$\frac{74}{1}$.	227. 7647
	Top of cap over same.	229. 0052

*New elevation. Previous elevation, see page 460.

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Quindaro, Kans.	T. B. M. 492.	235.8137
Near Nearman, Kans.	P. B. M. 239.	227.9057
	Top of cap over same.	229.1374
Near Pomeroy, Kans.	P. B. M. 240.	231.1864
Near Pomeroy, Kans.	T. B. M. 495.	231.1864
Near Pomeroy, Kans.	P. B. M. 241.	230.6078
	Top of cap over same.	231.8443
At Pomeroy, Kans,	P. B. M. 242.	236.3906
At Pomeroy, Kans.	P. B. M. 243.	229.7796
	Top of cap over same.	231.0126
Near Pomeroy, Kans.	P. B. M. 244=Old B. M. 260.	236.0860
Near Pomeroy, Kans.	T. B. M. 499.	229.9422
At Connors, Kans.	P. B. M. 245=$\frac{76}{1}$.	230.1813
	Top of cap over same.	231.4227
At Connors, Kans.	P. B. M. 246.	235.4261
Near Connors, Kans.	P. B. M. 247.	230.4899
	Top of cap over same.	231.7243
At Popes, Kans.	T. B. M. 506.	232.3943
Near Leavenworth Junction, Kans.	P. B. M. 248=$\frac{77}{1}$.	243.8595
	Top of cap over same.	245.1025
At Leavenworth Junction, Kans.	P. B. M. 249.	230.7390
	Top of cap over same.	231.9779
Near Leavenworth, Kans.	T. B. M. 513.	232.8148
Near Leavenworth, Kans.	T. B. M. 514.	235.0388
Near Leavenworth, Kans.	P. B. M. 250=$\frac{78}{1}$.	246.4224
	Top of cap over same.	247.6615
Near Leavenworth, Kans.	T. B. M. 515.	234.0687
At Leavenworth, Kans.	P. B. M. 251.	238.5008
At Leavenworth, Kans.	P. B. M. 252.	239.9748
At Leavenworth, Kans.	T. B. M. 516=Old B. M. 270.	234.6185
At Leavenworth, Kans.	P. B. M. 253.	236.4005
At Leavenworth, Kans.	T. B. M. 517.	235.3047
Near Leavenworth, Kans.	T. B. M. 518.	237.4612
At Fort Leavenworth, Kans.	P. B. M. 254=$\frac{79}{1}$.	240.3079
	Top of cap over same.	241.5532
At Fort Leavenworth, Kans.	P. B. M. 255.	240.4467
At Fort Leavenworth, Kans.	T. B. M. 520.	238.4951
At Fort Leavenworth, Kans.	T. B. M. 521=gauge B. M.	239.5720
At Fort Leavenworth, Kans.	P. B. M. 256.	236.6352
Near Fort Leavenworth, Kans.	P. B. M. 257.	235.8252
	Top of cap over same.	237.0650
Near Fort Leavenworth, Kans.	P. B. M. 258=$\frac{80}{1}$.	234.5580
	Top of cap over same.	235.8012
Near Wade, Kans.	T. B. M. 525.	235.9444
Near Kickapoo, Kans.	P. B. M. 259.	235.9619
	Top of cap over same.	237.1983
Near Kickapoo, Kans.	P. B. M. 260.	242.2728
Near Kickapoo, Kans.	T. B. M. 529=Old B. M. 278.	242.3972
Near Kickapoo, Kans.	T. B. M. 530.	241.8266
At Kickapoo, Kans.	P. B. M. 261=$\frac{81}{1}$.	244.3752
	Top of cap over same.	245.6134
At Kickapoo, Kans.	T. B. M. 531.	243.0510
Near Oak Mills, Kans.	P. B. M. 262.	236.1673
	Top of cap over same.	237.3985

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Oak Mills, Kans.	P. B. M. 263.	240.9631
At Oak Mills, Kans.	P. B. M. 264=$\frac{82}{1}$.	238.1327
	Top of cap over same.	239.3719
Near Oak Mills, Kans.	P. B. M. 265.	239.4948
Near Oak Mills, Kans.	T. B. M. 540.	239.6265
Near Atchison, Kans.	P. B. M. 266=$\frac{83}{1}$.	239.2682
	Top of cap over same.	240.4952
Near Atchison, Kans.	T. B. M. 542.	240.3229
Near Atchison, Kans.	P. B. M. 267.	242.7893
	Top of cap over same.	244.0274
Near Atchison, Kans.	T. B. M. 543.	240.9742
Near Atchison, Kans.	P. B. M. 268=Old B. M. 287.	243.7082
At Atchison, Kans.	P. B. M. 269=$\frac{84}{1}$.	243.4530
	Top of cap over same.	244.6789
At Atchison, Kans.	T. B. M. 548=City B. M.	244.4523
At Atchison, Kans.	P. B. M. 270.	255.9516
At Atchison, Kans.	T. B. M. 549.	255.2107
At Atchison, Kans.	T. B. M. 550=Old gauge B. M.	241.2443
At Atchison, Kans.	P. B. M. 271.	243.5519
At Atchison, Kans.	P. B. M. 272.	242.8138
At Atchison, Kans.	T. B. M. 551.	243.2895
Near East Atchison, Mo.	P. B. M. 273=$\frac{84}{2}$.	238.7823
	Top of cap over same.	240.0115
Near Rushville, Mo.	P. B. M. 274.	240.4509
	Top of cap over same.	241.6826
At Rushville, Mo.	P. B. M. 275=$\frac{85}{3}$.	245.9781
	Top of cap over same.	247.2074
Near Halls, Mo.	P. B. M. 276=$\frac{86}{2}$.	245.8732
	Top of cap over same.	247.1051
At Halls, Mo.	P. B. M. 277.	243.4669
	Top of cap over same.	244.7041
Near Kenmoor, Mo.	P. B. M. 278=$\frac{87}{2}$.	249.4765
	Top of cap over same.	250.7052
Near St. Joseph, Mo.	P. B. M. 279.	245.6806
	Top of cap over same.	246.9232
Near St. Joseph, Mo.	P. B. M. 280=$\frac{88}{2}$.	251.7201
	Top of cap over same.	252.9464
At St. George, Mo.	P. B. M. 281.	251.4654
	Top of cap over same.	252.6999
At St. George, Mo.	T. B. M. 579.	250.6002
At St. Joseph, Mo.	T. B. M. 580.	252.1038
At St. Joseph, Mo.	P. B. M. 282.	250.2586
At St. Joseph, Mo.	T. B. M. 582=old B. M. 313.	251.2301
At St. Joseph, Mo.	T. B. M. 583=old B. M. 312.	251.0093
At St. Joseph, Mo.	P. B. M. 283=$\frac{89}{3}$.	250.1638
	Top of cap over same.	251.3898
At St. Joseph, Mo.	P. B. M. 284.	253.9413
At St. Joseph, Mo.	T. B. M. 584.	252.0549
At St. Joseph, Mo.	P. B. M. 285.	266.7448
At St. Joseph, Mo.	P. B. M. 286.	256.6388

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At St. Joseph, Mo.	T. B. M. 585=City B. M.	255. 3951
At St. Joseph, Mo.	T. B. M. 586.	252. 6350
Near St. Joseph, Mo.	P. B. M. 287=89½.	249. 2049
	Top of cap over same.	250. 4288
Near St. Joseph, Mo.	P. B. M. 288.	247. 8690
	Top of cap over same.	249. 1022
Near St. Joseph, Mo.	T. B. M. 589.	250. 1559
Near St. Joseph, Mo.	P. B. M. 289.	251. 1427
Near St. Joseph, Mo.	P. B. M. 290=$\frac{90}{2}$.	250. 1941
	Top of cap over same.	251. 3820
Near Amazonia, Mo.	P. B. M. 291.	254. 7600
	Top of cap over same.	255. 9858
Near Amazonia, Mo.	P. B. M. 292=$\frac{91}{2}$.	253. 1825
	Top of cap over same.	254. 3943
Near Amazonia, Mo.	P. B. M. 293.	252. 2903
	Top of cap over same.	253. 5154
Near Amazonia, Mo.	P. B. M. 294=$\frac{92}{3}$.	254. 2165
	Top of cap over same.	255. 4266
Near Nodaway, Mo.	P. B. M. 295.	253. 7965
Near Nodaway, Mo.	P. B. M. 296=$\frac{93}{3}$.	257. 3421
	Top of cap over same.	258. 5523
Near Forbes, Mo.	P. B. M. 297.	255. 8192
	Top of cap over same.	257. 0250
Near Forbes, Mo.	P. B. M. 298=$\frac{94}{3}$.	260. 5653
	Top of cap over same.	261. 7700
Near Curzons, Mo.	P. B. M. 299.	257. 6751
	Top of cap over same.	258. 9057
Near Curzons, Mo.	P. B. M. 300=$\frac{95}{3}$.	258. 6031
	Top of cap over same.	259. 8162
Near Forest City, Mo.	T. B. M. 632.	260. 5482
Near Forest City, Mo.	P. B. M. 301=$\frac{96}{2}$.	262. 9783
	Top of cap over same.	264. 1884
At Forest City, Mo.	P. B. M. 302.	261. 8960
Near Forest City, Mo.	P. B. M. 303.	259. 1829
	Top of cap over same.	260. 4070
At Napier, Mo.	P. B. M. 304.	258. 2913
	Top of cap over same.	259. 5227
Near Bigelow, Mo.	P. B. M. 305.	258. 7578
	Top of cap over same.	259. 9822
At Bigelow, Mo.	P. B. M. 306.	260. 7111
	Top of cap over same.	261. 9384
Near Bigelow, Mo.	P. B. M. 307.	261. 3848
	Top of cap over same.	262. 6141
Near Craig, Mo.	P. B. M. 308.	263. 5681
Near Craig, Mo.	P. B. M. 309.	263. 6296
	Top of cap over same.	264. 8531
Near Craig, Mo.	P. B. M. 310.	264. 3311
Near Corning, Mo.	P. B. M. 311.	264. 5055
	Top of cap over same.	265. 7328
At Corning, Mo.	P. B. M. 312.	266. 9669
Near Corning, Mo.	P. B. M. 313.	266. 6972
	Top of cap over same.	267. 9186

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Nishnabotna, Mo.	P. B. M. 314.	266.2942
	Top of cap over same.	267.5195
Near Nishnabotna, Mo.	P. B. M. 315.	269.5299
Near Langdon, Mo.	P. B. M. 316.	269.2972
	Top of cap over same.	270.5233
Near Phelps, Mo.	P. B. M. 317.	269.8746
	Top of cap over same.	271.1014
At Phelps, Mo.	P. B. M. 318=$\frac{106}{3}$.	270.7853
	Top of cap over same.	272.0082
Near Watson, Mo.	P. B. M. 319.	271.4376
	Top of cap over same.	272.6653
Near Watson, Mo.	P. B. M. 320=$\frac{107}{2}$.	273.5628
	Top of cap over same.	274.7847
At Watson, Mo.	P. B. M. 321.	272.9093
	Top of cap over same.	274.1324
Near Watson, Mo.	P. B. M. 322.	275.1582
	Top of cap over same.	276.3848
Near Hamburg, Iowa	P. B. M. 323.	277.2076
Near Hamburg, Iowa	P. B. M. 324.	275.5918
	Top of cap over same.	276.8198
Near Hamburg, Iowa	P. B. M. 325=$\frac{110}{2}$.	276.3600
	Top of cap over same.	277.5761
Near Nebraska City Junction, Iowa	P. B. M. 326.	279.5160
	Top of cap over same.	280.7422
Near Nebraska City Junction, Iowa	P. B. M. 327.	280.6725
	Top of cap over same.	281.8988
Near Percival, Iowa	P. B. M. 328.	280.8262
	Top of cap over same.	282.0521
At Percival, Iowa	P. B. M. 329.	282.6684
	Top of cap over same.	283.8962
Near McPaul, Iowa	P. B. M. 330=$\frac{114}{3}$.	284.2468
	Top of cap over same.	285.4633
Near McPaul, Iowa	P. B. M. 331.	285.9306
	Top of cap over same.	287.1546
Near Bartlett, Iowa	P. B. M. 332.	286.3633
	Top of cap over same.	287.5871
Near Bartlett, Iowa	P. B. M. 333.	287.3610
	Top of cap over same.	288.5855
Near Haynies, Iowa	P. B. M. 334=$\frac{116}{3}$.	288.2741
	Top of cap over same.	289.4952
At Haynies, Iowa	P. B. M. 335.	289.2377
	Top of cap over same.	290.4607
Near Pacific Junction, Iowa.	P. B. M. 336 = $\frac{117}{3}$.	289.7957
	Top of cap over same.	291.0205
Near Pacific Junction, Iowa.	P. B. M. 337.	291.4335
	Top of cap over same.	292.6557
Near Hentons, Iowa.	P. B. M. 338.	292.3839
	Top of cap over same.	293.6113
At Hentons, Iowa.	P. B. M. 339.	293.6732
	Top of cap over same.	294.8954
Near Hentons, Iowa.	P. B. M. 340.	295.7483
	Top of cap over same.	296.9711

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Island Park, Iowa.	P. B. M. 341.	295.3554
	Top of cap over same.	296.5808
Near Council Bluffs, Iowa.	P. B. M. 342.	296.1945
	Top of cap over same.	297.4169
At Council Bluffs, Iowa.	P. B. M. 343.	299.4095
At Omaha, Nebr.	City B. M., Omaha.	317.6889
At Omaha, Nebr.	P. B. M. 344.	317.3728
At Omaha, Nebr.	P. B. M. 345.	299.5565
At Omaha, Nebr.	P. B. M. 346 = gauge B. M.	296.5589
	Top of cap over same.	297.7679
Near Omaha, Nebr.	T. B. M. 804.	307.0098
At Council Bluffs, Iowa.	P. B. M. 347.	301.1079
At Council Bluffs, Iowa.	P. B. M. 348=$\frac{121}{2}$.	302.2574
	Top of cap over same.	303.4821
At Council Bluffs, Iowa.	P. B. M. 349=$\frac{122}{2}$.	297.6932
	Top of cap over same.	298.9178
Near Council Bluffs, Iowa.	P. B. M. 350.	303.8686
	Top of cap over same.	305.0896
Near Council Bluffs, Iowa.	P. B. M. 351.	301.1657
	Top of cap over same.	302.3895
At Crescent, Iowa.	P. B. M. 352.	301.6862
	Top of cap over same.	302.9110
Near Honey Creek, Iowa.	P. B. M. 353.	304.0231
	Top of cap over same.	305.2449
At Honey Creek, Iowa.	P. B. M. 354.	306.6807
Near Honey Creek, Iowa.	P. B. M. 355.	305.4125
	Top of cap over same.	306.6373
At Loveland, Iowa.	P. B. M. 356.	305.2565
Near Missouri Valley, Iowa.	P. B. M. 357.	303.6964
	Top of cap over same.	304.9191
At Missouri Valley, Iowa.	P. B. M. 358.	307.1897
Near Missouri Valley, Iowa.	P. B. M. 359.	305.7243
	Top of cap over same.	306.9487
Near California Junction, Iowa.	P. B. M. 360=$\frac{127}{3}$.	305.9827
	Top of cap over same.	307.2038
Near California Junction, Iowa.	P. B M. 361.	306.8424
	Top of cap over same.	308.0655
Near Modale, Iowa.	P. B. M. 362.	307.8971
	Top of cap over same.	309.1139
Near Modale, Iowa.	P. B. M. 363.	308.3189
	Top of cap over same.	309.5413
Near Mondamin, Iowa.	P. B. M. 364.	309.4425
	Top of cap over same.	310.6666
At Mondamin, Iowa.	P. B. M. 365.	312.8718
Near Mondamin, Iowa.	P. B. M. 366.	311.9452
	Top of cap over same.	313.1652
Near Mondamin, Iowa.	P. B. M. 367 = $\frac{130}{2}$.	311.4913
	Top of cap over same.	312.7084
Near River Sioux, Iowa.	P. B. M. 368.	313.1232
	Top of cap over same.	314.3435
Near River Sioux, Iowa.	P. B. M. 369 = $\frac{131}{3}$.	314.9946
	Top of cap over same.	316.2131
Near River Sioux, Iowa.	P. B. M. 370.	314.0633
	Top of cap over same.	315.2843

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Blencoe, Iowa.	P. B. M. 371.	314.7404
	Top of cap over same.	315.9612
Near Blencoe, Iowa.	P. B. M. 372 = $\frac{132}{4}$.	.....
	Top of cap over same.	314.9836
Near Blencoe, Iowa.	P. B. M. 373.	315.6574
	Top of cap over same.	316.8775
At Blencoe, Iowa.	P. B. M. 374 = $\frac{133}{4}$.	316.6035
	Top of cap over same.	317.8201
Near Onawa, Iowa.	P. B. M. 375.	318.1419
	Top of cap over same.	319.3681
Near Onawa, Iowa.	P. B. M. 376.	318.8280
	Top of cap over same.	320.0536
At Onawa, Iowa.	P. B. M. 377.	321.2459
At Onawa, Iowa.	P. B. M. 378 = $\frac{134}{3}$.	319.7907
	Top of cap over same.	321.0300
Near Onawa, Iowa.	P. B. M. 379.	319.9724
	Top of cap over same.	321.1912
Near Whiting, Iowa.	P. B. M. 380.	320.8697
	Top of cap over same.	322.0960
Near Whiting, Iowa.	P. B. M. 381.	322.6618
	Top of cap over same.	323.9028
Near Whiting, Iowa.	P. B. M. 382.	323.6968
	Top of cap over same.	324.9206
Near Sloan, Iowa.	P. B. M. 383 = $\frac{138}{3}$.	324.4264
	Top of cap over same.	325.6645
Near Sloan, Iowa.	P. B. M. 384.	326.0285
	Top of cap over same.	327.2486
At Sloan, Iowa.	P. B. M. 385.	328.6336
Near Sloan, Iowa.	P. B. M. 386 = $\frac{139}{3}$.	326.5025
	Top of cap over same.	327.7226
Near Salix, Iowa.	P. B. M. 387.	327.1751
	Top of cap over same.	328.4018
Near Salix, Iowa.	P. B. M. 388.	329.2787
	Top of cap over same.	330.4984
Near Salix, Iowa.	P. B. M. 389.	331.3654
	Top of cap over same.	332.5866
Near Sargents Bluff, Iowa.	P. B. M. 390.	331.2770
	Top of cap over same.	332.5009
At Sargents Bluff, Iowa.	P. B. M. 391 = $\frac{142}{3}$.	332.8089
	Top of cap over same.	334.0252
Near Sargents Bluff, Iowa.	P. B. M. 392.	333.6550
	Top of cap over same.	334.8788
At Sioux City, Iowa.	P. B. M. 393.	335.1801
	Top of cap over same.	336.4068
At Sioux City, Iowa.	P. B. M. 394.	337.5078
At Sioux City, Iowa.	P. B. M. 395, gauge B. M.	.....
	Top of cap over same.	333.9859
At Sioux City, Iowa.	* P. B. M. 396 = $\frac{143}{3}$.	337.6734
At Sioux City, Iowa.	T. B. M. 966.	338.3755

* For elevation of top of cap over P. B. M. 396, see page 577.

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Sioux City, Iowa.	P. B. M. 397.	335.8887
	Top of cap over same.	337.1112
Near Sioux City, Iowa.	P. B. M. 398.	336.6623
	Top of cap over same.	337.8844
Near Sioux City, Iowa.	P. B. M. 399.	335.2881
	Top of cap over same.	336.5088
At Harrisburg, Pa.	P. R. R. 1.	97.5733
At Harrisburg, Pa.	P. R. R. 2.	102.7893
At Harrisburg, Pa.	364 Harrisburg (1899).	110.9397
At Harrisburg, Pa.	P. R. R. 4.	101.1801
Near Rockville, Pa.	P. R. R. 5.	106.5171
Near Rockville, Pa.	P. R. R. 6.	106.5537
Near Perdix, Pa.	P. R. R. 7.	105.3180
At Perdix, Pa.	P. R. R. 8.	106.1335
At Cove, Pa.	P. R. R. 9.	105.2219
Near Cove, Pa.	P. R. R. 10.	106.2824
Near Cove, Pa.	P. R. R. 11.	105.8129
At Cove Creek, Pa.	P. R. R. 12.	107.2028
At Shermans Creek, Pa.	P. R. R. 13.	108.3260
At Duncannon, Pa.	P. R. R. 14.	111.9345
At Juniata Bridge, Pa.	P. R. R. B.	109.5533
Near Juniata Bridge, Pa.	P. R. R. 15.	110.6745
Near Aqueduct, Pa.	P. R. R. 16.	113.7041
At Aqueduct, Pa.	P. R. R. 17.	113.1766
At Alters Run Bridge, Pa.	P. R. R. 18.	115.0200
At Loshs Run, Pa.	P. R. R. 19.	113.8397
Near Loshs Run, Pa.	P. R. R. 20.	117.6065
At Bailey, Pa.	P. R. R. 22.	117.2523
Near Bailey, Pa.	P. R. R. 23.	120.5315
At Trimmers Rock, Pa.	P. R. R. 24.	119.6681
Near Newport, Pa.	P. R. R. 25.	120.1459
At Newport, Pa.	P. R. R. 26.	120.7912
Near Newport, Pa.	P. R. R. 27.	120.9462
Near Newport, Pa.	P. R. R. 28.	122.4209
Near Old Ferry Station, Pa.	P. R. R. 29.	122.1153
At Millerstown, Pa.	P. R. R. 31.	124.7447
Near Durward, Pa.	P. R. R. 32.	125.0762
At Durward, Pa.	P. R. R. 33.	128.8675
Near Durward, Pa.	P. R. R. 34.	128.4343
At Thompsontown, Pa.	P. R. R. 35.	128.0735
Near Thompsontown, Pa.	P. R. R. 36.	127.6618
Near Thompsontown, Pa.	P. R. R. 37.	128.1091
At Vandyke, Pa.	P. R. R. C.	129.7726
Near Vandyke, Pa.	P. R. R. 39.	129.8211
At Tuscarora, Pa.	P. R. R. 40.	131.1039
At Mexico, Pa.	P. R. R. 41.	130.8133
Near Port Royal, Pa.	P. R. R. 42.	131.9162
At Port Royal, Pa.	P. R. R. 43.	134.4150
Near Mifflin, Pa.	P. R. R. 45.	134.9076
At Mifflin, Pa.	P. R. R. 46.	135.5688
Near Mifflin, Pa.	P. R. R. 47.	136.2571
At Denholm, Pa.	P. R. R. 49.	138.3135
Near Denholm, Pa.	P. R. R. 50.	141.9429
Near Narrows Station, Pa.	P. R. R. 51.	142.0780
Near Narrows Station, Pa.	P. R. R. 52.	144.3819
At Bixler Water Station, Pa.	P. R. R. 53.	145.1829
At Lewistown Junction, Pa.	P. R. R. 54.	151.9366
At Mayes Bridge, Pa.	P. R. R. 57.	152.3138
At Granville, Pa.	P. R. R. 58.	150.5296
At Anderson, Pa.	P. R. R. 59.	150.2541

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Longfellow Station, Pa.	P. R. R. 61.	151. 5847
Near Horingford Station, Pa.	P. R. R. 62.	152. 4558
Near Horingford Station, Pa.	P. R. R. 63.	159. 5995
At McVeytown, Pa.	P. R. R. 64.	160. 1903
Near McVeytown, Pa.	P. R. R. 65.	154. 2583
Near McVeytown, Pa.	P. R. R. 66.	154. 3371
Near Ryde, Pa.	P. R. R. 67.	155. 7143
At Ryde, Pa.	P. R. R. 68.	157. 0822
Near Ryde, Pa.	P. R. R. 69.	162. 5743
At Manayunk Bridge, Pa.	P. R. R. 70.	164. 1190
Near Vineyard Station, Pa.	P. R. R. 71.	171. 6561
Near Vineyard Station, Pa.	P. R. R. 72.	178. 2088
Near Newton Hamilton, Pa.	P. R. R. 73.	179 8541
At Newton Hamilton, Pa.	P. R. R. 74.	182. 6640
Near Mount Union, Pa.	P. R. R. 75.	183. 3792
At Mount Union, Pa.	P. R. R. 76.	183. 0435
Near Mount Union, Pa.	P. R. R. 77.	177. 5899
At Jackstown, Pa.	P. R. R. 78.	181. 0061
At Mapleton, Pa.	P. R. R. 79.	181. 9993
At Vandevanders Bridge, Pa.	P. R. R. 80.	183. 1907
At Bridgeport, Pa.	P. R. R. 81.	183. 1779
At Mill Creek, Pa.	P. R. R. 82.	184. 8965
At Mill Creek, Pa.	P. R. R. 83.	183. 2808
Near Mill Creek, Pa.	P. R. R. 84.	183. 6216
At Ardenheim, Pa.	P. R. R. 85.	183. 9316
Near Ardenheim, Pa.	P. R. R. 86.	189. 2436
At Huntingdon, Pa.	P. R. R. 87.	190. 3373
At Huntingdon, Pa.	P. R. R. 88	190. 3769
Near Warrior Ridge, Pa.	P. R. R. D.	203. 6827
At Warrior Ridge, Pa.	P. R. R. 90.	205. 9346
Near Petersburg, Pa.	P. R. R. 91.	205. 9099
At Petersburg, Pa.	P. R. R. 92.	207. 4850
Near Petersburg, Pa.	P. R. R. 93.	211. 0569
Near Petersburg, Pa.	P. R. R. 94.	211. 4221
Near Petersburg, Pa.	P. R. R. 95.	213. 2598
Near Barree, Pa.	P. R. R. 96.	219. 5809
Near Barree, Pa.	P. R. R. 97.	222. 1927
Near Barree, Pa.	P. R. R. 98.	231. 3818
Near Barree, Pa.	P. R. R. 99.	231. 9609
Near Union Furnace, Pa.	P. R. R. E.	238. 6173
Near Union Furnace, Pa.	P. R. R. 101.	239. 7081
At Union Furnace, Pa.	P. R. R. 102.	243. 4842
Near Union Furnace, Pa.	P. R. R. 103.	250. 3509
At Shoenberger, Pa.	P. R. R. 104.	255. 5320
Near Birmingham, Pa.	P. R. R. 105.	261. 5272
At Birmingham, Pa.	P. R. R. 106.	264. 1267
Near Birmingham, Pa.	P. R. R. 107.	270. 6246
Near Tyrone, Pa.	P. R. R. 108.	271. 4502
At Tyrone, Pa.	P. R. R. 109.	273. 0651
At Tyrone, Pa.	P. R. R. 110.	277. 5791
Near Tyrone, Pa.	P. R. R. 111.	281. 0351
Near Tyrone, Pa.	P. R. R. 112.	284. 7351
Near Grazierville, Pa.	P. R. R. F.	287. 4354
Near Grazierville, Pa.	P. R. R. 113.	289. 7638
At Tipton, Pa.	P. R. R. 114.	302. 7535
Near Fostoria, Pa.	P. R. R. 115.	313. 1861
At Bellwood, Pa.	P. R. R. 116.	323. 7312
Near Bellwood, Pa.	P. R. R. 117.	322. 5478
At Elizabeth Furnace, Pa.	P. R. R. 118.	327. 7898
Near Elizabeth Furnace, Pa.	P. R. R. 119.	335. 2358

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Blair Furnace, Pa.	P. R. R. 120.	340. 7643
Near Blair Furnace, Pa.	P. R. R. 121.	345. 2474
At Haggerty Run, Pa.	P. R. R. 122.	348. 1242
At Altoona, Pa.	P. R. R. 123.	353. 9606
At Altoona, Pa.	P. R. R. 124.	354. 3995
At Altoona, Pa.	P. R. R. 125.	356. 6337
At Altoona, Pa.	P. R. R. 126.	360. 0079
At Altoona, Pa.	P. R. R. 127.	363. 2845
At Kittanning Point, Pa.	P. R. R. 2.	495. 6749
At Allegrippus, Pa.	P. R. R. 3.	589. 9173
At Bennington, Pa.	P. R. R. 4.	618. 9489
At Allegheny Tunnel, Pa	P. R. R. 5.	648. 1207
At Gallitzin, Pa.	P. R. R. 6.	659. 7792
At Cresson, Pa.	P. R. R. 7.	616. 2337
Near Lilly, Pa.	P. R. R. 8.	594. 4788
At Lilly, Pa.	P. R. R. 9.	575. 7330
At Portage, Pa.	P. R. R. 12.	514. 2646
Near Portage, Pa.	P. R. R. 13.	494. 8145
At Wilmore, Pa.	P. R. R. 14.	476. 3157
Near Wilmore, Pa.	P. R. R. 15.	475. 1386
Near Ehrenfeld, Pa.	P. R. R. 16.	476. 2231
At Ehrenfeld, Pa.	P. R. R. 17.	463. 0369
Near Ehrenfeld, Pa.	P. R. R. 18.	452. 3103
At Conemaugh Viaduct, Pa	P. R. R. 20.	444. 2873
At Mineral Point, Pa.	P. R. R. 21.	431. 5429
Near Mineral Point, Pa.	P. R. R. 22a.	414. 8148
Near Mineral Point, Pa.	P. R. R. 23.	404. 3448
Near Conemaugh, Pa.	P. R. R. 24.	399. 5191
At Conemaugh, Pa.	P. R. R. 26.	373. 9425
At Woodvale, Pa.	P. R. R. 27.	361. 2744
At Johnstown, Pa.	P. R. R. 28.	361. 9809
At Johnstown, Pa.	P. R. R. 28a.	359. 7464
Near Sang Hollow, Pa.	P. R. R. 30a.	349. 8845
At Sang Hollow, Pa.	P. R. R. 31.	348. 8207
Near Big Spring Run, Pa.	P. R. R. 34.	343. 3911
At Big Spring Run, Pa.	P. R. R. 36.	333. 5451
At Piney Run, Pa.	P. R. R. 36a.	332. 7119
Near New Florence, Pa.	P. R. R. 36b.	329. 3945
Near New Florence, Pa.	P. R. R. 37.	327. 1140
At New Florence. Pa.	P. R. R. 37a.	329. 2534
Near Lockport, Pa.	P. R. R. 40.	317. 7585
Near Lockport, Pa.	P. R. R. 41.	320. 2874
At Lockport, Pa.	P. R. R. 42.	321. 5152
At Bolivar Junction, Pa.	P. R. R. 43.	314. 8331
At Bolivar Junction, Pa.	P. R. R. 44.	315. 5890
At Bolivar Junction, Pa.	P. R. R. 44a.	315. 7048
Near Bolivar, Pa.	P. R. R. 45.	330. 8037
At Pack Saddle, Pa.	P. R. R. 46.	336. 8867
At Pack Saddle, Pa.	P. R. R. 46a.	337. 4110
At Blairsville Intersection, Pa.	P. R. R. 47.	341. 2932
Near Blairsville, Pa.	P. R. R. 48.	339. 4708
At Millwood, Pa.	P. R. R. 51.	355. 2670
Near Millwood, Pa.	P. R. R. 52.	350. 6158
At Derry, Pa.	P. R. R. 53.	356. 2214
At Derry, Pa.	P. R. R. 54.	360. 2966
At Bradenville, Pa.	P. R. R. 56.	331. 0152
At Bradenville, Pa.	P. R. R. 56a.	330 7439
At Loyalhanna, Pa.	P. R. R. 57.	316. 7812
At Latrobe, Pa.	P. R. R. 58.	307. 3786
At Latrobe, Pa.	P. R. R. 58a.	301. 3893

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Latrobe, Pa.	P. R. R. 59.	324.2345
At Beatty, Pa.	P. R. R. 60.	328.3313
At Carney, Pa.	P. R. R. 61.	351.4450
Near Carney, Pa.	P. R. R. 62.	368.6817
At George, Pa.	P. R. R. 63.	365.5547
At Greensburg, Pa.	P. R. R. 65.	330.9759
At Greensburg, Pa.	P. R. R. 66.	339.4007
At Radebaugh, Pa.	P. R. R. 67.	354.1963
At Radebaagh, Pa.	P. R. R. 68.	354.9979
At Radebaugh, Pa.	P. R. R. 68a.	352.8216
At Radebaugh, Pa.	P. R. R. 69.	349.6395
At Radebaugh, Pa.	P. R. R. 69a.	347.7192
Near Grapeville, Pa.	P. R. R. 70.	336.2408
At Grapeville, Pa.	P. R. R. 71.	322.9548
At Penn, Pa.	P. R. R. 72.	296.7517
Near Penn, Pa.	P. R. R. 72a.	299.8912
Near Manor, Pa.	P. R. R. 73.	288.6992
At Irwin, Pa.	P. R. R. 76a.	267.9522
Near Larimer, Pa.	P. R. R. 77a.	262.7894
At Ardara, Pa.	P. R. R. 78.	254.6790
At Moss Side, Pa.	P. R. R. 81.	232.6271
At Wall, Pa.	P. R. R. 82.	229.0339
At Turtle Creek, Pa.	P. R. R. 84.	228.3517
At Brinton, Pa.	P. R. R. 85.	229.2542
At Brinton, Pa.	P. R. R. 86.	230.6289
Near West Penn Junction, Pa.	P. R. R. 27.	237.7737
Near Bagdad, Pa.	P. R. R. 28.	236.3508
Near Bagdad, Pa.	P. R. R. 29.	239.0892
Near Leechburg, Pa.	P. R. R. 30.	237.3561
At Leechburg, Pa.	P. R. R. 31.	240.5054
Near Leechburg, Pa.	P. R. R. 32.	237.7535
Near Hyde Park, Pa.	P. R. R. 33.	242.4640
Near Vandergrift, Pa.	P. R. R. 34.	247.2809
At Vandergrift, Pa.	P. R. R. 35.	244.1670
Near Vandergrift, Pa.	P. R. R. 36.	243.2962
Near Paulton, Pa.	P. R. R. 37.	245.7085
Near Paulton, Pa.	P. R. R. 38.	246.7452
Near Paulton, Pa.	P. R. R. 39.	250.0957
Near Roaring Run, Pa.	P. R. R. 40.	251.9465
Near Roaring Run, Pa.	P. R. R. 41.	252.3793
Near Salina, Pa.	P. R. R. 42.	254.5089
Near Salina, Pa.	P. R. R. 43.	253.0683
Near Salina, Pa.	P. R. R. 44.	257.4884
Near Salina, Pa.	P. R. R. 45.	257.2874
Near Edri, Pa.	P. R. R. 46.	256.3251
Near Edri, Pa.	P. R. R. 47.	254.3692
Near Edri, Pa.	P. R. R. 48.	256.4946
Near Saltsburg, Pa.	P. R. R. 49.	256.3001
At Saltsburg, Pa.	P. R. R. 50.	260.7754
Near White Rock, Pa.	P. R. R. 51.	265.8523
Near Tunnelton, Pa.	P. R. R. 52.	264.2871
Near Bow, Pa.	P. R. R. 53.	274.7379
Near Bow, Pa,	P. R. R. 54.	275.6067
Near Livermore, Pa.	P. R. R. 55.	281.3106
Near Livermore, Pa.	P. R. R. 56.	284.5301
Near Social Hall, Pa.	P. R. R. 57.	293.3674
At Social Hall, Pa.	P. R. R. 58.	293.8922
Near Blairsville, Pa.	P. R. R. 59.	304.6109
At Blairsville, Pa.	P. R. R. 60.	308.4304

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Blairsville, Pa.	P. R. R. 61.	298.4251
Near Blairsville, Pa.	P. R. R. 62.	294.9453
Near Bolivar Junction, Pa	P. R. R. 63.	305.9012
Near Hecks, Pa.	P. R. R. 1.	105.5724
At Hecks, Pa.	P. R. R. 1a.	106.0905
Near Dauphin, Pa.	P. R. R. 2.	105.7187
Near Dauphin, Pa.	P. R. R. 3.	106.4258
Near Dauphin, Pa.	P. R. R. 4.	105.9809
Near Geiger Point, Pa	P. R. R. 5.	106.9471
Near Clarks Ferry, Pa.	P. R. R. 6.	106.5265
Near Clarks Ferry, Pa.	P. R. R. 7.	107.4500
Near Clarks Ferry, Pa.	P. R. R. 8.	111.2327
Near Clarks Ferry, Pa.	P. R. R. 9.	111.5162
Near Clarks Ferry, Pa.	P. R. R. 10.	113.2170
Near Clarks Ferry, Pa.	P. R. R. 11.	111.6747
Near Clarks Ferry, Pa.	P. R. R. 12.	112.5830
Near Inglenook, Pa.	P. R. R. 12a.	113.8510
Near Halifax, Pa.	P. R. R. 13.	114.0004
Near Halifax, Pa.	P. R. R. 14.	115.1312
Near Halifax, Pa.	P. R. R. 15.	114.8142
Near Halifax, Pa.	P. R. R. 16.	115.5823
Near Halifax, Pa.	P. R. R. 17.	115.1953
Near Halifax, Pa.	P. R. R. 18.	114.6772
Near Halifax, Pa.	P. R. R. 19.	118.5603
Near Millersburg, Pa.	P. R. R. 20.	120.2795
Near Millersburg, Pa.	P. R. R. 21.	119.2035
Near Millersburg, Pa.	P. R. R. 22.	120.4258
Near Liverpool, Pa.	P. R. R. 23.	121.5475
At Liverpool, Pa.	P. R. R. 24.	120.7184
Near Liverpool, Pa.	P. R. R. 25.	121.2336
Near Liverpool, Pa.	P. R. R. 26.	122.5168
Near Liverpool, Pa.	P. R. R. 26a.	122.9314
At Mahantongo, Pa.	P. R. R. 27.	122.4345
Near Mahantongo, Pa.	P. R. R. 28.	122.6023
Near Georgetown, Pa.	P. R. R. 29.	123.8641
Near Georgetown, Pa.	P. R. R. 30.	125.9216
Near Georgetown, Pa.	P. R. R. 31.	126.6836
Near Georgetown, Pa.	P. R. R. 32.	125.2206
Near Georgetown, Pa.	P. R. R. 32a.	126.4185
Near Georgetown, Pa.	P. R. R. 33.	126.7263
Near Georgetown, Pa.	P. R. R. 34.	127.4304
Near Herndon, Pa.	P. R. R. 35.	128.0248
Near Herndon, Pa.	P. R. R. 36.	127.9608
Near Herndon, Pa.	P. R. R. 36a.	127.8664
At Herndon, Pa.	P. R. R. 37.	130.4145
Near Herndon, Pa.	P. R. R. 38.	129.4148
Near Herndon, Pa.	P. R. R. 39.	131.4478
Near Herndon, Pa.	P. R. R. 40.	131.5454
At Fishers Ferry, Pa.	P. R. R. 41.	131.5454
Near Selinsgrove Junction, Pa.	P. R. R. 42.	133.1365
Near Selinsgrove Junction, Pa.	P. R. R. 43.	133.2950
At Selinsgrove Junction, Pa.	P. R. R. 44.	132.1063
Near Selinsgrove Junction, Pa.	P. R. R. 45.	132.9720
Near Selinsgrove Junction, Pa.	P. R. R. 46.	134.4655
Near Sunbury, Pa.	P. R. R. 47.	134.7124
Near Sunbury, Pa.	P. R. R. 48.	134.2582
At Sunbury, Pa.	P. R. R. 49.	134.5205
At Sunbury, Pa.	P. R. R. 50.	135.5690
Near Sunbury, Pa.	P. R. R. 1.	135.4989

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Sunbury, Pa.	P. R. R. 2.	135.4928
Near Northumberland, Pa.	P. R. R. 3.	137.7605
Near Northumberland, Pa.	P. R. R. 4.	137.5898
Near Northumberland, Pa.	P. R. R. 5.	138.2665
Near Northumberland, Pa.	P. R. R. 6.	137.6936
Near Northumberland, Pa.	P. R. R. 7.	137.2729
Near Kapps, Pa.	P. R. R. 8.	138.5805
Near Kapps, Pa.	P. R. R. 9.	139.1779
Near Kapps, Pa.	P. R. R. 10.	137.2516
Near Montandon, Pa.	P. R. R. 11.	137.5899
Near Montandon, Pa.	P. R. R. 12.	137.9893
At Montandon, Pa.	P. R. R. 13.	139.9339
Near Montandon, Pa.	P. R. R. 14.	141.1257
Near Montandon, Pa.	P. R. R. 15.	142.2566
Near Dougal, Pa.	P. R. R. 16.	142.7382
At Milton, Pa.	P. R. R. 17.	145.1979
Near Milton, Pa.	P. R. R. 18.	144.2896
Near Milton, Pa.	P. R. R. 19.	142.8144
Near Watsontown, Pa.	P. R. R. 20.	143.2504
Near Watsontown, Pa.	P. R. R. 21.	143.6283
At Watsontown, Pa.	P. R. R. 22.	148.1638
At Watsontown, Pa.	P. R. R. 23.	147.6913
Near Watsontown, Pa.	P. R. R. 24.	147.0909
Near Dewart, Pa.	P. R. R. 25.	147.3165
Near Dewart, Pa.	P. R. R. 26.	149.5202
Near Montgomery, Pa.	P. R. R. 27.	148.4626
Near Montgomery, Pa.	P. R. R. 28.	149.2003
Near Montgomery, Pa.	P. R. R. 29.	147.5483
At Montgomery, Pa.	P. R. R. 30.	150.5749
At Montgomery, Pa.	P. R. R. 31.	149.8678
Near Montgomery, Pa.	P. R. R. 32.	152.8183
Near Muncy, Pa.	P. R. R. 33.	153.9492
Near Muncy, Pa.	P. R. R. 34.	156.1133
Near Muncy, Pa.	P. R. R. 35.	156.5583
Near Muncy, Pa.	P. R. R. 36.	155.9578
Near Muncy, Pa.	P. R. R. 37.	157.2320
Near Loyalsock, Pa.	P. R. R. 38.	157.6191
Near Loyalsock, Pa.	P. R. R. 39.	158.0458
Near Loyalsock, Pa.	P. R. R. 40.	157.3569
Near Loyalsock, Pa.	P. R. R. 41.	158.0550
Near Loyalsock, Pa.	P. R. R. 42.	158.2105
Near Williamsport, Pa.	P. R. R. 43.	156.9852
Near Williamsport, Pa.	P. R. R. 44.	159.3230
Near Williamsport, Pa.	P. R. R. 45.	160.0455
At Williamsport, Pa.	P. R. R. 45a.	159.2530
At Williamsport, Pa.	P. R. R. 46.	160.0790
At Williamsport, Pa.	P. R. R. 46a.	161.0086
At Williamsport, Pa.	P. R. R. 47.	161.0879
Near Ocean Springs, Miss.	P. B. M. Keenor.	5.5162
	Top of cap over same.	6.7295
Near Biloxi, Miss.	Biloxi Gauge B.	1.6984
Near Biloxi, Miss.	P. B. M. 19 A.	1.7359
At Biloxi, Miss.	T. B. M. 184.	5.3624
At Biloxi, Miss.	P. B. M. City Hall.	7.0231
At Biloxi, Miss.	T. B. M. 183.	7.1860
At Biloxi, Miss.	T. B. M. 186.	7.2563
At Biloxi, Miss.	P. B. M. Hygeia.	6.5083
	Top of cap over same.	7.7217

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Beauvoir, Miss.	P. B. M. 17.	7.8657
At Mississippi City, Miss.	P. B. M. 16.	6.3621
At White Harbor, Miss.	P. B. M. 14.	9.4098
At Pass Christian, Miss.	P. B. M. 13.	3.3724
At Bay St. Louis, Miss.	P. B. M. 11.	6.5252
At Bay St. Louis, Miss.	P. B. M. 10.	7.1769
At Waveland, Miss.	P. B. M. 9.	4.7274
At Chinchuba, Miss.	P. B. M. 8.	2.9644
At Claiborne, Miss.	P. B. M. 7.	1.2738
Near Claiborne, Miss.	P. B. M. 6.	3.1399
At Fort Macomb, Chef Menteur, La.	P. B. M. 4.	2.2309
At New Orleans, La.	T. B. M. 95.	1.1723
At New Orleans, La.	P. B. M. 41.	0.1823
At New Orleans, La.	P. B. M. 3.	1.3205
At New Orleans, La.	T. B. M. 175.	0.6555
At New Orleans, La.	P. B. M. 2.	2.8082
At New Orleans, La.	Halfway House.	1.6493
At New Orleans, La.	City Stone XXMR.	1.4819
At New Orleans, La.	City Park.	1.4850
At New Orleans, La.	T. B. M. 170.	2.8621
At Carrollton, La.	City Stone XXMB.	1.4182
At Carrollton, La.	T. B. M. 160.	1.9225
At Carrollton, La.	P. B. M. Carrollton.	2.7442
At Carrollton, La.	B. M. A (Ewens 1892).	1.8776
	Top of cap over same.	3.1218
Near St. Rose, La.	P. B. M. V.	4.6317
Near Hahnville, La.	P. B. M. VI.	4.1903
Near Sellers, La.	P. B. M. VII.	4.8335
At Mount Airy, La.	ⓐ Chenet.	3.2543
At Mount Airy, La.	P. B. M. X.	5.5738
Near Lutcher, La.	T. B. M. 83.	4.0434
Near Hester, La.	T. B. M. 71.	4.7835
Near Hester, La.	P. B. M. XII.	5.8644
Near Hester, La.	ⓐ Homestead.	4.9452
Near Hester, La.	P. B. M. XIII.	7.8879
Near Convent, La.	P. B. M. XIV.	7.3017
At Colomb, La.	P. B. M. XV.	7.1509
Near Burnside, La.	P. B. M. XVI.	7.5729
Near Belle Helene, La.	B. M. $\frac{185}{1}$.	6.1661
	Top of pipe over same.	7.6854
At New River, La.	P. B. M. New River.	6.2466
	Top of cap over same.	7.4582
Near Geismar, La.	P. B. M. XX.	7.2047
At St. Gabriel, La.	P. B. M. St. Gabriel.	5.4830
	Top of cap over same.	6.6912
Near Sunshine, La.	T. B. M. 22.	7.7873
Near Sunshine, La.	P. B. M. XXIV.	7.9479
Near Sunshine, La.	B. M. $\frac{179}{2}$.	7.8524
Near Burtville, La.	B. M. $\frac{175}{1}$.	5.9573
Near Baton Rouge, La.	P. B. M. XXIX.	8.4334
	Top of cap over same.	9.6506
Near Baton Rouge, La.	P. B. M. XXVIII.	9.3105
Near Baton Rouge, La.	P. B. M. XXX.	8.9710
At Baton Rouge, La.	P. B. M. City Limits.	9.3350
At Baton Rouge, La.	U. S. E. 2.	10.4900
At Baton Rouge, La.	T. B. M. 1.	18.4354
At Baton Rouge, La.	P. B. M. XXXI.	18.9710

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Baton Rouge, La.	P. B. M. Barracks.	17.8534
At Baton Rouge, La.	T. B. M. 2.	17.1712
At Baton Rouge, La.	P. B. M. Post-Office.	18.0284
At Baton Rouge, La.	P. B. M. North Boulevard.	15.8858
	Top of cap over same.	17.0895
At West Baton Rouge, La.	P. B. M. XXXII.	8.6454
Near West Baton Rouge, La.	T. B. M. 90.	8.7919
Near West Baton Rouge, La.	T. B. M. 89.	9.4098
Near West Baton Rouge, La.	T. B. M. 88.	9.4616
Near West Baton Rouge, La.	B. M. $\frac{170}{3}$.	9.9493
Near West Baton Rouge, La.	P. B. M. Poplar Grove.	8.6223
	Top of cap over same.	9.8385
Near West Baton Rouge, La.	T. B. M. 87.	9.5092
Near Lobdell, La.	T. B. M. 85.	9.2457
Near Lobdell, La.	T. B. M. 84.	9.2826
Near Lobdell, La.	B. M. $\frac{169}{4}$.	7.4924
	Top of cap over same.	9.0386
Near Lobdell, La.	P. B. M. XXXIII.	9.3545
Near Lobdell, La.	T. B. M. 83.	9.7066
At Lobdell, La.	T. B. M. 82.	8.9556
Near Lobdell, La.	T. B. M. 80.	8.3406
Near Lobdell, La.	P. B. M. Allendale.	7.8035
	Top of cap over same.	9.0134
Near Devall, La.	P. B. M. XXXIV.	9.5841
Near Devall, La.	T. B. M. 75.	10.1656
Near Devall, La.	T. B. M. 74.	9.9834
Near Devall, La.	P. B. M. Solitude.	9.0154
	Top of cap over same.	10.2185
Near Devall, La.	T. B. M. 73.	9.9177
Near Devall, La.	T. B. M. 72.	9.3092
Near Walls, La.	T. B. M. 70.	9.4277
Near Walls, La.	B. M. $\frac{165}{4}$.	9.2606
At Arbroth, La.	P. B. M. XXXV.	10.5315
Near Arbroth, La.	T. B. M. 65.	11.1108
Near Hermitage, La.	B. M. $\frac{164}{3}$.	11.1819
Near Hermitage, La.	T. B. M. 64.	10.3182
At Hermitage, La.	P. B. M. XXXVI.	11.5493
Near Hermitage, La.	T. B. M. 63.	10.7193
Near Anchor, La.	T. B. M. 61.	11.5980
Near Anchor, La.	B. M. $\frac{162}{3}$.	11.5553
Near Anchor, La.	P. B. M. XXXVII.	13.7548
Near Anchor, La.	T. B. M. 59.	11.6620
Near Bayou Sara, La.	T. B. M. 58.	11.8625
Near Bayou Sara, La.	T. B. M. 57.	12.2124
Near Bayou Sara, La.	T. B. M. 56.	11.9285
Near Bayou Sara, La.	P. B. M. XXXVIII.	12.0688
Near Bayou Sara, La.	T. B. M. 55.	12.2473
Near Bayou Sara, La.	P. B. M. XXXIX.	11.9743
Near Bayou Sara, La.	B. M. $\frac{160}{3}$.	11.6332
Near Bayou Sara, La.	T. B. M. 53.	9.8333
Near Pointe Coupee, La.	B. M. $\frac{159}{3}$.	9.4848
	Top of cap over same.	11.0078

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Pointe Coupee, La.	P. B. M. XL.	11.3992
Near Pointe Coupee, La.	T. B. M. 50.	12.1466
Near Brooks, La.	T. B. M. 49.	12.3846
Near Brooks, La.	P. B. M. XLI.	12.3265
Near Brooks, La.	T. B. M. 47.	12.4132
Near Brooks, La.	T. B. M. 46.	10.6379
Near Morganza, La.	B. M. $\frac{157}{3}$.	10.7429
	Top of cap over same.	12.2942
Near Morganza, La.	T. B. M. 43.	16.0555
Near Morganza, La.	T. B. M. 40.	15.6694
Near Morganza, La.	T. B. M. 39.	10.6354
Near Morganza, La.	B. M. $\frac{156}{3}$.	9.8908
Near Raccourci, La.	T. B. M. 38.	11.5117
At Raccourci, La.	T. B. M. 37.	12.0757
At Raccourci, La.	P. B. M. XLIII.	11.8552
Near Raccourci, La.	T. B. M. 35.	16.0067
Near Lacour, La.	T. B. M. 33.	14.3523
Near Ennis, La.	P. B. M. XLIV.	13.7563
At Williamsport, La.	T. B. M. 22.	14.9275
Near Smithland, La.	T. B. M. 20.	15.1501
Near Smithland, La.	P. B. M. Smithland.	13.4734
	Top of cap over same.	14.6867
At Smithland, La.	P. B. M. XLV.	14.8517
Near Smithland, La.	T. B. M. 17.	14.4240
At Red River Landing, La.	Gauge B. M. W.	12.5401
	Top of cap over same.	13.7793
At Red River Landing, La.	Gauge B. M. B.	13.9069
At Red River Landing, La.	Gauge B. M. D.	14.9830
Near Red River Landing, La.	B. M. $\frac{149}{3}$.	15.9725
Near Red River Landing, La.	T. B. M. 13.	13.3982
Near Red River Landing, La.	P. B. M. Carrs Point.	15.9867
Near Red River Landing, La.	T. B. M. 9.	14.1660
In Louisiana, opposite Tarbert, Miss.	T. B. M. 6.	15.4335
Near Point Breeze, La.	P. B. M. L.	16.2370
Near Point Breeze, La.	T. B. M. 5.	16.4264
Near Point Breeze, La.	P. B. M. LI.	16.2799
On Point Breeze, La.	T. B. M. 4=H. W. Gauge B. M. 49.	15.9216
On Point Breeze, La.	B. M. $\frac{147}{3}$.	16.6549
On Point Breeze, La.	P. B. M. Point Breeze.	15.3251
	Top of cap over same.	16.5358
Near Fort Adams, Miss.	P. B. M. XLVIII.	24.0570
Near Fort Adams. Miss.	T. B. M. 1.	13.7434
At Fort Adams, Miss.	P. B. M. XLIX.	20.9277
At Fort Adams, Miss.	P. B. M. Fort Adams.	15.7906
	Top of cap over same.	16.9995
At Newport, Ky.	A	156.1925
At Newport, Ky.	U. S. E	152.5335
At Covington, Ky.	B	156.5476
At Ludlow, Ky.	C	162.1342
At Crescent Springs, Ky.	D	237.4748
At Erlanger, Ky.	E	279.0156
At Dixon, Ky.	F	282.0042
At Richwood, Ky.	G	286.1500

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Walton, Ky.	H	278.5326
Near Crittenden, Ky.	I	273.0385
At Crittenden, Ky.	J	281.5653
At Sherman, Ky.	K	284.8903
At Dry Ridge, Ky.	L	292.0106
At Williamstown, Ky.	M	297.0643
At Mason, Ky.	N	278.9080
At Blanchett, Ky.	O	286.9713
At Corinth, Ky.	P	292.2714
At Hinton, Ky.	Q	290.6061
At Sadieville, Ky.	R	261.7000
Near Sadieville, Ky.	S	263.8432
At Rogers Gap, Ky.	T	275.3975
Near Kinkaid, Ky.	U	255.0700
Near Georgetown, Ky.	V	260.8480
At Georgetown, Ky.	W	267.3251
Near Donerail, Ky.	X	265.4026
At Greendale, Ky.	Y	285.2485
At Hillenmeyer, Ky.	Z	286.3536
At Lexington, Ky.	A_1	298.5680
Near Lexington, Ky.	B_1	308.1665
At Brannon, Ky.	C_1	313.5268
Near Brannon, Ky.	D_1	297.1967
At Nicholasville, Ky.	E_1	289.9171
At Nicholasville, Ky.	F_1	288.6547
At Jessamine, Ky.	G_1	269.9342
At Wilmore, Ky.	H_1	267.6703
Near High Bridge, Ky.	I_1	273.4231
At High Bridge, Ky.	J_1	232.8335
Near High Bridge, Ky.	K_1	234.6859
Between High Bridge and Burgin, Ky.	L_1	264.9874
At Burgin, Ky.	M_1	274.6768
At Burgin, Ky.	N_1	273.5080
At Faulconer, Ky.	O_1	271.2159
Near Danville, Ky.	P_1	280.8723
At Danville, Ky.	Q_1	301.2854
Near Junction City, Ky.	R_1	313.3220
Near Junction City, Ky.	S_1	289.5393
Near Moreland, Ky.	T_1	303.0528
At Moreland, Ky.	U_1	333.4880
Near Moreland, Ky.	V_1	292.0835
At McKinney, Ky.	W_1	308.2711
Near McKinney, Ky.	X_1	278.4284
Near Kings Mountain, Ky.	Y_1	305.0380
At Kings Mountain, Ky.	Z_1	353.3056
At Waynesburg, Ky.	A_2	369.5137
At Eubank, Ky.	B_2	356.1373
At Floyd, Ky.	C_2	340.3979
Near Pulaski, Ky.	D_2	340.5664
At Science Hill, Ky.	E_2	342.9037
At Norwood, Ky.	F_2	326.9509
Near Somerset, Ky.	G_2	292.2412
At Somerset, Ky.	A_5	262.0242
At Somerset, Ky.	B_5	268.0048
At Somerset, Ky.	C_5	272.1082
At Somerset, Ky.	D_5	268.3631
Near Burnside, Ky.	E_5	249.1773
At Burnside, Ky.	F_5	235.3324
Near Sloans Valley, Ky.	G_5	280.4394
At Alpine, Ky.	H_5	290.0582

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Greenwood, Ky.	I_5	363.5148
At Flat Rock, Ky.	J_5	393.5513
At Whitley, Ky.	K_5	401.5462
At Pine Knot, Ky.	L_5	430.2094
Between Strunk, Ky., and Isham, Tenn.	M_5	415.3075
Near Winfield, Tenn.	A	396.2498
At Oneida, Tenn.	B	438.5835
At Helenwood, Tenn.	C	422.9281
At New River, Tenn.	D	367.0762
At Robbins, Tenn.	E	419.4366
At Glen Mary, Tenn.	F	389.1414
At Sunbright, Tenn.	G	407.6567
At Annadel, Tenn.	H	375.4997
At Lancing, Tenn.	I	359.9213
Near Nemo, Tenn.	J	254.9997
At Oakdale, Tenn.	K	241.3531
At Oakdale, Tenn.	L	242.0124
At Elverton, Tenn.	M	248.9425
At Wheat, Tenn.	N	272.7071
Near Williams Ferry, Tenn.	Melton△	413.1087
At Oliver Springs, Tenn.	O	238.9518
At Dossett, Tenn.	P	275.7899
At Clinton, Tenn.	Q	253.5046
At Heiskell, Tenn.	R	274.8218
At Powell, Tenn.	S	302.9780
At Black Oak, Tenn.	T	336.0817
Near Harriman Junction, Tenn.	A_2	234.3404
At Harriman, Tenn.	B_2	242.0944
At Harriman, Tenn.	C_2	241.4888
At Harriman, Tenn.	City	239.5725
Near Emory Gap, Tenn.	D_2	254.7914
At Cardiff, Tenn.	E_2	241.9077
At Rockwood, Tenn.	F_2	267.7273
At Rockwood, Tenn.	G_2	268.2367
At Glen Alice, Tenn.	H_2	242.6395
At Roddy, Tenn.	I_2	235.2698
At Lorraine, Tenn.	J_2	244.7410
Near Spring City, Tenn.	K_2	233.4115
Near Sheffield, Tenn.	L_2	247.9739
Near Evensville, Tenn.	M_2	231.3143
Near Evensville, Tenn.	N_2	226.4447
At Dayton, Tenn.	O_2	215.4310
At Dayton, Tenn.	P_2	214.0917
Near Graysville, Tenn.	Q_2	232.7019
Near Graysville, Tenn.	R_2	215.9133
At Sale Creek, Tenn.	S_2	223.5450
Near Retro, Tenn.	T_2	222.0485
At Rathburn, Tenn.	U_2	235.2804
At Daisy, Tenn.	V_2	219.6878
Near Cave Springs, Tenn.	W_2	206.6209
Near Cave Springs, Tenn.	X_2	207.0877
At Hixson, Tenn.	Y_2	207.3367
Near Boyce, Tenn.	Z_2	209.9892
Near Boyce, Tenn.	A_3	209.9622
Near Chattanooga, Tenn.	B_3	203.8867
At Chattanooga, Tenn.	C_3	206.2569
At Chattanooga, Tenn.	Gauge	205.4847
Near Chattanooga, Tenn.	D_3	201.4072

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Wauhatchie, Tenn.	674N	203.7840
At Hooker, Ga.	E_3	261.1670
Near Whiteside, Tenn.	974N	295.8509
At Whiteside, Tenn.	F_3	262.5521
Near Shellmound, Tenn.	639N	193.9513
At Shellmound, Tenn.	U S	189.9173
At Shellmound, Tenn.	G_3	189.1777
Near Carpenter, Ala.	665N	201.7397
Near Bridgeport, Ala.	C	189.4287
Near Bridgeport, Ala.	U. S. E.	189.4321
At Bridgeport, Ala.	679N	205.8672
At Bolivar, Ala.	D	187.9148
Near Bolivar, Ala.	625N	189.4162
At Stevenson, Ala.	627N	190.2246
Near Stevenson, Ala.	E	184.5708
Near Cedar Grove, Ala.	F	185.2759
Near Fackler, Ala.	G	183.3426
Near Fackler, Ala.	H	184.3369
At Hollywood, Ala.	I	195.1599
Near Hollywood, Ala.	J	192.0730
At Scottsboro, Ala.	K	198.6853
Near Larkinsville, Ala.	L	198.3434
Near Larkinsville, Ala.	M	187.4355
At Lim Rock, Ala.	N	187.3516
Near Lim Rock, Ala.	O	203.1188
Near Swearengin, Ala.	P	219.4613
At Swearengin, Ala.	Q	413.8715
Near Swearengin, Ala.	Gunter △.	412.2719
Near Swearengin, Ala.	Gunter N.	412.4317
Near Swearengin, Ala.	Gunter S.	412.3677
Near Swearengin, Ala.	Gunter E.	412.3747
Near Swearengin, Ala.	Gunter W.	412.3699
At Woodville, Ala.	J_2	187.3405
At Woodville, Ala.	K_2	188.7084
Near Woodville, Ala.	L_2	187.7298
Near Woodville, Ala.	T. B. M. 1.	184.0007
At Paint Rock, Ala.	M_2	182.0615
At Gurley, Ala.	N_2	196.1259
Near Gurley, Ala.	T. B. M. 8.	187.8136
At Brownsboro, Ala.	O_2	192.8249
Near Brownsboro, Ala.	T. B. M. 12.	197.1915
Near Fearns, Ala..	P_2	244.5693
At Huntsville, Ala.	Q_2	194.7380
At Huntsville, Ala.	City.	193.8010
Near Madison, Ala.	R_2	188.8944
At Madison, Ala.	S_2	205.3940
Near Greenbrier, Ala.	T_2	178.5004
Near Belle Mina, Ala.	T. B. M. 38.	178.3793
At Belle Mina, Ala.	U_2	183.0579
Near Belle Mina, Ala.	T. B. M. 39.	174.6494
At Decatur, Ala.	P. B. M. 52.	173.1935
At Decatur, Ala.	P. B. M. 51.	172.4135
At Decatur, Ala.	P. B. M. 50.	169.5959
Near Flint, Ala.	V_2	173.1052
Near Hartsells, Ala.	W_2	201.1821
Near Leesdale, Ala.	T. B. M. 60.	181.0631
Near Falkville, Ala.	X_2	183.2269
Near Wilhite, Ala.	Y_2	205.7797

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Cullman, Ala.	Z_2	261.3708
At Cullman, Ala.	A_3	244.6550
At Johnson, Ala.	B_3	198.2580
Near Hanceville, Ala.	C_3	161.6996
Near Garden City, Ala.	D_3	130.1128
Near Blount Springs, Ala.	E_3	138.7641
Near Blount Springs, Ala.	F_3	124.2471
At Reids, Ala.	G_3	179.2881
At Warrior, Ala.	H_3	166.9422
Near Warrior, Ala.	I_3	125.7806
At Morris, Ala.	J_3	126.0720
Near Cunningham, Ala.	T. B. M. 107.	120.6817
At Newcastle, Ala.	K_3	157.6031
At Boyles, Ala.	L_3	178.1038
At Burnsville, Miss.	P. B. M. 1.	143.2635
At Burnsville, Miss.	P. B. M. 2.	141.8011
At Iuka, Miss.	P. B. M. 3.	172.1630
Near Pegram, Ala.	T. B. M. 41.	132.0730
Near Riverton Junction, Ala.	T. B. M. 43.	126.1225
At Margerum, Ala.	T. B. M. 45.	133.1565
Near Margerum, Ala.	T. B. M. 47.	134.7692
Near Cherokee, Ala.	T. B. M. 49.	148.8098
Near Barton, Ala.	T. B. M. 58.	151.0296
At Barton, Ala.	T. B. M. 59.	147.0809
Near Prides, Ala.	T. B. M. 63.	131.2656
At Prides, Ala.	T. B. M. 72.	130.8648
At Prides, Ala.	P. B. M. 7.	128.7870
At Prides, Ala.	T. B. M. 73.	127.7464
Near Prides, Ala.	T. B. M. 68.	148.7679
Near Prides, Ala.	T. B. M. 71.	138.0162
At Tuscumbia, Ala.	T. B. M. 79.	137.2378
At Tuscumbia, Ala.	T. B. M. 80.	142.7676
At Tuscumbia, Ala.	P. B. M. 8.	146.3530
At Tuscumbia, Ala.	P. B. M. 9.	143.1832
Near Florence, Ala.	T. B. M. 86.	141.3318
Near Florence, Ala.	P. B. M. 10.	134.5477
At Florence, Ala.	T. B. M. 87.	137.3127
At Florence, Ala.	Old Gauge B. M.	131.3827
At Florence, Ala.	P. B. M. 11.	131.5935
At Florence, Ala.	P. B. M. 12.	131.6935
At Florence, Ala.	T. B. M. 90.	139.8486
At Florence, Ala.	P. B. M. 13.	139.2488
At East Florence, Ala.	P. B. M. 14.	144.0428
Near East Florence, Ala.	T. B. M. 93.	133.4093
Near East Florence, Ala.	P. B. M. 15.	135.0232
Near East Florence, Ala.	P. B. M. 16.	133.4256
Near Bainbridge, Ala.	P. B. M. 17.	130.7129
Near Bainbridge, Ala.	T. B. M. 99.	131.3139
At Bainbridge, Ala.	P. B. M. 18.	133.9538
At Lock 9, Muscle Shoals Canal, Ala.	T. B. M. 102.	132.9804
At Lock 9, Muscle Shoals Canal, Ala.	P. B. M. 19.	132.9865
At Lock 8, Muscle Shoals Canal, Ala.	T. B. M. 103.	136.0526
At Lock 8, Muscle Shoals Canal, Ala.	P. B. M. 20.	136.0580
At Lock 7, Muscle Shoals Canal, Ala.	T. B. M. 104.	138.6363
At Lock 7, Muscle Shoals Canal, Ala.	P. B. M. 21.	139.7028
Near Lock 7, Muscle Shoals Canal, Ala.	P. B. M. 22.	139.5515
Near Lock 7, Muscle Shoals Canal, Ala.	T. B. M. 105.	139.9414
At Lock 6, Muscle Shoals Canal, Ala.	T. B. M. 107.	142.4424
At Lock 6, Muscle Shoals Canal, Ala.	P. B. M. 23.	143.6592

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Lock 6, Muscle Shoals Canal, Ala.	T. B. M. 108.	143.4156
Near Lock 6, Muscle Shoals Canal, Ala.	P. B. M. 24.	143.7213
Near Lock 6, Muscle Shoals Canal, Ala.	T. B. M. 109.	143.6014
Near Lock 5, Muscle Shoals Canal, Ala.	*P. B. M. 25.	143.7598
At Lock 5, Muscle Shoals Canal, Ala.	T. B. M. 113.	147.3002
At Lock 5, Muscle Shoals Canal, Ala.	P. B. M. 26.	147.2937
Near Lock 5, Muscle Shoals Canal, Ala.	P. B. M. 27.	147.3206
Near Lock 5, Muscle Shoals Canal, Ala.	T. B. M. 114.	147.1691
Near Lock 4, Muscle Shoals Canal, Ala.	P. B. M. 28.	148.3915
At Lock 4, Muscle Shoals Canal, Ala.	T. B. M. 116.	150.8397
At Lock 4, Muscle Shoals Canal, Ala.	P. B. M. 29.	150.3800
Near Lock 3, Muscle Shoals Canal, Ala.	P. B. M. 30.	152.2191
At Lock 3, Muscle Shoals Canal, Ala.	T. B. M. 118.	154.0495
At Lock 3, Muscle Shoals Canal, Ala.	P. B. M. 31.	154.0417
Near Lock 3, Muscle Shoals Canal, Ala.	T. B. M. 119.	154.1373
Near Lock 2, Muscle Shoals Canal, Ala.	T. B. M. 120.	154.6903
At Lock 2, Muscle Shoals Canal, Ala.	T. B. M. 121.	155.8959
At Lock 2, Muscle Shoals Canal, Ala.	P. B. M. 32.	155.8981
Near Lock 2, Muscle Shoals Canal, Ala.	P. B. M. 33.	156.4936
Near Lock 1, Muscle Shoals Canal, Ala.	T. B. M. 125.	158.9095
At Lock 1, Muscle Shoals Canal, Ala.	P. B. M. 34.	158.9163
Near Lock 1, Muscle Shoals Canal, Ala.	T. B. M. 126.	158.8302
Near Lambs Ferry, Ala.	T. B. M. 128.	156.9240
At Sycamore Landing, Ala.	P. B. M. 35.	160.2210
At Sycamore Landing, Ala.	P. B. M. 36.	161.2340
Near Lock B, Elk River Canal, Ala.	P. B. M. 37.	163.3842
Near Lock B, Elk River Canal, Ala.	P. B. M. 38.	166.5651
At Lock B, Elk River Canal, Ala.	T. B. M. 140.	161.4718
At Lock B, Elk River Canal, Ala.	P. B. M. 39.	161.4763
At Lock A, Elk River Canal, Ala.	P. B. M. 40.	164.1117
At Lock A, Elk River Canal, Ala.	T. B. M. 141.	164.5780
Near Lock A, Elk River Canal, Ala.	P. B. M. 41.	163.6340
Near Lock A, Elk River Canal, Ala.	P. B. M. 42.	164.1121
Near Lock A, Elk River Canal, Ala.	T. B. M. 142.	163.3414
Near Miltons Bluff, Ala.	P. B. M. 43.	163.7978
At Miltons Bluff, Ala.	T. B. M. 143.	163.3603
Near Miltons Bluff, Ala.	T. B. M. 146.	164.3354
Near Browns Ferry, Ala.	P. B. M. 44.	164.7419
Near Browns Ferry, Ala.	P. B. M. 45.	166.2565
Near Browns Ferry, Ala.	P. B. M. 46.	166.4721
Near Finleys Landing, Ala.	P. B. M. 47.	167.2936
At Decatur, Ala.	T. B. M. 176.	164.2609
At Decatur, Ala.	P. B. M. 48.	165.0309
At Decatur, Ala.	P. B. M. 49.	167.1220
At Decatur, Ala.	U. S.	*173.0282
At Decatur, Ala.	Old Railroad B. M.	†173.2576
		‡172.8824
At Riverton, Ala.	P. B. M. 4.	122.0614
Near Riverton, Ala.	Lift lock center line stone 3.	118.5866
Near Riverton, Ala.	P. B. M. 5.	126.2499
Near Riverton, Ala.	P. B. M. 6.	128.6263
Near Riverton, Ala.	P. B. M. 53.	123.3812
Near Paynes Landing, Ala.	P. B. M. 54.	121.5464
Near Indian Creek, Miss.	P. B. M. 55.	126.4342
At Buggs Landing, Miss.	P. B. M. 56.	113.2416

*This elevation is the result of leveling up to and including 1900. In October, 1901, this bench mark was reported as disturbed.

†1895.

‡1901. According to observer's note in 1901 the bench mark may have been disturbed or may not have been correctly identified.

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Buggs Landing, Miss.	P. B. M. 57.	118.0787
Near Yellow Creek, Tenn.	P. B. M. 58.	124.1530
Near Yellow Creek, Tenn.	P. B. M. 59.	112.6089
Near Boyds Landing, Tenn.	P. B. M. 60.	122.5066
Near Hamburg Landing, Tenn.	Old P. B. M. 1.	107.1940
At Pittsburg Landing, Tenn.	Old P. B. M. 2.	118.1734
At Pittsburg Landing, Tenn.	P. B. M. 61.	128.3844
At Decatur, Ala.	M_3	176.1945
At Decatur, Ala.	N_3	182.2773
At Decatur, Ala.	O_3	180.0882
At Trinity, Ala.	P_3	193.2193
At Hillsboro, Ala.	Q_3	182.3548
At Hillsboro, Ala.	R_3	183.1932
At Courtland, Ala.	S_3	172.9860
At Courtland, Ala.	T_3	172.6606
Near Courtland, Ala.	U_3	167.5941
Near Town Creek, Ala.	V_3	165.1016
At Leighton, Ala.	W_3	174.4821
Near Tuscumbia, Ala.	X_3	155.7345
Near Prides, Ala.	Y_3	134.6177
Near Cherokee, Ala.	Z_3	164.0895
Near Margerum, Ala.	A_4	134.1373
Near Riverton Junction, Ala.	B_4	126.4323
Near Riverton Junction, Ala.	C_4	132.0743
Near Burnsville, Miss.	A_3	164.1786
Near Corinth, Miss.	B_3	146.6452
At Corinth, Miss.	T. B. M. 1.	*137.0042
At Corinth, Miss.	C_3	136.6754
At South Rockwood, Mich.	A	179.0201
At Newport, Mich.	B	176.9056
At Monroe, Mich.	C	†177.1087
At Monroe, Mich.	P. B. M. M. C. Bridge.	178.0717
At Monroe, Mich.	D	180.0669
Near La Salle, Mich.	E	177.4923
At Vienna, Mich.	F	179.4748
At Alexis, Ohio.	U	178.4551
At Toledo, Ohio.	Toledo City, No. 165.	181.7888
At Toledo, Ohio.	Park △.	183.2213
At Toledo, Ohio.	V	179.5632
At Toledo, Ohio.	Power House.	177.6084
At Toledo, Ohio.	W	184.0653
At Toledo, Ohio.	Post-Office.	183.6608
At Toledo, Ohio.	Toledo City, No. 44.	181.7741
At Toledo, Ohio.	Toledo City, No. 296.	179.9396
Near Perrysburg, Ohio.	X	183.8342
At Perrysburg, Ohio.	Y	187.6646
At Roachton, Ohio.	Z	197.3872
At Hull Prairie, Ohio.	A_1	201.3251
At Haskins, Ohio.	B_1	203.5162
At Tontogany, Ohio.	C_1	204.0670
At Weston, Ohio.	D_1	208.3650
At Weston, Ohio.	E_1	208.0890
At Weston, Ohio.	Weston Village B. M.	207.8828
At Milton Center, Ohio.	F_1	210.2589
At Custar, Ohio.	G_1	212.3353
At Deshler, Ohio.	H_1	217.5410
At Deshler, Ohio.	I_1	217.3654
At Belmore, Ohio.	J_1	224.5467
At Leipsic, Ohio.	K_1	233.4664
At Leipsic, Ohio.	L_1	232.7772

*Bench mark apparently settled. Elevation from leveling of 1901 only. †Destroyed.

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Ottawa, Ohio.	M_1	226.6788
At Ottawa, Ohio.	N_1	222.3026
Near Columbus Grove, Ohio.	O_1	227.5160
At Columbus Grove, Ohio.	P_1	234.9993
At Columbus Grove, Ohio.	Q_1	236.5005
Near Monroe, Ohio.	R_1	240.9250
At West Cairo, Ohio.	S_1	248.2959
Near Lima, Ohio.	T_1	254.9336
At Lima, Ohio.	U_1	267.9413
At Lima, Ohio.	V_1	267.4470
At Lima, Ohio.	Lima City B. M.	266.0010
Near Cridersville, Ohio.	W_1	264.8539
At Cridersville, Ohio.	X_1	272.0008
Near Wapakoneta, Ohio.	Y_1	270.0867
At Wapakoneta, Ohio.	Z_1	273.8692
Near Wapakoneta, Ohio.	A_2	279.1701
At Botkins, Ohio.	B_2	306.3201
At Anna, Ohio.	C_2	314.0629
At Swanders, Ohio.	D_2	308.8382
Near Swanders, Ohio.	E_2	306.6396
At Sidney, Ohio.	F_2	305.0327
At Sidney, Ohio.	Sidney City B. M.	291.7126
At Sidney, Ohio.	G_2	293.4238
Near Sidney, Ohio.	H_2	293.1683
At Kirkwood, Ohio.	I_2	300.5615
Near Piqua, Ohio.	J_2	284.7624
At Piqua, Ohio.	K_2	273.9999
At Piqua, Ohio.	Penn. R. R. B. M.	263.7828
At Piqua, Ohio.	L_2	267.2688
At Farrington, Ohio.	M_2	260.6691
Near Troy, Ohio.	N_2	257.4101
At Troy, Ohio.	O_2	254.6425
At Troy, Ohio.	P_2	256.3519
At Troy, Ohio.	Troy City B. M.	255.3269
At Troy, Ohio.	Q_2	253.3338
Near Troy, Ohio.	R_2	252.1547
Near Troy, Ohio.	S_2	247.7526
At Tippecanoe City, Ohio.	T_2	245.9532
At Tippecanoe City, Ohio.	U_2	244.2094
Near Tippecanoe City, Ohio.	V_2	242.9953
At Tadmor, Ohio.	W_2	241.1054
Near Tadmor, Ohio.	X_2	235.7369
Near Dayton, Ohio.	Y_2	230.0237
At Dayton, Ohio.	Z_2	226.8995
At Dayton, Ohio.	Dayton City B. M.	226.6896
At Dayton, Ohio.	A_3	226.5994
At Dayton, Ohio.	B_3	226.7924
Near Dayton, Ohio.	E_4	224.5382
Near Dayton, Ohio.	C_3	222.0093
Near Alexandria, Ohio.	D_4	220.1139
Near Whitfield, Ohio.	D_3	217.7222
At Carrollton, Ohio.	C_4	216.8427
At Miamisburg, Ohio.	B_4	215.7305
Near Miamisburg, Ohio.	E_3	213.2778
At Miamisburg, Ohio.	F_3	212.4411
At Miamisburg, Ohio.	A_4	214.9220
Near Miamisburg, Ohio.	G_3	211.4568
Near Franklin, Ohio.	Z_3	214.6136
Near Carlisle, Ohio.	H_3	210.9459
At Franklin, Ohio.	I_3	209.9971

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Carlisle, Ohio.	J_3	206.5498
Near Franklin, Ohio.	V_3	208.6212
Near Poasttown, Ohio.	K_3	200.6466
Near Middletown, Ohio.	X_3	205.6479
At Heno, Ohio.	L_3	195.9981
At Middletown, Ohio.	M_3	203.1501
At Excello Mills, Ohio.	W_3	194.5336
Near Trenton, Ohio.	N_3	192.9411
At Le Sourdsville, Ohio.	V_3	190.4814
Near Overpeck, Ohio.	O_3	193.6565
Near Rockdale, Ohio.	U_3	192.1297
Near Hamilton, Ohio.	P_3	182.1642
Near Woodsdale, Ohio.	T_3	188.0472
At Hamilton, Ohio.	Q_3	180.1670
At Hamilton, Ohio.	Hamilton City B.M.	183.3774
At Hamilton, Ohio.	R_3	184.5009
At Hamilton, Ohio.	S_3	181.6615
Near Hamilton, Ohio.	Telegraph Pole 745.	186.0072
Near Hamilton, Ohio.	F_4	183.5934
Near Flockton, Ohio.	P.R.R. 24.	186.8932
Near Flockton, Ohio.	P.R.R. 23.	184.6023
Near Jones, Ohio.	G_4	194.7652
At Port Union, Ohio.	P.R.R. 21.	181.6886
Near Crescentville, Ohio.	P.R.R. 20.	179.6518
Near Crestvue, Ohio.	H_4	197.1689
Near Crescentville, Ohio.	P.R.R. 19.	176.5292
Near Port Union, Ohio.	P.R.R. 17.	174.8654
Near Glendale, Ohio.	I_4	185.0748
Near Glendale, Ohio.	J_4	174.7437
At Lockland, Ohio.	T_4	174.9816
At Rensselaer, Ohio.	K_4	164.2836
At Carthage, Ohio.	L_4	168.0681
At Carthage, Ohio.	S_4	168.0255
At St. Bernard, Ohio.	R_4	167.1379
At Ivorydale, Ohio.	M_4	152.2432
At Winston Springs, Ohio.	U.S.G.S. 498.	*151.7829
At Cincinnati, Ohio.	Q_4	164.9839
At Cincinnati, Ohio.	N_4	152.6957
At Cincinnati, Ohio.	O_4	149.8572
At Cincinnati, Ohio.	Cincinnati City.	153.7159
At Cincinnati, Ohio.	P_4	166.2081
At Cincinnati, Ohio.	Reference mark to Cincinnati City No. 1.	168.2226
At Cincinnati, Ohio.	Y_4	168.5784
At Cincinnati, Ohio.	Z_4	149.6017
At Cincinnati, Ohio.	Gauge B.M.	149.8500
At Cincinnati, Ohio.	U_4	150.5674
At Ludlow, Ky.	A_5	162.5000
At Cincinnati, Ohio.	V_4	153.7196
At Cincinnati, Ohio.	U.S.H.	152.2751
At Sedamsville, Ohio.	U.S.G.S.	149.8631
At Cincinnati, Ohio.	W_4	150.7183
At St. Joseph, Ohio.	X_4	148.1073
At Delhi, Ohio.	Canal Stone.	148.6569
Near Delhi, Ohio.	B_5	150.6195
At North Bend, Ohio.	C_5	149.8903
Near Lawrenceburg, Ind.	D_5	147.1069
At Lawrenceburg, Ind.	E_5	147.5056

*Original disk missing, 1899.

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Gibraltar, Mich.	(1877).	177.5549
At Gibraltar, Mich.	2 (1875).	178.3220
At Gibraltar, Mich.	1 (1898).	179.1037
At Trenton, Mich.	2 (1898).	183.3995
At Trenton, Mich.	(1877.)	183.9457
At Amherstburg, Canada.	Gauge.	176.5321
Near Sibleys, Mich.	P. B. M. 3.	180.8872
At Wyandotte, Mich.	P. B. M. 4.	178.5330
At Wyandotte, Mich.	(1877.)	178.7297
At Ecorse, Mich.	P. B. M. 5.	178.2410
At Ecorse, Mich.	P. B. M. 6.	176.3802
At Delray, Mich.	P. B. M. 7.	180.8436
At Detroit, Mich.	P. B. M. 8.	183.3400
At Detroit, Mich.	P. B. M. 9.	177.7015
At Detroit, Mich.	(1871.)	178.2518
At Detroit, Mich.	P. B. M. 10.	180.6877
At Detroit, Mich.	P. B. M. 11.	179.0890
At Windmill Point, Mich.	P. B. M. 12.	178.0705
At Grossepoint, Mich.	P. B. M. 13.	180.4664
At Grossepoint Farms, Mich.	P. B. M. 35.	184.3854
At Grossepoint Farms, Mich.	P. B. M. 36.	184.7410
Near Roseville, Mich.	P. B. M. 37.	178.2111
Near Roseville, Mich.	P. B. M. 38.	177.1167
Near Roseville, Mich.	P. B. M. 39.	177.0981
Near Mt. Clemens, Mich.	P. B. M. 40.	176.8542
Near Mt. Clemens, Mich.	P. B. M. 41.	180.1916
At New Baltimore, Mich.	P. B. M. 34.	179.9101
At New Baltimore, Mich.	P. B. M. 33.	179.4094
At New Baltimore, Mich.	P. B. M. 32.	182.9038
Near Fair Haven, Mich.	P. B. M. 31.	177.9445
At Fair Haven, Mich.	P. B. M. 30.	177.8502
At Algonac, Mich.	P. B. M. 29.	178.2781
At Algonac, Mich.	P. B. M. 28.	178.3538
Near Roberts Landing, Mich.	P. B. M. 27.	178.3699
At Marine City, Mich.	P. B. M. 26.	178.7523
At Marine City, Mich.	P. B. M. 25.	179.2712
At Marine City, Mich.	P. B. M. 24.	179.7864
At East China, Mich.	P. B. M. 23.	180.0894
At St. Clair, Mich.	P. B. M. 22.	182.7817
At St. Clair, Mich.	P. B. M. 21.	179.4688
At St. Clair, Mich.	P. B. M. 20.	191.2007
At Marysville, Mich.	P. B. M. 19.	179.8364
At Marysville, Mich.	P. B. M. 18.	178.9675
Near Black River, Mich.	P. B. M. 17.	181.8824
At Port Huron, Mich.	P. B. M. 16.	181.4373
At Port Huron, Mich.	P. B. M. 15.	182.7035
At Port Huron Mich.	P. B. M. 14.	182.9235
At Fort Gratiot, Mich.	L. H. (1877).	179.9367
At Lakeport, Mich.	Lakeport.	181.4931
At Lexington, Mich.	Lexington 1.	190.0419
At Lexington, Mich.	Lexington 2.	188.8642
At Lexington, Mich.	Lexington 3.	189.7876
At Lexington, Mich.	Lexington 4.	186.7946
At Sand Beach, Mich.	U. S. B. M.	179.1662
At Sand Beach, Mich.	U. S. B. M. A.	177.8693
At Sand Beach, Mich.	U. S. B. M. B.	177.7519
At Sand Beach, Mich.	U. S. B. M. E.	177.7620
At Sand Beach, Mich.	U. S. B. M. Jenks.	186.0986
At Sand Beach, Mich.	U. S. B. M. Bowlder in Harbor.	177.6004

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Mackinaw, Mich.	B. M. 1.	180. 1119
At Mackinaw, Mich.	B. M. 2.	180. 7940
At Mackinaw, Mich.	B. M. 3.	178. 9012
At Macki .aw, Mich.	B. M. R.	179. 8144
At Mack.naw, Mich.	B. M. 4.	178. 0464
At Milwaukee, Wis.	B. M. 1.	180. 7545
At Milwaukee, Wis.	B. M. 2.	193. 8701
At Milwaukee, Wis.	B. M. 3.	193. 2330
At Milwaukee, Wis.	B. M. 4.	181. 1446
At Milwaukee, Wis.	B. M. 5 (1876).	179. 9986
At Detour, Mich.	Goetz.	183. 6017
At Detour, Mich.	Detour 2.	178. 7748
At Detour, Mich.	Terrett.	182. 7885
At Detour, Mich.	Detour 1.	186. 5005
At Detour, Mich.	Detour 3.	180. 2159
At Detour, Mich.	Detour 4.	181. 3490
At Detour, Mich.	Detour 5.	179. 9727
At Detour, Mich.	Boat House.	177. 4475
Near Detour, Mich.	Caribou.	194. 9021
Near Schlesser, Mich.	Schlesser.	214. 2514
At Raber, Mich.	Raber.	177. 5291
Near Gatesville. Mich.	Gatesville.	218. 6928
Near Raber, Mich.	Hudson.	207. 3347
Near Stalwart, Mich.	Tripp.	207. 5100
Near Sterlingville, Mich.	Fairview.	209. 4733
Near Sterlingville, Mich.	Campbell.	191. 3572
At Kelden, Mich.	Munuscong.	183. 3394
At Barbeau, Mich.	Barbeau.	201. 4372
Near McCarron, Mich.	Charlotte	183. 5482
Near Rosedale, Mich.	Hinds.	180. 5007
Near Rosedale, Mich.	Newcomb.	178. 2442
Near Sault Sainte Marie, Mich.	Riverside.	179. 8686
Near Sault Sainte Marie, Mich.	Little.	178. 6936
At Sault Sainte Marie, Mich.	Soo.	188. 9070
At Sault Sainte Marie, Mich.	A	184. 7301
At Sault Sainte Marie, Mich.	B	179. 4145
At Sault Sainte Marie, Mich.	Meridian.	185. 2683
At Sault Sainte Marie, Mich.	Neesville.	195. 5952
Near Sault Sainte Marie, Mich.	B. M. 1.	195. 7102
Near Sault Sainte Marie, Mich.	Solomon.	185. 4218
Near Sault Sainte Marie, Mich.	Brush.	184. 0144
Near Sault Sainte Marie, Mich.	B. M. 2.	195. 4862
Near Brimley, Mich.	B. M. 3.	204. 3235
At Brimley, Mich.	B. M. 4.	197. 5225
At Bay Mills, Mich.	Bay Mills.	185. 7995
Near Bay Mills, Mich.	Mission.	194. 0624
At Iroquois Point, Mich.	P. B. M. △	188. 4956
At Iroquois Point, Mich.	Iroquois L. H.	189. 5959
At Iroquois Point, Mich.	Old B. M.	189. 8013
At Iroquois Point, Mich.	Iroquois 1.	187. 4807
At Iroquois Point. Mich.	Iroquois.	185. 3358
At Escanaba, Mich.	1 (1874).	180. 9320
At Escanaba, Mich.	3 (1876).	178. 9538
Near Maple Ridge, Mich.	4 (1876).	292. 3706
Near Sands, Mich.	5 (1876).	366. 5827
At Marquette, Mich.	6 (1876).	191. 5409
At Marquette, Mich.	1 (1871).	186. 0774

* Destroyed.

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Marquette, Mich.	2 (1874).	185.9250
At Marquette, Mich.	3 (1874).	185.9006
At Marquette, Mich.	11 (1896).	189.1830
At Olcott, N. Y.	P. B. M. 4.	79.0181
At Olcott, N. Y.	P. B. M. 5.	87.2659
At Olcott, N. Y.	P. B. M. 6.	76.1548
At Olcott, N. Y.	P. B. M. 3.	83.5120
At Olcott, N. Y.	P. B. M. 2.	84.0379
At Olcott, N. Y.	P. B. M. 1.	87.5711
Near Newfane, N. Y.	T. B. M. 60.	95.8289
Near Coomer, N. Y.	T. B. M. 59.	96.3152
Near Wilson, N. Y.	T. B. M. 53.	93.2200
At Wilson, N. Y.	Wilson.	88.3348
Near Ransomville, N. Y.	T. B. M. 47.	95.2713
Near Ransomville, N. Y.	T. B. M. 43.	97.7599
At Ransomville, N. Y.	Ransomville.	99.6962
At Ransomville, N. Y.	T. B. M. 41.	98.4499
Near Model City, N. Y.	T. B. M. 37.	100.2490
At Model City, N. Y.	Model City.	110.8345
Near Model City, N. Y.	T. B. M. 35.	126.1946
At Lewiston, N. Y.	Lewiston.	122.3259
At Lewiston Heights, N. Y.	Lewiston Heights 2.	154.3522
At Lewiston Heights, N. Y.	T. B. M. 31.	161.8245
Near Lewiston Heights, N. Y.	Lewiston Heights 1.	183.1456
Near Niagara Falls, N. Y.	University.	179.6347
At Niagara Falls, N. Y.	Suspension Bridge.	178.1183
At Niagara Falls, N. Y.	T. B. M. 24.	183.9411
At Niagara Falls, N. Y.	Echota.	174.6271
At Niagara Falls, N. Y.	Niagara 1.	172.6838
At Niagara Falls, N. Y.	Niagara 2.	174.2931
Near La Salle, N. Y.	Schoolhouse.	175.3409
At La Salle, N. Y.	La Salle 2.	176.8726
At La Salle, N. Y.	La Salle 1.	174.2273
Near La Salle, N. Y.	T. B. M. 16.	174.7211
Near La Salle, N. Y.	Wheatfield.	175.7301
Near North Tonawanda, N. Y.	Crossing.	174.4910
At North Tonawanda, N. Y.	North Tonawanda 2.	176.4252
At North Tonawanda, N. Y.	North Tonawanda 1.	176.7194
At Tonawanda, N. Y.	Tonawanda 1.	175.6304
At Tonawanda, N. Y.	Tonawanda 2.	175.3048
At Tonawanda, N. Y.	State Ditch.	175.3072
At Tonawanda, N. Y.	T. B. M. 11.	178.5900
At Pullman, N. Y.	T. B. M. 9.	184.1288
Near Buffalo, N. Y.	T. B. M. 8.	184.0448
At Buffalo, N. Y.	T. B. M. 7.	183.9787
At Buffalo, N. Y.	St. John.	180.4495
At Buffalo, N. Y.	Guard Lock.	175.7634
At Buffalo, N. Y.	Black Rock.	176.8503
At Buffalo, N. Y.	International Bridge 2.	177.4727
At Buffalo, N. Y.	International Bridge 1.	176.7397
At Buffalo, N. Y.	Water Works.	177.6390
At Buffalo, N. Y.	Fire Station.	177.3439
At Buffalo, N. Y.	L. H.	179.8630
Between Buffalo and Tonawanda, N. Y.	D. W. Cherry.*	175.6703
At Pendleton Center, N. Y.	D. W. Sawyers Creek.	177.2388
At Pendleton Center, N. Y.	D. W. Pendleton 1.	180.1833

*This bench mark may be identical with N. Y. 543. (See page 549.) If found to be the same the mean of the two elevations should be used.

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Pendleton Center, N. Y.	D. W. Pendleton 2.	189.2764
Near Lockport, N. Y.	D. W. Lockport 1, N. Y. 554	179.9354
Near Lockport, N. Y.	D. W. Lockport 2.	122.0710
At Lockport, N. Y.	D. W. Lockport 3.	113.4024
At Wrights Corners, N. Y.	D. W. Wrights.	123.2417
Near Newfane, N. Y.	U. S. G. S.	108.7819
At Newfane, N. Y.	D. W. Newfane 1.	93.0205
Near Newfane, N. Y.	D. W. Newfane 2.	100.6622
Near La Salle, N. Y.	D. W. Monument.	184.7962
At Lewiston, N. Y.	D. W. Lewiston 3.	110.7480
Near Lewiston, N. Y.	D. W. Lewiston 4.	99.1503
Near Lewiston, N. Y.	D. W. Lewiston 5.	86.7724
Near Niagara Falls, N. Y.	D. W. Niagara 2.	172.8270
On International Bridge, Canada.	D. W. International Bridge 3.	176.6247
At Fort Erie, Canada.	D. W. Fort Erie.	173.9180
On Lake Erie, Canada.	D. W. Lake Erie.	177.4415
At Detroit Junction, Mich.	U. S. B. M. Detroit Jct. (1877).	180.7205
At New Haven, Mich.	U. S. B. M. New Haven (1877).	192.3298
At Pine River, Mich.	U. S. B. M. Pine River (1877).	191.7288
At Port Colborne, Ontario.	B. M. Custom-house.	178.1501
At Port Colborne, Ontario.	B. M. Baptist Church.	176.8700
At Port Colborne, Ontario.	B. M. Church of England.	176.4280
At Port Dalhousie, Ontario.	B. M. A.	80.4328
At Port Dalhousie, Ontario.	B. M. B.	78.6101
At Port Dalhousie, Ontario.	B. M. C.	78.6650
At Rensselaer, N. Y.	L. S. 1.	4.2421
At Rensselaer, N. Y.	L. S. 2.	7.9743
At Rensselaer, N. Y.	L. S. 3.	6.5023
At East Albany, N. Y.	1(1875)=L. S. 4.	8.0079
At Albany, N. Y.	2(1875)=L. S. 5.	5.1279
At Albany, N. Y.	L. S. 6.	7.9873
Near Albany, N. Y.	L. S. 7.	9.1566
At Watervliet, N. Y.	L. S. 8.	7.8406
Near Watervliet, N. Y.	6(1875)=L. S. 9.	14.9359
At Cohoes, N. Y.	7a(1875)=L. S. 10.	21.2518
At Cohoes, N. Y.	8a(1875)=L. S. 11.	48.7101
At Cohoes, N. Y.	L. S. 12.	57.9357
Near Cohoes, N. Y.	L. S. 13.	58.6105
At Crescent, N. Y.	L. S. 14.	59.3196
Near Crescent, N. Y.	L. S. 15.	58.8366
Near Vischers Ferry, N. Y.	L. S. 16.	58.6133
Near Vischers Ferry, N. Y.	L. S. 17.	58.1407
Near Vischers Ferry, N. Y.	12(1875)=L. S. 18.	58.1773
At Vischers Ferry, N. Y.	L. S. 19.	61.9582
At Fondas Basin, N. Y.	L. S. 20.	64.6981
At Rexford Flats, N. Y.	L. S. 21.	67.5196
At Rexford Flats, N. Y.	L. S. 22.	70.5403
Near Rexford Flats, N. Y.	L. S. 23.	70.5078
Near Schenectady, N. Y.	L. S. 24.	71.5976
At Schenectady, N. Y.	L. S. 25.	71.6674
At Schenectady, N. Y.	L. S. 26.	70.9986
At Schenectady, N. Y.	L. S. 27.	70.9991
Near Schenectady, N. Y.	L. S. 28.	71.6413
Near Schenectady, N. Y.	L. S. 29.	73.0289
Near Schenectady, N. Y.	L. S. 30.	73.9591
Near Schenectady, N. Y.	L. S. 31.	77.3064

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Pattersonville, N. Y.	19(1875)=L. S. 32.	76.4894
Near Pattersonville, N. Y.	L. S. 33.	78.7224
At Pattersonville, N. Y.	L. S. 34.	78.9806
Near Pattersonville, N. Y.	L. S. 35.	79.0230
Near Amsterdam, N. Y.	L. S. 36.	78.7884
Near Amsterdam, N. Y.	21(1875)=L. S. 37.	80.3644
Near Amsterdam, N. Y.	L. S. 38.	80.3868
Near Amsterdam, N. Y.	L. S. 39.	82.8081
At Amsterdam, N. Y.	L. S. 40.	85.1686
At Amsterdam, N. Y.	L. S. 41.	84.2903
At Amsterdam, N. Y.	L. S. 42.	80.3604
Near Amsterdam, N. Y.	24a(1875)=L. S. 43.	85.3220
Near Fort Hunter, N. Y.	L. S. 44.	86.0924
At Fort Hunter, N. Y.	L. S. 45.	90.7997
Near Fultonville, N. Y.	L. S. 46.	91.5308
Near Fultonville, N. Y.	L. S. 47.	90.9751
At Fultonville, N. Y.	L. S. 48.	92.0643
Near Fultonville, N. Y.	L. S. 49.	91.4202
Near Fultonville, N. Y.	L. S. 50.	91.2529
Near Fultonville, N. Y.	L. S. 51.	90.5464
Between Downing and Sprakers, N. Y.	L. S. 52.	90.5993
Near Sprakers, N. Y.	L. S. 53.	91.1047
At Sprakers, N. Y.	L. S. 54.	92.6059
At Sprakers, N. Y.	29(1875)=L. S. 55.	93.0627
At Canajoharie, N. Y.	L. S. 56.	93.9230
At Canajoharie, N. Y.	31(1875)=L. S. 57.	93.4096
Near Fort Plain, N. Y.	L. S. 58.	93.6963
Near Fort Plain, N. Y.	L. S. 59.	95.1438
At Fort Plain, N. Y.	L. S. 60.	95.7792
Near Fort Plain, N. Y.	L. S. 61.	95.6249
Near St. Johnsville, N. Y.	L. S. 62.	95.4093
Near St. Johnsville, N. Y.	34(1875)=L. S. 63.	97.3491
At St. Johnsville, N. Y.	L. S. 64.	97.7064
Near Mindenville, N. Y.	L. S. 65.	99.2591
Near Mindenville, N. Y.	35a(1875)=L. S. 66.	100.0238
At Indian Castle, N. Y.	L. S. 67.	102.0854
Near Indian Castle, N. Y.	L. S. 68.	102.6631
At Little Falls, N. Y.	37(1875)=L. S. 69.	104.6951
At Little Falls, N. Y.	L. S. 70.	107.7553
At Little Falls, N. Y.	L. S. 71.	110.6913
At Little Falls, N. Y.	L. S. 72.	113.7541
Near Little Falls, N. Y.	38a(1875)=L. S. 73.	115.2961
Near Little Falls, N. Y.	L. S. 74.	116.1537
Near Little Falls, N. Y.	L. S. 75.	118.6194
Near Herkimer, N. Y.	39a(1875)=L. S. 76.	119.8858
At Herkimer, N. Y.	L. S. 77.	120.2414
At Mohawk, N. Y.	L. S. 78.	119.8260
Near Mohawk, N. Y.	L. S. 79.	121.4363
Near Mohawk, N. Y.	L. S. 80.	124.3579
At Ilion, N. Y.	L. S. 81.	124.7511
At Ilion, N. Y.	L. S. 82.	124.5253
Near Ilion, N. Y.	L. S. 83.	127.2400
At Frankfort, N. Y.	L. S. 84.	130.2493
At Frankfort, N. Y.	41(1875)=L. S. 85.	127.6240
Near Frankfort, N. Y.	L. S. 86.	131.7771
Near Utica, N. Y.	L. S. 87.	130.3564
Near Utica, N. Y.	L. S. 88.	131.4704
At Utica, N. Y.	L. S. 89.	131.5327
At Utica, N. Y.	L. S. 90.	130.3669
At Utica, N. Y.	L. S. 91.	131.5631

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Utica, N. Y.	L. S. 92.	131. 1893
Near Utica, N. Y.	L. S. 93.	132. 8047
At Whitesboro, N. Y.	L. S. 94.	132. 1885
At Whitesboro, N. Y.	L. S. 95.	132. 5782
Near Oriskany, N. Y.	L. S. 96.	133. 0617
At Oriskany, N. Y.	L. S. 97.	132. 2713
Near Oriskany, N. Y.	L. S. 98.	132. 8299
Near Oriskany, N. Y.	L. S. 99.	132. 0110
At Stanwix, N. Y.	L. S. 100.	133. 3888
At Rome, N. Y.	L. S. 101.	132. 1325
At Rome, N. Y.	L. S. 102.	132. 9204
Near Rome, N. Y.	L. S. 103.	132. 6692
Near Rome, N. Y.	L. S. 104.	132. 0165
Near Rome, N. Y.	L. S. 105.	132. 7074
At New London, N. Y.	L. S. 106.	132. 6912
At Stacys Basin, N. Y.	L. S. 107.	132. 7852
At Stacys Basin, N. Y.	49(1875)=L. S. 108.	132. 2432
Near Higginsville, N. Y.	51(1875)=L. S. 109.	131. 3843
At Higginsville, N. Y.	L. S. 110.	132. 0622
Near Higginsville, N. Y.	L. S. 111.	114. 3846
At Sylvan Junction, N. Y.	L. S. 112.	114. 9148
At North Bay, N. Y.	L. S. 113.	118. 0230
Near North Bay, N. Y.	L. S. 114.	128. 6620
At Cleveland, N. Y.	L. S. 115.	120. 3240
At Cleveland, N. Y.	L. S. 116.	128. 9328
At Bernhardts Bay, N. Y.	L. S. 117.	117. 8435
At Constantia, N. Y.	L. S. 118.	119. 9925
Near Constantia, N. Y.	L. S. 119.	125. 1865
At West Monroe, N. Y.	L. S. 120.	120. 4269
At Central Square, N. Y.	L. S. 121.	138. 3719
Near Caughdenoy, N. Y.	L. S. 122.	116. 0473
At Pennellville, N. Y.	L. S. 123.	125. 7206
Near Fulton, N. Y.	L. S. 124.	121. 8719
At Fulton, N. Y.	L. S. 125.	106. 0543
At Fulton, N. Y.	L. S. 126.	100. 2870
At Fulton, N. Y.	L. S. 127.	98. 5014
At Fulton, N. Y.	L. S. 128.	98. 2898
Near Fulton, N. Y.	L. S. 129.	97. 5918
Near Fulton, N. Y.	L. S. 130.	95. 1001
At Minetto, N. Y.	L. S. 131.	91. 8154
Near Minetto, N. Y.	L. S. 132.	88. 8892
Near Oswego, N. Y.	L. S. 133.	87. 3778
Near Oswego, N. Y.	L. S. 134.	82. 7754
Near Oswego, N. Y.	L. S. 135.	83. 7339
At Oswego, N. Y.	L. S. 136.	78. 9027
At Oswego, N. Y.	L. S. 137.	77. 7164
At Oswego, N. Y.	L. S. 138.	80. 0310
At Oswego, N. Y.	L. S. 139.	76. 7284
At Oswego, N. Y.	A	76. 7788
At Oswego, N. Y.	B	76. 9355
At Oswego, N. Y.	C	79. 8506
Near Bath, N. Y.	D. W. Bath.	6. 2264
At West Troy, N. Y.	N. Y. 12.	6. 4490
Near Troy, N. Y.	D. W. Troy 3.	5. 5604
At Cohoes, N. Y.	D. W. Cohoes 2.	33. 8541
At Cohoes, N. Y.	D. W. Cohoes 3.	47. 4763
Near Cohoes, N. Y.	N. Y. 33.	48. 9771
Near Cohoes, N. Y.	9a (1875).	58. 9073
Near Crescent, N. Y.	D. W. Crescent.	58. 6225
At Dunsbach Ferry, N. Y.	D. W. Dunsbach.	56. 7381

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Niskayuna, N. Y.	D. W. Niskayuna.	59.8078
Near Vischers Ferry, N. Y.	D. W. Vischers.	60.8309
Near Aqueduct Station, N. Y.	D. W. Aqueduct 1.	82.8844
At Aqueduct Station, N. Y.	N. Y. 57.	82.4500
Near Aqueduct Station, N. Y.	D. W. Aqueduct 3.	80.5106
At Schenectady, N. Y.	N. Y. 65.	73.2572
At Schenectady, N. Y.	N. Y. 67.	71.0044
Near Rotterdam Junction, N. Y.	N. Y. 76a.	76.4252
At Rotterdam Junction, N. Y.	D. W. Rotterdam 1.	76.7758
Near Rotterdam Junction, N. Y.	D. W. Rotterdam 2.	75.3407
At Pattersonville, N. Y.	D. W. Pattersonville.	82.7811
Near Amsterdam, N. Y.	D. W. Amsterdam 1.	85.5271
At Amsterdam, N. Y.	D. W. Amsterdam 2.	85.0492
At Fort Hunter, N. Y.	N. Y. 101.	91.1223
Near Auriesville, N. Y.	N. Y. 106.	92.2890
At Fultonville, N. Y.	N. Y. 115.	91.4256
Near Downing, N. Y.	N. Y. 121.	91.3727
Near Downing, N. Y.	N. Y. 124.	90.6078
Near Sprakers, N. Y.	N. Y. 131.	92.5210
At Fort Plain, N. Y.	N. Y. 142a.	95.7126
At Mindenville, N. Y.	N. Y. 154.	98.1071
Near Indian Castle, N. Y.	N. Y. 160.	100.2068
At Little Falls, N. Y.	N. Y. 173.	115.0638
Near Little Falls, N. Y.	N. Y. 175.	115.1563
Near Herkimer, N. Y.	N. Y. 182.	117.2696
At Herkimer, N. Y.	N. Y. 187.	118.4384
At Ilion, N. Y.	D. W. Ilion.	117.8296
At Frankfort, N. Y.	D. W. Frankfort 1.	122.4646
Near Frankfort, N. Y.	D. W. Frankfort 3.	124.4985
Near Utica, N. Y.	D. W. Utica 1.	120.9868
Near Oriskany, N. Y.	D. W. Oriskany 2.	128.5001
Near Rome, N. Y.	D. W. Rome 1.	130.4665
At Rome, N. Y.	D. W. Rome 2.	131.6099
At Rome, N. Y.	D. W. Rome 3.	131.9014
Near Rome, N. Y.	D. W. Rome 4.	128.2897
At New London, N. Y.	D. W. New London.	124.4320
Near Sylvan Beach, N. Y.	D. W. Sylvan Beach 1.	116.2860
Near Sylvan Beach, N. Y.	D. W. Sylvan Beach 2.	113.9518
Near North Bay, N. Y.	D. W. North Bay.	128.6171
At Brewerton, N. Y.	D. W. Brewerton.	113.6984
Near Caudenoy, N. Y.	D. W. High Banks.	112.0145
On Sand Ridge, N. Y.	D. W. Sand Ridge.	117.1284
Near Ingalls Crossing, N. Y.	D. W. Ingalls 1.	114.7236
Near Ingalls Crossing, N. Y.	D. W. Ingalls 2.	114.5712
At Phoenix, N. Y.	D. W. Phoenix.	109.1353
At Hinmanville, N. Y.	D. W. Hinmanville 1.	109.9359
Near Hinmanville, N. Y.	D. W. Hinmanville 2.	107.7527
Near Fulton, N. Y	D. W. Fulton 2.	95.1035
At Albany, N. Y.	N. Y. 1.	3.9127
At Albany, N. Y.	N. Y. 2.	5.6232
At Albany, N. Y.	N. Y. 4.	3.0860
Near Albany, N. Y.	N. Y. 5a.	7.6251
At Watervliet, N. Y.	N. Y. 8.	9.8005
At Watervliet, N. Y.	N. Y. 9.	7.9755
At Watervliet, N. Y.	N. Y. 10.	8.8519
At Watervliet, N. Y.	N. Y. 11.	8.6493
At Troy, N. Y.	N. Y. 13.	8.1763
Near Green Island, N. Y.	N. Y. 14.	11.4842
Near Green Island, N. Y.	N. Y. 15.	14.8868

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Cohoes, N. Y.	N. Y. 16.	18. 1738
Near Cohoes, N. Y.	N. Y. 17.	21. 2245
Near Cohoes, N. Y.	N. Y. 18.	24. 1655
Near Cohoes, N. Y.	N. Y. 19.	27. 2909
Near Cohoes, N. Y.	N. Y. 20.	30. 3818
Near Cohoes, N. Y.	N. Y. 21.	33. 4139
Near Cohoes, N. Y.	N. Y. 22.	36. 4661
Near Cohoes, N. Y.	N. Y. 23.	39. 5423
Near Cohoes, N. Y.	N. Y. 24.	42. 5603
At Cohoes, N. Y.	N. Y. 25.	45. 5910
At Cohoes, N. Y.	N. Y. 27.	48. 6796
At Cohoes, N. Y.	N. Y. 28.	51. 7102
At Cohoes, N. Y.	N. Y. 29.	54. 8012
Near Cohoes, N. Y.	N. Y. 31.	58. 0138
Near Cohoes, N. Y.	N. Y. 32.	58. 5497
At Crescent, N. Y.	N. Y. 37.	59. 2920
Near Crescent, N. Y.	N. Y. 38.	58. 3587
Near Crescent, N. Y.	N. Y. 41.	58. 2817
Near Vischers Ferry, N. Y.	N. Y. 43.	58. 5861
Near Vischers Ferry, N. Y.	N. Y. 44.	58. 5943
Near Vischers Ferry, N. Y.	N. Y. 47.	58. 8317
At Vischers Ferry, N. Y.	N. Y. 48.	60. 5039
Near Vischers Ferry, N. Y.	N. Y. 50.	63. 5245
At Fondas Basin, N. Y.	N. Y. 51.	64. 8285
At Rexford Flats, N. Y.	N. Y. 54.	70. 8163
At Rexford Flats, N. Y.	N. Y. 55.	71. 9377
Near Rexford Flats, N. Y.	N. Y. 56.	71. 8812
Near Schenectady, N. Y.	N. Y. 60.	71. 0768
At Schenectady, N. Y.	N. Y. 62.	71. 0273
At Schenectady, N. Y.	N. Y. 63.	71. 4867
At Schenectady, N. Y.	N. Y. 66a.	72. 0732
At Schenectady, N. Y.	N. Y. 66b.	71. 6501
At Schenectady, N. Y.	N. Y. 68.	71. 4070
At Schenectady, N. Y.	N. Y. 69.	68. 0429
Near Schenectady, N. Y.	N. Y. 70.	70. 7022
Near Schenectady, N. Y.	N. Y. 73.	73. 2304
Near Schenectady, N. Y.	N. Y. 74.	75. 5989
Near Schenectady, N. Y.	N. Y. 75.	76. 3832
Near Rotterdam Junction, N. Y.	N. Y. 76.	75. 9470
Near Rotterdam Junction, N. Y.	N. Y. 77.	76. 8120
Near Rotterdam Junction, N. Y.	N. Y. 78.	76. 3751
Near Rotterdam Junction, N. Y.	N. Y. 79.	76. 0208
Near Rotterdam Junction, N. Y.	N. Y. 80.	75. 6332
Near Pattersonville, N. Y.	N. Y. 82.	77. 9912
Near Pattersonville, N. Y.	N. Y. 84.	78. 9899
Near Pattersonville, N. Y.	N. Y. 85a.	78. 4743
Near Pattersonville, N. Y.	N. Y. 85.	78. 7913
Near Pattersonville, N. Y.	N. Y. 86.	79. 0626
Near Pattersonville, N. Y.	N. Y. 87.	77. 6824
Near Amsterdam, N. Y.	N. Y. 92.	82. 9125
Near Fort Hunter, N. Y.	N. Y. 96.	86. 0896
Near Fort Hunter, N. Y.	N. Y. 98.	87. 5550
Near Fort Hunter, N. Y.	N. Y. 99.	88. 5321
At Fort Hunter, N. Y.	N. Y. 100.	90. 8012
Near Fort Hunter, N. Y.	N. Y. 102.	92. 1349
Near Auriesville, N. Y.	N. Y. 104.	92. 0897
At Auriesville, N. Y.	N. Y. 105.	91. 6071
Near Auriesville, N. Y.	N. Y. 107.	91. 4698
Near Fultonville, N. Y.	N. Y. 110.	91. 7159
Near Fultonville, N. Y.	N. Y. 111.	92. 0124

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Fultonville, N. Y.	N. Y. 113.	91.6241
At Fultonville, N. Y.	N. Y. 116.	91.9002
Near Fultonville, N. Y.	N. Y. 119.	91.7178
Near Downing, N. Y.	N. Y. 122.	91.3170
Near Downing, N. Y.	N. Y. 123.	90.5935
Near West Downing, N. Y.	N. Y. 126.	91.3175
Near Sprakers, N. Y.	N. Y. 130.	93.3196
Near Sprakers, N. Y.	N. Y. 132.	92.8718
Near Sprakers, N. Y.	N. Y. 133.	92.5741
Near Canajoharie, N. Y.	N. Y. 134.	92.8534
Near Canajoharie, N. Y.	N. Y. 137.	93.6934
Near Canajoharie, N. Y.	N. Y. 138.	93.3289
Near Fort Plain, N. Y.	N. Y. 139.	93.1431
Near Fort Plain, N. Y.	N. Y. 143.	95.2367
Near Fort Plain, N. Y.	N. Y. 145.	93.7518
Near Fort Plain, N. Y.	N. Y. 146.	94.6502
Near St. Johnsville, N. Y.	N. Y. 147.	94.3951
Near St. Johnsville, N. Y.	N. Y. 149.	95.4937
Near St. Johnsville, N. Y.	N. Y. 150.	96.8132
Near St. Johnsville, N. Y.	N. Y. 152.	97.3433
At St. Johnsville, N. Y.	N. Y. 153.	97.7540
Near Mindenville, N. Y.	N. Y. 156.	99.2874
Near Mindenville, N. Y.	N. Y. 157.	99.8510
Near Mindenville, N. Y.	N. Y. 159.	99.9172
Near Indian Castle, N. Y.	N. Y. 161.	99.6172
Near Indian Castle, N. Y.	N. Y. 162.	99.5459
Near Indian Castle, N. Y.	N. Y. 163.	101.7449
Near Indian Castle, N. Y.	N. Y. 165.	102.4182
Near Indian Castle, N. Y.	N. Y. 166.	102.4396
Near Indian Castle, N. Y.	N. Y. 167.	103.1919
Near Little Falls, N. Y.	N. Y. 174.	114.9729
Near Little Falls, N. Y.	N. Y. 176.	115.3294
Near Little Falls, N. Y.	N. Y. 178.	116.1214
Near Herkimer, N. Y.	N. Y. 180.	117.4348
Near Herkimer, N. Y.	N. Y. 181.	117.3490
Near Herkimer, N. Y.	N. Y. 184.	119.8843
Near Mohawk, N. Y.	N. Y. 188.	119.5767
At Mohawk, N. Y.	N. Y. 190.	119.7515
At Mohawk, N. Y.	N. Y. 192.	123.8752
At Mohawk, N. Y.	N. Y. 194.	125.0552
At Ilion, N. Y.	N. Y. 196.	124.5442
At Ilion, N. Y.	N. Y. 198.	125.0652
Near Ilion, N. Y.	N. Y. 199.	124.7295
Near Ilion, N. Y.	N. Y. 201.	128.1188
Near Frankfort, N. Y.	N. Y. 202.	128.7741
Near Frankfort, N. Y.	N. Y. 205.	131.2049
Near Frankfort, N. Y.	N. Y. 206.	131.3128
At Frankfort, N. Y.	N. Y. 207.	130.8953
Near Frankfort, N. Y.	N. Y. 208.	131.4193
Near Frankfort, N. Y.	N. Y. 209.	131.3609
Near Utica, N. Y.	N. Y. 210.	131.0863
Near Utica, N. Y.	N. Y. 211.	130.9316
Near Utica, N. Y.	N. Y. 212.	130.6175
Near Utica, N. Y.	N. Y. 213.	131.3825
Near Utica, N. Y.	N. Y. 214.	130.9949
Near Utica, N. Y.	N. Y. 216.	131.1093
At Utica, N. Y.	N. Y. 218.	129.8773
At Utica, N. Y.	N. Y. 224.	132.3222
Near Utica, N. Y.	N. Y. 226.	132.7711
Near Whitesboro, N. Y.	N. Y. 227.	132.1371

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Oriskany, N. Y.	N. Y. 231.	132. 9363
Near Oriskany, N. Y.	N. Y. 234.	132. 6018
Near Oriskany, N. Y.	N. Y. 235.	132. 5691
Near Oriskany, N. Y.	N. Y. 236.	132. 9156
At Rome, N. Y.	N. Y. 238.	131. 8289
Near Rome, N. Y.	N. Y. 240.	132. 5625
Near New London, N. Y.	N. Y. 242.	131. 8851
Near New London, N. Y.	N. Y. 244.	130. 9088
Near Stacys Basin, N. Y.	N. Y. 246.	132. 7173
At Higginsville, N. Y.	N. Y. 248.	132. 2888
At Higginsville, N. Y.	N. Y. 249.	130. 4761
Near Higginsville, N. Y.	N. Y. 250.	131. 6407
Near Higginsville, N. Y.	N. Y. 251.	130. 5828
Near Higginsville, N. Y.	N. Y. 252.	130. 6062
Near Higginsville, N. Y.	N. Y. 253.	131 8292
Near Higginsville, N. Y.	N. Y. 254.	131. 8504
Near Higginsville, N. Y.	N. Y. 255.	130. 4818
Near Durhamville, N. Y.	N. Y. 256.	130. 6090
At Durhamville, N. Y.	N. Y. 257.	129. 1490
At Durhamville, N. Y.	N. Y. 258.	131. 8548
At Durhamville, N. Y.	N. Y. 259.	131. 4899
At Durhamville, N. Y.	N. Y. 260.	132. 0008
Near Durhamville, N. Y.	N. Y. 261.	132. 3243
Near Durhamville, N. Y.	N. Y. 262.	131. 1157
Near Canastota, N. Y.	N. Y. 263.	131. 6740
Near Canastota, N. Y.	N. Y. 264.	130. 4660
At Canastota, N. Y.	N. Y. 265.	131. 7550
At Canastota, N. Y.	N. Y. 266.	131. 1721
At Canastota, N. Y.	N. Y. 267.	131. 9787
At Canastota, N. Y.	N. Y. 268.	130. 8263
Near Canastota, N. Y.	N. Y. 269.	131. 9699
Near Canastota, N. Y.	N. Y. 270.	132. 0473
Near Canastota, N. Y.	N. Y. 271.	130. 6966
Near Canastota, N. Y.	N. Y. 272.	132. 0761
Near Canaseraga, N. Y.	N. Y. 273.	130. 4469
Near Canaseraga, N. Y.	N. Y. 274.	132. 1083
Near Chittenango, N. Y.	N. Y. 275.	131. 7998
At Chittenango, N. Y.	N. Y. 276.	131. 8936
Near Chittenango, N. Y.	N. Y. 277.	130. 5038
Near Chittenango, N. Y.	N. Y. 278.	132. 2839
Near Chittenango, N. Y.	N. Y. 279.	132. 6729
Near Kirkville, N. Y.	N. Y. 280.	132. 5861
Near Kirkville, N. Y.	N. Y. 281.	132. 7342
Near Manlius, N. Y.	N. Y. 282.	129. 8764
Near Manlius, N. Y.	N. Y. 283.	128. 1897
At Manlius, N. Y.	N. Y. 284.	132. 0359
Near Dewitt, N. Y.	N. Y. 285.	132. 5082
Near Dewitt, N. Y.	N. Y. 286.	132. 3465
Near Dewitt, N. Y.	N. Y. 287.	132. 7198
Near Dewitt, N. Y.	N. Y. 288.	130. 5902
Near Dewitt, N. Y.	N. Y. 289.	132. 2678
Near Syracuse, N. Y.	N. Y. 290.	132. 1439
Near Syracuse, N. Y.	N. Y. 291.	131. 5854
Near Syracuse, N. Y.	N. Y. 292.	131. 0910
At Syracuse, N. Y.	N. Y. 293.	131. 2525
At Syracuse, N. Y.	N. Y. 294.	128. 0211
At Syracuse, N. Y.	N. Y. 295.	125. 7933
At Syracuse, N. Y.	N. Y. 296.	125. 4707
At Syracuse, N. Y.	N. Y. 297.	124. 8824
At Syracuse, N. Y.	N. Y. 298.	124. 5007

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Syracuse, N. Y.	N. Y. 299.	123. 4743
At Syracuse, N. Y.	N. Y. 300.	122. 8036
At Syracuse, N. Y.	N. Y. 301.	123. 2370
At Syracuse, N. Y.	N. Y. 302.	123. 9335
At Syracuse, N. Y.	N. Y. 303.	123. 5205
At Syracuse, N. Y.	N. Y. 304.	123. 6143
At Syracuse, N. Y.	N. Y. 305=U. S. G. S.	123. 8192
At Syracuse, N. Y.	N. Y. 306.	123. 0419
At Syracuse, N. Y.	N. Y. 307.	123. 9597
Near Syracuse, N. Y.	N. Y. 308.	123. 1541
Near Syracuse, N. Y.	N. Y. 309.	124. 3093
Near Syracuse, N. Y.	N. Y. 310.	124. 1676
Near Syracuse, N. Y.	N. Y. 311.	121. 2616
Near Syracuse, N. Y.	N. Y. 312.	125. 1554
Near Belle Isle, N. Y.	N. Y. 313.	126. 7840
At Belle Isle, N. Y.	N. Y. 314.	126. 7742
Near Amboy, N. Y.	N. Y. 315.	124. 0353
Near Amboy, N. Y.	N. Y. 316.	126. 6953
Near Amboy, N. Y.	N. Y. 317.	125. 1713
Near Camillus, N. Y.	N. Y. 318.	123. 2163
Near Camillus, N. Y.	N. Y. 319.	126. 9690
Near Warners, N. Y.	N. Y. 320	126. 9717
At Warners, N. Y.	N. Y. 321=U. S. G. S.	125. 7559
Near Memphis, N. Y.	N. Y. 322.	126. 9534
Near Memphis, N. Y.	N. Y. 323.	123. 7966
Near Memphis, N. Y.	N. Y. 324.	126. 0787
Near Memphis, N. Y.	N. Y. 325.	126. 3694
Near Jordan, N. Y.	N. Y. 326.	125. 4310
Near Jordan, N. Y.	N. Y. 327.	125. 5090
At Jordan, N. Y.	N. Y. 328.	126. 1927
At Jordan, N. Y.	N. Y. 329.	126. 2759
At Jordan, N. Y.	N. Y. 330.	125. 9244
At Jordan, N. Y.	N. Y. 331.	125. 9269
Near Jordan, N. Y.	N. Y. 332.	125. 1594
Near Jordan, N. Y.	N. Y. 333.	123. 9640
Near Weedsport, N. Y.	N. Y. 334.	124. 6485
Near Weedsport, N. Y.	N. Y. 335.	123. 8006
Near Weedsport, N. Y.	N. Y. 336.	124. 3968
Near Weedsport, N. Y.	N. Y. 337.	124. 3203
Near Weedsport, N. Y.	N. Y. 338.	124. 0578
Near Weedsport, N. Y.	N. Y. 339.	124. 3349
Near Weedsport, N. Y.	N. Y. 340.	123. 2443
At Weedsport, N. Y.	N. Y. 341.	124. 0965
At Weedsport, N. Y.	N. Y. 342.	124. 3968
Near Weedsport, N. Y.	N. Y. 343.	124. 3608
Near Weedsport, N. Y.	N. Y. 344.	123. 3882
Near Port Byron, N. Y.	N. Y. 345.	124. 8189
At Port Byron, N. Y.	N. Y. 346.	122. 7533
At Port Byron, N. Y.	N. Y. 347.	124. 5681
At Port Byron, N. Y.	N. Y. 348.	124. 2063
At Port Byron, N. Y.	N. Y. 349.	123. 2120
At Port Byron, N. Y.	N. Y. 350=U. S. G. S.	124. 2185
At Port Byron, N. Y.	N. Y. 351=U. S. G. S.	123. 9381
At Port Byron, N. Y.	N. Y. 352=U. S. G. S.	122. 9197
Near Port Byron, N. Y.	N. Y. 353.	120. 6392
Near Montezuma, N. Y.	N. Y. 354.	120. 8081
Near Montezuma, N. Y.	N. Y. 355.	121. 1214
Near Montezuma, N. Y.	N. Y. 356.	120. 8126
At Montezuma, N. Y.	N. Y. 357.	121. 1345
At Montezuma, N. Y.	N. Y. 358.	121. 0556

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Montezuma, N. Y.	N. Y. 359.	120.9790
At Montezuma, N. Y.	N. Y. 360.	121.6681
At Montezuma, N. Y.	N. Y. 361.	121.0171
Near Montezuma, N. Y.	N. Y. 362.	120.9760
Near Montezuma, N. Y.	N. Y. 363=U. S. G. S.	120.8968
Near Montezuma, N. Y.	N. Y. 364.	119.4230
Near Montezuma, N. Y.	N. Y. 365.	120.0351
Near Montezuma, N. Y.	N. Y. 366.	120.7300
Near Meadville, N. Y.	N. Y. 367.	118.7254
Near Meadville, N. Y.	N. Y. 368.	118.5897
Near Meadville, N. Y.	N. Y. 369.	121.0409
Near Meadville, N. Y.	N. Y. 370.	118.2456
Near Meadville, N. Y.	N. Y. 371.	118.5830
Near Clyde, N. Y.	N. Y. 372.	118.8601
Near Clyde, N. Y.	N. Y. 373.	121.1045
Near Clyde, N. Y.	N. Y. 374.	120.5888
Near Clyde, N. Y.	N. Y. 375.	118.7282
At Clyde, N. Y.	N. Y. 376.	121.5863
At Clyde, N. Y.	N. Y. 377.	121.6958
Near Clyde, N. Y.	N. Y. 378.	122.3225
Near Clyde, N. Y.	N. Y. 379.	122.4178
Near Lock Berlin, N. Y.	N. Y. 380.	122.6165
Near Lock Berlin, N. Y.	N. Y. 381.	120.1029
At Lock Berlin, N. Y.	N. Y. 382.	122.2608
At Lock Berlin, N. Y.	N. Y. 383.	123.9201
Near Lock Berlin, N. Y.	N. Y. 384.	124.6544
Near Lock Berlin, N. Y.	N. Y. 385.	124.9167
Near Lock Berlin, N. Y.	N. Y. 386.	124.6904
Near Lyons, N. Y.	N. Y. 387.	124.6498
Near Lyons, N. Y.	N. Y. 388.	124.6288
Near Lyons, N. Y.	N. Y. 389.	124.8754
At Lyons, N. Y.	N. Y. 390.	124.7727
At Lyons, N. Y.	N. Y. 391.	124.2756
At Lyons, N. Y.	N. Y. 392.	125.7136
At Lyons, N. Y.	N. Y. 393.	125.8278
Near Lyons, N. Y.	N. Y. 394.	126.7723
Near Lyons, N. Y.	N. Y. 395.	127.0462
Near Lyons, N. Y.	N. Y. 396.	128.8568
Near Lyons, N. Y.	N. Y. 397.	129.5911
Near Lyons, N. Y.	N. Y. 398.	127.1134
Near Newark, N. Y.	N. Y. 399.	129.5133
Near Newark, N. Y.	N. Y. 400.	127.3704
At Newark, N. Y.	N. Y. 401.	131.1398
At Newark, N. Y.	N. Y. 402.	133.6711
At Newark, N. Y.	N. Y. 403.	136.0781
At Newark, N. Y.	N. Y. 404.	136.4825
At Newark, N. Y.	U. S. G. S.	139.4677
At Newark, N. Y.	N. Y. 405.	135.8613
Near Newark, N. Y.	N. Y. 406.	136.9946
Near Newark, N. Y.	N. Y. 407.	136.7858
Near Port Gibson, N. Y.	N. Y. 408.	136.7863
Near Port Gibson, N. Y.	N. Y. 409.	136.9029
At Port Gibson N. Y.	N. Y. 410.	136.8705
Near Palmyra, N. Y.	N. Y. 411.	137.0289
At Palmyra, N. Y.	N. Y. 412.	136.8375
At Palmyra, N. Y.	N. Y. 413.	137.5265
At Palmyra, N. Y.	N. Y. 414.	136.3832
At Palmyra, N. Y.	N. Y. 415.	136.7223
Near Palmyra, N. Y.	N. Y. 416.	136.1264
Near Palmyra, N. Y.	U. S. G. S.	136.1316

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Palmyra, N. Y.	N. Y. 417.	137. 1590
Near Macedon, N. Y.	N. Y. 418.	137. 1879
At Macedon, N. Y.	N. Y. 419.	139. 0817
At Macedon, N. Y.	N. Y. 420.	141. 2570
Near Macedon, N. Y.	N. Y. 421.	141. 9636
At Wayneport, N. Y.	N. Y. 422.	142. 1458
Near Fairport, N. Y.	N. Y. 423.	142. 4819
Near Fairport, N. Y.	N. Y. 424.	140. 6768
Near Fairport, N. Y.	N. Y. 425.	142. 4921
At Fairport, N. Y.	N. Y. 426.	142. 1116
Near Fairport, N. Y.	N. Y. 427.	142. 0245
Near Fairport, N. Y.	N. Y. 428.	138. 9898
Near Fairport, N. Y.	N. Y. 429.	141. 6109
Near Fairport, N. Y.	N. Y. 430.	142. 0199
Near Bushnell Basin, N. Y.	N. Y. 431.	141. 6166
Near Bushnell Basin, N. Y.	N. Y. 432=U. S. G. S.	141. 9637
Near Bushnell Basin, N. Y.	N. Y. 433.	141. 5632
Near Pittsford, N. Y.	N. Y. 434.	141. 9919
At Pittsford, N. Y.	N. Y. 435.	142. 1683
At Pittsford, N. Y.	N. Y. 436.	142. 1668
Near Pittsford, N. Y.	N. Y. 437.	142. 1213
Near Pittsford, N. Y.	N. Y. 438.	138. 5270
Near Pittsford, N. Y.	N. Y. 439.	137. 4854
Near Pittsford, N. Y.	N. Y. 440.	142. 0641
Near Pittsford, N. Y.	N. Y. 441.	143. 9656
Near Brighton, N. Y.	N. Y. 442.	144. 6017
Near Brighton, N. Y.	N. Y. 443.	145. 0756
Near Brighton, N. Y.	N. Y. 444.	145. 0519
Near Brighton, N. Y.	N. Y. 445.	145. 0308
At Brighton, N. Y.	N. Y. 446.	146. 6913
At Brighton, N. Y.	N. Y. 447.	149. 7368
Near Rochester, N. Y.	N. Y. 448.	152. 8246
At Rochester, N. Y.	N. Y. 449.	153. 8671
At Rochester, N. Y.	N. Y. 450.	155. 6652
At Rochester, N. Y.	N. Y. 451.	156. 5512
At Rochester, N. Y.	N. Y. 452.	156. 5060
At Rochester, N. Y.	N. Y. 453.	155. 5251
At Rochester, N. Y.	N. Y. 454.	156. 3641
At Rochester, N. Y.	N. Y. 455.	156. 1301
At Rochester, N. Y.	N. Y. 456.	156. 7923
Near Rochester, N. Y.	N. Y. 458.	156. 5141
Near Rochester, N. Y.	N. Y. 459.	156. 7387
Near South Greece, N. Y.	N. Y. 460.	156. 6554
Near South Greece, N. Y.	N. Y. 461.	156. 2355
At South Greece, N. Y.	N. Y. 462.	156. 4025
Near South Greece, N. Y.	N. Y. 463.	156. 8233
Near Spencerport, N. Y.	N. Y. 464.	156. 4493
Near Spencerport, N. Y.	N. Y. 465.	156. 5012
At Spencerport, N. Y.	N. Y. 466.	156. 5764
At Spencerport, N. Y.	N. Y. 467=U. S. G. S.	156. 8959
Near Spencerport, N. Y.	N. Y. 468.	156. 4797
Near Spencerport, N. Y.	N. Y. 469.	156. 7611
Near Spencerport, N. Y.	N. Y. 470.	156. 6354
Near Brockport, N. Y.	N. Y. 471.	157. 1045
Near Brockport, N. Y.	N. Y. 472.	155. 2287
Near Brockport, N. Y.	N. Y. 473.	156. 3376
Near Brockport, N. Y.	N. Y. 474.	156. 8298
At Brockport, N. Y.	N. Y. 475=U. S. G. S.	155. 9635
At Brockport, N. Y.	N. Y. 476.	156. 5162
At Brockport, N. Y.	N. Y. 477.	156. 0462

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Brockport, N. Y.	N. Y. 478.	157.2233
Near Holley, N. Y.	N. Y. 479.	155.9589
Near Holley, N. Y.	N. Y. 480.	157.4335
At Holley, N. Y.	N. Y. 481.	157.1732
Near Holley, N. Y.	N. Y. 482.	157.3440
At Hulberton, N. Y.	N. Y. 483.	157.2746
Near Hulberton, N. Y.	N. Y. 484.	157.0672
Near Hulberton, N. Y.	N. Y. 485.	157.4835
Near Albion, N. Y.	N. Y. 486.	157.5680
Near Albion, N. Y.	N. Y. 487.	157.1124
At Albion, N. Y.	N. Y. 488.	156.5296
Near Albion, N. Y.	N. Y. 489.	157.4272
Near Albion, N. Y.	N. Y. 490.	156.8818
At Eagle Harbor, N. Y.	N. Y. 491.	157.1880
At Eagle Harbor, N. Y.	N. Y. 492=U. S. G. S.	157.1901
Near Eagle Harbor, N. Y.	N. Y. 493.	157.5410
Near Knowlesville, N. Y.	N. Y. 494.	157.1830
Near Knowlesville, N. Y.	N. Y. 495.	155.6380
Near Knowlesville, N. Y.	N. Y. 496.	157.4677
Near Knowlesville, N. Y.	N. Y. 497.	156.5489
Near Medina, N. Y.	N. Y. 498.	157.0217
Near Medina, N. Y.	N. Y. 499.	157.4185
At Medina, N. Y.	N. Y. 500.	157.2349
At Medina, N. Y.	N. Y. 501.	156.5843
At Medina, N. Y.	N. Y. 502.	157.0945
At Medina, N. Y.	N. Y. 503=U. S. G. S.	157.6395
Near Medina, N. Y.	N. Y. 504.	156.7661
Near Medina, N. Y.	N. Y. 505.	155.9228
Near Medina, N. Y.	N. Y. 506.	157.3556
Near Medina, N. Y.	N. Y. 507.	157.8386
Near Middleport, N. Y.	N. Y. 508.	157.8227
Near Middleport, N. Y.	N. Y. 509.	155.9274
At Middleport, N. Y.	N. Y. 510.	157.1646
Near Middleport, N. Y.	N. Y. 511.	155.0844
Near Middleport, N. Y.	N. Y. 512.	157.4636
Near Middleport, N. Y.	N. Y. 513.	157.5134
Near Gasport, N. Y.	N. Y. 514.	157.3716
At Gasport, N. Y.	N. Y. 515.	155.5805
At Gasport, N. Y.	N. Y. 516.	155.2752
Near Gasport, N. Y.	N. Y. 517.	157.3102
Near Gasport, N. Y.	N. Y. 518.	155.0348
Near Gasport, N. Y.	N. Y. 519.	154.4995
Near Gasport, N. Y.	N. Y. 520.	158.7121
Near Lockport, N. Y.	N. Y. 521.	158.6580
Near Lockport, N. Y.	N. Y. 522.	158.8587
At Lockport, N. Y.	N. Y. 523.	156.3452
At Lockport, N. Y.	N. Y. 524.	157.1348
At Lockport, N. Y.	N. Y. 525.	157.4038
At Lockport, N. Y.	N. Y. 526.	158.1375
At Lockport, N. Y.	N. Y. 527.	173.9039
Near Lockport, N. Y.	N. Y. 528.	175.2519
Near Lockport, N. Y.	N. Y. 529.	176.0082
Near Lockport, N. Y.	N. Y. 530.	175.2003
Near Pendleton, N. Y.	N. Y. 531.	177.1941
At Pendleton, N. Y.	N. Y. 532.	175.3395
Near Pendleton, N. Y.	N. Y. 533.	175.5560
Near Pendleton, N. Y.	N. Y. 534.	175.7043
Near Pendleton, N. Y.	N. Y. 535.	175.9969
Near Pendleton, N. Y.	N. Y. 536.	175.3470
Near Tonawanda, N. Y.	N. Y. 537.	175.4574

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Tonawanda, N. Y.	N. Y. 538.	176.4841
At Tonawanda, N. Y.	N Y. 540.	176.3675
Near Tonawanda, N. Y.	N. Y. 541.	176.3177
Near Tonawanda, N. Y.	N. Y. 542.	176.3300
Near Tonawanda, N. Y.	N. Y. 543.	175.6178
Near Tonawanda, N. Y.	N. Y. 544.	175.9405
Near Buffalo, N. Y.	N. Y. 545.	176.2034
Near Buffalo, N. Y.	N. Y. 546.	176.6245
At Buffalo, N. Y.	N. Y. 548.	176.7394
At Buffalo, N. Y.	N. Y. 549.	177.2916
At Buffalo, N. Y.	N. Y. 550.	175.6462
At Buffalo, N. Y.	N. Y. 551.	177.3337
At Buffalo, N. Y.	N. Y. 552.	176.6359
At Phoenix, N. Y.	N. Y. 54.	111.0695
At Three River Point, N. Y.	N. Y. 55.	111.5895
At Belgium, N. Y.	N. Y. 56.	112.5879
Near Belgium, N. Y.	N. Y. 57.	111.1480
Near Belgium, N. Y.	N. Y. 58.	112.6306
Near Baldwinsville, N. Y.	N. Y. 59.	112.5477
Near Baldwinsville, N. Y.	N. Y. 60.	111.5802
Near Baldwinsville, N. Y.	N. Y. 61.	111.8381
Near Baldwinsville, N. Y.	N. Y. 62.	111.9530
Near Baldwinsville, N. Y.	N. Y. 63.	112.3319
Near Baldwinsville, N. Y.	N. Y. 64.	114.0031
Near Baldwinsville, N. Y.	N. Y. 65.	114.7032
Near Baldwinsville, N. Y.	N. Y. 66.	115.3637
Near Baldwinsville, N. Y.	N. Y. 67.	119.8013
Near Baldwinsville, N. Y.	N. Y. 68.	114.6953
Near Baldwinsville, N. Y.	N. Y. 69.	114.9464
Near Plainville, N. Y.	N. Y. 70.	116.0105
Near Plainville, N. Y.	N. Y. 71.	115.3207
Near Plainville, N. Y.	N. Y. 72.	119.7275
Near Plainville, N. Y.	N. Y. 73.	118.9200
Near Plainville, N. Y.	N. Y. 74.	115.8276
Near Plainville, N. Y.	N. Y. 75.	116.3503
Near Weedsport, N. Y.	N. Y. 76.	114.5715
Near Weedsport, N. Y.	N. Y. 77.	117.0081
Near Weedsport, N. Y.	N. Y. 78.	116.5405
Near Weedsport, N. Y.	N. Y. 80.	116.4787
Near Port Byron, N. Y.	N. Y. 81.	115.3540
Near Port Byron, N. Y.	N. Y. 82.	117.3778
Near Port Byron, N. Y.	N. Y. 83.	117.4449
Near Port Byron, N. Y.	N. Y. 84.	115.6822
At Fox Ridge, N. Y.	N. Y. 85.	117.8804
Near Fox Ridge, N. Y.	N. Y. 86.	118.5437
Near Savannah, N. Y.	N. Y. 87.	123.5299
Near Savannah, N. Y.	N. Y. 88.	119.7650
Near Savannah, N. Y.	N. Y. 89.	118.4419
Near Clyde, N. Y.	N. Y. 90.	120.9900
At Syracuse, N. Y.	N. Y. 1.	123.9966
At Syracuse, N. Y.	N. Y. 2.	123.4528
At Syracuse, N. Y.	N. Y. 3.	123.1794
Near Syracuse, N. Y.	N. Y. 4.	122.8350
Near Syracuse, N. Y.	N. Y. 5.	119.4752
Near Syracuse, N. Y.	N. Y. 6.	116.0669
Near Syracuse, N. Y.	N. Y. 7.	113.7815
Near Syracuse, N. Y.	N. Y. 8.	113.9156

*This bench mark may be identical with D. W. Cherry, see p. 537. If found to be the same the mean of the two elevations should be used.

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Syracuse, N. Y.	N. Y. 9.	113.3365
Near Liverpool, N. Y.	N. Y. 10.	111.3864
Near Liverpool, N. Y.	N. Y. 11.	113.4736
Near Belgium, N. Y.	N. Y. 12.	111.2885
Near Belgium, N. Y.	N. Y. 13.	113.7592
Near Belgium, N. Y.	N. Y. 14.	113.0929
At Waterford, N. Y.	D. W. Waterford 1.	9.0476
At Waterford, N. Y.	N. Y. 6.	10.8611
Near Waterford, N. Y.	N. Y. 13.	15.9016
At Mechanicsville, N. Y.	D. W. Mechanicsville 1.	18.6359
At Mechanicsville, N. Y.	D. W. Mechanicsville 2.	17.0356
At Mechanicsville, N. Y.	N. Y. 20.	26.9370
At Mechanicsville, N. Y.	N. Y. 21.	26.9931
At Mechanicsville, N. Y.	D. W. Mechanicsville 5.	28.0833
Near Mechanicsville, N. Y.	N. Y. 25.	26.2253
At Stillwater, N. Y.	N. Y. 30.	27.1416
Between Stillwater and Schaghticoke, N. Y.	D. W. Stillwater 2.	30.4365
At Bemis Heights, N. Y.	N. Y. 35.	31.4685
Near Bemis Heights, N. Y.	N. Y. 38.	32.0232
At Wilburs Basin, N. Y.	D. W. Wilburs Basin.	31.1078
Between Wilburs Basin and Coveville, N. Y.	U. S. G. S.	31.4540
At Coveville, N. Y.	N. Y. 50.	32.2470
At Schuylerville, N. Y.	N. Y. 55.	32.2799
At Schuylerville, N. Y.	N. Y. 57.	31.8067
At Northumberland, N. Y.	N. Y. 60.	33.2545
At Fort Miller, N. Y.	N. Y. 67.	37.5594
At Moses Kill, N. Y.	N. Y. 76.	43.2505
Near Fort Edward, N. Y.	N. Y. 82.	43.2720
At Fort Edward, N. Y.	U. S. G. S.	44.0652
At Dunhams Basin, N. Y.	N. Y. 95.	44.4064
At Smiths Basin, N. Y.	N. Y. 101.	43.1474
At Fort Ann, N. Y.	N. Y. 112.	42.4803
Near Comstock, N. Y.	N. Y. 115.	39.9538
Between Comstock and Whitehall, N. Y.	N. Y. 120.	40.7434
At Whitehall, N. Y.	D. W. Whitehall 1	37.4001
At Whitehall, N. Y.	U. S. C. S. 36.	31.5663
Near Whitehall, N. Y.	U. S. B. M.	32.6574
Near Snody Dock, N. Y.	D. W. Snody.	32.2121
At Chubbs Dock, N. Y.	D. W. Chubb.	32.3948
Near Dresden, N. Y.	D. W. Dresden.	32.6111
At Putnam, N. Y.	U. S. C. S. 39.	32.5008
At Putnam, N. Y.	D. W. Putnam 2.	32.0833
At Wrights, N. Y.	D. W. Wrights.	32.8052
At Fort Ticonderoga, N. Y.	D. W. Ticonderoga.	33.0917
At Ticonderoga, N. Y.	U. S. G. S.	33.3353
Between Addison Jct. and Crown Point, N. Y.	D. W. Five Mile Point.	32.5760
Near Crown Point, N. Y.	D. W. Crown Point.	34.5660
At Fort Frederick N. Y.	Crown Point North Base.	49.1169
At Crown Point Lighthouse, N. Y.	L. H.	39.5705
Near Cooperville, N. Y.	D. W. Cooperville.	31.1017
Near Cooperville, N. Y.	D. W. Leggets Crossing.	40.7591
At Rouse Point, N. Y.	Rouse Point 1882.	32.9031
At Fort Montgomery, N. Y.	U. S. E.	28.6512
Near Champlain, N. Y.	D. W. Champlain 1.	40.1846
At Champlain, N. Y.	D. W. Champlain 2.	33.0723
Near Champlain, N. Y.	D. W. Champlain 3.	49.9807
Near Champlain, N. Y.	D. W. Champlain 4.	51.8582
Near Champlain, N. Y.	D. W. Champlain 5.	60.2307

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Barrington, Quebec.	D. W. Barrington 1.	63. 3487
At Barrington, Quebec.	D. W. Barrington 2.	57. 4018
Near Barrington, Quebec.	D. W. Barrington 3.	53. 8323
Near St. Clothilde, Quebec.	D. W. St. Clothilde 1.	59. 9709
Near St. Clothilde, Quebec.	D. W. St. Clothilde 2.	52. 3872
At Aubrey, Quebec.	D. W. Aubrey 1.	41. 1855
Near Aubrey, Quebec.	D. W. Aubrey 2.	40. 3226
At Ormstown, Quebec.	D. W. Ormstown 1.	41. 9680
Near Ormstown and St. Stanislas, Quebec.	D. W. Ormstown 2.	47. 3627
Near St. Stanislas, Quebec.	D. W. Lake St. Francis.	47. 6794
At Valleyfield, Quebec.	D. W. Valleyfield.	47. 1430
At St. Stanislas, Quebec.	D. W. St. Stanislas.	50. 1849
At Huntingdon, Quebec.	D. W. Huntingdon.	48. 4440
At Carrs Crossing, Quebec.	D. W. Carr.	55. 6978
At Whites Station, Quebec.	D. W. White.	54. 5029
At St. Agnes, Quebec.	D. W. St. Agnes.	60. 2297
At Fort Covington, N. Y.	D. W. Fort Covington.	50. 7347
At St. Regis, Quebec.	P. B. M. A St. Regis.	51. 7697
At St. Regis, Quebec.	P. B. M. B St. Regis.	50. 8662
At Hogansburg, N. Y.	P. B. M. C Hogansburg.	54. 8489
At Hogansburg, N. Y.	P. B. M. P Hogansburg.	54. 3337
Near Racket River, N. Y.	P. B. M. 1.	52. 3896
Near Grass River, N. Y.	P. B. M. 2.	63. 3929
On River Road, N. Y.	P. B. M. 3.	62. 2945
On River Road, N. Y.	P. B. M. 4.	67. 4761
On River Road, N. Y.	P. B. M. 5.	75. 3947
At Richards Landing, N. Y.	P. B. M. 6.	70. 8298
At Louisville Landing, N. Y.	P. B. M. Louisville Landing.	70. 1072
Near Louisville Landing, N. Y.	P. B. M. 7.	68. 3396
At Bradfords Hill, N. Y.	P. B. M. 8.	79. 0699
Near Egg Island, N. Y.	P. B. M. 9.	72. 7944
Near Murphys Island, N. Y.	P. B. M. 10.	72. 0133
At Waddington, N. Y.	P. B. M. 11.	84. 8567
At Waddington, N. Y.	P. B. M. A Waddington.	83. 1748
At Waddington, N. Y.	P. B. M. B Waddington.	84. 1448
Near Waddells Point, N. Y.	P. B. M. 12.	77. 2048
At Tilden, N. Y.	P. B. M. 13A.	83. 3396
At Tilden, N. Y.	P. B. M. 13.	82. 2820
Near Lisbon, N. Y.	P. B. M. 14.	83. 3706
At Lisbon, N. Y.	P. B. M. 15.	84. 9550
Near Ogdensburg, N. Y.	P. B. M. 16.	86. 0240
At Ogdensburg, N. Y.	P. B. M. A Odgensburg.	84. 7033
At Ogdensburg, N. Y.	P. B. M. B Odgensburg.	85. 5713
At Ogdensburg, N. Y.	P. B. M. C Ogdensburg.	88. 3547
At Ogdensburg, N. Y.	P. B. M. D Ogdensburg.	76. 5117
Near Ogdensburg, N. Y.	P. B. M. 17.	79. 0644
Near Ogdensburg, N. Y.	P. B. M. 18.	75. 9099
Near Morristown, N. Y.	P. B. M. 19.	76. 0008
At Morristown, N. Y.	P. B. M. A Morristown.	83. 1155
At Morristown, N. Y.	P. B. M. B Morristown.	82. 6888
At Morristown, N. Y.	P. B. M. C Morristown.	78. 6380
Near Morristown, N. Y.	P. B. M. 20.	74. 8367
Near Morristown, N. Y.	P. B. M. 21.	104. 5567
Near Oak Point Village, N. Y.	P. B. M. 22.	103. 3980
Near Oak Point Village, N. Y.	P. B. M. Oak Point.	103. 1528
Near Oak Point Village, N. Y.	P. B. M. 23.	79. 2576
Near Chippewa Village, N. Y.	P. B. M. 23A.	79. 0627
At Chippewa Village, N. Y.	P. B. M. Chippewa Village.	88. 6050
Near Chippewa Village, N. Y.	P. B. M. 24.	88. 4935

Corrected elavations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Chippewa Village, N. Y.	P. B. M. 25.	111. 9048
Near Alexandria Bay, N. Y.	P. B. M. 26.	101. 7241
Near Alexandria Bay, N. Y.	P. B. M. 27.	83. 3734
At Alexandria Bay, N. Y.	P. B. M. A Alexandria Bay.	78. 9934
At Alexandria Bay, N. Y.	P. B. M. B Alexandria Bay.	86. 6374
Near Alexandria Bay, N. Y.	P. B. M. 28.	88. 0630
Near Alexandria Bay, N. Y.	P. B. M. 29.	83. 6222
Near Clayton, N. Y.	P. B. M. 30.	80. 5332
At Clayton, N. Y.	P. B. M. A Clayton.	84. 9830
At Clayton, N. Y.	P. B. M. B Clayton.	80. 5821
At Clayton, N. Y.	P. B. M. C Clayton.	79. 4397
Near Clayton, N. Y.	P. B. M. 31.	111. 1526
Near Clayton, N. Y.	P. B. M. 32.	83. 1710
Near Dodges Bay, N. Y.	P. B. M. 33.	79. 1870
Near Cape Vincent, N. Y.	P. B. M. 34.	79. 3374
At Cape Vincent, N. Y.	P. B. M. A Cape Vincent.	77. 4639
At Cape Vincent, N. Y.	P. B. M. B Cape Vincent.	79. 0871
At Cape Vincent, N. Y.	P. B. M. C Cape Vincent.	82. 9560
At Tibbetts Point, N. Y.	P. B. M. 35.	80. 4228
Near Waterford, N. Y.	N. Y. 1.	11. 6457
Near Waterford, N. Y.	N. Y. 2.	15. 1052
Near Waterford, N. Y.	N. Y. 3.	15. 6837
Near Waterford, N. Y.	N. Y. 4.	16. 9095
At Waterford, N. Y.	N. Y. 5.	14. 9924
Near Waterford, N. Y.	N. Y. 7.	16. 6085
Near Waterford, N. Y.	N. Y. 8.	18. 9632
Near Waterford, N. Y.	N. Y. 9.	22. 9900
Near Waterford, N. Y.	N. Y. 10.	24. 7022
Near Waterford, N. Y.	N. Y. 11.	24. 4708
Near Waterford, N. Y.	N. Y. 12.	24. 4734
Near Waterford, N. Y.	N. Y. 14.	24. 1950
Near Waterford, N. Y.	N. Y. 15.	25. 3062
Near Mechanicsville, N. Y.	N. Y. 16.	26. 8375
Near Mechanicsville, N. Y.	N. Y. 17.	28. 6869
Near Mechanicsville, N. Y.	N. Y. 18.	29. 0407
Near Mechanicsville, N. Y.	N. Y. 19.	29. 2479
At Mechanicsville, N. Y.	N. Y. 22.	28. 9835
Near Mechanicsville, N. Y.	N. Y. 23.	29. 0261
Near Mechanicsville, N. Y.	N. Y. 24.	28. 7523
Near Stillwater, N. Y.	N. Y. 26.	31. 4488
Near Stillwater, N. Y.	N. Y. 27.	31. 5423
Near Stillwater, N. Y.	N. Y. 28.	32. 1687
At Stillwater, N. Y.	N. Y. 29.	31. 5838
Near Stillwater, N. Y.	N. Y. 31.	31. 8715
Near Bemis Heights, N. Y.	N. Y. 32.	31. 9318
Near Bemis Heights, N. Y.	N. Y. 33.	32. 3141
Near Bemis Heights, N. Y.	N. Y. 34.	32. 0480
At Bemis Heights, N. Y.	N. Y. 36.	31. 5441
Near Bemis Heights, N. Y.	N. Y. 37.	31. 7272
Near Bemis Heights, N. Y.	N. Y. 39.	32. 1429
Near Bemis Heights, N. Y.	N. Y. 40.	31. 1998
Near Bemis Heights, N. Y.	N. Y. 41.	31. 9491
Near Bemis Heights, N. Y.	N. Y. 42.	32. 0892
Near Coveville, N. Y.	N. Y. 43.	31. 8721
Near Coveville, N. Y.	N. Y. 44.	32. 0778
Near Coveville, N. Y.	N. Y. 45.	31. 9270
Near Coveville, N. Y.	N. Y. 46.	32. 0675
Near Coveville, N. Y.	N. Y. 47.	31. 9915
Near Coveville, N. Y.	N. Y. 48.	31. 6455

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Coveville, N. Y.	N. Y. 49.	31. 2937
Near Coveville, N. Y.	N. Y. 51.	32. 3113
Near Schuylerville, N. Y.	N. Y. 52.	32. 5858
Near Schuylerville, N. Y.	N. Y. 53.	32. 4332
At Schuylerville, N. Y.	N. Y. 54.	32. 3927
At Schuylerville, N. Y.	N. Y. 56.	32. 1028
Near Schuylerville, N. Y.	N. Y. 58.	32. 7285
Near Northumberland, N. Y.	N. Y. 59.	33. 2372
Near Northumberland, N. Y.	N. Y. 61.	34. 2453
Near Fort Miller, N. Y.	N. Y. 62.	34. 7997
Near Fort Miller, N. Y.	N. Y. 63.	33. 9863
Near Fort Miller, N. Y.	N. Y. 64.	36. 9423
Near Fort Miller, N. Y.	N. Y. 65.	36. 6610
At Fort Miller, N. Y.	N. Y. 66.	37. 1730
Near Fort Miller, N. Y.	N. Y. 68.	37. 5137
Near Fort Miller, N. Y.	N. Y. 69.	40. 1671
Near Fort Miller, N. Y.	N. Y. 70.	40. 3923
Near Fort Miller, N. Y.	N. Y. 71.	40. 2180
Near Fort Miller, N. Y.	N. Y. 72.	40. 3911
Near Fort Miller, N. Y.	N. Y. 73.	40. 4867
Near Fort Miller, N. Y.	N. Y. 74.	40. 2726
Near Fort Miller, N. Y.	N. Y. 75.	42. 8014
Near Fort Edward, N. Y.	N. Y. 77.	42. 6602
Near Fort Edward, N. Y.	N. Y. 78.	42. 7565
Near Fort Edward, N. Y.	N. Y. 79.	42. 1944
Near Fort Edward, N. Y.	N. Y. 80.	43. 2301
Near Fort Edward, N. Y.	N. Y. 81.	43. 1126
Near Fort Edward, N. Y.	N. Y. 83.	42. 9581
Near Fort Edward, N. Y.	N. Y. 84.	42. 7310
Near Fort Edward, N. Y.	N. Y. 85.	43. 0380
Near Fort Edward, N. Y.	N. Y. 86.	43. 2220
Near Fort Edward, N. Y.	N. Y. 87.	43. 1383
At Fort Edward, N. Y.	N. Y. 88.	42. 6525
Near Fort Edward, N. Y.	N. Y. 90.	45. 2702
Near Fort Edward, N. Y.	N. Y. 91.	45. 6465
Near Fort Edward, N. Y.	N. Y. 92.	45. 2040
At Glenn Falls, N. Y.	N. Y. 93.	46. 5901
Near Glenn Falls, N. Y.	N. Y. 94.	45. 8488
Near Dunhams Basin, N. Y.	N. Y. 96.	45. 3809
Near Dunhams Basin, N. Y.	N. Y. 97.	45. 0423
Near Dunhams Basin, N. Y.	N. Y. 98.	45. 9436
Near Smiths Basin, N. Y.	N. Y. 99.	45. 9016
Near Smiths Basin, N. Y.	N. Y. 100.	46. 1672
At Smiths Basin, N. Y.	N. Y. 102.	45. 6912
Near Smiths Basin, N. Y.	N. Y. 103.	45. 6619
Near Smiths Basin, N. Y.	N. Y. 104.	45. 6944
Near Smiths Basin, N. Y.	N. Y. 105.	45. 6621
Near Fort Ann, N. Y.	N. Y. 106.	46. 1245
Near Fort Ann, N. Y.	N. Y. 107.	45. 4484
Near Fort Ann, N. Y.	N. Y. 108.	46. 2987
Near Fort Ann, N. Y.	N. Y. 109.	46. 0724
Near Fort Ann, N. Y.	N. Y. 110.	45. 2157
Near Fort Ann, N. Y.	N. Y. 111.	40. 2806
Near Comstock, N. Y.	N. Y. 113.	39. 1094
Near Comstock, N. Y.	N. Y. 114.	38. 6025
Near Comstock, N. Y.	N. Y. 116.	38. 1406
Near Comstock, N. Y.	N. Y. 117.	38. 0131
Near Comstock, N. Y.	N. Y. 118.	38. 4176
Near Comstock, N. Y.	N. Y. 119.	38. 6525
Near Comstock, N. Y.	N. Y. 121.	37. 5638

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Whitehall, N. Y.	N. Y. 122.	37.8084
Near Whitehall, N. Y.	N. Y. 123.	40.8259
Near Whitehall, N. Y.	N. Y. 124.	37.5273
Near Whitehall, N. Y.	N. Y. 125.	37.7598
Near Whitehall, N. Y.	N. Y. 126.	38.2754
Near Whitehall, N. Y.	N. Y. 127.	37.3974
Near Whitehall, N. Y.	N. Y. 128.	38.0679
At Whitehall, N. Y.	N. Y. 129.	37.0347
At Dobbs Ferry, N. Y.	T	4.2287
At Dobbs Ferry, N. Y.	U	4.5375
At Dobbs Ferry, N. Y.	W	2.8174
Between Ardsley and Irvington, N. Y.	R. R. 36.	1.9026
Near Tarrytown, N. Y.	X	3.4979
Near Tarrytown, N. Y.	Y	2.6099
At Tarrytown, N. Y.	Tidal 1 Tarrytown.	3.2720
At Tarrytown, N. Y.	Z	6.2494
Near Tarrytown, N. Y.	A_1	2.6193
Near Tarrytown, N. Y.	Iq′	3.2283
At Scarboro, N. Y.	B_1	2.0404
At Ossining, N. Y.	Tidal 2 Ossining.	2.6407
Near Ossining, N. Y.	R. R. 60.	2.2875
Near Croton, N. Y.	C_1	2.7427
Near Oscawana, N. Y.	R. R. 67.	3.1222
At Montrose, N. Y.	R. R. 71.	11.4113
At Verplanck, N. Y.	V. O. 12.	9.0932
At Peekskill, N. Y.	Im′	4.3109
At Peekskill, N. Y.	V. O. Peekskill.	3.2129
Near Peekskill, N. Y.	V. O. 11.	2.0695
Near Peekskill, N. Y.	R. R. 81.	2.9352
Near Highlands, N. Y.	R. R. 84.	2.3992
Near Highlands, N. Y.	D_1	2.4007
Near Garrison, N. Y.	R. R. 97.	3.2500
At Garrison, N. Y.	R. R. 99.	6.2899
At Coldspring, N. Y.	V. O. 9.	4.2779
At Coldspring, N. Y.	E_1	2.3410
Near Fishkill, N. Y.	Ik′	3.3955
At Fishkill, N. Y.	R. R. 118.	2.5151
Near Chelsea, N. Y.	F_1	1.6188
At New Hamburg, N. Y.	Ii′	4.4347
At Camelot, N. Y.	G_1	1.7640
At Poughkeepsie, N. Y.	H_1	9.6569
At Poughkeepsie, N. Y.	Ih′	11.7795
At Poughkeepsie, N. Y.	Ig′	13.1922
At Poughkeepsie, N. Y.	Vose.	12.1760
At Poughkeepsie, N. Y.	I_1	12.1961
Near Poughkeepsie, N. Y.	If′	6.1875
Near Hyde Park, N. Y.	R. R. 77½.	2.9919
Near Hyde Park, N. Y.	Ie′	2.0644
Near Hyde Park, N. Y.	R. R. 159.	2.5634
At Hyde Park, N. Y.	R. R. 161.	2.2747
Near Hyde Park, N. Y.	R. R. 162.	2.5651
Near Hyde Park, N. Y.	R. R. 163.	1.9734
Near Staatsburg, N. Y.	R. R. Dewitt.	7.3389
Near Rhinecliff, N. Y.	Iz	1.1636
At Rhinecliff, N. Y.	Iyyy	3.9659
At Rhinecliff, N. Y.	Iyy	4.7242
Near Barrytown, N. Y.	Iy	3.1320
Near Barrytown, N. Y.	Iv	0.6986
Near Tivoli, N. Y.	It	2.2335

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Tivoli, N. Y.	Is	2.3613
Near Germantown, N. Y.	Ir	2.7475
Near Germantown, N. Y.	Iq	2.6804
Near Germantown, N. Y.	Io	3.0040
Near Livingston Creek, N. Y.	In	2.4259
Near Linlithgo, N. Y.	R. R. 213.	2.7862
At Catskill Station, N. Y.	Im	4.5000
Near Hudson, N. Y.	Ik	2.3625
At Hudson, N. Y.	151 A.	46.1905
At Hudson, N. Y.	City 14.	46.2684
At Hudson, N. Y.	City 29.	29.1856
At Hudson, N. Y.	J_1	30.8477
At Hudson, N. Y.	V. O. 4.	3.2572
Between Hudson and Stockport Station, N. Y.	R. R. 223.	2.7085
At Stockport Station, N. Y.	D. W. Stockport 1.	2.0520
Near Coxsackie Station, N. Y.	R. R. 237.	2.0660
At Stuyvesant, N. Y.	Ih	4.0637
Near Stuyvesant, N. Y.	D. W. Stuyvesant 3.	2.7681
Near Schodack Landing, N. Y.	If	1.8033
Near Schodack Landing, N. Y.	K_1	3.2723
Near Castleton, N. Y.	D. W. Castleton 1.	4.4440
At Castleton, N. Y.	L_1	5.6662
At Castleton, N. Y.	Ib	5.1550
At Rensselaer, N. Y.	M_1	8.1925
At Rensselaer, N. Y.	V. O. 1.	6.7036
At Rensselaer, N. Y.	N_1	5.3675
At Greenbush (now Rensselaer), N. Y.	Gristmill.	4.2255
At Rensselaer, N. Y.	(1875)	4.2725
At Troy, N. Y.	O_1	8.1703
At Troy, N. Y.	D. W. Troy 2.	7.2415
At Troy, N. Y.	City 1.	7.0268
At Troy, N. Y.	P_1	8.2849
At Troy, N. Y.	City 2.	8.2237
At Hudson, N. Y.	D. W. Hudson 1.	2.2087
Near Hudson, N. Y.	D. W. Hudson 3.	2.4522
At Stockport Station, N. Y.	D. W. Stockport 2.	3.1665
Near Stockport Station, N. Y.	D. W. Stockport 3.	2.5809
Near Coxsackie Station, N. Y.	D. W. Coxsackie.	2.0627
Between Stuyvesant and Castleton in Columbia County, N. Y.	D. W. Stuyvesant 2.	2.0468
Between Stuyvesant and Castleton in Columbia County, N. Y.	D. W. Stuyvesant 4.	2.6443
Between Stuyvesant and Castleton in Columbia County, N. Y.	D. W. Stuyvesant 5.	3.3683
Near Castleton, N. Y.	D. W. Castleton 2.	3.0905
Near Castleton, N. Y.	D. W. Castleton 3.	3.7097
Near Castleton, N. Y.	D. W. Castleton 5.	3.8939
At Washington, D. C.	P. R. R. 139A.	3.2417
At Washington, D. C.	B. & O. 2.	12.5730
At Eckington, D. C.	B. & O. 3.	29.1058
Near Brookland, D. C.	B. & O. 3A.	32.7528
At Brookland, D. C.	B. & O. 4.	39.3688
Near Brookland, D. C.	B. & O. 5.	48.9758
At Stotts, D. C.	B. & O. 6.	62.3835
Near Takoma Park, D. C.	B. & O. 7.	81.3658
Near Silver Springs, Md.	B. & O. 8.	99.8520
Near Woodside, Md.	B. & O. 9.	98.5727
Near Linden, Md.	B. & O. 10.	97.5969
Near Capitol View, Md.	B. & O. 11.	94.3973

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Kensington, Md.	B. & O. 12.	91.6675
Near Garrett Park, Md.	B. & O. 13.	87.0419
Near Windham, Md.	B. & O. 14.	97.0077
Near Halpine, Md.	B. & O. 15.	113.6196
Near Halpine, Md.	B. & O. 16.	120.0591
Near Rockville Md.	B. & O. 17.	128.5485
Near Westmore, Md.	B. & O. 18.	134.8264
Near Westmore, Md.	B. & O. 19.	139.3960
At Derwood, Md.	B. & O. 20.	144.9743
Near Washington Grove, Md.	B. & O. 21.	151.5570
Near Gaithersburg, Md.	B. & O. 22.	158.1624
Near Ward, Md.	B. & O. 23.	149.5817
Near Ward, Md.	B. & O. 24.	136.0476
Near Clopper, Md.	B. & O. 25.	123.2811
At Waring, Md.	B. & O. 26.	111.1031
Near Germantown, Md.	B. & O. 27.	121.9197
Near Germantown, Md.	B. & O. 28.	134.7942
Near Darby, Md.	B. & O. 29.	128.8340
Near Boyd, Md.	B. & O. 30.	127.1561
Near Buck Lodge, Md.	B. & O. 31.	131.6643
Near Buck Lodge, Md.	B. & O. 32.	134.6395
Near Barnesville, Md.	B. & O. 33.	150.8923
Near Barnesville, Md.	B. & O. 34.	155.1640
Near Barnesville, Md.	B. & O. 35.	138.0620
Near Dickerson, Md.	B. & O. 36.	121.0315
Near Dickerson, Md.	B. & O. 37.	104.9907
Near Dickerson, Md.	B. & O. 38.	86.7435
Near Tuscarora, Md.	B. & O. 39.	77.7225
Near Tuscarora, Md.	B. & O. 40A.	68.9589
Near Tuscarora, Md.	B. & O. 41.	69.1594
Near Tuscarora, Md.	B. & O. 42.	69.1855
Near Washington Junction, Md.	B. & O. 43.	71.4061
At Point of Rocks, Md.	B. & O. 44A.	71.1169
Near Catoctin, Md.	B. & O. 45.	72.6731
At Catoctin, Md.	B. & O. 46.	72.9206
Near Catoctin, Md.	B. & O. 47.	74.0108
Near Catoctin, Md.	B. & O. 48.	74.9500
Near Brunswick, Md.	B. & O. 49.	75.5062
Near Brunswick, Md.	B. & O. 50.	75.5583
Near Brunswick, Md.	B. & O. 51.	76.3859
Near Knoxville, Md.	B. & O. 52.	79.1614
At Knoxville, Md.	B. & O. 53.	78.7089
Near Weverton, Md.	B. & O. 54.	78.7225
Near Weverton, Md.	B. & O. 55.	80.3194
Near Weverton, Md.	B. & O. 56.	85.4850
At Harpers Ferry, W. Va.	B. & O. 56A.	87.0595
Near Harpers Ferry, W. Va.	B. & O. 57.	88.7013
Near Engle, W. Va.	B. & O. 58.	94.5305
Near Engle, W. Va.	B. & O. 59.	108.1879
Near Engle, W. Va.	B. & O. 60.	117.8798
Near Engle, W. Va.	B. & O. 61.	125.4050
Near Duffields, W. Va.	B. & O. 62.	134.4485
At Duffields, W. Va.	B. & O. 63.	147.6695
Near Shenandoah Junction, W. Va.	B. & O. 64.	161.8027
Near Shenandoah Junction, W. Va.	B. & O. 65.	170.8525
Near Hobbs, W. Va.	B. & O. 66.	178.0478
Near Kerneysville, W. Va.	B. & O. 67.	172.1012
Near Kerneysville, W. Va.	B. & O. 68.	161.1116
Near Van Clevesville, W. Va.	B. & O. 69.	151.7196
Near Van Clevesville, W. Va.	B. & O. 70.	145.7896

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Van Clevesville, W. Va.	B. & O. 71.	137.4122
Near Van Clevesville, W. Va.	B. & O. 72.	123.1893
Near Opequon, W. Va.	B. & O. 73.	117.1323
Near Martinsburg, W. Va.	B. & O. 74.	121.7887
Near Martinsburg, W. Va.	B. & O. 75.	132.0236
Near Martinsburg, W. Va.	B. & O. 76.	143.2256
Near Martinsburg, W. Va.	B. & O. 77.	149.5049
Near Tabb, W. Va.	B. & O. 78.	160.7285
Near Tabb, W. Va.	B. & O. 79.	159.3751
Near Tabb, W. Va.	B. & O. 80.	157.9932
Near North Mountain, W. Va.	B. & O. 81.	154.5912
Near North Mountain, W. Va.	B. & O. 82.	160.9801
Near North Mountain, W. Va.	B. & O. 83.	161.1560
Near North Mountain, W. Va.	B. & O. 84.	153.7335
Near Back Creek, W. Va.	B. & O. 85.	140.8483
Near Back Creek, W. Va.	B. & O. 86.	130.0467
Near Cherry Run, W. Va.	B. & O. 87.	119.4515
Near Cherry Run, W. Va.	B. & O. 88.	117.3789
Near Cherry Run, W. Va.	B. & O. 89.	120.9647
Near Miller, W. Va.	B. & O. 90.	123.3249
Near Miller, W. Va.	B. & O. 91.	120.8764
Near Sleepy Creek, W. Va.	B. & O. 92.	121.7560
At Sleepy Creek, W. Va.	B. & O. 92A.	120.6510
Near Sleepy Creek, W. Va.	B. & O. 93.	122.3858
Near Sleepy Creek, W. Va.	B. & O. 94.	123.7677
Near Sleepy Creek, W. Va.	B. & O. 95.	124.1235
Near Hancock, W. Va.	B. & O. 96.	123.5483
Near Hancock, W. Va.	B. & O. 97.	124.7749
At Hancock, W. Va.	B. & O. 97A.	127.3076
Near Hancock, W. Va.	B. & O. 98.	127.7218
Near Hancock, W. Va.	B. & O. 99.	127.2564
Near Round Top, W. Va.	B. & O. 100.	126.7653
At Round Top, W. Va.	B. & O. 101.	130.1276
Near Round Top, W. Va.	B. & O. 102.	130.0492
Near Sir Johns Run, W. Va.	B. & O. 103.	129.6156
Near Sir Johns Run, W. Va.	B. & O. 104.	130.1518
Near Sir Johns Run, W. Va.	B. & O. 105.	130.1222
Near Great Cacapon, W. Va.	B. & O. 106.	133.0905
Near Great Cacapon, W. Va.	B. & O. 107.	132.8715
Near Great Cacapon, W. Va.	B. & O. 108.	138.1655
Near Woodmont, W. Va.	B. & O. 109.	137.3916
Near Lineburg, W. Va.	B. & O. 110.	138.5305
Near Lineburg, W. Va.	B. & O. 111.	139.7637
Near Lineburg, W. Va.	B. & O. 112.	142.9702
Near Orleans Road, W. Va.	B. & O. 113.	148.7994
Near Orleans Road, W. Va.	B. & O. 114.	153.8065
Near Rockwells Run, W. Va.	B. & O. 115.	159.5154
At Doe Gully, W. Va.	B. & O. 116.	166.7245
Near Doe Gully, W. Va.	B. & O. 117.	165.9347
Near Hansrotte, W. Va.	B. & O. 118.	158.7447
Near Hansrotte, W. Va.	B. & O. 119.	150.7459
Near Hansrotte, W. Va.	B. & O. 120.	151.8644
Near Baird, W. Va.	B. & O. 121.	151.7916
Near Baird, W. Va.	B. & O. 122.	149.4305
Near Magnolia, W. Va.	B. & O. 123.	150.7055
Near Magnolia, W. Va.	B. & O. 124.	151.7919
Near Magnolia, W. Va.	B. & O. 125.	153.1462
Near Magnolia, W. Va.	B. & O. 126.	156.0263
Near Paw Paw, W. Va.	B. & O. 127.	157.4610
Near Paw Paw, W. Va.	B. & O. 128.	160.6404

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Paw Paw, W. Va.	B. & O. 129.	162.9019
Near Paw Paw, W. Va.	B. & O. 130.	162.2939
Near Little Cacapon, W. Va.	B. & O. 131.	161.3135
Near Little Cacapon, W. Va.	B. & O. 132.	161.0716
Near Okonoko, W. Va.	B. & O. 133.	163.0306
Near Okonoko, W. Va.	B. & O. 134.	164.2170
Near Okonoko, W. Va.	B. & O. 135.	163.8262
Near French, W. Va.	B. & O. 136.	164.9564
Near French, W. Va.	B. & O. 137.	168.9862
Near French, W. Va.	B. & O. 138.	169.6625
Near Green Spring, W. Va.	B. & O. 139.	168.3569
Near Green Spring, W. Va.	B. & O. 140.	170.5835
Near Green Spring, W. Va.	B. & O. 141.	171.4495
Near Green Spring, W. Va.	B. & O. 142.	170.7192
Near Dans Run, W. Va.	B. & O. 143.	172.2979
Near Dans Run, W. Va.	B. & O. 144.	172.6118
Near Patterson Creek Cut-Off, W. Va.	B. & O. 145.	173.1294
At Patterson Creek Cut-Off, W. Va.	B. & O. 145A.	173.5449
At Patterson Creek Cut-Off, W. Va.	574 Patterson Creek.	175.0292
Near Patterson Creek, W. Va.	B. & O. 146.	175.4436
Near North Branch, Md.	B. & O. 147.	182.4990
At North Branch, Md.	B. & O. 147A.	183.7817
Near North Branch, Md.	B. & O. 148.	190.6889
Near North Branch, Md.	B. & O. 149.	194.3115
Near Evitts Creek, Md.	B. & O. 150.	191.9878
Near Evitts Creek, Md.	B. & O. 151.	194.7337
Near Cumberland, Md.	B. & O. 152.	197.6894
At Cumberland, Md.	B. & O. 153.	192.9574
At Cumberland, Md.	B. & O. 153A.	195.1414
At Cumberland, Md.	B. & O. 154.	196.5362
Near Cumberland, Md.	B. & O. 155.	199.3071
Near Cumberland, Md.	B. & O. 156.	200.1505
Near Mount Savage Junction, Md.	B. & O. 157.	207.8523
At Mount Savage Junction, Md.	B. & O. 158.	216.6826
At Ellerslie, Md.	B. & O. 160A.	222.0251
Near Ellerslie, Md.	B. & O. 160B.	226.1159
Near Cooks Mills, Pa.	B. & O. 161A.	228.5115
Near Cooks Mills, Pa.	B. & O. 163A.	237.6899
Near Cooks Mills, Pa.	B. & O. 165A.	256.6344
Near Hyndman, Pa.	B. & O. 167A.	275.6070
Near Hyndman, Pa.	P. R. R. 5.	288.2592
Near Hyndman, Pa.	B. & O. 168A.	292.1189
Near Hoblitzell, Pa.	B. & O. 170.	333.7788
Near Hoblitzell, Pa.	B. & O. 171.	359.7464
At Williams, Pa.	B. & O. 172.	382.3322
Near Fairhope, Pa.	B. & O. 173.	405.5535
Near Fairhope, Pa.	B. & O. 174.	427.2839
Near Fairhope, Pa.	B. & O. 174A.	440.1803
Near Foley, Pa.	B. & O. 175.	457.1705
At Foley, Pa.	B. & O. 176.	465.2839
At Dunkirk, N. Y.	598 D	182.5562
At Dunkirk, N. Y.	Nelson Block.	179.4868
At Forestville, N. Y.	871 D	265.7519
Near Smith Mills, N. Y.	1097 D	334.8625
At Dayton, N. Y.	1322 D	403.2288
At Cattaraugus, N. Y.	1401 D	422.3413
At Little Valley, N. Y.	1593 D	485.9266
Near Salamanca, N. Y.	1413 D	430.9181
At Salamanca, N. Y.	1391 D	424.1256

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Carrollton, N. Y.	1393 D	425.0873
At Allegany, N. Y.	1408 D	429.4451
At Olean, N. Y.	1450 D	442.5065
Near Hinsdale, N. Y.	1508 D	460.0320
Near Cuba, N. Y.	1515 D	462.3181
At Friendship, N. Y.	1520 D	463.6028
Near Belvidere, N. Y.	1351 D	412.1646
At Belmont, N. Y.	1416 D	432.1357
At Wellsville, N. Y.	1519 D	463.4534
Near Andover, N. Y.	1573 D	479.8194
Near Andover, N. Y.	1675 D	510.8778
At Alfred, N. Y.	1610 D	491.1531
At Almond, N. Y.	1383 D	421.5129
At Hornellsville, N. Y.	1141 D	348.2288
Near Canisteo, N. Y.	1113 D	339.5759
Near Adrian, N. Y.	1080 D	329.5454
At Cameron, N. Y.	1048 D	319.7098
At Rathbone, N. Y.	1006 D	306.9467
At Addison, N. Y.	1021 D	311.6749
At Painted Post, N. Y.	935 D	285.3527
At Corning, N. Y.	City Hall.	285.5248
Near Big Flats, N. Y.	899 D	274.5684
At Horseheads, N. Y.	901 D	274.9640
At Elmira, N. Y.	857 A	261.7098
At Elmira, N. Y.	Erie Station.	260.4805
At Wellsburg, N. Y.	824 A	250.9132
Near Chemung, N. Y.	804 A	244.7784
At Waverly, N. Y.	840 A	255.8301
Near Barton, N. Y.	798 A	243.0837
At Owego, N. Y.	815 A	248.4209
Near Owego, N. Y.	812 A	247.4003
Near Union, N. Y.	825 A	252.4824
At Binghamton, N. Y.	867 A	263.9744
Near Port Crane, N. Y.	959 A	292.1572
Near Sanitaria Springs, N. Y.	1126 A	343.0888
Near Tunnel, N. Y.	1384 A	421.8448
Near Harpersville, N. Y.	1051 A	319.7483
At Afton, N. Y.	973 A	296.5045
Near Bainbridge, N. Y.	978 A	297.9961
Near Bainbridge, N. Y.	989 A	301.6531
At Unadilla, N. Y.	1024 A	311.9100
At Wells Bridge, N. Y.	1047 A	319.0217
Near Otego, N. Y.	1051 A	320.0847
At Oneonta, N. Y.	1232 A	375.4874
At Oneonta, N. Y.	Oneonta.	331.1564
At Colliers, N. Y.	1119 A	340.9173
Near Maryland, N. Y.	1170 A	356.5708
At Schenevus, N. Y.	1272 A	387.5196
At Worcester, N. Y.	1311 A	399.3375
Near East Worcester, N. Y.	1406 A	428.3078
Near Richmondville, N. Y.	1224 A	372.7899
At Cobleskill, N. Y.	930 A	283.3439
At Barnerville Crossing, N. Y.	Barnerville.	275.4887
Near Howes Cave, N. Y.	731 A	222.7255
Near Esperance, N. Y.	753 A	229.3441
Near Duanesburg, N. Y.	681 A	207.5151
Near Kelleys, N. Y.	410 A	124.6659
At Schenectady, N. Y.	242 A	73.5164
Near Schenectady, N. Y.	15 (1875).	66.2161
Near Rexford Flats, N. Y.	14 (1875).	63.4916

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Rexford Flats, N. Y.	14a (1875).	63.5191
At Cohoes, N. Y.	Mill Race.	48.5863
At Cohoes, N. Y.	8 (1875).	48.7345
At Erie, Pa.	1 (1873).	175.3795
At Erie, Pa.	L. H.	176.0501
At Erie, Pa.	635 Pittsburg (1899).	193.9078
Near Belle Valley, Pa.	1103 Pittsburg (1899).	336.3261
Near Samson, Pa.	1214 Pittsburg (1899).	370.4198
Near Samson, Pa.	P. R. R. 85.	369.4289
Near Samson, Pa.	P. R. R. 82.	363.0241
Near Lebœuf, Pa.	1193 Pittsburg (1899).	363.9960
Near Millers, Pa.	1148 Pittsburg (1899).	349.9834
Near Venango, Pa.	1128 Pittsburg (1899).	344.0336
Near Saegerstown, Pa.	1109 Pittsburg (1899).	338.0965
Near Meadville, Pa.	1071 Pittsburg (1899).	326.7809
Near Cochranton, Pa.	1062 Pittsburg (1899).	323.8199
At Utica, Pa.	1038 Pittsburg (1899).	316.4816
Near Sugar Creek, Pa.	1013 Pittsburg (1899).	308.9547
At Franklin, Pa.	989 Pittsburg (1899).	301.5542
At Franklin, Pa.	987 Pittsburg (1899).	301.0750
At East Sandy, Pa.	970 Pittsburg (1899).	295.9324
Near Brandon, Pa.	957 Pittsburg (1899).	291.9126
Near Kennerdell, Pa.	941 Pittsburg (1899).	287.2359
Near St. George, Pa.	925 Pittsburg (1899).	282.3006
Near Rockland, Pa.	919 Pittsburg (1899).	280.6580
Near Dotter, Pa.	905 Pittsburg (1899).	276.1870
Near Emlenton, Pa.	898 Pittsburg (1899).	274.0416
At Parker, Pa.	883 Pittsburg (1899).	269.4481
At Monterey, Pa.	869 Pittsburg (1899).	265.1895
Near Lower Hillville, Pa.	855 Pittsburg (1899).	261.0271
At East Brady, Pa.	852 Pittsburg (1899).	259.8866
At Red Bank, Pa.	844 Pittsburg (1899).	257.4793
Near Rimerton, Pa.	820 Pittsburg (1899).	250.1833
At Mosgrove, Pa.	806 Pittsburg (1899).	246.0432
At Kittanning, Pa.	803 Pittsburg (1899).	244.9074
Near Rosston, Pa.	786 Pittsburg (1899).	239.8599
At West Penn Junction, Pa.	788 Pittsburg (1899).	240.3576
At West Penn Junction, Pa.	P. R. R. 26.	240.3518
At Edgecliff, Pa.	764 Pittsburg (1899).	232.7086
At Blacks Run, Pa.	770 Pittsburg (1899).	235.0605
At Wildwood, Pa.	P. R. R.	228.2436
Near Brilliant, Pa.	745 Pittsburg (1899).	227.1844
At Pittsburg, Pa.	Penn Ave. Curb.	224.5226
At Pittsburg, Pa.	P. R. R. 99.	226.6992
At Pittsburg, Pa.	738 Pittsburg (1899).	225.0597
At Pittsburg, Pa.	P. R. R. 100.	226.7510
Near Valley Falls, W. Va.	986 Pittsburg (1899).	300.4117
Near Powells, W. Va.	899 Pittsburg (1899).	274.0288
At Bentons Ferry, W. Va.	885 Pittsburg (1899).	269.7772
Near Fairmont, W. Va.	885 Pittsburg (1899).	269.7588
Near Catawba, W. Va.	873 Pittsburg (1899).	265.9704
Near Little Falls, W. Va.	859 Pittsburg (1899).	261.7762
At Uffington, W. Va.	828 Pittsburg (1899).	252.3393
At Morgantown, W. Va.	821 Pittsburg (1899).	250.2018
At Morgantown, W. Va.	U. S. E.	250.1991
Near Van Vorhis, W. Va.	815 Pittsburg (1899).	248.4788
Near Point Marion, Pa.	813 Pittsburg (1899).	247.7698
Near Outcrop, Pa.	1084 Pittsburg (1899).	330.3550

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Fairchance, Pa.	1065 Pittsburg (1899).	324.6687
At Uniontown, Pa.	999 Pittsburg (1899).	304.4448
Near Upper Middletown, Pa.	920 Pittsburg (1899).	280.3247
Near Tippecanoe, Pa.	868 Pittsburg (1899).	264.4041
Near West Brownsville Junction, Pa.	778 Pittsburg (1899).	237.0066
Near West Brownsville Junction, Pa.	P. R. R. 54.	237.0051
Near Woods Run, Pa.	764 Pittsburg (1899).	233.2459
Near Charleroi, Pa.	760 Pittsburg (1899).	230.9577
At Lock No. 4, Pa.	Lock No. 4.	226.6684
At Baird, Pa.	755 Pittsburg (1899).	230.1103
Near River View, Pa.	753 Pittsburg (1899).	229.5395
Near Peters Creek, Pa.	740 Pittsburg (1899).	225.3834
Near Coal Valley, Pa.	P. R. R. 19.	224.4257
Near Thomson, Pa.	767 Pittsburg (1899).	233.7458
Near Thomson, Pa.	P. R. R. 11.	232.8250
Near Bessemer, Pa.	760 Pittsburg (1899).	231.4935
At Braddock, Pa.	P. R. R. 88.	252.5996
At Homewood, Pa.	P. R. R. 92.	281.4429
Near Benvenue, Pa.	818 Pittsburg (1899).	249.3831
Near Elmira, N. Y.	1067 H	325.6301
At Snedekerville, Pa.	1265 H	385.6424
Near Columbia Crossroads, Pa.	1099 H	335.2365
Near Troy, Pa.	1139 H	347.3989
Near Cowley, Pa.	1358 H	414.1773
Near Canton, Pa.	1246 H	379.8832
At Roaring Branch, Pa.	966 H	294.5092
Near Ralston, Pa.	851 H	259.7254
Near Fields, Pa.	732 H	223.2702
Near Powys, Pa.	620 H	189.1453
At Williamsport, Pa.	528 H	161.0159
Near Red House, N. Y.	1340 D	408.7084
Near Quaker Bridge, N. Y.	1316 D	401.5131
Near Wolf Run, N. Y.	Bridge 121.	404.4757
Near Corydon, Pa.	1281 D	390.7131
Near Corydon, Pa.	Bridge 758.	387.4780
Near Sugar Run, Pa.	1253 D	382.3428
At Sugar Run, Pa.	Bridge 113.	379.5367
At Kinzua, Pa.	1229 D	374.9676
At Tuttletown, Pa.	Bridge.	375.5331
Near Great Bend, Pa.	Bridge 644.	372.2377
Near Hemlock, Pa.	1205 D	367.5189
At Warren, Pa.	1193 D	363.7749
At Warren, Pa.	P. R. R. 33.	364.1796
At Jacksons Crossing, Pa.	P. R. R. 37.	359.9017
Near Irvineton, Pa.	P. R. R. 38.	355.4500
Near Irvineton, Pa.	P. R. R. 39.	356.2970
Near Irvineton, Pa.	1167 D	355.9911
At Thompsons, Pa.	1135 D	346.2896
At Tidioute, Pa.	1116 D	340.4436
At Trunkeyville, Pa.	1098 D	334.8682
Near Hickory, Pa.	1086 D	331.1896
At Tionesta, Pa.	1063 D	324.3960
Near President, Pa.	1042 D	317.8144
Near Oleopolis, Pa.	1030 D	314.3525
Near South Oil City, Pa.	1009 P	307.7468
Near Langdon, N. Y.	860 A	262.2711

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Kirkwood, N. Y.	Signal tower	265.9447
At Great Bend, Pa.	880 A	268.4616
At Hickory Grove, Pa.	893 A	272.3761
Near Susquehanna, Pa.	955 A	291.4317
Near Deposit, N. Y.	1026 A	312.8910
Near Deposit, N. Y.	978 A	298.3911
Near Hancock, N. Y.	924 A	281.8556
Near Stockport, N. Y.	882 A	269.1098
At Lordville, N. Y.	865 A	263.9314
At Long Eddy, N. Y.	834 A	254.5680
At Hankins, N. Y.	801 A	244.4546
At Callicoon, N. Y.	780 A	237.9527
At Cochecton, N. Y.	746 A	227.6181
At Narrowsburg, N. Y.	718 A	219.0653
At Westcoolang Park.	665 A	202.8806
At Shohola, Pa.	648 A	197.8133
Near Pondeddy, Pa.	573 A	175.0266
Near Mill Rift, Pa.	491 A	149.9234
At Port Jervis, N. Y.	456 A	139.3173
At Guymard, N. Y.	780 A	238.0229
At Otisville, N. Y.	861 A	262.8047
At Middletown, N. Y.	558 A	170.3588
At Campbell Hall, N. Y.	408 A	124.6871
At Walden, N. Y.	National Bank.	114.3417
At Loyd, N. Y.	Centerville Hotel.	109.1725
At Highland, N. Y.	Bridge.	86.1171
At Poughkeepsie, N. Y.	Bridge.	68.6620
At Poughkeepsie, N. Y.	173 A	52.7276
At Maywood, N. Y.	1344 A	409.7753
Near Northfield, N. Y.	1766 A	538.5524
Near Northfield, N. Y.	Bridge.	400.1061
At Walton, N. Y.	1215 A	370.6532
Near Rock Rift, N. Y.	1214 A	370.2594
Near Cadosia, N. Y.	990 A	301.9268
Near Hancock, N. Y.	Bridge 18.	278.2051
At Utica, N. Y.	D. W. Utica 2.	123.4696
At Utica, N. Y.	P. O.	127.1650
At Utica, N. Y.	Seneca Street Bridge.	131.1069
At Utica, N. Y.	Whitsboro Street Bridge.	131.5385
Near Washington Mills, N. Y.	633 A	193.0558
At Richfield Junction, N. Y.	Station.	358.9460
Near Richfield Junction, N. Y.	1221 A	372.3175
At Leonardsville, N. Y.	1152 A	351.2982
At West Edmeston, N. Y.	U. S. B. M.	345.7093
Near West Edmeston, N. Y.	Bridge.	343.5650
Near South Edmeston, N. Y.	1110 A	338.3237
At New Berlin, N. Y.	1089 A	332.0165
Near New Berlin, N. Y.	Bridge.	332.6357
Near South New Berlin, N. Y.	Bridge.	321.5142
At South New Berlin, N. Y.	1059 A	322.9870
Near South New Berlin, N. Y.	Bridge.	327.4295
Near Holmesville, N. Y.	Bridge.	321.4232
At Mount Upton, N. Y.	1035 A	315.6848
Near Mount Upton, N. Y.	Bridge.	310.0034
At Sidney, N. Y.	Tel. Pole 991.	302.0932
At Charlotte, N. Y.	1 (1874).	86.3097
At Charlotte, N. Y.	2 (1874).	77.2297

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Rochester, N. Y.	Bridge 87.	156. 1263
At Rochester, N. Y.	N. Y. 457.	156. 2543
At Rochester, N. Y.	Rowe Street Bridge.	160. 6620
At Rochester, N. Y.	Bridge.	167. 2771
At Rochester, N. Y.	Culvert.	164. 0797
At Genesee Junction, N. Y.	Bridge.	159. 9456
Near Genesee Junction, N. Y.	Bridge.	160. 2938
Near Whites, N. Y.	Lock.	161. 8287
At Severance, N. Y.	Bridge.	161. 9638
Near Severance, N. Y.	Bridge.	162. 9251
At Scottsville, N. Y.	537 R	163. 2044
Near Scottsville, N. Y.	Culvert.	164. 6846
Near Scottsville, N. Y.	Bridge.	166. 7494
At Honeoye Junction, N. Y.	Bridge 34.	168. 7328
At Genesee Valley Junction, N. Y.	Bridge.	164. 2299
Near Genesee Valley Junction, N. Y.	Stone.	172. 5684
Near Avon, N. Y.	Cattle Pass.	172. 7404
At Avon, N. Y.	Tel. Pole.	177. 6402
Near Avon, N. Y.	Bridge.	168. 0364
Near Fowlerville, N. Y.	Lock.	168. 2450
At Fowlerville, N. Y.	Tel. Pole.	170. 7430
Near York, N. Y.	Culvert.	169. 3972
At Piffard, N. Y.	Wall.	172. 1988
Near Piffard, N. Y.	Culvert.	172. 6931
Near Cuylerville, N. Y.	Bridge 5.	173. 5200
Near Mount Morris, N. Y.	575 R	174. 9811
Near Mount Morris, N. Y.	Bridge.	184. 0126
Near Sonyea, N. Y.	Bridge.	186. 4045
Near Sonyea, N. Y.	Bridge 13.	215. 6698
Near Tuscarora, N. Y.	Bridge 15.	228. 2423
Near Tuscarora, N. Y.	773 R	235. 7030
At Nunda Junction, N. Y.	Tree.	264. 4361
At Nunda, N. Y.	944 R	287. 8371
Near Nunda, N. Y.	Culvert.	382. 2091
Near Ross Crossing, N. Y.	Culvert.	401. 7116
Near Swains, N. Y.	Bridge.	397. 8819
At Swains, N. Y.	1316 R	401. 3182
Near Swains, N. Y.	Bridge 9.	395. 3578
Near Swains, N. Y.	Bridge 8.	388. 8296
Near Canaseraga, N. Y.	Bridge 6¼.	384. 1494
At Canaseraga, N. Y.	1253 R	382. 2114
At Burns, N. Y.	Tel. Pole.	365. 0164
Near Burns, N. Y.	Culvert.	362. 7446
At Arkport, N. Y.	1188 R	362. 1895
Near Arkport, N. Y.	Bridge 4.	356. 3109
Near Hornellsville, N. Y.	Bridge 1.	356. 3237
At Buffalo, N. Y.	L. V. R. R.	178. 6826
At Buffalo, N. Y.	Switch tower.	179. 7077
At Buffalo, N. Y.	Bridge.	178. 5086
At Buffalo, N. Y.	R. R. B. M.	180. 2784
Near West Seneca, N. Y.	Bridge.	179. 5755
Near West Seneca, N. Y.	N. Y. C. R. R.	180. 2200
Near Blasdell, N. Y.	Culvert.	183. 7484
Near Athol Springs, N. Y.	Mile Post 11.	195. 2357
Near Athol Springs, N. Y.	631 R	192. 3626
Near Lake View, N. Y.	Culvert.	202. 8590
Near Derby, N. Y.	724 R	220. 6168
Near Derby, N. Y.	Trestle 236.	207. 5947
Near Angola, N. Y.	Trestle.	206. 3997

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Angola, N. Y.	Bridge 228.	207.2837
At Farnham, N. Y.	633 R	192.9252
Near Farnham, N. Y.	Culvert 218.	185.9752
Near Irving, N. Y.	Bridge 216.	180.1110
Near Silver Creek, N. Y.	Bridge.	187.1306
At Silver Creek, N. Y.	Bridge 207.	189.6180
Near Silver Creek, N. Y.	Bridge 204.	191.4199
Near Waites Crossing, N. Y.	Bridge.	190.0029
Near Waites Crossing, N. Y.	Bridge 195.	190.2275
Near Dunkirk, N. Y.	Culvert 187.	187.3351
Near Leboeuf, Pa.	Bridge.	366.1592
Near Union City, Pa.	Mile Post 74.	383.9270
Near Union City, Pa.	Mile Post 73.	391.4778
Near Union City, Pa.	Mile Post 72.	397.1299
Near Union City, Pa.	Bridge 27.	392.9269
Near Union City, Pa.	Bridge 29.	396.8675
Near Union City, Pa.	P. R. R. 72.	398.6463
Near Elgin, Pa.	P. R. R. 71.	417.4462
Near Elgin, Pa.	P. R. R. 70.	420.4712
At Elgin, Pa.	1382 P	421.1715
Near Lovell, Pa.	P. R. R. 69.	416.5637
Near Lovell, Pa.	P. R. R. 68.	418.3724
Near Corry, Pa.	P. R. R. 67.	421.2949
Near Corry, Pa.	P. R. R. 66.	430.6128
Near Corry, Pa.	1432 P	436.5785
Near Colza, Pa.	P. R. R. 64.	425.9669
Near Roach, Pa.	P. R. R. 62.	421.8958
At Spring Creek, Pa.	1406 P	428.4259
Near Spring Creek, Pa.	P. R. R. 58.	423.6863
Near Spring Creek, Pa.	P. R. R. 57.	425.1640
Near Spring Creek, Pa.	P. R. R. 56.	419.3587
Near Horn, Pa.	P. R. R. 55.	416.5382
Near Horn, Pa.	P. R. R. 54.	403.0480
Near Garland, Pa.	P. R. R. 51.	391.6902
Near Pittsfield, Pa.	P. R. R. 50.	385.4840
Near Pittsfield, Pa.	1244 P	348.7678
Near Pittsfield, Pa.	P. R. R. 47.	377.2467
Near Pittsfield, Pa.	P. R. R. 46.	375.2696
Near Youngsville, Pa.	P. R. R. 45.	372.3446
Near Youngsville, Pa.	P. R. R. 48.	367.9019
Near Youngsville, Pa.	P. R. R. 43.	369.2065
Near Irvineton, Pa.	P. R. R. 42.	357.5409
At Morehead City, N. C.	7 M. C.	2.1186
At Morehead City, N. C.	17 M. C.	5.1666
Near Atlantic, N. C.	18 M. C.	5.6521
Near Newport, N. C.	28 M. C.	8.5742
Near Haverlock, N. C.	26 M. C.	8.0985
At Riverdale, N. C.	25 M. C.	7.6166
Near Newbern, N. C.	7 M. C.	2.1567
At Newbern, N. C.	16 M. C.	4.5295
Near Clark, N. C.	27 M. C.	8.0838
Near Tuscarora, N. C.	51 M. C.	15.1979
At Cove Creek, N. C.	48 M. C.	14.2673
At Dover, N. C.	64 M. C.	19.1539
At Kinston, N. C.	48 M. C.	13.3560
At Falling Creek, N. C.	55 M. C.	16.5868
At Lagrange, N. C.	109 M. C.	33.0388
Near Bests, N. C.	120 M. C.	36.2044

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Goldsboro, N. C.	111 M. C.	33.5825
At Rose, N. C.	136 M. C.	41.1623
At Princeton, N. C.	152 M. C.	46.0696
At Selma, N. C.	178 M. C.	54.0468
At Wilsons Mills, N. C.	229 M. C.	69.6165
At Clayton, N. C.	346 M. C.	105.0990
At Garner, N. C.	384 M. C.	116.6428
At Raleigh, N. C.	363 M. C.	110.4705
At Cary, N. C.	497 M. C.	151.1013
Near Morrisville, N. C.	321 M. C.	97.6632
Near Nelson, N. C.	360 M. C.	109.4579
At Durham, N. C.	406 M. C.	123.4977
At University Station, N. C.	471 M. C.	143.4218
Near Robson, N. C.	549 M. C.	167.1533
At Chapel Hill, N. C.	503 M. C.	152.9447
At Hillsboro, N. C.	543 M. C.	165.2548
At Efland, N. C.	667 M. C.	202.9595
At Mebane N. C.	678 M. C.	206.3046
At Graham, N. C.	642 M. C.	195.3990
At Gibsonville, N. C.	721 M. C.	219.4337
At McLeansville, N. C.	744 M. C.	226.5713
At Greensboro, N. C.	839 M. C.	255.5846
Near Pomona, N. C.	813 M. C.	247.5705
At Jamestown, N. C.	793 M. C.	241.4969
At High Point, N. C.	940 M. C.	286.1617
At Thomasville, N. C.	852 M. C.	259.3184
Near Conrad, N. C.	665 M. C.	202.4548
At Lexington, N. C.	811 M. C.	246.7369
Near Linwood, N. C.	630 M. C.	191.7868
At Salisbury, N. C.	765 M. C.	232.9066
Near Majolica, N. C.	671 M. C.	204.0838
At Cleveland, N. C.	790 M. C.	240.3793
At Elmwood, N. C.	838 M. C.	254.9822
At Statesville, N. C.	926 M. C.	281.8899
At Plott, N. C.	776 M. C.	236.2459
At Catawba, N. C.	873 M. C.	265.7555
At Claremont, N. C.	970 M. C.	295.2229
At Newton, N. C.	996 M. C.	303.2181
At Hickory, N. C.	1164 M. C.	354.5091
Near Hildebran, N. C.	1087 M. C.	330.9072
At Connelly Springs, N. C.	1193 M. C.	363.2497
At Drexel, N. C.	1193 M. C.	363.2088
At Morganton, N. C.	1182 M. C.	359.9006
At Glen Alpine, N. C.	1215 M. C.	370.0108
Near Bridgewater, N. C.	1091 M. C.	332.0952
At Nebo, N. C.	1298 M. C.	395.2073
At Marion, N. C.	1438 M. C.	437.9549
At Greenlees, N. C.	1286 M. C.	391.4960
At Old Fort, N. C.	1437 M. C.	437.7224
At Round Knob, N. C.	1829 M. C.	557.2290
At Mudcut, N. C.	2153 M. C.	655.8010
Near Swannanoa, N. C.	2522 M. C.	768.3019
At Swannanoa, N. C.	2222 M. C.	676.7768
At Azalea, N. C.	2057 M. C.	626.6597
At Biltmore, N. C.	1996 M. C.	607.9056
At Asheville, N. C.	1986 M. C.	604.8843
Near Olivette, N. C.	1924 M. C.	586.1143
At Alexander, N. C.	1796 M. C.	546.9760
At Bailey, N. C.	1729 M. C.	526.7558
At Marshall, N. C.	1646 M. C.	501.4559

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Barnard, N. C.	1529 M. C.	465.8575
At Hot Springs, N. C.	1326 M. C.	403.8688
At Paint Rock. N. C.	1259 M. C.	383.2725
Near Wolf Creek, Tenn.	1184 M. C.	360.5752
Near Delrio, Tenn.	1141 M. C.	347.3845
At Bridgeport, Tenn.	1094 M. C.	333.2473
At Newport, Tenn.	1058 M. C.	322.1795
At Rankin, Tenn.	1010 M. C.	307.4932
At White Pine, Tenn.	1142 M. C.	347.8086
At Morristown, Tenn.	1351 M. C.	411.4123
At Talbot, Tenn.	1193 M. C.	363.2760
At Mossy Creek, Tenn.	1118 M. C.	340.3436
Near Hodges, Tenn.	905 M. C.	275.5246
Near Mascot, Tenn.	865 M. C.	263.2376
Near Caswell, Tenn.	867 M. C.	264.0014
At Knoxville, Tenn.	933 M. C.	284.0848
Near Wright, Tenn.	940 M. C.	286.2474
At Concord, Tenn.	820 M. C.	249.5362
At Lenoir City, Tenn.	799 M. C.	243.2490
At Loudon, Tenn.	784 M. C.	238.5476
At Philadelphia, Tenn.	860 M. C.	261.7080
At Sweetwater, Tenn.	918 M. C.	279.5822
At Mouse Creek, Tenn.	979 M. C.	297.9735
At Athens, Tenn.	869 M. C.	264.4847
At Riceville, Tenn.	807 M. C.	245.7401
Near Charleston, Tenn.	706 M. C.	214.9925
Near Tasso, Tenn.	798 M. C.	243.0550
At Cleveland, Tenn.	875 M. C.	266.3100
At Blue Springs, Tenn.	895 M. C.	272.5839
At Cohutta, Ga.	866 M. C.	263.8743
At Waring, Ga.	795 M. C.	242.0157
At Dalton, Ga.	774 M. C.	235.7384
At Phelps, Ga.	712 M. C.	216.7996
At Miller, Ga.	719 M. C.	218.7724
Near Oostanaula, Ga.	620 M. C.	188.6658
At Pinson, Ga.	653 M. C.	198.6440
At Rome, Ga.	614 M. C.	186.7231
At Chambers, Ga.	697 M. C.	212.1257
Near Seney, Ga.	799 M. C.	243.2209
At Rockmart, Ga.	774 M. C.	232.4880
Near Braswell, Ga.	1088 M. C.	331.3409
At McPherson, Ga.	1015 M. C.	309.0336
At Dallas, Ga.	1050 M. C.	319.8998
Near Powder Springs, Ga.	957 M. C.	291.4410
At Austell, Ga.	930 M. C.	283.2160
Near Lenox, Ga.	804 M. C.	244.9824
At Peyton, Ga.	855 M. C.	260.4217
At Atlanta, Ga.	1050 M. C.	319.9021
At Constitution, Ga.	847 M. C.	258.1680
At Ellenwood, Ga.	848 M. C.	258.3897
At Stockbridge, Ga.	810 M. C.	246.7501
At McDonough, Ga.	866 M. C.	263.7871
At Locust Grove, Ga.	837 M. C.	254.8852
At Jenkinsburg, Ga.	766 M. C.	233.2176
At Jackson, Ga.	727 M. C.	221.3727
At Cork, Ga.	546 M. C.	166.2983
At Juliette, Ga.	375 M. C.	114.3123
At Dames Ferry, Ga.	347 M. C.	105.6631
At Holton, Ga.	339 M. C.	103.2460
At Macon, Ga.	334 M. C.	101.7879

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Reid, Ga.	272 M. C.	82.8200
At Bullard, Ga.	259 M. C.	78.7811
At Adams Park, Ga.	259 M. C.	78.8335
At Westlake, Ga.	234 M. C.	71.3629
At McGriff, Ga.	259 M. C.	78.7960
At Cochran, Ga.	342 M. C.	104.0807
At Empire, Ga.	381 M. C.	116.1808
At Gresston, Ga.	400 M. C.	122.0077
At Eastman, Ga.	357 M. C.	108.7215
At Godwinsville, Ga.	312 M. C.	94.9333
At Chauncey, Ga.	300 M. C.	91.2250
At Achord, Ga.	275 M. C.	83.6774
At McRae, Ga.	229 M. C.	69.8990
At Scotland, Ga.	142 M. C.	43.2114
At Towns, Ga.	128 M. C.	38.8637
At Lumber City, Ga.	146 M. C.	44.3421
At Hazelhurst, Ga.	256 M. C.	77.9193
At Graham, Ga.	244 M. C.	74.3389
At Pine Grove, Ga.	229 M. C.	69.8347
At Baxley, Ga.	206 M. C.	62.7544
At Wheaton, Ga.	200 M. C.	61.1063
At Surrency, Ga.	187 M. C.	56.8238
At Brentwood, Ga.	167 M. C.	50.8090
At Odum, Ga.	155 M. C.	47.1861
At Jesup, Ga.	99 M. C.	30.3265
At Gardi, Ga.	61 M. C.	18.6968
At Pendarvis, Ga.	85 M. C.	25.9483
At Mount Pleasant, Ga.	55 M. C.	16.8990
At Everett, Ga.	16 M. C.	4.9698
At Sapps Still, Ga.	18 M. C.	5.5592
Near Dock Junction, Ga.	24 M. C.	7.5125
At Brunswick, Ga.	10 M. C.	3.2577
At Brunswick, Ga.	U. S. E. 1.	2.3342
At Brunswick, Ga.	U. S. E. 2.	2.6289
At Brunswick, Ga.	U. S. E. 3.	2.0940
Near Black Fox, Tenn.	789 N	239.6579
Near Hinches Switch, Tenn.	854 N	258.8698
At Ooltewah Junction, Tenn.	Ledge of Rock	237.3966
At Tyners, Tenn.	716 N	216.6701
Near McCarty, Tenn.	Bridge.	206.2391
At McCarty, Tenn.	Bridge.	204.9392
At Boyce, Tenn.	688 N	208.1829
At Chattanooga, Tenn.	698 N	211.1690
At Cleveland, Ohio.	U. S. E. 2.	176.0945
At Cleveland, Ohio.	U. S. E. 1.	177.2131
At Cleveland, Ohio.	U. S. E. 3.	181.2730
At Cleveland, Ohio.	Gauge.	174.5523
At Cleveland, Ohio.	Bridge.	180.4210
Near Cleveland, Ohio.	Bridge 15.	250.7652
Near Bedford, Ohio.	R. R. B. M.	276.3028
At Bedford, Ohio.	Town Hall.	289.4521
Near Macedonia, Ohio.	Bridge.	316.6136
At Macedonia, Ohio.	1004 Cleve.	305.8355
At Little York, Ohio.	Wall.	295.6509
At Highland Springs, Ohio.	Rock.	325.8452
Near Seasons, Ohio.	1002 Cleve.	305.5400
At Silver Lake Junction, Ohio.	1012 Cleve.	308.5176
At East Akron Junction, Ohio.	Wall.	293.7444

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At East Akron, Ohio.	983 Cleve.	299.7513
At Myersville, Ohio.	1076 Cleve.	327.7898
At New Berlin, Ohio.	1069 Canton.	325.4904
Near New Berlin, Ohio.	Bridge 43.	322.4582
Near New Berlin, Ohio.	Bridge 44.	320.1768
Near Monaca, Pa.	25 C	209.2284
Near Monaca, Pa.	Depot.	216.3801
Near New Brighton, Pa.	Bridge 26.	217.1496
Near New Brighton, Pa.	Bridge.	223.8021
At New Brighton, Pa.	Depot.	229.3964
At Kenwood, Pa.	Br. 29.	228.4060
At Beaver Falls, Pa.	Depot.	243.3424
At Geneva, Pa.	Depot.	252.6338
At Mansfield, Pa.	Br. 34.	261.9439
At Homewood, Pa.	Br. 38.	289.5484
Near Homewood, Pa.	Br. 39.	292.8909
At Summit, Pa.	Br. 40.	319.5445
At Harlow, Pa.	Br. 41.	300.1549
At New Galilee, Pa.	Br. 42.	292.5202
Near New Galilee, Pa.	Br. 44.	288.0470
At McCowans Crossing, Pa.	Bridge.	295.4047
At Enon, Pa.	Depot.	303.4701
Near Enon, Pa.	Br. 45.	311.0921
Near Ohio-Pa. State Line.	Br. 45½.	312.6318
Near Ohio-Pa. State Line.	Br. 46.	314.9636
Near Ohio-Pa. State Line.	Coal Tipple.	315.1633
Near East Palestine, Ohio.	Br. 47.	309.8904
At East Palestine, Ohio.	Br. 48.	308.7057
Near East Palestine, Ohio.	Br. 49.	309.4548
Near East Palestine, Ohio.	Br. 50.	315.5380
Near East Palestine, Ohio.	Br. 50½.	324.9581
At New Waterford, Ohio.	Bridge.	322.3482
Near New Waterford, Ohio.	Br. 51.	327.3466
Near Columbiana, Ohio.	Br. 52.	333.1215
At Columbiana, Ohio.	Depot.	340.5661
Near Columbiana, Ohio.	Br. 54.	332.8995
Near Columbiana, Ohio.	Br. 55.	328.2359
Near Columbiana. Ohio.	Br. 56.	327.1117
Near Leetonia, Ohio.	Br. 58.	311.2482
Near Leetonia, Ohio.	Water Table.	310.0779
Near Leetonia, Ohio.	Br. 59.	310.9326
Near Leetonia, Ohio.	Bridge.	314.7453
Near Leetonia, Ohio.	Br. 60.	323.2476
Near Sells Crossing, Ohio.	Br. 61.	335.7566
At Salem, Ohio.	Depot.	358.1482
Near Salem, Ohio.	Br. 63.	352.4993
Near Salem, Ohio.	Bridge.	372.2002
Near Garfield, Ohio.	Culvert.	348.7560
Near Beloit, Ohio.	Culvert.	334.1841
Near Sebring, Ohio.	Culvert.	337.3320
Near Sebring, Ohio.	Culvert.	338.4820
Near Sebring, Ohio.	Br. 64.	323.6205
Near Alliance, Ohio.	Br. 65.	321.8371
At Alliance, Ohio.	Lunch Room.	331.6686
Near Alliance, Ohio.	Br. 66.	334.2868
Near Alliance, Ohio.	Culvert.	341.3556
At Maximo, Ohio.	Br. 67.	355.9928
Near Maximo, Ohio.	Coping Stone.	360.4215
Near Louisville, Ohio.	Br. 68.	345.0177

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Louisville, Ohio.	Br. 69.	334.4942
Near Louisville, Ohio.	Bridge.	335.5588
Near Fairhope, Ohio.	Bridge.	326.0449
Near Fairhope, Ohio.	Br. 72.	323.8149
Near Canton, Ohio.	Br. 73.	319.5709
Near Canton, Ohio.	Br. 76.	316.2899
Near Canton, Ohio.	Br. 77.	313.6886
Near Massillon, Ohio.	Br. 78.	307.7791
Near Massillon, Ohio.	Br. 79.	301.2149
Near Massillon, Ohio.	Br. 80.	295.9715
Near Massillon, Ohio.	Br. 83.	289.4551
Near Massillon, Ohio.	Bridge.	287.0429
At Massillon, Ohio.	Br. 84.	286.1620
Near Massillon, Ohio.	Br. 86.	293.5940
Near Newman, Ohio.	Culvert.	296.0927
Near Newman, Ohio.	Culvert.	297.6965
Near Lawrence, Ohio.	Br. 88.	300.1760
At Lawrence, Ohio.	Br. 89.	302.2996
Near Lawrence, Ohio.	Br. 90.	302.8512
Near Lawrence, Ohio.	Br. 91.	303.0381
Near Lawrence, Ohio.	Culvert.	302.9012
Near Fairview, Ohio.	Culvert.	302.9301
Near Fairview, Ohio.	Bridge.	306.0886
Near Fairview, Ohio.	Br. 97.	307.6489
Near Fairview, Ohio.	Br. 98.	307.1878
Near Orville, Ohio.	Br. 99.	307.3759
Near Orville, Ohio.	Culvert.	309.7368
At Orville, Ohio.	Depot.	322.8626
Near Orville, Ohio.	Bridge.	318.4834
Near Orville, Ohio.	Bridge.	317.0758
Near Orville, Ohio.	Bridge.	316.9780
Near Orville, Ohio.	Bridge.	315.7311
Near Smithville, Ohio.	Br. 100.	312.3280
Near Smithville, Ohio.	Br. 102.	312.8864
Near Smithville, Ohio.	Culvert.	326.4474
Near Smithville, Ohio.	Br. 103.	332.9842
Near Smithville, Ohio.	Bridge.	330.4209
Near Smithville, Ohio.	Stone Arch.	323.8235
Near Wooster, Ohio.	Bridge.	305.2135
Near Wooster, Oh o.	Br. 106.	294.4614
Near Wooster, Ohio.	Bridge.	296.7534
At Wooster, Ohio.	Depot.	276.2241
Near Wooster, Ohio.	Bridge.	273.2821
Near Wooster, Ohio.	Br. 110.	270.7980
Near Wooster, Ohio.	Br. 112.	265.4811
Near Wooster, Ohio.	Br. 115.	259.2939
Near Wooster, Ohio.	Br. 117.	259.1580
Near Wooster, Ohio.	Br. 120.	258.9638
Near Wooster, Ohio.	Coal Tipple.	258.9302
Near Shreve, Ohio.	Br. 121.	256.8637
Near Shreve, Ohio.	Bridge.	255.8084
Near Shreve, Ohio.	Br. 124.	255.3026
At Shreve, Ohio.	Depot.	279.3936
Near Custaloga, Ohio.	Arch.	294.9380
Near Custaloga, Ohio.	Culvert.	293.8160
Near Big Prairie, Ohio.	Br. 128.	285.5124
Near Lakeville, Ohio.	Br. 129.	285.9239
Near Lakeville, Ohio.	Br. 131.	282.7205
Near Lakeville, Ohio.	Br. 132.	282.1051
Near Lakeville, Ohio.	Br. 134.	285.1849

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Lakeville, Ohio.	Br. 136.	288. 1448
Near Lakeville, Ohio.	Br. 137.	290. 3927
Near Londonville, Ohio.	Br. 138.	293. 2935
Near Londonville, Ohio.	Culvert.	296. 1955
Near Londonville, Ohio.	Br. 139.	291. 1708
Near Londonville, Ohio.	Bridge.	292. 1235
Near Perryville, Ohio.	Culvert.	294. 9800
Near Perryville, Ohio.	Br. 141.	296. 1724
Near Perryville, Ohio.	Br. 142.	301. 3839
Near Perryville, Ohio.	Br. 143.	296. 1524
Near Perryville, Ohio.	Br. 144.	300. 1198
Near Perryville, Ohio.	Br. 145.	303. 4532
Near Lucas, Ohio.	Br. 145½.	305. 5413
Near Lucas, Ohio.	Br. 146.	308. 7337
Near Lucas, Ohio.	Br. 147.	324. 2842
Near Lucas, Ohio.	Culvert.	337. 2750
Near Lucas, Ohio.	Br. 150.	352. 2133
Near Mansfield, Ohio.	Br. 151.	347. 6912
Near Mansfield, Ohio.	Br. 152.	347. 3349
Near Mansfield, Ohio.	Br. 154.	350. 4578
Near Mansfield, Ohio.	Culvert.	352. 6743
Near Mansfield, Ohio.	Br. 155.	352. 1588
Near Mansfield, Ohio.	Culvert.	352. 4754
Near Mansfield, Ohio.	Br. 156.	352. 6496
Near Mansfield, Ohio.	Br. 157.	353. 9977
Near Toledo Junction, Ohio.	Culvert.	355. 2477
Near Toledo Junction, Ohio.	Br. 159.	357. 9037
Near Toledo Junction, Ohio.	Br. 160.	358. 1515
Near Toledo Junction, Ohio.	Culvert.	362. 6872
Near Cookton, Ohio.	Br. 161.	368. 9108
Near Cookton, Ohio.	Culvert.	371. 2737
Near Cookton, Ohio.	Br. 162.	366. 5299
Near Cookton, Ohio.	Culvert.	364. 9474
Near Crestline, Ohio.	Br. 164.	358. 4772
Near Crestline, Ohio.	Br. 165.	354. 3045
Near Crestline, Ohio.	Br. 166.	352. 3496
Near Crestline, Ohio.	Br. 167.	351. 8109
At Crestline, Ohio,	Arch.	344. 2661
At Crestline, Ohio.	Shop.	352. 7084
At Crestline, Ohio.	Br. 4.	344. 0695
Near Robinson, Ohio.	Br. 11.	325. 3482
Near Robinson, Ohio.	Br. 13.	321. 4615
At Bucyrus, Ohio.	Depot.	304. 6815
Near Bucyrus, Ohio.	Br. 25.	300. 0036
Near Bucyrus, Ohio.	Br. 28.	301. 9651
Near Bucyrus, Ohio.	Br. 35.	301. 2925
Near Bucyrus, Ohio.	Br. 37.	297. 2183
Near Bucyrus, Ohio.	Br. 39.	294. 6837
Near Nevada, Ohio.	Br. 40.	294. 6680
Near Nevada, Ohio.	Br. 41.	294. 3527
Near Nevada, Ohio.	Br. 45.	286. 3295
Near Nevada, Ohio.	Br. 47.	282. 7818
Near Nevada, Ohio.	Br. 51.	275. 8159
Near Nevada, Ohio.	Br. 54.	278. 2793
Near Nevada, Ohio.	Br. 62.	262. 9533
Near Upper Sandusky, Ohio.	Br. 65.	260. 0395
Near Upper Sandusky, Ohio.	Br. 66.	259. 3996
Near Upper Sandusky, Ohio.	Br. 69.	255. 9512
Near Upper Sandusky, Ohio.	Br. 73.	257. 9162
Near Upper Sandusky, Ohio.	Br. 74.	256. 9315

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Upper Sandusky, Ohio.	Br. 75.	256.8277
Near Kirby, Ohio.	Br. 76.	253.5526
Near Kirby, Ohio.	Br. 77.	256.5517
Near Kirby, Ohio.	Br. 81.	262.6284
Near Kirby, Ohio.	Br. 85.	269.6442
Near Kirby, Ohio.	Br. 86.	273.5561
Near Forest, Ohio.	Br. 88.	279.5471
Near Forest, Ohio.	Br. 93.	277.2689
Near Forest, Ohio.	Br. 95.	273.7948
Near Forest, Ohio.	Br. 98.	273.6023
Near Dunkirk, Ohio.	Br. 103.	282.3790
Near Dunkirk, Ohio.	Br. 104.	284.3221
Near Dunkirk, Ohio.	Buildings.	289.2053
Near Washington, Ohio.	Br. 108.	288.0606
Near Washington, Ohio.	Br. 110.	287.1427
Near Washington, Ohio.	Br. 112.	286.6473
Near Ada, Ohio.	Br. 114.	286.4214
Near Ada, Ohio.	Br. 116.	286.3424
Near Ada, Ohio.	Br. 119.	287.2917
Near Ada, Ohio.	Br. 124.	288.5777
Near Ada, Ohio.	Br. 132.	289.9730
Near Ada, Ohio.	Br. 135.	289.8660
Near Lafayette, Ohio.	Br. 138.	284.7991
Near Lafayette, Ohio.	Br. 141.	283.8703
Near Lafayette, Ohio.	Br. 148.	282.0854
Near Lafayette, Ohio.	Br. 151.	280.3314
Near Lima, Ohio.	Br. 157.	275.8970
Near Lima, Ohio.	Br. 159.	268.0641
Near Lima, Ohio.	Br. 160.	265.5991
Near Lima, Ohio.	Br. 163.	264.3249
At Lima, Ohio.	Depot.	268.0538
At Solomon, Kans.	C_1	358.6780
At New Cambria, Kans.	D_1	366.0290
Near New Cambria, Kans.	E_1	365.6848
Near New Cambria, Kans.	Salina East Base △	366.0766
Near Salina, Kans.	Salina West Base△	372.1700
At Salina, Kans.	F_1	373.5409
At Salina, Kans.	G_1	373.9437
At Mentor, Kans.	A_4	386.0128
At Assaria, Kans.	B_4	391.0919
At Bridgeport, Kans.	C_4	396.9943
At Lindsborg, Kans.	D_4	407.5491
At Johnstown, Kans.	E_4	424.6301
At Hilton, Kans.	F_4	463.1282
At McPherson, Kans.	G_4	456.2092
At McPherson, Kans.	H_4	456.5470
Near McPherson, Kans.	I_4	454.2083
At Groveland, Kans.	J_4	452.0448
At Inman, Kans.	K_4	463.1472
At Medora, Kans.	L_4	450.4815
Near Hutchinson, Kans.	M_4	467.9816
At Hutchinson, Kans.	N_4	467.3536
At Hutchinson, Kans.	O_4	466.4117
At Fernie, Kans.	P_4	472.0964
At Darlow, Kans.	Q_4	474.7590
At Castleton, Kans.	R_4	447.1088
At Pretty Prairie, Kans.	S_4	480.2685
Near Pretty Prairie, Kans.	T_4	481.3653

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Varner, Kans.	U_4	463.5230
At Lashmet, Kans.	V_4	461.1252
At Kingman, Kans.	W_4	460.5383
Near Kingman, Kans.	X_4	505.2838
At Carvel, Kans.	Y_4	496.6148
At Basil, Kans.	Z_4	487.5964
At Rago, Kans.	A_5	441.2067
At Duquoin, Kans.	B_5	483.0386
At Harper, Kans.	C_5	433.5539
At Ascot, Kans.	D_5	432.9609
At Anthony, Kans.	E_5	422.4097
Near Anthony, Kans.	Anthony Southeast Base ◬	419.7640
Near Anthony, Kans.	Anthony Northwest Base ◬	425.4675
At Anthony, Kans.	F_5	409.9314
At Bowie, Tex.	1124 GAINV.	342.6371
At Bowie, Tex.	A	329.3394
At Bowie, Tex.	B	349.1321
Near Bowie, Tex.	C	289.8555
Near Bellevue, Tex.	Bowie Northwest Base ◬	327.4599
Near Bellevue, Tex.	Bowie Southeast Base ◬	333.3981
Near Bowie, Tex.	989 GAINV.	301.6398
Near Bowie, Tex.	D	292.6521
At Stoneburg, Tex.	E	285.1149
At Stoneburg, Tex.	936 GAINV.	285.4477
Near Stoneburg, Tex.	876 GAINV.	267.1009
Near Ringgold, Tex.	F	268.8824
Near Ringgold, Tex.	897 GAINV.	273.3300
At Ringgold, Tex.	894 GAINV.	272.6929
Near Terral, Ind. T.	G	248.6722
Near Terral, Ind. T.	809 Terral.	246.7256
At Terral, Ind. T.	A	258.2033
Near Terral, Ind. T.	B	253.3924
Near Ryan, Ind. T.	827 Ryan.	252.3238
Near Ryan, Ind. T.	C	252.1638
Near Sugden, Ind. T.	Geol. Sugden.	257.4869
Near Sugden, Ind. T.	844 Sugden.	257.4535
At Sugden, Ind. T.	D	258.5064
Near Sugden, Ind. T.	875 Boundary.	266.7637
Near Addington, Ind. T.	883 Addington.	269.4236
Near Addington, Ind. T.	E	277.4581
At Addington, Ind. T.	918 Addington.	279.8922
Near Addington, Ind. T.	F	283.7174
Near Comanche, Ind. T.	G	295.1043
At Comanche, Ind. T.	H	300.8727
Near Comanche, Ind. T.	I	309.9565
Near Duncan, Ind. T.	1104 Boundary.	336.6322
Near Duncan, Ind. T.	Duncan ◬	373.2995
Near Duncan, Ind. T.	Check B. M.	373.2724
At Duncan, Ind. T.	J	343.4505
Near Duncan, Ind. T.	1127 Duncan.	343.8119
Near Marlow, Ind. T.	K	395.7577
At Marlow, Ind. T.	L	400.5750
At Marlow, Ind. T.	Marlow Long. Sta.	400.1430
Near Marlow, Ind. T.	1331 Marlow.	406.1048
Near Marlow, Ind. T.	M	386.8988
At Rush Springs, Ind. T.	N	393.9522
At Rush Springs, Ind. T.	1349 Rush Springs.	411.5681
Near Rush Springs, Ind. T.	1292 Rush Springs.	394.0731
Near Ninnekah, Ind. T.	T.B. M. 95.	383.6387

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Ninnekah, Ind. T.	O	373.5117
Near Ninnekah, Ind. T.	P	328.2176
Near Chickasha, Ind. T.	1084 Chickasha.	330.7832
At Chickasha, Ind. T.	1091 Chickasha.	332.8713
At Chickasha, Ind. T.	Q	333.1899
Near Chickasha, Ind. T.	R	332.3697
Near Chickasha, Ind. T.	1105 Boundary.	337.0939
Near Chickasha, Ind. T.	S	332.0827
Near Chickasha, Ind. T.	T. B. M. 114.	335.8291
Near Minco, Ind. T.	Carson △	435.8337
Near Minco, Ind. T.	1284 Minco.	391.7611
At Minco, Ind. T.	T	395.4655
At Minco, Ind. T.	U	396.6382
Near Union, Okla.	1266.5 Union.	386.5570
At Union, Okla.	A	407.0108
Near Elreno, Okla.	Elreno East Base △	440.1881
Near Elreno, Okla.	Elreno West Base △	466.9251
At Elreno, Okla.	T. B. M. 142.	416.3202
At Elreno, Okla.	B	414.7302
At Elreno, Okla.	1357 Elreno.	414.3508
At Elreno, Okla.	City Elreno.	413.9378
At Reno Junction, Okla.	1327 Reno Junct.	405.2066
At Darlington, Okla.	C	407.4927
Near Caddo, Okla.	T. B. M. 148.	416.5556
At Okarche, Okla.	D	377.8897
At Kingfisher, Okla.	E	321.1227
At Kingfisher, Okla.	F	322.4467
At Kingfisher, Okla.	G	322.1483
At Dover, Okla.	H	315.3003
At Hennessey, Okla.	I	354.4082
At Hennessey, Okla.	J	354.5307
At Bison, Okla.	K	378.1774
At Waukomis, Okla.	L	385.5006
Near Waukomis, Okla.	Waukomis △	388.9006
Near Waukomis, Okla.	Waukomis E	384.7840
At Enid, Okla.	M	377.3545
At Enid, Okla.	N	380.3247
At North Enid, Okla.	O	381.1635
Near North Enid, Okla.	Enid △	385.2597
At Kremlin, Okla.	P	341.8561
At Pond Creek, Okla.	Q	320.3527
Near Jefferson, Okla.	R	319.5971
At Medford, Okla.	S	331.6002
At Medford, Okla.	T	335.2720
At Medford, Okla.	U	335.2267
At Clyde, Okla.	V	339.5228
At Wakita, Okla.	W	360.4692
At Gibbon, Okla.	X	360.8049
At Manchester, Okla.	Y	392.9531
At Spring, Kans.	G_5	417.0553
At Fruitland, Tex.	H	321.2785
At Sunset, Tex.	I	304.7984
At Alvord, Tex.	J	270.0598
At Cowen, Tex.	K	266.1167
At Decatur, Tex.	L	334.2942
At Herman, Tex.	M	282.7305
At Rhome, Tex.	N	285.9961
At Avondale, Tex.	O	256.4791
Near Saginaw, Tex.	P	229.0622

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Fort Worth, Tex.	Q	191.5263
At Fort Worth, Tex.	R	163.9332
At Fort Worth, Tex.	S	161.7200
At Fort Worth, Tex.	T	173.6345
At Fort Worth, Tex.	U	184.7280
At Fort Worth, Tex.	V	188.8092
At Handley, Tex.	W	176.3515
At Arlington, Tex.	X	188.4019
At Grand Prairie, Tex.	Y	159.9912
At Eagle Ford, Tex.	Z	134.4425
At Dallas, Tex.	A_2	132.3227
At Dallas, Tex.	B_2	136.4510
At Dallas, Tex.	C_2	132.8094
At Fisher, Tex.	D_2	161.1427
At Garland, Tex.	E_2	167.9673
At Rowlett, Tex.	F_2	153.9145
At Rockwall, Tex.	G_2	181.5762
At Fate, Tex.	H_2	180.1021
At Royse, Tex.	I_2	170.8861
At Caddo Mills, Tex.	J_2	161.7192
At Greenville Tex.	K_2	164.9090
At Greenville, Tex.	L_2	168.9606
At Greenville, Tex.	M_2	167.1757
Near Greenville, Tex.	N_2	173.3041
At Campbell, Tex.	O_2	178.5606
At Cumby, Tex.	P_2	197.8766
At Brashear, Tex.	Q_2	156.9990
At Sulphur Springs, Tex.	R_2	153.5244
At Como, Tex.	S_2	162.2517
At Pickton, Tex.	T_2	163.6533
At Winnsboro, Tex.	U_2	162.5864
At Scroggins, Tex.	V_2	108.4704
Near Leesburg, Tex.	W_2	119.1414
Near Pittsburg, Tex.	X_2	117.8257
At Pittsburg, Tex.	Y_2	121.2829
At Cason, Tex.	Z_2	99.3780
At Daingerfield, Tex.	A_3	122.7646
At Hughes, Tex.	B_3	115.2692
At Avinger, Tex.	C_3	120.4480
Near Avinger, Tex.	D_3	121.7816
At Lasater, Tex.	E_3	101.9821
At Kelleyville, Tex.	F_3	89.4179
At Jefferson, Tex.	G_3	57.7266
At Norwood, Tex.	I_3	63.0771
At Karnack, Tex.	J_3	70.4623
At Blocker, Tex.	K_3	80.7049
At Waskom, Tex.	L_3	91.1829
At Greenwood, La.	C	66.9175
At Nichols, La.	D	83.8979
At Jewella, La.	E	74.4312
At Shreveport, La.	F	57.5802
At Shreveport, La.	G	62.2327
At Shreveport, La.	H	55.3842
At Shreveport, La.	I	55.9547
At Fort Worth, Tex.	M_3	188.6548
Near Belt Junction, Tex.	N_3	199.6680
At Primrose, Tex.	O_3	234.9899
At Virgile, Tex.	P_3	287.9676
Near Cresson, Tex.	Q_3	318.6062

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Waples, Tex.	R_3	256.5102
At Granbury, Tex.	S_3	221.0426
Near Granbury, Tex.	Comanche △	374.7101
Near Granbury, Tex.	Comanche Ref. Mark	374.0162
Near Bethel, Tex	T_3	208.0312
At Burleson, Tex.	U_3	218.0068
At Egan, Tex.	V_3	252.2158
At Egan, Tex.	R. R.	255.2665
At Alvarado, Tex.	W_3	206.7792
At Conley, Tex.	X_3	227.3085
At Grand View, Tex.	Y_3	213.1559
At Itasca, Tex.	Z_3	216.0093
At Schofield, Tex.	A_4	200.1250
At Hillsboro, Tex.	B_4	193.2114
Near Abbott, Tex.	C_4	211.6719
At West, Tex.	D_4	199.8424
At Elmmott, Tex.	E_4	156.9421
At Waco, Tex.	F_4	125.9384
At Waco, Tex.	Hydrant 1.	122.8349
At Waco, Tex.	Hydrant 2.	130.0585
At Waco, Tex.	G_4	126.3336
At Hewitt, Tex.	H_4	199.7125
At Lorena, Tex.	I_4	179.6259
At Eddy, Tex.	J_4	204.5363
At Troy, Tex.	K_4	206.7074
At Temple, Tex.	L_4	205.2723
At Temple, Tex.	M_4	214.2166
At Temple, Tex.	N_4	209.5620
Near Belton, Tex.	O_4	155.0205
At Nolanville, Tex.	P_4	203.1138
Near Killeen, Tex.	Q_4	239.9935
Near Copperas Cove, Tex.	R_4	286.5098
Near Copperas Cove, Tex.	S_4	326.8760
Near Copperas Cove, Tex.	Gilmore △	392.1482
Near Copperas Cove, Tex.	Gilmore Ref. Mk.	390.6724
Near Kempner, Tex.	T_4	272.5320
Near Lampasas, Tex.	U_4	298.9218
Near Lampasas, Tex.	Lampasas N. E. Base △	315.4516
Near Lampasas, Tex.	Lampasas S. W. Base △	381.5919
At Little River, Tex.	V_4	150.1698
At Holland, Tex.	Z_4	*160.5910
At Holland, Tex.	X_4	160.9558
At Holland, Tex.	Y_4	†161.1222
Near Holland, Tex.	W_4	154.6978
At Solomon, Kans.	W_2	356.2402
At Solomon, Kans.	X_2	‡357.6372
At Abilene, Kans.	Z_2	353.0908
At Abilene, Kans.	Y_2	350.7773
At Talmage, Kans.	A_3	369.5064
At Manchester, Kans.	B_3	394.9466
At Longford, Kans.	C_3	401.0470
At Oak Hill, Kans.	D_3	387.1492
At Catlin, Kans.	E_3	405.0640
At Miltonvale, Kans.	F_3	419.8175
At Sulphur Springs, Kans.	G_3	479.9180

* Reported settled, Nov., 1903. † Reported destroyed, Nov., 1903. ‡ Reported destroyed, 1900.

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Aurora, Kans.	H_3	451.9162
At Huscher, Kans.	I_3	447.0694
At Concordia, Kans.	J_3	422.7024
At Concordia, Kans.	City B. M.	419.6304
At Concordia, Kans.	K_3	417.2175
At Hannum, Kans.	L_3	415.7927
At Oneonta, Kans.	M_3	426.1246
At Kackley, Kans.	N_3	461.6931
At Courtland, Kans.	O_3	457.7433
At Lovewell, Kans.	P_3	471.3142
At Webber, Kans.	Q_3	508.6728
Near Superior, Nebr.	R_3	472.8780
At Superior, Nebr.	B	479.9845
Near Superior, Nebr.	Superior No. 2.	476.8027
At Bostwick, Nebr.	C	489.1525
At Guide Rock, Nebr.	D	507.6734
At Amboy, Nebr.	E	515.6960
At Cowles, Nebr.	F	546.7338
Near Blue Hill, Nebr.	G	594.2191
Near Blue Hill, Nebr.	Blue Hill ◬	622.3584
At Blue Hill, Nebr.	H	601.2254
At Ayr, Nebr.	I	560.4750
At Brickton, Nebr.	J	557.9539
At Hastings, Nebr.	K	588.8357
At Hastings, Nebr.	Bank.	588.9429
At Hastings, Nebr.	Tower.	589.2854
At Hansen, Nebr.	L	592.3197
At Doniphan, Nebr.	M	593.0962
At Rivers, Nebr.	N	571.3672
Near Grand Island, Nebr.	O	572.4964
At Grand Island, Nebr.	P	568.5267
At Grand Island, Nebr.	Q	566.0564
Near Grand Island, Nebr.	R	579.8577
Near Alda, Nebr.	S	591.1818
At Wood River, Nebr.	T	599.4426
At Shelton, Nebr.	Shelton East Base ◬	615.9778
At Lockwood, Nebr.	U	550.1368
At Chapman, Nebr.	V	539.9953
At Paddock, Nebr.	W	525.0983
At Central City, Nebr.	X	519.0236
At Thummel, Nebr.	Y	505.8343
At Clarks, Nebr.	Z	495.8680
At Havens, Nebr.	A_1	483.2633
At Silver Creek, Nebr.	B_1	472.0295
At Duncan, Nebr.	C_1	455.2553
Near Columbus, Nebr.	Columbus No. 2.	443.5102
Near Columbus, Nebr.	Columbus No. 3.	440.1443
At Columbus, Nebr.	D_1	441.2711
At Columbus, Nebr.	E_1	441.7083
Near Columbus, Nebr.	F_1	446.4210
At Oconee, Nebr.	G_1	455.4185
At Platte Center, Nebr.	H_1	468.9996
At Tarnov, Nebr.	I_1	495.5247
At Humphrey, Nebr.	J_1	516.4078
Near Madison, Nebr.	K_1	495.1227
At Madison, Nebr.	L_1	485.0564
Near Madison, Nebr.	M_1	517.6443
Near Norfolk, Nebr.	N_1	464.2569
At Norfolk, Nebr.	O_1	465.4134
At Norfolk, Nebr.	P_1	464.6492
Near Norfolk, Nebr.	Norfolk No. 3.	462.3209

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Hope, Nebr.	Q_1	473.9381
At Hoskins, Nebr.	R_1	508.4308
At Apex, Nebr.	S_1	544.3945
At Winside, Nebr.	T_1	477.0301
At Wayne, Nebr.	U_1	444.9938
At Wakefield, Nebr.	V_1	431.2486
At Ridge, Nebr.	W_1	463.2012
At Emerson, Nebr.	X_1	434.8787
At Nacora, Nebr.	Y_1	429.4257
At Hubbard, Nebr.	Z_1	352.8716
At Coburn, Nebr.	A_2	336.6920
At Dakota City, Nebr.	M. R. C. Dakota City.	334.9979
At South Sioux City, Nebr.	B_2	336.3677
At Sioux City, Iowa.	P. B. M. 396, Top of Cap.	338.9126
At Hadar, Nebr.	C_2	474.8774
At Pierce, Nebr.	D_2	485.5213
At Foster, Nebr.	E_2	499.9119
At Plainview, Nebr.	F_2	517.8404
At Plainview, Nebr.	G_2	517.8575
At Brunswick, Nebr.	H_2	565.6014
At Savage, Nebr.	I_2	569.8291
At Orchard, Nebr.	J_2	592.1717
At Page, Nebr.	K_2	596.6448
Near Page, Nebr.	L_2	611.6528
Near Page, Nebr.	M_2	626.0748
Near Page, Nebr.	Page S. W. Base △	626.6000
Near O'Neill, Nebr.	N_2	596.0301
At O'Neill, Nebr.	O_2	606.1598
At O'Neill, Nebr.	P_2	610.1264
At Emmet, Nebr.	Q_2	616.7518
Near Atkinson, Nebr.	R_2	630.1429
At Atkinson, Nebr.	S_2	643.4765
Near Stuart, Nebr.	T_2	652.6954
At Stuart, Nebr.	U_2	657.5605
At Newport, Nebr.	V_2	680.4898
Near Bassett, Nebr.	W_2	693.8861
At Bassett, Nebr.	X_2	709.6207
At Long Pine, Nebr.	Y_2	732.8491
At Ainsworth, Nebr.	Z_2	769.5655
Near Johnstown, Nebr.	A_3	789.7151
Near Woodlake, Nebr.	B_3	810.3312
Near Woodlake, Nebr.	C_3	824.0684
Near Arabia, Nebr.	D_3	831.7668
At Thacher, Nebr.	E_3	809.4683
At Valentine, Nebr.	F_3	788.5429
Near Crookston, Nebr.	G_3	796.4243
Near Crookston, Nebr.	H_3	830.3783
At Georgia, Nebr.	I_3	889.1080
At Nenzil, Nebr.	J_3	948.5763
At Cody, Nebr.	K_3	945.0721
Near Cody, Nebr.	L_3	956.6258
Near Eli, Nebr.	M_3	981.6585
Near Eli, Nebr.	N_3	973.8129
Near Merriman, Nebr.	O_3	989.0054
Near Merriman, Nebr.	P_3	1016.0492
At Irwin, Nebr.	Q_3	1048.6278
Near Gordon, Nebr.	R_3	1081.0214
At Gordon, Nebr.	S_3	1083.8498

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
At Gordon, Nebr.	T_3	1084.6165
Near Clinton, Nebr.	U_3	1129.8388
At Rushville, Nebr.	V_3	1140.3661
Near Rushville, Nebr.	W_3	1145.6137
At Hay Springs, Nebr.	X_3	1167.4412
Near Bordeaux, Nebr.	Y_3	1137.9865
Near Chadron, Nebr.	Z_3	1033.7213
At Chadron, Nebr.	A_4	1027.5577
At Chadron, Nebr.	B_4	1034.4862
Near Chadron, Nebr.	C_4	1017.7599
Near Chadron, Nebr.	D_4	1006.2086
At Whitney, Nebr.	E_4	1039.8088
Near Crawford, Nebr.	F_4	1096.3879
At Crawford, Nebr.	G_4	1121.7170
At Fort Robinson, Nebr.	H_4	1153.9753
Near Glen, Nebr.	I_4	1221.6913
Near Andrews, Nebr.	J_4	1346.6923
Near Harrison, Nebr.	K_4	1483.0259
At Harrison, Nebr.	L_4	1487.4352
Near Harrison, Nebr.	M_4	1463.7672
Near Van Tassel, Nebr.	U_1	1452.9119
At Node Ranch, Wyo.	V_1	1505.2812
At Lusk, Wyo.	W_1	1529.1781
At Manville, Wyo.	X_1	1599.4274
At Keeline, Wyo.	Y_1	1612.4933
At Lost Spring, Wyo.	Z_1	1523.0181
At Shawnee, Wyo.	A_2	1532.0217
At Fisher, Wyo.	B_2	1451.6872
Near Silver Crown, Wyo.	X	1916.0309
At Silver Crown, Wyo.	Y	1951.8667
Near Volente, Wyo.	Z	2057.8254
At Islay, Wyo.	A_1	2044.2493
Near Horse Creek, Wyo.	B_1	1985.8043
Near Iron Mountain, Wyo.	C_1	1984.3929
Near Iron Mountain, Wyo.	D_1	1872.4823
Near Diamond, Wyo.	E_1	1764.3558
Near Diamond, Wyo.	F_1	1668.6771
Near Chugwater, Wyo.	G_1	1586.2126
Near Bordeaux, Wyo.	H_1	1508.5614
Near Wheatland, Wyo.	I_1	1440.3883
At Wheatland, Wyo.	4737 CHYN	1443.2775
At Wheatland, Wyo.	J_1	1445.1169
At Uva, Wyo.	K_1	1362.5457
Near Buckhorn, Wyo.	L_1	1446.1632
At Hartville Junction, Wyo.	M_1	1394.0010
At Wendover, Wyo.	N_1	1355.4245
At Cassa, Wyo.	O_1	1368.3504
Near Glendo, Wyo.	P_1	1432.5044
Near Bona, Wyo.	Q_1	1433.6496
Near Orin Junction, Wyo.	R_1	1425.1236
At Orin Junction, Wyo.	S_1	1434.7434
Near Orin Junction, Wyo.	T_1	1430.4786
Near Denver, Colo.	N_2	1565.0225
Near Hazeltine, Colo.	O_2	1552.6576
Near Henderson, Colo.	P_2	1535.2738
Near Brighton, Colo.	Q_2	1526.7216
At Brighton, Colo.	R_2	1514.5027
Near Lupton, Colo.	S_2	1505.3603
At Lupton, Colo.	T_2	1495.5993

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Lupton, Colo.	U_2	1484.9157
Near Platteville, Colo.	V_2	1475.1443
Near Platteville, Colo.	W_2	1469.6617
Near Platteville, Colo.	X_2	1462.3418
Near Nantes, Colo.	Y_2	1440.7166
Near La Salle, Colo.	Z_2	1418.1582
At Greeley, Colo.	A_3	1418.4538
At Lucerne, Colo.	B_3	1447.2021
At Eaton, Colo.	C_3	1473.4125
At Pierce, Colo.	D_3	1534.9675
At Dover, Colo.	E_3	1648.5862
At Carr, Colo.	F_3	1738.7886
At Athol, Wyo.	A	1921.1298
At Cheyenne, Wyo.	B	1847.6372
At Cheyenne, Wyo.	C	1847.4482
At Cheyenne, Wyo.	D	1847.4104
At Cheyenne, Wyo.	E	1859.0226
At Borie, Wyo.	F	2014.5504
At Otto, Wyo.	G	2120.0086
At Granite Canyon, Wyo.	H	2229.5041
At Sherman, Wyo.	I	2515.1531
At Sherman, Wyo.	J	2524.7580
At Dale Creek, Wyo.	K	2439.8634
At Dale Creek, Wyo.	L	2438.9524
At Red Buttes, Wyo.	M	2225.8430
At Laramie, Wyo.	N	2183.8625
At Laramie, Wyo.	O	2173.6570
At Howell, Wyo.	P	2164.8350
At Wyoming, Wyo.	Q	2157.3946
At Coopers Lake, Wyo.	R	2146.8180
At Lookout, Wyo.	S	2185.9988
At Harper, Wyo.	T	2136.2868
Near Rock Creek, Wyo.	U	2043.3980
At Rock Creek, Wyo.	V	2043.2056
At Rock Creek, Wyo.	W	* 2043.2650
Near Wilcox, Wyo.	C_2	2109.9766
Near Aurora, Wyo.	D_2	2055.7526
At Medicine Bow, Wyo.	E_2	2000.8580
At Medicine Bow, Wyo.	F_2	1999.2557
At Allen, Wyo.	G_2	2015.4356
Near Como, Wyo.	H_2	2062.8634
At Hanna, Wyo.	I_2	2065.9615
Near Hanna, Wyo.	J_2	2064.9867
At Dana, Wyo.	K_2	2069.8644
At Edson, Wyo.	L_2	2061.2213
Near Walcott, Wyo.	M_2	2012.8115
At Fort Steele, Wyo.	N_2	1985.2287
Near Greenville, Wyo.	Geological Survey W. B. △.	2006.2405
Near Greenville, Wyo.	O_2	2006.6194
At Rawlins, Wyo.	P_2	2056.5391
At Rawlins, Wyo.	Q_2	2058.3769
At Rawlins, Wyo.	R_2	2068.3947
At Solon, Wyo.	S_2	2110.1881
Near Daleys Ranch, Wyo.	T_2	2035.2078
At Riner, Wyo.	U_2	2059.1862
At Fillmore, Wyo.	V_2	2126.3991
At Creston, Wyo.	W_2	2166.7211

*Elevation from line of 1902 only. The bench mark had apparently settled about 5 mm since determination in 1899.

Corrected elevations of permanent bench marks—Continued.

Place.	Designation of bench mark.	Corrected elevation.
		meters.
Near Latham, Wyo.	X_2	2111.4433
At Wamsutter, Wyo.	Y_2	2044.5028
Near Red Desert, Wyo.	Z_2	2050.9118
Near Red Desert, Wyo.	A_3	2048.9067
At Red Desert, Wyo.	B_3	2047.6741
At Fort Hamilton, N. Y.	A	2.7012
At Fort Hamilton, N. Y.	C	3.8393
At Fort Hamilton, N. Y.	D	2.6831
At Fort Hamilton, N. Y.	F	1.1007
At Fort Hamilton, N. Y.	G	2.4144
At Fort Hamilton, N. Y.	H	8.7663

DESCRIPTIONS OF BENCH MARKS.*

GENERAL NOTES DESCRIBING DIFFERENT FORMS AND MARKINGS OF BENCH MARKS CONNECTED WITH THE LEVEL NET.

NOTE 1.—A bench mark referred to this note is a horizontal chisel mark cut in the end of a copper or brass bolt leaded horizontally into a stone or brick wall, lettered

U S C
⊖
& G S

NOTE 2.—A bench mark referred to this note is the top of a copper or brass bolt leaded vertically into stone or brick, lettered as indicated in note 1 above.

NOTE 3.—A bench mark referred to this note is the bottom of a square hole cut in stone, lettered

U S
□
B M

NOTE 4.—A bench mark referred to this note is the bottom of a square hole cut in stone, lettered

U S C
□
& G S

NOTE 5.—A bench mark referred to this note is the bottom of a square hole cut in brick or stone, or a square cut on stone, not lettered or lettering not given.

NOTE 6.—A bench mark referred to this note is the bottom of a square hole cut in the top of a limestone post, 30 to 40 inches long, set with not more than 7 inches projecting above the surface of the ground, lettered

U S
□
B M

* Any person who finds that one of the bench marks here described is 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.

NOTE 7.—A bench mark referred to this note is the top of a copper bolt, leaded vertically into stone or brick, at the intersection of two lines, not lettered or not described as lettered.

NOTE 8.—A bench mark referred to this note is the intersection of two lines cut in the top of a copper bolt leaded horizontally into stone or brick, not lettered or not described as lettered.

NOTE 9.—A bench mark referred to this note is the bottom of a square hole cut in the top of a limestone post, 30 to 36 inches long, set with not more than 7 inches projecting above the surface of the ground and lettered

U S
□
B M

There is also a sub-bench mark, which is the intersection of two lines cut in the end of a copper bolt leaded in a face of the post.

NOTE 10.—A bench mark referred to this note is the top of a copper bolt, leaded vertically into stone or brick, at the intersection of two lines, lettered

U S
⊕
B M

NOTE 11.—A bench mark referred to this note is the bottom of a square, 1 by 1 by ¼ inches, cut in the top of a Wyoming sandstone post 4½ feet long, with the upper 6 inches dressed to 6 by 6 inches, lettered

U S
□
B M

NOTE 12.—A bench mark referred to this note is the bottom of a square hole cut in the top of a Texas limestone post, 30 to 40 inches long, with the upper 6 inches dressed, projecting 5 to 8 inches out of the ground, lettered

U S
□
B M

NOTE 13.—A bench mark referred to this note is the intersection of two lines cut in the end of a copper bolt leaded horizontally into stone or brick, lettered

U S
⊕
B M

NOTE 14.—A bench mark referred to this note is the bottom of a square hole, 1¼ by 1¼ by ¼ inches, cut in the top of an Indiana Bedford limestone post 4½ feet long, with the upper 6 inches dressed to 6 by 6 inches, lettered

U S
□
B M

NOTE 15.—A bench mark referred to this note is an Indiana Bedford limestone post.

NOTE 16.—A bench mark referred to this note is described as a copper bolt leaded into stone or brick.

NOTE 17.—A bench mark referred to this note is the bottom of a square hole, 1 by 1 by ¼ inches, cut in the top of Indiana Bedford limestone post, 4½ feet long, set at least 4 feet in the ground, usually 6 inches by 7 or 8 inches in section except the upper 6 inches which is dressed to 6 by 6 inches, lettered

U S
□
B M

NOTE 18.—About the time that the line Dobbs Ferry to Greenbush was completed, the railroad company had all the mileposts (except between Rensselaer and Troy) removed, with the intention of putting in new stone ones. These new mileposts are to be about 20½ rails (rails 30 feet long) south of where the old ones were. Therefore, in all descriptions of bench marks referred to this note the old mileposts are meant, and the distances stated must be corrected by 20½ rails to refer them to the new mileposts.

NOTE 19.—A bench mark referred to this note is the intersection of two lines cut in the top of an iron fish-plate bolt set vertically in stone, not lettered (established by the New York Central and Hudson River Railroad engineers).

NOTE 20.—A bench mark referred to this note is a hole drilled in stone surrounded by a △. In 1902 the surface at the highest point in the triangle was made smooth and marked with a faint cross to indicate the point used.

NOTE 21.—A bench mark referred to this note is the top of a round-headed fish-plate bolt set vertically in a rock (established by the New York Central and Hudson River Railroad engineers).

NOTE 22.—A bench mark referred to this note is at a triangulation station. The station is marked by the point of a spike projecting from a pipe filled with concrete covered with one-half inch of cement. The bench mark is the bottom of a square hole cut in the cement near the station.

NOTE 23.—A bench mark referred to this note is one established by the United States Geological Survey,* and is an iron post with a cap on which is stamped the approximate elevation in feet. The number which is a part of the name assigned to the bench mark in this publication is this elevation.

NOTE 24.—A bench mark referred to this note is one established by the United States Geological Survey,* and is the intersection of two lines on a bronze tablet marked with the approximate elevation in feet. The number which is part of the name assigned to the bench mark in this publication is this elevation.

NOTE 25.—A bench mark referred to this note is one established by the United States Geological Survey,* and is a copper bolt marked "U. S. G. S. B. M.," with the approximate elevation in feet. The number which is part of the name assigned to the bench mark in this publication is this elevation.

NOTE 26.—A bench mark referred to this note is one established by the United States Geological Survey,* and is an iron post with a bronze cap stamped with the approximate elevation in feet and the letters M. C. The number which is a part of the name assigned to this bench mark in this publication is this elevation.

NOTE 27.—A bench mark referred to this note is one established by the United States Geological Survey,* and is the intersection of two lines on a bronze tablet marked with the approximate elevation in feet and the letters M. C. The number

*See illustration on p. 550, Appendix 8, Report for 1899. Also U. S. Geological Survey Report, 1896–97, Part I, pp 226–228.

which is a part of the name assigned to the bench mark in this publication is this elevation.

NOTE 28.—A bench mark referred to this note is one established by the United States Geological Survey,* and is a copper bolt marked "M. C.," with the approximate elevation in feet. The number which is a part of the name assigned to the bench mark in this publication is this elevation.

NOTE 29.—A bench mark referred to this note is a three-eighths-inch copper bolt leaded into a vitrified tile, 18 by 18 by 4 inches, buried 3 to 3½ feet below the surface of the ground. Surrounding the bolt on the surface of the tile is the inscription "Mississippi River Commission, 1898, U. S., P. B. M." On top of the tile is placed a 4-inch wrought-iron gas pipe, 4 feet long, concentric with the copper bolt. The lower end of the pipe is split into quarters and spread out to prevent the pipe from heaving by frost or being pulled up. A cast brass cap fits over the top of the pipe and is riveted thereto. The cap has the following inscription in sunken letters: "Mississippi River Commission, $250 fine for disturbing this mark. 1898. P. B. M., U. S. Latitude, ——. Longitude, ——. Elevation above sea, ——."

NOTE 30.—A bench mark referred to this note is one established by the United States Geological Survey,* and is an iron post with a cap on which is marked the approximate elevation in feet, followed by *Morehead*, *Morehed*, or *Mored* and the date *1898* or *1899*. The number which is a part of the name assigned to the bench mark in this publication is this elevation.

NOTE 31.—A bench mark referred to this note is at the end of a primary base line, upon a limestone block, embedded in concrete, approximately 2 by 2 feet in cross section and 1 foot in height, weighing six or seven hundred pounds. In the center of the top surface is the bronze station mark, and the surface of the 37-millimeter center of this is the bench mark. On the space between the inner and outer circles of the station mark the letters U. S. C. & G. S. are cast.

NOTE 32.—A bench mark referred to this note is the bottom of a square hole cut in the top of a 6 by 6 inch (stone) monument, or marking stone, usually granite, set flush or almost flush with the ground.

NOTE 33.—A bench mark referred to this note is the top of a wire nail of varying size driven vertically into a root of a tree or a bench cut on a root.

NOTE 34.—A bench mark referred to this note is the bottom of a square hole cut in the top of a limestone post, 6 inches square at the top, 4½ feet long, set about 4 feet into the ground, marked

U S
□
B M

NOTE 35.—A bench mark referred to this note is at the intersection of two lines cut in end of a half-inch copper bolt 2½ inches long, set vertically or horizontally. Some are set in brick or stone by wrapping the bolt with sheet lead and firmly tamping into the hole. Others were driven in a hole, the size of the bolt, drilled in hard rock. Bolt unmarked or marked as follows:

U+S, B+M, U S / + / B M

* See illustration on p. 550, Appendix 8, Report for 1899. Also U. S. Geological Survey Report, 1896-97, Part I, pp. 226-228.

NOTE 36.—A bench mark referred to this note is the bottom of a square hole cut in the top of a Texas limestone post about 36 inches long, with upper 6 inches dressed to 6 inches square, lettered

U S
□
B M

NOTE 37.—A bench mark referred to this note is a copper bolt on the Baltimore and Ohio Railroad line.

NOTE 38.—A bench mark referred to this note is the top of a section of rail set vertically in the ground, between the tracks, unless otherwise noted.

NOTE 39.—A bench mark referred to this note is a cross on the top of a section of rail set vertically in the ground, between the tracks, unless otherwise noted.

NOTE 40.—A bench mark referred to this note is the bottom of a square hole cut in the top of a limestone post, with upper 6 inches dressed to 6 by 6 inches, and marked

U S
□
B M

NOTE 41.—Bench marks referred to this note were established by the Board on Deep Waterways in 1900 and recovered by the New York State Engineer in 1900 and 1901. For convenience they are designated by their numbers in the report of the New York State Engineer for 1901. When the descriptions in the two publications differ, the phraseology of each is given. The abbreviation D. W. refers to the report of the Board on Deep Waterways, 1900, and N. Y. to the report of the New York State Engineer and Surveyor, 1901.

NOTE 42.—A bench mark referred to this note is a cross in a circle on the top of the coping, between the ends of the anchor of a gate of a lock.

NOTE 43.—A bench mark referred to this note is a cross in a circle, marked B. M., on the top of coping.

NOTE 44.—A bench mark referred to this note is a cross in a circle, marked B. M., on a projection in the stone wall of a lock or in a ledge of rock.

NOTE 45.—A bench mark referred to this note is the top of a copper plug between the anchor irons of a lock gate.

NOTE 46.—A bench mark referred to this note is one established by the United States Geological Survey,* and is a *bronze* tablet marked with the approximate elevation in feet, and "Harrisburg 1899." The number which is part of the name assigned to the bench mark in this publication is this elevation.

NOTE 47.—A bench mark referred to this note is similar to the one described in note 46, except the tablet is *aluminum* and marked "Dunkirk 1899."

NOTE 48.—A bench mark referred to this note is similar to the one described in note 46, except the tablet is *aluminum* and marked "Pittsburg 1899," or "Pittsburg 1902."

NOTE 49.—A bench mark referred to this note is similar to the one described in note 46, marked "Albany 1900."

*See illustration on p. 550, Appendix 8, Report for 1899. Also U. S. Geological Survey Report, 1896–97, Part I, pp. 226–228.

NOTE 50.—A bench mark referred to this note is similar to the one described in note 46, except the tablet is *aluminum* and marked "Harrisburg 1899."

NOTE 51.—A bench mark referred to this note is similar to the one described in note 46, except the tablet is *aluminum* and marked "Albany 1901."

DESCRIPTIONS OF PERMANENT BENCH MARKS BETWEEN BRAINERD AND LAKE ITASCA, MINN

(See Report of Chief of Engineers for 1901, Supplement, pp. 112–120.)

P. B. M. △ North Base (Brainerd Base Line).—*Brainerd, Minn.* (See. App. 8, Report for 1899, p. 783.)

P. B. M. $3\frac{1}{2}$.—*Brainerd, Minn.* (See App. 8, Report for 1899, p. 783, and note 29, p. 583 of this report.)

T. B. M. 201.—Is nail in root of 10-inch jack pine, 15 meters north of △ North Base, *Brainerd, Minn.*

T. B. M. 3—A 20-penny wire nail in west root of 12-inch pine stump about 11 meters east of center of Brainerd and Northern Minnesota Railway track and 35 meters south of road crossing, and about 400 meters south of signboard at *Leaks, Minn.*

T. B. M. 5—A 20-penny wire nail in top of a 14-inch pine stump 7½ meters east of center of track of Brainerd and Northern Minnesota Railway, 250 meters south of milepost 6, and about 2 miles from *Leaks, Minn.*

T. B. M. 6—A nail in root of burnt stump 7 meters east of center of track of Brainerd and Northern Minnesota Railway, opposite whistling post, and about 680 meters north of milepost 6; about 1¾ miles from *Merrifield, Minn.*

P. B. M. Merrifield.—A tile and pipe on west edge of right of way of Brainerd and Northern Minnesota Railway at *Merrifield* station and post-office, at east end of Long Lake. It is 12½ meters west of center of track, 78 meters south of store end of post-office building belonging to Ernest Miles, 175 meters north of south end of Merrifield siding, one-fourth mile north of milepost 8 from Brainerd. A 16-inch jack pine bearing T. B. M. 8 stands 6 meters west; an 18-inch Norway pine stands 6 meters northwest, both blazed with triangle facing the pipe. (See note 29, p. 583.)

T. B. M. 10.—A 10-penny wire nail in north root of 12-inch jack pine standing 18 meters east of center of track of Brainerd and Northern Minnesota Railway, about 900 meters north of milepost 9, and about 1½ miles from *Merrifield, Minn.*

T. B. M. 13.—A wire nail in root of 16-inch jack pine 20 meters west of center of track of Brainerd and Northern Minnesota Railway and opposite the third telegraph pole north of milepost 11, about 2 miles from *Hubert, Minn.*

T. B. M. 14.—A wire nail in root of 13-inch jack pine 14 meters north of center of track of Brainerd and Northern Minnesota Railway, 85 meters west of milepost 12, and about 1 mile from *Hubert, Minn.* Tree blazed with triangle over the nail.

T. B. M. 16.—A wire nail in root of small oak tree at *Hubert, Minn.*, 16 meters west of center of track of Brainerd and Northern Minnesota Railway and 17 meters south of section house.

T. B. M. 18.—A wire nail in stump 5 meters west of center of track of Brainerd and Northern Minnesota Railway, 127 meters north of milepost 15, on north side of farm road crossing, about 2 miles from *Hubert, Minn.*

T. B. M. 20.—A wire nail in top of 2-foot pine stump 20 meters west of center of track of Brainerd and Northern Minnesota Railway, about 150 meters north of road crossing and 1 000 meters south of milepost 17, and about 5 miles from *Pequot, Minn.*

T. B. M. 21.—A wire nail in root of burnt pine stump 15 meters east of center of track of Brainerd and Northern Minnesota Railway, at south end of cut and 385 meters north of milepost 17, and about 4 miles south of *Pequot, Minn.*

T. B. M. 22.—A wire nail in southwest root of 15-inch pine tree 35 meters east of center of track of Brainerd and Northern Minnesota Railway, and distant one-third length of fill from its south end. It is about 750 meters north of milepost 18 and about 2¾ miles south of *Pequot, Minn.*

T. B. M 23.—A wire nail in west root of a double jack pine 16 meters west of center of track of Brainerd and Northern Minnesota Railway, 378 meters south of milepost 20, and about 1½ miles south of *Pequot, Minn.* Tree is blazed on east (or track) side.

T. B. M. 24.—A wire nail in southwest root of double Norway pine at *Pequot, Minn.* It stands 37 meters east of center of track of Brainerd and Northern Minnesota Railway, and 20 meters south of old station, at rear of A. L. Cole's store and post-office.

P. B. M. Pequot.—A tile and pipe in the northeast corner of the yard of Alfred Lawrence in the village of *Pequot, Minn.* It is on the south side of the street leading west from A. L. Cole's store and post-office. Pipe is 57 meters west of the center of track of Brainerd and Northern Minnesota Railway. (See note 29, p. 583.)

T. B. M. 26.—A wire nail in north root of stump 4 meters west of center of track of Brainerd and Northern Minnesota Railway, at south end of long fill and north end of long cut, 274 meters north of milepost 23, about 2 miles north of *Pequot, Minn.*

T. B. M. 28.—A wire nail in burnt pine stump 11 meters west of center of track of Brainerd and Northern Minnesota Railway and 9 meters north of center of water tank at *Jenkins, Minn.*

T. B. M. 30.—A wire nail in root of poplar tree 40 meters west of center of Brainerd and Northern Minnesota Railway track and opposite sixth telegraph pole north of milepost 26, about 4 miles south of *Pine River, Minn.*

T. B. M. 31.—A wire nail in east root of lone 12-inch poplar tree 20 meters west of center of track of Brainerd and Northern Minnesota Railway and opposite milepost 27, about 3¼ miles south of *Pine River, Minn.*

T. B. M. 32.—A wire nail in east root of 14-inch jack pine 17 meters west of center of track of Brainerd and Northern Minnesota Railway, opposite milepost 28, 35 meters south of road crossing, 318 meters south of south end of railroad trestle over Pine River, and about 2¼ miles south of *Pine River, Minn.* Tree blazed with triangle over nail.

T. B. M. 33.—A wire nail in stump 5 meters west of center of track of Brainerd and Northern Minnesota Railway, 640 meters south of the trestle over Norway Brook, and halfway between mileposts 29 and 30, about a mile south of *Pine River, Minn.*

T. B. M. 35.—A wire nail in west root of 14-inch jack pine in the village of *Pine River, Minn.* It is near wagon road 16 meters east of center of track of Brainerd and Northern Minnesota Railway, 215 meters north of railway station, and 180 meters south of section house.

P. B. M. Pine River.—A tile and pipe in the village of *Pine River, Minn.* It is 15 meters west of center of track of Brainerd and Northern Minnesota Railway, 1 foot east of west right-of-way fence, and 26 meters south of south end of section house. (See note 29, p. 583.)

T. B. M. 37.—A wire nail in new stump of 3-inch jack pine 17 meters west of center of track of Brainerd and Northern Minnesota Railway, opposite seventh telegraph pole north of milepost 32, about 1 mile north of *Pine River, Minn.*

T. B. M. 39.—A wire nail in east root of stump 4½ meters east of center of track of Brainerd and Northern Minnesota Railway, 8 meters north of milepost 34, and about 700 meters south of *Mildred, Minn.*

T. B. M. 41.—A wire nail in root of burnt stump at base of fill on west side of track of Brainerd and Northern Minnesota Railway, 83 meters north of milepost 36, about 1¾ miles north of *Mildred, Minn.*

T. B. M. 43.—A wire nail in northwest root of 10-inch jack pine 15 meters east of center of track of Brainerd and Northern Minnesota Railway, 6 meters east of milepost 38, about three-fourths mile south of *Backus, Minn.* Tree has △ over nail.

P. B. M. Backus.—A tile and pipe at the village of *Backus, Minn.*, on land of the Pine Tree Lumber Company, at brow of hill sloping east, 26 meters east of center of track of Brainerd and Northern Minnesota Railway, 41 meters south of wagon road leading west across railway, 37 meters north of north end of station house, 61 meters north of water tank. A 14-inch and a 10-inch pine tree, blazed with triangle facing pipe, standing on slope of hill, 15½ meters northeast and 22 meters east, respectively, from pipe. (See note 29, p. 583.)

T. B. M. 46.—A wire nail in west root of pine stump 13 meters east of center of track of Brainerd and Northern Minnesota Railway opposite Koop's sawmill at "Spur of 42," and 340 meters north of milepost 41, about 1 mile south of *Island Lake, Minn.*

T. B. M. 48.—A wire nail in west root of pine stump 2 meters east of eighth telegraph pole north of milepost 43, Brainerd and Northern Minnesota Railway, about 1 mile north of *Island Lake, Minn.*

T. B. M. 49.—A wire nail in root of burnt stump 17 meters west of center of track of Brainerd and Northern Minnesota Railway, at edge of timber and opposite milepost 44, about 1¾ miles north of *Island Lake, Minn.*

T. B. M. 50.—A wire nail in top of stump 3 meters west of center of track of Brainerd and Northern Minnesota Railway, at north edge of swamp and south end of small cut, 155 meters north of milepost 45, about 2½ miles south of *Hackensack, Minn.*

T. B. M. 52.—A wire nail in top of stump 5 meters west of center of track of Brainerd and Northern Minnesota Railway, at north end of tangent and south end of small cut on curve, 1¼ miles south of *Hackensack, Minn.*

P. B. M. Hackensack.—A tile and pipe in village of *Hackensack, Minn.*, about 10 meters east of main track of Brainerd and Northern Minnesota Railway, 10 meters north of and in line with front of section house, and 90 meters south of station. (See note 29, p. 583).

T. B. M. 53.—The center of square hole cut in top of imbedded granite bowlder at village of *Hackensack, Minn.*, 5 meters north of telegraph pole, 2 meters west of sidetrack, 9 meters east of main track of Brainerd and Northern Minnesota Railway, 53½ meters south of center of station.

T. B. M. 54.—A wire nail in top of burnt stump 3 meters east of center of track of Brainerd and Northern Minnesota Railway, 690 meters south of milepost 49, about 1 mile north of *Hackensack, Minn.*

T. B. M. 55.—A wire nail in top of birch stump 7 meters west of center of track of Brainerd and Northern Minnesota Railway, 1¼ telegraph poles north of milepost 50, about 2½ miles north of *Hackensack, Minn.*

T. B. M. 56.—A wire nail in east root of 8-inch white pine tree 20 meters west of center of track of Brainerd and Northern Minnesota Railway, 1½ telegraph poles south of milepost 51, about 3½ miles north of *Hackensack, Minn.*

T. B. M. 57.—A wire nail in top of 2-foot white pine stump at north side of wagon road at road crossing, 7 meters east of center of track of Brainerd and Northern Minnesota Railway, at south end of siding at *Lothrop, Minn.*

P. B. M. Portage Lake.—A tile and pipe on hillside opposite northeast corner of Portage Lake, 12 meters east of center of track of Brainerd and Northern Minnesota Railway, and 15 meters east of and opposite water tower known as Hunter's water tower, one-half mile south of south end of siding at *Hunters, Minn.* (See note 29, page 583.)

T. B. M. 60.—A nail in root of large pine stump on east side of sidetrack at *Hunters, Minn.*, 70 meters north of head block at south end of switch.

T. B. M. 62.—A wire nail in top of 20-inch stump on bank of lake at end of cut and beginning of fill, 3 meters west of center of track of Brainerd and Northern Minnesota Railway, and 237 meters north of milepost 56, about 1½ miles north of *Hunters, Minn.*

T. B. M. 63.—A wire nail in cap of first bent at south end of trestle of Leech Lake Bridge, on west side of track of Brainerd and Northern Minnesota Railway, near *Walker, Minn.*

T. B. M. 64.—A blue keil mark on highest point of granite bowlder at south end of first cut north of trestle over arm of Leech Lake, known as Leech Lake Bridge, 3 meters east of center of track of Brainerd and Northern Minnesota Railway and 375 meters south of milepost 58, about 3 miles south of *Walker, Minn.*

T. B. M. 65.—The highest point on granite bowlder 3 meters east of center of track of Brainerd and Northern Minnesota Railway, at north end of cut and 282 meters south of milepost 59, about 1⅞ miles south of *Walker, Minn.*

P. B. M. Walker.—A tile and pipe in town of *Walker, Minn.*, on top bank of south shore of Leech Lake, on land of Capt. Ely Wright on north side of Cleveland boulevard and east side of Third street. Pipe stands two-thirds meter north of north line of and three-fourths meter east of northwest corner of porch of Mr. Wright's cottage. (See note 29, p. 583.)

P. B. M. Cole.—Center of small square cut on northeast corner of bedplate under iron column at southeast corner of the store building known as the Cole Block, standing on the northwest corner of Minnesota avenue and Fifth street, in the town of *Walker, Minn.*

P. B. M. Water Tank.—Top of copper bolt leaded vertically into top of southwest corner of sandstone cap on northwest pier forming the west wing foundations of water tank, in south portion of the town of *Walker, Minn.* Tank stands on knoll on east side of Fifth street. The letters U. S. P. B. M. are cut in the stone around the bolt.

T. B. M. 69.—Point in small square cut on embedded granite bowlder, about flush with ground, with letters U. S. cut under square, 5 meters north of center of track of Brainerd and Northern Minnesota Railway, at west end of short cut and east end of long fill where the Brainerd and Northern Minnesota Railway becomes parallel to the Great Northern Railway, about three-fourths mile west of station at *Walker, Minn.*

T. B. M. 71.— A wire nail in east root of 30-inch white-oak stump, 3 meters west of center of track of Great Northern Railway, 244 meters north of crossing of Brainerd and Northern Minnesota Railway and Great Northern Railway, near *Walker, Minn.*

T. B. M. 72.—A wire nail in northeast root of 3½-foot white-pine tree, having a hollow burnt out on the south side. Tree stands about 16 meters west of center of track of Great Northern Railway at the north edge of bottom along the Kabekona Narrows, 780 meters north of center of drawbridge No. 59 over Kabekona Narrows, and 135 meters south of south end of railroad cut, near *Walker, Minn.*

R. R. B. M.—Bench cut on root of 13-inch black-oak tree, about 12 meters east of center of track of Great Northern Railway, about 770 meters north of center of drawbridge No. 59 over Kabekona Narrows, near *Walker, Minn.*

T. B. M. 73.—A 20-penny wire nail in middle of top of 2-foot Norway-pine stump 2½ meters east of center of track of Great Northern Railway and 15 meters north of signboard reading "Drawbridge one mile," about 1 mile south of *Leech Lake, Minn.*

P. B. M. Leech Lake.—A tile and pipe at siding at *Leech Lake, Minn.*, on Great Northern Railway, 24 meters west of center of track, 15 meters west of west side of and directly opposite center of water tank. It is 4 meters east of edge of timber, 806 meters south of milepost 124.

T. B. M. 77.—A wire nail in top of 14-inch poplar stump 3½ meters west of center of track of Great Northern Railway, 618 meters north of milepost 125, about 2 miles north of *Leech Lake, Minn.*

T. B. M. 78.—A wire nail in root of burnt stump 8 meters east of center of track of Great Northern Railway, and about 200 meters north of milepost 127, about 3 miles south of *Wilkinson, Minn.*

T. B. M. 79.—Top of knob cut on highest point of bowlder projecting about 3 inches out of ground among three higher bowlders 5 meters east of center of track of Great Northern Railway and 822 meters north of milepost 128, about 2 miles south of *Wilkinson, Minn.*

T. B. M. 80.—A wire nail in 8-inch spruce stump about 15 meters west of center of track of Great Northern Railway, at north end of a borrow pit and 444 meters south of milepost 130, near *Wilkinson, Minn.*

T. B. M. 81.—A wire nail in 8-inch stump 5 meters west of center of track of Great Northern Railway, and 7 meters north of northern one of two hand-car houses at *Wilkinson, Minn.*

T. B. M. 82.—A wire nail in top of a 2-foot cedar stump at foot of embankment on west side of Great Northern Railway, 415 meters north of milepost 131, and 1,200 meters south of drawbridge No. 61 over Steamboat River, about a mile north of *Wilkinson, Minn.*

T. B. M. 83.—A tack in bench cut on southwest root of an 18-inch basswood tree near Steamboat River, 17 meters east of center of track of Great Northern Railway and 210 meters south of center of drawbridge No. 61 over Steamboat River, about 1½ miles north of *Wilkinson, Minn.*

T. B. M. Steamboat Lake.—A tile and pipe on high ground near old Indian hut, and about 18 meters from two Indian graves, 3 meters east of edge of bank of borrow pit, 19 meters east of center of track of Great Northern Railway, 201 meters south of south end of drawspan of drawbridge No. 61 over Steamboat River at east end of Steamboat Lake, about 1½ miles north of *Wilkinson, Minn.* (See note 29, p. 583.)

T. B. M. 85.—A wire nail in west root of 16-inch elm tree 15 meters east of center of track of Great Northern Railway, at edge of right of way, at north edge of swamp, a little north of milepost 133, about 3 miles north of *Wilkinson, Minn.*

T. B. M. 86.—A 20-penny wire nail in west edge of top of 2-foot pine stump 4 meters from track of Great Northern Railway, 150 meters north of milepost 134, about 4 miles north of *Wilkinson, Minn.*

T. B. M. 87.—A wire nail in sawed bench on large pine stump 2½ meters east of center of track of Great Northern Railway, 415 meters north of milepost 135, about 5 miles south of *Cass Lake, Minn.*

T. B. M. 89.—A wire nail in top of 4-foot white-pine stump 5½ meters east of center of track of Great Northern Railway, 612 meters south of milepost 137, about 3½ miles south of *Cass Lake, Minn.*

T. B. M. 90.—A wire nail in top of 12-inch pine stump 6 meters east of center of track of Great Northern Railway, 160 meters south of road crossing, and 374 meters south of milepost 138, about 2 miles south of *Cass Lake, Minn.*

P. B. M. Wye.—A tile and pipe in the wye at the junction of the Park Rapids division of the Great Northern Railway and the main line at *Cass Lake, Minn.*, in south fork of wye on line of the south line tangent produced and 113 meters north of head block of switch at south point of wye. It is 12.6 meters west of center of track of east leg and 23.4 meters east of track of west leg of the wye. (See note 29, p. 583.)

T. B. M. 93.—A wire nail in top of 30-inch pine stump 14 meters south of center of track of Great Northern Railway, 10 meters west of west end of bridge No. 231, 746 meters east of milepost 103, and about 2 miles west of station at *Cass Lake, Minn.*

T. B. M. 94.—A wire nail in top of 10-inch jack-pine stump 9 meters south of center of track of Great Northern Railway, 9 meters west of signpost marked $\frac{W}{X}$ (whistle for road crossing), 48 meters east of milepost 102, near *Farris, Minn.*

T. B. M. 97.—A wire nail in small pine stump on bank of cut 5 meters south of center of track of Great Northern Railway and 298 meters west of milepost 101, near *Farris, Minn.*

P. B. M. Midge Lake.—A tile and pipe in scattering jack pines on slope of south bank of Midge Lake. It is 22 meters north of center of track of Great Northern Railway, 19 meters south of water's edge of Midge Lake, 62 meters east of point where the water's edge of lake is nearest the railway, 170 meters west of milepost 100, near *Farris, Minn.* Two blazed jack pines stand east 3.1 meters and 4.7 meters, respectively; two others stand westerly 3.3 meters and 4.8 meters, respectively; telegraph pole stands 11 meters south. (See note 29, p 583.)

T. B. M. 101.—A wire nail in top of 13-inch stump 4½ meters north of center of track of Great Northern Railway and 196 meters west of milepost 99, near *Farris, Minn.*

T. B. M. 102.—A wire nail in top of 30-inch Norway-pine stump 11 meters north

of center of track of Great Northern Railway, directly opposite a log farmhouse, on bank of borrow pit, at edge of small patch of plowed ground and 38 meters west of road crossing, 212 meters northwest of milepost 98, about 2 miles east of *Rosby, Minn.*

T. B. M. 103.—A wire nail in the east root of 30-inch Norway-pine stump 8 meters north of center of track of Great Northern Railway, 75 meters west of culvert No. 223, and about three-fourths mile east of *Rosby, Minn.*

T. B. M. 105.—A wire nail in top of 12-inch tamarack stump 6 meters north of center of track of Great Northern Railway and 10 meters west of milepost 95, near *South Bemidji, Minn.*

T. B. M. 107.—A wire nail in west root of 10-inch jack-pine stump 5 meters south of center of track of Great Northern Railway, 4 meters west of road crossing, and 97 meters west of milepost 93, near *South Bemidji, Minn.*

T. B. M. 108.—A wire nail in top of 12-inch pine stump 1 foot north of north right-of-way fence of Great Northern Railway, 48 meters east of road crossing, and a little west of milepost 92, near *South Bemidji, Minn.*

P. B. M. △ Bemidji.—A tile and pipe planted on the north line of Great Northern Railway, one-third mile east of the point where the Mississippi River empties into Lake Bemidji, and one-half mile east of the town of *Bemidji, Minn.* It is on the north side of a deep cut and 75 meters east of the west end of the cut and at the west end of a small garden. The knoll through which the railway passes and on which the point stands is covered on the slope with brush and timber. It is about 50 meters south of the Brainerd and Northern Minnesota Railway and about 200 meters south of south end of Lake Bemidji. It is in S. E. ¼ of N. E. ¼ sec. 16, T. 146 N., R. 33 W. (See note 29, p. 583.)

T. B. M. 111.—A wire nail in north root of 15-inch pine stump 10 meters north of north side and 8 meters east of east end of station house of Great Northern Railway at *Bemidji, Minn.*

P. B. M. Willets.—A tile and pipe in southeast corner of yard of E. J. Willets, on the west side of Irving avenue and north side of Great Northern Railway right of way, in the town of *Bemidji, Minn.* It is 1 foot north of right-of-way fence, 37 meters north of center of wagon bridge over railway cut, and 83 meters south of the center of Second street. (See note 29, p. 583.)

P. B. M. Bemidji Tank.—Top of copper bolt leaded vertically into the west one of the two south stone abutments of city water tank on we t side of Irving avenue, between Second and Third streets, in the town of *Bemidji, Minn.* Bolt is in the southeast corner of the stone abutment, about 3 inches from either edge, and has the letters U. and S. cut on either side of it.

T. B. M. 114.—A wire nail in top of 10-inch pine stump at farm road crossing 11 meters south of spur track and 73 meters west of head block of switch where logging spur leads off of main line of Great Northern Railway, about 2 600 meters west of station at *Bemidji, Minn.*

P. B. M. Dorman.—A tile and pipe on top of the left bank of Mississippi River, 13 meters east of center of road leading south over Dorman's bridge over the Mississippi River, about 150 meters south of northwest corner of sec. 24, T. 146 N., R. 34 W., near *Bemidji, Minn.* Blazed trees stand as follows: One north 9 meters, one east 5

meters, two south 8½ meters, and one bearing T. B. M. 119 10 meters southwest. (See note 29, p. 583.)

P. B. M. Collette.—A tile and pipe on right bank of Mississippi River 11 meters from water's edge, near *Bemidji, Minn.*, 12 meters west of logging road that leads north from Collette's logging camp, which stands on shore of Twin or Loon Lake, 1 mile south of this point. It is 320 meters west of a point opposite a new log house standing on north or left bank of the river; 8-inch oak, bearing T. B. M. 125, stands 1.8 meters east, double birch stands 3 meters north, and a 10-inch elm stands 6 meters north. (See note 29, p. 583.)

P. B. M. △ County Line.—A tile and pipe on ridge covered with low brush and scattering pine snags, 10 miles southwest of Bemidji, Minn., 1½ miles southeast of Mississippi River, 500 meters northwest of Albert Nelson's house, 2½ miles northwest of *Maltby, Minn.*, 8 meters south of north line of Hubbard County, Minn. Section corner 31-32-5-6 stands east 46 meters; 22-inch Norway pine tree stands east-northeast 61 meters. (See note 29, p. 583.)

P. B. M. Hennepin.—A tile and pipe on high right bank of Mississippi River, near *mouth of Hennepin River, Minn.*, 5 meters from top edge of bank, in clump of jack pines (four of them blazed), 65 meters north of where river first touches base of high bank, one-half mile below mouth of Hennepin River. River runs north along this bank. (See note 29, p. 583.)

P. B. M. Rapids.—A tile and pipe on top of a knoll on first bank on right bank of Mississippi River, near what is known as "*The Rapids, Minn.*" about 30 meters south of the ford at the rapids where the Moose road crosses the river and 60 meters north of a dam in the river, and said to be 3 miles north of the mouth of La Salle River. River runs north here. (See note 29, p. 583.)

P. B. M. La Salle.—A tile and pipe on top and near west point of ridge on right bank of Mississippi River, immediately east of the *mouth of La Salle River, Minn.* A settler's log cabin stands in ravine 40 meters southeast; a blazed 8-inch jack pine stands 12 meters northeast. (See note 29, p. 583.)

P. B. M. △ Prospect Hill.—A tile and pipe on top of high hill, known as *Prospect Hill, Minn.*, about 20 meters east of bank where it slopes down abruptly to the west into the valley of the Mississippi. It is about 120 meters west of north-and-south road over the hill, and known as the Itasca road. It is about one-fourth mile northwest of junction of Itasca road with road from Smith's camp. (See note 29, p. 583.)

P. B. M. Sherratt.—A tile and pipe on slope of narrow ridge, near *Lake Itasca, Minn.*, 5 meters northeast of road leading to Mississippi River from Otto Sherratt's house. It is 400 meters northwest of junction of roads, which junction is 175 meters northwest of Sherratt's house. Pipe is 180 meters east of Mississippi River at its nearest point and 280 meters east-southeast from bridge over the river. It is in S.E. ¼ of N.W. ¼ sec. 22, T. 124 N., R. 36 W. Four blazed jack pines stand 15 meters northwest, 20 meters north, 13 meters northeast, and 65 meters east-northeast, respectively, from pipe. (See note 29, p. 583.)

P. B. M. Park Line.—A tile and pipe on top of east bank of *Lake Itasca, Minn.*, one-half meter west of fence corner and in line with fence marking the north boundary of the Itasca State Park. It is about 120°, 105 meters, from house occupied by Mr. Rust. A large white-pine tree standing at water's edge, 10 meters southwest of pipe, is blazed facing pipe. (See note 29, p. 583.)

P. B. M. △ Itasca.—A tile and pipe on low knoll in dense growth of poplar and aspen, about 600 meters northeast of the Itasca State Park commissioner's house, about 50 meters east of the center of the west line of sec. 1, T. 143 N., R. 36 W., near *Lake Itasca, Minn.* This knoll is on edge of ridge which slopes rapidly to the southeast toward Floating Bog Creek, and is about 50 meters west of deep ravine. A lone Norway pine stands on south slope of knoll 26 meters from pipe. (See note 29, p. 583.)

P. B. M. Park House.—A tile and pipe in Itasca State Park, Minn., 64.5 meters south of the park commissioner's house, 51 meters east of east bank of *Lake Itasca, Minn.*, 16 meters west of angle in road, and on north side of road leading to barn. (See note 29, p. 583.)

DESCRIPTIONS OF PERMANENT BENCH MARKS BETWEEN CASS LAKE AND GRAND RAPIDS, MINN.

[See Report, Chief of Engineers, 1901, Supplement, pp. 120–125.]

P. B. M. Roundhouse.—Top of copper bolt leaded vertically into north end of doorsill of double door to boiler room at extreme west end of Great Northern Railway roundhouse at *Cass Lake, Minn.* Bolt is 3¾ inches from west edge of sill and 4¾ inches from north end of sill.

U. S. E. B. M. 347.—Established by St. Paul United States Engineer Office, 1900, and is stone and pipe on top of high bank at east end of ridge on north side of Pike Bay, in southeast part of the town of *Cass Lake, Minn.*, about 500 meters south of the Eastern Railway of Minnesota, a part of the Great Northern Railway system, and 200 meters west of lumber of Scanlan & Gibson Lumber Company.

U. S. E. B. M. 342.—Established by St. Paul United States Engineer Office, 1900, and is stone and pipe on slope of north bank of Pike Bay, 9 meters south of center of track of Eastern Railway of Minnesota, 440 meters west of milepost 162. It is on south slope of high piece of hill left between railway cut and Pike Bay, 1⅔ miles from *Cass Lake, Minn.*

T. B. M. 169.—A wire nail in 16-inch jack pine stump 5 meters north of track of Eastern Railway of Minnesota, 133 meters west of milepost 161, near *Lomond, Minn.*

P. B. M. Lomond Spur.—A tile and pipe on high bank at southeast corner of Cass Lake, 15 meters east of logging spur which leaves main line of Eastern Railway of Minnesota at *Lomond, Minn.* It is just below loading works at end of spur track. Trees in vicinity blazed facing pipe. (See note 29, p. 583.)

U. S. E. B. M. 337.—Established by St. Paul United States Engineer Office, 1900, and is a stone and pipe on low bank of Cass Lake about 100 meters east of loading works at end of spur at *Lomond, Minn.*, 10 meters back of water's edge.

T. B. M. 170.—A wire nail in south root of 36-inch burnt stump 5 meters north of center of track of Eastern Railway of Minnesota and 100 meters east of west end of siding at *Cuba, Minn.*

T. B. M. 172.—A wire nail in top of 3-foot white pine stump at foot of embankment on south side of track of Eastern Railway of Minnesota, 158 meters west of milepost 158, and 2 miles from *Cuba, Minn.*

T. B. M. 174.—A wire nail in top of 2-foot pine stump 5 meters north of center of track of Eastern Railway of Minnesota, at west end of borrow pit, about 380 meters east of milepost 156, and 4⅓ miles from *Schley, Minn.*

T. B. M. 175.—A wire nail in root of 16-inch pine stump 6 meters south of center of track of Eastern Railway of Minnesota, at foot of embankment, about 500 meters east of milepost 155, and about 1⅓ miles from *Schley, Minn.*

T. B. M. 176.—A wire nail in north part of top of 30-inch Norway pine stump 5 meters south of center of track of Eastern Railway of Minnesota, 55 meters west of signboard reading "Station 1 mile" (meaning 1 mile east to *Schley, Minn*). It is 436 meters west of milepost 154.

T. B. M. 177.—A wire nail in southwest root of poplar stump 5 meters north of center of track of Eastern Railway of Minnesota, 736 meters east of milepost 154, and one-third mile from *Schley, Minn.*

T. B. M. 179.—A wire nail in small stump 3 meters north of center of track of Eastern Railway of Minnesota at east end of a fill, and 632 meters west of milepost 151, and about 2 miles from *Schley, Minn.*

T. B. M. 181.—A wire nail in root of 26-inch pine stump 5 meters south of center of track of Eastern Railway of Minnesota, 556 meters west of milepost 149, and 3½ miles from *Bena, Minn.*

T. B. M. 183.—A wire nail in top of 8-inch birch stump 3 meters north of center of track of Eastern Railway of Minnesota, 59 meters west of milepost 147, and about 1½ miles from *Bena, Minn.*

P. B. M. △ Bigosh.—A tile and pipe 10 meters south of center of track of Eastern Railway of Minnesota, 168 meters east of milepost 147, and 1 mile from *Bena, Minn.* Two large Norway pines south of pipe are blazed facing pipe. (See note 29, p. 583.)

P. B. M. △ Bena.—A tile and pipe 10 meters south of center of track of Eastern Railway of Minnesota, 287 meters west of milepost 146, and about 620 meters west of the railway station at *Bena, Minn.* (See note 29, p. 583.)

R. R. B. M.=B. M. 117 H.—A small nail in bench cut on north side of 28-inch Norway pine stump in the village of *Bena, Minn.*, opposite pump house for water tank and about 75 meters west of station, 21 meters south of main track of Eastern Railway of Minnesota, and 8 meters south of south siding. Used by St. Paul United States Engineer Office in 1900.

P. B. B. M. △ Norway Grove.—A tile and pipe 10 meters south of center of track of Eastern Railway of Minnesota, on bank of second cut east of *Bena, Minn.*, 205 meters east of milepost 144. (See note 29, p. 583.)

T. B. M. 188.—A wire nail in root of 22-inch pine stump 12 meters north of center of track of Eastern Railway of Minnesota, on bank of small cut, 540 meters east of milepost 143, and about 3 miles from *Bena, Minn.*

R. R. B. M.—A bench on south side of a large Norway pine, about 3 meters north of T. B. M. 188 and 3 miles from *Bena, Minn.*

T. B. M. 189.—A wire nail in south root of an 18-inch Norway pine, 15 meters north of center of track of Eastern Railway of Minnesota, 574 meters west of milepost 141, and at east end of a fill, near *Nushka, Minn.*

T. B. M. 191.—A wire nail in top of 12-inch cedar stump 2 meters north of center of track of Eastern Railway of Minnesota, 1 meter east of east head block of switch to siding at *Nushka, Minn.*

T. B. M. 192.—A wire nail in southeast root of 24-inch charred pine stump standing on top edge of cut, 12 meters north of center of track of Eastern Railway of Minnesota and 34 meters east of milepost 138, near *Nushka, Minn.*

P. B. M. △ Divide.—A tile and pipe 10 meters south of center of track of Eastern Railway of Minnesota, 135 meters east of milepost 137, near *Nushka, Minn.* (See note 29, p. 583.)

B. M. Mississip.—A tile and pipe on top of ridge 10.5 meters south of center of track of Eastern Railway of Minnesota, 523 meters east of milepost 135, and 620 meters west of west end of trestle over Mississippi River, near *Nushka, Minn.* (See note 29, p. 583.)

U. S. E. B. M. 304.—Established by St. Paul United States Engineer Office, 1900, and is a stone and pipe on high left bank of Mississippi River, about 400 meters east of drawbridge over Mississippi River and 58½ meters north of center of track of Eastern Railway of Minnesota, near *Ball Club, Minn.*

B. M. Tomahawk.—A tile and pipe 10½ meters south of center of track of Eastern Railway of Minnesota, 34 meters west of milepost 133, about one-half mile west of section house at *Ball Club, Minn.* (See note 29, p. 583.)

B. M. Wigwam.—A tile and pipe at first curve east of *Ball Club, Minn.*, about one-fourth mile east of east end of Ball Club siding. It is in the northeast corner of a small cultivated patch of ground, about 40 meters south of center of track of Eastern Railway of Minnesota, and about 64 meters east of milepost 132. (See note 29, p. 583.)

T. B. M. 15 C.—Established by St. Paul United States Engineer Office, 1899, and is nail in stump on north side of track of Eastern Railway of Minnesota, about 365 meters east of milepost 132, near *Ball Club, Minn.*

P. B. M. △ Starke.—A tile and pipe on north bank of ditch on north side of track of Eastern Railway of Minnesota, 46 meters west of head block of switch at *Starke spur, Minn.* (See note 29, p. 583.)

T. B. M. 200=T. P. 368 C.—A nail in top of large Norway pine stump standing on north edge of borrow pit, 5 meters south of center of track of Eastern Railway of Minnesota, and 19 meters east of head block of switch at *Starke spur, Minn.* Used by St. Paul United States Engineer Office in 1899.

T. B. M. 202=T. P. 354 C.—A nail in stump 3½ meters north of center of track of Eastern Railway of Minnesota, 167 meters west of milepost 129, near *Starke, Minn.* Used by St. Paul United States Engineer Office in 1899.

T. B. M. 203.—A wire nail in 24-inch Norway pine stump, 7 meters south of center of track of Eastern Railway of Minnesota, and 3 meters east of milepost 128, near *Deer River, Minn.*

P. B. M. △ Old Road.—A tile and pipe on old railroad grade on north side of Eastern Railway of Minnesota, 1 mile west of *Deer River, Minn.*, at first curve west of milepost 126, in line with the north rail of tangent east of curve, and 244 meters west of beginning of curve. (See note 29, p. 583.)

T. B. M. 206.—A small square cut on top southwest corner of south one of the two west stone piers of water tank of Eastern Railway of Minnesota at *Deer River, Minn.* Used by St. Paul United States Engineer Office in 1899.

P. B. M. △ Deer River.—A tile and pipe on south right of way of Eastern Railway of Minnesota, about 100 meters east of crossing of Eastern Railway of Minnesota and Itasca County Railway, at *Deer River, Minn.* (See note 29, p. 583.)

B. M. Roundhouse.—A tile and pipe 1 meter west of right-of-way fence, and 8½ meters west of center of track of Itasca County Railway. It is 17 meters south of south

end of a frame building used as a roundhouse, and about one-half mile south of crossing of Itasca County Railway and Eastern Railway of Minnesota at *Deer River, Minn.* (See note 29, p. 583.)

U. S. E. B. M. 192.—Established by St. Paul United States Engineer Office, and is a stone and pipe 60 meters south of center of track of Eastern Railway of Minnesota, on point of high ground, about one-half mile east of station at *Deer River, Minn.*, and about one-fourth mile west of railway bridge over Deer River.

U. S. Engineer Gauge.—A staff gauge nailed to a pile on south side of Eastern Railway of Minnesota bridge over Deer River, about three-fourths mile east of station at *Deer River, Minn.*

T. B. M. 208.—A wire nail in top of 10-inch tamarack stump at south right of way of Eastern Railway of Minnesota, opposite west end of spur and about 200 meters west of milepost 124, near *Deer River, Minn.*

T. B. M. 210.—A wire nail in top of 12-inch cedar stump at south side of track of Eastern Railway of Minnesota, about 320 meters west of milepost 122, near *Hull, Minn.*

T. B. M. 212.—The highest point on bowlder 3 meters south of center of track of Eastern Railway of Minnesota, 23 meters east of corner of fence at northwest corner of inclosure around abandoned house and near top of grade. It is 456 meters west of milepost 120, near *Hull, Minn.*

T. B. M. 213.—A wire nail in top of 6-inch poplar stump 6 meters south of center of track of Eastern Railway of Minnesota, and about 175 meters east of east head block of switch at *Hull, Minn.*, siding.

T. B. M. 215.—A wire nail in south root of a 14-inch pine tree, the middle one of three white pine trees in front of Cook & McHenry's saloon at *Cohasset, Minn.*, 16 meters north of center of track of Eastern Railway of Minnesota, and 10 meters east of Cohasset signboard.

U. S. E. B. M. 166.—Established by St. Paul United States Engineer Office, and is a stone and pipe 3 meters west of garden fence, 12 meters north of center of track of Eastern Railway of Minnesota, 7 meters east and about 23 meters south of the southeast corner of Cook's hotel, in central part of town of *Cohasset, Minn.*, and about 80 meters east of railway station platform.

B. M. Dam.—A tile and pipe on north side of track of Eastern Railway of Minnesota, nearly opposite Pokegama Dam. It is 12.2 meters west of the intersection of the tangents of the north rails of the railway, and practically on line with the tangent through north rail east of curve. It is 46 meters east of road crossing, near *Cohasset, Minn.* (See note 29, p. 583.)

Old U. S. B. M.—Point of arrow on highest point of granite bowlder at top of left bank of Mississippi River, about 20 meters below the office of the keeper of the Pokegama Dam, and about 25 meters below Pokegama Falls, near *Pokegama Lake, Minn.* Stone has letters U. S. B. M. cut on it near arrow, and the B. M. was established by United States Engineer Office at St. Paul, Minn., in 1874.

P. B. M. Pokegama Falls.—Top of copper bolt leaded vertically into highest point on largest granite bowlder, among other bowlders, in midst of the old buildings at Pokegama Falls, used as quarters in building the Pokegama Dam. It is 45 meters back of top of left bank of Mississippi River at Pokegama Falls, and 14 meters north-

northeast of office building of the keeper of the Pokegama Dam, near *Pokegama Lake, Minn.* The letters U. S. P. B. M. are cut in granite around the bolt.

U. S. E. B. M. 167.—Established by St. Paul United States Engineer Office, and is stone and pipe on right bank of Mississippi River, about 25 meters upstream from west approach to Pokegama Dam. It is 1 meter south of an east-and-west fence along north side of a grass field, and is about 20 meters from bank of river, near *Pokegama Lake, Minn.*

P. B. M. △ Grand Rapids.—A tile and pipe 102 meters south of center of track of Eastern Railway of Minnesota, at first curve west of *Grand Rapids, Minn.*, at the intersection of the south rail of the tangent east with the north rail of the tangent west of this curve. (See note 29, p. 583.)

T. B. M. 220.—A wire nail in south root of 14-inch white pine tree 24 meters north of Eastern Railway of Minnesota, 142 meters east of milepost 112, 545 meters west of depot of *Grand Rapids, Minn.*

P. B. M. Balustrade.—Top of copper bolt leaded vertically into the top of the south balustrade of the stone steps at the eastern entrance to the Itasca County court-house at *Grand Rapids, Minn.* Bolt is 14 inches from the face of the wall and in center of balustrade. The letters U. S. P. B. M. are cut around the bolt.

P. B. M. △ Race Track.—A tile and pipe one-fourth mile south of right bank of Mississippi River, nearly opposite B. M. Grand Rapids. It is on the north line of a cemetery and on south side of race track at fair grounds, *Grand Rapids, Minn.*, and about 150 meters east of the exhibit building.

B. M. Grand Rapids.—A tile and pipe in southeast corner of garden, at north right of way of Eastern Railway of Minnesota, about 580 meters east of depot at *Grand Rapids, Minn.*, and 350 meters west of milepost 111. (See note 29, p. 583.)

P. B. M. Prairie River.—Top of copper bolt leaded vertically into southeast corner of capstone in north end of west abutment of Eastern Railway of Minnesota bridge over the Prairie River, near *Grand Rapids, Minn.* Bolt is 2.5 meters north of gauge line of north rail of track and 0.2 meter from the north and east edges of the stone.

P. B. M. △ La Prairie.—A tile and pipe 10½ meters north of center of track of Eastern Railway of Minnesota, at first curve east of Prairie River, about halfway between mileposts 109 and 108, near *La Prairie, Minn.* (See note 29, p. 583.)

T. B. M. 226.—A wire nail in large knot on northwest side of a large pine stump 7 meters south of center of track of Eastern Railway of Minnesota and 175 meters east of milepost 107, near *La Prairie.*

T. B. M. 229.—A 20-penny wire nail in bench cut on west root of large burnt white pine stump 2.5 meters east of B. M. Blackberry, 74 meters east of milepost 105, 10½ meters north of center of track of Eastern Railway of Minnesota, at *Blackberry, Minn.*

B. M. Blackberry.—A tile and pipe 10½ meters north of center of track of Eastern Railway of Minnesota, 71 meters east of milepost 105, about 70 meters west of road crossing, and about 80 meters west of *Blackberry, Minn.*, schoolhouse. A blazed white pine tree stands 1 meter north of north right of way fence about 11 meters east of the pipe. (See note 29, p. 583.)

T. B. M. 230.—A 20-penny wire nail in bench cut on northeast root of a 24-inch white pine tree standing about 3 meters south of south right of way fence of Eastern

Railway of Minnesota, 18 meters west of a road crossing railway, 2 meters east of southeast corner of a fence inclosing a grave, about 123 meters east of milepost 105. Tree has a triangle on it over the nail, facing *Blackberry, Minn.*, schoolhouse. (See note 29, p. 583.)

DESCRIPTIONS OF PERMANENT BENCH MARKS BETWEEN WEST PENN JUNCTION AND BLAIRSVILLE INTERSECTION, PA.

[Pennsylvania Railroad Bench Mark Book, edition of May, 1899, pp. 78–80.]

P. R. R. 26.—Is at *West Penn Junction, Pa.* (See p. 865, App. 8, Report for 1899.)

P. R. R. 27.—Is 0.8 mile east of *West Penn Junction, Pa.;* water station, foundation of tub; square.

P. R. R. 28.—Is 0.9 mile west of *Bagdad, Pa.;* box culvert, south end; copper bolt.

P. R. R. 29.—Is 0.87 mile east of *Bagdad, Pa.;* rock, south side; shelf.

P. R. R. 30.—Is 0.9 mile west of *Leechburg, Pa.;* east abutment, south end bridge seat; copper bolt.

P. R. R. 31.—Is at *Leechburg, Pa.;* window sill of station; square.

P. R. R. 32.—Is 0.5 mile east of *Leechburg, Pa.;* west abutment, north end bridge seat; copper bolt.

P. R. R. 33.—Is 1.2 miles east of *Hyde Park, Pa.;* box culvert, south end; copper bolt.

P. R. R. 34.—Is 1.5 miles west of *Vandegrift, Pa.;* southeast wing wall of bridge, east end; copper bolt.

P. R. R. 35.—Is at *Vandegrift, Pa.;* doorsill of baggage room; square.

P. R. R. 36.—Is 1.2 miles east of *Vandegrift, Pa.;* box culvert, south end; copper bolt.

P. R. R. 37.—Is 0.8 mile west of *Paulton, Pa.;* northeast, west pier of bridge; copper bolt.

P. R. R. 38.—Is 0.2 mile west of *Paulton, Pa.;* county bridge, southeast wing wall; copper bolt.

P. R. R. 39.—Is 0.7 mile east of *Paulton, Pa.;* rock, south side track; copper bolt.

P. R. R. 40.—Is 0.51 mile east of *Roaring Run, Pa.;* rock, south side track; copper bolt.

P. R. R. 41.—Is 0.49 mile east of *Roaring Run, Pa.;* rock, south side track; copper bolt.

P. R. R. 42.—Is 1.1 miles west of *Salina, Pa.;* rock, south side track; square.

P. R. R. 43.—Is 0.2 mile east of *Salina, Pa.;* east abutment, south end bridge seat; copper bolt.

P. R. R. 44.—Is 0.8 mile east of *Salina, Pa.;* west end tunnel, north side, second course; shelf.

P. R. R. 45.—Is 1.1 miles east of *Salina, Pa.;* east end tunnel, north side, second course; shelf.

P. R. R. 46.—Is 1.3 miles west of *Edri, Pa.;* rock on north side; copper bolt.

P. R. R. 47.—Is 0.1 mile west of *Edri, Pa.;* west abutment, south end bridge seat; copper bolt.

P. R. R. 48.—Is 0.98 mile east of *Edri, Pa.;* rock 70 feet north center line; square.

P. R. R. 49.—Is one mile west of *Saltsburg, Pa.;* west abutment, south end bridge seat; square.

P. R. R. 50.—Is at *Saltsburg, Pa.;* passenger station, doorsill baggage room; square.

P. R. R. 51.—Is 0.5 mile east of *White Rock, Pa.;* north line of railway; copper bolt.

P. R. R. 52.—Is 1.1 miles west of *Tunnelton, Pa.;* northwest wing wall; copper bolt.

P. R. R. 53.—Is 0.4 mile west of *Bow, Pa.;* east end, northwest wing wall; copper bolt.

P. R. R. 54.—Is 0.3 mile west of *Bow, Pa.;* east end, north side Coad's Tunnel; shelf.

P. R. R. 55.—Is 0.7 mile west of *Livermore, Pa.;* southwest wing wall; copper bolt.

P. R. R. 56.—Is 0.2 mile east of *Livermore, Pa.;* southeast wing wall, bridge; copper bolt.

P. R. R. 57.—Is 0.8 mile west of *Social Hall, Pa.;* iron pipe drain, south wall; copper bolt.

P. R. R. 58.—Is at *Social Hall, Pa.;* bridge, southwest wing wall; copper bolt.

P. R. R. 59.—Is 0.4 mile west of *Blairsville, Pa.;* Walnut Street Bridge, northeast wing wall, third course; copper bolt.

P. R. R. 60.—Is at *Blairsville, Pa.;* passenger station, northeast corner, foundation offset; square.

P. R. R. 61.—Is 1.6 miles east of *Blairsville, Pa.;* iron pipe drain, north wall; copper bolt.

P. R. R. 62.—Is 2.8 miles east of *Blairsville, Pa.;* Toms Run Arch, coping south end; copper bolt.

P. R. R. 63.—Is 2.23 miles from *Bolivar Junction, Pa.;* rock 30 feet south of center line; copper bolt.

P. R. R. 43.—Is at *Bolivar Junction, Pa.* (See Report for 1899, App. 8, p. 873.)

P. R. R. 47.—Is at *Blairsville Intersection, Pa.* (See Report for 1899, App. 8, p. 873.)

DESCRIPTIONS OF PERMANENT BENCH MARKS BETWEEN HARRISBURG AND WILLIAMSPORT, PA.

(See P. R. R. B. M. Book, edition of May, 1899, pp. 110–113, 96–99.)

P. R. R. 5.—Is near *Rockville, Pa.* (See p. 868, App. 8, Report for 1899.)

P. R. R. 1.—Is near *Hecks, Pa.;* east end, north abutment, S. and S. railroad bridge; copper bolt.

P. R. R. 1a.—Is at *Hecks, Pa.;* foundation Heck's Tower, southeast corner; copper bolt.

P. R. R. 2.—Is near *Dauphin, Pa.;* bridge No. 148, east end, south abutment; copper bolt.

P. R. R. 3.—Is 1.4 miles north of *Dauphin, Pa,;* east side of track, 2 055 feet north of milepost 94–44, red shale rock; copper bolt.

P. R. R. 4.—Is near *Dauphin, Pa.;* bridge No. 150, southeast wing wall; copper bolt.

P. R. R. 5.—Is near *Geiger Point, Pa.;* east side of track, 20 feet south of milepost 96–42, sandstone rock; copper bolt.

P. R. R. 6.—Is near *Clarks Ferry, Pa.;* bridge No. 151, southeast back wall; copper bolt.

P. R. R. 7.—Is 0.9 mile south of *Clarks Ferry, Pa.;* coping of culvert, west side of track, 760 feet north of milepost 98–40; copper bolt.

P. R. R. 8.—Is near *Clarks Ferry, Pa.;* east side of track, 15 feet south of milepost 99–39, shaly sandstone; copper bolt.

P. R. R. 9.—Is near *Clarks Ferry, Pa.;* retaining wall, opposite Clarks Ferry; shelf.

P. R. R. 10.—Is north of *Clarks Ferry, Pa.;* northwest corner, foundation of water tank; copper bolt.

P. R. R. 11.—Is near *Clarks Ferry, Pa.;* bridge No. 152, northwest back wall; shelf.

P. R. R. 12.—Is near *Clarks Ferry, Pa.;* bridge No. 153, east end, north abutment; shelf.

P. R. R. 12a.—Is near *Inglenook, Pa.;* east side of track, 3 570 feet north of milepost 102–36, shaly sandstone rock; copper bolt.

P. R. R. 13.—Is near *Halifax, Pa.;* east side of track, milepost 104–34, shaly rock; shelf.

P. R. R. 14.—Is near *Halifax, Pa.;* east side of track, milepost 105–33, shaly rock; shelf.

P. R. R. 15.—Is near *Halifax, Pa.;* culvert, east side of track, 485 feet north of milepost 106–32; square.

P. R. R. 16.—Is 0.3 mile north of *Halifax, Pa.;* large rock, east side of track, 1 705 feet north of milepost 106–32; square.

P. R. R. 17.—Is near *Halifax, Pa.;* east end of coping, south wing wall of bridge No. 156; copper bolt.

P. R. R. 18.—Is near *Halifax, Pa.;* face of northwest back wall of bridge No. 157; shelf.

P. R. R. 19.—Is 2.9 miles north of *Halifax, Pa.;* foundation of barn, 310 feet south of milepost 109–29; copper bolt.

P. R. R. 20.—Is 1.2 miles south of *Millersburg, Pa.;* south end of retaining wall, east side of track, 1 140 feet south of milepost 111–27; shelf.

P. R. R. 21.—Is near *Millersburg, Pa.;* coping, west end, on north pier of bridge No. 159; copper bolt.

P. R. R. 22.—Is near *Millersburg, Pa.;* bridge No. 160, southwest wing wall; square.

P. R. R. 23.—Is near *Liverpool, Pa.;* face of west abutment of overhead bridge No. 160a; shelf.

P. R. R. 24.—Is at *Liverpool, Pa.;* rock, east of track opposite Liverpool station; copper bolt.

P. R. R. 25.—Is 1.2 miles north of *Liverpool, Pa.;* rock at road crossing, 1 080 feet north of milepost 115–23; copper bolt.

P. R. R. 26.—Is 1.9 miles north of *Liverpool, Pa.;* rock, east side of track, 300 feet south of milepost 116–22; copper bolt.

P. R. R. 26a.—Is 2.6 miles north of *Liverpool, Pa.;* rock, east side of track, 2 970 feet north of milepost 116–22; copper bolt.

P. R. R. 27.—Is 64 feet south of *Mahantago Station, Pa.;* set stone, west side of track; square.

P. R. R. 28.—Is near *Mahantago, Pa.;* bridge No. 162, face of southwest back wall; copper bolt.

P. R. R. 29.—Is 2.6 miles south of *Georgetown, Pa.;* face of retaining wall, west side of track, 2 536 feet north of milepost 119–19; shelf.

P. R. R. 30.—Is 2 miles south of *Georgetown, Pa.;* limestone rock, east side of track, 120 feet south of milepost 120–18; square.

P. R. R. 31.—Is 1.1 miles south of *Georgetown, Pa.;* rock, east side of track, 300 feet south of milepost 121–17; copper bolt.

P. R. R. 32.—Is 0.1 mile south of *Georgetown, Pa.;* east end of south abutment of open culvert, 480 feet south of milepost 122–16; copper bolt.

P. R. R. 32a.—Is near *Georgetown, Pa.;* bridge No. 165, west coping of stone arch; square.

P. R. R. 33.—Is 0.8 mile north of *Georgetown, Pa.;* northeast bridge seat of open culvert, 1 185 feet south of milepost 123–15; copper bolt.

P. R. R. 34.—Is near *Georgetown, Pa.;* bridge No. 166, northwest wing wall; shelf.

P. R. R. 35.—Is 2 miles south of *Herndon, Pa.;* rock cut, 10 feet north of milepost 125–13; shelf.

P. R. R. 36.—Is near *Herndon, Pa.;* bridge No. 169, east coping, stone arch; copper bolt.

P. R. R. 36a.—Is near *Herndon, Pa.;* bridge No. 170, northeast wing wall of stone arch; copper bolt.

P. R. R. 37.—Is at *Herndon, Pa.;* set stone, immediately north of Herndon station; square.

P. R. R. 38.—Is near *Herndon, Pa.;* bridge No. 171, southwest bridge seat; copper bolt.

P. R. R. 39.—Is 2 miles north of *Herndon, Pa.;* red sandstone 78 feet north of milepost 129–9; copper bolt.

P. R. R. 40.—Is near *Herndon, Pa.;* southeast abutment of bridge No. 172; copper bolt.

P. R. R. 41.—Is at *Fishers Ferry, Pa.;* west coping, box culvert; copper bolt.

P. R. R. 42.—Is near *Selinsgrove Junction, Pa.;* rock, east side of track, 90 feet north of milepost 132–6; shelf.

P. R. R. 43.—Is near *Selinsgrove Junction, Pa.;* rock, east side of track, 2 010 feet south of milepost 133–5; copper bolt.

P. R. R. 44.—Is at *Selinsgrove Junction, Pa.;* northeast bridge seat of bridge No. 21, Lewistown Division; copper bolt.

P. R. R. 45.—Is near *Selinsgrove Junction, Pa.;* bridge No. 176, southeast wing wall; copper bolt.

P. R. R. 46.—Is near *Selinsgrove Junction, Pa.;* rock, east side of track, 510 feet north of milepost 135–3; copper bolt.

P. R. R. 47.—Is near *Sunbury, Pa.;* rock, east side of track, 58 feet north of milepost 136–2; shelf.

P. R. R. 48 —Is near *Sunbury, Pa.;* west end of south back wall of bridge No. 179, copper bolt.

P. R. R. 49.—Is at *Sunbury, Pa.;* north end of foundation of water tank, south end of Sunbury Yard; square.

P. R. R. 50—Is at *Sunbury, Pa.;* passenger station, doorsill of women's waiting-room; copper bolt.

P. R. R. 1.—Is near *Sunbury, Pa.;* southwest wing wall of bridge 164¾; square.

P. R. R. 2.—Is near *Sunbury, Pa.;* foundation of roundhouse, north side; square.

P. R. R. 3.—Is near *Northumberland, Pa.;* northeast wing wall of bridge 164; copper bolt.

P. R. R. 4.—Is near *Northumberland, Pa.;* southeast wing wall of bridge 163; square.

P. R. R. 5.—Is near *Northumberland, Pa.;* southwest wing wall of bridge 163; copper bolt.

P. R. R. 6.—Is near *Northumberland, Pa.;* north end of arch culvert, 800 feet west of milepost 285–3; square.

P. R. R. 7.—Is near *Northumberland, Pa.;* south end of east bridge seat of bridge 161; copper bolt.

P. R. R. 8.—Is near *Kapps, Pa.;* back wall of culvert, 906 feet north of milepost 284–4, north side of track; shelf.

P. R. R. 9.—Is near *Kapps, Pa.;* side wall of culvert, 510 feet west of milepost 283–5, north side of track; square.

P. R. R. 10.—Is near *Kapps, Pa.;* capstone of pier of double box culvert, north side of track, 223 feet west of milepost 282–6; copper bolt.

P. R. R. 11.—Is near *Montandon, Pa.;* southwest wing wall of bridge 160; copper bolt.

P. R. R. 12.—Is near *Montandon, Pa.;* set stone at milepost 280–8, north side of track; square.

P. R. R. 13.—Is at *Montandon, Pa.;* southeast wing wall of box culvert, 1 520 feet west of milepost 279–9; copper bolt.

P. R. R. 14.—Is near *Montandon, Pa.;* north face of box culvert, 1 410 feet west of milepost 278–10; shelf.

P. R. R. 15.—Is near *Montandon, Pa.;* northeast wing wall of bridge 159, second course; copper bolt.

P. R. R. 16.—Is near *Dougal, Pa.;* set stone at milepost 276–12, north side of track; square.

P. R. R. 17.—Is at *Milton, Pa.;* middle window sill of passenger station; square.

P. R. R. 18.—Is near *Milton, Pa.;* west end of retaining wall, 2 460 feet east of milepost 274–14; shelf.

P. R. R. 19.—Is near *Milton, Pa.;* north coping of stone arch, bridge 157; copper bolt.

P. R. R. 20.—Is near *Watsontown, Pa.;* west side of wall culvert, 2 610 feet east of milepost 272–16, north side of track; square.

P. R. R. 21.—Is near *Watsontown, Pa.;* back wall of culvert, 1 690 feet west of milepost 272–16, north side of track; shelf.

P. R. R. 22.—Is opposite freight station at *Watsontown, Pa.;* west end of doorsill of J. M. Montgomery's residence; square.

P. R. R. 23.—Is west of *Watsontown, Pa.;* east end of water tank foundation.

P. R. R. 24.—Is near *Watsontown, Pa.;* northwest wing wall of bridge 155, second course; copper bolt.

P. R. R. 25.—Is near *Dewart, Pa.;* northwest wing wall of stone arch, bridge 154; copper bolt.

P. R. R. 26.—Is near *Dewart, Pa.;* rock, 2 135 feet east of milepost 267–21, north side of track; copper bolt.

P. R. R. 27.—Is near *Montgomery, Pa.;* culvert, 408 feet west of milepost 266–22, south side of track; copper bolt.

P. R. R. 28.—Is near *Montgomery, Pa.;* northeast wing wall of bridge 153; copper bolt.

P. R. R. 29.—Is near *Montgomery, Pa.;* northwest bridge seat of bridge 153; copper bolt.

P. R. R. 30.—Is at *Montgomery, Pa.;* south end of east doorsill of Montgomery House; square.

P. R. R. 31.—Is near *Montgomery, Pa.;* southwest bridge seat of bridge 151; copper bolt.

P. R. R. 32.—Is near *Montgomery, Pa.;* south coping of stone arch, bridge 149; square.

P. R. R. 33.—Is near *Muncy, Pa.;* north coping of stone arch, bridge 148; copper bolt.

P. R. R. 34.—Is near *Muncy, Pa;* northeast bridge seat of bridge 147; copper bolt.

P. R. R. 35.—Is near *Muncy, Pa.;* culvert, 410 feet east of milepost 259–29, north side of track; shelf.

P. R. R. 36.—Is near *Muncy, Pa.;* large rock, 955 feet east of milepost 258–30, 30 feet north of track; copper bolt.

P. R. R. 37.—Is near *Muncy, Pa.;* back wall of culvert, 510 feet west of milepost 257–31, south side of track; square.

P. R. R. 38.—Is near *Loyalsock, Pa.;* back wall of culvert, 1 443 feet west of milepost 256–32, south side of track; square.

P. R. R. 39.—Is near *Loyalsock, Pa.;* back wall of culvert, 86 feet east of milepost 255–33, south side of track; shelf.

P. R. R. 40.—Is near *Loyalsock, Pa.;* east end of retaining wall, 480 feet west of milepost 254–34, south side of track; copper bolt in shelf.

P. R. R. 41.—Is near *Loyalsock, Pa.;* culvert, 75 feet east of milepost 253–35, north side of track; copper bolt.

P. R. R. 42.—Is near *Loyalsock, Pa.;* back wall of culvert, 2 140 feet east of milepost 252–36, south side of track; copper bolt.

P. R. R. 43.—Is near *Williamsport, Pa.;* northwest bridge seat of bridge 146; copper bolt.

P. R. R. 44.—Is near *Williamsport, Pa.;* northeast bridge seat of bridge 145; copper bolt.

P. R. R. 45.—Is near *Williamsport, Pa.;* northwest bridge seat of bridge 145; copper bolt.

P. R. R. 45a.—Is at *Williamsport, Pa.;* doorsill of brick dwelling No. 314 Fourth street, 450 feet west of milepost 249–39, south side of track; square.

P. R. R. 46.—Is at *Williamsport, Pa.;* northwest corner base of Soldiers' Monument; square.

P. R. R. 46a.—Is at *Williamsport, Pa.;* north end of doorsill at east end of freight station; square.

P. R. R. 47.—Is at *Williamsport, Pa.;* water table, general superintendent's office building, north side, east of entrance; shelf.

DESCRIPTIONS OF PERMANENT BENCH MARKS BETWEEN BILOXI AND FORT ADAMS, MISSISSIPPI.

[See Report Chief of Engineers, 1900, Part 7, pp. 4726–4740.]

E_1.—Is near *Ocean Springs, Jackson County, Miss.*, near the east end of the Biloxi Bay bridge, and about 68 meters south of the Louisville and Nashville Railroad track, in the yard of the frame house owned and occupied by the Rev. J. B. Walker, and 0.8 meter from the brick pier under the northwest corner, and consists of the bottom of a square cut in the top of a marble stone 6 by 4 inches on top and about 2½ feet long, projecting about 4 inches above the ground, with the letters U. S. C. S. cut upon the top.

P. B. M. Keenor.—Is near *Ocean Springs, Jackson County, Miss.*, on the east side of Biloxi Bay, 75 meters north of the Louisville and Nashville Railroad track, and about 90 meters east of the Biloxi Bay railroad trestle; 1 meter west of the gallery of the summer cottage of Bishop J. C. Keenor, and 3½ meters north of the southwest corner of the gallery in front of the house. (See note 29, p. 583.)

Biloxi Gauge B.—Is near *Biloxi, Harrison County, Miss.*, on the upper edge of the iron plate of the Biloxi gauge, at angle in the line of piling near gauge house. Marks are cut thus: ⋀ in the iron, and the letter B is cut in plank near the bench mark.

P. B. M. 19 A.—Is near *Biloxi, Harrison County, Miss.*, 225 meters west of Biloxi Bay bridge, and 30 meters south of the center of track of the Louisville and Nashville Railroad, on the top of a stone post. P. B. M. 19 or H_1 was established on this stone, but the top was broken off, destroying the mark. The present bench mark is the intersection of cross lines in the corner of stone nearest the bay. Pine trees near the stone are blazed facing it.

T. B. M. 184.—Is at *Biloxi, Harrison County, Miss.*, in the northeast corner of the yard of the public school, on the south side of the Louisville and Nashville Railroad, and on the west side of the street which leads south to the city hall, in the northeast root of a leaning sycamore tree about one-half inch under the surface of the ground. (See note 33, p. 583.)

P. B. M. City Hall.—Is at *Biloxi, Harrison County, Miss.*, and is the top of copper bolt leaded vertically into the top of the southeast corner of the buttress standing on the east side of the entrance to the city hall and court-house, on the north side of Howard avenue and facing Main street leading south to the beach. The top of the buttress is the same height as the water table of the building, and is built of brick and covered with cement. The bolt is 0.1 meter from the east and south edges of the buttress and nearly flush with its surface.

T. B. M. 183.—Is at *Biloxi, Harrison County, Miss.*, about 60 meters southwest of the southwest corner of the passenger depot in one of the many northeast roots of the large, lone, double, live oak tree standing in open plat of ground which belongs to the Louisville and Nashville Railroad Company and is a proposed park. (See note 33, p. 583.)

T. B. M. 186.—Is at *Biloxi, Harrison County, Miss.*, 13 meters south of the warehouse and 115 meters west of the Louisville and Nashville Railroad passenger depot, in the northwest portion of open plat of ground belonging to the railroad and proposed as a park; 25 meters east of the Hygeia ice plant, in the south root of a 4-foot live-oak tree, about 3 feet from the body of the tree. (See note 33, p. 583.)

P. B. M. Hygeia.—Is at *Biloxi, Harrison County, Miss.*, in the southeast corner of the yard of the Hygeia ice plant, owned by Charles McCormack; 30 meters south of the ice-factory building, 74 meters south of the Louisville and Nashville Railroad, 136 meters west of the passenger depot, about 1 meter each from the south and east fences. The cap is about 2 feet above the ground. (See note 29, p. 583.)

P. B. M. 17.—Is at *Beauvoir, Harrison County, Miss.*, and is a copper bolt leaded in the top of a marking stone 11 meters south of the center of the track of the Louisville and Nashville Railroad, 2½ meters west and 1 meter north of the southwest corner of the station building. The corners of the stone are chipped off.

P. B. M. 16.—Is at *Mississippi City, Harrison County, Miss.*, in the west wall of the jail and is the center of copper bolt leaded horizontally in center of fifth brick from northwest corner, in the fifteenth course above the water table. It is marked

U S
⊙
B M

P. B. M. 14.—Is 252 meters east of the station at *White Harbor, Harrison County, Miss.*, and is the top of a copper bolt leaded in the top of a stone marked U. S., 8 meters north of center of track of the Louisville and Nashville Railroad, and 193 meters east of milepost 62 N. O.

P. B. M. 13.—Is at *Pass Christian, Harrison County, Miss.*, and is top of a copper bolt leaded in the top of a stone marked U. S., about 9 meters south of the center of the Louisville and Nashville Railroad track, 5½ meters south of the platform, and 8½ rail lengths east of the passenger depot. The stone projects about 1 inch out of the ground and has one corner broken off.

P. B. M. 11.—Is at *Bay St. Louis, Hancock County, Miss.*, and is the top of a copper bolt leaded in the top of a stone, marked U. S., about one-half meter north of the fence along the south side of right of way of the Louisville and Nashville Railroad and about 1 meter west of the corner of the fence at the west side of Front street; about 12 meters south of the center of the track, and about 30 meters west of the railroad trestle over Bay St. Louis. The stone is about 2 inches above ground and has its corners chipped off.

P. B. M. 10.—Is at *Bay St. Louis, Hancock County, Miss.*, and is the center of a copper bolt leaded horizontally in the face of the southern brick wall of the vestibule of the Catholic Church, about half way between the side entrance of the vestibule and the main front wall and about 1 meter above the ground. The building has been stuccoed over and a hole left in the stucco at the bolt.

P. B. M. 9.—Is at *Waveland, Hancock County, Miss.*, 36 meters south of the southwest corner of the station, on the Louisville and Nashville Railroad, in line with the fence on the west side of the lane along the west side of Merwood dairy farm, 12 meters north from the corner of the fence at the end of the lane, 12 meters west of the shell road leading toward the bay, and consists of the top of a cross in the center of a marking stone marked U. S., projecting 3 inches above the ground.

P. B. M. 8.—Is at *Chinchuba, Hancock County, Miss.*, in the northwest portion of the yard around the section house at the station and about 10 meters south of the center of the Louisville and Nashville Railroad track and is the top of a cross in the center of a stone, marked U. S., projecting about one-half foot above the ground.

P. B. M. 7.—Is at *Claiborne, Hancock County, Miss.*, and is the center of a cross cut in the top of a stone, marked U. S., just north of the north fence of the house lot of Pat. Ferril, 18 meters south of the center of the Louisville and Nashville Railroad track, 12 meters (measured parallel to the track) east of the station house.

P. B. M. 6.—Is near *Claiborne, Hancock County, Miss.*, and is the top of a copper bolt leaded into the top of a stone, standing 10 inches above the ground, on a high point of ground just east of East Pearl River; 200 meters east of the iron truss bridge over the East Pearl River on the Louisville and Nashville Railroad; 27.2 meters south of the center of the track; in the gravel walk along the front of Baldwin Lodge, and 12 meters west of the house. The property is owned by A. Baldwin, of New Orleans. The stone is marked thus:

1882
U. S.
B. M.

P. B. M. 4.—Is at *Fort Macomb, Chef Menteur, La.*, and is the center of a copper bolt leaded horizontally in the wall of Fort Macomb, on the right-hand side (as you go in) of the entrance. There is a moat around the wall. The bridge over the moat has rotted away. The sill to the entrance to the fort is removed, but the wall seems to be in first-class condition. The bench mark is marked around the bolt thus:

U. S.
18 ⊙ 82
P. B. M.

T. B. M. 95.—Is at *New Orleans, Orleans Parish, La.*, in the southeast root of a 30-inch live-oak tree, the first one north of North Claiborne street, on the west side of Elysian Fields street; 14 meters north of the gate leading to the residence of Dr. R. Tudury, midway between the curb line and granitoid walk. (See note 33, p. 583.)

P. B. M. 41.—Is at *New Orleans, Orleans Parish, La.*, and is the top of a vertical copper bolt in the brick pier under the south post of the electric-light tower at the southwest corner of Anthonia and Claiborne streets; 3 inches east of the southeast corner of the iron bedplate, about 2 feet inside of the curb line on the west side of Anthonia street, and 2.7 meters south of the southwest corner of the two streets. The bolt is about 3 inches under ground.

P. B. M. 3.—Is at *New Orleans, Orleans Parish, La.*, established by the Mississippi River Commission in 1882, and is a horizontal line on the end of a horizontal copper bolt in the east face of the middle brick gatepost of the Gentilly gate, on the east side of the fair grounds, in the fifth course of bricks above the ground, and marked thus: U. ⊙ S.

T. B. M. 175 (Paige, 1893).—Is at *New Orleans, Orleans Parish, La.*, and is a + cut on the iron bedplate supporting the southern post of the electric-light tower at the corner of Lapeyrouse street and Gentilly road.

P. B. M. 2.—Is at *New Orleans, Orleans Parish, La.*, established by the Mississippi River Commission in 1882, and is the center of the end of a horizontal copper bolt in the northwest face of the southern wing of the abutment at the northwest end of the drawbridge over Bayou St. John, on the Esplanade road. It is marked thus:

U S
⊙
P B M

The brick wing of the abutment in which the bolt is leaded is very badly cracked (1900) and shows signs of settling.

Halfway House.—Is at *New Orleans, Orleans Parish, La.*, and is a + on the top surface of a granite marking stone on the west side of the canal near the entrance to Metairie Cemetery; in line with the fence along the south side of the cemetery, 4.7 meters from the southern end of the wall forming the cemetery entrance, and 41 meters from the western end of the bridge crossing the canal. The top of the stone is 120 by 200 millimeters, marked thus: ⊞, and is quite rough. It is lower at the intersection of the + than elsewhere, and the rod was held at this point.

City Stone XXMR.—Is at *New Orleans, Oleans Parish, La.*, and is a granite monument 1 foot square, in the southwest corner of the City Park; 3 meters each from the south and west fences. The top of stone is marked thus:

XXMR
JUNE
1874

and the bench mark is the center of the upper part of figure 8.

City Park.—Is at *New Orleans, Orleans Parish, La.*, and is a cross on the highest part of a limestone monument, 5 inches square, in the City Park, 9 meters from the west fence and 95 meters from the south fence. The cross is about 1 inch south of the hole in the center of the stone.

T. B. M. 170.—Is at *New Orleans, Orleans Parish, La.*, and is a point in square cut on the southeast corner of the projection of a brick post at the southeast corner of Calumet National Cemetery, three-fourths of a mile below Jackson Barracks in New Orleans, at the end of the brick wall in front of the cemetery, on the north side of the road, 5 meters from the inner base of the levee.

City Stone XXMB.—Is at *Carrollton, Orleans Parish, La.*, and is the top of a granite marking stone in the line of trees on the west side of the electric car tracks on Carrollton avenue, 44.3 meters from the northwest corner of Elm street and Carrollton avenue,

52.9 meters from the southwest corner of Zimple street and Carrollton avenue, 14.2 meters from the west line of Carrollton avenue, and 2 meters west of the west rail of the street-car track. The top of the stone is 1 foot below ground and is marked thus:

X X M B
JUNE
+
1874

Rods held on the point indicated on the sketch by a cross; there is no cross on the stone. The bench mark was reported in good condition in 1898.

T. B. M. 160.—Is at *Carrollton*, *Orleans Parish*, *La.*, and is a nail in the west root of an 18-inch live-oak tree on the east side of Carrollton avenue, the first tree north of the entrance to the school building, McDonough No. 23.

P. B. M. Carrollton.—Is at *Carrollton*, *Orleans Parish*, *La.*, and is the center of a small hole in the center of a copper bolt, leaded horizontally in the northeast face of the masonry at the north corner of the school building, McDonough No. 23 (old court-house), on Carrollton avenue. The bolt is in the middle of the base of the pilaster at the corner of the building 0.3 feet below the water table of pilaster and about 1.5 feet above ground, marked

U S
⊙
P B M

B. M. A. (Ewens, 1892).—Is at *Carrollton*, *Jefferson Parish*, *La.*, and is the Carrollton gauge bench mark. It is a stone and pipe located to the left of the steps of the entrance to a tin shop belonging to F. Marsel, 6 meters back of the levee, about 80 meters above the end of St. Charles avenue at the levee, in a flower bed 1 foot from the front porch. Cap of pipe marked with letters U. S. E. B. M.

P. B. M. V.—Is near *St. Rose*, *La.*, on *Destrehan Plantation*, *St. Charles Parish*, *La.*, and is a point in a square cut on the granite sill under the middle of a small iron gate to footway on the west side of the large iron gate at the main entrance to the yard in front of Judge Rost's house, about 12 meters from the inner base of the levee, marked

U S
⊡
B M

This bench mark was moved back about 100 feet in the summer of 1894, when a new levee was built.

P. B. M. VI.—Is nearly opposite *Hahnville*, *St. Charles Parish*, *La.*, and is a point in a square cut on top of the southwest corner of the pedestal under the column on the eastern side of the steps at the front entrance of Edward Sarpy's house on Prospect plantation. The pedestal is of brick, covered with hard stucco, 14 meters back from the inner base of the levee, marked

U S
18 ⊡ 80
B M

The bench mark was in good condition in 1898.

P. B. M. VII.—Is near *Sellers*, *St. Charles Parish*, *La.*, and is the head of an iron bolt in a cement post at the foot of a large pecan tree in front of the house on the estate of Marcellus Roussell, about one-half mile below Gipsy plantation. The bench mark is buried beneath the surface of the ground and covered over with earth. It is 1 foot and 1.5 feet, respectively, from two nails driven in projecting roots of the tree. The tree is blazed with a triangle facing the bench mark. It was reported in good condition in 1898.

△ Chenet.—Is at *Mount Airy*, in *St. John the Baptist Parish*, *La.*, 3 miles below Lutcher, La., and is a screw pile 70 meters north of the Yazoo and Mississippi Valley Railroad, 125 meters west of the east head block of Mount Airy siding, about 50 meters east of a bridge marked L. 36–62, about 1 200 meters below the parish line between St. John the Baptist and St. James parishes. The bench mark is a cross on top of cap of pile. Cap is badly broken, but the cross is firm (1898).

P. B. M. X.—Is at *Mount Airy*, *La.*, and is a point surrounded by a groove cut in the upper surface of the granite sill at the foot of the iron stairway in front of the house of Joseph Lebourgeois, on Mount Airy plantation, St. John the Baptist Parish, La. It is marked with the letters U. S. B. M., 1880, and was reported in good condition in 1898.

T. B. M. 83.—Is about 760 meters above the depot at *Lutcher*, *St. James Parish*, *La.*, in the root of a 12-inch hackberry tree about 60 meters toward the river from the Yazoo and Mississippi Valley Railroad track, on the edge of a north and south ditch, and 12 meters west of a 24-inch pecan tree. (See note 33, p. 583.)

T. B. M. 71.—Is on *Belmont Plantation*, near *Hester*, *St. James Parish*, *La.*, in the north root of a 30-inch live-oak tree, 20 meters south of the Yazoo and Mississippi Valley Railroad track, 12 meters east and 38 meters north of Belmont store. (See note 33, p. 583.)

P. B. M. XII.—Is on *Belmont Plantation*, near *Hester*, *La.*, 2½ miles below Jefferson College, at *College Point*, *St. James Parish*, *La.*, about 60 meters outside of the new levee, in front of Belmont store on the ruins of the mansion house which was burned about February, 1894, and the columns only left standing, in the cement pedestal of the column at the southwest corner. It consisted originally of the bottom of a square cavity marked with the letters U. S. B. M. Earth has been taken from around the ruin for the new levee and the cement is broken off the corner of the pedestal, leaving only one corner of the square cavity and part of the letters, but the elevation of the bench mark seems to be undisturbed (1898).

△ Homestead.—Is on *Oneida Plantation*, near *Hester*, *La.*, on a screw pile on the west side of a small ditch, 35 meters south of the Yazoo and Mississippi Valley Railroad, 59 meters below milepost 48, 76 meters below a large ditch, and 465 meters above the quarters on the plantation. The + marking the geodetic point on top of the cap used as the bench mark.

P. B. M. XIII.—Is near *Hester*, *St. James Parish*, *La.*, near the southeast side of the large gateway in front of Jefferson College, on the iron post which divides the carriage drive and the footpath, 3.8 feet and 17.8 feet, respectively, from the east and west brick buttresses of the gateway. The bench mark is a horizontal line cut on two sides of the southwest corner of the post, 4.9 feet above brick foundation. It was reported in good condition in 1898.

P. B. M. XIV.—Is near *Convent, St. James Parish, La.*, in the south end of granite doorsill at the most southern entrance on the front or west side of the Convent of the Sacred Heart, 7 meters north of the southwest corner of the convent and about 4 feet above the ground. It was reported in good condition in 1898. (See note 3, p. 580.)

P. B. M. XV.—Is at *Colomb, St. James Parish, La.*, and is a point in a square cut on the northwest corner of the stone pedestal of the pillar on the south side of the entrance to the house of George Schepp, formerly owned by Leopold Colomb. The house stands about 10 meters back of the levee, opposite Colomb station, on the Yazoo and Mississippi Valley Railroad, and about 70 meters above Colomb Park store. It is marked

U S B M
X ◇ V

It was reported in a good state of preservation in 1898.

P. B. M. XVI.—Is on *Union Plantation*, 2½ miles below *Burnside, Ascension Parish, La.*, and is a point in a square cut on a limestone slab at the side of the front steps of the main residence, just back of the levee on the left bank of the river, one-half mile above stone line 190, and 900 meters from the Yazoo and Mississippi Valley Railroad. It is marked with the letters U. S. B. M., and was reported in good condition in 1898.

B. M. $\frac{1}{1}\frac{8}{6}$.—Is near *Belle Helene, Ascension Parish, La.*, on Linwood plantation, on the north side of the road leading back from Linwood Landing, about 600 meters toward the river from the Yazoo and Mississippi Valley Railroad, 100 meters southwesterly from a large brick house between the road and the ditch, and consist of a flat stone and iron pipe, with cap of pipe gone. Blazed trees: 12-inch magnolia is 5 meters north; 12-inch magnolia 13 meters west.

P. B. M. New River.—Is at *New River, Ascension Parish, La.*, on the Yazoo and Mississippi Valley Railroad, 14½ meters west of the track, 83 meters below the depot, on the west edge of the right of way, 18 meters above the road crossing, 2 feet from the junction of the right-of-way fence and the fence on the north side of the road leading to the river. (See note 29, p. 583.)

P. B. M. XX.—Is a point on the upper surface of the projecting brick foundation running around the house, on *Southwood plantation*, near *Geismar, La.*, formerly called *Hard Times*, at the extreme upper end of *Ascension Parish, La.* A square opening was cut through the stucco covering, so as to allow the rods to rest upon the brick. The bench mark is marked with the letters U. S. B. M. and the date 1880, and was reported in good condition in 1897.

P. B. M. St. Gabriel.—Is at *St. Gabriel, Iberville Parish, La.*, on the Yazoo and Mississippi Valley Railroad, on a small ridge between two small ditches, 1 meter north of the fence along the south side of the road, at the east end of the lane leading from the river back to the railroad station, 31 meters west of the southwest corner of the depot, 46 meters west of the main railroad track, 35 meters from the corner of the fence on the west side of the right of way, 10 meters from a 24-inch hackberry tree, and 3 meters south of an 18-inch honey-locust tree. The trees are marked with a triangular blaze. (See note 29, p. 583, except the tile is marked △ 1895, and cap is marked U. S. P. B. M. 1891).

T. B. M. 22.—Is near *Sunshine, La.*, on *Willow Glen plantation, Iberville Parish, La.*, and is the head of a spike driven in the west root of a 24-inch pecan tree, on the east side of the road at the foot of the levee, 6 meters north of the gate on the crossroad from the public road to the railroad, 11 meters north of the northwest corner of the front yard of the main house.

P. B. M. XXIV.—Is near *Sunshine, La.*, at *Forlorn Hope Landing, Iberville Parish, La.*, on the left bank of the river, 10 meters back of the levee, 145 meters in front of Grenada sugar house, 2 meters east of the southwest corner of a yard just outside of the fence along the road, and 65 meters above the tramway running from the sugar house to the levee, in the top of a granite post, which was reported in good condition in 1897. (See note 5, p. 580.)

B. M. $1\frac{1}{2}$.—Is near *Sunshine, Iberville Parish, La.*, and is a copper bolt in the top of a limestone post on the left bank, in a back yard, 11 meters north from the northeast corner of kitchen, 17½ meters northwest of a 30-inch sycamore tree. Stone in good condition (1897).

B. M. $1\frac{1}{2}$.—Is near *Burtville, East Baton Rouge Parish, La.*, on the left bank of the river, opposite Manchac Point, 450 meters east of the Yazoo and Mississippi Valley Railroad, about 75 meters south of the tramway running back from the river to a sawmill, and about 50 meters southeast from a house, and consists of a flat stone and iron pipe. In 1897 it was reported that the stone was in good condition, but the cap was gone from the pipe.

P. B. M. XXIX.—Is near *Baton Rouge, East Baton Rouge Parish, La.*, and is the top of a square cut on the top of a limestone monument 14 inches square, at the south end of the Baton Rouge base line; the stone is 4 feet under the inner or east slope of the levee, 10 feet from the inner base of the levee, 20 meters below the angle in the levee, 10 meters down the river from the plantation line on which stands a 14-inch pecan tree in line of fence along the road, 2 meters down the river from a point opposite an 18-inch hackberry stump 5 feet high, which stands on the opposite side of the road 10 meters from the bench mark, and is blazed with a triangle; a pecan tree blazed with triangle is 14.8 meters from the bench mark. A 4-foot pipe was placed over the copper bolt in the center of the stone in 1897; its cap is marked U. S. P. B. M. 1891, and just shows above the slope of the levee. The bench mark is not of any value as a bench mark on account of the great weight upon it, especially during high water when the levee is thoroughly saturated.

P. B. M. XXVIII.—Is about 4 miles below *Baton Rouge, East Baton Rouge Parish, La.*, and is the bottom of a small square cavity cut in the top of a marble monument, which is 6 inches square at the top, on the left bank of the Mississippi River, on Arlington plantation, about 120 meters west of the levee, 40 meters from the river bank. Blazed trees: 40-inch live oak 10 meters southeast, 40-inch live oak 20 meters northeast. Monument in good condition in 1897.

P. B. M. XXX.—Is about 700 meters south of the city limits of *Baton Rouge, East Baton Rouge Parish, La.*, and is the top of a copper bolt in the top of a limestone monument 14 inches square, marked with U. S. on the north face and 1880 on the south face, at the north end of the Baton Rouge base line, 80 meters west of the Yazoo and Mississippi Valley Railroad, 40 meters east of the levee, in a truck patch, 2 meters north of a small

ditch, 200 meters below a sugar mill which stands outside of the levee. The monument was 6 inches above ground and in good condition in 1897.

P. B. M. City Limits.—Is at *Baton Rouge, East Baton Rouge Parish, La.*, at the base of the levee, 90 meters below the south side of South boulevard, on the top of a 6 by 6 inch marble stone marking the southwest corner of the city limits of Baton Rouge. The top of the stone is sloping and is marked

CITY
LIMITS
1874

The bench mark is the highest part inside of the upper part of the figure 8.

U. S. E. 2.—Is at *Baton Rouge, East Baton Rouge Parish, La.*, and is on the top of the cast-iron coping of the brick foundation for the iron fence on the west side of the capitol grounds, on the southwest corner of the pedestal under the seventh iron post south of the northwest corner of the grounds, marked

75
U S E
/\

The rod was held between the apex of the angle and the straight line.

T. B. M. 1.—Is at *Baton Rouge, East Baton Rouge Parish, La.*, on the north end of the lowest granite step of the west entrance to the State capitol building, 4 inches from the front of the step, and 4 inches from the balustrade. (See note 5, p. 580).

P. B. M. XXXI.—Is at *Baton Rouge, East Baton Rouge Parish, La.*, and is a bench mark of the United States Engineers; it is the top edge of the marble foundation stone under the center of the west side of the tower on the north side of the west entrance to the State capitol building, directly under the round window in the west face of the tower, 27 inches above the ground, 5 inches above the top granite foundation stone, directly over and 29 millimeters above the horizontal furrow of mark ($\overline{\wedge}$) cut in the face of the stone. The edge is at the base of the molding cut in the stone.

P. B. M. Barracks.—Is at *Baton Rouge, East Baton Rouge Parish, La.*, and is the top of a copper bolt leaded vertically into the top of the southeast corner of the pedestal under the column at the southeast corner of building "B" in the university campus (old barracks), marked

P B M
⊙
U S

T. B. M. 2.—Is at *Baton Rouge, East Baton Rouge Parish, La.*, in the north root of a live-oak tree on the south line of a small park in the center of North boulevard, at its intersection with St. Louis street, opposite city hall. (See note 33, p. 583).

P. M. M. Post-Office.—Is at *Baton Rouge, East Baton Rouge Parish, La.*, on the Government post-office building on the northwest corner of North boulevard and Church street, and is the top of a copper bolt leaded vertically into the corner of the water table

at the southeast corner of the colonnade in front of the building, 1 414 millimeters above the granitoid pavement and 100 millimeters from the southeast corner of the water table, marked

U S
⊙
P B M

The foundation of the post-office was laid in 1894.

P. B. M. North Boulevard.—Is at *Baton Rouge, East Baton Rouge Parish, La.*, on the south side of a small park in the center of North boulevard, on line with center of Church street, 36.6 meters from the northeast corner of Church street and North boulevard, 37.6 meters from the southeast corner of the post-office building, 20 meters east of the band stand in the park, and 30.7 meters from the southwest corner of North boulevard and St. Ferdinand street, and about 190 meters east of the State capitol building. (See note 29, p. 583, except the tile is marked "1893" and the cap of the iron pipe is marked "1897.")

P. B. M. XXXII.—Is at *West Baton Rouge, La.*, in the center of a granite post buried in the flower garden in front of a plantation house, 90 meters back of the levee, 190 meters back from the right bank of the river, about 200 meters above a point directly opposite the State capitol building, and about 400 meters below the ferry landing. The plantation house was owned by J. H. Gay in 1880. The stone is 1 foot above ground, in good condition (1897). (See note 3, p. 580.)

T. B. M. 90.—It is near *West Baton Rouge, La.*, on *Homestead plantation, West Baton Rouge Parish, La.*, in the west root of a 2½-foot live-oak tree in the road back of the levee, in front of the residence of J. H. Hiss, 1 meter from the yard fence, halfway between the front gate and the south line of the yard. (See note 33, p. 583.)

T. B. M. 89.—Is near *West Baton Rouge, La.*., on *Anchorage plantation, West Baton Rouge Parish, La.*, 143 meters below the dividing line of Anchorage and Poplar Grove plantations, in the east root of a 3-foot pecan tree, standing in the road back of levee and 3 meters from the fence, and 1 meter below a large gate. A 5-foot pecan tree stands about 45 meters up the road from the bench-mark tree. (See note 33, p. 583.)

B. M. $1\frac{1}{3}$.—Is near *West Baton Rouge, La.*, on *Poplar Grove plantation, West Baton Rouge Parish, La.*, on the river side of the new levee, at its base, and 35 meters below the prolongation of the fence along the south side of the yard around the residence of Mr. Auguste Lesseps, and consists of a copper bolt in a stone post, about 3 inches above ground.

T. B. M. 88.—Is near *West Baton Rouge, La.*, on *Poplar Grove plantation, West Baton Rouge Parish, La.*, in the east root of a 10-inch china-berry tree standing in the front yard of Mr. Auguste Lesseps's residence, 5 meters from the front fence, and on the lower side of the footpath leading from the road to the house. (See note 33, p. 583.)

P. B. M. Poplar Grove.—Is near *West Baton Rouge, La.*, on *Poplar Grove plantation, West Baton Rouge Parish, La.*, on the downstream side of the front steps to gallery of the plantation residence, occupied by Mr. Auguste Lesseps, agent for Mrs. Harris, owner; 0.4 meter below the downstream outer edge of the steps, and 1.14 meters out from the face line of the brick pillars under the gallery. (See note 29, p. 583.)

T. B. M. 87.—Is near *West Baton Rouge, La.*, on *Favrot plantation, West Baton Rouge Parish, La.*, in the east root of a large live-oak tree standing inside of a fence back of the road back of the levee, 103 meters below the lower edge of the residence of Mr. Favrot. The bench mark is outside the fence. (See note 33, p. 583.)

T. B. M. 85.—Is near *Lobdell, La.*, on *Belair Point, West Baton Rouge Parish, La.*, in the root of an 8-inch tree standing one-half meter back of the fence, back of the road, back of the levee, back of the high-water gauge No. 36. (See note 33, p. 583.)

T. B. M. 84.—Is near *Lobdell, La.*, on *Viola plantation, West Baton Rouge Parish, La.*, in the south root of a 3-foot live-oak tree with top cut off, standing in the road about 1 meter from the inner base of the levee, about 2 meters west of the east yard fence and 44 meters east of the entrance to the plantation residence, about 250 meters below stone line No. 169. (See note 33, p. 583.)

T. B. M. $\frac{169}{4}$.—Is near *Lobdell, La.*, on *Viola plantation, West Baton Rouge Parish, La.*, and is a flat stone and iron pipe, 840 meters from the levee and on the south bank of a large ditch; it is 359°, 572 meters from the sugar house.

P. B. M. XXXIII.—Is near *Lobdell, La.*, on *Belmont plantation, West Baton Rouge Parish, La.*, and is a granite post buried in front of the pillar at the northwest corner of the house of Mr. A. Guesnard.

T. B. M. 83.—Is near *Lobdell, La., West Baton Rouge Parish, La.*, in an osage orange stump standing at the side of the road at the end of the hedge which forms the dividing line between Belmont and Lobdell plantations. (See note 33, p. 583.)

T. B. M. 82.—Is at *Lobdell, La., West Baton Rouge Parish, La.*, 7 meters back of the rear corner of G. W. Ory & Co.'s store and Lobdell post-office building, on the downstream side of the lane leading back from the river; in the root toward the river of an osage orange stump standing one-half meter from the fence. (See note 33, p. 583.)

T. B. M. 80.—Is near *Lobdell, La., West Baton Rouge Parish, La.*, 30 meters upstream from the road crossing the levee and leading back to the Allendale sugar mill; on the upstream root of an 8-inch china berry tree just inside of fence back of the road back of the levee. (See note 33, p. 583.)

P. B. M. Allendale.—Is near *Lobdell, La., West Baton Rouge Parish, La.*, 30 meters back of the fence back of the road back of the levee, 64 meters back of center of levee, 48 meters west of the road which crosses the levee and leads back to the sugar mill on Allendale plantation owned by Mr. Martin Kahoa, 14 meters south of the east and west fence which runs back of the first cabin nearest the road; in the southwest corner of the north portion of the mule lot, 0.47 meter east of the fence, 0.45 meter north of the northwest corner of the large barn, 9.3 meters west of the cistern. (See note 29, p. 583.)

P. B. M. XXXIV.—Is about half a mile above the store and post-office of *Devall* at *Grassmans Landing, West Baton Rouge Parish, La.*, and is a granite post in front of the house of Mr. B. Chamberlain, jr.

T. B. M. 75.—Is near *Devall, La.*, on *Batture plantation, West Baton Rouge Parish, La.*, 65 meters northeast of the dividing line between Batture and Clarkland plantations, on the south side of a live-oak grove in front of Mr. A. M. Kean's residence; in the east root of a 2½-foot pecan tree standing in line with the fence back of the road back of levee. (See note 33, p. 583.)

P. B. M. Solitude.—Is near *Devall, La., West Baton Rouge Parish, La.*, on *Solitude plantation*, 240 meters below the square angle in the levee (at high-water gauge No. 38), where it leaves the river and turns south across the point toward Devalls Landing; on the south side of the road, 9 meters south of the garden fence around the house of George Williams, colored, and 50 meters west of the levee; midway between two pecan trees, the nearest ones toward the levee in a row of three, distant 10 meters from a triangular blaze 4 feet above the ground on each, and facing the bench mark. (See note 29, p. 583.)

T. B. M. 74.—Is near *Devall, La.*, on *Solitude plantation, West Baton Rouge Parish, La.*, 11 meters east of P. B. M. Solitude, on the south root of 3-foot pecan tree, the easterly one in a row of three. (See note 33, p. 583.)

T. B. M. 73.—Is near *Devall, La.*, on *Solitude plantation, West Baton Rouge Parish, La.*, on the side toward the river of a sycamore tree standing inside of the yard fence of James Price (the observer of high-water gauge No. 38), 15 meters north of the northwest corner of the house. (See note 33, p. 583.)

T. B. M. 72.—Is near *Devall, West Baton Rouge Parish, La.*, about 1 500 meters above the square angle in the levee where high-water gauge No. 38 is situated; on side toward the river of a large cottonwood tree, with top broken off, standing back of the road back of the levee; 84 meters below the corner of the fence around the field in which stands a large cottonwood tree. (See note 33, p. 583.)

T. B. M. 70.—Is near *Walls, La.*, about 375 meters above the residence on Alford's *Rosehill plantation*, West Baton Rouge Parish, La.; nearly opposite the mouth of a lane on the south side of which is a church in a field; on a live-oak stump standing in the middle of the road back of levee. (See note 33, p. 583.)

B. M. $\frac{18}{4}$.—Is near *Walls, La.*, about west of *Highland Landing*. West Baton Rouge Parish, La., 252 meters back of the new levee, 125 meters in front of the new railroad, 150 meters north of an east and west hedge fence, 10 meters north of an 18-inch tree; on the west side of a ditch and 4 meters south of the intersection of ditches, and is a 6 by 6 inch limestone monument marked U. S., with a hole in the center. The stone is leaning toward the ditch, and rod was held on the high point inside of the lower part of the letter S.

P. B. M. XXXV.—Is 125 meters below *Arbroth* store and post-office, West Baton Rouge Parish, La., 54 meters back from the inner base of the levee, 14 meters back of a small store, 1 meter below the fence, below tramway running back from river at *False River Landing, La.* The stone is marked thus:

U S
B ⊡ M
1880

and was reported in good condition in 1900. (See note 32, p. 583.)

T. B. M. 65.—Is near *Arbroth, La.*, 1 000 meters above the present *Kelson Landing*, West Baton Rouge Parish, La., near the lower end of a pecan grove, on a large root on the back side of the large pecan tree nearest the levee on which high-water gauge No. 39 is situated. (See note 33, p. 583.)

B. M. $\frac{18}{3}$.—Is near *Hermitage, La.*, on *Wildwood plantation*, West Baton Rouge Parish, La., and is a stone post standing in the fence line back of the road back of the

levee and near the middle of the front side of the pecan grove around the site of the old Robert Clemon residence. The house has been destroyed, but the chimney was still standing in 1900.

T. B. M. 64.—Is about three-fourths of a mile below *Hermitage*, West Baton Rouge Parish, La., and just above a negro cabin; on the north root of a 3-foot gum tree, 4 meters inside of the fence on the south side of the road back of the levee. (See note 33, p. 583.)

P. B. M. XXXVI.—Is at *Hermitage*, *West Baton Rouge Parish*, *La.*, 75 meters below the bank of the outlet of False River, on the right bank of the river. A 3-foot live-oak, bearing high-water gauge No. 40, stands 10 meters north, and a 2-foot live-oak stands 13 meters southwest, both bearing blazed triangles facing the stone, which is marked thus:

U S
B ⊡ M
1880

The house that originally stood by the bench mark is destroyed. (See note 32, page 583.)

T. B. M. 63.—Is near *Hermitage*, *West Baton Rouge Parish*, *La.*, 149 meters above *Grand Bay Landing* warehouse, *Pointe Coupee Parish*, *La.*, 10 meters back of the old levee, on the long northwest root of a 2-foot thorn tree about 4 feet from the trunk of the tree. (See note 33, p. 583.)

B. M. $\frac{182}{3}$.—Is near *Anchor*, *Pointe Coupee Parish*, *La.*, 214 meters below the cotton gin at *Cooks Landing*, which is the landing for *Anchor* post-office; two meters east of the ditch and 17 meters west of the west base of the old levee and is the highest point in a small square cut on the south corner of a 6 by 6 inch stone monument with top broken off projecting 8 inches out of ground.

T. B. M. 61.—Is near *Anchor*, *Point Coupee Parish*, *La.*, 170 meters below the cotton gin at *Cooks Landing*, at the back edge of the road back of the old levee, in the top of a 4-inch honey-locust stump which joins a 6-inch honey-locust tree. (See note 33, p. 583.)

P. B. M. XXXVII.—Is on the building known as the *St. Claude Landing* warehouse (upper part used as a dwelling), *Pointe Coupee Parish*, *La.*, near *Anchor*, owned by the heirs of Mr. Robin, and the only brick building in the vicinity, and is the upper edge of a horizontal notch cut in brick, nearly on the middle line of the front face and 5.4 feet above the ground.

T. B. M. 59.—Is three-fourths of a mile above *St. Claude Landing* warehouse, *Pointe Coupee Parish*, *La.*, near *Anchor*, about 150 meters below a point in the road opposite an old sugar mill, on side toward the river of a 24-inch honey-locust tree standing in a square angle of the fence on the side of the road back of the levee. Levee B. M. 224 is on same tree. (See note 33, p. 583.)

T. B. M. 58.—Is in Pointe Coupee Parish, near *Bayou Sara*, *Feliciana Parish*, *La.*, about 400 meters below high-water gauge No. 41, on the west root of a 2½-foot dead pecan tree standing in the middle of the road behind the levee. Levee B. M. 221 is on the same tree on the opposite side. (See note 33, p. 583.)

T. B. M. 57.—Is in Pointe Coupee Parish, near *Bayou Sara*, *Feliciana Parish*, *La.*, 2 870 meters below P. B. M. XXXVIII on Preston plantation, on the south root of a

2-foot pecan tree standing in the middle of the road below the levee and the fence. (See note 33, p. 583.)

T. B. M. 56.—Is 1 560 meters below P. B. M. XXXVIII, in Pointe Coupee Parish, near *Bayou Sara, Feliciana Parish, La.*, on a 2-foot thorn tree standing in the center of the road behind the levee. (See note 33, p. 583.)

P. B. M. XXXVIII = △ S. E. Base.—Is in Pointe Coupee Parish, La., about 1 mile below a point opposite *Bayou Sara, Feliciana Parish, La.*, on the right bank, on Preston plantation, 700 meters above the division line between Preston and Woodburn plantations; 94 meters back of the inner base of the levee, 14 meters west of the lower end of a deep hole in the pasture, and consists of the top of a copper bolt leaded in the top of a limestone monument 14 inches square, projecting 6 inches above ground. A blazed double thorn tree, 2 feet in diameter, stands 75 meters east by the roadside, and a blazed dead 2-foot thorn tree north 70° west, 44 meters.

T. B. M. 55.—Is in Pointe Coupee Parish, near *Bayou Sara, Feliciana Parish, La.*, and one-half mile below P. B. M. XXXIX, about 80 meters back from the river and the same distance above a clump of timber on the backside of a large cottonwood tree on the side of the levee toward the river. (See note 33, p. 583.)

P. B. M. XXXIX = △ N. W. Base.—Is in Pointe Coupee, Parish, La., opposite Freehan's warehouse at *Bayou Sara, Feliciana Parish, La.*, and 800 meters below the ferry landing on the right bank and consists of the top of a copper bolt in a limestone monument 14 inches square, standing 2 feet above ground, marked U. S. on the west side and 1880 on the east side. The concrete bed has dirt partly washed out from beneath it, and it may have been disturbed, as it is at the top edge of the river bank.

B. M. $\frac{1}{191}$.—Is in Pointe Coupee Parish, opposite *Bayou Sara, Feliciana Parish, La.*, 7 meters in front of a cotton gin, 30 meters below a road crossing the levee from the ferry landing, in the fence line back of the road back of the levee; and is top of a copper bolt in a stone post standing 8 inches out of ground; the bolt is flush with top of stone.

T. B. M. 53.—Is in Pointe Coupee Parish, near *Bayou Sara, Feliciana Parish, La.*, one-half mile below Scoot crevasse, about 200 meters below the junction of the levees and about 500 meters back of the right bank of the river on a root on face toward the river of 5-pronged cypress tree standing in the fence line back of the road back of the levee. Levee B. M. 192 is on the same tree. (See note 33, p. 583.)

B. M. $\frac{1}{192}$.—Is 655 meters east of Red Store, now *Pointe Coupee* post-office, *Pointe Coupee Parish, La.*, on the right bank in an open field on Judge Cooley s plantation, on the south bank of a ditch, 200 meters from the levee, and is a flat stone and an iron pipe. The stone has no bolt in it; the rod was held on the top of the stone at the edge of the hole where the bolt should have been. There is no cap on the pipe.

P. B. M. XL.—Is 720 meters above Red Store, now *Pointe Coupee* post-office, *Pointe Coupee Parish, La.*, 445 meters below the Union Store, on the downstream side of the steps of the residence of Mr. N. Carmanche, on the right bank, 67 meters back of the new levee. (See note 32, p. 583.)

T. B. M. 50.—Is near *Pointe Coupee, Pointe Coupee Parish, La.*, 1 010 meters above the Union Store and 350 meters above high-water gauge No. 42; on the side toward the river of a 3-foot live-oak tree standing 1 meter inside of the fence back of the road back of the levee on right bank. The tree is one of three standing in a triangular position. (See note 33, p. 583.)

T. B. M. 49.—Is near *Brooks, Pointe Coupee Parish, La.*, 80 meters below P. F. Bourgeois & Son's general store; on the side toward the river of a 5-foot pecan tree standing in the road 2 meters from the fence back of the levee. Levee B. M. 168 is on same tree. (See note 33, p. 583.)

P. B. M. XLI.—Is near *Brooks, Pointe Coupee Parish, La.*, on the right bank immediately back of a prominent angle in the levee around an old crevasse pool, at the downstream end of the steps leading to the gallery in front of the residence of Mr. Ed. Morrison. The stone is marked

U S
⊡
1880

(See note 32, p. 583.)

T. B. M. 47.—Is near *Brooks, Pointe Coupee Parish, La.*, 353 meters above P. B. M. XLI, on the south side of the road back of the levee, in the highest part of a large stump. (See note 33, p. 583.)

T. B. M. 46.—Is near *Brooks, Pointe Coupee Parish, La.*, near *Morganza crevasse*, on the right bank 210 meters above the angle in the levee which is opposite high-water gauge No. 43, on the north side of a 1½ foot leaning willow tree standing on the south side of the road back of the levee. (See note 33, p. 583.)

B. M. $1\frac{51}{3}$.—Is near *Morganza, Pointe Coupee Parish, La.*, 500 meters above *Morganza crevasse*, in cottonwoods on the right bank, 80 meters outside of the piece of old levee known as Grand Levee, 350 meters outside of the outer base of the present main levee, 350 meters below a prominent angle in the same, 1 195 meters below the junction of the main levee and the old Grand Levee, where a watchman's station is located, known by a square enlargement of the levee for a cabin and levee materials, and is a flat stone and an iron pipe. The surrounding trees are blazed facing the pipe. The stone has no bolt in it; the rod was held in the center of the pipe.

T. B. M. 43.—Is near *Morganza, Pointe Coupee Parish, La.*, 1 mile above *Morganza crevasse*, on levee at watchman's station, known by a square enlargement of the levee for a cabin and levee materials, at junction of the old Grand Levee and the present main levee, 450 meters below the mouth of lane leading back along the lower side of Morganza plantation, and is top of the period after the date 1895 on the levee bench mark. (P. B. M. XLII at this junction is either covered up or destroyed.)

T. B. M. 40.—Is near *Morganza, Pointe Coupee Parish, La.*, 1 450 meters below the lane or State road leading back from *New Texas Landing*, at the top inner edge of levee, at an angle, and is the highest part of the rim around the hole of the levee bench mark, marked U. S. 1895.

T. B. M. 39.—Is near *Morganza, Pointe Coupee Parish, La.*, at New Texas Landing, Pointe Coupee Parish, La., on Stone Line 156, in the line of fence on the south side of the State road leading back from the levee, on the east root of a 2½-foot cottonwood tree, 14 meters back from corner of the fence at the junction of the roads. (See note 33, p. 583.)

B. M. $1\frac{58}{9}$.—Is near *Morganza, Pointe Coupee Parish, La.*, on north side of the State road or lane leading back from *New Texas Landing, Pointe Coupee Parish, La.*, 279 meters west of a corner of the fences at the mouth of the lane, just back of the road back of the new levee, 1 meter south of the line of fence, and is a square marking

stone whose edges of stone have been chipped off. The copper bolt was gone and the rod was held on the highest point of the stone.

T. B. M. 38.—Is about 1 000 meters below *Raccourci, Pointe Coupee Parish, La.*, about 375 meters below a Catholic church, on the north side of the road, behind the levee, on the northwest root of an 18-inch sycamore tree. (See note 33, p. 583.)

T. B. M. 37.—Is at *Raccourci, Pointe Coupee Parish, La.*, in the yard of Ed. Lacour's residence, a little above and back of the levee from the store and post-office, on the south root of a 2-foot pecan tree, 58 meters in front of the house, on the upper side of the walk. (See note 33, p. 583.)

P. B. M. XLIII.—Is at *Raccourci, Pointe Coupee Parish, La.*, at the new house of Edgard Lacour, a little above and back of levee from the store and post-office, under the top front step to the gallery, about 1 foot to the left of the center; it was in front of the old house. (See note 32, p. 583.)

T. B. M. 35.—Is near *Raccourci, Pointe Coupee Parish, La.*, about 3 000 meters above the residence of Edgard Lacour (distance taken along the levee). It is the top of the period after the date, 1895, on levee bench mark at the top edge of the levee at a prominent angle.

T. B. M. 33.—Is near *Lacour, Pointe Coupee Parish, La.*, on the Favorite plantation, about 15 meters inside of the northwest corner of the yard fence of Mr. V. Lacour's residence, on the north root of a 2-foot china berry tree. (See note 33, p. 583.)

P. B. M. XLIV.—Is 2½ miles below the town of *Williamsport, Pointe Coupee Parish, La.*, on Old River, and 1¾ miles above the *Ennis* Oil Mill, 220 meters back of fence, back of road, back of levee, back of Old River, at the house of Dr. A. A. Batchelor, at the lower side of the steps, in the angle where they join the gallery on the front of the house. (See note 32, p. 583.)

T. B. M. 22.—Is at *Williamsport, Pointe Coupee Parish, La.*, on Old River, 30 meters south of the blacksmith shop at the lower end of the town, on the south root of a 4-foot cottonwood tree on west side of road, back of levee. (See note 33, p. 583.)

T. B. M. 20.—Is about 400 meters below the house occupied by Mr. A. J. Noland, near *Smithland, Pointe Coupee Parish, La.*, on the east root of a 2½-foot pecan tree standing 3 feet west of north and south hedge fence on west side of road behind levee. The tree stands near where B. M. $1\frac{5}{4}^{0}$ should be. The bench mark pipe was pulled up and found lying by the side of the road. (See note 33, p. 583.)

P. B. M. Smithland.—Is 780 meters below *Smithland* post-office, *Pointe Coupee Parish, La.*, and 300 meters below where the road crosses the levee leading south from the landing at the plantation residence owned by Mr. Archie D. Smith and occupied by Mr. A. J. Noland, in the northeast corner of the yard, 1 meter from each fence, 30 meters north of the end and 4 meters east of the prolongation northward of a row of 6 large live oak trees. (See note 29, p. 583.)

P. B. M. XLV.—Is at *Smithland, Pointe Coupee Parish, La.*, northeast of the warehouse in rear of which is Smithland post-office, 22 meters back of the right bank of the river, in a lot 3 meters north and west, respectively, of two fences. The stone is marked thus:

U S
B ⊡ M
1880

(See note 32, p. 583.)

T. B. M. 17.—Is about 1 300 meters above *Smithland, Pointe Coupee Parish, La.*, on edge of the borrow pit at the back edge of the road back of the levee opposite a prominent angle in the levee at junction of the old levee leading southeast toward the river, on face toward the river of 5-inch thorn tree. (See note 33, p. 583.)

B. M. W. (Ewens, 1890).—Is at *Red River Landing, Pointe Coupee Parish, La.*, in the front yard, just to the left of gate as you enter, of Mr. Rodech's residence, back of levee, and is a copper bolt in a limestone slab, under the ground, with an iron pipe on top.

B. M. B. (Ewens, 1892).—Is at *Red River Landing, Pointe Coupee Parish, La.*, nearly in front (a little below) of Mr. G. W. Reagan's store on face toward the river of a large cypress. (See note 33, p. 583.)

B. M. D. (Ewens, 1896).—Is at *Red River Landing, Pointe Coupee Parish, La.*, on little knoll directly back of Mr. G. W. Reagan's residence, on large sycamore tree. (See note 33, p. 583.)

B. M. $\frac{14}{3}$.—Is on the right bank about 1 mile above *Red River Landing, Pointe Coupee Parish, La.*, and 154 meters below the Catholic Church, in line with the center lane running back from the river, and just above the wagon road crossing the levee. It is a 6 by 6 inch limestone monument standing on inner slope of levee, 5 feet above the base.

T. B. M. 13.—Is near *Red River Landing, Pointe Coupee Parish, La.*, on the right bank, 840 meters above B. M. $\frac{14}{3}$, 600 meters above the mouth of Old River (or Red River), and 35 meters back from right bank of Old River, on the east root of a four-foot willow tree. (See note 33, p. 583).

P. B. M. Carrs Point.—Is near *Red River Landing, Pointe Coupee Parish, La.*, on *Carrs Point Plantation, Concordia Parish, La.*, owned by Lewis Trager, 1 mile above the mouth of Old River (or Red River), in the line of fence running east and west on the south side of the road running in front of the cabins, 257 meters back from the right bank and 9½ meters south of south line of cabins, and consists of the top of a copper bolt cemented in the top of 6 by 6 inch marble monument projecting 10 inches from the ground, and marked thus:

U S
⊙
N O

T. B. M. 9.—Is in Concordia Parish, La., near *Red River Landing*, 1½ miles above *Carrs Point Landing*, about 230 meters below a small levee standing square with the river bank, 10 meters back of main right bank and 2 meters back of road, on the base of a 15-inch sycamore tree, on face toward the river. (See note 33, p. 583).

T. B. M. 6.—Is opposite *Tarbert Landing, Wilkinson County, Miss.*, in Concordia Parish, La., 2,500 meters below P. B. M. L. 5 meters from the top of the right bank on side toward the river of a 2½-foot locust tree. (See note 33, p. 583).

P. B. M. L = △ S. W. Base.—Is about 2 miles below *Point Breeze, Concordia, Parish, La.*, on the land of B. M. Lemley, of Vicksburg, Miss., 60 meters above and 76 meters back of a 1½-story house on road, top of right bank, 21 meters above the lane running back from the river, 7 meters back of turn row or headland in cotton field, and 18 meters toward the river from the corner of garden, and consists of the top

of a copper bolt in the top of a stone monument 14 inches square on top, set flush with the ground.

P. B. M. LI=△ N. E. Base.—Is 1 mile below the upper end of *Point Breeze, Concordia Parish, La.*, on land of G. W. Reagan, 80 meters above the line fence between Reagan and Lemley, and about 45 meters back of the road along the top of the main right bank, 7 meters south of the southwest corner of the garden fence back of the negro cabin owned by Eli Lennox, and 23 meters southwest of the cabin, and consists of the top of a copper bolt in the top of a stone monument, 14 inches square on top, standing nearly flush with the ground in a cotton row.

T. B. M. 5.—Is near *Point Breeze, Concordia Parish, La.* It is 565 meters below P. B. M. LI=△ N. E. Base on the side of north and south road along the east side of a cotton field, on the west root of a 3-foot sycamore stump. There is timber east of the road. (See note 33, p. 583.)

T. B. M. 4=High-water gauge B. M. 49.—Is 710 meters above P. B. M. LI or ◎ N. E. Base and 900 meters below the upper end of *Point Breeze, Concordia Parish, La.*, a little above and in front of a large cabin occupied by Reverend Rickson Jones (colored), the observer of the gauge, in the inner face of a 6-inch thorn tree, one of three standing together on the slope of the main right bank, back of willow and cottonwood timber. The gauge is nailed to the outer one.

P. B. M. Point Breeze.—Is on *Point Breeze, Concordia Parish, La.*, 66 meters below B. M. $1\frac{1}{3}^1$, and about 335 meters below the upper end of Point Breeze, along the high bank, 3 meters outside of the road and 8 meters back from the top of the main right bank. The cap on the pipe is about 9 inches above the ground. (See note 29, p. 583.)

B. M. $1\frac{1}{3}^1$.—Is 270 meters below the upper end of *Point Breeze, Concordia Parish, La.*, in the south end of a lane on the top of the main right bank, immediately east of the second cabin below the upper end of the point, occupied by Uriah Pollock, and consists of the top of a small square cut on the top of 6 by 6-inch marking stone, projecting 6 inches from the ground.

P. B. M. XLVIII.—Is about 400 meters below the present landing for *Fort Adams, Wilkinson County, Miss.*, about 30 meters above a ravine, on the small flat on the side of the bluff, between and a little back of two small cabins on the flat and 50 meters back of a large house standing at foot of slope. In 1900 it was reported that the store originally near the stone was gone, that the bluff above and below the stone had been sliding into the river, but it seemed stable around the stone, and that the stone was in good condition. (See note 32, p. 583.)

T. B. M. 1.—Is about 600 meters below the lower end of the village of *Fort Adams, Wilkinson County, Miss.*, 635 meters below P. B. M. Fort Adams, and 1 300 meters above the present landing on the river of Fort Adams; on east root of a 2-foot willow tree standing in road at foot of bluff. (See note 33, p. 583.)

P. B. M. Fort Adams.—Is in the lower end of the village of *Fort Adams, Wilkinson County, Miss.*, in the front yard of Mr. H. L. Stutzmans, on the east side of Main street and north side of the street running east to the foot of the bluffs, 3½ meters east of the northeast corner of the street intersection, 3 meters south of the southwest corner of the house, 69 meters below the south end of the bridge over a ravine. (See note 29, p. 583.)

P. B. M. XLIX.—Is at *Fort Adams, Wilkinson County, Miss.*, just above the

corners at the upper end of the village, at southwest corner of the house of Mr. Baker, 455 meters above P. B. M. XLIX. The stone was reported in good condition in 1900. (See note 32, p. 583.)

DESCRIPTIONS OF PERMANENT BENCH MARKS BETWEEN CINCINNATI, OHIO, AND SOMERSET, KY.

Y_4.—*Cincinnati, Ohio.* (See p. 665, App. 8, Report for 1899.)

Z_4.—*Cincinnati, Ohio.* (See p. 665, App. 8, Report for 1899.)

A_5.—*Ludlow, Kenton County, Ky.* (See p. 665, App. 8, Report for 1899.)

A.—Is a copper bolt at *Newport, Campbell County, Ky.*, at the south end of the Newport and Cincinnati bridge (Louisville and Nashville Railroad), on the east end of bridge seat of first pier south of overhead superstructure, 0.19 meter north of retaining wall, 0.59 meter west of east end of bridge-seat stone, and 0.3 meter below surface of sidewalk. (See note *z*, p. 580.)

U. S. E.—Is in *Newport, Campbell County, Ky.*, 3 feet west of Cincinnati, Newport and Covington Electric Railway, at the south end of the Newport and Cincinnati bridge on end of stone of coping, about 12 inches above level of street, being the highest point in a square hole cut in the surface of the stone, 9 inches east of west face, 8 inches south of north face, and 6 inches north of iron pole set in center of stone. (See note 3, p. 580.)

B.—Is in *Covington, Kenton County, Ky.*, on the south side of Third street, east of the north entrance to the Covington post-office, being a copper bolt in the first course of limestone below the water table 1.2 meters above the surface of the ground, 6 inches west of east end of first stone east of stairway. (See note 1, p. 580.)

C.—Is a square hole cut at the north side of depot at *Ludlow, Kenton County, Ky.*, on the south abutment of the viaduct under the track at the east end of the abutment, 2.2 meters below track, on the second step of the abutment, 8 inches west of east face, 4½ inches south of north face, and 17 inches east of first step. (See note 4, p. 580.)

D.—Is at *Crescent Springs, Kenton County, Ky.*, at overhead road crossing east of the depot, 2.4 meters south of south rail of track, about level with the rail on the center of the large base stone supporting the center of bridge, 0.15 meter back of edge of stone, 0.5 meter east of west center pier, and 0.6 meter west of east center pier. (See note 4, p. 580.)

E.—Is in the village of *Erlanger, Kenton County, Ky.*, on the Town Hall building owned by Baker & Scott, on the northeast corner of Lexington and Commonwealth avenues, on the top of an iron plate covering a foundation stone, 0.25 meter west of the corner iron column and one-half inch north of south face, being center of square cut in the surface of the plate with a cold chisel.

F.—Is 125 meters north of depot at *Dixon, Boone County, Ky.*, on the line of Cincinnati, New Orleans and Texas Pacific Railway, 2.25 meters west of west rail and 0.25 meter above it, on a large capstone between brick piers supporting a bridge, 7 inches back from face and 1.28 meters south of south side of center pier. (See note 4, p. 580.)

G.—Is a copper bolt 85 meters west of the track and 300 meters south of the depot of Cincinnati, New Orleans and Texas Pacific Railway at *Richwood, Boone County, Ky.*, at northeast corner of the water table of a brick dwelling belonging to the heirs of Reuben Connors, 0.96 meter south of north corner of house. (See note 1, p. 580.)

H.—Is at an overhead wagon bridge 600 meters south of Cincinnati, New Orleans and Texas Pacific Railway depot at *Walton*, *Boone County*, *Ky.*, 1.3 meters west of and 1.8 meters above the west rail, on top of a wall between pillars supporting the bridge, 1.92 meters north from south wall and 1.15 meters back from the face. (See note 4, p. 580.)

I.—Is on a culvert in Kenton County, about 1½ miles north of *Crittenden*, *Grant County*, *Ky.*, opposite George Slett's, on line of Cincinnati, New Orleans and Texas Pacific Railway, 130 feet north of milepost "Cin. 23," 28 feet east of east rail, on the coping stone at the east end of the culvert, 0.42 meter south of center of culvert and 5½ inches back from its face. (See note 4, p. 580.)

J.—Is a copper bolt in the south face of foundation of Joe. Collins's house in *Crittenden*, *Grant County*, *Ky.*, 50 meters west of the Cincinnati and Lexington turnpike, 2.18 meters east of the southwest corner of the house, in the first course below the base-board and 122 millimeters below the same. (See note 1, p. 580.)

K.—Is 210 meters below the Cincinnati, New Orleans and Texas Pacific Railway depot at *Sherman*, *Grant County*, *Ky.*, 4.2 meters east of the east rail, on the northwest corner of the capstone of the northwest pillar of a water tank (311). (See note 4, p. 580.)

L.—Is a horizontal chisel mark cut in the end of a copper bolt leaded horizontally into a retaining wall on the west side of the Lexington turnpike, in front of Lottie Bradford's residence at *Dry Ridge*, *Grant County*, *Ky.*, 1.15 meters south of the iron gate, 0.56 meter below the coping of the wall and 0.54 meter above the ground.

M.—Is a copper bolt in the north face of the foundation of the county record office at *Williamstown*, *Grant County*, *Ky.*, 3.11 meters east of the northwest corner of the building, 0.66 meter above the brick walk, 0.39 meter below the lower edge of the sandstone water table, and about 50 feet west of Main street (Lexington turnpike), on the south side of alley. (See note 1, p. 580.)

N.—Is on the south side, at the west end, of stone culvert 100 meters north of Cincinnati, New Orleans and Texas Pacific Railway station at *Mason*, *Grant County*, *Ky.*, on a step 0.623 meter below the coping stone and 6 inches back from the face. (See note 4, p. 580.)

O.—Is at overhead wagon bridge No. 12, 0.7 mile north of *Blanchett*, *Grant County*, *Ky.*, on the line of Cincinnati, New Orleans and Texas Pacific Railway, 2.1 meters east of east rail and 0.5 meter above it, and 3.62 meters south of the north end of the foundation, on fourth capstone from the north end and 0.15 meter from its west face. (See note 4, p. 580.)

P.—Is a copper bolt at *Corinth*, *Grant County*, *Ky.*, about 70 meters west of the depot on the west side of Main street, in the south side of the foundation of a store owned by Joe S. Horner, 5.2 meters west of the southeast corner, 1.49 meters above the ground and 0.25 meter below the baseboard. (See note 1, p. 580.)

Q.—Is a horizontal V-shaped groove in the bottom of a square cut in the north face of the store of R. Lancaster at *Hinton*, *Scott County*, *Ky.*, 80 feet west of the tracks and 50 feet south of the Cincinnati, New Orleans and Texas Pacific Railway station, 0.31 meter west of east corner of the building, 0.7 meter above the ground and 0.2 meter below the baseboard. (See note 4, page 580.)

R.—Is a copper bolt at *Sadieville, Scott County, Ky.*, about 2 meters below the level of the Cincinnati, New Orleans and Texas Pacific Railway, on the south abutment of an iron bridge over a street, on west end of the top through course below the bridge seat stone, midway between the north and south faces of the stone and 8 inches west of west face of the bridge seat stone. (See note 2, p. 580.)

S.—On a viaduct or culvert of the Cincinnati, New Orleans and Texas Pacific Railway, 3¼ miles south of *Sadieville, Scott County, Ky.*, on the north side of the west end, on the northwest corner of a large coping stone, 10 inches from the west face and 6 inches from the north face. (See note 4, p. 580.)

T.—Is 50 meters north of the Cincinnati, New Orleans and Texas Pacific Railway station at *Rogers Gap, Scott County, Ky.*, on the north end of the west side of a culvert under the track, 3 inches east of the west face and 12½ inches south of the north face. (See note 4, p. 580.)

U.—Is three-fourths of a mile south of *Kinkaid, Scott County, Ky.*, on the south abutment of the east end of bridge No. 15, over Dry Run Creek, on the coping stone of the abutment, midway between its north and south faces, 18 inches west of the east face and 2 meters below the Cincinnati, New Orleans and Texas Pacific Railway tracks. (See note 4, p. 580.)

V.—Is at overhead bridge No. 19, three-fourths of a mile north of Cincinnati, New Orleans and Texas Pacific Railway station at *Georgetown, Scott County, Ky.*, on the coping stone of a pier, 2.26 meters west of the west rail and 3.15 meters north of its south end, at the same elevation as the top of rail. (See note 4, p. 580.)

W.—Is a copper bolt 75 feet southwest of the Cincinnati, New Orleans and Texas Pacific Railway station at *Georgetown, Scott County, Ky.*, on the northeast corner of the foundation of the warehouse of E. N. Offutt & Son, on the west side of Maddox street, 110 feet north of Jackson street, in the north face of the foundation, 6 inches west of the corner and 0.83 meter above the ground. (See note 1, p. 580.)

X.—Is 12 meters north of milepost 71, 590 meters north of Cincinnati, New Orleans and Texas Pacific Railway station at *Donerail, Fayette County, Ky.*, on northeast corner of a coping stone over the east end of an arched culvert under the track, 8 inches south of the north face and 17 inches west of the east face. (See note 4, p. 580.)

Y.—Is 175 meters south of the Cincinnati, New Orleans and Texas Pacific Railway station at *Greendale, Fayette County, Ky.*, on the northwest corner of a coping stone over an arched culvert under the tracks, 10 inches east of the west face and 6 inches south of the north face. (See note 4, p. 580.)

Z.—Is 150 meters south of the Cincinnati, New Orleans and Texas Pacific Railway station at *Hillenmeyer, Fayette County, Ky.*, on the west end of the south side of the Cincinnati, New Orleans and Texas Pacific Railway trestle over a wagon road, on a bridge-seat stone, 6 inches south of its north face and 10 inches east of its west face. (See note 4, p. 580.)

A_1.—Is a brass bolt at the northeast corner of North Main and Maxville streets, *Lexington, Fayette County, Ky.*, on Dr. H. A. Phillips's drug store, at the east stairway entrance, in the center of the west end of the door stone, 5 inches east of its west end and 4 inches above the concrete walk. (See note 2, p. 580.)

B_1.—Is on the south side of the viaduct under Cincinnati, New Orleans and Texas Pacific Railway in front of Bedford's farm, 3.8 miles south of *Lexington, Fayette*

County, Ky., on the second step below the bridge-seat stone, 3½ inches from the front face of the first step, 10 inches north of south face of stone and 10 inches west of east face. (See note 4, p. 580.)

C_1.—Is on the north side of west end of Lyne's arched culvert, 340 meters south of the Cincinnati, New Orleans and Texas Pacific Railway depot at *Brannon, Jessamine County, Ky.*, on the first step, 5 inches west of the capstone and 5 inches north of its south face. (See note 4, p. 580.)

D_1.—Is on the Cincinnati, New Orleans and Texas Pacific Railway viaduct over Catnip Hill pike, 1.8 miles south of *Brannon, Jessamine County, Ky.*, on the north side of the west end, on the first step below bridge-seat stone, 4 inches from its west face stone and 15 inches north of the south face of the step. (See note 4, p. 580.)

E_1.—Is 150 meters north of the depot at *Nicholasville, Jessamine County, Ky.*, on the top foundation stone of an overhead wagon bridge, 1.6 meters east of and 8 inches above the east rail of the Cincinnati, New Orleans and Texas Pacific Railway, 2.3 meters south of the north end of the foundation, about midway between the ends of the second stone, 6½ inches east of the west face of the stone, and 6 inches west of bottom stringer of bridge. (See note 4, p. 580.)

F_1.—Is a brass bolt in the court-house at *Nicholasville, Jessamine County, Ky.*, in the first stone of the water table east of the corner stone at the northwest corner of the main building, midway between the upper and lower edges, 1 meter above the ground and 7 meters east of corner. (See note 1, p. 580.)

G_1.—Is 50 meters south of the Cincinnnti, New Orleans and Texas Pacific Railway depot at *Jessamine, Jessamine County, Ky.*, on the viaduct over Lass Mill pike, at the south side of the east end, on a bridge-seat stone, 8 inches east of the coping stone, 18 inches south of the north face and 18 inches west of the east face of the bridge-seat stone. (See note 4, p. 580.)

H_1.—Is at *Wilmore, Jessamine County, Ky.*, 60 meters northwest of the Cincinnati, New Orleans and Texas Pacific Railway depot, on south side of the main cross street, at the east side of the entrance to Wilmore Mercantile Company's store, on the northeast corner of an iron plate under an iron column; being the top surface circumscribed by two lines $\frac{1}{16}$ inch deep, cut at right angles with a cold chisel.

I_1.—Is a square cut on a shelf of rock *in situ*, 2¾ miles north of *High Bridge, Jessamine County, Ky.*, 54 meters north of the overhead wagon bridge of Pleasant Hill and Jessamine County pike, 0.27 meter below and 1.85 meters west of the west rail of the track of the Cincinnati, New Orleans and Texas Pacific Railway. An arrow is cut in the side of the rock 10 inches above the bench mark and pointing to it.

J_1.—Is a brass bolt, 70 meters south of the depot at *High Bridge, Jessamine County, Ky.*, on the west side of bridge over the Kentucky River, at the north end, on the coping stone of the abutment, 0.25 meters east of the west face, 1.56 meters north of the south face, 0.5 meter below, and 2.75 meters west of the west rail of Cincinnati, New Orleans and Texas Pacific Railway. (See note 2, p. 580.)

K_1.—Is a brass bolt, ¼ mile south of *High Bridge, Mercer County, Ky.*, 36 meters south of the south side of the south pier of proposed suspension bridge over the Kentucky River, 2.62 meters west of and 1.34 meters above the west rail, in the center of old drill hole made when the rock was blasted out for the cut of Cincinnati, New Orleans and Texas Pacific Railway. (See note 1, p. 580.)

L_1.—Is about midway between *High Bridge* and *Burgin* in *Mercer County, Ky.*, $\frac{1}{10}$ mile south of the milepost "Cin. 103," 160 meters north of the Curdville road crossing, on a coping stone of box stone culvert of Cincinnati, New Orleans and Texas Pacific Railway, on the east side of the north end, 12 inches from north face, and 12 inches from both east and west faces. (See note 4, p. 580.)

M_1.—Is a brass bolt at *Burgin, Mercer County, Ky.*, about 300 feet southwest of the southwest corner of the Cincinnati, New Orleans and Texas Pacific Railway depot, in the east foundation wall of the Burgin Roller Mills, owned by Cook & Spencer, 33 feet north of the southeast corner, 22 inches above the ground and 4½ inches below the tin siding. (See note 1, p. 580.)

N_1.—Is at *Burgin, Mercer County, Ky.*, 330 meters east of the Cincinnati, New Orleans and Texas Pacific Railway, on the north side of Main street, 35 feet east of the east line of Maple street, on the east end of an iron base plate under a window of the J. P. Miller Building, 6 inches west of the east buttress close to the front edge of the plate; being the surface of the plate within a square one inch on a side, cut with a cold chisel.

O_1.—Is on a shelf of rock *in situ* in *Faulconer, Boyle County, Ky.*, 168 meters south of the center of the road crossing, 7.55 meters west of the west rail of the main track of Cincinnati, New Orleans and Texas Pacific Railway, 32 millimeters above the grade of track, 24 meters west of the center of the stone wall at the east boundary of railway right of way, and 96 meters north of the southern switch block of the siding, and is a square hole cut in the rock, letters U S G S.

P_1.—Is on the east side at the north end of a culvert under Cincinnati, New Orleans and Texas Pacific Railway, 2.3 miles north of *Danville*, in *Boyle County, Ky.*, 16 meters north of the J. C. Cowell road crossing, on a coping stone, 0.3 meter below and 2.1 meters east of the east rail, 93 millimeters west of the east face and 318 millimeters south of the north face of the stone. (See note 4, p. 580.)

Q_1.—Is a brass bolt 46 meters south of the intersection of Depot and Main streets, in *Danville, Boyle County, Ky.*, in the northwest corner of the foundation of the Theological Building of Center College, in a large stone, 31 inches below the water table, 33 inches above the ground, 18¼ feet west of a doorway and 16⅓ feet east of the northwest corner of building. (See note 1, p. 580.)

R_1.—Is in a rock cut about 0.8 mile north of *Junction City, Boyle County, Ky.*, 101 meters south of the yard-limit post, 43 meters north of milepost "Cin. 117," 2.16 meters west and 30 millimeters above the west rail. It is marked by an arrow 1.25 meters above and pointing toward it. (See note 4, p. 580.)

S_1.—Is at bridge No. 41, 1¼ miles south of *Junction City*, in *Lincoln County, Ky.*, 122 meters south of the county line of Lincoln and Boyle counties, 59 meters south of a water tank, on line with the north face of the south abutment of the bridge, 3.25 meters west and 2.86 meters below west rail, on a coping stone of the south end of the circular dam of a reservoir. (See note 4, p. 580.)

T_1.—Is on a solid shelf of rock *in situ*, at the Bowen Coal Chutes, about 2⅝ miles north of *Moreland*, in *Lincoln County, Ky.*, 212 meters north of the north end of bridge No. 43, 90 meters north of a water-tank standpipe, 6 meters north of the second chute from north end, 1.57 meters west and 0.07 meter above the west rail of Cincinnati, New Orleans and Texas Pacific Railway. It is marked by an arrow 7 inches above and pointing to it. (See note 4, p. 580.)

U_1.—Is a brass bolt about 230 meters southeast of the Cincinnati, New Orleans and Texas Pacific Railway depot at *Moreland, Lincoln County, Ky.*, 45 meters west of the west rail, in the east side of the brick foundation of B. P. Shewmaker's residence, 10½ inches above the ground, 4 inches below the weatherboarding, 8⅔ feet north of the southeast corner, and 11⅔ feet south of the northeast corner. (See note 1, p. 580.)

V_1.—Is on the east side of the south abutment of bridge No. 45, over Rolling Fork Creek, 2 miles north of *McKinney* and 2.8 miles south of *Moreland, Lincoln County, Ky.*, 4 inches back from the east face of the abutment, 3 meters south of the northeast corner and 0.83 meter below rail. (See note 4, p. 580.)

W_1.—Is a brass bolt 255 meters south of the depot at *McKinney, Lincoln County, Ky.*, in the center of a rock cut, on the largest plane-faced rock, surface 7 by 8 feet, at the west side, 2.02 meters from and 1.03 meters above the west rail. (See note 1, p. 580.)

X_1.—Is on the south abutment of bridge No. 47, at Green River, 2.3 miles south of *McKinney, Lincoln County, Ky.*, at the east end of the bridge, just west of the south end of overhead truss, on a bridge seat stone, 6 inches north of the coping, 17 inches east of the west face and 1.2 meters west of the east face. (See note 4, p. 580.)

Y_1.—Is 3.2 miles north of *Kings Mountain, Lincoln County, Ky.*, at the south end of South Fork trestle, on the east end of the lower shelf of the south abutment supporting iron stringers, 1.45 meters below and 1.2 meters east of the east rail, 6.5 meters from the south end of the abutment, 4 inches west of the east face and 21 inches south of the north face. (See note 4, p. 580.)

Z_1.—Is a brass bolt 506 meters north of the depot at *Kings Mountain, Lincoln County, Ky.*, at the south end of tunnel No. 2, 1.06 meters above and 1.95 meters east of the east rail, in the south face of the wall and 8 inches east of the corner. (See note 1, p. 580.)

A_2.—Is 316 meters south of the depot at *Waynesburg, Lincoln County, Ky.*, 3.74 meters west of and 1.28 meters below the west rail, on the south end of a large coping stone of a stone box culvert, 7½ inches east of the west face and 7½ inches north of the south face. (See note 4, p. 580.)

B_2.—Is a brass bolt 725 meters north of the depot at *Eubank, Lincoln County, Ky.*, on the west end of a heavy stone box culvert, 4.4 meters west of and 2.17 meters below the west rail, in a heavy covering stone below the coping, 3½ inches south of the south wall and 8 inches above the opening. (See note 1, p. 580.)

C_2.—Is 200 meters south of the center of the station platform at *Floyd, Pulaski County, Ky.*, just north of a road crossing, on the west side of the south end of a very large arched culvert or viaduct, on the second step below the coping, about 11 meters west of and 4.6 meters below the west rail, midway between the west face of first step and edge of the second step, and 5½ inches south of the north face. (See note 4, p. 580.)

D_2.—Is 0.3 mile north of *Pulaski, Pulaski County, Ky.*, 7.3 meters east of and 3.9 meters below the top of the east rail on the east end of a culvert in front of George Shumer's farm, 1 foot from the east edge and 2¾ inches south of the north face. (See note 4, p. 580.)

E_2.—Is a brass bolt 172 meters west of the depot at *Science Hill, Pulaski County, Ky.*, in the south side, at the west end of foundation of the Methodist Episcopal Church, 4 feet 2 inches east of southwest corner, 11 inches below the weatherboarding, and 2 feet 3 inches above the ground. (See note 1, p. 580.)

F_2.—Is 1 mile south of the depot at *Norwood*, *Pulaski County*, *Ky.*, on the south side at the east end of an arched stone culvert, on the first step below the coping, 6 inches west of the east face, 5½ inches south of the north face and about 3.4 meters below the top of the east rail. (See note 4, p. 580.)

G_2.—Is a brass bolt about 1¾ miles north of *Somerset*, *Pulaski County*, *Ky.*, in a rock cut, 271 meters north of milepost 156, 306 meters north of the center of a road crossing, on the largest plane-faced rock *in situ*, 75 feet from the north end and 110 feet from the south end of the cut, 2.9 meters west and 0.8 meter above the west rail. (See note 1, p. 580.)

A_5.—*Somerset*, *Pulaski County*, *Ky.*

B_5.—*Somerset*, *Pulaski County*, *Ky.*

DESCRIPTIONS OF PERMANENT BENCH MARKS BETWEEN SOMERSET, KY., AND KNOXVILLE, TENN.

A_5.—Is in *Somerset*, *Pulaski County*, *Ky.*, on the east side of an arched stone culvert about 200 yards north of the Cincinnati, New Orleans and Texas Pacific Railway depot, on the top course of masonry, 5 inches from the edge of the course and 20 inches east from the south angle formed by the culvert and a wall, 15 inches from the lower bent sill of the trestle and near the batter post, north end of the siding. The batter post is blazed at its inner edge, where it connects with bent sill. (See note 3, p. 580.)

B_5.—Is at *Somerset*, *Pulaski County*, *Ky.*, near the center of a large sandstone in the second course from the sidewalk under the column supporting north part of the arch at the entrance of the Cumberland Hotel. The bench mark is the intersection of two lines on the head of a copper bolt leaded into the stone.

C_5.—Is on the water tank south of the roundhouse at *Somerset*, *Pulaski County*, *Ky.*, on the top surface of the second sandstone block from the top supporting the northeast one of the four inner columns under the tank, 1 inch from the north edge and 3 inches from the east edge of the block. (See note 3, p. 580.)

D_5.—Is near *Somerset*, *Pulaski County*, *Ky.*, about 20 rails south of the railroad sign "Corporation Somerset Line," in the top of a large rock *in situ*, 30 feet north of the telegraph pole marked 15/159, 22 feet north of a sign post marked $\frac{W}{X}$, 12 feet east from the rail of the east track and 1 foot from the west edge of the rock, and in line between the middle two of four drill holes, used in breaking a piece from the rock. (See note 5, p. 580.)

E_5.—Is on a rock on the Cincinnati, New Orleans and Texas Pacific Railroad right of way, about one-half mile north of two tunnels and about 2 miles north of *Burnside*, *Pulaski County*, *Ky.*, near the south end of a large cut, 6 rails north of a post marked CHA 172 CIN 163, and across the track from a signpost marked $\frac{X}{W}$, about 8 feet from the outer rail on a curve and 3 inches from the edge of the rock nearest the rail. (See note 5, p. 580.)

F_5.—Is at *Burnside*, *Pulaski County*, *Ky.*, on a rock *in situ*, 8 paces south of a block-signal alarm near the station, 9 paces from the nearest rail, 8 inches from a stone wall, and 2 inches from each side of an angle on the top surface of the rock. (See note 5, p. 580.)

G_5.—Is about one-half mile north of *Sloans Valley*, *Pulaski County*, *Ky.*, on the top surface of the small bridge seat south of tunnel No. 5 on the Cincinnati, New

Orleans and Texas Pacific Railroad, on the east stone of the south abutment and 6 inches from the east and south edges of the stone. (See note 5, p. 580.)

H_5.—Is on the bridge seat at the south end of the long trestle No. 61 of the Cincinnati, New Orleans and Texas Pacific Railroad, north of *Alpine, Pulaski County, Ky.*, on the east side of the track and 2 inches from the east and north edges of the stone. (See note 5, p. 580.)

I_5.—Is a stone post set just back of the railroad right-of-way post opposite the Cincinnati, New Orleans and Texas Pacific Railroad station at *Greenwood, Pulaski County, Ky.* (See note 6, p. 580.)

J_5.—Is at *Flat Rock, Pulaski County, Ky.*, about 150 feet north of the Cincinnati, New Orleans and Texas Pacific Railroad station, 6 feet east of the second telegraph pole north of the station, and about 6 feet below the level of the railroad track. (See note 6, p. 580.)

K_5.—Is at *Whitley, Pulaski County, Ky.*, in line with and between the first and second telegraph poles north of T. J. Wilson's store, 6 feet from the first pole and 25 feet east of the railroad track, across the tracks from a large wooden water tank, near a mill, three telegraph poles south of the railroad station. (See note 6, p. 580.)

L_5.—Is at *Pine Knot, Whitley County, Ky.*, on the right of way of the Cincinnati, New Orleans and Texas Pacific Railroad, about 75 yards south of the station, on the opposite side of the track, 3 feet from the fence and 20 feet from the nearest rail of the siding. Across the tracks from it are three large trees close together and in a line parallel to the tracks. (See note 6, p. 580.)

M_5.—Is near *Strunk, Whitley County, Ky.*, about one-half mile north of *Isham, Tenn.*, on a stone forming the bridge seat on the east side of the north abutment of trestle No. 71 of the Cincinnati, New Orleans and Texas Pacific Railroad, about 3 inches from the south edge and 2 inches from the east edge of the stone. (See note 5, p. 580.)

A.—Is about three-fourths mile above *Winfield, Scott County, Tenn.*, on the top stone at the west side of the southern of the two piers near the middle of trestle No. 74 of the Cincinnati, New Orleans and Texas Pacific Railroad, and 2 inches from the west edge and 3 inches from the north edge of the stone. (See note 5, p. 580.)

B.—Is on the railroad right of way about 100 feet south of the Cincinnati, New Orleans and Texas Pacific Railroad station at *Oneida, Scott County, Tenn.*, about 40 feet north of the tracks and 75 feet west from two large trees opposite the station. (See note 6, p. 580.)

C.—Is on the right of way of the Cincinnati, New Orleans and Texas Pacific Railroad at *Helenwood, Scott County, Tenn.*, about 40 feet west of the southwest corner of the station, 2 feet from the fence, 35 feet from the siding, and about 75 feet south of Mrs. Voss's boarding house. (See note 6, p. 580.)

D.—Is at *New River, Scott County, Tenn.*, on a sandstone block supporting the northernmost one of the western two of twelve wooden columns under the tank, ½ inch each way from the north and west edges of the stone. (See note 5, p. 580.)

E.—Is 1 mile south of *Robbin, Scotts County, Tenn.*, just north of the post marked "CHA 115," on a stone of the top course of masonry on the east side of the south abutment of trestle No. 82 of the Cincinnati, New Orleans and Texas Pacific Railroad, one-half inch each way from east and north sides of stone. (See note 5, p. 580.)

F.—Is just south of *Glen Mary, Scott County, Tenn.*, on a stone about 5 feet square, which supports the trestle work of bridge No. 84 of the Cincinnati, New Orleans and

Texas Pacific Railroad, on the east side of the track, on top course of masonry of the north abutment of the bridge, 3½ inches from the west and 3 inches from the north edge of stone. (See note 5, p. 580.)

G.—Is a stone post at *Sunbright, Morgan County, Tenn.*, on the railroad right of way, 7 feet north of the first telegraph pole west of the one nearly opposite the station, which is marked $\frac{25}{2}$, and between two poles near battery station 241 of the block-signal system. (See note 6, p. 580.)

H.—Is at *Annadel, Morgan County, Tenn.*, about 100 yards north of the station, on the most southern stone of the top course of masonry of the west wall of the south bridge head of trestle No. 86 of the Cincinnati, New Orleans and Texas Pacific Railroad over Rock Creek, 1 inch from the north and 1 inch from the west edge of the stone. (See note 5, p. 580.)

I.—Is on the railroad right of way of the Cincinnati, New Orleans and Texas Pacific Railroad at *Lancing, Morgan County, Tenn.*, in the southeast corner of a small plot of ground about 200 feet south of the station and 40 feet west of the railroad track, 2½ feet from the east and 2½ feet from the south fence of the inclosure. (See note 6, p. 580.)

J.—Is near *Nemo* and 5 miles north of *Oakdale, Morgan County, Tenn.*, near telegraph pole $\frac{5}{247}$, on the east pier in the center of covered bridge No. 90 of the Cincinnati, New Orleans and Texas Pacific Railroad, near the center of the semicircumference of the top stone of the circular pier, and about 2½ inches from the edge. (See note 3, p. 580.)

K.—Is at *Oakdale, Morgan County, Tenn.*, on the outer angle of a fence surrounding the Babahatchie Inn, about 75 feet from the northeast corner of the inn and about 75 feet from the northwest corner of the depot, which is across the tracks, 25 feet from the nearest rail and 8 feet below the grade. (See note 6, p. 580.)

L.—Is about 200 yards south of the station at *Oakdale, Morgan County, Tenn.*, on the west side of the north pier of a bridge over a small creek running into Emory River, about 6 inches from the south and west edges of the stone upon which it is cut. (See note 3, p. 580.)

A_2.—Is near *Harriman Junction Morgan County, Tenn.*, on the north abutment of the Cincinnati, New Orleans and Texas Pacific Railroad bridge over the Emory River, on the west side of the tracks, on the first stone of the bridge seat course east of the stone supporting the bridge, 42 centimeters west of the corner of the retaining wall, and on line with the face of the retaining wall. (See note 4, p. 580.)

B_2.—Is at *Harriman, Roane County, Tenn.*, on the northwest corner of Roane and Crescent streets, on the Denny Block, on the northeast corner of iron plate under iron column at the right hand of the open corner as one enters the corner door, 155 centimeters north of the southeast corner of the brick corner column, and 31 centimeters above the sidewalk, being the top surface inclosed with a square one inch on a side cut with a cold chisel.

C_2.—Is in *Harriman, Roane County, Tenn.*, on the foundation of the southeast bay window of the American University on the southeast corner of Walden and Roane streets, in the third course of masonry below the brick work, in the center of the second stone from the north end of the curve, 126 centimeters above the ground. (See note 1, p. 580.)

City.—Is in *Harriman, Roane County, Tenn.*, and was furnished by Mr. Griffith, City Engineer. It is the top surface at the outer angle of the stone supporting the southwest brick corner of the First National Bank building, about 2½ inches above the sidewalk.

M.—Is at *Elverton, Roane County, Tenn.*, on the Southern Railway right of way, about 50 feet north of the tracts and 100 feet northwest of the station, and 25 feet west of a lone cedar tree 5 inches in diameter. (See note 6, p. 580.)

N.—Is a copper bolt leaded into the first course of stone below the brick in the foundation of the Baptist church at *Wheat, Roane County, Tenn.*, on the south face of the church and near the southeast corner, about 4½ inches from the edge and midway between the upper and lower surfaces of the stone. The center of the cross cut on the bolt is the bench mark.

Melton △.—Is on the land of Mr. George Lee, about one-fourth mile southeast of Martin Vann's house and about one mile north of *Williams Ferry* on the Clinch River. It is on the highest point in the ridge known as Copper Ridge, in *Roane County, Tenn.* It is most accessible on the west side from the road to the ferry, which passes within one-half mile of it, and through the small field of Mr. Vann's on the ridge between the road and △. A heavy limestone post 3½ feet long, 1½ feet wide, and 1 foot thick marks the station. The top is roughly dressed, rising 4 inches above the surface, and marked thus:

U	S
C	S

The intersection of the grooves at the center of the top of the stone is the bench mark.

O.—Is at *Oliver Springs, Anderson County, Tenn.*, about 60 feet west of the station and in line between the first and second telegraph poles from the station, 7 feet from the first pole and 15 feet from the nearest rail of the siding. (See note 6, p. 580.)

P.—Is across the tracks from the station at *Dossett, Anderson County, Tenn.*, almost in line with the west side of the station and 12 paces from the nearest rail of the Southern Railway tracks. (See note 6, p. 580.)

Q.—Is at *Clinton, Anderson County, Tenn.*, on the Southern Railway bridge over the Clinch River, on the north bridge head on the east side, on top surface of a large stone supporting the trestle work, 5 inches from the south and 5 inches from the east edge of the stone. (See note 3, p. 580.)

R.—Is on the Southern Railway right of way at *Heiskell, Knox County, Tenn.*, 80 feet west of the station, 10 feet north of the nearest rail of the siding, and 6 feet southwest of the first telegraph pole west of the station. (See note 6, p. 580.)

S.—Is on the right of way of the Southern Railway at *Powell, Knox County, Tenn.*, about 200 feet west of the station, 12 feet south of the nearest rail of the siding, 15 feet west of the second telegraph pole west of the station, 15 feet east of the switch stand, and 40 feet east of the mail stand. (See note 6, p. 580.)

T.—Is on the right of way of the Southern Railway at *Black Oak, Knox County, Tenn.*, 5 rails west of the station sign, 20 feet south of the nearest rail of the main tracks, 8 feet north of a 7-inch oak tree, 10 feet northeast of a 10-inch oak tree. (See note 6, p. 580.)

933 M. C.—At *Knoxville, Tenn.* Established by the United States Geological Survey. Described later. See index.

867 M. C.—Near *Caswell, Knox County, Tenn.* Established by the United States Geological Survey. Described later. See index.

940 M. C.—Near *Wright, Knox County, Tenn.* Established by the United States Geological Survey. Described later. See index.

DESCRIPTIONS OF PERMANENT BENCH MARKS BETWEEN HARRIMAN, TENN., AND WOODVILLE, ALA., 1900.

A_2.—Near *Harriman Junction*, on Emory River, *Morgan County, Tenn.* (See p. 630.)

B_2.—*Harriman, Roane County, Tenn.* (See p. 630.)

C_2.—*Harriman, Roane County, Tenn.* (See p. 630.)

D_2.—Is on the right of way of the Cincinnati, New Orleans and Texas Pacific Railroad, 550 meters north of *Emory Gap, Roane County, Tenn.*, just north of a switch leading to a coal mine siding, on the north abutment of a viaduct bridge 1.83 meters north of the southwest corner of the abutment and 6 inches north of the south face. (See note 4, p. 580.)

E_2.—Is 252 meters south of the station at *Cardiff, Roane County, Tenn.*, on the south side at the east end of a heavy stone cattle pass, 1.15 meters east of the east rail, 1.12 meters below the top of the rail and 5½ inches from either face of the heavy corner stone. (See note 4, p. 580.)

F_2.—Is in *Rockwood, Roane County, Tenn.*, on the Peterman Block, on the south side of Rockwood Avenue, in the stone base under the first window east of the large arched entrance, 0.158 meter west of the brick work and 0.117 meter back from the face of the stone. (See note 2, p. 580.)

G_2.—Is in *Rockwood, Roane County, Tenn.*, on the east face of the Mourfield Hotel, owned by J. A. Black, 3.93 meters north of the southeast corner of the main building, 1.08 meters above the ground, in the south end of a stone window sill, being a horizontal chisel mark in the end of a brass bolt leaded horizontally into the stone.

H_2.—Is in *Glen Alice, Roane County, Tenn.*, 205 meters north of the station of the Cincinnati, New Orleans and Texas Pacific Railroad, just east of the wagon road between the end of the heavy box culvert and the track, on the east end of the culvert, on the coping stone, 7 inches west of the east face and 1½ feet east of the west face. (See note 4, p. 580.)

I_2.—Is in *Roddy, Rhea County, Tenn.*, 509 meters south of the Cincinnati, New Orleans and Texas Pacific station, on the north abutment of bridge No. 107, on the east side, on the second stone north from the south face, 1.1 meters north of the south face and 4½ inches west of the east face of the stone. (See note 4, p. 580.)

J_2.—Is 550 meters north of the station platform of the Cincinnati, New Orleans and Texas Pacific Railroad at *Lorraine, Rhea County, Tenn.*, on the east end of the stone box culvert, 5.8 meters east and 2.9 meters below the east rail, on the coping stone, 0.55 meter north of the south face and 5 inches west of the east face. (See note 4, p. 580.)

K_2.—Is one-half mile north of *Spring City, Rhea County, Tenn.*, on the south abutment of the Cincinnati, New Orleans and Texas Pacific Railroad bridge over Little Piney Creek, 3.04 meters east and 2.9 meters below the top of the east rail, 1.12 meters above ground, and 4 meters west of the extreme eastern end of the abutment. (See note 1, p. 580.)

L_2.—Is 630 meters south of *Sheffield, Rhea County, Tenn.*, on Cincinnati, New Orleans and Texas Pacific Railroad, on a heavy arched culvert, on the west side of the north end, 5.65 meters west of and 2.8 meters below the west rail, on the third step

below the coping, 8 inches north of the south face and 6 inches east of the west face. (See note 4, p. 580.)

M_2.—Is 1 225 meters north of the Cincinnati, New Orleans and Texas Pacific station at *Evensville, Rhea County, Tenn.*, on the corner stone of the bridge seat course of bridge No. 119, on the west side, at the north end of the bridge, 2.7 meters west and 1.3 meters below the west rail, 8 inches east of the west face and 10 inches north of the south face of the stone. (See note 4, p. 580.)

N_2.—Is 1 330 meters south of *Evensville, Rhea County, Tenn.*, on the south abutment of the Cincinnati, New Orleans and Texas Pacific Railroad bridge over Little Richland Creek, at the east end, on the second step below the coping, 2.65 meters east and 1 meter below the east rail, 6 inches south of the north face and 5 inches west of the east face of the step. (See note 4, p. 580.)

O_2.—Is on the county court building in *Dayton, Rhea County, Tenn.*, on the south face of the water table, 0.42 meter east of the southwest corner and 1.15 meters above the ground. (See note 1, p. 580.)

P_2.—Is on the Dayton Bank and Trust Company building on the south side of Main street, in *Dayton, Rhea County, Tenn.*, at the northeast corner of the building, 1.18 meters above the sidewalk and 0.28 meter west of the northwest corner. (See note 1, p. 580.)

Q_2.—Is 1.4 miles north of *Graysville, Rhea County, Tenn.*, on the east side of the north end of a large arched culvert or viaduct of the Cincinnati, New Orleans and Texas Pacific Railroad, on the first step below the coping, 7 inches east of the east face of the coping, 4 inches north of the south face and 12 inches west of the east face of the step. (See note 4, p.. 580)

R_2. – Is about 0.7 mile south of *Graysville, Rhea County, Tenn.*, on the east end of the south abutment to bridge No. 125 of the Cincinnati, New Orleans and Texas Pacific Railroad over Roaring Creek, on the coping of the abutment which projects beyond the bridge seat blocks, 2.45 meters east of and 1.85 meters below the east rail, 4 inches west of the east face and 7 inches south of the north face of the stone. (See note 4, p. 580.)

S_2.—Is 275 meters north of the Cincinnati, New Orleans and Texas Pacific station platform at *Sale Creek, Hamilton County, Tenn.*, on the corner stone of the bridge seat course, on the west side at the north end of the railroad bridge over Rock Creek, 5 inches north of the south face and 8 inches east of the west face. (See note 2, p. 580.)

T_2.—Is 1 250 meters south of *Retro, Hamilton County, Tenn.*, on the south abutment of the Cincinnati, New Orleans and Texas Pacific Railroad bridge No. 131, over Opossum Creek, on the southwest corner of the coping, 2.4 meters west and 1.75 meters below the west rail, 8 inches east of the west face and 13 inches north of the south face of the stone. (See note 4, p. 580.)

U_2.—Is 205 meters north of the Cincinnati, New Orleans and Texas Pacific station at *Rathburn, Hamilton County, Tenn.*, on the north side of the south abutment of the railroad bridge over Little Soddy Creek, 1.2 meters west of and 2.5 meters below the west rail, on a bridge seat stone, 8 inches south of the north face and 6½ inches east of the west edge. (See note 4, p. 580.)

V_2.—Is 230 meters north of the station at *Daisy, Hamilton County, Tenn.*, on the north abutment at the east end of Cincinnati, New Orleans and Texas Pacific Railroad

bridge No. 135, on the corner stone of the bridge seat course, 2.5 meters east of and 1.11 meters below the east rail, 4½ inches west of the east face and 10 inches north of the south face of the stone. (See note 4, p. 580.)

W_2.—Is 1.2 miles north of *Cave Springs, Hamilton County, Tenn.*, on the south side of the west end of a stone box culvert under the track of the Cincinnati, New Orleans and Texas Pacific Railroad, 3.35 meters west of and 1.32 meters below the west rail, on the first step below the coping, 4 inches east of the west face and 6 inches south of the north face. (See note 4, p. 580.)

X_2.—Is 1.4 miles south of *Cave Springs, Hamilton County, Tenn.*, on the south abutment of Cincinnati, New Orleans and Texas Pacific Railroad bridge No. 138 over North Chickamauga Creek, at the milepost marked "CIN 323," 2.8 meters west and 0.97 meter below the west rail on the corner stone of the coping, 5 inches east of the west face, 1.1 meters south of the north face and 0.65 meter north of the south face. (See note 4, p. 580.)

Y_2.—Is 187 meters south of the Cincinnati, New Orleans and Texas Pacific station at *Hixson, Hamilton County, Tenn.*, in the vertical face of a rock *in situ* about the center of a rock cut, 3.15 meters west of and 0.75 meter above the west rail. (See note 1, p. 580.)

Z_2.—Is between *Hixson* and *Boyce, Hamilton County, Tenn.*, on the west end of the north abutment of the Cincinnati, New Orleans and Texas Pacific Railroad bridge over Tennessee River, 2.25 meters west of and 1.17 meters below the west rail, on the northwest corner of the coping stone, 7 inches east of the west face and 7 inches south of the north face. (See note 2, p. 580.)

A_3.—Is between *Hixson* and *Boyce, Hamilton County, Tenn.*, on the south abutment of the Cincinnati, New Orleans and Texas Pacific Railroad bridge over the Tennessee River, on the southwest corner of the bridge seat stone, 2.2 meters west and 1.17 meters below the west rail, 8 inches north of the south face and 7 inches east of the west face of the stone. (See note 4, p. 580.)

B_3.—Is near *Chattanooga, Hamilton County, Tenn.*, to the eastward, at the crossing of the Knoxville branch of the Southern Railway over the Cincinnnti, New Orleans and Texas Pacific Railroad, on the east retaining wall, in the center of a stone of the third course above the ground, 1.7 meters east of and 1 meter above the east rail of the Nashville, Chattanooga and St. Louis Railroad track, 11½ inches south of the north edge of the stone and 10 inches north of the north end of the bridge seat stone. (See note 1, p. 580.)

698 N.—Is a bronze tablet marked "698 Nashville 1899," established by the United Stated Geological Survey on the United States Government building at *Chattanooga, Hamilton County, Tenn.*, on the lower course of stone at the southeast corner of the building, 3 feet north of the corner. (See note 24, p. 582.)

C_3.—Is in *Chattanooga, Hamilton County, Tenn.*, on the southwest corner of Broad and West Eighth streets, on the north wall of the foundation of the First National Bank building, in a large sandstone block in the third course above the sidewalk, being the third stone west of the basement entry. The bench mark consists of a horizontal chisel mark in the end of a brass bolt leaded horizontally into the stone 1.1 meters above the sidewalk and 0.85 meter east of the basement window.

Gauge.—Is a bench mark which has been established by the city engineer on the east end of the water table of the old First National Bank building at the southwest corner of Market and Sixth streets in *Chattanooga*, *Hamilton County*, *Tenn.*

D_3.—Is near *Chattanooga*, *Hamilton County*, *Tenn.*, on the south end at the east side of the Nashville, Chattanooga and St. Louis Railroad bridge over Chattanooga Creek, 0.85 meter east of and 1.75 meters below the east rail, on the bridge seat stone, 4 inches north of the south face and 8 inches west of the pier supporting the iron superstructure. (See note 4, p. 580.)

674 N.—Is a bronze tablet marked "674 Nashville 1899," established by the United States Geological Survey at *Wauhatchie*, *Hamilton County*, *Tenn.*, in the center of the foundation at the northeast side of a block signal tower. (See note 24, p. 582.)

E_3.—Is 80 meters west of the Nashville, Chattanooga and St. Louis station at *Hooker*, *Dade County*, *Ga.*, at the south end of an iron pipe drain under the track, 4.82 meters south of and 2.28 meters below the south rail, on the east end of a large base stone, 0.64 meter east of the center of the pipe and 4½ inches below the pipe. (See note 4, p. 580.)

974 N.—Is a bronze tablet marked "974 Nashville 1899," established by the United States Geological Survey 1.7 miles south of *Whiteside*, *Marion County*, *Tenn.*, at the west end of the face of a tunnel on the south side of the track, about 4 feet above the rail. (See note 24, p. 582.)

F_3.—Is 220 meters north of the Nashville, Chattanooga and St. Louis station at *Whiteside*, *Marion County*, *Tenn.*, on the north side at the west end of a culvert about 5.8 meters below the west rail, on the northwest corner of the coping stone, 10 inches from either face. (See note 4, p. 580.)

U. S.—Is in *Shellmound*, *Marion County*, *Tenn.*, 11 meters west of the station and 30 meters north from the north side of it, and 8 meters east of Mr. Hammond's store. It is a monument established by the United States Engineers, with its upper surface flush with the ground and marked "U X S," the exact point taken as the bench mark being the center of the circle of which the lower loop of the S is a segment.

639 N.—Is a bronze tablet marked "639 Nashville 1899," established by the United States Geological Survey 2.5 miles east of *Shellmound*, *Marion County*, *Tenn.*, in the top of the top step in the south wing of the east abutment of the railroad bridge over a highway. (See note 24, p. 582.)

G_3.—Is 560 meters west of *Shellmound*, *Marion County*, *Tenn.*, on the south end of the west abutment of the Nashville, Chattanooga and St. Louis Railroad bridge over the Nicojack Creek, 2.55 meters south of and 1.78 meters below the south rail, on the coping, 6 inches north of the south face and 10 inches east of the west face. (See note 2, p. 580.)

C.—Is near *Bridgeport*, *Jackson County*, *Ala.*, at the east end of the Nashville, Chattanooga and St. Louis Railroad bridge over the Tennessee River, on the south side of the abutment, on the large coping stone below the bridge seat block, 0.65 meter east of the west face, 0.165 meter north of the edge, and 1.49 meters below the south rail. (See note 4, p. 580.)

679 N.—Is a bronze tablet marked "679 Nashville 1899," established by the United States Geological Survey in front of the post-office in *Bridgeport*, *Jackson County*, *Ala.*, at the southwest corner, 4 feet above the sidewalk. (See note 24, p. 582.)

U. S. E.—Is at the east end of the east bridge over the Tennessee River at *Bridgeport, Jackson County, Ala.*, on the abutment on the south side, on the southwest corner of the coping, below the bridge seat block. It is not marked.

665 N.—Is a bronze tablet marked "665 Nashville 1899," established by the United States Geological Survey 1.7 miles east of *Carpenter, Jackson County, Ala.*, in the top of the capstone at the north end of the stone culvert. (See note 24, p. 582.)

D.—Is 446 meters east of the Nashville, Chattanooga and St. Louis station platform at *Bolivar, Jackson County, Ala.*, on the south end of the west abutment of the bridge over Widow Creek, 2.04 meters south of and 1.34 meters below the south rail, in the large bridge seat block, 0.15 meter north of its south face and 0.25 meter east of its west face. (See note 4, p. 580.)

625 N.—Is a bronze tablet marked "625 Nashville 1899," established by the United States Geological Survey, 0.8 mile west of *Bolivar, Jackson County, Ala.*, at the west end of the face of the capstone at the north end of a stone culvert.

627 N.—Is a bronze tablet marked "627 Nashville 1899," established by the United States Geological Survey, 840 feet north of the station at *Stevenson, Jackson County, Ala.*, at the top of the southeast coruer of the capstone at the east end of a stone culvert.

E.—Is 1 mile west of *Stevenson, Jackson County, Ala.*, on the south wall of the west abutment of the Southern Railway bridge over Crow Creek, in a large stone just below the coping, 1.7 meters above the ground and 0.64 meter below the top of the pier, and 15 inches west of the east face. (See note 1, p. 580.)

F.—Is 225 meters west of the *Cedar Grove* siding of the Southern Railway, in *Jackson County, Ala.*, on the second step of the retaining wall on the east side, at the south end of bridge No. 282.9 A, 1.5 meters south and 1.1 meters below the south (?) rail, 8 inches east of the west face, 13 inches north of the south face of the second step and 7 inches south of the first step. (See note 4, p. 580.)

G.—Is 0.7 mile west of *Fackler, Jackson County, Ala.*, on the east end at the north side of the Southern Railway bridge No. 287.1 A, over Pole Branch, on the second step of the east retaining wall, 2.45 meters north of and 1.54 meters below the north rail, 7 inches south of the north face and 11 inches east of the west face of the step. (See note 4, p. 580.)

H.—Is 1¾ miles west of *Fackler, Jackson County, Ala.*, on the south side of the east end of the east abutment of the Southern Railway bridge over Mud Creek, 1.45 meters south and 1.4 meters below the south rail, on the coping under the bridge seat block, 4 inches from the south face and 0.45 meter east of the west face. (See note 4, p. 580.)

I.—Is in *Hollywood, Jackson County, Ala.*, north of the railway station, 85 meters north of the track, in the east face of G. W. Chapman's Hotel, in the seventh course of stonework below the top of the foundation of the brick chimney, 1.18 meters above the ground, 8¾ inches south of the end of the stone and the corner of the chimney. (See note 1, p. 580.)

J.—Is 3 miles west of *Hollywood, Jackson County, Ala.*, on the Southern Railway, on the north side, at the east end of bridge No. 295.2 A, 2.1 meters north of and 1.28 meters below the north rail, on the second step of the retaining wall, 8 inches east of the west face and 5 inches south of the north face. (See note 4, p. 580.)

K.—Is in *Scottsboro, Jackson County, Ala.*, 350 meters south of the Southern Railway station, in the west wall of the court-house, 10 feet north of the southwest corner, midway between the first and second windows, in the water table of the chimney offset, 2.25 feet above the ground. (See note 1, p. 580.)

L.—Is 1.3 miles east of *Larkinsville, Jackson County, Ala.*, on a rock *in situ* at the east end of a deep stone cut of the Southern Railway, 25 meters west of a road crossing, 0.35 meter above and 2.23 meters north of the north rail. (See note 1, p. 580.)

M.—Is one-half mile west of *Larkinsville, Jackson County, Ala.*, on the west side at the south end of Southern Railway bridge No. 303.6 A, 2.45 meters south of and 1.36 meters below the south rail, on the second step below the coping of the retaining wall, 0.2 meter west of the east face and 0.15 meter north of the south face. (See note 4, p. 580.)

N.—Is at *Lim Rock, Jackson County, Ala.*, 213 meters west of the Southern Railway station, on the south end of the east abutment to a bridge or cattle guard at the west end of village, at the right of way fence, 1.15 meters south of and 0.75 meter below the south rail, on the end stone of the coping, 6 inches north of the south face and 7 inches east of the west face. (See note 4, p. 580.)

O.—Is 1.8 miles west of *Lim Rock, Jackson County, Ala.*, in the north wall of a deep stone cut of the Southern Railway, about one-quarter of the length of the cut from the eastern end, 166 meters west of a road crossing, 2.55 meters north of and 0.76 meter above the north rail. (See note 1, p. 580.)

J_2.—At *Woodville, Jackson County, Ala.* (See p. 638.)

K_2.—At *Woodville, Jackson County, Ala.* (See p. 638.)

P.—Is at *Dossett* about 2 miles from *Swearengin, Marshall County, Ala.*, in T. 5 S., R. 4 E., on the line of the Woodville and Guntersville highway, at the foot of Gunter Mountain, on the north side, at the point where the road leaves Wrights Cove Creek and ascends the mountain, 46 meters southward from the creek and 23 meters eastward from the road, on a high and prominent point of a large sheet of rock. (See note 2, p. 580.)

Q.—Is in *Swearengin, Marshall County, Ala.*, T. 5 S., R. 4 E., on the north side of Mr. W. B. Huggins's residence on the Woodville and Guntersville road, 500 feet north of the main road crossing, 26 feet west of the center of the road, in a stone chimney, 6½ inches west of the northeast corner and 32 inches above the ground. (See note 1, p. 580.)

Gunter △.—Is near *Swearengin* in *Marshall County, Ala.*, T. 5 S., R. 4 E., on the top of a gently rounded hill known as Gunter Mountain, covered with a dense growth of brush and small timber. It is on the land of Mrs. L. Gideon, 1.2 miles N. 75° E. from the main road crossing at Swearengin, one-quarter mile N. 85° E. from Prospect Church, and 350 feet S. 70° E. from a point on the Carlile and Henderson road to Saltpeter Cave, or Lim Rock, 1 170 feet east from its junction with the Scottsboro road, said junction being 4 800 feet N. 70° E. from the road crossing at Swearengin. The bench mark is the bottom of a square cut in the southwest quarter of the cross on the top of the stone lettered U. S. C. S. marking the triangulation point Gunter.

Gunter N.—Is the bottom of a square cut in the southwest quarter of the cross on a reference stone 6 feet north of the stone marking the triangulation station Gunter described above.

Gunter S.—Is the bottom of a square cut in the southwest quarter of the cross on a reference stone 6 feet south of the stone marking the triangulation station Gunter described above.

Gunter E.—Is the bottom of a square cut in the southwest quarter of the cross on a reference stone 6 feet east of the stone marking the triangulation station Gunter described above.

Gunter W.—Is the bottom of a square cut in the southwest quarter of the cross on a reference stone 6 feet west of the stone marking the triangulation station Gunter described above.

DESCRIPTIONS OF PERMANENT BENCH MARKS BETWEEN WOODVILLE AND BIRMINGHAM, ALA.

J_2.—Is at *Woodville, Jackson County, Ala.*, on the right of way of the Southern Railway, opposite the station house and in line with the west side of the platform, 8 paces south of the south rail of the main track. Sub-bench mark is on the north side of the post, 0.2952 meter below the surface bench mark. (See note 9, p. 581.)

K_2.—Is at *Woodville, Jackson County, Ala.*, about 500 feet west of the depot, on the north side of the west bridge seat of a small trestle, being a copper bolt in the projecting end of the first rock of the second course of masonry from the top, and at the north end, about 5 inches from the north and 8 inches from the east edge of the stone. (See note 10, p. 581, except no cross lines are noted.)

L_2.—Is about 1 mile west of *Woodville, Jackson County, Ala.*, near the center of a big fill, 25 feet below the surface of the grade, on an arched stone waterway, 9 telegraph poles west of mile pole No. 314A, being a copper bolt sunk in the surface of the west stone on the north side of the waterway, 1 foot from the north side and 9 inches from the east side of the stone. (See note 10, p. 581, except no cross lines are noted.)

T. B. M. 1.—Is about 2 miles west of *Woodville, Jackson County, Ala.*, on the north side of the east bridge head of trestle No. 315.3A over Paint Rock River, 5 inches from the east and south edges of stone supporting the steel frame work of the trestle. (See note 5, p. 580.)

M_2.—Is at *Paint Rock, Jackson County, Ala.*, on the west abutment of trestle No. 318.1A, west of the station, being a copper bolt in the top rock at the north end of the masonry, 6 inches from the north and east edges. (See note 16, p. 581.)

N_2.—Is at *Gurley, Madison County, Ala.*, about 275 feet west of the station, 7 paces south of the south rail of the main track of the Southern Railway, and across the tracks from the third telegraph pole west of the station, 30 paces east of the switch stand to the siding. Sub-bench mark is on the east side of post, 0.2778 meter below the surface bench mark. (See note 9, p. 581.)

T. B. M. 8.—Is about 2 miles west of *Gurley, Madison County, Ala.*, on the south side of the east abutment of trestle No. 324.0A, 4½ inches from the south and 5 inches from the west edge of the large stone at the south end. (See note 5, p. 580.)

O_2.—Is at *Brownsboro, Madison County, Ala.*, on the right of way of the Southern Railway, about 30 feet west of and across the tracts from the station house, 5 paces from the north rail, and 5 feet east of the first telegraph pole west of the station. Sub-bench mark is in the south side of post, 0.2845 meter below the surface bench mark. (See note 9, p. 581.)

T. B. M. 12.—Is one-half mile west of *Brownsboro, Madison County, Ala.*, on the south side of the east abutment to trestle No. 328.1 over Flint River, 18 inches south of the south rail and 5 inches from the south and west edges of a large stone just beneath the rails. (See note 5, p. 580.)

P_2.—Is in a long cut 0.4 mile west of *Fearns, Madison County, Ala.*, near the center of the top surface of a large rock *in situ* between the railroad track and milepost 335A and is 1.7 meters from the milepost, about 8 feet above level of the railroad grade. (See note 7, p.581.)

City.—Is at *Huntsville, Ala.*, on the doorsill of the corner entrance to the city hall, corner of Clinton and Washington streets, and is the center of a horseshoe mark.

Q_2.—Is at *Huntsville, Madison County, Ala.*, on the city hall, near the center of the third stone from the easternmost of the four large doors on the Clinton street side of the building, in the fourth course from the sidewalk. (See note 8, p. 581.)

R_2.—Is about 3 miles east of *Madison, Madison County, Ala.*, on the south side of the west abutment to trestle No. 345.7A, 4 inches from south and west edges. (See note 7, p. 581.)

S_2.—Is near the court-house at *Madison, Madison County, Ala.*, just inside the railway right of way, 75 feet west of the station and across the tracks therefrom; 30 feet from the south rail of the main track, and 6 feet north of a small tree on the boundary of the right of way. Sub-bench mark is in the north side of the post, 0.2980 meter below the surface bench mark. (See note 9, p. 581.)

T_2.—Is about 1 mile east of *Greenbrier, Limestone County, Ala.*, in the east abutment to the trestle at mile pole 353A, on the northeast one of the four caps to the abutments, in the second stone from the top, 8 inches from the southeast corner, at the edge formed by the curved surface of the cap. (See note 7, p. 581.)

T. B. M. 38.—Is a half mile east of *Belle Mina, Limestone County, Ala.*, on the south side of the east abutment of trestle No. 355.8A over Limestone Creek, 7 inches from the outer corner. (See note 5, p. 580.)

U_2.—Is at *Belle Mina, Limestone County, Ala.*, on the Southern Railway right of way, 50 feet west of the station and 7 paces south of the south rail of the main track. (See note 6, p. 580.)

T. B. M. 39.—About 1 mile west of *Belle Mina, Limestone County, Ala.*, on the north side of the east pier of trestle No. 357.3A, 5 inches from the north and east edges of the pier. (See note 5, p. 580.)

P. B. M. 50.—*Decatur, Ala.* (See App. 8, Report for 1899, p. 707.)

U. S.—*Decatur, Ala.* (See App. 8, Report for 1899, p. 707.)

P. B. M. 51.—*Decatur, Ala.* (See App. 8, Report for 1899, p. 707.)

P. B. M. 52.—*Decatur, Ala.* (See App. 8, Report for 1899, p. 707.)

V_2.—Is about 1½ miles south of *Flint, Morgan County, Ala.*, on the west side of the north abutment of trestle No. 4, being a copper bolt, sunk in the top surface of the third stone from the south end, 5 inches from the north edge of the stone. (See note 10, p. 581.)

W_2.—Is one-fourth mile south of *Hartsells, Morgan County, Ala.*, in the west side of an arched stone culvert, being a copper bolt, 5 inches from the west edge of the third stone from the south end. (See note 10, p. 581.)

T. B. M. 60.—Is about 3 miles south of *Hartsells, Morgan County, Ala.*, and three-fourths mile north of *Leesdale, Morgan County, Ala.*, on the north abutment of trestle No. 10, on the northeast corner of the east stone supporting the trestlework. (See note 5, p. 580.)

X_2.—Is a mile south of *Falkville, Morgan County, Ala.*, 3 paces south of milepost

D □ M Y
20 163

and 12 feet west of the west rail of the main track of the Louisville and Nashville Railway, being a square cut on the top surface of a rock *in situ*. (See note 3, p. 580.)

Y_2.—Is 1½ miles south of *Wilhite, Cullman County, Ala.*, in the west bridge seat stone of the south abutment of trestle No. 19, being a copper bolt, 3½ inches from the north edge and 2½ inches from the west edge of the stone. (See note 7, p. 581.)

Z_2.—Is 3½ miles north of *Cullman, Cullman County, Ala.*, about 20 rails south of milepost 30 (from Decatur), along the Louisville and Nashville Railway, in the top surface of the north stone of the east side of a culvert, being a copper bolt, 4½ inches from the east edge and 30 inches from the north edge of the stone. (See note 7, p. 581.)

A_3.—Is at *Cullman, Cullman County, Ala.*, in a stone block supporting the northeastern one of the four inner columns of the railway water tank, 2½ inches from the north and 4 inches from the east edge of the stone. (See note 7, p. 581.)

B_3.—Is about 200 yards north of the railroad sign at *Johnson, Cullman County, Ala.*, 4 rails south of milepost 40 (from Decatur), along the line of the Louisville and Nashville Railway, on the east side of the south abutment to trestle No. 33, being a copper bolt sunk in the top surface of the second course of the masonry from the top, 6 inches from the east and the north edges of the stone. (See note 7, p. 581.)

C_3.—Is about 3 miles south of *Hanceville, Blount County, Ala.*, one-fourth mile south of milepost 44 (from Decatur), on the west side of a stone culvert, being a copper bolt in second stone from north end, 4 inches from the west edge and 7 inches from the north edge of the stone. (See note 7, p. 581.)

D_3.—Is 1 mile south of *Garden City, Blount County, Ala.*, on the mid-river pier of trestle No. 36 over Mulberry Branch of Black Warrior River, in a △-shaped stone, on the top of the east side of the pier, being a copper bolt 6 inches from each side and 8 inches from the outer point of the stone. (See note 7, p. 581.)

E_3.—Is about three-fourths of a mile north of *Blount Springs, Blount County, Ala.*, in the top stone on the east side of the north abutment to bridge No. 38, being a copper bolt 13 inches from the east edge and 16 inches from the north edge of the stone. (See note 7, p. 581.)

F_3.—Is about three-fourths of a mile south of *Blount Springs, Blount County, Ala.*, on the east side of the south bridge-seat stone of trestle No. 41, being a copper bolt in the top surface of a large stone, 6 inches from the east and 8 inches from the north side of the stone. (See note 7, p. 581.)

G_3.—Is about 200 yards south of *Reids, Blount County, Ala.*, and 100 feet south of milepost 58 (from Decatur), on the west side of the south part of an arched stone culvert, being a copper bolt on the first stone of the downstream revetment to the

culvert, below the top course of masonry, 3 inches from the west and 3½ inches from the north edge of the stone. (See note 7, p. 581.)

H_3.—Is just within the right of way of the Louisville and Nashville Railway, at *Warrior, Jefferson County, Ala.*, on a stone post 15 paces west of the siding, and 75 feet north of the station house, and across the tracks therefrom, 4 feet from the boundary fence, and 4 paces south of a 14-inch oak and back of the tool house of railroad company. (See note 6, p. 580.)

I_3.—Is about 2 miles south of *Warrior, Jefferson County, Ala.*, on the long trestle No. 45, over Locust Branch of Black Warrior River, in a stone under the bridge seat stone, on the east side of the south abutment, being a copper bolt 6 inches from the east and 8 inches from the north edge of the stone. (See note 7, p. 581.)

J_3.—Is at *Morris, Jefferson County, Ala.*, on a stone post, 20 paces west of the siding and 60 feet north of the station house, 2½ feet from the fence running east and west, and 7 paces west from the corner of the fence at the intersection of the railroad right of way line and the county road. (See note 6, p. 580.)

T. B. M. 107.—Is about 2 miles north of *Cunningham, Jefferson County, Ala.*, on the east side of the south abutment of trestle No. 50, on the bridge seat stone, 2 inches from the east and 8 inches from the south edge of the stone. (See note 5, p. 580.)

K_3.—Is at *Newcastle, Jefferson County, Ala.*, on a stone post 30 paces east of the main track of the Louisville and Nashville Railway, 15 paces south of the station house, about on a level with the railroad grade, but on the side of a hill near a small group of trees. (See note 6, page 580.)

L_3.—Is at *Boyles, Jefferson County, Ala.*, on a stone post, 30 paces south of the station, 25 paces west of the tracks, and 4 paces north of a large 14-inch tree. (See note 6, p. 580.)

P. B. M. 2.—At *Birmingham, Ala.* (See App. 8, Report for 1899, p. 709.)

P. B. M. 3.—At *Birmingham, Ala.* (See App. 8, Report for 1899, p. 709.)

DESCRIPTIONS OF PERMANENT BENCH MARKS BETWEEN DECATUR, ALA., AND CORINTH, MISS.

P. B. M. 51.—Is at *Decatur, Ala.* (See p. 707, App. 8, Report for 1899.)

P. B. M. 50.—Is at *Decatur, Ala.* (See p. 707, App. 8, Report for 1899.)

Old R. R. B. M.—Is at *Decatur, Ala.* (See p. 707, App. 8, Report for 1899.)

M_3.—Is at *Decatur, Morgan County, Ala.*, 500 feet west of the Southern Railway bridge across the Tennessee River, on the railroad and highway bridge across the Southern Railway tracks on Market street, on the west side of the north abutment, on the second stone from the ground, 9 inches from the west and south edges of the stone. (See note 3, p. 580.)

N_3.—Is at *Decatur, Morgan County, Ala.*, on the First National Bank Building, at the corner of Bank and Pond streets, on the pedestal stone supporting the east column of the portico, on the southeast side of the column and the corner toward both streets. (See note 3, p. 580.)

O_3.—Is at *Decatur, Morgan County, Ala.*, on the portico of the south entrance to the county court-house, at the east end of the portico, 9 or 10 feet east of the center of the entrance, on the stone sill, 7 inches from the main wall, and on the middle line of the stone. (See note 3, p. 580.)

P_3.—Is at *Trinity, Morgan County, Ala.*, on the stone foundation of the water tank, about 25 feet east of the center of the main track, on the stone projecting from under the northeast corner of the tank. (See note 3, p. 580.)

Q_3.—Is at *Hillsboro, Lawrence County, Ala.*, on the two-story brick store building known as the Robinson Block, south of and across the street from the Southern Railway depot; on the front sill, 3½ feet from the northwest corner of the building, 8 inches east of the jamb at the northwest corner, and 8 inches from the front edge of the sill. (See note 3, p. 580.)

R_3.—Is at *Hillsboro, Lawrence County, Ala.*, on the front of the first two-story brick store building west of the brick building known as the Robinson Block, separated from it at present by a shed 15 feet wide; 12 inches from the northwest corner and about 4 feet from the ground, in the center of the eleventh brick above the iron doorsill. (See note 13, p. 581.)

S_3. Is at *Courtland, Lawrence County, Ala.*, on the front of the two-story brick building owned and occupied by the Merchants' Bank of Courtland, on the east side of the square, and adjoining the right of way of the Southern Railway, in the fifteenth brick above the iron doorsill and two brick lengths north of the southwest corner. (See note 13, p. 581.)

T_3.—Is at *Courtland, Lawrence County, Ala.*, at the northeast corner of the "Square," in the stone horse block, a hard limestone rock with two steps cut in the east side, rising above the ground 3 feet and said to extend 3 feet below the surface of the ground and to have been set about seventy-five years ago; in the south side, 12 inches below the top and 7 inches from the west edge. (See note 13, p. 581.)

U_3.—Is a half mile west of *Courtland, Lawrence County, Ala.*, on the right of way of the Southern Railway, on a hard limestone rock *in situ* on the west bank of Big Nance Creek 27 feet south of the center of the railway track on a line drawn perpendicular to the track at a point about 3 feet east of the west abutment of the trestle (No. 383.5). A large bowlder is between the bench mark and the creek, separated from the rock on which the mark was placed by a fissure about 8 inches wide. A sycamore tree about 2 feet in diameter with old blaze on the north side is about 14 feet south and a cedar tree 8 inches in diameter is 10 feet west of the bench mark. (See note 3, p. 580.)

V_3.—Is 3 miles west of *Town Creek, Lawrence County, Ala.*, on the north end of the east abutment of the iron bridge of the Southern Railway across Town Creek, on the top of the abutment, 8 inches from the shore face and 10 inches from the downstream end, 11 inches diagonally from the bridge seat. (See note 3, p. 580.)

W_3.—Is at *Leighton, Colbert County, Ala.*, in the brick wall of the store building known as the King Building and now occupied by King & Co., 16 inches from the northwest corner, in the seventeenth brick from the brick sidewalk. (See note 13, p. 581.)

X_3.—Is 4 miles east of *Tuscumbia, Colbert County, Ala.*, on the right of way of the Southern Railway, 33 feet north of the track, 2 feet from the railway fence, about 300 yards west of the west switch stand at the Hobgood siding of the Southern Railway, in the top of a stone post 5 feet long, with 1 foot projecting, octagonal in shape, and about 8 inches in diameter. (See note 3, p. 580.)

P. B. M. 9.—Is at *Tuscumbia, Ala.* (See p. 702, App. 8, Report for 1899.)

T. B. M. 80.—Is at *Tuscumbia, Ala.* (See p. 701, App. 8, Report for 1899.)

P. B. M. 8.—Is at *Tuscumbia, Ala.* (See p. 701, App. 8, Report for 1899.)

T. B. M. 71.—Is near *Prides, Ala.* (See p. 701, App. 8, Report for 1899.)

T. B. M. 68.—Is near *Prides, Ala.* (See p. 701, App. 8, Report for 1899.)

T. B. M. 72.—Is at *Prides, Ala.* (See p. 701, App. 8, Report for 1899.)

T. B. M. 73.—Is at *Prides, Ala.* (See p. 701, App. 8, Report for 1899.)

P. B. M. 7.—Is at *Prides, Ala.* (See p. 701, App. 8, Report for 1899.)

T. B. M. 63.—Is near *Prides, Ala.* (See p. 701, App. 8, Report for 1899.)

Y_3.—Is in *Colbert County, Ala.*, 2.7 miles west of *Prides, Ala.*, 48 feet north of the center of the Southern Railway track, on a line drawn perpendicular to the track at a point about 9 feet east of trestle No. 416.4A (from Bristol) on a large hard limestone rock *in situ*, about 4 by 9 feet and rising about 10 inches above the ground at its highest part, the southeast one of a number of similar rocks 3 feet from the south edge and 16 inches from the west edge of the rock. (See note 3, p. 580.)

T. B. M. 58.—Is near *Barton, Ala.* (See p. 701, App. 8, Report for 1899.)

Z_3.—Is 2654 feet west of *Cherokee, Colbert County, Ala.*, in a deep cut, 10 feet north of the center of the track, on the face of the stratum of sandstone, 2 feet above the top of the rails. (See note 13, p. 581.)

A_4.—Is 1¼ miles east of *Margerum, Colbert County, Ala.*, on the west abutment of the Southern Railway deck plate girder of bridge No. 426.8A (from Bristol), over Buzzard Roost Creek, on the lowest step of the retaining wall, 13 feet north of the center of the track, 5½ feet below the top of the ties and 2 feet above the top of the abutment proper, 12 inches from the north edge of the stone and 11 inches from the east edge. (See note 3, p. 580.)

T. B. M. 45.—Is at *Margerum, Ala.* (See p. 701, App. 8, Report for 1899.)

B_4.—Is 1¼ miles west of *Riverton Junction, Colbert County, Ala.*, on the south end of the west abutment of the bridge over Big Bear Creek, on the coping stone, 8 inches and 30 inches from the south and west edges, respectively, 1 foot below the top of the pedestal stone, about 3 inches below the top of the ties, and about 10 feet from the center of the track. (See note 3, p. 580.)

T. B. M. 41.—Is near *Pegram, Ala.* (See p. 700, App. 8, Report for 1899.)

C_4.—Is about 2 miles west of *Riverton Junction, Colbert County, Ala.*, on the stone post marking the State line between *Alabama* and *Mississippi*, 15 feet north of the center of the track. The post rises above the ground about 4 feet and leans slightly to the westward, but appears to be set firmly in the ground. The bench mark is the intersection of the two line cut on side of the post toward the railway track. Marked

$$\frac{S}{M}\Big|\frac{L}{A}$$

P. B. M. 3.—Is at *Iuka, Miss.* (See p. 700, App. 8, Report for 1899.)

P. B. M. 1.—Is at *Burnsville, Miss.* (See p. 700, App. 8, Report for 1899.)

A_3.—Is 9 miles west of *Burnsville, Tishomingo County, Miss.*, 607 feet east of mile post 453A (from Bristol), on the north end of a stone culvert, on the west coping stone, 8 inches from the north edge and 16 inches from the west edge. (See note 3, p. 580.)

B_3.—Is 4¼ miles east of *Corinth, Alcorn County, Miss.*, 2,900 feet east of mile post 455A (from Bristol), on the south end of a stone arch culvert, on the east coping stone, 12 inches and 10 inches from the south and east edges, respectively. (See note 3, p. 580.)

V.—Is at *Corinth, Miss.* (See p. 596, App. 8, Report for 1899.)

T. B. M. 1.—Is at *Corinth, Miss.* (See p. 700, App. 8, Report for 1899.)

W.—Is at *Corinth, Miss.* (See p. 596, App. 8, Report for 1899.)

C_3.—Is at *Corinth, Alcorn County, Miss.*, on a store building occupied by J. C. Small, hardware merchant, on the southwest corner of Franklin and Cruse streets, one block west and two blocks south of the court-house, on the stone sill under the show window on the east side of the store, 12 feet south of the northeast corner and 8 inches above the pavement. (See note 3, p. 580.)

DESCRIPTION OF PERMANENT BENCH MARKS BETWEEN GIBRALTAR AND LEXINGTON, MICH., AND AT AMHERSTBURG, ONT.

[From information furnished by the U. S. Lake Survey. For descriptions of the other bench marks on this line, see App. 8, Coast and Geodetic Survey Report for 1899, pp. 843-847.]

Gauge B. M.—*Amherstburg, Ontario, Canada.* Top of a ship spike driven into the top of a maple stump 1 foot in diameter and about one-half foot above the ground. The stump is about 30 feet from the water's edge and about 100 feet north from a point abreast of the gauge house.

P. B. M. No. 6.—Is in *Ecorse, Mich.*, opposite the head of Fighting Island, at the Tecumseh Salt Works, 136 feet east of the northeast corner of boiler room, on the river front, at the end of railroad track, 11 feet west of the bumper and 4½ feet north of north rail, on top of pile 10 inches in diameter and 14 inches above ground; being top of 20 penny wire spike driven to surface and circumscribed by a 2-inch square cut into the wood with a cold chisel.

U. S. B. M. Detroit 1871.—Is in *Detroit, Mich.*, on the foundation of Lighthouse depot, at foot of Mount Elliott avenue, 8.2 feet below the outer edge of the water table, on the west jam of south door; being center of cross cut in the stone.

P. B. M. Lakeport.—Is in *Lakeport, Mich.* It is the top of a brass bolt leaded vertically in the top of a granite stone 14 by 14 by 8 inches, buried 2½ feet underground in the southeast corner of lot No. 2, block 2. It is in the southeast corner of hotel yard owned by Mr. John Thoday, 20 inches north of fence on north side of Milwaukee street and 14 inches west of fence on west side of Second street. A granite stone 6 by 6 inches extends 4 inches above the ground and is directly over P. B. M.

P. B. M. Lexington 3.—Is in *Lexington, Mich.* It is the summit of a brass bolt leaded vertically in the north end of stone sill of the north door of city hall. Bolt is 3 inches south of north end of sill and 1½ inches back of front edge. It is about 10 feet south of the northwest corner of building. Building is a three-story brick and fronts on Main street between Huron avenue and Simons street. Ground floor used for hose house, second floor for council room, and third floor for masonic hall.

P. B. M. Lexington 1.—Is in *Lexington, Mich.*, center of a period between the letters M. and E. in the center of the cornerstone of the Methodist Episcopal Church at Lexington, Mich. Church stands on the northeast corner of Main and Lake streets, and was rebuilt in 1890. Mark is about 3 feet above ground, 9 inches north of the southwest corner. Cornerstone marked

FIRST
M. E.
CHURCH,
1851-1890.

P. B. M. Lexington 2.—Is in *Lexington, Mich.* It is the summit of a small square cut on top of water table on west side of a 2-story brick building, owned by John L. Fead, at the northeast corner of Main and Boynton streets. Mark is 25 inches north of southwest corner of building and 3 inches back from front of water table.

P. B. M. Lexington 4.—Is in *Lexington, Mich.* It is the summit of a brass bolt leaded vertically in the top of a large granite bowlder which is in the front yard of Mrs. Martha Henry's property. It is 22 meters north of the north end of Dallas street and the north side of Simons street. (Foot of street is at dock.) It is about 40 meters back from high bank of lake and about 125 meters south of the Lexington Woolen Mills.

DESCRIPTIONS OF BENCH MARKS FROM DETOUR TO IROQUOIS POINT, MICH., CONNECTED WITH OR ESTABLISHED BY PRECISE LEVELS OF UNITED STATES LAKE SURVEY IN 1901.

(From information furnished by U. S. Lake Survey.)

P. B. M. Goetz.—*Detour, Mich.* Top of a brass bolt leaded vertically in the top of a granite bowlder near the center of the foot of St. Marys street, about 35 meters from the water's edge of St. Marys River and projecting about 5 inches above the ground. The bowlder is 7 meters south and 1½ meters east of the corner of the sidewalk, one block north of Anthony's dock, 70 meters east and 8 meters south of the southwest corner of Hotel Detour, owned by J. F. Goetz.

P. B. M. Detour 2.—*Detour, Mich.* Top of an iron bolt 1¼ by 1¼ inches square cemented in the top of a granite bowlder, the top of which is about flush with the ground, 85 meters east and 20 meters south of the Huron House, 55 meters south of Bennett's store and post-office, 17 meters from water's edge of St. Marys River, 24 meters northeast of the northeast corner of J. T. Bennett's yard, near Anthony's coal dock.

P. B. M. Terrett.—*Detour, Mich.* Top of a brass bolt leaded vertically in top of a large limestone bowlder which lies at the junction of Superior and Huron streets, about 2 meters west of the east line of Superior street and at a point where Superior street angles to the west. It is 8 meters northwest of a large granite bowlder, 17½ meters east of a fence corner, which is the southeast corner of a block, also southeast corner of Mr. Richard Terrett's yard; 26½ meters southeast of the northeast corner of Mr. Terrett's house, 22 meters northeast of a log house, 80 meters northwest from the water's edge of St. Marys River and 1 block (130 meters) south of P. B. M. Detour 1. Marked

U S
P B M

P. B. M. Detour 1.—*Detour, Mich.* Top of a ½-inch iron bolt leaded vertically in the top of a cut stone 6 by 6 by 20 inches and buried 2½ feet below the surface of the ground, at the intersection of Superior and Drummond streets. It is 4 meters north and 3 meters east of a fence corner at the southeast corner of street intersection. A cedar post 6 inches in diameter and 4 by 4 inches at the top is planted over the bench for a surface mark and projects about 3 feet above ground. Letters U. S. B. M. are cut on opposite sides of the post. Established 1895.

P. B. M. Detour 3.—*Detour, Mich.* Intersection of a cross cut on top of iron plate about 6 inches northwest of northwest corner post of Detour Lighthouse. Marked U. S. + B. M. Established 1895.

P. B. M. Detour 4.—*Detour, Mich.* Top of a brass bolt leaded vertically in the summit of a very large limestone bowlder which lies 5 meters north and 1½ meters east of the northwest corner of the tower of Detour Lighthouse. The stone is marked thus:

S Ω
+
P B M

the bolt being on the western point of the cross which is an old T. B. M.

P. B. M. Detour 5.—*Detour, Mich.* Top of a brass bolt leaded vertically in the top of a large limestone bowlder which lies 11 meters northwest of the northwest corner of the light keeper's dwelling. The bowlder is well embedded and projects about one-half meter above the ground. The bolt projects about one-fourth inch above the bowlder. Marked U. S.

P. B. M. Boat House.—*Detour, Mich.* Top of a brass bolt leaded vertically in the top of a limestone bowlder 1 by 1½ meters, and projecting about 0.3 meter above the ground. Bowlder is well embedded and lies on gravel beach on the east shore of the bay and on the west side of Detour Point. It is 65 meters north of boathouse belonging to Detour Lighthouse, 74 meters northeast of outer end of pier at boathouse, 3 meters east of water's edge, 7 meters west of edge of brush and 300 meters from Detour Lighthouse. Bolt is about 6 inches from north edge of bowlder. Marked U. S.

P. B. M. Caribou.—Four and one-half miles west of *Detour, Mich.* Top of an iron bolt leaded in the top of a cut stone, 6 by 6 by 20 inches, buried in sand with its top end 2½ feet below the surface. A 6-inch cedar post, 4 by 4 inches at the top and marked U. S. B. M. on opposite sides, is planted over the stone for a surface mark. The stone is 364 meters east of the point where the wagon road leaves the water's edge of Caribou Lake, 2½ meters north of the center of the wagon road and 50 meters south of Caribou Lake. Established 1895.

P. B. M. Schlesser.—One mile west and 1 mile north of *Schlesser, Mich.* Top of a ⅜-inch iron bolt leaded vertically in the top of a cut stone, 6 by 6 by 20 inches, and buried with its top 2½ feet below the surface of the ground. The bolt projects one-fourth inch above the surface of the stone between the letters U. S. A stone 6 by 8 by 14 inches is planted in a vertical position over the mark and projects 2½ inches above the ground. The stone is at Rusk's corner, 1 mile north of Cameron's corner, in the center of the road leading west, near the west fence line of the north and south road, 57½ meters northeast of the northeast corner of the school house, 190 meters east of the creek crossing the road, 17½ meters northwest of the fence corner and 15½ meters southwest of another fence corner. The surface stone is marked on top, thus:

U S
P B M

Established 1895.

P. B. M. Raber.—*Raber, Mich.* Top of a ¼-inch iron bolt leaded in top of a cut stone, 6 by 6 by 20 inches, buried 2½ feet below the surface of the ground. It

is on south line of the main street, 65 meters west of the water's edge of the St. Marys River, 76 meters east of intersection of narrow gauge railroad and the main street, 75 meters from the entrance of a new church, 37 meters from the southwest corner of the Mud Lake Lumber Company's general store. A cedar post, 6 inches in diameter and 4 by 4 inches at the top, with the letters U. S. B. M. cut on opposite sides, is planted over the mark and projects 2 feet above the ground for a surface mark. Established 1895.

P. B. M. Gatesville.—One mile north of *Gatesville, Mich.* Top of a ⅜-inch iron bolt set in the top of a cut stone, 6 by 6 by 20 inches, marked U. S. on top and buried in the sand with its top 3 feet below the surface of the ground. A 6-inch cedar post, 4 by 4 inches on top and marked U. S. B. M. on opposite sides, is planted over the stone for a surface mark. The post projects 2½ feet above the ground on the north side of the county road 1 mile north of Gatesville post-office, and is 7 feet west of a large hemlock stump at the corner of the road. Established 1895.

P. B. M. Hudson.—SE. corner sec. 27, T. 43 N., R. 2 E., Chippewa County, near *Raber, Mich.* Top of a ¼-inch iron bolt leaded in the top of a cut stone, 6 by 6 by 20 inches, which is buried in a vertical position in sand with its top 2½ feet below the surface; the letters U. S. are cut in the top of the stone. It is 13 meters northwest of a section corner stake, 3 meters south of east and west fence which is the south line of Mr. Frank Huber's property. It is 150 meters east of a point in the road opposite Mr. Huber's house, 125 meters north of creek crossing the road in the bottom of a large ravine and one mile north of county road. A cedar post 6 inches in diameter, with its upper end 4 by 4 inches square, is planted over the stone for a surface mark and has the letters U. S. B. M. cut on opposite sides. Post projects about 2 feet above ground. Established 1895.

P. B. M. Tripp.—NE. cor. sec. 21, T. 43 N., R. 2 E., Chippewa County, near *Stalwart, Mich.* Top of a three-eighths-inch iron bolt in top of a cut stone, 6 by 6 by 20 inches, buried about 2½ feet deep. Bolt projects about one-half inch above stone, between the letters U. S. A cedar post, 6 inches in diameter and 4 by 4 inches at the top, with the letters U. S. B. M. cut on opposite sides, is planted over the stone and projects about 1½ feet above ground. Stone is on east side of road at the turn by the bluff and 12½ meters south of section corner. Witness trees have all burned down. Established 1895.

P. B. M. Fairview.—SE. cor. sec. 1, T. 43 N., R. 1 E., Chippewa County, near *Sterlingville, Mich.* Top of a one-half-inch bolt leaded vertically in the top of a dressed stone, 6 by 6 by 24 inches, buried 2½ feet below the surface of the ground. A cedar post 4 inches square at the top is planted over the stone for a surface mark and projects about 2½ feet above ground, with the letters U. S. B. M. on opposite sides. It is on the east fence line of the county road, 26 meters north of junction of roads at section corner and 38 meters south of the southwest corner of Fairview schoolhouse. Established 1895.

P. B. M. Campbell.—One mile east and one-fourth mile south of *Sterlingville, Mich.* Top of a brass bolt leaded in the top of a very large bowlder embedded in a field belonging to Robert Campbell. The bowlder, marked U. S. and projecting 4 feet above ground, is 40 meters east of the east fence line of the north and south road, 400 meters south of road intersection, and 400 meters north of Robert Campbell's house, which stands on a high bluff 2 miles south of the Big Munuscong River.

P. B. M. Munuscong.—*Kelden, Mich.* Top of a one-half-inch iron bolt cemented

in the top of a cut stone, 6 by 6 by 24 inches, which is buried with its top 3 feet below the ground and marked by a 4 by 4 inch cedar post which is planted over the mark. The post, projecting 1 foot above the ground and marked U. S. B. M. on the sides, is 4 meters east of the east fence line of the north and south road, 91 meters north of the north end of the large barn on the east side of the road, 440 meters south of the center of the wagon bridge over the Little Munuscong River, 950 meters north of the Big Munuscong River, and 420 meters south of the Kelden post-office. Established 1895.

P. B. M. Barbeau.—*Barbeau, Mich.* Top of a one-half-inch iron bolt leaded vertically in the top of a dressed stone, 6 by 6 by 24 inches, which is buried on end, and 3 feet under the surface of the ground. It is surmounted by a 4 by 4 inch cedar post, which projects about 1 foot above ground and is marked U. S. B. M. on the sides. It is 1 meter north of the south fence of an east and west road, 59 meters west of an 8-inch lone oak tree standing in the road, and 31 meters east of a point in the road opposite the east line of a small schoolhouse which stands north of road. It is on top of a hill and in front of Mr. Alex. Scales's house 330 meters east of Barbeau post-office, which stands at the southeast corner of junction of roads. Established 1895.

P. B. M. Charlotte.—Charlotte River at Hay Lake road crossing, near *McCarron, Mich.* Top of a five-eighths-inch iron bolt projecting 2 inches above the top of a cut stone, 6 by 6 by 24 inches, which is marked by the letters U. S. and buried with its top 3 feet below the surface. For a surface mark a 4-inch squared cedar post is planted over the stone projecting 1 foot above the ground and marked with the letters U. S. B. M. on its sides. It stands 3 feet east of the Hay Lake road and 140 feet south of Charlotte River and is referenced as follows: A 4 by 4 inch stone projecting 5 inches above ground and marked U. S. on top is S. 64° 00′ W., and 59 feet distant; B. M. 3½ is N. 0° 50′ W., and 126 feet distant; the northeast corner of the house on the east side of road is S. 1° 10′ E.; the southeast corner of the house west of the road is S. 20° 40′ W. Established 1895.

P. B. M. Hinds.—Three miles north of Charlotte River at junction of Hay Lake and Rosedale roads, near *Rosedale, Mich.* Top of a brass bolt leaded vertically in a sandstone bowlder 2 by 1½ by 1½ feet, buried with its flat top 2½ feet below the surface of the ground. The surface mark is a small bowlder placed over the mark, projecting 4 inches above the surface, and is 2 feet east and 1 foot south of the fence corner which is the southwest corner of property of Mrs. John Hinds. The property on the south of Rosedale road and east of Hay Lake road belongs to Van Lenven, and is 10½ miles south of the "Soo" locks, three-fourths mile west of St. Marys River, and 3 miles due north of Charlotte River.

P. B. M. Newcomb.—St. Marys River, 7 miles below the "Soo" locks on the Hay Lake road, near *Rosedale, Mich.* Top of an iron bolt cemented in the top of a bowlder buried with its surface 15 inches below the ground in the south end of an ash grove on the right bank of the St. Marys River and belonging to Mrs. Newcomb. A squared 5-inch pine post projecting 6 inches above the ground is planted over the bolt for a surface mark and is 10 meters from top of bank, 5 meters south of the south fence line of lane leading from the house to the river, and 3 meters south of line of the north side of the large barn.

P. B. M. Riverside.—Riverside Cemetery, 4½ miles below the "Soo" locks, *Sault Ste. Marie, Mich.* Center of a brass bolt leaded horizontally in the center of the

sixth masonry course above ground at the south end of the gateway to the cemetery. The bolt, about 4 feet above ground, faces the St. Marys River and the stone is marked thus:

U S
P B M

P. B. M. Little.—Two and one-half miles below "Soo" locks, near *Sault Ste. Marie, Mich.* Gauge B. M. on upper island. Top of a square iron bolt cemented in the top of a sandstone bowlder set flush with surface of ground, on upper island of Little Rapids, 10 meters back of Government light on right shore of main channel of St. Marys River.

P. B. M. Soo.—*Sault Ste. Marie, Mich,* Center of a brass bolt leaded horizontally in the north side of a red sandstone, the third above ground, at the northeast corner of the Chippewa County court-house, and is 2½ feet above the ground and 6 inches west of the northeast corner of building.

P. B. M. A.—*Sault Ste. Marie, Mich.* Summit of a square, 2 by 2 inches, cut on top of masonry on the north side of the Weitzel lock. It is 10 inches south of the north edge of masonry and is directly in line of lower gate at the upper end of the Weitzel lock, and about 150 meters west of the Government building. Established 1881.

P. B. M. B.—*Sault Ste. Marie, Mich.* Summit of a square, 1½ by 1½ inches, cut on top of masonry at the foot and on the north side of Poe lock. It is 5 inches south of the south side of steps leading down on the north side of Poe lock, and is directly in line with front edge of the second step from bottom.

P. B. M. Meridian.—*Sault Ste. Marie, Mich.* Summit of a square head of an iron bolt leaded in the top of a stone monument marking the intersection of the principal meridian and the south line of the Sault Ste. Marie grant. It is in line of center of Meridian street (Meridian street bounds Fort Brady on the west), and is 4 feet east and 12 feet north of southeast corner of stone abutment of plate girder bridge, carrying Soo Railroad over wagon road. Mark is 2 feet below the surface of the ground, and the hole is walled up and covered with large stones. Established 1892.

P. B. M. Neesville.—*Sault Ste. Marie, Mich.* Top of a brass bolt leaded vertically in the top of a large sandstone bowlder which lies, well embedded, in small ditch in small cut of the Soo Railroad. The bolt is 1.95 meters south of south rail of track, 35 meters west of road crossing, 63 meters east of point of curve of track, and 185 meters east of smokestack of Northwestern Leather Company's tannery. Marked in 3-inch letters, U S.

P. B. M. 1.—On the Duluth, South Shore and Atlantic Railroad, 200 meters north of the 3-mile post, near *Sault Ste. Marie, Mich.* Top of a copper bolt set in the summit of a large bowlder 12 feet west of the center line of the track and marked on the east face with the letters U. S. B. M. Established 1892.

P. B. M. Solomon.—Brush Point, St. Marys River, near *Sault Ste. Marie, Mich.* Top of a brass bolt leaded vertically in the top of a sandstone, 15 inches by 12 inches by 6 inches, buried in Solomon's clearing, 3 feet below the surface of the ground, 3½ meters west of a 15-inch white-pine tree, on which is blazed a 9-inch triangle. The surface mark—a stone 15 by 8 by 6 inches, marked U S on top and projecting 6 inches above the ground—is placed over the bolt and is 16 meters south of the top of the river bank on the line of an old fence running back from the river 925 meters, by shore line, below Brush Point.

P. B. M. Johnson.—Destroyed.

P. B. M. Brush.—Brush Point, near *Sault Ste. Marie, Mich.* Top of center one of 5 wire spikes driven in the top of a very large hub on top of low bank and is 5 meters back of staff gauge and 35 meters west of the northwest corner of a large boathouse on the south shore of St. Marys River.

P. B. M. 2.—On the Duluth, South Shore and Atlantic Railroad, near *Sault Ste. Marie, Mich.*, 29 feet north of the sixth milepost. Top of a copper bolt leaded vertically in the summit of a bowlder buried to a depth of 4 feet, 41 feet west of the center of the track. A red sandstone, projecting 1 foot above the ground and marked U. S. B. M. on top, is set directly over the bolt for a surface mark. Established 1892.

P. B. M. 3.—On the Duluth, South Shore and Atlantic Railroad, near *Brimley, Mich.*, 21½ feet north of the 9-mile post. Top of a copper bolt leaded vertically in the summit of a stone monument buried 31 feet west of the center of the track to a depth of 4 feet. A 6-inch square cedar post projecting 16 inches above the ground is planted over the bolt for a surface mark.

P. B. M. 4.—*Brimley, Mich.* On the Duluth, South Shore and Atlantic Railroad 200 feet east of the station. Top of a copper bolt leaded vertically in the top of a stone monument 18 inches square, 4 feet below the surface of the ground, 34½ feet north of the center of the track, 192 feet west of the west end of the Waiska River railroad bridge, and due north of the frog for the branch railroad across Waiska Bay. An old cedar post carved with the letters U. S. B. M. stands 1 foot west of the bolt, and a red sandstone 20 by 8 by 6 inches, projecting 8 inches above the ground and marked

U S B M No. 4

lies directly over the bolt. Established 1892.

P. B. M. Bay Mills.—*Bay Mills, Mich.* Top of a brass bolt leaded vertically, 8 inches from the west and 7 inches from the north side of the pedestal (marked U. S.) on the southeast foundation for the steel water tank tower which stands on the south side of Hall & Munson's factory power house.

P. B. M. Mission.—Two and one-half miles above *Bay Mills, Mich.* Top of a brass bolt leaded vertically in the top of a sandstone 14 by 10 by 6 inches and buried about 3 feet under the ground on top of a point of a sand terrace in the upper end of the mission and on the west side of a broad ravine running back from St. Marys River. It is about 4 meters back from crest of high bank of river, 16 meters northeast of a spruce tree blazed with a 4-inch triangle (T. B. M. No. 109 on root of tree), 42 meters east of a log house owned by Duel Cameron, 142 meters above a small bridge over small creek crossing the road in bottom of ravine, and 1 mile above store at lower end of mission. A sandstone 8 by 10 by 15 inches is set directly over the P. B. M. for a surface mark and projects about 5 inches above ground. Marked

U S P B M

P. B. M. △.—*Iroquois Point, Mich.* Top of a brass bolt leaded vertically in top of a stone monument 6 inches square set in the ground at the east side of the lighthouse yard, 2 feet west of the north and south fence, 37½ feet east of the northeast corner of lighthouse building and about on line with north side of building. Marked U S.

P. B. M. Iroquois Lighthouse.—*Iroquois Point, Mich.* Center of a brass bolt leaded horizontally in the center of a large stone on north side of Iroquois Lighthouse. Stone is in the top course of masonry of foundation of the lighthouse which is built of brick and was erected in 1870. It is 5 feet east of old B. M., and marked

U S
P B M

P. B. M. Old B. M.—*Iroquois Point, Mich.* A square notch cut in top of foundation of the lighthouse on north side and 5 feet west of P. B. M. Iroquois Lighthouse. Marked □ B. M.

P. B. M. Iroquois 1. —*Iroquois Point, Mich.* Top of a brass bolt leaded vertically in the top of a stone 8 by 8 by 20 inches, buried 2½ feet underground in the southeast corner of the lighthouse yard. It is 1 foot from the south fence and 2 feet from the east fence. A stone 8 by 8 by 18 inches is set in ground directly over the P. B. M. for a surface mark and projects about 6 inches above ground. It is 11½ meters east and 18 meters south of extreme southeast corner of the lighthouse building. Marked

U S
P B M

P. B. M. Iroquois.—*Iroquois Point, Mich.* Top of an iron bolt 1 inch square cemented in the top of a bowlder 4 meters east of walk from light-house to engine house 29 meters south of east entrance of engine house, 60 meters south of shore of St. Marys River and 30 meters north of high bank.

DESCRIPTIONS OF PERMANENT BENCH MARKS BETWEEN ESCANABA AND MARQUETTE, MICH.

(From information furnished by U. S. Lake Survey. The other bench marks on this line are described on p. 791, App. 8, Report for 1899.)

B. M. 3 (1874).—*Marquette, Mich.* (Reported destroyed.)

B. M. 11 (1896).—Is on the water table 10 inches from southwest corner on south side of new pump house of city waterworks, *Marquette, Mich.*

DESCRIPTIONS OF PERMANENT BENCH MARKS AT SAND BEACH AND MACKINAW, MICH., AND MILWAUKEE, WIS., CONNECTED WITH THE PRECISE LEVEL NET BY WATER LEVELING ONLY.

(From information furnished by U. S. Lake Survey.)

U. S. B. M.—*Sand Beach, Mich.* Is on a granite bowlder about three-fourths of a mile from the custodian's office. The bowlder is at the edge of the bluff and nearly in line with the north side of the west pier. The bench mark is in relief, about 3 inches square, three-eighths inch above the remainder of the stone and bears the letters U. S. B. M.

U. S. B. M. A.—*Sand Beach, Mich.* Is the top of a round iron rod 1 inch in diameter, slightly sharpened at the top and resembling a drift bolt. The rod is fox-

wedged into the rock, and is at the west end of the United States boathouse in front of the United States Engineer's office.

U. S. B. M. B.—*Sand Beach, Mich.* Is the top of a mill shaft 1½ inches in diameter, with head turned on at the top; it is fox-wedged into the rock just south of the United States boathouse and near the east end.

U. S. B. M. E.—*Sand Beach, Mich.* Is the top of a bar driven into the rock under the dock, about one-fourth mile from the United States Engineer's office. It is about 250 feet from the outer end of dock.

U. S. B. M. Jenks.—*Sand Beach, Mich.* Is on the water table at the southwest corner of J. Jenks & Co.'s brick store. The bench mark is marked.

U. S. B. M. Bowlder in Harbor.—*Sand Beach, Mich.* Is the center of a square cut on a bowlder about 350 feet south of the United States Engineer's office. This bench mark was established in 1873–74 by Assistant Engineer Gilbert.

B. M. 1.—*Mackinaw, Mich.* Is a level summit 1 by 1 inch on a shelf 1 by 2 inches cut in the rough stone face of the first course of masonry on the north side of "Old Point Mackinaw" lighthouse. It is 1½ feet above the ground and 2 feet west of the center of a slot window facing the water. The letter "B" is cut above the east end of the shelf.

B. M. 2.—*Mackinaw, Mich.* Is the top of edge of stone forming doorsill in the light keeper's house that is nearest the lighthouse tower, the bench mark being at the easterly side of the door on the level part of the stone next to the bevel of the sill and at the middle of the 8-foot stone the west half of which forms the doorsill.

B. M. 3.—*Mackinaw, Mich.* Is the top of a ½-inch brass tube set vertically in a block of concrete 1 foot in diameter and 2.7 feet long, set 1.8 feet below the surface of the ground just north of the railway crossing on Huron avenue. It is 13.3 feet north of north rail of most northerly track of Michigan Central Railroad, 6.9 feet south of south rail of Grand Rapids and Indiana Railroad, 6.4 feet east of lamp-post between above-named tracks, 2.6 feet west of west edge of plank sidewalk on west side of Huron avenue. Top of concrete is marked

B. M. R.—*Mackinaw, Mich.* Is the top of a railroad rail set vertically in the ground on the west side of Huron avenue, near the west street line. It is 44.8 feet north of bench mark No. 3; 184.1 feet west of northwest corner of pump house, measurement made in line with north face of pump house, which is on the east side of Huron avenue. The rail projects about 1 foot above ground.

B. M. 4.—*Mackinaw, Mich.* Is the top of a ½-inch brass tube set vertically in a concrete block 1.4 feet long, set 2.3 feet below the ground. It is 64.7 feet east of B. M. R.; 85.4 feet northeast of B. M. 3; 119.4 feet west of northwest corner of pump house, on east side of Huron avenue, measured in line with north face of pump house. Top of the concrete is marked

B. M. 1.—*Milwaukee, Wis.* This bench mark was formerly on house of Dr. I. A. Lapham, but has been destroyed by repairs to the house.

B. M. 2.—*Milwaukee, Wis.* Stone monument in court-house square, near the southeast corner thereof, in the Seventh Ward.

B. M. 3.—*Milwaukee, Wis.* Stone monument on sidewalk at southeast corner of Eighth and Chestnut streets, Second Ward.

B. M. 4.—*Milwaukee, Wis.* The highest point of the stone water table at the corner of the building, Ludington's Block, northwest corner of East Water and Wisconsin streets.

B. M. 5 (1876).—*Milwauke, Wis.* A cross on the masonry of the Kilbourne grist-mill at the foot of Poplar street. It is cut in the stone 10½ inches from the southeast corner on the east wall and about 3 feet above the surface of the ground.

DESCRIPTIONS OF BENCH MARKS FROM OLCOTT, N. Y., TO BUFFALO, N. Y., ESTABLISHED OR CONNECTED WITH BY PRECISE LEVELS OF UNITED STATES LAKE SURVEY IN 1901.

(From information furnished by U. S. Lake Survey.)

P. B. M. 4.—Is in *Olcott, N. Y.*, on stone water table at southwest corner of a two-story brick building, now owned and occupied as a general store by C. D. Shaw, on north side of street about 200 meters west of wagon bridge over Eighteen-mile Creek, being a square cut on stone. Established by Board on Deep Waterways.

P. B. M. 5.—Is in *Olcott, N. Y.*, on top of hill west of Eighteen-mile Creek, 125 meters south of main road leading north from wagon bridge over creek, on stone water table at southwest corner of a one-story schoolhouse, which is built of concrete and veneered with water-worn pebbles, being a square cut on stone. Established by Board on Deep Waterways.

P. B. M. 6.—Is in *Olcott, N. Y.*, on top of bridge seat at north end of west abutment of a wagon bridge over Eighteen-mile Creek, being a square cut on stone 4 inches west and 1½ inches south of northeast corner, and marked U □ S.

P. B. M. 3.—Is in *Olcott, N. Y.*, on stone cap of foundation under west post of porch over carriageway in front of Albright Hotel, being a square cut on southeast corner of stone and marked

U S
□

P. B. M. 2.—Is in *Olcott, N. Y.*, on large stone door sill at front entrance of the Albright Hotel, being a small square cut on west side of entrance, 1½ inches back from front edge of stone and 3 inches east of west door jamb.

P. B. M. 1.—Is in *Olcott, N. Y.*, on south end of stone door sill at front entrance to the First Universalist Church (erected in 1858), which is built of red brick and situated on the east side of the first north-and-south street east of Eighteen-mile Creek and about 250 meters south of the south shore of Lake Ontario, being a small square cut on front edge of stone, 4 inches north of a large square on same stone, which is the old bench mark at same elevation. Established by Board on Deep Waterways.

T. B. M. 60.—Is about 300 meters west of *Newfane, N. Y.*, on the first step above the bridge seat at the south end of the east abutment of the New York Central and Hudson River Railroad bridge over Eighteen-mile Creek, being the top of a square cut on southwest corner of stone step.

T. B. M. 59.—Is near *Coomer*, three-fourths mile west of *Eighteen-mile Creek*, *N. Y.*, on the north end of the west abutment of a railway bridge over Hopkins Creek, on the New York Central and Hudson River Railroad, being the summit of a small square cut on top of stone.

T. B. M. 53.—Is about 1½ miles east of *Wilson*, *N. Y.*, in the south root of a poplar tree 2½ feet in diameter standing on fence line on north side of east-and-west road, at east end of hedge row and at the southwest corner of lawn in front of the residence of Mr. H. Pease, being the top of a 30-d. wire nail driven into root 2½ feet south of trunk of tree.

P. B. M. Wilson.—Is in *Wilson*, *N. Y.*, on water table at the northwest corner of Exley Methodist Episcopal Church, being the center of a brass bolt, 17 inches east of the northwest corner, leaded horizontally and marked thus:

U S
○
P B M

T. B. M. 47.—Is 4 miles east of *Ransomville*, *N. Y.*, or 697 meters west of milepost 158, on the south end of the west abutment of a plate girder railway bridge over the east branch of Twelve-mile Creek, on the New York Central and Hudson River Railroad, being a square cut in top of bridge seat and marked U □ S.

T. B. M. 43.—Is 2650 meters east of *Ransomville*, *N. Y.*, or 340 meters east of milepost 161, at edge of timber and on north end of west wall of open culvert, on the New York Central and Hudson River Railroad, being a square cut on stone, on top of second step from top, 6 inches from north and east edges of the stone, respectively.

P. B. M. Ransomville.—Is in *Ransomville*, *N. Y.*, on water table 20 inches west of northeast corner of brick building standing on the southwest corner of intersection of the two main streets of the village and owned as well as occupied by W. H. H. Ransom & Son as a general store, being the top of a brass bolt leaded vertically in top of water table and marked U ⊙ S.

T. B. M. 41.— Is in *Ransomville*, *N. Y.*, 100 meters east of the east end of Ransomville Station on the south end of the west abutment of a plate girder railway bridge on the New York Central and Hudson River Railroad, being the top of a small square cut on the third stone step from ground, 3 inches from the south and east edges of stone step and about 6 inches below bridge seat.

T. B. M. 37.—Is 1690 meters north of *Model City*, *N. Y.*, and 225 meters north of road crossing, on flange of rail set in ground 2 meters west of track and marking the one hundred and sixty-seventh milepost on the New York Central and Hudson River Railroad, being the top of a square cut on flange.

P. B. M. Model City.—Is in *Model City*, *N. Y.*, about 200 meters south of railway station in the south face of the fifth stone above ground in southeast corner of the Erie Preserving Company's warehouse, being the center of a brass bolt leaded horizontally in stone 12 inches west of corner, 30 inches above ground, and 13 inches below platform in front of building.

T. B. M. 35.—Is 1 892 meters southwest of *Model City*, *N. Y.*, and just east of railroad crossing of main road leading east from Lewiston, on stone coping at north end of box culvert on the New York Central and Hudson River Railroad; being a square cut on stone.

P. B. M. Lewiston.—Is in *Lewiston, N. Y.*, at corner of Center and Ninth streets, on the northwest corner of stone sill of north door of west wing of old seminary building; being a square cut on stone. Established by Board on Deep Waterways.

P. B. M. Lewiston Heights 2.—Is 101 meters east of the center of *Lewiston Heights, N. Y.*, in face of solid rock ledge on upper side of wagon road leading down from Lewiston Heights station to Lewiston; being the center of a brass bolt leaded horizontally in vertical face of rock 21 inches below top of ledge, and marked thus in 3-inch letters:

U S
O
P B M

T. B. M. 31.—Is in *Lewiston Heights, N. Y.*, on top of retaining wall on south side of wagon road, 3 meters north of center of track of the New York Central and Hudson River Railroad and 12 meters east of northeast corner of Lewiston Heights station; being the top of a small square cut on large stone.

P. B. M. Lewiston Heights 1.—Is near *Lewiston Heights, N. Y.*, on a flat rock at north end of small drain under railway, approximately 30 feet in front of north pillar of Penjerrick Gateway, which is on east side of military road and about 200 feet south of junction with river road; being the summit of a small square cut on rock. This mark is not very permanent and is liable to be disturbed. Established by Board on Deep Waterways.

P. B. M. University.—Is about 2 miles north of *Niagara Falls, N. Y.*, and 60 meters east of top of gorge of Niagara River, in west corner of the main building of Niagara University; being the center of a brass bolt leaded horizontally into stone 4½ inches east of corner and 20 inches above ground.

P. B. M. Suspension Bridge.—Is in *Niagara Falls, N. Y.*, in the northwest corner of passenger station called *Suspension Bridge* on the New York Central and Hudson River Railroad; being the center of a brass bolt leaded horizontally into center of seventh stone above the water table, 43 inches above the platform and 6 inches south of the northwest corner of the building.

T. B. M. 24.—Is in *Niagara Falls, N. Y.*, on top of granite bowlder, about the size of an oil barrel, on the west line of Sugar street, 65 meters south of the New York Central and Hudson River Railroad track to Lockport and 426 meters north of Ontario street; being the top of a small square cut in top of bowlder.

P. B. M. Niagara 1.—Is in *Niagara Falls, N. Y.*, on a stone 5½ inches square with a small square cut on northwest corner, now used as a reference stone for the center line of the tunnel of the Niagara Falls power plant, and is set in concrete in the gutter about 10 feet northwest of entrance to main building of the Niagara Falls power plant, 3 meters north of north door jamb and 1 meter out from building; being the top of a copper bolt leaded in the center of the stone.

P. B. M. Echota.—Is in *Niagara Falls, N. Y.*, on the west end of stone sill of west door on south side of the New York Central and Hudson River Railroad station called *Echota;* being the top of a small square in the southeast corner of a larger square cut on the stone. Established by Board on Deep Waterways.

P. B. M. Niagara 2.—Is in *Niagara Falls, N. Y.*, on sill of first window west of northeast corner of Niagara Falls Power Company's power house; being the top

of a brass bolt leaded vertically in east end of stone, 5¼ feet from front of building, 5 inches back from front edge of window sill, 7 inches west of east side of window and on side of building facing Buffalo avenue.

P. B. M. Schoolhouse.—Is in *Niagara County, N. Y.*, on stone water table at southwest corner of brick schoolhouse in district No. 5, Niagara Township, 1 mile west of *La Salle* on north side of main river road; being the top of a square cut on stone. Established by Board on Deep Waterways.

B. P. M. La Salle No. 2.—Is in *La Salle, N. Y.*, on the top of water table at the southeast corner of brick residence belonging to Mr. E. H. Smith, about one-fourth mile west of the New York Central and Hudson River Railroad station on main road along river front; being the top of a brass bolt leaded vertically in water table.

P. B. M. La Salle 1.—Is in *La Salle, N. Y.*, just south of La Salle station, on the northwest corner of bridge seat of east abutment of the New York Central and Hudson River Railroad bridge over Cayuga Creek; being the top of a square cut on stone. Established by Board on Deep Waterways.

T. B. M. 16.—Is near *La Salle, N. Y.*, 2 625 meters north of Niagara Falls and Buffalo Electric Railway bridge, over railroads and roadway, on the south root of an elm tree 28 inches in diameter which stands alone just inside the southeast corner of small field near fence on west side of road along river front: being the top of a 20-penny wire nail driven into root.

P. B. M. Wheatfield.—Is near *La Salle, N. Y.*, in *Wheatfield Township, Niagara County, N. Y.*, on the south end of stone water table on east front of brick schoolhouse, which is in district No. 2, and stands on the right bank of Niagara River and on main road 510 meters below Niagara Falls and Buffalo Electric Railway bridge over railroads and wagon road; being a square cut on stone. Established by Board on Deep Waterways.

P. B. M. Crossing.—Is between *North Tonawanda* and *La Salle, N. Y.*, on the northeast corner of the north foundation of the first iron trestle bent of trestle over roadway west of west pier of bridge carrying electric railway over the New York Central and Hudson River Railroad and the Erie Railroad, and about 1 mile below city limits of North Tonawanda; being the top of a 1-inch anchor bolt in foundation stone and marked with a chisel thus: +. Established by Board on Deep Waterways.

P. B. M. North Tonawanda 2.—Is in *North Tonawanda, N. Y.*, on stone water table 2 meters south of entrance to the old engine house (1873) of the Tonawanda Iron and Steel Company, situated on the right bank of the Niagara River and on the west side of Main street; being the top of a small square in the northeast corner of large square cut in corner of stone. Established by Board on Deep Waterways.

P. B. M. North Tonawanda 1.—Is in *North Tonawanda, N. Y.*, on west end of granite doorsill at the most eastern entrance to the front of Ascension Church, on the corner of Vandervoort and Robinson streets; being the top of a square cut on top of stone. Established by Board on Deep Waterways.

P. B. M. Tonawanda 2.—Is in *Tonawanda, N. Y.*, on the northeast surface stone of the south abutment of the Tonawanda Dam, being the top of a high point between bolted iron bars, in small square inside of large square cut on top of stone. Established by Board on Deep Waterways.

P. B. M. Tonawanda 1.—Is in *Tonawanda, N. Y.*, on stone water table on west side of steeple of Christian Chapel Church, a red brick building on southeast corner of Broad and Seymour streets, being the intersection of two cross marks cut in center of large square on top of stone. Established by Board on Deep Waterways.

P. B. M. State Ditch.—Is in *Tonawanda, N. Y.*, on top of stone coping on west end of north abutment of bridge over State Ditch on Main street, 1 200 meters south of bridge over Erie Canal on Main street, being the top of a brass bolt leaded vertically in top of stone and marked thus:

U S
O
P B M

T. B. M. 11.—Is in *Tonawanda, N. Y.*, on top of stone cover of catch-basin on east side of Main street, 5 meters west of German Cemetery fence and 27 meters south of entrance to cemetery; being a square cut on top of stone 4 inches from west and south sides of stone, respectively.

T. B. M. 9.—Is at *Pullman, N. Y.*, on military road, on the southeast root of an elm tree 20 inches in diameter standing farthest north in a line of five trees, 12 meters west of center of electric-car tracks, and 180 meters north of large frame house on west side of road opposite steel ball factory at Pullman station; being the top of a 20-penny wire nail driven into the root.

T. B. M. 8.—Is on the city limits of *Buffalo, N. Y.*, on top of large boulder on north side of military road on street line 220 meters north of large saloon building at city limits and bearing the following sign in red letters on the top: "Globe Liniment is the Best;" being the top of a square cut on top of bowlder 6 inches from west and south sides, respectively.

T. B. M. 7.—Is in *Buffalo, N. Y.*, on the west root of an elm tree 13 inches in diameter standing 73 meters west of military road and 145 meters south of Delaware, Lackawanna and Western Railroad tracks; being the top of a 20 penny wire nail driven into root.

P. B. M. St. John.—Is in *Buffalo, N. Y.*, on water table on the front of St. John the Baptist Church on the northwest corner of the intersection of Hertel avenue and East street, 8 inches east of east doorjamb and 1 inch back from edge of water table; being the highest point in square cut on stone.

P. B. M. Guard Lock.—Is in *Buffalo, N. Y.*, in the center of coping stone on tow-path side of guard lock of Erie Canal, 600 meters below International Bridge over Erie Canal at Black Rock; being the highest point in small square cut in the southeast corner of larger square which is opposite the hinge of the upper gate and 7 meters below upper end of lock, marked thus: ⊟. Said to be established by Board on Deep Waterways, but the descriptions differ slightly and the Deep Waterway elevation is lower by 6 centimeters.

P. B. M. Black Rock.—Is in *Buffalo, N. Y.*, on top of bottom step, or sixth course of masonry below bridge seat, of south end of east abutment of bridge No. 192 over Erie Canal on Bridge street, or the first bridge over Erie Canal below the International Bridge; being the top of a brass bolt leaded vertically into top of stone 6 inches from south and west faces of stone, respectively.

P. B. M. International Bridge 2.—Is in *Buffalo, N. Y.*, on a projection of stone in fourth course of masonry below bridge seat on the north end of east abutment of International Bridge over main channel of Niagara River; being a square cut on stone 1.735 meters below bridge seat and 1.150 meters back of the northwest corner of abutment, the stone above being marked in white paint thus:

"U. S. B. M."
88

Established by Board on Deep Waterways.

P. B. M. International Bridge 1.—Is in *Buffalo, N. Y.*, on projecting ledge of third stone from south, and fifth course below bridge seat of east abutment of International Bridge over Erie Canal, being the highest point of square cut on stone. Established by Board on Deep Waterways.

P. B. M. Waterworks.—Is in *Buffalo, N. Y.*, on stone window sill of center window on the river side of main building of pumping station of the Buffalo Waterworks, being the center of a brass bolt leaded horizontally into stone 6 inches from north end of sill and 35 inches above the water table at the ground, marked thus:

U. S.
O
P. B. M.

P. B. M. Fire Station.—Is in *Buffalo, N. Y.*, on water table at the northwest corner of fire-tug station at the foot of Genesee street, on lake front; being the top of knob cut on corner of stone, 2½ feet above the pavement.

L. H.—Is in *Buffalo, N. Y.*, on plinth of most northerly Buffalo Lighthouse, south of United States pier (and connected with the pier) and in line with Erie street; being the top of a high point on east corner and upper surface of plinth.

DESCRIPTIONS OF PERMANENT BENCH MARKS BETWEEN BUFFALO AND OLCOTT, N. Y.

(See Report of Board on Deep Waterways, 1900, Part II, pp. 1037–1038.)

L. H.—Is at *Buffalo, Erie County, N. Y.*

International Bridge 1.—Is at *Buffalo, Erie County, N. Y.* (See above.)

Guard Lock.—Is at *Buffalo, Erie County, N. Y.* (See p. 657.)

D. W. Cherry.—Is near *Tonawanda, Erie County, N. Y.*, on west abutment of Cherry's Bridge, and is a square cut on the second stone below the coping, projecting back of the abutment. This bench mark is apparently not identical with N. Y. 543,* or if identical the elevation has changed.

Tonawanda 1.—Is at *Tonawanda, Erie County, N. Y.* (See p. 657.)

Tonawanda 2.—Is near *Tonawanda, Erie County, N. Y.* (See p. 656.)

North Tonawanda 1.—Is at *North Tonawanda, Niagara County, N. Y.* (See p. 656.)

North Tonawanda 2.—Is at *North Tonawanda, Niagara County, N. Y.* (See p. 656.)

D. W. Sawyers Creek.—Is near *Pendleton Center, Niagara County, N. Y.*, and is a square cut on stone water table at southwest corner of barrel-organ factory.

D. W. Pendleton 1.—Is at *Pendleton Center, Niagara County, N. Y.*, and is a square

*See description of bench marks, Albany to Buffalo.

cut on top of bowlder, about 3 feet in diameter, of light colored gneiss or granite. The bowlder is on the east side of the highway, and about 400 feet north of Erie Railroad station.

D. W. Pendleton 2.—Is at *Pendleton Center, Niagara County, N. Y.*, and is a square cut on corner of stone water table at the west corner of brick house owned by H. S. Taylor. Building is east of the church.

D. W. Lockport 1=N. Y. 554.—Is about a mile west of *Lockport, Niagara County, N. Y.*, and is a square cut on projection of stone at angle of abutment and wing wall, lower course, south angle of west abutment of the more westerly of the two subways under the New York Central Railroad, at head of gulf.

D. W. Lockport 2.—Is about 2½ miles northwest of *Lockport, Niagara County, N. Y.*, and is a square cut on the north corner of water table of two-story red-brick dwelling occupied by Mr. Pickles. Building is on the stone road.

D. W. Lockport 3.—Is at *Lockport, Niagara County, N. Y.*, and is a square cut on the west end of the stone doorstep of red-brick schoolhouse (No. 13). Building is at intersection of turnpike and Ewing road.

D. W. Wrights.—Is at *Wrights Corners, Niagara County, N. Y.*, and is a square cut on stone water table on two-story brick residence occupied by Mr. Boist, at the northeast corner of house. House is about 300 feet north of intersection of Lake avenue and turnpike road.

U. S. G. S.—Is 1½ miles south of *Newfane, Niagara County, N. Y.*, in cemetery on east side of Lake avenue, and is the loop of capital P, on lot monument, Pettit lot, southeast corner.

D. W. Newfane 1.—Is at *Newfane, Niagara County, N. Y.*, and is a square cut on cut-stone bridge seat of iron highway bridge on crossroad over Eighteen Mile Creek in northern portion of village. Square is at north end of east abutment.

D. W. Newfane 2.—Is about 2 700 feet north of *Newfane, Niagara County, N. Y.*, and is a square cut on southwest corner of stone water table of brick schoolhouse (No. 10) on west creek road.

Olcott 5.—Is at *Olcott, Niagara County, N. Y.* (See p. 653.)

Olcott 4.—Is at *Olcott, Niagara County, N. Y.* (See p. 653.)

Olcott 1.—Is at *Olcott, Niagara County, N. Y.* (See p. 653.)

DESCRIPTION OF PERMANENT BENCH MARKS FROM LASALLE TO LEWISTON, N. Y.

(See Report of Board on Deep Waterways, 1900, Part II, p. 1039.)

D. W. Monument.—Is near *Lasalle, N. Y.*, and is a square cut at northwest corner of cut-stone monument between tracks. Monument is numbered 16 and is at a point about 600 feet west of military road, where Cataract Construction Company's line branches to southwest.

L. S. Lewiston Heights 1.—Is a Deep Waterways bench mark at *Lewiston Heights, N. Y.* (See p. 655).

L. S. Lewiston.—Is a Deep Waterways bench mark at *Lewiston, Niagara County, N. Y.* (See p. 655)

D. W. Lewiston 3.—Is at *Lewiston, Niagara County, N. Y.*, and is a square cut on water table northeast corner of foundation of brick store owned by Eugene Murphy. Building is on lot 252, on south side of Center street, between Fourth and Fifth streets.

D. W. Lewiston 4.—Is near *Lewiston, Niagara County, N. Y.*, and is head of spike driven in bench cut on root of white-oak tree 12 inches diameter. Tree is just west of river road, 1.3 miles north of Lewiston, and about 1 600 feet north of the residence of F. Hays.

D. W. Lewiston 5.—Is near *Lewiston, Niagara County, N. Y.*, and is a square cut on top of west wing of north abutment of trestle No. 2, on George route over Fish Creek, about 5 600 feet south of New York Central Railroad station. The square is on the southeast corner of fifth stone from west end of wing.

DESCRIPTIONS OF PERMANENT BENCH MARKS ON CANADIAN SIDE OF NIAGARA RIVER FROM INTERNATIONAL BRIDGE TO FOOT OF LAKE ERIE.

(See Report of Board on Deep Waterways, 1900, Part II, p. 1038.)

L. S. International Bridge 2.—Is at *Buffalo, N. Y.* (See p. 658.)

D. W. International Bridge 3.—Is in *Canada*, near *Buffalo, N. Y.*, at the northeast corner of west or Canadian abutment of the *International Bridge*, and is a square cut on projecting face of stone of fifth course below bridge seat.

D. W. Fort Erie.—Is at *Fort Erie, Welland County, Ontario, Canada*, and is the head of a spike driven in bench cut on root of cottonwood tree. The tree is about 220 feet north of Fort Erie Ferry landing, and about 10 feet east of the Maine Central Railroad tracks.

D. W. Lake Erie.—Is at foot of *Lake Erie*, in *Welland County, Ontario, Canada*, and is the head of a spike driven in bench cut in north tree of row of six willows just south of group of five willows in front of Constable Metcalf's house, at the head of Niagara River on Canadian side.

DESCRIPTION OF PERMANENT BENCH MARKS FROM NORTH TONAWANDA TO NIAGARA FALLS, N. Y.

(See Report of Board on Deep Waterways, 1900, Part II, p. 1038.)

L. S. Crossing.—Is a Deep Waterways bench mark near *Lasalle, N. Y.* (See p. 656.)

L. S. Wheatfield.—Is a Deep Waterways bench mark near *Lasalle N. Y.* (See p. 656.)

L. S. Lasalle.—Is a Deep Waterways bench mark at *Lasalle, N. Y.* (See p. 656.)

L. S. Schoolhouse.—Is a Deep Waterways bench mark near *Lasalle, N. Y.* (See p. 656.)

L. S. Echota.—Is a Deep Waterways bench mark at *Echota, N. Y.* (See p. 655.)

L. S. Niagara 1.—Is a Deep Waterways bench mark at *Niagara, N. Y.* (See p. 655.)

D. W. Niagara 2.—Is at *Niagara, N. Y.*, at foot of elm tree just outside of curb on Buffalo avenue, and 800 feet west of entrance to power house of the Niagara Falls Power Company, and is the top of a spike in wood set down in pit with brick walls.

DESCRIPTIONS OF PERMANENT BENCH MARKS FROM RENSSELAER (GREENBUSH), N. Y., TO OSWEGO, N. Y., CONNECTED WITH OR ESTABLISHED BY PRECISE LEVELS OF UNITED STATES LAKE SURVEY, 1902.

(From information furnished by United States Lake Survey.)

Gristmill.*—See page 848, Appendix 8, Report for 1899.

L. S. 1.—Is at *Rensselaer, N. Y.* It is the center of a three-eighths-inch brass bolt leaded horizontally in the side facing the river of the stone foundation of Irwin Steam Mill and Elevator near the river at the foot of and on the south side of Second avenue. Bench marks 6.7 feet downstream from "Gristmill" or old Greenbush bench mark, 5 feet above ground, 4.3 feet upstream from upper jamb of door facing river, and 8.7 feet downstream from upper face of building. It is marked U. S. B. M. above the bolt and A beneath it.

L. S. 2.—Is at *Rensselaer, N. Y.* It is the center of a three-eighths-inch brass bolt leaded horizontally in the west wing wall of south abutment of railroad bridge over Second avenue. It is 23.2 feet south of north face of south abutment, 4.5 feet above ground, and 23.2 feet north of south end of wing wall. It is marked U. S. B. M. over the bolt and B beneath it.

L. S. 3.*—Is at *Rensselaer, N. Y.* It is a cross cut on top of stone at southwest corner of foundation of water tank at the south end of viaduct on which Broadway street crosses the New York Central and Hudson River Railroad tracks. Deep Waterways bench mark, 1898.

L. S. 4=1 (1875).—Is at *East Albany, N. Y.* (See p. 848, App. 8, Report for 1899.)

L. S. 5=2 (1875).—Is at *Albany, N. Y.* (See p. 848, App. 8, Report for 1899.)

L. S. 6.—Is at *Albany, N. Y.*, on southwest gate of west lock of Lock No. 2. New York State B. M. No. 5, 1901. (See note 42, p. 584.)

L. S. 7.—Is north of *Albany, N. Y.*, in first step of towpath abutment, east end of south wing wall of Delaware and Hudson Railroad bridge over Erie Canal. New York State B. M. No. 6, 1901. (See note 5, p. 580.)

L. S. 8.—Is at *Watervliet, N. Y.*, on coping of retaining wall at south end of towpath parapet of culvert about 1¼ miles north of Delaware and Hudson Railroad bridge over canal, marked ⊕. New York State B. M. No. 7, 1901.

L. S. 9=6 (1875).—Is north of *Watervliet, N. Y.* (See p. 848, App. 8, Report for 1899.)

L. S. 10=7a (1875).—Is at *Cohoes, N. Y.* (See p. 848, App. 8, Report for 1899.)

L. S. 11=8a (1875).—Is at *Cohoes, N. Y.* (See p. 848, App. 8, Report for 1899.)

L. S. 12.—Is at *Cohoes, N. Y.*, on southwest gate of west Lock No. 18. (See note 42, p. 584.) New York State B. M. No. 30, 1901.

L. S. 13.—Is 2.9 miles north of *Cohoes, N. Y.*, at end of the south wing wall of towpath abutment of bridge No. 33. New York State B. M. No. 35, 1901. (See note 43, p. 584.)

L. S. 14.—Is at *Crescent, N. Y.*, on top of parapet wall at southwest corner of southeast wing of Lower Mohawk aqueduct. New York State B. M. No. 36, 1901, marked ⊕.

L. S. 15.—Is 5 miles east of *Vischers Ferry, N. Y.*, in sixth course below coping in center of face of towpath abutment of bridge No. 37. New York State B. M. No. 39, 1901. (See note 44, p. 584.)

* See also descriptions of bench marks, Dobbs Ferry to Rensselaer (Greenbush).

L. S. 16.—Is 3.3 miles east of *Vischers Ferry, N. Y.*, in sixth course below coping in face of towpath abutment, near west angle of bridge No. 39. New York State B. M. No. 42, 1901. (See note 44, p. 584.)

L. S. 17.—Is 2.2 miles east of *Vischers Ferry, N. Y.*, in sixth course below coping near center of face of towpath abutment of bridge No. 43. New York State B. M. No. 45, 1901. (See note 44, p. 584.)

L. S. 18 = 12 (1875).—Is 1 mile east of *Vischers Ferry, N. Y.*, in fifth course of masonry below coping of bridge No. 46, at east angle of south abutment (bridge is second canal bridge below Lock No. 19). (See note 44, p. 584.)

L. S. 19.—Is at *Vischers Ferry, N. Y.*, on third course of masonry of east wing wall of towpath abutment of bridge No. 48. New York State B. M. No. 49, 1901. (See note 5, p. 580.)

L. S. 20.—Is at *Fondas Basin, N. Y.*, on top of coping at east end of east wing wall of towpath abutment of bridge No. 49, marked ⊕.

L. S. 21.—Is at *Rexford Flats, N. Y.*, on the northeast corner of coping of Lock No. 21, about 10 feet from end of anchor of southeast gate of south lock. New York State B. M. No. 52, 1901. (See note 5, p. 580.)

L. S. 22.—Is at *Rexford Flats, N. Y.*, on coping of Lock No. 22, between ends of anchor of northeast gate of north lock. New York State B. M. No. 53, 1901. (See note 5, p. 580.)

L. S. 23.—Is 1.8 miles west of *Rexford Flats, N. Y.*, in lower course in face of towpath abutment of bridge No. 52 near west angle. New York State B. M. No. 59, 1901. (See note 44, p. 584.)

L. S. 24.—Is 1.8 miles east of *Schenectady, N. Y.*, on second step at west end of towpath abutment of Delaware and Hudson Railroad bridge, marked □ B. M. New York State B. M. No. 61, 1901.

L. S. 25.—Is at *Schenectady, N. Y.*, on southwest corner of coping at west end of towpath abutment of swing bridge at Schenectady Locomotive Works. New York State B. M. No. 64, 1901. (See note 5, p. 580.)

L. S. 26.—Is at *Schenectady, N. Y.*, on first step of west wing wall of towpath abutment of Green street bridge over canal. New York State B. M. No. 66, 1901. (See note 5, p. 580.)

L. S. 27.—Is at *Schenectady, N. Y.*, on the southeast corner of foundation stone of the northeast column of Church street lift bridge. It is 0.9 foot from south edge of stone and 0.6 foot from the east edge. (See note 5, p. 580.)

L. S. 28.—Is 1.8 miles west of *Schenectady, N. Y.*, on northwest corner on top of north stone in third course of stones of the east abutment of bridge No. 63. Deep Waterways B. M., 1898. (See note 5, p. 580.)

L. S. 29.—Is 2.6 miles west of *Schenectady, N. Y.*, on northeast gate of north lock of lock 23. New York State B. M. No. 72, 1901. (See note 43, p. 584.)

L. S. 30.—Is 3.3 miles west of *Schenectady, N. Y.*; is a square cut on east corner of northeast end of shelf at lower end of lock No. 24, marked □ B. M. Deep Waterways B. M., 1898.

L. S. 31.—Is 5.6 miles west of *Schenectady, N. Y.*, on lower step of east wing wall of north abutment of bridge No. 67. (See note 5, p. 580.)

L. S. 32 = 19 (1875).—East of *Pattersonville, N. Y.* (See p. 849, App. 8, Report for 1899.) Marked ⊕.

L. S. 33.—Is 1.8 miles east of *Pattersonville, N. Y.*, at end of west wing wall of towpath abutment of bridge No. 71. New York State B. M. No. 83, 1901. (See note 43, p. 584.)

L. S. 34.—Is at *Pattersonville, N. Y.*, on bottom step east wing wall of north abutment of bridge No. 74. (See note 5, p. 580.)

L. S. 35.—Is 2.7 miles west of *Pattersonville, N. Y.*, on step of east wing wall of north abutment of bridge No. 75, 7½ inches from west edge of stone and 6 inches from south edge. (See note 5, p. 580.)

L. S. 36.—Is 3.5 miles east of *Amsterdam, N. Y.*, on first stone under coping of east wing wall of towpath abutment of bridge No. 76. New York State B. M. No. 88. (See note 44, p. 584.)

L. S. 37=21 (1875).—Is 2.8 miles east of *Amsterdam, N. Y.* (See p. 849, App. 8, Report for 1899.) Marked ⊕.

L. S. 38.—Is 2.8 miles east of *Amsterdam, N. Y.*, on northeast gate of north lock of lock No. 26. New York State B. M. No. 90, 1901. (See note 43, p. 584.)

L. S. 39.—Is 2.5 miles east of *Amsterdam, N. Y.*, on coping of lock No. 27, between ends of anchor of northeast gate of north lock. New York State B. M. No. 91, 1901. (See note 5, p. 580.)

L. S. 40.—Is at *Amsterdam, N. Y.*, on top of lower step at west end of towpath abutment of bridge No. 78, marked ⊗ B. M. New York State B. M. No. 93, 1901.

L. S. 41.—Is at *Amsterdam, N. Y.*, on bottom step of west wing wall of towpath abutment of Market Street bridge, near center of south edge of step. (See note 5, p. 580.)

L. S. 42.—Is at *Amsterdam, N. Y.*, at center pier of Chuctanunda Creek culvert, towpath side. New York State B. M. No. 94, 1901. (See note 43, p. 584.)

L. S. 43=24a (1875).—Is 2.8 miles west of *Amsterdam, N. Y.* (See p. 850, App. 8, Report for 1899.)

L. S. 44.—Is 1 mile east of *Fort Hunter, N. Y.*, on coping of west wing wall of towpath abutment of bridge No. 80, first bridge east of lock No. 29. Deep Waterways B. M., 1898. (See note 5, p. 580.)

L. S. 45.—Is at *Fort Hunter, N. Y.*, on first stone east of junction of old wall and extension of north wall of south lock of lock No. 30. New York State B. M. No. 100a, 1901. (See note 5, p. 580.)

L. S. 46.—Is described by the Lake Survey as "2 miles east of *Fultonville, N. Y.*, on fourth course of stones below coping in face of abutment, near west angle of bridge No. 88, marked ⊗ B. M. New York State B. M. No. 109, 1901." The description of N. Y. 109 in the Report of the New York State Engineer for 1901, page 662, is the same as the above except the bench mark is said to be near east angle. The elevation of N. Y. 109 as determined from the New York Engineer's line would be $91^{m}.4700$. (See note 44, p. 584.)

L. S. 47.—Is 1.4 miles east of *Fultonville, N. Y.;* is a point cut on the face of the most westerly stone, about 3 feet from the corner of the first course in the west wing wall of the north abutment of bridge No. 90, the third bridge east of Main Street Bridge and about 7 000 feet east of it. Deep Waterways B. M., 1898.

L. S. 48.—Is at *Fultonville, N. Y.*, on second step of east wing wall of berme abutment of Main Street bridge, bridge No. 93, marked ⊗ B. M. New York State B. M. No. 114, 1901.

L. S. 49.—Is 1.6 miles west of *Fultonville, N. Y.*, in fourth course of stones below coping in face of abutment, near east angle of bridge No. 96. New York State B. M. No. 117, 1901. (See note 44, p. 584.)

L. S. 50.—Is 3 miles west of *Fultonville, N. Y.*, a projecting point on the upper west corner on the face of the second stone from the west corner of the west wing wall of the north abutment of bridge No. 97, the first bridge crossing the Erie Canal east of the aqueduct, about 3 miles west of Fultonville, N. Y. Deep Waterways B. M., 1898. Marked □ B. M.

L. S. 51.—Is 3.2 miles west of *Fultonville, N. Y.*, at end of east wing wall of Tokkon Creek aqueduct, towpath side. New York State B. M. No. 120, 1901. (See note 43, p. 584.)

L. S. 52.—Is between *Downing* and *Sprakers, N. Y.*, on the coping at the northeast corner of the northwest wing wall of the north wall of the second Erie Canal aqueduct west of Downing, N. Y., and about 2 miles west of the town. Deep Waterways B. M., 1898. (See note 5, p. 580.)

L. S. 53.—Is 2¼ miles east of *Sprakers, N. Y.*, and is a point on the face of the second stone from the east end in the first course of the east wing wall of the north abutment of the first bridge, No. 102, over the Erie Canal, east of Lock No. 31. Deep Waterways B. M., 1898. Marked ⊗ B. M.

L. S. 54.—Is at *Sprakers, N. Y.*, on northeast gate of south lock of Lock No. 31. New York State B. M. No. 128, 1901. (See note 2, p. 584.) Marked B. M.

L. S. 55=29 (1875).—Is at *Sprakers, N. Y.*, and is the top of iron bolt in coping of west wing wall of towpath abutment of Ferry Street Bridge, No. 104. (See p. 850, App. 8, Report for 1899.)

L. S. 56.—Is at *Canajoharie, N. Y.*, on coping of parapet of northeast wing wall of Canajoharie Creek aqueduct, towpath side, marked B. M. ⊗. New York State B. M. No. 135, 1901.

L. S. 57=31 (1875).—Is at *Canajoharie, N. Y.* Bench mark is in first stone of second course. (See p. 850, App. 8, Report for 1899.)

L. S. 58.—Is 2.4 miles east of *Fort Plain, N. Y.*, and is a point dressed square on the top of the east corner of the second course of masonry of the southeast wing wall of the northeast abutment of the first bridge, No. 113, east of the steel skew bridge of the West Shore Railroad at Fort Plain, N. Y. Deep Waterways B. M., 1898.

L. S. 59.—Is three-fourths of a mile east of *Fort Plain, N. Y.*, on northeast gate of north lock of lock No. 32. New York State B. M. No. 141, 1901. (See note 42, p. 584.) Marked B. M.

L. S. 60.—Is at *Fort Plain, N. Y.*, at end of west wing wall of towpath abutment of bridge No. 117. New York State No. 142, 1901. (See note 43, p. 584.)

L. S. 61.—Is 0.7 mile west of *Fort Plain, N. Y.*, on second course above ground, near center of face of towpath abutment of West Shore Railroad bridge No. 278. New York State B. M. No. 144, 1901. (See note 44, p. 584.)

L. S. 62.—Is 1.5 miles east of *St. Johnsville, N. Y.*, on the south corner of the capstone of the southeast wing wall of the northeast abutment of the first bridge, No. 119, east of Lock No. 33, Deep Waterways B. M., 1898. (See note 5, p. 580.)

L. S. 63=34 (1875).—Is near *St. Johnsville, N. Y.*, west of Lock No. 33, on second course of masonry near center of east wing wall of towpath abutment of bridge No. 120. (See note 44, p. 584.)

L. S. 64.—Is at *St. Johnsville, N. Y.*, a square cut on top of second step of east wing wall of towpath abutment of bridge No. 121, marked B. M. New York State B. M. No. 153, 1901. (The elevation of N. Y. 153 as determined by the New York State Engineers differs 5 centimeters from the elevation of L. S. 64 from this line and is described in the New York State Engineer Report as "New B. M." L. S. 64 is therefore possibly identical with some older bench mark.)

L. S. 65.—Is about one-fourth mile west of *Mindenville, N. Y.*, on coping of Lock No. 34 between ends of anchor of northeast gate of north lock, marked ⊡ B. M. New York State B. M. No. 155, 1901.

L. S. 66=35a (1875).—Is about 1 mile west of *Mindenville, N. Y.*, in the third bridge, No. 125, west of Lock No. 34. (See p. 850, App. 8, Report for 1899.) (See note 44, p. 584.)

L. S. 67.—Is at *Indian Castle, N. Y.*, on capstone of east wing wall of aqueduct No. 12, towpath side, marked □ B. M. Deep Waterways B. M., 1898.

L. S. 68.—Is 2.6 miles west of *Indian Castle, N. Y.*, on southeast corner of the capstone on the east end of the east wing wall of the north abutment of the bridge, No. 133, crossing the canal at a point about 600 feet north of the Herkimer Monument. Deep Waterways B. M., 1898. (See note 5, p. 580.)

L. S. 69=37 (1875).—Is at *Little Falls, N. Y.*, top of iron bolt between ends of anchor of northeast gate of north lock of Lock No. 36, marked ⊗.

L. S. 70.—Is at *Little Falls, N. Y.*, on coping of Lock No. 37, at ends of anchor of northeast gate of north lock, marked ⊙. New York State B. M. No. 170, 1901.

L. S. 71.—Is at *Little Falls, N. Y.*, on coping of Lock No. 38 between ends of anchor of northeast gate of north lock. New York State B. M. No. 171, 1901. (See note 5, p. 580.)

L. S. 72.—Is at *Little Falls, N. Y.*, on coping of Lock No. 39, at ends of anchor of northeast gate of north lock, marked ⊗. New York State B. M. No. 172, 1901.

L. S. 73=38a (1875).—Is 2.5 miles west of *Little Falls, N. Y.*, on first bridge, No. 138, east of Lock No. 40, marked with chisel. (See p. 851, App. 8, Report for 1899.)

L. S. 74.—Is 3 miles west of *Little Falls, N. Y.*, a cross cut on the top of the end bolt through the north branch of the iron collar of the northeast gate of the north lock of Lock No. 40. Deep Waterways B. M., 1898.

L. S. 75.—Is 5.7 miles west of *Little Falls, N. Y.*, on northeast gate of north lock of Lock No. 41. New York State B. M. No. 183, 1901. (See note 42, p. 584.)

L. S. 76=39a (1875).—Is 1 mile east of *Herkimer, N. Y.*, on the coping of west wing wall of towpath abutment of bridge No. 143. (See note 5, p. 580.)

L. S. 77.—Is at *Herkimer, N. Y.*, on northeast corner of lower step of east wing wall of towpath abutment of bridge No. 144, Herkimer road bridge, marked ○. New York State B. M. No. 186, 1901.

L. S. 78.—Is at *Mohawk, N. Y.*, on projection of fourteenth stone from west end in second course of towpath abutment of West Shore Railroad bridge over the canal, marked ⊗. New York State B. M. No. 189, 1900.

L. S. 79.—Is one-half mile west of *Mohawk, N. Y.*, on coping of Lock No. 42, between ends of anchor of northeast gate of towpath lock, New York State B. M. No. 191, 1900. (See note 5, p. 580.)

L. S. 80.—Is three-fourths mile west of *Mohawk, N. Y.*, on northeast corner of towpath parapet wall of Fulmer Creek Aqueduct, marked with a cross in circle. New York State B. M. No. 193, 1900.

L. S. 81.—Is at *Ilion, N. Y.*, on southwest corner of west wing wall of towpath abutment of Typewriters bridge, marked ⊡. New York State B. M. No. 195, 1900.

L. S. 82.—Is at *Ilion, N. Y.*, on west corner of coping of Steel Creek Aqueduct, towpath side, marked ⊗. New York State B. M. No. 197, 1900.

L. S. 83.—Is 1.1 miles west of *Ilion, N. Y.*, on coping between ends of anchor of northeast gate, towpath lock, Lock No. 44. New York State B. M. No. 200, 1900. (See note 5, p. 580.)

L. S. 84.—Is at *Frankfort, N. Y.*, on coping of towpath lock, towpath side, of Lock No. 45, 2 feet east of east hollow quoin, marked ⊗. New York State B. M. No. 204, 1900.

L. S. 85=41 (1875).—Is at *Frankfort, N. Y.* (See p. 851, App. 8, Report for 1899.) Marked ○.

L. S. 86.—Is 2.6 miles west of *Frankfort, N. Y.*, on southwest corner of lower step of west wing wall of north abutment of bridge No. 164. (See note 5, p. 580.)

L. S. 87.—Is 3.2 miles east of *Utica, N. Y.*, on southeast corner of coping stone on the extreme east end of parapet wall of Furguson Creek Aqueduct, marked ⊗. New York State B. M. No. 215, 1900.

L. S. 88.—Is 2.1 miles east of *Utica, N. Y.*, top of copper plug in southeast corner of lower step of east wing wall of towpath abutment of Green's road bridge at Herkimer-Oneida County line. New York State B. M. No. 217, 1900.

L. S. 89.—Is at *Utica, N. Y.*, top of copper plug in southwest corner of west end of towpath abutment of Broad street lift bridge. New York State B. M. No. 219, 1900.

L. S. 90.—Is at *Utica, N. Y.*, top of copper plug in southwest corner of stone forming foundation of western stairway of Broadway street footbridge. New York State B. M. No. 221, 1900.

L. S. 91.—Is at *Utica, N. Y.*, top of copper plug in southwest corner of west end of towpath abutment of Whitesboro street lift bridge. New York State B. M. No. 222, 1900.

L. S. 92.—Is at *Utica, N. Y.*, copper plug between ends of anchor of northeast gate of towpath lock of lock No. 46. New York State B. M. No. 223, 1900.

L. S. 93.—Is 1.9 miles west of *Utica, N. Y.*, top of copper plug in lower step of east wing wall of towpath abutment of Whitesboro road bridge at west boundary of city of Utica. New York State B. M. No. 225, 1900.

L. S. 94.—Is at *Whitesboro, N. Y.*, top of copper plug in southeast corner of bottom step of east wing wall of towpath abutment of Clinton street bridge. New York State B. M. No. 228, 1900.

L. S. 95.—Is at *Whitesboro, N. Y.*, top of copper plug in bottom step of east wing wall of towpath abutment of Westmoreland street bridge. New York State B. M. No. 229, 1900.

L. S. 96.—Is 1.8 miles east of *Oriskany, N. Y.*, top of copper plug in southwest corner of bottom step of east wing wall of towpath abutment of Bradley's road bridge. New York State B. M. No. 230, 1900.

L. S. 97.—At *Oriskany, N. Y.*, top of copper plug in southwest corner of stone at west end of towpath coping of Oriskany aqueduct. New York State B. M. No. 232, 1900.

L. S. 98.—Is 1 mile west of *Oriskany, N. Y.*, top of copper plug in southwest corner of bottom step of west wing of towpath abutment of Brainard's farm bridge. New York State B. M. No. 233, 1900.

L. S. 99.—Is 4.2 miles west of *Oriskany, N. Y.*, top of copper plug on northwest corner of east stone of parapet of waste wier No. 2, just below bridge No. 31.

L. S. 100.—Is at *Stanwix, N. Y.*, top of copper plug in southeast corner of bottom step of east wing wall of towpath abutment of Stanwix road bridge. New York State B. M. No. 237, 1900.

L. S. 101.—Is at *Rome, N. Y.*, top of copper bolt in northeast corner of east wall of Black River feeder to Erie Canal, 100 feet west of center of Depeyster street bridge over canal. Whitesboro street crosses feeder by an arch marked S. W. Morton, contractor, 1851.

L. S. 102.—Is at *Rome, N. Y.*, square cut in the southwest corner of lower step at west end of north abutment of George street bridge, marked B. M. □.

L. S. 103.—Is 1.1 miles west of *Rome, N. Y.*, top of copper plug in bottom step of east wing wall of towpath abutment of Barnes's farm bridge. New York State B. M. No. 239, 1900.

L. S. 104.—Is 2.7 miles west of *Rome, N. Y.*, top of copper plug in southeast corner of end stone on west end of parapet of Fort Bull waste weir.

L. S. 105.—Is 4.8 miles west of *Rome, N. Y.*, top of copper plug in lower step of west wing wall of towpath abutment of Armstrong's farm bridge. New York State B. M. No. 241, 1900.

L. S. 106.—Is at *New London, N. Y.*, top of copper plug in bottom step of east wing wall of towpath abutment of New London road bridge. New York State B. M. No. 243, 1900.

L. S. 107.—Is at *Stacys Basin, N. Y.*, top of a copper plug in lower step of east wing wall of towpath abutment of bridge No. 49. New York State B. M. No. 245, 1901.

L. S. 108.=49 (1875).—Is at *Stacys Basin, N. Y.*, on bridge No. 49. (See p. 852, App. 8 of Report for 1899.)

L. S. 109.=51 (1875.)—Is 1 mile east of *Higginsville, N. Y.*, on bridge No. 50. (See p. 852, App. 8, Report for 1899.)

L. S. 110.—Is at *Higginsville, N. Y.*, top of copper plug in second step of east wing wall of towpath abutment of east road bridge at Higginsville, bridge No. 51. New York State B. M. No. 247, 1901.

L. S. 111.—Is 2.4 miles west of *Higginsville, N. Y.*, nail in the root of a 2-foot maple tree on fence line on south side of road, the largest tree in the vicinity, about 2,000 feet west of intersection of roads about 2⅛ miles west of Higginsville along old side cut to Oneida Lake.

L. S. 112.—Is at *Sylvan Junction, N. Y.*, square cut on top of east end of south abutment of New York, Ontario and Western Railroad bridge over Fish Creek at Sylvan Junction, N. Y. The letters U. S. B. M. are marked above the square.

L. S. 113.—Is at *North Bay, N. Y.*, nail in root on north side of a 14-inch maple tree in the northeast corner of Sautell's field, about 400 feet west of depot and about 60 feet south of New York, Ontario and Western Railroad track.

L. S. 114.—Is 1.7 miles west of *North Bay, N. Y.*, top of a three-eighths-inch brass bolt leaded vertically in a 1.2 by 1.2 by 0.5 foot triangular stone buried 2.7 feet below ground in the north side of the highway in front of the ruins of John Kinney's house. It is 70 feet northeast of northeast corner of barn on south side of road, 161 feet east of large willow tree; 104 feet east of fence opposite barn; 6.4 feet south of stone wall on north side of road; 12 feet south of most westerly tree in row of maple trees on north side of road, and 1.4 feet west of center of surface stone, which projects 4 inches above ground and whose dimensions are 2.6 by 1.2 by 0.6 feet. Surface stone is in line with western wall of foundation of burned house on the John Kinney farm. Surface stone marked U. S. B. M. N.

L. S. 115.—Is at *Cleveland, N. Y.*, top of a three-eighth-inch brass bolt leaded vertically in a 1.4 by 1.4 by 0.5 foot stone buried 2½ feet below surface of ground at center of intersection of Bridge and North streets. It is 120 feet east of center of bridge over Black Creek; 37.5 feet north of fence on south side of Bridge street; 172 feet south of southwest corner of St. James Episcopal Church; 71.2 feet south of hydrant on west side of North street, and 1.6 feet west of surface stone marked U. S. B. M., which projects 2 inches above ground and whose dimensions are 2.2 feet by 1.0 by 0.5 foot.

L. S. 116.—Is at *Cleveland, N. Y.*, top of a copper nail in root of maple tree 2½ feet in diameter, 100 feet west of second highway crossing the New York, Ontario and Western Railroad, west of railroad siding, and 540 feet west of milepost marked N. Y. 285. Deep Waterways B. M., 1898.

L. S. 117.—Is at *Bernhardts Bay, N. Y.*, top of a three-eighth-inch brass bolt leaded vertically in a 1.2 by 0.8 by 0.5 footstone buried 2½ feet under the surface of the ground on the north side of the road opposite J. Richardson's blacksmith shop. It is 26 feet west of east line of foundation of C. Winn's burned store; 15 feet north of center of road and opposite center of blacksmith shop; 148 feet east of center of bridge over small brook west of blacksmith shop; 25 feet southeast of southwest corner of ruins of C. Winn's store; 79 feet southwest of Sarah Jane Mickle's house on north side of road; 59 feet north of northeast corner of blacksmith shop, and 1.5 feet east of center of surface stone which projects 2 inches above ground, whose dimensions are 1.7 feet by 0.9 by 0.5 foot, marked U. S. B. M.

L. S. 118.—Is at *Constantia, N. Y.*, top of a three-eighth-inch brass bolt leaded vertically, 4.8 feet north of north rail of track, in corner of stone in coping at north end of west abutment of culvert No. 395, just east of New York, Ontario and Western depot, over second creek east of depot, marked

U. S. B. M.
R.

L. S. 119.—Is about one-half mile west of *Constantia, N. Y.*, top of a copper nail in root on south side of a chestnut tree two feet in diameter, 15 feet north of the north right-of-way line of the New York, Ontario and Western Railroad, and 305 feet east of highway crossing railroad about one-half mile west of depot. Deep Waterways B. M. 1898.

L. S. 120.—Is at *West Monroe, N. Y.*, top of a 30d. spike in root on south side of third elm tree, the third from cross road to depot, in a row of four large elm trees on the south side of the main road opposite Cross and Wrightman's store.

L. S. 121.—Is at *Central Square, N. Y.*, a square cut on the northwest corner of doorstep of door of Low's store, facing band stand, marked with the letters U. S. B. M. above the square.

L. S. 122.—Is about one-fourth mile west of depot at *Caughdenoy, N. Y.*, a square cut on coping on north side of east abutment of New York, Ontario and Western Railroad bridge No. 420, first railroad bridge west of Caughdenoy depot. It is 0.8 foot east of west face of abutment, 1 foot west of step, and 4.8 feet north of north rail of track, marked U. S. B. M. above the square.

L. S. 123.—Is at *Pennellville, N. Y.*, top of a three-eighths-inch brass bolt leaded vertically in a 1.5 by 1.5 by 0.6 foot stone buried 2½ feet under surface of ground in west side of school yard, 57.8 feet from northwest corner of schoolhouse, 67.4 feet northwest from southwest corner of schoolhouse, 111.8 feet north of the northwest corner of Methodist Church, in line with the north face of schoolhouse, and 1.7 feet west of a 0.6 by 0.9 by 2.5 foot surface stone which is 34.6 feet east of center of road on west side of schoolhouse and 119.3 feet south of center of road on north side of schoolhouse; it projects 4 inches above ground and is marked

U S B M
W

L. S. 124.—Is 2.8 miles southeast of *Fulton, N. Y.*, center of a one-fourth-inch brass bolt leaded horizontally in a brick in the west face near the northwest corner of W. M. Whalin's brick house, on south side of Pennellville-Fulton road. Bolt is 2.45 feet from northwest corner of house and 3.9 feet above ground, marked U. S. B. M.

L. S. 125.—Is at *Fulton, N. Y.*, on east leaf of north gate of Lock No. 8, Oswego Canal. (See note 45, p. 584.)

L. S. 126.—Is at *Fulton, N. Y.*, on east leaf of north gate of Lock No. 10, Oswego Canal. (See note 45, p. 584.)

L. S. 127.—Is at *Fulton, N. Y.*, top of a copper plug in coping of south wing wall of towpath abutment of first bridge below Lock No. 10.

L. S. 128.—Is at *Fulton, N. Y.*, top of a copper plug, flush with the masonry, in first step of south wing wall of east abutment of highway bridge over Oswego Canal on North First street. New York State B. M. No. 19, 1901.

L. S. 129.—Is 0.6 mile north of *Fulton, N. Y.*, on east leaf of middle gate of Lock No. 11. (See note 45, p. 584.)

L. S. 130.—Is 1.6 miles north of *Fulton, N. Y.*, on east leaf of middle gate of Lock No. 12. (See note 45, p. 584.)

L. S. 131.—Is at *Minetto, N. Y.*, flush with masonry, between anchor irons on northeast lower hollow quoin stone of Lock No. 13. New York State B. M. No. 21, 1901.

L. S. 132.—Is 0.6 mile north of *Minetto, N. Y.*, top of copper plug, flush with masonry, between anchor irons of east leaf of north gate of Lock No. 14.

L. S. 133.—Is 2.8 miles south of *Oswego, N. Y.*, top of a copper plug, flush with masonry, between anchor irons on northeast lower hollow quoin stone of Lock No. 15. New York State B. M. No. 22.

L. S. 134.—Is 0.6 mile south of *Oswego, N. Y.*, on east leaf of north gate of Guard Lock No. 5. (See note 45, p. 584.)

L. S. 135.—Is 0.3 mile south of *Oswego, N. Y.*, on east leaf of north gate of Lock No. 17. (See note 45, p. 584.)

L. S. 136.—Is at *Oswego, N. Y.*, top of a three-eighths inch brass bolt leaded vertically in coping between anchor irons of east leaf of middle gate of Lock No. 18.

L. S. 137.—Is at *Oswego, N. Y.*, center of a three-eighths inch brass bolt leaded horizontally in water table under chimney at northwest corner of Northwestern Elevator, at the foot of Schuyler street. Bolt is on the north face, 8.9 feet east of northwest corner, marked

U S B M
3

L. S. 138.—Is at *Oswego, N. Y.*, a circle 2 centimeters in diameter cut on the highest point of the large bowlder marking the site of Fort Oswego, at the foot of West First street. Circle is 7.3 feet from southeast post of iron fence around the bowlder and 7.17 feet from the southwest post.

L. S. 139.—Is at *Oswego, N. Y.*, is the top of a three-eighths-inch brass bolt leaded vertically in top of masonry of old Government pier at the foot of West Third street. It is 68.9 feet north of old U. S. L. S. B. M. "A" 1875, 72.4 feet north of dock running east, 0.6 feet from east face of dock, 86 feet south of rear face of dock running east toward lighthouse, 35.2 feet northeast of bottom step of elevated portion of dock, marked

U S B M
⊡
No. 1

A.—Is at *Oswego, N. Y.*, top of an iron bolt in top of masonry of old Government pier at foot of West Third street, 0.5 foot from east face of masonry, 3.5 feet north of north face of wooden dock leading to Government boathouse. Bolt is sunk one-half inch below top of masonry, marked

U S
+
M

United States Lake Survey B. M., 187_.

B.—Is at *Oswego, N. Y.*, top of stone post in prolongation south of west face of stone pier at the foot of West Third street, 8 feet south of masonry of pier. Top of post is flush with the ground and is at one of the southwest corners of the Government reservation. United States Lake Survey B. M., 1875.

C.—Is at *Oswego, N. Y.*, a cross cut on shop of dry dock of marine railroad at foot of West Second street. Cross is in third course of stones from ground on west side of shop and 3 feet north of southwest corner. United States Lake Survey B. M., 1875.

DESCRIPTIONS OF PERMANENT BENCH MARKS FROM RENSSELAER (GREENBUSH) TO OSWEGO, N. Y.

(See Report of Board on Deep Waterways, 1900, Part II, pp. 1017–1023.)

Gristmill.—Is at *Rensselaer (Greenbush), Rensselaer County, N. Y.* (See p. 848, App. 8, Report for 1899.) See also descriptions of bench marks, Dobbs Ferry to Rensselaer (Greenbush).

D. W. Rensselaer=L. S. 3.—Is at *Rensselaer, Rensselaer County, N. Y.*, and is a cross cut in stone on southwest corner of foundation of water tank at the south end of viaduct on which Broadway, Rensselaer, crosses the New York Central and Hudson River Railroad. (See p. 661.)

D. W. Bath.—Is near *Bath, Rensselaer County, N. Y.*, and is center of square cut in top stone at the northeast corner of stone culvert under the New York Central and Hudson River Railroad, about 1 000 feet north of Bath Dyke Light.

D. W. Troy 3.—Is near *Troy, Rensselaer County, N. Y.*, and is a cross cut in top stone of northwest corner of culvert under the New York Central and Hudson River Railroad, about 300 feet north of Covills Folly Light.

D. W. Troy 2.—Is at *Troy, Rensselaer County, N. Y.* See descriptions of bench marks, Rensselaer (Greenbush) to Troy.

N. Y. 12.—Is at *West Troy, Albany County, N. Y.*, on second stone of second course in the northeast corner of the west abutment of Congress Street Bridge and is a cross marked "B. M." (See note 41, p. 584.)

8a (1875)=L. S. 11.—Is at *Cohoes, N. Y.* (See p. 848, App. 8, Report for 1899.)

D. W. Cohoes 2.—Is at *Cohoes, Albany County, N. Y.*, and is a square cut on south corner of doorsill of house at No. 1 Mohawk street.

D. W. Cohoes 3.—Is at *Cohoes, Albany County, N. Y.*, and is a crow foot on the northeast corner of retaining wall on the east bank of the hydraulic canal and on the west end of Cohoes Falls.

N. Y. 33.—Is near *Cohoes, Albany County, N. Y.*, in the southwest corner of the top stone on the south end of the breakwater above the Cohoes Water Company's gate-house and near the western end of this company's dam, and is "a square" (D. W.), or "an arrow" (N. Y.). (See note 41, p. 584.)

9a (1875).—Is near *Cohoes, N. Y.* (See p. 848, App. 8, Report for 1899.)

D. W. Crescent.—Is near *Crescent, Albany County, N. Y.*, and is a cross in circle cut in south corner of coping stone on south wing of northeast abutment of second bridge over the Erie Canal south of the Lower Mohawk aqueduct and about 3 200 feet south of the southern end of this aqueduct.

N. Y. 36 = L. S. 14.—Is at *Crescent, Albany County, N. Y.* (See p. 661.)

D. W. Dunsbach.—Is at *Dunsbach Ferry, Albany County, N. Y.*, on the southeast corner of bottom stone of doorstep on south side of house, about 200 feet south of south end of bridge over the Mohawk River.

D. W. Niskayuna.—Is at *Niskayuna, Albany County, N. Y.*, and is a cross cut on corner of top stone of foundation on the southwest corner of the depot of Troy and Schenectady Branch of New York Central and Hudson River Railroad.

D. W. Vischers.—Is near *Vischers Ferry, Saratoga County, N. Y.*, on north corner of north stone of northeast end of culvert No. 37, on Troy and Schenectady Branch of New York Central and Hudson River Railroad and about 1 mile west of Vischers Ferry.

D. W. Aqueduct 1.—Is near *Aqueduct Station, Schenectady County, N. Y.*, and is a cross cut in southeast corner of capstone of culvert No. 40 on the Troy and Schenectady Branch of the New York Central and Hudson River Railroad, about 6 000 feet east of railroad station.

N. Y. 57.—Is at *Aqueduct Station, Schenectady County, N. Y.*, and is a square cut in extreme west corner of step under ladies' entrance to the railroad station of the Troy

and Schenectady Branch of the New York Central and Hudson River Railroad. (See note 41, p. 584.)

D. W. Aqueduct 3.—Is near *Aqueduct Station, Schenectady County, N. Y.*, about 3 000 feet west of railroad station, and is the extreme southeast corner of top of keystone of bridge No. 44 of the Troy and Schenectady Branch of the New York Central and Hudson River Railroad.

N. Y. 65.—Is at *Schenectady, Schenectady County, N. Y.*, opposite the Schenectady Locomotive Works, and about 400 feet east of Romeyn Street crossing, and is a square cut on the southwest end of the top of the southwest coping stone of culvert No. 47 of the Troy and Schenectady Branch of the New York Central and Hudson River Railroad. (See note 41, p. 584.)

N. Y. 67.—Is at *Schenectady, Schenectady County, N. Y.*, on the southeast corner of the foundation stone of the northwest column of the Church Street lift bridge over the Erie Canal, and is a "cross" (D. W.), or a "square" (N. Y.). (See note 41, p. 584.)

N. Y. 71=L. S. 28.—Is near *Schenectady, Schenectady County, N. Y.* (See p. 662.)

N. Y. 74=L. S. 30.—Is between *Schenectady* and *Rotterdam Junction, N. Y.* (See p. 662.)

N. Y. 76a.—Is about 2 miles east of *Rotterdam Junction, Schenectady County, N. Y.*, and is a square cut on the north corner of the bottom stone step at the east corner of brick house, "Van Slyck homestead" (N. Y.), at bridge No. 66, 700 feet east of the Erie Canal aqueduct over Flat Stone Creek. (See note 41, p. 584.)

D. W. Rotterdam 1.—Is at *Rotterdam Junction, Schenectady County, N. Y.*, and is an arrow cut on the north corner of projecting course of brick on the north corner of brick house, about 700 feet east of Lock No. 25 of the Erie Canal and about 150 feet south of the schoolhouse.

D. W. Rotterdam 2.—Is between *Rotterdam Junction* and *Pattersonville, Schenectady County, N. Y.*, and is a square cut in the coping stone west of the center and on the north edge of coping on the north end of culvert under highway, about 1 600 feet east of railroad bridge over the Mohawk River, which is about 1 mile east of Pattersonville, N. Y.

D. W. Pattersonville.—Is at *Pattersonville, Schenectady County, N. Y.*, and is a square cut on northeast corner of large square stone under foot of flight of steps on southwest corner of coal shed, opposite Pattersonville Hotel, and about 300 feet east of West Shore Railroad station.

21 (1875)=N. Y. 89=L. S. 37.—Is near *Amsterdam, Montgomery County, N. Y.* (See p. 663.)

D. W. Amsterdam 1.—Is near *Amsterdam, Montgomery County, N. Y.*, and is a square cut on the northeast corner of the west abutment of bridge No. 238 of the West Shore Railroad, about 9 000 feet east of bridge over the Mohawk River at Amsterdam, N. Y.

D. W. Amsterdam 2.—Is at *Amsterdam, Montgomery County, N. Y.*, and is a square cut in the top of the north corner of the northwest abutment of bridge No. 242 of the West Shore Railroad, crossing Chuctenunda Creek.

D. W. Akin=L. S. 43.—Is near *Amsterdam, Montgomery County, N. Y.* (See p. 663.)

N. Y. 97=L. S. 44.—Is near *Fort Hunter, Montgomery County, N. Y.* (See p. 663.)

N. Y. 101.—Is at *Fort Hunter, Montgomery County, N. Y.*, on the Erie Canal aqueduct over Schoharie Creek and is a square cut "on lower course of the extreme SW. corner of the NW. side" (D. W.), or, "at the foot of the parapet on end of west wing, towpath side, and marked B. M." (N. Y.). "Canal B. M. 140" (N. Y.) (See note 41, p. 584.)

N. Y. 106.—Is about 2 000 feet west of the West Shore Railroad station at *Auriesville, Montgomery County, N. Y.*, and is a square cut on the west end of the west wing of the wall of the north abutment of bridge No. 85 over the Erie Canal. (See note 41 p. 584.)

D. W. Fultonville=L. S. 47.—Is near *Fultonville, Montgomery County, N. Y.* (See p. 663.)

N. Y. 115.—Is at *Fultonville, Montgomery County, N. Y.*, and is a point cut on the top of the projection of the fourth stone of the second course in the west end of the towpath abutment of "Bridge No. 94" (N. Y.) "the first bridge over the Erie Canal west of Main street bridge" (D. W.). "Marked ⊡ B. M." (N. Y.). (See note 41, p. 584.)

D. W. Yatesville=L. S. 50.—Is between *Fultonville* and *Yatesville, Montgomery County, N. Y.* (See p. 664.)

N. Y. 121.—Is on "bridge No. 98" (N. Y.), "the first bridge over the Erie Canal east of *Downing, Montgomery County, N. Y.*" (D. W.) "at the angle of the east wing wall with the face of the north abutment" (D. W.) and is "the top of small projection on the first course of masonry" (D. W.), or "on projection of fourth stone below coping on face of towpath abutment marked ⊗ B. M." (N. Y.), "Canal B. M. 154" (N. Y.). (See note 41, p. 584.)

N. Y. 124.—Is near *Downing, Montgomery County, N. Y.*, "about 3 300 feet west of the station of the West Shore Railroad," (D. W.) on the towpath side of the Erie Canal aqueduct over Leonardsons Creek, on the top of the coping of the southeast corner of the west wing, and is a square, "marked B. M." (N. Y.) (See note 41, p. 584.)

D. W. Downing 3=L. S. 52.—Is between *Downing* and *Sprakers, Montgomery County, N. Y.* (See p. 664.)

D. W. Sprakers=L. S. 53.—Is near *Sprakers, Montgomery County, N. Y.* (See p. 664.)

N. Y. 131.—Is about 1 mile from *Sprakers, Montgomery County, N. Y.*, "on bridge No. 106" (N. Y.), "the third bridge over the Erie Canal west of the Erie Canal Aqueduct at *Sprakers*" (D. W.) on projection of bottom course first stone from east end of east wing "towpath side" (N. Y.) "on the middle of the face" (D. W.) of the first stone from the east end and is "a square" (D. W.), or, is "marked ⊗ B. M." (N. Y.). (See note 41, p. 584.)

31 (1875)=L. S. 57.—Is at *Canajoharie, Montgomery County, N. Y.* (See p. 664.)

D. W. Fort Plain=L. S. 58.—Is near *Fort Plain, Montgomery County, N. Y.* (See p. 664.)

N. Y. 142a—Is at *Fort Plain, Montgomery County, N. Y.*, on "the first bridge over the Erie Canal west of the River Street bridge" (D. W.), or, "the first bridge east of *Fort Plain*," (N. Y.) "at the end of the southeast wing of the northeast abutment" (D. W.), or "on coping of the east wing towpath abutment" (N. Y.) "on the

extreme south corner of the southeast capstone" (D. W.), and "is a square." (N. Y.) (See note 41, p. 584.)

D. W. St. Johnsville=L. S. 62.—Is near *St. Johnsville, Montgomery County, N. Y.* (See p. 664.)

D. W. St. Johnsville=L. S. 63.—Is near *St. Johnsville, Montgomery County, N. Y.* (See p. 664.)

N. Y. 154.—Is at *Mindenville, Montgomery County, N. Y.*, on "bridge No. 122" (N. Y.), "the first bridge crossing the Erie Canal east of Lock No. 34" (D. W.) on southeast corner of bottom step of the east wing wall of north abutment, "marked □ B. M." (N. Y.). (See note 41, p. 584.)

35a (1875)=L. S. 66.—Is near *Mindenville, Montgomery County, N. Y.* (See p. 665.)

N. Y. 160.—Is between *Mindenville* and *Indian Castle, Herkimer County, N. Y.*, on "bridge No. 127" (N. Y.), "the bridge crossing the Erie Canal opposite the entrance of the East Canada Creek to the Mohawk River" (D. W.) "on the southeast wing wall of the northeast abutment" (D. W.), or, "east wing rear of towpath abutment" (N. Y.) and is a square on the east corner of the end stone in the third course "marked B. M." (N. Y.). (See note 41, p. 584.)

D. W. Indian Castle.=L. S. 67.—Is at *Indian Castle, Herkimer County, N. Y.* (See p. 665.)

L. S. 68.—Between *Indian Castle* and *Little Falls, Herkimer County, N. Y.* (See p. 665.)

37 (1875)=L. S. 69.—Is at *Little Falls, Herkimer County, N. Y.* (See p. 665.)

N. Y. 173.—Is at *Little Falls, Herkimer County, N. Y.*, on the Bellinger Street bridge, "on the southwest wing of the northwest abutment" (D. W.), or, the "west wing of the towpath abutment" (N. Y), "on the top of the coping" (N. Y.), or "on south corner of capstone on the southwest end" (D. W.), and is a square "marked with a chisel" (N. Y.). (See note 41, p. 584.)

N. Y. 175.—Is near *Little Falls, Herkimer County, N. Y.*, on "bridge No. 137" (N. Y.), "the second bridge crossing the Erie Canal west of Bellinger Street bridge" (D. W.) on the east wing of the north or towpath abutment "on the top of the coping" (N. Y.), or "on the southeast corner of capstone on the east end, and is a circle" (D. W.), or is "marked ⊗, with a chisel" (N. Y.), "Canal B. M. No. 204" (N. Y.). (See note 41, p. 584.)

38a (1875)=L. S. 73.—Is between *Little Falls* and *Herkimer, Herkimer County, N. Y.* (See p. 665.)

L. S. 74.—Is between *Little Falls* and *Herkimer, Herkimer County, N. Y.* (See p. 665.)

N. Y. 182.—Is near *Herkimer, Herkimer County, N. Y.*, on the southeast corner of capstone on the east end of the east wing wall of the north or towpath abutment, on the second bridge east of lock No. 41, and is a square marked with a chisel. (See note 41, p. 584.)

N. Y. 187.—Is at *Herkimer, Herkimer County, N. Y.*, on the north abutment "of the First Street bridge" (D. W.), or, "of Mohawk River bridge, Washington Street" (N. Y.), on the top of the masonry near the northeast corner, marked by a cross cut in a circle and the letters U. S. D. W. B. M. (See note 41, p. 584.)

D. W. Ilion.—Is at *Ilion, Herkimer County, N. Y.*, and is top of covering stone of masonry of northwest corner of culvert at southwest wing wall of the south highway bridge over the Mohawk River.

D. W. Frankfort 1.—Is at *Frankfort, Herkimer County, N. Y.*, and is top of the northwest corner of water table of pilaster, at West Shore Railroad roundhouse.

N. Y. 203=L. S. 85.—Is at *Frankfort, Herkimer County, N. Y.* (See p. 666.)

D. W. Frankfort 3.—Is between *Utica* and *Frankfort, Herkimer County, N. Y.*, and is a copper nail in root of wild-cherry tree about 500 feet southeast of milepost 209 from Buffalo, on New York Central and Hudson River Railroad.

D. W. Utica 1.—Is between *Utica* and *Frankfort, Herkimer County, N. Y.*, and is a copper nail in root of tree about 50 feet north of north rail of the New York Central and Hudson River Railroad, and 200 feet east of culvert No. 496.

D. W. Utica 2.—Is near *Utica, Oneida County, N. Y.*, and is a copper nail in root of elm tree about 50 feet north of north bank of Mohawk River, and about 830 feet northeast from north end of railroad bridge over Mohawk River, on the Black River branch of the New York Central and Hudson River Railroad.

N. Y. 232=L. S. 97.—Is at *Oriskany, Oneida County, N. Y.* (See p. 667.)

D. W. Oriskany 2.—Is between *Rome* and *Oriskany, Oneida County, N. Y.*, and is the top of the southwest corner of the stone foundation of milepost 246 from New York and 194 from Buffalo, on the New York Central and Hudson River Railroad, about 1¾ miles west of Oriskany Station.

D. W. Rome 1.—Is between *Rome* and *Oriskany, Oneida County, N. Y.*, and is the top of southwest corner of the east abutment of bridge No. 538 of the New York Central and Hudson River Railroad; point on masonry above bridge seat, about 1 foot below top of rail, and 5 feet south of south rail.

D. W. Rome 2.—Is at *Rome, Oneida County, N. Y.*, and is a copper nail in root of elm tree about 20 feet east of east line of Lawrence street, and about 900 feet north, measured along street from center of bridge crossing the old Erie Canal.

D. W. Rome 3.—Is at *Rome, Oneida County, N. Y.*, and is the top of the southeast corner of the masonry, about 1 foot below top of rail of bridge of the Rome, Watertown and Ogdensburg Railroad crossing highway about 1 mile west of Rome, N. Y., near the beet sugar company's buildings.

D. W. Rome 4.—Is between *New London* and *Rome, Oneida County, N. Y.*, and is a copper nail in root of elm tree on the south side of the angle in the highway, and about 550 feet east, measured along the highway from the east side of the house of Mark Thron.

D. W. New London.—Is at *New London, Oneida County, N. Y.*, and is a copper nail in root of large elm tree in highway; about 75 feet south of the intersection of highways, also about 1 050 feet south of highway bridge crossing Wood Creek.

D. W. Sylvan Beach 1.—Is between *Sylvan Beach* and *New London, Oneida County, N. Y.*, and is a copper nail in south root of small tree in south corner of woods on the property of W. Warner, about 800 feet east of Drum Creek and about 500 feet west of east line of the W. Warner property.

D. W. Sylvan Beach 2.—Is near *Sylvan Beach, Oneida County, N. Y.*, and is a copper nail in root of tree about 10 feet east of east right-of-way line of the New York, Ontario and Western Railroad, and about 1 030 feet southwest, measured along

the railroad, from the south end of the railroad bridge crossing Fish Creek, about one-half mile east of Sylvan Beach, N. Y.

D. W. North Bay.—Is near *North Bay, Oneida County, N. Y.*, and is a copper nail in root of oak tree 2 feet in diameter, 12½ feet north of north right-of-way line of New York, Ontario and Western Railroad and 1 185 feet east of milepost marked "279."

L. S. 116.—Is at *Cleveland, Oswego County, N. Y.* (See p. 668.)

L. S. 119.—Is near *Constantia, Oswego County, N. Y.* (See p. 668.)

D. W. Brewerton.—Is at *Brewerton, Oswego County, N. Y.*, and is a copper nail in root of elm tree on the north bank of the Oneida River about one-half mile east of the highway bridge and about 150 feet southeast of the house of Doctor Oberlander.

D. W. High Banks.—Is near "*High Banks,*" south of *Caughdenoy, Oswego County, N. Y.*, and is a copper nail in root of elm tree on east bank of the Oneida River and on the west side of the highway about 850 feet northerly, measured on highway, from wooden bridge over Black Creek.

D. W. Sand Ridge.—Is on *Sand Ridge, Oswego County, N. Y.*, and is a copper nail in root of elm tree on property line between J. Ray and C. Breshnahan and about 1 000 feet westerly of highway, measured along property line.

D. W. Ingalls 1.—Is between *Ingalls Crossing* and *Sand Ridge, Oswego County, N. Y.*, and is top of masonry of northwest corner of south abutment of highway bridge crossing Bell Creek about 250 feet southeast of house of G. Hollenbeck.

D. W. Ingalls 2.—Is near *Ingalls Crossing, Oswego County, N. Y.*, and is a copper nail in root of tree about 20 feet north of north right-of-way line of New York, Ontario and Western Railroad and about 20 feet west of line fence between Chapman estate and A. Wolever; also about 3 400 feet west of west head block of siding at Ingalls Crossing.

D. W. Phoenix.—Is at *Phoenix, Oswego County, N. Y.*, and is a copper nail in root of oak tree located 750 feet southwest in the direction of highway from the intersection of highways about 200 feet east of bridge over Brandy Brook and about 150 feet southeast, at right angles to highway, from this highway; also about 450 feet north of north edge of Oswego Canal.

D. W. Hinmanville 1.—Is at *Hinmanville, Oswego County, N. Y.*, and is a copper bolt, flush with masonry, between anchors on lower hollow quoin (towpath side) of Lock No. 6, Oswego Canal.

D. W. Hinmanville 2.—Is between *Fulton* and *Hinmanville, N. Y.*, and is a copper bolt, flush with masonry, between anchors on middle hollow quoin (towpath side) of Lock No. 7, Oswego Canal.

L. S. 128.—Is at *Fulton, Oswego County, N. Y.* (See p. 669.)

D. W. Fulton 2.—Is between *Minetto* and *Fulton, N. Y.*, and is a copper bolt, flush with masonry, between anchors in middle hollow quoin (towpath side) of Guard Lock No. 4, Oswego Canal.

L. S. 131.—Is at *Minetto, N. Y.* (See p. 669.)

L. S. 133.—Is between *Oswego* and *Minetto, N. Y.* (See p. 669.)

A.—Is at *Oswego, Oswego County, N. Y.* (See p. 670.)

DESCRIPTION OF PERMANENT BENCH MARKS BETWEEN ALBANY AND BUFFALO, N. Y.

[The originals of these descriptions may be found in the Report of the State Engineer and Surveyor of New York for 1901, pp. 657-707.]

N. Y. 1.—Is at *Albany, Albany County, N. Y.*, and is a cross cut in iron bolt, northeast corner north coping stone, west abutment Island bridge, foot of State street.

N. Y. 2.—Is at *Albany, Albany County, N. Y.*, Government building, foot of State street, lower basement window sill, east end State street side, marked cross in circle.

N. Y. 3.—Is at *Albany, Albany County, N. Y.*, State hall. Destroyed.

N. Y. 4.—Is at *Albany, Albany County, N. Y.*, on shelf, at lower end of pier between locks at Lock No. 1, marked cross in circle with chisel. (Canal B. M. No. 1.)

N. Y. 4a=L. S. 5.—Is at *Albany, Albany County, N. Y.* (See p. 661.)

N. Y. 5=L. S. 6.—Is at *Albany, Albany County, N. Y.* (See p. 661.)

N. Y. 5a.—Is near *Albany, Albany County, N. Y.*, on the north end towpath parapet of culvert, marked cross in circle with chisel, east of bridge No. 6. (Canal B. M. No. 8.)

N. Y. 6=L. S. 7.—Is near *Albany, Albany County, N. Y.* (See p. 661.)

N. Y. 7=L. S. 8.—Is at *Watervliet, Albany County, N. Y.* (See p. 661.)

N. Y. 8.—Is at *Watervliet, Albany County, N. Y.*, bridge No. 12, northeast corner north wing of towpath abutment, on coping; marked cross in circle with chisel. (Canal B. M. No. 14.)

N. Y. 9.—Is at *Watervliet, Albany County, N. Y.*, on coping of lock at "lower side cut," at anchor of northwest gate, marked cross in circle with chisel. (Canal B. M. No. 15.)

N. Y. 10.—Is at *Watervliet, Albany County, N. Y.*, on towpath abutment of old arsenal bridge, at north angle of main wall, top of lower course, marked cross in circle, and above, B. M., with chisel. (Canal B. M. No. 16.)

N. Y. 11.—Is at *Watervliet, Albany County, N. Y.*, and is a square cut near northeast corner of foundation stone, south of main tower, towpath end of lift bridge, Congress street.

N. Y. 12.—Is a Deep Waterways bench mark at *West Troy, Albany County, N. Y.* (See p. 671.)

N. Y. 13.—Is at *Troy, Albany County, N. Y.*, and is on coping of north wall of north lock of "upper side cut," northwest corner of west stone, marked cross in circle with chisel. (Canal B. M. No. 18.)

N. Y. 14.—Is near *Green Island, Albany County, N. Y.*, on coping of Lock No. 3, between ends of anchor, southwest gate of west lock, marked cross in circle with chisel. (Canal B. M. No. 21.)

N. Y. 15.—Is near *Green Island, Albany County, N. Y.*, on coping of Lock No. 4, between ends of anchor, southwest gate of west lock, marked cross in circle with chisel. (Canal B. M. No. 23.)

N. Y. 16.—Is near *Cohoes, Albany County, N. Y.*, on coping of Lock No. 5, between ends of anchor, southwest gate of west lock, marked cross in circle with chisel. (Canal B. M. No. 25.)

N. Y. 17.—Is near *Cohoes, Albany County, N. Y.*, on coping of Lock No. 6, between ends of anchor, southwest gate of west lock, marked cross in circle with chisel. (Canal B. M. No. 27.)

N. Y. 18.—Is near *Cohoes, Albany County, N. Y.*, on coping of Lock No. 7, between ends of anchor, southeast gate of east lock, marked □ with chisel. (Canal B. M. No. 29.)

N. Y. 19.—Is near *Cohoes, Albany County, N. Y.*, on coping of Lock No. 8, between ends of anchor, southwest gate of west lock, marked cross in circle with chisel. (Canal B. M. No. 31.)

N. Y. 20.—Is near *Cohoes, Albany County, N. Y.*, on coping of Lock No. 9, between ends of anchor, southeast gate of east lock, marked cross in circle with chisel. (Canal B. M. No. 33.)

N. Y. 21.—Is near *Cohoes, Albany County, N. Y.*, and is □ cut on coping of Lock No. 10, between ends of anchor, southwest gate of west lock. (Canal B. M. No. 35.)

N. Y. 22.—Is near *Cohoes, Albany County, N. Y.*, on coping of Lock No. 11, between ends of anchor, southwest gate of west lock, marked cross in circle with chisel. (Canal B. M. No. 37.)

N. Y. 23.—Is near *Cohoes, Albany County, N. Y.*, on coping of Lock No. 12, between ends of anchor, southwest gate of west lock, marked cross in circle with chisel. (Canal B. M. No. 39.)

N. Y. 24.—Is at *Cohoes, Albany County, N. Y.*, on coping of Lock No. 13, between ends of anchor, southeast gate of east lock, marked cross in circle with chisel. (Canal B. M. No. 41.)

N. Y. 25.—Is at *Cohoes, Albany County, N. Y.*, on coping of Lock No. 14, between ends of anchor, southeast gate of east lock, marked cross in circle with chisel. (Canal B. M. No. 43.)

N. Y. 26=L. S. 11.—Is at *Cohoes, Albany County, N. Y.* (See p. 661.)

N. Y. 27.—Is at *Cohoes, Albany County, N. Y.*, on coping of Lock No. 15, between ends of anchor, southeast gate of east lock, marked cross in circle with chisel. (Canal B. M. No. 45.)

N. Y. 28.—Is at *Cohoes, Albany County, N. Y.*, on coping of Lock No. 16, between ends of anchor, southeast gate of east lock, marked cross in circle with chisel. (Canal B. M. No. 47.)

N. Y. 29.—Is at *Cohoes, Albany County, N. Y.*, and is bolt head in coping of Lock No. 17, between ends of anchor, southwest gate of west lock, marked + with chisel.

N. Y. 30=L. S. 12.—Is at *Cohoes, Albany County, N. Y.*, on coping of Lock No. 18, between ends of anchor, southwest gate of west lock, marked cross in circle with chisel. (Canal B. M. No. 51.)

N. Y. 31.—Is near *Cohoes, Albany County, N. Y.*, and is a square cut on coping, east end of south side wall of wasteweir No. 5, just north of bridge No. 30. (Canal B. M. destroyed.)

N. Y. 32.—Is near *Cohoes, Albany County, N. Y.*, and is point cut in square □ on northeast corner lower step, north end of berme abutment bridge No. 31; new bench mark.

N. Y. 33.—Is a Deep Waterways bench mark near *Cohoes, Albany County, N. Y.* (See p. 671.)

N. Y. 35=L. S. 13.—Is near *Cohoes, Albany County, N. Y.* (See p. 661.)

N. Y. 36=L. S. 14.—Is at *Crescent, N. Y.* (See p. 661.)

N. Y. 37.—Is at *Crescent, Albany County, N. Y.*, on top of coping, northwest corner, southeast wing of aqueduct at Crescent, marked cross in circle with chisel. Canal B. M. No. 60.

N. Y. 38.—Is near *Crescent, Albany County, N. Y.*, on bridge No. 36, at center of towpath abutment, on face, sixth course, under coping, marked cross in circle B. M. with chisel. Canal B. M. No. 62.

N. Y. 39=L. S. 15.—Is near *Crescent, Albany County, N. Y.* (See p. 661.)

N. Y. 41.—Is near *Crescent, Albany County, N. Y.*, on bridge No. 38, on projection, sixth course, below coping, near center towpath abutment, marked cross in circle B. M. with chisel. Canal B. M. No. 64.

N. Y. 42=L. S. 16.—Is near *Vischers Ferry, Saratoga County, N. Y.* (See p. 662.)

N. Y. 43.—Is near *Vischers Ferry, Saratoga County, N. Y.*, on bridge No. 41, on face, towpath abutment, sixth course, below coping, near east angle, marked cross in circle B. M. Canal B. M. No. 68.

N. Y. 44.—Is near *Vischers Ferry, Saratoga County, N. Y.*, on bridge No. 42, on face, towpath abutment, fifth course, below coping, near west angle, marked cross in circle B. M. Canal B. M. No. 69.

N. Y. 45=L. S. 17.—Is near *Vischers Ferry, Saratoga County, N. Y.* (See p. 662.)

N. Y. 46=L. S. 18.—Is near *Vischers Ferry, Saratoga County, N. Y.* (See p. 662.)

N. Y. 47.—Is near *Vischers Ferry, Saratoga, County, N. Y.*, on bridge No. 47, first bridge east of Lock No. 19, on top of first stone, under coping, east corner, east wing, on towpath abutment, marked cross in circle B. M. Canal B. M. No. 73.

N. Y. 48.—Is at *Vischers Ferry, Saratoga County, N. Y.*, on coping of Lock No. 19, near the end of the anchor, northeast gate, south lock, pier wall, marked cross in circle B. M. Canal B. M. No. 75.

N. Y. 49=L. S. 19.—Is at *Vischers Ferry, Saratoga County, N. Y.* (See p. 662.)

N. Y. 50.—Is near *Vischers Ferry, Saratoga County, N. Y.*, and is a point cut in a square between ends of anchor, north lock, southeast gate of Lock No. 20, new bench mark.

N. Y. 51.—Is at *Fondas Basin, Schenectady County, N. Y.*, on bridge 49, top of coping, east end wing, berme abutment, marked ⊗. Canal B. M. No. 8.

N. Y. 52=L. S. 21.—Is at *Rexford Flats, Saratoga County, N. Y.* (See p. 662.)

N. Y. 53=L. S. 22.—Is at *Rexford Flats, Saratoga County, N. Y.* (See p. 662.)

N. Y. 54.—Is at *Rexford Flats, Saratoga County, N. Y.*, on northeast corner of coping, on end of towpath wing, at north end of Upper Mohawk aqueduct, marked cross in circle B. M. Canal B. M. No. 86.

N. Y. 55.—Is at *Rexford Flats, Saratoga County, N. Y.*, on top dowel in coping of parapet, near end of parapet, towpath wing, south end of Upper Mohawk aqueduct, marked cross in circle B. M. Canal B. M. No. 87.

N. Y. 56.—Is near *Rexford Flats, Saratoga County, N. Y.*, on bridge No. 51, on top of coping, north wing, berme abutment, first bridge west of aqueduct, marked cross in circle B. M. Canal B. M. No. 88.

N. Y. 57.—Is a Deep Waterways bench mark at *Aqueduct Station, Schenectady County, N. Y.* (See p. 671.)

N. Y. 58=15 (1875).—Is near *Schenectady, Schenectady County, N. Y.* (See p. 849, App. 8, Report for 1899.)

N. Y. 59=L. S. 23.—Is near *Schenectady, Schenectady County, N. Y.* (See p. 662.)

N. Y. 60.—Is near *Schenectady, Schenectady County, N. Y.*, on bridge No. 53, on face of towpath abutment, near center, on projection of sixth course under coping, marked cross in circle B. M. Canal B. M. No. 90.

N. Y. 61=L. S. 24.—Is near *Schenectady, Schenectady County, N. Y.* (See p. 662.)

N. Y. 62.—Is at *Schenectady, Schenectady County, N. Y.*, on bridge No. 54, on top of coping, west wing wall, berme abutment, marked cross in circle B. M. Canal B. M. No. 92.

N. Y. 63.—Is at *Schenectady, Schenectady County, N. Y.* on bridge No. 55, on top coping, on end of east wing of towpath abutment, marked cross in circle B. M. Canal B. M. No. 93.

N. Y. 64=L. S. 25.—Is at *Schenectady, Schenectady County, N. Y.* (See p. 662.)

N. Y. 65.—Is a Deep Waterways bench mark at *Schenectady, Schenectady County, N. Y.* (See p. 672.)

N. Y. 66=L. S. 26.—Is at *Schenectady, Schenectady County, N. Y.* (See p. 662.)

N. Y. 66a.—Is at *Schenectady, Schenectady County, N. Y.*, on bridge No. 57, Jefferson street, on southwest corner of coping of retaining wall, east of towpath abutment, marked cross in circle B. M. Canal B. M. No. 95.

N. Y. 66b.—Is at *Schenectady, Schenectady County, N. Y.*, on bridge No. 59, Liberty street, on coping of retaining wall, west end of bridge approach, towpath abutment, new bench mark, marked □ with chisel.

N. Y. 67.—Is a Deep Waterways bench mark at *Schenectady, Schenectady County, N. Y.* (See p. 672.)

N. Y. 68.—Is at *Schenectady, Schenectady County, N. Y.*, on top of coping, west end of parapet, southwest corner of waste weir, opposite Westinghouse Works, marked cross in circle B. M. Canal B. M. No. 97.

N. Y. 69.—Is at *Schenectady, Schenectady County, N. Y.*, and is a square cut on northeast corner of coping on culvert No. 28, towpath at west end of General Electric works, new bench mark.

N. Y. 70.—Is near *Schenectady, Schenectady County, N. Y.*, on bridge No. 63, Navoniers Bay, on projection of sixth course, below coping, near center of towpath abutment, on face, marked cross in circle B. M. Canal B. M. No. 98.

N. Y. 71=L. S. 28.— Is near *Schenectady, N. Y.* (See p. 662.)

N. Y. 72=L. S. 29.—Is near *Schenectady, Schenectady County, N. Y.* (See p. 662.)

N. Y. 73.—Is near *Schenectady, Schenectady County, N. Y.*, on bridge No. 64, on face towpath abutment, near west angle, on projection of sixth course below coping, marked cross in circle B. M. Canal B. M. No. 101.

N. Y. 74a=L. S. 30.—Near *Schenectady, N. Y.* (See p. 662.)

N. Y. 74.—Is near *Schenectady, Schenectady County, N. Y.*, on coping of Lock No. 24, between ends of anchor, northeast gate of north lock, marked cross in circle B. M. Canal B. M. No. 103.

N. Y. 75.—Is near *Schenectady, Schenectady County, N. Y.*, on bridge No. 65, on projection of sixth course, on face, near center of towpath abutment, marked cross in circle B. M. Canal B. M. No. 104.

N. Y. 76a.—Is a Deep Waterways bench mark near *Rotterdam Junction, Schenectady County, N. Y.* (See p. 672.)

N. Y. 76.—Is near *Rotterdam Junction, Schenectady County, N. Y.*, on bridge No. 66, on projection of sixth course below coping on face near east angle towpath abutment, marked cross in circle B. M. Canal B. M. No. 105.

N. Y. 77.—Is near *Rotterdam Junction, Schenectady County, N. Y.*, on Flat Stone Creek aqueduct, square cut east end of parapet, northeast corner, towpath side, new bench mark.

N. Y. 78.—Is near *Rotterdam Junction, Schenectady County, N. Y.*, on bridge No. 67, on projection of sixth course below coping near center on face of towpath abutment, marked cross in circle B. M. Canal B. M. 107.

N. Y. 79.—Is near *Rotterdam Junction, Schenectady County, N. Y.*, on bridge No. 68, on projection of seventh course below coping on face near west angle towpath abutment, marked cross in circle B. M. Canal B. M. 108.

N. Y. 80.—Is near *Rotterdam Junction, Schenectady County, N. Y.*, on projection of seventh course below coping near center on face of towpath abutment, marked cross in circle B. M. Canal B. M. 109.

N. Y. 81=L. S. 32.—Is near *Pattersonville, Schenectady County, N. Y.* (See p. 662.)

N. Y. 82.—Is near *Pattersonville, Schenectady County, N. Y.*, on coping of lock No. 25 between ends of anchor northeast gate of north lock, marked cross in circle B. M. Canal B. M. 111.

N. Y. 83=L. S. 33.—Is near *Pattersonville, Schenectady County, N. Y.* (See p. 663.)

N. Y. 84.—Is near *Pattersonville, Schenectady County, N. Y.*, on bridge No. 72, on projection of fourth course below coping on face of towpath abutment near west angle, marked cross in circle B. M. Canal B. M. 113.

N. Y. 85a.—Is near *Pattersonville, Schenectady County, N. Y.*, on projection of seventh course fourth stone from southeast angle of pier railroad bridge over Erie Canal and Mohawk River about three-quarters of a mile east of Pattersonville, marked cross in circle B. M. New bench mark.

N. Y. 85.—Is near *Pattersonville, Schenectady County, N. Y.*, on bridge No. 73, on coping end of west wing berme abutment, marked cross in circle B. M. Canal B. M. No. 114.

N. Y. 86.—Is near *Pattersonville, Schenectady County, N. Y.*, on the coping of parapet Sansai Kill aqueduct at east angle (junction of wing with straight wall), marked cross in circle B. M. Canal B. M. No. 115.

N. Y. 87.—Is near *Pattersonville, Schenectady County, N. Y.*, on flat sandstone on back angle of towpath at west end of second tangent east of bridge No. 76, marked cross in circle B. M. Canal B. M. No. 118.

N. Y. 88=L. S. 36.—Is near *Amsterdam, Montgomery County, N. Y.* (See p. 663.)

N. Y. 89=L. S. 37.—Is near *Amsterdam, Montgomery County, N. Y.* (See p. 663.)

N. Y. 90=L. S. 38.—Is near *Amsterdam, Montgomery County, N. Y.* (See p. 663.)

N. Y. 91=L. S. 39.—Is near *Amsterdam, Montgomery County, N. Y.* (See p. 663.)

N. Y. 92.—Is near *Amsterdam, Montgomery County, N. Y.*, and is a square cut on northwest corner of wasteweir top of east wall, one-half mile east of Amsterdam River bridge. New bench mark.

N. Y. 93=L. S. 40.—Is at *Amsterdam, Montgomery County, N. Y.* (See p. 663.)

N. Y. 94=L. S. 42.—Is at *Amsterdam, Montgomery County, N. Y.* (See p. 663.)

N. Y. 95=L. S. 43.—Is near *Amsterdam, Montgomery County, N. Y.* (See p. 663.)

N. Y. 96.—Is near *Fort Hunter, Montgomery County, N. Y.*, on bridge No. 80, on projection sixth course below coping on face in center of towpath abutment, marked cross in circle B. M. Canal B. M. No. 134.

N. Y. 97=L. S. 44.—Is near *Fort Hunter, Montgomery County, N. Y.* (See p. 663.)

N. Y. 98.—Is near *Fort Hunter, Montgomery County, N. Y.*, on the coping of Lock No. 29 between ends of anchor, northeast gate of north lock, marked cross in circle B. M. Canal B. M. No. 139.

N. Y. 99.—Is near *Fort Hunter, Montgomery County, N. Y.*, on bridge No. 81, on projection of fourth course below coping on face of towpath abutment near east angle, marked cross in circle B. M. Canal B. M. No. 137.

N. Y. 100.—Is at *Fort Hunter, Montgomery County, N. Y.*, on coping of Lock No. 30 between ends of anchor, northeast gate of north lock, marked cross in circle B. M. Condition poor. Canal B. M. No. 139.

N. Y. 100a=L. S. 45.—Is at *Fort Hunter, Montgomery County, N. Y.* (See p. 663.)

N. Y. 101.—Is a Deep Waterway bench mark at *Fort Hunter, Montgomery County, N. Y.* (See p. 673.)

N. Y. 102.—Is near *Fort Hunter, Montgomery County, N. Y.*, on bridge No. 83, and is cross cut on face of corner stone, fifth course, northeast corner of towpath abutment, marked cross in circle B. M.

N. Y. 104.—Is near *Auriesville, Montgomery County, N. Y.*, on bridge No. 84, on top of lower step west wing berme abutment, marked cross in circle B. M. Canal B. M. No. 142.

N. Y. 105.—Is at *Auriesville, Montgomery County, N. Y.*, on bridge No. 85, on face towpath abutment near east angle on projection fifth course below coping, marked cross in circle B. M. Canal B. M. 143.

N. Y. 106.—Is a Deep Waterways bench mark near *Auriesville, Montgomery County, N. Y.* (See p. 673.)

N. Y. 107.—Is near *Auriesville, Montgomery County, N. Y.*, on bridge No. 86, on face of towpath abutment near west angle on projection sixth course below coping, marked cross in circle B. M. canal B. M. No. 144.

N. Y. 109.—Is near *Fultonville, Montgomery County, N. Y.* (See L. S. 46, p. 663.)

N. Y. 110.—Is near *Fultonville, Montgomery County, N. Y.*, on bridge No. 89, on face of towpath abutment near west angle on projection of fourth course below coping, marked cross in circle B. M. Canal B. M. No. 146.

N. Y. 111.—Is near *Fultonville, Montgomery County, N. Y.*, on bridge No. 90, on top of lower step west wing berme abutment, marked cross in circle B. M. Canal B. M. No. 147.

N. Y. 112=L. S. 47.—Is near *Fultonville, Montgomery County, N. Y.* (See p. 663.)

N. Y. 113.—Is near *Fultonville, Montgomery County, N. Y.*, on bridge No. 91, on top of lower step east berme abutment, marked cross in circle B. M. Canal B. M. No. 148.

N. Y. 114=L. S. 48.—Is at *Fultonville, Montgomery County, N. Y.* (See p. 663.)

N. Y. 115.—Is at Deep Waterways bench mark at *Fultonville, Montgomery County, N. Y.* (See p. 673.)

N. Y. 116.—Is at *Fultonville, Montgomery County, N. Y.*, at bridge No. 95, on top coping at end of east wing towpath abutment, marked cross in circle B. M. Canal B. M. No. 150.

N. Y. 117=L. S. 49.—Is near *Fultonville, Montgomery County, N. Y.* (See p. 664.)

N. Y. 118=L. S. 50.—Is near *Fultonville, Montgomery County, N. Y.* (See p. 664.)

N. Y. 119.—Is near *Fultonville, Montgomery County, N. Y.*, on bridge No. 97, on the face of the top stone, end of west wing, towpath abutment, marked cross in circle B. M. Canal B. M. No. 152.

N. Y. 120=L. S. 51.—Is near *Fultonville, Montgomery County, N. Y.* (See p. 664.)

N. Y. 121.—Is a Deep Waterways bench mark near *Downing, Montgomery County, N. Y.* (See p. 673.)

N. Y. 122.—Is near *Downing, Montgomery County, N. Y.*, on bridge No. 99, on top of second stone, below coping, at end of east wing, berm abutment, marked cross in circle B. M. Canal B. M. No. 155.

N. Y. 123.—Is near *Downing, Montgomery County, N. Y.*, on top of coping, northeast corner of northeast wing of Leonardson's Creek aqueduct, towpath side, marked cross in circle B. M. Canal B. M. No. 156.

N. Y. 124.—Is a Deep Waterways bench mark near *Downing, Montgomery County, N. Y.* (See p. 673.)

N. Y. 125=L. S. 52.—Is near *Downing, Montgomery County, N. Y.* (See p. 664.)

N. Y. 126.—Is near *West Downing, Montgomery County, N. Y.*, on face of towpath abutment of private road bridge, east lock No. 31, on projection of second course from bottom near center. New bench mark marked cross in circle B. M.

N. Y. 127=L. S. 53.—Is near *Sprakers, Montgomery County, N. Y.* (See p. 664.)

N. Y. 128=L. S. 54.—Is at *Sprakers, Montgomery County, N. Y.* (See p. 664.)

N. Y. 129=L. S. 55.—Is at *Sprakers, Montgomery County, N. Y.* (See p. 664.)

N. Y. 130.—Is near *Sprakers, Montgomery County, N. Y.*, on bridge No. 105, on face towpath abutment, near west angle on projection, fifth course below coping, marked cross in circle B. M. Canal B. M. No. 162.

N. Y. 131.—Is a Deep Waterways bench mark near *Sprakers, Montgomery County, N. Y.* (See p. 673.)

N. Y. 132.—Is near *Sprakers, Montgomery County, N. Y.*, on bridge 106, on face of towpath abutment near center, sixth course below coping. (See note 44, p. 584.)

N. Y. 133.—Is near *Sprakers, Montgomery County, N. Y.*, on bridge No. 107, on face of towpath abutment, near west angle, on projection, seventh course below coping, marked ⊕ B. M. Canal B. M. No. 164.

N. Y. 134.—Is near *Canajoharie, Montgomery County, N. Y.*, at bridge No. 108, on face of towpath abutment near center, on projection of fourth course below coping, marked cross in circle B. M. Canal B. M. No. 165.

N. Y. 135=L. S. 56.—Is at *Canajoharie, Montgomery County, N. Y.* (See p. 664.)

N. Y. 136=L. S. 57.—Is at *Canajoharie, Montgomery County, N. Y.* (See p. 664.)

N. Y. 137.—Is near *Canajoharie, Montgomery County, N. Y.*, on bridge No. 111, on coping at end of west wing towpath abutment, marked cross in circle B. M. Canal B. M. No. 167.

N. Y. 138.—Is near *Canajoharie, Montgomery County, N. Y.*, on bridge No. 112, on rear upper corner of stone under coping at west wing, berme abutment, marked cross in circle B. M. Canal B. M. No. 168.

N. Y. 139.—Is near *Fort Plain, Montgomery County, N. Y.*, on bridge No. 113, on face near center of east wing, towpath abutment, on projection second stone above ground, marked cross in circle B. M. Canal B. M. No. 169.

N. Y. 140=L. S. 58.—Is near *Fort Plain, Montgomery County, N. Y.* (See p. 664.)

N. Y. 141=L. S. 59.—Is near *Fort Plain, Montgomery County, N. Y.* (See p. 664.)

N. Y. 142a—Is a Deep Waterways bench mark at *Fort Plain, Montgomery County, N. Y.* (See p. 673.)

N. Y. 142=L. S. 60.—Is at *Fort Plain, Montgomery County, N. Y.* (See p. 664.)

N. Y. 143.—Is near *Fort Plain, Montgomery County, N. Y.*, on bridge No. 118, on face of towpath abutment, on projection sixth course below coping, marked cross in circle B. M. Canal B. M. No. 174.

N. Y. 144=L. S. 61.—Is near *Fort Plain, Montgomery County, N. Y.* (See p. 664).

N. Y. 145.—Is near *Fort Plain, Montgomery County, N. Y.*, on coping of culvert No. 63, near center of towpath, marked cross in circle B. M. Canal B. M. No. 175.

N. Y. 146.—Is near *Fort Plain, Montgomery County, N. Y.*, on top of coping of west wing of culvert No. 65, towpath side, marked □ B. M. New bench mark.

N. Y. 147.—Is near *St. Johnsville, Montgomery County, N. Y.*, on corner of coping east of wing wall, towpath side, of culvert No. 67, marked cross in circle B. M. Canal B. M. No. 176.

N. Y. 148=L. S. 62.—Is near *St. Johnsville, Montgomery County, N. Y.* (See p. 664.)

N. Y. 149.—Is near *St. Johnsville, Montgomery County, N. Y.*, on bridge No. 119, on face of towpath abutment, near west angle, on projection of sixth course below coping, marked cross in circle B. M. Canal B. M. No. 177.

N. Y. 150.—Is near *St. Johnsville, Montgomery County, N. Y.*, on coping of Lock No. 33, between ends of anchor, northeast gate of north lock, marked cross in circle B. M. Canal B. M. No. 179.

N. Y. 151=L. S. 63.—Is near *St. Johnsville, Montgomery County, N. Y.* (See p. 664.)

N. Y. 152=34a (1875).—Is near *St. Johnsville, Montgomery County, N. Y.*, on bridge No. 120, on face of second course of masonry, west wing wall, towpath abutment, marked B. M. with a chisel.

N. Y. 153.—Is at *St. Johnsville, Montgomery County, N. Y.*, on top of second step, east wing, towpath abutment of bridge No. 121, and is a new bench mark, marked □ B. M. This bench mark is not identical with L. S. 64, p. 665.

N. Y. 154.—Is a Deep Waterways bench mark at *Mindenville, Montgomery County, N. Y.* (See p. 665.)

N. Y. 155=L. S. 65.—Is near *Mindenville, Montgomery County, N. Y.* (See p. 665.)

N. Y. 156.—Is near *Mindenville, Montgomery County, N. Y.*, on bridge No. 124, on the face of the towpath abutment near west angle on projection of seventh course below coping, marked cross in circle B. M. Canal B. M. No. 185.

N. Y. 157.—Is near *Mindenville, Montgomery County, N. Y.*, on bridge No. 125, on projection of second course east wing towpath abutment, marked cross in circle B. M.

N. Y. 158=L. S. 66.—Is near *Mindenville, Montgomery County, N. Y.* (See p. 665.)

N. Y. 159.—Is near *Mindenville, Montgomery County, N. Y.*, on bridge No. 126, on projection of seventh course below coping near center towpath abutment, marked cross in circle B. M. Canal B. M. No. 186.

N. Y. 160.—Is a Deep Waterways bench mark near *Indian Castle, Herkimer County, N. Y.* (See p. 674.)

N. Y. 161.—Is near *Indian Castle, Herkimer County, N. Y.*, on bridge No. 128, on face of towpath abutment near west angle on projection of seventh course below coping, marked cross in circle B. M. Canal B. M. No. 187.

N. Y. 162.—Is near *Indian Castle, Herkimer County, N. Y.*, on bridge No. 129, on face of towpath abutment near center on projection seventh course below coping marked cross in circle B. M. Canal B. M. No. 188.

N. Y. 163.—Is near *Indian Castle, Herkimer County, N Y.*, on coping of lock No. 35 between ends of anchor northeast gate of north lock marked cross in circle B. M. Canal B. M. No. 190.

N. Y. 164=L. S. 67.—Is at *Indian Castle, Herkimer County, N. Y.* (See p. 665.)

N. Y. 165.—Is near *Indian Castle, Herkimer, County, N. Y.*, on bridge No. 131, at center of west wing on face of towpath abutment third course from ground, marked with circle.

N. Y. 166.—Is near *Indian Castle, Herkimer County, N. Y.*, on bridge No. 131, on face towpath abutment on projection third course from ground (near center), marked with circle.

N. Y. 167.—Is near *Indian Castle, Herkimer, County, N. Y.*, on bridge No. 132, on top of coping, east wing, berme abutment of farm bridge, marked cross in circle with chisel. Canal B. M. No. 192.

N. Y. 168=L. S. 68.—Is near *Indian Castle, Herkimer County, N. Y.* (See p. 665.)

N. Y. 169=L. S. 69.—Is at *Little Falls, Herkimer County, N. Y.* (See p. 665.)

N. Y. 170=L. S. 70.—Is at *Little Falls, Herkimer County, N. Y.* (See p. 665.)

N. Y. 171=L. S. 71.—Is at *Little Falls, Herkimer County, N. Y.* (See p. 665.)

N. Y. 172=L. S. 72.—Is at *Little Falls, Herkimer County, N. Y.* (See p. 665.)

N. Y. 173.—Is a Deep Waterways bench mark at *Little Falls, Herkimer County, N. Y.* (See p. 674.)

N. Y. 174.—Is near *Little Falls, Herkimer County, N. Y.*, on top of lower step east wing towpath abutment third bridge west of lock No. 39, marked □ with chisel (private bridge).

N. Y. 175.—Is a Deep Waterways bench mark near *Little Falls, Herkimer County, N. Y.* (See p. 674.)

N. Y. 176.—Is near *Little Falls, Herkimer County, N. Y.*, on bridge No. 138, on top of coping, west wing, berme abutment of farm bridge, marked cross in circle with chisel. Canal B. M. No. 205.

N. Y. 177=L. S. 73.—Is near *Little Falls, Herkimer County, N. Y.* (See p. 665.)

N. Y. 178.—Is near *Little Falls, Herkimer County, N. Y.*, on coping of lock No. 40 at ends of anchor, northeast gate, north lock, marked cross in circle with chisel. Canal B. M. No. 207.

N. Y. 179=L. S. 74.—Is near *Little Falls, Herkimer County, N. Y.* (See p. 665.)

N. Y. 180.—Is near *Herkimer, Herkimer County, N. Y.*, on bridge No. 139, on top of lower step, east wing, towpath abutment, second bridge west of lock No. 40, marked □ with chisel.

N. Y. 181.—Is near *Herkimer, Herkimer County, N. Y.*, on bridge No. 140, on top of coping, west wing, towpath abutment of farm bridge, marked cross in circle with chisel. Canal B. M. No. 209.

N. Y. 182.—Near *Herkimer, Herkimer County, N. Y.* (See p. 674.)

N. Y. 183=L. S. 75.—Is near *Herkimer, Herkimer County, N. Y.* (See p. 665.)

N. Y. 184.—Is near *Herkimer, Herkimer County, N. Y.*, on bridge No. 143, on coping, east wing, towpath abutment, farm bridge, marked with chisel.

N. Y. 185=L. S. 76.—Is near *Herkimer, Herkimer County, N. Y.* (See p. 665.)

N. Y. 186=L. S. 77.—Is at *Herkimer, Herkimer County, N. Y.* (See p. 665.)

N. Y. 187.—At *Herkimer, Herkimer County, N. Y.* (See p. 674.)

N. Y. 188.—Is near *Mohawk, Herkimer County, N. Y.*, cut in small shelf on third stone from west end lower course, towpath abutment, of street railway bridge between Herkimer and Mohawk.

N. Y. 189=L. S. 78.—Is at *Mohawk, Herkimer County, N. Y.* (See p. 665.)

N. Y. 190.—Is at *Mohawk, Herkimer County, N. Y.*, and is a cross cut in circle on northwest corner, lower step, west wing, berme abutment, Mohawk canal bridge.

N. Y. 191=L. S. 79.—Is at *Mohawk, Herkimer County, N. Y.* (See p. 665.)

N. Y. 192.—Is at *Mohawk, Herkimer County, N. Y.*, on lock No. 43, square cut on coping between ends of anchor, northeast gate, towpath lock.

N. Y. 193=L. S. 80.—Is near *Mohawk, Herkimer County, N. Y.* (See p. 666.)

N. Y. 194.—Is at *Mohawk, Herkimer County, N. Y.*, circle cut in square on southwest corner, lower step, west wing, towpath abutment, Meyer's farm bridge.

N. Y. 195=L. S. 81.—Is at *Ilion, Herkimer County, N. Y.* (See p. 666.)

N. Y. 196.—Is at *Ilion, Herkimer County, N. Y.*, and is a circle cut in square on southeast corner of top foundation stone of northeast stair landing near post of Railroad street lift bridge.

N. Y. 197=L. S. 82.—Is at *Ilion, Herkimer County, N. Y.* (See p. 666.)

N. Y 198.—Is at *Ilion, Herkimer County, N. Y.*, and is a circle cut in square on southwest corner, lower step of west wing of towpath abutment of London bridge.

N. Y. 199.—Is near *Ilion, Herkimer County, N. Y.*, and is a cross cut in circle on the northeast corner, second step of east wing, towpath abutment of street railway bridge between Ilion and Frankfort.

N. Y. 200=L. S. 83.—Is near *Ilion, Herkimer County, N. Y.* (See p. 666.)

N. Y. 201.—Is near *Illion, Herkimer County, N. Y.*, and is a circle cut in square on southwest corner, lower step, west wing, towpath abutment of bridge 650 feet of west lock 44, Erie Canal.

N. Y. 202.—Is near *Frankfort, Herkimer County, N. Y.*, and is a circle cut in square on southwest corner of lower step, west wing, towpath abutment Reese's road bridge.

N. Y. 203=L. S. 85.—Is at *Frankfort, Herkimer County, N. Y.* (See p. 666.)

N. Y. 204=L. S. 84.—Is at *Frankfort, Herkimer County, N. Y.* (See p. 666.)

N. Y. 205.—Is about three-quarters of a mile west of *Frankfort, Herkimer County, N. Y.*, and is a circle cut in square on southeast corner of lower step, east wing, towpath abutment of Beehive bridge.

N. Y. 206.—Is near *Frankfort, Herkimer County, N. Y.*, and is a cross cut in circle on southeast corner, second step, east wing, towpath abutment, bridge No. 161, next west of Beehive bridge.

N. Y. 207.—Is at *Frankfort, Herkimer County, N. Y.*, and is a circle cut in a projection on the face of fifth stone from the west end in the second course in towpath abutment, Center bridge.

N. Y. 208.—Is near *Frankfort, Herkimer County, N. Y.*, and is a circle cut on the southwest corner, of the lower step, west wing, towpath abutment, Bargy's farm bridge, 5 miles east of Herkimer-Oneida county line.

N. Y. 209.—Is near *Frankfort, Herkimer County, N. Y.*, and is a circle cut in the southwest corner, lower step, west wing, towpath abutment, farm bridge No. 164, 4.4 miles east of Herkimer-Oneida county line.

N. Y. 210.—Is near *Utica, Oneida County, N. Y.*, and is a cross cut in a circle on the face of stone near west angle of towpath abutment of farm bridge No. 165, 4 miles east of Herkimer-Oneida county line.

N. Y. 211.—Is near *Utica, Oneida County, N. Y.*, and is a circle cut on the first stone west of east angle, second course, towpath abutment, farm bridge No. 163, 3 miles east of Herkimer-Oneida county line.

N. Y. 212.—Is near *Utica, Oneida County, N. Y.*, and is a cross cut in a circle on projection of first stone in second course, west angle of towpath abutment, farm bridge No. 167, 3.7 miles east of Herkimer-Oneida county line.

N. Y. 213.—Is near *Utica, Oneida County, N. Y.*, and is a cross cut in a circle on projection on face of first stone west of east angle in second course, towpath abutment, farm bridge No. 168, 2.2 miles east of Herkimer-Oneida county line.

N. Y. 214.—Is near *Utica, Oneida County, N. Y.*, and is a circle cut in a square on a projection on the face of the second stone from the east angle in the second course, towpath abutment, harbor bridge No. 169.

N. Y. 215=L. S. 87.—Is near *Utica, Oneida County, N. Y.* (See p. 666.)

N. Y. 216.—Is near *Utica, Oneida County, N. Y.*, and is a cross cut in a circle on the southeast corner, lower step, east wing, towpath abutment of first bridge east of Herkimer-Oneida county line.

N. Y. 217=L. S. 88.—Is near *Utica, Oneida County, N. Y.* (See p. 666.)

N. Y. 218.—Is at *Utica, Oneida County, N. Y.*, and is a tack in an elm stub 40 feet from the front angle of towpath, about 200 feet east of Mohawk Valley Cotton Mills.

N. Y. 219=L. S. 89.—Is at *Utica, Oneida County, N. Y.* (See p. 666.)

N. Y. 220=U. S. G. S.—Is at *Utica, Oneida County, N. Y.*, on the post-office; bronze tablet west of east basement door, rear of building, marked U. S. Geological Survey B. M.

N. Y. 221=L. S. 90.—Is at *Utica, Oneida County, N. Y.* (See p. 666.)

N. Y. 222=L. S. 91.—Is at *Utica, Oneida County, N. Y.* (See p. 666.)

N. Y. 223=L. S. 92.—Is at *Utica, Oneida County, N. Y.* (See p. 666.)

N. Y. 224.—Is at *Utica, Oneida County, N. Y.*, and is a copper plug in the bottom step, east wing, towpath abutment, Platt street.

N. Y. 225=L. S. 93.—Is near *Utica, Oneida County, N. Y.* (See p. 666.)

N. Y. 226.—Is near *Utica, Oneida County, N. Y.*, and is a copper plug, lower step, east wing, towpath abutment, Yorkville road bridge.

N. Y. 227.—Is near *Whitesboro, Oneida County, N. Y.*, and is a copper plug in the second stone from the northeast end of the towpath parapet wall of Saquoit Creek aqueduct.

N. Y. 228=L. S. 94.—Is at *Whitesboro, Oneida County, N. Y.* (See p. 666.)

N. Y. 229=L. S. 95.—Is at *Whitesboro, Oneida County, N. Y.* (See p. 666.)

N. Y. 230=L. S. 96.—Is near *Oriskany, Oneida County, N. Y.* (See p. 666.)

N. Y. 231.—Is near *Oriskany, Oneida County, N. Y.*, and is a copper plug, southeast corner, bottom step, east wing, towpath abutment, Evans's farm bridge, just east of Oriskany.

N. Y. 232=L. S. 97.—Is at *Oriskany, Oneida County, N. Y.* (See p. 666.)

N. Y. 233=L. S. 98.—Is near *Oriskany, Oneida County, N. Y.* (See p. 666.)

N. Y. 234.—Is 1¾ miles west of *Oriskany, Oneida County, N. Y.*, and is a copper plug in the southwest corner, bottom step, west wing, towpath abutment, Kieley's farm bridge.

N. Y. 235.—Is 3 miles west of *Oriskany, Oneida County, N. Y.*, and is a copper plug, southeast corner, bottom step, east wing, towpath abutment, Murphy's farm bridge.

N. Y. 236.—Is 4½ miles west of *Oriskany, Oneida County, N. Y.*, and is a copper plug, southwest corner, bottom step, west wing, towpath abutment, Clark's farm bridge.

N. Y. 237=L. S. 100.—Is at *Stanwix, Oneida County, N. Y.* (See page 666.)

N. Y. 238.—Is at *Rome, Oneida County, N. Y.*, and is a knob cut on projection on face of stone in lower course near west end of towpath abutment, George street bridge.

N. Y. 239=L. S. 103.—Near *Rome, Oneida County, N. Y.* (See p. 666.)

N. Y. 240.—Is near *Rome, Oneida County, N. Y.*, and is a knob cut on the face of the first stone, third course, west wing, towpath abutment, Brainard's farm bridge, just east of Fort Bull waste weir.

N. Y. 241=L. S. 105.—Is 4.8 miles west of *Rome, Oneida County, N. Y.* (See p. 666.)

N. Y. 242.—Is near *New London, Oneida County, N. Y.*, and is a knob cut on the face of stone in second course, towpath abutment, Sand's farm bridge.

N. Y. 243=L. S. 106.—Is at *New London, Oneida County, N. Y.* (See p. 666.)

N. Y. 244.—Is near *New London, Oneida County, N. Y.*, and is a copper plug in west end of foundation stone of berme supports, Grove Spring road bridge.

N. Y. 245=L. S. 107.—Is at *Stacys Basin, Oneida County, N. Y.* (See p. 666.)

N. Y. 246.—Is near *Stacys Basin, Oneida County, N. Y.*, on bridge No. 50, Happy Valley road bridge, copper plug, lower step, east wing, towpath abutment.

N. Y. 247=L. S. 110.—Is at *Higginsville, Oneida County, N. Y.* (See p. 666.)

N. Y. 248.—Is at *Higginsville, Oneida County, N. Y.*, on bridge No. 52, west road bridge, square cut on fourth step, west wing, towpath abutment.

N. Y. 249.—Is at *Higginsville, Oneida County, N. Y.*, and is a square cut on the northeast corner of parapet of first culvert west of bridge No. 52, towpath side.

N. Y. 250.—Is near *Higginsville, Oneida County, N. Y.*, on bridge No. 53, Dunbarton bridge, copper plug, step flush with ground, east wing, towpath abutment.

N. Y. 251.—Is near *Higginsville, Oneida County, N. Y.*, on culvert No. 30, square cut northeast corner of coping, towpath side.

N. Y. 252.—Is near *Higginsville, Oneida County, N. Y.*, on culvert No. 31, square cut northeast corner of coping, towpath side.

N. Y. 253.—Is near *Higginsville, Oneida County, N. Y.*, on bridge No. 54, Durkee's road bridge, copper plug, third step, east wing, towpath abutment.

N. Y. 254.—Is near *Higginsville, Oneida County, N. Y.*, on bridge No. 55, State road bridge, copper plug, second step, east wing, towpath abutment.

N. Y. 255.—Is near *Higginsville, Oneida County, N. Y.*, and is a square cut on the northeast corner of coping of culvert just east of Midland Railroad bridge, towpath side.

N. Y. 256.—Is near *Durhamville, Oneida County, N. Y.*, and is on culvert No. 34, copper plug, northeast corner, east end of parapet coping, towpath side.

N. Y. 257.—Near *Durhamville, Oneida County, N. Y.*, on bridge No. 56, east road bridge, copper plug, third step, west wing, towpath abutment.

N. Y. 258.—Is at *Durhamville, Oneida County, N. Y.*, on bridge No. 57, Main street bridge, copper plug, third step, east wing, towpath abutment.

N. Y. 259.—Is at *Durhamville, Oneida County, N. Y.*, on waste weir No. 4, square cut on southeast corner of stone, north end of coping of west abutment.

N. Y. 260.—Is at *Durhamville, Oneida County, N. Y.*, on bridge No. 58, Bennett's road bridge, copper plug, lower step, west wing, towpath abutment.

N. Y. 261.—Is near *Durhamville, Oneida County, N. Y.*, on bridge No. 59, Sholhamer's road bridge, copper plug, second step, east wing, berme abutment.

N. Y. 262.—Is near *Durhamville, Oneida County, N. Y.*, on the Cowasselon aqueduct No. 3, copper plug near center of east face of coping of the buttress, east wing, towpath side.

N. Y. 263.—Is near *Canastota, Madison County, N. Y.*, on bridge No. 60, Lenox basin road bridge, copper plug, second step, west wing, towpath abutment.

N. Y. 264.—Is near *Canastota, Madison County, N. Y.*, on culvert No. 38, copper plug, coping of parapet over face of east wing, towpath abutment.

N. Y. 265.—Is at *Canastota, Madison County, N. Y.*, on the Elmira, Cortland and Northern Railroad bridge, point cut on projection of third course of masonry above ground, towpath abutment, near center.

N. Y. 266.—Is at *Canastota, Madison County, N. Y.*, on bridge No. 61, Peterboro street bridge, chisel mark on coping, berme vertical wall, west side of bridge, foot of step.

N. Y. 267.—Is at *Canastota, Madison County, N. Y.*, on bridge No. 62, Main street bridge, copper plug, third step, east wing, towpath abutment.

N. Y. 268.—Is at *Canastota, Madison County, N. Y.*, on culvert at cider mill, copper plug, northeast corner coping of parapet, towpath side.

N. Y. 269.—Is near *Canastota Madison County N. Y.*, on bridge No. 63, Beebe's road bridge, copper plug, fourth step, east wing, towpath abutment.

N. Y. 270.—Is near *Canastota, Madison County, N. Y.*, on bridge No. 64, Herrick's road bridge, square cut on fourth step, east wing, towpath abutment.

N. Y. 271.—Is near *Canastota, Madison County, N. Y.*, on culvert No. 43, copper plug, northwest corner, coping of parapet, towpath side, at Fuller's bridge.

N. Y. 272.—Is near *Canastota, Madison County, N. Y.*, on bridge No. 66, New Boston road bridge, copper plug, fourth step, east wing, towpath abutment.

N. Y. 273.—Is near *Canaseraga, Madison County, N. Y.*, on culvert No. 44, square cut on northwest corner of coping of parapet, towpath side.

N. Y. 274.—Is near *Canaseraga, Madison County, N. Y.*, on bridge No. 67, Canaseraga road bridge, copper plug, fourth step, east wing, towpath side abutment.

N. Y. 275.—Is near *Chittenango, Madison County, N. Y.*, on bridge No. 68, Chittenango road bridge, square cut on second step, east wing, towpath abutment.

N. Y. 276.—Is at *Chittenango, Madison County, N. Y.*, Chittenango aqueduct No. 4, copper plug, stone under coping of parapet, west wing, towpath side.

N. Y. 277.—Is near *Chittenango, Madison County, N. Y.*, on culvert No. 45, square cut on northeast corner of coping of parapet, towpath side.

N. Y. 278.—Is near *Chittenango, Madison County, N. Y.*, on bridge No. 69, Bolivar road bridge, copper plug, stone under coping of buttress, west wing, towpath abutment.

N. Y. 279.—Is near *Chittenango, Madison County, N. Y.*, on bridge No. 70, White's road bridge, copper plug, coping of buttress, east wing, towpath abutment.

N. Y. 280.—Is near *Kirkville, Onondaga County, N. Y.*, on bridge No. 71, Pools Brook road bridge, copper plug, coping buttress, east wing, towpath abutment.

N. Y. 281.—Is near *Kirkville, Onondaga County, N. Y.*, on bridge No. 72, Kirkville road bridge, copper plug, coping of buttress, east wing, towpath abutment.

N. Y. 282.—Is near *Manlius, Onondaga County, N. Y.*, on culvert No. 47, copper plug, northeast corner coping, towpath parapet.

N. Y. 283.—Is near *Manlius, Onondaga County, N. Y.*, on culvert No. 48, copper plug, northeast corner of coping, towpath parapet.

N. Y. 284.—Is at *Manlius, Onondaga County, N. Y.*, on bridge No. 73, Manlius road bridge, copper plug, lower step, east wing, berme abutment.

N. Y. 285.—Is near *Dewitt, Onondaga County, N. Y.*, on bridge No. 74, Stearn's farm bridge, square cut, lower step, east wing, berme abutment.

N. Y. 286.—Is near *Dewitt, Onondaga County, N. Y.*, on Limestone Creek aqueduct, copper plug, southwest corner of parapet coping, west wing, towpath side.

N. Y. 287.—Is near *Dewitt, Onondaga County, N. Y.*, on bridge No. 76, Burdick's road bridge, square cut on coping of buttress, east wing, towpath abutment.

N. Y. 288.—Is near *Dewitt, Onondaga County, N. Y.*, on culvert No. 49, square cut, northeast corner coping of parapet, towpath side.

N. Y. 289.—Is near *Dewitt, Onondaga County, N. Y.*, on Butternut Creek aqueduct, copper plug, coping of parapet, east stone, east wing, towpath side.

N. Y. 290.—Is near *Syracuse, Onondaga County, N. Y.*, on Thompsons Landing road bridge, copper plug, coping of west buttress, towpath side.

N. Y. 291.—Is near *Syracuse, Onondaga County, N. Y.*, on private bridge, point cut on second step, east wing, towpath side.

N. Y. 292.—Is near *Syracuse, Onondaga County, N. Y.*, on stop gate one-half mile east of lock No. 47, copper plug, west end of coping, towpath side.

N. Y. 293.—Is at *Syracuse, Onondaga County, N. Y.*, on lock No. 47, copper plug, southeast hollow quoin, towpath lock.

N. Y. 294.—Is at *Syracuse, Onondaga County, N. Y.*, on lock No. 48, copper plug, southeast hollow quoin, towpath lock.

N. Y. 295.—Is at *Syracuse, Onondaga County, N. Y.*, on bridge No. 80, William street bridge, copper plug, third step, east wing, towpath abutment.

N. Y. 296.—Is at *Syracuse, Onondaga County, N. Y.*, on bridge No. 81, Catherine street bridge, square cut west of bridge, seat on vertical wall, towpath side.

N. Y. 297.—Is at *Syracuse, Onondaga County, N. Y.*, on lock No. 49, copper plug, southeast hollow quoin, towpath lock.

N. Y. 298.—Is at *Syracuse, Onondaga, County, N. Y.*, on bridge No. 82, Orange street, square cut on second step, east wing, towpath abutment.

N. Y. 299.—Is at *Syracuse, Onondaga County, N. Y.*, on bridge No. 88, Grape street, copper plug, third step, west wing, towpath abutment.

N. Y. 300.—Is at *Syracuse, Onondaga County, N. Y.*, on weighlock, copper plug, northeast hollow quoin.

N. Y. 301.—Is at *Syracuse, Onondaga County, N. Y.*, United States Geological Survey bench mark, at weighlock; tablet set in doorsill of entrance to collector's office.

N. Y. 302.—Is at *Syracuse, Onondaga County, N. Y.*, on bridge No. 86, Salina street bridge, square cut southwest corner on belting of abutment 2½ feet above, towpath side.

N. Y. 303.—Is at *Syracuse, Onondaga County, N. Y.*, on bridge No. 87, Clinton street bridge, square cut on northwest corner of east foundation stone to stairway on towpath side.

N. Y. 304.—Is at *Syracuse, Onondaga County, N. Y.*, on bridge No. 89, West street, copper plug, in capstone, northeast corner lift tower.

N. Y. 305=U. S. G. S.—Is at *Syracuse, Onondaga County, N. Y.*, on bridge No. 90, Geddes street, southwest corner of stairway landing pier, foot of west towpath stairs.

N. Y. 306.—Is at *Syracuse, Onondaga County, N. Y.*, on New York Central Railroad bridge, over Genesee street bridge, square cut on first step, south wing, west abutment.

N. Y. 307.—Is at *Syracuse, Onondaga County, N. Y.*, on bridge No. 92, Bridge street, square cut on stone under coping, west wing, towpath abutment.

N. Y. 308.—Is near *Syracuse, Onondaga County, N. Y.*, on discharge well, near salt company's bridge, copper plug, southwest corner stone coping.

N. Y. 309.—Is near *Syracuse, Onondaga County, N. Y.*, on bridge No. 93, Blast Furnace road bridge, square cut on coping at buttress, west wing, towpath abutment.

N. Y. 310.—Is near *Syracuse, Onondaga County, N. Y.*, on bridge No. 94, Gere's Landing bridge, copper plug, coping buttress, west wing, towpath abutment.

N. Y. 311.—Is near *Syracuse, Onondaga County, N. Y.*, on culvert about 700 feet east of lock No. 50, square cut on northeast corner of parapet coping, towpath side.

N. Y. 312.—Is near *Syracuse, Onondaga County, N. Y.*, on lock No. 50, copper plug, southeast hollow quoin between anchors, towpath lock.

N. Y. 313.—Is near *Belle Isle, Onondaga County, N. Y.*, on bridge No. 95, Gere's road bridge, copper plug, lower step, east wing, towpath abutment.

N. Y. 314.—Is at *Belle Isle, Onondaga County, N. Y.*, on bridge No. 96, Belle Isle road bridge, copper plug, lower step, west wing, towpath abutment.

N. Y. 315.—Is near *Amboy, Onondaga County, N. Y.*, on first culvert east Amboy road bridge, copper plug, west end of parapet coping, towpath side.

N. Y. 316.—Is near *Amboy, Onondaga County, N. Y.*, on bridge No. 97, Amboy road bridge, copper plug, lower step, west wing, towpath abutment.

N. Y. 317.—Is near *Amboy, Onondaga County, N. Y.*, on nine-mile creek aqueduct, copper plug, northwest corner of coping, east retaining wall, towpath side.

N. Y. 318.—Is near *Camillus, Onondaga County, N. Y.*, on culvert No. 58, square cut northeast corner of coping, east wall, first culvert east of Camillus road bridge, towpath side.

N. Y. 319.—Is near *Camillus, Onondaga County, N. Y.*, on bridge No. 98, Camillus road bridge, copper plug, lower step, west wing, towpath abutment.

N. Y. 320.—Is near *Warners, Onondaga County, N. Y.*, on bridge No. 99, Newport road bridge, copper plug, lower step, west wing, towpath abutment.

N. Y. 321=U. S. G. S.—Is at *Warners, Onondaga County, N. Y.*, southwest corner of hotel barn, 30 feet north of canal, chisel mark on bowlder.

N. Y. 322.—Is near *Memphis, Onondaga County, N. Y.*, on bridge No. 100, Memphis road bridge, copper plug, lower step, east wing, towpath abutment.

N. Y. 323.—Is three-fourths of a mile west of *Memphis, Onondaga County, N. Y.*, on culvert No. 59, copper plug, coping of buttress, west wing, towpath abutment.

N. Y. 324.—Is near *Memphis, Onondaga County, N. Y.*, on bridge No. 101, Peru road bridge, copper plug, lower step, west wing, towpath abutment.

N. Y. 325.—Is near *Memphis, Onondaga County, N. Y.*, on bridge No. 102, Shanty Point road bridge, copper plug, third step, east wing, towpath abutment.

N. Y. 326.—Is near *Jordan, Onondaga County, N. Y.*, on Carpenter Brook waste-weir, square cut on northeast corner of coping of west wall, towpath side.

N. Y. 327.—Is near *Jordan, Onondaga County, N. Y.*, at Jordan Cement Works, square cut on southeast corner of concrete foundation at end of railroad siding at back angle of towpath.

N. Y. 328.—Is at *Jordan, Onondaga County, N. Y.*, on bridge No. 103, Beaver street, copper plug, lower step, west wing, towpath abutment.

N. Y. 329.—Is at *Jordan, Onondaga County, N. Y.*, at Jordan Aqueduct, copper plug, coping of parapet, east wing, towpath side.

N. Y. 330.—Is at *Jordan, Onondaga County, N. Y.*, on bridge No. 104, Main street, copper plug, lower step, west wing, towpath abutment.

N. Y. 331.—Is at *Jordan, Onondaga County, N. Y.*, on bridge No. 105, Hamilton street, copper plug, lower step, east wing, towpath abutment.

N. Y. 332.—Is near *Jordan, Onondaga County, N. Y.*, on lock No. 51, copper plug, southeast hollow quoin, towpath lock.

N. Y. 333.—Is near *Jordan, Onondaga County, N. Y.*, on bridge No. 106, Cold Spring road bridge, copper plug, third step, west wing, towpath abutment.

N. Y. 334.—Is near *Weedsport, Cayuga County, N. Y.*, on bridge No. 107, Fountainville road bridge, copper plug, fourth step, east wing, towpath abutment.

N. Y. 335.—Is near *Weedsport, Cayuga County, N. Y.*, on bridge No. 108, Field's road bridge, copper plug, second step, east wing, towpath abutment.

N. Y. 336.—Is near *Weedsport, Cayuga County, N. Y.*, on West Shore Railroad bridge east of Weedsport, square cut on lower step, east wing, towpath abutment.

N. Y. 337.—Is near *Weedsport, Cayuga County, N. Y.*, on bridge No. 109, Putnam's farm bridge, copper plug, third step, east wing, towpath abutment.

N. Y. 338.—Is near *Weedsport, Cayuga County, N. Y.*, on bridge No. 110, Young's farm bridge, copper plug, second step, east wing, towpath abutment.

N. Y. 339.—Is near *Weedsport, Cayuga County, N. Y.*, on the Southern Central Railroad bridge, square cut on second step, east wing, towpath abutment.

N. Y. 340.—Is near *Weedsport, Cayuga County, N. Y.*, on Weedsport wasteweir, copper plug in coping, east end of east wall of bulkhead.

N. Y. 341.—Is at *Weedsport, Cayuga County, N. Y.*, on bridge No. 111, Seneca street, copper plug, third step, east wing, towpath abutment.

N. Y. 342.—Is at *Weedsport, Cayuga County, N. Y.*, on bridge No. 112, Brutus street, copper plug, third step, east wing, towpath abutment.

N. Y. 343.—Is near *Weedsport, Cayuga County, N. Y.*, on West Shore Railroad bridge, square cut on lower step west wing, towpath abutment.

N. Y. 344.—Is near *Weedsport, Cayuga County, N. Y.*, on Centerport aqueduct, square cut on northeast corner of coping buttress, west wing, towpath side.

N. Y. 345.—Is near *Port Byron, Cayuga County, N. Y.*, on bridge No. 113, Centerport road bridge, square cut on fourth step, east wing, towpath abutment.

N. Y. 346.—Is at *Port Byron, Cayuga County, N. Y.*, on first culvert east of Utica street, square cut on northeast corner of coping, towpath side.

N. Y. 347.—Is at *Port Byron, Cayuga County, N. Y.*, on bridge No. 114, Utica street, copper plug, third step, east wing, towpath abutment.

N. Y. 348.—Is at *Port Byron, Cayuga County, N. Y.*, on bridge No. 115, Main street, copper plug, lower step, east wing, towpath abutment.

N. Y. 349.—Is at *Port Byron, Cayuga County, N. Y.*, on Port Byron aqueduct, copper plug, coping north buttress, east wing, towpath side.

N. Y. 350=U. S. G. S.—Is at *Port Byron, Cayuga County, N. Y.*, on bridge No. 116, Owasco street, copper plug, fourth step, east wing, towpath abutment.

N. Y. 351=U. S. G. S.—Is at *Port Byron, Cayuga County, N. Y.*, on bridge No. 117, Canal street, copper plug, second step, east wing, towpath abutment.

N. Y. 352=U. S. G. S.—Is at *Port Byron, Cayuga County, N. Y.*, on lock No. 52, copper plug, fourth step from west end, north side of lock pier.

N. Y. 353.—Is near *Port Byron, Cayuga County, N. Y.*, on bridge No. 118, Houghtaling road bridge, copper plug, lower step, east wing, towpath abutment.

N. Y. 354.—Is near *Montezuma, Cayuga County, N. Y.*, on bridge No. 119, McLeod's road bridge, copper plug, second step, west wing, towpath abutment.

N. Y. 355.—Is near *Montezuma, Cayuga County, N. Y.*, on Crane Brook aqueduct, copper plug, coping parapet, end of west wing, towpath abutment.

N. Y. 356.—Is near *Montezuma, Cayuga County, N. Y.*, on bridge No. 120, Bucklin's farm bridge, square cut on third step, west wing, towpath abutment.

N. Y. 357.—Is at *Montezuma, Cayuga County, N. Y.*, on bridge No. 121, Salt street, copper plug, fourth step, west wing, towpath abutment.

N. Y. 358.—Is at *Montezuma, Cayuga County, N. Y.*, on bridge No. 122, Change bridge, copper plug, second step, west wing, towpath abutment.

N. Y. 359.—Is at *Montezuma, Cayuga County, N. Y.*, on bridge No. 123, Clark street, copper plug, third step, west wing, towpath abutment.

N. Y. 360.—Is at *Montezuma, Cayuga County, N. Y.*, on Seneca River aqueduct A 12, copper plug, coping parapet, east end, towpath side.

N. Y. 361.—Is at *Montezuma, Cayuga County, N. Y.*, on Seneca River aqueduct A 12, copper plug, coping parapet, west end, towpath side.

N. Y. 362.—Is near *Montezuma, Cayuga County, N. Y.*, on bridge No. 124, Mays Point road and Change bridge, copper plug, third step, west wing, south abutment.

N. Y. 363.—Is near *Montezuma, Cayuga County, N. Y.*, on bridge No. 124, Mays Point road and Change bridge, United States Geological Survey tablet set in third step, south abutment, west wing.

N. Y. 364.—Is near *Montezuma, Cayuga County, N. Y.*, on first culvert west of Mays Point bridge, square cut on southwest corner of coping, towpath abutment.

N. Y. 365.—Is near *Montezuma, Cayuga County, N. Y.*, on second culvert west of Mays Point bridge, copper plug, coping of parapet, towpath side.

N. Y. 366.—Is near *Montezuma, Cayuga County, N. Y.*, on bridge No. 1, western division, Wayne County line bridge, point cut on projection of fifth course of masonry below coping, near center, towpath abutment.

N. Y. 367.—Is near *Meadville, Wayne County, N. Y.*, and is square cut on southwest corner of coping of parapet, towpath side, culvert No. 1, western division.

N. Y. 368.—Is near *Meadville, Wayne County, N. Y.*, and is square cut on southwest corner of coping of parapet, towpath side, culvert No. 2, western division.

N. Y. 369.—Is near *Meadville, Wayne County, N. Y.*, and is square cut on coping of buttress, west wing, towpath abutment, bridge No. 2, Pittlock's road bridge.

N. Y. 370.—Is near *Meadville, Wayne County, N. Y.*, and is square cut on center of coping of parapet, towpath side, culvert No. 3, western division.

N. Y. 371.—Is near *Meadville, Wayne County, N. Y.*, and is square cut on southeast corner of coping of parapet, towpath side, culvert No. 4, western division.

N. Y. 372.—Is near *Clyde, Wayne County, N. Y.*, and is on southwest corner of parapet wall, culvert No. 5, western division, marked □ with chisel.

N. Y. 373.—Is near *Clyde, Wayne County, N. Y.*, and is on Waldruff's bridge, No. 3, towpath abutment, west wing, northwest corner, marked [ ]

N. Y. 374.—Is near *Clyde, Wayne County, N. Y.*, on east wing of West Shore Railroad bridge, marked [ ]

N. Y. 375.—Is near *Clyde, Wayne County, N. Y.*, on Dive culvert, towpath, on parapet wall, marked [ ]

N. Y. 376.—Is at *Clyde, Wayne County, N. Y.*, on Glasgow street bridge No. 4, berme, on east wing, marked [ ]

N. Y. 377.—Is at *Clyde, Wayne County, N. Y.*, on lock No. 53, berme, middle hollow quoin, marked [ ]

N. Y. 378.—Is near *Clyde, Wayne County, N. Y.*, on Siegmund's bridge No. 6, towpath, on west wing, marked [ ]

N. Y. 379.—Is near *Clyde, Wayne County, N. Y.*, on Baker's farm bridge, No. 7, towpath, on east wing, marked [ ]

N. Y. 380.—Is near *Lock Berlin, Wayne County, N. Y.*, Long's farm bridge No. 8, towpath, on east wing, marked [ ]

N. Y. 381.—Is near *Lock Berlin, Wayne County, N. Y.*, on Dive culvert, towpath, on parapet wall, marked [ ]

N. Y. 382.—Is at *Lock Berlin, Wayne County, N. Y.*, on highway bridge No. 9, towpath, on east wing, marked [ ]

N. Y. 383.—Is at *Lock Berlin, Wayne County, N. Y.*, No. 54, berme, middle hollow quoin, marked [ ].

N. Y. 384.—Is about 0.4 mile west of *Lock Berlin, Wayne County, N. Y.*, at Horton's bridge, No. 10, berme, on east wing, marked [ ]

N. Y. 385.—Is near *Lock Berlin, Wayne County, N. Y.*, on Goetzman's farm bridge, No. 11, berme, on east wing, marked [ ]

N. Y. 386.—Is near *Lock Berlin, Wayne County, N. Y.*, on Kiaus's highway bridge, No. 12, towpath, on west wing, marked [ ]

N. Y. 387.—Is near *Lyons, Wayne County, N. Y.*, on Richmond's farm bridge, No. 13, berme, on west wing, marked [ ]

N. Y. 388.—Is near *Lyons, Wayne County, N. Y.*, on Cole's highway bridge, No. 14, towpath, on west wing, marked [ ]

N. Y. 389.—Is at *Lyons, Wayne County, N. Y.*, on Geneva street bridge, No. 15, towpath, on west wing, marked [ ]

N. Y. 390.—Is at *Lyons, Wayne County, N. Y.*, on Montezuma street bridge, No. 16, towpath, on west wing, marked [ ]

N. Y. 391.—Is at *Lyons, Wayne County, N. Y.*, on Water street bridge, No. 17, towpath, on east wing marked [ ]

N. Y. 392.—Is at *Lyons, Wayne County, N. Y.*, at lock No. 55, berme, on middle hollow quoin, marked [ ]

N. Y. 393.—Is at *Lyons, Wayne County, N. Y.*, at Mud Creek aqueduct, towpath, west wing, on buttress, marked [ ]

N. Y. 394.—Is near *Lyons, Wayne County, N. Y.*, on Prime's farm bridge, No. 19, berme, on west wing, marked [ ]

N. Y. 395.—Is near *Lyons, Wayne County, N. Y.*, on Park's highway bridge No. 20, towpath, on east wing, marked [ ]

N. Y. 396.—Is near *Lyons, Wayne County, N. Y.*, on Poorhouse lock No. 56, berme, on middle hollow quoin, marked [ ]

N. Y. 397.—Is near *Lyons, Wayne County, N. Y.*, Mosher's highway bridge No. 21, towpath on west wing, marked [ ]

N. Y. 398.—Is near *Lyons, Wayne, County, N. Y.*, on Dive culvert, towpath, on parapet wall, marked [ ]

N. Y. 399.—Is near *Newark, Wayne County, N. Y.*, on N. Y. C. R. R. bridge, east wing, lower step, marked [ ]

N. Y. 400.—Is near *Newark, Wayne County, N. Y.*, on Dive culvert, towpath, on center parapet wall, marked [ ]

N. Y. 401.—Is at *Newark, Wayne County, N. Y.*, on Lockville lock No. 57, berme, on east hollow quoin, marked [ ]

N. Y. 402.—Is at *Newark, Wayne County, N. Y.*, on Middle Lockville lock No. 58, berme, on east hollow quoin, marked [ ]

N. Y. 403.—Is at *Newark, Wayne County, N. Y.*, on Upper Lockville lock No. 59, berme, on east hollow quoin, marked [ ]

N. Y. 404.—Is at *Newark, Wayne County, N. Y.*, on Charles street bridge No. 24, towpath, on east wing, marked [ ]

U. S. G. S.—Is at *Newark, Wayne County, N. Y.*, on Newark Baptist Church, corner Charles and Miller streets, tablet in water table, marked 457 OSWGO.

N. Y. 405.—Is at *Newark, Wayne County, N. Y.*, on waste weir, towpath, middle parapet wall, marked [ ]

N. Y. 406.—Is near *Newark, Wayne County, N. Y.*, on Allerton's highway bridge No. 26, towpath, on east wing, marked [ ]

N. Y. 407.—Is near *Newark, Wayne County, N. Y.*, on Peck's highway bridge No. 27, towpath, on west wing, marked [ ]

N. Y. 408.—Is near *Port Gibson, Wayne County, N. Y.*, on Sweezey's farm bridge No. 28, towpath, east wing, first course below coping, marked O.

N. Y. 409.—Is near *Port Gibson, Wayne County, N. Y.*, on Palmer's farm bridge No. 29, towpath, on east wing, marked [ ]

N. Y. 410.—Is at *Port Gibson, Wayne County, N. Y.*, on Port Gibson bridge No. 30, towpath, on west wing, marked [ ]

N. Y. 411.—Is near *Palmyra, Wayne County, N. Y.*, on Galloway's highway bridge No. 31, towpath, east wing, on lower step, marked [ ]

N. Y. 412.—Is at *Palmyra, Wayne County, N. Y.*, on Kent street bridge No. 31½, berme, on west wing, on second lower step, marked [ ]

N. Y. 413.—Is at *Palmyra, Wayne County, N. Y.*, on Railroad avenue bridge No. 32, berme, on west wing, marked [ ]

N. Y. 414.—Is at *Palmyra, Wayne County, N. Y.*, on Church street bridge No. 34, towpath, on east wing, lower step, marked [ ]

N. Y. 415.—Is at *Palmyra, Wayne County, N. Y.*, on Change bridge No. 35, towpath, east wing, north side, marked [ ]

N. Y. 416.—Is near *Palmyra, Wayne County, N. Y.*, on Mud Creek aqueduct, towpath, west wing, on buttress, marked [ ]

U. S. G. S.—Is near *Palmyra, Wayne County, N. Y.*, on Mud Creek aqueduct, towpath, west wing, on buttress, copper tablet, marked 446 feet.

N. Y. 417.—Is near *Palmyra, Wayne County, N. Y.*, on Crandell's highway bridge No. 36, towpath, on east wing, marked [ ]

N. Y. 418.—Is near *Macedon, Wayne County, N. Y.*, on Clark's farm bridge No. 37, towpath, east wing, lower step, marked [ ]

N. Y. 419.—Is at *Macedon, Wayne County, N. Y.*, on lock No. 60, berme, on middle hollow quoin, marked [ ]

N. Y. 420.—Is at *Macedon, Wayne County, N. Y.*, on lock No. 61, berme, on middle hollow quoin, marked [ ]

N. Y. 421.—Is near *Macedon, Wayne County, N. Y.*, on Frear's highway bridge No. 41, towpath, on west wing, marked [ ]

N. Y. 422.—Is at *Wayneport, Wayne County, N. Y.*, on Highway bridge No. 42, towpath, on west wing, marked [ ]

N. Y. 423.—Is near *Fairport, Monroe County, N. Y.*, on Knappsville highway bridge No. 43, towpath, on east wing, marked [ ]

N. Y. 424.—Is near *Fairport, Monroe County, N. Y.*, on Thomas Creek culvert No. 26, towpath, on center parapet, marked [ ]

N. Y. 425.—Is near *Fairport, Monroe County, N. Y.*, on Baker's highway bridge No. 44, towpath, on east wing, marked [ ]

N. Y. 426.—Is at *Fairport, Monroe County, N. Y.*, on waste weir, towpath, middle parapet wall, marked [ ]

N. Y. 427.—Is near *Fairport, Monroe County, N. Y.*, on Fullman's basin bridge No. 47, towpath, on east wing, marked [ ]

N. Y. 428.—Is near *Fairport, Monroe County, N. Y.*, on Pipe culvert No. 27, towpath, middle parapet wall, marked [ ]

N. Y. 429.—Is near *Fairport, Monroe County, N. Y.*, on Wapping's highway bridge No. 48, towpath, on east wing, marked [ ]

N. Y. 430.—Is near *Fairport, Monroe County, N. Y.*, on Wiltsie's highway bridge No. 49, berme, on east wing, marked [ ]

N. Y. 431.—Is near *Bushnell Basin, Monroe County, N. Y.*, on stop gate, towpath, on east end recess coping, marked [ ]

N. Y. 432=U. S. G. S.—Is near *Bushnell Basin, Monroe County, N. Y.*, on Bushnell's basin bridge No. 50, towpath, inner face of west wing, copper tablet, marked "OSWGO 465 ft.

N. Y. 433.—Is near *Bushnell Basin, Monroe County, N. Y.*, on Cartersville bridge No. 51, towpath, middle abutment, inner face, fifth course below coping, marked "O."

N. Y. 434.—Is near *Pittsford, Monroe County, N. Y.*, on Guernsey's bridge No. 52, towpath, abutment, fifth course below coping, projecting stone, marked "O."

N. Y. 435.—Is at *Pittsford, Monroe County, N. Y.*, on highway bridge No. 53, towpath, on east wing, marked [ ]

N. Y. 436.—Is at *Pittsford, Monroe County, N. Y.*, on Main street bridge No. 54, middle towpath abutment, fifth course below coping, projecting stone, marked "O."

N. Y. 437.—Is near *Pittsford, Monroe County, N. Y.*, on Sutherland's highway bridge No. 55, towpath, on east wing, marked [ ]

N. Y. 438.—Is near *Pittsford, Monroe County, N. Y.*, on culvert No. 33, towpath, middle parapet wall, marked [ ]

N. Y. 439.—Is near *Pittsford, Monroe County, N. Y.*, on culvert No. 34, towpath, middle parapet wall, marked [ ]

N. Y. 440.—Is near *Pittsford, Monroe County, N. Y.*, on Cook's highway bridge No. 56, towpath, east wing, marked [ ]

N. Y. 441.—Is near *Pittsford, Monroe County, N. Y.*, on Lock No. 62, berme, on middle hollow quoin, marked [ ]

N. Y. 442.—Is near *Brighton, Monroe County, N. Y.*, on Weed's bridge No. 57, towpath, on east wing, marked [ ]

N. Y. 443.—Is near *Brighton, Monroe County, N. Y.*, on Billinghurst's bridge No. 58, towpath, on east wing, marked [ ]

N. Y. 444.—Is near *Brighton, Monroe County, N. Y.*, on Donely's bridge No. 59, towpath, on east wing, marked [ ]

N. Y. 445.—Is near *Brighton, Monroe County, N. Y.*, on Drake's No. 60, towpath, on east wing, marked [ ]

N. Y. 446.—Is at *Brighton, Monroe County, N. Y.*, on Miller's Lock No. 63, berme, on middle hollow quoin, marked [ ]

N. Y. 447.—Is at *Brighton, Monroe County, N. Y.*, on Sipple's Lock No. 64, berme, on middle hollow quoin (center stone), not marked.

N. Y. 448.—Is near *Rochester, Monroe County, N. Y.*, on Lock No. 65, berme, on middle hollow quoin, marked [ ]

N. Y. 449.—Is at *Rochester, Monroe County, N. Y.*, on Culver street bridge No. 62, towpath, on east wing, marked [ ]

N. Y. 450.—Is at *Rochester, Monroe County, N. Y.*, on Lock No. 66, berme, on middle hollow quoin, marked [ ]

N. Y. 451.—Is at *Rochester, Monroe County, N. Y.*, on Goodman street bridge No. 64, towpath, on east wing, marked [ ]

N. Y. 452.—Is at *Rochester, Monroe County, N. Y.*, on Averill avenue bridge No. 66, towpath, on east wing, marked [ ]

N. Y. 453.—Is at *Rochester, Monroe County, N. Y.*, on weigh lock, east end pier, near snubbing post, marked [ ]

N. Y. 454.—Is at *Rochester, Monroe County, N. Y.*, on Ford street bridge No. 78, east end towpath abutment, on third step, marked [ ]

N. Y. 455.—Is at *Rochester, Monroe County, N. Y.*, on Niagara Falls Railroad bridge, towpath, east end, on first step, marked [ ]

N. Y. 456.—Is at *Rochester, Monroe County, N. Y.*, on Emerson street bridge No. 85, towpath, parapet wall on west end, marked [ ]

N. Y. 457=U. S. G. S.—Is at *Rochester, Monroe County, N. Y.*, on Rowe street bridge No. 86, towpath, foundation under east tower, marked [ ]

N. Y. 458.—Is near *Rochester, Monroe County, N. Y.*, on Scott's bridge No. 88, towpath, on east wing, marked [ ]

N. Y. 459.—Is near *Rochester, Monroe County, N. Y.*, on Four Mile Grocery bridge No. 89, towpath, on east wing, marked [ ]

N. Y. 460.—Is near *South Greece, Monroe County, N. Y.*, on Spier's bridge No. 90, towpath abutment, west wing face, corner of coping, marked [ ] with a chisel.

N. Y. 461.—Is near *South Greece, Monroe County, N. Y.*, on Douglass's farm bridge No. 92, towpath abutment, west wing, near face corner, marked [ ] with a chisel.

N. Y. 462.—Is at *South Greece, Monroe County, N. Y.*, on Findlay's bridge No. 93, east wing, near face corner, berme abutment, marked [ ] with a chisel.

N. Y. 463.—Is near *South Greece, Monroe County, N. Y.*, on Cromwell's bridge No. 95, towpath abutment, east wing, near center of coping stone, marked [ ] with a chisel.

N. Y. 464.—Is near *Spencerport, Monroe County, N. Y.*, on Hiscock's bridge No. 96, towpath abutment, east wing, near center of coping stone, marked [ ] with a chisel.

N. Y. 465.—Is near *Spencerport, Monroe County, N. Y.*, on Norman's farm bridge No. 97, towpath abutment, west wing, near center coping stone, marked [ ] with paint.

N. Y. 466.—Is at *Spencerport, Monroe County, N. Y.*, on Amity street bridge No. 99, towpath abutment, west wing, near center bottom step, marked [ ] with a chisel.

N. Y. 467=U. S. G. S.—Is at *Spencerport, Monroe County, N. Y.*, Amity street bridge No. 99, bronze tablet in center of abutment, facing towpath and canal, marked "514 B."

N. Y. 468.—Is near *Spencerport, Monroe County, N. Y.*, on Webster's bridge No. 101, towpath abutment, east wing, center of bottom step, marked [ ] with a chisel.

N. Y. 469.—Is near *Spencerport, Monroe County, N. Y.*, on Cressy's bridge No. 102, towpath abutment, west wing, marked [ ] with a chisel.

N. Y. 470.—Is near *Spencerport, Monroe County, N. Y.*, on Adams's Basin bridge No. 103, towpath abutment, east wing, marked [ ] with a chisel.

N. Y. 471.— Is near *Brockport, Monroe County, N. Y.*, on Doty's bridge No. 104, berme abutment, east wing, coping, marked [ ] with a chisel.

N. Y. 472.—Is near *Brockport, Monroe County, N. Y.*, culvert No. 55, towpath, parapet, marked [ ] on coping.

N. Y. 473.—Is near *Brockport, Monroe County, N. Y.*, on Brockway's bridge No. 105, towpath abutment, west wing, marked [ ] with a chisel.

N. Y. 474.—Is near *Brockport, Monroe County, N. Y.*, on Cooley's Basin bridge No. 106, towpath abutment, east wing, third course, marked [ ] with a chisel.

N. Y. 475=U. S. G. S.—Is at *Brockport, Monroe County, N. Y.*, on Mechanic street bridge No. 107, towpath abutment, east wing, lower step, marked [ ] with a chisel.

N. Y. 476.—Is at *Brockport, Monroe County, N. Y.*, on Smith street bridge No. 109, towpath abutment, east wing, on lower step, marked [ ] with a chisel.

N. Y. 477.—Is at *Brockport, Monroe County, N. Y.*, on waste weir, abutment, on east pier, marked [ ] with a chisel.

N. Y. 478.—Is near *Brockport, Monroe County, N. Y.*, on Danforth's bridge No. 110, towpath abutment, east wing, coping, marked [ ] with a chisel.

N. Y. 479.—Is near *Holley, Monroe County, N. Y.*, on Miner's bridge No. 111, east wing, towpath, on offset, marked [ ] with a chisel.

N. Y. 480.—Is near *Holley, Orleans County, N. Y.*, on Orr's bridge No. 113, west wing, towpath abutment, marked [ ] with a chisel.

N. Y. 481.—Is at *Holley, Orleans County, N. Y.*, on Main street bridge No. 115, east wing, towpath abutment, marked [ ] with red paint.

N. Y. 482.—Is near *Holley, Orleans County, N. Y.*, on Tuttle's bridge No. 117, east wing, towpath abutment, marked [ ] with chisel and red paint.

N. Y. 483.—Is at *Hulberton, Orleans County, N. Y.*, on bridge No. 119, east wing, towpath abutment, marked [ ] with a chisel.

N. Y. 484.—Is near *Hulberton, Orleans County, N. Y.*, on Brockville bridge No. 120, east wing, towpath abutment, marked [ ] with a chisel.

N. Y. 485.—Is near *Hulberton, Orleans County, N. Y.*, on Hindsburg bridge No. 121, east wing, towpath abutment, marked [ ] with chisel and red paint.

N. Y. 486.—Is near *Albion, Orleans County, N. Y.*, on Jacqueth's bridge No. 123, east wing, towpath abutment, marked [ ] with chisel and ○ with red paint.

N. Y. 487.—Is near *Albion, Orleans County, N. Y.*, on Brailey's bridge No. 125, west wing, towpath abutment, marked [ ] with a chisel.

N. Y. 488.—Is at *Albion, Orleans County, N. Y.*, on Ingersoll street bridge No. 127, towpath abutment, east wing, on lower step, marked [ ] with a chisel.

N. Y. 489.—Is near *Albion, Orleans County, N. Y.*, on Lattin's bridge No. 129, west wing, towpath abutment, marked [ ] with a chisel.

N. Y. 490.—Is near *Albion, Orleans County, N. Y.*, on Gaines Basin bridge No. 130, west wing, towpath abutment, on lower step, marked [ ] with a chisel.

N. Y. 491.—Is at *Eagle Harbor, Orleans County, N. Y.*, on Eagle Harbor bridge No. 131, towpath abutment, east wing, lower step, marked [ ] with a chisel.

N. Y. 492=U. S. G. S.—Is at *Eagle Harbor, Orleans County, N. Y.*, on Eagle Harbor bridge No. 131, towpath abutment, east wing, lower step, copper bolt, marked U. S. G. S. B. M. 516 feet.

N. Y. 493.—Is near *Eagle Harbor, Orleans County, N. Y.*, on Starkweather's farm bridge No. 132, towpath, east wing, marked [ ] with chisel.

N. Y. 494.—Is near *Knowlesville, Orleans County, N. Y.*, on Long's bridge No. 134, east wing, towpath abutment, face corner, marked [ ] with chisel.

N. Y. 495.—Is near *Knowlesville, Orleans County, N. Y.*, on Dive culvert No. 91, towpath parapet, marked [ ]

N. Y. 496.—Is near *Knowlesville, Orleans County, N. Y.*, on Knowlesville bridge No. 135, west wing, towpath abutment, second lower step, marked [ ] with a chisel.

N. Y. 497.—Is near *Knowlesville, Orleans County, N. Y.*, on Knowlesville stop gate, east abutment, towpath side, marked [ ]

N. Y. 498.—Is near *Medina, Orleans County, N. Y.*, on Beal's bridge, towpath abutment, east wing, marked [ ] with a chisel.

N. Y. 499.—Is near *Medina, Orleans County, N. Y.*, on Hastings's bridge No. 137, west wing, towpath abutment, on corner coping, marked [ ] with a chisel.

N. Y. 500.—Is at *Medina, Orleans County, N. Y.*, on Holloway's bridge No. 138, east wing, towpath abutment, marked [ ] around anchor bolt.

N. Y. 501.—Is at *Medina, Orleans County, N. Y.*, on Medina aqueduct, west buttress, on the northwest corner, marked [ ] with a chisel.

N. Y 502.—Is at *Medina, Orleans County, N. Y.*, on Church street bridge No. 139, east wing, towpath abutment, marked [ ] around anchor bolt.

N Y. 503=U. S. G. S.—Is at *Medina, Orleans County, N. Y.*, on Prospect street bridge No. 140½, east wing, towpath abutment, copper bolt, marked U. S. G. S. B. M.

N. Y. 504.—Is near *Medina, Orleans County, N. Y.*, on old stop gate, east end of towpath abutment, marked [ ] with red paint.

N. Y. 505.—Is near *Medina, Orleans County, N. Y.*, on dive culvert No. 100, on towpath parapet, marked [ ]

N. Y. 506.—Is near *Medina, Orleans County, N. Y.*, on Jackson's bridge No. 141, west wing, towpath abutment, marked [ ] with a chisel.

N. Y. 507.—Is near *Medina, Orleans County, N. Y.*, on Shelby Basin bridge No. 142, east wing, towpath abutment, marked [ ] with a chisel.

N. Y. 508.—Is near *Middleport, Niagara County, N. Y.*, on Gorman's bridge No. 143, east wing, towpath abutment, marked [ ] with a chisel.

N. Y. 509.—Is near *Middleport, Niagara County, N. Y.*, on dive culvert No. 104, on center of towpath parapet, marked [ ] with a chisel.

N. Y. 510.—Is at *Middleport, Niagara County, N. Y.*, on Main street bridge No. 145, west wing, towpath abutment, on lower step, marked [ ] with chisel.

N. Y. 511.—Is near *Middleport, Niagara County, N. Y.*, on dive culvert No. 108, on towpath parapet, end of coping, marked [ ] with chisel.

N. Y. 512.—Is near *Middleport, Niagara County, N. Y.*, on Watson's bridge No. 147, west wing, towpath abutment, marked [ ] with a chisel.

N. Y. 513.—Is near *Middleport, Niagara County, N. Y.*, on Hurd's bridge No. 148, east wing, towpath abutment, marked [ ] around anchor bolt.

N. Y. 514.—Is near *Gasport, Niagara County, N. Y.*, on Reynolds Basin bridge No. 149, east wing, towpath abutment, lower step, marked [ ] with a chisel.

N. Y. 515.—Is at *Gasport, Niagara County, N. Y.*, on dive culvert No. 114, towpath parapet, marked [ ] with chisel.

N. Y. 516.—Is at *Gasport, Niagara County, N. Y.*, on dive culvert No. 115, towpath parapet, marked [ ] with chisel.

N. Y. 517.—Is near *Gasport, Niagara County, N. Y.*, on Orangeport bridge No. 152, west wing, towpath abutment, marked [ ] with chisel.

N. Y. 518.—Is near *Gasport, Niagara County, N. Y.*, on dive culvert No. 116, towpath parapet, marked [ ] with chisel.

N. Y. 519.—Is near *Gasport, Niagara County, N. Y.*, on dive culvert No. 117, towpath parapet, marked [ ] with chisel.

N. Y. 520.—Is near *Gasport, Niagara County, N. Y.*, on Millard's bridge No. 153, east wing, towpath abutment, marked [ ] with paint.

N. Y. 521.—Is near *Lockport, Niagara County, N. Y.*, on Wakeman's bridge No. 154, west wing, towpath abutment on coping, marked [ ] with paint.

N. Y. 522.—Is near *Lockport, Niagara County, N. Y.*, on Young's bridge No. 155, west wing, towpath abutment, on coping marked [ ] with paint.

N. Y. 523.—Is at *Lockport, Niagara County, N. Y.*, on New York Central and Hudson River Railroad bridge (lower town branch), towpath abutment, east end, rear corner, marked [ ] with chisel.

N. Y. 524.—Is at *Lockport, Niagara County, N. Y.*, on Adams street bridge No. 157, towpath abutment, east wing, lower step, marked [ ] with chisel.

N. Y. 525.—Is at *Lockport, Niagara County, N. Y.*, on Cady street bridge No. 160, west wing, towpath abutment, first lower step, marked [ ] with chisel.

N. Y. 526.—Is at *Lockport, Niagara County, N. Y.*, on lock 67, towpath, first lower step, marked [ ] with chisel.

N. Y. 527.—Is at *Lockport, Niagara County, N. Y.*, on lock 71, east berme, hollow quoin, marked [ ] with chisel.

N. Y. 528.—Is near *Lockport, Niagara County, N. Y.*, 200 feet east of bridge No. 165, iron ringbolt at northeast corner of plank towpath bridge over horse hole.

N. Y. 529.—Is near *Lockport, Niagara County, N. Y.*, on stone wall, marked [ ] with paint and improvement bench mark No. 13½.

N. Y. 530.—Is near *Lockport, Niagara County, N. Y.*, on Hawley's bridge No. 167, towpath abutment, west end of pier, on first course of stone, marked [ ] with chisel.

N. Y. 531.—Is near *Pendleton, Niagara County, N. Y.*, on Sulphur Springs guard lock, 1.5 miles east of Pendleton, east berme, hollow quoin, marked [ ] with chisel.

N. Y. 532.—Is at *Pendleton, Niagara County, N. Y.*, on Pendleton Change bridge No. 169, berme side, east wing, east end of lower step, marked [ ] with chisel.

N. Y. 533.—Is near *Pendleton, Niagara County, N. Y.*, on highway bridge over Black Creek, west abutment, northwest wing, marked [ ] with chisel.

N. Y. 534.—Is near *Pendleton, Niagara County, N. Y.*, on New Home bridge No. 173, towpath abutment, west wing, corner, first lower step, marked [ ] with chisel.

N. Y. 535.—Is near *Pendleton, Niagara County, N. Y.*, on Pickard's bridge, No. 174, towpath, on face of abutment, near west end, marked [ ] with chisel.

N. Y. 536.—Is near *Pendleton, Niagara County, N. Y.*, on Stone road culvert, northeast corner, marked [ ] with chisel.

N. Y. 537.—Is near *Tonawanda, Erie County, N. Y.*, on Bush's bridge No. 175, on face of towpath abutment, marked [ ] with chisel and paint.

N. Y. 538.—Is at *Tonawanda, Erie County, N. Y.*, on Erie Railroad bridge, towpath abutment, west wing, first lower step, marked [ ]with chisel.

N. Y. 539=Tonawanda 2.—Is at *Tonawanda, Erie County, N. Y.* (See p. 656.)

N. Y. 540.—Is at *Tonawanda, Erie County, N. Y.*, on Bouck street bridge No. 180, towpath abutment, west wing, marked [ ] with chisel

N. Y. 541.—Is near *Tonawanda, Erie County, N. Y.*, at Tonawanda change bridge, No. 182, towpath abutment, first coping stone, marked [ ] with chisel.

N. Y. 542.—Is near *Tonawanda, Erie County, N. Y.*, on Three Mile bridge No. 183, east wing, towpath abutment, marked [ ] with chisel.

N. Y. 543.—Is near *Tonawanda, Erie County, N. Y.*, on Cherry's bridge No. 184, towpath, west wing, rear of abutment, second course below coping, marked [ ] with chisel and U. S. B. M. 218 with paint.

N. Y. 544.—Is near *Tonawanda, Erie County, N. Y.*, on Spies bridge No. 185, towpath abutment, east wing, marked [ ] with chisel and U. S. B. M. 216 with paint.

N. Y. 545.—Is near *Buffalo, Erie County, N. Y.*, at Grand Island Ferry (Scott's bridge No. 186), west wing, towpath abutment, marked [ ] with chisel and U. S. B. M. with paint.

N. Y. 546.—Is near *Buffalo, Erie County, N. Y.*, on Change bridge No. 187, 0.97 mile east of International bridge, towpath, south side of west wing, marked [ ] with chisel and U. S. B. M. No. 9 with paint.

N. Y. 548.—Is at *Buffalo, Erie County, N. Y.*, on International bridge, towpath, on face of abutment, marked [ ] with chisel and U. S. B. M. No. 7 with paint.

N. Y. 549.—Is at *Buffalo, Erie County, N. Y.*, on Ferry street bridge No. 194, towpath abutment, west wing, marked [ ] with chisel and U. S. B. M. No. 6 with paint.

N. Y. 550.—Is at *Buffalo, Erie County, N. Y.*, on Porter avenue bridge No. 196, towpath, on face of abutment, bottom course, between fourth and fifth arch ribs, marked [ ] with chisel.

N. Y. 551.—Is at *Buffalo, Erie County, N. Y.*, on Hudson street bridge No. 196½, towpath abutment, south wing, first lower step, marked [ ] with chisel and U. S. B. M. No. 211 with paint.

N. Y. 552.—Is at *Buffalo, Erie County, N. Y.*, on Commercial street bridge No. 204, towpath abutment, north wing, second lower step, marked [ ] with chisel.

L. H.—Is at *Buffalo, Erie County, N. Y.* (See p. 658.)

N. Y. 554=D. W. Lockport 1.—Is near *Lockport, Niagara County, N. Y.* (See p. 659.)

PERMANENT BENCH MARKS BETWEEN PHOENIX AND CLYDE, N. Y.

(See Report of New York State Engineer and Surveyor, 1901, pp. 697, 698.)

N. Y. 53=D. W. Phoenix.—Is at *Phoenix, Oswego County, N. Y.* (See p. 676.)

N. Y. 54.—Is at *Phoenix, Oswego County, N. Y.*, and is a copper plug on coping of guard lock No. 1, between straps, on the southeastern hollow quoin.

N. Y. 55.—Is at *Three River Point, Onondaga County, N. Y.*, and is a copper plug in step on east wing, north abutment of bridge over Oneida River.

N. Y. 56.—Is at *Belgium, Onondaga County, N. Y.*, and is a copper plug in door sill of brick building, 50 feet north of the east wing of highway bridge over Seneca River.

N. Y. 57.—Is near *Belgium, Onondaga County, N. Y.*, and is a nail in the root of a 20-inch elm tree on property of Henry Lacey, 350 feet from Italian shanty, and 550 feet from place where ditch running into Seneca River crosses division line between lands of Henry Lacey and Luke Collins.

N. Y. 58.—Is near *Belgium, Onondaga County, N. Y.*, and is nail in root of elm tree located 220 feet from the dwelling of John Doyle, at foot of bluff on flats south side of Seneca River, 1⅛ miles below Cold Spring bridge.

N. Y. 59.—Is near *Baldwinsville, Onondaga County, N. Y.*, and is the highest point on stone monument, about 725 feet above Cold Spring bridge, on the left bank of Seneca River.

N. Y. 60.—Is near *Baldwinsville, Onondaga County, N. Y.*, and is nail in root of oak tree, about 40 feet west of wire fence, on property of Jay B. Klein, about 6 000 feet above Cold Spring bridge.

N. Y. 61.—Is near *Baldwinsville, Onondaga County, N. Y.*, and is nail in root of 16-inch elm tree on back angle of towpath on property of Jay B. Klein, 5 feet from wire fence, about 1 500 feet west of division line between properties of Alonzo Wagner and J. B. Klein.

N. Y. 62.—Is near *Baldwinsville, Onondaga County, N. Y.*, and is nail in root of 16-inch poplar, 170 feet east of bridge over small creek, and 350 feet from division line between properties of Harriet and Elmer Dixon and E. I. Bisdie, and on the property of E. I. Bisdie.

N. Y. 63.—Is near *Baldwinsville, Onondaga County, N. Y.*, and is nail in root of 10-inch ash tree on left bank of Seneca River, 300 feet from division line between properties of W. S. Names and Curtis Names, on property of W. S. Names, about 1 200 feet above Delaware, Lackawanna and Western Railroad bridge.

N. Y. 64.—Is near *Baldwinsville, Onondaga County, N. Y.*, and is point on stone monument, near slaughterhouse, about 700 feet below lock in Baldwinsville side-cut canal.

N. Y. 65.—Is near *Baldwinsville, Onondaga County, N. Y.*, and is point cut in coping on the south side of last stone on the west end of wall at the north end of Baldwinsville dam.

N. Y. 66.—Is near *Baldwinsville, Onondaga County, N. Y.*, and is a nail in root of elm tree on property of Otis M. Bigelow, one-half mile from Baldwinsville post-office, on the north river bank.

N. Y. 67.—Is near *Baldwinsville, Onondaga County, N. Y.*, and is the highest point on bowlder on top of river bank, on property of Mrs. Jennie M. Adsit, 550 feet from farm house and 420 feet from highway.

N. Y. 68.—Is near *Baldwinsville, Onondaga County, N. Y.*, and is mark cut on bowlder 200 feet from water's edge, 15 feet from angle in rail fence between properties of Judson Maerfield and Hannah Butler, on Maerfield property.

N. Y. 69.—Is near *Baldwinsville, Onondaga County, N. Y.*, and is nail in root of elm tree, 5 feet from river, on the property of Adelbert and Frank Fowler, 1 075 feet from west line and 1 100 feet from their east property line, about 4 miles above Baldwinsville, opposite property of Seneca River Brick Company.

N. Y. 70.—Is near *Plainville, Onondaga County, N. Y.*, and is nail in root of chestnut tree on land of D. E. Voorheese, 500 feet from his east line and 2 000 feet from his west line.

N. Y. 71.—Is about 1½ miles south of *Plainville, Onondaga County, N. Y.*, and is nail in root of 13-inch elm in the north edge of woods on property of David Tillison.

N. Y. 72.—Is near *Plainville, Onondaga County, N. Y.*, and is nail in root of stump beside 15-inch oak tree on top of river bank in edge of woods and at end of rail fence, on the property of Emerson Gates, about 1 500 feet north of highway bridge over State ditch at Jacks Reef.

N. Y. 73.—Is near *Plainville, Onondaga County, N. Y.*, and is nail in root of hickory tree on east side of road 125 feet south of the east end of Jacks Reef River bridge.

N. Y. 74—Is near *Plainville, Onondaga County, N. Y.*, and is nail in root of large hickory tree on shore of Seneca River, at the beginning of lane along river on property of R. Graves, about opposite upper end of State ditch.

N. Y. 75.—Is near *Plainville, Onondaga County, N. Y.*, and is nail in root of large hickory tree on shore of Cross Lake, 1,200 feet south of outlet near high-water mark on property of W. T. Stephens.

N. Y. 76.—Is near *Weedsport, Cayuga County, N. Y.*, and is nail in root of 10-inch maple stump on south shore of Cross Lake in woods, 1,100 feet west of lane to boathouse on land of Mrs. Brotton.

N. Y. 77.—Is near *Weedsport, Cayuga County, N. Y.*, and is point cut on northeast corner of coping stone, south abutment, iron bridge over Seneca River, about three-fourths mile up stream from Cross Lake.

N. Y. 78.—Is near *Weedsport, Cayuga County, N. Y.*, and is nail in root of 3-foot elm 50 feet north of Skaneateles Creek, about 1,500 feet east of Bonta's Bridge over Seneca River, on property of J. A. Clements.

N. Y. 80.—Is near *Weedsport, Cayuga County, N. Y.*, and is point cut on bridge seat on east side of south abutment of river bridge on highway directly north of Weedsport.

N. Y. 81.—Is near *Port Byron, Cayuga County, N. Y.*, and is nail in root of willow tree just west of clubhouse known as Casey's, and about 10 feet away.

N. Y. 82.—Is near *Port Byron, Cayuga County, N. Y.*, and is a mark cut on east corner, south abutment, bridge seat of Free Bridge across Seneca River, about 1½ miles north of New York Central & Hudson River Railroad station.

N. Y. 83.—Is about two miles north of *Port Byron, Cayuga County, N. Y.*, and is a point cut on bridge seat at east angle south of abutment Mosquito Point bridge over Seneca River.

N. Y. 84.—Is near *Port Byron, Cayuga County, N. Y.*, and is nail in root of maple tree, about 200 feet from river and 570 feet west of lower bridge to Howland's Island.

N. Y. 85.—Is at *Fox Ridge, Cayuga County, N. Y.*, and is a point cut on large bowlder at the roadside just south of New York Central depot, and about 10 feet from wire fence.

N. Y. 86.—Is near *Fox Ridge, Cayuga County, N. Y.*, and is point cut on northeast pedestal stone of water-tank foundation at New York Central water station No. 39, Seneca River, about 100 feet west of bridge over Seneca River.

N. Y. 87.—Is about one-half mile east of *Savannah, Wayne County, N. Y.*, and is highest point on rail driven into ground at base and in front of New York Central mile post, N. Y. 322, Buffalo, 118.

N. Y. 88.—Is about three-fourths of a mile west of *Savannah, Wayne County, N. Y.*, and is point cut on face of stone in east end, lower course, north abutment of high way bridge over New York Central Railroad.

N. Y. 89.—Is about 2 miles west of *Savannah, Wayne County, N. Y.*, and is point cut on northwest corner of bridge seat of West Shore Railroad bridge over Crusoe Creek.

N. Y. 90.—Is about 1.8 miles east of *Clyde, Wayne County, N. Y.*, and is point cut on back of lower step, towpath abutment, north wing of New York Central Railroad bridge over Erie Canal.

N. Y. 91=N. Y. 372.—Is near *Clyde, Wayne County, N. Y.* (See p. 694.)

DESCRIPTIONS OF PERMANENT BENCH MARKS BETWEEN SYRACUSE AND PHŒNIX.

(See Report of New York State Engineer and Surveyor, 1901, p. 693.)

N. Y. 300.—Is at *Syracuse, Onondaga County, N. Y.* (See p. 694.)

N. Y. 1.—Is at *Syracuse, Onondaga County, N. Y.*, on Willow street bridge, copper plug, third step, south wing, towpath abutment.

N. Y. 2.—Is at *Syracuse, Onondaga County, N. Y.*, on Division street bridge, copper plug, third step, south wing, towpath abutment.

N. Y. 3.—Is at *Syracuse, Onondaga County, N. Y.*, on Bear street bridge, copper plug, first step, south wing, towpath abutment.

N. Y. 4.—Is near *Syracuse, Onondaga County, N. Y.*, on lock No. 1, copper plug, northeast lower berme hollow quoin.

N. Y. 5.—Is near *Syracuse, Onondaga County, N. Y.*, on lock No. 2, copper plug, southeast upper towpath hollow quoin.

N. Y. 6.—Is near *Syracuse, Onondaga County, N. Y.*, on lock No. 3, copper plug, northeast lower towpath hollow quoin.

N. Y. 7.—Is near *Syracuse, Onondaga County, N. Y.*, on Change bridge, square cut on coping buttress, north wing, west abutment.

N. Y. 8.—Is near *Syracuse, Onondaga County, N. Y.*, on Change bridge, copper plug in west side of coping, north wing, east abutment.

N. Y. 9.—Is near *Syracuse, Onondaga County, N. Y.*, on Rome, Watertown and Ogdensburg Railroad bridge, square cut on coping of buttress, south wing, towpath abutment.

N. Y. 10.—Is near *Liverpool, Onondaga County, N. Y.*, on culvert, square cut on northwest capstone, towpath side.

N. Y. 11.—Is near *Liverpool, Onondaga County, N. Y.*, on the Liverpool road bridge, copper plug, first step, south wing, towpath abutment.

N. Y. 12.—Is near *Belgium, Onondaga County, N. Y.*, on culvert, square cut on northwest capstone, towpath side.

N. Y. 13.—Is near *Belgium, Onondaga County, N. Y.*, on Road and Change bridge, copper plug, first step, south wing, towpath abutment.

N. Y. 14.—Is near *Belgium, Onondaga County, N. Y.*, on lock No. 5, copper plug, northeast lower towpath hollow quoin, between anchors.

N. Y. 15=N. Y. 56.—Is at *Belgium, Onondaga County, N. Y.* (See p. 703.)

N. Y. 16=N. Y. 54.—Is at *Phoenix, Oswego County, N. Y.* (See p. 703.)

DESCRIPTION OF PERMANENT BENCH MARKS BETWEEN TROY AND WHITEHALL, NEW YORK.

(See Report New York State Engineer and Surveyor, 1901, pp. 671-675.)

N. Y. 12=D. W. Troy.—Is at *West Troy, Albany County, N. Y.* (See p. 677.)

N. Y. 13.—Is at *Troy, Albany County, N. Y.* (See p. 677.)

N. Y. 14.—Is at *Troy, Albany County, N. Y.* (See p. 677.)

N. Y. 1.—Is near *Waterford, Saratoga County, N. Y.*, on coping of lock No. 1, between ends of anchor southeast gate, marked ⊕ with chisel. Canal B. M. No. 1.

N. Y. 2.—Is near *Waterford, Saratoga County, N. Y.*, on coping of lock No. 2, between ends of anchors of southeast gate, marked ⊕ with chisel. Canal B. M. No. 3.

N. Y. 3.—Is near *Waterford, Saratoga County, N. Y.*, on coping of lock No. 3, between ends of anchor southwest gate, marked ⊕ with chisel. Canal B. M. No. 5.

N. Y. 4.—Is near *Waterford, Saratoga County, N. Y.*, on coping of lock No. 4, between ends of anchor northeast gate, marked □ with chisel.

N. Y. 5.—Is at *Waterford, Saratoga County, N. Y.*, on coping of Waterford side cut, southwest angle, upper combined lock, marked ⊕ with chisel. Canal B. M. No. 9.

N. Y. 6=D. W. Waterford 2.—Is at *Waterford, Saratoga County, N. Y.* (See p. 713.)

N. Y. 7.—Is ¼ mile north of *Waterford, Saratoga County, N. Y.*, on Delaware and Hudson Railroad bridge over canal, on lower step, north wing, towpath abutment, marked □ with chisel.

N. Y. 8.—Is near *Waterford, Saratoga County, N. Y.*, on coping of lock No. 5, between ends of anchor, southeast gate, marked □ with chisel.

N. Y. 9.—Is near *Waterford, Saratoga County, N. Y.*, on coping of lock No. 6, between ends of anchor, southeast gate, marked □ with chisel.

N. Y. 10.—Is near *Waterford, Saratoga County, N. Y.*, on bridge No. 11, on third step, north wing towpath abutment, marked □.

N. Y. 11.—Is near *Waterford, Saratoga County, N. Y.*, on bridge No. 13, on second step, south wing towpath abutment, marked □ with chisel (third bridge north of lock No. 6).

N. Y. 12.—Is near *Waterford, Saratoga County, N. Y.*, on bridge No. 15, on first step, south wing towpath abutment, marked □ with chisel.

N. Y. 13 = D. W. Waterford 3.—Is near *Waterford, Saratoga County, N. Y.* (See p. 713.)

N. Y. 14.—Is near *Waterford, Saratoga County, N. Y.*, on bridge No. 16, on first step, north wing towpath abutment of farm bridge, marked □ with chisel.

N. Y. 15.—Is near *Waterford, Saratoga County, N. Y.*, on coping of lock No. 7, between ends of anchor, southeast gate, marked □ with chisel.

N. Y. 16.—Is near *Mechanicsville, Saratoga County, N. Y.*, on bridge No. 19, on first step, north wing towpath abutment, about 400 feet west of schoolhouse, marked □ with chisel.

N. Y. 17.—Is near *Mechanicsville, Saratoga County, N. Y.*, on coping of lock No. 8, between ends of anchor, southeast gate, marked □ with chisel.

N. Y. 18.—Is near *Mechanicsville, Saratoga County, N. Y.*, on bridge No. 21, southwest corner south wing, lower step towpath abutment, marked □ with a chisel.

N. Y. 19.—Is near *Mechanicsville, Saratoga County, N. Y.*, on bridge No. 22, on first step south wing towpath abutment, and is a square marked with a chisel.

N. Y. 20=D. W. Mechanicsville 3.—Is at *Mechanicsville, Saratoga County, N. Y.* (See p. 714.)

N. Y. 21=D. W. Mechanicsville 4.—Is at *Mechanicsville, Saratoga County, N. Y.* (See p. 714.)

N. Y. 22.—Is at *Mechanicsville, Saratoga County, N. Y.*, on bridge No. 24, square cut on southwest corner of south foundation of lift bridge, Park avenue, towpath side.

N. Y. 23.—Is near *Mechanicsville, Saratoga County, N. Y.*, on pulp mill sidetrack bridge, southwest corner of south foundation, towpath side, and is a square marked with chisel.

N. Y. 24.—Is near *Mechanicsville, Saratoga County, N. Y.*, on wasteweir No. 5, on northeast corner of coping stone of south abutment, first wasteweir north of Mechanicsville, and is a square marked with chisel.

N. Y. 25=D. W. Mechanicsville.—Is near *Mechanicsville, Saratoga County, N. Y.* (See p. 714.)

N. Y. 26.—Is near *Stillwater, Saratoga County, N. Y.*, on coping lock No. 9, between ends of anchor southwest gate, marked with a square made with a chisel.

N. Y. 27.—Is near *Stillwater, Saratoga County, N. Y.*, on bridge No. 30, on second step south wing berme abutment, and is a square marked with chisel.

N. Y. 28.—Is near *Stillwater, Saratoga County, N. Y.*, on bridge No. 32, on lower step south wing berme abutment, and is a square marked with a chisel.

N. Y. 29.—Is at *Stillwater, Saratoga County, N. Y.*, on bridge No. 33, on lower step south wing towpath abutment, Sisson street, and is a square marked with a chisel.

N. Y. 30=D. W. Stillwater 1.—Is at *Stillwater, Saratoga County, N. Y.* (See p. 714.)

N. Y. 31.—Is near *Stillwater, Saratoga County, N. Y.*, on bridge No. 35, second step south wing towpath abutment, marked with a square made by a chisel.

N. Y. 32.—Is near *Bemis Heights, Saratoga County, N. Y.*, on bridge No. 36, on second step south wing towpath abutment of farm and highway bridge, and is a square marked with a chisel.

N. Y. 33—Is near *Bemis Heights, Saratoga County, N. Y.*, on bridge No. 38, on projection south wing, about 3 feet above ground, towpath abutment, Ford's farm bridge, and is a square marked with a chisel.

N. Y. 34.—Is near *Bemis Heights, Saratoga County, N. Y.*, on bridge No. 39, on the lower step south wing towpath abutment, Britton's farm bridge, and is a square marked with a chisel.

N. Y. 35=D. W. Bemis 1.—Is at *Bemis Heights, Saratoga County, N. Y.* (See p. 714.)

N. Y. 36.—Is at *Bemis Heights, Saratoga County, N. Y.*, on the southeast corner of the middle abutment of Bemis Heights wasteweir, and is a cross marked with a chisel.

N. Y. 37.—Is near *Bemis Heights, Saratoga County, N. Y.*, on bridge No. 41, point cut on face of masonry second course above the ground at the east angle towpath abutment.

N. Y. 38=D. W. Bemis 2.—Is near *Bemis Heights, Saratoga County, N. Y.* (See p. 714.)

N. Y. 39.—Is near *Bemis Heights, Saratoga County, N. Y.*, on bridge No. 44, on the lower step south wing towpath abutment of Van Wie's farm bridge, and is a square marked with a chisel.

N. Y. 40.—Is near *Bemis Heights, Saratoga County, N. Y.*, on Wilber's waste-weir, and is a square cut on the northeast corner of stone, first step from top of middle abutment.

N. Y. 41.—Is near *Bemis Heights, Saratoga County, N. Y.*, on bridge No. 48, on the lower step north wing towpath abutment of farm bridge, marked with a circle made with a chisel.

N. Y. 42.—Is near *Bemis Heights, Saratoga County, N. Y.*, on bridge No. 49, circle cut on lower step north wing towpath abutment (bridge down).

N. Y. 43.—Is near *Coveville, Saratoga County, N. Y.*, on bridge No. 50, on lower step south wing towpath abutment of road bridge, and is a circle made with a chisel.

N. Y. 44.—Is near *Coveville, Saratoga County, N. Y.*, on bridge No. 51, on lower step north wing towpath abutment of farm bridge, and is a circle made with a chisel.

N. Y. 45.—Is near *Coveville, Saratoga County, N. Y.*, on bridge No. 52, on second step south wing berme abutment, first bridge south of Salisbury's road bridge, and is a square made with a chisel.

N. Y. 46.—Is near *Coveville, Saratoga County, N. Y.*, on bridge No. 53, on first step north wing towpath abutment of Salisbury's road bridge, and is a square made with a chisel.

N. Y. 47.—Is near *Coveville, Saratoga County, N. Y.*, on bridge No. 54, on the second step north wing towpath abutment of farm bridge, and is a square marked with a chisel.

N. Y. 48.—Is near *Coveville, Saratoga County, N. Y.*, on bridge No. 55, on the second step north wing towpath abutment, first bridge south of electric railroad bridge near Coveville, and is a circle made with a chisel.

N. Y. 49.—Is at *Coveville, Saratoga County, N. Y.*, on wasteweir, on coping of north abutment, and is a circle made with a chisel.

N. Y. 50=D. W. Coveville.—Is at *Coveville, Saratoga County, N. Y.* (See p. 714.)

N. Y. 51.—Is near *Coveville, Saratoga County, N. Y.*, on bridge No. 58, on the lower step north wing towpath abutment, marked a circle with a chisel.

N. Y. 52.—Is near *Schuylerville, Saratoga County, N. Y.*, on bridge No. 59, on the lower step south wing towpath abutment, and is a circle marked with a chisel.

N. Y. 53.—Is near *Schuylerville, Saratoga County, N. Y.*, on bridge No. 60, on lower step south wing towpath abutment, and is a square made with a chisel (Dwyer farm bridge).

N. Y. 54.—Is at *Schuylerville, Saratoga County, N. Y.*, on bridge No. 62, on lower step north wing towpath abutment, first bridge south of Ferry street, and is a square made with a chisel.

N. Y. 55=D. W. Schuylerville 1.—Is at *Schuylerville, Saratoga County, N. Y.* (See p. 714.)

N. Y. 56.—Is at *Schuylerville, Saratoga County, N. Y.*, on bridge No. 64, Saratoga street, on the lower step, north wing, towpath abutment, first bridge north of Ferry street, and is a square marked with a chisel.

N. Y. 57=D. W. Schuylerville 2.—Is at *Schuylerville, Saratoga County, N. Y.* (See p. 715.)

N. Y. 58.—Is near *Schuylerville, Saratoga County, N. Y.*, on the lower step, south wing, towpath abutment, marked a square with a chisel. Bridge down.

N. Y. 59.—Is near *Northumberland, Saratoga County, N. Y.*, on the coping of lock No. 10, between ends of anchor, southeast gate, and is a circle with two diameters crossing at right angles, marked with a chisel. (Canal B. M. No. 46.)

N. Y. 60=D. W. Northumberland.—Is at *Northumberland, Saratoga County, N. Y.* (See p. 715.)

N. Y. 61.—Is near *Northumberland, Saratoga County, N. Y.*, on the coping of lock No. 11, between ends of anchor, southeast gate, and is a square marked with a chisel.

N. Y. 62.—Is near *Fort Miller, Saratoga County, N. Y.*, on bridge No. 69, on the lower step, south wing berme abutment, first bridge north of lock No. 11, and is a circle with two diameters crossing each other at right angles, made with a chisel.

N. Y. 63.—Is near *Fort Miller, Saratoga County, N. Y.*, on waste weir No. 12, on the top step, south abutment, towpath side, and is a square marked with a chisel.

N. Y. 64.—Is near *Fort Miller, Saratoga County, N. Y.*, on coping of lock No. 12, between ends of anchor, southeast gate, and is a square marked with a chisel.

N. Y. 65.—Is near *Fort Miller, Saratoga County, N. Y.*, on waste weir No. 13, on top of coping, south wing, and is a square marked with a chisel.

N. Y. 66.—Is at *Fort Miller, Saratoga County, N. Y.*, on bridge No. 74, on the lower step, north wing of east abutment of Fort Miller change bridge, and is a square marked with a chisel.

N. Y. 67=D. W. Fort Miller.—Is at *Fort Miller, Saratoga County, N. Y.* (See p. 715.)

N. Y. 68.—Is near *Fort Miller, Saratoga County, N. Y.*, on bridge No. 75, on the lower step, north wing, towpath abutment, first bridge south of lock No. 13, marked ⊕ with a chisel.

N. Y. 69.—Is near *Fort Miller*, *Saratoga County*, *N. Y.*, on coping of lock No. 13, between ends of anchor, southwest gate, and is a circle marked with a chisel.

N. Y. 70.—Is near *Fort Miller*, *Saratoga County*, *N. Y.*, on bridge No. 77, on the lower step, north wing, towpath abutment of farm bridge, and is a square marked with a chisel.

N. Y. 71.—Is near *Fort Miller*, *Saratoga County*, *N. Y.*, on bridge No. 78, on the second step, north wing, towpath abutment of farm bridge, and is marked ⊕ with a chisel.

N. Y. 72.—Is near *Fort Miller*, *Saratoga County*, *N. Y.*, on bridge No. 79, on the lower step, north wing, berme abutment of Comer's farm bridge, and is marked ⊕ with a chisel.

N. Y. 73.—Is near *Fort Miller*, *Saratoga County*, *N. Y.*, on bridge No. 80, on the lower step, south wing, berme abutment of farm bridge, marked ⊕ with chisel.

N. Y. 74.—Is near *Fort Miller*, *Saratoga County*, *N. Y.*, on bridge No. 81, on lower step, south wing, towpath abutment, and is a circle made with a chisel.

N. Y. 75.—Is near *Fort Miller*, *Saratoga County*, *N. Y.*, on coping of lock No. 14, between ends of anchor, southeast gate, marked ⊕ with a chisel. Canal B. M. No. 63.

N. Y. 76=D. W. Moses Kill.—Is near *Fort Edward*, *Saratoga County*, *N. Y.* (See p. 715.)

N. Y. 77.—Is near *Fort Edward*, *Saratoga County*, *N. Y.*, on bridge No. 84, on the lower step, south wing, towpath abutment, and is a circle marked with a chisel.

N. Y. 78.—Is near *Fort Edward*, *Saratoga County*, *N. Y.*, on bridge No. 85, on the second step, north wing, towpath abutment, and is a square marked with a chisel.

N. Y. 79.—Is near *Fort Edward*, *Saratoga County*, *N. Y.*, on waste weir No. 14, on the northwest corner of coping of south abutment, and is a square marked with a chisel.

N. Y. 80.—Is near *Fort Edward*, *Saratoga County*, *N. Y.*, on bridge No. 87, on the lower step, south wing, berme abutment, first bridge north of Satterlee's footbridge, and is a square marked with a chisel.

N. Y. 81.—Is near *Fort Edward*, *Saratoga County*, *N. Y.*, on bridge No. 88, on the lower step, north wing, towpath abutment of road bridge, marked ⊕ with chisel.

N. Y. 82=D. W. Snook Kill.—Is near *Fort Edward*, *Saratoga County*, *N. Y.* (See p. 715.)

N. Y. 83.—Is near *Fort Edward*, *Saratoga County*, *N. Y.*, on bridge No. 91, on the lower step, south wing, berme abutment of farm bridge, marked ⊕, about 600 feet north of brick house in field.

N. Y. 84.—Is near *Fort Edward*, *Saratoga County*, *N. Y.*, on bridge No. 93, on the lower step, south wing, berme abutment of farm bridge, marked ⊕ with a chisel.

N. Y. 85.—Is near *Fort Edward*, *Saratoga County*, *N. Y.*, on bridge No. 94, on the lower step, north wing, berme abutment of farm bridge, marked ⊕ with chisel.

N. Y. 86.—Is near *Fort Edward*, *Saratoga County*, *N. Y.*, on bridge No. 95, on the lower step, north wing, berme abutment of road bridge, first bridge south of electric railroad near Fort Edward, marked ⊕ with chisel.

N. Y. 87.—Is near *Fort Edward*, *Saratoga County*, *N. Y.*, on bridge No. 96, on the second step, north wing, towpath abutment, marked ⊕ with chisel.

N. Y. 88.—Is at *Fort Edward, Saratoga County, N. Y.*, on south end of coping of wall at edge of canal, towpath side of aqueduct No. 4, Fort Edward, marked ⊕ with chisel.

N. Y. 89=U. S. G. S.—Is at *Fort Edward, Saratoga County, N. Y.* (See p. 715.)

N. Y. 90.—Is near *Fort Edward, Saratoga County, N. Y.*, on the coping of lock No. 15, between the ends of anchor southeast gate, marked ⊕ with chisel. Canal B. M. No. 79.

N. Y. 91.—Is near *Fort Edward, Saratoga County, N. Y.*, on bridge No. 99, on the lower step, south wing, berme abutment, first bridge north of lock No. 15, marked ⊕ with chisel.

N. Y. 92.—Is near *Fort Edward, Saratoga County, N. Y.*, on waste weir No. 15, on the coping of the east wing, north abutment, about 1¼ miles north of Fort Edward, and is a square marked with a chisel.

N. Y. 93.—Is at *Glens Falls, Saratoga County, N. Y.*, on bridge No. 100, on the lower step, north wing, berme abutment of change bridge at Glens Falls feeder, marked ⊕ with chisel.

N. Y. 94.—Is near *Glens Falls, Saratoga County, N. Y.*, on bridge No. 101, on the second step, north wing, berme abutment of farm bridge, and is a circle marked with a chisel.

N. Y. 95=D. W. Dunham—Is at *Dunhams Basin, Washington County, N. Y.* (See p. 715).

N. Y. 96.—Is near *Dunhams Basin, Washington County, N. Y.*, on bridge No. 102, on lower step, north wing, berme abutment of Dunham's road bridge, and is a square marked with a chisel.

N. Y. 97.—Is near *Dunhams Basin, Washington County, N. Y.*, on the northwest corner of a red barn, on towpath, on stone foundation, and is a square marked with a chisel.

N. Y. 98.—Is near *Dunhams Basin, Washington County, N. Y.*, and is a spike in the west side of the elm tree, about 30 feet from front angle of towpath in Davison's front yard, about 3 miles north of Dunhams Basin.

N. Y. 99.—Is near *Smiths Basin, Washington County, N. Y.*, on bridge No. 103, on projection, north end of second course of masonry, towpath abutment, marked with a square made by a chisel.

N. Y. 100.—Is near *Smiths Basin, Washington County, N. Y.*, on bridge No. 104, on the lower step of north wing, towpath abutment, and is a square marked with a chisel.

N. Y. 101=D. W. Smith.—Is at *Smiths Basin, Washington County, N. Y.* (See p. 715.)

N. Y. 102.—Is at *Smiths Basin, Washington County, N. Y.*, on bridge No. 105, on the second step north wing towpath abutment, and is a square marked with a chisel.

N. Y. 103.—Is near *Smiths Basin, Washington County, N. Y.*, on bridge No. 106, on the lower step south wing berme abutment, marked ⊕ with a chisel.

N. Y. 104.—Is near *Smiths Basin, Washington County, N. Y.*, on bridge No. 107, on the lower step north wing berme abutment, and is a square marked with a chisel.

N. Y. 105.—Is near *Smiths Basin, Washington County, N. Y.*, on bridge No. 108, on the lower step south wing berme abutment, and is a square marked with a chisel.

N. Y. 106.—Is near *Fort Ann, Washington County, N. Y.*, on bridge No. 110, on the lower step north wing berme abutment of road bridge, 1½ miles south of Fort Ann, and is a square marked with a chisel.

N. Y. 107.—Is near *Fort Ann, Washington County, N. Y.*, on bridge No. 111, on the lower step north wing towpath abutment of road bridge, and is a square marked with a chisel.

N. Y. 108.—Is near *Fort Ann, Washington County, N. Y.*, on bridge No. 112, on the lower step north wing, towpath abutment of farm bridge, and is a square marked with a chisel.

N. Y. 109.—Is near *Fort Ann, Washington County, N. Y.*, on bridge No. 113, on the lower step, south wing berme abutment of farm bridge, and is a square marked with a chisel.

N. Y. 110.—Is near *Fort Ann, Washington County, N. Y.*, on coping of lock No. 16, between ends of anchor, southwest gate, and is a square marked with a chisel.

N. Y. 111.—Is near *Fort Ann, Washington County, N. Y.*, on coping of lock No. 18, between ends of anchor, northeast gate, and is a square marked with a chisel.

N. Y. 112=D. W. Fort Ann.—Is at *Fort Ann, Washington County, N. Y.* (See p. 715.)

N. Y. 113.—Is near *Comstock, Washington County, N. Y.*, on Dewey's private bridge on projection of fifth stone in second course of masonry of south wing, towpath abutment, marked with chisel.

N. Y. 114.—Is near *Comstock, Washington County, N. Y.*, on coping of lock No. 19, between ends of anchor of northwest gate, and is a square marked with a chisel.

N. Y. 115=D. W. Comstock 1.—Is near *Comstock, Washington County, N. Y.* (See p. 715.)

N. Y. 116.—Is near *Comstock, Washington County, N. Y.*, on Comstock's road bridge No. 118, on projection of first course of masonry, south wing, towpath abutment, and is a square marked with a chisel.

N. Y. 117.—Is near *Comstock, Washington County, N. Y.*, on private road bridge, on projection of fifth course of masonry below coping, towpath abutment (near center), and is a circle marked with a chisel.

N. Y. 118.—Is near *Comstock, Washington County, N. Y.*, on bridge No. 120, on the second step, south wing, towpath abutment, and is a square marked with a chisel.

N. Y. 119.—Is near *Comstock, Washington County, N. Y.*, on coping of lock No. 20, between the ends of anchor of northwest gate, and is a square marked with a chisel.

N. Y. 120=D. W. Comstock 2.—Is between *Comstock and Whitehall, Washington County, N. Y.* (See p. 716.)

N. Y. 121.—Is between *Comstock and Whitehall, Washington County, N. Y.*, on bridge No. 125, on the lower step north wing, berme abutment of farm bridge, about 1 mile north of lock No. 20, and is a square marked with a chisel.

N. Y. 122.—Is between *Comstock and Whitehall, Washington County, N. Y.*, on bridge No. 126, lower step north wing, towpath abutment (iron bridge), and is a square marked with a chisel.

N. Y. 123.—Is near *Whitehall, Washington County, N. Y.*, on bridge No. 127, lower step north wing, towpath abutment of bridge, and is a square marked with a chisel.

N. Y. 124.—Is near *Whitehall, Washington County, N. Y.*, on bridge No. 129, on lower step north wing, towpath abutment of farm bridge, and is a square marked with a chisel.

N. Y. 125.—Is near *Whitehall, Washington County, N. Y.*, on bridge No. 130, on the second step south wing, berme abutment of farm bridge, marked ⊕ with a chisel.

N. Y. 126.—Is near *Whitehall, Washington County, N. Y.*, on bridge No. 131, on the lower step north wing, berme abutment, first bridge south of Delaware and Hudson Railroad bridge, and is a square marked with a chisel.

N. Y. 127.—Is at *Whitehall, Washington County, N. Y.*, on waste weir No. 24, on coping of north wall east stone, about 1,100 feet south of Delaware and Hudson Railroad, Rutland branch, and is a square marked with a chisel.

N. Y. 128.—Is at *Whitehall, Washington County, N. Y.*, on bridge No. 132, on the lower step north wing, towpath abutment, Fordman street, and is a square marked with a chisel.

N. Y. 129.—Is at *Whitehall, Washington County, N. Y.*, on coping of lock No. 21, between ends of anchor, northeast gate, and is a square marked with a chisel.

N. Y. 130=U. S. C. S. 36.—Is at *Whitehall, Washington County, N. Y.* (See p. 715.)

DESCRIPTIONS OF PERMANENT BENCH MARKS BETWEEN WATERFORD AND WHITEHALL, N. Y.

(See Report of Board on Deep Waterways, 1900, Part II, pp. 1023-1025.)

N. Y. 12.—Is at *West Troy, Albany County, N. Y.* (See p. 671.)

D. W. Waterford 1.—Is at *Waterford, Saratoga County, N. Y.*, and is a crow foot on the southwest corner of the bridge seat of the north abutment of the Delaware and Hudson Railroad bridge over the Fourth Branch of the Mohawk River.

N. Y. 6.—Is at *Waterford, Saratoga County, N. Y.*, and is a square cut in the south end of the stone doorsill to the west entrance of the Delaware and Hudson Canal Company's railroad passenger (lower) depot. (See note 41, p. 584.)

N. Y. 13.—Is "about 3½ miles north of *Waterford, Saratoga County, N. Y.*, and about one-fourth mile east of canal" (N. Y.), on the south side of George S. Forse's road house "on east side of Waterford and Whitehall road" (D. W.), and is a square cut in east end of "stone window sill of west cellar window" (D. W.). (See note 41, p. 584.)

D. W. Mechanicsville 1.—Is at *Mechanicsville, Saratoga County, N. Y.*, and is a square cut on the north end of the stone sill of the most northerly window on the west face of the Hudson River Power Transmission Company's power house.

D. W. Mechanicsville 2.—Is at *Mechanicsville, Saratoga County, N. Y.*, and is a square cut in the surface of the concrete masonry of the sluice gates near the southwest corner of the same and at the west end of weir of Hudson River Power Transmission Company's dam.

N. Y. 20.—Is at *Mechanicsville, Saratoga County, N. Y.*, and is a square cut near the south end of the sill of the basement window between the tower and the main entrance of the Presbyterian Church, on Main street. (See note 41, p. 584.)

N. Y. 21.—Is at *Mechanicsville, Saratoga County, N. Y.*, and is a notch cut in the angle of the stone water table at the northeast corner of the main building of the Methodist Episcopal Church, Main street. (See note 41, p. 584.)

D. W. Mechanicsville 5.—Is at *Mechanicsville, Saratoga County, N. Y.*, and is a square cut on the north end of the stone sill of the south door on the west front of chipping mill at Duncan Company's pulp and paper mills.

N. Y. 25.—Is between *Mechanicsville* and *Stillwater, Saratoga County, N. Y.*, and is the head of bolt at the base of the first south column just east of the electric railway track at the west end of the Fitchburg Railroad bridge over the Hudson River. (See note 41, p. 584.)

N. Y. 30.—Is at *Stillwater, Saratoga County, N. Y.*, and is a square cut in the south end of a large flat stone step at the entrance to the First Methodist Episcopal Church. (See note 41, p. 584.)

D. W. Stillwater 2.—Is between *Stillwater* and *Schaghticoke*, in *Rensselaer County, N. Y.*, and is a spike in the bench cut in a root on the west side of an elm tree, on the right bank of the Hoosick River, about 200 feet from the water's edge in the main channel and about 1,000 feet downstream from the mouth of the Tourhannock Creek.

N. Y. 35.—Is at *Bemis Heights, Saratoga County, N. Y.*, on the north abutment of "waste weir" (N. Y.) or "sluice gate of Champlain Canal near iron truss canal bridge No. 36" (D. W.) in the southeast corner of top stone and is the top of an iron bolt "with stone chiseled away around it" (N. Y.). (See note 41, p. 584.)

N. Y. 38.—Is about 1 mile north of *Bemis Heights, Saratoga County, N. Y.*, "on the south end of east abutment of iron truss canal bridge No. 39" (D. W.), or "the south wing of the towpath abutment of bridge No. 43" (N. Y.), and is a square cut "in the southwest corner of stone in lower course" (D. W.). (See note 41, p. 584.)

D. W. Wilburs Basin 1.—Is at *Wilburs Basin, Saratoga County, N. Y.*, and is a square cut on the southwest corner of the stone at the north end of the semicircular coping on the stonework of the outlet of the basin.

U. S. G. S.—Is between *Wilburs Basin* and *Coveville*, in *Saratoga County, N. Y.*, and is a circle painted with red paint on the northeast corner of the top stone of the east end of north abutment of sluice gate, on Champlain Canal, 1.7 miles north of Wilburs Basin, established by the United States Geological Survey.

N. Y. 50.—Is about 1 000 feet "east" (D. W.) or "north" (N. Y.) of *Coveville, Saratoga County, N. Y.*, "on the south abutment of Champlain Canal bridge No. 54" (D. W.), or "on the north wing, towpath abutment, bridge No. 57" (N. Y.), and is "a square marked with chisel on lower step" (N. Y.), or "a circle cut on the northeast corner of last stone of second course above the surface of the ground" (D. W.). (See note 41, p. 584.)

N. Y. 55.—Is at *Schuylerville, Saratoga County, N. Y.*, on the Ferry street bridge, "Canal bridge No. 60" (D. W.), or "bridge No. 63" (N. Y.), on north wing wall of east or towpath abutment, and is a circle marked with chisel "on the second step" (N. Y.), or "on northeast corner of ninth stone of third course from ground" (D. W.). (See note 41, p. 584.)

N. Y. 57.—Is at *Schuylerville, Saratoga County, N. Y.*, "on south wing berme abutment road and trolly bridge No. 65" (N. Y.), or "on south wing wall west abutment of Champlain Canal bridge No. 62, on the road leading to new iron truss bridge over the Hudson River" (D. W.), and is a square marked with chisel "on second step" (N. Y.), or "on the southeast corner of the stone at the south end of the second course of masonry above water surface" (D. W.). (See note 41, p. 584.)

N. Y. 60.—Is at *Northumberland, Saratoga County, N. Y.*, and is a square cut on the southeast corner of the coping at south end of the east wall, lock No. 10. (See note 41, p. 584.)

N. Y. 67.—Is at *Fort Miller, Washington County, N. Y.*, "about 1 700 feet north of Tharp & Wegman's pulp mill" (D. W.), and is a square cut in the south end of south window sill in front of brick blacksmith shop and on the east side of the highway along east bank of Hudson River. (See note 41, p. 584.)

N. Y. 76.—Is at *Moses Kill, Washington County, N. Y.*, "on bridge No. 83" (N. Y.), or "the Champlain Canal bridge just north of aqueduct" (D. W.) on "west abutment" (D. W.) or "north wing towpath abutment" (N. Y.), and is a square marked with chisel "on rear of second course of masonry" (N. Y.), or "on northwest corner of north stone in second course above the ground" (D. W.). (See note 41, p. 584.)

N. Y. 82.—Is near *Fort Edward, Washington County, N. Y.*, "across the river from and almost 600 feet south of the mouth of Snook Kill" (D. W.), "on road bridge No. 90" (N. Y.) over canal on north wing west or towpath abutment and is a square marked with a chisel "on second step" (N. Y.) or "in northeast corner of north stone third course above ground" (D. W.). (See note 41, p. 584.)

N. Y. 89=U. S. G. S.—Is at *Fort Edward, Washington County, N. Y.*, on the wall over the north side of the west entrance of high school building and is "a nickel plate about 5 inches in diameter" (D. W.) or "an aluminum bronze tablet" (N. Y.). (See note 41, p. 584, except bench mark was established by the Geological Survey.)

N. Y. 95.—Is at *Dunhams Basin, Washington County, N. Y.*, on south abutment of Delaware and Hudson Railroad bridge over canal overflow 600 feet south of highway, and is a square cut with chisel on northwest corner of west stone, top course of masonry. (See note 41, p. 584.)

N. Y. 101.—Is at *Smiths Basin, Washington County, N. Y.*, on northwest corner of west stone of top course of masonry on south abutment of small plate girder bridge on Delaware and Hudson Railroad just north of the station, and is marked □ with chisel. (See note 41, p. 584.)

N. Y. 112.—Is at *Fort Ann, Washington County, N. Y.*, on the coping of the parapet wall to the north abutment of the Delaware and Hudson Railroad bridge "over Wood Creek" (D. W.) or "over canal" (N. Y.) and is a cross near the north edge of stone and directly opposite space between the two bridges; "cross in hollow" (N. Y.). (See note 41, p. 584.)

N. Y. 115.—Is near *Comstock, Washington County, N. Y.*, and is a square cut in the southeast corner of south stone of coping of culvert and on the east side of roadbed of Delaware and Hudson Railroad, about 2 800 feet south of station. (See note 41, p. 584).

N. Y. 120.—Is between *Comstock* and *Whitehall, Washington County, N. Y.*, and is a square cut on southeast corner of stone, south berme abutment of Delaware and Hudson Railroad bridge over canal on west side at the north end of plate girder where it connects with middle truss of bridge.

D. W. Whitehall 1.—Is near *Whitehall, Washington County, N. Y.*, and is a square cut on the east stone, top course of south abutment, canal sluice, 1 100 feet south of bridge over canal, of Rutland branch of Delaware and Hudson Railroad.

N. Y. 130=U. S. C. S. 36.—Is at *Whitehall, Washington County, N. Y.*, on coping of west wall of lower lock "No. 23" (N. Y.) "just north of hollow quoin of lower gate" (D. W.), "between end of anchor N. W. gate" (N. Y.), marked "U. S. Coast Survey. Elv.=104.71" (D. W.) or "U. S." (N. Y.) (See note 41, p. 584, except the bench mark was established by the Coast and Geodetic Survey.)

DESCRIPTIONS OF PERMANENT BENCH MARKS FROM WHITEHALL TO CROWN POINT L. H.

(See Report of Board on Deep Waterways, 1900, pp. 1025, 1026.)

U. S. B. M.—Is near *Whitehall, Washington County, N. Y.*, and is a square cut on the shelf of rock about 1 foot above ground in the east side of the second rock cut north of the town, near the middle of the cut. The rock wall is marked 1 foot above the bench mark by chiseled letters "U. S. B. M."

D. W. Snody.—Is about 1 000 feet south of *Snody Dock, Washington County, N. Y.*, and is a square cut on the northwest corner of the north stone of coping of culvert, and is on the west side of the roadbed of Delaware and Hudson Railroad.

D. W. Chubb.—Is near *Chubbs Dock, Washington County, N. Y.*, and is a square cut on the southeast corner of east large stone at top course of the north abutment of small plate-girder bridge No. 5, Delaware and Hudson Railroad, about 400 feet north of station.

D. W. Dresden.—Is about 1 900 feet north of *Dresden, Washington County, N. Y.*, and is a square cut on the southwest corner of south stone of coping of arch culvert on the west side of roadbed of Delaware and Hudson Railroad.

U. S. C. S. 39.—Is at *Putnam, Washington County, N. Y.*, and is cut on a ledge of rock on the west side of the railroad track near the north end of the first rock cut south of the station. It consists of the letters "B. M." and a cross and circle chiseled into the rock.

D. W. Putnam 2.—Is about 1 900 feet north of *Putnam, Washington County, N. Y.*, and is a square cut on the southeast corner of south stone coping, west face of large culvert on Delaware and Hudson Railroad.

D. W. Wrights.—Is about 1 800 feet north of *Wrights, Washington County, N. Y.*, and is a square cut in the northeast corner of the second course of masonry from top south abutment of bridge No. 16, Delaware and Hudson Railroad.

D. W. Ticonderoga.—Is at *Fort Ticonderoga, Essex County, N. Y.*, and is a square cut on the southwest corner of masonry projection of water tank south of depot.

U. S. G. S.—Is at *Ticonderoga, Essex County, N. Y.*, and is a circle with a hole in the center in large stone on the southeast corner of the north abutment of the Delaware and Hudson Railroad drawbridge No. 19 over Ticonderoga Creek near its mouth. The bench mark is marked "U. S. G. S. B. M."

D. W. Five Mile Point.—Is between *Addison Junction* and *Crown Point* in *Essex County, N. Y.*, and is a square cut on the southeast corner of the east coping of culvert on Delaware and Hudson Railroad over creek entering Lake Champlain about 2 200 feet south of Five Mile Point.

D. W. Crown Point.—Is about 2 800 feet north of *Crown Point, Essex County, N. Y.*, and is a square cut on the surface of coping at south end of the east wing wall of the south abutment of bridge No. 23 on Delaware and Hudson Railroad bridge over Putnam Creek.

Crown Point North Base.—Is about 1 600 feet south of the ruins of old English fort at *Fort Frederick, Essex County, N. Y.* The bench mark is a lead bolt in the center of pyramid cut on the natural rock outcrop in the center of thornbush thicket, 1 700 feet west of the highway. The bench mark is the north base of Crown Point base line and is marked "U. S. C. S. Base Line, 1872."

L. H.—Is at *Crown Point Lighthouse, Essex County, N. Y.*, and is a square cut in the masonry on the east side just south of the corner of the second course above ground of light-house.

DESCRIPTIONS OF PERMANENT BENCH MARKS BETWEEN COOPERVILLE AND HOGANSBURG, N. Y.

(See Report of Board on Deep Waterways, 1900, Part II, pp. 1026–1029.)

D. W. Cooperville.—Is near *Cooperville, Clinton County, N. Y.*; is the center of a square cut in the southwest corner of the coping stone on the southwest corner of the center pier of the Delaware and Hudson Railroad bridge over the Great Chazy River. Destroyed in railroad accident, August, 1903.

D. W. Leggets Crossing.—Is about 800 feet south of Legget's crossing and 1.5 miles north of *Cooperville, Clinton, County, N. Y.*, and is a point in a square on iron pin in coping stone on the west side of the Delaware and Hudson Railroad track, 2 feet west of the west side of opening and 6 inches back from the north edge of a culvert.

Rouse Point 1882.—Is at *Rouse Point, Clinton County, N. Y.*, on the water table on the north side of the Chapman Block building, 20.6 feet west from the northeast corner, on the west side of Lake street and on the south side of Chapman street, and is 1.6 feet above the ground, and consists of a cross and circle.

U. S. E.—Is at *Fort Montgomery, Clinton County, N. Y.* Level of the base of scarp wall on the north face of bastion B, Fort Montgomery, about 3 feet from the angle with the east curtain of the fort, and corresponds with the United States Engineers' bench mark at this point.

D. W. Champlain 1.—Is between *Cooperville* and *Champlain* in *Clinton County, N. Y.*, and is a nail driven in the root of the southwest side of an elm tree 3¾ feet in diameter, standing on the south side of the highway on the east side of the Great Chazy River. It is about 7 500 feet from the Oak Street bridge at Champlain, N. Y., as measured along the highway, and about 900 feet east of the east bank of the river.

D. W. Champlain 2.—Is at *Champlain, Clinton County, N. Y.*, on a 2-inch square cut in the top of the first step above the main abutment on the west side of the north abutment of the Oak Street bridge over the Great Chazy River.

D. W. Champlain 3.—Is about 1 mile north of *Champlain, Clinton County, N. Y.*, on a 1½-inch square cut in the stone step near the east side of the front door of the Champlain waterworks.

D. W. Champlain 4.—Is between *Champlain, Clinton County, N. Y.*, and *Barrington, Quebec*, and is a nail in the root on the west side of an elm tree 1½ feet in diameter, on the north side of the Great Chazy River, about 2.6 miles northwest of Champlain, N. Y. It is about 80 feet west of a small creek, about 1 400 feet north of the north bank of the Great Chazy River and about 730 feet south of the international boundary line.

D. W. Champlain 5.—Is between *Champlain, Clinton County, N. Y.*, and *Barrington, Quebec*, and is a square, 1½ inches on a side cut in the top of a bowlder about 50 feet south of barn on the property of James Straps, located about 5.6 miles northwest of Champlain, N. Y., and is about 1 360 feet east of the intersection of the highway running north and south with the road to Hemmingford.

D. W. Barrington 1.—Is about 2.7 miles south of *Barrington, Quebec*, and is a nail in the root on the northeast side of an elm tree 2 feet in diameter, on the property of Joseph Robinson, about 50 feet east of the Little Montreal River and about 550 feet north of east and west highway and 300 feet west of the north and south highway.

D. W. Barrington 2.—Is at *Barrington, Quebec*, and is a nail in the root on the west side of an elm tree 2½ feet in diameter on the west side of the highway running northeast and southwest through Barrington, and is about 2 400 feet southwest of the crossing of this highway with the Grand Trunk Railroad.

D. W. Barrington 3.—Is between *Barrington* and *St. Clothilde, Quebec*, and is a nail in the root on the northwest side of a maple tree 10 inches in diameter, on the south side of the right of way of the Canada and Atlantic Railroad, and 150 feet east of the east end of bridge over Cranberry Creek, about 3 miles west of Barrington.

D. W. St. Clothilde 1.—Is about 1½ miles southeast of *St. Clothilde, Quebec*, and is a nail in the root on the north side of an elm tree 8 inches in diameter, about 100 feet south of south right of way line of the Canada and Atlantic Railroad, and about 600 feet west of Holton railroad station.

D. W. St. Clothilde 2.—Is between *St. Clothilde* and *Aubrey, Quebec*, and is a nail in the root on the south side of an elm tree 16 inches in diameter, about 40 feet north of north right of way line of the Canada and Atlantic Railroad, and about 750 feet west of the first highway crossing west of Holton station.

D. W. Aubrey 1.—Is at *Aubrey, Quebec*, and is a nail in the root on the west side of an ash tree 14 inches in diameter, about 80 feet south of the south bank of the English River and about 500 feet north of the intersection of highways at Aubrey.

D. W. Aubrey 2.—Is between *Aubrey* and *Ormstown, Quebec*, and is a nail in the root on the south side of an oak tree 18 inches in diameter, on the Fertile Creek road about 3.6 miles west of Aubrey and about 700 feet southwest of the culvert on this highway over Fertile Creek.

D. W. Ormstown 1.—Is at *Ormstown, Quebec*, and is the center of a 1½-inch square cut in the top of coping stone near the northwest corner of the east abutment of the highway bridge over the Chateauguay River.

D. W. Ormstown 2.—Is between *Ormstown* and *St. Stanislas, Quebec*, and is a nail in the root on the west side of a poplar tree 2 feet in diameter, on the south side of the highway at a point about 750 feet west of the intersection of highways about 4 miles northwest of highway bridge at Ormstown.

D. W. St. Stanislas.—Is at *St. Stanislas, Quebec*, and is on the top of horizontal offset of water table, which is about 1 inch below the top of the west doorstep of the St. Stanislas Roman Catholic church. It is on top of angle at the east side of pilaster near the southwest corner of the church, and the angle at the bench mark is 5½ feet west of the west doorstep of the church. There are no marks to indicate the location of the bench mark.

D. W. Lake St. Francis.—Is about 2.7 miles from *St. Stanislas, Quebec*, and is on a 1½-inch square marked "B. M.," cut in the top ledge of limestone about 64 feet from lake shore on a point of land projecting into Lake St. Francis, about 2 150 feet west of the intersection of highway running northwest from St. Stanislas with highway near the lake shore.

D. W. Valleyfield.—Is at *Valleyfield, Quebec*. Coping of north wall of Lock No. 14, Beauharnois Canal. Bench mark is on the iron bolt in strap, 6 inches from heel post of upper gate.

D. W. Huntingdon.—Is at *Huntingdon, Quebec*, on the top of an iron monument on the southeast corner of the first street intersection south of the Grand Trunk Railroad depot.

D. W. Carr.—Is a nail in the root on the west side of an elm tree 14 inches in diameter, 160 feet north of the center of the track of the Grand Trunk Railroad, and 360 feet east of the road at *Carrs Crossing, Quebec*.

D. W. White.—Is a nail in the root on the north side of a maple tree 14 inches in diameter, 20 feet south of the center of the track of the Grand Trunk Railroad, and 3 feet east of the east road fence at *Whites Station, Quebec*.

D. W. St. Agnes.—Is a nail in the root on the north side of an elm tree 20 inches in diameter, 60 feet from the center of the track of the Grand Trunk Railroad, in the east fence line of the road east of *St. Agnes, Quebec*.

D. W. Fort Covington.—Is a two-inch square, 1 foot from the south edge and 1 foot from the east edge of the east abutment of the Grand Trunk Railroad bridge over the Salmon River at *Fort Covington, N. Y.*

DESCRIPTIONS OF PERMANENT BENCH MARKS BETWEEN DOBBS FERRY AND RENSSELAER (GREENBUSH), N. Y.

Tidal 1 Dobbs Ferry.—Is at *Dobbs Ferry, Westchester County, N. Y.* (See App. 8 of Report for 1899, p. 557.) Is probably Van Orden's Is'. The mark has worn off the rock, destroying the bench mark.

V.—Is at *Dobbs Ferry, Westchester County, N. Y.* (See App. 8, Report for 1899, p. 557.) Reported in fair state of preservation and apparently undisturbed in 1902.

T.—Is at *Dobbs Ferry, Westchester County, N. Y.*, about 150 feet south of the railroad station, about 75 feet north of the center of the highway bridge across the tracks, on the retaining wall on the east side of the track, in the capstone of the lowest "step," about 18 feet from the north end and about 8 inches from the end of the next higher "step." (See note 3, p. 580.)

U.—Is at *Dobbs Ferry, Westchester County, N. Y.*, on the west side of the stone railroad station, in the fourth stone above the sill, 10 inches south of the door to the baggage room, 5 feet above the ground and 4 feet north of the southwest corner of the building. (See note 13, p. 581.)

W.—Is at *Dobbs Ferry, Westchester County, N. Y.*, one-fourth mile north of the railroad station on the east side of the track, on a very hard stone projecting from the foundation of the main and most southern building of the Manila Anchor Brewing Company's plant, on the west side of the building, 18 feet from the north end and 90 feet from the south end, 2½ inches from the brick wall, and 6 inches above the ground. (See note 3, p. 580.)

R. R. 36.—Is between *Ardsley* and *Irvington, Westchester County, N. Y.*, on the west side of the south abutment of culvert No. 54, and consists of a round-headed iron bolt set vertically into the rock. The center of the bolthead, not the highest part, is the point used.

X.—Is about one-half mile south of *Tarrytown, Westchester County, N. Y.*, just south of the first cut below the station, on a hard rock *in situ*, about 100 yards south of the center of the mound of earth left standing on the river side of the tracks, 8 feet west of the west rail, and 3 feet above the top of the rails. (See note 3, p. 580.)

Y.—Is about one-half mile south of *Tarrytown, Westchester County, N. Y.*, and 100 yards north of B. M. X., 198 feet south of the center of culvert No. 63, on the east side of the track, 6 feet from the east rail and 8 inches below the top of the rail, about opposite the center of the mound of earth left standing on the west side of the tracks, on a horizontal ledge of very hard stone projecting from the bottom of the face of the cut. (See note 3, p. 580).

Tidal 1 Tarrytown.—Is at *Tarrytown, Westchester County, N. Y.*, on the top edge of the coping stone on an approximate level with the floor of the Tarrytown Tile Works on Main street, a short distance west of the railroad, 3.5 feet east of the middle door and 2.8 feet above the ground. An arrowhead on the sloping face of the coping stone points to the exact spot where the rod was held, and the letters U. S. C. S. B. M. were cut in the first row of brick above the bench mark.

Z.—Is at *Tarrytown, Weschester County, N. Y.*, on the first highway bridge across the tracks north of the railroad station, on the south end of the east abutment, 4 feet above the ground and 12 inches from the face next the tracks. (See note 13, p. 581.)

A_1.—Is about 1¾ miles north of *Tarrytown, Westchester County, N. Y.*, 22 rails north of milepost 27 from New York, in a bed of hard stone 9 feet west of the west rail and in plain view from the edge of the track. The head of the bolt was smoothed off with a file and a cross cut in the center to mark the exact point used. This bench mark was left unlettered. It is probably a railroad line mark, but it is not mentioned in the list of descriptions furnished by the railroad. (See notes 13 and 18, p. 581, 582.)

Iq'.—Is about 2 miles north of *Tarrytown, Westchester County, N. Y.*, on the Rockefeller property, 12½ rails south of tower 25. New mark just north of hole. (See note 20, p. 582.)

B_1.—Is at *Scarboro, Westchester County, N. Y.*, 41 rails north of the station, on the first bridge above Scarboro, on the center line of the south abutment, 2 feet from the west end. The stone was made smooth and a shallow cross mark made to fix the spot where the rod was held, and this was inclosed in a square 1¼ inches on the side cut in the stone and lettered thus:

U S
⊞
B M

Tidal 2 Ossining.—Is at *Ossining, Westchester County, N Y.*, on a brick building on the west side of the railroad track, on the next block north of the depot, on top of the stone sill of the north window on the west side, and consists of cross lines with three-fourths-inch square cut at the intersection and lettered thus:

R. R. 60.—Is about 1½ miles north of *Ossining, Westchester County, N. Y.*, on the west end of the north abutment of bridge No. 92, being the highest point in a triangle cut in the stone.

C_1.—Is about one-half mile north of *Croton, Westchester County, N. Y.*, on the first small rocky point north of the coal chutes and water tanks, 178 meters north of milepost 35 from New York, on the top of a large bed of rock, about 6 feet west of the west rail. (See notes 3 and 18, pp. 580, 582.)

R. R. 67.—Is near *Oscawana, Westchester County, N. Y.*, 100 feet north of tower 33, about half way between mileposts 36 and 37 from New York, on the east side of the track, a little higher than the top of the rail. (See notes 18 and 21, p. 582.)

R. R. 71.—Is about 100 yards south of *Montrose, Westchester County, N. Y.*, on the east end of the first stone culvert south of the station. (See note 21, p. 582).

V. O. 12.—Is at *Verplanck, Westchester County, N. Y.*, about 1½ miles north of Montrose, a short distance west of Buchanan's oilcloth factory, on the east side of the track, on a stone over a gutter. And consists of a bolt near the center of the stone, with the letters B. M. under it.

Im'.—Is at *Peekskill, Westchester County, N. Y.*, 20.7 rails south of the station, on a rock on the east side of a cut, 5 feet above the ground, and consists of cross lines on the top of a brass bolt with the letters U. S. cut in the rock beneath it.

V. O. Peekskill.—Is at *Peekskill, Westchester County, N. Y.*, on the stone sill of the door to ladies' waiting room, Peekskill station, and consists of a cross cut on the southwest corner of the sill. In 1902 the rod was held on the smooth surface of the stone in the crotch of the cross nearest the edge of the sill.

V. O. 11.—Is about one-half mile northwest of *Peekskill, Westchester County, N. Y.*, on the abutment at the southwest corner of the bridge over Peekskill Creek, near the center of a large stone. It was reported in 1902 that the bench mark would be available for only a short time longer as the bridge piers were being reconstructed, and this abutment would soon be replaced by new masonry.

R. R. 81.—Is north of *Peekskill, Westchester County, N. Y.*, on a rock *in situ* in a cut 200 feet north of tower No. 39, 6 feet west of west rail. (See note 21, p. 582).

R. R. 84.—Is 1½ miles south of *Highlands*, in *Westchester County, N. Y.*, on a small culvert near where milepost 44 from New York should be, and consists of a cross cut on the northwest corner of the west wall. (See note 18, p. 582.)

D_1.—Is about one-half mile south of *Highlands, Putnam County, N. Y.*, 45 feet west of the center of a small stream, just north of the first small rock cut north of milepost 45, 35 paces (about 3 feet each) east of the east rail, on a large flat rock *in situ* nearly level with the ground. (See notes 3 and 18, pp. 580, 582.)

R. R. 97.—Is about 1 mile north of *Garrison, Putnam County, N. Y.*, 85 meters north of milepost 49, in a cut on the east side of the track. (See notes 18 and 21, p. 582.)

R. R. 99.—Is at *Garrison, Putnam County, N. Y.*, 180 feet north of milepost 50, 680 feet south of the mouth of the tunnel. (See notes 18 and 21, p. 582.)

V. O. 9.—Is at *Cold Spring, Putnam County, N. Y.*, near a standpipe, 5 rails north of the station and just at the south end of a rock cut. (See note 21, p. 582.)

E_1.—Is at *Cold Spring, Putnam County, N. Y.*, about 100 feet west of the railroad station, at the northern terminus of the first north and south street west of the depot, on a ledge of rock about in line with the center of the street and 4 feet above its general level. (See note 3, p. 580.)

Ik'.—Is near *Fishkill, Dutchess County, N. Y.*, 40½ rails south of the station at th end of a cut on the west side of the track, and consists of a step cut in a sloping rock.

R. R. 118.—Is at *Fishkill, Dutchess County, N. Y.*, near the northern end of the first rock cut north of the station, 623 feet north of mile post 59 and 310 feet south of bridge No. 162, on the east side of the track, and consists of cross on the end of an iron rod about 1½ inches in diameter set vertically in the rock and projecting about 4 or 5 inches. (See note 18, p. 582.)

F_1.—Is 1½ miles north of *Chelsea, Dutchess County, N. Y.*, 10 rails south of tower 53, 9 paces (about 3 feet each) east of the east rail, on top of the northwestern one of four stone piers, about 3 feet high. (See note 3, p. 580)

Ii'.—Is at *New Hamburg, Dutchess County, N. Y.*, 19⅓ rails south of a stream crossing the track, on an irregular-shaped rock at the west edge of a gutter. The north edge of the hole is broken out and the cross is just to the east of the hole. (See note 20, p. 582.)

G_1.—Is at *Camelot, Dutchess County, N. Y.*, on the north side of a low rocky point of land, 6 feet from the river bank, 4 feet above high water and about 6 feet west of a bunch of cedar trees, about 60 feet west of the west rail and 12 feet north of the prolongation of the north wall of the railroad station. (See note 3, p. 580.)

H_1.—Is about 1¼ miles south of the railroad station at *Poughkeepsie, Dutchess County, N. Y.*, 2 rails south of tower No. 57, about 40 feet east of the east rail, 12 feet east of the wire fence, on top of a large flat rock 1 foot high. (See note 3, p. 580.)

Ih'.—Is at *Poughkeepsie, Dutchess County, N. Y.*, on the Union street bridge on the west side, in the east face, and consists of a one-half-inch hole surrounded by a triangle, near the top of a large stone. In 1902 the horizontal diameter of the hole was used as the bench mark.

173 A.—Is a bench mark of the United States Geological Survey at *Poughkeepsie, Dutchess County, N. Y.*, on the front face of the City Hall, and consists of an aluminum tablet, stamped "173 A." (See p. 742.)

Ig'.—Is at *Poughkeepsie, Dutchess County, N. Y.*, in the east face of the west side of the arched bridge at the station in the fifth stone above the ground and second from the east edge of the column, and consists of a cross in the top of a brass bolt. The lower left hand side of head of the bolt is broken off and the letters U. S. are cut under it.

Vose.—Is at *Poughkeepsie, Dutchess County, N. Y.*, on the east face of the west side of the arched bridge at the station, north of If', and consists of a cross deeply cut

in the rock. The horizontal mark of the cross is about one-half inch wide, and the estimated center of this line at the intersection was used as the bench mark.

I_1.—Is at *Poughkeepsie, Dutchess County, N. Y.*, at the east door leading to the waiting room of the brick railroad station, the fourth door from the south end of the building, on the north end of the sill. (See note 3, p. 580.)

If'.—Is about 2 miles north of *Poughkeepsie, Dutchess County, N. Y.*, near the State Hospital pumping station, on a rock 4 by 6 feet by 13 inches high and irregular on top, beside the path from the railroad, 8 feet from the track, and 16 feet from the southeast corner of the coal shed. The cross is northeast of the hole. (See note 20, p. 582.)

R. R. 77½.—Is 2 miles south of *Hyde Park, Dutchess County, N. Y.*, about one-half mile north of milepost 77 from New York, about the center of the first rock cut north of this milepost, on the west side of the track, about 6 or 8 feet from the west rail. (See notes 18 and 19, p. 582.)

Ie'.—Is about 1½ miles south of *Hyde Park, Dutchess County, N. Y*, on the south abutment of bridge No. 220, on the northeast corner of the east end. (See note 21, p. 582.)

R. R. 159.—Is about 1 mile south *Hyde Park, Dutchess County, N. Y.*, 625 feet north of bridge No. 222, 6 feet east of the east rail, in the top of a rock 2 feet high. (See note 19, p. 582.)

R. R. 161.—Is just north of *Hyde Park, Dutchess County, N. Y.*, 210 feet north of bridge No. 223, in a flat rock in the gutter on the east side of the track. (See note 21, p. 582.)

R. R. 162.—Is about three-fourths of a mile north of *Hyde Park, Dutchess County, N. Y.*, 42 meters south of milepost 80 from New York, east of track, about 6 inches below top of rail. (See notes 18 and 21, p. 582.)

R. R. 163.—Is about 1¼ miles north of *Hyde Park, Dutchess County, N. Y.*, five-eighths mile north of milepost 80 from New York, about middle of east wall of culvert 226. (See notes 18 and 21, p. 582.)

R. R. De Witt.—Is at the first cut south of *Staatsburg, Dutchess County, N. Y.*, 193 meters south of mile post 83 from New York, on the east side of track, in a large rock about 2 feet high, just east of the gutter. (See notes 18 and 21, p. 582.)

Iz.—Is about 1 mile south of *Rhinecliff, Dutchess County, N. Y.*, on the north trestle bed of abutment to bridge No. 249, in the southeast corner of the east end. (See note 21, p. 582.)

Iyyy.—Is at *Rhinecliff, Dutchess County, N. Y.*, in the rock at the rear of the southeast end of the station. (See note 21, p. 582.)

Iyy.—Is at *Rhinecliff, Dutchess County, N. Y.*, in the rock to the rear of the northeast corner of the station, about 5½ feet above the ground, and consists of a bolt with cross in head leaded into the rock and the letters

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cut beneath it.

Iy.—Is about 1¼ miles south of *Barrytown, Dutchess County, N. Y.*, 30 feet north of culvert 261, in a shoulder of rock outside of gutter. (See note 21, p. 582.)

Iv.—Is about 1¾ miles north of *Barrytown, Dutchess County, N. Y.*, on the south abutment of bridge No. 269, in the top of the east draw-bed stone, at the east end, and consists of an iron pin, which was filed off a little to give a suitable surface for the rod.

It.—Is about 1 mile north of *Tivoli, Dutchess County, N. Y.*, in the south end of east wall of culvert 279. (See note 21, p. 582.)

Is.—Is about 1¾ miles north of *Tivoli, Dutchess County, N. Y.*, on culvert No. 280, near J. H. Livingstone's pumping house, on the south top stone of the east covering. (See note 21, p. 582.)

Ir.—Is about 2½ miles south of *Germantown, Columbia County, N. Y.*, 5⅔ rails north of milepost 102, on a rock just at the edge of gutter, on the east side of track. (See notes 18 and 21, p. 582.)

Iq.—Is about 1¾ miles south of *Germantown, Columbia County, N. Y.*, 73 rails south of milepost 103, on a rock just outside of the gutter, on the east side of the track. (See notes 18 and 21, p. 582.)

Io.—Is near *Germantown, Columbia County, N. Y.*, in the first rock cut below the landing, on the east side of the track, with the letters B. M. in red on the rock. (See note 21, p. 582.)

In.—Is about three-fourths mile south of *Livingston Creek, Columbia County, N. Y.*, on the east end of the north abutment of bridge No. 290, on the southeast top stone. (See note 21, p. 582.)

R. R. 213.—Is about three-fourths mile north of *Linlithgo, Columbia County, N. Y.*, 13½ rails south of tower 80, 19 rails south of mile post 109, near the southeast corner of the stone foundation supporting an overhead bridge, on the west side of the track. (See notes 18 and 21, p. 582.)

Im.—Is at *Catskill Station, Columbia County, N. Y.*, about 8 rails north of milepost 110 and 2½ rails south of the station, on a rock embedded in a bank on the east side of the road crossing the railroad tracks, and directly opposite the road opening in the east line fence, and consists of a half-inch hole drilled in the rock. In 1902, as the mouth of the hole by which it is marked presented too rough a surface to hold the rod upon safely, a faint cross mark was made on the smooth surface of the stone beside the hole on the north side and the rod held upon this mark. (See note 18, p. 582.)

Ik.—Is about 1 mile south of *Hudson, Columbia County, N. Y.*, 13 rails south of milepost 113, and 2 or 3 rails south of Hollenbeck's house, on the south abutment of bridge No. 296, in the top of the east stone at the east end. (See notes 18 and 21, p. 582.)

151 A.—Is a U. S. Geological Survey bench mark at *Hudson, Columbia County, N. Y.*, consisting of the intersection of cross lines on a bronze tablet marked "151 ALBANY," on the northeast corner of the upper station of the Boston and Albany Railway, 1 foot above the platform.

City 14.—Is a bench mark of the city engineers at *Hudson, Columbia County, N. Y.*, at the south entrance to the public square near the upper end of Warren street, on the top of the western post, which is of granite and about 1 foot square, projecting above the sidewalk about 18 inches and apparently set well into the ground. Its top has the form of a flat pyramid, and the bench mark is a 2-inch square cut at the center.

City 29.—Is a bench mark of the city engineers at *Hudson, Columbia County, N. Y.*, at the north or main entrance to the court-house grounds, in the triangle

formed by the sidewalk and the two curved walks leading into the main walk to the court-house entrance, on a monument called No. 2, a marble post 6 inches square with cross mark on top, set into the ground and projecting 4 or 5 inches, and marking the center of the street approaching the court-house. The rod was held upon the smooth surface of the stone in the southeast quadrant formed by the intersecting lines.

J_1.—Is at *Hudson, Columbia County, N. Y.*, on the court-house, on the east side of the portico of the main (north) entrance, on the water table. (See note 3, p. 580.)

V. O. 4.—Is at *Hudson, Columbia County, N. Y.*, under the overhead bridge leading to the docks and Athens ferry, the first bridge above Hudson station, in the west side of the top of the stone pier, under the second iron column from the south, in the first row of columns from the east. (See note 21, p. 582.)

R. R. 223.—Is near *Stockport Station, Columbia County, N. Y.*, on culvert or bridge No. 304, on the east side of the abutment.

D. W. Stockport 1.—Is a Deep Waterways bench mark at *Stockport Station, Columbia County, N. Y.*, on bridge 307, just south of the station, and consists of the center of a square cut on the northwest corner of the south abutment.

R. R. 237.—Is about three-fourths mile north of *Coxsackie Station, Columbia County, N. Y.*, in the top of the east end of culvert 318, about the middle of the wall. (See note 21, p. 582.)

Ih.—Is at *Stuyvesant, Columbia County, N. Y.*, at the door to waiting room on west side of the station, on the southwest corner of the sill, and consists of a cross in a circle cut in the stone.

D. W. Stuyvesant 3.—Is a Deep Waterways bench mark about 1¾ miles north of *Stuyvesant, Columbia County, N. Y.*, at *Stuyvesant Lighthouse*, on the north davit for boat, 3 feet north of the northwest corner of the light-house, and consists of a cross cut on a bolt.

If.—Is 1¾ miles south of *Schodack Landing, Rensselaer County, N. Y.*, a short distance south of milepost 129, on the south abutment of sluice bridge No. 328, at the east end on the northeast corner of the top stone. (See notes 18 and 21, p. 582.)

K_1.—Is about 1½ miles south of *Schodack Landing, Rensselaer County, N. Y.*, 11 rails south of milepost 129, 5 rails north of culvert 329, 8 feet east of the east rail, and about on a level with the top of this rail, on the top of a hard rock projecting from the face of the cut. (See note 3, p. 580.)

D. W. Castleton 1.—Is a Deep Waterways bench mark about 2½ miles south of *Castleton, Rensselaer County, N. Y.*, near signal tower 94 and opposite Mulls Lighthouse, on east side of foundation of water tank, and consists of a cross cut on stone. In 1902 the highest part of the stone in the southeast quadrant formed by the intersecting lines was used as the bench mark.

L_1.—Is at *Castleton, Rensselaer County, N. Y.*, 500 feet south of the railroad station and 20 feet east of the east rail, in the rear (west) wall of the Phibb's Opera House, 21 bricks, or about 5 feet, above the ground, and 4 bricks, or about 33 inches, north of the southwest corner of the building. (See note 13, p. 581.)

Ib.—Is at *Castleton, Rensselaer County, N. Y.*, at the north door on the west side of the New York Central and Hudson River Railroad depot, on the southwest corner of the stone sill, and consists of a cross in a circle cut in the stone.

M_1.—Is at *Rensselaer*, *Rensselaer County*, *N. Y.*, about 1 mile south of the railroad station, at the bridge by which the Albany and Hudson "third rail" electric road crosses the New York Central and Hudson River Railroad tracks, on the pier supporting the southwest end of the first bent of the iron trestle approaching the bridge, on the bottom stone (first above ground), on the west corner (one nearest tracks), about 40 feet east of the east rail. (See note 3, p. 580.)

V. O. 1.—Is at *Greenbush* (now *Rensselaer*), *Rensselaer County*, *N. Y.*, in the southern part, at the west side of an overhead bridge, near a pork-packing house, in a rock at the south end of an open ditch where water goes underground. (See note 21, p. 582.)

N_1.—Is at *Rensselaer*, *Rensselaer County*, *N. Y.*, about one-half mile south of the railroad station and about 200 yards south of Second avenue, about 100 feet west of the west rail of the New York Central and Hudson River Railroad, on the water table of the brick car house of the electric railway company, on the east side of the building (side nearest tracks), 3 feet from the northeast corner, and 3 feet above ground; being the bottom of a three-quarter-inch square, lettered thus: U S □ B M

Gristmill.—Is at *Greenbush* (now *Rensselaer*), *Rensselaer County*, *N. Y.* (see App. 8 of Report for 1899, p. 848). It is at the foot of Second avenue (not Second street), on the lower side of the avenue. The letters "B. M." are painted in white besides the cross mark. In 1902 it was reported that the building was no longer used as a gristmill and the superstructure was falling to decay, but the foundation was in a good state of preservation.

(1875).—This is a United States Engineers' bench mark at *Greenbush* (now *Rensselaer*), *Rensselaer County*, *N. Y.* (see App. 8, Report for 1899, p. 848). In 1902 it was found that the bolt had been removed and a cross mark was made beside the hole on the north side with the horizontal line, which was used as the bench mark, on a level (estimated) with the center of the hole.

L. S. 3.—Is a Deep Waterways bench mark at *Rensselaer*, *Rensselaer County*, *N. Y.*, on water tank at south end of viaduct on which Broadway, Rensselaer, crosses the New York Central and Hudson River Railroad tracks, on the southwest corner of the foundation, and consists of a cross on stone. In 1902 the rod was held upon the highest part of the stone in the quadrant of the cross nearest the tracks.

1 (1875).—Is a United States Engineers bench mark at *Rensselaer* (formerly *East Albany*), *Rensselaer County*, *N. Y.* (See App. 8, Report 1899, p. 848.)

O_1.—Is at *Troy*, *Rensselaer County*, *N. Y.*, on the brick building of the Hudson River Terminal Warehouse Company, a prominent building just east of the New York Central and Hudson River Railroad, on Jackson street, in the southern edge of the city, in the front (north) wall, 2 feet from the northwest corner and about 4 feet 8 inches above the ground, in the third brick from the corner and the nineteenth above the stone foundation. (See note 13, p. 581.)

D. W. Troy 2.—Is a Deep Waterways bench mark at *Troy*, *Rensselaer County*, *N. Y.*, and is a cross cut at the south end of the east side of the Trojan warehouse of the Fuller & Warren Company, on the northwest corner of Monroe and River streets, on the north end of the stone doorsill, and consists of a cross with a square cut around it.

City 1.—Is a bench mark of the city engineers at *Troy*, *Rensselaer County*, *N. Y.*,

and described by them as "water table northeast corner of Monroe and First streets." It was used only to obtain a connection with the city leveling.

P_1.—Is at *Troy, Rensselaer County, N. Y.*, on the rear (east) wall of the brick building of the International Shirt and Collar Company, on the northeast corner of Adams and River streets, 5 feet above ground and 18 inches from the southeast corner, in the center of the third brick from the corner and the twentieth above ground. (See note 13, p. 581.)

City 2.—Is a bench mark of the city engineers at *Troy, Rensselaer County, N. Y.*, and described by them as "water table of house on northwest corner of Adams and First streets." The house is a residence, and is No. 197 First street. The half-meter scale was held on top of the water table, flat against the brick wall on the east side, and 2 inches from the southeast corner of the building. An arrowhead was cut into the sloping surface of the water table pointing to the point used.

DESCRIPTIONS OF PERMANENT BENCH MARKS BETWEEN RENSSELAER (GREENBUSH), AND HUDSON, N. Y.

(See Report of Board on Deep Waterways, 1900, Part II, pp. 1016, 1017.)

D. W. Hudson 1.—Is at *Hudson, Columbia County, N. Y.*, and is a knob in a square on the top stone at the northwest corner of the south abutment of bridge No. 298, New York Central and Hudson River Railroad, about 3 200 feet south of the Hudson Railroad station.

V. O. 4.—Is at *Hudson, Columbia County, N. Y.* (See p. 725.)

D. W. Hudson 3.—Is near *Hudson, Columbia County, N. Y.*, and is the center of a square cut in the top stone at the northeast corner of the north wing wall of bridge No. 303 of New York Central and Hudson River Railroad, about 5 500 feet north of the Hudson Railroad station.

D. W. Stockport 1.—Is at *Stockport Station, Columbia County, N. Y.* (See p. 725.)

D. W. Stockport 2.—Is at *Stockport Station, Columbia County, N. Y.*, and is center of a square cut in a large stone on the east side of New York Central and Hudson River Railroad, 10 feet from the east rail and 1 000 feet south of Stockport boat landing.

D. W. Stockport 3.—Is near *Stockport Station, Columbia County, N. Y.*, and is a square cut in the top stone at the northwest corner of bridge No. 311, New York Central and Hudson River Railroad, about 4 200 feet north of Stockport landing.

D. W. Coxsackie.—Is near *Coxsackie Station, Columbia County, N. Y.*, and is a cross in a circle on stone on southeast wing wall of bridge No. 318, New York Central and Hudson River Railroad, about 2 800 feet north of Coxsackie station. Reported of no value in 1902.

Ih.—Is at *Stuyvesant, Columbia County, N. Y.* (See p. 725.)

D. W. Stuyvesant 2.—Is between *Stuyvesant* and *Castleton*, in *Columbia County, N. Y.*, center of square cut in stone on southeast corner of stone culvert on New York Central and Hudson River Railroad, about 1 300 feet south of road to Stuyvesant light-house.

D. W. Stuyvesant 3.—Is between *Stuyvesant* and *Castleton*, in *Columbia County, N. Y.* (See p. 725.)

D. W. Stuyvesant 4.—Is between *Stuyvesant* and *Castleton*, in *Columbia County, N. Y.*, and is the center of a square cut in the top stone on the southwest corner of bridge No. 326, New York Central and Hudson River Railroad, about 2 600 feet south of the south end of Hotaling Island.

D. W. Stuyvesant 5.—Is between *Stuyvesant* and *Castleton*, in *Columbia County, N. Y.*, opposite New Baltimore Lighthouse, and is the center of a square cut on the natural ledge, 60 feet east of New York Central and Hudson River Railroad track, in line with the south side of warehouse at dock for loading brick, 1½ miles south of Schodack Landing.

D. W. Castleton 1.—Is near *Castleton, Rensselaer County, N. Y.* (See p. 725.)

D. W. Castleton 2.—Is near *Castleton, Rensselaer County, N. Y.*, and is a square cut on stone on the east end of culvert No. 337 of New York Central and Hudson River Railroad about 2 200 feet south of the Castleton Lighthouse.

D. W. Castleton 3.—Is near *Castleton, Rensselaer County, N. Y.*, and is a cross in a circle cut on the stone forming the second step of the southwest wing wall of bridge No. 339 of New York Central and Hudson River Railroad, about 1 mile south of Castleton, N. Y., and opposite Castleton Lighthouse.

Ib.—Is at *Castleton, Rensselaer County, N. Y.* (See p. 725.)

D. W. Castleton 5.—Is near *Castleton, Rensselaer County, N. Y.*, and is a square cut in stone at the southwest corner of the north abutment of bridge No. 341 of New York Central and Hudson River Railroad, opposite the lower end of Campbells Island, and about 1 mile north of Castleton station.

Gristmill.—Is at *Rensselaer (Greenbush), Rensselaer County, N. Y.* (See p. 848, App. 8, Report, 1899, and p. 726, this report.)

DESCRIPTIONS OF PERMANENT BENCH MARKS BETWEEN WASHINGTON, D. C., AND FOLEY, PA.

(From information furnished by Baltimore and Ohio Railroad.)

Capitol B. M.—At *Washington, D. C.* (See Appendix 8, Report for 1899, page 627.)

P. R. R. 139A.—Is at *Washington, D. C.*, at the north end of the train shed of the Pennsylvania Railroad station, and consists of a square cut on the northeast pedestal.

B. & O. 2.—Is at *Washington, D. C.*, opposite milepost, Washington 1 mile (See note 39, p. 584.)

B. & O. 3.—Is at *Eckington, D. C.*, between the tracks opposite milepost, Washington 2 miles. (See note 39, p. 584.)

B. & O. 3A.—Is near *Brookland, D. C.*, in the bridge seat between the tracks at the south end of bridge No. 2A, under the grade crossing of the electric car line. (See note 37, p. 584.)

B. & O. 4.—Is at *Brookland, D. C.*, in the bridge seat between the tracks at the north end of the bridge culvert No. 3A. (See note 37, p. 584.)

B. & O. 5.—Is about 1 mile northwest of *Brookland, D. C.*, about 3⅝ miles from Washington, on the west side of the tracks and on the south side of a box culvert, opposite telegraph pole 3/25. (See note 37, p. 584.)

B. & O. 6—Is at *Stotts, D. C.*, in the west end of the bridge seat on the south abutment of bridge No. 5B. (See note 37, p. 584.)

B. & O. 7.—Is near *Takoma Park, D. C.*, between the tracks in the bridge seat on the east abutment of bridge 7A. (See note 37, p. 584.)

B. & O. 8.—Is about one-half mile east of *Silver Spring, Montgomery County, Md.*, opposite milepost, Washington 7 miles. (See note 39, p. 584.)

B. & O. 9.—Is about three-tenths mile east of *Woodside, Montgomery County, Md.*, opposite milepost, Washington 8 miles. (See note 39, p. 584.)

B. & O. 10.—Is about three-tenths mile east of *Linden, Montgomery County, Md.*, opposite milepost, Washington 9 miles. (See note 39, p. 584.)

B. & O. 11.—Is about four-tenths mile east of *Capitol View, Montgomery County, Md.*, opposite milepost, Washington 10 miles. (See note 39, p. 584.)

B. & O. 12.—Is at *Kensington, Montgomery County, Md.*, opposite milepost, Washington 11 miles. (See note 39, p. 584.)

B. & O. 13.—Is about four-tenths mile east of *Garrett Park, Montgomery County, Md.*, opposite milepost, Washington 12 miles. (See note 39, p. 584.)

B. & O. 14.—Is about three-tenths mile east of *Windham, Montgomery County, Md.*, opposite milepost, Washington 13 miles. (See note 39, p. 584.)

B. & O. 15.—Is about seven-tenths mile east of *Halpine, Montgomery County, Md.*, opposite milepost, Washington 14 miles. (See note 39, p. 584.)

B. & O. 16.—Is about three-tenths mile west of *Halpine, Montgomery County, Md.*, opposite milepost, Washington 15 miles. (See note 39, p. 584.)

B. & O. 17.—Is about one-half mile east of *Rockville, Montgomery County, Md.*, opposite milepost, Washington 16 miles. (See note 39, p. 584.)

B. & O. 18.—Is about seven-tenths mile east of *Westmore* and about one-half mile west of *Rockville, Montgomery County, Md.*, opposite milepost, Washington 17 miles. (See note 39, p. 584.)

B. & O. 19.—Is about three-tenths mile west of *Westmore, Montgomery County, Md.*, opposite milepost, Washington 18 miles. (See note 39, p. 584.)

B. & O. 20.—Is at *Derwood, Montgomery County, Md.*, opposite milepost, Washington 19 miles. (See note 39, p. 584.)

B. & O. 21.—Is about seven-tenths mile east of *Washington Grove, Montgomery County, Md.*, opposite milepost, Washington 20 miles. (See note 39, p. 584.)

B. & O. 22.—Is about six-tenths mile east of *Gaithersburg, Montgomery County, Md.*; opposite milepost, Washington 21 miles. (See note 39, p. 584.)

B. &. O. 23.—Is about one-tenth mile east of *Ward* and about four-tenths mile west of *Gaithersburg, Montgomery County, Md.*, on the south side of the tracks by milepost, Washington 22 miles. (See note 39, p. 584.)

B. & O. 24.—Is about nine-tenths mile west of *Ward, Montgomery County, Md.*, on the south side of the tracks by milepost, Washington 23 miles. (See note 39, p. 584.)

B. & O. 25.—Is about two-tenths mile east of *Clopper, Montgomery County, Md.*, on the south side of the tracks by milepost, Washington 24 miles. (See note 39, p. 584.)

B. & O. 26.—Is at *Waring, Montgomery County, Md.*, on the south side of the tracks by milepost, Washington 25 miles. (See note 39, p. 584.)

B. & O. 27.—Is about one-half mile east of *Germantown, Motngomery County, Md.*, on the south side of the tracks by milepost, Washington 26 miles. (See note 39, p. 584.)

B. & O. 28.—Is about one-half mile west of *Germantown, Montgomery County, Md.*, on the south side of the tracks by milepost, Washington 27 miles. (See note 39, p. 584.)

B. & O. 29.—Is about 1½ miles west of *Darby, Montgomery County, Md.*, on the south side of the tracks by milepost, Washington 28 miles. (See note 39, p. 584.)

B. & O. 30.—Is about one-tenth mile east of *Boyd, Montgomery County, Md.*, on the south side of the tracks by milepost, Washington 29 miles. (See note 39, p. 584.)

B. & O. 31.—Is about one-half mile east of *Buck Lodge, Montgomery County, Md.*, on the south side of the tracks by milepost, Washington 30 miles. (See note 39, p. 584.)

B. & O. 32.—Is about one-half mile west of *Buck Lodge, Montgomery County, Md.*, on the south side of the tracks by milepost, Washington 31 miles. (See note 39, p. 584.)

B. & O. 33.—Is about 1.1 miles east of *Barnesville, Montgomery County, Md.*, on the south side of the tracks by milepost, Washington 32 miles. (See note 39, p. 584.)

B. & O. 34.—Is about one-tenth mile east of *Barnesville, Montgomery County, Md.*, on the south side of the tracks by milepost, Washington 33 miles. (See note 39, p. 584.)

B. & O. 35.—Is about nine-tenths mile west of *Barnesville, Montgomery County, Md.*, on the south side of the tracks by milepost, Washington 34 miles. (See note 39, p. 584.)

B. & O. 36.—Is about seven-tenths mile east of *Dickerson, Montgomery County, Md.*, on the south side of the tracks by milepost, Washington 35 miles. (See note 39, p. 584.)

B. & O. 37.—Is about three-tenths mile west of *Dickerson, Montgomery County, Md.*, on the south side of the tracks by milepost, Washington 36 miles. (See note 39, p. 584.)

B. & O. 38.—Is about 1.3 miles west of *Dickerson, Montgomery County, Md.*, about 225 feet west of milepost, Washington 37 miles, in the bridge seat of culvert, on the south end of the east side. (See note 37, p. 584.)

B. & O. 39.— Is about 1.3 miles east of *Tuscarora, Frederick County, Md.*, on south side of tracks by milepost, Washington 38 miles. (See note 39, p. 584.)

B. & O. 40A.—Is three-tenths mile east of station at *Tuscarora, Frederick County, Md.;* copper bolt set in south end of east wall of box culvert, about 150 feet west of milepost, Washington 39 miles. (See note 37, p. 584.)

B. & O. 41.—Is about seven-tenths mile west of *Tuscarora, Frederick County, Md.*, on south side of tracks by milepost, Washington 40 miles, cross top vertical rail section. (See note 39, p. 584.)

B. & O. 42.—Is about 1.7 miles west of *Tuscarora, Frederick County, Md.*, on south side of tracks by milepost, Washington 41 miles. (See note 39, p. 584.)

B. & O. 43.—Is about nine-tenths mile east of *Washington Junction, Frederick County, Md.*, on the south side of the tracks by milepost, Washington 42 miles. (See note 39, p. 584.)

B. & O. 44A.—Is at *Point of Rocks, Frederick County, Md.*, on the south side of the tracks, and in the foundation arch at the east end of Point of Rocks Tunnel. (See note 37, p. 584.)

B. & O. 45.—Is about 1 mile southeast of *Catoctin, Frederick County, Md.*, opposite milepost, Baltimore 70 miles. (See note 38, p. 584.)

B. & O. 46.—Is at *Catoctin, Frederick County, Md.*, opposite milepost, Baltimore 71 miles. (See note 38, p. 584.)

B. & O. 47.—Is about 1 mile northwest of *Catoctin, Frederick County, Md.*, opposite milepost, Baltimore 72 miles. (See note 38, p. 584.)

B. & O. 48.—Is about 2 miles west of *Catoctin, Frederick County, Md.*, and about 2 miles east of *Brunswick, Frederick County, Md.*, opposite milepost, Baltimore 73 miles. (See note 38, p. 584.)

B. & O. 49.—Is about 1½ miles from *Brunswick, Frederick County, Md.*, opposite milepost, Baltimore 74 miles, at the east end of the Brunswick Yards. (See note 38, p. 584.)

B. & O. 50.—Is one-half mile east of *Brunswick, Frederick County, Md.*, in the Brunswick Yards, opposite milepost, Baltimore 75 miles. (See note 38, p. 584.)

B. & O. 51.—Is one-half mile west of *Brunswick, Frederick County, Md.*, in the southwest corner of culvert 39 G. (See note 37, p. 584.)

B. & O. 52.—Is about 1 mile east of *Knoxville, Frederick County, Md.*, opposite milepost, Baltimore 77 miles. (See note 37, p. 584.)

B. & O. 53.—Is at *Knoxville, Frederick County, Md.*, on the north side of the tracks by milepost, Baltimore 78 miles. (See note 38, p. 584.)

B. & O. 54.—Is about 2 miles west of *Weverton, Washington County, Md.*, on the west end of the north end wall of culvert No. 39–I. (See note 37, p. 584.)

B. & O. 55.—Is about 1.3 miles west of *Weverton, Washington County, Md.*, 100 feet east of milepost, Baltimore 80 miles; in the native rock on the north side of the tracks. (See note 37, p. 584.)

B. & O. 56.—Is about 2½ miles west of *Weverton, Washington County Md.*, and near *Harpers Ferry, Jefferson County, W. Va.;* about 400 feet east of Harpers Ferry Tunnel, in a box culvert 300 feet west of milepost, Baltimore 81 miles. (See note 37, p. 584.)

B. & O. 56A.—Is at *Harpers Ferry, Jefferson County, W. Va.*, on the north side of the tracks almost directly across from Harpers Ferry Signal Tower; in the cap stone of the north wing of the west abutment of the bridge. (See note 37, p. 584.)

B. & O. 57.—Is about one-half mile west of *Harpers Ferry, Jefferson County, W. Va.*, in the native rock on the south side of the tracks about 180 feet west of milepost, Baltimore 82 miles. (See note 37, p. 584.)

B. & O. 58.—Is about 1¾ miles east of *Engle, Jefferson County, W. Va.*, about 70 feet east of milepost, Baltimore 83 miles, in the native rock on the north side of the tracks and about 8 feet from the tracks. (See note 37, p. 584.)

B. & O. 59.—Is about seven-tenths mile east of *Engle, Jefferson County, W. Va.*, on the south side of the tracks, in the middle of the coping of bridge No. 45. (See note 37, p. 584.)

B. & O. 60.—Is about two-tenths mile west of *Engle, Jefferson County, W. Va.*, and about 30 feet west of milepost, Baltimore 85 miles, in the native rock on the south side of the tracks. (See note 37, p. 584.)

B. & O. 61.—Is about 1¼ miles west of *Engle, Jefferson County, W. Va.*, about 600 feet east of milepost, Baltimore 86 miles, in the native rock on the north side of the tracks. (See note 37, p. 584.)

B. & O. 62.—Is about 1 mile east of *Duffields, Jefferson County, W. Va.*, in the south end of the east wall of culvert No. 45G. (See note 37, p. 584.)

B. & O. 63.—Is at *Duffields, Jefferson County, W. Va.*, about 50 feet east of milepost, Baltimore 88 miles, in the west end of the north coping of culvert 45L. (See note 37, p. 584.)

B. & O. 64.—Is about three-tenths mile west of *Shenandoah Junction, Jefferson County, W. Va.*, about 400 feet west of milepost, Baltimore 89 miles, in the native rock on the south side of the tracks. (See note 37, p. 584.)

B. & O. 65.—Is about 1½ miles west of *Shenandoah Junction, Jefferson County, W. Va.*, about 500 feet west of milepost, Baltimore 90 miles, in a ledge of rock on the north side of the tracks and opposite telegraph pole 90 4. (See note 37, p. 584.)

B. & O. 66.—Is near *Hobbs, Jefferson County, W. Va.*, about 200 feet west of milepost, Baltimore 91 miles, in the north end of the west abutment of bridge No. 45. (See note 37, p. 584.)

B. & O. 67.—Is about three-tenths mile south of *Kearneysville, Jefferson County, W. Va.*, about 75 feet east of milepost, Baltimore 92 miles, in a rock on the north side of the tracks. (See note 37, p. 584.)

B. & O. 68.—Is about 1¼ miles north of *Kearneysville, Jefferson County, W. Va.*, opposite milepost, Baltimore 93 miles. (See note 38, p. 584.)

B. &. O. 69.—Is about 1¼ miles southeast of *Van Clevesville, Jefferson County, W. Va.*, opposite milepost, Baltimore 94 miles. (See note 38, p. 584.)

B. & O. 70.—Is about two-tenths mile south of *Van Clevesville, Jefferson County, W. Va.*, in a large rock on the north side of the tracks and almost directly behind milepost, Baltimore 95 miles. (See note 37, p. 584.)

B. & O. 71.—Is about eight-tenths mile northwest of *Van Clevesville, Jefferson County, W. Va.*, and 250 feet west of milepost, Baltimore 96 miles, in rock on south side of tracks.

B. & O. 72.—Is about 1.8 miles northwest of *Van Clevesville, Jefferson County, W. Va.*, about 500 feet west of milepost, Baltimore 97 miles, in the west end of the south coping of a culvert. (See note 37, p. 584.)

B. & O. 73.—Is near *Opequon, Jefferson County, W. Va.*, about 600 feet east of milepost, Baltimore 98 miles, on the north side of the tracks, on the west end of the coping of culvert at telegraph pole 97 34. (See note 37, p. 584.)

B. & O. 74.—Is about seven-tenths mile east of *Martinsburg, Jefferson County, W. Va.*, 240 feet west of milepost, Baltimore 99 miles, in the middle of the north coping of bridge No. 49.2. (See note 37, p. 584.)

B. & O. 75.—Is about two-tenths mile west of the station at *Martinsburg, Jefferson County, W. Va.*, about 280 feet east of milepost, Baltimore 100 miles, in the middle of the north coping of an arch. (See note 37, p. 584.)

B. & O. 76.—Is about 1½ miles northwest of that at *Martinsburg, Jefferson County, W. Va.*, opposite milepost, Baltimore 101 miles. (See note 38, p. 584.)

B. & O. 77.—Is about 2½ miles northwest of *Martinsburg, Jefferson County, W. Va.*, about 800 feet west of milepost, Baltimore 102 miles, in the native rock on the north side of the tracks. (See note 37, p. 584.)

B. & O. 78.—Is near *Tabb, Jefferson County, W. Va.*, about 40 feet east of milepost, Baltimore 103 miles, in the native rock. (See note 37, p. 584.)

B. &. O. 79.—Is near *Tabb, Jefferson County, W. Va.*, about 200 feet west of milepost, Baltimore 104 miles, in a large rock on the north side of the tracks. (See note 37, p. 584.)

B. & O. 80.—Is about 1¼ miles northwest of *Tabb, Jefferson County, W. Va.*, opposite milepost, Baltimore 105 miles. (See note 38, p. 584.)

B. & O. 81.—Is about 1¼ miles southeast of *North Mountain, Jefferson County, W. Va.*, about 500 feet west of milepost, Baltimore 106 miles, between the tracks in the bridge seat of the east abutment of bridge No. 52. (See note 37, p. 584.)

B. & O. 82.—Is about two-tenths mile south of the station of *North Mountain, Jefferson County, W. Va.*, 850 feet west of milepost, Baltimore 107 miles, between the tracks in the bridge seat of the east abutment of bridge No. 52½. (See note 37, p. 584.)

B. & O. 83.—Is about one-half mile north of *North Mountain, Jefferson County, W. Va.*, opposite milepost, Baltimore 108 miles. (See note 38, p. 584.)

B. & O. 84.—Is about 1½ miles northwest of *North Mountain, Jefferson County, W. Va.*, about 100 feet east of milepost, Baltimore 109 miles. (See note 38, p. 584.)

B. & O. 85.—Is near *Back Creek, Jefferson County, W. Va.*, opposite milepost, Baltimore 110 miles. (See note 38, p. 584.)

B. & O. 86.—Is west of *Back Creek, Jefferson County, W. Va.*, in the north end of the west abutment of bridge No. 53. (See note 37, p. 584.)

B. & O. 87.—Is in *Jefferson County*, about 1½ miles southeast of *Cherry Run, Morgan County, W. Va.*, opposite milepost, Baltimore 112 miles, between the tracks. (See note 38, p. 584.)

B. & O. 88.—Is in *Jefferson County*, and about six-tenths mile east of *Cherry Run, Morgan County, W. Va.*, in the south end of the bridge seat of the west abutment of bridge No. 54. (See note 37, p. 584.)

B. & O. 89.—Is about one-half mile west of *Cherry Run, Morgan County, W. Va.*, opposite milepost, Baltimore 114 miles. (See note 38, p. 584.)

B. & O. 90.—Is near *Miller, Morgan County, W. Va.*, opposite milepost, Baltimore 115 miles. (See note 38, p. 584.)

B. & O. 91.—Is near *Miller, Morgan County, W. Va.*, opposite milepost, Baltimore 116 miles. (See note 38, p. 584.)

B. & O. 92.—Is about four-tenths mile east of *Sleepy Creek, Morgan County, W. Va.*, opposite milepost, Baltimore 117 miles. (See note 38, p. 584.)

B. & O. 92A.—Is at *Sleepy Creek, Morgan County, W. Va.*, between the tracks in a bridge seat of the east abutment of bridge No. 55. (See note 37, p. 584.)

B. & O. 93.—Is about one-half mile west of *Sleepy Creek, Morgan County, W. Va.*, opposite milepost, Baltimore 118 miles. (See note 38, p. 584.)

B. & O. 94.—Is about 1½ miles west of *Sleepy Creek, Morgan County, W. Va.*, opposite milepost, Baltimore 119 miles. (See note 38, p. 584.)

B. & O. 95.—Is about 2½ miles west of *Sleepy Creek, Morgan County, W. Va.*, opposite milepost, Baltimore 120 miles. (See note, 38, p. 584.)

B. & O. 96.—Is about 2 miles east of *Hancock, Morgan County, W. Va.*, opposite milepost, Baltimore 121 miles. (See note 38, p. 584.)

B. & O. 97.—Is about 1 mile east of *Hancock, Morgan County, W. Va.*, opposite milepost, Baltimore 122 miles. (See note 38, p. 584.)

B. & O. 97A.—Is at *Hancock, Morgan County, W. Va.*, on the west end of the north coping of bridge No. 56. (See note 37, p. 584.)

B. & O. 98.—Is about two-tenths mile west of *Hancock, Morgan County, W. Va.*, opposite mile post, Baltimore 123 miles. (See note 38, p. 584.)

F.—Is at *Hancock, Md.* (See App. 8, Report for 1899, p. 561.)

B. & O. 99.—Is about 1¼ miles southwest of *Hancock, Morgan County, W. Va.*, opposite milepost, Baltimore 124 miles. (See note 38, p. 584.)

B. & O. 100.—Is about 1 mile northeast of *Round Top, Morgan County, W. Va.*, opposite milepost, Baltimore 125 miles. (See note 38, p. 584.)

B. & O 101.—Is at *Round Top, Morgan County, W. Va.*, opposite milepost, Baltimore 126 miles. (See note 38, p. 584.)

B. & O. 102.—Is about 1 mile southeast of *Round Top, Morgan County, W. Va.*, 150 feet east of milepost, Baltimore 127 miles, in a rock outcrop on the north side of the tracks. (See note 37, p. 584.)

B. & O. 103.—Is about one-half mile north of *Sir Johns Run, Morgan County, W. Va.*, opposite milepost, Baltimore 128 miles. (See note 38, p. 584.)

B. & O. 104.—Is about one-half mile south of *Sir Johns Run, Morgan County, W. Va.*, 20 feet west of telegraph pole 128/38; copper bolt set in native rock, on south side of tracks. (See note 37, p. 584.)

B. & O. 105.—Is about one-half mile south of *Sir Johns Run, Morgan County, W. Va.*, about 400 feet west of milepost, Baltimore 130 miles; copper bolt set in culvert coping on south side of tracks. (See note 37, p. 584.)

B. &. O. 106.—Is about 1 mile east of *Great Cacapon, Morgan County, W. Va.*, about 200 feet east of milepost, Baltimore 131 miles; in a large rock on the north side of the track. (See note 37, p. 584.)

B. & O. 107.—Is near *Great Cacapon, Morgan County, W. Va.* between the tracks in a bridge seat of the east abutment of bridge No. 57, across Great Cacapon river. (See note 37, p. 584.)

B. & O. 108.—Is about 1 mile west of *Great Cacapon, Morgan County, W. Va.*, opposite milepost, Baltimore 133 miles. (See note 38, p. 584.)

B. & O. 109.—Is about three-tenths mile west of *Woodmont, Morgan County, W. Va.*, opposite milepost, Baltimore 134 miles. (See note 38, p. 584.)

B. & O. 110.—Is about eight-tenths mile east of *Lineburg, Morgan County, W. Va.*, opposite telegraph pole 135/4, in a rock on the south side of the tracks. (See note 37, p. 584.)

B. & O. 111.—Is about two-tenths mile west of *Lineburg, Morgan County, W. Va.*, opposite milepost, Baltimore 136 miles. (See note 38, p. 584.)

B. & O. 112.—Is about 1¼ miles south of *Lineburg, Morgan County, W. Va.*, 25 feet east of milepost, Baltimore 137 miles, in a rock on the south side of the tracks.

B. & O. 113.—Is about three-fourths mile east of *Orleans Road, Morgan County, W. Va.*, opposite milepost, Baltimore 138 miles. (See note 38, p. 584.)

B. & O. 114.—Is about three-tenths mile south of *Orleans Road, Morgan County, W. Va.*, opposite milepost, Baltimore 139 miles. (See note 38, p. 584.)

B. & O. 115.—Is near *Rockwells Run, Morgan County, W. Va.*, 500 feet beyond milepost, Baltimore 140 miles, in a rock on the south side of the tracks. (See note 37, p. 584.)

B. & O. 116.—Is at *Doe Gully, Morgan County, W. Va.*, opposite milepost, Baltimore, 141 miles. See note 38, p. 584.)

B. & O. 117.—Is about 1 mile south of *Doe Gully, Morgan County, W. Va.*, opposite milepost, Baltimore 142 miles. (See note 38, p. 584.)

B. & O. 118.—Is about 1 mile northeast of *Hansrotte, Morgan County, W. Va.*, directly opposite milepost, Baltimore 143 miles, in a rock on the south side of the tracks. (See note 37, p. 584.)

B. & O. 119.—Is near *Hansrotte, Morgan County, W. Va.*, opposite milepost, Baltimore 144 miles. (See note 38, p. 584.)

B. & O. 120.—Is about 1 mile west of *Hansrotte, Morgan County, W. Va.*, opposite milepost, Baltimore 145 miles. (See note 38, p. 584.)

B. & O. 121.—Is near *Baird, Morgan County, W. Va.*, opposite milepost, Baltimore 146 miles. (See note 38, p. 584.)

B. & O. 122.—Is about 1 mile southwest of *Baird, Morgan County, W. Va.*, opposite milepost, Baltimore 147 miles. (See note 38, p. 584.)

B. & O. 123.—Is about 1 mile northwest of *Magnolia, Morgan County, W. Va.*, opposite milepost, Baltimore 148 miles. (See note 38, p. 584.)

B. & O. 124.—Is about two-tenths mile east of *Magnolia, Morgan County, W. Va.*, 500 feet beyond milepost, Baltimore 149 miles, on the south side of the tracks in the east end of the coping of bridge No. 47D. (See note 37, p. 584.)

B. & O. 125.—Is about 1 mile southeast of *Magnolia, Morgan County, W. Va.*, opposite milepost, Baltimore 150 miles. (See note 38, p. 584.)

B. & O. 126.—Is about 2 miles south of *Magnolia, Morgan County, W. Va.*, opposite milepost, Baltimore 151 miles. (See note 37, p. 584.)

B. & O. 127.—Is about 1 mile north of *Pawpaw, Morgan County, W. Va.*, opposite milepost, Baltimore 152 miles, in a rock on the south side of the tracks. (See note 37, p. 584.)

B. & O. 128.—Is about eight-tenths mile north of *Pawpaw, Morgan County, W. Va.*, opposite milepost, Baltimore 153 miles. (See note 38, p. 584.)

B. & O. 129.—Is about two-tenths mile south of *Pawpaw, Morgan County, Va.*, opposite milepost, Baltimore 154 miles. (See note 38, p. 584.)

B. & O. 130.—Is about 1½ miles south of *Pawpaw, Morgan County, W. Va.*, opposite milepost, Baltimore 155 miles. (See note 38, p. 584)

B. & O. 131.—Is about 1 mile east of *Little Cacapon, Hampshire County, W. Va.*, about 500 feet east of milepost, Baltimore 156 miles, on the south side of the tracks in the middle stone of the coping of the culvert. (See note 37, p. 584.)

B. & O. 132.—Is near *Little Cacapon, Hampshire County, W. Va.*, about 600 feet east of milepost, Baltimore 157 miles, between the tracks, in a bridge seat of the west abutment of bridge No. 59. (See note 37, p. 584.)

B. & O. 133.—Is about four-fifths of a mile east of *Okonoko, Hampshire County, W. Va.*, opposite milepost, Baltimore 158 miles. (See note 38, p. 584.)

B. & O. 134.—Is about one-fifth of a mile west of *Okonoko, Hampshire County, W. Va.*, and about 800 feet east of milepost, Baltimore 159 miles, in the north end of the west abutment of bridge No. 60. (See note 37, p. 584.)

B. & O. 135.—Is about 1¼ miles southwest of *Okonoko, Hampshire County, W. Va.*, opposite milepost, Baltimore 160 miles. (See note 38, p. 584.)

B. & O. 136.—Is about four-tenths of a mile east of *French, Hampshire County, W. Va.*, opposite milepost, Baltimore 161 miles. (See note 38, p. 584.)

B. & O. 137.—Is about eight-tenths mile west of *French, Hampshire County, W. Va.*, between the tracks in a bridge seat of the east abutment of bridge No. 61A. (See note 37, p. 584.)

B. & O. 138.—Is about 1¾ miles west of *French, Hampshire County, W. Va.*, near the west end of a cut near where milepost, Baltimore 163 miles, would be if planted; in a rock on the south side of the tracks. (See note 37, p. 584.)

B. & O. 139.—Is near *Green Spring, Hampshire County, W. Va.*, at milepost, Baltimore 164 miles; on the south side of the tracks in the center of the coping of culvert 62. (See note 37, p. 584.)

B. & O. 140.—Is about 1 mile west of *Green Spring, Hampshire County, W. Va.*, opposite milepost, Baltimore 165 miles. (See note 38, p. 584.)

B. & O. 141.—Is about 2 miles west of *Green Spring, Hampshire County, W. Va.*, opposite milepost, Baltimore 166 miles. (See note 38, p. 584.)

B. & O. 142.—Is in *Mineral County*, about 3 miles west of *Green Spring, Hampshire County, W. Va.*, opposite milepost, Baltimore 16 7miles. (See note 38, p. 584.)

B. & O. 143.—Is near *Dans Run, Mineral County, W. Va.*, opposite milepost, Baltimore 168 miles. (See note 38, p. 584.)

B. & O. 144.—Is about 1 mile west of *Dans Run, Mineral County, W. Va.*, opposite milepost, Baltimore 169 miles. (See note 38, p. 584.)

B. & O. 145.—Is about one-half mile east of bridge at *Patterson Creek Cut-Off, Mineral County, W. Va.*, opposite milepost, Baltimore 170 miles. (See note 38, p. 584.)

574 Patterson Creek.—Is a bench mark of the United States Geological Survey at *Patterson Creek Cut-Off, Mineral County, W. Va,*, on the south end of the west abutment of the railroad bridge over Patterson Creek, marked 574 feet.

B. & O. 145A.—Is at *Patterson Creek Cut-Off, Mineral County, W. Va.*, between the tracks, in a bridge seat of the east abutment of bridge No. 63. (See note 37, p. 584.)

B. & O. 146.—Is about three-tenths mile northwest of *Patterson Creek, Mineral County, W. Va.*, opposite milepost, Baltimore 171 miles. (See note 38, p. 584.)

B. & O. 147.—Is about one-half mile southeast of *North Branch, Allegany County, Md.*, opposite milepost, Baltimore 172 miles. (See note 38, p. 584.)

B. & O. 147A.—Is at *North Branch, Allegany County, Md.*, between the tracks, in a bridge seat of the west abutment of a bridge over the north branch of the Potomac River. (See note 37, p. 584.)

B. & O. 148.—Is about one-half mile northwest of *North Branch, Allegany County, Md.*, opposite milepost, Baltimore 173 miles. (See note 38, p. 584.)

B. & O. 149.—Is about 1½ miles northwest of *North Branch, Allegany County, Md.*, between the tracks, opposite milepost, Baltimore 174 miles. (See note 38, p. 584.)

B. & O. 150.—Is about 1 mile southeast of *Evitts Creek, Allegany County, Md.*, opposite milepost, Baltimore 175 miles. (See note 38, p. 584.)

B. & O. 151.—Is about one-tenth mile west of *Evitts Creek, Allegany County, Md.*, opposite milepost, Baltimore 176 miles. (See note 38, p. 584.)

B. & O. 152.—Is 1 mile east of *Cumberland, Allegany County, Md.*, opposite milepost, Baltimore 177 miles. (See note 38, p. 584.)

B. & O. 153.—Is in *Cumberland, Allegany County, Md.*, opposite milepost, Baltimore 178 miles. (See note 38, p. 584.)

B. & O. 153A.—Is at *Cumberland, Allegany County, Md.*, in the top of the wall in front of a railing to the right of the stairway leading to the relief department, Queen City Hotel. (See note 37, p. 584.)

I.—Is at *Cumberland, Md.* (See App. 8, Report for 1889, p. 561.)

B. & O. 154.—Is in *Cumberland, Allegany County, Md.*, on the south side of the tracks at the east end of viaduct bridge, Grafton Line. (See note 37, p. 584.)

B. & O. 155.—Is about 1½ miles west of *Cumberland, Allegany County, Md.*, on the south side of the tracks, in the foundation for the overhead foot bridge. (See note 37, p. 584.)

B. &. O, 156.—Is about 2½ miles west of *Cumberland, Allegany County, Md.*, in the south end of the east pier of the north span of Pennsylvania Railroad overhead crossing at the Narrows. (See note 37, p. 584.)

B. & O. 157.—Is between the tracks of the east abutment of the first bridge east of *Mount Savage Junction, Allegany County, Md.* (See note 37, p. 584.)

B. & O. 158.—Is at *Mount Savage Junction, Allegany County, Md.*, between the tracks of the east abutment of bridge No. 1, Connellsville Division. (See note 37, p. 584.)

B. & O. 160A.—Is at *Ellerslie, Allegany County, Md.*, between the tracks in a bridge seat of the east abutment of bridge No. 2½. (See note 37, p. 584.)

B. & O. 160B.—Is in Pennsylvania about 2 miles south of *Cooks Mills, Bedford County, Pa.*, and about three-fourths mile north of *Ellerslie, Allegany County, Md.*, between the tracks in a bridge seat of the east abutment of bridge No. 4. (See note 37, p. 584.)

B. & O. 161A.—Is about 1½ miles south of *Cooks Mills, Bedford County, Pa.*, between the tracks in a bridge seat of the east abutment of bridge No. 7. (See note 37, p. 584.)

B. & O. 163A.—Is three-tenths mile north of *Cooks Mills, Bedford County, Pa.*, between the tracks in the east abutment of bridge No. 8. (See note 37, p. 584.)

B. & O. 165A.—Is about 2 miles north of *Cooks Mills, Bedford County, Pa.*, in the south coping of the culvert across from Walley farm, about 11½ miles from Cumberland. (See note 37, p. 584.)

B. & O. 167A.—Is six-tenths mile southeast of *Hyndman, Bedford County, Pa.*, on the south end of the east abutment of bridge No. 9. (See note 37, p. 584.)

P. R. R. 5.—Is three-tenths mile north of *Hyndman, Bedford County, Pa.*, in the bridge seat of the south abutment of a bridge, and consists of a copper bolt.

B. & O. 168A.—Is one-half mile northwest of *Hyndman, Bedford County, Pa.*, between the tracks in the east abutment of bridge No. 10. (See note 37, p. 584.)

B. & O. 170.—Is 600 feet east of *Hoblitzell, Bedford County, Pa.*, in the east end of the south coping of the culvert. (See note 37, p. 584.)

B. & O. 171.—Is about on the county line between *Bedford* and *Somerset counties, Pa.*, about 1 mile from *Hoblitzell, Bedford County, Pa.*, in a rock on the north side of the tracks, opposite watch box, about 500 feet west of milepost, Cumberland 17 miles. (See note 37, p. 584.)

B. & O. 172.—Is at *Williams, Somerset County, Pa.*, in a bowlder on the north side of the tracks, about 500 feet west of milepost, Cumberland 18 miles. (See note 37, p. 584.)

B. & O. 173.—Is one-half mile east of *Fairhope, Somerset County, Pa.*, in a rock on the north side of the tracks, about 200 feet east of milepost, Cumberland 19 miles. (See note 37, p. 584.)

B. & O. 174.—Is about three-fourths mile west of *Fairhope, Somerset County, Pa.*, in a rock on the north side of the track 30 feet east of milepost, Cumberland 20 miles. (See note 37, p. 584.)

B. & O. 174A.—Is about 1¼ miles southwest of *Fairhope, Somerset County, Pa.*, between the tracks in the east abutment of bridge No. 17, Falls Cat tunnel. (See note 37, p. 584.)

B. & O. 175.—Is about one-third mile north of *Foley, Somerset County, Pa.*, in the north end of the east abutment of bridge No. 19A. (See note 37, p. 584.)

B. & O. 176.—Is at *Foley, Somerset County, Pa.*, between the tracks in the east abutment of bridge No. 19B. (See note 37, p. 584.)

DESCRIPTIONS OF PERMANENT BENCH MARKS BETWEEN ELMIRA, N. Y., AND WILLIAMSPORT, PA., 1897.

(From information furnished by U. S. Geological Survey.)

857 A.—Is at *Elmira, Chemung County, N. Y.* (See p. 861, App. 8, Report for 1899.)

1067 H.—Is 7.1 miles south of *Elmira, Chemung County, N. Y.*, in the wall of the creek and cattle pass culvert, on the west side of the railroad. (See note 46, p. 584.)

1265 H.—Is at *Snedekerville, Bradford County, Pa.*, in the foundation wall of the store and railroad station, 50 feet west of the railroad. (See note 46, p. 584.)

1099 H.—Is 1.8 miles south of *Columbia Crossroads, Bradford County, Pa.*, on the top of the north wall of the culvert and cattle pass, on the west side of the railroad. (See note 46, p. 584.)

1139 H.—Is two-tenths mile south of the station at *Troy, Bradford County, Pa.*, in the top of the coping stone of the foundation, on the north side of the railroad water tank. (See note 46, p. 584.)

1358 H.—Is one-half mile south of *Cowley, Bradford County, Pa.*, in the top of the coping stone of the railroad creek culvert on the east side of the railroad. (See note 46, p. 584.)

1246 H.—Is four-tenths mile south of *Canton, Bradford County, Pa.*, in the south abutment of an old railroad bridge masonry, 20 feet east of the railroad. (See note 50, p. 585.)

966 H.—Is at *Roaring Branch, Lycoming County, Pa.*, 600 feet north of the station, on the bridge seat of the east abutment of a steel highway bridge. (See note 50, p. 585.)

851 H.—Is two-tenths mile north of the station at *Ralston, Lycoming County, Pa.*, in the south abutment of the west side of the railroad bridge. See note 46, p. 584.)

732 H.—Is one-tenth mile north of *Fields, Lycoming County, Pa.*, in the south abutment of the east side of the iron railroad bridge. (See note 46, p. 584.)

620 H.—Is seven-tenths mile south of *Powys, Lycoming County, Pa.*, in the northwest wing abutment of a small creek culvert. (See note 50, p. 585.)

528 H.—Is at *Williamsport, Lycoming County, Pa.*, on the city hall in the front face by the main entrance. (See note 50, p. 585.)

P. R. R. 47.—Is at *Williamsport, Lycoming County, Pa.* (See p. 604.)

P. R. R. 46.—Is at *Williamsport, Lycoming County, Pa.* (See p. 604.)

DESCRIPTIONS OF PERMANENT BENCH MARKS BETWEEN SALAMANCA, N. Y., AND IRVINETON, PA., 1899, 1902.

(From information furnished by U. S. Geological Survey.)

1391 D.—Is at *Salamanca, Cattaraugus County, N. Y.* (See p. 860, App. 8, Report for 1899.)

1340 D.—Is 0.56 mile southwest of *Red House, Cattaraugus County, N. Y.*, on the southeast corner of bridge number 126, on the foundation coping stone. (See note 47, p. 584.)

1316 D.—Is 1.03 miles southwest of *Quaker Bridge, Cattaraugus County, N. Y.*, at the northeast corner of the steel truss bridge, on the foundation coping stone. See note 47, p. 584.)

Bridge 121.—Is ten one-hundreths mile west of *Wolf Run, Cattaraugus County, N. Y.*, on the southeast corner of bridge No. 121, on the parapet coping stone, and is a chiseled square.

1281 D.—Is at *Corydon, Warren County, Pa.*, thirty-three one-hundredths mile north of the station; at the southeast corner of the steel bridge over Willow Creek, on the foundation coping stone. (See note 47, p. 584.)

Bridge 758.—Is 2.04 miles south of *Corydon, Warren County, Pa.*, at the southeast corner of bridge No. 758, on the foundation coping stone, and is a chiseled square.

1253 D.—Is 1.4 miles south of *Sugar Run, Warren County, Pa.*, on the southwest corner of bridge No. 114, on the foundation coping stone. (See note 47, p. 584.)

Bridge 113.—Thirteen one-hundredths mile south of station at *Sugar Run, Warren County, Pa.*, southwest corner of bridge 113, on parapet coping stone, and is a chiseled square.

1229 D.—Is at *Kinzua, Warren County, Pa.*, 500 feet south of the station, at the northwest corner of the steel truss bridge across Kinzua Creek, 2.5 feet west of the chord, on the foundation stone. (See note 47, p. 584.)

Bridge.—Is 400 feet south of *Tuttletown, Warren County, Pa.*, at the northeast corner of the four-span bridge over Allegheny River, on the parapet coping stone, and is a chiseled square.

Bridge 644.—Is eighty one-hundredths mile southwest of *Great Bend, Warren County, Pa.*, on the northeast corner of bridge No. 644, on the foundation stone, and is a chiseled square.

1205 D.—Is two-tenths mile southeast of *Hemlock, Warren County, Pa.*, at the northwest corner of steel girder bridge No. 110, 5 inches from the bed plate, on the foundation coping stone. (See note 47, p. 584.)

1193 D.—Is near *Warren, Warren County, Pa.*, 300 feet south of the station, at the northwest corner of the double track steel truss bridge No. 54 over Allegheny River, on coping of the parapet wall. (See note 47, p. 584.)

P. R. R. 33.—Is at *Warren, Warren County, Pa.*, at the station, in the doorsill of the waiting room, and is a copper plug.

P. R. R. 37.—Is 650 feet east of *Jacksons Crossing*, *Warren County*, *Pa.*, on the southwest corner of bridge No. 53, on the foundation coping stone, and is a copper plug.

P. R. R. 38.—Is 1.48 miles east of *Irvineton*, *Warren County*, *Pa.*, on the southwest corner of a small girder bridge No. 52, on the top of the second step from the top of the wing wall, and is a copper plug.

P. R. R. 39.—Is three-fourths of a mile east of *Irvineton*, *Warren County*, *Pa.*, on the southeast corner of the open drain on the foundation coping stone, and is a copper plug.

1167 D.—Is twenty-four one-hundredths mile east of the station at *Irvineton*, *Warren County*, *Pa.*, on the east abutment of the double track steel girder bridge No. 50 across Brokenstraw Creek, on the north side of the middle girder, on the foundation coping stone. (See note 47, p. 584.)

DESCRIPTIONS OF PERMANENT BENCH MARKS BETWEEN IRVINETON AND FRANKLIN, PA., 1899.

(From information furnished by U. S. Geological Survey.)

1167 D.—Is at *Irvineton*, *Warren County*, *Pa.*

1135 D.—Is at *Thompson*, *Warren County*, *Pa.*, one-eighth mile northeast of the Western, New York and Pennsylvania station, at the east end of the south abutment of a small girder bridge, No. 85A, on the coping stone. (See note 47, p. 584.)

1116 D.—Is at *Tidioute*, *Warren County*, *Pa.*, 100 feet east of the station, 270 feet south of the center of the track at the north end of the suspension road bridge across the Allegheny River, on the face of the west cable anchor. (See note 47, p. 584.)

1098 D.—Is at *Trunkeyville*, *Forest County*, *Pa.*, 350 feet south of the flag post, 45 feet west of the center of the main track, 4½ feet south from a large chestnut tree, in a large bowlder. (See note 47, p. 584.)

1086 D.—Is two-tenths mile north of *Hickory*, *Forest County*, *Pa.*, at the northeast corner of the steel truss combination railroad and highway bridge across the Allegheny River, on the foundation wall. (See note 47, p. 584.)

1063 D.—Is at *Tionesta*, *Forest County*, *Pa.*, 180 feet north of station, 70 feet east of the main track, at the southwest corner of the highway bridge across the Allegheny River, on the coping stone. (See note 47, p. 584.)

1042 D.—Is three-tenths mile north of *President (flag station)*, *Venango County*, *Pa.*, 17.5 feet east of the center of the track, 2.4 feet below the top of rail, on the top of a large bowlder 5 feet high, 12 feet long. (See note 47, p. 584.)

1030 D.—Is at *Oleopolis*, *Venango County*, *Pa.*, three-tenths mile northeast of the flag station, at the northwest corner of the one-span steel truss bridge, No. 74, 13 feet north of the center of the track, on the coping stone of the abutment wall. (See note 47, p. 584.)

1009 P.—Is at *South Oil City*, *Venango County*, *Pa.*, four-tenths mile east of the Allegheny Valley Railroad station, on the bridge seat at the northeast corner of a large three-span truss bridge (Allegheny Valley Railroad) across Allegheny River, 7 feet north of the center of the track, 5.1 feet below the top of the rail, and 6 inches from the end of the chord. (See note 48, p. 584.)

987 P.—Is at *Franklin*, *Venango County*, *Pa.* (See p. 864, App. 8, Report for 1899.)

DESCRIPTIONS OF PERMANENT BENCH MARKS BETWEEN BINGHAMTON AND HANCOCK, N. Y., 1900.

(From information furnished by U. S. Geological Survey.)

867 A.—Is at *Binghamton, Broome County, N. Y.* (See App. 8, Report for 1899, p. 862.)

860 A.—Is near *Langdon, Broome County, N. Y.*, 1 000 feet north of the station, on a creek culvert, at the top of the south abutment on the west side. (See note 49, p. 584.)

Signal tower.—Is half a mile south of *Kirkwood, Broome County, N. Y.*, on the retaining wall of the signal tower, 7 feet northwest of the tower house, and is a railroad spike in the northeast corner in the top of the timber of the retaining wall.

880 A.—Is at *Great Bend, Susquehanna County, Pa.*, 200 feet north of the station, on the railroad water tank, in the face of the southeast foundation stone. (See note 49, p. 584.)

893 A.—Is at *Hickory Grove, Susquehanna County, Pa.*, 600 feet north of the station, on the top of the southeast abutment of an iron bridge.

955 A.—Is 1.3 miles south of *Susquehanna, Susquehanna County, Pa.*, on the long iron bridge over highway and stream, at the top of the west side of the south abutment. (See note 49, p. 584.)

1026 A.—Is 1 mile west of *Deposit, Broome County, N. Y.*, in the south wing of the east abutment of the iron bridge over the river. (See note 49, p. 584.)

978 A.—Is 4.4 miles south of *Deposit, Broome County, N. Y.*, on the west side of the top of the bridge seat of the north abutment of an iron bridge. (See note 49, p. 584.)

924 A.—Is seven-tenths mile northwest of *Hancock, Delaware County, N. Y.*, on top of southeast abutment of steel railroad bridge, on the east side of the track. (See note 49, p. 584.)

DESCRIPTIONS OF PERMANENT BENCH MARKS BETWEEN HANCOCK AND POUGHKEEPSIE, N. Y., 1900.

(From information furnished by U. S. Geological Survey.)

924 A.—Is near *Hancock, Delaware County, N. Y.*

882 A.—Is 1.1 miles south of *Stockport, Delaware County, N. Y.*, on bridge No. 17, on the west abutment, on the south side, on the top of the second step. (See note 49, p. 584.)

865 A.—Is at *Lordville, Delaware County, N. Y.*, at railroad station, on the suspension bridge over the Delaware River, in the face of the north abutment. (See note 49, p. 584.)

834 A.—Is at *Long Eddy, Sullivan County, N. Y.*, 400 feet north of the station, on a girder bridge, on the east side of the south abutment, in the top of the bridge seat. (See note 49, p. 584.)

801 A.—Is 1 mile south of *Hankins, Sullivan County, N. Y.*, 100 feet west of milepost "J. C. 141," south of the railroad, in the west abutment of a small bridge over a creek. (See note 49, p. 584, except the tablet is aluminum.)

780 A.—Is at *Callicoon, Sullivan County, N. Y.*, 900 feet south of station, on the railroad girder bridge over Delaware River, on the top of the east side of the north abutment. (See note 49, p. 584.)

746 A.—Is at *Cochecton, Sullivan County, N. Y.*, 100 feet north of the station, on the railroad bridge over the highway, on the top of the east side of the north abutment. (See note 49, p. 584.)

718 A.—Is at *Narrowsburg, Sullivan County, N. Y.*, 600 feet west of the station, on the north side of a rock cut, 100 feet west of the east end of the cut. (See note 49, p. 584.)

665 A.—Is at *Westcoolang Park, Pike County, Pa.*, 100 feet east of station, on a railroad bridge, on the top of the west end of the abutment on the south side. (See note 49, p. 584.)

648 A.—Is at *Shohola, Pike County, Pa.*, between Shohola Glen and store, on the stone steps opposite the east end of the station, and the third step from the bottom. (See note 49, p. 584.)

573 A.—Is two-tenths mile east of *Pondeddy, Pike County, Pa.*, 350 feet east of station whistling post, in the face of the rock of a cut on the south side of the railroad. (See note 49, p. 584.)

491 A.—Is three-tenths mile east of *Mill Rift, Pike County, Pa.*, on the long iron bridge over Delaware River, on south side of the top of the west abutment. (See note 49, p. 584.)

456 A.—Is at *Port Jervis, Orange County, N. Y.*, on the Erie railroad bridge over East Main street, at the top of west side of the south abutment, on the first step below the bridge seat. (See note 49, p. 584.)

780 A.—Is at *Guymard, Orange County, N. Y.*, 600 feet north of the station, on a railroad culvert, on the top of the west side of the north abutment. (See note 49, p. 584.)

861 A.—Is at *Otisville, Orange County, N. Y.*, 500 feet west of station, on a small railroad bridge over a private road, at the north side of the west abutment, on the top of bridge seat. (See note 49, p. 584.)

558 A.—Is at *Middletown, Orange County, N. Y.*, Clemson Brothers' saw shop, in front face, left of office entrance, in brickwork. (See note 49, p. 584.)

408 A.—Is at *Campbell Hall, Orange County, N. Y.*, on Campbell Hall Hotel, in the brickwork of the south face. (See note 49, p. 584.)

National Bank.—Is at *Walden, Ulster County, N. Y.*, Walden National Bank, in the southwest corner, and is an aluminum tablet marked 376.

Centerville Hotel.—Is at *Loyd, Ulster County, N. Y.*, Centerville Hotel, in the southeast corner, and is a bronze tablet marked 359.

Bridge.—Is at *Highland, Ulster County, N. Y.*, 100 feet south of station, on the top of the bridge abutment, at the north end, on the east side, marked □ 283.

Bridge.—Is at *Poughkeepsie, Dutchess County, N. Y.*, Poughkeepsie Bridge, on the south end of the west abutment, on the southwest corner of the top stone, and is a chisel mark.

173 A.—Is at *Poughkeepsie, Dutchess County, N. Y.*, at the corner of Main and Washington streets, in the front face of the city hall, and is an aluminum tablet marked 173 A.

DESCRIPTIONS OF PERMANENT BENCH MARKS BETWEEN SIDNEY AND HANCOCK, N. Y., 1901.

(From information furnished by U. S. Geological Survey.)

Tel. Pole 991.—Is at *Sidney, Delaware County, N. Y.* (See p. 744.)

1344A.—Is at *Maywood, Delaware County, N. Y.* (Sidney Center), on trestle 216, under the north side of the third trestle tower from the east end. (See note 51, p. 585.)

1766A.—Is about thirty-seven one-hundredths mile northwest of *Northfield, Delaware County, N. Y.*, at the south end of zigzag tunnel, 30 feet south of the south end, on the west side of the track about 6 feet above the rail. on the vertical face of the rock. (See note 51, p. 585.)

Bridge.—Is 5.95 miles southeast of *Northfield, Delaware County, N. Y.*, at the southeast corner of the bridge, in the foundation stone, and is a chiseled square.

1215A.—Is at *Walton, Delaware County, N. Y.*, at the southwest corner of North and Gardiner streets, at the northeast corner of Ogden Free Library, on the east face of the corner stone of the water table. (See note 51, p. 585.)

1214A.—Is five-tenths mile north of *Rock Rift, Delaware County, N. Y.*, 150 feet south of the crossing, on the east side of the track, 4 feet above the rail, on the face of the ledge. (See note 51, p. 585.)

990A.—Is seventeen one-hundredths mile west of *Cadosia, Delaware County, N. Y.*, on the west abutment of trestle B1, on the parapet wall, on the south corner of the coping stone. (See note 51, p. 585.)

Bridge 18.—Is three-tenths mile south of the station at *Hancock, Delaware County, N. Y.*, on bridge No. 18, at the southeast corner, on the foundation stone, and is a chiseled square.

924A.—Is near *Hancock, Delaware County, N. Y.* (See p. 741.)

DESCRIPTIONS OF PERMANENT BENCH MARKS BETWEEN UTICA AND BAINBRIDGE, N. Y., 1901.

(From information furnished by U. S. Geological Survey.)

D. W. Utica 2.—Is at *Utica, Oneida County, N. Y.* (See p. 675.)

P. O.—Is at *Utica, Oneida County, N. Y.*, on the post-office, on the west side of the eastern of the two rear entrances in the basement area, on the building wall, and is a bronze tablet marked 419 feet.

Seneca Street Bridge.—Is at *Utica, Oneida County, N. Y.*, on the Seneca Street Bridge, on the top of the southwest corner of lower step of the west wing of the towpath (north) abutment, and is a chiseled square.

Whitesboro Street Bridge.—Is at *Utica, Oneida County, N. Y.*, on the Whitesboro Street Bridge, on the top of the southeast corner of the stone platform at the base of the east stairs of the towpath abutment, about 3 feet above the towpath, and is a chiseled circle with the letters "B. M." marked on the south face of the stone.

L. S. 91.—Is at *Utica, Oneida County, N. Y.* (See p. 666.)

L. S. 92.—Is at *Utica, Oneida County, N. Y.* (See p. 666.)

633A.—Is fifty-four one-hundredths mile south of *Washington Mills, Oneida County, N. Y.*, on the southeast corner of bridge No. 76, on the northeast corner of the stone under the bed plate. (See note 51, p. 585.) (Reported as possibly disturbed.)

Station.—Is at *Richfield Junction, OneidaCounty, N. Y.*, on the new station, in the baseboard under the ticket office, marked + B. M.

1221A.—Is thirty-six one-hundredths mile south of *Richfield Junction, Oneida County, N. Y.*, on the south end of the foundation wall of a wooden trestle bent, on the west side of the track. (See note 49, p. 584.)

1152A.—Is at *Leonardsville, Madison County, N. Y.*, at the southeast corner of the milk station, in the face of the corner stone of the foundation. (See note 51. p. 585.)

U. S. B. M.—Is at *West Edmeston, Madison County, N. Y.*, on the highway bridge, at the northeast corner of the bridge, on the coping stone of the east abutment, and is a chisel mark U. S. □ B. M

Bridge.—Is 1.55 miles south of *West Edmeston, Madison County, N. Y.*, on the southwest corner of the highway bridge, on the coping stone of the foundation, and is a chiseled square.

1110A.—Is two-tenths mile east of *South Edmeston, Madison County, N. Y.*, at the northeast corner of the highway bridge, on the top stone of the foundation. (See note 51, p. 585.)

1089A.—Is at *New Berlin, Chenango County, N. Y.*, on the New York, Ontario and Western bridge, No. 52, near the northwest end of the bridge, on the top of the coping stone of the center pier. (See note 51, p. 585.)

Bridge.—Is 1.01 miles south of *New Berlin, Chenango County, N. Y.*, on the stone arch highway bridge, on the south side, on the face of the keystone, and is a chiseled cross.

Bridge.—Is seventy-seven one-hundredths mile north of *South New Berlin, Chenango County, N. Y.*, southeast of the railroad crossing, at the south end of the stone arch highway bridge on the west side wall, and is a chiseled square.

1059 A.—Is at *South New Berlin, Chenango County, N. Y.*, on the Baptist Church, near the northwest corner of the building, near the north side of the entrance, under the front window, in the third course of brick above the water table. (See note 51, p. 585.)

Bridge.—Is 1.21 miles south of *New Berlin, Chenango County, N. Y.*, and is a chiseled square on the southeast corner of abutment of railroad bridge.

Bridge.—Is 1.77 miles south of *Holmesville, Chenango County, N. Y.*, and is a chiseled square on the southeast abutment of a wooden railroad bridge.

1035 A.—Is at *Mount Upton, Chenango County, N. Y.*, on the east side of the Methodist Church, on the north side of the front entrance, in the third course of foundation stone above the ground. (See note 51, p. 585.)

Bridge.—Is 2.38 miles south of *Mount Upton, Chenango County, N. Y.*, at the northwest corner of the large iron highway bridge over Unadilla River, 150 feet south of the track, and is a chiseled square on the coping, marked U S.

Tel. Pole 991.—Is at *Sidney, Delaware County, N. Y.*, 150 feet west of the crossing of the Delaware and Hudson and the New York, Ontario and Western railroads, and is a railroad spike in a large telegraph pole, marked with paint 991.

989 A.—Is 2.7 miles east of *Bainbridge, Chenango County, N. Y.* (See p. 862, App. 8, Report for 1899.)

DESCRIPTIONS OF PERMANENT BENCH MARKS BETWEEN CHARLOTTE AND HORNELLSVILLE, N. Y., 1901–2.

(From information furnished by U. S. Geological Survey.)

1 (1874).—Is at *Charlotte, Monroe County, N. Y.*, 0.22 mile northeast of the New York Central Railroad station, on the old lighthouse, on the upper side of the water table at the south-southeast angle east of the south window, and is a chiseled circle.

2 (1874).—Is at *Charlotte, Monroe County, N. Y.*, on the top of the circular wall of the railroad turntable, southwest part of the wall, and is marked B X M.

Bridge 87.—Is at *Rochester, Monroe County, N. Y.*, on highway bridge No. 87, over Barge Canal, on the south abutment of the east wing, on the lowest step, and is a chiseled square.

N. Y. 457.—Is at *Rochester, Monroe County, N. Y.*, on Rowe street bridge No. 86, near the towpath, on the foundation under the east tower, was established by the New York State engineers, and is a chiseled square.

Rowe Street Bridge.—Is at *Rochester, Monroe County, N. Y.*, on the Buffalo, Rochester and Pittsburg Railroad bridge, on the southwest corner of the bridge, on the parapet stone, and is a chiseled square.

Bridge.—Is at *Rochester, Monroe County, N. Y.*, on the Buffalo, Rochester and Pittsburg Railroad bridge over the Niagara Falls Railroad, on the southwest corner of the bridge, on the parapet wall, and is a chiseled square.

Culvert.—Is at *Rochester, Monroe County, N. Y.*, 0.22 mile south of the Buffalo, Rochester and Pittsburg Railroad crossing, west of the track, near the north end of a stone culvert, and is a chiseled square.

Bridge.—Is at *Genesee Junction, Monroe County, N. Y.*, west side of grade crossing of West Shore Railroad, on the northeast corner of the Pennsylvania Railroad bridge, near northwest corner of parapet stone, and is a chiseled square.

Bridge.—Is 1.49 miles south of *Genesee Junction, Monroe County, N. Y.*, on the southeast corner of small bridge over old canal, on coping of foundation wall; chiseled square.

Lock.—Is 0.72 miles south of *Whites, Monroe County, N. Y.*, on an old lock, on the west side wall, at the south quoin between the anchors, and is a chiseled square.

Bridge —Is 640 feet south of *Severance, Monroe County, N. Y.*, on the northwest corner of a bridge over the canal, on the coping stone, and is a chiseled square.

Bridge.—Is 2.23 miles south of *Severance, Monroe County, N. Y.*, on the northeast corner of a highway bridge over the canal, on the coping stone, and is a chiseled square.

537 R.—Is at *Scottsville, Monroe County, N. Y.*, 800 feet north of the station, on the south side of a creek overflow dam, on the top of the stone pier, and is a bronzed tablet marked 537 Rochester, 1902.

Culvert.—Is 1.75 miles south of *Scottsville, Monroe County, N. Y.*, on the southwest corner of a culvert, on the coping stone, and is a chiseled square.

Bridge.—Is 2.54 miles south of *Scottsville, Monroe County, N. Y.*, on an overhead bridge at the crossing of the Lehigh Valley Railroad, on the southwest corner, on the eleventh step from the top of the wing wall, on the extreme southeast corner, and is a paint mark.

Bridge 34.—Is at *Honeoye Junction, Livingston County, N. Y.*, on bridge No. 34, of the Lehigh Valley Railroad, on the northeast corner, near the corner of the foundation coping stone, and is a chiseled square.

Bridge.—Is 240 feet north of *Genesee Valley Junction, Livingston County, N. Y.*, at northeast corner of a bridge, on the coping stone, and is a painted square.

Stone.—Is 0.80 mile south of *Genesee Valley Junction, Livingston County, N. Y.*, on the east side of the track, on a stone, and is a painted square.

Cattle Pass.—Is 0.59 mile north of *Avon, Livingston County, N. Y.*, on the southwest corner of a cattle pass, on the coping of the foundation, and is a painted square.

Tel. Pole.—Is at *Avon, Livingston County, N. Y.*, 700 feet north of the station on west side of the track, and is a spike in a telegraph pole.

Bridge.—Is 0.73 mile west of *Avon, Livingston County, N. Y.*, on the northwest corner of a bridge over Genesee River, on the foundation coping stone, and is a painted square.

Lock.—Is 1.42 miles north of *Fowlerville, Livingston County, N. Y.*, on the remains of an old canal lock, on the west wall near the center of the top stone, and is a chiseled square.

Tel. Pole.—Is at *Fowlerville, Livingston County, N. Y.*, 75 feet north of the station, at the northwest corner of the road crossing, and is a spike in a telegraph pole.

Culvert.—Is 1.02 miles south of *York, Livingston County, N. Y.*, on the east side of the track, on the coping stone of a culvert, and is a chiseled square.

Wall.—Is 660 feet north of *Piffard, Livingston County, N. Y.*, on west side of the track, on the east side wall of a drain from the salt works, on the coping stone, and is a chiseled square.

Culvert.—Is 1.91 miles south of *Piffard, Livingston County, N. Y.*, east side of track, on southeast corner of large culvert wall, on coping stone, and is a chiseled square.

Bridge 5.—Is 0.53 mile south of *Cuylerville, Livingston County, N. Y.*, on the northwest corner of bridge No. 5, on the northwest corner of parapet wall, and is a chiseled square.

575 R.—Is near *Mount Morris, Livingston County, N. Y.*, 2,200 feet east of Delaware, Lackawanna and Western station, at the northwest corner of the railroad bridge, on coping stone, and is an aluminum tablet marked 575 Rochester, 1901.

Bridge.—Is near *Mount Morris, Livingston County, N. Y.*, 0.48 mile south of the Erie Railroad station, on the southeast corner of the Pennsylvania railroad bridge, near the northeast corner of the parapet wall, and is a chiseled square.

Bridge.—Is 0.30 mile north of *Sonyea, Livingston County, N. Y.*, on the southwest corner of girder bridge over highway, top of the parapet wall, and is a chiseled square.

Bridge 13.—Is 2.38 miles south of *Sonyea, Livingston County, N. Y.*, southeast corner of bridge No. 13, near the northeast corner of the parapet wall, and is a chiseled square.

Bridge 15.—Is 0.61 mile north of *Tuscarora, Livingston County, N. Y.;* southeast corner of bridge No. 15; northeast corner of the parapet wall, and is a chiseled square.

773 R.—Is 1 100 feet south of *Tuscarora, Livingston County, N. Y.*, southeast corner of bridge, on the top of the parapet wall, and is a bronze tablet marked 773 Rochester, 1902.

Tree.—Is at *Nunda Junction, Livingston County, N. Y.*, 100 feet east of station, and is a spike in the root of an elm tree.

944 R.—Is at *Nunda, Livingston County, N. Y.*, Fireman's Hall, front face, 1 foot from the west corner; in the water table, and is an aluminum tablet marked 944 Rochester, 1902.

Culvert.—Is 4.27 miles southeast of *Nunda, Livingston County, N. Y.*, 60 feet south of crossing, west side of track, on coping stone of box drain, and is a chiseled square.

Culvert.—Is 200 feet southeast of *Ross Crossing, Livingston County, N. Y.*, between the tracks, on the north side of an open culvert, on the coping stone, and is a chiseled square.

Bridge.—Is 1.7 miles north of *Swains, Allegany County, N. Y.*, on the southeast corner of the steel girder bridge over a small stream, on the parapet wall, and is a chiseled square.

1316 R.—Is at *Swains, Allegany County, N. Y.*, 200 feet south of Erie station, on the northwest corner of the foundation wall of a small union church, and is an aluminum tablet marked 1316 Rochester, 1902.

Bridge 9.—Is 0.40 mile southeast of *Swains, Allegany County, N. Y.*, on the northwest corner of bridge No. 9, on the coping stone foundation, and is a chiseled square.

Bridge 8.—Is 1.79 miles southeast of *Swains, Allegany County, N. Y.*, on the northeast corner of bridge No. 8, on the parapet wall, and is a chiseled square.

Bridge 6¼.—Is 0.19 mile northeast of *Canaseraga, Allegany County, N. Y.*, northeast corner of bridge No. 6¼, on the foundation stone, and is a chiseled square.

1253 R.—Is at *Canaseraga, Allegany County, N. Y.*, on the southwest corner of the Kingston Hotel, in the water table, and is an aluminum tablet, marked 1253 Rochester 1902.

Tel. Pole.—Is at *Burns, Steuben County, N. Y.*, east of the station, and is a spike in the foot of a telegraph pole.

Culvert.—Is one-half mile southeast of *Burns, Steuben County, N. Y.*, north side of track, on east wall of open culvert; chiseled square.

1188 R.—Is at *Arkport, Steuben County, N. Y.*, on the southeast corner of the Methodist Protestant Church, in the foundation stone, and is an aluminum tablet, marked 1188 Rochester 1902.

Bridge 4.—Is 1.91 miles south of *Arkport, Steuben County, N. Y.*, southeast corner of bridge No. 4, on wing wall; chiseled square.

Bridge 1.—Is 0.66 mile north of station at *Hornellsville, Steuben County, N. Y.*, on the southeast corner of bridge No. 1, on the foundation stone, and is a chiseled square.

1141 D.—Is 0.7 mile east of the station at *Hornellsville, Steuben County, N. Y.*, at the northeast corner of iron railroad bridge, on the foundation wall, and is an aluminum tablet, marked 1141 D.

DESCRIPTIONS OF PERMANENT BENCH MARKS BETWEEN BUFFALO AND DUNKIRK, N. Y., 1902.

(From information furnished by U. S. Geological Survey.)

L. H.—Is at *Buffalo, Erie County, N. Y.* (See p. 658.)

L. V. R. R.—Is at *Buffalo, Erie County, N. Y.*, and is a bench mark of the Lehigh Valley Railroad, on the northwest corner of the bridge over Ohio Slip, in the top of the foundation stone, and is an iron bolt.

Switch Tower.—Is at *Buffalo, Erie County, N. Y.*, northwest of the New York Central switch tower, 24 feet from the old stone milepost, 10 feet west of the track, and is the top of rail driven vertically in the ground.

Bridge.—Is at *Buffalo, Erie County, N. Y.*, at the southeast corner of the three-span iron truss bridge, at the overhead crossing of the Delaware, Lackawanna and Western Railroad, on the south corner of the fourteenth step from top of the wing wall, about level with the track, and is a chiseled square.

R. R. B. M.—Is at *Buffalo, Erie County, N. Y.*, on the northwest corner of the two-span steel truss bridge, No. 267, over Buffalo River, on the southwest corner of the parapet wall, and is a chiseled circle.

Bridge.—Is 0.58 mile north of *West Seneca, Erie County, N. Y.*, at the end of trestle and two-span bridge of the overhead crossing, at the north end of stone pier, about 4 feet above the main track, on the coping stone, and is a chiseled square.

N. Y. C. R. R.—Is 1.04 miles south of *West Seneca, Erie County, N. Y.*, 20 feet south of the survey station 606–50, 400 feet south of switch tower, and is the top of a rail driven vertically in the ground.

Culvert.—Is 0.56 mile south of *Blasdell, Erie County, N. Y.*, on the stone arch culvert over Rush Creek, at the north end of the west coping wall, and is a chiseled square.

Mile Post 11.—Is 0.76 mile south of *Athol Springs, Erie County, N. Y.*, on milepost "B 11," on the north face, 6 feet above ground, and is a chiseled cross.

631 R.—Is 0.91 mile south of *Athol Springs, Erie County, N. Y.*, at the southeast corner of a stone culvert bridge, in the south face of the coping stone, and is a bronze tablet marked 631 Rochester 1902.

Culvert.—Is 1.99 miles north of *Lake View, Erie County, N. Y.*, at the west end of a box culvert, in the northeast corner of the coping stone, and is a chiseled square.

724 R.—Is 1.29 miles north of *Derby, Erie County, N. Y.*, 200 feet east of the Lake Shore and Michigan Southern track, at the southeast corner of highway bridge crossing the Pennsylvania railroad, in the west face of the concrete wing wall, 2 feet above the ground, and is a bronze tablet marked 724 Rochester 1902.

Trestle 236.—Is 1.27 miles south of *Derby, Erie County, N. Y.*, on the southwest corner of trestle No. 236, near the northwest corner of the coping stone, and is a chiseled square.

Trestle.—Is 1.69 miles north of *Angola, Erie County, N. Y.*, at the northeast corner of the trestle over the cattle pass, 1 foot above the track, on the coping stone of the wing wall, and is a chiseled square.

Bridge 228.—Is 0.51 mile north of *Angola, Erie County, N. Y.*, on the southwest corner of the truss and stone arch bridge No. 228, near the northwest corner of the coping, and is a chiseled square.

633 R.—Is at *Farnham, Erie County, N. Y.*, on the southeast corner of bridge No. 220, in the east face of the parapet coping stone, and is a bronzed tablet marked 633 Rochester 1902.

Culvert 218.—Is 1.21 miles south of *Farnham, Erie County, N. Y.*, at the northeast corner of culvert 218, on the coping stone, and is a chiseled square.

Bridge 216.—Is 0.73 mile south of *Irving, Erie County, N. Y.*, on the southeast corner of bridge 216, near the northeast corner of the parapet wall, and is a chiseled square.

Bridge.—Is 0.45 mile north of *Silver Creek, Chautauqua County, N. Y.*, on the southwest corner of the stone arch bridge over the street, and on the southwest corner of the coping stone, and is a chiseled square.

Bridge 207.—Is at *Silver Creek, Chautauqua County, N. Y.*, on the southeast corner of bridge No. 207 over Dunkirk street, near the east corner of the parapet wall, and is a chiseled square.

Bridge 204.—Is 1.58 miles south of *Silver Creek, Chautauqua County, N. Y.*, on the southeast corner of bridge No. 204 (A 52), near the southeast corner of the parapet stone, and is a chiseled square.

Bridge.—Is 0.45 mile north of *Waites Crossing, Chautauqua County, N. Y.*, on the south pier of the foundation underbent of the overhead highway bridge crossing, on the west side of the track, on the southwest corner.

Bridge 195.—Is 0.70 mile south of *Waites Crossing, Chautauqua County, N. Y.*, on the southeast corner of the cattle pass bridge No. 195, at the east corner of the parapet stone, and is a chiseled square.

Culvert 187.—Is 1.20 miles northeast of *Dunkirk, Chautauqua County, N. Y.*, on the south end of culvert No. 187, on the northeast end of the coping stone, and is a chiseled square.

598 D.—Is at *Dunkirk, Chautauqua County, N. Y.* (See p. 859, App. 8, Report for 1899.)

DESCRIPTIONS OF PERMANENT BENCH MARKS BETWEEN LEBOEUF AND IRVINETON, PA., 1902.

(From information furnished by U. S. Geological Survey.)

1193 P.—Is 1.5 miles west of *Leboeuf, Erie County, Pa.* (See p. 864, App. 8, Report for 1899.)

Bridge.—Is 1 mile southwest of *Leboeuf, Erie County, Pa.*, near the Erie Railroad crossing, on the large highway bridge, on the southwest corner, on the foundation coping stone, and is a chiseled square.

Milepost 74.—Is 1.69 miles west of *Union City, Erie County, Pa.*, on the Erie Railroad, on the top of the stone milepost No. 74, and is a chiseled square.

Milepost 73.—Is 0.64 mile west of *Union City, Erie County, Pa.*, on the Erie Railroad, on top of the stone milepost No. 73, and is a chiseled square.

Milepost 72.—Is 0.31 mile east of *Union City, Erie County, Pa.*, on the top of stone milepost No. 72, and is a chiseled square.

Bridge 27.—Is 0.78 mile east of the Pennsylvania Railroad station at *Union City, Erie County, Pa.*, on bridge No. 27, on the northeast corner, on the parapet wall, and is a chiseled square.

Bridge 29.—Is 1.97 miles east of *Union City, Erie County, Pa.*, on the northeast corner of bridge No. 29, on the foundation stone, and is a chiseled square.

P. R. R. 72.—Is 2.22 miles east of *Union City, Erie County, Pa.*, on the east corner of bridge No. 30, on the foundation wall, and is a copper plug.

P. R. R. 71.—Is 1.09 miles west of *Elgin, Erie County, Pa.*, on the northwest corner of bridge No. 32, on the parapet stone, and is a chiseled square.

P. R. R. 70.—Is 0.13 mile west of *Elgin, Erie County, Pa.*, on the northeast corner of bridge No. 33, on the foundation stone, and is a copper plug.

1382 P.—Is 330 feet west of the station at *Elgin, Erie County, Pa.*, north of the track, on the store of D. S. Lyon, at the southeast corner, on the foundation wall. (See note 48, p. 584.)

P. R. R. 69.—Is 0.84 mile west of *Lovell, Erie County, Pa.*, on the northeast corner of bridge No. 34, on the foundation wall, and is a copper bolt.

P. R. R. 68.—Is 0.16 mile east of *Lovell, Erie County, Pa.*, on the southwest corner of bridge No. 37, on the foundation stone, and is a copper plug.

P. R. R. 67.—Is 2.68 miles west of *Corry, Erie County, Pa.*, at the southeast corner of bridge No. 38, on the foundation stone, and is a copper plug.

P. R. R. 66.—Is 1.13 miles west of *Corry, Erie County, Pa.*, on the northwest corner of bridge No. 40, on bottom coping stone of wing wall, and is a copper plug.

1432 P.—Is 0.05 mile southwest of the station at *Corry, Erie County, Pa.*, on the northeast corner of the Phoenix Hotel, on the base of the water table. (See note 48, p. 584.)

P. R. R. 64.—Is 0.34 mile west of *Colza, Erie County, Pa.*, on the southeast corner of bridge No. 41, on the foundation wall, and is a copper plug.

P. R. R. 62.—Is 0.24 mile east of *Roach, Warren County, Pa.*, on the southwest corner of bridge 42 (large steel through truss bridge), on the parapet wall, and is a chiseled square.

1406 P.—Is at *Spring Creek, Warren County, Pa.*, 100 feet northeast of the station, on the southwest corner of Donaldson Bros.' general store, in the water table. (See note 48, p. 584.).

P. R. R. 58.—Is 0.26 mile east of *Spring Creek, Warren County, Pa.*, on the south side of the track, on the coping stone at the culvert, and is a chiseled square.

P. R. R. 57.—Is 0.70 mile east of *Spring Creek, Warren County, Pa.*, on the west side of an open culvert on the north side of the track, on the foundation stone, and is a copper plug.

P. R. R. 56.—Is 2.09 miles north of *Spring Creek, Warren County, Pa.*, on the northeast corner of girder bridge No. 42½, on the wing wall, and is a copper plug.

P. R. R. 55.—Is 0.17 mile west of *Horn, Warren County, Pa.*, on the southwest corner of a small girder bridge, on the foundation stone, and is a copper plug.

P. R. R. 54.—Is 1.18 miles east of *Horn, Warren County, Pa.*, on the south end of a box culvert, on the coping stone, and is a copper plug.

P. R. R. 51.—Is 1.12 miles east of *Garland, Warren County, Pa.*, on the southwest corner of "Blue Eye" Bridge over Blue Eye Creek, on the foundation coping stone, and is a copper plug.

P. R. R. 50.—Is 1.83 miles west of *Pittsfield, Warren County, Pa.*, on the southwest corner of railroad bridge, on the top of the foundation wall, and is a copper plug.

1244 P.—Is 0.52 mile west of *Pittsfield, Warren County, Pa.*, on the southeast corner of the large steel through truss bridge over creek on the foundation stone, except tablet is bronze. (See note 48, p. 584.)

P. R. R. 47.—Is 0.13 mile east of *Pittsfield, Warren County, Pa.*, on the northwest corner of bridge No. 46, on the foundation wall, and is a chiseled square.

P. R. R. 46.—Is 0.75 mile east of *Pittsfield, Warren County, Pa.*, on the southwest corner of a small bridge, on the foundation wing wall, and is a copper plug.

P. R. R. 45.—Is 0.86 mile west of *Youngsville, Warren County, Pa.*, on the southwest corner of bridge No. 47, on the foundation wall, and is a copper plug.

P. R. R. 48.—Is 0.32 mile west of *Youngsville, Warren County, Pa.*, on the southwest corner of the six-span girder bridge over Brokenstraw Creek, and is a copper plug.

P. R. R. 43.—Is 0.15 mile west of *Youngsville, Warren County, Pa.*, on the northeast corner of the Dunkirk, Allegheny Valley and Pittsburg Railroad bridge, on projection of bottom foundation stone pier, and is a chiseled square.

P. R. R. 42.—Is 0.70 mile west of *Irvineton, Warren County, Pa.*, on the southwest corner of bridge No. 49, on the foundation wall, and is a chiseled square.

1167 D.—Is near *Irvineton, Warren County, Pa.* (See p. 740.)

DESCRIPTIONS OF PERMANENT BENCH MARKS BETWEEN MOREHEAD CITY, N. C., AND BRUNSWICK, GA.

(U. S. Geol. Survey Reports, 1896-7, Part I, pp. 295-301; 1897-8, Part I, pp. 247-251; 1898-9, Part I, pp. 381-383.)

7 M. C.—Is at *Morehead City, Carteret County, N. C.*, 8.3 feet east of the depot, 5.6 feet north of the north rail of the Atlantic and North Carolina Railroad, 96.9 feet west of said railroad company's bulkhead of wharf. (See note 23, p. 582.)

17 M. C.—Is at *Morehead City, Carteret County, N. C.*, at the northwest corner of Eighth and Arendal streets; at the southeast corner of a brick house owned by George Dees. (See note 24, p. 582.)

18 M. C.—Is 1.92 miles west of *Atlantic, Carteret County, N. C.*, 23 feet south of the north rail at the southwest corner of M. D. Oglesby's freight platform. (See note 23, p. 582.)

28 M. C.— Is 2.31 miles west of *Newport, Carteret County, N. C.*, 25 feet south of the north rail, in line with the telegraph poles. (See note 23, p. 582.)

26 M. C.—Is 1.74 miles west of *Havelock, Craven County, N. C.*, 26 feet south of the north rail, in line with the telegraph poles. (See note 23, p. 582.)

25 M. C.—Is at *Riverdale, Craven County, N. C.*, 5 feet north of north rail at mail catcher. (See note 23, p. 582.)

7 M. C.—Is about 1 mile south of *Newbern, Craven County, N. C.*, 2 feet from the north end of the west abutment of Scott Creek trestle. (See note 24, p. 582.)

16 M. C.—Is at *Newbern, Craven County, N. C.*, at the northwest corner of Broad and Craven streets, in the corner stone at the northeast corner of the county courthouse. (See note 24, p. 582.)

27 M. C.—Is about 3 miles east of *Clark, Craven County, N. C.*, 0.73 mile west of milepost G 54 M 41, 30 feet south of the north rail, in line with the telegraph poles. (See note 23, p. 582.)

51 M. C.—Is 1.14 miles west of *Tuscarora, Craven County, N. C.*, 30 feet south of the north rail, in line with the telegraph poles. (See note 23, p. 582.)

48 M. C.—Is at *Cove Creek, Craven County, N. C.*, 75 feet south of the north rail, 4 feet northeast of the northeast corner of L. F. Taylor's store, on the west side of the Trenton road. (See note 23, p. 582.)

64 M. C.—Is at *Dover, Craven County, N. C.*, 19 feet east of the main crossroad and 77 feet south of the north rail. (See note 23, p. 582.)

48 M. C.—Is at *Kinston, Lenoir County, N. C.*, on the county court-house, on the north face of the northwest corner of the portico on the west end of the building. (See note 24, p. 582.)

55 M. C.—Is at *Falling Creek, Lenoir County, N. C.*, 31 feet south of the north rail of the main track, on the west side of the road. (See note 23, p. 582.)

109 M. C.—Is at *Lagrange, Lenoir County, N. C.*, 31 feet south of the north rail of the main track, at the southeast corner of the ticket office. (See note 23, p. 582.)

120 M. C.—Is 4.18 miles west of *Bests, Wayne County, N. C.*, 30 feet west of the country road and 30 feet south of the north rail, in line with the telegraph poles. (See note 23, p. 582.)

111 M. C.—Is at *Goldsboro, Wayne County, N. C.*, on the county court-house, at the northwest corner. (See note 24, p. 582.)

136 M. C.—Is at *Rose, Wayne County, N. C.*, in line with the telegraph poles. (See note 23, p. 582.)

152 M. C.—Is at *Princeton, Johnston County, N. C.*, 23.2 feet north of the north rail of the main track, at the east side of the platform. (See note 23, p. 582.)

178 M. C.—Is at *Selma, Johnston County, N. C.*, 158 feet south of the north rail of the main track of the Southern Railway, 128 feet west of the west building line of Webb street, near the east end of a one-story brick store occupied by N. B. Snipe & Bro. (See note 24, p. 582.)

229 M. C.—Is at *Wilsons Mills, Johnston, County, N. C.*, in the coping over the west edge of the opening at the north end of a 3 by 3 foot box culvert. (See note 25, p. 582.)

346 M. C.—Is at *Clayton, Johnston County, N. C.*, 162 feet south of the north rail of the main track, on the front of the brick store of W. H. McCullers, sr., & Son, near the east corner. (See note 24, p. 582.)

384 M. C.—Is at *Garner, Wake County, N. C.*, 25 feet north of the north rail of the main track and 12 feet west of the southwest corner of the ticket office. (See note 23, p. 582.)

363 M. C.—Is at *Raleigh, Wake County, N. C.*, on the corner stone of the State Capitol. (See note 24, p. 582.)

497 M. C.—Is at *Cary, Wake County, N. C.*, 22 feet south of the north rail of the main track and 3 feet east of the northeast corner of the station. (See note 23, p. 582.)

321 M. C.—Is 0.59 mile west of *Morrisville, Wake County, N. C.*, 33.6 feet south of the north rail and 26.8 feet east of a 6-inch hickory tree. (See note 23, p. 582.)

360 M. C.—Is 2.06 miles west of *Nelson, Durham County, N. C.*, in a stone over the north end of 3 by 3 foot box culvert. (See note 25, p. 582.)

406 M. C.—Is at *Durham, Durham County, N. C.*, on the county court-house, on the west side of the Main street entrance. (See note 24, p. 582.)

471 M. C.—Is at *University Station, Orange County, N. C.*, 1.5 feet north of the northwest corner of the station. (See note 23, p. 582.)

549 M. C.—Is 2.46 miles south of *Robson, Orange County, N. C.*, 23 feet east of the west rail, and 2 feet south of the signpost at the road crossing. (See note, 23, p. 582.)

503 M. C.—Is at *Chapel Hill, Orange County, N. C.*, at the University of North Carolina, and consists of a stone tablet on the north side of Memorial Hall. (See note 24, p. 582.)

543 M. C.—Is at *Hillsboro, Orange County, N. C.*, at the northwest corner of the county court-house. (See note 24, p. 582.)

667 M. C.—Is 0.17 mile west of *Efland, Orange County, N. C.*, 32 feet north of the north rail, in line with the telegraph poles. (See note 23, p. 582.)

678 M. C.—Is at *Mebane, Alamance County, N. C.*, 28.4 feet south of the north rail of the main track, at the northeast corner of the station. (See note 23, p. 582.)

642 M. C.—Is at *Graham, Alamance County, N. C.*, on the county court-house, on the north front, 2 feet west of the main doorway. (See note 24, p. 582.)

721 M. C.—Is at *Gibsonville, Guilford County, N. C.*, 25.7 feet north of the rail of the main track, at the southeast corner of the ticket office. (See note 23, p. 582.)

744 M. C.—Is at *McLeansville, Guilford County, N. C.*, 95 feet south of the north rail of the main track, near the northwest corner of a small store. (See note 23, p. 582.)

839 M. C.—Is at *Greensboro, Guilford County, N. C.*, at the northeast corner of the Federal court-house and post-office. (See note 24, p. 582.)

813 M. C.—Is 1.5 miles south of *Pomona, Guilford County, N. C.*, 2 feet from the east end of the north back wall of bridge No. 290.7. (See note 25, p. 582.)

793 M. C.—Is at *Jamestown, Guilford County, N. C.*, 185 feet south of the depot in a large bowlder, 182 feet east of the west rail of the main track. (See note 25, p. 582.)

940 M. C.—Is at *High Point, Guilford County, N. C.*, on J. R. Flagg's drug store, at the east corner of brick front, 99 feet west of the west rail of the main track. (See note 24, p. 582.)

852 M. C.—Is at *Thomasville, Davidson County, N. C.*, 28 feet east of the west rail of the main track, at the southwest corner of the ticket office. (See note 23, p. 582.)

665 M. C.—Is 1.04 miles west of *Conrad, Davidson County, N. C.*, on the coping of the east end of the north back wall of the bridge over Rich Fork, No. 315.9. (See note 25, p. 582.)

811 M. C.—Is at *Lexington, Davidson County, N. C.*, at the southeast corner of the county court-house. (See note 24, p. 582.)

630 M. C.—Is 0.72 mile south of *Linwood, Davidson County, N. C.*, on the coping at the east end of the south abutment of bridge No. 326.4. (See note 25, p. 582.)

765 M. C.—Is at *Salisbury, Rowan County, N. C.*, at the southwest corner of the county court-house. (See note 24, p. 582.)

671 M. C.—Is 3.72 miles west of *Majolica, Rowan County, N. C.*, at Second Creek bridge, on the southeast corner of the southeast pedestal block. (See note 25, p. 582.)

790 M. C.—Is at *Cleveland, Rowan County, N. C.*, 20 feet north of the north rail of the main track, at the southwest corner of the station. (See note 23, p. 582.)

838 M. C.—Is at *Elmwood, Iredell County, N. C.*, 34.5 feet south of the north rail of the main track, at the northeast corner of the station. (See note 23, p. 582.)

926 M. C.—Is at *Statesville, Iredell County, N. C.*, on the southeast corner of the county court-house. (See note 24, p. 582.)

776 M. C.—Is 0.15 mile west of the station at *Plott, Iredell County, N. C.*, on the coping at the southeast end of the north abutment of the bridge. (See note 25, p. 582.)

873 M. C.—Is at *Catawba, Catawba County, N. C.*, on J. U. Long & Co.'s store, on the brickwork near the north corner of the east front, 437 feet south of the north rail of the main track. (See note 24, p. 582.)

970 M. C.—Is at *Claremont, Catawba County, N. C.*, 29.5 feet south of the north rail of the main track, at the northeast corner of the station. (See note 23, p. 582.)

996 M. C.—Is at *Newton, Catawba County, N. C.*, on the county court-house, at the west end of the north portico. (See note 24, p. 582.)

1164 M. C.—Is at *Hickory, Catawba County, N. C.*, 148.8 feet north of the north rail of the main track, at the northeast corner of the First National Bank building. (See note 24, p. 582.)

1087 M. C.—Is 0.91 mile west of *Hildebran, Burke County, N. C.*, 3 feet from the east end of the coping, at the north end of the culvert. (See note 25, p. 582.)

1193 M. C.—Is at *Connelly Springs, Burke County, N. C.*, 142.4 feet north of the north rail of the main track, on James Hudson's brick store, on the south front, near the east corner. (See note 24, p. 582.)

1193 M. C.—Is at *Drexel, Burke County, N. C.*, 15 feet north of the north rail of the main track, 0.14 mile east of milepost 74. (See note 23, p. 582.)

1182 M. C.—Is at *Morganton, Burke County, N. C.*, on the county court-house, on the extreme northwest corner of the north portico. (See note 24, p. 582.)

1215 M. C.—Is at *Glen Alpine, Burke County, N. C.*, 73.2 feet north of the north rail of the main track, at the southeast corner of the brick basement of Hennessee & Co.'s store. (See note 24, p. 582.)

1091 M. C.—Is 0.4 mile east of *Bridgewater, Burke County, N. C.*, on the bridge seat at the west end of Muddy Creek bridge, 2.75 feet south of the south rail. (See note 25, p. 582.)

1298 M. C.—Is at *Nebo, McDowell County, N. C.*, 134.2 feet north of the north rail of the main track, on the south basement wall, 1 foot from the east front of J. D. Pitt's store. (See note 24, p. 582.)

1438 M. C.—Is at *Marion, McDowell County, N. C.*, on the county court-house, on the west face at the south end of the portico. (See note 24, p. 582.)

1286 M. C.—Is at *Greenlees, McDowell County, N. C.*, 11.7 feet south of the north rail of the main track, at the east end of the platform. See note 23, p. 582.)

1437 M. C.—Is at *Old Fort, McDowell County, N. C.*, 40.7 feet north of the north rail of the main track, at the southwest corner of the ticket office. (See note 23, p. 582.)

1829 M. C.—Is at *Round Knob, McDowell County, N. C.*, 9 feet south of the north rail and 46.1 feet east of the entrance to Round Knob Hotel, in the face of a solid rock. (See note 24, p. 582.)

2153 M. C.—Is at *Mud Cut, McDowell County, N, C.*, 14.2 feet south of the north rail of the main track and 293 feet east of the switch point. (See note 23, p. 582.)

2522 M. C.—Is at *Swannanoa Tunnel, in McDowell County*, about 3 miles east of *Black Mountain, Buncombe County, N. C.*, on the north side wall of the tunnel. 2.6 feet east of the west portal. (See note 24, p. 582.)

2222 M. C.—Is at *Swannanoa, Buncombe County, N. C.*, 50.6 feet south of the north rail of the main track, on the west side of the ticket office. (See note 23, p. 582.)

2057 M. C.—Is at *Azalea, Buncombe County, N. C.*, in the face of the rock, 12.75 feet south of the north rail of the main track, 59.75 feet west of the switch point. (See note 24, p. 582.)

1996 M. C.—Is at *Biltmore, Buncombe County, N. C.*, at office of the Biltmore estate, set in the bottom stone of the northwest pillar of the porte-cochère. (See note 24, p. 582.)

1986 M. C.—Is at *Asheville, Buncombe County, N. C.*, 19.3 feet north of the north rail, 505 feet east of milepost 141, on the pedestal block of the northeast corner post of the train shed. (See note 24, p. 582.)

1924 M. C.—Is 1.13 miles east of *Olivette, Buncombe County, N. C.*, 40.8 feet north of the north rail of the main track, 400 feet east of the water tank, in a bowlder containing 50 cubic yards. (See note 25, p. 582.)

1796 M. C.—Is at *Alexander, Buncombe County, N. C.*, 310 feet west of the station, 11.1 feet south of the north rail of the main track, at the east side of the road crossing. (See note 25, p. 582.)

1729 M. C.—Is 0.97 mile west of *Bailey, Madison County, N. C.*, in the top of a solid rock 19 feet east of milepost 158, 11.5 feet south of the main track. (See note 25, p. 582.)

1646 M. C.—Is at *Marshall, Madison County, N. C.*, at the county court-house, on the southeast corner. (See note 24, p. 582.)

1529 M. C.—Is 0.19 mile west of *Barnard, Madison County, N. C.*, in the solid rock, 140 feet west of milepost 171, and 6.5 feet north of the north rail of the main track. (See note 25, p. 582.)

1326 M. C.—Is at *Hot Springs, Madison County, N. C.*, at the southeast corner of the east abutment of Spring Creek bridge. (See note 25, p. 582.)

1259 M. C.—Is at *Paint Rock, Madison County, N. C.*, at the north end of the west abutment of Grass Creek bridge. (See note 24, p. 582.)

1184 M. C.—Is 0.75 mile west of *Wolf Creek, Cocke County, Tenn.*, in the solid rock, 200 feet west of the road crossing, 10.5 feet south of the north rail. (See note 28, p. 583.)

1141 M. C.—Is at Big Creek bridge (No. S. 195.3), near *Delrio, Cocke County, Tenn.*, in the north wing wall of the west abutment, 12 feet north of the north rail. (See note 28, p. 583.)

1094 M. C.—Is at *Bridgeport, Cocke County, Tenn.*, 72.7 feet south of the north rail of the main track, in the center pilaster of J. B. Huff's brick store. (See note 27, p. 582.)

1058 M. C.—Is at *Newport, Cocke County, Tenn.*, on the county court-house, in the northeast corner of the building, 6.5 feet above the surface of the ground. (See note 27, p. 582.)

1010 M. C.—Is at *Rankin, Cocke County, Tenn.*, 125 feet south of the north rail of the main track, 95 feet west of the road crossing, in the face of the bay window of W. V. Fine's brick residence. (See note 27, p. 582.)

1142 M. C.—Is at *White Pine, Jefferson County, Tenn.*, 67 feet north of the north rail of the main track and 150 feet east of milepost 219, on the southwest corner of the brick dwelling occupied by George Ivy. (See note 27, p. 582.)

1351 M. C.—Is at *Morristown, Hamblen County, Tenn.*, in the northeast corner of the county court-house. (See note 27, p. 582.)

1193 M. C.—Is at *Talbot, Jefferson, County, Tenn.*, 4.9 feet west of the west end of the depot, 30 feet north of the north rail of the main track. (See note 26, p. 582.)

1118 M. C.—Is at *Mossy Creek, Jefferson County, Tenn.*, 90 feet east of the station, 116 feet south of the north rail of the main track, in the northeast corner of the Mossy Creek Bank building. (See note 27, p. 582.)

905 M. C.—Is 0.63 mile east of *Hodges, Jefferson County, Tenn.*, in the southeast corner of the east abutment of culvert (No. A 110.4), 13.5 feet south of the north rail of the track. (See note 28, p. 583.)

865 M. C.—Is near *Mascot, Knox County, Tenn.*, in the abutment of Flat Creek bridge (No. A 117.7), 9 feet south of the north rail. (See note 28, p. 583.)

867 M. C.—Is 0.45 mile east of *Caswell, Knox County, Tenn.*, on culvert (No. A 124.0), at the south corner of the west abutment, 12 feet south of the north rail. (See note 28, p. 583.)

933 M. C.—Is at *Knoxville, Knox County, Tenn.*, in the northeast corner of the Clinch street entrance to the custom-house. (See note 27, p. 582.)

940 M. C.—Is 0.91 mile east of *Wright, Knox County, Tenn.*, on culvert (No. A 138.9), in the east wall, 11.3 feet south of the north rail. In 1900 it was found that this culvert was marked 138.1. (See note 28, p. 583.)

820 M. C.—Is at *Concord, Knox County, Tenn.*, in the north front of the depot, 24.6 feet west of the east end, and 28.2 feet south of the north rail of the main track. (See note 27, p. 582.)

799 M. C.—Is at *Lenoir City, Loudon County, Tenn.*, 291.6 feet north of the north rail of the main track, 154 feet east of the depot, in the southeast corner of the Lenoir City Bank. (See note 27, p. 582.)

784 M. C.—Is at *Loudon, Loudon County, Tenn.*, at the county court-house, in the southwest corner of the Grove street entrance. (See note 27, p. 582.)

860 M. C.—Is at *Philadelphia, Loudon County, Tenn.*, 31.6 feet north of the north rail of the main track, 2 feet east of the depot. (See note 26, p. 582.)

918 M. C.—Is at *Sweetwater, Monroe County, Tenn.*, 198 feet north of the north rail of the main track, in the east front of the Sweetwater Bank. (See note 27, p. 582.)

979 M. C.—Is at *Mouse Creek, McMinn County, Tenn.*, 33.6 feet north of the north rail of the main track, in the west face of the station, 3.1 feet north of the south front. (See note 27, p. 582.)

869 M. C.—Is at *Athens, McMinn County, Tenn.*, at the county court-house, in the northwest corner of Jackson street entrance. (See note 27, p. 582.)

807 M. C.—Is at *Riceville, McMinn County, Tenn.*, 18.2 feet south of the north rail of the main track, in the north front of the depot, 2.2 feet from the east corner. (See note 27, p. 582.)

706 M. C.—Is near *Charleston, Bradley County, Tenn.*, on bridge over Hawassee River (No. A 200.5 three spans, 391 feet long), in the south end of the west back wall. (See note 27, p. 582.)

798 M. C.—Is 0.2 mile west of *Tasso, Bradley County, Tenn.*, in the south end of the west wall of culvert (No. A 206.9), 9.4 feet south of the north rail of the main track. (See note 28, p. 583.)

875 M. C.—Is at *Cleveland, Bradley County, Tenn.*, at the county court-house, in the water table on the north side of Ocoee street entrance. (See note 27, p. 582.)

895 M. C.—Is at *Blue Springs, Bradley County, Tenn.*, 146.7 feet east of the west rail of the main track, 73.3 feet north of the north switch point, in the face of a ledge of rock. (See note 27, p. 582.)

866 M. C.—Is at *Cohutta, Whitfield County, Ga.*, 157 feet east of the west rail of the main track; in the north front of W. A. Williams's brick store. (See note 27, p. 582.)

795 M. C.—Is at *Waring, Whitfield County, Ga.*, 24 feet west of the west rail of the main track and 6.6 feet north of milepost No. H 35. (See note 26, p. 582.)

774 M. C.—Is at *Dalton, Whitfield County, Ga.*, at the county court-house; in the water table on the north side of the Cleveland street entrance. (See note 27, p. 582.)

712 M. C.—Is at *Phelps, Whitfield County, Ga.*, 50 feet west of the west rail, opposite the switch point, at the south end of the side track and near the southeast corner of the post-office. (See note 26, p. 582.)

719 M. C.—Is at *Miller, Gordon County, Ga.*, 76.4 feet west of the west rail of the main track, at the northeast corner of L. C. Rooker's store. (See note 26, p. 582.)

620 M. C.—Is near *Oostanaula, Gordon County, Ga.*, on the west pedestal block of the south abutment of bridge (No. H 61.3) over Oostanaula River, 7.6 feet west of the west rail. (See note 28, p. 583.)

653 M. C.—Is at *Pinson, Floyd County, Ga.*, 23.3 feet east of the west rail and 15.3 feet north of the switch point. (See note 26, p. 582.)

614 M. C.—Is at *Rome, Floyd County, Ga.*, at the city post-office, and is an aluminum tablet, set in the face of the steps to the Fourth avenue entrance, marked 614 M. C.

697 M. C.—Is 0.08 mile south of *Chambers, Floyd County, Ga.*, in the north abutment of trestle No. H 86.3, 7 feet west of the west rail. (See note 28, p. 583.)

799 M. C.—Is in *Polk County, Ga.*, 0.45 mile south of *Seney, Ga.*, on a 6-foot arch culvert, in the west face wall, 6.3 feet south of the center of the arch. (See note 28, p. 583.)

774 M. C.—Is 0.13 mile north of *Rockmart, Polk County, Ga.*, on the Euharlee Creek bridge, in the south abutment, 5.7 feet west of the west rail. (See note 28, p. 583.)

1088 M. C.—Is 0.54 mile south of *Braswell, Paulding County, Ga.*, in the west wall of the tunnel, 3 feet from the north portal. (See note 27, p. 582.)

1015 M. C.—Is at *McPherson, Paulding County, Ga.*, 79.8 feet west of the west rail of the main track, 30 feet south of the road crossing, and is a United States Geological Survey iron bench-mark post, set 2 feet from the northeast corner of J. E. Butler's house, marked 1015 M. C.

1050 M. C.—Is at *Dallas, Paulding County, Ga.*, at the county court-house, at the west side of the south entrance. (See note 27, p. 582.)

957 M. C. —Is 2.22 miles north of *Powder Springs, Cobb County, Ga.*, and 0.31 mile north of milepost 128, in the rock formation on the west side of the cut. (See note 28, p. 583.)

930 M. C.—Is at *Austell, Cobb County, Ga.*, at W. E. Shelerton's Hotel, in the north front of the building, 6.7 feet from the west corner. (See note 27, p. 582.)

804 M. C.—Is 0.42 mile west of *Lenox*, *Cobb County*, *Ga.*, 70 feet west of milepost, in the solid rock, 142.8 feet south of the south rail of the main track. (See note 28, p. 583.)

855 M. C.—Is at *Peyton*, *Fulton County*, *Ga.*, 16 feet south of the south rail of the main track and 12 feet west of the west side of the station. (See note 26, p. 582.)

1050 M. C.—Is at *Atlanta*, *Fulton County*, *Ga.*, on the State capitol; and is an aluminum tablet in the north newel post of the Washington street entrance, marked 1050 M. C.

847 M. C.—Is at *Constitution*, *Dekalb County*, *Ga.*, 4 feet southeast of the station signpost, and 25 feet south of the railroad. (See note 30, p. 583.)

848 M. C.—Is at *Ellenwood*, *Clayton County*, *Ga.*, 2 feet northwest of the station platform, and 20 feet south of the track. (See note 30, p. 583.)

810 M. C.—Is at *Stockbridge*, *Henry County*, *Ga.*, on the brick post-office building, 18 feet to the left of the front doorway, 2½ feet above ground, and is an aluminum tablet marked 810 MOREHEAD, 1898.

866 M. C.—Is at *McDonough*, *Henry County*, *Ga.*, on the county court-house, on the granite footstone of the stone arch at the right of the main entrance, and is an aluminum tablet marked 866 MOREHEAD, 1898.

837 M. C.—Is at *Locust Grove*, *Henry County*, *Ga.*, 55 feet north of the railroad station, 25 feet west of the main track, 3 feet north of a small black-oak tree 4 inches in diameter. (See note 30, p. 583.)

766 M. C.—Is at *Jenkinsburg*, *Butts County*, *Ga.*, 25 feet west of the Southern Railway station, 20 feet south of the track. (See note 30, p. 583.)

727 M. C.—Is at *Jackson*, *Butts County*, *Ga.*, on the county court-house, in the sandstone just above the water table at the right of the front entrance, and is an aluminum tablet marked 727 MOREHEAD, 1898.

546 M. C.—Is at *Cork*, *Butts County*, *Ga.*, 10 feet south of the station platform. (See note 30, p. 583.)

375 M. C.—Is at *Juliette*, *Monroe County*, *Ga.*, 88 feet south of railroad station, 15 feet west of the center of the track, 3 feet south of milepost 217. (See note 30, p. 583.)

347 M. C.—Is at *Dames Ferry*, *Monroe County*, *Ga.*, 3 feet north of the station, 23 feet west of the center of the main track. (See note 30, p. 583.)

339 M. C.—Is at *Holton*, *Bibb County*, *Ga.*, 35 feet north of the station, 29 feet west of the center of the tract. (See note 30, p. 583.)

334 M. C.—Is at *Macon*, *Bibb County*, *Ga.*, on the United States post-office building at the corner of Mulberry and Third streets, in water table at the left of the Mulberry street entrance, and is an aluminum tablet marked 334 MOREHEAD, 1898.

272 M. C.—Is at *Reid*, *Twiggs County*, *Ga.*, opposite the signboard, 40 feet southwest of the center of the main track. (See note 30, p. 583.)

259 M. C.—Is at *Bullard*, *Twiggs County*, *Ga.*, 2 feet south of the south end of the platform and 35 feet east of the center of the main track. (See note 30, p. 583.)

259 M. C.—Is at *Adams Park*, *Twiggs County*, *Ga.*, 3½ feet south of the platform, 19 feet east of the center of the main track. (See note 30, p. 583.)

234 M. C.—Is at *Westlake*, *Twiggs County*, *Ga.*, 2½ feet south of the station platform, 33 feet east of the center of the main track. (See note 30, p. 583.)

259 M. C.—Is at *McGriff*, *Pulaski County*, *Ga.*, 4½ feet south of the pump house, 12½ feet west of the center of the track. (See note 30, p. 583.)

342 M. C.—Is at *Cochran*, *Pulaski County*, *Ga.*, 55 feet west of the station platform, 33 feet west of the center of the main track, 3 feet north of a large telegraph pole. (See note 30, p. 583.)

381 M. C.—Is at *Empire*, *Dodge County*, *Ga.*, 50 feet north of the station platform, 13 feet west of the center of the main track, 4 feet south of a post marked STOP. (See note 30, p. 583.)

400 M. C.—Is at *Gresston*, *Dodge County*, *Ga.*, 36 feet west of the southwest corner of the station, 17 feet west of the center of the track. (See note 30, p. 583.)

357 M. C.—Is at *Eastman*, *Dodge County*, *Ga.*, 37 feet north of the station, 38 feet west of the center of the track. (See note 30, p. 583.)

312 M. C.—Is at *Godwinsville*, *Dodge County*, *Ga.*, 15 feet north of the station, 20½ feet west of the center of the main track. (See note 30, p. 583.)

300 M. C.—Is at *Chauncey*, *Dodge County*, *Ga.*, 2 feet east of the station platform, 47 feet north of the center of the main track. (See note 30, p. 583.)

275 M. C.—Is at *Achord*, *Dodge County*, *Ga.*, opposite the signboard near the west end of the siding, 100 feet south of the southwest corner of a store, 28 feet south of the center of the main track. (See note 30, p. 583.)

229 M. C.—Is at *McRae*, *Telfair County*, *Ga.*, at the Southern Railway station, 8 feet east of the platform, 1 foot east of telegraph pole, and 32 feet south of the center of the main track. (See note 30, p. 583.)

142 M. C.—Is at *Scotland*, *Telfair County*, *Ga.*, at the Southern Railway station, 8 inches east of the east edge of the platform, 35 feet south of the center of the main track. (See note 30, p. 583.)

128 M. C.—Is at *Towns*, *Telfair County*, *Ga.*, at the Southern Railway station, 39 feet south of the center of the platform, 34 feet south of the center of the main track. (See note 30, p. 583.)

146 M. C.—Is at *Lumber City*, *Telfair County*, *Ga.*, 200 feet east of the Southern Railway station, 52 feet north of the center of the main track, 26 feet southwest of the corner of a barber shop, and 3½ feet west of a chinaberry tree. (See note 30, p. 583.)

256 M. C.—Is at *Hazlehurst*, *Appling County*, *Ga.*, at the Southern Railway station, 2 feet east of the platform, 30½ feet south of the center of the main track. (See note 30, p. 583.)

244 M. C.—Is at *Graham*, *Appling County*, *Ga.*, 9½ feet west of the Southern Railway station, 26 feet south of the center of the main track, 2½ feet north of telegraph pole. (See note 30, p. 583.)

229 M. C.—Is at *Pine Grove*, *Appling County*, *Ga.*, at the Southern Railway station, 39 feet east of the road crossing, 47 feet east of the freight platform, 16 feet south of the center of the main track, between two posts holding the sign "Pine Grove." (See note 30, p. 583.)

206 M. C.—Is at *Baxley*, *Appling County*, *Ga.*, 67 feet east of the end of the Southern Railway station, 37 feet south of the center of the main track, 4 feet west of a telegraph pole. (See note 30, p. 583.)

200 M. C.—Is at *Wheaton*, *Appling County*, *Ga.*, at the Southern Railway station, 57 feet northeast of the northeast corner of the freight platform, 44 feet south of the corner of a shanty, 33 feet north of the center of the main track. (See note 30, p. 583.)

187 M. C.—Is at *Surrency*, *Appling County*, *Ga.*, at the Southern Railway station, 45 feet south of the platform, 37 feet south of the center of the main track. (See note 30, p. 583.)

167 M. C.—Is at *Brentwood*, *Wayne County*, *Ga.*, at the Southern Railway station, 54 feet east of the freight building and platform, 36 feet north of the center of the main track, 45 feet south of the store. (See note 30, p. 583.)

155 M. C.—Is at *Odum*, *Wayne County*, *Ga.*, at the Southern Railway station, 78 feet west of the platform, 25½ feet south of the center of the main track, 43½ feet north of the porch of L. Carter & Bro.'s warehouse. (See note 30, p. 583.)

99 M. C.—Is at *Jesup*, *Wayne County*, *Ga.*, 2½ feet southwest of the Southern Railway station (also Savannah, Florida and Western Railway station), 33 feet northwest of the center of the main track of the Savannah, Florida and Western Railway. (See note 30, p. 583.)

61 M. C.—Is at *Gardi*, *Wayne County*, *Ga.*, 2½ feet from the southeast corner of the Southern Railway station, 39 feet northeast of the center of the main track. (See note 30, p. 583.)

85 M. C.—Is at *Pendarvis*, *Wayne County*, *Ga.*, between the posts holding the signboard, 850 feet south of the head block at the north end of the siding, 22 feet northeast of the center of the main track, 174 feet south of the corner of the dwelling house. (See note 30, p. 583.)

55 M. C.—Is at *Mount Pleasant*, *Wayne County*, *Ga.*, 95 feet northwest of the Southern Railway station, 42 feet southwest of the center of the main track. (See note 30, p. 583.)

16 M. C.—Is at *Everett*, *Glynn County*, *Ga.*, 29 feet west of the Southern Railway station, 11½ feet west of the center of the main track, 109½ feet northwest of the center of the crossing of the Southern Railway and Florida Central and Peninsular Railroad, 2½ feet northwest of the telegraph pole. (See note 30, p. 583.)

18 M. C.—Is at *Sapp Still* (Pennick post-office), *Glynn County*, *Ga.*, 160 feet north of the head block at the south end of the siding, 24 feet east of the center of the main track, between the posts supporting the signboard. (See note 30, p. 583.)

24 M. C.—Is 2 miles north of *Dock Junction*, *Glynn County*, *Ga.*, at the crossing of the Southern Railway and the Brunswick and Western Railroad, 22 feet northeast of the center of the Brunswick and Western track, and 23½ feet east of the center of the Southern track. (See note 30, p. 583.)

10 M. C.—Is at *Brunswick*, *Glynn County*, *Ga.*, on the city hall building, at the southwest corner of the intersection of Newcastle and Mansfield streets, in the foundation wall at the right of the Newcastle-street entrance, and is an aluminum tablet marked 10 MOREHEAD, 1899.

U. S. E. 1.—Is at *Brunswick*, *Glynn County*, *Ga.*, in Glauber & Isaacs's warehouse, near McCullough's wharf, and is a large spike in an oak stump under a hole made through the floor.

U. S. E. 2.—Is at *Brunswick, Glynn County, Ga.*, 80 feet south of Glauber & Isaacs's warehouse, 12 feet west of the office building, on a spike in a notch in the southwest side of a live-oak tree 20 inches in diameter.

U. S. E. 3.—Is at *Brunswick, Glynn County, Ga.*, on McCullough's wharf, 20 feet back from and 16 feet from the south edge of ballast pile, and is the top of the coupling of a 1½-inch gas pipe driven in the ground, now about 15 inches above the surface.

DESCRIPTIONS OF PERMANENT BENCH MARKS BETWEEN CLEVELAND AND CHATTANOOGA, TENN., 1902.

[From information furnished by U. S. Geological Survey.]

875 M. C.—Is at *Cleveland, Bradley County, Tenn.* (See p. 756.)

789 N.—Is 0.3 mile west of the crossing at *Black Fox, Bradley County, Tenn.*, on the north end of the culvert over Black Fox Creek, 4 feet from the west end of the capstone and 5 feet from the edge of the same, and is a bronze tablet marked 789 NASHVILLE 1899.

854 N.—Is 0.16 mile northeast of *Hinches Switch, James County, Tenn.*, at the road crossing, 18 feet west of the center of the track, 15 feet north of the road, in the east face of a ledge of rock, and is a bronze tablet marked 854 NASHVILLE 1899.

Ledge of rock.—Is 300 feet west of the station at *Ooltewah Junction, James County, Tenn.*, 150 feet east of the switch, 18 feet south of the center of the Atlanta track, 20 feet west of the water tank on top of a ledge of rock, and is a chiseled square.

716 N.—Is 900 feet southwest of the station at *Tyners, Hamilton County, Tenn.*, 80 feet southwest of the highway, at the east end of the culvert under the tracks, 3.4 feet from the north end, in the face of the capstone, and is a bronze tablet marked 716 NASHVILLE 1899.

Bridge.—Is 0.33 mile northeast of *McCarty, Hamilton County, Tenn.*, on bridge No. 235.4 over Chickamauga creek, at the east end of the girder bridge, and the west end of the truss bridge, at the southeast corner of the pier, and is a chiseled square.

Bridge.—Is at *McCarty, Hamilton County, Tenn.*, on the southeast corner of the stone arch railroad bridge of the Southern Railway over the Western and Atlantic Railroad, on the edge of the fifth course of stone, and is a chiseled cross.

688 N.—Is 600 feet northwest of the station at *Boyce, Hamilton County, Tenn.*, at the main entrance to the Sherman House, at the east end of the stone door sill, in the upper surface, and is a bronze tablet marked 688 NASHVILLE 1899.

698 N.—Is at *Chattanooga, Hamilton County, Tenn.*, on the United States Government building (post-office), 3 feet north of the southeast corner of the building, in the lower course of stones, and is a bronze tablet marked 698 NASHVILLE 1899.

DESCRIPTIONS OF PERMANENT BENCH MARKS BETWEEN CLEVELAND AND CANTON, OHIO, 1902.

[From information furnished by U. S. Geological Survey.]

U. S. E. 1.—Cleveland, Ohio. A mark (B×M) on the top of the northeast wall of the Ohio Canal lock, at the connection of the canal with the river.

U. S. E. 2.—Is at *Cleveland, Cuyahoga County, Ohio*, on the south corner of Front and River streets, on the north corner of the Johnson House Block, on the corner stone of the water table, and is a chiseled cross.

U. S. E. 3.—Cleveland, Ohio. A cross (×) on the stone water table, southwest corner of brick block, northeast corner of River and Superior streets.

Gauge.—Is at *Cleveland, Cuyahoga County, Ohio* (United States Engineer water gauge), zero mark, which equals mean elevation of Lake Erie for the years 1860 to 1875, inclusive.

Bridge.—Is at *Cleveland, Cuyahoga County, Ohio*, on the east corner of Independence street and East Clark avenue, at the north corner of the railroad bridge over the canal and the street, on the fourth step of the wing wall above the avenue, and is a chiseled square.

Bridge 15.—Is at *Cleveland, Cuyahoga County, Ohio*, on Miles avenue, 0.84 mile south of the station, on the northwest corner of girder bridge No. 15 over A., B. and C. Electric Railway, on the coping stone of the foundation, and is a chiseled square.

R. R. B. M.—Is 2.16 miles northwest of *Bedford, Cuyahoga County, Ohio*, on the west side of the track, on the second step of the south wall of the drain, and is a chiseled cross.

Town Hall.—Is at *Bedford, Cuyahoga County, Ohio*, on the north corner of the town hall, on the face of the fourth course of foundation stones from the top, and is a chiseled cross.

Bridge.—Is 1.52 miles north of *Macedonia, Summit County, Ohio*, on the southwest corner of the girder bridge over the highway, on the coping stone of the foundation, and is a chiseled square.

1004 Cleve.—Is at *Macedonia, Summit County, Ohio*, on the southwest wing wall of the girder bridge over the road, in the highest step, and is a bronze tablet marked 1004 CLEVELAND.

Wall.—Is at *Little York, Summit County, Ohio*, 350 feet south of the station, on the north end of the arch wall, on the east side of the highway, and is a chiseled square.

Rock.—Is at *Highland Springs, Summit County, Ohio*, at the northwest corner of the crossroads, on a rock in the fence corner, and is a chiseled square.

1002 Cleve.—Is 0.27 mile south of *Seasons, Summit County, Ohio*, at the southeast corner of the girder bridge, on the coping stone of the parapet wall, and is an aluminum tablet marked 1002 CLEVELAND 1902.

1012 Cleve.—Is at *Silver Lake Junction, Summit County, Ohio*, at the southwest end of a large stone arch bridge over Cuyahoga River, on the end coping stone of the west side wall, and is an aluminum tablet marked 1012 CLEVELAND 1902.

Wall.—Is at *East Akron Junction, Summit County, Ohio*, at the northwest corner of the stone arch bridge over Cleveland Terminal and Valley Railroad, on the top stone of wing wall, and is a chiseled square marked B M.

983 Cleve.—Is at *East Akron, Summit County, Ohio*, 520 feet south of the station, on the north abutment of a girder bridge, between the tracks, on the coping stone, and is an aluminum tablet marked 983 CLEVELAND 1902.

1076 Cleve.—Is at *Myersville, Summit County, Ohio*, 200 feet northeast of the station, on the northeast corner of the highway bridge, on the southeast corner of the foundation stone, and is a bronze tablet marked 1076 CLEVELAND.

1069 Canton.—Is at *New Berlin, Stark County, Ohio*, 400 feet east of the Cleveland Terminal and Valley Railroad highway bridge over Nimisilá Creek, on the northeast corner of the west abutment, on the coping stone, and is a bronze tablet marked 1069 CANTON 1901.

Bridge 43.—Is 1.59 miles south of *New Berlin, Stark County, Ohio*, on the north corner of bridge No. 43 over a brook, on the coping stone of the foundation, and is a chiseled square.

Bridge 44.—Is 2.08 miles south of *New Berlin, Stark County, Ohio*, on the west abutment of bridge No. 44 over a brook, on the foundation, on the coping stone, and is a chiseled square.

Bridge 77.—Is at *Canton, Stark County, Ohio.* (See p. 765.)

DESCRIPTIONS OF PERMANENT BENCH MARKS FROM MONACA, PA., TO LIMA, OHIO.

[From information furnished by the U. S. Geological Survey.]

25 C.—Is near *Monaca, Pa.*, and is seat cut in southwest end of land pier, Pittsburg and Lake Erie Railroad bridge over Ohio River (between Monaca and Beaver, Pa.). Pier on right shore of river. Bench mark 3 inches below top of nineteenth course of stone from top of pier and 3 feet east of west side of pier, marked U. S. B. M.

Depot.—Is near *Monaca, Pa.*, and is on the southeast corner of the water table to the depot.

Bridge 26.—Is near *New Brighton, Pa.*, and is on the northeast corner of the east bridge seat, bridge No. 26.

Bridge.—Is near *New Brighton, Pa.*, and is on the northeast corner of the east bridge seat, over public road.

Depot.—Is at *New Brighton, Pa.*, and is on the southeast corner of the water table to the depot.

Bridge 29.—Is at *Kenwood, Pa.*, and is on the northeast corner of the east back wall, bridge 29.

Depot.—Is at *Beaver Falls, Pa.*, and is on the northeast corner of the doorsill of the depot.

Depot.—Is at *Geneva, Pa.*, and is on the southeast corner of the east doorsill of the depot.

Bridge 34.—Is at *Mansfield, Pa.*, and is on the northeast corner of the east bridge seat, bridge 34.

Bridge 38.—Is at *Homewood, Pa.;* top step of the northeast wing wall, bridge 38.

Bridge 39.—Is near *Homewood, Pa.;* northeast corner of the east back wall, bridge 39.

Bridge 40.—Is at *Summit, Pa.;* northeast corner of the east back wall, bridge 40.

Bridge 41.—Is at *Harlow, Pa.;* northeast corner of the north coping of bridge 41.

Bridge 42.—Is at *New Galilee, Pa.;* northeast corner of the east back wall of bridge 42.

Bridge 44.—Is near *New Galilee, Pa.;* northwest corner of bridge seat 44, KY tower, L. Beaver.

Bridge.—Is at *McCowans Crossing, Pa.;* northeast corner of bridge seat.

Depot.—Is at *Enon, Pa.;* southeast corner of the projecting water table on depot.

Bridge 45.—Is near *Enon, Pa.;* northeast corner of the north coping of bridge 45.

Bridge 45½.—Is near *Ohio-Pennsylvania State Line;* northeast corner of the north coping of bridge 45½.

Bridge 46.—Is near *Ohio-Pennsylvania State Line;* northeast corner of the east bridge seat of bridge 46.

Coal Tipple.—Is near *Ohio-Pennsylvania State Line;* southeast corner of the southeast pier of coal tipple.

Bridge 47.—Is near *East Palestine, Ohio;* northwest corner of the east bridge seat of bridge No. 47.

Bridge 48.—Is at *East Palestine, Ohio;* northwest corner of the east bridge seat of bridge No. 48.

Bridge 49.—Is near *East Palestine, Ohio;* northwest corner of the east bridge seat of bridge No. 49.

Bridge 50.—Is near *East Palestine, Ohio;* northwest corner of the east bridge seat of bridge No. 50, Mgr. R. Crossing.

Bridge 50½.—Is near *East Palestine, Ohio;* northwest corner of the east bridge seat of bridge No. 50½, Mgr. R. Crossing.

Bridge.—Is at *New Waterford, Ohio;* northeast corner of the north coping of bridge.

Bridge 51.—Is near *New Waterford, Ohio;* northwest corner of the east bridge seat of bridge No. 51.

Bridge 52.—Is near *Columbiana, Ohio;* northwest corner of the east bridge seat of bridge No. 52.

Depot.—Is at *Columbiana, Ohio;* southwest corner of the door sill of the depot.

Bridge 54.—Is near *Columbiana, Ohio;* northeast corner of the north coping of bridge No. 54.

Bridge 55.—Is near *Columbiana, Ohio;* northwest corner of the east bridge seat of bridge No. 55.

Bridge 56.—Is near *Columbiana, Ohio;* northeast corner of the north coping of bridge No. 56, C. T. Tower.

Bridge 58.—Is near *Leetonia, Ohio;* northwest corner of the east bridge seat of bridge No. 58.

Water table.—Is near *Leetonia, Ohio;* northwest corner of the northwest pedestal to water table.

Bridge 59.—Is near *Leetonia, Ohio;* northwest corner of the east back wall of bridge No. 59.

Bridge.—Is near *Leetonia, Ohio;* top of the northeast wing wall of bridge.

Bridge 60.—Is near *Leetonia, Ohio;* northwest corner of the east bridge seat of bridge No. 60, C. F. Tower.

Bridge 61.—Is near *Sells Crossing, Ohio;* northwest corner of the east back wall of bridge No. 61.

Depot.—Is at *Salem, Ohio;* southwest corner of the west doorsill of the waiting room in the depot.

Bridge 63.—Is near *Salem, Ohio;* northwest corner of the east bridge seat of bridge No. 63.

Bridge.—Is near *Salem, Ohio;* southeast corner of the north pier of the overhead bridge.

Culvert.—Is near *Garfield, Ohio;* northwest corner of the cover stone on box culvert.

Culvert.—Is near *Beloit, Ohio;* southwest corner of the cover stone on box culvert.

Culvert.—Is near *Sebring, Ohio;* northeast corner of the east abutment on box culvert.

Culvert.—Is near *Sebring*, *Ohio;* northeast corner of the east abutment on open culvert.

Bridge 64.—Is near *Sebring*, *Ohio;* northeast corner of the east back wall of bridge No. 64.

Bridge 65.—Is near *Alliance*, *Ohio;* northwest corner of the east abutment of bridge No. 65.

Lunch Room.—Is at *Alliance*, *Ohio;* northwest corner of the lunch room.

Bridge 66.—Is near *Alliance*, *Ohio*; northwest corner of the east abutment of bridge No. 66.

Culvert.—Is near *Alliance, Ohio;* northeast corner of the top of Mas. stone box culvert.

Bridge 67.—Is at *Maximo*, *Ohio;* northeast corner of the coping on north side of track on bridge No. 67.

Coping Stone.—Is near *Maximo*, *Ohio;* east end of north coping stone.

Bridge 68.—Is near *Louisville*, *Ohio;* northwest corner of the east abutment of bridge No. 68.

Bridge 69.—Is at *Louisville*, *Ohio;* northwest corner of the east abutment of bridge No. 69.

Bridge.—Is near *Louisville*, *Ohio;* northwest corner of the east abutment of bridge.

Bridge.—Is near *Fairhope*, *Ohio;* northwest corner of the east abutment of bridge (solid floor cal.).

Bridge 72.—Is near *Fairhope*, *Ohio;* northwest corner of the east abutment of bridge No. 72.

Bridge 73.—Is near *Canton*, *Ohio;* northwest corner of the east abutment of bridge No. 73.

Bridge 76.—Is near *Canton*, *Ohio;* northwest corner of the east abutment of bridge No. 76.

Bridge 77.—Is near *Canton*, *Ohio;* northwest corner of the east abutment of bridge No. 77; a chiseled square.

Bridge 78.—Is near *Massillon*, *Ohio;* northeast corner of the east top of arch of bridge No. 78.

Bridge 79.—Is near *Massillon*, *Ohio;* bridge No. 79.

Bridge 80.—Is near *Massillon*, *Ohio;* north end of east abutment of bridge No. 80.

Bridge 83.—Is near *Massillon*, *Ohio;* north end of east abutment of bridge No. 83.

Bridge.—Is near *Massillon*, *Ohio;* northeast corner of the coping of bridge column.

Bridge 84.—Is at *Massillon*, *Ohio;* north end of the east back wall of bridge No. 84.

Bridge 86.—Is near *Massillon*, *Ohio;* northwest corner of the east abutment of bridge No. 86.

Culvert.—Is near *Newman*, *Ohio;* northeast corner of the east abutment of S. F. branch culvert.

Culvert.—Is near *Newman*, *Ohio;* north end of east abutment of S. F. branch culvert.

Bridge 88.—Is near *Lawrence*, *Ohio;* northwest corner of the east abutment of bridge No. 88.

Bridge 89.—Is at *Lawrence, Ohio;* north end of the east abutment of bridge No. 89.

Bridge 90.—Is near *Lawrence, Ohio;* north end of the east abutment of bridge No. 90.

Bridge 91.—Is near *Lawrence, Ohio;* north end of the east abutment of bridge No. 91.

Culvert.—Is near *Lawrence, Ohio;* northeast corner of the east abutment of S. F. branch culvert.

Culvert.—Is near *Fairview, Ohio;* north end of the east abutment of S. F. branch culvert.

Bridge.—Is near *Fairview, Ohio;* northwest corner of the east abutment of I. B. bridge.

Bridge 97.—Is near *Fairview, Ohio;* north end of the east parapet of bridge No. 97, W. Ast.

Bridge 98.—Is near *Fairview, Ohio;* northwest corner of the east back wall of bridge No. 98.

Bridge 99.—Is near *Orville, Ohio;* north end of the east abutment of bridge No. 99.

Culvert.—Is near *Orville, Ohio;* northeast corner of the east abutment of S. F. branch culvert.

Depot.—Is at *Orville, Ohio;* east end, north doorsill of the gentlemen's room of the depot at Orville.

Bridge.—Is near *Orville, Ohio;* northwest corner of the east abutment of I. B. bridge.

Bridge.—Is near *Orville, Ohio;* northwest corner of the east abutment.

Bridge.—Is near *Orville, Ohio;* northwest corner of the east abutment.

Bridge.—Is near *Orville, Ohio;* northwest corner of the east abutment.

Bridge 100.—Is near *Smithville, Ohio;* northwest corner of the east abutment of bridge No. 100.

Bridge 102.—Is near *Smithville, Ohio;* northwest abutment of bridge No. 102.

Culvert.—Is near *Smithville, Ohio;* northeast corner of the box culvert.

Bridge 103.—Is near *Smithville, Ohio;* northwest corner of the east abutment of bridge No. 103.

Bridge.—Is near *Smithville, Ohio;* northwest corner of the east abutment of I. B. bridge.

Stone arch.—Is near *Smithville, Ohio;* northeast corner of the parapet stone arch.

Bridge.—Is near *Wooster, Ohio;* northeast corner of the east abutment of I. B. bridge.

Bridge 106.—Is near *Wooster, Ohio;* northwest corner of the east abutment of bridge No. 106.

Bridge.—Is near *Wooster, Ohio;* northeast corner of the east abutment of I. B. bridge.

Depot.—Is at *Wooster, Ohio;* northeast doorsill of the ladies' waiting room.

Bridge.—Is near *Wooster, Ohio;* northwest corner of the east parapet of plate-girder bridge.

Bridge 110.—Is near *Wooster, Ohio;* northeast corner of the east parapet wall of bridge No. 110.

Bridge 112.—Is near *Wooster, Ohio;* northwest corner of the east parapet of bridge No. 112.

Bridge 115.—Is near *Wooster, Ohio;* northeast corner of the east abutment of bridge No. 115.

Bridge 117.—Is near *Wooster, Ohio;* northeast corner of the east abutment of bridge No. 117.

Bridge 120.—Is near *Wooster, Ohio;* northeast corner of the east parapet of bridge No. 120.

Coal Tipple.—Is near *Wooster, Ohio;* northeast pier of the coal tipple.

Bridge 121.—Is near *Shreve, Ohio;* northeast corner of the east abutment of bridge No. 121.

Bridge.—Is near *Shreve, Ohio;* northeast corner of the east abutment of I. B. bridge.

Bridge 124.—Is near *Shreve, Ohio;* east abutment of bridge No. 124.

Depot.—Is at *Shreve, Ohio;* water table on the southeast con. ticket of Shreve.

Arch.—Is near *Custaloga, Ohio;* northwest corner of the top step of the east wall to arch.

Culvert.—Is near *Custaloga, Ohio;* northeast corner stone of the box culvert.

Bridge 128.—Is near *Big Prairie, Ohio;* northeast corner of the east abutment of bridge No. 128.

Bridge 129.—Is near *Lakeville, Ohio;* northwest corner of the west abutment of bridge No. 129.

Bridge 131.—Is near *Lakeville, Ohio;* northwest corner of the east abutment of bridge No. 131.

Bridge 132.—Is near *Lakeville, Ohio;* abutment of bridge No. 132.

Bridge 134.—Is near *Lakeville, Ohio;* northeast corner of the coping C. stone arch of bridge 134.

Bridge 136.—Is near *Lakeville, Ohio;* northeast corner of the coping C. stone arch of bridge No. 136.

Bridge 137.—Is near *Lakeville, Ohio;* northeast corner of the east abutment of bridge No. 137.

Bridge 138.—Is near *Londonville, Ohio;* northeast corner of the east abutment of bridge No. 138 E.

Culvert.—Is near *Londonville, Ohio;* northwest corner of the stone box culvert.

Bridge 139.—Is near *Londonville, Ohio;* northwest corner of the first step of the east wall of N. S. bridge 139.

Bridge.—Is near *Londonville, Ohio;* northeast corner of the east abutment of I. B. bridge.

Culvert.—Is near *Perryville, Ohio;* north end of the east abutment of the culvert.

Bridge 141.—Is near *Perryville, Ohio;* northeast corner of the second step E. par. bridge 141.

Bridge 142.—Is near *Perryville, Ohio;* northeast corner of the east abutment of bridge 142.

Bridge 143.—Is near *Perryville, Ohio;* northeast corner of the second step of bridge 143.

Bridge 144.—Is near *Perryville, Ohio;* northwest corner of the east abutment of bridge 144.

Bridge 145.—Is near *Perryville, Ohio;* northwest corner of the east abutment of bridge 145.

Bridge 145½.—Is near *Lucas, Ohio;* northwest corner of the east abutment of bridge 145½.

Bridge 146.—Is near *Lucas, Ohio;* northwest corner of the east abutment of bridge 146.

Bridge 147.—Is near *Lucas, Ohio;* northeast corner of the north coping C. arch of bridge 147.

Culvert.—Is near *Lucas, Ohio;* northeast corner of the north coping of culvert.

Bridge 150.—Is near *Lucas, Ohio;* northwest corner of the east abutment of bridge 150.

Bridge 151.—Is near *Mansfield, Ohio;* northwest corner of the east back wall of bridge 151.

Bridge 152.—Is near *Mansfield, Ohio;* northeast corner of the east abutment of bridge 152.

Bridge 154.—Is near *Mansfield, Ohio;* northeast corner of the east abutment of bridge 154.

Culvert.—Is near *Mansfield, Ohio;* northeast corner of the north coping of culvert.

Bridge 155.—Is near *Mansfield, Ohio;* northwest corner of the east abutment of bridge 155.

Culvert.—Is near *Mansfield, Ohio;* northeast corner of the north coping of culvert.

Bridge 156.—Is near *Mansfield, Ohio;* northeast corner of the east abutment of bridge 156.

Bridge 157.—Is near *Mansfield, Ohio;* northeast corner of the east abutment of bridge 157.

Culvert.—Is near *Toledo Junction, Ohio;* northeast corner of the north coping of culvert.

Bridge 159.—Is near *Toledo Junction, Ohio;* northwest corner of the east abutment of bridge 159.

Bridge 160.—Is near *Toledo Junction, Ohio;* northeast corner of the east abutment of bridge 160.

Culvert.—Is near *Toledo Junction, Ohio*; northeast corner of the north coping of culvert.

Bridge 161.—Is near *Cookton, Ohio;* northeast corner of the north coping stone arch of bridge 161.

Culvert.—Is near *Cookton, Ohio;* northeast corner of the north coping of culvert.

Bridge 162.—Is near *Cookton, Ohio;* northwest corner of the east abutment of bridge 162.

Culvert.—Is near *Cookton, Ohio;* northeast corner of the north coping stone arch of culvert.

Bridge 164.—Is near *Crestline, Ohio;* northeast corner of the east abutment of bridge 164.

Bridge 165.—Is near *Crestline, Ohio;* northwest corner of the east abutment of bridge 165.

Bridge 166.—Is near *Crestline, Ohio;* northeast corner of the east abutment of bridge 166.

Bridge 167.—Is near *Crestline, Ohio;* northeast corner of the east abutment of bridge 167.

Arch.—Is at *Crestline, Ohio;* northwest corner of the north coping of stone arch.

Shop.—Is at *Crestline, Ohio;* northeast corner of the carpenter shop.

Bridge 4.—Is at *Crestline, Ohio;* center of the north coping of bridge 4.

Bridge 11.—Is near *Robinson, Ohio;* top of the flange of pipe on the south side of bridge 11. (Not very good.)

Bridge 13.—Is near *Robinson, Ohio;* southwest corner of the south coping of bridge 13.

Depot.—Is at *Bucyrus, Ohio;* northeast corner of the doorsill of the men's waiting room in the depot.

Bridge 25.—Is near *Bucyrus, Ohio;* northeast corner of the east abutment of bridge 25.

Bridge 28.—Is near *Bucyrus, Ohio;* southeast corner of the south coping of bridge 28.

Bridge 35.—Is near *Bucyrus, Ohio;* northeast corner of the west abutment of bridge 35.

Bridge 37.—Is near *Bucyrus, Ohio;* northwest corner of the north coping of bridge 37.

Bridge 39.—Is near *Bucyrus, Ohio;* northeast corner of the north coping of bridge 39.

Bridge 40.—Is near *Nevada, Ohio;* northeast corner of the north coping of bridge 40.

Bridge 41.—Is near *Nevada, Ohio;* northeast corner of the north coping of bridge 41.

Bridge 45.—Is near *Nevada, Ohio;* northeast corner of the north coping of bridge 45.

Bridge 47.—Is near *Nevada, Ohio;* northeast corner of the north coping of bridge 47.

Bridge 51.—Is near *Nevada, Ohio;* northwest corner of the east ballast wall of bridge 51.

Bridge 54.—Is near *Nevada, Ohio;* northeast corner of the north coping of bridge 54.

Bridge 62.—Is near *Nevada, Ohio;* northeast corner of the north coping of bridge 62.

Bridge 65.—Is near *Upper Sandusky, Ohio;* northeast corner of the north coping of bridge 65.

Bridge 66.—Is near *Upper Sandusky, Ohio;* northeast corner of the north coping of bridge 66.

Bridge 69.—Is near *Upper Sandusky, Ohio;* northwest corner of the east back wall of bridge 69.

Bridge 73.—Is near *Upper Sandusky, Ohio;* northwest corner of the north coping of bridge 73.

Bridge 74.—Is near *Upper Sandusky, Ohio;* northwest corner of the east bridge seat of bridge 74.

Bridge 75.—Is near *Upper Sandusky, Ohio;* northwest corner of the east bridge seat of bridge 75.

Bridge 76.—Is near *Kirby, Ohio;* southwest corner of the east bridge seat of bridge 76.

Bridge 77.—Is near *Kirby, Ohio;* northeast corner of the north coping of bridge 77.

Bridge 81.—Is near *Kirby, Ohio;* northeast corner of the north coping of bridge 81.

Bridge 85.—Is near *Kirby, Ohio;* northeast corner of the north coping of bridge 85.

Bridge 86.—Is near *Kirby, Ohio;* northeast corner of the north coping of bridge 86.

Bridge 88.—Is near *Forest, Ohio;* northeast corner of the north coping of bridge 88.

Bridge 93.—Is near *Forest, Ohio;* southwest corner of the south coping of bridge 93.

Bridge 95.—Is near *Forest, Ohio;* top step of the northeast wing wall of bridge 95.

Bridge 98.—Is near *Forest, Ohio;* northwest corner of the east back wall of bridge 98.

Bridge 103.—Is near *Dunkirk, Ohio;* northeast corner of the step on the northwest wing wall of bridge 103.

Bridge 104.—Is near *Dunkirk, Ohio;* northeast corner of the north coping of bridge 104.

Building.—Is near *Dunkirk, Ohio;* southeast corner of the water table of Be. Building, north of the track on the west side of Main street.

Bridge 108.—Is near *Washington, Ohio;* southwest corner of the east bridge seat of bridge 108.

Bridge 110.—Is near *Washington, Ohio;* northeast corner of the west bridge seat of bridge 110.

Bridge 112.—Is near *Washington, Ohio;* northwest corner of the east abutment of bridge 112.

Bridge 114.—Is near *Ada, Ohio;* northwest corner of the east abutment of bridge 114.

Bridge 116.—Is near *Ada, Ohio;* northeast corner of the west abutment of bridge 116.

Bridge 119.—Is near *Ada, Ohio;* northeast corner of the west back wall of bridge 119.

Bridge 124.—Is near *Ada, Ohio;* northwest corner of the east abutment of bridge 124.

Bridge 132.—Is near *Ada, Ohio;* southwest corner of the south coping of bridge 132.

Bridge 135.—Is near *Ada, Ohio;* southeast corner of the south coping of bridge 135.

Bridge 138.—Is near *Lafayette, Ohio;* southeast corner of the south coping of culvert 138.

Bridge 141.—Is near *Lafayette, Ohio;* southeast corner of the south coping of culvert 141.

Bridge 148.—Is near *Lafayette, Ohio;* northwest corner of the east abutment of bridge 148.

Bridge 151.—Is near *Lafayette, Ohio;* northwest corner of the north coping of culvert 151.

Bridge 157.—Is near *Lima, Ohio;* northwest corner of the north coping of culvert 157.

Bridge 159.—Is near *Lima, Ohio;* northwest corner of the north coping of culvert 159.

Bridge 160.—Is near *Lima, Ohio;* southwest corner of the east back wall of bridge 160.

Bridge 163.—Is near *Lima, Ohio;* northeast corner of the north coping of bridge 163.

Depot.—Is at *Lima, Ohio;* northeast corner of the women's waiting room in the station at Lima.

U_1.—Is at *Lima, Ohio.* (See page 657, App. 8 of Report for 1899.)

DESCRIPTIONS OF PERMANENT BENCH MARKS BETWEEN SOLOMON AND ANTHONY, KANS.

W_2.—At *Solomon*, *Dickinson County*, *Kans.* (See App. 8 of Report for 1899, p. 647.)

X_2.—At *Solomon*, *Dickinson County*, *Kans.* (See App. 8 of Report for 1899, p. 647.) This bench mark has been destroyed.

C_1.—At *Solomon*, *Dickinson County*, *Kans.* (See App. 8 of Report for 1899, p. 579.)

D_1.—At *New Cambria*, *Saline County*, *Kans.* (See App. 8 of Report for 1899, p. 579.)

E_1.—Is near *New Cambria*, *Saline County*, *Kans.* (See App. 8 of Report for 1899, p. 579.)

Salina East Base △.—Is near *New Cambria*, *Saline County*, *Kans.* (See App. 8 of Report for 1899, p. 580.)

Salina West Base △.—Is near *Salina*, *Saline County*, *Kans.* (See App. 8 of Report for 1899, p. 580.)

F_1.—At *Salina*, *Saline County*, *Kans.* (See App. 8 of Report for 1899, p. 580.)

G_1.—At *Salina*, *Saline County*, *Kans.* (See App. 8 of Report for 1899, p. 580.)

H_1.—At *Salina*, *Saline County*, *Kans.* (See App. 8 of Report for 1899, p. 580.)

A_4.—Is in *Mentor*, *Saline County*, *Kans.*, T. 15, R. 2 W., on the right of way of the Salina and Southwestern Railway, 3.5 meters north of the station sign, 11.1 meters north of the public road. (See note 14, p. 581.)

B_4.—Is at *Assaria*, *Saline County*, *Kans.*, T. 16, R. 3 W., on the right of way of the Salina and Southwestern Railway, 18.8 meters north of the station and 3.8 meters north of the first telegraph pole north of the station, in line with the telegraph poles, between the tracks of the Salina and Southwestern Railway and a public road, being 9.3 meters west of the former and 10 meters east of the latter. (See note 14, p. 581.)

C_4.—Is at *Bridgeport*, *Saline County*, *Kans.*, T. 16, R. 3 W., on the right of way of the Salina and Southwestern Railway, nearly at the intersection of the north and west platforms of the depot, 2.8 meters north from the north face of the depot and 5.4 meters east of the center of the Salina and Southwestern Railway tracks. (See note 14, p. 581.)

D_4.—Is in *Lindsborg*, *McPherson County*, *Kans.*, T. 17, R. 3 W., on the east face of the large three-story brick grist mill, 25 paces west of the Salina and Southwestern Railway, owned by the Lindsborg Milling and Elevator Company (Incorporated), 1.82 meters south of the northeast corner of the mill and 3.05 meters north of the north side of the large doorway to the mill, on the east side. (See note 8, p. 581.)

E_4.—Is at *Johnstown*, *McPherson County*, *Kans.*, T. 18, R. 3 W., 4 meters directly east of the station post and 8.2 meters east of the center of the railroad track. (See note 14, p. 581.)

F_4.—Is at *Hilton*, *McPherson County*, *Kans.*, T. 19, R. 3 W., on the land of the Peavey Elevator Company, between the office and the elevator, 4.7 meters north of the north face of the elevator and 3.3 meters south of the south face of the office, 13.7 meters east of the center of the main track and 4.6 meters east of the center of the switch. (See note 14, p. 581.)

G_4.—Is at *McPherson*, *McPherson County*, *Kans.*, T. 19, R. 3 W., on the stone slab at the south side of the base of the standpipe which supplies McPherson with water, 55

paces northwest of the waterworks station, 54 paces east of the center of the main track of the Salina and Southwestern Railway. (See note 3, p. 580.)

H_4.—Is at *McPherson*, *McPherson County*, *Kans.*, T. 19, R. 3 W., on the stone steps of the main doorway on the south side of the McPherson Opera House, on the east end of the second stone step from the bottom, about 0.3 meter from the east stone column supporting the archway over the entrance. (See note 3, p. 580.)

I_4.—Is about 1½ miles west of *McPherson*, *McPherson County*, *Kans.*, T. 19, R. 3 W., on the right of way of the Chicago, Rock Island and Pacific Railway, at the junction of the Chicago, Rock Island and Pacific Railway with the Missouri Pacific Railway, in the southwest corner formed by the intersection of the two roads, 14 meters from the center of the Chicago, Rock Island and Pacific track and 16 meters from the center of the Missouri Pacific track. (See note 14, p. 581.)

J_4.—Is at *Groveland*, *McPherson County*, *Kans.*, T. 20, R. 4 W., on the property of the Chicago, Rock Island and Pacific Railway, 1.55 meters south of their elevator office, 27.5 meters east of the center of the main track, and 12.5 meters east of the center of the siding leading to their office. (See note 14, p. 581.)

K_4.—Is at *Inman*, *McPherson County*, *Kans.*, T. 21, R. 4 W., on the property of Mr. Henry Vogt, 0.7 meters north of the northwest corner of his lumber-yard office, 4.3 meters south of the hydrant adjacent to the office on the north side, about 250 feet east of the main track of the Chicago, Rock Island and Pacific Railway, and about 185 feet east of the center of the siding. (See note 14, p. 581.)

L_4.—Is at *Medora*, *Reno County*, *Kans.*, T. 22, R. 5 W., in the northwest corner of the lot owned by Mr. Benjamin Richard, upon which is a large building used as a hotel, the largest building in the town, 62 paces southeast of the southeast corner of the Chicago, Rock Island and Pacific Railway, and 20 paces north of the northwest corner of the hotel. (See note 14, p. 581.)

M_4.—Is about 1 mile east of *Hutchinson*, *Reno County*, *Kans.*, T. 22, R. 5 W., on the State Reformatory, on the north side of the southwest pavilion, on the sill of the second window from the northwest corner, 13 centimeters from the east side of the window and 1.06 meters from the west side. (See note 5, p. 580.)

N_4.—Is at *Hutchinson*, *Reno County*, *Kans.*, at the west entrance to the First Presbyterian Church, at the corner of Sherman and Poplar streets, on the north end of the top step. (See note 14, p. 581.)

O_4.—Is at *Hutchinson*, *Reno County*, *Kans.*, at the southwest entrance to the Citizens' Bank, at the corner of Second and Main streets, on the northwest end of the top step. (See note 3, p. 580.)

P_4.—Is at *Fernie*, *Reno County*, *Kans.*, a stock siding on the Hutchinson and Southern Railway (Atchison, Topeka and Santa Fe), in T. 22, R. 6 W., 4.7 meters south of the south fence of the stock yard, and 13.4 meters east of the center of the main track. (See note 14, p. 581.)

Q_4.—Is at *Darlow*, *Reno County*, *Kans.*, T. 24, R. 6 W., on the right of way of the Hutchinson and Southern Railway (Atchison, Topeka and Santa Fe), 7.2 meters south of the mail crane and 2.6 meters west of the center of the main track, 5.6 meters south of the south wall of the general merchandise store of Mrs. Ottir Umstat. (See note 14, p. 581.)

R_4.—Is at *Castleton, Reno County, Kans.*, T. 25, R. 6 W., on the right of way of the Hutchinson and Southern Railway, 5.7 meters east of the center of the main track and 2.0 meters north of the north face of the railroad station. (See note 14, p. 581.)

S_4.—Is at the town of *Pretty Prairie, Reno County, Kans.*, T. 26, R. 6 W., at the northeast corner of the property owned by Mr. Peter Kabiel, of Pretty Prairie, about 35 paces west of the center of the main track of the Hutchinson and Southern Railway (Atchison, Topeka and Santa Fe), and about 25 paces directly south of Hollingwood's granary. (See note 14, p. 581.)

T_4.—Is about one-fourth of a mile south and one-half mile east of *Pretty Prairie, Reno County, Kans.*, at the intersection of the range and section line at the northeast corner of section 24, township 26 S., about one-half mile northwest from triangulation station Pretty Prairie. (See note 14, p. 581.)

U_4.—Is at *Varner, Kingman County, Kans.*, T. 27 S., R. 7 W., on the right of way of the Hutchinson and Southern Railway, in line with the telegraph poles, 15 meters north of the center of the public road through Varner, 9.5 meters west of the center of the main track. (See note 14, p. 581.)

V_4.—Is at *Lashmet, Kingman County, Kans.*, T. 27 S., R. 7 W., on the right of way of the Hutchinson and Southern Railway, directly north of the station platform, 4 meters west of the center of the track, 34 meters north of the center of the public road at Lashmet, and 37 paces northeast of the northeast corner of the house owned by John Lashmet. (See note 14, p. 581.)

W_4.—Is at *Kingman, Kingman County, Kans.*, at the west entrance to the First National Bank, in the foundation stone which forms the top step, 0.16 meter south of the main wall of the building, 0.15 meter south of the north end of the stone step, and 0.22 meter east of the west edge. (See note 3, p. 580.)

X_4.—Is about 3⅛ miles south and 2¼ miles west of the city hall at *Kingman, Kingman County, Kans.*, T. 28 S., R. 8 W., 35.6 meters northwest of the schoolhouse and 350 paces directly east of the windmill which marks the triangulation station Kingman. (See note 14, p. 581.)

A copper bolt with cross in top is leaded into the north side of the stone, and intersection of the cross lines is 0.4427 meter below the bench mark.

Y_4.—Is at *Carvel, Kingman County, Kans.*, T. 29 S., R. 8 W., on the right of way of the Hutchinson and Southern Railway, and 1.15 meters northwest from the northwest face of the mill owned by D. N. Barnhill, of Carvel, 16.3 meters southwest from the center of the main track of the railway. (See note 14, p. 581.)

Z_4.—Is at *Basil, Kingman County, Kans.*, T. 29 S., R. 7 W., 29 paces west of the center of the side track at Basil, on the property of Mr. N. J. Blake, of Basil, in line with the front line of his porch, 0.7 meter from the northeast corner. (See note 14, p. 581.)

A_5.—Is at *Rago, Kingman County, Kans.*, T. 30 S., R. 7 W., 34 paces southeast of the intersection of the Englewood and the Hutchinson and Southern branches of the Atchison, Topeka and Santa Fe Railway, 18 paces directly south of the Englewood branch, on the northwest corner of the property of Dave Stratton, of Rago. (See note 14, p. 581.)

B_5.—Is at *Duquoin, Harper County, Kans.*, T. 31 S., R. 7 W., 44 paces directly west of the Atchison, Topeka and Santa Fe tracks, pacing from a point about 30 feet north of the depot, 3.18 meters northeast of the northeast corner of a building occupied by Mr. Maxwell as a general merchandise store. (See note 14, p. 581.)

C_5.—Is at *Harper, Harper County, Kans.*, T. 32 S., R. 7 W., in the west face of a building on the northeast corner of Central avenue and Main street, controlled by Attorney Nashburn, of Harper, and occupied as a barber shop by M. E. Parker, and an implement and supply house by Clarence Rogers. It is on the sixteenth brick above the foundation and on the third brick from the north side of the window in the southwest corner of the building. (See note 8, p. 581.)

D_5.—Is at *Ascot, Harper County, Kans.*, T. 33 S., R. 7 W., on the right of way of the Hutchinson and Southern Railway, between the switch and main track, 7.1 meters west of the center of the main track and 7.2 meters east of the center of the switch; in line with the station sign at Ascot. (See note 14, p. 581.)

E_5.—Is at *Anthony, Harper County, Kans.*, exactly 1 kilometer northwest of Anthony Southeast Base, along the line of the base and about 150 paces east of the Atchison, Topeka and Sante Fe tracks. (See note 14, p. 581.)

Anthony S. E. B. △.—Is at the triangulation station Anthony Southeast Base, 1⅛ miles north of the schoolhouse at *Anthony, Kans.*, about 89 meters east of Springfield avenue, on the north side of a road, on the property of R. R. Beam. (See note 31, p. 583.)

Anthony N. W. B. △.—Is at the trangulation station Anthony Northwest Base, about equally distant from the towns of *Anthony* and *Harper, Harper County, Kans.*, on land belonging to W. W. Millican, of Thorntown, Ind. (See note 31, p. 583.)

F_5.—Is at *Anthony, Harper County, Kans.*, T. 33 S., R. 7 W., on the property of the Poorman Milling Company, 3 paces north of their office, 21 paces from the middle of the road east of their office. (See note 14, p. 581.)

DESCRIPTIONS OF PERMANENT BENCH MARKS BETWEEN BOWIE, TEX., AND ANTHONY, KANS.

1124 Gainv.—Is a bench mark of the U. S. Geological Survey at *Bowie, Montague County, Tex.*, at Brown Hotel, known in 1902 as *Bowie* Hotel, 100 feet east of the Fort Worth and Denver City Railway station, at the southwest corner of the street, and is an iron post marked 1124 Gainv.

A.—Is at *Bowie, Montague County, Tex.*, about 300 meters north of the Chicago, Rock Island and Texas Railway station, about 25 feet west of the main track of the Chicago, Rock Island and Texas Railway, and 10 feet below the same, on the west side of a stone culvert, 3½ feet from the southwest corner, 3 inches from the edge of the stone. (See note 5, p. 580.)

B.—Is at *Bowie, Montague County, Tex.*, on the north side of the City National Bank building, in the fourth brick west of the third double window and 4 feet from the ground. (See note 8, p. 581.)

C.—Is 6 miles west of *Bowie, Montague County, Tex.*, about 30 feet south of the railroad track, in a rock *in situ*, on a line between the third and fourth telegraph poles west of mile pole 75 on the Fort Worth and Denver City Railway, 20 inches from the north and 16 inches from the west edges of the stone. (See note 7, p. 580.)

Bowie N. W. Base △.—Is about a mile southeast of *Bellevue, Clay County, Tex.*, on a prominent knoll on the farm belonging to the Orton brothers. (See note 31, p. 583.)

Bowie S. E. Base △.—Is at the triangulation station Bowie Southeast Base, near *Bellevue, Clay County, Tex.*, on the highest part of a prominent ridge on the farm of C. H. Bodeker. (See note 31, p. 583.)

D.—Is 5 miles northwest of *Bowie, Tex.*, just south of milepole No. 539, on the west side of the track of the Chicago, Rock Island and Texas Railway, in the northwest corner of the south concrete abutment of a bridge. (See note 7, p. 581.)

989 Gainv.—Is a bench mark of the United States Geological Survey, and consists of an iron post marked 989 Gainv., 4 miles northwest of *Bowie, Montague County, Tex.*, 40 feet east of the Chicago, Rock Island and Texas Railway track, at a public road crossing, 210 feet south of milepole 540.

E.—Is at *Stoneburg, Montague County, Tex.*, on the southwest corner of the southwest one of the four inner stone blocks supporting the railway water tank, 4 inches from either edge. (See note 7, p. 581.)

936 Gainv.—Is a bench mark of the United States Geological Survey, and consists of an iron post marked 936 Gainv., at *Stoneburg, Montague County, Tex.*, 500 feet west of the Chicago, Rock Island and Texas Railway station, at the northeast corner of the post-office building.

876 Gainv.—Is a bench mark of the United States Geological Survey, and consists of an iron post marked 876 Gainv., 4½ miles northwest of *Stoneburg, Montague County, Tex.*, 50 feet west of the railroad track, on the right of way, 50 feet south of milepole 531, opposite Walker's ranch.

897 Gainv.—Is a bench mark of the United States Geological Survey, and consists of an iron post marked 897 Gainv., 3 miles south of *Ringgold* and 7½ miles northwest of *Stoneburg*, in *Montague County, Tex.*, at the intersection of a public road and railroad crossing, 300 feet north of milepost 528, 46 feet east of the railroad track.

F.—Is south of *Ringgold, Montague County, Tex.*, 2½ telegraph poles north of milepole 528.5, on the west side of Chicago, Rock Island and Texas Railway, 30 feet from the track and nearly in line with the poles, about in the center of the larger of two rocks *in situ*. (See note 7, p. 581).

894 Gainv.—Is a bench mark of the United States Geological Survey, and consists of an iron post marked 894 Gainv., at *Ringgold, Tex.*, 180 feet east of the Missouri, Kansas and Texas Railway station, at the end of the platform, between the main tracks and the switch.

G.—Is in Texas, about a mile south of *Terral, Ind. T.*, north of *Ringgold, Montague County, Tex.*, and on the Chicago, Rock Island and Texas Railway bridge No. 3219, over Red River, in the top of the west side of the south concrete abutment, 8 inches from the north edge and 5 feet from the west edge. (See note 7, p. 581.)

809 Terral.—Is a bench mark of the United States Geological Survey, 1 mile south of *Terral, Ind. T.*, and consists of a copper bolt in the west end of the north pier of the Chicago, Rock Island and Texas Railway bridge over Red River, marked 809.

A.—Is at *Terral, Ind. T.*, in the northwest corner of the southeast pier supporting the railway water tank, 5 inches from either edge. (See note 7, p. 581.)

B.—Is 5 miles north of *Terral, Ind. T.*, in the west side of the stone culvert of the Chicago, Rock Island and Pacific Railway, south of milepole 514, 25 feet west of and 20 feet below the railroad track. (See note 7, p. 581.)

C.—Is 1 mile north of *Ryan, Ind. T.*, on the Chicago, Rock Island and Pacific Railway bridge No. 3212, over Beaver Creek, in the east side of the south abutment, 6 inches from the east and north edges of the stone. (See note 7, p. 581.)

827 Ryan.—Is a bench mark of the United States Geological Survey, 1 mile north of *Ryan, Ind. T.*, on the outside anchor bolt on the west side of the south pier of bridge 3212, over Beaver Creek. The bench mark is the highest point of the bolt.

Geol. Sugden.—Is a bench mark of the United States Geological Survey, a half-mile south of *Sugden, Ind. T.*, about 600 feet west of the railroad track and 1 000 feet east of "844 Sugden," and consists of an iron post without any elevation on the cap.

844 Sugden.—Is a bench mark of the United States Geological Survey, one-half mile south of *Sugden, Ind. T.*, at the standard corner of T. 5 S., Rs. 7 and 8 W., about 1 600 feet west of the point of intersection of the railroad with the first standard parallel south, and consists of an iron post stamped 844. It was reported in 1902 that this post was very loose in the ground and could easily be pulled up.

D.—Is at *Sugden, Ind. T.*, about 500 feet north of the railroad station, on the east side of the track in the angle of the right of way fence and the fence crossing the track, 4 feet from each fence and 45 feet from the nearest rail of the main track, and consists of a marble post 30 inches long, dressed to 6 by 6 inches and marked as in note 12 (p. 581).

875 Boundary.—Is a bench mark of the United States Geological Survey, 6 miles north of *Sugden, Ind. T.*, on the Indian Territory and Oklahoma boundary line, 600 feet west of the railroad track and about 2 000 feet south of milepole 500 on the Chicago, Rock Island and Pacific Railway. It consists of an iron post marked 875 feet and is milepost No. 10 on the boundary from the Red River.

883 Addington.—Is a bench mark of the United States Geological Survey in *Oklahoma Territory*, 4½ miles south of *Addington, Ind. T.*, about 1 100 feet north of milepole 499, in the coping stone on the west end of the south pier of bridge 3202 over Cow Creek, and consists of a square hole cut in the stone.

918 Addington.—Is a bench mark of the United States Geological Survey at *Addington, Ind. T.*, and consists of a square hole cut in the northwest corner of the top stone of the north foundation and in the second tier from the front of the water tank. (See note 5, p. 580.)

E.—Is near *Addington, Ind. T.*, in the angle formed by the east right of way fence of the railroad and the first fence crossing the railroad track south of the station, about 200 feet east of the track, and consists of a marble post dressed to 6 by 6 inches and marked as in note 12, p. 581.

F.—Is about 3½ miles north of *Addington, Ind. T.*, on the east side of the north abutment of a culvert just south of mile pole 490, in the first step below the coping stone, 6 inches from either edge. (See note 7, p. 581.)

G.—Is a mile and a half south of *Comanche, Ind. T.*, just south of mile pole 486, on the east side of the north abutment to bridge No. 3187, 12 inches from the east and south edges of the stone. (See note 5, p. 580.)

H.—Is at *Comanche, Ind. T.*, in a stone building owned by J. S. Minton, in the second stone column west of the entrance to the part of the building occupied by the owner, about 4 feet above the sidewalk. (See note 8, p. 581.)

I.—Is 4 miles north of *Comanche, Ind. T.*, in the coping of a railway culvert, 7 poles north of mile pole 481, on the west side of the track, in the northwest corner of the coping, about 6 inches from either edge. (See note 7, p. 581.)

J.—Is at *Duncan, Ind. T.*, in the northeast corner of a pier supporting the railway water tower on the south and east side, 4 inches from either edge, and in the lower tier. (See note 7, p. 581.)

1127 Duncan.—Is a bench mark of the United States Geological Survey, one-third of a mile north of *Duncan, Ind. T.*, on the Indian Base Line, at the quarter-section corner between T. 1 N., R. 7 W., sec. 32 and T. 1 S., R. 7 W., sec. 5, 1 000 feet west of the track, and consists of an iron post, 8 inches out of the ground, stamped 1127.

1104 Boundary.—Is a bench mark of the United States Geological Survey, on the Oklahoma-Indian Territory boundary, 2½ miles west of *Duncan, Ind. T.*, and about one-half mile south of where the Duncan-Lawton wagon road crosses the boundary. It consists of an iron post marked 1104, and is milepost No. 33 on the boundary from the Red River.

Duncan △.—Is at Duncan triangulation station, in sec. 16, T. 1 S., R. 8 W., about 5 miles west and 1½ miles south of *Duncan, Ind. T.*, on the top of a high flat hill with woods on the east and north. The bench mark is one decimeter west of the △. (See note 22, p. 582.) Check bench mark is an iron spike 10 inches long driven flush with the ground 6 decimeters from the east leg of the inner tripod and in a line with the leg and station mark, and is 0.0271 meter below B. M. Duncan △.

K.—Is 2½ miles south of *Marlow, Ind. T.*, 1½ poles north of mile pole 468, on a 2½-foot iron pipe culvert, 10 feet below the tracks and 20 feet from the rail, and consists of a cross on the highest point on the east end of the pipe.

L.—Is at *Marlow, Ind. T.*, on the east side of the First National Bank building, 6 inches from the south end of the water table to double window, and consists of a square marked by lines 1 inch on a side.

Marlow Long. Sta.—Is at *Marlow, Ind. T.*, on the northeast corner of the public school lot at the southwest corner of Fifth street and Brummett avenue, on a concrete pier (red sandstone and Portland cement), used by E. Smith, in 1899, for longitude observations. The longitude station is marked by a bronze station mark similar to that described in note 31, p. 583. The bench mark is at the cross marking the station.

1331 Marlow.—Is the bench mark of the United States Geological Survey, 2½ miles north of *Marlow, Ind. T.*, at the section corner between T. 2 N., R. 7 W., secs. 5 and 4, and T. 3 N., R. 7 W., secs. 32 and 33, 50 feet west of the track, and consists of an iron post 12 inches out of the ground, stamped 1331.

M.—Is 4½ miles north of *Marlow, Ind. T.*, in the coping stone to the east side of an arched stone culvert, 6 inches from the south and east edges of the stone. (See note 7, p. 581.)

N.—Is at *Rush Springs, Ind. T.*, in the northwest stone pier of the center set of supports to the railway water tank. (See note 5, p. 580.)

1349 Rush Springs.—Is a bench mark of the U. S. Geological Survey 1 mile north of township line, at *Rush Springs, Ind. T.*, on the left side of the main entrance to the Masonic building, and consists of a bronze tablet in the middle of the northeast face of the second stone above the sidewalk, stamped 1349.

1292 Rush Springs.—Is a bench mark of the United States Geological Survey, 6 miles north of *Rush Springs, Ind. T.*, on the first standard parallel north, between T. 4 N., R. 7 W., sec. 4, and T. 5 N., R. 7 W., sec. 33, 37.9 feet west of the track, 15.3 feet south of the twentieth telegraph pole north of mile pole 451, and consists of an iron post 10 inches above ground, stamped 1292.

T. B. M. 95.—Is at siding No. 2, 6 miles south of *Ninnekah, Ind. T.*, on the top of a section of iron rail used as a marker for mile pole 449.

O.—Is 4 miles south of *Ninnekah, Ind. T.*, on the coping stone to a culvert, 4½ poles north of mile pole 447½, on the west side of the track, 4 inches from west and 28 inches from the south edges of the stone. (See note 5, p. 580.)

P.—Is one-half mile north of *Ninnekah, Ind. T.*, on the west side of the south abutment of the bridge over Little Washita River, in the bridge seat, 6 inches from the north and 30 inches from the west edge of the stone. (See note 7, p. 581.)

1084 Chickasha.—Is a bench mark of the United States Geological Survey, 1¾ miles south of *Chickasha, Ind. T.*, at the quarter-section corner between T. 6 N., R. 7 W., sec. 3, and T. 7 N., R. 7 W., sec. 34, about 180 feet west of the track, and consists of an iron post 8 inches out of the ground, stamped 1084.

1091 Chickasha.—Is a bench mark of the United States Geological Survey in *Chickasha, Ind. T.*, at the northeast corner of a brick building owned by J. C. Griggers, situated at the corner of Chickasha avenue and Second street, and consists of a bronze tablet set in the middle of the east face of the foundation stone, and stamped 1091.

Q.—Is at *Chickasha, Ind. T.*, in the top step of the eastern entrance to the First National Bank building, about 12 inches from the north end of the step and 5 inches from the iron grating. (See note 7, p. 581.)

R.—Is three-fourths of a mile north of *Chickasha, Ind. T.*, on the southwest corner of the north abutment of the Chicago, Rock Island and Pacific Railway bridge No. 3164, 4 inches from the west and 12 inches from the south edge of the stone. (See note 5, p. 580).

1105 Boundary.—Is a bench mark of the United States Geological Survey, about 4 miles west of *Chickasha, Ind. T.*, and about 200 feet south of the Anadarka branch of the Chicago, Rock Island and Pacific Railway, and consists of an iron post marked 1105 ft., and is milepost No. 73 on the boundary from the Red River.

S.—Is 2½ miles north of *Chickasha, Ind. T.*, on the northeast corner of the south abutment to the Chicago, Rock Island and Pacific Railway bridge over Washita River, about 6 inches from the north and east edges of the stone. (See note 5, p. 580.)

T. B. M. 114.—Is 4 miles north of *Chickasha, Ind. T.*, and consists of an iron rail on end, used as a marker for mile pole 432.

Carson △.—Is about 3 miles south of *Minco* in the *Chickasaw Nation, Ind. T.*, in sec. 8 T. 9 N., R. 7 W., on the property of Kit Carson of Minco, on old trail or road from Minco to Chickasha, on the highest point of a bold ridge three-fourths of a mile west of the Chicago, Rock Island and Pacific Railway. The bench mark is 1 decimeter west of the △, between the U. and the S. (See note 22, p. 582.)

1284 Minco.—Is a bench mark of the United States Geological Survey, 1½ miles south of *Minco, Ind. T.*, at the quarter-section corner between T. 9 N., R. 7 W., sec. 4, and T. 10 N., R. 7 W., sec. 33, about 150 feet east of the track, and consists of an iron post stamped 1284.

T.—Is at *Minco, Ind. T.*, on the southeast corner of the northeast pier supporting the central part of the railway water tank, about 3 inches from either edge. (See note 5, p. 580.)

U.—Is at *Minco, Ind. T.*, on the water table to the double window on the north side of the Bank of Minco, about 4 inches from the west end. (See note 5, p. 580.)

1266.5 Union.—Is a bench mark of the United States Geological Survey, about 2 miles south of *Union, Canadian County, Okla.*, about 1,000 feet north of the Chicago, Rock Island and Pacific Railway bridge crossing the Canadian River, in line with the telegraph poles on the west side of the track, close to the third pole north of mile pole 414, and consists of an iron post, 15 inches out of the ground, marked 1266.5 ft.

A.—Is at *Union, Canadian County, Okla.*, in an angle of the fence, about 1,000 feet north of the station, 70 feet east of the track. (See note 12, p. 581.)

Elreno E. B. △.—Is at the triangulation station Elreno East Base, 5 miles south of *Elreno, Canadian County, Okla.*, on the land of Mr. G. L. Newman, 1.2 kilometers east of the track of the Chicago, Rock Island and Pacific Railway. (See note 31, p. 583.)

Elreno W. B. △.—Is at the triangulation station Elreno West Base, about 7 miles southwest of *Elreno, Canadian County, Okla.*, on the land of Mr. J. T. Seawell. (See note 31, p. 583.)

T. B. M. 142.—Is at *Elreno, Canadian County, Okla.*, across the tracks from and in line with the south end of the railroad station, and consists of the top of a section of iron rail in the ground.

B.—Is at *Elreno, Canadian County, Okla.*, on the north side of the Minneapolis Threshing Machine Company building, which is close to the railroad track and one-fourth of a mile north of the Chicago, Rock Island, and Pacific Railway station, on west side of doorstep to office entrance. (See note 5, p. 580.)

1357 Elreno.—Is a bench mark of the United States Geological Survey, at *Elreno, Canadian County, Okla.*, on the northeast face of the First National Bank, on the right-hand side of the entrance, on the second stone above the sidewalk, and consists of a bronze plate marked 1357 ft.

City Elreno.—Is a bench mark of the city engineers in *Elreno, Canadian County, Okla.*, on Bickford avenue between Hays and Woodson streets, on a building with a galvanized iron front, painted and sanded to represent white stone, facing east, with a drug store occupying the north room (1902), and consists of the center of an iron step in the stairway.

1327 Reno Junction.—Is a bench mark of the United States Geological Survey at *Reno Junction, Canadian County, Okla.*, at the crossing of the Choctaw, Oklahoma and Gulf Railway, and the Chicago, Rock Island and Pacific Railway, 54 feet south of the former, 44 feet east of the latter, and consists of an iron post marked 1327 feet.

C.—Is at *Darlington, Canadian County, Okla.*, in the southeast corner of the northeast pier supporting the central part of the railway water tank. (See note 5, p. 580.)

T. B. M. 148.—Is one-half mile north of *Caddo, Canadian County, Okla.*, on the top of a section of iron rail in the ground used as a marker for mile pole 396.

D.—Is at *Okarche, Canadian County, Okla.*, 6 telegraph poles north of the station and 3½ poles south of mile pole 388, in an angle of the fence, 30 feet west from and 6 feet above the tracks. (See note 12, p. 581.)

E.—Is at *Kingfisher, Kingfisher County, Okla.*, on the northeast corner of the southeast pier supporting the central part of the water tank. (See note 5, p. 580.)

F.—Is at *Kingfisher, Kingfisher County, Okla.*, on south corner of iron shoe plate upon concrete, on which rests south iron column supporting standpipe to city water plant, and consists of a square bounded by edges of plate and two chisel marks.

G.—Is at *Kingfisher, Kingfisher County, Okla.*, on the east side of the Kingfisher National Bank, on the window sill of the third window from the corner, eight inches from the south edge of the sill. (See note 5, p. 580.)

H.—Is at *Dover, Kingfisher County, Okla.*, on the southwest corner of the base stone to the northwest pier supporting the outer part of the railway water tank. (See note 5, p. 580.)

I.—Is at *Hennessey, Kingfisher County, Okla.*, on the northeast corner of the southeast pier supporting the central part of the railway water tank. (See note 5, p. 580.)

J.—Is in *Hennessey, Kingfisher County, Okla.*, on S. N. Bree's (1901) brick building near the corner of Main street and Oklahoma avenue, near the base of the iron column at the left of the entrance, and consists of the center of a square formed by the edges of the base plate and two chisel marks.

K.—Is at *Bison, Garfield County, Okla.*, between the sixth and seventh poles north of the station, 10 feet from the seventh pole and one pole south of the switch stand. (See note 12, p. 581.)

L.—Is at *Waukomis, Garfield County, Okla.*, in the large brick public school building on the west side, in the northwest corner pilaster, 9 inches from the corner and 4 feet above the ground, in the center of a brick. (See note 8, p. 581.)

Waukomis △.—Is one-half mile northwest of *Waukomis, Garfield County, Okla.*, sec. 23, T. 21 N., R. 7 W., on the property of J. Crick, about 100 meters northwest of of his dwelling. The bench mark is 5 inches west of the △. (See note 22, p. 582.)

Waukomis E.—Is one-half mile northwest of *Waukomis, Garfield County, Okla.*, 210.050 meters east of Waukomis △, in the northeast corner of J. Crick's garden near the public road. The bench mark is the flat part of the concrete near the projecting point of the spike used as a reference mark for Waukomis △.

M.—Is at *Enid, Garfield County, Okla.*, about 1 600 feet north of the Chicago, Rock Island and Pacific Railway station, in the northeast corner of the south concrete abutment to bridge (1902), 9 inches from the east and north edges of the concrete. (See note 35, p. 583.)

N.—Is at *Enid, Garfield County, Okla.*, at the eastern entrance to the First National Bank on Broadway street, on the north end of the lowest step, about 4 inches from the north column to the arch of the doorway and 5 inches above the sidewalk. (See note 5, p. 580.)

O.—Is at *North Enid, Garfield County, Okla.*, on the southeast corner of the foundation stone of the east one of the outer supports on the south side of the railway water tank. (See note 5, p. 580.)

Enid △.—Is about 2 miles north and 2½ miles east of *North Enid, Garfield County, Okla.*, in sec. 22, T. 23 N., R. 6 W., on a prominent ridge, in the line of fence on south side of the road (the northern boundary of property of Mr. Smith), about 76 meters from corner of sections 14, 15, 22, and 23. The bench mark is 5 inches north of the △, and is marked by the head of a nail driven flush with the bottom of the square. (See note 22, p. 582.)

P.—Is at *Kremlin, Garfield County, Okla.*, 12 feet south of the sixth telegraph pole north of the station. (See note 12, p. 581.)

Q.—Is at *Pond Creek, Grant County, Okla.*, on the stone doorstep of the schoolhouse (1895), 4 inches from the eastern side of the arch to the south doorway and 2 inches from the edge of the stone. (See note 5, p. 580.)

R.—Is one-half mile south of *Jefferson, Grant County, Okla.*, on the northwest corner of the southwest foundation stone supporting the column to the central part of the railway water tank. (See note 5, p. 580.)

S.—Is at *Medford, Grant County, Okla.*, in the southeast angle formed by the Chicago, Rock Island and Pacific Railway and the Atchison, Topeka and Santa Fe Railway, about 60 feet from each track. (See note 12, p. 581.)

T.—Is at *Medford, Grant County, Okla.*, in the east face of a brick school building, 4 feet above the ground, near the center of the third brick from the northeast corner. (See note 35, p. 583.)

U.—Is at *Medford, Grant County, Okla.*, on the southwest corner of the east one of the outer supports on the north side of the Atchison, Topeka and Santa Fe Railway water tank. (See note 5, p. 580.)

V.—Is at *Clyde, Grant County, Okla.*, 10 feet west of the third telegraph pole east of and across the tracks from the Atchison, Topeka and Santa Fe Railway station. (See note 12, p. 581.)

W.—Is at *Wakita, Grant County, Okla.*, on the south face of the east column of the Masonic Hall, on Main street, in the middle brick in the seventeenth tier from the sidewalk. (See note 35, p. 583.)

X.—Is at *Gibbon, Grant County, Okla.*, 2 poles east of and across the tracks from the station sign, 10 feet west of the second telegraph pole west of mile pole 305. (See note 12, p. 581.)

Y.—Is at *Manchester, Grant County, Okla.*, in the north face of the Odd Fellows Hall, in the center of the brick column at the northeast corner, in fifteenth tier above stone foundation. (See note 35, p. 583.)

G_5.—Is at *Spring, Harper County, Kans.*, six feet north of the telegraph pole at the station sign, on the right of way of the Atchison, Topeka & Santa Fe Railway. (See note 12, p. 581.)

F_5.—Is at *Anthony, Harper County, Kans.* (See p. 774.)

Anthony S. E. B. △.—Is 1⅛ miles north of *Anthony, Harper County, Kans.* (See p. 774.)

DESCRIPTIONS OF PERMANENT BENCH MARKS FROM BOWIE, TEX., TO SHREVEPORT, LA.

1124 Gainv.—Is at *Bowie, Montague County, Tex.* (See p. 774.)

B.—Is at *Bowie, Montague County, Tex.* (See p. 774.)

H.—Is at *Fruitland, Montague County, Tex.*, in the west side of the stone chimney on the south side of the house owned by W. H. Scarborough; about 5 feet from the ground and 6 inches from edge of the chimney. (See note 35, p. 583.)

I.—Is at *Sunset, Montague County, Tex.*, in the middle column of store owned by Dr. H. F. Schoolfeld, in the center of the fourth stone above the sidewalk. (See note 35, p. 583.)

J.—Is at *Alvord, Wise County, Tex.*, in the stone column at the east side of the Masonic Building (occupied by bank), in the center of the third block above the sidewalk. (See note 35, p. 583.)

K.—Is at *Cowen, Wise County, Tex.*, 40 feet from the track, on the east side and in line with the station sign, and 3 feet from the right-of-way fence. (See note 36, p. 584.)

L.—Is at *Decatur, Wise County, Tex.*, at the northwest corner of the public school building (1883), about 4 feet above the ground, in the center of the north side of the second sandstone block. (See note 35, p. 583.)

M.—Is at *Herman, Wise County, Tex.*, about 3 feet inside of the right-of-way fence, and 50 feet east of the railroad track and in line with the station sign. (See note 36, p. 584.)

N.—Is at *Rhome, Wise County, Tex.*, in the north corner of the railroad lot (used by pumping houses and water tank), 2 feet from west fence and 3 feet from east fence, near the fourth telegraph pole north of railroad station. (See note 36, p. 584.)

O.—Is at *Avondale, Tarrant County, Tex.*, 6 feet south of the third telegraph pole south of and across the tracks from railroad station, and 30 feet from the tracks, in line with the telegraph poles. (See note 36, p. 584.)

P.—Is 1¼ miles north of *Saginaw, Tarrant County, Tex.*, on an arched concrete abutment of the Chicago, Rock Island and Pacific Railway, 4 telegraph poles north of mile pole 10 of Fort Worth and Denver City Railway, on the east side of the abutment, in the northeast corner, 9 inches from either edge. (See note 35, p. 583.)

Q.—Is about 1½ miles north of Trinity River crossing at *Fort Worth, Tarrant County, Tex.*, in the northwest corner of the west side of an arched concrete culvert at mile pole 608 (Chicago, Rock Island and Pacific Railway track) 8 inches from the north and 4 inches from the west edge. (See note 35, p. 583.)

R.—Is about 3 miles north of Union Station at *Fort Worth, Tex.*, on a large stone pier (the first from the north bank of Trinity River) of the Chicago, Rock Island and Pacific Railway bridge No. 3306, on the northwest corner of the west side, 8 inches from either edge. (See note 5, p. 580.)

S.—Is about 2 miles north of Union Station at *Fort Worth, Tarrant County, Tex.*, on the south end of the west pier supporting the Missouri, Kansas and Texas track (over the Chicago, Rock Island and Pacific Railway track) at the north end of the freight yards of the Chicago, Rock Island and Pacific Railway, on the lowest step at the southeast corner, 6 inches from either edge. (See note 5, p. 580.)

T.—Is a mile north of Union Station at *Fort Worth, Tarrant County, Tex.*, on the

northwest corner of the large block forming the lowest step to the west side of the south abutment supporting the Fort Worth and Denver City Railway track (over the Chicago, Rock Island and Pacific Railway track), 4 inches from the adjacent edges of the stone and 3½ feet from the ground. (See note 5, p. 580.)

U.— Is at *Fort Worth, Tarrant County, Tex.*, at the west side of the south abutment where the railroad tracks pass over the Fort Worth and Dallas Electric Line tracks, on the second step from the top, 6 inches from the adjacent edges of stone. (See note 5, p. 580.)

Hydrant 1.—Is a city bench mark at *Fort Worth, Tarrant County, Tex.*, and is a cross made by a chisel mark on the top of the old water hydrant near the crossing of the main tracks of the Texas and Pacific and the Missouri, Kansas and Texas Railways, 9 paces south of the Texas and Pacific track, 9 paces west of the Missouri, Kansas and Texas track, 7 paces east of the Houston and Texas Central track, and 5 paces west of Santa Fe Railroad track. On account of "filling in" only a few inches of the hydrant projects above the ground.

Hydrant 2.—Is a city bench mark at *Fort Worth, Tarrant County, Tex.*, and is the top of the water hydrant at the northeast corner of the city hall, on Throckmorton street.

V.—Is at *Fort Worth, Tarrant County, Tex.*, at the northeast corner of the city fire department building (central station), on Throckmorton street, between Eighth and Ninth, near the center of the east face of a block of stone in the fourth tier and about 4 feet from the ground, 15 inches from the corner of the building, 13 inches from a window. (See note 35, p. 583.)

W.—Is at *Handley, Tarrant County, Tex.*, in the center of the middle pilaster on the northeast side of the power house of the Northern Texas Traction Company, about 4 feet from the ground. (See note 35, p. 583.)

X.—Is at *Arlington, Tarrant County, Tex.*, at the east side of the north face of the Citizens' National Bank building, in the middle brick of the eastern brick column, about 4½ feet above the ground. (See note 35, p. 583.)

Y.—Is at *Grand Prairie, Dallas County, Tex.*, in line with the telegraph poles, 15 feet west of the first pole west of mile pole 234, about 200 feet west of and across the tracks from the station. (See note 36, p. 584.)

Z.—Is at *Eagle Ford, Dallas County, Tex.*, in an angle formed by a wagon road and the railroad right-of-way fence, 32 paces south of the tracks and opposite the station. (See note 36, p. 584.)

A_2.—Is at *Dallas, Dallas County, Tex.*, in the west corner of the buttress to the county court-house, in the second tier of stone, about 2½ feet from the ground. The bolt points almost to the intersection of Houston and Main streets. (See note 35, p. 583.)

B_2.—Is at *Dallas, Dallas County, Tex.*, at the east side of the doorstep to the north entrance, on Main street, of the United States custom-house and post-office building, 8 inches from the eastern column of the doorway, 8 inches from the wooden door frame, and 13 inches from the outer edge of the stone doorstep. (See note 35, p. 583.)

C_2.—Is at *Dallas, Dallas County, Tex.*, at the southeast corner of the city hall, corner of Commerce and Akard streets, on the side facing the Oriental Hotel, 4 feet above the sidewalk, in the third tier, near the center of a stone. (See note 35, p. 583.)

D_2.—Is at *Fisher, Dallas County, Tex.*, just within the right-of-way fence, 14 paces south of the tracks and about 350 feet west of the station sign. (See note 36, p. 584.)

E_2.—Is at *Garland, Dallas County, Tex.*, in the stone window sill of the western window on the north side of the Citizens' Bank, about 2 inches from the edge of the sill and 4 inches from the west frame of the window, and about 4 feet from the ground. (See note 5, p. 580.)

F_2.—Is at *Rowlett, Dallas County, Tex.*, in the angle formed by the right-of-way fence and the fence at a road crossing about 700 feet east of the station, 16 paces north of the center of the railroad track, 4 paces west from the crossing, and between the fourth and the fifth telegraph poles east of the station. (See note 36, p. 584.)

G_2.—Is at *Rockwall, Rockwall County, Tex.*, at the southwest corner of the county court-house, in the south face, 4 feet above the ground, in the fourth tier from the foundation and about midway between the corner of the building and a window. (See note 35, p. 583.)

H_2.—Is at *Fate, Rockwall County, Tex.*, in the middle brick column of the double building owned by Low & Sawyer, in the front facing south and about 4 feet from ground. (See note 35, p. 583.)

I_2.—Is at *Royse, Rockwall County, Tex.*, in the center of a large stone block at the left of the entrance to the Royse City Bank, on the west side, about 16 inches above sidewalk. (See note 35, p. 583.)

J_2.—Is about 200 feet east of the railroad station at *Caddo Mills, Hunt County, Tex.*, 8 feet west of the second telegraph pole east of the station, about 20 feet north of the track, in line with the telegraph poles. (See note 36, p. 584.)

K_2.—Is at *Greenville, Hunt County, Tex.*, on the Central schoolhouse on Weslie street, on the part of the building jutting out to form the main entrance, in a stone in the fifth tier above the ground, the course of stone which runs entirely around the building, about 4½ feet from the north side of the main entrance, and 10 inches from the edge of the stone. (See note 35, p. 583.)

L_2.—Is at *Greenville, Hunt County, Tex.*, in the column to the right of the corner entrance to the building known as Beckham Hotel Annex, on the side facing Lee street, in the center of the fourth tier of stone, and about 4 feet from the ground. (See note 35, p. 583.)

M_2.—Is at *Greenville, Hunt County, Tex.*, in the top step to the main (Lee street) entrance to the county court-house, near the base of the right-hand columns of two false arches forming part of the entrance, 5 inches from adjacent corners of the columns. (See note 35, p. 583.)

N_2.—Is 5 miles east of *Greenville, Hunt County, Tex.*, 6 feet west of the telegraph pole south of and directly opposite the switch stand at the east end of the *new* siding (to be called *Husband*), near mile pole 719, on a T-shaped section of iron rail, 42 inches long, projecting about 10 inches above the ground, and is marked by a large cross made with chisel where the base and stem of the T join, and stamped—

U X S
B
M

O_2.—Is at *Campbell, Hunt County, Tex.*, 9 paces south of the main track, 10 feet east of the railroad-crossing sign about 175 feet east of the station. The side of the top of the post has a piece broken off. (See note 36, p. 584.)

P_2.—Is at *Cumby*, *Hopkins County*, *Tex.*, in the First National Bank building; on the west side, near the southwest corner, about 4 feet from the ground, 5 bricks from the corner, and about midway between the corner and the window. (See note 35, p. 583.)

Q_2.—Is at *Brashear*, *Hopkins County*, *Tex.*, directly opposite the station, 23 paces south of the main track, 5 feet from the right-of-way fence and 38 paces west from the corner of this fence near the road crossing. (See note 36, p. 584.)

R_2.—Is at *Sulphur Springs*, *Hopkins County*, *Tex.*, to the right of entrance, at Church and Jefferson streets, of the county court-house, in the red sandstone cap to a small basement window facing Church street, 6 inches from the top and the left side of the window cap. (See note 35, p. 583.)

S_2.—Is at *Como*, *Hopkins County*, *Tex.*, 10 paces north of the track, in a triangle formed by a telegraph pole and two guys thereto, about 100 feet east of and across tracks from the station. (See note 36, p. 584.)

T_2.—Is about 150 feet west of the station at *Pickton*, *Hopkins County*, *Tex.*, 4 paces west of the first telegraph pole west of the station, 9 paces north of the track, in line with the telegraph poles. (See note 36, p. 584.)

U_2.—Is at *Winnsboro*, *Wood County*, *Tex.*, in the north face of the First National Bank building, in the second brick from the corner just to left of entrance and about 4 feet above the ground. (See note 35, p. 583.)

V_2.—Is at *Scroggins*, *Wood County*, *Tex.*, about 7 feet within the right-of-way fence, 12 paces south of and at right angles to the track from a point 45 feet east of the east end of wooden bridge, 6 telegraph poles east of station sign. (See note 36, p. 584.)

W_2.—Is about 250 feet from the station at *Leesburg*, *Camp County*, *Tex.*, 9 feet south of the second telegraph pole east of and across the tracks from the station. (See note 36, p. 584.)

X_2.—Is one-fourth mile west of the station at *Pittsburg*, *Camp County*, *Tex.*, on a concrete arched culvert on Missouri, Kansas and Texas Railway, one telegraph pole east of mile pole 786, and about 60 feet east of water tank, in the top of the coping to the north side, 6 inches from the north, and 8 inches from the east edge. (See note 35, p. 583.)

Y_2.—At *Pittsburg*, *Camp County*, *Tex.*, in the west face of the Carnegie Library Building, about 4 feet from the ground, in the middle brick of the second course of brick above the concrete forming the base of the pilaster at the right of the small entrance on the west side of the building. (See note 35, p. 583.)

Z_2.—Is at *Cason*, *Cass County*, *Tex.*, 15 paces south of the track, in an angle of the fence on the west side of the road crossing, 7 telegraph poles west of station and 5 feet from the south and east fences. (See note 36, p. 584.)

A_3.—Is at *Daingerfield*, *Morris County*, *Tex.*, in the west side of the county court-house, in the center of the fourth brick from the northwest corner of the building, about 4 feet from the ground and midway between the window and the northwest corner. (See note 35, p. 583.)

B_3.—Is at *Hughes*, also called *Hughes Spring*, *Cass County Tex.*, in the west face of a brick building owned by Mr. T. B. Keaster, in the new part of building, in the double column where the old and the new buildings join, 11 paces from the northwest

corner of the building and in the twenty-first tier of brick above the concrete sidewalk. (See note 35, p. 583.)

C_3.—Is at *Avinger, Cass County, Tex.*, 26 paces north of the old track, 19 paces west of the old railroad station, 2 telegraph poles east of mile pole 817, 12 paces north of the public road paralleling the railroad. (See note 36, p. 584.)

D_3.—Is about 1 mile east of *Avinger, Cass County, Tex.*, and 2½ telegraph poles west of mile pole 818, on south side of an arched concrete culvert under the new grade, in center of the top of the coping, about 13 inches from the west end. (See note 35, p. 583.)

E_3.—Is at *Lasater, Marion County, Tex.*, 9 paces north of the old abandoned grade, 35 paces north of the new track, 10 feet east of second telegraph pole (old line), west of platform used as station, 44 paces west of railroad-crossing sign at road crossing. (See note 36, p. 584.)

F_3.—Is at *Kellyville, Marion County, Tex.*, 30 feet west of and across the track from the switch stand at the west end of the siding, between the third and fourth telegraph poles east of mile pole 830, 14 paces north of the track, in an angle formed by the right-of-way fence and the fence crossing the railway. (See note 36, p. 584.)

G_3.—Is at *Jefferson, Marion County, Tex.*, 7 feet north of the telegraph pole just opposite the Missouri, Kansas and Texas station, almost in line with the east end of the building and 16 paces north of the track. (See note 36, p. 584.)

I_3.—Is at *Norwood, Harrison County, Tex.*, and directly across the track from the second telegraph pole east of mile pole 843, and 2½ poles west of the mail-catch stand, 30 paces north of the track and about 5 feet inside of the right-of-way fence. (See note 36, p. 584.)

J_3.—Is about 600 feet east of and across the tracks from the station at *Karnack, Harrison County, Tex.*, 12 paces east of and 18 paces south of the fourth telegraph pole west of mile pole 848, 24 paces south of the track and 10 paces north of the right-of-way fence. (See note 36, p. 584.)

K_3.—Is about 230 feet east of the station at *Blocker, Harrison County, Tex.*, 4 paces south of the second telegraph pole east of the station and 12 paces south of the track. The top of a corner of the post is broken off. (See note 36, p. 584.)

L_3.—Is at *Waskom, Harrison County, Tex.*, about 250 feet west of the station (Missouri, Kansas and Texas) and 8 paces south of track, 6 feet southwest of third telegraph pole west of station. (See note 36, p. 584.)

C.—Is at *Greenwood, Caddo Parish, La.*, in the top of a concrete abutment on the Texas and Pacific Railroad, 600 feet east of Texas and Pacific station, in south side of west abutment, 30 inches from the east and 20 inches from the south edge of the concrete. The bolt is five-eighths inch in diameter and projects about one-half inch above the surface of the abutment. (See note 35, p. 583.)

D.—Is at *Nichols, Caddo Parish, La.*, 11 paces south of the track, 4 paces south of the second telegraph pole west of mile pole 874, two poles east of and across the tracks from the switch stand at the east end of the siding, and is the bottom of a square hole cut in the top of a rough limestone post marked U S.

E.—Is at *Jewella, Caddo Parish, La.*, 12 paces north of the track, in an angle formed by the right-of-way fence and the fence crossing the tracks about 250 feet east of station. Half of the top of the post is rough. (See note 36, p. 584.)

F.—Is at *Shreveport, Caddo Parish, La.*, about two blocks east of central station, on north side of west abutment to steel bridge over Marshall street on the main track of the Vicksburg, Shreveport and Pacific Railway, and consists of a square cut, lettered U⊞S, near the center of the top of the fifth step from the bottom and the seventh below the coping, the step to which is fastened the iron brace to the iron railing running down the side of the steps to the abutment. The abutments are of brick excepting the bridge seats and side steps, which are of sandstone.

G.—Is at *Shreveport, Caddo Parish, La.*, in the east face of the parish court-house, near the center of a large block of stone in the fifth tier above the ground, the second stone from the southeast corner of the building; 28 inches from the southeast corner and about 4 feet from the ground. (See note 35, p. 583.)

H.—Is at *Shreveport, Caddo Parish, La.*, on the Vicksburg, Shreveport and Pacific Railway bridge over Red River, on the south side of the first stone pier from the west bank, upon which rests the east end of the first span of steel trestle work, and to which the United States Engineers river gauge is attached, in the southwest quadrant of the semicircular top-stone, 8 inches from the edge and projecting one-half an inch above the stone; 18 inches from where the pier lantern hook is attached and 43 inches from the iron base plate to the trestle. (See note 35, p. 583.)

I.—Is at *Shreveport, Caddo Parish, La.*, on the south side of the east abutment to the Vicksburg, Shreveport and Pacific Railway bridge over Red River, on the granite bridge seat, 5 inches from the south and 6 inches from the west edge of the stone, and is about 4 feet below the level of the track. (See note 5, p. 580.)

P. B. M. 45.—Is near *Shreveport, Caddo Parish, La.* (See p. 670, App. 8, Report for 1899.)

P. B. M. 46.—Is at *Bodcau, Bossier Parish, La.* (See p. 670, App. 8, Report for 1899.)

DESCRIPTIONS OF PERMANENT BENCH MARKS FROM FORT WORTH TO COMANCHE, TEX., 1902.

T.—Is at *Fort Worth, Tarrant County, Tex.* (See p. 782.)

U.—Is at *Fort Worth, Tarrant County, Tex.* (See p. 783.)

M_3.—Is at *Fort Worth, Tarrant County, Tex.*, on top of the stone base to one of the iron supports to the viaduct over tracks, one-fourth mile west of Texas and Pacific Railway station. The mark is on the base under the second support east in second row north of main track, at southeast corner, 3½ inches from south and east edges. (See note 5, p. 580.)

N_3.—Is a mile east of *Belt Junction, Tarrant County, Tex.*, 15 paces from the eighth telegraph pole west of milepost 3 on Fort Worth and Rio Grande Railroad, on the southwest corner of the west abutment of a culvert. (See note 5, p. 580.)

O_3.—Is at *Primrose, Tarrant County, Tex.*, 5 poles west of the station sign, 6 telegraph poles east of mile pole 12, in an angle of the right-of-way fence on the Fort Worth and Rio Grande Railroad, 16 paces north of the track. (See note 36, p. 584.)

P_3.—Is at *Virgile, Tarrant County, Tex.*, 10 feet north of the third pole west of the station sign, in an angle of the right-of-way fence on the Fort Worth and Rio Grande Railway, 15 paces north of the track. (See note 36, p. 584.)

Q_3.—Is in *Parker County, Tex.*, just across the county line from *Cresson, Tarrant County, Tex.*, 50 paces east of the station, 5 paces east of mile pole 25, and 20 paces north of the track of the Fort Worth and Rio Grande Railroad. (See note 36, p. 584.)

R_3.—Is at *Waples, Hood County, Tex.*, 3 paces north of the first telegraph pole east of mile pole 34, and 15 paces north of the tracks on the Fort Worth and Rio Grande Railway. (See note 36, p. 584.)

S_3.—Is at *Granbury, Hood County, Tex.*, on the east side of the Hood County court-house, 10 feet north of the east door, in the stone water table, 4½ feet from the ground. (See note 35, p. 583.)

Comanche △.—Is at the triangulation station Comanche, southwest of *Granbury, Hood County, Tex.*, on what is known as "Comanche Peak," in the part which is open ground and near the southern edge. The triangulation station was placed over the same point used by the Geological Survey in 1888. The station mark of the Geological Survey, a stone about 15 inches in diameter and 3 inches thick, was removed and in its place was put a galvanized pipe 2 inches in diameter and 18 inches long. The pipe was filled with concrete, level with the surface of the ground, and the top of the pipe being covered one-half an inch with the cement. A 60-penny wire nail was set in the upper end of the pipe.

Comanche Reference Mark.—Is about 4½ miles southwest of *Granbury, Hood County, Tex.*, on "Comanche Peak," at the edge of the timber to the southwest of the open ground, 49.306 meters from the triangulation station. It is marked by a terra-cotta pipe, 2 feet long, covered with cement one-half inch thick. A 60-penny wire nail was set in the cement to mark the station, and the top of the nail is the bench mark.

DESCRIPTION OF PERMANENT BENCH MARKS BETWEEN FORT WORTH AND TEMPLE, TEX.

T.—Is at *Fort Worth, Tarrant County, Tex.* (See p. 782.)

U.—Is at *Fort Worth, Tarrant County, Tex.* (See p. 782.)

T_3.—Is one-half mile north of the siding at *Bethel, Tarrant County, Tex.*, 50 feet west of the railroad track, in the right of way of the Missouri, Kansas and Texas main line, 3 feet east of telegraph pole opposite mile pole 764. (See note 40, p. 584.)

U_3.—Is at *Burleson, Johnson County, Tex.*, in the brick building used as the post-office, in the east front, 4½ feet above the sidewalk, in a panel north of the northern-most window. (See note 10, p. 581.)

V_3.—Is at the siding at *Egan, Johnson County, Tex.*, in the Missouri, Kansas and Texas Railway right of way at the left and 7 feet below the track, 50 feet northeast of the south switch and 3 feet from the telegraph pole, the second one south of the station sign. (See note 40, p. 584.) The railway company reported in May, 1903, that on account of grading necessary for the construction of new tracks the bench mark was covered 6 feet. The following bench mark, "R. R.," was then established.

R. R.—Is at *Egan, Johnson County, Tex.*, and consists of a piece of rail placed in the ground in front of the ticket window, established by the Missouri, Kansas and Texas Railway engineers. The end of the ball of the top of the rail is 10.00 feet above bench mark V_3.

W_3.—Is at *Alvarado, Johnson County, Tex.*, one-fourth mile south of the station, in north stone abutment of the Missouri, Kansas and Texas Railway iron bridge, on the

lowest step west of the track and 3½ feet below its level. It is 8 inches from the south and 10 inches from the west edge of the stone. (See note 5, p. 580.)

X_3.—Is at *Conley*, *Johnson County*, *Tex.*, 25 feet east of the Missouri, Kansas and Texas Railway track, in the right of way near the first telegraph post north of the south switch. (See note 40, p. 584.)

Y_3.—Is at *Grand View*, *Johnson County*, *Tex.*, in the west wall near the northwest corner of the brick building occupied by the post-office, on the south side of Main street and across from the Missouri, Kansas and Texas tracks, about 300 yards south of the depot; 4 feet above the sidewalk, and 10 inches from the corner of the building. (See note 16, p. 581.)

Z_3.—Is at *Itasca*, *Johnson County*, *Tex.*, in the brick building leased by the Itasca National Bank, in the west front, north of large window, 4 feet from the walk. The building is the second one from Main street and on the east side of the street. (See note 16, p. 581.)

A_4.—Is at *Schofield*, *Hill County*, *Tex.*, 3 feet east of the fourth telephone pole south of the station sign, in the right of way, 50 feet west of the Missouri, Kansas and Texas track, and 1 foot from the right of way fence. (See note 40, p. 584.)

B_4.—Is at *Hillsboro*, *Hill County*, *Tex.*, in white stone in the northwest corner of the Hill County court-house, in the cornice about 5 feet from the ground and 1½ feet north of the water spout. It faces west, being set in a recess of the corner. (See note 13, p. 581.)

C_4.—Is near *Abbott*, *Hill County*, *Tex.*, 1½ miles north of the station, 35 feet east of the Missouri, Kansas and Texas Railway track and 10 feet from the right of way fence, 6 feet northwest of telegraph pole, fifth south of bridge No. 672, near the opening of the first railway cut north of Abbott. (See note 40, p. 584.)

D_4.—Is at *West*, *McLennan County*, *Tex.*, in the brick building on Main street, on the east side of the street and faces the Missouri, Kansas and Texas track. It is south of the south window of the third store north of Boone street. The building is occupied by a grocery, and is two doors north of the West National Bank. (See note 16, p. 581.)

E_4.—Is at *Elmmott*, *McLennan County*, *Tex.*, in the right of way 40 feet east of the Missouri, Kansas and Texas track, in angle of the right of way fence, and 2 feet west of the telegraph pole, the second south of the depot, directly across the track from the cattle-loading pen, opposite a small brown house on the road leading south from the station. (See note 40, p. 584.)

F_4.—Is at *Waco*, *McLennan County*, *Tex.*, in a brick building on the southeast corner of South Fifth and Jackson streets, occupied by McCleary's feed store. The bolt is 4½ feet above the ground and 1½ feet from the southernmost window toward the Missouri, Kansas and Texas tracks. (See note 13, p. 581.)

Hydrant 1.—Is at *Waco*, *McLennan County*, *Tex.*, on the southeast corner of South First and Jackson streets. The bench mark is the top of the hydrant.

Hydrant 2.—Is at *Waco*, *McLennan County*, *Tex.*, on the northwest corner of Thirteenth and Jackson streets, near large cotton factory. The bench mark is the top of the hydrant.

G_4.—Is at *Waco*, *McLennan County*, *Tex.*, at the northwest corner of Fifth and Jackson streets, in a brick building occupied by bottling works, 10 inches below the third window from the front of the building on the side toward the Missouri, Kansas and Texas main track. (See note 13, p. 581.)

H_4.—Is at *Hewitt, McLennan County, Tex.*, between two telegraph poles, 100 yards north of the station, 4 feet from either pole, and about 70 feet west of the Missouri, Kansas and Texas track, in the right of way. (See note 40, p. 584.)

I_4.—Is at *Lorena, McLennan County, Tex.*, 100 feet east of the Missouri, Kansas and Texas Railway track, in very rocky ground about two telegraph poles south of the water tank, and near the highway, across the track from a cotton gin. (See note 40, p. 584.)

J_4.—Is at *Eddy, McLennan County, Tex.*, in the Missouri, Kansas and Texas Railway right of way, 45 feet west of the track, and 300 yards north of the depot. The stone is in rocky ground, and could be sunken only a part of its length, the stones and dirt being mounded about it to a height of 1 foot. (See note 40, p. 584.)

K_4.—Is at *Troy, Bell County, Tex.*, 5 feet south of the second telegraph pole south of the depot; 50 feet east of the Missouri, Kansas and Texas Railway main track, 30 feet west of the side track. (See note 40, p. 584.)

L_4.—Is at *Temple, Bell County, Tex.*, at the crossing of the Missouri, Kansas and Texas and the Santa Fe railways, 60 feet west from the Missouri, Kansas and Texas track, and 40 feet north of the Gulf, Colorado and Santa Fe track, halfway between a telephone pole and its guy-wire pole. (See note 40, p. 584.)

M_4.—Is at *Temple, Bell County, Tex.*, on the south side of the stone building on the corner of Depot and Main streets, occupied by the Palace saloon, in the alley corner of the building, 3 feet above the sidewalk, and 8 inches from the corner of the building. (See note 13, p. 581.)

N_4.—Is at *Temple, Bell County, Tex.*, in the right of way of the Missouri, Kansas and Texas Railway, across the track from a large cotton oil mill, 35 feet east of the main track and 1 foot from the fence, 6 feet south of a telephone pole and diagonally opposite the railroad crossing sign. (See note 40, p. 584.)

DESCRIPTION OF PERMANENT BENCH MARKS BETWEEN TEMPLE AND LAMPASAS NORTHEAST BASE, TEX.

O_4.—Is near *Belton, Bell County, Tex.*, in the northwest stone abutment of the iron bridge, Gulf, Colorado and Santa Fe Railway, across the Leon River, 2 inches from the north and east edges of the top stone. (See note 5, p. 580.)

P_4.—Is at *Nolanville, Bell County, Tex.*, 3 feet south of the first telegraph pole west of mile pole 233, in the right of way of the Gulf, Colorado and Santa Fe Railway, 30 feet south of the track. (See note 40, p. 584.)

Q_4.—Is near *Killeen, Bell County, Tex.*, in the right of way of the Gulf, Colorado and Santa Fe Railway, 2 feet south of mile pole 241, and 60 feet south of the track. (See note 40, p. 584.)

R_4.—Is near *Copperas Cove, Coryell County, Tex.*, in the right of way of the Gulf, Colorado and Santa Fe Railway, 10 feet south of the first telegraph pole east of mile pole 250 and 40 feet south of the railroad. (See note 40, p. 584.)

S_4.—Is near *Copperas Cove, Coryell County, Tex.*, in the north top stone of the stone arch one-fourth mile east of Copperas Cove on the Gulf, Colorado and Santa Fe Railway, 2 inches from the north and east edges of the stone, and 4 feet below the track level. (See note 5, p. 580.)

Gilmore △.—Is about 2 miles southwest of *Copperas Cove*, *Coryell County*, *Tex.*, upon the highest point of a wooded starfish-shaped mountain, upon the land of J. N. Gilmore, 150 yards north of the telephone line where it crosses the ridge; about 1¼ miles a little southwest of the house of H. B. Scott, and about three-fourths mile south of the house of C. H. Casper. The station mark is a galvanized iron pipe 2 inches in diameter and 18 inches long. The pipe was filled with concrete level with the surface of the ground, the top of the pipe being covered 1½ inches with the cement. A 60 penny wire nail was set in the upper end of the pipe, and the top of the nail is the bench mark.

Gilmore Reference Mark.—Is about 2 miles southwest of *Copperas Cove*, *Coryell County*, *Tex.*, and is 91.106 meters northeast of the station mark. It is marked by a terra cotta pipe 2 feet feet long, covered with cement one-half inch thick. A 60-penny wire nail was set in the cement to mark the station, and the top of the nail is the bench mark.

T_4.—Is near *Kempner*, *Lampasas County*, *Tex.*, in the right of way of the Gulf, Colorado and Santa Fe Railway, south of the track 60 feet, and halfway between mile pole 262 and the right of way fence. (See note 40, p. 584.)

U_4.—Is 3 miles east of *Lampasas*, *Lampasas County*, *Tex.*, in the right of way of the Gulf, Colorado and Santa Fe Railway, 20 feet south of the track and 20 feet from the fence; 50 feet west of mile pole 271. (See note 40, p. 584.)

Lampasas N.E. Base.—Is in *Lampasas County Tex.*, about 2½ miles south 80° E. of *Lampasas*, 250 meters north of the "Lampasas-Belton" Road, on the highest and most northerly wooded point, and about 300 meters south of Sulphur Creek, on the land of J. W. Mosely. (See note 31, p. 583.)

Lampasas S.W. Base.—Is about 2 miles southeast of *Lampasas*, *Lampasas County*, *Tex.*, on the land of J. H. H. Berry. (See note 31, p 583.)

DESCRIPTIONS OF PERMANENT BENCH MARKS BETWEEN TEMPLE AND HOLLAND, TEX.

V_4.—Is one-fourth mile south of *Little River*, *Bell County*, *Tex.*, in the right of way of the Missouri, Kansas and Texas Railway, 70 feet west of the main track and 7 feet south of the telephone pole opposite milepost 888. (See note 40, p. 584.)

W_4.—Is one-fourth mile south of *Holland*, *Bell County*, *Tex.*, in the northeast concrete abutment of the iron bridge, 1 inch from the south and east edges of the stone (artificial) shelf on which the iron work rests. (See note 3, p. 580, except the letters are at the corner of the square.)

X_4.—Is at *Holland*, *Bell County*, *Tex.*, in the brick building occupied by the Bank of Holland. The building is on the north side of the main street and is the easternmost building of the row. The bench mark is 3 feet from the corner and 4 feet from the ground, in the wall facing the Missouri, Kansas and Texas track. Building partially burned and rebuilt previous to November, 1903, but without apparently changing the bench mark. (See note 14, p. 581.)

Y_4.—Is at *Holland*, *Bell County*, *Tex.*, in the east wall of the building occupied and owned by the Mewhinney Mercantile Company. It is 4 feet from the northeast corner, 4 feet from the ground, and slightly above the stairway leading to the public hall. (See note 14, p. 581.) Reported destroyed, November, 1903.

Z_4.—Is at *Holland, Bell County, Tex.*, in a brick culvert 300 yards north of the Missouri, Kansas and Texas station. The cut is east of the track, and 2 inches from the north and east edges of the cement top of the culvert. (See note 5, p. 580.) Reported settled, November, 1903.

DESCRIPTIONS OF PERMANENT BENCH MARKS BETWEEN NORFOLK, NEBR., AND SIOUX CITY, IOWA.

N_1.—Is at *Norfolk, Madison County, Nebr.* (See App. 8, Report for 1899, p. 653.)

O_1.—Is at *Norfolk, Madison County, Nebr.* (See App. 8, Report for 1899, p. 653.)

P_1.—Is at *Norfolk, Madison County, Nebr.* (See App. 8, Report for 1899, p. 653.)

Q_1.—Is at *Hope, Madison County, Nebr.*, about 5 meters west of the main track of the Chicago, St. Paul, Minneapolis and Omaha Railway, 150 feet south of north head block, about 8 feet northwest of milepost No. 44 and about 300 feet north of a line connecting the insane asylum and Mrs. Keiner's house. (See note 17, p. 582.)

R_1.—Is at *Hoskins, Wayne County, Nebr.*, about 15 meters southeast from the office of the Sidney Grain Company, about 30 meters northeast of the store owned by Ludwig Zeiner, in the south corner of land owned by Mr. John Foster, and between the last two trees from the south end of the row separating his land from the road. (See note 17, p. 582.)

S_1.—Is at *Apex, Wayne County, Nebr.*, about 350 feet from the north head block of the switch of the Chicago, St. Paul, Minneapolis and Omaha Railway, and 10 feet west of the track. (See note 17, p. 582.)

T_1.—Is at *Winside, Wayne County, Nebr.*, in the eastern end of the little park owned by the town, between the two center trees of the east row, 28.8 meters north of the Chicago, St. Paul, Minneapolis and Omaha Railway, 1.8 meters west of the eastern fence of the park, and 44.6 meters east of the eastern side of the band stand in the center of the park. (See note 17, p. 582.)

U_1.—Is at *Wayne, Wayne County, Nebr.*, in the south front of the two-story brick building owned by the First National Bank, 13.12 meters west from the stone column supporting the southeast corner, 3.25 meters from the east side of the door leading into Messrs. Strahn & Grimsley's office, in the support between the fourth and fifth windows from the southeast corner, in second course of brick from the foundation, in the second brick from fourth window, and in the fourth brick from the east edge of the fifth window. (See note 8, p. 581.)

V_1.—Is at *Wakefield, Dixon County, Nebr.*, in the east front of the store owned by G. M. Hypse, of Omaha, and occupied by Mr. Collins as a clothing store, in the support on the northeast corner, in the sixteenth course of brick from the bottom and in the second brick from the north side. (See note 8, p. 581.)

W_1.—Is at *Ridge, Thurston County, Nebr.*, about 5 miles north of Wakefield, 28.3 meters directly north of the central switch post of the Chicago, St. Paul, Minneapolis and Omaha Railway. (See note 17, p. 582.)

X_1.—Is at *Emerson, Dixon County, Nebr.*, in the north front of the three-story brick grist mill owned by James McHenry, about 425 feet southwest from the depot of the Chicago, St. Paul, Minneapolis and Omaha Railway, and about 225 feet south from the

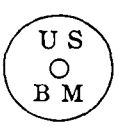
main track, 19.68 meters east of the northwest corner of the mill, 13.5 meters west of the northeast corner of the elevator part of mill, 1.18 meters above surface of the earth, in the seventh brick east of the large door on the north side and 1.29 meters east of east side of door, 0.475 meter above the middle small cellar window on the north side, and 1.185 meters below and to the left of the most easterly window in the mill. (See note 8, p. 581.)

Y_1.—Is at *Nacora, Dakota County, Nebr.*, on the property of Mr. H. F. Mosema and leased by Mr. M. B. McCarty, 46.8 meters northeast of the building of the Peavey Elevator Company, 17.4 meters southwest of the store on Mr. Mosema's property, and 27.6 meters east of the Chicago, St. Paul, Minneapolis and Omaha Railway. (See note 17, p. 582.)

Z_1.—Is at *Hubbard, Dakota County, Nebr.*, on the property of the Peavey Elevator Company, 4.5 meters north of the intersection of the main street and the Chicago, St. Paul, Minneapolis and Omaha Railway track, and 11.3 meters from the latter. (See note 17, p. 582.)

A_2.—Is at *Coburn, Dakota County, Nebr.*, at the intersection of the Newcastle Railway and the Chicago, St. Paul, Minneapolis and Omaha Railway, 5.2 meters from the frog, 2.9 meters from switch post, and 35.5 meters from east end of depot platform. (See note 17, p. 582.)

M. R. C. Dakota City.—Is an iron-pipe post at *Dakota City, Dakota County, Nebr.*, in the northeast corner of the court-house grounds, 8.25 meters east of the east tree in the north row, and 8.8 meters north of the north tree of the east row of trees in the grounds, and 66.2 meters northeast from northeast corner of the court-house. The top of cap is marked



and the center is the bench mark.

B_2.—Is at *South Sioux City, Dakota County, Nebr.*, on the graded ground north of the Chicago, St. Paul, Minneapolis and Omaha Railway station, 7.2 meters from intersection of inside rails of main track and switch, 6.3 meters from former and 6.15 meters from latter. (See note 17, p. 582.)

P. B. M. 395=Gauge B. M.—Is in *Sioux City, Woodbury County, Iowa.* (See App. 8, Report for 1899, p. 841.)

P. B. M. 396=$1\frac{8}{3}$.—Is in *Sioux City, Woodbury County, Iowa.* (See App. 8, Report for 1899, p. 841.)

P. B. M. 397.—Is about 3½ miles above *Sioux City, Woodbury County, Iowa.* (See App. 8, Report for 1899, p. 841.)

DESCRIPTIONS OF PERMANENT BENCH MARKS BETWEEN NORFOLK AND PAGE, NEBR.

O_1.—Is at *Norfolk, Madison County, Nebr.* (See App. 8, Report for 1899, p. 653.)

P_1.—Is at *Norfolk, Madison County, Nebr.* (See App. 8, Report for 1899, p. 653.)

C_2.—Is at *Hadar, Pierce County, Nebr.*, 0.89 meter from the northwest corner of the office of the grain, coal, and lumber firm of Nye & Schneider Company, and 0.76 meter from the northwest corner of the bay window, 46 paces east of the Fremont, Elkhorn and Missouri Valley Railroad track. (See note 14, p. 581.)

D_2.—Is at *Pierce, Pierce County, Nebr.*, in the stone foundation of the court-house, 4.8 meters from the southeast corner, in the fifth course of stone from the bottom, 1.36 meters from the south end of the fifth stone from the southeast corner, 3 meters south of the large doorway on the east side, and directly above the second basement window from the southeast corner. (See note 8, p. 581.)

E_2.—Is at *Foster, Pierce County, Nebr.*, 1.2 meters northwest of and in line with the northeast side of the elevator of the Nye & Schneider Company, 35 paces south of their office and 31 paces northeast of the Fremont, Elkhorn and Missouri Valley Railroad track. (See note 14, p. 581.)

F_2.—Is at *Plainview, Pierce County, Nebr.*, in the west side of the Farmers' State Bank (Incorporated) Building, at the intersection of Main and Locust streets, in the ninth course of brick above the corner stone under the southwest corner and in the second brick from the corner. (See note 8, p. 581.)

G_2.—Is at *Plainview, Pierce County, Nebr.*, on the building on the north side of Locust street, owned by N. M. Nelson and occupied by him as a hardware store, in the brick pillar supporting the southeast corner, in the middle brick, in the ninth course of brick above the corner stone. (See note 8, p. 581.)

H_2.—Is at *Brunswick, Antelope County, Nebr.*, 10 paces southwest from the elevator of the Sidman Grain Company and 1 meter from the northwest corner of and in line with the west side of their office and 25 paces south of the Great Northern Railway track. (See note 14, p. 581.)

I_2.—Is at *Savage, Antelope County, Nebr.*, 52 meters west of the west face of the depot and 11.6 meters north of the north rail of the Great Northern Railway, 2.44 meters north of the north pile of and in line with the west row of four piles supporting the water tank. (See note 14, p. 581.)

J_2.—Is at *Orchard, Antelope County, Nebr.*, 58 meters east of the station, in line with and between the first and second telegraph poles east of the station; 5.1 meters north of the main track and 8.3 meters south of the siding of the Great Northern Railway. (See note 14, p. 581.)

K_2.—It at *Page, Holt County, Nebr.*, at the north corner formed by the west and south platforms to the station, 4.02 meters from the southwest corner of the depot and 4.8 meters north of the north rail of the Great Northern Railway. (See note 14, p. 581.) Reported firm and stable in 1901.

L_2.—Is 1½ miles north of *Page, Holt County, Nebr.*, 2.1 meters north of the row of trees separating the property of Mr. C. W. Denel from the east and west road, 110 paces southwest of the southwest corner of his home, and 62 paces west of the doorway. (See note 14, p. 581.) It was reported in 1901 that the soil was separated from the stone by a crack and the stone was movable to a slight extent by pressure from the hands.

M_2.—Is 1½ miles north and 1 mile west of *Page, Holt County, Nebr.*, 17.3 meters east of the southeast corner of Mr. William Lord's house, and 100 paces southeast of Page Southwest Base. (See note 14, p. 581.) It was reported in 1901 that the bench mark seemed firm although the soil was separated from it.

Page Southwest Base △.—Is about 2 miles north and 1 mile west of *Page, Holt County, Nebr.*, 12 miles east of and 2 miles south of O'Neill, on the land owned by Mr. William Lord, northwest of his dwelling about 100 meters, on a limestone block 24 by 24 by 14 inches, securely set in cement, lettered, and with a copper bolt in the center of its upper surface marked with cross lines.

DESCRIPTIONS OF PERMANENT BENCH MARKS BETWEEN PAGE AND CHADRON, NEBR.

Page Southwest Base △.—Near *Page, Holt County, Nebr.*

M_2.—Near *Page, Holt County, Nebr.*

L_2.—Near *Page, Holt County, Nebr.*

K_2.—At *Page, Holt County, Nebr.*

N_2.—Is about 3 miles east of *O'Neill, Holt County, Nebr.*, T. 28, R. 11, on the right of way of the Great Northern Railway, 13.8 meters south of the track, 170 paces west of milepost 124, and 100 paces east of the country road crossing the railroad diagonally in line with fence dividing the farm of David Babcock from that of Mr. Stainsley, and 1.2 meters from railroad right of way fence. (See note 15, p. 581.)

O_2.—Is in *O'Neill, Holt County, Nebr.*, in the lower stair of the entrance to the First National Bank, at the northeast corner of the step, 5 inches from outside of stone, 3 inches from the end, and 4 inches from the wall of the building. (See note 7, p. 581.)

P_2.—Is at *O'Neill, Holt County, Nebr.*, in the court-house square, 21 meters south of the southwest corner of the brick foundations, in a line with the west face of the building 12 meters east of the inside of the sidewalk, on a white limestone post, established for a magnetic station 32 inches long, set 29 inches in the ground, 4 by 4 inches on top, lettered U. S. C. & G. S. A small hole in the center of the top surface is the bench mark.

Q_2.—Is at *Emmet, Holt County, Nebr.*, on a stone culvert, 48 feet east of the switch signal east of the station on the Fremont, Elkhorn and Missouri Valley Railroad, on the north side of the track, in the middle of the west one of two top stones, 0.3 meter west of the east end. (See note 5, p. 580.)

R_2.—Is about 4 miles east of *Atkinson, Holt County, Nebr.*, T. 30, R. 14, sec. 11, on the right of way, on the south side of the track, 13½ meters from the track, 1.2 meters from the right-of-way fence, and 11½ meters from the road crossing the railroad at this point. The adjoining land is said to belong to a Mrs. Minor. (See note 15, p. 581.) The post is dressed 6 by 6 inches and is marked

U S
□
B M

S_2.—Is at *Atkinson, Holt County, Nebr.*, in the southwest corner of the stone base of the railway water tower, 47 paces west of the station and 5 paces from the north rail of the track. (See note 7, p. 581.)

T_2.—Is about 3 miles east of *Stuart, Holt County, Nebr.*, in a concrete culvert of the Fremont, Elkhorn and Missouri Valley Railroad, on the south side of the tracks, on the west side of the culvert, on the lower ledge, 1 meter from the south end, and 0.25 meter from the inside edge. (See note 7, p. 581.)

U_2.—Is at *Stuart, Holt County, Nebr.*, on the right of way of the Fremont, Elkhorn and Missouri Valley Railroad, about 286 meters west of the station, on the south side of the track and in line with the telegraph poles, 12.45 meters from the south rail of the main track, and 26 paces west of section tool house. (See note 15, p. 581.)

V_2.—Is at *Newport, Rock County, Nebr.*, on the right of way of the Fremont, Elkhorn and Missouri Valley Railroad, on the north side of the track, 3.6 meters from the north rail of the main track and 5.1 meters west of the station. (See note 15, p. 581.)

W_2.—Is about 6 miles east of *Bassett, Rock County, Nebr.*, T. 30, R. 18, sec. 4, on the right of way of the Fremont, Elkhorn and Missouri Valley Railroad, 15 meters from where the country road crosses the railroad, 1.9 meters north of the railroad fence, and 2.5 meters west of the fence along the country road, in line with the telegraph poles, 12.35 meters south of the south rail of the track. (See note 15, p. 581.)

X_2.—Is at *Bassett, Rock County, Nebr.*, on the railroad right of way, on the south side of the track, 5.9 meters south of the south rail of the main track, in line with and 7.35 meters east of the Fremont, Elkhorn and Missouri Valley Railroad station. (See note 15, p. 581.)

Y_2.—Is at *Long Pine, Brown County, Nebr.*, in a lot by the depot of the Fremont, Elkhorn and Missouri Valley Railroad, 1.2 meters north of the fence along the railroad, and 3.6 meters from the fence along the street. (See note 15, p. 581.)

Z_2.—Is at *Ainsworth, Brown County, Nebr.*, on the right of way of the Fremont, Elkhorn and Missouri Valley Railroad, in line with the telegraph poles, about 44 rods west of the station, 11.8 meters south of the south rail of the main track, and 11.3 meters west of the railroad section tool house. (See note 15, p. 581.)

A_3.—Is 2 miles east of *Johnstown, Brown County, Nebr.*, on the right of way of the Fremont, Elkhorn and Missouri Valley Railroad, in line with the telegraph poles, 13.4 meters south of the south rail of the track, and 1 meter north of railroad fence at a point where a line fence meets the railroad fence. (See note 15, p. 581.)

B_3.—Is about 3 miles east of *Woodlake, Cherry County, Nebr.*, on the right of way of the Fremont, Elkhorn and Missouri Valley Railroad, just across the tracks from milepost, "Fremont 241 miles," in line with the telegraph poles, 11.3 meters south of the south rail of the track, and 3.7 meters north of the railroad fence. (See note 15, p. 581.)

C_3.—Is about 3 miles west of *Woodlake, Cherry County, Nebr.*, on the right of way of the Fremont, Elkhorn and Missouri Valley Railroad, at milepost, "Fremont 247 miles," 12.7 meters north of north rail of the track, and 1.6 meters south of the milepost. (See note 15, p. 581.)

D_3.—Is about 1 mile west of *Arabia, Cherry County, Nebr.*, on the right of way of the Fremont, Elkhorn and Missouri Valley Railroad, in line with the telegraph poles, about 10 rods west of milepost, "Fremont 254 miles," 1.3 meters north of railroad fence, and 13.5 meters south of the south rail of the track. (See note 15, p. 581.)

E_3.—Is at *Thacher, Cherry County, Nebr.*, on the right of way of the Fremont, Elkhorn and Missouri Valley Railroad, in line with the telegraph poles, 32.3 meters east of the post bearing the sign of "Thacher," just across the track from the railroad section tool house, and 5.2 meters south of the south rail of the main track. (See note 15, p. 581.)

F_3.—Is at *Valentine, Cherry County, Nebr.*, on the south side of the steps leading to the main entrance of the new county court-house, about the center of the horizontal end of the stone. (See note 16, p. 581.)

G_3.—Is about 4 miles east of *Crookston, Cherry County, Nebr.*, in a stone culvert at milepost, "Fremont 277 miles," on the south side of the railroad and 3.8 meters from the south rail, in the center of a large stone on the east wing of the culvert, 1 decimeter from the end of the stone. (See note 16, p. 581.)

H_3.—Is about 2 miles west of the town of *Crookston*, *Cherry County*, *Nebr.*, in line with the telegraph poles on the right of way of the Fremont, Elkhorn and Missouri Valley Railroad, about 3½ rods west of milepost, "Fremont 283 miles," 14.1 meters south of the south rail of the track and 6 decimeters north of the railroad fence. (See note 15, p. 581.)

I_3.—Is at *Georgia*, *Cherry County*, *Nebr.*, on the right of way of the Fremont, Elkhorn and Missouri Valley Railroad, 19.7 meters southeast of post bearing sign of "Georgia," 3 meters northwest of the section house, and 8.6 meters south of the south rail of track. (See note 15, p. 581.)

J_3.—Is at *Nenzil*, *Cherry County*, *Nebr.*, at the northeast corner of a lot by the railroad section house, about 8 rods west of a post bearing sign of "Nenzil," 5 meters south of the south rail of the Fremont, Elkhorn and Missouri Valley Railroad track. (See note 15, p. 581.)

K_3.—Is a stone post at *Cody*, *Cherry County*, *Nebr.*, 70.5 meters west of the southwest corner of the railroad station, 19.3 meters southeast of the southeast corner of the section house, 46 paces east of the southeast corner of the coaling station, and 3.9 meters north of the north rail of the main track.

L_3.—Is 7 miles west of *Cody*, *Cherry County*, *Nebr.*, in stone culvert No. 509, on the Fremont, Elkhorn and Missouri Valley Railroad, in the southeast wing of the culvert abutment and 2.5 decimeters from the end on the coping stone, 2 decimeters from each side, and 5.4 meters south of the south rail of the track. (See note 17, p. 582.)

M_3.—Is a mile west of *Eli*, *Cherry County*, *Nebr.*, on the right of way of the Fremont, Elkhorn and Missouri Valley Railroad, in line with the telegraph poles, 36.9 meters west of post marked "Station one mile," and 10.9 meters south of the south rail of the track. (See note 15, p. 581.)

N_3.—Is 5 miles west of *Eli*, *Cherry County*, *Nebr.*, on the right of way of the Fremont, Elkhorn and Missouri Valley Railroad, east of milepost 326, just east of a cut and south of a railroad crossing. (See note 15, p. 581.)

O_3.—Is about three-fourths of a mile east of *Merriman*, *Cherry County*, *Nebr.*, on a stone culvert on the south side of track on the coping stone, 22 centimeters from the end and 25 centimeters from either side, 3.7 meters from the south rail of the track. (See note 7, p. 581.)

P_3.—Is 6 miles west of *Merriman*, *Cherry County*, *Nebr.*, in stone culvert on the Fremont, Elkhorn and Missouri Valley Railroad, on the coping stone running parallel with the railroad, 53 centimeters from the west end and 25 centimeters from the north edge, 3.6 meters north of the north rail. (See note 16, p. 581.)

Q_3.—Is at *Irwin*, *Cherry County*, *Nebr.*, on the Fremont, Elkhorn and Missouri Valley Railroad right of way, 35 paces southeast of post bearing name "Irwin," and 7.8 meters northwest of the northwest corner of western section house. (See note 15, p. 581.)

R_3.—Is about 5 miles east of *Gordon*, *Sheridan County*, *Nebr.*, on railroad culvert No. 552, on the Fremont, Elkhorn and Missouri Valley Railroad, east of milepost 355 miles from Fremont, on the south wing of the east abutment, on the top stone of the stepping of the wall, 12 centimeters from the end of the stone and 11 centimeters from the side, 5.5 meters south of the south rail. (See note 5, p. 580.)

S_3.—Is at *Gordon*, *Sheridan County*, *Nebr.*, on the Fremont, Elkhorn and Missouri Valley Railroad, near the southwest corner of the park at the east end of the station, 6.6 meters from the southeast corner of the station, near the intersection of the platforms running at right angles on the south and east sides of the station, 4.2 meters north of the north rail of the track. (See note 15, p. 581.)

T_3.—Is at *Gordon*, *Sheridan County*, *Nebr.*, at the entrance to the Maverick Bank, on the west side of the street intersecting the railroad just west of the station, at the north end and near the outer edge of the stone sill. (See note 16, p. 581.)

U_3.—Is about 1 mile east of *Clinton*, *Sheridan County*, *Nebr.*, in stone culvert No. 573, on the Fremont, Elkhorn and Missouri Valley Railroad, in the top step of the north wing of the east abutment, 17 centimeters from the end of the stone and 13 centimeters from the side, 3.55 meters north of north rail of track. (See note 16, p. 581.)

V_3.—Is at *Rushville*, *Sheridan County*, *Nebr.*, in the park adjoining the east end of the station of the Fremont, Elkhorn and Missouri Valley Railroad, 6.2 meters east of the northeast corner of the station, near the corner formed by the intersection of the platforms on the north and east sides of the depot, 4.2 meters south from the south rail of the track. (See note 15, p. 581.)

W_3.—Is 5¼ miles west of *Rushville*, *Sheridan County*, *Nebr.*, on stone culvert No. 597, on the Fremont, Elkhorn and Missouri Valley Railroad, at the east end of the large coping stone which lies parallel with the track, 20 centimeters from the east end and 20 centimeters from the north side of the stone, 5.1 meters north of the north rail. (See note 7, p. 581.)

X_3.—Is at *Hay Springs*, *Sheridan County*, *Nebr.*, in the lawn adjoining the west end of the railroad station of the Fremont, Elkhorn and Missouri Valley Railroad, 5.9 meters from the southwest corner of the station, 4.1 meters north of the north rail, and 21.7 meters northwest of the northwest corner of the grain elevator opposite the station. (See note 15, p. 581.)

Y_3.—Is 1 mile east of *Bordeaux*, *Dawes County*, *Nebr.*, in stone culvert No 635, on the Fremont, Elkhorn and Missouri Valley Railroad, in the north wing of the east abutment, in the middle of the stone 40 centimeters from the end, and 5.4 meters north of the north rail of the track. (See note 7, p. 581.)

Z_3.—Is 3 miles east of *Chadron*, *Dawes County*, *Nebr.*, on stone culvert No. 653, on the south side of the track of the Fremont, Elkhorn and Missouri Valley Railroad, in the middle stone over the arch, 13 centimeters from the south edge of the stone, between two large notches cut in the edge of the stone. (See note 5, p. 580.)

A_4.—Is at *Chadron*, *Dawes County*, *Nebr.*, near the junction of Main avenue with the Fremont, Elkhorn and Missouri Valley Railroad, just east of the avenue, at the west end of the grass plot adjoining the office of the American Express Company, 63 steps west of the west wall of the express office, 4½ steps south of the line of telegraph poles running along the north fence of the grass plot, 14.7 meters south of the south rail of the main track. (See note 15, p. 581.)

B_4.—Is at *Chadron*, *Dawes County*, *Nebr.*, in the north and front entrance to the court-house, in the west stone supporting two iron columns, between the column and the wall, 20 centimeters from the east side of the stone and 73 centimeters from the north edge, 19½ centimeters from the brick column projecting beyond the main wall and 41½ centimeters from the main entrance wall. (See note 16, p. 581.)

C_4.—Is 1 mile west of *Chadron, Dawes County, Nebr.*, 123.7 meters east of the post bearing the sign "Station, one mile." It is 12.9 meters south of south rail of track and in line with telegraph poles. (See note 15, p. 581.)

DESCRIPTIONS OF PERMANENT BENCH MARKS BETWEEN CHADRON, NEBR., AND ORIN JUNCTION, WYO.

A_4.—*Chadron, Dawes County, Nebr.*

B_4.—*Chadron, Dawes County, Nebr.*

C_4.—*Chadron, Dawes County, Nebr.*

D_4.—Is 7½ miles west of *Chadron* and nearly 8 miles east of *Whitney*, in *Dawes County, Nebr.*, on the right of way of the Fremont, Elkhorn and Missouri Valley Railroad, 17 rails west of milepost 414, 9 rails west of trestle 670, about 33 feet south of the center of the track, and about 6 feet north of the wire fence. (See note 17, p. 582.)

E_4.—Is at *Whitney, Dawes County, Nebr.*, on the right of way of the Fremont, Elkhorn and Missouri Valley Railroad, 100 yards west of the railroad station, about 20 feet north of the track, in the corner of the section-house yard nearest the depot and the track. (See note 17, p. 582.)

F_4.—Is 3½ miles east of *Crawford, Dawes County, Nebr.*, at milepost 429, on the right of way of the Fremont, Elkhorn and Missouri Valley Railroad, on the south side of the track, 33 feet from the center of the track and 12 feet from the fence. (See note 17, p. 582.)

G_4.—Is at *Crawford, Dawes County, Nebr.*, on the west side of the brick building known as the Syndicate Block, on the corner now occupied by the Bank of Crawford, a few inches above the sidewalk, 6 or 7 feet from the southwest corner, 10 inches from the north end of the stone sill. (See note 3, p. 580.)

H_4.—Is at *Fort Robinson, Dawes County, Nebr.*, in the corner of the station park, 3 feet from the east and north fences, 66 feet east of the east end of the depot, and 20 feet south of the center of the track. (See note 17, p. 582.)

I_4.—Is about 7 miles west of *Fort Robinson* and three-fourths mile east of *Glen*, in *Sioux County, Nebr.*, about one-third mile west of milepost 442, on the north side of the track, on the east abutment (concrete) of a small culvert, No. 725, under the Fremont, Elkhorn and Missouri Valley Railroad, 2½ feet from the north end. (See note 3, p. 580.)

J_4.—Is one-half mile east of *Andrews*, in *Sioux County, Nebr.*, on the right of way of the Fremont, Elkhorn and Missouri Valley Railroad, 30½ rails east of milepost 451, and 4½ rails east of the tile drain No. 750½, on the south side of the track, 36 feet from its center and 10 feet from the fence. (See note 17, p. 582.)

K_4.—Is about 1½ miles east of *Harrison, Sioux County, Nebr.*, on the right of way of the Fremont, Elkhorn and Missouri Valley Railroad, 2½ rails east of milepost 459, 9 paces south of the railroad track and about 3 paces north of a telegraph pole. (See note 17, p. 582.)

L_4.—Is at *Harrison, Sioux County, Nebr.*, on the county court-house, near the middle of the south wall, which is of very soft brick, in the second row of brick above the water table, 3 feet east of the east side of the middle (closed) window. The letters U. S. B. M. were cut on the vertical face of the sandstone water table underneath the

bench mark with an arrow directly below the bench mark and pointing toward it. (See note 8, p. 581.)

M_4.—Is 6½ miles west of *Harrison*, *Sioux County*, *Nebr.*, on the right of way of the Fremont, Elkhorn and Missouri Valley Railroad, opposite milepost 467, in line with the telegraph poles on the south side of the track. (See note 17, p. 582.)

U_1.—Is 3 miles west of *Van Tassel*, in *Converse County*, *Wyo.*, on the right of way of the Fremont, Elkhorn and Missouri Valley Railroad, 11¾ rails east of milepost 474, in line with the telegraph poles on the south side of the track, 35 feet from the center of the track and 65 feet from the fence, about opposite the grade point at the western end of a shallow cut. (See note 17, p. 582.)

V_1.—Is at *Node Ranch*, *Converse County*, *Wyo.*, opposite and 7 feet south of the station sign, about 300 yards east of section house No. 92, 24 feet south of the station platform, and 36 feet south of the center of the main track. (See note 17, p. 582.)

W_1.—Is at *Lusk*, *Converse County*, *Wyo.*, in the northwest corner of the station park, 8 feet from either fence, 115 feet west of the west end of the depot, and 18 feet south of the center of the main track. (See note 17, p. 582.)

X_1.—Is at *Manville*, *Converse County*, *Wyo.*, 6 paces west of milepost 500, about 45 feet north of the center of the Fremont, Elkhorn and Missouri Valley Railroad track, and 6 rails west of where the main street of Manville crosses the track. (See note 17, p. 582.)

Y_1.—Is at *Keeline*, *Converse County*, *Wyo.*, 10 rails west of section house 96, and 1 rail east of the east end of station platform, 72 feet south of the track, 21 feet north of the fence. (See note 17, p. 582.)

Z_1.—Is at *Lost Spring*, *Converse County*, *Wyo.*, on the right of way of the Fremont, Elkhorn and Missouri Valley Railroad, 18½ rails west of the west end of the station platform, in line with the telegraph poles, and the south side of section house 97, 9 rails east of the east side of section house, 16 paces from the center of the track, and 16 paces from the fence. (See note 17, p. 582.)

A_2.—Is at *Shawnee*, *Converse County*, *Wyo.*, on the right of way of the Fremont, Elkhorn and Missouri Valley Railroad, in line with the telegraph poles, 57 feet from the fence, 39 feet south of the track, 6¾ rails west of the switch stand, and 5½ rails east of the station sign. (See note 17, p. 582.)

B_2.—Is at *Fisher*, *Converse County*, *Wyo.*, on the right of way of the Fremont, Elkhorn and Missouri Valley Railroad, 42 feet south of the track, in line with the telegraph poles, 2 rails east of the east end of the station platform, and 3½ rails east of the station sign. (See note 17, p. 582.)

R_1.—*Orin Junction*, *Converse County*, *Wyo.* (See p. 802.)

S_1.—*Orin Junction*, *Converse County*, *Wyo.* (See p. 802.)

T_1.—*Orin, Junction Converse County*, *Wyo* (See p. 802.)

DESCRIPTIONS OF PERMANENT BENCH MARKS, CHEYENNE-ORIN JUNCTION, WYO.

B.—At *Cheyenne*, *Laramie County*, *Wyo.* (See App. 8, Report for 1899, p. 645.)

E.—At *Cheyenne*, *Laramie County*, *Wyo.* (See App. 8, Report for 1899, p. 645.)

X.—Is about 4½ miles east of *Silver Crown*, *Laramie County*, *Wyo.*, T. 14 S. R. 68 W., on the right of way of the Colorado and Southern Railroad, about 100 yards

from North Crow Creek in the line of telegraph poles, 11 steps to the right of the track going northward, between the eighth and ninth telegraph poles to the south of telegraph mile pole No. 9 (from Cheyenne), 15 poles north of telegraph pole No. 8 and 21 steps from the nearest pole. (See note 11, p. 581.)

Y.—Is at *Silver Crown, Laramie County, Wyo.*, T. 14 S. R. 68 W., in the southwest stone pier of the water tank on the Colorado and Southern Railroad. (See note 3, p. 580.)

Z.—Is about 1 mile northwest of *Volente, Laramie County, Wyo.*, about 10 feet north of telegraph pole No. 21, about 60 feet east of the railroad track in a pasture owned by Mr. Arnold, 2 miles south of his ranch house. (See note 11, p. 581.)

A_1.—Is at *Islay, Laramie County, Wyo.*, about 50 feet east of the railroad track, in the line of telegraph poles, about 10 feet north of the first pole south of the station. (See note 11, p. 581.)

B_1.—Is about 1 mile west of *Horse Creek, Laramie County, Wyo.*, about 10 feet west of the second telegraph pole west of telegraph mile pole No. 34, about 50 feet north of the railroad track. The post is set 4 feet in the ground. (See note 11, p. 581.)

C_1.—Is about 3½ miles south of *Iron Mountain, Laramie County, Wyo.*, in the line of telegraph poles, about 30 feet south of telegraph mile pole No. 42, about 50 feet east of the railroad track. (See note 11, p. 581.)

D_1.—Is about 2½ miles northeast of *Iron Mountain, Laramie County Wyo.*, on the stone foundation of the most eastern one of the two north iron supports of the water tank on the Colorado and Southern Railroad. (See note 3, p. 580.)

E_1.—Is about 3 miles south of *Diamond, Laramie County, Wyo.*, on the right of way of the Colorado and Southern Railroad, about 50 feet east of the railroad track, in the line of telegraph poles, between the ninth and tenth poles south of mile pole No. 57. (See note 11, p. 581.)

F_1.—Is 5.3 miles north of *Diamond, Laramie County, Wyo.*, on the right of way of the Colorado and Southern Railroad, about fifty feet east of the track and in the line of telegraph poles, about 20 feet south of telegraph mile pole 65. (See note 11, p. 581.)

G_1.—Is 2½ miles north of *Chugwater, Laramie County, Wyo.*, on the right of way of the Colorado and Southern Railroad, about 50 feet east of the track and about 15 feet south of mile pole No. 73. (See note 11, p. 581.)

H_1.—Is about 3 miles south of *Bordeaux, Laramie County, Wyo.*, on the right of way of the Colorado ond Southern Railroad, about 50 feet east of the railroad track, between the sixth and seventh telegraph poles north of mile pole 81. (See note 11, p. 581.)

I_1.—Is 6.7 miles south of *Wheatland, Laramie County, Wyo.*, on the right of way of the Colorado and Southern Railroad, about 40 feet north of the railroad track, between the first and second telegraph poles west of telegraph mile pole 89, about 50 feet west of the first pole east of telegraph mile pole 89. (See note 11, p. 581.)

J_1.— Is at *Wheatland Laramie County, Wyo.*, about 100 feet west of the main railroad track, one block north of the depot, in the stone foundation, on the east side of the Wheatland Roller Mills, about 20 feet from the south end of the building, 20 inches above the ground; 10 inches below the twenty-ninth brick of the first course numbering from the south end of the building, 3 feet north of the south wareroom door. (See note 10, p. 581.)

4737 CHYN.—Is a bench mark of the United States Geological Survey at *Wheatland, Laramie County, Wyo.*, about 115 feet east of the Colorado and Southern railroad depot. It is an iron pipe, about three inches in diameter, projecting about 15 inches above the ground with a bronze cap, 3½ inches in diameter, riveted on the top. Around the circumference of the cap is lettered, "United States Geological Survey," and at the center are two intersecting lines and the lettering "Elevation 4737 feet." Just below this is marked CHYN 59 B. M. The intersection of the lines is the bench mark.

K_1.—Is at *Uva, Laramie County, Wyo.*, in the southwest stone pier of a water tank on the north side of the Colorado and Southern railroad. (See note 3, p. 580.)

L_1.—Is about a mile south east of *Buckhorn, Laramie County, Wyo.*, about 40 feet north of the railroad track and about 12 feet west of the telegraph mile post 111. (See note 11, p. 581.)

M_1.—Is about 300 yards north of the railroad section house at *Hartville Junction, Laramie County, Wyo.*, 4 paces south of the third telegraph pole south of a mile pole No. 119, 11 steps west of the track. (See note 11, p. 581.) This stone was broken in shipping and the letters B. M. were destroyed, but the bench mark was not injured.

N_1.—Is at *Wendover, Laramie County, Wyo.*, on the Colorado and Southern Railroad, in the northeast stone pier of the water tank. (See note 3, p. 580.)

O_1.—Is at the railroad siding called *Cassa, Laramie County, Wyo.*, about 40 feet east of the track, 10 feet south of the first telegraph pole north of mile pole No. 131, on a post set 4 feet in the ground. (See note 11, p. 581.)

P_1.—Is a half mile south of *Glendo, Laramie County, Wyo.*, on a small deck girder bridge (Colorado and Southern Railroad bridge No. 185), in the top of the north abutment, about 10 feet to the west of the west rail and about 5 feet below the top of the rail, 8 inches from the inner edge of the abutment, and 12 inches from the retaining wall at the end of the bridge. (See note 3, p. 580.)

Q_1.—Is a mile south of *Bona, Laramie County, Wyo.*, about 25 feet east of the railroad track, between the third and fourth telegraph poles south of mile pole 147, about 10 feet north of the fourth pole, on a 4½-foot sandstone post projecting 6 inches from the ground. (See note 5, p. 580.)

R_1.—Is 0.8 mile southeast of *Orin Junction, Converse County, Wyo.*, on the right of way of the Colorado and Southern Railroad, 6 feet from telegraph mile pole No. 153 and 15 feet east of the center of the track, on a post set with 6 inches projecting from the ground. (See note 11, p. 581.)

S_1.—Is at *Orin Junction, Converse County, Wyo.*, in the southwest stone pier of the water tank, on the side toward the Colorado and Southern track. (See note 3, p. 580.)

T_1.—Is about a half mile east of *Orin Junction, Converse County, Wyo.*, on the Fremont, Elkhorn and Missouri Valley Railroad, on a small red sandstone arched culvert on the south side of the track, on the top stone of the west wall, about 11 feet from the center of the track. (See note 3, p. 580.)

DESCRIPTIONS OF PERMANENT BENCH MARKS FROM ROCK CREEK TO RED DESERT, WYOMING.

V.—Is at *Rock Creek*, *Albany County*, *Wyo.* (See App. 8, Report for 1899, p. 647.) Reported in good condition in 1902.

W.—Is at *Rock Creek*, *Albany County*, *Wyo.* (See App. 8, Report for 1899, p. 647.) Reported in 1902 as in fair condition, but having settled.

U.—Is at *Rock Creek*, *Albany County*, *Wyo.* (See App. 8, Report for 1899, p. 647.) It was reported in 1902 that the bench mark was apparently undisturbed, although the bridge corresponding to the abutment upon which it is located had been removed. The abutment seemed to be in a fair state of preservation at that time, but no doubt in a few years would be undermined by the river. The Union Pacific Railroad in the vicinity of Rock Creek has been changed to a new route, so that the bench mark is now about seven miles from the railroad.

C_2.—Is about 2 miles west of *Wilcox*, *Albany County*, *Wyo.*, on the south side of the track, on a small stone culvert under the Union Pacific Railroad, on the east wing 8 inches from the end of the cap stone. (See note 3, p. 580.)

D_2.—Is about 2 miles west of *Aurora*, *Carbon County*, *Wyo.*, and 1½ miles east of *Ridge*, *Carbon County*, *Wyo.*, on the right of way of the Union Pacific Railroad, opposite the grade point of the west end of the second long fill east of Ridge, opposite a telegraph pole, 40 feet north of the track and 10 feet south of the wire fence. (See note 34, p. 583.)

E_2.—Is at *Medicine Bow*, *Carbon County*, *Wyo.*, about 50 yards east of the depot, on the southeast corner of the stone foundation under the most eastern one of the two northern iron columns supporting the railroad water tank. (See note 3, p. 580.)

F_2.—Is at *Medicine Bow*, *Carbon County*, *Wyo.*, at a point 24 rails west of the station semaphore, opposite the fifth telegraph pole west of the station, 48 feet south of this pole and 171 feet south of the main track. (See note 34, p. 583.)

G_2.—Is at *Allen*, *Carbon County*, *Wyo.*, on the right of way of the Union Pacific Railroad, 90 feet north of the center of the main track and 6 feet south of the wire fence, at a point 10 rails west of the station sign, and 63 feet west of the west side of the section house. (See note 34, p. 583.)

H_2.—Is about 2½ miles west of *Como*, *Carbon County*, *Wyo.*, on the right of way of the Union Pacific Railroad, 36 feet south of the track and 4 feet north of the wire fence, 8½ rails west of a small culvert, which is the only one in the vicinity, and about 150 yards west of a small cut, which is the only cut for several miles west of Como. (See note 34, p. 583.)

I_2.—Is at *Hanna*, *Carbon County*, *Wyo.*, 425 meters east of the water tank on the right of way of the Union Pacific Railroad, 90 feet north of the center of the main track, in line with the telegraph poles, about halfway below the first and second telegraph poles east of an angle in the line of telegraph poles. (See note 34, p. 583.)

J_2.—Is east of the station at *Hanna*, *Carbon County*, *Wyo.*, on one of the stone piers, on the southeastern corner of the pier under the eastern one of the two northern columns supporting the water tank. (See note 3, p. 580.)

K_2.—Is at *Dana, Carbon County, Wyo.*, on the right of way of the Union Pacific Railroad, 39 feet from the center of the main track at a point 1½ rails east of the east end of the depot. (See note 34, p. 583.)

L_2.—Is at *Edson, Carbon County, Wyo.* (old station), on the right of way of the Union Pacific Railroad, 84 feet north of the center of the main track, and 16 feet south of the wire fence, 14 rails east of the most western switch stand, 23 rails west of the section house, and 26 rails west of the station sign. (See note 34, p. 583.)

M_2.—Is three-fourths mile west of *Walcott, Carbon County, Wyo.*, on the south side of the track near the center of the capstone of the stone facing of a drain pipe. (See note 3, p. 580.)

N_2.—Is at *Fort Steele, Carbon County, Wyo.*, and is the bottom of a square cut on the southeast corner of the stone foundation under the most eastern one of the two southern iron columns supporting the railroad water tank west of the station.

The letters U. S. B. M. are cut on the east face of the foundation just under the bench mark.

Geol. Survey West Base △.—Is a station of the Geological Survey and is located about three-fourths mile east of *Greenville, Carbon County, Wyo.*, about 100 yards south of Union Pacific Railroad track. It is marked by a bronze plate in the top of stone post set into the ground. The top of the stone is nearly flush with the ground, the exposed face being about 6 inches by 10 inches. Iron pipes are set on the north, south, and east sides for reference marks, and at present there is a quadrapod signal erected over the station. The center of the triangle in the bronze plate is the point where elevation was determined. This is not considered as a permanent bench mark, as the mark is too unstable to be reliable.

O_2.—Is about one-half mile east of *Greenville, Carbon County, Wyo.*, on the south side of the track, near west end of the capstone of a small culvert, the only stone one in this vicinity, and consists of a square lettered U S □ B M.

P_2.—Is at *Rawlins, Carbon County, Wyo.*, on the stone sill of the northeast window of the roundhouse and is the bottom of a square lettered thus: U S □ B M.

Q_2.—Is at *Rawlins, Carbon County, Wyo.*, on the stone sill of a one-story stone building on the northwest corner of Fourth and Cedar streets and is 2 feet from southwest corner of the sill and 8 inches above the sidewalk. (See note 3, p. 580.)

R_2.—Is at *Rawlins, Carbon County, Wyo.*, on the county court-house, in one of the corner stones on the west side, 11 inches from the southwest corner and 5 feet above the ground. (See note 13, p. 581.)

S_2.—Is at *Solon, Carbon County, Wyo.*, 96 feet west of the depot platform, 48 feet south of the center of the main track, 12 feet south of the fence, 2 rails east of east switch stand for the south siding, and between the third and fourth telegraph poles east of the new section house. The depot is soon to be moved about 100 yards west and to the opposite (north) side of the track (1902). (See note 34, p. 583.)

T_2.—Is 1 mile east of *Daleys Ranch, Carbon County, Wyo.*, and is on the south side of the track, on the east abutment of a small deck-plate girder, 1 foot from the end of the abutment. (See note 3, p. 580.)

U_2.—Is at *Riner, Sweetwater County, Wyo.*, 40 feet south of the center of the main track, 5 feet north of wire fence, 20½ rails west of the west end of the depot, 11½ rails

west of the west water tank, and 1½ rails east of the west switch stand, just east of a cut. (See note 34, p. 583.)

V_2.—Is at *Fillmore*, *Sweetwater County*, *Wyo.*, on the right of way of the Union Pacific Railroad, at the west end of a small cut, 3 rails east of the station sign and about 9 rails west of the first switch stand east of the station sign, 43 feet south of the center of the main track and 7 feet north of the railroad fence, in line with telegraph poles. (See note 34, p. 583.)

W_2.—Is at *Creston*, *Sweetwater County*, *Wyo.*, 6 rails west of the west end of the depot, 46 feet south of the center of the main track and 4 feet north of the railroad fence, 6 feet south of the line of telegraph poles and directly behind a sign marked "Divide of the Continent. Elevation 7014 ft." (See note 34, p. 583.)

X_2.—Is about one-half mile west of *Latham*, *Sweetwater County*, *Wyo.*, on the top of the stone facing of a drainpipe, on the south side of the track, on the east wing wall, 8 inches from the southeast corner of the capstone. The drainpipe is 10 rails east of a semaphore and is the only one in the vicinity. (See note 3, p. 580.)

Y_2.—Is at *Wamsutter*, *Sweetwater County*, *Wyo.*, on the northeastern corner of the stone foundation of the railroad water tank under the more southern of the two eastern columns. The letters U. S. B. M. are cut on the east face of the stone just under the bench mark.

Z_2.—Is 1 mile east of *Red Desert*, *Sweetwater County*, *Wyo.*, on the right of way of the Union Pacific Railroad, about 4½ rails east of the beginning of the first curve east of the station and 15½ rails west of the station whistle post; 38 feet south of the track and 8 feet north of the fence. (See note 34, p. 583.)

A_3.—Is about one-half mile east of *Red Desert*, *Sweetwater County*, *Wyo.*, on the east abutment of a through plate girder, a few inches from the south end on a stone projecting from under the retaining wall. (See note 3, p. 580.)

B_3.—Is at *Red Desert*, *Sweetwater County*, *Wyo.*, 45 feet west of the prolongation of the west wall of the depot, 213 feet north of the main track, 135 feet north of the fence. (See note 34, p. 583.)

DESCRIPTIONS OF BENCH MARKS, WASHINGTON, D. C.

No. 8, or E.—*Washington*, *D. C.* The center of a rude cross and circle ⊕ cut into the top of one of the coping stones of the wharf or dock on the east side of the slip to the boathouse, navy-yard. It is 28 feet 9 inches south from the boathouse, and 10 inches from outer edge of stone.

No. 14, or Ordnance.—*Washington*, *D. C.* The bottom of a square hole, about 0.15 or 0.0125 foot deep, cut into the north end of the granite doorstep of the main entrance to the Ordnance Office, navy-yard. It was marked thus:

U S
C & ■ G S
B M

The step is about 8 feet long, 14 inches wide by 8 inches thick, and is set on 3 feet of concrete.

No. 16 or 24.—*Washington*, *D. C.* The southeast corner of foundation at entrance on Eighth street, near the southeast corner of the Capital Traction Company's building, corner of Eighth and M streets SE.

No. 22.—*Washington, D. C.* The center of a rude cross in middle of stone doorsill of M street entrance to Bruen Mission Church, on corner of M and Half streets SE.

No. 25.—*Washington, D. C.* The center of a rude circle cut into the stone abutment on southwest corner of M Street Bridge at First street SW.

No. 30.—*Washington, D. C.* A rude cross cut in the southwest corner of the top surface of the stone doorsill of Faith Chapel, on M street, between Four-and-a-half and Sixth streets SW.

No. 36 or Arsenal.—*Washington, D. C.* The northwest corner of iron plate on stone foundation of the west post of the central or carriage gate to the old Arsenal Grounds.

No. 41.—*Washington, D. C.* A rude cross cut on the upper surface of the corner of foundation stone on west side of western entrance to the Seventh street power house from P street SW.

No. 47 or Brewery.—*Washington, D. C.* The north corner of the northern window sill of the brewery on the corner of Delaware avenue and E street SW.

No. 79.—*Washington, D. C.* A rude cross cut in the south corner of the south doorsill of St. Paul's African Methodist Episcopal Church on Eighth street SW.

No. 80.—*Washington, D. C.* A rude cross cut into the south end of the top stone of the south doorstep of Kendall Green Baptist Church on Ninth street, between B and C streets SW.

No. 82.—*Washington, D. C.* A rude cross cut into the west side of the stone sill of the outer door of the main northern entrance to the National Museum.

No. 84, or Smithsonian.—*Washington, D. C.* A cross cut in the stone coping of the area wall in front of the basement window at the northeast corner of the Smithsonian Institution.

No. 88.—*Washington, D. C.* Is about 3 feet below the surface of the ground, in the southeast corner of the Washington Monument Grounds, near the Bureau of Engraving and Printing, 25 feet east of the board walk, 150 feet from the fence, about 20 feet northeast of a large elm tree (near bridle path), and about 120 feet from the intersection of the bridle path and roadway. It consists of a brass plug set into a stone which rests on concrete, with an iron tube covered by a rough, flat stone on the surface. It was established by the United States Engineers.

No. 92.—*Washington, D. C.* The top surface of an underground obelisk covered with an iron plate, about 34 meters south of Washington Monument, a few feet outside of the driveway. It was established by the United States Engineers.

No. 93.—*Washington, D. C.* The top surface of an iron plate, about 2 inches below the surface of granolithic pavement at the southwest corner of Washington Monument.

No. 95.—*Washington, D. C.* The top of brass cap over iron rod just outside granolithic pavement at southwest corner of Washington Monument.

No. 96.—*Washington, D. C.* The top of brass cap over iron rod just outside granolithic pavement at southeast corner of Washington Monument.

No. 97.—*Washington, D. C.* The top of brass cap over iron rod just outside granolithic pavement at northeast corner of Washington Monument.

No. 98.—*Washington, D. C.* The top of brass cap over iron rod just outside granolithic pavement at northwest corner of Washington Monument.

No. 101.—*Washington, D. C.* The east corner of the doorsill of the office of Heurich Brewery, on C street, between Twenty-fifth and Twenty-sixth streets NW. No mark was made to indicate the point used, but the rod was held against the bricks on the outer right-hand corner of the sill upon entering the door.

No. 102.—*Washington, D. C.* Is the outer west corner of the doorsill of the south entrance to Washington Gas Company's Office, on the northwest corner of Twenty-sixth and G streets NW. No mark was made to indicate the point used, but the rod was held against the left-hand side of the door upon entering it.

No. 103.—*Washington, D. C.* A rude cross cut in the sea wall about 2 feet north of Engineer's Wharf at Easby Point.

DESCRIPTION OF BENCH MARKS, FORT HAMILTON, N. Y.

A.—Is at the intersection of a cross + about 6 inches long cut in the level surface of the cap stone on the western side of the stone pier belonging to the Government at *Fort Hamilton, N. Y.* The cross is about 7 feet from the southwest corner of the wharf.

C.—Is at *Fort Hamilton, N. Y.*, and is the top of a cannon ball forming part of an iron mooring post near the southeast corner of the stone pier and about 3.75 feet above the wharf at *Fort Hamilton, N. Y.*

D.—Is at *Fort Hamilton, N. Y.*, and is the highest point within the 3-inch circle cut in the cap stone of the wharf about 12 feet north of B. M. C. It is level with the top of the wharf.

F.—Is the highest portion of a notch about an inch deep and 4 inches long cut in face of the sea wall about 113 feet south of the shore end of the stone pier at *Fort Hamilton, N. Y.* It is about 4.33 feet below the top of the cap stone, measured along the slope, and nearly 4 feet south of a drain.

G.—Is the highest point within the 3-inch circle cut in cap stone of sea wall about 75 feet south of B. M. F. at *Fort Hamilton, N. Y.* An arrowhead was also cut in the stone to point out the mark.

H.—Is the highest point of a notch cut in the vertical face of a stone in the retaining wall on west side of *Fort Hamilton, N. Y.*, nearly in line with the medial line of the stone pier, and about 6 feet south of a drain. The notch is an inch and a half deep and 4 inches long.

CORRECTIONS TO DESCRIPTIONS AND ELEVATIONS OF BENCH MARKS PUBLISHED IN APPENDIX 8, REPORT FOR 1899.

The following bench marks, of which the descriptions are printed on pages 565–567, were reported in 1901 by Mr. Walter M. Dawley as having been destroyed: LXV, at *Delhi, Ohio;* LXVI, near *Lawrenceburg, Ind.;* LXVII, near *Cochran, Ind.;* LXVIII, near *Delaware, Ind.;* LXIX, near *North Vernon, Ind.;* V, near *Medora, Ind.;* LXX, near *Fort Ritner, Ind.;* W, near *Scottsville, Ind.;* III, near *Clay City, Ill.;* IV, near *Iuka, Ill.;* E_3, near *Carlisle, Ill.;* VIII, near *Aviston, Ill.;* and IX near *Caseyville, Ill.*

Page 567. *Collins* station, Illinois, in description of bench mark VII, is now known as *Huey*.

Page 592. It was reported in April, 1902, in regard to bench mark C_1 at *Scranton, Miss.*, that the shank of the copper bolt remains imbededd in the brickwork. Its head

has been chiseled off flush with the face of the building. The bolt is covered with a thin film of cement, but it can readily be located by measuring along the tenth course of bricks above the water table 0.33 meter (1.09 feet) from the northeast corner of the building.

Page 635. It has been reported that the house upon which the bench mark Archer, at *Archer, Fla.*, was placed has been burned down and the bench mark has disappeared.

Page 645. The building at *Cheyenne, Wyo.*, upon which bench mark C was placed is reported in 1901 to be known as "The Paint Shop."

Page 647. Bench mark X_2 at *Solomon, Kans.*, was reported in 1900 as having been destroyed.

Page 670. P. B. M. 45, opposite *Shreveport, La.*, which is said to be the same as the triangulation station West Base of the Shreveport Base Line, was reported in 1902 to be a wooden post 6 inches square, of which the top is rotten. The post is also reported to be loose in the ground, and of no value as a permanent bench mark.

Page 707. It was reported in 1901 that old B. M. U. S. at *Decatur, Ala.*, has been disturbed in its elevation by a change in the bridge-seat stone.

Page 707. It was reported in 1901 that P. B. M. 48 at *Decatur, Ala.*, is probably lost, as the bolt could not be found, but the hole supposed to have been left by the bolt was found.

Page 707. It was reported in 1901 that the elevation of P. B. M. 49 at *Decatur, Ala.*, had been disturbed.

Page 710. The description of T. B. M. 63 should have been inserted after T. B. M. 60, near the bottom of the page, as follows: "T. B. M. 63.—Is three-quarters of a mile below *Olmstead, Ala.*, at the west end of upper solid rock cut on north side, being highest point in square."

Page 725. It was reported in 1901 that P. B. M. 17, near *Hannibal, Mo.*, had been destroyed.

Page 737. It was reported by Mr. C. H. Judson, in April, 1901, that the description of P. B. M. 99 is erroneous, and should be corrected as follows: "The bolt is now leaded horizontally into the masonry about 2 feet above its original location, or about 1 foot above the wooden platform which has been erected level with floor of freight house. It is directly above its original location." The elevation given is correct for the present bench mark.

Page 850. The description of B. M. 35 (1875) should be as follows: "B. M. 35 (1875).—On projecting point of stone in second course of stones on southeast wing of northeast abutment of bridge *above Lock No. 34, Erie Canal.*"

Page 851. The description of B. M. 38 (1875) should read as follows: "B. M. 38 (1875).—Top of coping at corner of east wing of north abutment of bridge *above Lock No. 37 (or 39), Erie Canal.*"

Page 399, the reference opposite line No. 26. The pages should be 385–388, 392.

Page 401, line No. 122, in the column "Difference of Elevation." The entry should be −19.0180 instead of that printed with the plus sign.

Page 409, in the last column but one in the table, on the third line from the top, the sign should be minus before the quantity 1.1314.

Page 422, the first paragraph on the page is erroneous to the following extent. The entire line, Cape Vincent–Hogansburg, was run by Mr. D. A. Molitor, using the

Mendenhall level and the method of observation described in Transactions of American Society of Civil Engineers (Vol. XLV, June 1901, pp. 1–114).

Also, Mr. Molitor ran the portion of the line Gibraltar–Fort Gratiot between Grosse Point and New Baltimore, using this instrument and method.

Pages 478 and 479. The elevation of bench marks commencing with C near *Pike View, Colo.*, are erroneous as printed by a variable amount, on account of an error in computation. The heights of these bench marks should have been printed as follows:

Designation of bench mark.	Corrected elevation.	Designation of bench mark.	Corrected elevation.
	Meters.		*Meters.*
C_1	1 895.1080	O_1	1 780.2932
D_1	1 947.4074	P_1	1 711.2419
E_1	1 986.6796	Q_1	1 677.9180
F_1	2 007.4176	R_1	1 648.0053
G_1	2 121.4802	S_1	1 634.8162
H_1	2 202.5511	T_1	1 610.1124
I_1	2 154.3721	U_1	1 609.2481
J_1	2 101.2234	V_1	1 609.0009
K_1	2 035.9068	W_1	1 609.2967
L_1	1 923.4930	X_1	1 581.3582
M_1	1 890.8193	Y_1	1 580.7400
N_1	1 833.0750		

These elevations are superseded by those printed on p. 462 of this Report.

Page 496. P. R. P. Glendora should be stated to be near *Glendora, La.*, instead of near Pace Lake.

Page 501. The elevation of P. B. M. 1, *Birmingham, Ala.*, should have been printed as 186.0369 instead of 180.0369.

Page 513. T. B. M. 227 should be stated to be at *North McGregor, Iowa*, instead of McGregor, Iowa.

Page 515. P. B. M. 315 and P. B. M. 316 should be stated to be near *Bellevue, Iowa*, instead of near Goldens, Iowa.

Page 546. P. R. R. 169 should be stated to be near *Ryde, Pa.*, instead of at Overhead Bridge, Pa.

Page 555. L at *Fort Hamilton, N. Y.*, was destroyed October, 1901.

Page 868. P. R. R. 5 should be described as at *Rockville, Pa.*, and P. R. R. 6 as near *Rockville, Pa.*

Page 627. No. XI.—*West Washington (Georgetown), D. C.* This bench mark is on the west wing of the abutment at the north end of the bridge and south of the canal, and is on a projection extending along the face of the abutment about 7 feet below the top on fourth stone from the end.

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APPENDIX No. 4.

REPORT 1903.

TRIANGULATION SOUTHWARD ALONG THE NINETY-EIGHTH MERIDIAN IN 1902.

By JOHN F. HAYFORD,
Inspector of Geodetic Work; Assistant, Coast and Geodetic Survey.

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TRIANGULATION SOUTHWARD ALONG THE NINETY-EIGHTH MERIDIAN IN 1902.

By JOHN F. HAYFORD *Inspector of Geodetic Work; Assistant, Coast and Geodetic Survey.*

GENERAL STATEMENT.

The purpose of this appendix is to set forth fully in convenient form the results of the triangulation of 1902 southward along the ninety-eighth meridian from its former terminus near the southern boundary of Kansas to central Texas.

The work of 1902 is the most rapid and economical triangulation of a primary degree of accuracy yet executed in the United States, and so far as the writer knows it has not been equaled in these respects in any other country. This makes the methods employed of unusual interest. From the point of view of the geodesist it is always interesting to know the method of adjustment of a triangulation and the accuracy attained in the field observations. The information as to the accuracy attained is of more than usual interest in this particular case as the methods have been somewhat novel, and it is important to know accurately and to what extent the novel features have been justified or condemned by the outcome of the season in regard to accuracy. The information in regard to accuracy has therefore been set forth with unusual detail in this report and with an unusual number of comparisons with past work, the purpose being to show in full whether accuracy has been sacrificed in the attempt to secure rapid triangulation at relatively small cost.

The engineer, intent only upon securing the necessary information to enable him to extend this triangulation or base other surveys upon it, will find the information he desires in the latter part of this appendix commencing with the explanation of positions, lengths, and azimuths. The index of positions, descriptions, and elevations, used in connection with the sketches at the end of the appendix, will enable him to find quickly the data he desires for any given locality.

At the beginning of the season of 1902, the southern limit of triangulation along the ninety-eighth meridian was in the Anthony base net, near the southern boundary of Kansas, the base net being not yet complete. The triangulation of 1901, and the triangulation adjacent to it to the northward, is reported upon in Appendix 3 of the Report for 1902, entitled "Triangulation in Kansas." The reconnaissance from the stations Arlington and Sunflower, in southern Kansas, to the Rio Grande had been

made by Assistant Stehman Forney in 1898 and 1899. Six of the seven bases necessary to control the lengths along the triangulation from the Anthony base to the Rio Grande were measured by the party under Mr. A. L. Baldwin in 1900.* The only base remaining to be measured is the one at the extreme southern end of the arc near the Rio Grande.

The triangulation party of 1902 in eight months of field work extended the triangulation from the vicinity of the Anthony Base to the Lampasas Base, in central Texas.

No astronomic determinations have been made along the arc so far completed, save one determination of longitude made in advance of the triangulation and for a special purpose. Hence no part of the arc is available as yet for the determination of the figure of the earth. It is believed that the astronomic observations can be made more economically by special parties than by the triangulation parties during the progress of their work.

Several different members of the Computing Division and several field officers temporarily assigned to the Computing Division have taken part in the preparation of this appendix. Mr. M. H. Doolittle, assisted by Miss L. J. Harvie, made all the difficult least square adjustments.

THE PARTY OF 1902.

The field organization of 1902, all under the direction of Assistant William Bowie, consisted of a building party, two observing parties, and five light-keepers.

The building party consisted of three carpenters and three hands, under the direction of Signalman J. S. Bilby, a man of long experience in the building of signals. The equipment and work of this party will be treated later under the heading "Signals and their Construction."

The first observing party consisted of Assistant William Bowie as observer and in charge of the whole work of the organization, a foreman in charge of the camp and aiding the party in various other ways, a recorder, a driver, and a cook. The equipment of the party consisted of the necessary instruments and camp outfit of tents, bedding, cooking utensils, etc., a heavy covered spring wagon and two horses.

The chief of party, foreman, and recorder traveled in this wagon on the moves between stations and carried the instruments and observing tents. They usually reached the new station and had the signal ready for observing before the freight wagons arrived. The outfit weighed about 4 000 pounds, and was carried in three farm wagons hired for each trip from farmers or ranchmen living near the signals.†

The second observing party, in direct charge of Assistant O. W. Ferguson, who acted as observer, was similar in organization to the first observing party except that it contained no foreman. "The outfit was practically the same as that of the first observing party, but slightly lighter in weight. Only two freight teams were necessary."

The work of the two observing parties were similar, except that Assistant Bowie, of the first observing party, being in charge of the whole organization, which was scattered widely, and being responsible for all accounts, had a heavy correspondence to be

*See Appendix 3, Report for 1901: "On the Measurement of Nine Bases along the Ninety-eighth Meridian."

†This quotation, as well as many others which follow, is from the season's report by Assistant William Bowie, a concise and admirable statement of the season's operations, which has been utilized to a much greater extent in the preparation of this report than is indicated by the quotations from it.

attended to in addition to the other office work of the party. Mr. Bowie recommends that when another double party is organized an additional man be placed in the first observing party to aid in this office work, and that a foreman be added to the second observing party.

The corps of light-keepers consisted of five men. Their work will be described later under the heading "The Light-keepers."

The parties were organized at Bowie, Tex., early in March, 1902, and progressed northward toward Anthony, Kans., which was reached by the building party in July and the observing party in August. As soon as the connection with the work of the preceding season, near Anthony, had been completed the parties returned to Bowie, Tex., and progressed southward until the Lampasas Base was reached in October by the building party and in November by the observing party. Operations were commenced at Bowie, Tex., rather than at Anthony for the sake of keeping the party in more favorable weather than would otherwise have been encountered.

The building party and equipment arrived at Bowie, Tex., early in March, and the building of signals was begun on March 10. It completed its work and disbanded at Lampasas, Tex., on October 3. Between these dates, in an interval of less than seven months, the signalman and his party of six built 70 double observing towers or signals of an average height to the instrument of 42 feet (13 meters) distributed over the whole length of the belt of triangulation 444 miles (715 kilometers), had revised the reconnaissance in certain regions where such revision was found to be desirable, and had placed the permanent station marks in position at the triangulation stations.

Assistants Bowie and Ferguson, the two observers, arrived at Bowie, Tex., on March 10. They finished the organization of the observing parties and reached their first stations, the ends of the Bowie Base, on March 17. Between that date and October 25, an interval of but little more than seven months, they made complete horizontal and vertical angle observations at 75 primary stations and at several secondary stations, thus extending the triangulation along the ninety-eighth meridan 6° 27′, or 444 miles (715 kilometers) to the southward from its former limit. Their parties were disbanded at Lampasas, Tex., less than eight months after their arrival at Bowie, Tex., in the spring.

THE METHODS OF 1902.

All of the angle measures were made by the direction method. Each series of observations consists of successive pointings on the various stations in order, from left to right, with corresponding readings of the horizontal circle with three micrometer microscopes, followed immediately by pointings on the same stations in the reverse order after reversing the position of the horizontal axis of the telescope in the wyes and turning the alidade 180° in azimuth, each pivot remaining in contact with the same wye as before. Each observation of an angle consists therefore of two pointings on each station involved, one in each position of the telescope, together with the corresponding micrometer readings, 24 in all, both a forward and a backward reading of each micrometer being made in each of its positions.

Mr. Bowie used direction theodolite No. 167, and Mr. Ferguson No. 168. These are duplicate instruments of the same type that had been in use since 1899 on the ninety-eighth meridian triangulation. These instruments are fully described in Appendix 8

of the Report for 1894, entitled, "Notes on some Instruments recently made in the Instrument Division of the Coast and Geodetic Survey." These theodolites each carry a horizontal circle 30 centimeters (12 inches) in diameter graduated to 5 minute spaces and read directly by three micrometer microscopes to single seconds. The clear aperture of the telescope is 61 millimeters (2.4 inches) and its focal length 74 centimeters (29 inches).

Each observer made all pointings for horizontal angles by using two parallel vertical lines in the diaphragm of the telescope, placed so as to subtend a horizontal angle of about 20 seconds. The center of the image pointed upon was placed as nearly as possible midway between the two lines. This arrangement of lines in the telescope is not new, having been used for many years,* as well as the oblique cross. It is believed that the triangulation of 1902 furnishes strong evidence in favor of the use of such parallel vertical lines. In brief, it is claimed that when all conditions as to brightness are favorable to accurate pointing the same accuracy is obtained with the parallel vertical lines as with the oblique cross, the difficulty of bisecting accurately by eye an interval of nearly 20 seconds being more apparent than real; that with an extremely bright image of a heliotrope or light the lines of a cross are apt to disappear or be apparently burned off near the image, but the parallel lines under these conditions remain apparently undisturbed; that in making pointings in the darkness upon an extremely faint image of a light, the very faint illumination necessary to make the lines visible will cause the image of the light to disappear or nearly disappear when an attempt is made to secure a pointing by placing the image pointed on very near the intersection of the oblique cross, but the illumination of the parallel lines under the same conditions will produce comparatively little effect upon the faint image nearly 10 seconds away; and therefore in both these difficult cases better pointings will be secured with the parallel vertical lines than with either of the other arrangements, and in some cases good observations will be obtained with the parallel lines when observations with the other arrangement would be impossible.

It was necessary to elevate the instrument considerably above the ground at nearly every station. Two reasons led to a decision to build a low signal even at the stations from which observations could have been taken at the height of the observer's eye above the ground. The observing tents used to shelter the instrument and described later in this report, in connection with the signals, were designed to fit on the outside of and be supported by the framework of the outer tower or scaffold. Either a special tent or a special framework would have been necessary if the observations were taken with the observer upon the ground. It was also believed that the elevation of the instrument a few feet, so as to lift the lines of sight above the lower strata of air, in which the more erratic refraction occurs in the immediate vicinity of the station, would increase the accuracy of the observations and lengthen the daylight observing period. The minimum elevation of the instrument was therefore 11 feet (3.4 meters), the signals in these cases being one section high. The average height of instrument above the ground for the season was about 39 feet (11.9 meters). The maximum elevation was 75 feet (23 meters). The lights and heliotropes were usually

*See Appendix No. 7 of the Report for 1898, "Determination of Time, Longitude, Latitude, and Azimuth," p. 380, for a statement in regard to this method of pointing and its former use.

shown from a fixed table 5 feet (1.5 meters) above the instrument. The maximum height of a light above the ground occurred at station Burson, 138 feet (42 meters), the light at this station being placed far above the instrument, as it was discovered, after the height of the instrument had been fixed by building the signal, that one line of sight was obstructed.

The following extracts from, and comments upon, the general instructions under which the observers acted will serve to indicate the more important features of the methods of observation.

The first paragraph of the general instructions reads:

In making the measurements of horizontal directions you will measure each direction in the primary scheme sixteen times, a direct and reverse reading being considered one measurement, and sixteen positions of the circle are to be used, corresponding approximately to the following readings upon the initial signal:

	°	′	″		°	′	″
No. 1,	0	00	40	No. 9,	128	00	40
No. 2,	15	01	50	No. 10,	143	01	50
No. 3,	30	03	10	No. 11,	158	03	10
No. 4,	45	04	20	No. 12,	173	04	20
No. 5,	64	00	40	No. 13,	192	00	40
No. 6,	79	01	50	No. 14,	207	01	50
No. 7,	94	03	10	No. 15,	222	03	10
No. 8,	109	04	20	No. 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.

In regard to the positions specified in these instructions, it is important to note three points:

1. In each of the four groups of four positions each, the readings of the three microscopes on the circle corresponding to pointings on the initial station will be nearly uniformly spaced at intervals of approximately 15° over the whole 360°, and therefore the mean values of the angles from each group of four positions will be but little affected by periodic errors of graduation. In connection with this statement it is necessary to keep in mind that, during each measure, the alidade is turned 180° between the direct and reverse readings when the position of the telescope is changed, and therefore the three microscopes which are at intervals of 120° furnish readings at nearly uniform intervals of 60° during each measure.

2. In each group of four positions the micrometer readings corresponding to the initial station, and therefore those corresponding to each station, are nearly uniformly distributed over the 5′ interval covered by the micrometer. The effect of this is to insure that if corrections for run are applied, the algebraic sum of such corrections for each micrometer corresponding to pointings on each station will be nearly zero. In other words, the mean value of any angle from observations in four positions uncorrected for run is almost independent of the run. No corrections for run are necessary for observations made under these instructions and considerable time is thereby saved in the computation.

3. No microscope ever returns for pointings on a given station to any position on the circle which it has formerly occupied. When the observations in sixteen positions have been completed the circle has been read at ninety-six points scattered over the

whole circle at intervals which are each either 4° or about 3°. This insures that the mean value of each angle from sixteen positions is still more completely freed from the effect of periodic errors of graduation than are the means from the separate groups of four positions each.

The requirement as to the observations on missing signals is such that no local adjustment of the observations is necessary, and the computation is much simpler than would be the case if this requirement were not adhered to.

During the season of 1902 four observations were made on secondary stations, and from secondary stations, with the circle in the first four positions specified, and two complete observations were made on tertiary stations with the circle in positions 1 and 3.

The second paragraph of the general instructions reads:

> In selecting the conditions under which to observe primary directions you should 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.

It should be noted that the observer is directed in this paragraph not to select the conditions under which to observe with reference to the appearance of the object. According to the spirit of this direction, the observer is not to decline to observe because the image of a heliotrope on which he is attempting to point is large, say 20 seconds in diameter, or vibrating irregularly through a range of, say, 10 seconds, nor to decline to observe upon a light at night because it is very faint or very diffuse or apparently dancing about irregularly. On the contrary, he is to take observations upon such images, and if he finds that the triangles close within the required limit he is to continue to so observe. He is to gauge the difficulties of the pointings which are allowable solely by the resulting closing errors and not by the appearance of the image in the telescope, nor even by the range of the observations secured. This paragraph in the instructions is based upon the idea that in general difficult pointings are accompanied by an increase of accidental errors, which is unimportant, but that in general systematic or constant errors, which are the really serious errors in triangulation, are no more likely to be encountered in such pointings than in those made under apparently favorable conditions. The effect of a conscientious adherence to the spirit of this paragraph is to lead an observer to observe under a greater variety of conditions than he otherwise would, and to lengthen his available daily observing period by commencing observations comparatively early in the afternoon.

A portion of the ninth paragraph of the instructions reads:

> Vertical measures are to be made at each primary station on each primary station upon which horizontal measures are made. These vertical measures should be made on as many days and nights 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. A single measure, with the telescope in both the direct and reversed positions, on each day or night is all that is required. These measures may be made in daylight between 11.30 a. m. and 4.30 p. m. or in the darkness not less than two hours after sunset. * * *

It was known that during the season of 1902 the stay at each station would be brief. The limited evidence available seemed to the writer to indicate that night observations of vertical angles during the hours indicated in the instructions would be of a grade of accuracy not very different from the day observations. It was, therefore,

believed to be wise, since daylight observations would probably be secured on but few days at a station, to take night observations to supplement them. This proved to be a mistake, for it was found that the night observations of vertical angles were of so low a degree of accuracy, apparently on account of irregular refraction, as to be of very little value.

A single measure of a vertical angle during any one observing period on a day was considered to be substantially as good as more, since it was well known that the principal errors in trigonometric leveling are those due to irregular refraction. These refraction errors would not be reduced appreciably by additional observations soon after the first one and before the conditions as to refraction had been given much time to change.

According to Mr. Bowie's report for the season:

> The daily programme was to begin observing vertical angles at 3 o'clock in the afternoon, on the heliotropes if showing, otherwise on some part of the signals when they were visible. Vertical angles were usually taken between 3 and 4 o'clock, but sometimes it was necessary to take them on the tertiaries after the air became steady enough to make pointings. As soon as the vertical angles were finished the vertical circle was replaced by the theodolite and the measurement of primary horizontal directions begun, if the heliotropes were sufficiently steady. If not, it was usual to observe upon the tertiaries, and start on the primaries after the air became steady. A systematic search was made at each station for objects suitable for tertiary points, and directions were measured to every one which might possibly be observed from another station. Observations were discontinued for the afternoon a short time before sundown, when the observers and light keepers went to their evening meal. Primary horizontal directions were begun for the night about an hour after sundown and continued until 10.30 or 11 p. m., when the theodolite was replaced by the vertical circle. Vertical angles were then measured on all lights showing. This completed the work for the day, although sometimes after the vertical angles were taken the theodolite was again put up and horizontal observations continued. The light keepers left the lights burning upon going from the towers at 11.30, and it was possible to observe to a much later time if so desired.

No attempt was made to secure morning observations. The parties found that during the early hours of the day and until 3 p. m. they were kept sufficiently busy with correspondence, computations, and other miscellaneous business.

Among the somewhat novel features of this season's work which are worthy of special mention are the following:

1. Practically all primary observations were made either on heliotropes or lights. Some observations were made by pointing on the signals in daylight, but these were so few in number as to be hardly worthy of consideration. In former primary triangulation in the United States the observations have usually been made upon poles, upon poles and heliotropes, upon heliotropes alone, or upon lights alone. The use of both lights and heliotropes, with the omission of all poles, has been comparatively rare and had not until 1902 been tried on the ninety-eighth meridian triangulation.

2. The observers took more risks in 1902 in observing under conditions apparently unfavorable to accuracy than had been customary. These risks were taken in accordance with the spirit of the second paragraph of the instructions already quoted.

3. The use of both heliotropes and lights, together with the practice of observing under apparently unfavorable conditions, made the possible hours of observing so long that during much of the time in the field the rate of progress of the party was limited by the endurance of its members rather than by the weather conditions. The party spent its time trying to keep the necessary office work, the computations, and correspondence up with the observations rather than in waiting for favorable weather.

4. There are 5 stations out of the 75 occupied at which all the primary observations were made on a single day. The writer knows of no similar cases in former primary triangulation in the United States. At 27 other stations of the 75, the primary observations were all made on two days. Even this has rarely occurred previous to 1902.

5. When the observations have in the past been made in daylight, with the instrument mounted on a tower, it has been at times and by some observers considered necessary to shelter the inner tower or tripod supporting the instrument from the sun and wind, in part at least, by screens of canvas or cloth supported by the outer tower. Mr. Bowie states in his report for the season that—

> No signal screens were used during the season. The signal towers were very rigid, even in quite strong winds, and few days were lost on account of heavy vibrations. The records did not show any signs of twist. The levels did not change materially during the observations, but it was noticed that they were slightly more unsteady during the day than at night.

As this is directly contradictory to past experience, about two days were spent by computers at the office in examining the records after the close of the season for evidence of twist. No convincing evidence that any systematic twist occurs could be found. Whatever twisting of the tripod head in azimuth occurs, if regular and continuous in one direction for considerable periods, is so slow as to be concealed by accidental errors in pointing and reading. There is possibly a very irregular twisting, with frequent reversals or stops, the effect of which is to introduce errors of the accidental class into the results which can not be separated from the other accidental errors.

6. The observers kept in communication with the light-keepers by the heliograph method, using the Morse alphabet and flashes of light from the heliotropes or lights. This saved many days for the party during the course of the season, as each observer virtually had a telegraph station always within sound of his voice and could give the light-keepers such orders within a few minutes of the completion of observations at a station as would enable them to move during the next day, when the observer was also moving, and to be ready to show to him at his next station as soon as he reached it. To depend upon the mail or ordinary telegraph messages, or upon sending a team to the light-keepers, is an exceedingly slow process in comparison with the method used.

7. Observations of vertical angles were made at night as well as in the daytime. This, as shown later in this report, proved to be unsatisfactory.

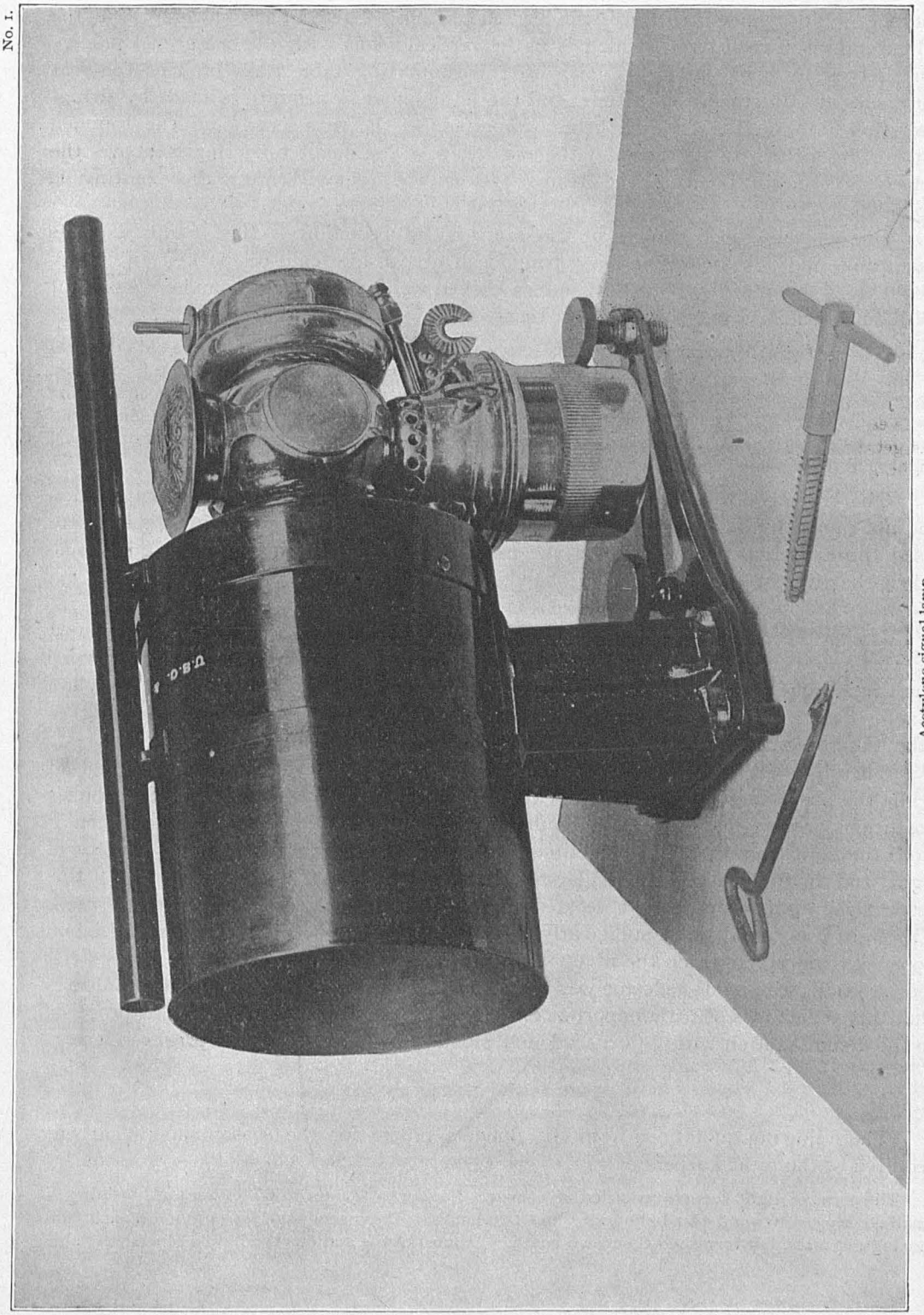
THE NEW ACETYLENE SIGNAL LAMPS.

The acetylene lamps used during this season on the ninety-eighth meridian were of a new design made in the Instrument Division of the Survey, and used for the first time on regular work on triangulation in South Carolina and Georgia, by Assistant W. B. Fairfield, early in 1902.

The lamp itself is an ordinary acetylene bicycle lamp, modified for the particular use proposed by taking off the front door and substituting for the ordinary lens an optically good pair of condensing lenses. The particular lamp used is known in the trade as the "solar gas lamp, model 1902." The condensing lenses were 5 inches in diameter.

The accompanying illustration, No. 1, shows more clearly than a description alone how the lamp and lenses are mounted. The lamp is held in place behind the lens by a

No. 1.



Acetylene signal lamp.

bayonet joint, connecting it with the lens mounting. The center screw shown in the illustration is a wood screw, which is in the vertical plane with the center of the lens, and serves to hold the light down to the supporting table. A screw at the rear furnishes an adjustment in altitude, and the adjustment in azimuth is made by swinging the light on the table, it being supported by the rear screw and the rounded supporting points at the front of the mounting. The small tube shown above the lenses is used in pointing the lamp. It can be removed after the pointing is completed.

One of the good features of the lamp is its portability. The lamp, with its mounting and accessories and a 5-pound can of carbide, can be packed in a box about 16½ by 10½ by 7 inches, and so packed weighs but 21½ pounds. Assistant William Bowie says in his field report that—

> the acetylene signal lamp proved very satisfactory and had many advantages over the old oil signal lamp. It was more easily centered and pointed; it was constructed in such a manner that it could not be injured from overheating; there was no possibility of the tower being burned; it was cleaner and more easily cared for; the flame was steadier and not affected materially by wind; and the lamp could not get out of order easily. Its only disadvantages were that it required recharging several times each night, and it was more complicated than an oil signal lamp.

The correspondence with the field parties shows that the additional complication did not cause any difficulty in securing reliable results when trained light-keepers were used throughout the season, as on the ninety-eighth meridian, but was troublesome when the lights were placed in the hands of untrained men as in South Carolina and Georgia.

It should be noted perhaps that these lamps must not be boxed up. They must be used entirely in the open, in order that there may be a free circulation of air to keep the lamps sufficiently cool. Under these conditions there is little doubt that they are much safer than oil lamps, which are affected by wind and will usually burn higher after they become thoroughly warmed up than when first lighted.

The observers reported that as compared with the oil lamps it was noticeable that while the image in the telescope from the oil lamp gradually disappears under difficult conditions on very long lines by becoming a faint diffused blur, under the same conditions the light from this lamp sometimes became an exceedingly small intense point of light, and finally disappeared by becoming too small and faint to be observed. In this respect the light seems to be a decided improvement over the oil lamps formerly used. The light was found to be sufficiently powerful for the lines on which it was used in 1902, varying in length on the ninety-eighth meridian from 5 to 51 kilometers.

A small, well-made reflector was placed behind the flame, but experience indicates that this reflector is of little importance, as sensibly the same amount of light proceeds to the distant station with a tarnished and smoked reflector as with a bright reflector.

THE LIGHT-KEEPERS.

The following quotations from Mr. Bowie's report for the season show what was required of the light-keepers:

> The corps of light-keepers consisted of 5 men. Each man was provided with a tent, bedding, a small cooking outfit, and two heliotropes and two lamps. They were paid $55 per month each, and moving expenses, but furnished their own board. At most of the stations the light-keepers were able

to get their meals with a farmer or ranchman. They made their moves between stations in farm wagons.

Horizontal directions and vertical angles were measured both day and night, and between the hours of 3 and 11 30 p. m. Heliotropes were used until sundown, and signal lamps at night. The light-keepers were required to start showing heliotropes promptly at 3 o'clock, and a few minutes before sundown the heliotropes were replaced by the lamps, which were lighted at once if the man in charge expected any delay in preparing or going for his evening meal; otherwise the lamps were started about one hour after sundown, which was the usual time for beginning the night observations.

A light-keeper was required to watch his lamps and keep them burning brightly. In order to do this he went on the tower each half hour until 10 o'clock. He stayed on the tower continuously from this time until 11.30 p. m., which was the usual period for the observers to signal the light-keepers.

The corps of light-keepers was organized and trained at Bowie, Tex., while the outfits were being prepared, but for various reasons only two of them remained with the party through the season. Whenever a light-keeper left the party or was discharged the man acting as driver in the first observing party would take his place, and his training in camp proved most valuable to him as a light-keeper. Having been with an observer, he realized the necessity of promptness, accuracy, and close attention to his duties. There was no change in the force of light-keepers after the 1st of July.

The light stand, 3 feet square, was of ample proportions for posting heliotropes and lights to the two observers, except in rare cases where the angle between the lines was very acute. This difficulty was overcome by placing the heliotrope and light to one observer on a board extended from the stand to the railing.

The light-keepers posted their own lights and heliotropes during the entire season. At all stations occupied by an observer lines were accurately drawn on the light stand to each signal observed upon, and a light-keeper following had simply to use these lines. The stations ahead of the observers had no lines laid out, consequently the light-keepers had to use their ingenuity in finding the directions to the observers. This, however, did not prove very difficult, as each man was given a sketch of the reconnaissance, and by placing the sketch on the light stand and orienting it approximately by the meridian line, he was enabled to locate at least one of the signals. He would then orient the sketch accurately over this direction and lightly mark on the stand the directions to all of the stations as given by the sketch. He would then begin showing to the observers. If he did not get lights from them in reply he would swing his heliotrope or lamp through a small angle to each side of the approximate direction. (The term "light" will be used hereafter to indicate either the heliotrope or lamp.) As soon as an observer saw a light from one of the stations ahead he showed a steady light, to enable the light-keeper to get a correct line. Most of the forward lines were found at night, as the lamps would show over a wider angle than the heliotropes. The work of finding the lines was greatly facilitated by the observers, who could usually locate the signals just before sundown the first day at a station; the lines would then be marked on the stand, and at night a lamp was posted to each forward light-keeper, who could then get his direction at once.

The light-keepers were usually able to pick up some range, such as a lone or high tree, fence corner, or some other more or less prominent object, by which they could post their heliotropes, and also the lamps, if put up before dark. This method was preferable to simply using the lines drawn on light stand.

Each observer would see more or less of the other's light at night when the angle was less than 25 degrees. This was prevented by placing a board on edge between the lamps to cut off the lateral rays.

THE SIGNAL CODE.

In order to facilitate the work, instructions and messages were sent to the light-keepers and between the observers by flashing with the lights. The Morse alphabet was used and a simple code was made out which covered most of the communications. The numerals were spelled out, as they were so seldom employed.

Copies of the Morse alphabet and code were given each light-keeper and each member of the observing parties, and they were required to commit them to memory. After a very short time this was satisfactorily accomplished by all.

No general rule could be adopted in regard to the length of the dots and dashes used, as they varied with the length of line and the strength of the light. But their lengths were such that

they were easily distinguishable, and the space between words was made much longer than the spaces between the elements of a word. The following are the rules and code messages used on the field:

SIGNALS AND METHODS TO BE USED BY ALL.

Call by your initial, repeated until answered.
Answer a call by a series of slow dots.
Then the one calling is to begin sending message.
A series of slow dots = I understand, Yes, All right, etc.
A series of quick dots = Have made a mistake; will begin again.
A series of r's = Repeat message.
A series of a's = Wait a while.
A series of n's = Your light is too faint.
Repeat all messages.

SIGNALS TO BE USED BY THE OBSERVERS WHEN COMMUNICATING WITH A LIGHT-KEEPER.

S T followed by name of a station = Stop showing to the sender and begin showing to station named, to-morrow.

For an observer to send initial of the other followed by "at" and the name of a station = The observer mentioned is at the station named, and begin showing to him at once.

D G followed by name of a station = DONE where you are, Go to station named.

Unless the light-keeper is informed by letter regarding the movements of the observers, send this message, as follows:

D G and names of three stations = Go to first station named and show to the second and third stations.

F I N I = FINISHED on you; obey written instructions, or signals from other observer.

V E R T = Have finished horizontal observations on you. Show for verticals only; that is, from 3 to 4 in the afternoon, and from 9.30 to 11.30 at night.

T H D = Have finished on your light for the half day; that is, afternoon or night.

MONEY, or CARBIDE, or MAIL, followed by name of a place = The article is at point named.

SIGNALS TO BE USED BETWEEN OBSERVERS.

F I N I = Have finished; will move to-morrow.
V E R T and T H D = Same as to light-keepers.
N O, followed by the name of a station = I do not get any light from station named.

SIGNAL TO BE USED BY LIGHT-KEEPERS.

MONEY, or CARBIDE, etc. = I am short of, or in need of, the article named.

The above were the only code messages used. Anything else was spelled out in full. Occasionally one observer communicated with the other observer through a light-keeper.

The observers often called up a light-keeper at night, before 10 o'clock, by simply showing him a light. Then he would answer when he came on the tower to investigate his lamp, as mentioned previously.

The chief of party kept the second observer and the light-keepers fully advised by mail as to their movements and those of the other members of the party, and this, while making the office work heavy, added considerably to the progress of the work.

Five men as light-keepers were just the number necessary in the party. All of them were kept busy continually, and an extra man was only necessary in the base nets, when usually the driver of the first observing party would act as light-keeper at one end of the base.

The usual scheme of placing the light-keepers was to have two ahead of the observers and two behind them, with the fifth man at the central station of a figure, or at any other place where he was needed. Each of the observers took a side of the scheme of triangulation, and never crossed over between bases. The same was nearly always true with regard to the light-keepers. The forward light-keepers moved to the next stations ahead, and the ones in the rear came up to the points left by

the observers. The observers were usually directly across the scheme from each other, and if they moved forward the same day each station to be observed upon would have a light-keeper, but when they did not move at the same time, and in the base nets, an observer often finished on one station the first or second day of observations and signalled the man to a station without a keeper. Many delays were prevented in this way.

Carbide was distributed by the observers, who left it with the owner of the property at a station for the light-keeper following. The forward men would wait for the observers to come up to them to get their supply, unless they could be supplied by express or freight.

A man to be a good light keeper must have education enough to keep his accounts, but what is most essential is a practical turn of mind which will enable him to overcome difficulties and get his lights posted in spite of floods, breakdowns, etc.; of course it goes without saying that he must be conscientious and faithful. Unless a man shows the above qualities it is not advisable to keep him in the party longer than is required to get another man.

SIGNALS AND THEIR CONSTRUCTION.

The signals built during the season of 1902 and the method of their construction are especially interesting because the signals served their purpose well and were erected at an extremely low cost, and with great rapidity. On these signals observations of the required degree of accuracy were obtained without the use of any canvas or cloth screens on the outer tower to protect the inner one from sun and wind.

The service required of the signals in 1902, or when used by similarly organized double observing parties, is, briefly, that the outer tower must support the observer and the tent which protects him and his instrument from the sun and wind, and must at the same time and without interference with the observer or his work support a light-keeper and the lights or heliotropes; and that the inner tower must support the instrument with such stability that its motion in azimuth shall never be so rapid or irregular as to seriously affect the accuracy of the measurements of angles, its disturbance in level never so rapid as to inconvenience the observer by making frequent adjustments necessary, and its vibration due to wind must seldom be so great as to interfere seriously with accurate pointing. These signals must, moreover, be strong enough to stand without injury in all ordinary winds and in most storms. It would be poor practice to build them so strong as to withstand the most violent storms.

The success attained in 1902 in building rapidly and at small cost signals which satisfy these conditions is due largely to the genius and energy of Mr. Jasper S. Bilby, Signalman, in charge of the signal-building party, from whose written report on the work of the season the following description of the signals and method of their construction is adapted:

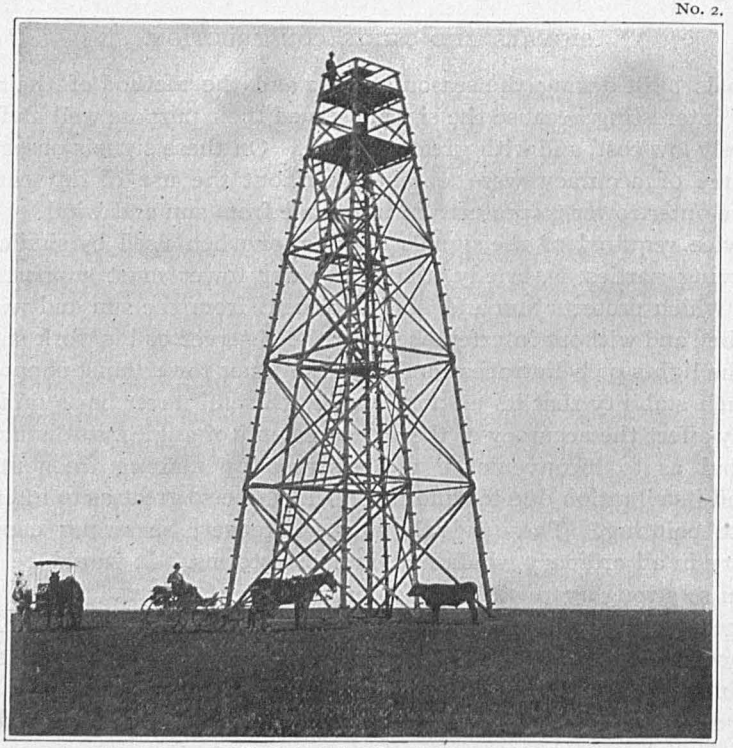
For convenience, the inner tower, which supports the instrument and has three legs, is called the tripod; the outer tower, having four legs and supporting the observer and light-keeper, is called the scaffold; and the whole structure, comprising both towers, is called a signal. A completed signal 60 feet high to the instrument is shown in illustration 2. In the following general directions the various steps in the process in framing and erection of such a signal are given in approximate order of time, it being understood that at times two or more processes are going on at the same time.

The first step is the framing of the tripod legs and of one side of the tripod, with all the material lying on the ground. In illustration 3, A is a pattern used in making the scarfs; B shows the positions in which the timbers are laid before the work of framing begins; C shows the scarfs cut; D shows one leg nailed together. All

scarfs are nailed together except on unusually tall signals, as indicated later. E shows the leg chamfered ready for framing. Illustration 4 shows tripod legs Nos. 1 and 2 with two of the horizontal ties in position, the legs being in such a position that the chamfers which form a bearing surface for the ties and diagonals are horizontal. The chamfers as seen in this position are cut 1¼ inches back from the corner on the top and 2½ inches on a side and are 2 feet long, and are marked with chamfer patterns.

In framing the first side of the tripod cut the bottom first horizontal tie to the length given in illustration 4, or the table on p. 839, place the two legs to be framed in the position shown in illustration 4, and nail on the first and second ties G and H. The length of the horizontal tie G is such that for a 60-foot tripod the legs, when

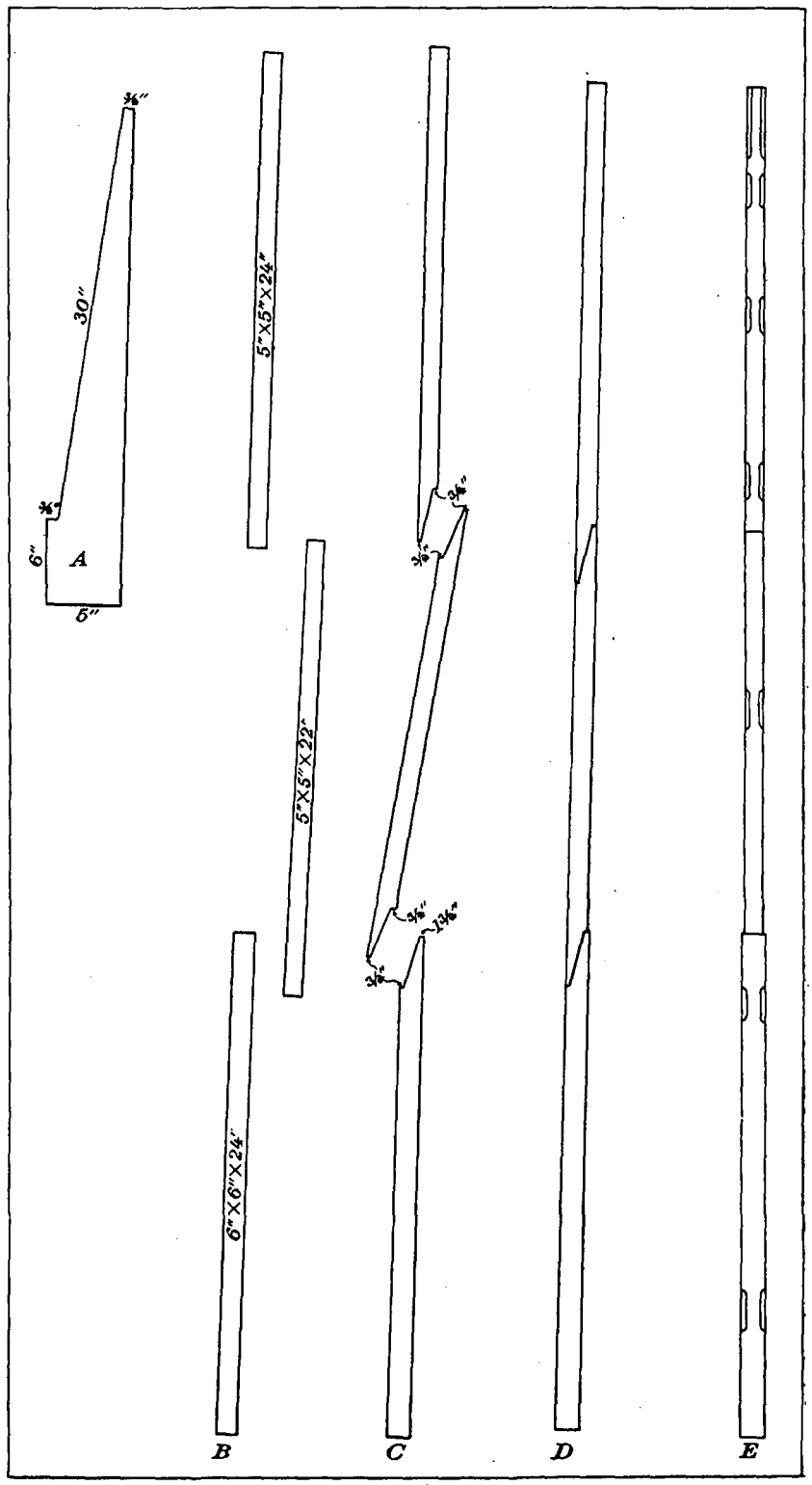
No. 2.



Sixty-foot signal complete.

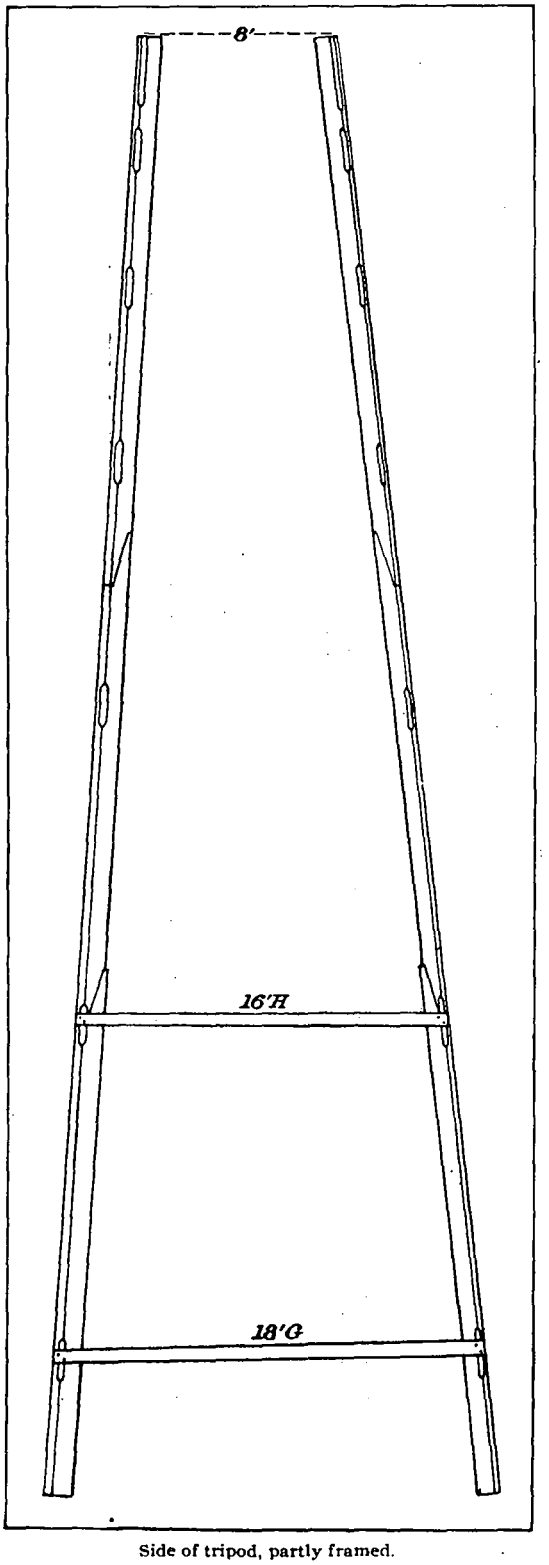
straight, will be about 8 feet apart at the top, as shown by illustration 4. For tripods of other heights the distance apart at the top when the legs are straight will vary with the height, and is to be fixed by the judgment of the builder as to the amount of the curvature to be put into the legs. Then draw the upper ends of the two legs toward each other, thus putting a bend into each one of them, and nail on the successive ties from the bottom upward with the legs in this bent position. The lengths of all ties above G are to be such as to give the legs the desired bend. When the tie 5 feet from the top is nailed on, the tops of the two legs should meet, as shown in illustration 5. The distance along the legs to each horizontal tie is reckoned from zero at the top. Each panel must then be squared, by using a steel tape, to make the two diagonals of the panel equal in

No. 3.



Scarfs.

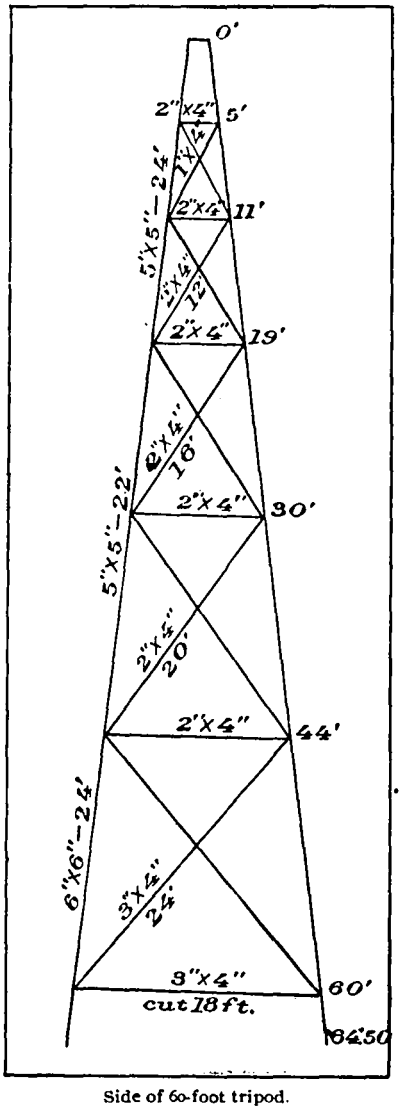
No. 4.



Side of tripod, partly framed.

length. The ends of the ties should be cut off with the same slant as the leg, and leaving 1½ inches overhang. Time should not be spent in measuring the diagonals of the panels before cutting. Instead, they should be laid on at the place where they are to be used and sawed off, each end parallel with the horizontal tie and nailed in place, the panel having been already sprung to its proper position. Then saw off the portions of the ends which project beyond the end of the horizontal tie. Use two

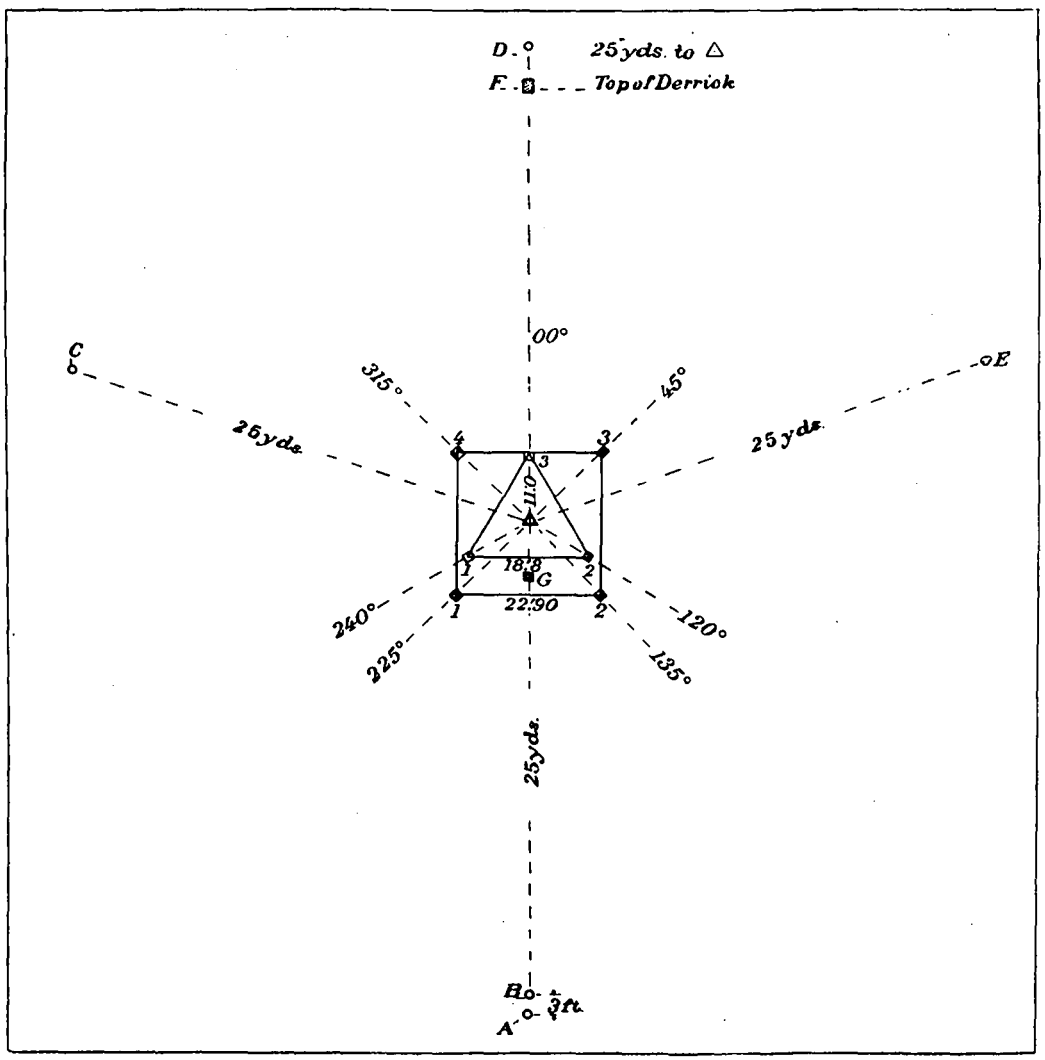
No. 5.



Side of 60-foot tripod.

nails in each end of the horizontal ties and diagonals, and also nail each pair of diagonals together with one nail at the point where they intersect. Use 60-penny nails for all 3 by 4 pieces, and 40-penny nails for all 2 by 4 pieces. The dimensions for each part of a side of a tripod are given in illustration No. 5.

No. 6.



Ground plan of signal.

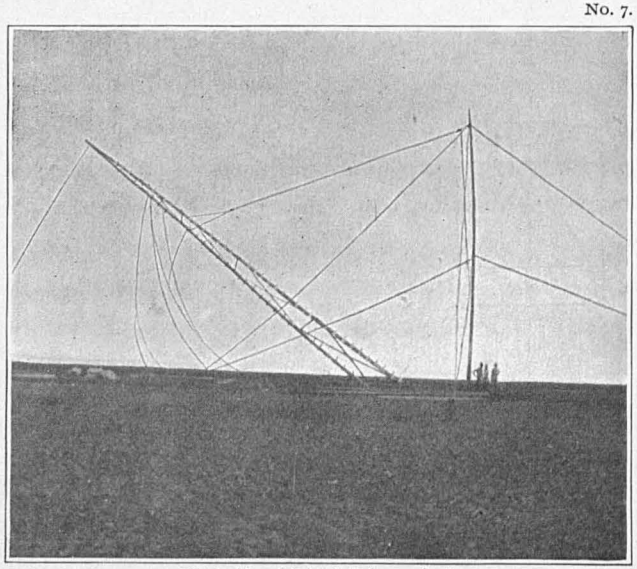
Call the side of the tripod framed first No. 1. Cut the horizontal ties and diagonals for sides Nos. 2 and 3 by laying each piece to be cut on that of the corresponding piece on side No. 1 and cut to match, thus avoiding any necessity for measurements with a tape or square. Lay out each piece for sides Nos. 2 and 3 ready to send aloft, the nails all being started. With a pencil, mark a cross on the top end of each diagonal before it is laid out. When picking each timber up to lay it out in

its proper position face the top of side No. 1, and face the triangulation station when laying it down. This will bring each piece right end to when it is picked up and sent aloft.

The holes for the foundation are laid off, and stakes for holes driven as shown by the ground plan in illustration 6. For locating the holes it is convenient to use a small theodolite and a steel tape. The angles shown on illustration 6 are counted from zero at the foot of the tripod leg No. 3. The holes for the tripod legs and the scaffold legs are to be made 3 feet wide, 3½ feet long, and 3½ to 4 feet deep.

Spend no time in bringing the bottoms of the holes accurately to the same level, but after they are dug and the tripod foot plates set, take a round of levels, either with a carpenter's level or leveling instrument, using foot-plate No. 3 as a bench mark; then cut legs Nos. 1 and 2 to correspond with the differences of elevation found, No. 3 having been already cut to the exact length shown by illustration 5.

No. 7.



First side of tripod being raised.

Do not delay raising tripod by waiting for the holes for scaffold. They can be dug after the tripod is raised. Use the lower horizontal tie at the No. 3 tripod leg for a bench mark, it being exactly 4½ feet above its foot-plate, and take a round of levels on the scaffold foot-plates. Cut off each scaffold leg as much above or below the 4½-foot mark already on it as the corresponding foot-plate is above or below No. 3 tripod foot-plate as shown by the levels.

The foot-plates are 2 by 12 inches, and 3 feet long. They should be carefully set so that the legs will rest near the center, and so as to have a firm bearing on the ground.

One or more sections of a leg of the scaffold may be used as a derrick for raising a side of the tripod. The derrick should be about two-thirds the height of the side of the tripod to be raised. Posts for guys should be set as shown in illustration 6, A and B being the positions of the posts for the back guys, C and E for the side guys, and D for the forward guy. F on the ground plan represents the position of the top of the derrick when laid out ready for raising, and G the foot of the derrick. Before raising the derrick put on the side guys and make them fast to the posts at C and E, leaving about 2 feet of slack. A double fall or winch tackle should be used for the back guy to B. Before beginning to raise the derrick put on the hoisting tackle so that it will be ready for use when the derrick is up. One set of guys will do for a derrick 40 feet high, but two sets of guys should be used for one that is higher.

The posts for guys should be either 4 by 4 inches or an equivalent size of round timber. For high signals where there is doubt about the back guy holding, or in any

case in which there is uncertainty as to any guy holding on account of soft ground, a double guy post should be used. The second post is to be placed behind the first, and is to hold a short guy attached to the top of the forward or main guy post 2 feet or more above the ground to prevent it from being drawn forward. The strain is then put on the forward guy post as near to the surface of the ground as possible.

Start the derrick up by using props, and then raise with the back guy fall. Let the derrick rake back about 4 feet, so that when the heavy strain comes the derrick will stand about vertical, as shown in illustration 7.

Before raising the tripod, cleat the legs, using strips 1 by 4 by 16 inches. Drag side No. 1 of the tripod back with the hoisting fall of the derrick until the feet come to the edge of the tripod holes Nos. 1 and 2, as shown on the ground plan, illustration 6. Put the bridle rope on about one-third the distance down from the top of the derrick. Fasten two guys to the side of the tripod to lead backward and two forward, fastening these guys near the bridle rope. Place the hoisting lines one on each tripod leg near the top before commencing to hoist it up. Hook the hoisting tackle in the bridle rope and take the loose end of the fall to the winch or to the rear end of the wagon, as the case may be. If horses can be used for the hoisting the work is much easier than raising with the winch. A good pair of horses will raise one side of any signal up to 90 feet in height, using a double fall. Illustration 7 shows the derrick and side No. 1 of a 60-foot tripod being raised to position.

When side No. 1 of the tripod is in a standing position and the backward and forward guys made fast to the posts B and D, the hoisting tackle should be taken off of No. 1 side, overhauled, and used in raising the third leg of the tripod. For the third leg three guys are required, one each to posts C, D, and E, shown on the ground plan, illustration 6; a hauling line is made fast near the top and the leg raised to its final position. Next put on the horizontal ties on sides Nos. 2 and 3 of the tripod, two men working aloft, while two men below send the timbers up in their proper order, using the hauling lines. At the top the tripod head is to be made very rigid by planking up the top 3 feet of the tripod with 2 by 12 plank.

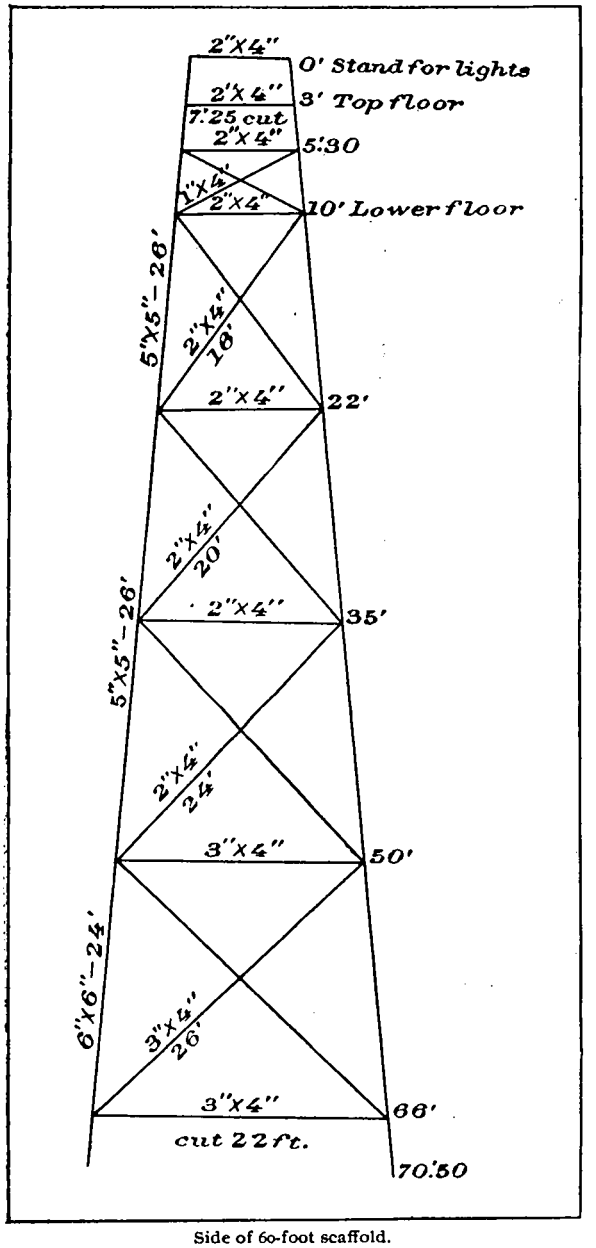
When the tripod is completed nail the feet to the foot plates and put on the anchors. To construct the anchors, take two pieces 2 by 4 inches by 3 feet long, spike them to the foot of the leg, one on each side, and parallel to each other; fill in with earth to a level with the top of the anchor, then nail two more pieces of the same size at right angles to the first two. Lay boards or any other pieces 2 or 3 feet long across the top of the lower pieces, and after filling earth level with the second set of anchors shorter blocks may be laid on them. This construction makes an anchor platform about 3 feet square. Fill the holes to the top, keeping the earth well tamped. All the legs of both the tripod and scaffold are to be anchored in this manner.

THE FRAMING OF THE SCAFFOLD.

Begin by scarfing and splicing the legs in the same manner as described above for the tripod. Mark the lines for the horizontal ties as shown by illustration 8. Lay out legs Nos. 3 and 4 on the forward side of the tripod and legs Nos. 1 and 2 on the rear side. The bottom horizontal tie and the top floor tie are to be cut to the length given on the working plan, illustration 8, and nailed on in their places as there

indicated. As the intermediate horizontal ties are nailed on, force each leg out so as to give it the desired bend. The amount of bowing or bending is to be put in by estimation and may be directed by the foreman, standing at one end of the side being framed and directing the men as they nail on the ties. After the ties are nailed in position they should be sawed off even with the outer side of the legs. Next, square each panel, commencing at the bottom by making its two diagonals measure the same, using a steel tape, and nail the diagonals in position. It should be noticed that none of the horizontal ties except the one at the top and bottom are cut to measure, and no measures are necessary to fix the lengths of the diagonals. When the framing of the first side of the scaffold has been completed, cut the horizontal ties and diagonals for the other three sides, by using this first side as a pattern. Side No. 3 may be framed fully before raising, as well as side No. 1.

No. 8.



Side of 60-foot scaffold.

RAISING THE SCAFFOLD.

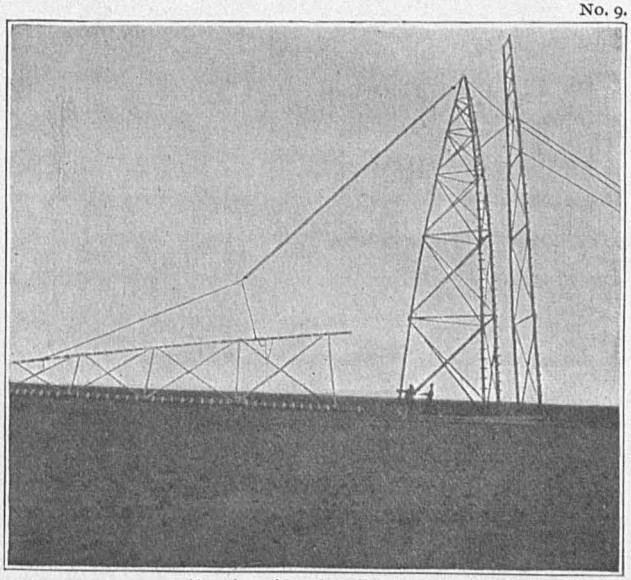
Send the hoisting tackle to the top of the tripod, as shown in illustration 9, ready for raising the scaffold. Make the bridle rope fast on one leg of the side to be raised, hook the hoisting tackle in it, and turn the side of the scaffold over so that the ties and diagonals will be on the under side; illustration 9 shows this operation of turning over. Next make the bridle rope fast for raising the side. When the two sides are raised to their final position let two men go aloft and nail on the ties and diagonals, while two men below send them up in their order, first taking one panel on one side, and then shifting to another side, and so on to the top. The legs may now be anchored down and the necessary floors and ladders constructed to complete the scaffold, as shown in illustration 2.

The lower floor of the scaffold is at the height indicated in illustration 8, and the tripod cut off to the exact height required by the observer. The upper floor is placed 3 feet below the top of the scaffold in position to support the light tender. The table 3 by 3 feet is constructed at the top of the scaffold and at its center for supporting the lamps and heliotropes.

Two trap doors should be made in the lower floor, one where the ladder comes up and the other in another corner of the floor, to be used in hoisting the instrument; the latter trap door should be placed at leg No. 3 or No. 4 of the scaffold.

The wall of the observing tent is a strip of canvas 4.6 feet wide reaching around the outside of the scaffold with the two ends overlapping at one corner; the bottom of the wall is made fast to the lower floor with loops over nails driven in the floor. The top of the wall is made fast to the horizontal tie on the scaffold 5.3 feet below its top in the same manner. The roof of the tent is a tarpaulin which fits over the top floor and carries four canvas curtains which overlap at the four corners of the scaffold and also overlap the wall of the tent, and may be tied to it. The space of 7 feet between the top and lower floor of the scaffold is thus inclosed, furnishing to the observer a room 9 by 9 feet on the floor. The tent requires no poles or extra timbers for its support.

No. 9.



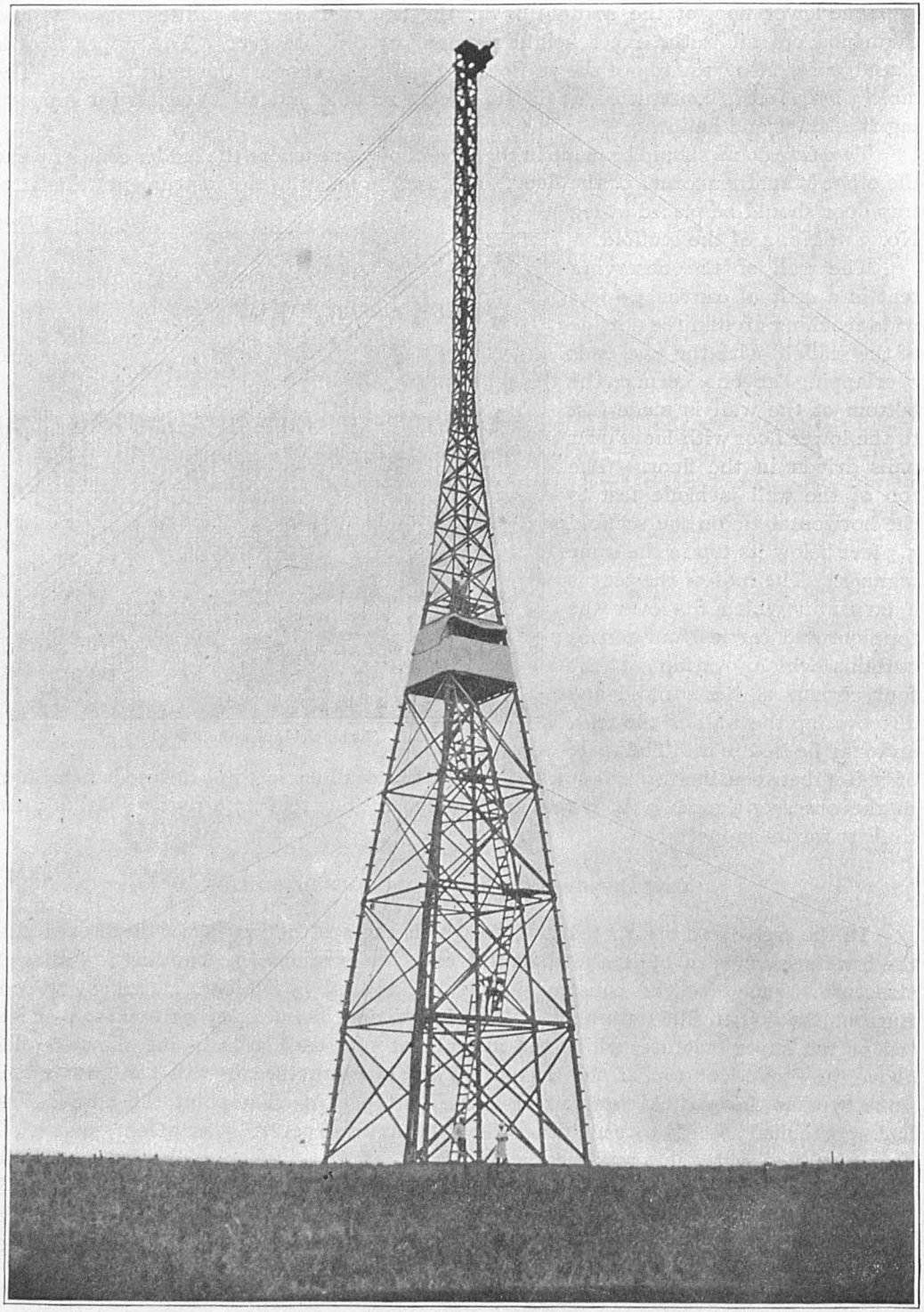
Turning side of scaffold over.

DESIGNS OF SIGNALS OF VARIOUS HEIGHTS.

In the case of an obstructed line, on which the obstruction is not discovered until the towers have been built, the difficulty may be overcome by building up a superstructure,* such as was constructed on the top of a 66-foot signal at station Burson, shown in illustration 10. The lamps and heliotropes were posted on the top of the superstructure, while the instrument was used at a point about 66 feet above the ground on top of the tripod. The superstructure in this case was of the same type as the scaffold for 24 feet above its top. At that point the corner posts had approached so near to each other that the superstructure was 2 feet square. It was continued with that cross section to a point 48 feet higher. The horizontal ties were placed 4 feet apart. Two sides of the superstructure were framed on the ground in sections 12 feet long and hoisted to position with the hauling lines. The horizontal ties and diagonals for the other two sides were cut from the first side as a pattern and hoisted

*This type of superstructure was designed by Mr. Jasper S. Bilby.

No. 10.



Signal at Burson.

aloft with the hauling lines. Two sets of wire guys (No. 12 smooth wire) were put on the superstructure, one set at the top and the other set 24 feet lower. The guys were made fast to special posts set for the purpose. The light-keeper went up the inside of the superstructure and passed out to a seat constructed 2 feet below the table made for lights and heliotropes at the top of the signal. The superstructure proved to be sufficiently stable. This type of superstructure could safely be built to a height of 150 feet above a scaffold.

For scaffolds of various heights the top portion of the signal down to a point 10 feet below the top is the same for all. The following table gives the lengths of the lower horizontal tie for tripods and scaffolds of various heights. The first column is the distance from the lower horizontal tie of the tripod to the top of the tripod as measured along the tripod leg.

Length of tripod leg.	Length of lower horizontal tie of tripod.	Length of lower horizontal tie of scaffold.
Feet.	*Feet.*	*Feet.*
10	6	10
15	7.5	11.5
25	10	13.5
45	14	17
60	18	22
75	19	23

These are the only dimensions fixed directly by measurement. The lengths of the intermediate horizontal ties and of all the diagonals are fixed as indicated in the preceding description of the process of framing and construction. The legs for the scaffolds are in each case 6 feet longer than the tripod legs. When a 10-foot tripod is used, let the diagonals of the scaffold reach from the bottom tie to the tie which is 5.3 feet below the top of the scaffold and is between the two floors. In all other respects the scaffolds and tripods of different heights correspond in design to those shown in illustrations 2 to 9.

The list of material required for any height of signal can be determined quickly by making working drawings similar to those shown on illustrations 5 and 8 to scale and measuring off the lengths required on each side.

For signals higher than 75 feet the design shown may be extended by putting on other sections at the bottom somewhat heavier than the lowest section of the 75-foot signal. Signals not greater than 90 feet in height may be framed and raised as described, and no bolts need be used. If the signal is more than 90 feet, a section 75 to 90 feet high may be raised as one piece and the higher sections must be framed with bolts and then raised to position and erected on top of the first section.

It is sometimes found to be difficult to secure lumber of the dimensions called for by the foregoing plans, especially 6 by 6, 5 by 5, and 3 by 4 pieces. In such cases pieces of approximately the required dimensions have been built up by nailing together 2 by 6 pieces or 2 by 4 pieces. It is believed that the strength and stiffness of such a signal is about the same as that of the ordinary type. The cost is about the same, and delays may be frequently avoided by this plan.

ADVANTAGES OF THE SLENDER TYPE OF SIGNALS.

Some of the points of advantage claimed for these slender signals over many of those formerly used on the Coast and Geodetic Survey, and especially over the broad ones described in Appendix 10, Report for 1882, "On the construction of observing tripods and scaffolds," are given below. The slender type was devised by F. W. Perkins, Assistant, in 1881.

There is only about one-half as much lumber per vertical foot in the slender signals as in the broad. This not only reduces greatly the cost of the material required for a signal of given height and the cost of hauling the material, but also considerably reduces the cost of construction.

Much less area is exposed to wind pressure for a signal of given height in the slender signals than in the broad ones, and therefore much less strength is needed. Much more important than this, however, is the fact that on account of the horizontal ties and diagonals, the relatively light pieces in the structure, being very much shorter in the slender than in the broad signals, the vibrations of these individual pieces due to the effects of the wind are much reduced. Such vibrations impart a tremor of short period and small amplitude to the instrument and also to the floor supporting the observer, which is likely to prevent observations in a strong wind long before there is any danger of collapse of the signal or any other troublesome motions on the part of the signal. The experience of 1902 indicates that observations may be continued in a stronger wind without screens on the slender signals than on the broad ones.

The bowing of the legs of the slender towers during construction puts the posts and horizontal ties under a moderate initial strain which adds greatly to the stiffness of the structure and somewhat to its strength.

As the observing tent used in 1902 is supported by the timbers of the tower and is really on the outside of the tower it leaves every part of the floor space available and makes it possible to work as comfortably on a 9 by 9 floor on the slender scaffolds as on a 12 by 12 floor on the broad ones with other styles of observing tent. This reduction in the size of the floor is important, as it allows a corresponding reduction in the size of the signal throughout its whole height.

The second or upper floor and light table make it possible for the heliotroper or light-keeper to do his work without the slightest interference with the observer, and to show his lights or heliotropes mounted directly over the station while the observer is at work instead of eccentrically by several feet.

The slender signals, although they contain much less lumber than the broad ones, and have a much smaller spread of base for a given height, are no more apt to collapse in a strong wind than the broad ones. Experience indicates that either type is sufficiently strong to make the losses by collapse very small.

LIST OF TOOLS.

The following list of tools is given by the signalman as being necessary for a party of four or five men engaged in building towers not more than 90 feet high:

2 axes.
2 shovels.
1 spade.
1 pick.
1 mattock.
1 spud.
1 post-hole digger.
4 handsaws.
1 compass saw.
1 saw set.
1 brace.
6 assorted bits.
3 heavy hammers.
1 claw hammer.
2 hatchets.
1 adz.
1 wood chisel.
1 cold chisel.
1 carpenter's level.
1 oilstone.
1 monkey wrench.
1 plane.
1 plummet.
1 steel tape (50-foot).
1 square (2-foot).
1 try-square.
1 bevel.
3 rules.
1 screw-driver.
1 trowel.

TACKLE.

2 falls, 500 feet each, ¾-inch rope.
15 guys, 110 feet each, ⅝-inch rope.
2 bridle ropes, 40 feet each, 1⅛-inch.
4 pieces ¾-inch rope, 12 feet each.
4 slings ⅝-inch rope, 2 feet each.
4 double blocks, patent bushed, 8-inch.
4 single blocks, patent bushed, 6-inch.
1 leading block, 7 inch.
4 hauling lines, 200 feet each, ½-inch rope.

THE BUILDING PARTY OF 1902.

The building party of 1902 was in immediate charge of the signalman and consisted of three carpenters and three hands. This party was sometimes divided into two subparties and work was done on two signals at once. The signalman was with one or the other of the subparties except when arranging for the purchase and delivery of lumber, or when revising the reconnaissance or testing doubtful lines. Besides the regular force extra laborers were sometimes employed for short periods, amounting in all to about twenty days' labor for one man each month. Each of the subparties was provided with two horses and a freight wagon for moving the men and outfit. The signalman was provided with a horse and light spring wagon, which he found a great convenience, as his work of purchasing and arranging for the delivery of lumber and revising reconnaissance required frequent and rapid movements. The signal party depended upon the country for their meals.

The lumber for the signals was bought either by the carload from large dealers or in smaller quantities from the local dealers. In either case the signalman arranged with local teamsters to haul the lumber to the sites for the towers before the arrival of the building party.

The signalman and his party of six between March 10 and October 3, less than seven months, built 70 signals of an average height to the light table of 42 feet (13 meters), distributed over the whole belt of triangulation, 444 miles (715 kilometers) long, placed permanent station marks and reference marks in position at all stations, except a few which had already been marked, and made such revisions of reconnaissance as were found necessary.

There were two intervals during the season when the progress of the building was seriously interrupted. In April there were twenty days when little was accomplished, as a delay was caused by the failure of a carload of lumber to arrive. The car had broken down, and the local railroad officials could not for some time either locate the car or cause it to be forwarded. From June 28 to July 19 the building party was engaged in placing the station marks at three stations near Anthony, Kans., where signals had been erected in 1901, in opening the difficult line between stations Burson and Wingard, in erecting the high superstructures needed at these stations, and in making the long trip from the vicinity of Anthony, Kans., to the stations to the southward of the Bowie base net. If these two seasons of interruption to the building be omitted, and also the interval at the beginning of the season before the first serious interruption, when the party was somewhat new to its work and the weather unfavorable, two periods remain during which the building party proceeded with comparatively little interruption and showed its skill. Commencing with the signal at station Duncan, 30 signals of the average height to the light table of 55 feet (17 meters) were erected in 69 consecutive days, or at the rate of one in each 2.3 days. Similarly, commencing with the first signal erected south of Bowie base net and extending to the close of the building season, 29 signals of an average height of 40 feet (12 meters) were erected in seventy-two consecutive days, or at the rate of a new signal every 2.5 days. The distance which the building party had to travel between signals may be appreciated by consulting illustrations 11 to 15 at the end of this appendix. As illustrating the rapidity with which the party did its work after arriving at a station, the material being already there, it may be stated that each of the 66-foot signals at Monument, Duncan, and Wingard (without superstructure) was erected in two days, and the 81-foot signal at McCoy was erected in three days. These high signals were erected by J. S. Bilby, Signalman, and three men.

The cost of the signals ready for occupation by the observer was $3.20 per vertical foot measured to the light table,* including the expenses of the building party even of transportation to and from the field, the cost of all material and all charges for hauling. It also includes the material for station and reference marks and the cost of putting them in place. The signalman estimates that the cost per vertical foot is nearly the same under the conditions encountered in 1902 for low signals as for high ones. The material costs more per vertical foot for high signals than for low ones, but in the former case the building party spends a smaller percentage of its time in moving, and the hauling can be done at considerably less cost per ton.

PROGRAMME OF OCCUPATION OF STATIONS.

In the following tables the stations occupied during 1902 by each of the two observers are arranged in the order in which they were occupied. The second column indicates the days on which observations on primary stations were taken; the third column the number of such days; and the fourth column gives approximate height of the instrument above the ground. In using the heliotrope the light observed upon was placed about 1.6 meters above the instrument. The exceptional cases occurred at stations Blue, Burson, and Wingard, at which the light was placed for certain observations 8, 23, and 14 meters above the instrument, respectively.

* The average cost of the lumber used during this season, on the cars, or at the lumber yard, was about $25 per 1000 feet.

Assistant WM. BOWIE, *Observer.*

Station.	Days on which observations of primary horizontal angles were made.	Number of days.	Height of instrument above ground.
			meters.
Bowie N. W. Base.	March 20–21–22–24–26.	5	4
Spradling.	March 28–31–April 1.	3	14
Indian.	April 5–7.	2	4
Queen.	April 10–11–12–14–15–16.	6	4
Blue Mound.	April 18–19–22–23–26–May 5–6.	7	9
Grady.	May 9.	1	4
Benton.	May 12–13.	2	5
Lone Tree.	May 21–22–23.	3	14
Duncan.	May 26–27–29.	3	18
Osaria.	June 2–3–4–5.	4	19
Kechi.	June 9–10.	2	3
Lanier.	June 12–13–14–16.	4	19
Carson.	June 19–21.	2	23
Elreno W. Base.	June 24–25.	2	4
Elreno E. Base.	June 27–28–30.	3	14
Caddo.	July 2–7–8–10.	4	23
Burson.	July 12–14.	2	19
Parnell.	July 16–17–18.	3	14
Waukomis.	July 19–21.	2	23
Enid.	July 23–24.	2	19
McCoy.	July 28–29.	2	23
Vicar.	July 31–August 1.	2	4
Sand Hill.	August 6–7–8.	3	4
Miller.	August 9–11–12.	3	8
Spradling.	August 26.	1	14
Moore.	August 29.	1	9
Davis.	September 1–2–3.	3	19
Gilbert.	September 5–6.	2	9
Comanche.	September 11–12.	2	4
Lone Mountain.	September 16–17–18–19.	4	4
Pilot.	September 20–22.	2	9
Stephenville N. Base.	September 23–24.	2	4
Stephenville S. Base.	September 26–27.	2	14
Gibson.	September 30–October 1–2.	3	14
Chamliss.	October 4–6.	2	15
Brown.	October 8–9.	2	14
Franklin.	October 11–13.	2	9
Flat Top.	October 15–16–17.	3	4
May.	October 20.	1	19
Bachelor.	October 22–23–24.	3	4

Assistant O. W. FERGUSON, *Observer.*

			meters.
Bowie S. E. Base.	March 18–19–20–21–22–24–25–26–29–30.	10	3
Jones.	March 31–April 1–2–3–4–5.	6	7
Myers.	April 7–8–9–10–16–23–May 5–6–7.	9	4
Cube.	April 19–22–May 8–9.	4	9
Monument.	May 13–14–15–16.	4	19
Arbuckle.	May 21–22–23–24–26–27.	6	15
Arbuckle Mountain.	May 30–31.	2	3
Table Hill.	June 3–4–5–6.	4	14
Purcell.	June 10–11.	2	19
Smith.	June 14–16–17–18–19–21.	6	19
Yukon.	June 22–23–24–25–26–27.	5	23

Assistant O. W. FERGUSON, *Observer*—Continued.

Station.	Days on which observstions of primary horizontal angles were made.	Number of days.	Height of instrument above ground.
			meters.
Edmonds.	June 30, July 1-2-3-5-7-8.	7	23
Eichoff.	July 10-11-12-14.	4	14
Wingard.	July 16-17-18-19.	4	18
Mitchell.	July 21-22-23-24.	4	8
Garber.	July 25-26.	2	3
Hahn.	July 28-29-30.	3	23
Renfrow.	August 2-4-5-6.	4	14
Fowler.	August 8-9-11-12.	4	21
Anthony S. E. Base.	August 13-14-15.	3	8
Indian.	August 26-27.	2	4
Woolly.	August 30-September 1.	2	19
Kyle.	September 3-4-5.	3	2
Oaks.	September 8-9-10.	3	9
McClenny.	September 13-15-16-17.	4	14
Gatlin.	September 18-19-22.	3	9
Alarm.	September 23-24-25.	3	9
Young.	September 26-27-29-30.	4	14
Gleason.	October 2-3-4.	3	14
Scoggins.	October 6-7.	2	14
King.	October 9-10.	2	4
Gilmore.	October 13-14-15-16.	4	14
Gabriel.	October 18-20.	2	4
Lampasas S. W. Base.	October 22-23.	2	14
Lampasas N. E. Base.	October 24.	1	19

The following summary shows the essential facts in regard to the length of occupation of each station in the southward extension of the ninety-eighth meridian triangulation, together with similar information with respect to the triangulation in adjacent areas in Kansas and Nebraska:

Years and locality.	Number observations.	Total number days of observation.	Number stations.	Average number days of observation.	Maximum number days of observation at any station.	Minimum number days of observation at any station.
1890, 1891, 1892, 1896, thirty-ninth parallel, Kansas.	34	168	16	10.5	18	5
1897, 1898, 1899, ninety-eighth north, Kansas and Nebraska.	24	204	29	7.0	11	3
1900-1901, ninety-eighth meridian north, Nebraska.	16	62	12	5.2	7	3
1899, ninety-eighth meridian south, Kansas.	24	41	3	13.7	23	7
1900, ninety-eighth meridian south, Kansas.	16	34	6	5.7	6	5
1901, ninety-eighth meridian south, Kansas.	16	51	14	3.6	6	2
1902, ninety-eighth meridian south, Kansas, Indian Territory, Oklahoma, Texas; Bowie, observer.	16	107	40	2.7	7	1
1902, ninety-eighth meridian south, Kansas, Indian Territory, Oklahoma, Texas; Ferguson, observer.	16	133	35	3.8	10	1

The weather conditions and conditions with respect to the topography, ease of access to stations, and ease of securing supplies, are not widely different in the various parts of the area to which this summary refers, and therefore the comparisons between various seasons of triangulation are especially interesting, as indicating the effects of the gradual changes in the plan of operations.

It is obvious that there has been a gradual increase in the rapidity of the work from year to year, on both the northern and southern extension of the ninety-eighth meridian triangulation, and that the observing was done much more rapidly in 1902 than during any previous season.

As showing the extent to which the observations were delayed by unfavorable weather it is important to note the ratio of the number of observing days at a station to the total number of days at the station exclusive of the time before the first observation and after the last observation. This ratio was during 1902 for Mr. Bowie, 0.77, and for Mr. Ferguson, 0.80. For comparison it may be noted that this ratio was 0.78 for the first three groups in the above summary, and 0.86 for the seasons of 1900 and 1901 on the triangulation to the southward. This furnishes strong evidence that the average weather conditions differed but slightly over this whole region.

It has already been shown* that the reduction of the number of observations from 34 to 16 saved about six days for the party at each station, and the reduction from 24 to 16 about three days at each station.

At the beginning of 1902 no change was made in the number of observations; it remained 16, as in 1900 and 1901. The column headed "Average number of days of observations at a station" in the above summary shows, however, a considerable gain in rapidity in 1902 as compared with previous years. This was undoubtedly due largely to the fact that the use of lights at night, in addition to the heliotropes by day, greatly increased the length of the daily observing period. About 70 per cent of the primary observations in 1902 were made on lights at night.

The great increase in rapidity of the triangulation in 1902 is not fully appreciated, however, until the promptness with which the party of 1902 appeared at the next station after closing observations at a given station is investigated.

In 1900, Assistant F. D. Granger, on the ninety-eighth meridian triangulation in Nebraska, occupied 11 stations with an average interval from the first to the last day of primary observations at each station of 6.3 days, an average interval from the last observation at one station to the first at the next of 7.2 days, including Sundays, delays on account of bad weather, taking down and putting up camp, and the moving between stations, and in some cases the building of signals; a total average period of 13.5 days per station. This was the best season's record known to the writer up to that time.

In 1901 Assistant A. T. Mosman, on the ninety-eighth meridian triangulation southward in Kansas, occupied 14 stations.† The average length of stay at a station from the first to the last observation was 4 days; the average interval from the last observation at each station to the first at the next was 3.7 days, or a total of 7.7 days per station. The shortening of the period between stations by Mr. Mosman was probably due, in part at least, to the fact that his signals were erected by a signalman

*See page 224, Appendix 3, Report for 1902. Triangulation in Kansas.

†Excluding Anthony S. E. Base, which was left incompleted.

and party working almost independently of the observing party, whereas Mr. Granger's signals were erected by the observing party or men detailed from it.

In 1902 Assistant William Bowie occupied 40 primary stations, at which the average interval between the first and last observation at a station was 3.5 days; the average interval from the last observation at one station to the first observation at the next, 1.8 days, and the total period for each station was 5.3 days.*

The corresponding figures for Assistant O. W. Ferguson are, from first to last observation at station, 4.7 days; from the last observation at one station to the first at the next, 1.4 days, and the average total period per station, 6.1 days.

The great reduction made in 1902 in the time spent between stations is probably due in part to the use of comparatively light camps, but is mostly due to the promptness with which the light-keepers were informed of the proposed movements of the observers by the heliographic method, and the resulting promptness with which the light-keepers moved and established their lights in the new positions.

If the last two months only of the season be considered, this being the period during which the party extended the triangulation southward from the Bowie base net, the showing is still more remarkable, and this is especially interesting as indicating the great advantage of keeping a party continuously in the field for a long period, for although the great gain in rapidity during the latter part of the season over the first part of the season was probably due in a small part to the more favorable weather conditions, a close examination of the work of the party shows plainly that it was due mostly to the skill which had been acquired by the observing parties and the light-keepers. From the Bowie base net southward Mr. Bowie occupied 16 stations, at which the average interval from the first observation to the last at a station was 2.4 days. The average interval between the last observation at a station and the first at the next was 1.5 days, and the average total interval for a station 3.9 days. During this period Mr. Ferguson occupied 15 stations, at which the corresponding average intervals were 3.1, 1.0, and 4.1 days. The average length of move between stations by road was, during this time, for Mr. Bowie 23 miles and for Mr. Ferguson 32 miles.

The average rate of progress of each observer in 1902 was therefore during the last two months of the season about double that of the most rapid observing party of 1901, and much more than three times that of the most rapid observing party up to 1900.

STATEMENT OF ADJUSTMENTS.

No local adjustments of directions were made because they have become unnecessary since the method of supplying missing observations in broken series specified in the first paragraph of the general instructions has been followed. (See p. 821.)

The lengths and directions of the lines Rutherford–Miller and Miller–Fowler before the adjustments here set forth were commenced had been fixed by the adjustment published in Appendix 3 of the Report for 1902, "Triangulation in Kansas," and in which the observations of 1902 at stations Miller, Anthony Southeast Base, and Fowler had been utilized.

*In these figures for 1902 the long move by rail and wagon in the midst of the season from the vicinity of the Anthony Base to the southern edge of Bowie base net has, of course, been omitted.

The lengths of the Elreno, Bowie, Stephenville, and Lampasas bases, with which the triangulation of 1902 connected had been measured in 1900, and a full account of these base measures may be found in Appendix 3 of the Report for 1901, "On the Measurement of Nine Base lines along the Ninety-eighth Meridian." The lengths of these bases, as they are published, depend in each case upon an estimated approximate elevation for one end of each base, as the precise levels connecting these bases were not completed when the report mentioned was prepared for the printer. During 1902 and the first three months of 1903 a precise level line southward from the Anthony Base connected with each of these four bases. The resulting elevations for one end of each base and the length of the bases reduced to sea level are as follows:

Base.	Elevation.	Reduced length.	Logarithm of length.
	Meters.	*Meters.*	
Elreno Base	E. Base 440. 1881	12886. 672	4. 1101407
Bowie Base	NW. Base 327. 4599	8196. 028	3. 9136034
Stephenville Base	S. Base 400. 34	6255. 090	3. 7962336
Lampasas Base	NE. Base 315. 4516	5961. 171	3. 7753315

The adjustments were made in four sections.

The first section extends from the line Spradling–Indian to the line Burson–Wingard, and includes both the Bowie and the Elreno base nets. (See illustrations 12 and 13.) It is important to note that the length equation in this adjustment extends from base to base instead of from the border of one base net to the border of the adjacent base net, as has been the practice of the Coast and Geodetic Survey in general up to 1901.*

The second section extends from the line Burson–Wingard, fixed in length by the adjustment of the first section, to the lines Rutherford–Miller and Miller–Fowler, fixed in length and direction as a part of the Anthony base net, as indicated above. (See illustration 11.)

The third section extends from the line Indian–Spradling, at the south edge of the Bowie base net, of which the length had already been fixed by the adjustment of the first section, to the line Gibson–Gleason, at the south edge of the Stephenville base net. The length equation extends to the Stephenville Base. (See illustration 14.)

The fourth section extends from the line Gibson–Gleason to the line May–Gabriel, at the south edge of the Lampasas base net. This adjustment includes the Lampasas base net and the length equation extends to the base. (See illustration 15.)

In the following condition equations the numbers assigned to the directions correspond to those shown in illustrations 11 to 15. The number of a direction inclosed in parenthesis, 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, those which refer to ratios of sides next, and the length equations last. In the side and length equations the absolute term is expressed in units of the sixth decimal place of logarithms.

*The advantages of the new method of adjustment are set forth on pages 372–373, Appendix 6, Report for 1901, "Triangulation northward along the ninety-eighth meridian."

CONDITION EQUATIONS.

Bowie Base to Elreno Base.

No.

1 | 0=+1.24−(2)+(3)−(5)+(6)−(11)+(13)

2 | 0=−0.55−(1)+(2)−(6)+(8)−(18)+(20)

3 | 0=−0.96−(5)+(8)−(12)+(13)−(18)+(19)

4 | 0=+1.29−(7)+(8)−(18)+(22)−(26)+(27)

5 | 0=−1.23−(10)+(12)−(19)+(22)−(26)+(28)

6 | 0=−1.14−(8)+(9)+(18)−(24)−(33)+(34)

7 | 0=+0.83−(12)+(14)+(19)−(24)−(32)+(34)

8 | 0=−2.04−(23)+(24)−(34)+(35)−(36)+(37)

9 | 0=+1.92−(22)+(23)−(25)+(26)−(37)+(38)

10 | 0=+0.10−(14)+(15)−(30)+(32)−(42)+(43)

11 | 0=+2.19−(15)+(16)−(41)+(42)−(44)+(46)

12 | 0=−4.43−(30)+(31)−(41)+(43)−(45)+(46)

13 | 0=−2.33−(40)+(41)−(46)+(47)−(52)+(53)

14 | 0=+1.10−(47)+(48)−(51)+(52)−(54)+(55)

15 | 0=−0.09−(50)+(51)−(55)+(56)−(57)+(58)

16 | 0=−0.34−(49)+(50)−(58)+(59)−(64)+(65)

17 | 0=+1.07−(39)+(40)+(49)−(53)−(65)+(66)

18 | 0=−0.52−(59)+(60)−(63)+(64)−(69)+(70)

19 | 0=−0.39−(62)+(63)−(70)+(71)−(74)+(75)

20 | 0=−0.59−(71)+(72)−(73)+(74)−(79)+(80)

21 | 0=+2.74−(60)+(61)−(68)+(69)−(81)+(82)

22 | 0=−1.68−(67)+(68)−(82)+(83)−(84)+(85)

23 | 0=+0.50+(67)−(72)−(78)+(79)−(85)+(86)

24 | 0=−1.13−(77)+(78)−(86)+(87)−(90)+(91)

25 | 0=+1.65−(76)+(77)−(91)+(92)−(96)+(97)

26 | 0=−1.53−(92)+(93)−(95)+(96)−(103)+(104)

27 | 0=−2.21−(87)+(88)−(89)+(90)−(105)+(106)

28 | 0=−1.56+(89)−(94)−(106)+(107)−(108)+(109)

29 | 0=+3.56−(93)+(94)−(102)+(103)−(109)+(110)

30 | 0=−1.71−(101)+(102)−(110)+(111)+(113)−(118)

31 | 0=+0.73−(111)+(112)−(117)+(118)−(126)+(127)

32 | 0=+0.86−(115)+(117)−(121)+(122)−(127)+(128)

33 | 0=+0.86−(100)+(101)−(113)+(114)+(131)−(135)

34 | 0=−0.91−(114)+(115)−(122)+(123)−(133)+(135)

35 | 0=−2.09−(99)+(100)−(123)+(124)−(131)+(133)

36 | 0=−0.67−(98)+(99)−(124)+(125)−(136)+(138)

37 | 0=−0.12−(98)+(100)−(131)+(132)−(137)+(138)

38 | 0=−0.34−(116)+(117)−(127)+(129)−(142)+(143)

39 | 0=−0.64−(115)+(116)−(120)+(122)+(139)−(143)

40 | 0=−1.55−(114)+(116)−(134)+(135)−(143)+(144)

41 | 0=+1.55−(129)+(130)−(141)+(142)−(145)+(146)

42 | 0=−0.40−(140)+(141)−(146)+(147)−(148)+(149)

43 | 0=−0.49−(119)+(120)−(139)+(140)−(149)+(150)

44 | 0=+2.7−1.54(5)+2.30(6)−0.76(8)−7.83(11)+10.34(12)−2.51(13)−2.85(18)
+13.15(19)−10.30(20)

45 | 0=−1.6+1.43(5)+3.99(7)−5.42(8)−3.72(10)+7.59(12)−3.87(13)−2.80(26)
+4.54(27)−1.74(28)

46 | 0=−3.81−0.387(12)+8.188(13)−7.801(14)+0.422(18)−0.407(19)−0.015(24)
−13.877(32)+14.170(33)−0.293(34)

47 | 0=−2.7−3.72(10)+7.35(12)−3.63(14)−0.05(25)+1.79(26)−1.74(28)
−2.84(32)+4.04(34)−1.20(35)−3.04(36)+6.71(37)−3.67(38)

48 | 0=+21.7−10.62(1)−0.40(3)+11.02(4)−1.54(5)+2.30(6)−0.76(8)+4.06(11)−2.51(13)
−1.55(17)−2.85(18)+28.62(20)−25.77(21)

49 | 0=−1.4+2.24(10)−0.66(12)−1.58(17)−6.88(19)+7.13(21)−0.25(22)−1.16(26)
+11.19(28)−10.03(29)

50 | 0=+14.2−0.74(30)+5.21(31)−4.47(32)−3.12(41)+4.61(42)−1.49(43)−2.58(44)
+3.07(45)−0.49(46)

51 | 0=−12.7−5.55(39)+6.68(40)−1.13(41)−2.17(46)+5.83(47)−3.66(48)
+0.40(54)−1.06(55)+0.66(56)−3.68(57)+7.70(58)−4.02(59)−0.36(64)
+3.09(65)−2.73(66)

52 | 0=+7.6−1.24(59)+1.83(60)−0.59(61)−0.80(62)+2.81(63)−2.01(64)−0.79(73)
+2.14(74)−1.35(75)−1.68(78)+2.75(79)−1.07(80)−2.13(81)+3.49(82)
−1.36(83)−0.90(84)+2.09(85)−1.19(86)

CONDITION EQUATIONS—continued.

Bowie Base to Elreno Base—Continued.

No.

53 | o=+10.1−0.90(76)+1.86(77)−0.96(78)−0.89(86)+5.32(87)−4.43(88)−1.89(95)
+2.64(96)−0.75(97)−1.43(102)+2.06(103)−0.63(104)+0.43(105).
+0.51(106)−0.94(107)−3.74(108)+5.44(109)−1.70(110)

54 | o=+7.9−2.24(99)+5.20(101)−2.96(102)−2.45(110)+3.23(111)−0.78(112)
−2.47(121)+4.13(122)−1.66(124)−1.87(126)+5.46(127)−3.59(128)

55 | o=+15.6−12.24(99)+15.42(100)−3.18(101)−2.72(113)+4.67(114)−1.95(115)
−2.35(122)+14.47(123)−12.12(124)

56 | o=+3.1−3.78(98)+6.96(100)−3.18(101)−2.72(113)+4.67(114)−1.95(115)
−2.35(122)+4.64(123)−2.29(125)−0.30(136)+2.34(137)
−2.04(138)

57 | o=+1.0−2.93(115)+3.56(116)−0.63(117)−2.77(120)+3.47(121)
−0.70(122)−2.20(127)+8.91(128)−6.71(129)

58 | o=−1.2−1.95(114)+4.88(115)−2.93(116)−3.71(133)+3.68(134)
+0.03(135)−2.18(139)−0.65(143)+2.83(144)

59 | o=+4.5−1.87(119)+5.34(120)−3.47(121)−8.91(128)+9.31(129)−0.40(130)
−1.53(145)+4.33(146)−2.80(147)−0.70(148)+5.14(149)−4.44(150)

60 | o=−5.2−0.63(1)+0.63(2)−1.30(8)+1.30(9)+3.63(12)−3.63(14)−0.82(15)
+0.82(16)+2.85(18)−0.90(19)−2.85(20)+0.90(24)−0.74(30)+0.74(32)
+2.93(33)−2.93(34)−5.55(39)+5.55(40)+1.49(42)−1.49(43)+0.49(44)−2.66(46)
+2.17(47)−0.69(49)+0.69(50)+0.60(52)−0.60(53)+4.02(58)−5.26(59)
+1.24(60)−0.80(62)+0.80(63)+2.73(65)−2.73(66)+0.85(67)
+0.59(69)−0.59(70)−0.85(72)−0.79(73)+2.14(74)−1.35(75)−0.90(76)
+0.90(77)+1.07(79)−1.07(80)+1.19(85)−2.08(86)+0.89(87)+1.94(90)
−1.94(91)−0.63(93)+0.63(94)−1.89(95)+2.64(96)−0.75(97)−3.78(98)
+3.78(100)+0.63(103)−0.63(104)+1.70(109)−4.15(110)+2.45(111)
−2.20(113)+2.72(114)−0.52(118)+0.72(131)−0.72(135)+2.04(137)−2.04(138)

Anthony base net to Elreno base net.

No.

1 | o=+1.40+(1)−(4)−(10)+(11)

2 | o=−1.49−(2)+(3)−(8)+(9)

3 | o=+0.65−(3)+(4)−(7)+(8)−(11)+(12)

4 | o=−1.61−(6)+(7)−(12)+(13)+(15)−(18)

5 | o=+0.88−(13)+(14)−(17)+(18)−(20)+(21)

6 | o=+0.57−(5)+(6)−(15)+(16)−(27)+(28)

7 | o=−0.55−(16)+(17)−(21)+(22)−(26)+(27)

8 | o=−0.68−(22)+(23)−(25)+(26)−(32)+(33)

9 | o=+1.78+(19)−(23)+(32)−(36)−(37)+(38)

10 | o=+0.70−(24)+(25)+(29)−(31)−(33)+(34)

11 | o=−0.13−(30)+(31)−(34)+(35)−(45)+(46)

12 | o=−0.41−(35)+(36)−(38)+(39)−(44)+(45)

13 | o=−0.72−(39)+(40)−(43)+(44)−(47)+(48)

14 | o=+1.67−(40)+(41)+(47)−(50)−(51)+(52)

15 | o=−1.38−(42)+(43)−(48)+(49)−(53)+(54)

16 | o=−2.17−(49)+(50)−(52)+(53)

17 | o=+0.3−1.51(1)−0.85(2)−2.33(7)+5.72(8)−3.39(9)−2.42(10)+4.78(11)
−2.36(12)

18 | o=−5.0−2.09(5)+3.79(6)−1.70(7)−1.56(12)+4.72(13)−3.16(14)
+1.63(20)+4.21(21)−2.58(22)−3.69(26)+5.16(27)−1.47(28)

19 | o=−6.7−2.24(19)−3.90(22)+6.14(23)−0.88(24)+4.56(25)−3.68(26)
−0.78(29)+1.14(30)−0.36(31)−1.94(37)+2.50(38)−0.56(39)
−3.41(44)+7.22(45)−3.81(46)

20 | o=+1.90−1.20(39)+4.87(40)−3.67(41)−1.12(42)+4.23(43)
−3.11(44)−4.07(51)+5.70(52)+4.38(53)−1.16(54)

21 | o=+1.00+1.51(1)+0.22(3)−0.22(4)−2.09(5)+2.09(6)+2.33(7)
−2.33(8)+2.42(10)−2.42(11)−1.56(12)+1.56(13)−0.55(15)+0.82(16)
−0.82(17)+0.55(18)+2.24(19)+2.58(21)−2.58(22)−2.24(23)
−3.68(25)+3.68(26)+1.47(27)−1.47(28)−1.31(32)+1.31(33)
−0.63(35)+0.63(36)+1.94(37)−1.94(38)−1.20(39)+1.20(40)
−1.12(42)+1.12(43)+3.41(44)−3.41(45)+0.16(47)−0.16(48)
+0.17(49)−0.17(50)+1.63(52)+1.16(53)−1.16(54)

CONDITION EQUATIONS—continued.

Bowie base net to Stephenville Base.

No.

1 $0 = -0.69 - (1) + (2) - (5) + (6) - (9) + (10)$

2 $0 = +0.58 - (2) + (3) - (8) + (9) - (11) + (12)$

3 $0 = +1.75 - (4) + (5) + (7) - (10) - (19) + (20)$

4 $0 = -1.32 - (7) + (8) - (12) + (13) - (18) + (19)$

5 $0 = -0.06 - (13) + (15) - (17) + (18) - (21) + (22)$

6 $0 = -0.36 - (13) + (14) - (16) + (18) - (29) + (30)$

7 $0 = -0.60 - (16) + (17) - (22) + (23) - (28) + (30)$

8 $0 = +1.15 - (23) + (24) - (27) + (28) + (31) - (34)$

9 $0 = +0.05 - (24) + (25) - (33) + (34) - (35) + (36)$

10 $0 = +0.51 - (26) + (27) - (31) + (32) - (44) + (45)$

11 $0 = -0.82 - (32) + (33) - (36) + (37) - (43) + (44)$

12 $0 = +1.88 - (37) + (39) - (42) + (43) - (47) + (48)$

13 $0 = -1.63 - (39) + (40) - (46) + (47) - (54) + (55)$

14 $0 = +0.09 - (37) + (38) - (41) + (43) - (64) + (65)$

15 $0 = -0.85 - (41) + (42) - (48) + (49) - (63) + (65)$

16 $0 = +0.11 + (46) - (52) - (55) + (56) - (67) + (68)$

17 $0 = +1.51 + (46) - (53) - (55) + (57) - (71) + (72)$

18 $0 = +1.55 - (56) + (57) - (66) + (67) - (71) + (75)$

19 $0 = +2.50 - (50) + (52) - (68) + (69) + (79) - (83)$

20 $0 = +1.48 - (50) + (53) - (72) + (73) + (79) - (84)$

21 $0 = -2.00 - (49) + (50) - (62) + (63) - (79) + (80)$

22 $0 = +0.58 - (49) + (53) - (61) + (63) - (72) + (74)$

23 $0 = -0.50 - (69) + (70) - (81) + (83) - (88) + (89)$

24 $0 = -0.81 - (73) + (76) - (81) + (84) - (87) + (89)$

25 $0 = +1.34 - (60) + (62) - (80) + (81) + (85) - (89)$

26 $0 = -0.26 - (51) + (53) - (72) + (78) - (90) + (91)$

27 $0 = +1.83 - (59) + (62) - (80) + (82) - (92) + (94)$

28 $0 = -0.59 - (59) + (60) - (85) + (86) - (93) + (94)$

29 $0 = -0.49 - (58) + (59) - (94) + (95) - (96) + (98)$

30 $0 = -1.05 - (58) + (61) - (74) + (77) - (97) + (98)$

31 $0 = -0.52 - (77) + (78) - (90) + (95) - (96) + (97)$

32 $0 = +7.2 - 1.18(1) + 2.88(2) - 1.70(3) - 5.30(4) + 6.86(5) - 1.56(6) - 1.73(11) + 4.64(12) - 2.91(13) - 1.55(18) + 4.77(19) - 3.22(20)$

33 $0 = -0.4 - 2.90(13) + 2.83(14) + 0.07(15) - 2.04(21) + 4.13(22) - 2.09(23) - 0.88(28) + 3.15(29) - 2.27(30)$

34 $0 = -4.9 - 3.12(23) + 5.92(24) - 2.80(25) - 0.76(26) + 3.95(27) - 3.19(28) - 3.47(35) + 3.56(36) - 0.09(37) - 2.79(43) + 6.46(44) - 3.67(45)$

35 $0 = -2.1 - 1.04(37) + 7.54(38) - 6.50(39) - 3.80(41) + 6.80(42) - 3.00(43) - 5.9(63) + 5.54(64) - 0.05(65)$

36 $0 = -1.3 - 3.21(49) + 3.56(50) - 0.35(53) - 9.93(61) + 15.10(62) - 5.17(63) - 4.57(72) + 20.91(73) - 16.34(74)$

37 $0 = +3.0 - 7.54(38) + 10.36(39) - 2.82(40) + 0.46(54) + 0.23(55) - 0.69(57) - 3.10(61) + 8.64(63) - 5.54(64) - 1.99(71) + 5.35(72) - 3.36(74)$

38 $0 = +6.5 - 3.21(49) + 3.56(50) - 0.35(53) - 3.23(60) + 8.40(62) - 5.17(63) - 4.57(72) + 10.54(73) - 5.97(76) - 0.59(85) - 0.66(87) + 1.25(89)$

39 $0 = +1.0 - 0.35(46) - 5.77(52) + 6.12(53) - 2.03(55) + 6.38(56) - 4.35(57) - 0.41(71) + 3.34(72) - 2.93(75)$

40 $0 = +0.06 - 1.583(73) + 2.585(75) - 1.002(76) - 0.026(81) + 2.358(83) - 2.332(84) - 1.630(87) + 1.728(88) - 0.098(89)$

41 $0 = +10.2 - 1.14(50) + 7.26(52) - 6.12(53) - 3.34(72) + 13.36(75) - 10.02(76) - 0.38(79) - 0.26(81) + 0.64(83) - 16.30(87) + 17.28(88) - 0.98(89)$

42 $0 = +2.1 - 3.90(50) + 4.25(51) - 0.35(53) - 4.57(72) + 5.26(73) - 0.69(78) - 2.91(90) + 18.02(91) - 15.11(92)$

43 $0 = -1.97 - 0.597(73) + 0.759(76) - 0.162(78) - 0.735(81) + 0.742(82) - 0.007(84) - 0.250(90) + 2.839(92) - 2.589(93)$

44 $0 = -9.3 - 2.75(59) + 8.21(60) - 5.46(61) - 9.82(74) + 11.44(76) - 1.62(78) - 2.50(90) + 9.50(93) - 7.00(94)$

45 $0 = +5.0 - 1.93(58) + 3.22(59) - 1.29(61) - 1.00(74) + 4.61(77) - 3.61(78) - 2.81(96) + 3.93(97) - 1.12(98)$

46 $0 = -3.3 - 1.70(2) + 1.70(3) - 1.56(5) + 1.56(6) + 0.03(7) - 0.03(8) + 0.96(9) - 0.96(10) + 1.73(11) - 1.73(12) + 0.07(13) - 0.07(15) - 0.87(16) + 0.87(17) + 1.55(18) - 1.55(19) + 2.04(21) - 2.04(22) - 2.80(24) + 2.80(25) - 3.19(27) + 4.07(28) - 0.88(30) + 0.87(31) - 1.46(32) + 1.46(33) - 0.87(34) + 3.47(35) - 3.47(36) - 2.82(39) + 2.82(40) - 3.00(42) + 5.79(43) - 2.79(44) + 0.33(47) - 0.33(48) - 1.14(50) + 1.14(52) - 0.46(54) - 1.57(55) + 2.03(56) + 1.56(67) - 1.56(68) - 3.38(69) + 3.38(70) - 0.38(79) + 0.38(83) + 0.38(88) - 0.98(89)$

CONDITION EQUATIONS—continued.

Stephenville base net to Lampasas Base.

No.	
1	o=+0.20+ (2)− (4)− (5)+ (6)
2	o=+0.58+ (1)− (3)−(13)+(14)
3	o=−0.10− (1)+ (2)− (5)+ (7)−(12)+(13)
4	o=+0.25− (7)+ (9)−(11)+(12)−(15)+(16)
5	o=−0.71−(10)+(11)−(16)+(17)−(22)+(24)
6	o=+1.21− (8)+ (9)−(15)+(17)−(22)+(23)
7	o=−2.09−(17)+(18)−(21)+(22)−(25)+(26)
8	o=+1.40−(20)+(21)−(26)+(27)−(36)+(37)
9	o=+0.81−(18)+(19)+(25)−(30)−(38)+(39)
10	o=−0.20−(27)+(30)−(35)+(36)−(39)+(40)
11	o=−0.69−(27)+(28)−(32)+(36)−(49)+50)
12	o=+0.09−(32)+(35)−(40)+(42)−(47)+(50)
13	o=−0.91−(32)+(34)−(48)+(50)−(52)+(53)
14	o=+0.25−(34)+(35)−(40)+(41)+(52)−(55)
15	o=+0.13−(46)+(48)−(53)+(54)−(58)+(60)
16	o=+0.23−(29)+(30)−(39)+(43)−(56)+(57)
17	o=−0.53−(27)+(29)−(33)+(36)−(57)+(59)
18	o=+0.16−(28)+(29)−(46)+(49)−(57)+(60)
19	o=−0.22−(42)+(44)−(45)−(47)−(62)+(64)
20	o=+0.04−(43)+(44)+(56)−(61)−(62)+(63)
21	o=−1.77−(31)+(32)−(50)−(51)−(67)+(68)
22	o=+0.65+(45)−(51)−(64)+(65)−(66)+(67)
23	o=−1.8+4.39(1)−1.25(2)−1.86(5)+3.80(6)−1.94(7)—0.34(12)+3.59(13) −3.25(14)
24	o=−1.9+0.22(7)+2.92(8)−3.14(9)−2.71(10)+4.98(11)−2.27(12) −2.11(22)+2.52(23)−0.41(24)
25	o=−1.8−1.22(17)+3.96(18)−2.74(19)−2.90(20)+4.10(21) −1.20(22)−2.03(35)+4.15(36)−2.12(37)−2.69(38) +5.47(39)−2.78(40)
26	o=−1.3+0.25(27)+3.05(29)−3.30(30)−3.42(33)+5.45(35) −2.03(36)−1.73(56)+1.65(57)+0.08(59)
27	o=−5.2−7.62(28)+10.67(29)−3.05(30)+0.13(39)+8.82(42) −8.95(43)−3.36(46)+3.77(47)−0.41(49)
28	o=−4.7−5.81(32)+7.80(33)−1.99(35)−2.27(40)+11.09(42)−8.82(43) +2.29(56)+2.09(59)−4.38(60)
29	o=−1.4−4.86(32)+14.44(33)−9.58(34)−2.20(46)+2.73(48)−0.53(50) −3.16(58)+3.74(59)−0.58(60)
30	o=−1.5−8.85(41)+14.07(42)−5.22(43)−2.20(46)+8.06(47)−5.86(48) −1.09(56)+1.67(58)−0.58(60)
31	o=+7.0−8.82(42)+13.46(43)−4.64(44)−0.85(45)+4.62(46) −3.77(47)−5.30(62)+10.20(63)−4.90(64)
32	o=−0.2−1.52(31)+3.51(32)−1.99(35)−2.27(40)+4.99(42)−2.72(44) −2.11(62)+2.95(64)−0.84(65)−3.16(66)+6.60(67)−3.44(68)
33	o=−9.4+1.25(2)−1.67(3)+1.67(4)+1.86(5)−1.86(6)+0.22(7) −0.22(9)−2.71(10)+2.71(11)+0.34(12)−0.34(14)+2.41(15) −2.41(16)−1.22(17)+1.22(18)−2.90(20)+2.90(21)+0.41(22) −0.41(24)+1.23(25)−1.23(26)−1.98(27)+1.98(28)−4.86(32) +4.86(34)+2.12(36)−2.12(37)−2.20(46)+2.20(48)+2.46(49) −2.46(50)+0.34(52)−0.34(53)+0.58(58)−0.58(60)

ACCURACY AS INDICATED BY CORRECTIONS TO OBSERVED DIRECTIONS.

The corrections to observed directions resulting from the figure adjustments which precede are as follows: (The numbers of the directions are shown on illustrations 11 to 15.)

Bowie Base to Elreno 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	+0.102	39	−0.005	77	−0.684	115	+0.465
2	+0.696	40	+0.145	78	+0.398	116	+0.269
3	−0.573	41	+0.890	79	−0.268	117	+0.129
4	−0.225	42	−0.601	80	+0.348	118	−0.381
5	−0.374	43	−0.429	81	+0.519	119	−0.273
6	−0.774	44	+0.266	82	−0.811	120	−0.457
7	+0.846	45	+0.195	83	+0.293	121	+0.185
8	−0.427	46	−0.561	84	−0.142	122	−0.514
9	+0.729	47	+0.624	85	−0.233	123	−0.420
10	−0.604	48	−0.522	86	+0.086	124	+0.928
11	+0.417	49	−0.173	87	−0.548	125	+0.551
12	−0.112	50	+0.175	88	+0.839	126	+0.018
13	+0.846	51	−0.194	89	−0.135	127	−0.258
14	−0.482	52	−0.104	90	−0.015	128	−0.084
15	−0.131	53	+0.296	91	+0.665	129	+0.390
16	−0.004	54	+0.095	92	−0.258	130	−0.067
17	+0.072	55	+0.055	93	+0.547	131	−0.258
18	+0.121	56	−0.151	94	−0.804	132	−0.362
19	+0.175	57	−0.245	95	+0.094	133	+0.290
20	−0.271	58	+0.420	96	−0.131	134	+0.039
21	+0.343	59	+0.058	97	+0.036	135	+0.292
22	+0.198	60	+0.105	98	−0.207	136	−0.700
23	−0.688	61	−0.338	99	−0.241	137	+0.318
24	+0.121	62	+0.028	100	−0.051	138	+0.382
25	+0.274	63	−0.121	101	−0.144	139	+0.355
26	−0.383	64	+0.047	102	+1.037	140	+0.190
27	−0.478	65	+0.399	103	−0.669	141	+0.224
28	+0.331	66	−0.353	104	+0.276	142	−0.371
29	+0.257	67	−0.085	105	−0.601	143	−0.539
30	+0.951	68	+0.579	106	+0.105	144	+0.141
31	−1.404	69	−0.388	107	+0.497	145	+0.130
32	+0.328	70	−0.084	108	−0.219	146	−0.365
33	−0.170	71	−0.088	109	+0.277	147	+0.235
34	−0.188	72	+0.064	110	−0.224	148	−0.121
35	+0.484	73	−0.061	111	+0.055	149	−0.358
36	−0.247	74	−0.243	112	+0.111	150	+0.479
37	+0.314	75	+0.304	113	−0.135		
38	−0.066	76	+0.206	114	−0.347		

Anthony base net to Elreno 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	−0.612	15	+0.246	29	−0.116	43	+0.184
2	−0.550	16	−0.064	30	−0.084	44	+0.202
3	+0.533	17	+0.109	31	+0.210	45	+0.337
4	+0.443	18	−0.291	32	−0.250	46	+0.010
5	−0.057	19	−0.318	33	+0.144	47	−0.294
6	−0.152	20	−0.048	34	−0.210	48	−0.212
7	+0.046	21	−0.006	35	−0.035	49	−0.288
8	−0.121	22	−0.137	36	+0.351	50	+0.794
9	+0.285	23	+0.510	37	+0.098	51	−0.251
10	+0.267	24	+0.070	38	−0.249	52	−0.838
11	−0.078	25	+0.042	39	−0.363	53	+0.251
12	−0.472	26	−0.319	40	+0.255	54	+0.792
13	+0.403	27	+0.187	41	+0.252		
14	−0.119	28	+0.021	42	−0.733		

Bowie base net to Stephenville 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	−0.062	26	−0.019	51	+0.432	76	+0.614
2	−0.201	27	+0.351	52	−0.207	77	−0.360
3	+0.263	28	−0.279	53	−0.264	78	+0.475
4	+0.183	29	+0.082	54	+0.063	79	−0.582
5	−0.499	30	−0.135	55	+0.333	80	+0.665
6	+0.316	31	−0.212	56	−0.148	81	−0.089
7	−0.474	32	−0.176	57	−0.248	82	−0.540
8	+0.275	33	+0.158	58	−0.019	83	+0.465
9	+0.092	34	+0.230	59	+0.089	84	+0.080
10	+0.107	35	+0.196	60	+0.079	85	−0.366
11	+0.312	36	−0.018	61	+0.086	86	−0.040
12	−0.550	37	+0.288	62	−0.183	87	+0.258
13	−0.031	38	−0.197	63	+0.088	88	+0.189
14	+0.114	39	−0.455	64	−0.118	89	−0.040
15	+0.154	40	+0.185	65	−0.021	90	−0.117
16	−0.245	41	−0.154	66	+0.381	91	+0.140
17	+0.060	42	+0.279	67	−0.072	92	+0.279
18	+0.187	43	+0.144	68	+0.366	93	−0.352
19	+0.242	44	+0.323	69	−0.425	94	−0.080
20	−0.244	45	−0.593	70	−0.250	95	+0.130
21	+0.126	46	−0.275	71	+0.695	96	+0.131
22	−0.130	47	+0.445	72	−0.224	97	−0.433
23	+0.023	48	−0.553	73	−0.325	98	+0.302
24	−0.055	49	−0.031	74	−0.571		
25	+0.036	50	+0.454	75	−0.304		

Stephenville base net to Lampasas 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	−0.034	18	+0.450	35	+0.140	52	−0.342
2	+0.150	19	−0.004	36	+0.250	53	+0.405
3	−0.081	20	−0.093	37	−0.283	54	−0.014
4	+0.224	21	−0.295	38	+0.157	55	−0.049
5	+0.042	22	+0.329	39	−0.063	56	−0.072
6	−0.087	23	−0.191	40	−0.113	57	+0.221
7	−0.229	24	+0.250	41	+0.190	58	−0.111
8	+0.225	25	−0.308	42	+0.040	59	+0.145
9	+0.048	26	+0.352	43	−0.164	60	−0.113
10	−0.591	27	−0.307	44	−0.047	61	−0.071
11	+0.307	28	+0.182	45	+0.083	62	−0.006
12	+0.180	29	+0.251	46	−0.274	63	−0.164
13	+0.365	30	−0.169	47	+0.163	64	+0.222
14	−0.261	31	−0.599	48	+0.016	65	−0.052
15	+0.157	32	−0.110	49	−0.170	66	−0.181
16	−0.245	33	+0.203	50	−0.329	67	−0.128
17	−0.358	34	+0.400	51	+0.513	68	+0.309

The maximum correction to a direction in the first section adjusted was 1".40 to the direction from Myers to Blue. The maximum in the second section was 0".84 to the direction from Burson to Parnell; in the third section, 0".70 to the direction from Young to Gatlin; in the fourth section, 0".60 to the direction from Gilmore to Gabriel. In the four sections in which the triangulation along the ninety-eighth meridian previous to 1902 was adjusted, the largest maximum correction in any section was 1".39, and the smallest maximum correction for any section was 0".62. Of the 46 sections of triangulation of which the statistics are given in this appendix, under the heading "Accuracy and Economy," there were 14 for which the maximum correction was greater than 1".40, and only one for which it was less than 0".60, the extremes for 1902.

The probable error of 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 error for observed direction for each of the four sections is given below, preceded, for the purpose of comparison, by the corresponding values for other sections of triangulation in Kansas and Nebraska under the same general conditions as to climate, topography, and length of line.

Salina base net	±0."44	from 30 directions.
Salina base net to El Paso base net	±0."50	from 225 directions.
Salina base net to Versailles base net	±0."35	from 188 directions.
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.
Bowie Base to Elreno Base	±0."33	from 150 directions.
Elreno base net to Anthony base net	±0."36	from 54 directions.
Bowie base net to Stephenville Base	±0."29	from 98 directions.
Stephenville base net to Lampasas Base	±0."23	from 68 directions.

As measured by this standard, the triangulation of 1902 was more accurate than the former triangulation in adjacent regions under similar conditions. The last section of 1902 has a smaller d (± 0.23) than any other section involved in this comparison. So far as the writer knows there is but one other section anywhere in the United States having so small a value d as this, namely, the Nevada–California section of the transcontinental triangulation ($d = \pm 0.''23$). Four average values of d are as follows:

Eastern oblique arc	$\pm 0.''51$
Transcontinental triangulation	$\pm 0.''44$
Ninty-eighth meridian triangulation previous to 1902	$\pm 0.''31$
Ninety-eighth meridian triangulation in 1902	$\pm 0.''30$

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 Anthony base net to the Lampasas Base, together with 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.

Anthony base net to Elreno base net.

Stations.	Corrections to angles.	Error of closure of triangle.	Corrected spherical angles.			Spherical excess.
	″	″	°	′	″	″
Sand Hill	−0.35		40	57	27.78	
Rutherford	−0.61	−1.40	54	22	58.90	1.27
Miller	−0.44		84	39	34.59	
Renfrow	+0.41		31	49	51.36	
Miller	+0.53	+1.49	80	13	09.34	0.87
Fowler	+0.55		67	57	00.17	
Sand Hill	−0.39		41	41	40.18	
Miller	−0.09	−0.65	96	10	10.21	1.56
Renfrow	−0.17		42	08	11.17	
Vicar	+0.54		75	20	34.47	
Sand Hill	+0.87	+1.61	53	30	24.99	2.25
Renfrow	+0.20		51	09	02.79	
McCoy	+0.04		52	20	58.75	
Sand Hill	−0.52	−0.88	33	42	56.00	1.58
Vicar	−0.40		93	56	06.83	
Hahn	−0.17		55	06	55.96	
Vicar	−0.31	−0.57	79	38	23.03	2.05
Renfrow	−0.09		45	14	43.06	
McCoy	−0.13		39	11	45.05	
Vicar	+0.17	+0.55	111	04	55.67	1.32
Hahn	+0.51		29	43	20.60	
Enid	+0.39		121	51	10.34	
McCoy	+0.65	+0.68	28	21	19.25	1.09
Hahn	−0.36		29	47	31.50	

Anthony base net to Elreno base net—Continued.

Stations.	Corrections to angles.	Error of closure of triangle.	Corrected spherical angles.			Spherical excess.
	//	//	°	′	//	//
Waukomis	−0.35		47	19	49.54	
McCoy	−0.83	−1.78	43	13	49.48	1.25
Enid	−0.60		89	26	22.23	
Garber	−0.32		69	39	55.86	
Enid	−0.35	−0.70	42	51	15.46	0.82
Hahn	−0.03		67	28	49.50	
Mitchell	−0.33		28	54	57.97	
Enid	+0.17	+0.13	32	36	51.41	1.17
Garber	+0.29		118	28	11.79	
Waukomis	−0.11		75	02	48.50	
Enid	+0.39	+0.41	73	14	20.56	2.05
Mitchell	+0.13		31	42	52.99	
Parnell	+0.08		85	40	25.97	
Waukomis	+0.62	+0.72	60	16	20.46	1.89
Mitchell	+0.02		34	03	15.46	
Burson	−0.59		27	20	46.22	
Waukomis	0.00	−1.67	29	47	54.06	1.11
Parnell	−1.08		122	51	20.83	
Wingard	+0.54		61	13	18.71	
Parnell	−0.08	+1.38	56	52	25.08	2.47
Mitchell	+0.92		61	54	18.68	
Burson	+0.84		52	11	52.37	
Parnell	+1.08	+2.17	94	35	48.12	2.05
Wingard	+0.25		33	12	21.56	

Bowie Base to Elreno Base.

	//	//	°	′	//	//
Queen	+0.43		40	03	12.01	
Bowie Southeast Base	−1.27	−1.24	86	00	22.38	0.21
Bowie Northwest Base	−0.40		53	56	25.82	
Jones	−0.39		36	25	41.58	
Bowie Northwest Base	+0.35	+0.55	70	10	58.94	0.26
Bowie Southeast Base	+0.59		73	23	19.74	
Jones	+0.05		27	19	41.83	
Bowie Northwest Base	−0.05	+0.96	124	07	24.76	0.35
Queen	+0.96		28	32	53.76	
Jones	−0.45		9	05	59.74	
Queen	−0.53	−1.65	11	30	18.25	0.12
Bowie Southeast Base	−0.67		159	23	42.13	
Spradling	−0.10		24	52	20.65	
Jones	+0.08	−1.29	127	21	41.56	0.39
Bowie Northwest Base	−1.27		27	45	58.18	
Spradling	+0.81		25	33	41.97	
Bowie Northwest Base	+1.22	+3.48	96	21	26.58	0.80
Queen	+1.45		58	04	52.25	
Spradling	+0.72		50	26	02.63	
Jones	+0.02	+1.23	100	01	59.72	0.84
Queen	+0.49		29	31	58.49	

Bowie Base to Elreno Base—Continued.

Stations.	Corrections to angles.	Error of closure of triangle.	Corrected spherical angles.			Spherical excess.
	"	"	°	′	"	"
Myers	−0.02		35	43	27.55	
Bowie Northwest Base	+1.16	+1.14	58	17	28.74	0.65
Jones	0.00		85	59	04.36	
Myers	−0.52		36	35	36.28	
Queen	−0.37	−0.83	30	05	38.55	1.03
Jones	+0.06		113	18	46.20	
Bowie Northwest Base	−1.10		177	35	06.51	
Myers	−0.50	−2.93	0	52	08.73	0.03
Queen	−1.33		1	32	44.79	
Indian	+0.56		34	41	19.12	
Myers	+0.67	+2.04	60	19	46.21	1.44
Jones	+0.81		84	58	56.11	
Indian	−0.38		29	51	04.52	
Jones	−0.88	−1.92	61	40	17.98	0.96
Spradling	−0.66		88	28	38.46	
Bowie Standpipe	. . .		79	03	46.76	
Bowie Southeast Base	+0.35	. . .	39	43	44.20	0.15
Queen	+0.34		61	12	29.19	
Bowie Standpipe	. . .		90	16	33.95	
Jones	+0.17	. . .	17	00	38.97	0.37
Queen	−0.18		72	42	47.45	
Bowie Standpipe	. . .		11	12	47.20	
Jones	+0.61	. . .	7	54	39.22	0.10
Bowie Southeast Base	+0.33		160	52	33.68	
Bowie Standpipe	. . .		35	53	17.59	
Spradling	+0.64	. . .	61	05	22.46	0.81
Jones	−0.14		83	01	20.76	
Bowie Standpipe	. . .		126	09	51.55	
Spradling	−0.07	. . .	10	39	19.84	0.34
Queen	−0.68		43	10	48.95	
Cube	+0.17		54	35	15.12	
Queen	+0.35	−0.10	54	39	29.53	2.99
Myers	−0.62		70	45	18.34	
Blue	−0.07		34	23	48.87	
Queen	+0.48	+2.14	123	34	33.88	1.75
Myers	+1.73		22	01	39.00	
Blue	−0.83		77	07	05.23	
Queen	+0.13	−2.19	68	55	04.35	2.27
Cube	−1.49		33	57	52.69	
Cube	−1.32		88	33	07.81	
Blue	−0.76	−4.43	42	43	16.36	3.51
Myers	−2.35		48	43	39.34	
Benton	+0.40		74	15	03.40	
Blue	+1.18	+2.33	44	08	37.67	2.48
Cube	+0.75		61	36	21.41	
Grady	−0.04		100	51	38.36	
Blue	−1.15	−1.10	29	54	59.42	1.25
Benton	+0.09		49	13	23.47	

Bowie Base to Elreno Base—Continued.

Stations.	Corrections to angles.	Error of closure of triangle.	Corrected spherical angles.			Spherical excess.
	″	″	°	′	″	″
Lone Tree	+0.67		29	43	50.52	
Grady	−0.21	+0.09	107	16	33.68	1.10
Benton	−0.37		42	59	36.90	
Monument	+0.35		80	26	50.11	
Lone Tree	−0.36	+0.34	27	40	04.66	1.39
Benton	+0.35		71	53	06.62	
Monument	−0.75		37	34	46.34	
Benton	−0.47	−1.07	121	38	49.61	1.01
Cube	+0.15		20	46	25.06	
Arbuckle	+0.30		74	15	16.95	
Lone Tree	+0.05	+0.52	59	28	05.07	1.87
Monument	+0.17		46	16	39.85	
Duncan	+0.55		57	22	27.26	
Arbuckle	−0.01	+0.39	53	25	36.36	2.06
Monument	−0.15		69	11	58.44	
Osaria	+0.62		63	05	00.55	
Arbuckle	+0.15	+0.59	47	22	56.60	2.20
Duncan	−0.18		69	32	05.05	
Arbuckle Mountain	−1.33		44	45	22.17	
Lone Tree	−0.44	−2.74	74	32	11.36	1.94
Arbuckle	−0.97		60	42	28.41	
Table Hill	−0.09		66	48	58.38	
Arbuckle Mountain	+1.11	+1.68	57	04	46.69	2.31
Arbuckle	+0.66		56	06	17.24	
Table Hill	+0.32		60	25	24.98	
Arbuckle	−0.15	−0.50	68	07	24.42	2.63
Osaria	−0.67		51	27	13.23	
Lanier	+0.68		47	22	30.44	
Table Hill	−0.63	+1.13	67	11	22.55	4.08
Osaria	+1.08		65	26	11.09	
Kechi	+0.16		70	21	14.34	
Lanier	−0.92	−1.65	42	50	40.11	3.73
Osaria	−0.89		66	48	09.28	
Carson	+0.94		73	17	00.01	
Lanier	+0.81	+1.53	58	40	13.81	3.55
Kechi	−0.22		48	02	49.73	
Purcell	+0.70		101	33	32.47	
Table Hill	+1.39	+2.21	25	25	35.25	1.92
Lanier	+0.12		53	00	54.20	
Smith	+0.50		29	21	06.77	
Purcell	+0.39	+1.56	65	48	49.96	1.95
Lanier	+0.67		84	50	05.22	
Smith	−0.50		51	03	39.88	
Lanier	−1.35	−3.56	73	15	36.23	3.28
Carson	−1.71		55	40	47.17	
Carson	+0.16		29	06	05.30	
Elreno West Base	+0.06	+0.12	45	56	51.19	0.60
Elreno East Base	−0.10		104	57	04.11	

Bowie Base to Elreno Base—Continued.

Stations.	Corrections to angles.	Error of closure of triangle.	Corrected spherical angles.			Spherical excess.
	"	"	°	′	"	"
Caddo	+0.97		42	32	45.01	
Elreno East Base	+0.65	+2.63	55	26	29.15	0.51
Elreno West Base	+1.01		82	00	46.35	
Caddo	−0.38		32	41	51.87	
Carson	−0.03	+0.67	19	20	31.39	0.81
Elreno West Base	+1.08		127	57	37.55	
Elreno East Base	+0.55		160	23	33.26	
Carson	+0.19	+2.09	9	45	33.91	0.31
Caddo	+1.35		9	50	53.14	
Yukon	−0.21		37	43	19.23	
Carson	−0.10	−0.86	33	31	46.96	0.79
Elreno East Base	−0.55		108	44	54.60	
Yukon	+0.81		47	11	58.19	
Elreno East Base	0.00	+0.91	90	51	32.14	0.82
Caddo	+0.10		41	56	30.49	
Yukon	+0.60		84	55	17.42	
Carson	+0.10	+2.14	43	17	20.88	1.92
Caddo	+1.44		51	47	23.62	
Smith	+0.28		40	41	25.55	
Carson	+1.18	+1.71	35	24	27.24	1.90
Yukon	+0.25		103	54	09.11	
Edmonds	−0.28		48	17	18.85	
Smith	+0.06	−0.73	69	45	50.09	1.93
Yukon	−0.51		61	56	52.99	
Edmonds	+0.17		30	24	05.28	
Yukon	−0.33	−0.86	109	13	40.49	2.03
Caddo	−0.70		40	22	16.26	
Eichoff	+0.68		36	02	23.17	
Yukon	+0.62	+1.55	82	55	43.62	1.11
Elreno East Base	+0.25		61	01	54.32	
Eichoff	+0.21		36	37	48.58	
Elreno East Base	−0.25	0.00	29	49	37.82	0.69
Caddo	+0.04		113	32	34.29	
Eichoff	+0.90		72	40	11.76	
Yukon	−0.20	+0.64	35	43	45.42	0.98
Caddo	−0.06		71	36	03.80	
Eichoff	−0.17		62	48	38.33	
Edmonds	+0.65	+0.34	43	41	28.66	2.05
Yukon	−0.14		73	29	55.06	
Eichoff	+0.73		135	28	50.09	
Edmonds	+0.47	+1.84	13	17	23.37	1.00
Caddo	+0.64		31	13	47.54	
Wingard	−0.50		53	53	38.44	
Edmonds	−0.46	−1.55	79	22	55.71	2.82
Eichoff	−0.59		46	43	28.68	
Burson	+0.84		25	23	15.04	
Eichoff	−0.17	+0.49	106	20	51.01	1.05
Caddo	−0.18		48	15	55.00	
Burson	−0.24		71	33	25.49	
Wingard	+0.60	+0.40	36	59	47.12	2.84
Eichoff	+0.04		71	26	50.23	

Bowie base net to Stephenville Base.

Stations.	Corrections to angles.	Error of closure of triangle.	Corrected spherical angles.	Spherical excess.
	//	//	° ′ //	//
Moore	+0.02		65 36 29.87	
Indian	−0.14	+0.69	60 52 16.04	1.32
Spradling	+0.81		53 31 15.41	
Woolly	−0.86		50 29 31.02	
Indian	+0.46	−0.58	50 56 49.60	1.31
Moore	−0.18		78 33 40.69	
Davis	−0.49		33 07 42.73	
Moore	−0.58	−1.75	125 12 18.76	0.87
Spradling	−0.68		21 39 59.38	
Davis	+0.05		53 29 41.02	
Woolly	+0.52	+1.32	35 52 49.27	0.98
Moore	+0.75		90 37 30.69	
Kyle	−0.26		45 50 43.94	
Woolly	+0.19	+0.06	91 55 37.83	1.95
Davis	+0.13		42 13 40.18	
Gilbert	−0.22		33 45 06.29	
Woolly	+0.15	+0.36	36 34 11.90	2.11
Davis	+0.43		109 40 43.92	
Gilbert	+0.14		67 17 58.21	
Kyle	+0.15	+0.60	45 15 00.92	2.88
Davis	+0.31		67 27 03.75	
Kyle	−0.10		91 05 44.87	
Woolly	+0.04	+0.30	55 21 25.93	2.72
Gilbert	+0.36		33 32 51.92	
Oaks	−0.45		112 34 35.41	
Kyle	−0.08	−1.16	34 00 10.38	1.35
Gilbert	−0.63		33 25 15.56	
McClenny	−0.21		31 13 56.71	
Kyle	+0.09	−0.05	36 53 18.53	1.55
Oaks	+0.07		111 52 46.31	
Comanche	−0.92		29 47 50.20	
Oaks	+0.04	−0.51	80 14 42.24	2.77
Gilbert	+0.37		69 57 30.33	
Comanche	+0.18		37 03 23.18	
McClenny	+0.31	+0.82	87 38 43.43	2.64
Oaks	+0.33		55 17 56.03	
Pilot	−1.00		81 05 44.39	
McClenny	−0.74	−1.88	63 49 57.27	1.88
Comanche	−0.14		35 04 20.22	
Gatlin	+0.27		102 12 00.85	
McClenny	+0.64	+1.63	36 45 29.87	0.49
Pilot	+0.72		41 02 29.77	
Lone Mountain	+0.10		67 42 32.85	
McClenny	−0.49	−0.09	48 13 31.36	2.61
Comanche	+0.30		64 03 58.40	
Lone Mountain	−0.11		88 31 01.52	
Pilot	+0.52	+0.85	62 29 21.58	1.28
Comanche	+0.44		28 59 38.18	

Bowie base net to Stephenville Base—Continued.

Stations.	Corrections to angles.	Error of closure of triangle.	Corrected spherical angle.			Spherical excess.
	"	"	°	′	"	"
Pilot	−0.47		143	35	05.98	
McClenny	−0.26	−0.94	15	36	25.90	0.55
Lone Mountain	−0.21		20	48	28.67	
Alarm	+0.44		53	25	40.02	
Gatlin	−0.48	−0.11	46	01	14.21	0.40
Pilot	−0.07		80	33	06.17	
Young	−0.92		46	34	17.13	
Gatlin	−0.58	−1.51	71	51	27.17	0.53
Pilot	−0.01		61	34	16.23	
Young	−1.00		78	51	29.09	
Gatlin	−0.10	−1.55	25	50	12.96	0.30
Alarm	−0.45		75	18	18.25	
Alarm	−0.01		128	43	58.27	
Young	−0.08	−0.15	32	17	11.96	0.17
Pilot	−0.06		18	58	49.94	
Stephenville North Base	−1.05		79	54	28.57	
Alarm	−0.79	−2.50	38	32	00.80	0.20
Pilot	−0.66		61	33	30.83	
Stephenville North Base	−0.66		74	45	02.56	
Young	−0.10	−1.48	24	42	37.00	0.33
Pilot	−0.72		80	32	20.77	
Alarm	−0.81		167	15	59.06	
Young	+0.02	−1.17	7	34	34.96	0.04
Stephenville North Base	−0.38		5	09	26.02	
Stephenville North Base	+1.25		124	33	37.10	
Pilot	+0.48	+2.00	33	15	47.25	0.18
Lone Mountain	+0.27		22	10	35.83	
Young	−0.35		32	02	57.43	
Pilot	−0.23	−0.58	113	48	08.03	0.68
Lone Mountain	0.00		34	08	55.22	
Stephenville North Base	−0.59		160	41	20.34	
Lone Mountain	−0.27	−1.11	11	58	19.39	0.16
Young	−0.25		7	20	20.43	
Stephenville South Base	−0.23		65	07	13.81	
Alarm	+0.18	+0.50	31	57	07.70	0.17
Stephenville North Base	+0.55		82	55	38.66	
Stephenville South Base	−0.30		72	28	45.87	
Young	+0.94	+0.81	19	26	09.73	0.28
Stephenville North Base	+0.17		88	05	04.68	
Stephenville South Base	−0.33		74	19	52.06	
Stephenville North Base	−0.75	−1.34	72	36	15.67	0.17
Lone Mountain	−0.26		33	03	52.44	
Stephenville South Base	−0.62		146	48	37.94	
Young	+1.19	+0.58	12	05	49.30	0.29
Lone Mountain	+0.01		21	05	33.05	
Alarm	+0.63		160	46	53.24	
Stephenville South Base	−0.07	+1.48	7	21	32.06	0.07
Young	+0.92		11	51	34.77	

Bowie base net to Stephenville Base—Continued.

Stations.	Corrections to angles.	Error of closure of triangle.	Corrected spherical angles.			Spherical excess.
	"	"	°	′	"	"
Gibson	+0.04		56	52	52.30	
Young	+1.04	+1.08	64	32	08.84	1.91
Lone Mountain	0.00		58	35	00.77	
Gibson	+0.26		29	13	40.11	
Young	+0.70	+0.26	96	35	06.28	1.29
Pilot	−0.70		54	11	14.90	
Gibson	−0.22		27	39	12.19	
Pilot	+0.46	+0.24	59	36	53.12	1.30
Lone Mountain	0.00		92	43	55.99	
Gibson	+0.39		35	53	29.04	
Young	+0.80	+1.80	71	52	29.28	1.26
Stephenville North Base	+0.61		72	14	02.94	
Gibson	−0.36		20	59	23.25	
Stephenville North Base	−1.20	−1.83	88	27	17.40	0.81
Lone Mountain	−0.27		70	33	20.16	
Stephenville North Base	−0.05		146	59	05.50	
Gibson	+0.14	+0.07	6	39	48.94	0.31
Pilot	−0.02		26	21	05.87	
Gibson	−0.24		40	07	54.09	
Young	−0.14	−0.09	52	26	19.55	1.10
Stephenville South Base	+0.29		87	25	47.46	
Gibson	+0.27		16	44	58.20	
Stephenville South Base	+0.33	+0.59	125	45	34.60	0.52
Lone Mountain	−0.01		37	29	27.72	
Stephenville South Base	+0.01		159	54	33.35	
Gibson	−0.63	−1.07	4	14	25.05	0.13
Stephenville North Base	−0.45		15	51	01.73	
Gleason	+0.17		62	08	56.65	
Gibson	+0.21	+0.49	70	25	09.36	1.89
Lone Mountain	+0.11		47	25	55.88	
Gleason	+0.73		34	00	28.68	
Young	+0.21	+1.05	39	58	36.96	2.29
Lone Mountain	+0.11		106	00	56.65	
Gleason	−0.56		28	08	27.97	
Gibson	+0.25	+0.52	127	18	01.66	1.51
Young	+0.83		24	33	31.88	

Stephenville base net to Lampasas Base.

	"	"	°	′	"	"
Chamliss	−0.13		48	28	25.74	
Gibson	+0.15	−0.20	59	08	05.21	1.83
Gleason	−0.22		72	23	30.88	
Scoggins	−0.63		30	21	28.50	
Gibson	+0.03	−0.58	25	37	04.81	1.19
Gleason	+0.08		124	01	27.88	
Scoggins	−0.44		80	54	38.07	
Chamliss	−0.14	−0.28	47	27	26.22	1.29
Gleason	+0.30		51	37	57.00	

Stephenville base net to Lampasas Base—Continued.

Stations.	Corrections to angles.	Error of closure of triangle.	Corrected spherical angles.			Spherical excess.
	"	"	°	′	"	"
Chamliss	−0.27		95	55	51.96	
Gibson	+0.18	+0.10	33	31	00.40	1.93
Scoggins	+0.19		50	33	09.57	
Brown	−0.40		41	08	32.67	
Chamliss	+0.28	−0.25	95	57	41.40	1.43
Scoggins	−0.13		42	53	47.36	
King	+0.44		39	08	17.59	
Chamliss	+0.46	+1.67	60	07	21 76	1.88
Scoggins	+0.77		80	44	22.53	
King	−0.08		79	01	07.51	
Brown	−0.11	+0.71	63	08	19.09	1.77
Scoggins	+0.90		37	50	35.17	
Brown	−0.51		104	16	51.76	
Chamliss	−0.18	−1.21	35	50	19.64	1.32
King	−0.52		39	52	49.92	
Franklin	+0.66		59	41	08.85	
Brown	+0.81	+2.09	60	03	05.22	1.08
King	+0.62		60	15	47.01	
Gilmore	−0.54		44	52	52.45	
Franklin	−0.66	−1.40	99	09	04.42	1.03
King	−0.20		35	58	04.16	
Flat Top	−0.22		38	03	27.01	
Brown	−0.45	−0.81	37	35	35.03	1.20
Franklin	−0.14		104	20	59.16	
Gilmore	+0.11		46	01	41.91	
Flat Top	−0.05	+0.20	37	09	31.54	1.02
Franklin	+0.14		96	48	47.57	
Bachelor	−0.33		49	49	51.10	
Flat Top	+0.10	−0.58	80	04	49.58	1.21
Franklin	−0.35		50	05	20.53	
Bachelor	−0.16		40	34	04.02	
Franklin	+0.49	+0.69	46	43	27.04	0.97
Gilmore	+0.36		92	42	29.91	
Bachelor	−0.49		90	23	55.12	
Flat Top	+0.15	−0.09	42	55	18.04	1.16
Gilmore	+0.25		46	40	48.00	
Lampasas Northeast Base	+0.75		80	49	58.74	
Gilmore	+0.51	+0.91	23	24	06.85	0.42
Bachelor	−0.35		75	45	54.83	
Lampasas Northeast Base	−0.29		122	18	46.34	
Flat Top	+0.30	−0.25	34	24	33.13	0.62
Gilmore	−0.26		23	16	41.15	
Lampasas Northeast Base	−0.45		156	51	14.93	
Bachelor	−0.15	−0.75	14	38	00.28	0.12
Flat Top	−0.15		8	30	44.91	
Lampasas Southwest Base	0.00		74	41	05.60	
Lampasas Northeast Base	−0.42	−0.13	61	29	52.81	0.11
Bachelor	+0.29		43	49	01.70	

Stephenville base net to Lampasas Base—Continued.

Stations.	Corrections to angles.	Error of closure of triangle.	Corrected spherical angles.			Spherical excess.
	//	//	°	′	//	//
Lampasas Southwest Base	−0.04		62	41	48.80	
Flat Top	−0.36	−0.44	21	56	49.30	0.21
Lampasas Northeast Base	−0.04		95	21	22.11	
Lampasas Southwest Base	−0.04		137	22	54.40	
Flat Top	−0.21	+0.19	13	26	04.39	0.21
Bachelor	+0.44		29	11	01.42	
Lampasas Southwest Base	+0.29		51	50	41.97	
Flat Top	−0.10	−0.23	93	30	53.98	0.89
Franklin	−0.42		34	38	24.94	
Lampasas Southwest Base	−0.08		40	13	31.52	
Franklin	+0.56	+0.53	62	10	22.63	1.16
Gilmore	+0.05		77	36	07.01	
Lampasas Southwest Base	+0.21		92	04	13.49	
Flat Top	−0.05	+0.09	56	21	22.44	1.02
Gilmore	−0.07		31	34	25.09	
Lampasas Northeast Base	+0.33		142	19	51.55	
Gilmore	+0.20	+0.78	8	17	43.95	0.19
Lampasas Southwest Base	+0.25		29	22	24.69	
Bachelor	−0.05		119	34	56.54	
Lampasas Southwest Base	−0.25	+0.01	45	18	40.91	0.35
Gilmore	+0.31		15	06	22.90	
May	+0.23		44	55	49.69	
Flat Top	−0.09	+0.22	37	49	00.84	1.07
Bachelor	+0.08		97	15	10.54	
Lampasas Southwest Base	0.00		133	57	39.62	
May	−0.16	−0.04	21	39	24.45	0.52
Flat Top	+0.12		24	22	56.45	
Lampasas Southwest Base	+0.04		88	39	25.98	
Bachelor	−0.36	+0.07	68	04	09.12	0.34
May	+0.39		23	16	25.24	
Gabriel	+0.44		31	29	58.14	
Bachelor	+0.84	+1.77	94	18	52.46	1.68
Gilmore	+0.49		54	11	11.08	
Gabriel	+0.05		33	42	53.28	
May	−0.27	−0.65	68	15	06.37	1.53
Bachelor	−0.43		78	02	01.88	
Lampasas Southwest Base	−0.33		85	32	12.43	
Franklin	+0.07	−0.16	15	26	55.59	0.53
Bachelor	+0.10		79	00	52.51	

The maximum correction of any angle is 2″.35 to the angle at Myers between Cube and Blue, in the section Bowie Base to Elreno Base. This angle involved the line of sight from Myers to Blue, which passed very near to the ground and over which the observations were difficult to secure.

The statistics as to closures of triangles and in regard to 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), are given in the following table:

Section.	Number of triangles	Number of plus closures.	Number of minus closures.	Average closure.	Maximum closure.	Mean error of an angle.
				//	//	//
Bowie to Elreno	51	*31	*19	1.19	4.43	0.97
Elreno to Anthony	16	9	7	1.05	2.17	0.69
Bowie to Stephenville	44	23	21	0.90	2.50	0.63
Stephenville to Lampasas	32	15	17	0.56	2.09	0.45
Whole season	143	78	64	0.94	4.43	†0.72

The decrease in the average closure of a triangle, and in the mean error of an angle, for each successive section is interesting evidence of the increasing skill of the observers.

For comparison with triangulation under the same general conditions as to climate, topography, and length of line, it may be stated that for the seven sections, all wholly or in part in Kansas and Nebraska, the average closing error for the three sections in the transcontinental triangulation is 0.″96, and for the four in the ninety-eighth meridian triangulation previous to 1902 is 0.″67. Similarly for these three sections of the transcontinental triangulation the mean value of a is $\pm$0.69, and for these four sections of the ninety-eighth meridian triangulation it is $\pm$0.46. As shown by the first of these two standards the triangulation of 1902 is intermediate in accuracy between the triangulation along the thirty-ninth parallel and that along the ninety-eighth meridian, made under similar conditions, and by the second standard slightly below even the first of these.

It is interesting and important to note that the party of 1902 was not attempting to secure the highest degree of accuracy, but on the contrary had been directed to "proceed upon the assumption that the maximum speed consistent with the requirement that the closing error of the single triangle in the primary scheme shall seldom exceed three seconds, and the average closing error shall be but little greater than one second, is what is desired rather than a greater accuracy than that indicated." The average closing error of 0.″94 corresponds very closely with the second part of these specifications, and the fact that 3 triangles out of 143 had closing errors greater than 3″, corresponds with the first part. Each of these three triangles involved a line of sight which passed very near to the ground or to trees.

* One triangle closes exactly.

† Weighted mean.

The following general comparison may be made for triangulation extending over a considerable portion of the United States and necessarily embracing various conditions as to climate, topography, and length of lines:

	Average closing error.	a (Mean value.)
	″	″
Eastern oblique arc	1.19	±0.82
Transcontinental triangulation	1.06	±0.77
Ninety-eighth meridian previous to 1902	0.67	±0.46
Ninety-eighth meridian in 1902	0.94	±0.72

Of the 38 sections in this comparison of triangulation along the eastern oblique arc and the transcontinental triangulation, there is not one for which the average closing error is as small as for the section Stephenville–Lampasas of 1902, and only one, the Nevada–California section of the transcontinental triangulation, for which the mean error of an angle is less ($a=\pm 0.''42$) than for the Stephenville–Lampasas section of the 1902 work.

No attempt has been made 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 closures of the triangles are studied or an attempt is made to adjust the figure.

THE ACCORD OF BASES.

There are five bases which serve to fix the length in the triangulation of 1902, viz, the Anthony, Elreno, Bowie, Stephenville, and Lampasas 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 the discrepancy in length, after all the conditions relating to closures of triangles and ratios of lengths had been satisfied, became known. In the following table the discrepancies developed between bases in 1902 are given in terms of the seventh decimal place of logarithms and are also expressed as ratios. A plus sign before the discrepancy expressed in the 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 the three sections of the ninety-eighth meridian triangulation completed before 1902.

Bases.	Discrepancy in seventh place of logarithms.	Discrepancy expressed as a ratio.
Anthony–Elreno, 1902	+ 7	$\frac{1}{320000}$
Elreno–Bowie, 1902	−64	$\frac{1}{35000}$
Bowie–Stephenville, 1902	−77	$\frac{1}{30000}$
Stephenville–Lampasas, 1902	−47	$\frac{1}{52000}$
Salina–Anthony, 1899–1901	+41	$\frac{1}{110000}$
Salina–Shelton, 1897–1899	+75	$\frac{1}{58000}$
Shelton–Page, 1899–1901	−16	$\frac{1}{270000}$

Five out of the nine discrepancies in the transcontinental triangulation are greater than the maximum for 1902, the greatest being 169 in the seventh place of logarithms. There is but one section of the transcontinental triangulation for which the discrepancy is less than that between the Anthony and Elreno bases in 1902.

A STUDY OF ERRORS.

The work of 1902 furnishes an unusually good opportunity of testing the results of two widely different ways of making pointings and readings.

Mr. Ferguson's habit was to make very careful and deliberate pointings. He always studied each pointing for a moment after he believed it to be perfect and corrected it, or watched it still longer if he found it apparently changing. Mr. Bowie made his pointings equally carefully, but with much greater rapidity, and as soon as a pointing seemed perfect he proceeded at once, without the slightest hesitation, to take up the next operation on the supposition that it is more important to reduce the time interval between observations, during which interval the instrument has an opportunity to change its shape and position, than to make a slight improvement in the pointings. This contrast in the habits of the two observers existed for pointings on the graduation of the circle with the micrometer microscopes, as well as for pointings on distant stations with the telescope. At the beginning of the season Mr. Ferguson's observing was done at the rate of 3.4 minutes for each pointing on a distant signal, and at the end of the season under more favorable conditions 2.5 for each pointing. Mr. Bowie, under similar conditions, took 2.0 minutes for each pointing at the beginning of the season and 1.3 at the end.

The probable error of the mean of 16 measures of an angle is shown in the following table for each of these observers and for each of the four sections of the triangulation in order of time.

Section.		Ferguson.	Bowie.
		″	″
Bowie–Elreno		±0.28	±0.24
Elreno–Anthony		0.28	0.37
Bowie–Stephenville		0.15	0.23
Stephenville–Lampasas		0.22	0.18
Whole season	Weighted mean.	0.245	0.253

These probable errors were computed from the discrepancies between the means of sets of four observations each and the mean of all sixteen observations, and are therefore practically free from any effect of errors due to periodic errors of graduation of the circle or to run of micrometer. The probable errors do not, however, furnish any information as to the existence or nonexistence of constant errors. The above comparison indicates that the more deliberate observer has made observations of which the accidental errors are considerably smaller than those of the more rapid observer.

The most severe test of accuracy which can be made is furnished by the corrections to directions resulting from figure adjustment. These corrections exhibit the constant errors as well as the accidental errors. A comparison between the two observers on this basis is as follows:

Corrections to directions.

	Assistant Ferguson.			Assistant Bowie.		
	Number of directions.	Average correction.	Maximum correction.	Number of directions.	Average correction.	Maximum correction.
		"	"		"	"
Elreno–Bowie	69	0.324	1.404	81	0.339	1.037
Anthony–Elreno	*21	0.222	0.792	*32	0.279	0.838
Bowie–Stephenville	43	0.260	0.695	55	0.226	0.665
Stephenville–Lampasas	30	0.234	0.599	38	0.175	0.450
Whole season	173	0.261	1.404	206	0.269	1.037

It will be noted that this comparison shows the accuracy to be substantially the same for the two observers. The average correction to a direction for the deliberate observer, Mr. Ferguson, is very slightly less than for the rapid observer, Mr. Bowie, but, on the other hand, the maximum correction in three sections out of the four is greater for the deliberate observer than for the rapid observer.

The conclusion from this investigation must, therefore, be that the deliberate observer reduced his accidental errors very slightly by taking more time to each pointing, and that the real accuracy of his observing was but slightly if any greater than for the other observer, as shown by the more severe test of accuracy given by the corrections to directions found to be necessary in the figure adjustments. The deliberate observer apparently increased his systematic or constant errors by giving his instrument more time to change in form and position sufficiently to offset what he gained by reducing the accidental errors. If, therefore, he had made his pointings much more rapidly there would have been a considerable saving in the cost of the work, and probably no decrease in accuracy.

Observers usually suppose that observations on signals which are visible only when the refraction is abnormally large, and for which even then the line of sight passes very near to the ground or intervening trees, are of an unusually low degree of accuracy. There were eight such lines especially mentioned in the field report of the work of this season, namely, Queen–Spradling, Blue–Myers, Lanier–Smith, Smith–Carson, Carson–Caddo, Caddo–Edmonds, Enid–McCoy, and Burson–Wingard. The sixteen cor-

* Total number of directions in section is 54. The omitted direction is Rutherford to Sand Hill, by A. T. Mosman, 1901.

rections to the directions observed over these lines were examined, and it was found that they were, upon an average, 44 per cent larger than the average corrections in corresponding sections of the triangulation, thus confirming the prevalent belief. The maximum correction to a direction for the whole season, namely, to the direction from Myers to Blue, occurred on one of these lines.

In view of the fact that during this season for the first time the extreme has been reached of taking all the primary observations at a station on a single day, it is important as well as interesting to note carefully whether such observations were subject to any unusual error. The following tabular statement shows the facts in regard to the five such stations which were occupied in 1902:.

Stations at which all the primary observations were made on a single date.

Station.	Number of directions.	Average correction to direction.	Maximum correction to direction.	Average correction to all directions in same section.	Maximum correction to a direction in same section.
		"	"	"	"
Grady	3	0.100	0.151	0.33	1.464
Spradling*	3	0.333	0.499	0.24	0.695
Moore	4	0.237	0.474	0.24	0.695
May	4	0.111	0.222	0.20	0.599
Lampasas Northeast Base	4	0.202	0.405	0.20	0.599
Mean		0.20		0.24	

The average correction to a direction for these stations is of about the same magnitude as for the sections in which they are located. The means indicate that the observations at these stations were really slightly more accurate than at the average station, but the slight difference between 0.20 and 0.24 may be only a chance difference due to the small number of corrections included in the first mean. The maximum correction at no one of these five stations approaches in magnitude the maximum correction in the corresponding section. The indication is very strong that even the extraordinary procedure of taking all the observations at a given station on a single date is not accompanied by any decrease in accuracy, and that contrary to the usual traditions of geodesists it is not necessary to extend the observations over several days in order to secure great accuracy. This conclusion is sustained by much evidence in addition to that shown here, which is simply that from extreme cases, cited as illustrations rather than positive proof.

In view of the fact that a considerable increase in the rapidity of the triangulation was secured during the years 1900–1902 over that of previous years by cutting down the number of observations of primary directions from 22, 24, 26, 34, or even more, to 16, and that this reduction in the number of observations has not been accompanied by a decrease in the accuracy of the results, it is important to consider the probable effect on the accuracy of a still further reduction of the number of observations.

A careful examination of this question was made by the method of least squares,

* All the directions used in the adjustment of the section Bowie to Stephenville were observed on one day, August 26. The statistics here given are from these directions only.

using the data available from the 1902 observations. The conclusion reached was that a reduction of the number of observations to 12 or 8 would be accompanied by a considerable decrease in accuracy, and that there would probably be difficulty in securing the degree of accuracy indicated by the triangle closures specified in the instructions and corresponding to the best primary triangulation of the past. It was decided, therefore, to continue to take 16 observations.

ACCURACY AND ECONOMY.

The evidence in brief that the triangulation of 1902 along the ninety-eighth meridian ranges near the top of the list for accuracy as compared with other triangulation in the United States and at the same time is the most economical primary triangulation yet executed is here brought together for convenient reference.

In the following table fifty 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 two 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 864 and 865.

Sections of triangulation in order of accuracy.

Serial 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	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	Dauphin Island base net.	0.26	0.51	0.83	0.49	1.25	
5	New England section.	0.26	0.53	1.29	1.17	3.35	†+ 44
6	Meades Ranch–Waldo to Shelton base net.	0.27	0.35	0.50	0.62	1.42	+ 75
7	Shelton base net to Page Base.	0.29	0.44	0.60	0.87	1.77	— 16
8	Olney base net.	0.29	0.54	0.78	0.70	1.78	
9	BOWIE BASE NET TO STEPHENVILLE BASE.	0.29	0.63	0.90	0.70	2.50	— 77
10	Eastern Oblique Arc to Augusta.	0.30	0.60	0.78	0.74	2.73	
11	Rocky Mountain series.	0.32	0.57	0.84	0.80	2.31	+ 85
12	Salt Lake base net.	0.32	0.66	0.81	0.84	3.18	
13	Shelton Base net.	0.33	0.45	0.80	0.88	2.07	
14	ELRENO BASE TO BOWIE BASE.	0.33	0.97	1.19	1.40	4.43	— 64
15	Fire Island base net.	±0.34	±0.49	0.70	1.43	1.43	

*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.

†There were three bases connected by this section, Epping, Massachusetts, and Fire Island. The three discrepancies were +44, +3, and +41.

Sections of triangulation in order of accuracy—Continued.

Serial 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.
16	Illinois series.	±0.34	±0.57	0.79	0.99	1.72	− 6
17	Holton base net.	0.34	0.58	0.79	0.84	2.28	
18	Indiana series.	0.34	0.60	0.80	1.31	3.20	− 71
19	Atlanta base net–Dauphin Island base net, IV.	0.34	0.63	0.85	0.93	2.19	+ 2
20	Transcontinental Triangulation to Anthony Base.	0.35	0.54	0.79	1.39	1.98	+ 41
21	Missouri–Kansas series.	0.35	0.60	0.88	1.12	2.37	+169
22	Atlanta base net–Dauphin Island base net, V.	0.35	0.68	0.97	1.12	2.87	+ 2
23	Kent Island base net–Atlanta base net, II.	0.35	1.31	1.80	2.05	4.64	+ 24
24	ANTHONY BASE NET TO ELRENO BASE NET.	0.36	0.69	1.05	0.84	2.17	+ 7
25	Atlanta base net–Dauphin Island base net, III.	0.36	0.77	1.10	0.84	2.69	+ 2
26	Versailles base net.	0.40	0.64	0.90	0.95	2.71	
27	El Paso base net.	0.40	0.68	0.94	0.93	2.60	
28	Kent Island base net–Atlanta base net, I.	0.41	0.88	1.14	1.48	3.60	
29	Yolo base net–Los Angeles base net.	0.41	0.91	1.16	1.34	5.52	*+ 13
30	Kent Island base net.	0.41	0.91	1.33	0.75	2.97	
31	Salina base net.	0.44	0.75	1.13	1.11	2.37	
32	Los Angeles base net.	0.44	0.91	1.39	1.22	3.09	
33	Ohio series.	0.45	0.85	1.14	1.32	5.08	− 24
34	Allegheny series.	0.45	0.98	1.37	1.37	4.03	+ 11
35	Epping base net.	0.47	0.63	0.90	1.25	2.63	
36	Fire Island base net–Kent Island base net.	0.47	0.86	1.29	2.02	3.35	+ 46
37	St. Albans base net.	0.47	1.04	1.38	1.53	4.94	
38	Kansas–Colorado series.	0.50	0.75	1.00	1.43	3.92	− 92
39	Los Angeles base net–Mexican Boundary.	0.50	0.82	1.16	1.15	2.53	
40	Epping base net to Canadian Boundary.	0.51	0.74	1.15	1.12	2.09	
41	Dauphin Island westward, I.	0.53	0.78	1.12	1.31	2.80	
42	Kent Island base net–Atlanta base net, III.	0.62	0.78	1.66	1.72	4.03	
43	Atlanta base net.	0.65	1.00	1.19	1.31	4.35	
44	Missouri series.	0.66	0.81	1.09	1.89	4.64	+ 86
45	Atlanta base net–Dauphin Island base net, II.	0.67	0.78	1.03	1.84	2.88	+ 2
46	Coast Range series.	0.67	1.37	1.80	2.73	6.49	
47	Eastern Shore series.	0.72	1.22	1.75	1.85	5.24	
48	Dauphin Island base net–New Orleans.	0.78	1.20	1.50	2.65	5.40	
49	Atlanta base net–Dauphin Island base net, I.	0.79	0.97	1.35	2.19	3.44	+ 2
50	American Bottom base net.	±0.82	±1.59	2.22	1.80	6.36	

Of the fifty sections of triangulations tabulated, the four sections of 1902 along the ninety-eighth meridian rank as numbers 2, 9, 14, and 24. The mean d for all four sections is 0.31, which falls between numbers 10 and 11 in the above list, and would fall between numbers 8 and 9 if these four sections of which 0.31 is the mean were omitted.

*This was the discrepancy existing before the angle and the side equations were satisfied. In every other case given in the table it is that remaining after the angle and side equations had been satisfied.

It is especially worthy of note that the section Stephenville–Lampasas, 1902, on which the angles were measured more rapidly than any previous section of triangulation in the United States, at the rate of more than seven stations per month for each observer, is exceeded in accuracy by only one section out of the fifty.

The unit costs of this triangulation are as follows:

Cost per station occupied	$300.00 (75 stations).
Cost per point determined	98.00 (231 points).
Cost per square mile in main scheme	2.30 (9 800 square miles).
Cost per square mile covered	2.20 (10 400 square miles).
Cost per linear mile of progress along the ninety-eighth meridian	51.00 (444 miles).

The total cost of the work of the season was $22 613.

The cost, as given above, includes all salaries and wages chargeable to this field work, either in preparation or execution, and at the end of the field season the preparation of field reports and the putting of reports and computations in the final form in which they were submitted to the Computing Division in the Office. It includes even an addition of one-eleventh to the salaries actually paid to members of the permanent force during this service, to take account of the fact that in general in such cases twelve months' salary is paid for each eleven months' work. It also includes all transportation of officers and men to and from the field, of outfit, and of material bought.

Figures for comparisons with these are difficult to secure, as little in regard to the cost of triangulation has been published. The writer does not believe, from the examinations he has made of the available evidence, both published and unpublished, that there has ever been a whole season of primary triangulation previous to 1902 on which the unit costs (excluding those which are expressed in terms of square miles) have not been more than 50 per cent in excess of those for 1902, and in a great many cases they have been more than double those of 1902. The cost per square mile for 1902 does not differ much from that for the portion of the thirty-ninth parallel triangulation in the mountains where the belt of triangulation was from two to ten times as wide as on the ninety-eighth meridian triangulation.*

The cost of the signals ready for occupation, including all salaries, wages, and transportation, as well as the cost of the material, and including also the cost of the materials for and placing in position of the station and reference marks, was about $3.20 per vertical foot, measured to the light table. The total cost of the signals in 1902 was about 42 per cent of the total cost of the triangulation during the season.

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 Anthony, Elreno, Bowie, Stephenville, and Lampases 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)$\left(\frac{\text{mean elevation of two ends of line in meters}}{6370000}\right)$. The maximum value of this

*The cost per square mile, as given on page 18 of the "Transcontinental Triangulation," does not include salaries and omits some of the other large items of expense here included.

correction does not exceed $\frac{1}{13000}$ of the length for 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 $\frac{1}{4000000}$ of the length for any portion of this triangulation.

The positions—that is, the latitudes, longitudes, and the azimuths—need a special explanation.

All of the positions and azimuths have been computed upon the Clarke spheroid of 1866, 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.

* Many such positions had been published in Appendix No. 8, Report for 1885, Appendix No. 8, for 1888, and Appendix No. 10 for 1894. Since the adoption of the United States Standard Datum many positions in Kansas and Nebraska reduced to that datum have been published in Appendix 6, Report for 1901, and Appendix 3 for 1902.

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. The first two of these objects are purely practical; the third is purely scientific. 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 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 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.

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

The positions here published on the United States Standard Datum therefore differ considerably from those given in "The Transcontinental Triangulation" (pp. 854–865), which depend upon a special geodetic datum which was adopted for the special purpose of that publication, and which was based upon the astronomic observations connected with that triangulation alone.

The position given for the station Meades Ranch, in "The Transcontinental Triangulation" (p. 862), is—

	° ′ ″
φ	=39 13 25.006
λ	=98 32 30.469
α to Waldo	=75 28 16.52

The corrections to reduce this position to the United States Standard Datum are—

	″
$\Delta\varphi$	=+1.680
$\Delta\lambda$	=+0.037
$\Delta\alpha$	=−2.00

Such corrections to reduce a position from one datum to another are not constant, but vary slightly from station to station.

INDEX TO POSITIONS, DESCRIPTIONS, AND ELEVATIONS.

*List includes a few stations in Kansas.

Index to positions, descriptions, and elevations—Continued.

Station.	Position.	Description.	Elevation.
STATIONS IN OKLAHOMA—continued.	*Page.*	*Page.*	*Page.*
Kansas and Oklahoma Boundary Stone 160	885	911	922
Kansas and Oklahoma Boundary Stone 163	885	911	922
Kechi	882	900	923
Kerfoot Hotel, Elreno	888	.....	923
Kingfisher College	887	.....	923
Kingfisher Court-House	887	.....	923
Kingfisher Standpipe	887	.....	923
Kremlin Elevator	886	.....	922
Kremlin Schoolhouse	886	.....	922
Livingoods House.....Kansas	885	.....	922
Manchester Schoolhouse	885	.....	922
McCoy	882	896	922
Medford Mill	886	.....	.....
Medford Schoolhouse	886	.....	922
Midland Schoolhouse	888	.....	923
Miller Eccentric.....Kansas	885	.....	922
Miller.....Kansas	881	895	922
Mitchell	882	896	923
North Enid Congregational Church	887	.....	922
Numa Elevator	886	.....	922
Okarche Catholic Church	887	.....	923
Okarche Elevator	888	.....	923
Oklahoma City Church	888	.....	923
Parnell	882	897	923
Pond Creek Roller Mill	886	.....	922
Pond Creek Schoolhouse	886	.....	922
Pond Creek Standpipe	886	.....	922
Quarter Section Corner, sections 9 and 16	890	913	.....
Quarter Section Corner, sections 23 and 24	887	911	.....
Quarter Section Corner, sections 25 and 36	885	911	922
Red Barn.....Kansas	885	.....	922
Reference Mark, Caddo	888	911	.....
Reference Mark, Sand Hill	885	911	.....
Renfrow	881	895	922
Renfrow Christian Church	885	.....	922
Renfrow High Elevator	886	.....	922
Renfrow Low Elevator	885	.....	922
Rutherford.....Kansas	881	895	922
Sand Hill	881	895	922
Sand Hill Auxiliary	885	.....	.....
Sand Hill Reference Mark	885	911	922
Second Auxiliary.....Kansas	885	.....	.....
Section 3, southwest corner	886	911	.....
Section 9, southeast corner	888	911	.....
Section 13, northwest corner.....Oklahoma and Kansas	885	911	922
Section 14, southeast corner	886	911	.....
Section 17, southeast corner	888	911	.....
Section 29, southwest corner	887	911	923
Section Center, section 25	886	.....	.....
Section Corner, quarter common to sections 25 and 36	885	911	922
Section Corner, quarter near Waukomis	887	911	.....
Smith	882	898	923
Township Corner, Ts. 25 and 26	886	.....	.....
Union Catholic Church	888	.....	923
Union Methodist Church	888	.....	.....
Union Red Elevator	889	.....	923
Vicar	881	895	922

Index to positions, descriptions, and elevations—Continued.

Index to positions, descriptions, and elevations—Continued.

Index to positions, descriptions, and elevations—Continued.

TABLE OF POSITIONS, AZIMUTHS, AND LENGTHS.

The following tables give the positions of all points, and the azimuths and lengths of all lines, fixed by the ninety-eighth meridian triangulation from the Kansas-Oklahoma boundary to the Lampasas Base in Texas.

These tables may be conveniently consulted by using as finders the five sketches at the end of this appendix and the preceding index. In the third column of the index will be found for each point a reference to the page on which its description is given, and in the fourth column the page on which its elevation above sea level may be found.

The azimuth and length of every line over which observations have been made in one or both directions are given in the list in connection with the position of one end only of the line.

The positions of all points for which the latitudes and longitudes are given to thousandths of seconds have been fixed by a complete adjustment of the triangulation concerned, so as to make all the triangles close and remove all discrepancies between lengths, azimuths, and positions. Such adjustments are of a very high degree of accuracy, as indicated in the preceding pages, for points on the primary scheme, of a less degree of accuracy for secondary points, and of a still more approximate character for tertiary points determined by intersections only. In each class all discrepancies are

*See U. S. Geological Survey Bulletin No. 122, p. 251.

removed to the limit given by the decimal place shown. The above statements in regard to the various degrees of accuracy refer to the manner in which the discrepancies were removed.

If less than three decimal places are given in the latitudes and longitudes the point in question has not been fixed by fully adjusted triangulation, or is fixed in such a way as to furnish no check on its position, and the accuracy with which its position is known is indicated in part by the number of decimal places given.

The seconds of latitude and longitude are also given in meters for the convenience of draftsmen.

In the column giving azimuths, distances, and logarithms of distances various numbers of decimal places are given, the intention being to indicate the accuracy to a certain extent, it being understood that in each quantity two doubtful figures are given. In some cases there is very little doubt of the correctness of the second figure from the right, and in a few cases some doubt may be cast upon the third figure.

The following tables give the positions of 72 primary stations and 159 subordinate stations, or 231 in all, which have not before been published. The positions of a few stations near the Kansas-Oklahoma boundary which were published in Appendix 3 of the Report for 1902, "Triangulation in Kansas," are here repeated for the sake of completeness.

For the convenience of those who may wish to compare the lengths here given with others which are expressed in feet, or vice versa, 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

Station.	Latitude and longitude.	Seconds in meters.	Azimuth.	Back azimuth.	To station.	Distance.	Logarithms.
	° ′ ″	*m*	° ′ ″	° ′ ″		*meters*	
Rutherford	37 08 57.928	1785.9					
1901	98 06 31.618	780.2					
Miller	37 02 20.963	646.3	127 28 17.95	307 21 47.30	Rutherford	20139.64	4.3040518
1902	97 55 43.908	1085.1					
Fowler	37 07 35.852	1105.3	46 29 33.16	226 25 23.81	Miller	14090.87	4.1489378
1902	97 48 50.372	1243.4	95 36 23.39	275 25 42.68	Rutherford	26314.85	4.4202009
Renfrow	36 54 20.782	640.6	126 46 35.84	306 38 33.15	Miller	24762.76	4.3937991
1902	97 42 21.332	528.2	158 36 27.20	338 32 32.98	Fowler	26328.60	4.4204278
Sand Hill	36 52 26.036	802.5	181 44 23.54	1 44 46.20	Rutherford	30590.70	4.4855895
1902	98 07 09.255	229.2	222 41 51.32	42 48 43.36	Miller	24976.44	4.3975305
			264 23 31.50	84 38 24.67	Renfrow	37012.85	4.5683526
Vicar	36 40 28.107	866.4	138 01 58.10	317 53 56.49	Sand Hill	29795.14	4.4741454
1902	97 53 44.786	1112.1	213 22 32.57	33 29 21.88	Renfrow	30756.55	4.4879376

Station.	Latitude and longitude.	Seconds in meters.	Azimuth.	Back azimuth.	To station.	Distance.	Logarithms.
	° ′ ″	*m*	° ′ ″	° ′ ″		*meters*	
Hahn	36 34 49.254	1518.2	113 10 43.69	293 00 55.60	Vicar	26625.47	4.4252972
1902	97 37 19.073	474.3	168 17 39.65	348 14 38.83	Renfrow	36882.73	4.5668230
McCoy	36 32 21.047	648.7	171 39 04.05	351 36 52.49	Sand Hill	37543.20	4.5745313
1902	98 03 29.151	725.1	224 00 02.80	44 05 51.27	Vicar	20888.29	4.3199028
			263 11 47.86	83 27 23.09	Hahn	39310.84	4.5945123
Enid	36 27 46.148	1422.5	111 41 38.04	291 33 07.11	McCoy	22994.50	4.3616240
1902	97 49 10.204	254.1	233 32 48.38	53 39 51.59	Hahn	21980.24	4.3420325
Garber	36 26 26.959	831.0	96 32 37.18	276 24 03.84	Enid	21653.68	4.3355317
1902	97 34 46.205	1150.8	166 12 33.04	346 11 02.09	Hahn	15943.12	4.2025734
Mitchell	36 14 20.366	627.8	129 13 01.30	309 00 55.25	Enid	39367.14	4.5951338
1902	97 28 45.253	1130.0	158 07 59.27	338 04 25.38	Garber	24136.99	4.3826832
Waukomis	36 17 02.851	87.9	154 52 13.50	334 46 56.59	McCoy	31271.91	4.4951545
1902	97 54 35.266	880.1	202 12 03.03	22 15 15.81	Enid	21420.18	4.3308231
			277 14 51.52	97 30 08.31	Mitchell	39015.83	4 5912408
Parnell	36 06 05.874	181.1	157 34 29.75	337 31 11.98	Waukomis	21910.34	4.3406492
1902	97 49 00.345	8.6	243 14 55.72	63 26 52.85	Mitchell	33977.80	4.5311952
Wingard	35 56 47.428	1461.7	120 18 54.91	300 07 20.80	Parnell	34197.95	4.5340000
1902	97 29 20.129	504.5	181 32 13.62	1 32 34.17	Mitchell	32465.02	4.5114157
Burson	35 55 33.417	1029.9	187 17 06.07	7 19 06.05	Waukomis	40067.50	4.6027922
1902	97 57 58.853	1475.6	214 37 52.29	34 43 08.92	Parnell	23702.97	4.3748028
			266 49 44.66	87 06 33.35	Wingard	43142.20	4.6349023
Eichoff	35 41 47.180	1454.1	158 27 04.91	338 23 10.16	Burson	27384.49	4.4375046
1902	97 51 17.645	443.6	229 53 55.14	50 06 46.23	Wingard	43169.87	4.6351807
Edmonds	35 39 32.111	989.6	96 51 01.12	276 37 23.82	Eichoff	35485.66	4.5500529
1902	97 27 56.292	1416.0	176 13 56.83	356 13 07.79	Wingard	31978.00	4.5048513
Caddo	35 36 33.333	1027.3	183 45 31.38	3 46 25.20	Burson	35213.38	4.5467077
1902	97 59 30.932	778.6	232 01 26.38	52 06 13.91	Eichoff	15733.32	4.1968204
			263 15 13.92	83 33 37.75	Edmonds	47988.83	4.6811402
Yukon	35 28 50.368	1552.2	123 45 44.05	303 37 30.18	Caddo	25719.61	4.4102644
1902	97 45 21.397	539.5	159 29 29.48	339 26 02.15	Eichoff	25565.42	4.4076530
			232 59 24.54	53 09 32.47	Edmonds	32920.42	4.5174653
Smith	35 22 51.003	1571.8	115 05 23.02	294 56 17.53	Yukon	26191.92	4.4181673
1902	97 29 40.448	1020.9	184 51 13.11	4 52 13.62	Edmonds	30964.21	4.4908601
Carson	35 16 24.848	765.7	175 26 02.34	355 24 53.81	Caddo	37362.49	4.5724358
1904	97 57 32.760	828.0	218 43 23.21	38 50 26.64	Yukon	29473.14	4.4694263
			254 07 50.45	74 23 57.46	Smith	43882.06	4.6422870
Elreno East Base	35 26 40.226	1239.7	165 35 49.06	345 34 00.67	Caddo	18872.19	4.2758453
1900	97 56 24.414	615.7	195 25 26.88	15 28 25.32	Eichoff	28999.12	4.4623848
			256 27 21.20	76 33 45.86	Yukon	17192.26	4.2353330
			5 12 15.80	185 11 36.25	Carson	19042.98	4.2797350
Elreno West Base	35 29 04.043	124.6	208 03 55.12	28 06 45.68	Caddo	15695.20	4.1957668
1900	98 04 24.320	613.1	290 04 41.47	110 09 19.91	Elreno East Base	12886.671	4.1101407
			336 01 32.66	156 05 30.95	Carson	25599.32	4.4082285
Lanier	35 04 02.998	92.4	129 59 00.06	309 48 37.63	Carson	35642.55	4.5519688
1902	97 39 32.174	815.2	203 14 36.29	23 20 17.59	Smith	37845.92	4.5780191
Purcell	35 00 37.551	1157.2	108 11 59.26	288 04 41.51	Lanier	20336.05	4.3082665
1902	97 26 49.721	1260.7	174 00 49.22	353 59 10.82	Smith	41319.32	4.6161532
Table Hill	34 40 17.963	553.5	161 11 13.36	341 05 35.71	Lanier	46404.20	4.6665573
1902	97 29 41.577	1058.5	186 36 48.61	6 38 26.80	Purcell	37834.61	4.5778892
Osaria or Marlow	34 41 40.428	1245.7	208 19 42.44	28 28 06.15	Lanier	47031.39	4.6723878
U. S. G. S.	97 54 12.978	330.2	273 45 53.53	93 59 50.81	Table Hill	37541.76	4.5745146
1902							
Kechi	34 56 02.392	73.7	202 59 33.80	23 05 37.65	Carson	40938.28	4.6121296
1902	98 08 05.471	138.8	251 01 23.53	71 18 46.26	Lanier	45901.03	4.6618224
			321 23 37.87	141 31 33.16	Osaria	33958.51	4.5309486
Arbuckle or Velma	34 26 01.913	58.9	145 20 32.73	325 13 06.76	Osaria	35183.59	4.5463401
U. S. G. S.	97 41 06.887	175.8	213 27 57.15	33 34 25.83	Table Hill	31639.96	4.5002360
1902							
Arbuckle Mountain	34 26 08.247	254.1	89 47 01.77	269 34 14.39	Arbuckle	34648.60	4.5396857
1902	97 18 29.818	761.3	166 51 48.46	326 45 27.45	Table Hill	31286.87	4.4953621

Station.	Latitude and longitude.	Seconds in meters.	Azimuth.	Back azimuth.	To station.	Distance.	Logarithms.
	° ′ ″	*m*	° ′ ″	° ′ ″		*meters*	
Lone Tree	34 14 08.226	253.5	150 21 19.38	330 16 42.80	Arbuckle	25311.99	4.4033264
1902	97 32 56.528	1446.6	224 53 30.74	45 01 39.60	Arbuckle Mt.	31353.27	4.4962828
Monument	34 14 23.204	715.0	224 24 13.41	44 31 59.75	Arbuckle	30168.06	4.4795474
1902	97 54 53.654	1373.1	270 40 53.26	90 53 14.31	Lone Tree	33710.13	4.5277605
Duncan	34 28 30.488	939.4	208 13 15.86	28 18 07.30	Osaria	27635.39	4.4414656
1902	98 02 46.412	1184.3	277 45 20.91	97 57 36.12	Arbuckle	33485.49	4.5248567
			335 07 48.17	155 12 14.97	Monument	28766.97	4.4588942
Benton	34 05 35.068	1080.6	171 08 39.01	351 07 43.37	Monument	16469.44	4.2166789
1902	97 53 14.577	373.7	243 01 45.63	63 13 09.65	Lone Tree	34977.29	4.5437737
Grady	34 02 51.813	1596.4	106 07 43.87	286 01 22.53	Benton	18165.03	4.2592361
1902	97 41 53.865	1381.5	213 24 17.55	33 29 19.13	Lone Tree	24977.71	4.3975527
Blue	33 48 00.402	12.4	155 20 11.15	335 14 46.00	Benton	35769.79	4.5535164
1902	97 43 32.315	831.2	185 15 10.57	5 16 05.51	Grady	27580.97	4.4406096
Cube	33 55 37.314	1149.6	208 35 35.42	28 42 29.71	Monument	39530.21	4.5969291
1902	98 07 12.930	332.1	229 22 00.48	49 29 49.40	Benton	28319.07	4.4520790
			290 58 21.89	111 11 33.48	Blue	39135.04	4.5925657
Myers	33 37 36.423	1122.2	199 27 15.03	19 31 29.70	Cube	35326.04	4.5480950
1902	98 14 50.995	1314.4	248 10 54.37	68 28 17.12	Blue	52053.84	4.7164528
Queen	33 37 30.133	928.4	90 25 11.66	270 12 33.37	Myers	35295.12	4.5477147
1902	97 52 01.658	42.7	145 04 41.19	324 56 14.58	Cube	40886.83	4.6115834
			213 59 45.54	34 04 28.24	Blue	23432.34	4.3698156
Jones	33 31 21.306	656.4	126 53 40.33	306 48 09.65	Myers	19270.97	4.2849037
1902	98 04 53.052	1369.1	240 12 26.53	60 19 33.12	Queen	22911.02	4.3600444
Bowie Northwest Base	33 37 21.756	670.3	32 55 18.73	212 52 44.69	Jones	13226.31	4.1214388
1900	98 00 14.492	373.6	91 12 47.47	271 04 42.11	Myers	22596.65	4.3540440
			268 47 53.98	88 52 26.88	Queen	12705.70	4.1039988
Bowie Southeast Base	33 33 49.987	1540.0	69 22 46.49	249 18 26.26	Jones	12984.96	4.1134406
1900	97 57 02.107	54.3	142 46 06.24	322 44 19.80	Bowie NW. Base	8196.028	3.9136034
			228 46 28.62	48 49 14.86	Queen	10296.37	4.0126843
Spradling	33 23 53.748	1655.9	160 16 11.91	340 14 26.24	Jones	14649.74	4.1658298
1902	98 01 41.405	1070.0	185 08 32.56	5 09 20.55	Bowie NW. Base	24994.31	4.3978412
			210 42 14.54	30 47 34.62	Queen	29265.66	4.4663583
Indian	33 19 29.978	923.5	187 06 26.54	7 07 55.86	Myers	33731.54	4.5280362
1902	98 17 32.919	851.4	221 47 45.66	41 54 44.22	Jones	29421.61	4.4686664
			251 38 50.18	71 47 33.44	Spradling	25907.28	4.4134218
Bowie Standpipe, U.S. G.S.	33 33 57.636	1775.7	41 27 24.97	221 21 34.37	Spradling	24805.73	4.3945519
	97 51 05.911	152.5	77 20 42.56	257 13 05.48	Jones	21876.36	4.3399751
1902			88 33 29.76	268 30 12.82	Bowie SE. Base	9190.42	3.9633351
			114 09 43.03	293 55 39.49	Bowie NW. Base	15479.79	4.1897652
			167 37 16.52	347 36 45.67	Queen	6702.74	3.8262522
Jim Ned, U.S.G.S.	33 36 45.999	1417.2	75 49 08.9	255 41 50.4	Bowie Standpipe	21084.5	*4.3239625
1902	97 37 53.365	1375.7	93 37 24.5	273 29 34.8	Queen	21908.7	4.3406170
			157 14 24.3	337 11 16.2	Blue	22536.8	4.3528919
Moore	33 11 07.733	238.2	132 37 03.09	312 31 06.22	Indian	22872.93	4.3593217
1902	98 06 42.139	1091.6	198 13 32.96	18 16 18.04	Spradling	24848.61	4.3953020
Davis	33 03 49.932	1538.3	143 29 22.40	323 25 51.72	Moore	16786.56	4.2249617
1902	98 00 16.601	430.6	176 37 05.13	356 36 18.66	Spradling	37150.89	4.5699692
Woolly	33 03 48.491	1493.9	183 27 18.75	3 27 55.82	Indian	29057.17	4.4632534
1902	98 18 40.628	1053.9	233 56 49.78	54 03 22.41	Moore	23022.03	4.3621436
			269 49 39.06	89 59 41.38	Davis	28639.74	4.4569691
Gilbert	32 48 11.037	340.0	126 37 27.35	306 23 50.96	Woolly	48537.47	4.6860771
1902	97 53 38.984	1014.2	160 22 33.63	340 18 57.46	Davis	30712.42	4.4873140
Kyle	32 49 18.014	554.9	181 44 59.72	1 45 16.89	Woolly	26828.07	4.4285895
1902	98 19 12.209	317.6	227 35 43.67	47 46 01.21	Davis	39895.53	4.6009243
			272 50 44.59	93 04 35.43	Gilbert	39939.53	4.6014030
Oaks	32 41 33.621	1035.6	126 57 30.96	306 50 54.97	Kyle	23823.73	4.3770098
1902	98 07 00.358	9.3	239 32 06.37	59 39 19.87	Gilbert	24189.15	4.3836206
Comanche	32 22 38.642	1190.3	139 56 56.13	319 46 48.61	Oaks	45729.53	4.6601967
1902	97 48 10.756	281.2	169 44 46.33	349 41 49.54	Gilbert	47973.46	4.6810010

*Computed. Line observed by Geol. Survey, but not by Coast and Geodetic Survey.

Station.	Latitude and longitude.	Seconds in meters.	Azimuth.	Back azimuth.	To station.	Distance.	Logarithms.
	° ′ ″	*m*	° ′ ″	° ′ ″		*meters*	
McClenny	32 27 09.026	278.0	163 48 20.05	343 44 13.50	Kyle	42637.12	4.6297878
1902	98 11 35.060	915.8	195 02 16.75	15 04 44.64	Oaks	27579.80	4.4405912
			282 41 00.18	102 53 32.95	Comanche	37627.41	4.5755043
Pilot	32 15 38.086	1173.1	166 32 41.79	346 30 57.45	McClenny	21884.73	4.3401413
1902	98 08 20.098	526.1	247 38 26.18	67 49 12.73	Comanche	34182.87	4.5338086
Lone Mountain	32 09 51.011	1571.2	130 12 05.58	310 07 47.76	Pilot	16574.52	4.2194409
1902	98 00 16.443	430.9	151 00 34.24	330 54 31.54	McClenny	36571.29	4.5631402
			218 43 07.09	38 49 34.55	Comanche	30327.77	4.4818405
Young	32 11 27.552	848.7	243 50 35.16	63 55 55.79	Pilot	17533.22	4.2438616
1902	98 16 21.365	559.7	275 53 32.59	96 03 10.36	Lone Mountain	28577.84	4.4560293
Gatlin	32 19 50.528	1556.4	203 14 28.33	23 16 27.32	McClenny	14701.69	4.1673672
1902	98 15 17.171	449.2	305 26 29.18	125 30 12.02	Pilot	13399.32	4.1270828
			17 17 56.35	197 16 18.03	Young	16225.52	4.2101936
Stephenville North Base	32 11 41.730	1285.4	88 39 16.66	268 33 12.16	Young	17925.90	4.2534809
	98 06 57.205	1498.6	163 24 19.23	343 [illegible] 35.02	Pilot	7596.89	3.8806357
1900			287 57 56.33	108 01 29.75	Lone Mountain	11038.91	4.0429260
Alarm	32 11 02.124	65.4	96 10 14.92	276 07 47.12	Young	7310.38	3.8639401
1902	98 13 43.897	1150.1	171 28 33.18	351 27 43.39	Gatlin	16458.03	4.2163779
			224 54 13.20	44 57 05.85	Pilot	12005.90	4.0793946
			263 26 13.99	83 29 50.64	Stephenville N.B.	10722.74	4.0303058
			275 51 06.67	95 58 16.63	Lone Mountain	21267.54	4.3277173
Stephenville South Base	32 08 18.665	574.9	108 05 24.84	287 59 21.89	Young	18787.45	4.2738679
	98 06 59.579	1561.6	115 26 56.91	295 23 21.68	Alarm	11729.73	4.0692881
1900			180 34 10.72	0 34 11.98	Stephenville N. B.	6255.09	3.7962336
			254 54 02.78	74 57 37.31	Lone Mountain	10940.58	4.0390405
Gibson	31 56 36.636	1128.4	160 28 58.61	340 25 41.43	Young	29119.05	4.4641773
1902	98 12 09.973	262.0	189 42 38.72	9 44 40.89	Pilot	35671.12	4.5523168
			196 22 27.65	16 25 13.72	Stephenville N. B.	29059.97	4.4632951
			200 36 52.70	20 39 37.38	Stephenville S. B.	23105.96	4.3637240
			217 21 50.90	37 28 09.59	Lone Mountain	30806.46	4.4886418
Gleason	31 52 21.238	654.1	107 55 11.61	287 47 00.26	Gibson	25660.60	4.4092668
1902	97 56 40.370	1061.2	136 03 39.59	315 52 09.55	Young	49112.09	4.6911884
			151 11 07.22	331 05 39.04	Stephenville S. B.	33671.60	4.5272637
			170 04 08.27	350 02 13.71	Lone Mountain	32827.48	4.5162376
Chamliss	31 39 23.364	719.6	166 57 33.37	346 55 05.47	Gibson	32669.87	4.5141474
1902	98 07 29.303	772.0	215 25 59.11	35 31 40.73	Gleason	29421.48	4.4686645
Scoggins	31 40 56.399	1737.0	83 01 07.41	262 53 25.33	Chamliss	23361.10	4.3684933
1902	97 52 49.174	1295.1	133 34 16.98	313 24 05.07	Gibson	42080.68	4.6240828
			163 55 45.48	343 53 43.73	Gleason	21952.59	4.3414857
Brown	31 26 18.791	578.7	178 51 16.33	358 51 06.73	Chamliss	24168.64	4.3832522
1902	98 07 10.964	289.5	219 59 48.99	40 07 20.05	Scoggins	35314.89	4.5479579
King	31 23 35.221	1084.8	103 15 12.11	283 08 08.08	Brown	22069.77	4.3437978
1902	97 53 37.479	990.2	143 08 02.02	323 00 47.09	Chamliss	36528.77	4.5626350
			182 16 19.61	2 16 44.88	Scoggins	32092.09	4.5063980
Franklin	31 14 48.747	1501.3	163 13 19.52	343 11 13.30	Brown	22198.66	4.3463267
1902	98 03 08.307	219.8	222 54 28.37	42 59 25.10	King	22151.67	4.3454065
Gilmore	31 06 56.398	1737.0	142 07 14.30	322 03 32.79	Franklin	18437.68	4.2657062
1902	97 56 00.478	12.7	187 00 06.75	7 01 20.94	King	30992.83	4.4912613
Flat Top	31 08 39.455	1215.2	200 42 45.65	20 46 48.33	Brown	34886.97	4.5420632
1902	98 14 58.214	1542.1	238 46 12.66	58 52 20.36	Franklin	21968.09	4.3417923
			275 55 44.20	96 05 32.39	Gilmore	30309.18	4.4815741
Bachelor	30 59 39.956	1230.4	138 55 44.49	318 51 02.24	Flat Top	22051.43	4.3434367
1902	98 05 51.294	1360.9	188 45 35.59	8 46 59.83	Franklin	28318.89	4.4520763
			229 19 39.61	49 24 44.39	Gilmore	20640.94	4.3147295
Lampasas Northeast Base	31 03 41.385	1274.6	130 23 47.82	310 20 17.33	Flat Top	14172.75	4.1514540
	98 08 10.745	284.9	252 42 34.16	72 48 51.24	Gilmore	20266.02	4.3067684
1900			333 32 32.90	153 33 44.78	Bachelor	8304.18	3.9192969
Lampasas Southwest Base	31 01 02.884	88.8	152 19 30.38	332 17 06.63	Flat Top	15880.02	4.2008511
	98 10 19.781	524.7	204 10 12.35	24 13 55.42	Franklin	27884.54	4.4453635
1900			215 01 19.18	35 02 25.71	Lampasas NE. B.	5961.171	3.7753315
			244 23 43.87	64 31 07.29	Gilmore	25248.79	4.4022405
			289 42 24.78	109 44 43.08	Bachelor	7566.42	3.8788904

Station.	Latitude and longitude.	Seconds in meters.	Azimuth.	Back azimuth.	To station.	Distance.	Logarithms.
	° ′ ″	*m*	° ′ ″	° ′ ″		*meters*	
May	30 51 55.386	1705.5	176 40 37.99	356 40 03.08	Flat Top	30973.56	4.490991 1
1902	98 13 50.442	1340.0	198 20 02.44	18 21 50.76	Lampasas SW. B.	17763.78	4.2495353
			221 36 27.68	41 40 33.96	Bachelor	19144.26	4.2820387
Gabriel	30 45 41.644	1282.4	110 01 45.28	289 51 34.05	May	33741.12	4.5281595
1902	97 53 57.202	1521.3	143 44 38.56	323 38 32.08	Bachelor	32035.58	4.5056325
			175 14 36.70	355 13 33.31	Gilmore	39393.10	4.5954202
Miller Eccentric	37 02 19.452	599.6	306 31 37.4	126 39 40.6	Renfrow	24751.7	4.393605
1902	97 55 44 752	1105.9	42 50 58.4	222 44 06.9	Sand Hill	24928.1	4.396689
			170 20 43.3	350 19 09.6	Quarry	22792.7	4.357796
			204 06 08.4	24 06 08.9	Miller	51.052	1.708013
Section 13, NW. cor., T. 29, R. 7 W	36 59 54.905	1692.4	53 07 32.0	233 00 05.1	Sand Hill	23025.8	4.362214
	97 54 45.539	1126.0	161 49 11.7	341 48 36.0	Miller Eccentric	4690.1	3.671186
1902			299 09 34.1	119 17 01.4	Renfrow	21097.8	4.324237
Boundary Stone 160	36 59 54.982	1694.9	89 52 36.9	269 52 10.7	Section Corner 13	1077.2	3.032299
1902	97 54 01.975	48.8	150 18 16.3	330 17 14.4	Miller Eccentric	5127.2	3.709884
			150 45 43.4	330 44 41.8	Miller	5157.6	3.712448
			300 39 51.4	120 46 52.5	Renfrow	20165.1	4.304601
Red Barn, near Section 13, south gable	37 01 00.800	24.7	1 36 22.9	181 36 21.5	Boundary Stone 160	2029.7	3.307434
	97 53 59.674	1475.3	29 10 33.5	209 10 05.9	Section Corner 13	2326.4	3.366683
1902			133 02 24.1	313 01 20.8	Miller Eccentric	3553.1	3.550604
Livingood's house, chimney	37 00 10.546	325.1	200 16 56.1	20 17 31.9	Miller Eccentric	4236.5	3.627011
	97 56 44.176	1092.2	279 19 27.7	99 20 39.1	Section Corner 13	2972.7	3.473158
1902							
First Auxiliary	36 59 54.827	1690.0	182 07 10.7	2 07 11.1	Livingood's house	484.9	2.685635
1902	97 55 44.901	1110.2	198 26 21.0	18 26 57.2	Miller Eccentric	4699.7	3.672069
			269 56 37.3	89 57 49.1	Section Corner 13	2951.4	3.470028
Second Auxiliary	37 00 02.287	70.5	252 09 14.9	72 09 34.1	Livingood's house,	830.9	2.919534
1902	97 57 16.163	399.7	286 33 53.0	106 34 11.8	First Auxiliary	806.5	2.906590
Boundary Stone 163	36 59 54.728	1687.1	181 45 40.9	1 45 41.1	Second Auxiliary	233.1	2.367604
1902	97 57 16.453	406.8	238 34 23.2	58 34 42.6	Livingood's house	935.3	2.970930
			269 46 20.7	89 46 39.7	First Auxiliary	780.2	2.892193
Camchester Schoolhouse, belfry *	37 00 04.00	123.3	245 54 13	65 58 04	Miller	10354.3	4.015121
	98 02 06.38	157.8	27 59 24	207 56 22	Sand Hill	15983.6	4.203675
1902							
Manchester Schoolhouse, belfry *	36 59 37.14	1144.8	241 01 14	61 04 56	Miller	10433.5	4.018430
	98 01 53.23	1316.3	30 30 13	210 27 03	Sand Hill	15419.8	4.188080
1902							
Sand Hill Auxiliary	36 52 08.978	276.8	208 25 47.3	28 25 54.2	Sand Hill	597.9	2.776657
1902	98 07 20.749	513.9					
Quarter Section Cor., secs. 25 and 36, stone	36 52 09.134	281.6	89 13 34.4	269 13 25.8	Sand Hill Auxiliary	354.962	2.550182
	98 07 06.419	159.0	172 19 20.0	352 19 18.3	Sand Hill	525.7	2.720768
1902							
Sand Hill Reference Mark	36 52 08.785	270.8	90 58 04.9	270 57 56.4	Sand Hill Auxiliary	352.0	2.546570
	98 07 06.538	161.5	172 47 20.4	352 47 18.8	Sand Hill	536.0	2.729166
1902			195 23 43.5	15 23 43.5	Quarter Section, cor. 25 and 36	11.14	1.046942
Wakita Low Elevator, east gable *	36 53 06.65	205.0	85 59 13	265 52 07	Sand Hill	17628.7	4.246221
	97 55 19.22	475.9	177 57 16	357 57 01	Miller	17098.4	4.232955
1902							
Wakita High Elevator, east gable *	36 53 06.11	188.3	86 03 52	265 56 43	Sand Hill	17729.9	4.248705
	97 55 15.08	373.4	177 36 52	357 36 34	Miller	17119.0	4.233478
1902							
Wakita Church, white spire *	36 52 59.30	1828.0	86 41 18	266 34 16	Sand Hill	17438.5	4.241510
	97 55 26.33	652.0	178 33 44	358 33 33	Miller	17319.6	4.238538
1902							
Renfrow Christian Church, center, spire *	36 55 35.09	1081.6	63 30 39	243 28 47	Renfrow	5132.8	3.710354
	97 39 15.77	390.4	117 11 36	297 01 42	Miller	27454.9	4.438620
1902							
Renfrow Low Elevator, east gable *	36 55 26.19	807.3	82 31 13	262 14 26	Sand Hill	41882.5	4.622033
	97 39 12.57	311.1	117 37 29	297 27 32	Miller	27651.6	4.441720
1902							

* No check on this position.

Station.	Latitude and longitude.	Seconds in meters.	Azimuth.	Back azimuth.	To station.	Distance.	Logarithms.
	° ′ ″	*m*	° ′ ″	° ′ ″		*meters*	
Renfrow High Elevator, east gable* 1902	36 55 23.90 97 39 14.07	736.7 348.3	82 36 33 117 47 22	262 19 47 297 37 26	Sand Hill Miller	41836.7 27651.6	4.621557 4.441720
Section 14, SE. cor. T. 28 N., R. 5 W* 1902	36 53 51.82 97 41 45.55	1597.4 1127.8	135 13 51	315 13 30	Renfrow	1257.7	3.099577
Medford Schoolhouse, cupola* 1902	36 48 34.50 97 44 07.01	1063.5 173.8	145 57 30 193 46 16	325 50 32 13 47 19	Miller Renfrow	30766.2 10990.5	4.488074 4.041019
Medford Mill, center of tower* 1902	36 48 11.21 97 44 04.80	345.5 119.0	192 40 20 337 47 51	12 41 22 157 51 53	Renfrow Hahn	11677.0 26693.5	4.067332 4.426406
Numa Elevator, center shaft* 1902	36 48 12.35 97 36 17.91	380.7 444.0	3 30 54 141 37 32	183 30 18 321 33 54	Hahn Renfrow	24801.8 14492.8	4.394483 4.161152
Antioch Church, center spire* 1902	36 46 01.10 97 33 06.63	33.9 164.4	16 51 40 138 18 07	196 49 09 318 12 35	Hahn Renfrow	21637.3 20643.9	4.335204 4.314791
Pond Creek Schoolhouse, dome* 1902	36 40 15.641 97 47 55.366	482.1 1374.9	57 51 07.3 128 17 27.3 302 25 04.9	237 41 50.5 308 05 56.5 122 31 24.5	McCoy Sand Hill Hahn	27433.6 36411.1 18739.4	4.438283 4.561234 4.272756
Pond Creek Roller Mill, east cupola* 1902	36 40 11.38 97 48 08.71	350.8 216.3	301 32 37 57 42 43	121 39 04 237 33 34	Hahn McCoy	18951.0 27083.2	4.277632 4.432700
Pond Creek Standpipe 1902	36 40 08.637 97 47 53.353	266.3 1324.9	58 17 26.7 93 57 47.7 128 30 29.2 197 22 25.0 301 56 21.3	238 08 08.7 273 54 17.8 308 18 57.2 17 25 43.8 122 02 39.9	McCoy Vicar Sand Hill Renfrow Hahn	27361.9 8747.4 36584.4 27527.4 18582.1	4.437146 3.941879 4.563296 4.439766 4.269094
Township Corner, Ts. 25-26, Rs. 6-7, cedar post* 1902	36 40 49.68 97 53 35.92	1531.5 891.9	18 19 13 136 51 03	198 19 08 316 42 56	Vicar Sand Hill	700.4 29454.3	2.845377 4.469147
Friends' College Church, spire 1902	36 39 30.718 97 55 44.165	946.8 1096.7	144 38 45.0 239 09 57.6 287 26 32.1	324 31 54.9 59 11 08.7 107 37 31.2	Sand Hill Vicar Hahn	29323.6 3452.3 28798.1	4.467218 3.538107 4.459364
Kremlin Elevator, east gable 1902	36 32 47.614 97 50 03.085	1467.6 76.7	351 56 06.0 87 43 40.0 158 48 16.6	171 56 37.5 267 35 40.1 338 46 04.5	Enid McCoy Vicar	9385.0 20066.2 15226.2	3.972435 4.302465 4.182592
Kremlin Schoolhouse, belfry* 1902	36 32 45.28 97 49 52.88	1395.7 1315.4	353 25 32 158 01 19	173 25 57 337 59 01	Enid Vicar	9281.5 15386.4	3.967618 4.187137
Hunter Elevator, center* 1902	36 33 46.10 97 39 48.78	1421.0 1213.1	242 22 41 51 35 22	62 24 10 231 29 48	Hahn Enid	4200.6 17839.8	3.623311 4.251389
Section 3, SW. cor. T. 24 N., R. 4 W., stone* 1902	36 34 41.44 97 37 19.37	1277.4 481.6	181 45 21	1 45 21	Hahn	240.92	2.381873
Garber Elevator, center shaft 1902	36 26 25.386 97 34 49.663	782.5 1237.0	166 33 00.5 240 36 53.4 337 50 25.5	346 31 31.6 60 36 55.4 157 54 01.4	Hahn Garber Mitchell	15970.0 98.8 24124.4	4.203304 1.994908 4.382456
Garber Church, white spire 1902	36 26 12.731 97 35 01.748	392.4 435.4	336 48 58.6 97 49 49.1 167 53 50.7	156 52 41.7 277 41 25.0 347 52 29.0	Mitchell Enid Hahn	23880.6 21324.4 16283.8	4.378045 4.328877 4.211756
Center Section 25, T. 23, R. 4 W., post* 1902	36 26 26.66 97 34 38.13	821.8 946.8	92 37 11	272 37 06	Garber	201.33	2.303908
Cropper East Elevator, north gable 1902	36 26 26.927 97 41 22.170	829.9 552.1	101 52 17.5 201 19 10.4 269 57 42.1	281 47 39.4 21 21 35.0 90 01 37.2	Enid Hahn Garber	11908.2 16623.3 9861.9	4.075847 4.220718 3.993960
Breckenridge M. E. Church, spire 1902	36 26 17.264 97 43 45.073	532.2 1122.6	108 43 17.8 211 17 39.9 268 40 47.7 43 32 32.7	288 40 04.7 31 21 29.6 88 46 07.8 223 26 07.2	Enid Hahn Garber Waukomis	8547.7 18474.8 13424.6 23554.1	3.931847 4.266579 4.127900 4.372066

*No check on this position.

Station.	Latitude and longitude.	Seconds in meters.	Azimuth.	Back azimuth.	To station.	Distance.	Logarithms.
	° ′ ″	*m*	° ′ ″	° ′ ″		*meters*	
Breckenridge Highest Elevator, east gable* 1902	36 26 15.61 97 44 06.45	481.2 160.6	42 40 15 110 16 36	222 34 02 290 13 36	Waukomis Enid	23152.8 8062.8	4.364604 3.906484
North Enid Congregational Church, spire* 1902	36 26 28.84 97 51 25.64	889.0 638.7	234 44 46 15 10 40	54 46 06 195 08 48	Enid Waukomis	4129.6 18074.6	3.615913 4.257069
Enid Schoolhouse, cupola* 1902	36 24 31.74 97 52 35.65	978.4 888.4	220 28 43 12 10 32	40 30 45 192 09 21	Enid Waukomis	7879.9 14153.9	3.896523 4.150876
Enid Catholic Church, spire* 1902	36 23 48.81 97 53 06.73	1504.5 167.7	218 49 40 10 00 51	38 52 00 189 59 58	Enid Waukomis	9393.0 12706.2	3.972806 4.104015
Enid Ice Plant, stack 1902	36 23 19.827 97 52 37.760	611.1 941.1	212 11 15.1 12 56 21.4 14 09 53.4	32 13 18.3 192 55 17.0 194 08 43.8	Enid Quarter Sect. Cor. Waukomis	9701.5 12145.4 11983.3	3.986841 4.084412 4.078578
Enid Big Four Elevator, east gable* 1902	36 23 14.08 97 52 42.91	434.0 1069.5	212 16 10 13 46 10	32 18 16 193 45 04	Enid Waukomis	9919.6 11780.6	3.996496 4.071168
Waukomis Schoolhouse, belfry 1902	36 16 39.944 97 53 53.777	1231.2 1342.2	339 24 44.4 124 17 46.5 276 23 35.4	159 27 37.7 304 17 22.2 96 38 27.6	Parnell Waukomis Mitchell	20873.3 1253.3 37903.9	4.319592 3.098048 4.578684
Quarter Section Corner, secs. 23 and 24 1902	36 16 55.783 97 54 26.732	1719.4 667.1	135 39 09.7 300 41 34.3	315 39 04.6 120 41 53.8	Waukomis Waukomis Schoolhouse	304.7 956.5	2.483850 2.980664
Bison Highest Elevator, center shaft 1902	36 11 43.796 97 53 18.413	1349.9 460.0	13 13 45.7 168 57 52.1 328 12 15.0	193 11 00.6 348 57 06.8 148 14 47.3	Burson Waukomis Parnell	30721.0 10019.5 12251.6	4.487436 4.000847 4.088193
Bison Low Elevator, center* 1902	36 11 49.15 97 53 17.76	1515.0 443.8	168 41 16 328 40 16	348 40 30 148 42 48	Waukomis Parnell	9860.8 12383.7	3.993910 4.092850
Hennessey Roller Mill, stack* 1902	36 06 49.59 97 54 04.91	1528.6 122.8	177 42 18 280 00 20	357 42 00 100 03 20	Waukomis Parnell	18917.3 7736.0	4.276858 3.888518
Hennessey Windmill, at railroad 1902	36 06 29.507 97 54 02.771	909.5 69.3	16 18 55.2 177 37 16.8 275 28 32.4	196 16 36.3 357 36 57.6 95 31 30.6	Burson Waukomis Parnell	21068.0 19537.9 7599.5	4.323623 4.290878 3.880786
Hennessey Schoolhouse, dome 1902	36 06 14.458 97 53 53.816	445.6 1346.1	17 16 23.2 177 02 13.4 272 02 23.1	197 13 59.1 357 01 49.0 92 05 16.0	Burson Waukomis Parnell	20688.5 20011.7 7345.5	4.315730 4.301285 3.866022
Hennessey Elevator, center square top 1902	36 06 34.808 97 54 02.637	1072.9 66.0	16 12 00.7 177 35 28.7 276 42 06.7	196 09 41.7 357 35 09.4 96 45 04.8	Burson Waukomis Parnell	21225.7 19374.8 7613.5	4.326862 4.287237 3.881584
Section 29, SW. corner, T. 17 N., R. 7 W. 1902	35 54 46.587 97 58 42.900	1435.8 1075.7	217 24 57.7 335 00 25.6	37 25 23.5 155 04 46.1	Burson Eichoff	1817.3 26495.4	3.259436 4.423170
Kingfisher Court-House, dome 1902	35 51 37.735 97 55 55.073	1163.0 1381.7	339 01 44.5 11 01 48.6 156 52 12.5	159 04 26.7 190 59 42.6 336 51 00.0	Eichoff Caddo Burson	19489.1 28396.3 7899.5	4.289791 4.453262 3.897598
Kingfisher College, belfry 1902	35 52 03.580 97 54 32.017	110.3 803.2	345 34 23.9 128 37 30.2 141 17 06.3	165 36 17.5 308 35 03.2 321 15 05.0	Eichoff Sec. 29, SW. corner Burson	19614.6 8051.8 8290.5	4.292580 3.905895 3.918580
Kingfisher Standpipe 1902	35 51 43.600 97 56 00.741	1343.8 18.6	338 49 48.5 10 40 47.0 157 18 54.1	158 52 34.0 190 38 44.3 337 17 44.9	Eichoff Caddo Burson	19708.8 28547.1 7677.6	4.294661 4.455562 3.885226
Guthrie Standpipe* 1902	35 52 38.15 97 24 40.20	1175.7 1008.5	11 30 32 137 36 32	191 28 37 317 33 48	Edmonds Wingard	24721.3 10406.4	4.393072 4.017302
Guthrie, St. Joseph Church, east spire 1902	35 52 15.114 97 27 45.267	465.8 1135.7	0 40 32.2 61 29 52.2 164 11 03.1	180 40 25.8 241 16 06.4 344 10 07.5	Edmonds Eichoff Wingard	23517.4 40406.9 8723.4	4.371389 4.606455 3.940688
Okarche Catholic Church, spire 1902	35 43 44.610 97 58 34.485	1374.8 866.6	6 06 03.6 182 20 29.9 288 12 23.7	186 05 30.7 2 20 50.8 108 16 38.7	Caddo Burson Eichoff	13367.3 21863.7 11561.7	4.126045 4.339724 4.063022

* No check on this position.

Station.	Latitude and longitude.	Seconds in meters.	Azimuth.	Back azimuth.	To station.	Distance.	Logarithms.
	° ′ ″	*m*	° ′ ″	° ′ ″		*meters*	
Okarche Elevator, center, top 1902	35 43 29.987 97 58 23.885	924.1 600.3	7 29 12.3 181 36 44.0 286 26 21.9	187 28 33.2 1 36 58.7 106 30 30.7	Caddo Burson Eichoff	12951.3 22305.2 11173.1	4.112313 4.348405 4.048175
Section 17, SE. corner, T. 14 N., R. 6 W.* 1902	35 40 54.68 97 51 05.70	1685.2 143.4	57 40 44 169 29 17	237 35 49 349 29 10	Caddo Eichoff	15047.5 1645.7	4.177465 3.216357
Edmonds College, dome 1902	35 39 24.098 97 28 24.683	742.7 620.9	177 31 31.4 250 55 17.6 52 44 38.8	357 30 59.0 70 55 34.2 232 34 47.5	Wingard Edmonds Yukon	32185.7 755.6 32201.5	4.507663 2.878316 4.507876
Caddo Schoolhouse, water tank, center 1902	35 36 52.009 97 59 44.109	1602.9 1110.0	234 25 48.0 330 02 55.0 26 05 55.0	54 30 43.2 150 03 02.7 206 03 12.1	Eichoff Caddo Elreno West Base	15654.4 664.3 16056.5	4.194635 2.822342 4.205651
Caddo Reference Mark* 1902	35 36 41.48 97 59 37.13	1278.2 934.5	233 05 42 328 08 02	53 10 33 148 08 06	Eichoff Caddo	15704.6 295.4	4.196027 2.470504
Darlington Water Tank, center 1902	35 34 36.124 98 00 33.778	1113.4 850.5	29 35 40 5 203 38 46.3 336 47 12.9	209 33 26.5 23 39 22.8 156 49 37.7	Elreno West Base Caddo Elreno East Base	11767.6 3943.6 15956.0	4.070688 3.595888 4.202924
Fort Reno high Water Tank, center* 1902	35 33 50.83 98 02 09.71	1566.5 244.5	326 43 04 21 00 14	146 46 24 200 58 55	Elreno East Base Elreno West Base	15869.4 9466.9	4.200561 3.976206
Fort Reno low Water Tank* 1902	35 33 49.81 98 02 10.70	1535.1 269.5	218 34 53 20 55 53	38 36 26 200 54 35	Caddo Elreno West Base	6447.9 9428.6	3.809420 3.974447
Fort Reno Flag Pole* 1902	35 33 44.35 98 02 07.70	1366.8 193.9	326 28 19 21 44 10	146 31 38 201 42 51	Elreno East Base Elreno West Base	15674.9 9299.3	4.195204 3.968451
Elreno Standpipe 1902	35 32 15.106 97 57 19.784	465.6 498.3	352 17 37.4 61 12 20.9 157 28 27.4 289 09 26.0	172 18 09.6 241 08 14.3 337 27 11.1 109 16 23.2	Elreno East Base Elreno West Base Caddo Yukon	10414.4 12211.6 8616.2 19171.6	4.017636 4.086772 3.935317 4.282659
Elreno, Kerfoot Hotel, cupola 1902	35 32 02.919 97 57 13.295	90.0 334.9	352 56 00.1 63 06 33.2 157 24 47.5	172 56 28.5 243 03 22.9 337 24 27.5	Elreno East Base Elreno West Base Caddo	10020.9 12180.8 9025.8	4.000908 4.085675 3.955487
Elreno Catholic Church, spire 1902	35 31 55.477 97 57 21.493	1709.7 541.5	351 34 17.2 63 39 37.2 159 10 19.4 287 23 34.2	171 34 50.4 243 35 31.6 339 09 04.1 107 30 32.5	Elreno East Base Elreno West Base Caddo Yukon	9821.5 11893.4 9162.6 19022.8	3.992177 4.075306 3.962020 4.279274
Elreno Fire Department, belfry 1902	35 31 55.273 97 57 15.562	1703.5 392.1	352 25 54.8 64 00 14.1 158 19 08.4 287 30 41.3	172 26 24.5 243 56 05.1 338 17 49.6 107 37 36.1	Elreno East Base Elreno West Base Caddo Yukon	9794.5 12024.8 9222.6 18878.3	3.990982 4.080077 3.964852 4.275964
Elreno, Canadian Milling Company's Elevator, east gable 1902	35 31 30.393 97 57 15.624	936.6 393.6	351 46 52.8 67 22 31.4 159 57 39.3 285 15 52.1	171 47 22.6 247 18 22.4 339 56 20.6 105 22 47.0	Elreno East Base Elreno West Base Caddo Yukon	9035.2 11707.5 9938.6 18663.6	3.955937 4.068465 3.997326 4.270995
Midland Schoolhouse, belfry 1902	35 29 37.762 98 03 37.937	1163.9 956.1	296 33 22.2 339 18 17.9 48 22 20.0	116 37 33.8 159 21 49.4 228 21 53.2	Elreno East Base Carson Elreno West Base	12223.3 26116.4 1564.3	4.087187 4.416914 3.194307
Section 9, SE. corner, T. 11 N., R. 7 W. 1902	35 26 07.162 97 56 13.308	220.7 335.7	6 23 04.7 113 48 09.0 164 37 55.5	186 22 18.7 293 43 24.1 344 37 49.0	Carson Elreno West Base Elreno East Base	18057.4 13528.1 1056.8	4.256656 4.131237 3.023989
Oklahoma City Church, highest spire* 1902	35 28 33.99 97 30 06.45	1047.6 162.6	356 26 49 91 19 38	176 27 04 271 10 47	Smith Yukon	10590.6 23071.2	4.024922 4.363070
House with square roof, chimney* 1902	35 29 31.32 97 27 10.97	965.2 276.5	17 00 20 176 28 36	196 58 53 356 28 10	Smith Edmonds	12900.5 18550.7	4.110606 4.268361
Union Catholic Church, spire 1902	35 23 39.396 97 56 27.357	1214.1 690.4	7 02 11.9 129 47 16.0 180 45 47.4	187 01 34.1 309 42 39.5 0 45 49.1	Carson Elreno West Base Elreno East Base	13493.2 15646.8 5573.4	4.130116 4.194425 3.746118
Union Methodist Church, spire* 1902	35 23 37.33 97 56 27.21	1150.5 686.5	129 57 28 180 43 02	309 52 51 0 43 04	Elreno West Base Elreno East Base	15690.4 5636.9	4.195634 3.751040

* No check on this position.

Station.	Latitude and longitude.	Seconds in meters.	Azimuth.	Back azimuth.	To station.	Distance.	Logarithms.
	° ′ ″	*m*	° ′ ″	° ′ ″		*meters*	
Union Red Elevator, center top	35 23 38.397	1183.2	7 40 52.9	187 40 11.7	Carson	13481.8	4.129747
1902	97 56 21.461	541.6	129 31 44.0	309 27 04.0	Elreno West Base	15781.0	4.198134
			179 14 18.2	359 14 16.4	Elreno East Base	5604.2	3.748510
Boundary Mark, Indian Territory and Oklahoma	35 20 01.067	32.9	158 08 18.6	338 05 44.3	Elreno West Base	18032.8	4.256062
1902	97 59 57.947	1463.5	203 38 26.6	23 40 30.3	Elreno East Base	13429.9	4.128075
			331 09 23.1	151 10 47.0	Carson	7606.3	3.881172
Minco, Elmeta Bond College, belfry	35 18 58.306	1796.9	14 09 51.6	194 09 24.3	Carson	4877.5	3.688191
1902	97 56 45.536	1150.2	148 13 51.5	328 09 25.7	Elreno West Base	21966.1	4.341752
			182 08 35.3	2 08 47.5	Elreno East Base	14245.4	4.153675
Minco Red Elevator, center top	35 19 00.427	13.2	19 07 57.3	199 07 19.3	Carson	5074.7	3.705414
1902	97 56 26.950	680.7	147 06 46.5	327 02 09.8	Elreno West Base	22161.9	4.345608
			180 15 30.9	0 15 32.4	Elreno East Base	14170.2	4.151376
Carson Reference Mark*	35 16 33.47	1031.1	15 29 56	195 29 54	Carson	275.776	2.44056
1902	97 57 29.84	754.1	107 22 31	287 22 25	Old Boundary Post	278.3	2.44458
Quarter Section corner, sections 5 and 8, T. 9 N., R. 7 W.*	35 16 36.44	1123.0	288 19 06	108 19 13	Reference Mark	290.5	2.46322
1902	97 57 40.76	1030.1	330 29 07	150 29 12	Carson	410.3	2.61312
Old Boundary Post*	35 16 36.17	1714.7	331 10 43	151 10 47	Carson	398.2	2.60009
1902	97 57 40.36	1020.0					
Moore Elevator, west end of ridge*	35 18 52.42	1615.5	126 17 28	306 07 50	Yukon	31192.4	4.494049
1902	97 28 44.07	1113.1	169 02 49	349 02 16	Smith	7488.8	3.874415
Norman Standpipe*	35 13 27.22	838.9	2 51 29	182 51 02	Purcell	23748.2	4.375630
1902	97 26 03.02	75.4	162 28 19	342 26 13	Smith	18222.0	4.260596
Norman College, belfry*	35 12 33.21	1023.5	0 07 54	180 07 52	Purcell	22054.2	4.343491
1902	97 26 47.72	1207.0	167 06 11	347 04 32	Smith	19532.6	4.290761
Noble Elevator	35 08 16.557	510.2	17 54 10.0	197 52 26.5	Purcell	14863.5	4.172120
1902	97 23 49.519	1253.7	71 57 09.3	251 48 07.3	Lanier	25120.5	4.400028
			161 48 26.8	341 45 04.6	Smith	28370.6	4.452868
Quarter Section corner, sections 7 and 8, T. 6 N., R. 2 W.*	35 00 28.24	870.3	119 07 45	299 07 33	Purcell	589.27	2.770314
1902	97 26 29.42	746.0					
Marlow Secondary	34 42 46.582	1435.4	301 48 19.0	121 49 32.5	Osaria	3866.7	3.587338
1902	97 56 22.085	562.0	20 23 54.5	200 20 16.3	Duncan	28139.0	4.449308
Boundary Mile 45	34 39 59.681	1839.0	250 29 31.2	70 32 47.4	Osaria	9308.9	3.968900
1902	97 59 57.724	1469.7	298 47 16.2	118 48 41.3	Marlow Nat. Bank	4348.5	3.638341
			296 03 47.1	116 05 12.1	Marlow Bapt. Ch.	4235.7	3.626928
			301 39 50.6	121 41 15.4	Marlow Meth. Ch.	4462.3	3.649558
Marlow Latitude Sta.	34 38 50.54	1557.3	270	90	Marlow Long. Station	3.109	0.49262
1899	97 57 38.54	981.2					
Marlow Longitude Sta.	34 38 50.54	1557.3	223 48.3	43 48.3	Marlow Bapt. Ch.	372.3	2.57092
1899	97 57 38.42	978.4	310 20.5	130 20.5	Marlow Meth. Ch.	328.4	2.51646
Marlow Azimuth Station	34 38 47.27	1456.5	180 00	0 00	Marlow Long. Station	101.00	2.00430
1899	97 57 38.42	978.4					
Marlow National Bank, flag pole	34 38 51.697	1593.0	193 03 41.2	13 04 18.7	Marlow Secondary	7430.2	3.871000
1902	97 57 28.074	714.9	223 40 32.0	43 42 23.0	Osaria	7190.6	3.856764
Marlow Baptist Church, spire	34 38 59.262	1826.1	193 31 36.3	13 32 13.9	Marlow Secondary	7204.7	3.857615
1902	97 57 28.309	720.8	225 01 23.8	45 03 14.9	Osaria	7028.1	3.846837
Marlow Methodist Church, spire	34 38 43.638	1344.6	192 44 16.1	12 44 53.9	Marlow Secondary	7675.2	3.885087
1902	97 57 28.589	728.1	222 25 04.4	42 26 55.7	Osaria	7381.0	3.868116
Section 3, SE. corner T. 2 N., R. 3 E.*	34 39 59.79	1842.3	159 41 24	339 41 19	Table Hill	597.0	2.775974
1902	97 29 33.44	851.3					

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	° ′ ″	*m*	° ′ ″	° ′ ″		*meters*	
Section 21, SE. corner T. 1 S., R. 1 W.* 1902	34 26 03.08 97 17 59.06	94.9 1507.9	101 27 48	281 27 31	Arbuckle Mountain	801.2	2.903768
Section 25, SW. corner T. 1 S., R. 5 W.* 1902	34 26 03.33 97 41 04.14	102.6 105.7	58 12 25	238 12 23	Arbuckle	82.6	1.917243
Duncan Baptist Church, spire* 1902	34 30 16.87 97 57 21.58	519.9 550.3	287 27 02 68 26 46	107 36 14 248 23 42	Arbuckle Duncan	26086.2 8912.8	4.416410 3.950015
Quarter section corner, secs. 9 and 16* 1902	34 28 41.81 98 02 35.93	1288.3 916.9	37 29 05	217 28 59	Duncan	439.5	2.642969
Section 2, NE. corner T. 4 S., R. 7 W.* 1902	34 14 43.76 97 54 44.01	1348.4 1126.1	21 17 15	201 17 10	Monument	679.7	2.832298
Township corner, Tps. 3 and 4 S., Rs. 3 and 4 W.* 1902	34 14 17.39 97 33 12.22	535.8 312.7	305 07 12	125 07 21	Lone Tree	490.8	2.690931
Section 24, SW. corner T. 5 S., R. 7 W.* 1902	34 05 34.22 97 53 09.85	1054.4 252.5	102 07 52	282 07 49	Benton	123.9	2.093176
Section corner, near Grady* 1902	34 02 31.27 97 42 01.17	963.6 30.0	196 29 12	16 29 16	Grady	660.0	2.819544
House east of Grady, north gable 1902	34 00 30.875 97 37 53.478	951.4 1372.2	111 42 41.7 125 10 10.0 196 47 23.8	291 34 06.0 305 07 55.6 16 50 10.4	Benton Grady Lone Tree	25415.4 7542.5 26308.4	4.405097 3.877515 4.420094
Nocona Baptist Church, cupola 1902	33 47 33.066 97 43 39.980	1018.7 1028.6	34 51 16.8 185 29 31.3 193 10 35.2	214 46 38.3 5 30 30.5 13 10 39.5	Queen Grady Blue	22626.4 28437.9 865.0	4.354615 4.453898 2.937014
Nocona Schoolhouse, cupola 1902	33 47 29.250 97 43 34.966	901.1 899.6	35 17 38.4 156 03 35.1 184 03 55.4 185 12 44.8	215 12 57.2 335 58 11.5 4 03 56.9 5 13 41.0	Queen Benton Blue Grady	22604.2 36616.7 962.2 35933.5	4.354190 4.563679 2.983282 4.555500
Ringgold Presbyterian Church, spire* 1902	33 49 11.55 97 56 33.88	355.8 871.3	125 56 28 276 09 46	305 50 32 96 17 01	Cube Blue	20273.6 20221.1	4.306930 4.305804
Henrietta Court-House, dome 1902	33 48 57.377 98 11 44.340	1767.7 1140.3	209 29 36.7 304 43 17.6 12 54 58.5	29 32 08.0 124 54 14.3 192 53 14.9	Cube Queen Myers	14159.6 37088.1 21523.2	4.151052 4.569235 4.332907
Henrietta Schoolhouse, spire* 1902	33 48 47.64 98 11 29.73	1467.7 764.8	207 35 09 14 04 59	27 37 32 194 03 08	Cube Myers	14243.4 21319.4	4.153615 4.328774
Henrietta Standpipe 1902	33 49 12.670 98 11 40.490	390.3 1041.3	210 06 13.6 305 24 14.9 321 03 54.6 12 53 38.1	30 08 42.7 125 35 09.3 141 10 15.4 192 51 52.3	Cube Queen Bowie NW. Base Myers	13701.6 37277.9 28136.7 22004.6	4.136770 4.571451 4.449274 4.342513
House, 5 miles southeast of Henrietta, southeast gable* 1902	33 45 51.25 98 07 59.13	1578.9 1521.6	34 51 39 183 45 36	214 47 50 3 46 02	Myers Cube	18572.4 18095.6	4.268869 4.257573
House on ridge, north chimney* 1902	33 42 05.77 97 59 40.80	177.8 1050.7	70 34 56 155 05 38	250 26 31 335 01 26	Myers Cube	24874.8 27575.2	4.395759 4.440518
Bellevue, Webbs House, cupola 1902	33 37 47.960 98 01 29.823	1477.6 768.8	292 34 11.5 316 42 19.6 23 45 51.7 89 04 32.0	112 34 53.2 136 44 47.8 203 43 59.3 268 57 08.4	Bowie NW. Base Bowie SE. Base Jones Myers	2102.8 10069.8 13014.3 20652.7	3.322792 4.003019 4.114422 4.314976
Bellevue M. E. Church, east gable* 1902	33 38 04.05 98 00 49.91	124.8 1286.3	274 20 53 324 58 58	94 25 45 144 59 18	Queen Bowie NW. Base	13655.1 1590.9	4.135294 3.201640

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	° ′ ″	*m*	° ′ ″	° ′ ″		*meters*	
Bellevue, Ortons Windmill 1902	33 37 24.164 98 00 05.562	744.4 143.4	33 34 35.0 72 08 34.7 269 07 05.2 324 21 00.9	213 31 56.0 252 08 29.9 89 11 33.2 144 22 42.5	Jones Bowie NW. Base Queen Bowie SE. Base	13414.5 241.8 12474.2 8118.9	4.127576 2.383550 4.096012 3.909497
Bowdeckers Windmill tower* 1902	33 34 29.47 97 57 23.51	907.9 606.4	335 35 08 140 18 11	155 35 20 320 16 36	Bowie SE. Base Bowie NW. Base	1335.8 6899.9	3.125741 3.838840
Bowie National Hotel, cupola 1902	33 33 37.875 97 50 57.174	1166.9 1474.8	79 01 27.6 92 17 54.0 115 40 58.2 166 55 24.7	258 53 46.1 272 14 32.2 295 35 49.7 346 54 49.0	Jones Bowie SE. Base Bowie NW. Base. Queen	21972.3 9420.4 15940.1 7346.2	4.341875 3.974071 4.202492 3.866065
Bowie Methodist Church, spire 1902	33 33 40.646 97 50 53.898	1252.2 1390.2	78 50 56.7 91 45 49.9 166 07 28.4	258 43 12.5 271 42 26.3 346 06 50.9	Jones Bowie SE. Base Queen	22071.7 9501.9 7282.9	4.343835 3.977809 3.862303
Young's (J. B.) House, north chimney* 1902	33 32 49.37 98 08 08.65	1521.0 223.2	130 28 29 298 14 54	310 24 46 118 16 42	Myers Jones	13632.8 5729.9	4.134584 3.758148
Chico Church, with open spire 1902	33 22 10.665 98 54 14.378	328.5 371.7	15 29 23.9 43 30 45.3 105 24 11.2	195 26 05.5 223 23 55.0 285 20 05.3	Davis Moore Spradling	35183.6 28134.5 11982.7	4.546340 4.449239 4.078555
Chico Church, with square-top spire 1902	33 22 07.178 97 53 58.296	221.2 1507.1	16 11 29.0 44 16 26.1 105 22 25.3	196 08 01.8 224 09 27.0 285 18 10.5	Davis Moore Spradling	35193.8 28345.4 12412.0	4.546466 4.452482 4.093842
Jacksboro Court-House, statue 1902	33 13 07.204 98 09 28.696	221.9 743.1	133 17 43.6 211 13 04.2 310 27 27.5	313 13 18.0 31 17 20.8 130 28 58.7	Indian Spradling Moore	17207.5 23299.5 5670.7	4.235718 4.367347 3.753633
Jacksboro Jail, cupola* 1902	33 13 02.66 98 09 25.17	81.9 651.8	210 50 57 309 57 59	30 55 11 129 59 28	Spradling Moore	23372.4 5510.6	4.368704 3.741195
Old Chimney, northwest of Joplin* 1902	33 08 45.02 98 02 26.95	1387.0 698.6	339 35 44 123 38 23	159 36 56 303 36 03	Davis Moore.	9698.4 7940.6	3.986700 3.899854
Agnes Highest Windmill* 1902	32 58 56.61 97 47 16.85	1743.8 437.6	26 34 04 114 07 13	206 30 37 294 00 08	Gilbert Davis	22229.3 22162.7	4.346926 4.345623
Agnes Schoolhouse, cupola* 1902	32 58 41.63 97 47 14.41	1282.3 374.2	27 15 28 115 07 51	207 11 59 295 00 45	Gilbert Davis	21846.7 22412.5	4.339385 4.350491
Weatherford Tank, near white house* 1902	32 45 29.29 97 48 46.25	902.2 1204.0	358 44 28 123 12 34	178 44 47 303 09 55	Comanche Gilbert	42231.1 9102.8	4.625632 3.959176
Weatherford White House, with red roof, cupola* 1902	32 45 30.08 97 48 44.68	926.6 1163.1	358 47 51 122 56 23	178 48 09 302 53 44	Comanche Gilbert	42254.7 9123.7	4.625875 3.960173
Weatherford Yellow House, with dark roof, cupola* 1902	32 44 18.63 97 47 45.27	573.9 1178.7	0 57 11 127 53 50	180 56 58 307 50 38	Comanche Gilbert	40050.0 11662.1	4.602603 4.066777
Lingleville Schoolhouse, cupola 1902	33 14 26.436 98 22 39.386	814.3 1031.2	229 11 57.9 264 19 57.7 281 32 59.1 283 27 40.3 294 08 45.4 309 10 38.3	49 14 54.1 84 27 36.4 101 41 21.6 103 39 36.1 114 12 30.9 129 12 55.9	Gatlin Pilot Stephenville N. B. Lone Mountain Alarm Young	15282.4 22601.6 25188.6 36181.4 15370.8 8718.6	4.184192 4.354139 4.401204 4.558486 4.186696 3.940449
Lingleville Open Belfry* 1902	32 14 33.16 98 22 37.08	1021.4 970.9	229 37 39 316 28 13	49 41 34 130 30 29	Gatlin Young	15101.8 8804.8	4.179030 3.944718
Stephenville Court-House, tower, center. 1902	32 13 11.996 98 12 07.828	369.5 205.0	32 10 36.3 158 01 56.4 288 50 46.6 318 11 16.1 00 06 19.1	212 09 45.1 338 00 15.3 108 53 32.2 138 14 00.4 180 06 18.0	Alarm Gatlin Stephenville N. B. Stephenville S. B. Gibson	4725.8 13238.0 8597.0 12118.0 30658.4	3.674478 4.121822 3.934348 4.083430 4.486550

*No check on this position.

Station.	Latitude and longitude.	Seconds in meters.	Azimuth.	Back azimuth.	To station.	Distance.	Logarithms.
	° ′ ″	*m*	° ′ ″	° ′ ″		*meters*	
Stephenville Oil Mill, stack *	32 13 18.77	578.2	24 24 01	204 23 22	Alarm	4621.6	3.664794
1902	98 12 31.02	812.3	160 11 45	340 10 17	Gatlin	12826.5	4.108107
Stephenville, Tarleton College, dome center	32 13 01.623	50.0	19 51 44.9	199 51 17.9	Alarm	3913.5	3.592566
	98 12 53.139	1391.6	163 21 01.4	343 19 42.5	Gatlin	13147.1	4.118829
			284 45 42.1	104 48 51.8	Stephenville N. B.	9641.2	3.984131
1902			313 13 53.3	133 17 01.7	Stephenville S. B.	12718.4	4.104431
Long House, north center chimney	32 12 18.436	567.9	69 18 30.8	249 17 06.4	Young	4433.5	3.646745
	98 15 43.027	1127.0	182 46 48.5	2 47 02.4	Gatlin	13941.8	4.144319
1902			306 58 53.7	126 59 57.2	Alarm	3906.7	3.591806
Johnsonville Cotton Gin, stack *	32 08 44.04	1356.6	140 04 57	320 01 19	Pilot	16635.6	4.221039
	98 01 32.26	845.5	223 55 07	43 55 47	Lone Mountain	2863.9	3.456964
1902							
Skippers Gap Windmill	32 08 46.466	1431.3	116 25 32.7	296 21 51.7	Stephenville N. B.	12143.4	4.084339
	98 00 02.034	53.3	134 13 19.0	314 08 53.6	Pilot	18190.9	4.259854
1902			169 14 53.2	349 14 45.6	Lone Mountain	2023.6	3.306132
Dublin Standpipe	32 05 29.603	911.9	199 53 20.1	19 54 41.1	Young	11725.5	4.069132
1902	98 20 53.651	1407.0	227 41 14.9	47 45 03.5	Alarm	15224.0	4.182528
			242 20 04.0	62 27 29.0	Stephenville N. B.	24737.1	4.393349
			255 57 54.5	76 08 52.5	Lone Mountain	33414.4	4.523934
			302 22 00.3	122 34 50.1	Gleason	45225.6	4.655384
			320 01 29.1	140 06 10.4	Gibson	21409.3	4.330603
Dublin High School, cupola	32 05 19.040	586.5	195 05 15.1	15 06 17.2	Young	11756.5	4.070277
	98 20 18.190	477.0	224 19 53.9	44 23 23.6	Alarm	14780.8	4.169698
1902			224 33 42.9	44 40 05.3	Pilot	26786.4	4.427915
			240 37 34.0	60 44 40.1	Stephenville N. B.	24075.4	4.381574
			255 01 08.8	75 11 47.9	Lone Mountain	32595.8	4.513161
			255 08 18.5	75 15 23.0	Stephenville South	21655.3	4.335564
			302 39 38.2	122 52 09.1	Gleason	44266.6	4.646076
			321 26 01.8	141 30 20.6	Gibson	20568.7	4.313207
Dublin Church, tall spire	32 05 17.490	538.8	224 52 20.3	44 58 47.7	Pilot	26994.2	4.431270
			240 49 19.7	60 56 30.8	Stephenville N. B.	24315.5	4.385883
1902	98 20 27.730	727.2	255 11 31.2	75 18 40.8	Stephenville S. B.	21908.6	4.340614
			320 48 49.3	140 53 13.1	Gibson	20691.0	4.315781
Dublin Oil Mill, center *	32 05 14.04	432.5	194 40 00	14 41 01	Young	11892.7	4.075280
	98 20 16.32	427 9	223 46 55	43 50 23	Alarm	14857.3	4.171941
1902							
Purves Schoolhouse, cupola	32 00 18.154	559.2	214 48 24.0	34 53 21.1	Stephenville N. B.	25655.9	4.409188
	98 16 16.311	428.2	224 34 21.5	44 39 17.1	Stephenville S. B.	20791.1	4.317878
1902			316 30 43.7	136 32 54.1	Gibson	9401.3	3.973189
Purves Cotton Gin, stack	32 00 10.630	327.4	214 28 41.2	34 33 37.8	Stephenville N. B.	25835.6	4.412218
	98 16 15.572	408.7	224 05 24.0	44 10 19.2	Stephenville S. B.	20943.3	4.321046
1902			315 36 31.3	135 38 41.3	Gibson	9221.0	3.964778
Carleton Cotton Gin, stack	31 55 15.810	486.9	129 31 52.2	309 30 51.4	Gibson	3911.9	3.592389
	98 10 15.098	396.7	191 59 50.1	12 01 33.8	Stephenville S. B.	24652.5	4.391861
1902			351 31 50.0	171 33 17.4	Chamliss	29657.6	4.472137
Olin Cotton Gin, stack *	31 57 26.15	805.4	302 29 51	122 34 48	Gleason	17460.3	4.242052
	98 06 00.63	16.5	2 00 26	183 59 39	Chamliss	33431.1	4.524151
1902							
Evans (?) U. S. G. S.	31 52 21.14	651.0	63 15 37	243 15 37	Gleason	6.95	0.84217
1902	97 56 40.13	1054.9					
White Church Spire, southeast of Chamliss *	31 37 16.01	493.1	16 42 05	196 40 05	Brown	21131.0	4.324919
	98 03 21.00	553 5	120 57 37	300 55 27	Chamliss	7628.7	3.882450
1902							
Copperas Cove Church, spire *	31 07 20.84	641.8	77 02 08	257 01 05	Gilmore	3354.8	3.525673
	97 53 57.09	1512.7	133 25 22	313 20 36	Franklin	20082.0	4.302806
1902							
Copperas Cove Schoolhouse, cupola *	31 07 16.98	523.0	79 02 20	259 01 16	Gilmore	3331.1	3.522586
	97 53 57.06	1511.9	133 40 01	313 35 15	Franklin	20164.8	4.304594
1902							

Station.	Latitude and longitude.	Seconds in meters.	Azimuth.	Back azimuth.	To station.	Distance.	Logarithms.
	° ′ ″	*m*	° ′ ″	° ′ ″		*meters*	
Waters Mountain U. S. G. S. 1902	31 05 31.568 98 20 36.996	972.2 980.6	237 10 11.46 279 40 47.05 294 41 17.17 296 46 39.53	57 13 06.54 99 47 12.26 114 48 53.92 116 51 57.92	Flat Top Lampasas NE. B. Bachelor Lampasas SW. B.	10679.9 20070.7 25862.6 18337.9	4.0285684 4.3025618 4.4126714 4.2633503
Lampasas Court-House, dome* 1902	31 03 55.39 98 10 39.61	1705.9 1050.1	354 20 49 141 56 40	174 20 59 321 54 26	Lampasas SW. B. Flat Top	5338.3 11113.1	3.727405 4.045834
Lampasas Spring-house, cupola* 1902	31 04 03.66 98 10 33.60	112.7 890.7	140 28 31 280 15 24	320 26 15 100 16 38	Flat Top Lampasas NE. B.	11014.2 3848.9	4.041952 3.585335
Lampasas School-house, cupola* 1902	31 04 06.52 98 10 51.94	200.8 1377.0	351 25 22 142 11 26	171 25 39 322 09 19	Lampasas SW. B. Flat Top	5719.2 10641.6	3.757335 4.027008
Lampasas First Baptist Church, spire 1902	31 03 51.218 98 10 56.954	1577.4 1510.0	144 15 13.1 313 38 42.9 349 13 51.5	324 13 08.4 133 41 20.5 169 14 10.7	Flat Top Bachelor Lampasas SW. B.	10939.5 11206.7 5276.9	4.038999 4.049478 3.722380

*No check on this position.

DESCRIPTIONS OF STATIONS.

This list may be conveniently consulted by reference to the illustrations at the end of this appendix and the index on pages 876–880.

In each description the tense used is appropriate to the date at which the description was written.

All directions in the descriptions are given in the form of azimuths reckoned continuously from south around by west to 360°, west being 90°, north 180°, and east 270°. The azimuths are true, not magnetic.

In general, the surface and underground marks described are not in contact, so that a disturbance of the surface mark will not, in general, affect the undergound 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 is disturbed, or that the description no longer fits the facts, is requested to send such information to

SUPERINTENDENT,
COAST AND GEODETIC SURVEY,
Washington, D. C.

GENERAL NOTES IN REGARD TO STATION MARKS.

Note 1.—The method of marking each station referred to this note is as follows: A hole is dug to a depth of 4½ feet, its diameter being 18 inches for the first 2 feet and 12 inches for the remaining distance. A terra-cotta pipe 2 feet long and 4 inches in diameter is placed in the lower part of this hole. The pipe and surrounding hole is then filled with a concrete made of Portland cement, sand, and broken rock. Set vertically in the upper part of the pipe is a 60-penny wire nail, the point of which projects one-quarter of an inch above the cement and is the underground mark. A layer of 6 inches of sand is then put into the hole. Directly over the underground mark, and extending from the sand to the surface of the ground, is a terra-cotta pipe similar to the one just described. The surface mark is the point of a 60-penny wire nail set in the cement, which fills the pipe and the surrounding hole and also covers the pipe to a depth of half an inch.

The reference mark is a 4-inch terra-cotta pipe 2 feet long set in a hole 1 foot in diameter, both pipe and hole filled with concrete. The top of pipe is level with the surface of the ground. A 60-penny wire nail is placed in upper end of pipe and projects one-fourth inch above it.

Note 2.—The permanent marks at the ends of the bases which are referred to this note were put in position when the base was located. Below the surface a limestone block 6 by 6 inches in cross section and 1 foot long was set in concrete with its top 4 feet below the surface. Into the top surface of this post a copper bolt was secured, and the center of the station (underground) is a millimeter hole in this bolt.

At the surface a hard limestone block 23 by 23 inches and 16 inches high, weighing 700 pounds, set in a mass of concrete 4 feet square and 4 feet deep, carries at the center of its top surface a bronze station mark, the millimeter hole in the center of which marks the end of the base.

These station marks are made of a composition of copper and brass, and have a shank 7.6 millimeters 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 out at the bottom of the hole, which is made larger there than at the top, and in this manner 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.

Between the bottom of the surface monument and the bolt marking the point below the surface there is an earthenware drainpipe 7 inches in diameter and 25 inches long. This drainpipe is embedded in the upper mass of concrete and covered with a piece of galvanized iron to prevent anything from falling on the underground mark.

PRIMARY TRIANGULATION STATIONS.

ANTHONY BASE NET TO ELRENO BASE NET.

Rutherford (Harper County, Kans., A. T. Mosman, 1901; W. Bowie, 1902).—See description, page 280, Appendix 3, Report for 1902.

Miller (Harper County, Kans., William Bowie, 1902).—See description, page 281, Appendix 3, Report for 1902.

Fowler (Harper County, Kans., William Bowie, 1902).—See description, page 281, Appendix 3, Report for 1902.

Renfrow (Grant County, Okla., O. W. Ferguson, 1902).—This station is in the southeast corner of NW. ¼, sec. 14, T. 28 N., R. 5 W., 91.40 meters north of east and west fence and 82.78 meters west of north and south fence, on land of Tony Tucker. The azimuths and distances to certain points are: To southeast corner of sec. 14, 315° 13′ 30″, 1 257.7 meters; to reference mark, 317° 31′ 21″, 121.770 meters; to Mr. Zimmerman's house, center chimney, 254° 49′ 04″, five-eighths mile; to Elmer Behann's house, center chimney, 286° 48′ 53″, three-eighths mile; to Richland Schoolhouse, belfry, 318° 17′ 11″, five-eighths mile. The reference mark is 0.60 meter west of north and south fence, and 0.77 meter north of east and west fence. (See note 1, p. 894).

Sand Hill (Woods County, Okla., William Bowie, 1902).—This station is in SW. ¼, sec. 25, T. 28 N., R. 9 W., about 9½ miles south and 4½ miles west of Manchester, on the north edge of what are known as the Sand Hills. The distances and azimuths to certain points are: To quarter-section corner, 352° 19′ 24″, 525.75 meters; to reference mark, 352° 47′ 11″, 536.00 meters. The reference mark is in the fence corner south of the quarter-section stone common to sections 25 and 36. (See note 1, p 894).

Vicar (Grant County, Okla., William Bowie, 1902).—This station is in NE. ¼, sec. 1, T. 25 N., R. 7 W., 5 miles west and one-half mile north of Pond Creek, on the highest point of a low ridge running about east and west, on the property of J. F. Vickers. The azimuths and distances to certain points are: To reference mark, 301° 58′ 34″, 261.82 meters; to cedar post at corner of ranges 6 and 7, townships 25 and 26,

198° 19′ 08″, 700.4 meters. The reference mark is near quarter-section corner common to sections 1 of R. 7 W. and 6 of R. 6 W. (See note 1, p. 894).

Hahn (Garfield County, Okla., O. W. Ferguson, 1902).—This station is in sec. 3, T. 24 N., R. 4 W., on land of J. K. Myers, 240.9 meters north of south line of section, 15.85 meters east of line of hedge on west side of road, and 0.11 meter west of line of posts on east side of road. The azimuths and distances to certain points are: To stone marking southwest corner of sec. 3, 1° 45′ 21″, 240.92 meters; to reference mark, 359° 49′ 48″.6, 232.694 meters; to tower of J. A. Meikles's windmill, 7° 36′ 30″, five-eighths mile; to tower of J. K. Myers's windmill, 275° 31′ 26″, 1 mile; to tower of A. J. Hahn's windmill, 73° 46′ 57″, three-eighths mile. The reference mark is just within the field at southwest corner of sec. 3, 0.85 meter east of road fence and 0.94 meter north of east-and-west fence. (See note 1, p. 894.)

McCoy (Garfield County, Okla., William Bowie, 1902).—This station is in SE. ¼, sec. 21, T. 24 N., R. 8 W., 12½ miles west and three-fourths mile south of Kremlin, on highest point of land on property of A. S. McCoy. The azimuth and distance to reference mark are 17° 36′ 15″ and 409.97 meters, respectively. The reference mark is in the fence corner on south side of road, opposite the quarter-section corner common to sections 21 and 28. (See note 1, p. 894.)

Enid (Garfield County, Okla., William Bowie, 1902).—This station is in sec. 22, T. 23 N., R. 6 W., in the line of fence on south side of road, on property of Mr. Smith. The azimuths and distances to certain points are: To reference mark, 271° 29′ 20″, 66.166 meters; to section corner common to sections 14, 15, 22, and 23, 264° 28′ 20″, 76.318 meters. The reference mark is in the northeast corner of Mr. Smith's property and very near section corner just referred to. (See note 1, p. 894.)

Garber (Garfield County, Okla., O. W. Ferguson, 1902).—This station is in sec. 25, T. 23 N., R. 4 W., at the northeast edge of the town of Garber, on land of Chicago, Rock Island and Pacific Railway, 28.05 meters north from center of track, 2.37 meters south of wire fence bounding railroad's right of way, 68.40 meters from northwest corner of cattle pen, and 75.46 meters from center of track at switch block. The azimuths and distances to certain points are: To reference mark, 90° 40′ 37″, 252.176 meters; to center of section, 272° 37′ 06″, 201.33 meters; to Mr. Schieber's chimney, center of square-topped house, 8° 06′ 55″, 175 meters; to M. E. Church spire, 15° 38′ 54″, 275 meters; to center of large elevator, 60° 37′ 26″, 85 meters. The marking is the same as that described in note 1, page 894, except that a 1½-inch gas pipe, 24 inches long, was used instead of 4 by 24 inches terra-cotta pipe. The reference mark is west of station and is opposite east window of north face of depot.

Mitchell (Garfield County, Okla., O. W. Ferguson, 1902).—This station is in sec. 2, T. 20 N., R. 3 W., 1½ miles south and 1 mile east of Ladysmith, and 78.8 meters west of the east end of half-section line. The land north of station is owned by Mr. T. J. Mitchell. The azimuths and distances to certain points are: To reference mark, 69° 44′ 34″, 70.052 meters; to chimney of T. J. Mitchell's house, 139° 54′ 26″.8, one-half mile; to chimney of main part of Fred Frank's house, 291° 08′ 18″, 1 mile; to chimney of main part of A. Smith's house, 52° 19′ 52″.8, 1 mile. The reference mark is on the west side of north and south road between sections 1 and 2. The markings of station and reference marks are same as described in note 1, page 894, except that galvanized-iron pipe, 1½ by 24 inches was used instead of 4 by 24 inches terra-cotta pipe.

Waukomis (Garfield County, Okla., William Bowie, 1902).—This station is in sec. 23, T. 21 N., R. 7 W., 100 meters northwest of Waukomis, on property of J. Crick. The azimuth and distance to reference mark are 284° 08′ 01″ and 210.050 meters, respectively. The reference mark is in the northeast corner of Mr. Crick's garden, by the public road. (See note 1, p. 894.)

Parnell (Kingfisher County, Okla., William Bowie, 1902).—This station is in T. 19 N., R. 6 W., 75 meters east of the corner common to sections 22, 23, 26, and 27, in fence line on south side of the road, about 6 miles east and one-half mile south of Hennessey, on the property of B. H. Parnell. The reference mark is distant 66.156 meters, in azimuth 90° 04′ 12″ in the northwest corner of the property of B. H. Parnell. (See note 1, p. 894.)

Wingard (Logan County, Okla., O. W. Ferguson, 1902).—This station is in SW. ¼ sec. 14, T. 17 N., R. 3 W., on property of J. B. Wingard, about 5 miles north and 3¾ miles west of Guthrie. The land is gently sloping, and is cultivated to broom corn, the station being located on the highest ground. The azimuths and distances to certain points are: To reference mark, 194° 42′ 03″, 329.096 meters; to corner stone of quarter section, between 14 and 23, 2° 04′ 56″, 490.9 meters; to east end of ridge of James Dodd's house, 56° 05′ 36″, three-fourths mile; to chimney in center of square-roofed house of William Dodd, 67° 57′ 18″, three-fourths mile; to south end of ridge of John Gooch's house, 121° 30′ 15″.3, three-fourths mile. The reference mark is in the southwest quarter, very near the center of the section, 0.94 meter south of east and west fence, and 0.50 meter west of north and south fence. (See note 1, p. 894.)

Burson (Kingfisher County, Okla., William Bowie, 1902).—This station is in NE. ¼ sec. 29, T. 17 N., R. 7 W., on the property of Isaac Burson, about 5 miles north and 2 miles west of Kingfisher. The reference mark is in the northwest corner of the school lot, and is distant from station 427.66 meters; azimuth, 246° 22′ 56″. Section corner 29, southwest corner thereof, is distant 1,817.3 meters; in azimuth, 37° 25′ 23″. (See note 1, p. 894.)

ELRENO BASE TO BOWIE BASE.

Eichoff (Canadian County, Okla., O. W. Ferguson, 1902).—This station is on section line between sections 8 and 17, T. 14 N., R. 6. W, about 289 meters west of the east corner, on land of Gustave Thelan, 4 miles west and 2 miles north of Mathewson. The station is on the highest ground in the vicinity, and is 9.75 meters north of fence along the south side of the road. The azimuths and distances to certain points are: To reference mark, 272° 43′ 40″, 279.835 meters; to southeast corner of sec. 17, 349° 29′ 10″; to east chimney of Mr. Thelan's house, 351° 06′ 18″, 900 meters. The reference mark is set in field at northeast corner of sec. 17 and is 0.48 meter south from east and west fence and 0.30 meter west from north and south fence. (See note 1, p. 894.)

Edmonds (Oklahoma County, Okla., O. W. Ferguson, 1902).—This station is near the middle of sec. 25, T. 14 N., R. 3 W., on land of Pete Wilderson, at the northeast outskirts of the village of Edmonds. The azimuths and distances to certain points are: To reference mark, 263° 11′ 39″, 79.402 meters; to quarter corner in middle of sec. 25, 110° 42′ 53″, 334.83 meters; to center of dome of Territorial Normal College, 70° 54′ 33″.9, 650 meters; to cross on spire of Catholic church, 63° 29′ 31″.6. The station is at east edge of cultivated land, about 100 meters north-northeast of highest ground,

and is 119.60 meters south of the east and west wire fence running to the section corner. The reference mark is in the north and south fence. (See note 1, p. 894.)

Caddo (Canadian County, Okla., William Bowie, 1902).—This station is in sec. 17, T. 13 N., R. 7 W., on highest point of land in the Cheyenne Indian school reservation, and about 600 meters from the school building, 7 miles from El Reno, in a direction a little west of north. The reference mark is distant 295.4 meters from station, in azimuth 148° 08′ 06″, and is located on a sand dune at edge of woods. (See note 1, p. 894.)

Yukon (Canadian County, Okla., O. W. Ferguson, 1902).—This station is in SW. ¼ of SW. ¼ sec. 29, T. 12 N., R. 5 S., upon the highest ground in the vicinity, 1⅞ miles south and one-half mile west from the school building at Yukon, and 12⅞ miles west of Oklahoma City, on land of John Olive, about 25 meters west of north and south center line through the SW. 40 acres of SW. ¼ sec. The azimuths and distances to certain points are: To reference mark, 2° 16′ 45″, 194.677 meters; to center north gable of Mrs. Art's house, 14° 36′ 45″, 243.18 meters; to north gable of A. Well's house, 296° 02′ 14″; to south gable of John Olive's house, 131° 28′ 40″; to center chimney of George Thompson's house, 141° 41′ 21″; to southwest corner of section 29, 61° 22′ 01″, 417.3 meters. (See note 1, p. 894.)

Smith (Oklahoma County, Okla., O. W. Ferguson, 1902).—This station is in the SE. ¼ sec. 34, T. 11 N., R. 3 W., on land of N. H. Smith, at the fence line on west side of the highway, 6½ miles south and 1 mile east of Oklahoma City, and 3 miles north and one-fourth mile west of Moore. The azimuths and distances to certain points are: To reference mark, 178° 44′ 35″, 130.154 meters; to south gable of main part of Mr. Smith's house, 166° 23′ 30″, 101.22 meters; to corner common to sections 2, 3, 34, and 35, 357° 56′ 28″, 406.10 meters. The reference mark is on the west side of the road, just north of the driveway to Smith's house, 1.02 meters north of line of black locust trees and 0.71 meter east of wire fence on west side of road. (See note 1, p. 894.)

Carson (Chickasaw Nation, Ind. T., William Bowie, 1902).—This station is in sec. 8, T. 9 N., R. 7 W., on property of Kit Carson, of Minco, 3 miles south and 1 mile west of Minco, on highest point of a ridge three-fourths mile west of Chicago, Rock Island and Pacific Railroad. The azimuths and distances to certain points are: To reference mark, 179° 42′ 36″, 275.776 meters; to old boundary mark of Oklahoma–Indian Territory boundary, 151° 10′ 47″, 398.2 meters; to quarter-section stone common to sections 5 and 8, 150° 29′ 12″, 410.3 meters. The old boundary mark is an 8-inch cottonwood post with top squared, projecting 3 or 4 feet above the ground, and surrounded by a mound of earth. The reference mark is placed near fence line north of station. (See note 1, p. 894.)

Elreno East Base (Canadian County, Okla., A. L. Baldwin, 1900, William Bowie, 1902).—This station is in sec. 9, T. 11 N., R. 7 W., on the land of Mr. G. L. Newman. The marking of the station is fully described in note 2, page 894, except that the surface block is of red sandstone.

The azimuth and distances to certain points are: To reference mark, 270° 46′ 22″, 277.20 meters; to section corner common to sections 9, 10, 15, and 16, 344° 37′ 51″, 1,056.8 meters. The reference mark is placed in the northeast corner of G. L. Newman's peach orchard, on the west side of the public road. (See note 1, p. 894, for description of reference mark.)

Elreno West Base (Canadian County, Okla., A. L. Baldwin, 1900, William Bowie, 1902).—This station is on the land of J. T. Seawell, on the summit of a prominent hill 2½ miles south and 6¾ miles west of the Rock Island depot in Elreno. The azimuth and distance to reference mark are, respectively, 114° 25′ 59″, and 226.731 meters. (See note 2, p. 894, for description of marking, except that the surface block is of red sandstone, and note 1, p. 894, for a description of the reference mark.)

Lanier (Chickasaw Nation, Ind. T., William Bowie, 1902).—This station is in sec. 19, T. 7 N., R. 4 W., and on the highest point of a prominent ridge, on which are some scattered black jack oak trees. The azimuth and distance to reference mark are, respectively, 327° 17′ 56″, and 136.408 meters. The reference mark is placed within several meters of three large oak trees, on each of which is cut a triangle facing the mark. (See note 1, p. 894.)

Purcell (Chickasaw Nation, Ind. T., U. S. G. S., and O. W. Ferguson, 1902).—This station is 5 miles east by north from Purcell and is on land of J. E. Givens. The Purcell-Chickasha road passes 1 mile south from station. The azimuths and distances to certain points are: To west reference mark, 74° 17′ 07″, 292.138 meters; to east reference mark, 253° 13′ 43″, 122.620 meters; to corner stone between secs. 7 and 8, T. 6 N., R. 2 W., 299° 07′ 32″, 589.27 meters. The Geological Survey mark was found in good condition and is used for a surface mark. It is a triangle in center of a copper bolt bearing the inscription U. S. G. S., and set in a stone 8 by 12 by 17 inches. The stone is cemented into place, and underneath and separated therefrom by 5 inches of sand is placed the usual underground mark described in note 1, page 894. The west reference mark is set in fence line running north and south; the east reference mark is about halfway to the bank of deep wash.

Table Hill (Chickasaw Nation, Ind. T., U. S. G. S., and O. W. Ferguson, 1902).—This station is about 4½ miles north of the village of Foster, and 2 miles south and 80° west of the highest and most table-like of the hills locally known as the Table Hills. It is on a high, flat, timbered tract of land owned by John W. Hunter, and about 600 meters east of the wagon road. The azimuths and distances to certain points are: To corner stone common to secs. 2, 3, 10, and 11, T. 2 N., R. 3 E., 339° 41′, 597 meters; to east gable of J. M. Hunter's house, 187° 24′ 05″, 641.9 meters; to north reference mark, 179° 28′ 34″, 126.440 meters; to south reference mark, 348° 10′ 49″, 124.873 meters. The Geological Survey mark was found in good condition and is used for a surface mark. It is a triangle in center of a copper bolt bearing the inscription U. S. G. S., and set in a stone 6 by 14 by 15 inches. The stone is cemented into place, and underneath and separated therefrom by 5 inches of sand is placed the usual underground mark described in note 1, page 894. The cement is marked U. S. C. and G. S., 1902.

Osaria (Chickasaw Nation, Ind. T., William Bowie, 1902).—This station is in sec. 35, T. 3 N., R. 7 W., and was a Geological Survey station called Marlow. The United States Geological Survey mark was found in good condition, and was replaced by the usual United States Coast and Geodetic Survey mark (described in note 1, p. 894). Four trees within 15 meters of the station are marked with a triangle cut into the bark on the side facing the station. The azimuth and distance to reference mark are, respectively, 164° 03′ 04″ and 9.304 meters. The reference mark is a brown sandstone 16 inches deep and about 12 inches square, projecting about 4 inches above the ground. A cross on a copper bolt set in this stone is the center of the reference mark. The stone is 14 meters south of an oak tree having a triangle cut in the bark.

Kechi (Caddo County, Okla., William Bowie, 1902).—This station is in sec. 3, T. 5 N., R. 9 E., on town site of Cement and about one-half mile to the east of a branch of the St. Louis and San Francisco Railroad, extending from Chickasha to Lawton. The station is on a prominent rocky peak among what are known as Kechi Hills, and is marked as follows: A hole 1 inch in diameter and 4 inches deep was drilled in solid rock, in which a 60-penny wire nail was set with cement. A cap of concrete 4 inches thick and 18 inches in diameter is placed over the hole, and through the center of this the point of the nail projects one-fourth inch. The azimuth and distance to reference mark are, respectively, 36° 11′ 45″ and 288.813 meters. (For description of reference mark, see note 1, p. 894.)

Arbuckle (Chickasaw Nation, Ind. T., O. W. Ferguson, 1902).—This station is 9 miles north from the village of Laco, 2 miles S. 19° W. from the town of Velma, on the northwest quarter of a high, timbered, rocky ridge. It is 75 meters south of the wire fence on south side of tract leased by J. B. Frensley and J. M. Fitzhue. The azimuths and distances to certain points are: To corner stone common to sections 25, 26, 35, and 36, T. 1 S., R. 5 W., 238° 12′ 24″, 82.65 meters; to reference mark, 239° 27′ 20″, 77.210 meters; to north end of ridge beam of unoccupied house, 345° 02′, 285.90 meters. This station is the United States Geological station Velma. The mark (a stone 15 by 10 by 12 inches) had been disturbed. The station was recovered and marked as follows: A hole 2 feet in diameter was dug 20 inches deep in rock and clay, and continued 6 inches farther with a diameter of 6 inches. The lower hole was filled with cement, in which was set a 60-penny wire nail for the underground mark. Over this 5 inches of sand and then the United States Geological Survey stone previously described were placed. A cross in center of bolt in this stone is the surface mark. The stone was cemented into place, and in this concrete was marked U. S. C. and G. S., 1902. The reference mark is set 0.46 meter south of Frensley's and Fitzhue's south fence.

Arbuckle Mountain (Chickasaw Nation, Ind. T., U. S. G. S., and O. W. Ferguson, 1902).—This station is 6½ miles east by north from the village of Elk, 6½ miles south of the village of Hennepin, one-half mile west of road from Elk and Woodford intersecting Hennepin and Davis road; 1½ miles southwest of J. F. Copeland's house, 3 miles south of spring forming head of Five-Mile Creek, three-fourths mile southwest of head of Zanders Creek, on a high point of Arbuckle Mountain on south side of head of valley or "draw" forming creek that runs into Eight-Mile Creek, on land occupied by L. Johnson but claimed by J. F. Copeland. The azimuths and distances to certain points are: To corner stone common to sections 22, 27, 21, and 28, T. 1 S., R. 1 W., 281° 27′ 42″, 801.25 meters; to reference mark, 250° 16′ 01″, 47.034 meters. The reference mark is the center of ½-inch hole drilled to depth of 1½ inches in a prominent outcropping rock, circumscribed by a triangle cut into the surface, 6 inches on a side, one apex pointing to the station. The station mark is described in the United States Geological Survey Bulletin No. 175, 1900, as "a stone post 26 by 7 by 7 inches, set 24 inches in the ground, with a copper bolt marked $\frac{\text{U. S.}}{\text{G. S.}}$ + sunk in center of top.

Lone Tree (Chickasaw Nation, Ind. T., William Bowie, 1902).—This station is in sec. 6, T. 4 S., R. 3 W., 6 miles north and 2 miles east of the town of Cornish, on

bare, prominent ridge called Lone Tree Hill, on land claimed by James Kelly. The azimuths and distances to certain points are: To corner of sec. common to T. 3 S., T. 4 S., R. 3 W., and R 4 W., 125° 07′ 21″, 490.830 meters; to reference mark No. 1, 141° 57′ 08″, 295.443 meters; to reference mark No. 2, 322° 23′ 21″, 106.587 meters. The reference marks are in line with and on opposite sides of station, one within a few feet of the only two trees on the hill. (See note 1, p. 894.)

Monument (Chickasaw Nation, Ind. T., O. W. Ferguson, 1902).—This station is 3 miles east of the village of Addington, on what is known as Monument Hill, 35 meters, N. 8° E., of the highest rock on the hill and 4.8 feet lower than it; 146.3 meters, N. 80° E. of highest rock in the ledge forming the western support of the hill; 4.85 meters east of the prolongation of the north and south fence that joins the east and west fences at the station; on land leased by H. J. Hensley. The azimuths and distances to certain points are: To northeast corner of sec. 2, T. 4 S., R. 7 W., 201° 17′ 09″, 679.67 meters; to reference mark, 176° 03′ 48″, 180.76 meters. The reference mark is 2.03 meters west of the north and south fence and 2.06 meters north of the east and west fence. (See note 1, p. 894.)

Duncan (Comanche County, Okla., William Bowie, 1902).—This station is in school sec. 16, T. 1 S., R. 8 W., on a flat-topped hill with woods to east and north, 5 miles west and 1½ miles south of the town of Duncan, Ind. T. The azimuths and distances to certain points are: To corner stone ¼ sec. common to sections 9 and 16, 217° 29′ 00″, 439.51 meters; to reference mark, 297° 09′ 42″, 189.320 meters. The reference mark is on the edge of woods to the east of station. (See note 1, p. 894.)

Benton (Chickasaw Nation, Ind. T., William Bowie, 1902).—This station is in sec. 26, T. 5 S., R. 7 W., 5 miles east and 1 mile north of Sugden, at the highest point of a ridge running north and south on land claimed by T. W. Williams and leased by J. F. Jackson. The azimuths and distances to certain points are: To corner common to sections 23, 24, 25, and 26, T. 5 S., R. 7 W., 282° 07′ 48″, 123.93 meters; to reference mark, 233° 24′ 44″, 23.10 meters. The underground station mark is a bottle set in concrete, the top of which is 2½ feet below the surface mark. (For description of surface mark, see note 1, p. 894.) The reference mark is a stone 9 by 11 by 21 inches set in concrete in the southwest corner of Jackson's yard, the center of mark being a cross cut in the stone.

Grady (Chickasaw Nation, Ind. T., William Bowie, 1902).—This station is 2 miles west and 1 mile north of the village of Grady, and 4 miles north of the Red River, on the highest and most northerly part of a bare ridge three-eighths mile long running north and south in an open prairie, on land claimed by Thomas Gardiner and leased by Calvin Duger. The azimuths and distances to certain points are: To section corner west of station, 16° 29′ 16″, 660.0 meters; to reference mark, 97° 00′ 36″, 179.06 meters. The reference mark is on a section line west of station. The usual station and reference marks were used (see note 1, p. 894), except that instead of a terra cotta pipe a block of cement 8 inches in diameter and 5 inches deep with a 40-penny wire nail was used for the underground mark, and placed 0.72 meter below the surface mark.

Blue (Montague County, Tex., William Bowie, 1902).—This station is one-half mile north of town of Nocona on Missouri, Kansas and Texas Railroad, on a prominent hill known as Blue Mound, 7 meters north of road fence, on land of D. R.

Skeen. The azimuths and distances to certain points are: To reference mark 273° 34′ 10″, 128.958 meters; to Nocona Sch. Cup. 4° 03′ 57″, 962.2 meters. The reference mark is at a fence corner east of the station. (See note 1, p. 894.)

Cube (Clay County, Tex., O. W. Ferguson, 1902).—This station is 9½ miles south and 2½ miles west of Henrietta, 3 miles east and 1½ miles south of Herrnville, 1 mile south of the schoolhouse, which is on the Henrietta and Riverdale road, and near the southeast corner of a tract of land designated as "abstract No. 307, Montague County School Land Survey No. E," on land of M. Cueba. It is on the highest part of hill, midway between Cueba's house and barn. The azimuths and distances to certain points are: To reference mark, 333° 16′ 39″, 223.174 meters; to east end of ridge of barn, 21° 42′ 07″, 47.66 meters; to southwest corner of stone chimney of house, 236° 21′ 30″, 52.46 meters. The reference mark is in the field at the southeast corner of Cueba's land, 9.537 meters west of stone in center of road marking Cueba's property corner, and 0.32 meter north of the center line of posts of his south fence. (See note 1, p. 894.)

Myers (Clay County, Tex., O. W. Ferguson, 1902).—This station is 14 miles S. 12° 30′ W. of Henrietta, and 3½ miles S. 8° W. of Blue Grove, between the Henrietta and Antelope road to the northwest and the Henrietta and Jacksboro road to the east, on the high wooded ridge S. 76° W., 413 meters of W. H. Myers's house, and N. 7° 35′ E., 185 meters of the broken rocky bluff at end of hill, about 140 meters northeast of the highest part of the hill, on land known as the Charlton Thompson survey, owned by W. H. Myers. The azimuths and distances to certain points are: To reference mark, 8° 17′ 57.2″, 156.174 meters; to west gable of Myers's house, 256° 55′, 413 meters. The reference mark, about in center of a rocky break and 28 meters south of north end of central promontory, is a hole one-half inch in diameter and 3 inches deep, circumscribed by an equilateral triangle (one point directed to station) 10 inches on a side, deeply cut into the top surface of a very prominent rock. The underground mark is a hole 6 inches in diameter cut 6 inches deep in rock and filled with concrete; the mark has a spike point, as usual; 4 inches of sand are placed between the underground and surface marks. (See note 1, p. 894, for description of surface mark.)

Queen.—(Montague County, Tex., William Bowie, 1902.)—This station is 6 miles west of north from Bowie, on a prominent cone-shaped peak, known as "Queen Peak," at its highest point, on land of E. Bates. The azimuths and distances to certain points are: To reference mark No. 1, 192° 49′, 5.57 meters; to reference mark No. 2, 327° 31′, 5.14 meters. The reference marks are two holes drilled in solid rock three-fourths inch in diameter and 1½ inches deep, circumscribed by a triangle. The station mark is a hole dug between three large rocks to a depth of 26 inches, containing at the bottom 6 inches of concrete with the usual nail, and above this 3 inches of sand and the usual surface mark. (See note 1, p. 894, for description of surface mark.)

Jones (Clay County, Tex., O. W. Ferguson, 1902).—This station is 2¼ miles south and 3 miles west of the town of Vashti, 277.3 meters south from the south fence of the Newport and Henrietta road measured on the line of George's partition fence and 348 meters southwest from the fence corner formed by intersection of south and west roads at the northeast corner of George's lane, also 3.48 meters south and 3.80 meters west of the southeast corner of George's plowed field, on land formerly belonging to Freestone

County School, now owned by J. E. George. The azimuths and distances to certain points are: To reference mark, 96° 01′ 58″, 99.028 meters. The reference mark is in the corner of pasture land 0.62 meters east of fence running north, and 0.70 meters south of fence running to station. (See note 1, p. 894.)

Bowie Northwest Base (Clay County, Tex., A. L. Baldwin, 1900; William Bowie, 1902).—This station is on a prominent knoll 1 mile southeast of Bellevue, which is on the Fort Worth and Denver Railroad, one end of the Bowie base line measured by party under Computer A. L. Baldwin in 1900, on land of J. D. Orton. The azimuths and distances to certain points are: To reference mark 176° 42′, 159.16 meters; to southwest corner of Orton's house, 262° 27′, 123.74 meters; to southwest fence corner of Orton's garden, 191° 12′, 22.6 meters. The underground mark is a copper bolt leaded into bed rock 3 feet below the surface of the ground, over which is placed a pier of cement and concrete, with a station mark as described in note 2, p. 894. The reference mark is on the fence line between Orton's ranch and that to the north. It is a red sandstone post 12 inches deep and 6 inches square, with a hole 1 inch in diameter drilled in the center of the top, and so sunk as to project 3 inches above ground.

Bowie Southeast Base (Clay County, Tex., A. L. Baldwin, 1900, O. W. Ferguson, 1902).—This station is west of the city of Bowie and southeast of the town of Bellevue, on the highest part of a prominent ridge, the southeast terminal of the Bowie base line measured by the party under Computer A. L. Baldwin in 1900, on land of C. H. Bodeker. The azimuths and distances to certain points are: To reference mark, 45° 30′ 44″, 74.849 meters; to post marking a corner, 109° 50′, 423.5 meters. For description of the station marks see note 2, p. 894. The reference mark is at the top of the ledge southwest of the station, 14 feet from the front angle of break in rock and about in the center of a high knob of the rock, projecting about 4 inches above surface. It is the center of a hole ½ inch in diameter and 2½ inches deep, and is surrounded by a triangle 7 inches on a side cut in the rock.

BOWIE BASE NET TO STEPHENVILLE BASE.

Spradling (Jack County, Tex., William Bowie, 1902).—This station is on a wooded hill 450 meters east of the Newport–Jacksboro road, 6 miles south of Newport and 8 miles north of Cundiff, on land of J. A. Spradling. The azimuths and distances to certain points are: To reference mark, 148° 52′, 11.975 meters; to center of Spradling house, 358° 02′, 700 meters (about); to chimney of Mayo's house, 78° 58′, 700 meters (about); normal to fence between properties of J. A. Spradling and J. W. Mayo, 97° 02′, 39.3 meters. (See note 1, p. 894.)

Indian (Jack County, Tex., William Bowie, 1902).—This station is 1½ miles west of the eastern branch of the Jacksboro–Antelope road, at the highest point of the most southwesterly of the three prominent peaks known as the Indian Hills, on land of Gabe Washburn. The azimuths and distances to certain points are: To reference mark, 7° 06′ 26″, 13.33 meters. The station mark is a hole, 18 inches in diameter at top and 10 inches at bottom, dug to depth of 28 inches, containing 6 inches of concrete at the bottom in which is set a 60-penny wire nail with point projecting one-fourth inch, and above the concrete 3 inches of sand. The surface mark is as usual (see note 1, p. 894), except that the length of pipe is 20 inches. The reference mark is a hole three-fourths

inch in diameter drilled to a depth of 1½ inches in solid rock and surrounded by a triangular mark.

Jim Ned, U. S. G. S. (Montague County, Tex., U. S. Geological Survey).—This station is 8 miles southwest from St. Jo, 8 miles southeast from Montague, and 1 mile south of Dy Mound (P. O.), at the highest point of the bare, flat hill known as "Jim Ned Lookout," one-eighth mile east of the Dy Mound–Bowie road, and one-half mile northeast of house of B. R. Raymond, on land of B. R. Raymond. The azimuth and distance to Bowie Standpipe are, respectively, 75° 49′ 09″, and 13 miles. The station mark is a bronze tablet in a sandstone post 30 by 10 by 8 inches, set 28 inches in the ground.

Moore (Jack County, Tex., William Bowie, 1902).—This station is 4½ miles southeast of Jacksboro, at the highest point of the south end of a wooded ridge running north and south on land of H. H. Cobb, of Fort Worth, about one-half mile north of his house. The azimuth and distance to reference mark are, 185° 42′ 18″, 86.719 meters. The reference mark is in a clearing in the woods north of the station. (See note 1, p. 894.)

Davis (Jack County, Tex., William Bowie, 1902).—This station is 16 miles southeast of Jacksboro, on the Jacksboro and Gibtown wagon road, 150 yards southwest of the road, 4¼ miles west of Gibtown, and 3 miles south of Joplin, at the highest point of a wooded hill, on land of H. P. Sillivant. The azimuth and distance to reference mark are, respectively, 284° 24′ 46″.4, and 103.115 meters. The reference mark is at the fence corner east of the station on the west side of the Jacksboro–Gibtown road. (See note 1, p. 894.)

Woolly (Jack County, Tex., O. W. Ferguson, 1902).—This station is in the southwest corner of Jack County, 2 miles south of the Weatherford–Graham wagon road, 10 miles east of south from Bryson, 10 miles west of north from Christian, 7 miles northeast of Finis, 1 mile southwest of Sam Martin's house, and 1 mile south-southeast of Leslie Knight's house, on high table-land which forms the top of a spur of Salt Creek Mountains 4½ miles long by one-half to 1 mile wide, extending north-northeast and south-southwest, and lying between Long Hollow Creek to the north and west and Salt Creek to the east, on a level piece of ground on which oak trees are growing, about 1 mile from the southern end of the table-land, on property of Leslie Knight. The azimuths and distances to certain points are: To reference mark, 321° 08′ 33″, 131.051 meters; to Martin's house, west gable, 226° 55′ 02″, 1 mile (about). The reference mark is indicated by three square-blazed oak trees, one 6 inches in diameter N. 84° W., 7.30 meters; another 11 inches in diameter N 81° E., 8.36 meters; the third 9 inches in diameter S 13° E., 11.70 meters. (See note 1, p. 894.)

Gilbert (Parker County, Tex., William Bowie, 1902).—This station is 6½ miles, by road, north of west from Weatherford, 1½ miles north of the railway station at Lambert, one-half mile north of the Weatherford–Mineral Wells wagon road, and one-half mile south of the Blue Springs–Weatherford road, at about the center of a prominent bare ridge, on land of Mrs. A. N. Spivey. The azimuths and distances to certain points are: To reference mark, 261° 56′ 39″, 109.831 meters. The reference mark is located in a fence line near the top of the ridge east of the station. (See note 1, p. 894.)

Kyle (Palo Pinto County, Tex., O. W. Ferguson, 1902).—This station is 4 miles north by west of the town of Palo Pinto, 1⅓ miles west of the Palo Pinto–Jacksboro

wagon road, 3 miles south of the ford where this road crosses the Brazos River, on the highest part of Kyle Mountain, which rises above the south bank of the Brazos, and the top of which is table land of 2 acres area, in the middle of this area longitudinally and about one-fourth of the distance from the northeast end, on land of Mrs. T. Anna McClure. The azimuths and distances to certain points are: To reference mark, 38° 07′ 22″, 52.472 meters. The station mark is a 6-inch bed of concrete sunk 24 inches below the surface, containing a wire spike, point projecting one-fourth inch above the top of the concrete, covered with 4 inches of sand, above which a piece of terra-cotta pipe 14 inches long is placed together with a 60-penny wire nail, held in place by surrounding concrete. The reference mark is on one of the highest and most prominent of the large rocks near the station. It is a hole five-eighths inch in diameter and 1½ inches deep drilled into the rock, and surrounded by a triangle, 5 inches on a side, one apex pointing to station, cut into the rock.

Oaks (Palo Pinto County, Tex., O. W. Ferguson, 1902).—This station is 9 miles by wagon road south of Mineral Wells, on the east shore of the Brazos River, at about the extreme southwest point of a long, high ridge of table-land, 50 meters from the edge of the bluff to the southwest, on or near the south end of G. D. Oaks's ranch, on land claimed by G. D. Oaks and J. H. Whorton, lawsuit as to ownership pending. The azimuths and distances to certain points are: To reference mark, 198° 13′ 58″, 131.432 meters; to west pier of the Texas and Pacific Railroad bridge across the Brazos, 354° 05′ 15″, 1¾ miles (about). The station mark is indicated by two trees, one an elm 10 inches in diameter, blazed with a box blaze 3 feet above ground, 5.9 meters distant, N. 19° W.; the other an oak 12 inches in diameter, box blazed, 7.4 meters, S. 7° E. The station mark consists of a 20-inch hole, 34 inches deep, containing 6 inches of concrete at the bottom and a 60-penny wire nail set in the concrete, and the usual surface mark. (See note 1, p. 894.) The reference mark is 1.1 meters south of the east and west wire fence put up by Whorton and in line (extended) of the wire fence running from this fence northwest.

Comanche (Hood County, Tex., U. S. G. S. 1888, William Bowie, 1902.)—This station is 4¼ miles west of south from the town of Granbury, on what is known as Comanche Peak, near the southern edge in open ground, over the same point as used by the United States Geological Survey in 1888. The azimuth and distance to reference mark are, respectively, 78° 20′ 01″, and 49.306 meters. The station mark was as usual (see note 1, p. 894) except that 2-inch galvanized iron pipes were used in place of the usual terra-cotta pipe. The reference mark is at the edge of the brush west of the station.

McClenny (Erath County, Tex., O. W. Ferguson, 1902).—This station is 6 miles by road north of the town of Morgan Mills, on the Morgan Mills–Caraway–Roberts Settlements road, between the Morgan Mills–Gordon road to the west and the Morgan Mills–Santo road to the east, at the center and highest point of a long wooded ridge extending east-northeast and west-southwest, between Paluxy Creek to the south and Buck Creek to the north, also three-fourths mile west by south, from what is known as "B. D." spring, and 100 yards east of the road, on land of Dr. R. E. McClenny. The azimuths and distances to certain points are: To reference mark, 198° 47′ 28″, 53.915 meters; to east gable end of ridge beam of O. G. Roberts's house, 138° 56′ 45″, three-fourths mile (about). The station mark is indicated by three square-blazed oak

trees—one 14 inches in diameter, N. 38° E., 13.17 meters; another 9 inches in diameter, S. 65° E., 6.20 meters; the third, 8 inches in diameter, N. 88° W., 5.13 meters. The reference mark is indicated by three oak trees—one 10 inches in diameter, N. 34° E., 3.10 meters; another 6 inches in diameter, S. 56° E., 6.25 meters; the third, 8½ inches in diameter, S. 83° W., 6.70 meters. (See note 1, p. 894.)

Pilot (Erath County, Tex., William Bowie, 1902).—This station is 5 miles northeast of Stephenville and three-fourths mile south of the upper Stephenville–Granbury wagon road, on a round flat-top peak, known as "Pilot Knob," in its northwest corner and about 60 meters northeast of a pond of water on the western side of the hill, on land of J. W. Chenault. The azimuth and distance to reference mark are respectively 62° 29′ 22″ and 315.473 meters. The station mark is as usual (see note 1, p. 894), except that the underground mark is a 60-penny wire nail, set in 6 inches of concrete. The reference mark is in the southwest corner of Chenault's garden.

Lone Mountain (Erath County, Tex., William Bowie, 1902).—This station is 1 mile west of north from Skipper's Gap, near the southeast corner of the top of "Lone Mountain," on land of J. B. Vesey. The azimuth and distance to reference mark are respectively 323° 26′ 57″ and 35.027 meters. The station mark is as usual (see note 1, p. 894), except that the terra-cotta pipe is only 8 inches in length. The reference mark is a hole drilled in a rock and surrounded by a triangle cut in the rock, located southeast of the station, and indicated by a pile of stones 3 feet high placed over it.

Young (Erath County, Tex., O. W. Ferguson, 1902).—This station is 6 miles west-southwest of Stephenville, 6½ miles southwest by south from Singleville, 8 miles north by east from Dublin, and one-half mile north of the Stephenville–De Leon road, on high prairie pasture lying south of the South Bosque, northwest of Alarm Creek, and northeast of the Green Creek tributaries, on land of J. H. Young. The azimuths and distances to certain points are: To reference mark, 357° 11′ 51″, 291.457 meters; to D. D. H. Moore's house, center of chimney at west end, 3° 13′ 35″, 650 meters (about); to N. W. Kiker's house, center of chimney at west end, 35° 58′ 39″, 800 meters (about); to house of J. H. Young, tile chimney at south end, 236° 45′ 05″, 1,500 meters (about). The reference mark is just within fence in the southwest corner of Young's pasture, 4.51 meters from the center of the narrow lane running northeast and southwest, and 2.28 meters northeast of the lane running northwest and southeast. (See note 1, p. 894.)

Gatlin (Erath County, Tex., O. W. Ferguson, 1902).—This station is 9 miles by road N. 21° W. from the court-house at Stephenville, 3 miles S. 72° 30′ E. from Huckabay, 1 mile northeast of the Stephenville–Thurber road, about 600 yards east from the Bethel–Huckabay road, 107 meters northeast from the lane running to the house of Mrs. W. E. Carr, and 36.34 meters north from the line fence of Gatlin and Thompson running northeast and southwest, at the highest point of a wooded rocky hill, on land of E. J. Gatlin. The azimuths and distances to certain points are: To reference mark, 77° 18′ 44″, 107.772 meters; to center of the eastern face of stone chimney at eastern end of Mrs. Carr's house, 44° 01′ 24″, 166.85 meters; to center of chimney of house of Robert Thompson, 307° 23′ 05″, one-half mile (about). The underground station mark is 6 inches of cement with a 60-penny wire nail; the surface mark is as usual. (See note 1, p. 894.) The reference mark is 0.2 meter from the northeast fence along the lane to Mrs. Carr's house, on the field side.

Stephenville North Base (Erath County, Tex., A. L. Baldwin, 1900; William Bowie, 1902).—This station is 5½ miles east of the court-house at Stephenville and one-half mile north of the road to Skippers Gap post-office, at the highest point of a knoll known as Bunker Hill, on land of J. B. McAdams. The azimuth and distance to reference mark are respectively 165° 28′ 32″ and 9.94 meters. (For description of station mark see note 2, p. 894.) The reference mark is a hole surrounded by a triangle on the south side of the remains of an old chimney just north of the station.

Alarm (Erath County, Tex., O. W. Ferguson, 1902).—This station is 3 miles S. 32° W. from the court-house at Stephenville, one-fourth mile north of Lee Hughes's house, which stands on the north side of the "Lower Dublin road," on a high wooded ridge, which is girded on the south, west, and east sides by a bend of Alarm Creek, on land of J. P. Syler. The azimuths and distances to certain points are: To reference mark, 148° 25′ 59″, 76.584 meters; to end of ridge beam, west gable, house of W. H. Shanley, 256° 16′ 42″, 300 meters (about); to chimney, north end of house of Lee Hughes, 342° 38′ 05″, 400 meters (about). The station is indicated by three box-blazed oak trees near by—one 10.42 meters distant, S. 25° W., 10 inches in diameter; another 7.51 meters, S. 44° W., 11 inches in diameter; the third, 6.05 meters, N. 84° W., 7 inches in diameter. The reference mark is indicated by two box-blazed oak trees—one 4.30 meters, S. 72° E., 12 inches in diameter; the other 6.13 meters, S. 34° W., 10 inches in diameter. (For description of station and reference marks see note 1, p. 894.)

Stephenville South Base (Erath County, Tex., A. L. Baldwin, 1900; William Bowie, 1902).—This station is 1 mile south of west of Selden, 8 miles southeast of Stephenville, near the southern extremity of a low wooded ridge, 300 meters south of house of Thomas Perry. The azimuth and distance to reference mark, 44° 32′ 23″, 24.722 meters. (For description of station mark see note 2, p. 894.) The reference mark is a crosscut in a stone, which is about 12 by 4 by 30 inches deep, and is set in the ground southwest of the station, marked "U. S.," and is 2 meters from a tree blazed with a triangle.

STEPHENVILLE BASE NET TO LAMPASAS BASE.

Gibson (Erath County, Tex., William Bowie, 1902).—This station is 14 miles southeast of Dublin and 3 miles by road northwest of Carlton, in the corner of a field 65 meters southwest of the house of J. T. Gibson, and 15 meters from the Dublin–Carlton–Hamilton wagon road, on land of J. T. Gibson. The azimuth and distance to reference mark are respectively 202° 47′ 31″ and 39.213 meters. The reference mark is located just southwest of Gibson's house, in the corner of his garden. (For description of station and reference mark, see note 1, p. 894.)

Gleason (Hamilton County, Tex., O. W. Ferguson, 1902).—This station is 9 miles S. 33° E. from the city of Hico, 2½ miles northeast by east from the village of Fairy or Martins Gap, on a high ridge one-half mile north of what is known as Cedar Spring, and 180 meters north of the center of the land of John Linebarger. The azimuths and distances to certain points are: To reference mark, 331° 42′ 16″, 85.059 meters; to a stone 12 by 14 by 3 inches, slightly embedded, bearing the faint mark $\begin{matrix} U & S \\ + & \\ G & S \end{matrix}$ 243° 15′ 36″, 6.953 meters; to center of oak tree 20 inches in diameter, on

which the scaffold of the United States Geological Survey rested, 243° 56′ 18″, 8.380 meters; to south end of ridge beam, house of J. F. Merritt, 109° 58′ 44″, one-half mile (about); to north end of ridge beam, house of John Linebarger, 117° 57′ 34″, one-fourth mile (about). The reference mark is 0.32 meter from Linebarger's partition fence running north and south between the cultivated and the pasture land, on the pasture (western) side. The underground station mark is a 60-penny wire nail set in 6 inches of concrete. The surface station mark and the reference mark are as usual (see note 1, p. 894), except that galvanized iron pipe 2 inches in diameter is substituted for the terra-cotta pipe.

Chamliss (Hamilton County, Tex., William Bowie, 1902).—This station is 3 miles south of the town of Hamilton, on the more northern of two prominent knolls on land of J. M. Chamliss, 100 meters northwest of his house. The azimuth and distance to the reference mark are respectively 240° 04′ 48″ and 271.296 meters. The reference mark is located near the Hamilton–Lampasas wagon road at a fence corner which is the northeast corner of Chamliss's property. (For description of mark see note 1, p. 894.) The station mark is as follows: A hole 20 inches in diameter was dug 16 inches deep down to bed rock, and then a hole 3 inches in diameter and 8 inches deep was drilled in the rock; this lower hole was nearly filled with cement and in the cement a 60-penny wire nail was inserted, the point of the nail being 2 inches below the surface of the rock; the lower hole was then filled with sand level with the rock, and a piece of terra-cotta pipe 16 inches long and the surface mark set in in the usual way.

Scoggins (Hamilton County, Tex., O. W. Ferguson, 1902).—This station is 5 miles from Jonesboro, at the west side of the road along a high ridge, on land of J. S. Scoggin. The azimuths and distances to certain points are: To reference mark, 188° 37′ 45″, 69.286 meters; to west end of ridge beam of house of J. S. Scoggin, 320° 06′ 41″, 144.033 meters. The underground mark is a 60-penny wire nail set in concrete. The surface and reference marks are as usual (see note 1, p. 894), except that 2-inch galvanized-iron pipe is substituted for the 4-inch terra-cotta pipe. The station is indicated by an oak stump, 20 inches in diameter and 5½ feet high, in bend of fence, 16.09 meters distant, S. 83° 30′ E. The reference mark is 0.15 meter west of the fence on the east side of the road which separates the meadow land from the pasture land.

Brown (Coryell County, Tex., William Bowie, 1902).—This station is 4 miles by wagon road southeast of Evant, and one-fourth mile north of the Pearl–Evant wagon road, in the southeast corner of a field on land of W. H. Brown, and about 600 meters south of his house. The azimuth and distance to the reference mark are respectively 9° 23′ 32″, 94.035 meters. The station and reference marks are as usual, except that 2 by 24 inch galvanized iron pipe is used instead of terra cotta. (For description see note 1, p. 894.) The reference mark is located in the woods south of the station within 10 meters of three large oak trees marked with a triangle on side facing it.

King (Coryell County, Tex., O. W. Ferguson, 1902).—This station is 9¼ miles southwest from Gatesville, 1 mile northeast from King P. O., 1¼ miles south of the Gatesville–Pearl wagon road, one-fourth mile north of the Gatesville–Lampasas road, 1⅓ miles north-northeast from Cowhouse Creek, at the highest point of the rolling, brushy ground on the most prominent hill or mountain, owned by J. F. Culp. The

azimuths and distances to certain points are: To reference mark, 118° 15′ 55″, 57.153 meters; to south end of ridge beam, house of A. F. Neutzter, 190° 52′ 45″, three-fourths mile (about); to spire of the German Evangelical Church, 213° 36′ 32″, 2 miles (about). The station and reference marks are as usual (see note 1, p. 894), except that galvanized iron pipe 2 by 24 inches is used instead of the 4-inch terra-cotta pipe. The reference mark is in an open space of ground in line with two live-oak trees, 1.9 meters apart and 0.15 meter in diameter, the one nearer to the reference mark being box-blazed and distant 4.45 meters, N. 7° E.

Franklin (Lampasas County, Tex., William Bowie, 1902).—This station is 14 miles southwest of Copperas Cove and 3 miles south of east of Higgins Gap, near the southern extremity of a very prominent wooded ridge, running about northwest and southeast, on land of B. M. Franklin, of Lampasas. The azimuth and distance to the reference mark are respectively, 342° 55′ 33″ and 82.585 meters. The station and reference marks are as usual (see note 1, p. 894) except in the substitution of 2 by 24 inch galvanized iron pipe for the terra cotta. The reference mark is south of the station and about 2 meters east of a twin oak tree, each branch of which is marked with a triangle on the side facing it.

Gilmore (Coryell County, Tex., O. W. Ferguson, 1902).—This station is in the southwest corner of Coryell County, 2 miles S. 78° W. from the village of Copperas Cove, at the highest point and center of the wooded, starfish-shaped mountain, 150 yards north of the point where the telephone line crosses the ridge, on land of J. N. Gilmore. The azimuths and distances to certain points are: To reference mark, 215° 49′ 12″, 91.106 meters; to center of south face of stone chimney, house of H. B. Scott, 201° 51′ 41″, 1¼ miles (about); to center of chimney, house of C. H. Cosper, 180° 58′ 11″, three-fourths mile (about). The station is indicated by three trees, one a black oak, 7 inches diameter, S. 55° E., 11.41 meters, another a live oak, 12 inches diameter, S. 25° W., 20.15 meters, the third a red oak, 8 inches diameter, N. 11° E., 17.11 meters distant. The reference mark is indicated by two box-blazed live oaks, one 6 inches diameter, N. 18° E., 5.57 meters, the other 8 inches diameter, N. 73° E., 3.36 meters distant. (For description of station and reference marks see note 1, p. 894.)

Flat Top (Lampasas County, Tex., William Bowie, 1902).—This station is 8 miles northwest of Lampasas and three-fourths mile north of the Lampasas–Lorrietta wagon road, at about the center of the crest and 75 meters from the southeast end of what is known as Flat Top Peak. The azimuth and distance to the reference mark are, respectively, 149° 53′ 08″ and 17.396 meters. The station is marked as follows: A hole 20 inches in diameter was dug 16 inches deep, to bed rock, then a hole 3 inches in diameter was drilled to a depth of 8 inches; in this lower hole a copper bolt one-half inch in diameter and 4 inches long was set and surrounded by cement, the top of the bolt being 4 inches below the surface of the rock; the top of the lower hole was next filled to the surface of the rock with sand. The surface mark is a piece of 4-inch terra-cotta pipe set in the usual way. (For description see note 1, p. 894.) The reference mark is a hole drilled in solid rock and surrounded by a triangle cut in the rock.

Bachelor (Burnet County, Tex., William Bowie, 1902).—This station is 8 miles by road south of east from Lampasas and 600 meters northeast of the Lampasas–Georgetown wagon road, at the center of the top of a sharp-pointed hill called "Bachelor Peak," on land of A. S. Eldredge. No reference mark was put in on account of the

sharp-pointedness of the hill. The peak was a station of the United States Geological Survey, but no station mark was found. Owing to the shape of the hill, it is probable that the station of the United States Geological Survey was within a meter of the station of the Coast and Geodetic Survey. The station mark is the same as described for Flat Top (see p. 909) except that a 60-penny wire nail was used for the underground mark.

Lampasas Northeast Base (Lampasas County, Tex., A. L. Baldwin; 1900, O. W. Ferguson, 1902).—This station is 2½ miles S. 80° E. of Lampasas, 250 meters north of the "Lampasas–Belton" road, and 300 meters south of Sulphur Creek, at the highest and most northerly rocky and wooded point, on land of J. W. Mosley. The azimuths and distances to certain points are: To reference mark 70° 57′ 31″, 24.743 meters; to stone chimney, house of Judge Parks, 191° 39′ 49″, 500 meters; to stone chimney, house of Alec Northern, 310° 36′ 40″, 900 meters; to stone chimney, house of Will Griffin, 314° 44′ 20″, 1,100 meters. The reference mark is a three-fourths inch hole drilled to a depth of 2 inches, and surrounded by a triangle cut into the rock which is the highest in the vicinity. (For description of station mark see note 2, p. 894.)

Lampasas Southwest Base (Burnet County, Tex., A. L. Baldwin, 1900; O. W. Ferguson, 1902).—This station is 2 miles S. 8° E. from Lampasas, one-third mile east of the Settlement road, and 1 mile west of the Lampasas–Austin road, on land of J. H. H. Berry. The azimuths and distances to certain points are: To reference mark, 52° 33′ 13″, 43.957 meters; to stone chimney, Russell house, 253° 00′ 08″, 1¼ miles; to stone chimney, house of J. P. Berry, 294° 24′ 41″, one-half mile. The reference mark, located at the break of the hill in the most prominent cap rock, is a hole three-fourths inch in diameter drilled 1¾ inches deep into the rock and surrounded by a triangle 5 inches on a side cut in the rock. (For description of the station mark see note 2, p. 894.)

May (Burnet County, Tex., William Bowie, 1902).—This station is 17 miles west of south from Lampasas, 8 miles north of Burnet, and 30 meters west of the Lampasas–Burnet wagon road, on a wooded ridge running about northeast and southwest, and on land of A. L. May, 100 meters northeast of his house. The azimuths and distances to certain points are: To reference mark, 51° 56 09″, 151.635 meters; to flag pole, in tree, of United States Geological Survey, 143° 29′ 36″, 57.54 meters. The reference mark is 60 meters west of May's house. (For description of the underground station mark, see description of Flat Top, p. 909; for surface and reference marks see note 1, p. 894.)

Gabriel (Williamson County, Tex., O. W. Ferguson, 1902).—This station is about 650 meters east of the Georgetown–Roundrock–Gabriel Mills–Lampasas road, 2 miles S. 37° W. from Gabriel Mills, on the southwest point of what is known as Pilot Knob, on land of J. M. Pearson, three-fourths mile west of his house The azimuths and distances to certain points are: To reference mark No. 1, 184° 32′ 10″, 76.260 meters; to reference mark No. 2, 15° 38′ 51″, 24.067 meters. The reference mark to the north (No. 1) is indicated by two trees box-blazed, one a post oak, 8 inches in diameter, N. 86° E., 8.36 meters, the other a black jack, 5 inches diameter, S. 18° E., 4.94 meters. The reference mark to the south (No. 2), located at the southwest corner of the hill, is a hole three-fourths inch in diameter and seven-eighths inch deep, drilled in the rock, and surrounded by a triangle 3 inches on a side. This mark is indicated

by three oak trees, one 6 inches in diameter, N. 42° E., 15.83 meters; another 14 inches in diameter, N. 78° E., 13.05 meters; the third, 10 inches in diameter, S. 67° E., 18.86 meters. (For description of reference mark No. 1 and station mark see note 1, p. 894.)

SUBORDINATE TRIANGULATION STATIONS.

ANTHONY BASE NET TO LAMPASAS BASE.

Section 13, northwest corner T. 29 N., R. 7 W. (Oklahoma and Kansas, William Bowie, 1902).—This station is the center of stone approximately in the boundary line between Oklahoma and Kansas. It is common to secs. 13 and 14, T. 29 N., R. 7 W., of Oklahoma.

Boundary Stone 163 (Kansas and Oklahoma, William Bowie, 1902).—This station is on the southern line of sec. 15, T. 35 S., R. 6 W., of Kansas, 670 meters west of the southeast corner of sec. 15 and 157.3 meters east of the fence corner on the eastern side of the entrance to the house of Ira Livingood. The stone, which is of white sandstone 12 by 5 by 20 inches deep, was found in good condition and solidly set in the ground, projecting about 6 inches. It is marked as follows: On top, "163," north side, "K," and south side, "I. T."

Boundary Stone 160 (Kansas and Oklahoma, William Bowie, 1902).—This station is in the line of fence on south side boundary road, on northern line of school sec. 13, T. 29 N., R. 7 W., and 1077.1 meters east of the northwest corner of said section. Stone was found loose and reversed, but was placed in right position. It is of white sandstone, 12 by 5 by 20 inches deep, projects about 9 inches, and is marked on top, "160," north side "K," and south side, "I. T."

Sand Hill Reference Mark (Woods County, Okla., William Bowie, 1902).—Located in fence corner south of corner stone common to secs. 25 and 36, T. 28 N., R. 9 W. (See under Sand Hill, p. 895.)

Quarter Section Corner, secs. 25 and 36 (Woods County, Okla., William Bowie, 1902).—Stone. (See under Sand Hill, p. 895.)

Section 14, southeast corner, T. 28 N., R. 5 W. (Grant County, Okla., O. W. Ferguson, 1902).—See under Renfrow, p. 895.)

Township Corner, Ts. 25 and 26, Rs. 6 and 7 (Grant County, Okla., William Bowie, 1902).—Cedar post. (See under Vicar, p. 895.)

Section 3, southwest corner T. 24 N., R. 4 W. (Garfield County, Okla., O. W. Ferguson, 1902).—Stone. (See under Hahn, p. 896.)

Center Section 25, T. 23 N., R. 4 W. (Garfield County, Okla., O. W. Ferguson, 1902).—(See under Garber, p. 896.)

Quarter Section Corner, secs. 23 and 24 (Garfield County, Okla., William Bowie, 1902).—Stone. (See under Waukomis, p. 897.)

Section 29, southwest corner T. 17 N., R. 7 W. (Kingfisher County, Okla., William Bowie, 1902).—(See under Burson, p. 897.)

Section 17, southeast corner, T. 14 N, R. 6 W. (Canadian County, Okla., O. W. Ferguson, 1902).—Stone. (See under Eichoff, p. 897.)

Caddo Reference Mark (Canadian County, Okla., William Bowie, 1902).—Sand dune. (See under Caddo, p. 898.)

Section 9, southeast corner, T. 11 N., R. 7 W. (Canadian County, Okla., William Bowie, 1902).—Stone. (See under Elreno East Base, p. 898.)

Old Boundary Post (Chickasaw Nation, Ind. T., William Bowie, 1902).—Cottonwood post. (See under Carson, p. 898.)

Carson Reference Mark (Chickasaw Nation, Ind. T., William Bowie, 1902).—(See under Carson, p. 898.)

Quarter Section Corner, secs. 5 and 8, T. 9 N., R. 7 W. (Chickasaw Nation, Ind. T., William Bowie, 1902).—Stone. (See under Carson, p. 898.)

Quarter Section Corner, secs. 7 and 8, T. 6 N., R. 2 W. (Chickasaw Nation, Ind. T., O. W. Ferguson, 1902).—Stone. (See under Purcell, p. 899.)

Boundary Mark (Canadian County, Okla., sec. 9, T. 11 N., R. 7 W., William Bowie, 1902).—Monument. (See under Elreno East Base, p. 898.)

Marlow Secondary (Chickasaw Nation, Ind. T., William Bowie, 1902).—This station is 4½ miles north and one-half mile east of the town of Marlow, one-half mile east of the Chicago, Rock Island and Pacific Railroad, on a bare hill, in sec. 21, T. 3 N., R. 7 W. The station was marked as follows: An iron pipe 2 inches in diameter by 24 inches long was set in the ground so as to project 6 inches, and filled and surrounded by a column of concrete 20 inches deep and 18 inches in diameter; in the top of the pipe a 40-penny wire nail was inserted with the point projecting one-fourth inch as station center.

Marlow Latitude Station (Marlow, Ind. T., Edwin Smith, 1899).—This station is in the northeast corner of the public-school lot, at the southwest corner of Fifth street and Brummett avenue, and is a rough stone pier 10.2 feet west of Marlow Longitude Station.

Marlow Longitude Station (Marlow, Ind. T., Edwin Smith, 1899).—See under Marlow Latitude Station. The station is a concrete pier (stone and Portland cement) marked by a bronze station mark in the center of the pier.

Marlow Azimuth Station (Marlow, Ind. T., Edwin Smith, 1899).—This station is located 331.35 feet south of Marlow Longitude Station. The station mark is a stone with copper bolt, which is set accurately to within a fraction of a minute of arc.

Boundary Mile 45 (Oklahoma and Indian Territory, William Bowie, 1902).—This station is 2¼ miles west and 1¼ miles north of the town of Marlow, and is one of the United States Geological Survey boundary marks. The station mark is an iron post, surrounded by a brick and cement pier, with a copper or brass cap, on which is the following:

U. S. Geol. Survey
Oklahoma
Boundary
Line
Indian Territory
Mile 45
Elevation 1 269 feet
T. 2 N., R. 8 W.
S. 1.

Section 3, southeast corner, T. 2 N., R. 3 E. (Chickasaw Nation, Ind. T., O. W. Ferguson, 1902).—Stone. (See under Table Hill, p. 899.)

Section 21, southeast corner, T. 1 S., R. 1 W. (Chickasaw Nation, Ind. T., O. W Ferguson, 1902).—Stone. (See under Arbuckle Mountain, p. 900.)

Section 25, southwest corner, T. 1 S., R. 5 W. (Chickasaw Nation, Ind. T., O. W. Ferguson, 1902).—Stone. (See under Arbuckle, p. 900.)

Quarter-section corner, secs. 9 and 16 (Comanche County, Okla., William Bowie, 1902).—Stone. (See under Duncan, p. 901.)

Section 2, northeast corner, T. 4 S., R. 7 W. (Chickasaw Nation, Ind. U., O. W. Ferguson, 1902).—Stone. (See under Monument, p. 901.)

Township corner, Tps. 3 and 4 S., Rs. 3 and 4 W. (Chickasaw Nation, Ind. T., William Bowie, 1902).—(See under Lone Tree, p. 900.)

Section 24, southeast corner, T. 5 S., R. 7 W. (Chickasaw Nation, Ind. T., William Bowie, 1902).—(See under Benton, p. 901.)

Section corner, near Grady (Chickasaw Nation, Ind. T., William Bowie, 1902).—(See under Grady, p. 901.)

Evans, (?) U. S. G. S. (Hamilton County, Tex., O. W. Ferguson, 1902).—Stone. (See under Gleason, p. 907.)

COMPUTATION, ADJUSTMENT, AND ACCURACY OF THE ELEVATIONS ALONG THE NINETY-EIGHTH MERIDIAN SOUTHWARD.

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 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 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 Rutherford, Fowler, and Miller of the Anthony base net, southward to and including the Lampasas Base, were adjusted in six sets of equations.

The first adjustment involved all stations in the primary scheme from these three stations of the Anthony base net to and including the stations Enid and Waukomis.

The second adjustment involved all of the stations of the primary scheme from Waukomis and Garber, except Burson, to and including those in the Elreno base net.

The third adjustment involved all of the stations of the primary scheme from Yukon, Edmonds, and Carson to stations Duncan and Arbuckle.

The fourth adjustment involved all of the stations of the primary from Table Hill, Arbuckle, and Duncan to and including those of the Bowie base net, except Indian and Spradling.

The fifth adjustment involved those stations of the primary scheme from Bowie Northwest Base and Jones to and including those of the Stephenville base net.

The sixth and last adjustment involved the stations of the primary scheme from the Stephenville base net to and including the Lampasas base net.

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 applied to an observed difference of elevation to obtain the adjusted difference of elevation.

Station 1.	Station 2.	Weight p.	Observed diff. of elev. h_2-h_1.	Adjusted diff. of elev. h_2-h_1.	Adj.—Obs. v.	pv^2.
			m.	*m.*	*m.*	
Rutherford.	Sand Hill.	1.07	+13.78	+15.07	+1.29	1.780
Fowler.	Renfrow.	1.44	−15.86	−16.37	−0.51	0.374
Miller.	Renfrow.	1.63	−40.20	−40.42	−0.22	0.078
Miller.	Sand Hill.	1.60	−30.34	+30.32	−0.02	0.006
Renfrow.	Sand Hill.	0.73	+70.51	+70.74	+0.23	0.039
Renfrow.	Vicar.	1.06	−13.09	−11.72	+1.37	1.990
Sand Hill.	Vicar.	1.13	−83.10	−82.46	+0.64	0.463
Renfrow.	Hahn.	0.73	−33.70	−31.29	+2.41	4.240
Vicar.	Hahn.	1.41	−21.07	−19.57	+1.50	3.172
Vicar.	McCoy.	2.29	+67.69	−67.35	−0.34	0.266
Sand Hill.	McCoy.	0.71	−15.39	−15.11	+0.28	0.055
Hahn.	McCoy.	0.65	+85.35	+86.92	+1.57	1.602
Hahn.	Enid.	2.07	+43.66	+42.91	−0.75	1.163
Hahn.	Garber.	3.94	+16.58	+17.55	+0.97	3.708
Enid.	Garber.	2.13	−23.57	−25.36	−1.79	6.824
McCoy.	Waukomis.	1.02	−40.81	−40.37	+0.44	0.198

In the first adjustment, of which the direct results are indicated above, the elevations of the stations Rutherford, Fowler, and Miller were fixed by previous adjustment at the values 429.31, 390.01, and 414.06 meters, respectively, which are the elevations set forth on pages 284 and 288 of Appendix 3, Report for 1902, corrected by -15^{cm} to take account of the effect of new leveling recently introduced into the precise level net. Two other elevations were fixed by precise leveling, viz, Enid, 385.26 meters, and Waukomis, 388.90 meters.

The elevations of the six remaining stations connected by the observations are the unknowns to be determined by least squares from the sixteen observed differences of elevation indicated above.

The probable error of an observation of weight unity derived from the adjustment is ±1.09 meters. In other words, the reciprocal day observations over a line 31.71 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 1.09 meters. 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 precise leveling are about ±0.03 meter. The probable error approaches this value for stations adjacent to those fixed by precise leveling and is greatest for the most remote stations. Station Vicar 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 ±0.59 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 ±0.59.

In other words, for the least accurately determined station in the main scheme between the Anthony base net and the station Waukomis, there is an even chance that the elevation is correct within 0.6 meter, or 2.0 feet, and for most stations in the main scheme the accuracy is greater than this.

The results of the second adjustment, in which the stations concerned are those from Waukomis and Garber to the Elreno Base, are shown below in the form used for the first adjustment.

Station 1.	Station 2.	Weight p.	Observed diff. of elev. h_2-h_1.	Adjusted diff. of elev. h_2-h_1.	Adj.—Obs. v.	pv^2.
			m.	*m.*	*m.*	
Garber.	Mitchell.	1.72	+26.20	+26.76	+0.56	0.540
Waukomis.	Mitchell.	0.66	− 2.54	− 2.24	+0.30	0.059
Waukomis.	Parnell.	2.08	−30.84	−31.39	−0.55	0.629
Mitchell.	Wingard.	0.95	−36.78	−35.54	+1.24	1.461
Parnell.	Wingard.	0.86	− 5.10	− 6.39	− 1.29	1.431
Wingard.	Eichoff.	0.54	+57.82	+58.26	+0.44	0.105
Wingard.	Edmonds.	0.98	+22.16	+21.94	−0.22	0.047
Eichoff.	Edmonds.	0.79	−37.71	−36.32	+1.39	1.526
Eichoff.	Yukon.	1.53	+17.73	+16.74	−0.99	0.150
Eichoff.	Caddo.	4.04	+26.18	+26.53	+0.35	0.495
Edmonds.	Yukon.	0.92	+52.30	+53.06	+0.76	0.532
Caddo.	Yukon.	1.51	−10.21	−10.21	0.00	0.000
Caddo.	Elreno East Base.	2.80	+ 4.11	+ 4.28	+0.17	0.081
Yukon.	Elreno East Base.	3.38	+14.28	+14.07	−0.21	0.149
Caddo.	Elreno West Base.	4.06	+31.09	+31.02	−0.07	0.020
Elreno East Base.	Carson.	2.76	− 4.45	− 4.68	−0.23	0.146
Elreno West Base.	Carson.	1.53	−31.47	−31.42	+0.05	0.005
Yukon.	Carson.	1.15	+ 8.89	+ 9.39	+0.50	0.288

In this second adjustment the elevations of four stations were taken as fixed, namely: Garber fixed by the previous adjustment, its elevation being 359.90 meters, and the stations Waukomis, Elreno East Base, and Elreno West Base fixed by precise leveling, their elevations being 388.90, 440.19, and 466.93 meters, respectively. The elevations of the eight remaining stations indicated by the observations are the eight unknowns determined by least squares from the eighteen observed differences of elevation given in the above table.

In connection with this adjustment the elevation of station Burson was determined by using simultaneous observations, made between this station and station Eichoff, as the observers failed to secure reciprocal observations over other lines from Burson.

The probable error of an observation of weight unity derived from this adjustment is 0.59 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 0.59 meter. The probable errors of lines for 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 ±0.03 meter. The probable error approaches this value for stations adjacent to those fixed by precise leveling and is greatest for the most remote stations. Station Edmonds 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 ±0.42 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 ±0.42.

In other words, for the least accurately determined station in the main scheme between the line Waukomis–Garber and the Elreno Base there is an even chance that the elevation is correct within 0.4 meter, or 1.3 feet, and for most stations in the main scheme the accuracy is greater than this.

The results of the third adjustment, in which the stations concerned are those between the Elreno base net and station Arbuckle, are shown below in the form used for the first adjustment.

Station 1.	Station 2.	Weight p.	Observed diff. of elev. h_2-h_1.	Adjusted diff. of elev. h_2-h_1.	Adj.—Obs. v.	pv^2.
			m.	*m.*	*m.*	
Yukon.	Smith.	1.46	−20.32	−20.08	+0.24	0.09
Edmonds.	Smith.	1.04	+33.00	+32.98	−0.02	0.00
Carson.	Lanier.	0.79	−18.91	−19.49	−0.58	0.27
Smith.	Purcell.	0.59	−23.98	−23.43	+0.55	0.18
Lanier.	Purcell.	2.42	−33.20	−33.41	−0.21	0.10
Lanier.	Kechi.	0.47	+64.77	+64.62	−0.15	0.01
Lanier.	Osaria.	0.45	+25.28	+25.32	+0.04	0.00
Kechi.	Osaria.	0.87	−39.22	−39.30	−0.08	0.01
Purcell.	Table Hill.	0.70	+12.14	+11.86	−0.28	0.06
Lanier.	Table Hill.	0.46	−21.83	−21.55	+0.28	0.04
Osaria.	Table Hill.	0.71	−47.14	−46.87	+0.27	0.05
Osaria.	Duncan.	1.31	−67.85	−68.04	−0.19	0.05
Table Hill.	Arbuckle.	1.00	+ 2.67	+ 2.79	+0.12	0.01
Arbuckle.	Duncan.	0.71	−24.13	−23.96	+0.17	0.02

In this third adjustment the elevations of four stations were taken as fixed, namely: Yukon, Edmonds, and Carson, fixed by the previous adjustment, their elevations being 426.12, 373.06, and 435.51 meters, respectively, and the station Duncan, fixed by precise leveling, its elevation being 373.30 meters. The elevations of the seven remaining stations indicated by the observations are the seven unknowns determined by least squares from the fourteen observed differences of elevation given in the above table.

The probable error of an observation of weight unity derived from the adjustment is ±0.24 meter. Unit weight corresponds to reciprocal observations over a line 31.7 kilometers (19⅔ miles) long.

The probable error of the elevation of the station fixed by precise leveling is about ±0.03 meter. The probable errors of elevation vary from this to ±0.25 meter at station Kechi, as explained in connection with the first and second adjustments.

The results of the fourth adjustment, in which the stations concerned are those between the station Duncan and the Bowie Base, are shown below in the form used for the first adjustment.

Station 1.	Station 2.	Weight p.	Observed diff. of elev. h_2-h_1.	Adjusted diff. of elev. h_2-h_1.	Adj.—Obs. v.	pv^2.
			m.	*m.*	*m.*	
Table Hill.	Arbuckle Mountain.	1.02	+ 33.61	+ 33.14	−0.47	0.225
Arbuckle Mt.	Lone Tree.	1.02	−101.46	−101.93	−0.47	0.225
Arbuckle.	Lone Tree.	1.56	− 71.80	− 71.58	−0.22	0.075
Duncan.	Monument.	1.20	− 43.57	− 43.43	+0.14	0.024
Arbuckle.	Monument.	1.10	− 67.32	− 67.39	−0.07	0.006
Lone Tree.	Monument.	0.88	+ 4.05	+ 4.19	+0.14	0.018
Monument.	Benton.	3.69	− 28.41	− 28.43	−0.02	0.015
Lone Tree.	Benton.	0.82	− 23.74	− 24.24	−0.50	0.205
Lone Tree.	Grady.	1.60	− 42.80	− 42.70	+0.10	0.016
Benton.	Grady.	3.04	− 18.41	− 18.46	−0.05	0.006
Benton.	Blue.	0.78	+ 9.75	+ 10.69	+0.94	0.690
Monument.	Cube.	0.64	− 31.64	− 31.11	+0.53	0.180
Benton.	Cube.	1.25	− 1.78	− 2.68	−0.90	1.012
Blue.	Cube.	0.65	− 12.71	− 13.37	−0.66	0.283
Blue.	Queen.	1.82	+ 49.70	+ 50.34	+0.64	0.746
Cube.	Myers.	0.80	+ 48.06	+ 46.55	−1.51	1.824
Queen.	Jones.	1.91	− 0.78	− 0.02	+0.76	1.104
Queen.	Bowie Northwest Base.	6.19	− 35.04	− 35.00	+0.04	0.012
Jones.	Bowie Northwest Base.	5.71	− 35.09	− 34.98	+0.11	0.069
Myers.	Bowie Northwest Base.	1.96	− 17.22	− 17.84	−0.62	0.753
Queen.	Bowie Southeast Base.	9.44	− 29.02	− 29.07	−0.05	0.019
Jones.	Bowie Southeast Base.	5.93	+ 29.19	− 29.05	+0.14	0.119

In this fourth adjustment the elevations of five stations were taken as fixed, as follows: Table Hill and Arbuckle, fixed by the previous adjustment, their elevations being 394.47 and 397.26 meters, respectively, and the stations Duncan, Bowie Northwest Base, and Bowie Southeast Base fixed by precise leveling, their elevations being 373.30, 327.46, and 333.40 meters, respectively. The elevations of the ten remaining stations indicated by the observations are the ten unknowns determined by least squares from the twenty-two observed differences of elevation given in the above table.

The probable error of an observation of weight unity derived from this adjustment is ±0.52 meter. Unit weight as before corresponds to reciprocal observations over a line 31.7 kilometers (19⅔ miles) long.

The probable errors of the elevations of the three stations fixed by precise leveling are about ±0.03 meter. The probable errors of elevation vary from this to ±0.32 meter, or 1.0 foot, at station Blue, as explained in connection with the first and second adjustments.

The results of the fifth adjustment, in which the stations concerned are those between the Bowie Base and the Stephenville Base, are shown below in the same form used for the first adjustment.

Station 1.	Station 2.	Weight p.	Observed diff. of elev. h_2-h_1.	Adjusted diff. of elev. h_1-h_1.	Adj. Obs. v.	pv^2.
			m.	m.	m.	
Bowie Northwest Base.	Spradling.	1.60	+48.86	+48.25	—0.61	0.595
Jones.	Spradling.	4.66	+12.96	+13.27	+0.31	0.447
Jones.	Indian.	1.16	+32.81	+32.78	—0.03	0.001
Spradling.	Indian.	1.49	+19.44	+19.51	+0.07	0.007
Spradling.	Moore.	1.62	+ 8.07	+ 7.91	—0.16	0.042
Indian.	Moore.	1.91	—11.92	—11.60	+0.32	0.195
Moore.	Davis.	3.55	+ 3.21	+ 2.85	—0.36	0.462
Spradling.	Davis.	0.72	+ 9.89	+10.76	+0.87	0.545
Indian.	Woolly.	1.19	+54.96	+54.48	—0.48	0.274
Moore.	Woolly.	1.89	+65.20	+66.08	+0.88	1.463
Davis.	Woolly.	1.22	+63.78	+63.23	—0.55	0.368
Woolly.	Kyle.	1.39	—37.35	—37.33	+0.02	0.000
Woolly.	Gilbert.	0.42	—53.48	—52.54	+0.94	0.371
Kyle.	Gilbert.	0.63	—15.48	—15.21	+0.27	0.046
Gilbert.	Oaks.	1.71	—62.58	—62.34	+0.24	0.099
Kyle.	Oaks.	1.76	—77.21	—77.55	—0.34	0.204
Kyle.	McClenny.	0.55	—11.67	—10.81	+0.86	0.407
Oaks.	McClenny.	1.32	+66.56	+66.74	+0.18	0.042
Gilbert.	Comanche.	0.43	—22.84	—22.45	+0.39	0.065
Oaks.	Comanche.	0.48	+40.80	+39.89	—0.91	0.397
McClenny.	Comanche.	0.71	—27.16	—26.85	+0.31	0.068
McClenny.	Gatlin.	4.62	+51.18	+51.19	+0.01	0.000
McClenny	Pilot.	2.09	+24.55	+24.79	+0.24	0.121
Gatlin.	Pilot.	5.57	—26.40	—26.40	+0.00	0.000
Comanche.	Pilot.	0.86	+51.57	+51.64	+0.07	0.004
Pilot.	Lone.	3.64	+ 2.68	+ 2.62	—0.06	0.015
McClenny.	Lone.	0.75	+27.56	+27.41	—0.15	0.016
Comanche.	Lone.	1.09	+54.75	+54.26	—0.49	0.262
Gatlin.	Young.	3.80	+ 6.82	+ 7.31	+0.49	0.912
Pilot.	Young.	3.25	+33.74	+33.71	—0.03	0.003
Lone.	Young.	1.22	+30.82	+31.09	+0.27	0.089
Pilot.	Alarm.	6.93	+ 5.38	+ 5.78	+0.40	1.109
Gatlin.	Alarm.	3.69	—20.13	—20.62	—0.49	0.886
Young.	Alarm.	18.71	—27.96	—27.93	+0.03	0.017
Pilot.	Stephenville N. Base.	17.34	+ 0.62	+ 0.52	—0.10	0.173
Lone.	Stephenville N. Base.	8.20	— 2.07	— 2.10	—0.03	0.008
Alarm.	Stephenville N. Base.	8.69	— 5.33	— 5.26	+0.07	0.043
Young.	Stephenville N. Base.	3.11	—33.35	—33.19	+0.16	0.081
Lone.	Stephenville S. Base.	8.36	—28.57	—28.63	—0.06	0.030
Young.	Stephenville S. Base.	2.83	—59.88	—59.72	+0.16	0.074
Alarm.	Stephenville S. Base.	7.26	—31.93	—31.79	+0.14	0.145

In this fifth adjustment the elevations of three stations were taken as fixed, as follows: Jones fixed by the previous adjustment, its elevation being 362.45 meters and Bowie Northwest Base and Comanche fixed by precise leveling, their elevations being 327.47 and 374.71 meters, respectively. In addition to these three fixed elevations, one difference of elevation was taken as fixed, that between Stephenville North Base and Stephenville South Base having been fixed by precise leveling as 26.53 meters, which decreases by one the number of unknown stations remaining to be fixed. The elevations of the fifteen remaining stations indicated by the observations are the

fifteen unknowns determined by the least squares from the forty-one ooserved 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 as before corresponds to reciprocal observations over a line 31.7 kilometers (19⅔ miles) long.

The probable errors of the elevations of the two stations fixed by precise leveling are about ±0.03 meter. The probable errors of elevation vary from this to ±0.31 meter or 1.0 foot at station Gilbert, as explained in connection with the first and second adjustments.

The probable error of the Stephenville North Base and Stephenville South Base was computed to be ±0.24 meter, including the errors of the precise leveling.

The results of sixth adjustment, in which the stations concerned are those between the Stephenville Base and the Lampasas Base, are shown below in the same form for the first adjustment.

Station 1.	Station 2.	Weight p.	Observed diff. of elev. h_2-h_1.	Adjusted diff. of elev. h_2-h_1.	Adj.—Obs. v.	pv^2.
			m.	m.	m.	
Young.	Gibson.	1.18	− 36.85	− 37.05	− 0.20	0.047
Lone.	Gibson.	1.05	− 6.52	− 5.96	+ 0.56	0.330
Stephenville N. B.	Gibson.	1.18	− 4.18	− 3.86	+ 0.32	0.120
Stephenville S. B.	Gibson.	1.87	+ 22.75	+ 22.67	− 0.08	0.011
Lone Mountain.	Gleason.	0.93	− 24.38	− 23.11	+ 1.27	1.500
Gibson.	Gleason.	1.52	− 17.04	− 17.15	− 0.11	0.018
Gibson.	Chamliss.	0.94	− 13.83	− 14.21	− 0.38	0.135
Gleason.	Chamliss.	1.16	+ 2.07	+ 2.94	− 0.87	0.878
Gibson.	Scoggins.	0.56	− 45.07	− 43.08	+ 1.99	2.218
Chamliss.	Scoggins.	1.83	− 28.56	− 28.87	− 0.31	0.176
Chamliss.	Brown.	1.71	+ 39.18	+ 39.44	+ 0.26	0.116
Scoggins.	Brown.	0.80	+ 67.61	+ 68.31	+ 0.70	0.392
Chamliss.	King.	0.75	− 52.17	− 51.12	+ 1.05	0.825
Brown.	King.	2.05	− 90.21	− 90.56	− 0.35	0.250
Brown.	Franklin.	2.03	− 22.25	− 21.08	+ 1.17	2.779
King.	Franklin.	2.04	+ 69.42	+ 69.48	+ 0.06	0.008
King.	Gilmore.	1.04	+ 34.57	+ 34.51	− 0.06	0.004
Franklin.	Gilmore.	2.94	− 35.22	− 34.97	+ 0.25	0.182
Brown.	Flat Top.	0.82	+ 19.36	+ 18.54	− 0.82	0.551
Franklin.	Flat Top.	2.07	+ 39.79	+ 39.62	− 0.17	0.039
Gilmore.	Flat Top.	1.09	+ 74.87	+ 74.59	− 0.28	0.085
Flat Top.	Bachelor.	2.06	− 42.77	− 43.05	− 0.28	0.161
Franklin.	Bachelor.	1.25	− 4.49	− 3.43	+ 1.06	1.405
Gilmore.	Bachelor.	2.35	+ 30.55	+ 31.54	+ 0.99	1.903
Bachelor.	Lampasas NE. Base.	14.49	−108.43	−108.24	+ 0.19	0.522
Flat Top.	Lampasas NE. Base.	4.98	−151.28	−151.29	− 0.01	0.000
Bachelor.	Lampasas SW. Base.	17.46	− 42.24	− 42.10	+ 0.14	0.332
Flat Top.	Lampasas SW. Base.	3.96	− 85.08	− 85.15	− 0.07	0.020
Franklin.	Lampasas SW. Base.	1.29	− 46.17	− 45.55	+ 0.62	0.495
Bachelor.	May.	2.73	+ 42.96	+ 42.98	+ 0.02	0.000
Flat Top.	May.	1.04	+ 0.36	− 0.07	− 0.43	0.192
Lampasas SW. B.	May.	3.17	+ 84.84	+ 85.08	+ 0.24	0.184
Gilmore.	Gabriel.	0.64	− 23.42	− 23.88	− 0.46	0.136
Bachelor.	Gabriel.	1.00	− 55.35	− 55.42	− 0.07	0.005
May.	Gabriel.	0.88	− 98.82	− 98.40	+ 0.42	0.155

In this sixth adjustment the elevations of seven stations were taken as fixed, as follows: Lone, Young, Stephenville North Base and Stephenville South Base fixed by the previous adjustment, their elevations being 428.97, 460.06, 426.87, and 400.34 meters,

respectively, and Gilmore, Lampasas Northeast Base and Lampasas Southwest Base fixed by precise leveling, their elevations being 392.15, 315.45, and 381.59 meters, respectively. The elevations of the eleven remaining stations indicated by the observations are the eleven unknowns determined by the least squares from the thirty-five observed differences of elevation given in the above table.

The probable error of an observation of weight unity derived from this adjustment is ±0.55 meter. Unit weight has the same meaning as in the preceding adjustments.

The probable errors of the elevations of the three stations fixed by precise leveling are about ±0.03 meter. The probable errors of elevation vary from this to ±0.38 meter, or 1.3 feet, at station Scoggins, as explained in connection with the first and second adjustments.

In the preceding adjustments day observations only were used. The elevations published in this appendix depend on day observations alone.

During this season the unusual plan was followed of taking night observations of the vertical angles as well as day observations. The writer believed from the little information on the subject available to him that the night observations would be of about the same degree of accuracy as the day observations. Accordingly, adjustments similar to those shown on the preceding pages were made, using the night observations only. The computation showed that for each of the localities covered by these adjustments the errors in the night observations were from two to ten times as large upon an average as the errors of the day observations, or the weights from one-fourth to one one-hundreth as large as for day observation. This was true of the mean results, even though the night observations over each line were in general more numerous than the day observations. Accordingly, the night observations were all rejected as being of too low a grade of accuracy to be of value.

TABLE OF ELEVATIONS.

The datum for all the elevations is mean sea level.

The stations are in three classes: First, those fixed directly by the precise leveling, and of which the elevation is subject to a probable error of ±0.03 meter; second, the primary stations fixed by reciprocal measures of vertical angles and which are subject to probable errors varying from ±0.1 to ±0.6 meter; third, the tertiary stations of which the elevations are fixed by measurements of vertical angles which are not reciprocal, the tertiary stations not being occupied. These elevations are subject to probable errors which may be a great as ±2 meters in some cases. For more exact elevations of the stations fixed by the precise leveling, and for an exact description of the point on each station mark to which such elevations are referred see Appendix 3 of this Report.

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 precise leveling, as indicated in class 1 of the following table. Station Vicar is probably least accurately determined of all the stations to the southward of the Anthony base net or Kansas-Oklahoma Line, its probable error being ±0.6 meter.

For a table to be used in converting feet to meters, or vice versa, see page 881

Table of elevations.

Stations.	Point to which elevation refers.	Elevation.
Class 1.		*Meters.*
Enid.	Square cut.	385. 26
Waukomis.	Square cut.	388. 90
Class 2.		
Rutherford.	Station mark.	429. 3
Fowler.	Station mark.	390. 0
Miller.	Station mark.	414. 1
Renfrow.	Station mark.	373. 6
Sand Hill.	Station mark.	444. 4
Vicar.	Station mark.	361. 9
Hahn.	Station mark.	342. 4
McCoy.	Station mark.	429. 3
Garber.	Station mark.	359. 9
Class 3.		
Miller Eccentric.	Ground.	413. 7
Section 13, northwest corner.	Ground.	385. 4
Livingood's House.	Top of chimney.	392. 0
First Auxiliary.	Ground.	382. 6
Boundary Stone 160.	Top of stone.	382. 2
Red Barn.	Ridge of roof.	391. 8
Boundary Stone 163.	Top of stone.	373. 2
Camchester Schoolhouse.	Ridge of roof.	414. 2
Manchester Schoolhouse.	Ridge of roof.	398. 4
Quarter section corner, sections 25 and 36.*	Stone.	428. 0
Sand hill Reference Mark.	Top.	428. 6
Wakita Low Elevator.	Top.	369. 1
Wakita High Elevator.	Top.	372. 8
Wakita Church.	Ridge of roof.	365. 2
Renfrow Christian Church.	Top of spire.	385. 6
Renfrow Low Elevator.	Top.	381. 8
Renfrow High Elevator.	Top.	385. 6
Medford Schoolhouse.	Center of dome.	349. 8
Numa Elevator.	Ridge of shaft.	352. 2
Antioch Church.*	Top of spire.	353. 6
Pond Creek Schoolhouse.	Top of dome.	339. 1
Pond Creek Roller Mill, east cupola.	Top.	336. 2
Pond Creek Standpipe.*	Bottom of tank.	348. 5
Kremlin Schoolhouse.	Bottom of cupola.	352. 1
Kremlin Elevator, east gable.	Top.	357. 8
Garber Elevator, center shaft.	Ridge of roof.	374. 9
Garber Church, white spire.	Top of spire.	372. 4
Cropper East Elevator.	Ridge of roof.	374. 6
Breckenridge M. E. Church.	Ridge of roof.	379. 6
Breckenridge Highest Elevator.	Ridge of roof.	381. 3
North Enid Congregational Church	Ridge of roof.	395. 0
Enid Schoolhouse.*	Bottom of spire.	394. 5
Enid Catholic Church.	Bottom of spire.	391. 4
Enid Ice Plant, stack.	Top of stack.	403. 0
Enid Big Four Elevator.	Top.	397. 1
Class 1.		
Elreno East Base.	Station mark.	440. 19
Elreno West Base.	Station mark.	466. 93

*No check on this elevation.

Table of elevations—Continued.

Stations.	Point to which elevation refers.	Elevation.
		Meters.
Class 2.		
Mitchell.	Station mark.	386.7
Parnell.	Station mark.	357.5
Wingard.	Station mark.	351.1
Eichoff.	Station mark.	409.4
Burson.	Station mark.	356.5
Edmonds.	Station mark.	373.1
Caddo.	Station mark.	435.9
Yukon.	Station mark.	426.1
Carson.	Station mark.	435.5
Class 3.		
Waukomis Schoolhouse.	Bottom of cupola.	398.6
Bison Highest Elevator, center shaft.	Top.	393.0
Bison Low Elevator.	Top.	391.1
Hennessey Roller Mill, stack.*	Top of stack.	372.0
Hennessey Windmill.	Center of wheel.	371.2
Hennessey Schoolhouse.	Bottom of cupola.	365.7
Hennessey Elevator.	Top.	370.5
Section 29, T. 17 N., R. 7 W., southwest corner.*	Top.	354.5
Kingfisher Court-House.*	Bottom of dome.	340.4
Kingfisher College.*	Top of dome.	351.8
Kingfisher Standpipe.	Top.	367.2
Guthrie Standpipe.	Top.	345.9
Guthrie St. Joseph Church.	Top of east spire.	350.8
Okarche Catholic Church.	Ridge of roof.	383.6
Okarche Elevator, center top.	Ridge of roof.	395.5
Edmonds College.	Top of dome.	396.4
Caddo Schoolhouse, water tank.	Top.	448.2
Darlington Water Tank.	Top of cylinder.	431.9
Fort Reno high Water Tank.	Top.	445.7
Fort Reno low Water Tank.*	Top.	440.4
Elreno Standpipe.	Top.	460.5
Elreno Kerfoot Hotel.	Bottom of cupola.	432.1
Elreno Catholic Church.	Bottom of spire.	428.1
Elreno Fire Department.	Bottom of bellfry.	432.0
Elreno Can. Mill. Co. Elevator.	Ridge of roof.	443.6
Midland Schoolhouse.	Ridge of roof.	445.3
Oklahoma City Church, highest spire.	Top of spire.	396.9
House with square roof.	Top of north chimney.	390.1
Union Catholic Church.	Ridge of roof.	414.3
Union Red Elevator.	Top.	417.5
Minco, Elmeta Bond College.	Bottom of cupola.	410.5
Minco Red Elevator.	Top.	417.8
Quarter section corner, sections 5 and 8.*	Top.	421.3
Class 1.		
Duncan.	Square cut in concrete.	373.30
Marlow Longitude Station.	Cross on Sta. mark.	400.14
Class 2.		
Smith.	Station mark.	406.0
Lanier.	Station mark.	416.0
Purcell.	Station mark.	382.6
Kechi.	Station mark.	480.6
Osaria.	Station mark.	441.3
Table Hill.	Station mark.	394.5
Arbuckle.	Station mark.	397.3

* No check on this elevation.

Table of elevations—Continued.

Stations.	Point to which elevation refers.	Elevation.
		Meters.
Class 3.		
Moore Elevator.	Ridge of roof.	398.9
Marlow Secondary.	Station mark.	427.5
Boundary Mile 45.*	Top of post.	386.8
Marlow Baptist Church.	Bottom of spire.	406.6
Marlow Methodist Church.	Top of spire.	410.4
Class 1.		
Bowie Northwest Base.	Center of mark.	327.46
Bowie Southeast Base.	Center of mark.	333.40
Class 2.		
Arbuckle Mountain.	Station mark.	427.6
Lone Tree.	Station mark.	325.7
Monument.	Station mark.	329.9
Benton.	Station mark.	301.4
Grady.	Station mark.	283.0
Blue.	Station mark.	312.1
Cube .	Station mark.	298.8
Queen.	Station mark.	362.5
Myers.	Station mark.	345.3
Jones.	Station mark.	362.4
Class 3.		
Nocona Baptist Church.	Ridge of roof.	313.2
Nocona Schoolhouse.	Ridge of roof.	315.8
Ringgold Presbyterian Church.	Top of tower.	289.6
Henrietta Court-House.	Top of tower.	311.8
Henrietta Schoolhouse.	Top of tower.	297.4
Henrietta Standpipe.	Top.	311.7
House, 5 miles southeast of Henrietta.	Ridge of roof.	302.7
House, east of Grady.*	Ridge of roof.	285.8
House on ridge, north chimney.	Top of chimney.	317.7
Bellevue, Webb's House.	Peak of cupola.	336.3
Bellevue, M. E. Church.*	East gable.	345.7
Bellevue, Orton's Windmill.	Center of wheel.	333.3
Bowdeckers Windmill.	Center of wheel.	340.8
Bowie National Hotel.	Lower edge of conical roof of tower.	365.5
Bowie Methodist Church.	Ridge of roof.	359.3
Bowie Standpipe.	Top.	383.3
Class 1.		
Comanche.	Station mark.	374.71
Class 2.		
Spradling.	Station mark.	375.7
Indian.	Station mark.	395.2
Moore.	Station mark.	383.6
Davis.	Station mark.	386.5
Woolly.	Station mark.	449.7
Kyle.	Station mark.	412.4
Gilbert.	Station mark.	397.2
Oaks.	Station mark.	334.8
McClenny.	Station mark.	401.6
Pilot.	Station mark.	426.4
Gatlin.	Station mark.	452.8
Lone.	Station mark.	429.0
Young.	Station mark.	460.1

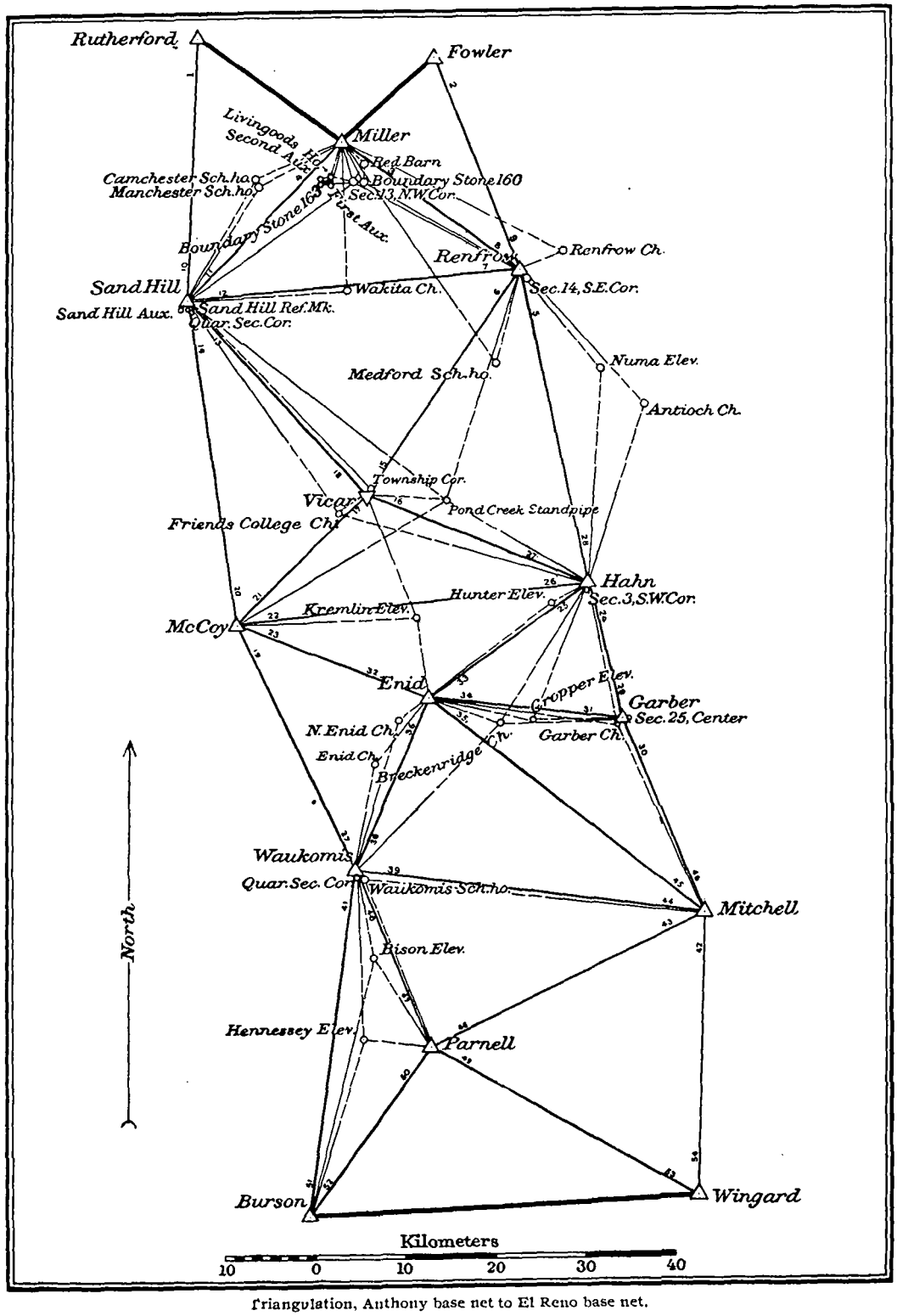
* No check on this elevation.

Table of elevations—Continued.

Stations.	Point to which elevation refers.	Elevation.
Class 2—Continued.		*Meters.*
Alarm.	Station mark.	432.1
Stephenville North Base.	Station mark.	426.9
Stephenville South Base.	Station mark.	400.3
Class 3.		
Chico Church with open spire.	Ridge of roof.	338.1
Chico Church with square-top spire.	Ridge of roof.	338.8
Jacksboro Court-House.	Ridge of roof.	349.0
Jacksboro Jail.	Top of spire.	339.6
Old Chimney, northwest of Joplin.	Top of chimney.	372.5
Agnes Highest Windmill.	Center of wheel.	387.0
Agnes Schoolhouse.	Ridge of roof.	387.1
Weatherford White House.*	Bottom of cupola.	367.4
Weatherford Yellow House.	Bottom of cupola.	358.2
Weatherford Tank near White House.*	Top of tank.	368.4
Lingleville Open Belfry.	Top of belfry.	489.6
Lingleville Schoolhouse.	Top of cupola.	493.8
Stephenville Court-House.	Top of spire.	423.7
Stephenville Oil Mill.	Top of stack.	416.1
Stephenville, Tarleton College.	Top of conical tower.	423.6
Stephenville, Tarleton College.	Top of roof.	413.6
Long House, north center chimney.	Top of chimney.	448.6
Johnsonville Cotton Gin.	Top of stack.	395.0
Dublin Standpipe.	Top.	477.1
Dublin High School.	Ridge of roof.	475.2
Dublin Church.	Ridge of roof.	466.1
Dublin Oil Mill.	Top of tower.	470.7
Class 1.		
Lampasas Northeast Base.	Center of mark.	315.45
Lampasas Southwest Base.	Center of mark.	381.59
Gilmore.		392.15
Class 2.		
Gibson.	Station mark.	423.0
Gleason.	Station mark.	405.9
Chamliss.	Station mark.	408.8
Scoggins.	Station mark.	379.9
Brown.	Station mark.	448.2
King.	Station mark.	357.7
Franklin.	Station mark.	427.1
Flat Top.	Station mark.	466.7
Bachelor.	Station mark.	423.7
May.	Station mark.	466.7
Gabriel.	Station mark.	368.3
Class 3.		
Purves Schoolhouse.	Top of roof.	445.8
Purves Cotton Gin.	Top of stack.	450.5
Carleton Cotton Gin.	Top of stack.	429.0
Olin Cotton Gin.*	Top of stack.	421.3
White Church, southeast of Chamliss.	Ridge of roof.	377.1
Copperas Cove Church.*	Top of spire.	342.0
Copperas Cove Schoolhouse.	Top of roof.	343.2
Waters Mountain, U. S. G. S.	Station mark.	486.8
Lampasas Court-House.	Top of dome.	334.7
Lampasas Springhouse.	Top of cupola.	334.9
Lampasas Schoolhouse.	Top of cupola.	335.8
Lampasas First Baptist Church, spire.	Top of pyramid.	343.8

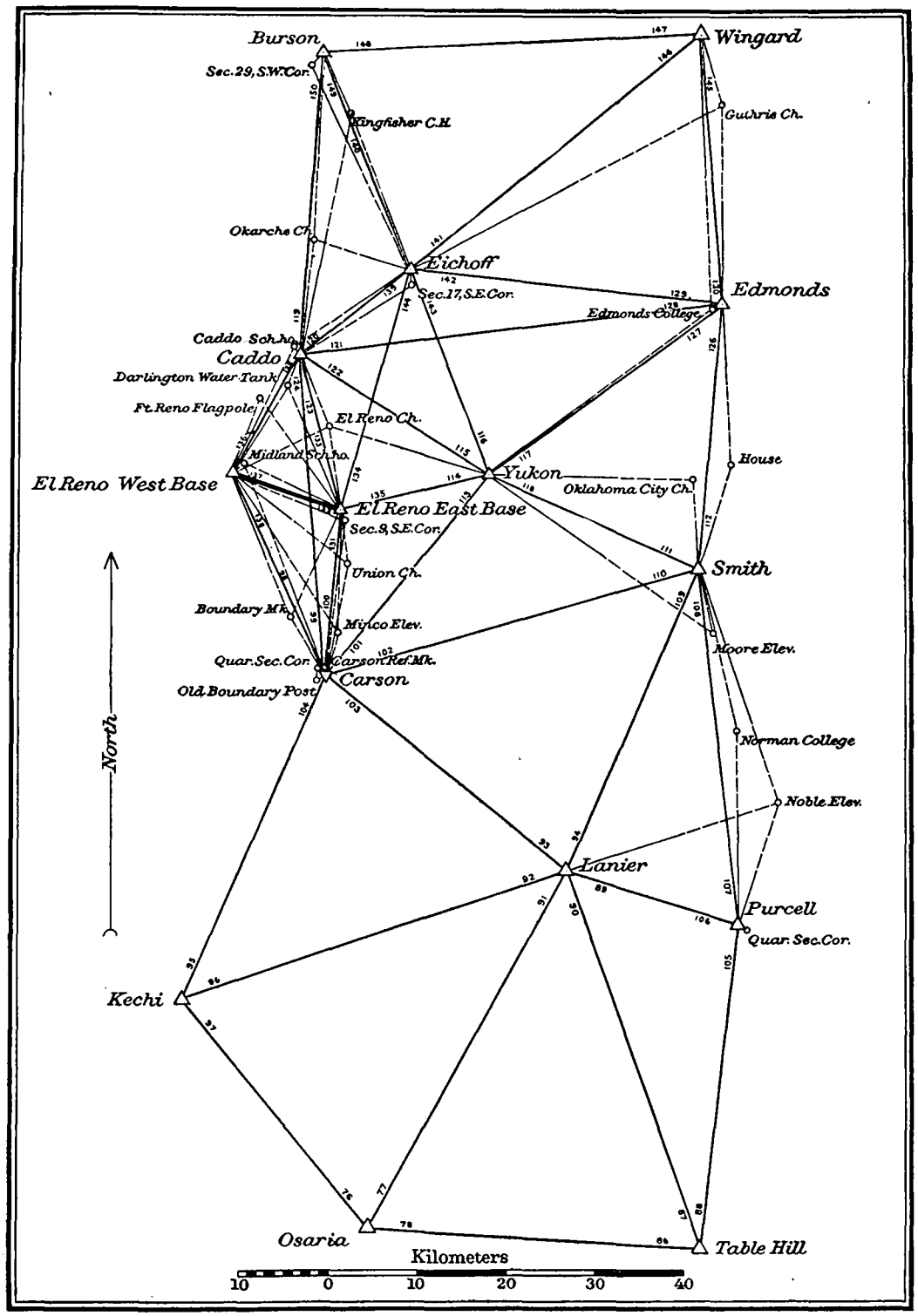
* No check on this elevation.

No. 11.



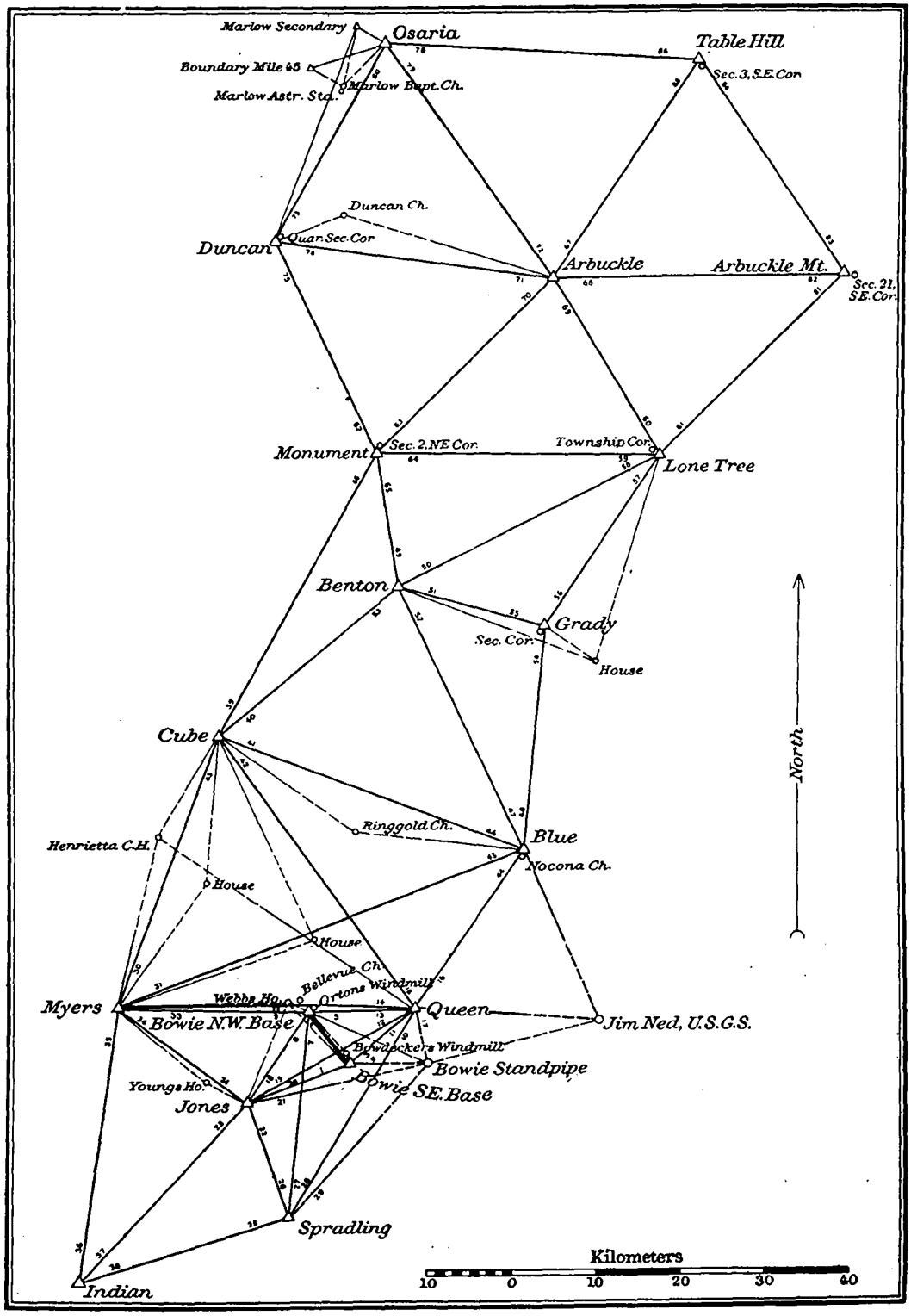
Triangulation, Anthony base net to El Reno base net.

No. 12.



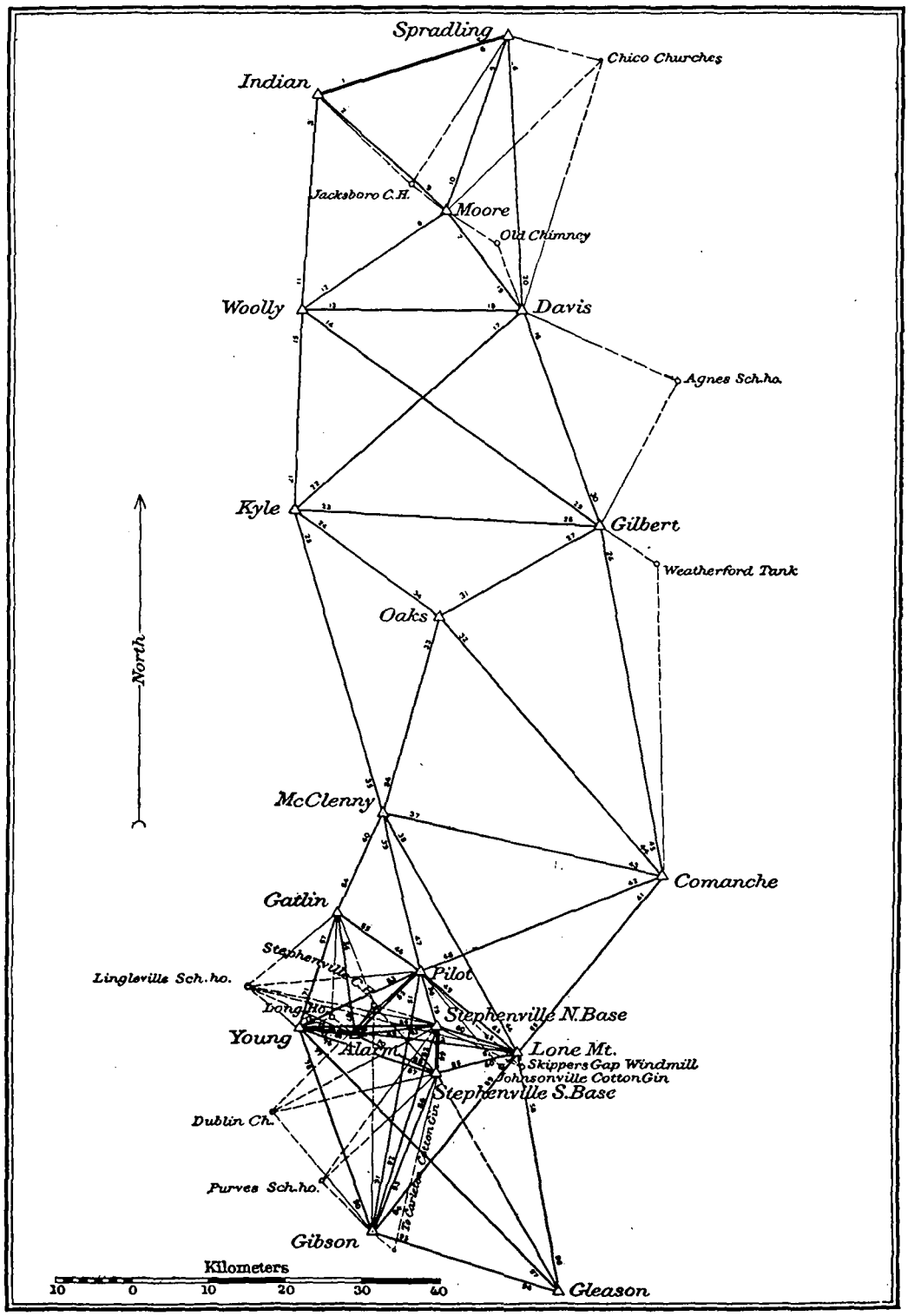
Triangulation, El Reno base net to Osaria-Table Hill.

No. 13.



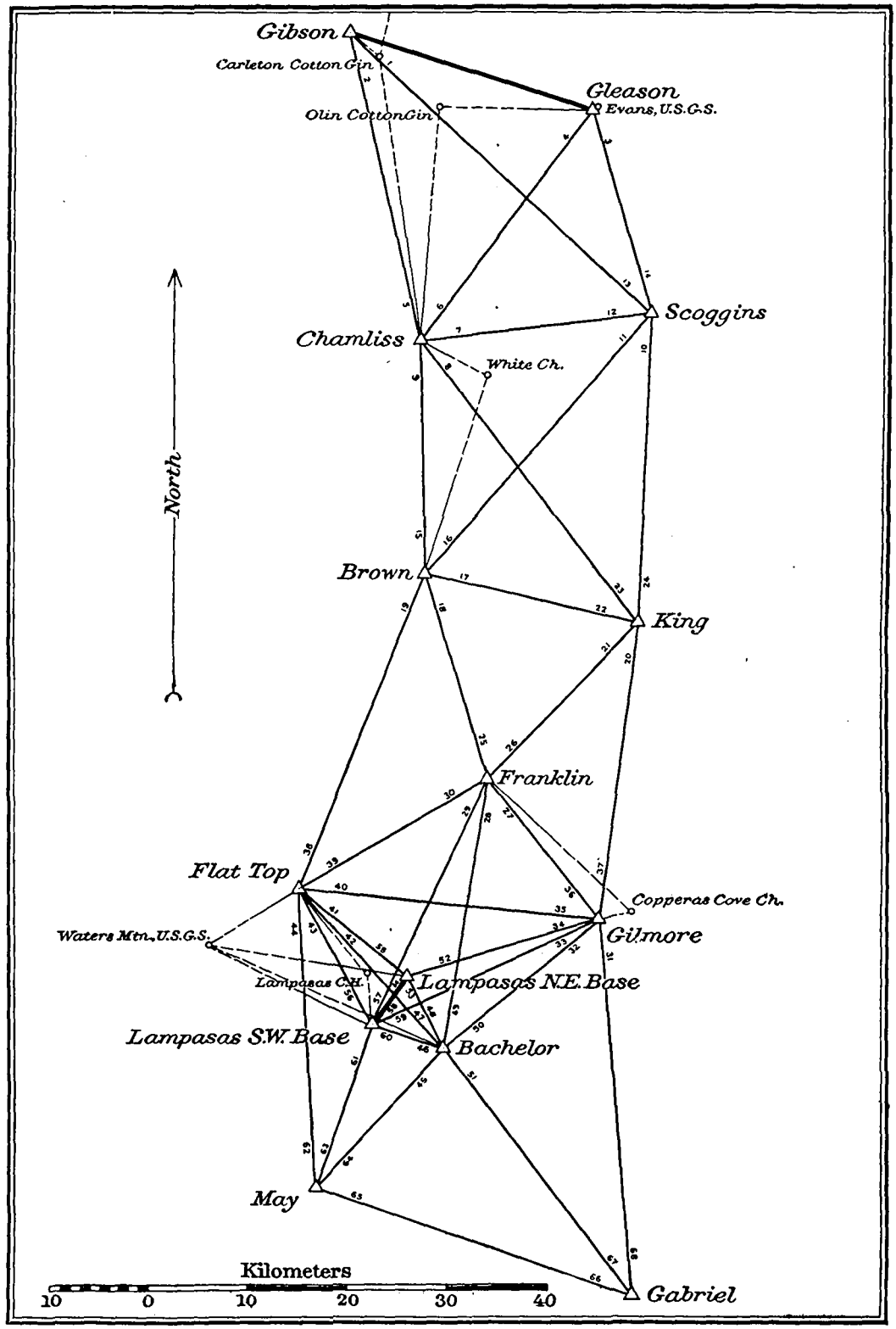
Triangulation, Osaria-Table Hill to Bowie base net.

No. 14



Triangulation, Bowie base net to Stephenville base net.

No. 15.



Triangulation, Stephenville base net to Lampasas base net.

APPENDIX No. 5.

REPORT 1903.

RESULTS OF MAGNETIC OBSERVATIONS MADE BY THE COAST AND GEODETIC SURVEY BETWEEN JULY 1, 1902, AND JUNE 30, 1903.

By L. A. BAUER,

Inspector of Magnetic Work and Chief of Division of Terrestrial Magnetism,

Assistant, Coast and Geodetic Survey.

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CONTENTS.

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RESULTS OF MAGNETIC OBSERVATIONS MADE BY THE COAST AND GEODETIC SURVEY BETWEEN JULY 1, 1902, AND JUNE 30, 1903.

By L. A. BAUER, *Inspector of Magnetic Work and Chief of Division Terrestrial Magnetism, Assistant, Coast and Geodetic Survey.*

INTRODUCTION.

The "Magnetic Declination Tables,"* published in 1902, contained the results of declination observations made by the Coast and Geodetic Survey prior to June 30, 1902, and descriptions of the stations occupied between 1881 and that date. The publication of the dip and intensity results was brought up to the same date in Appendix No. 6, of the Report of the Superintendent for 1902,† and the intention was there expressed to publish the results of future observations made in the prosecution of the magnetic survey of the United States in the Annual Report of the Superintendent for the fiscal year in which the observations were made, thus making them available for use by persons outside the Survey at the earliest possible moment.

In pursuance of that policy the present appendix contains the results of the magnetic observations made by officers of the Coast and Geodetic Survey between July 1, 1902, and June 30, 1903, together with a few results obtained during the previous year, but not heretofore published, and brief descriptions of the stations occupied.

The detailed results of the observations at the magnetic observatories, of which five are now in operation,‡ will be published separately as soon as their discussion has advanced far enough to warrant it.

GEOGRAPHIC DISTRIBUTION OF STATIONS.

The plan for the magnetic survey of the United States contemplates an original density of distribution of stations corresponding roughly to one in every county, hence, on the average, about 25 to 30 miles distant from one another, with subsequent additions in locally disturbed areas. The season's work of a magnetic observer is usually

*U. S. Magnetic Declination Tables and Isogonic Charts for 1902, and Principal Facts Relating to the Earth's Magnetism, by L. A. Bauer. Washington, Government Printing Office, 1902. The second edition of this special publication of the Coast and Geodetic Survey was recently issued.

† Magnetic Dip and Intensity Observations, January, 1897, to June 30, 1902, by D. L. Hazard, with preface by L. A. Bauer. Appendix 6, Report of Superintendent of United States Coast and Geodetic Survey for 1902. Washington, Government Printing Office, 1903.

‡ Situated at Cheltenham (Maryland), Baldwin (Kansas), Sitka (Alaska), near Honolulu (Hawaii), and Vieques Island (Porto Rico). For description of observatories, see Appendix No. 5, Report for 1902.

confined to a single northern State in summer and a single southern State in winter, so that the bulk of the results here presented are confined to a few States. The work in Texas, Pennsylvania, Nebraska, Florida, and Virginia, begun in previous years, was carried nearly to completion, and good progress was made in Arizona, Kansas, New Mexico, and Ohio. A beginning was also made in Louisiana in cooperation with the State Geological Survey, the Coast and Geodetic Survey furnishing the observer and instruments and the State paying the incidental field expenses. The number of stations occupied during the fiscal year for which the results are given and their geographic distribution is shown in the following table:

Summary of results.

	Declination.	Dip.	Intensity.	Stations.	Localities.
Alabama.	6	6	6	6	6
Alaska.	14	4	3	14	7
Arizona.	58	54	53	54	42
Arkansas.	2	2	2	2	2
Colorado.	5	5	5	5	4
District of Columbia.	12	8	11	1	1
Florida.	27	29	28	26	25
Georgia.	5	8	7	4	4
Hawaii.	1	1	1	1	1
Kansas.	60	64	64	49	48
Louisiana.	15	15	18	15	15
Maryland.	16	13	14	8	7
Michigan.	14	16	17	14	7
Minnesota.	3	3	3	3	1
Mississippi.	6	6	6	6	6
Nebraska.	20	21	21	19	19
Nevada.	3	0	0	3	3
New Jersey.	1	1	1	1	1
New Mexico.	7	7	7	7	7
New York.	2	0	0	2	2
Ohio.	18	19	19	19	18
Oklahoma.	1	1	1	1	1
Pennsylvania.	52	42	44	52	42
Philippines.	7	0	0	7	7
Porto Rico.	11	7	10	9	9
South Carolina.	4	8	4	4	4
Tennessee.	1	0	0	1	1
Texas.	76	78	79	72	71
Virginia.	12	12	12	12	11
Washington.	0	1	1	1	1
Wisconsin.	1	1	2	1	1
Foreign countries.	11	3	13	11	9
Total.	471	435	452	430	383

In several cases more than one station was occupied in the same locality in order to develop a suspected local disturbance, and at Phœnix and Flagstaff, Arizona, observations were made to determine the suitability of these places as sites for a magnetic observatory. A column has therefore been added to the table, giving the number of localities where observations were made.

Special Investigations.

Some of the results enumerated in the above table were obtained incidentally by parties engaged in other branches of the work of the Survey, or were due to special investigations. Under the latter head may be mentioned a trip of inspection made by

L. A. Bauer, Inspector of Magnetic Work, in the autumn of 1902, which furnished a favorable opportunity for testing a new Lloyd-Creak dip circle, No. 28, intended primarily for use on ship-board and adapted for determining the relative total intensity by Lloyd's method. His outfit also included a small magnetometer and dip circle of the French magnetic survey type. This trip embraced a series of stations extending from northern Michigan to southern Texas and included at least one of the stations of each magnetic observer at that time in the field. Observations were made at the Cheltenham observatory before and after the trip, and at the Baldwin observatory at about the middle of the trip. In this way direct comparisons were obtained between his two dip circles over as great a range of dip as is obtainable in the compact part of the United States, and also comparisons of his instruments with those in use by the various observers. He also occupied several stations on Mackinac Island, Michigan, in preparation for the work to be done later on the ice and investigated a marked local disturbance at Duluth, Minn.

In the following February, when the Straits of Mackinac were frozen over, Assistant O. B. French occupied four stations on the ice. These, in connection with L. A. Bauer's work on Mackinac Island, already referred to, and future observations on the opposite side of the Straits, in the vicinity of Mackinaw City, will aid in determining whether the values of the magnetic elements on the water in this region may be safely inferred from those observed on the adjacent land.

In January, 1903, the Lloyd-Creak dip circle was mounted on its gimbal stand on the Coast and Geodetic Survey steamer *Blake*, and the trip of that vessel to Porto Rico and back marked the beginning of magnetic observations at sea by the Coast and Geodetic Survey vessels. Some compass work has also been done by other vessels. The work thus far has been largely of an experimental nature. It has been determined, however, that valuable results may be expected whenever the necessary precautions are taken.

In February, 1903, a temporary magnetic observatory was established, by permission of the Governor of Porto Rico, in Fort Isabel, on Vieques Island, Porto Rico, under the direction of L. A. Bauer, partly with a view to the closer study of the relation between magnetic, seismic, and volcanic disturbances. Mr. Bauer's return from Porto Rico to Washington was made by way of Santo Domingo, Cuba, and Key West in order to pay a visit of inspection to the magnetic observer at work in Florida. During short stops of the steamer he secured magnetic observations at two stations in Santo Domingo and five stations in Cuba.

Instruments and Methods of Observing.

The regular outfit of a magnetic observer consists of a combined magnetometer and theodolite, a dip circle, a chronometer beating half seconds, and a small observing tent. A complete series of observations at any one station includes observations of the Sun for azimuth and local mean time, two sets in the morning and two in the afternoon, and circum-meridian altitudes for latitude; two sets of declination; dip with two needles; and two sets each of oscillations and deflections at two distances for horizontal intensity, the two sets of deflections being made between the two sets of oscillations. As often as possible the chronometer is compared with the standard telegraphic time signals, thus furnishing a means for an approximate determination of longitude.

For determining the declination in connection with triangulation, a compass declinometer has usually been employed in recent years. With a view to obtaining dip and intensity results as well as declination from a very small instrumental outfit, several dip circles have been supplied with a compass needle mounted on top of the dip circle and provided with compass sights. By means of the alidade of the dip circle the angle may be measured between the magnetic meridian, as indicated by the compass needle and some object of which the true azimuth is known from the triangulation. The dip will be obtained in the usual manner with the regular dip needles and the relative total intensity by Lloyd's method, by determining the dip with a loaded needle and then using that needle to deflect a second needle. From these relative total intensity observations results another determination of dip with the unloaded or deflected needle. Thus, with only a dip circle and its compass attachment, the three magnetic elements may be determined with sufficient accuracy to yield results of value, provided the instrument is properly standardized at some base station before and after the season's work and at some intermediate period when practicable.

For some further information regarding methods followed in the field work, see paragraphs on "Reduction of observations."

Accuracy of Results.

With the methods of observing outlined at the beginning of the foregoing paragraph it is usually found that under favorable conditions the latitude, azimuth, and declination are determined within 1 minute of the truth, the longitude and dip within 2 minutes, and the horizontal intensity within 1 part in 1000, thus fulfilling all requirements of a magnetic survey. With a compass declinometer the uncertainty in the declination is probably 5 minutes; with the compass attachment of the dip circle alluded to above, a declination can be obtained within 2 to 3 minutes.

Comparison of Instruments.

A large Wild-Edelmann combination instrument, comprising declinometer, magnetometer, earth inductor, and theodolite, has been installed at the Cheltenham observatory, near Washington, and has been adopted as the standard to which all other instruments are to be referred.

During the year special observations were made at Cheltenham to standardize two new dip circles, Nos. 27 and 28, the former made by Tesdorpf, of Stuttgart, and provided with an auxiliary magnet and deflection arm designed for the determination of relative total or vertical intensity, and the latter, the Lloyd-Creak dip circle already mentioned, made by Casella, but provided with Dover needles. Other instruments were standardized as circumstances required, and numerous comparisons were obtained as the result of the occupation of the same station by different observers with different instruments. These observations show that few changes are required in the instrumental constants adopted last year.* The various dip circles used and the corrections which have been applied to the results by each are given in the following table. The figures after the decimal point indicate the particular needles to which the correction applies; thus 15.24 means dip circle 15, needles 2 and 4.

*Appendix No. 6, Report for 1902, pp. 349, 350.

Corrections to dip circles.

Dip circle.	Needles.	Pattern.	Designation.	Correction.
				′
15	2 and 4	Kew-Casella. *	15. 24	+0. 5
18	1	Kew-Casella. †	18. 1	+0. 7
18	1 and 2	Kew-Casella. †	18. 12	+0. 4
18	1 and 4	Kew-Casella. †	18. 14	+1. 2
21	1 and 2	Kew-Casella.	21. 12	+6. 0
23	3 and 4	Kew-Casella.	23. 34	−0. 4
24	1 and 2	French Magnetic Survey.	24. 12	+6. 6
27	21 and 24	Tesdorpf.	27. 14	−0. 2
28	1 and 2	Lloyd-Creak. ‡	28. 12	−4. 8
28	3	Lloyd-Creak. ‡	28. 3	+2. 0
56	3 and 4	Kew-Casella. ‡	56. 34	−1. 2
4655	1 and 2	Kew-Casella.	55. 12	+1. 0
5676	3 and 4	Kew-Casella.	76. 34	0. 0
5678	1 and 2	Kew-Casella.	78. 12	−3. 0

* Needle No. 2 by Dover and No. 4 by Casella. † Needles Nos. 1 and 2 by Dover. ‡ Needles by Dover.

No. 4655 was damaged by a fall last year, which may account for the change in its relation to the standard instrument. No. 56 has been supplied with new needles made by Dover. The comparisons between dip circles Nos. 24 and 28, made at stations between northern Michigan and southern Texas, show a fairly constant difference between the two instruments. Comparisons at Vieques Island (Porto Rico), Key West and Ocala, Fla., and Savannah, Ga., between Nos. 24 and 27 indicate, however, that the correction to No. 24 may vary with the dip, and the publication of the results with that instrument during the trip from Porto Rico has been deferred until this subject has been more fully investigated.

Magnetometers Nos. 10, 20, and 21* continue to give results for horizontal intensity less than the standard, though not quite so much less as indicated by observations of the preceding year. The results with these three instruments have been corrected as follows:

No. 10	+.0025 *H*.
No. 20	+.0025 *H*.
No. 21	+.007 *H*.

Index corrections have been applied to declination results obtained with compass declinometer or compass needle. The magnetometers required no corrections for declinations obtained with them.

Reduction of the Observations.

Every observer is obliged to make a first, or preliminary, reduction of his observations before transmitting them to the Office, and, in general, the reduction is carried far enough before he leaves a station, to enable him to see whether the observations are satisfactory. The general experience has been that this is in the line of economy, for errors can be detected much more quickly by the observer while he is in the field than by an office computer unfamiliar with the precise conditions under which the observations were made. If the observer has evidence of magnetic perturbations having occurred during the interval of his observations, he is expected to repeat his work. Usually one

*Dip circle 24 and magnetometer No. 21 are of the French magnetic survey type and were made by Chasselon of Paris. The brass of which they are constructed contains impurities. See App. 6, Report for 1902, p. 350.

day's complete observations suffice for a station, except for repeat stations at which observations are made on two or three days, according to circumstances.

Before transmitting his records by registered mail, the observer makes an abstract of the essential quantities, both for the purpose of preventing loss of results in case the original records fail to reach the Office and also to enable him to exercise proper control over his instrumental constants and the elements of observation obtained from station to station.

At the Office, an independent and final reduction of the observations is made in the Division of Terrestrial Magnetism under the general supervision of the Chief of that Division, the computations being performed by various persons assigned to the Division from time to time under the immediate direction of the computer in charge of magnetic computations, Mr. D. L. Hazard, who exercises the final control in the revisions, enters the results in the register kept for that purpose and prepares the final tabulation for publication.

For the reason already set forth in the preface to Appendix 6, Report for 1902, containing the dip and intensity results from January, 1897, to June 30, 1902, the reduction for secular variation is at present deferred. The corrections applied are as follows:

a. Referring the magnetic declination results to the mean of the particular month in which the observation occurs, with the aid of the continuous magnetic observations at the magnetic observatory nearest to the station. Where there was much difference in magnetic latitude, allowance was made in accordance with the general law of the increase of the diurnal variation with increasing dip and decreasing horizontal intensity.

b. Applying, for the present, to the dip and intensity results merely the corrections necessary for referring them to the adopted standard instruments.

Further details regarding methods of observation, computation, and reduction will be given in the manual of directions for magnetic work, which is in preparation.

Arrangement of the Tables.

The values of declination, dip, and horizontal intensity here presented are arranged by States alphabetically, the results for each State being given in the order of increasing latitudes. The latitudes and longitudes are in most cases the result of solar observations made with the small theodolite which forms a part of the magnetometer. In default of observations the geographic position was scaled from the best available map, either the U. S. Geological Survey topographic sheets, Post Route map, or Rand & McNally State map. In such cases only the even minute of latitude and longitude is given. The horizontal intensity is expressed in gammas (γ), 100 000 gammas being equal to one unit of intensity in the C. G. S. system.

In order to include the desired amount of information in the available space, resort has been made to various abbreviations. Only the month and day of the date are given, since the observations were all made between July 1, 1902, and June 30, 1903, unless otherwise noted. The names of the months have been abbreviated as follows:

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

In the column headed "Instruments," M. stands for "magnetometer" and D. C. for "dip circle." Italicized numbers in the magnetometer column mean that the declination was determined with a compass declinometer of the number given. The dip circles have been given the designations indicated on page 939, the figures after the decimal point denoting the needles used as already explained. The name of the observer is indicated by his initials as follows:

S. J. Barnett.	A. L. Giacomini	E. D. Preston.
L. A. Bauer.	D. L. Hazard.	H. W. Rhodes.
H. M. Davie.	J. S. Hill.	L. G. Schultz.
H. M. W. Edmonds.	C. J. Houston.	C. H. Sinclair.
J. H. Egbert.	J. M. Kuehne.	E. Smith.
W. Eimbeck.	F. M. Little.	L. B. Smith.
R. L. Faris.	H. L. Marindin.	W. F. Wallis.
J. A. Fleming.	J. W. Milburn.	W. Weinrich, jr.
H. F. Flynn.	H. C. Mitchell.	A. H. Wise.
O. B. French.	W. J. Peters.	H. I. Woods.

Results of magnetic observations from July 1, 1902, to June 30, 1903.

ALABAM

Station.	Latitude.	Longitude.	Date.	Declination.	Dip.	Horizontal intensity.	Instruments.		Observer.
							M.	D. C.	
				East.					
	° ′	° ′		° ′	° ′	γ			
Ozark.	31 28.6	85 38.2	Fe. 11, 12	3 16.0	62 20.5	26280	10	18.14	L. B. S.
Troy.	31 52.7	85 56.9	Fe. 9	3 18.9	62 43.4	25844	10	18.14	Do.
Eufaula.	31 53.4	85 08.3	Fe. 13–17	2 39.3	63 04.6	25467	10	18.14	Do.
Selma.	32 26.7	87 02.8	Fe. 4, 5	2 57.8	62 54.6	26101	10	18.14	Do.
Livingston.	32 35.4	88 10.7	Ja. 26–29	4 39.3	63 10.4	25850	10	18.14	Do.
Greensboro.	32 43.8	87 35.1	Ja. 30, 31	4 14.7	63 37.2	25670	10	18.14	Do.

ALASKA.

				East.					
	° ′	° ′		° ′	° ′	γ			
Sitka, Mag'c Obs'y	57 02.9	135 20.2	De. Ja.	29 52.9	74 47.5	15443	25	25.48	H.M.W.E.
Douglas Island:									
Treadwell.	58 15.1	134 20.3	Oc.* 7, 8	161 28	88 46	2000	*743*	78	L. A. B.
Do.	.. ....	... .	Oc.* 8	41 41	.. ..	900	19	..	Do.
Sheep Creek.	58 15.4	134 18.4	Oc.* 8	29 32	76 01	....	*743*	78	Do.
Juneau Isle.	58 16.4	134 22.5	Oc.* 6, 8	32 52	75 48	....	*743*	78	Do.
Nunivak Island.	60 03.9	167 14.4	Se. 23	17 00	.. ..	....	*742*	..	A. L. G.
Port Etches:									
First.	60 19.9	146 30.8	Au. 2	28 21	.. ..	....	*735*	..	H. F. F.
Grass.	60 21.0	146 34.4	Se. 19	28 17	.. ..	....	*735*	..	Do.
St. Lawrence I.	63 15.8	168 42.9	Se. 24	17 26	.. ..	....	*742*	..	A. L. G.
St. Michael:									
I.	63 28.8	162 01.4	Se. 1, 2	21 55	.. ..	....	*742*	..	W. E.
II.	63 28.8	162 01.4	Se. 3, 4	22 18	.. ..	....	*742*	..	Do.
III.	63 28.8	162 01.4	Se. 4, 5	21 43	.. ..	....	*742*	..	Do.
Mesa.	63 29.1	162 01.4	Au. 29–31	21 34	.. ..	....	*742*	..	Do.
Hill Top.	63 29.2	162 00.8	Se. 6–8	21 30	.. ..	....	*742*	..	Do.

* Observations in October, 1900, not heretofore published. This is a region of marked local disturbance, the station at Treadwell manifesting the properties of a local magnetic pole. A special investigation of the region around Juneau and Douglas Island was made in the summer of 1903 by the Coast and Geodetic Survey in cooperation with the Geological Survey.

Results of magnetic observations from July 1, 1902, to June 30, 1903—Continued.

ARIZONA.

Station.	Latitude.	Longitude.	Date.	Declination.	Dip.	Horizontal intensity.	Instruments.		Observer.
							M.	D. C.	
				East.					
	° ′	° ′		° ′	° ′	γ			
Nogales.	31 20.3	110 56.5	Mh. 19	12 43.4	57 56.8	28148	19	55.12	F. M. L.
Naco.	31 20.5	109 57.0	Mh. 23	12 16.6	57 58.8	28304	19	55.12	Do.
Douglas.	31 20.5	109 33.1	My. 23	12 28.8	58 19.4	28117	19	55.12	Do.
Crittenden.	31 35.0	110 43.6	Mh. 15, 16	12 41.2	58 17.3	28061	19	55.12	Do.
Tombstone.	31 44.9	110 03.8	Mh. 20, 21	12 14.7	58 40.2	28192	19	55.12	Do.
Benson.	31 58.2	110 17.9	Mh. 14	12 47.4	58 53.5	27734	19	55.12	Do.
Cochise.	32 07.4	109 55.2	Mh. 26	12 44.3	58 47.3	27906	19	55.12	Do.
Tucson.	32 13.5	110 57.7	Mh. 12	13 06.6	58 54.2	27831	19	55.12	Do.
Bowie.	32 21.3	109 28.6	Mh. 27	12 38.6	59 08.9	27704	19	55.12	Do.
Red Rock.	32 34.9	111 19.8	Mh. 9	13 23.3	59 31.3	27390	19	55.12	Do.
Wellton.	32 40.1	114 07.5	Ja. 22	13 44.1	58 45.7	27672	19	55.12	Do.
Yuma.	32 43.5	114 37.4	Ja. 21	13 59.1	58 48.5	27582	19	55.12	Do.
Duncan.	32 43.8	109 06.0	My. 20	12 22.1	59 40.6	27560	19	55.12	Do.
Mohawk Summit.	32 44.4	113 45.1	Ja. 23	13 47.8	58 54.1	27622	19	55.12	Do.
Solomonville.	32 49	109 37.9	Ap. 1, 2	13 11.3	59 34.0	27632	19	55.12	Do.
Sentinel.	32 51.4	113 13.0	Mh. 2, 3	14 12.7	59 08.9	27876	19	55.12	Do.
Casa Grande.	32 52.3	111 44.7	Mh. 6	13 34.1	59 24.8	27553	19	55.12	Do.
Gila Bend.	32 57.4	112 44.5	Mh. 1, 2	13 38.6	59 09.2	27566	19	55.12	Do.
Florence.	33 01.7	111 24.3	Mh. 7	13 42.0	59 34.1	27325	19	55.12	Do.
Fort Thomas.	33 02.8	109 58.7	Mh. 31	12 49.0	59 41.3	27603	19	55.12	Do.
Maricopa.	33 03.2	112 03.4	Mh. 5	13 32.7	59 26.7	27440	19	55.12	Do.
Clifton.	33 03.4	109 17.8	My. 21	11 50.2	60 21.3	26920	19	55.12	Do.
San Carlos.	33 12.5	110 20.6	Mh. 30	12 58.6	60 00.3	27420	19	55.12	Do.
Globe.	33 24.5	110 47.1	Mh. 29	13 35.6	59 39.0	27518	19	55.12	Do.
Phoenix A.	33 30.7	112 03.4	Ja. 2, 3, 5	13 36.9	59 47.8	.....	11	15.24	E. D. P.
Do.	.. ....	... .	Ja. 6	13 40.8	59 46.9	27372	19	55.12	F. M. L.
Phoenix B.	.. ....	... .	Ja. 2, 3, 5	13 38.7	59 48.3	27384	19	55.12	Do.
Do.	.. ....	... .	Ja. 6	13 40.4	59 48.1	.....	11	15.24	E. D. P.
Phoenix 1.	.. ....	... .	Ja. 8, 13	13 40.8	59 45.5	27349	11	15.24	Do.
Phoenix 2.	.. ....	... .	Ja. 7, 13	13 36.8	59 50.1	27329	11	15.24	Do.
Phoenix 3.	.. ....	... .	Ja. 9, 10	13 40.1	59 48.2	27354	11	15.24	Do.
Do.	.. ....	... .	Ja. 8, 12	13 37.4	59 46.9	27367	19	55.12	F. M. L.
Phoenix 3a.	.. ....	... .	Ja. 10	13 37.4	.. ....	27368	19	.....	Do.
Do.	.. ....	... .	Ja. 10, 12	13 36.7	59 48.7	27351	11	15.24	E. D. P.
Phoenix 4.	.. ....	... .	Ja. 7	13 40.4	59 46.6	27359	19	55.12	F. M. L.
Hot Springs Junction.	33 52.5	112 39.7	Ja. 19, 20	13 46.4	60 26.0	26834	11	15.24	E. D. P.
Congress Junction.	34 10.8	112 51.4	Ja. 21, 22	14 01.1	60 44.1	27016	11	15.24	Do.
Mayer.	34 25.5	112 14.7	Ja. 29	13 55.8	60 49.6	26624	11	15.24	Do.
Kirkland.	34 25.7	112 45.2	Ja. 23, 24	13 49.2	60 50.7	26774	11	15.24	Do.
Prescott.	34 34	112 30.2	Ja. 26, 27	13 54.5	60 58.8	26517	11	15.24	Do.
Jerome Junction.	34 47.5	112 26.4	Fe. 2, 3	14 02.6	61 21.0	26362	11	15.24	Do.
Holbrook.	34 55.1	110 10.1	Mh. 11, 12	13 35.5	62 36.1	25666	11	15.24	Do.
Winslow.	35 02.0	110 43.2	Mh. 9	14 25.6	62 01.1	26000	11	15.24	Do.
Navajo.	35 08.9	109 32.9	Mh. 14, 15	13 43.4	62 24.4	25942	11	15.24	Do.
Kingman.	35 13.6	114 02.8	Fe. 6, 7	14 34.5	61 33.7	26145	11	15.24	Do.
Flagstaff.	35 13.7	111 39.1	Fe. 24-26	14 01.6	61 45.1	26320	11	15.24	Do.
Flagstaff A.	.. ....	... .	Fe. 27-28	14 03.0	61 43.7	26345	11	15.24	Do.
Flagstaff B.	.. ....	... .	Fe. 28	14 04.5	61 45.7	26369	11	15.24	Do.
Flagstaff C.	.. ....	... .	Mh. 2, 3	14 04.0	61 45.1	26320	11	15.24	Do.
Ash Fork.	35 15.5	112 30.3	De. 22, 23	15 07.2	62 28.4	25674	11	15.24	Do.
Williams.	35 16.7	112 10.9	De. 16-18	14 15.2	61 50.5	26094	11	15.24	Do.
Seligman.	35 21.9	112 53.1	Fe. 16, 17	10 22.1	61 38.6	25877	11	15.24	Do.
Seligman A.	.. ....	... .	Fe. 17	12 07.8	.. ....	.....	11	.....	Do.
Seligman B.	.. ....	... .	Fe. 17	12 42.3	.. ....	.....	11	.....	Do.
Seligman C.	.. ....	... .	Fe. 18	12 59.2	.. ....	.....	11	.....	Do.
Hackberry.	35 24.1	113 45.4	Fe. 9, 10	14 48.2	61 32.9	26182	11	15.24	Do.
Peach Springs.	35 32.9	113 25.9	Fe. 12, 13	15 19.7	61 58.6	26021	11	15.24	Do.
Grand Canyon.	36 05.9	112 07.3	Fe. 20	14 21.8	62 43.2	25653	11	15.24	Do.

Results of magnetic observations from July 1, 1902, to June 30, 1903—Continued.

ARKANSAS.

Station.	Latitude.	Longitude.	Date.	Declination.	Dip.	Horizontal intensity.	Instruments.		Observer.
							M.	D. C.	
				East.					
	° ′	° ′		° ′	° ′	γ			
Marion.	35 14.5	90 12.9	Ja. 8–10	5 59.5	65 47.6	24227	10	18.14	L. B. S.
Hardy.	36 19.7	91 28.9	Ja. 6, 7	6 24.7	66 40.8	23322	10	18.14	Do.

COLORADO.

				East.					
	° ′	° ′		° ′	° ′	γ			
Trinidad, old.	37 11.0	104 31.9	Mh. 21,23	14 41.2	65 01.1	24612	11	15.24	E. D. P.
Trinidad, new.	37 11.0	104 30.8	Mh. 24	13 47.3	65 26.5	24107	11	15.24	Do.
Thatcher.	37 35.0	104 07.9	Mh. 30	12 36.8	65 57.8	23846	11	15.24	Do.
La Junta.	37 59.9	103 33.8	Ap. 2, 3	13 21.4	66 05.9	23872	11	15.24	Do.
Las Animas.	38 04.8	103 14.5	Ap. 6, 7	13 02.6	66 32.3	23574	11	15.24	Do.

DISTRICT OF COLUMBIA.

				West.					
	° ′	° ′		° ′	° ′	γ			
Washington	38 53.2	77 00.5	Jy. 21	5 11.5	.. ....	20374	19	.....	D. L. H.
Do.	.. ....	.. ....	Au. 29, 30	5 08.9	69 58.7	20338	11	15.24	E. D. P.
Do.	.. ....	.. ....	Se. 10	5 09.6	.. ....	20346	30	.....	S. A. D.
Do.	.. ....	.. ....	De. 4, 26	5 11.2	69 54.4	20347	20	56.34	E. S.
Do.	.. ....	.. ....	Ap. 15–19	5 14.0	69 56.0	20348	20	76.34	W. J. P.
Do.	.. ....	.. ....	Ap. 21–23	5 17.0	69 55.5	20328	11	15.24	E. D. P.
Do.	.. ....	.. ....	My. 5, 15	5 13.4	.. ....	20344	11	.....	J. W. M.
Do.	.. ....	.. ....	My. 8, 11	5 14.4	.. ....	20323	20	.....	A. H. W.
Do.	.. ....	.. ....	Ap. 17	. ....	69 55.7	.....	..	21.12	D. L. H.
Do.	.. ....	.. ....	Ap. 27	. ....	69 56.5	.....	..	23.34	Do.
Do.	.. ....	.. ....	My. 28	5 13.5	.. ....	20354	20	.....	L. B. S.
Do.	.. ....	.. ....	Je. 12,13	5 14.4	69. 56.2	20326	20	18.14	E. D. P.
Do.	.. ....	.. ....	Je. 15	5 11.0	69 55.8	20356	19	55.12	F. M. L.
Do.	.. ....	.. ....	Je. 29	5 12.3	.. ....	.....	BF	.....	L. B. S.

FLORIDA.

				East.					
	° ′	° ′		° ′	° ′	γ			
Key West.	24 33.5	81 47.7	Mh. 9	2 33.8	.. ....	29631	21	.....	L. A. B.
Do.	.. ....	.. ....	Mh. 9	. ....	54 52.8	*41966**	..	27.14	Do.
Key West, beach.	.. ....	.. ....	Mh. 9	2 32.7	.. ....	.....	21	.....	Do.
Miami.	25 47.3	80 11.7	Ap. 24, 25	1 39.7	56 28.5	28895	10	18.14	L. B. S.
Punta Gorda.	26 57.1	82 02.6	Ap. 8, 9	2 16.6	57 45.9	28354	10	18.14	Do.
Jupiter.	26 58.3	80 03.6	Ap. 27, 28	1 43.2	57 47.8	28174	10	18.14	Do.
Arcadia.	27 13.9	81 52.2	Ap. 7	2 00.1	58 08.7	28157	10	18.14	Do.
St. Petersburg.	27 47.6	82 38.4	Mh. 30, 31	2 24.4	58 48.8	27966	10	18.1	Do.
Bartow.	27 53.3	81 50.8	Ap. 4, 6	1 29.6	58 49.9	27678	10	18.1	Do.
Tampa.	27 58.4	82 27.9	Ap. 1, 2	2 12.4	59 00.1	27969	10	18.1	Do.
Eau Gallie.	28 09.4	80 37.1	Ap. 30	1 05.6	58 50.2	27903	10	18.14	Do.
Do.	.. ....	.. ....	My. 1	. ....	58 53.2	.....	..	24.12	Do.
Tarpon Springs.	28 09.8	82 45.0	Mh. 27, 28	1 55.1	58 45.3	28075	10	18.1	Do.
Kissimmee.	28 18.1	81 24.2	Ap. 10, 11	1 43.2	59 03.5	27841	10	18.14	Do.

*Vertical intensity with dip circle.

Results of magnetic observations from July 1, 1902, to June 30, 1903—Continued.

FLORIDA—Continued.

Station	Latitude.	Longitude.	Date.	Declination.	Dip.	Horizontal intensity.	Instruments.		Observer.
							M.	D.C.	
	° ′	° ′		*East.* ° ′	° ′	γ			
Dade City.	28 23.3	82 11.2	Mh. 24, 25	2 01.3	59 14.3	27684	10	18.14	L. B. S.
Orlando.	28 33.3	81 21.0	Ap. 20	1 06.6	59 02.6	28003	10	18.14	Do.
Brooksville.	28 34.7	82 23.8	Mh. 21, 23	1 45.4	59 23.8	27754	10	18.14	Do.
Titusville.	28 38.3	80 48.4	My. 2, 4	0 54.0	59 28.6	27503	10	18.14	Do.
Do.	.. ....	.. ....	My. 4	. ....	59 27.1	.....	..	24.12	Do.
Sumterville.	28 46.2	82 04.1	Ap. 17	1 58.8	59 51.7	27341	10	18.14	Do.
Homosassa.	28 48.1	82 36.6	Mh. 16, 17	2 09.4	59 47.9	27396	10	18.14	Do.
Tavares.	28 49.4	81 43.7	Ap. 14, 15	2 06.5	60 14.5	27142	10	18.14	Do.
Inverness.	28 51.2	82 19.7	Mh. 19, 20	2 11.6	59 53.2	27363	10	18.14	Do.
Deland.	29 03.4	81 18.2	Ap. 22	1 31.2	60 00.3	27318	10	18.14	Do.
Ocala.	29 13.2	82 08.6	Mh. 11, 12	1 55.8	60 15.7	27354	10	18.14	Do.
Do.	.. ....	.. ....	Mh. 12	1 55.9	.. ....	27390	21	.....	L. A. B.
Do.	.. ....	.. ....	Mh. 12	. ....	60 18.2	*48108**	..	27.14	Do.
Starke.	29 57.6	82 06.5	Mh. 7, 9	2 06.7	61 17.5	26606	10	18.14	L. B. S.
Mayo.	30 04.0	83 11.6	Mh. 2	1 48 6	61 05.9	26971	10	18.14	Do.
Lake City	30 11.2	82 38.4	Mh. 5, 6	1 32.0	61 06.4	26853	10	18.14	Do.
Live Oak.	30 20.4	83 00.0	Fe. 27, 28	1 40.0	61 23.9	26693	10	18.14	Do.

GEORGIA.

	° ′	° ′		*East.* ° ′	° ′	γ			
Valdosta.	30 50.3	83 16.8	Fe. 24, 25	2 01.6	61 53.9	26440	10	18.14	L. B. S.
Irwinville.	31 38.8	83 20.9	Fe. 21, 23	1 56.0	62 52.8	25525	10	18.14	Do.
Cuthbert.	31 46.8	84 47.0	Fe. 18, 19	2 45.5	62 51.1	25789	10	18.14	Do.
Savannah.	32 05.7	81 04.7	Mh. 14	0 40.7	63 19.9	25368	21	24.12	L. A. B.
Do.	.. ....	.. ....	Mh. 14	. ....	63 24.1	*50655**	..	27.14	Do.
Do.	.. ....	.. ....	Mh. 14	. ....	63 27.2	*56444†*	..	27.3	Do.
Do.	.. ....	.. ....	My. 6, 11	0 42.5	63 25.3	25335	10	18.14	L. B. S.
Do.	.. ....	.. ....	My. 11	. ....	63 23.6	.....	..	24.12	Do.

HAWAII.

	° ′	° ′		*East.* ° ′	° ′	γ			
Honolulu Magnetic Obsy.	21 19.2	158 03.8	De. Ja.	9 18.2	40 14.2	29224	22	22EI	W. W.

KANSAS.

	° ′	° ′		*East.* ° ′	° ′	γ			
Liberal.	37 04.6	100 54.6	No. 27, 28	11 22.8	66 01.0	23910	11	15.24	E. D. P.
Sedan.	37 08.0	96 12.9	Au. 5, 6	8 52.2	67 02.2	23227	21	24.12	S. J. B.
Anthony.	37 10.3	98 00.7	No. 8, 9	9 13.6	66 45.0	23411	11	15.24	E. D. P.
Oswego.	37 10.7	95 07.7	Jy. 29, 30	9 05.4	66 54.4	23292	21	24.12	S. J. B.
Ashland.	37 12.3	99 44.7	No. 18	11 09.4	66 18.5	23654	11	15.24	E. D. P.
Hugoton.	37 12.9	101 20.6	De. 1, 2	11 37.4	66 08.3	23727	11	15.24	Do.
Independence.	37 13.9	95 43.8	Au. 2, 4	8 58.4	67 05.5	23231	21	24.12	S. J. B.
Winfield.	37 14.8	96 59.0	Au. 8, 9	9 21.0	66 59.9	23292	21	24.12	Do.
Do.	.. ....	.. ....	Oc. 27	9 20.2	66 59.4	23277	21	24.12	L. A. B.

*Vertical intensity with dip circle. †Total intensity with dip circle.

Results of magnetic observations from July 1, 1902, to June 30, 1903—Continued.

KANSAS—Continued.

Station.	Latitude.	Longitude.	Date.	Declination.	Dip.	Horizontal intensity.	Instruments.		Observer.
							M.	D. C.	
				East.					
	° ′	° ′		° ′	° ′	γ			
Winfield.	.. ....	.. ....	Oc. 27	....	66 58.3	59577*	..	28.12	L. A. B.
Do.	.. ....	.. ....	No. 1	9 28.8	67 04.8	23230	11	15.24	E. D. P.
Wellington.	37 17.3	97 23.7	No. 5	9 37.1	66 55.5	23344	11	15.24	Do.
Coldwater.	37 17.3	99 20.0	No. 16	11 21.5	66 20.5	23596	11	15.24	Do.
Medicine Lodge.	37 18.5	98 35.0	No. 12	11 05.6	66 46.7	23452	11	15.24	Do.
Meade.	37 18.7	100 22.2	No. 21	11 09.0	66 07.7	23936	11	15.24	Do.
Howard.	37 27.6	96 15.3	Au. 11, 12	9 14.6	67 25.8	22798	21	24.12	S. J. B.
Fredonia.	37 31.4	95 50.3	Au. 14, 15	9 34.6	67 28.3	22898	21	24.12	Do.
Girard.	37 31.6	94 51.4	Jy. 19–22	8 49.6	67 30.1	22784	21	24.12	Do.
Erie.	37 34.5	95 12.7	Jy. 24, 25	8 12.4	67 27.5	22957	21	24.12	Do.
Greensburg.	37 37.7	99 17.8	De. 5	10 53.2	66 53.7	23300	11	15.24	E. D. P.
Eureka.	37 49.8	96 13.6	Au. 20–22	9 49.8	67 23.6	22796	21	24.12	S. J. B.
Fort Scott.	37 50.3	94 43.4	Jy. 16–18	8 07.8	67 34.4	22746	21	24.12	Do.
Yates Center.	37 53.6	95 43.6	Au. 18, 19	9 31.0	67 44.4	22535	21	24.12	Do.
Syracuse.	38 00.8	101 44.8	Ap. 11	11 40.6	66 49.9	23314	11	15.24	E. D. P.
Coolidge.	38 04.3	102 00.8	Ap. 9	12 02.5	66 56.2	23214	11	15.24	Do.
Mound City.	38 08.4	94 50.3	Jy. 12, 14	7 40.7	68 01.9	22384	21	24.12	S. J. B.
Emporia.	38 24	96 11	Au. 27	....	67 51.6	22650	21	24.12	Do.
Paola.	38 34.2	94 52.5	Jy. 10, 11	8 32.0	68 31.1	21988	21	24.12	Do.
Ottawa.	38 37.3	95 16.2	Jy. 7, 8	8 18.6	68 28.4	22142	21	24.12	Do.
Baldwin Magnetic Obsy.	38 47.0	95 10.0	Jy. 3–5	8 23.7	68 37.8	21965	21	24.12	Do.
Do.	.. ....	.. ....	Au. 29, 30	8 23.2	68 40.8	21957	21	24.12	Do.
Do.	.. ....	.. ....	Se. 6, 7	8 22.2	68 40.6	21949	11	15.24	E. D. P.
Do.	.. ....	.. ....	Oc. 10, 11	8 22.8	68 39.2	21967	10	18.14	S. A. D.
Do.	.. ....	.. ....	Oc. 20, 21	8 23.7	68 38.5	21967	21	24.12	W. F. W.
Do.	38 47.0	95 10.0	Oc. 20	.. ....	68 34.9	60212*	..	28.12	L. A. B.
Do.	.. ....	.. ....	Oc. 21	.. ....	68 36.8	60292*	..	28.12	Do.
Do.	.. ....	.. ....	Oc. 21	.. ....	68 37.7	.....	..	24.12	Do.
Do.	.. ....	.. ....	Oc. 28, 29	8 26.3	68 39.2	21925	11	15.24	E. D. P.
Do.	.. ....	.. ....	De. 17, 18	8 22.8	68 40.6	21993	10	18.14	S. A. D.
Do.	.. ....	.. ....	Ja. 2, 3	8 27.0	68 40.7	21964	10	18.14	Do.
Do.	.. ....	.. ....	De. Ja.	8 23.8	68 39.1	21934	30	78.12	W. F. W.
Abilene.	38 56.0	97 13.1	Au. 13	10 13.0	68 21.7	22235	20	78.12	H. I. W.
Alma.	39 01.3	96 17.0	Au. 9, 11	9 17.2	68 35.3	22023	20	78.12	Do.
Topeka.	39 01.7	95 42.8	Au. 7, 8	9 07.1	68 50.1	21796	20	78.12	Do.
Minneapolis.	39 08.5	97 43.0	Oc. 24, 25	10 21.6	68 14.4	22315	11	15.24	E. D. P.
Do.	.. ....	.. ....	Oc. 25	10 16.1	.. ....	22341	21	.....	L. A. B.
Minneapolis B.	39 08.7	97 43.2	Oc. 25	10 12.6	67 48.0	22156	21	24.12	Do.
Oskaloosa.	39 11.7	95 18.6	Au. 19–21	8 30.8	68 46.0	21904	20	78.12	H. I. W.
Hoxie.	39 22.0	100 27.0	Oc. 10, 11	11 43.8	68 09.4	22324	11	15.24	E. D. P.
Goodland.	39 22.2	101 40.6	Se. 23	12 11.0	67 57.2	22454	11	15.24	Do.
Hill City.	39 23.5	99 51.1	Oc. 13–15	11 17.0	68 24.6	22142	11	15.24	Do.
Colby.	39 25.0	101 03.4	Se. 27, 28	12 02.3	68 16.2	22209	11	15.24	Do.
Stockton.	39 27.2	99 16.2	Oc. 17, 18	11 34.4	68 37.8	21961	11	15.24	Do.
Osborne.	39 27.8	98 42.5	Oc. 19, 20	11 05.4	68 51.9	21745	11	15.24	Do.
Beloit.	39 28.6	98 06.2	Oc. 22, 23	10 15.2	68 36.0	22234	11	15.24	Do.
Do.	.. ....	.. ....	Oc. 25	10 11.1	68 32.0	22236	21	24.12	L. A. B.
Atchison.	39 35.7	95 06.4	Au. 25, 26	8 27.8	69 11.2	21594	20	78.12	H. I. W.
Troy.	39 46.3	95 06.0	Au. 28	8 46.9	69 28.8	21504	20	78.12	Do.
Bird City.	39 46.8	101 33.4	De. 10, 11	12 21.5	68 25.8	22089	10	18.14	S. A. D.
Phillipsburg.	39 46.8	99 19.0	Se. 18, 19	11 36.3	68 58.0	21654	11	15.24	E. D. P.
Smith Center.	39 48.0	98 46.8	Se. 17	12 01.9	68 55.5	21656	11	15.24	Do.
Mankato.	39 48.1	98 09.1	Se. 13, 15	10 40.0	69 22.2	21411	11	15.24	Do.
Belleville.	39 50.4	97 38.0	Se. 11	10 04.0	69 18.9	21404	11	15.24	Do.
Norton.	39 51.3	99 53.9	Se. 30, 31	11 33.6	69 00.3	21694	11	15.24	Do.
Oberlin.	39 51.6	100 32.2	Oc. 7, 8	11 50.8	68 24.5	22164	11	15.24	Do.

*Total intensity by Lloyd's method.

Results of magnetic observations from July 1, 1902, to June 30, 1903—Continued.

LOUISIANA.

Station.	Latitude.	Longitude.	Date.	Declination.	Dip.	Horizontal intensity.	Instruments. M.	Instruments. D. C.	Observer.
	° ′	° ′		East. ° ′	° ′	γ			
Houma.	29 35.7	90 43.6	Fe. 17	5 42.6	59 33.8	27893	20	56.34	E. S.
Do.	.. ....	.. ....	Fe. 17	. ....	.. ....	*54694**	..	56.14	Do.
Thibodaux.	29 47.6	90 47.4	Fe. 9	5 44.0	59 43.4	27789	20	56.34	Do.
Franklin.	29 48	91 30.4	Fe. 18, 19	6 02.4	59 33.9	27927	20	56.34	Do.
Napoleonville.	29 56.4	91 00.5	Fe. 5	5 47.4	59 51.4	27756	20	56.34	Do.
Hahnville.	29 58.3	90 22.2	Fe. 12	5 35.6	59 58.5	27734	20	56.34	Do.
Convent.	30 01.0	90 49.6	Ja. 15	5 45.6	59 57.5	27710	20	56.34	Do.
Edgard.	30 02.0	90 31.6	Fe. 11	5 39.5	60 05.2	27674	20	56.34	Do.
Donaldsonville.	30 06.6	90 57.7	Fe. 2, 3	5 46.5	60 04.8	27629	20	56.34	Do.
Baton Rouge.	30 28.2	91 11.5	Ja. 19	5 51.5	60 29.5	27305	20	56.34	Do.
Do.	.. ....	.. ....	Ja. 19	. ....	.. ....	*55396**	..	56.14	Do.
Covington.	30 29.0	90 07.3	Ja. 6	5 27.6	60 41.4	27201	20	56.34	Do.
New Roads.	30 41.8	91 27.9	Ja. 28–30	6 00.0	60 47.1	27200	20	56.34	Do.
Do.	.. ....	.. ....	Ja. 28	. ....	.. ....	*55484**	..	56.14	Do.
Amite.	30 44.3	90 28.7	Ja. 8	5 43.4	60 49.9	27173	20	56.34	Do.
St. Francisville.	30 45.9	91 20.3	Ja. 24, 26	6 00.2	60 50.8	27131	20	56.34	Do.
Greensburg.	30 49.5	90 42.0	Ja. 12, 13	5 47.8	60 55.4	27115	20	56.34	Do.
Clinton.	30 53.4	91 00.3	Ja. 22	5 50.7	60 53.5	27120	20	56.34	Do.

MARYLAND.

	° ′	° ′		West. ° ′	° ′	γ			
Cheltenham Magnetic Obsy.	38 44.0	76 50.5	Se. 11, 12	5 07.0	.. ....	20168	30	.....	S. A. D.
Do.	.. ....	.. ....	No. 8, 11	5 07.4	70 20.8	20178	21	24.12	L. A. B.
Do.	.. ....	.. ....	No. 8–13	. ....	70 21.3	.....	..	28.12	Do.
Do.	.. ....	.. ....	Mh. 17, 18	5 07.0	70 22.6	20158	21	24.12	Do.
Do.	.. ....	.. ....	Mh. 17	. ....	70 24.7	.....	..	27.14	Do.
Do.	.. ....	.. ....	Je. 26, 27	5 09.7	.. ....	20154	20	.....	L. B. S.
Do.	.. ....	.. ....	Je. 26, 27	5 07.4	.. ....	.....	BF	.....	Do.
Do.	.. ....	.. ....	Jy.–De.	5 07.5	70 23.3	20184	8	E11	L. G. S.
Upper Marlboro.	38 49.0	76 45.2	Ap. 6	5 28.1	.. ....	20122	21	.....	L. A. B.
Do.	.. ....	.. ....	Ap. 6	5 27.2	70 20.1	20138	8	23.34	Do.
Linden.	39 00.5	77 03.1	Ap. 1, 2	3 46.9	70 45.4	19702	21	24.12	Do.
Do.	.. ....	.. ....	Ap. 1, 2	3 47.9	70 45.7	19685	8	23.34	J. H. E.
Rockville.	39 05.0	77 09.1	Ap. 20, 21	6 02.0	70 00.8	20459	20	56.34	Do.
Dawsonville.	39 08.3	77 20.4	Ap. 24, 25	4 13.0	70 36.0	19832	20	56.34	Do.
Boyds.	39 10.5	77 20.3	Ap. 22, 23	4 03.6	70 36.2	19726	20	56.34	Do.
Baltimore A.	39 15.7	76 34.8	Ap. 28, 30	5 54.5	70 56.1	19488	20	56.34	L. A. B.
Do.	.. ....	.. ....	My. 1, 2	5 52.0	.. ....	.....	21	.....	Do.
Baltimore B.	.. ....	.. ....	My. 1, 2	5 43.3	70 56.6	19544	21	56.34	Do.

MICHIGAN.

	° ′	° ′		West. ° ′	° ′	γ			
Harbor Point.	45 25.1	84 58.7	Se. 18	0 01.0	75 43.1	15492	21	24.12	L. A. B.
Mackinac Straits:									
D.	45 46.6	84 38.0	Mh. 3	1 48.2	76 03.4	15270	8	21.12	O. B. F.
C.	45 47.2	84 40.9	Mh. 2, 3	1 01.2	76 02.1	15292	8	21.12	Do.
B.	45 48.8	84 38.1	Mh. 2	1 00.5	76 06.8	15260	8	21.12	Do.
A.	45 48.8	84 43.9	Fe. 26	0 48.2	76 01.3	15369	8	21.12	Do.

*Total intensity by Lloyd's method.

Results of magnetic observations from July 1, 1902, to June 30, 1903—Continued.

MICHIGAN—Continued.

Station.	Latitude.	Longitude.	Date.	Declination.	Dip.	Horizontal intensity.	Instruments. M.	Instruments. D. C.	Observer.
	° ′	° ′		*West.* ° ′	° ′	γ			
Round Island.	45 50.0	84 31.8	Se. 27	1 43.9	76 05.3	15175	21	24.12	L. A. B.
Mackinac Island:									
Brow.	45 51.3	84 35.4	Se. 29	1 46.4	.. ....	.....	21	.....	Do.
Fort, west.	45 51.5	84 36.0	Se. 20	1 45.4	76 07.2	15177	21	24.12	Do.
Fort, east.	45 51.5	84 35.8	Se. 22, 23	1 47.8	76 07.7	15181	21	24.12	Do.
Pte. aux Pins.	45 53.2	84 36.6	Se. 25	1 56.8	76 06.7	15208	21	24.12	Do.
Do.	.. ....	.. ....	Se. 25	. ....	76 08.8	*63672**	21	28.12	Do.
Sault Ste. Marie:									
New Fort Brady.	46 29.6	84 23.9	Oc. 2, 3	2 20.7	76 55.7	14293	21	24.12	Do.
Do.	.. ....	.. ....	Oc. 2	. ....	76 54.2	*63485**	..	28.12	Do.
Old Fort Brady.	46 29.9	84 20.0	Oc. 3	2 30.9	76 58.4	14261	21	24.12	Do.
				East.					
Marquette.	46 32.9	87 22.4	Oc. 17	2 13.0	.. ....	16005	21	24.12	Do.
Do.	.. ....	.. ....	Oc. 17	. ....	75 22.2	*63856**	..	28.12	Do.
Houghton.	47 07	88 33.6	Oc. 15	1 01.0	76 40.8	14640	21	24.12	Do.
Do.	.. ....	.. ....	Oc. 15	. ....	76 39.4	*63901**	..	28.12	Do.

MINNESOTA.

	° ′	° ′		*East.* ° ′	° ′	γ			
Duluth:									
Minnesota Pt.	46 44.2	92 04.0	Oc. 10, 11	8 40.0	76 08.4	15242	21	24.12	L. A. B.
Old station.	46 46.8	92 05.4	Oc. 10	12 25.3	76 27.4	14714	21	24.12	Do.
Met. obsy.	46 47.4	92 07.2	Oc. 13	12 17.4	74 59.7	16489	21	24.12	Do.

MISSISSIPPI.

	° ′	° ′		*East.* ° ′	° ′	γ			
Ship Island.	30 12.8	88 57.9	De. 19	4 54.0	60 29.7	27287	8	21.12	O. B. F.
Mississippi City.	30 22.7	89 02.8	De. 20	4 54.4	60 43.9	27168	8	21.12	Do.
Greenwood.	33 31.0	90 13.1	Ja. 22, 23	5 41.8	63 49.1	25601	10	18.14	L. B. S.
Charleston.	34 01.6	90 04.9	Ja. 19, 20	5 22.5	64 24.3	25113	10	18.14	Do.
Sardis.	34 29.1	89 56.6	Ja. 15, 16	5 31.9	65 00.9	24507	10	18.14	Do.
Hernando.	34 49.9	90 00.2	Ja. 13, 14	5 07.4	65 20.3	24401	10	18.14	Do.

NEBRASKA.

	° ′	° ′		*East.* ° ′	° ′	γ			
Benkelman.	40 03.5	101 30.4	De. 6–9	12 34.2	68 33.3	22007	10	18.14	S. A. D.
Fairbury.	40 07.9	97 10.6	Oc. 17	10 23.6	69 26.8	21609	10	18.14	Do.
Culbertson.	40 14.7	100 45.6	No. 27	12 15.7	69 04.4	21644	10	18.14	Do.
Indianola.	40 16.5	100 22.3	No. 24, 25	11 54.6	69 10.7	21615	10	18.14	Do.
Beatrice.	40 16.6	96 47.8	Oc. 14, 15	10 14.5	69 58.5	20867	10	18.14	Do.
Tecumseh.	40 23.3	96 12.5	Oc. 21, 24	8 30.4	70 01.0	20722	10	18.14	Do.
Do.	.. ....	... .	Oc. 23, 24	8 29.0	70 03.9	20697	21	24.12	L. A. B.
Do.	.. ....	... .	Oc. 23	.. ....	69 58.1	*60590**	..	28.12	Do.

* Total intensity by Lloyd's method.

Results of magnetic observations from July 1, 1902, to June 30, 1903—Continued.

NEBRASKA—Continued.

Station.	Latitude.	Longitude.	Date.	Declination.	Dip.	Horizontal intensity.	Instruments. M.	Instruments. D. C.	Observer.
	° ′	° ′		*East.* ° ′	° ′	γ			
Holdrege.	40 27.9	99 20.4	No. 21, 22	11 47.5	69 23.3	21326	10	18.14	S. A. D.
Hayes Center.	40 31.9	100 58.0	No. 29	11 16.9	69 27.3	21362	10	18.14	Do.
Imperial.	40 32.6	101 35.7	De. 2, 3	12 52.4	69 10.8	21613	10	18.14	Do.
Geneva.	40 33.3	97 36.0	Oc. 29, 30	11 15.2	69 35.1	21391	10	18.14	Do.
Stockville.	40 33.7	100 22.2	No. 17, 18	12 07.8	69 34.7	20982	10	18.14	Do.
Hastings.	40 36.6	98 23.6	No. 1, 3	10 16.8	70 00.0	20892	10	18.14	Do.
Elwood.	40 36.6	99 51.5	No. 19, 20	12 26.4	69 39.4	20965	10	18.14	Do.
Kearney.	40 41.7	99 04.8	No. 6, 7	13 01.2	70 05.9	20702	10	18.14	Do.
Lincoln.	40 49.0	96 42.3	Oc. 22, 23	10 10.0	70 27.1	20510	10	18.14	Do.
Grant.	40 52.1	101 41.3	No. 15	12 51.9	69 42.2	21033	10	18.14	Do.
North Platte.	41 08.1	100 46.1	No. 8, 11	11 54.3	69 39.9	21091	10	18.14	Do.
Ogallala.	41 09.2	101 41.8	No. 13	13 38.0	69 54.0	20832	10	18.14	Do.
Wahoo.	41 14.4	96 37.6	Oc. 27, 28	9 06.4	70 56.8	20124	10	18.14	Do.

NEVADA.

	° ′	° ′		*East.* ° ′					
Tonopah.	38 04	117 14	Se. 9	16 43	.. ....	.....	*741*	.....	C. H. S.
Hot Spring.	38 55.2	118 11.8	Oc. 18	17 31	.. ....	.....	*741*	.....	Do.
Esmeralda Mill.	38 57.8	118 13.6	Oc. 28	17 18	.. ....	.....	*741*	.....	Do.

NEW JERSEY.

	° ′	° ′		*West.* ° ′	° ′	γ			
Burlington Island.	40 05.4	74 52.2	Se. 10	7 44.0	71 16.6	19310	8	21.12	J. A. F.

NEW MEXICO.

	° ′	° ′		*East.* ° ′	° ′	γ			
Rodeo.	31 50.5	109 01.1	My. 26	12 21.2	58 50.4	27953	19	55.12	F. M. L.
Hachita.	31 55.4	108 19.2	My. 27	12 31.2	59 08.8	27773	19	55.12	Do.
Separ.	32 13.0	108 25.4	My. 28	12 35.2	59 27.5	27628	19	55.12	Do.
Deming.	32 16.0	107 44.9	My. 30	12 04.2	59 33.0	27668	19	55.12	Do.
Lordsburg.	32 20.4	108 42.1	My. 18	12 39.2	59 39.9	27309	19	55.12	Do.
Laguna.	35 03.4	107 24.4	Mh. 19	13 08.7	62 41.0	26016	11	15.24	E. D. P.
Folsom.	36 51.9	103 55.6	Mh. 27, 28	12 44.4	65 10.9	24376	11	15.24	Do.

NEW YORK.

	° ′	° ′		*West.* ° ′					
Lightning.	40 57.9	72 58.7	Mh. 6	9 59.3	.. ....	.....	*737*	.....	H. L. M.
Crane Neck.	40 57.9	73 09.3	Mh. 12, 13	9 16.8	.. ....	.....	*737*	.....	Do.

Results of magnetic observations from July 1, 1902, to June 30, 1903—Continued.

OHIO.

Station.	Latitude.	Longitude.	Date.	Declination.	Dip.	Horizontal intensity.	Instruments.		Observer.
							M.	D. C.	
	° ′	° ′		*West.* ° ′	° ′	γ			
West Union.	38 49.1	83 32.0	Ap. 28	0 01.0	70 06.3	20602	8	21.12	J. A. F.
				East.					
Georgetown.	38 52.6	83 57.8	Ap. 27	0 25.6	69 59.7	20796	8	21.12	Do.
				West.					
Jackson.	39 04.4	82 36.8	Ap. 21	0 04.6	70 24.7	20146	8	21.12	Do.
				East.					
Batavia	39 06	84 12.0	Ap. 29, 30	0 39.1	70 11.9	20527	8	21.12	Do.
Cincinnati Observatory.	39 08.4	84 25.3	My. 1, 2	1 09.0	70 13.0	20523	8	21.12	C. J. H.
Cincinnati University.	39 08.4	84 30.2	My. 4, 6	. ....	70 07.8	20600	8	21.12	Do.
				West.					
Waverly.	39 09.1	83 00.2	Ap. 23	2 05.2	70 12.4	20419	8	21.12	J. A. F.
				East.					
Hillsboro.	39 13.7	83 36.4	Ap. 24, 25	0 01.6	70 20.7	20279	8	21.12	Do.
Hamilton.	39 24.1	84 31.9	My. 8–10	0 25.6	70 36.5	20332	8	21.12	C. J. H.
Lebanon.	39 24.4	84 14.8	My. 26, 27	0 48.1	70 42.9	20196	8	21.12	Do.
Wilmington.	39 27.6	83 48.9	Je. 2, 3	0 25.7	70 40.2	20170	8	21.12	Do.
Oxford.	39 30.3	84 44.3	My. 12, 13	1 30.0	70 56.0	20094	8	21.12	Do.
Centerville.	39 39.4	84 10.4	My. 20, 21	0 20.2	70 53.9	19969	8	21.12	Do.
Wilberforce	39 42.4	83 54.3	Je. 5, 8	0 01.2	70 58.2	19866	8	21.12	Do.
Eaton.	39 45.9	84 39.4	My. 15, 16	0 46.8	70 47.4	20196	8	21.12	Do.
				West.					
London.	39 57.4	83 27.0	Je. 10, 12	0 36.0	71 13.7	19555	8	21.12	Do.
				East.					
Springfield.	39 58.7	83 55.8	Je. 17, 18	0 10.4	71 04.3	19706	8	21.12	Do.
				West.					
Troy.	40 01.6	84 06.1	Je. 26, 27	0 03.2	71 04.6	19706	8	21.12	Do.
				East.					
Urbana.	40 05.9	83 43.6	Je. 19–24	0 21.9	71 01.9	19767	8	21.12	Do.

OKLAHOMA.

	° ′	° ′		*East.* ° ′	° ′	γ			
Guymon.	36 42.8	101 29.5	Se. 14	11 41.4	65 28.6	24263	19	55.12	F. M. L.

PENNSYLVANIA.

	° ′	° ′		*West.* ° ′	° ′	γ			
Waynesburg.	39 54	80 10.4	Jy. 16, 17	3 05.5	71 11.5	19731	3	21.12	S. A. D.
Bedford, new	40 00	78 30.8	Jy. 23, 24	4 30.0	71 14.8	19484	3	21.12	Do.
Bedford, old.	40 01	78 30.6	Jy. 22, 23	3 04.3	.. ....	.....	3	.....	Do.

Results of magnetic observations from July 1, 1902, to June 30, 1903—Continued.

PENNSYLVANIA—Continued.

Station.	Latitude.	Longitude.	Date.	Declination.	Dip.	Horizontal intensity.	Instruments.		Observer.
							M.	D.C.	
	° ′	° ′		West. ° ′	° ′	γ			
Somerset.	40 01	79 04.8	Jy. 19, 21	4 36.4	71 16.7	19511	3	21.12	S. A. D.
Greensburg.	40 17.4	79 34.5	Jy. 8	....	....	19110	3	.....	Do.
Doylestown.	40 17.4	75 10.5	Se. 12	7 07.6	71 29.8	19170	8	21.12	J. A. F.
Do.	40 17.4	75 10.5	No. 7	7 09.0	71 28.0	19155	21	28.12	L. A. B.
Do.	.. ....	.. ....	No. 7	....	....	*60484**	..	28.34	Do.
Doylestown, M. L.	40 17.4	75 09.0	Se. 12	7 45.8	.. ....	.....	8	.....	J. A. F.
Allegheny.	40 29.5	80 01	Jy. 7	3 50.2	71 59.1	18758	3	21.12	L. A. B.
Allentown.	40 36.3	75 30.0	Se. 13, 14	6 28.7	72 19.2	18450	8	21.12	J. A. F.
Easton.	40 42.0	75 15.5	Se. 15	7 11.0	71 52.9	18856	8	21.12	Do.
Westover.	40 44.8	78 44.0	Oc. 31	4 37.7	72 00.6	18822	8	21.12	Do.
Kittanning.	40 49.0	79 31.2	Jy. 10	3 27.6	72 11.8	18544	3	21.12	S. A. D.
East Mauchchunk.	40 52.4	75 44.8	Oc. 13	7 03.0	72 16.5	18388	8	21.12	J. A. F.
Butler.	40 53	79 56.4	Jy. 14	4 04.2	71 56.6	18862	3	21.12	S. A. D.
Danville.	40 57.9	76 37.0	Oc. 16	6 48.0	72 11.4	18565	8	21.12	J. A. F.
Curwensville.	40 59	78 33	Oc. 30	5 12.5	72 11.6	18636	8	21.12	Do.
E. Stroudsburg.	40 59.4	75 11.1	Se. 17	7 18.4	72 39.8	18118	8	21.12	Do.
Bloomsburg.	41 00.4	76 27.1	Oc. 15	6 57.8	72 09.6	18546	8	21.12	Do.
Newcastle.	41 01.4	80 21	No. 15	2 55.4	72 09.3	18644	8	21.12	Do.
Brookville.	41 09.6	79 06	No. 3	4 11.5	72 23.5	18484	8	21.12	Do.
Brookville, S. M.	.. ....	.. ....	No. 3	4 11	.. ....	.....	8	21.12	Do.
Clarion, S. M.	41 12.4	79 24	No. 4	3 40.8	72 22.6	18449	8	21.12	Do.
Clarion, N. M.	.. ....	.. ....	No. 4	5 17.9	.. ....	.....	8	21.12	Do.
Wilkesbarre.	41 12.9	75 54	Oc. 11	7 24.0	72 17.9	18394	8	21.12	Do.
Mercer.	41 13.1	80 14	No. 14	2 59.8	72 16.8	18598	8	21.12	Do.
Mercer, S. M.	41 13.5	80 14	No. 14	3 01.9	.. ....	.....	8	.....	Do.
Keating.	41 16.1	77 57	Oc. 29	5 46.7	72 30.9	18362	8	21.12	Do.
Milford.	41 19.0	74 47.5	Se. 24	7 57.0	73 00.0	17837	8	21.12	Do.
Milford, N. M.	41 19.8	74 47.5	Se. 24	5 06.5	.. ....	.....	8	.....	Do.
Scranton.	41 24.0	75 38.7	Se. 18, 19	7 55.9	72 26.6	18254	8	21.12	Do.
Rocky Grove.	41 24.4	79 50	No. 10	4 09.4	72 40.9	18348	8	21.12	Do.
Ridgway, N. M.	41 24.5	78 47.4	Oc. 25	6 23	.. ....	.....	8	21.12	Do.
Ridgway.	41 24.8	78 48.2	Oc. 25	5 40.3	72 34.4	18316	8	21.12	Do.
Slate Run.	41 28.8	77 32	Oc. 20	5 44.3	72 39.6	18197	8	21.12	Do.
Satterfield.	41 29.2	76 24	Oc. 9	7 31.3	72 26.9	18374	8	21.12	Do.
Tionesta.	41 29.9	79 27	No. 8	4 48.1	72 32.0	18356	8	21.12	Do.
E. Emporium.	41 30.6	78 14	Oc. 27	4 59.8	72 46.5	18060	8	21.12	Do.
Tunkhannock.	41 31.7	76 00.2	Oc. 7	7 51.6	72 37.2	18140	8	21.12	Do.
Honesdale.	41 34.7	75 15.1	Se. 22	8 29.6	72 37.6	18094	8	21.12	Do.
Honesdale, S. M.	.. ....	.. ....	Se. 23	8 24.3	.. ....	.....	8	.....	Do.
Penbryn.	41 35	76 54	Oc. 17, 18	6 52.9	72 35.2	18343	8	21.12	Do.
Elulalia.	41 35	79 00	No. 5	3 45.6	73 00.1	17943	8	21.12	Do.
Meadville.	41 37.1	80 07	No. 13	4 05.2	72 39.4	18295	8	21.12	Do.
Wellsboro.	41 45.5	77 18	Oc. 21	5 52.4	72 56.6	17924	8	21.12	Do.
Wellsboro, S. M.	.. ....	.. ....	Oc. 21	5 58	.. ....	.....	8	.....	Do.
Towanda.	41 46.6	76 31.8	Oc. 8	7 45.4	72 49.4	18045	8	21.12	Do.
Coudersport.	41 46.7	78 02	Oc. 22	5 35.8	72 49.6	18037	8	21.12	Do.
Smethport.	41 47.8	78 29.1	Oc. 23, 24	5 47.2	72 55.8	17992	8	21.12	Do.
Montrose.	41 50	75 53	Oc. 1	8 23.0	72 45.9	18014	8	21.12	Do.
Warren.	41 50.4	79 09	No. 6	4 34.4	72 45.7	18096	8	21.12	Do.
Warren, S. M.	41 51.1	79 09	No. 6	4 58.9	.. ....	.....	8	.....	Do.
Silver Lake.	41 55.9	75 57	Oc. 3	8 18.4	72 54.9	17898	8	21.12	Do.

*Total intensity by Lloyd's method.

Results of magnetic observations from July 1, 1902, to June 30, 1903—Continued.

PHILIPPINE ISLANDS.

Station.	Latitude.	Longitude.	Date.	Declination.	Dip.	Horizontal intensity.	Instruments. M.	Instruments. D.C.	Observer.
		East.		East.					
Mindanao:	° ′	° ′	1902.	° ′					
Misamis.	8 08.5	123 50.7	Fe. 26	1 42.6	.. ....	.....	733	.....	H. C. M.
Cebu:			1901.						
Cebu.	10 17.5	123 54.3	Jy. 5–24	1 23.9	.. ....	.....	734	.....	J. S. H.
Panay:			1902.						
Capiz.	11 35.1	122 45.1	Ap. 12	1 04.2	.. ....	.....	733	.....	H. C. M.
Culion:			1902.						
Halsey Harbor.	11 47.8	119 57.1	Mh. 19	1 29.1	.. ....	.....	734	.....	H. M. D.
Masbate:			1902.						
Masbate.	12 22	123 37	Ap. 29, 30	0 53.1	.. ....	.....	18	.....	J. S. H.
Luzon:			1902.						
Tabaco.	13 21.9	123 44.3	My. 7	0 52.4	.. ...	.....	734	.....	H. W. R.
			1901.						
Bolinao.	16 24	119 55	De. 9	0 38.4	.. ....	.....	734	.....	Do.

PORTO RICO.

				West.					
	° ′	° ′		° ′	° ′	γ			
Aibonita.	18 07.7	66 15.8	Fe. 22	2 40.2	.. ....	29189	21	.....	L. A. B.
Porto Rico Magnetic Obsy.	18 08.3	65 26.4	Fe. 3, 4	1 07.7	.. ....	29231	21	.....	Do.
Do.	... .	.. ....	Fe. 5, 6	1 09.2	49 31.1	29305	3	27.14	Do.
Do.	.. ....	.. ....	Fe. 3	....	49 30.3	.....	..	28.12	Do.
Mayaguez.	18 11.8	67 08.6	Fe. 21, 24	1 09.0	.. ....	29545	21	.....	Do.
Goat.	18 12.9	65 36.6	Ap. 30	2 13.7	49 40.5	46378*	..	28.12	R. L. F.
Caguas.	18 13	66 03	Fe. 23	1 05.4	.. ....	29996	21	....	L. A. B.
Scorpion Point.	18 18.2	65 18.7	Mh. 25	1 45.2	49 35.5	45004*	..	28.12	R. L. F.
Obispo Cayo.	18 20.6	65 37.2	Jy. 31	1 29.0	49 23.9	45743*	21	28.13	L. A. B.
Do.	.. ....	.. ....	My. 24	1 23.6	49 15.9	45860*	..	28.12	R. L. F.
Palominos.	18 21.0	65 34.2	My. 22	1 21.0	49 19.6	45905*	..	28.12	Do.
Cueva.	18 21.5	65 37.7	Fe. 1	1 25.9	.. ....	.....	21	.....	L. A. B.

SOUTH CAROLINA.

				East.					
	° ′	° ′		° ′	° ′	γ			
Hampton.	32 52.7	81 06.7	My. 13–15	0 35.3	64 18.0	24884	10	18.14	L. B. S.
Do.	.. ....	.. ....	My. 14	....	64 16.1	.. ..	..	24.12	Do.
Orangeburg.	33 30.8	80 51.2	My. 18	0 12.7	65 06.9	24 71	10	18.14	Do.
Do.	.. ....	.. ....	My. 19	....	65 05.9	.....	..	24.12	Do.
				West.					
Sumter.	33 56.3	80 20.4	My. 20	0 17.2	65 43.2	23725	10	18.14	Do.
Do.	.. ....	.. ....	My. 21	....	65 33.8	.....	..	24.12	Do.
Florence.	34 11.3	79 45.4	My. 22, 23	0 36.3	65 59.8	23485	10	18.14	Do.
Do.	.. ....	.. ....	My. 22	....	65 58.4	.....	..	24.12	Do.

TENNESSEE.

				East.					
	° ′	° ′		° ′					
Iron mountain furnace tract.	36 29.8	88 00	De. 29	4 24	.. ....	.....	737	.....	C. H. S.

*Total intensity by Lloyd's method.

Results of magnetic observations from July 1, 1902, to June 30, 1903—Continued.

TEXAS.

Station.	Latitude.	Longitude.	Date.	Declination.	Dip.	Horizontal intensity.	Instruments.		Observer.
							M.	D. C.	
				East.					
	° ′	° ′		° ′	° ′	γ			
Lindenau.	29 07.6	97 22.3	Jy. 2, 3	8 15.8	57 47.0	28864	10	18.12	J. M. K.
Do.	.. ....	.. ....	Se. 20, 22	8 15.0	57 49.0	28824	10	18.14	Do.
San Antonio.	29 29.3	98 32.1	Oc. 31	8 48.2	57 56.2	28734	21	24.12	L. A. B.
Do.	.. ....	.. ....	Oc. 31	....	57 58.5	*54340**	..	28.12	Do.
Houston.	29 47.1	95 20.7	Jy. 21, 22	7 45.8	59 10.6	28296	10	18.12	J. M. K.
Lagrange, new.	29 52.1	96 49.4	Jy. 7, 8	8 07.1	58 50.9	28318	10	18.12	Do.
Lagrange, old.	29 53.4	96 53.5	Jy. 5, 7	7 35.7	58 26.9	28783	10	18.12	Do.
San Marcos.	29 54.1	97 56.3	Se. 18	8 21.8	58 44.0	28406	10	18.14	Do.
Bellville.	29 56.3	96 12.8	Jy. 9	8 03.8	59 10.0	28166	10	18.12	Do.
Liberty.	30 03.6	94 48.2	Jy. 25	7 37.2	59 45.4	27819	10	18.12	Do.
Do.	.. ....	.. ....	No. 1	7 36.1	59 40.6	27816	21	24.12	L. A. B.
Do.	.. ....	.. ....	No. 1	....	59 39.0	*55292**	..	28.12	Do.
Conroe.	30 18.6	95 26.5	Jy. 17	7 50.2	59 42.5	27830	10	18.12	J. M. K.
Anderson.	30 28.8	95 59.2	Jy. 15	7 38.2	59 45.3	27829	10	18.12	Do.
Caldwell.	30 31.6	96 46.4	Jy. 10, 11	8 25.9	59 32.4	27911	10	18.12	Do.
Georgetown.	30 38.7	97 40.5	Se. 27	8 26.7	59 44.8	27837	10	18.14	Do.
Livingston.	30 42.9	94 56.2	Jy. 30, 31	7 33.8	60 14.2	27587	10	18.12	Do.
Cameron.	30 52.3	96 57.8	Se. 15	8 12.0	59 51.4	27754	10	18.14	Do.
Madisonville.	30 56.6	95 54.8	Au. 5	8 04.8	60 11.7	27617	10	18.12	Do.
Trinity.	30 57.2	95 22.4	Au. 2	7 43.4	60 16.7	27551	10	18.12	Do.
Franklin.	31 00.8	96 29.8	Jy. 14	8 20.2	60 05.2	27673	10	18.12	Do.
Lufkin.	31 21.4	94 44.0	Au. 13, 14	7 38.2	60 51.5	27285	10	18.12	Do.
Gatesville.	31 26.8	97 44.6	Se. 12	8 44.0	60 15.3	27562	10	18.14	Do.
Waco.	31 35.8	97 08.4	Se. 8	8 18.4	60 32.7	27386	10	18.14	Do.
Palestine.	31 47.2	95 37.5	Au. 8	7 47.5	61 07.4	27132	10	18.12	Do.
Center.	31 48.5	94 10.8	Au. 16	7 40.3	61 26.5	26927	10	18.14	Do.
Meridian.	31 57.3	97 39.5	Se. 10	8 25.6	61 05.7	27139	10	18.14	Do.
Jacksonville.	31 58.3	95 23.4	Au. 12	7 37.0	61 26.6	26907	10	18.12	Do.
Henderson.	32 10.6	94 49.2	Au. 9, 11	7 51.6	61 45.5	26772	10	18.12	Do.
Athens.	32 12.8	95 51.0	Se. 1, 2	8 00.6	61 41.6	26879	10	18.14	Do.
Waxahachie.	32 25.0	96 51.8	Se. 5, 6	8 18.8	61 41.3	26811	10	18.14	Do.
Kaufman.	32 35.4	96 19.6	Se. 3, 4	8 05.2	61 58.5	26692	10	18.14	Do.
Mineola.	32 40.9	95 29.8	Au. 29	7 45.6	62 09.2	26506	10	18.14	Do.
Jefferson.	32 46.1	94 21.3	Au. 18–20	7 24.6	62 25.0	26352	10	18.14	Do.
Sulphur Springs.	33 09.1	95 35.7	Au. 23	7 43.8	62 40.1	26270	10	18.14	Do.
Mount Pleasant.	33 10.4	94 57.6	Au. 21, 22	7 44.2	62 46.3	26215	10	18.14	Do.
McKinney.	33 13.1	96 36.3	Au. 27, 28	8 37.6	62 22.0	26587	10	18.14	Do.
Lubbock.	33 36.2	101 51.6	No. 14	10 27.5	62 21.8	26267	19	55.12	F. M. L.
Emma.	33 37.2	101 20.7	No. 16	10 17.2	62 03.0	26331	19	55.12	Do.
Paris.	33 40.7	95 35.0	Au. 25	7 57.2	63 19.1	25832	10	18.14	J. M. K.
Floydada.	33 59.2	101 15.4	No. 18	10 19.4	62 25.1	26356	19	55.12	F. M. L.
Crowell.	33 59.6	99 42.1	No. 27	10 34.8	62 51.5	25983	19	55.12	Do.
Matador.	34 00.3	100 41.7	No. 19	10 04.6	62 41.4	26062	19	55.12	Do.
Paducah.	34 02.2	100 15.8	No. 25	10 14.0	62 35.2	26156	19	55.12	Do.
Plainview.	34 11.6	101 45.0	No. 12	10 47.2	62 44.2	26199	19	55.12	Do.
Quanah.	34 17	99 44.3	No. 29	10 04.0	62 58.3	26054	19	55.12	Do.
Childress.	34 26.3	100 08.7	De. 1	10 36.9	63 08.4	25928	19	55.12	Do.
Silverton.	34 28.2	101 23.0	No. 10	10 27.7	63 13.7	25830	19	55.12	Do.
Bovina.	34 31.4	102 53.0	Oc. 17, 18	10 16.2	63 17.7	25669	19	55.12	Do.
Dimmitt.	34 33.4	102 19.0	Oc. 15, 16	12 25.2	63 04.2	25762	19	55.12	Do.
Tulia.	34 34.3	101 50.7	No. 8–11	11 09.0	63 10.0	25872	19	55.12	Do.
Memphis.	34 44.0	100 31.9	De. 5	9 58.2	63 24.4	25754	19	55.12	Do.
Hereford.	34 49.2	102 23.7	Oc. 28	11 34.9	63 03.5	25945	21	24.12	L. A. B.
Do.	.. ....	... .	Oc. 28	.. ....	.. ....	*57208**	..	28.	Do.
Do.	.. ....	... .	No. 1–4	11 34.3	63 06.4	25887	19	55.12	F. M. L.

*Total intensity by Lloyd's method.

Results of magnetic observations from July 1, 1902, to June 30, 1903—Continued.

TEXAS—Continued.

Station.	Latitude.	Longitude.	Date.	Declination.	Dip.	Horizontal intensity.	Instruments.		Observer.
							M.	D. C.	
	° ′	° ′		*East.* ° ′	° ′	γ			
Wellington.	34 51.3	100 12.3	De. 2, 4	10 57.8	63 32.8	25658	19	55.12	F. M. L.
Clarendon.	34 56.7	100 53.2	De. 9	10 27.8	63 45.1	25580	19	55.12	Do.
Canyon.	34 59.9	102 00.5	No. 6, 7	11 27.6	63 35.0	25666	19	55.12	Do.
Claude.	35 08.0	101 23.4	De. 11	10 50.6	63 55.4	25420	19	55.12	Do.
Amarillo.	35 13.0	101 50.9	Au. 7–9	11 37.2	63 59.4	25455	19	55.12	Do.
Do.	.. ....	... .	De. 22	11 38.7	64 01.8	25428	19	55.12	Do.
Panhandle.	35 20.8	101 22.8	Oc. 11	10 53.0	64 15.0	25043	19	55.12	Do.
Lefors.	35 26.2	100 48.6	Oc. 9, 10	10 43.8	64 18.9	25248	19	55.12	Do.
Pampa.	35 32.6	100 58.5	Oc. 8	10 54.0	64 35.4	24902	19	55.12	Do.
Tascosa.	35 32.8	102 14.1	Au. 27, 28	11 44.7	64 12.4	25165	19	55.12	Do.
Mobeetie.	35 33.5	100 25.9	Oc. 6	10 41.2	64 36.2	24776	19	55.12	Do.
Channing.	35 40.8	102 17.4	Se. 2	11 48.8	64 21.3	25120	19	55.12	Do.
Miami.	35 42.0	100 37.6	Se. 30	10 43.7	64 27.5	24935	19	55.12	Do.
Plemons.	35 48.4	101 18.2	Se. 20	11 16.3	64 37.6	24799	19	55.12	Do.
Hartley.	35 50.7	102 23.3	Se. 6	11 47.8	64 32.0	24962	19	55.12	Do.
Dumas.	35 51.7	101 59.0	Se. 3, 4	11 46.8	64 37.6	24894	19	55.12	Do.
Canadian.	35 55.1	100 23.5	Se. 29	10 58.2	64 43.9	24952	19	55.12	Do.
Dalhart.	36 04.3	102 31.0	Se. 10	11 54.0	64 41.8	24739	19	55.12	Do.
Higgins.	36 08.0	100 01.1	Se. 27	10 52.2	65 23.4	24420	19	55.12	Do.
Hansford.	36 12.6	101 15.9	Se. 16, 17	11 08.6	64 48.6	24820	19	55.12	Do.
Lipscomb.	36 14.6	100 14.8	Se. 24, 25	11 00.4	65 19.5	24397	19	55.12	Do.
Ochiltree.	36 17	100 47.6	Se. 22, 23	11 01.3	65 06.2	24643	19	55.12	Do.
Stratford.	36 19.9	102 03.5	Se. 12	11 50.2	65 03.5	24516	19	55.12	Do.
Texline.	36 22.9	103 00.8	Se. 8	12 16.9	64 58.9	24419	19	55.12	Do.

VIRGINIA.

	° ′	° ′		*West.* ° ′	° ′	γ			
Jonesville.	36 42.2	83 10.6	Jy. 14, 15	0 50.8	68 00.2	22450	11	15.24	E. D. P.
Lebanon.	36 55.7	82 06.6	Jy. 7, 8	1 27.2	67 55.1	22470	11	15.24	Do.
Wytheville.	36 57.0	81 03.9	Jy. 1	1 11.6	68 25.3	21805	11	15.24	Do.
Wise.	36 59.9	82 36.8	Jy. 11–13	0 15.3	68 29.6	21932	11	15.24	Do.
Pulaski, C. H.	37 03.5	80 47.4	Jy. 26	1 15.0	68 34.6	21648	11	15.24	Do.
Pulaski Inn.	37 03	80 46.1	Jy. 25	1 23.6	68 35.7	21626	11	15.24	Do.
Bland.	37 07.9	81 08.4	Jy. 3, 4	1 00.8	68 27.6	21836	11	15.24	Do.
Clintwood.	37 10.6	82 29.7	Jy. 18, 19	0 09.7	68 32.8	21799	11	15.24	Do.
Shack Mills.	37 12.2	81 58.6	Jy. 22, 23	1 04.1	68 38.9	21972	11	15.24	Do.
Hanover.	37 46.6	77 20.6	Ap. 27	4 12.8	69 19.3	20945	11	15.24	Do.
Bowling Green.	38 03.9	77 21.1	Ap. 28, 29	4 35.6	69 33.5	20835	11	15.24	Do.
Spottsylvania.	38 12.8	77 34.5	My. 1	4 41.8	69 36.1	20791	11	15.24	Do.

WASHINGTON.

	° ′	° ′			° ′	γ			
Seattle.	47 39.6	122 18.4	Je. 8, 9	.....	70 48.4	19340	11	15.24	J. W. M.

WISCONSIN.

	° ′	° ′		*East.* ° ′	° ′	γ			
Milwaukee.	43 04.0	87 52.0	Oc. 18	3 32.8	.. ....	17731	21	.....	L. A. B.
Do.	43 04.0	87 52.0	Oc. 18	. ....	73 42.0	*63302**	..	28.12	Do.

* Total intensity by Lloyd's method.

Results of magnetic observations from July 1, 1902, to June 30, 1903—Concluded.

FOREIGN COUNTRIES.

Station.	Latitude.	Longitude.	Date.	Declination.	Dip.	Horizontal intensity.	Instruments.		Observer.
							M.	D. C.	
Santo Domingo.	° ′	° ′		*West.* ° ′	° ′	γ			
San Pedro de Macoris.*	18 28.0	69 19.5	Fe. 26	0 02.6	.. ....	30247	21	.....	L. A. B.
				East.					
Santo Domingo.*	18 28.7	69 53.0	Fe. 26	0 03.0	.. ....	30262	21	.....	Do.
Cuba.									
Santiago.*	20 00.2	75 50.1	Fe. 28	1 32.4	.. ....	30478	21	.....	L. A. B.
Baracoa.*	20 21.5	74 29	Mh. 1	0 59.8	.. ....	30418	21	.....	Do.
Gibara.*	21 06.7	76 09.6	Mh. 2	1 14.7	.. ....	30502	21	.....	Do.
Habana, villa.*	23 06.6	82 22.0	My. 6	3 01.8	.. ....	30452	21	.....	Do.
Habana, college.*	23 08.2	82 22.0	Mh. 5	3 04.4	.. ....	30482	21	.....	Do.
Canada.									
Fort William:									
Mission.	48 23.7	89 13.5	Oc. 7	3 32.9	77 54.7	13236	21	24.12	L. A. B.
Do.	.. ....	.. ....	Oc. 7	. ....	77 55.1	*64230*†	..	28.12	Do.
School.	48 24.5	89 12.6	Oc. 8	3 49.9	.. ....	13280	21	.....	Do.
Do.	.. ....	.. ....	Oc. 8	. ....	77 54.6	*63988*†	..	28.12	Do.
Victoria.	48 24.5	123 23.6	Je. 21	24 04.6‡	.. ....	18804	11	.....	J. W. M.
Union.	49 35.4	124 54.5	Je. 19	26 00.0‡	.. ....	19016	11	.....	Do.

* Dip results at these stations were obtained with dip circle No. 24; their publication is deferred because of reasons stated on p. 939.
† Total intensity by Lloyd's method.
‡ Results obtained with compass declinometer 742.

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 detailed description so that the station may be located even if the marking should be destroyed, and to determine the true bearing of two or three prominent objects in addition to the one used as a 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 on application to the Superintendent of the Coast and Geodetic Survey. The usual method of marking a station is by a stone post about 3 feet long and 6 or 8 inches square set so as to project an inch or two above ground and lettered on top U. S. C. & G. S., with a drill hole in the center to mark the exact point. Whenever the local authorities desired and were willing to bear the expense, a second stone was set to denote the true meridian.

The descriptions of stations are arranged alphabetically by States and by name of station.

ALABAMA.

Eufaula, Barbour County.—The old station being no longer available a new station was located on the grounds of the Eufaula High School for Girls. The station is 172.4 feet from the northeast corner of the school building and 50.5 feet from the north fence of the school grounds. The station is marked by a limestone post, 33 by 10 by 6 inches, set so as to project 1 inch above the ground, and

Descriptions of Stations—Continued.

ALABAMA—Continued.

lettered on top U. S. C. & G. S. 1903. The spire of the Methodist Church bears 65° 02′.2 east of true south. The spire of the Baptist Church bears 73° 16′.1 east of true south.

Greensboro, Hale County.—The station is on the campus of Southern University, 45.2 feet from the south fence and 67.7 feet from the west fence. The station is marked by a limestone post, 30 by 6 by 4½ inches, sunk 1 inch below the ground, and roughly lettered on top U. S. The highest point of the city water tower bears 53° 57′.9 west of true north. The right-hand edge of the southeast chimney on Mrs. Walker's residence bears 73° 37′.7 east of true north. The north gable of Mr. Carter Bank's house bears 21° 09′.9 west of true south.

Livingston, Sumter County.—To reach the station proceed one block southeast from the court-house square and then turn one-half block northeast; the station is in the street. It is 27.6 feet from the fence on the northwest, and 54.2 feet from the fence on the southeast, and is about midway between the nearest intersecting streets. The station is marked by a limestone post, 34 by 11 by 11 inches, set flush with the ground, and roughly lettered on top U. S. C. S. The spire on the colored Methodist Church bears 37° 51′.4 east of true north. The spire of the Baptist Church bears 6° 09′.3 west of true north. The dome of the court-house bears 77° 21′.9 west of true north.

Ozark, Dale County.—The station is on the public school grounds, 252.3 feet from the southwest corner of the schoolhouse and 64.8 feet from the alley west of the school yard. The station is marked by a limestone post, 30 by 7 by 6 inches, sunk 2 inches below the ground, and lettered on top U. S. C. & G. S., 1903. The dome of the court-house bears 51° 09′.4 west of true north. The tower on Mr. William Garner's residence bears 48° 16′.6 west of true north. The spire of the Baptist Church bears 80° 48′.3 west of true north.

Selma, Dallas County.—The old station at Selma being no longer available, the new station was located on the ground adjoining the colored Presbyterian Church and near the intersection of Robinson and Sylvan streets. The station is 70.8 feet from the southwest corner and 82.3 feet from the northwest corner of the church building. The station is marked by a limestone post, 33 by 8 by 6 inches, sunk 1 inch below the ground, and lettered on top U. S. C. & G. S., 1903. The dome of the court-house bears 15° 02′.2 west of true south. The spire of the Methodist Church bears 23° 14′.1 west of true south. The east edge of the city water tower bears 10° 51′.6 east of true south.

Troy, Pike County.—The station is located on the county poor farm, near the south edge of the poor-farm cemetery. It is 47 paces from the fence, east of south, and 33 paces south of an oak tree. The station is marked by a limestone post, 36 by 9 by 5 inches, set so as to project 2 inches above the ground, and roughly lettered on top U. S. The east edge of the city water tower bears 3° 15′.6 west of true south. The right-hand edge of the chimney on Mr. Brazzle's residence bears 48° 57′.4 west of true south. The tower on Mrs. Seller's residence bears 11° 16′.5 east of true south.

ALASKA.

Douglas Island.—Several stations were occupied near Juneau in 1900, in order to develop the strong local attraction present in that locality. The principal station was on the side of the hill east of the town, in the center of a large spruce stump about 6 feet in diameter. The mark used was the flagstaff on Captain Campbell's house, which bears 8° 44′.0 west of true south.

Two stations were about 25 paces beyond the powder magazine below Ready Bullion Mine at Treadwell. The one of October 7 was on a large spruce stump, the other was about 9 feet south of it. These were probably near the center of the disturbance. Another station was on the south side of the mouth of Sheep Creek, and another on the northeast corner of Juneau Isle, opposite Douglas City.

First, Port Etches.—The station is on the prominent point forming the southwest side of the entrance to Mosquito Bight, Port Etches. It is on the extreme edge of the point, about 6 feet from the edge of the bluff, which is about 35 feet high. It is marked by a 2 by 4 stub. Two trees were blazed as witness marks. One is 32.9 feet nearly east of the station and the other 17.5 feet to the southwest. The mark used was the triangulation station Gnat, which bears 53° 09′.8 west of true south.

Grass, Port Etches.—The station is on the end of the grassy spit on the inside of the northern side of the entrance to Constantine Harbor. It is on the south end of the spit and is marked by a 3 by 3 stub. The mark used was the triangulation station Slope, which bears 61° 48′.2 west of true north.

Nunivak Island.—The magnetic station was 6 meters due north of the astronomical station, which

Descriptions of Stations—Continued.

ALASKA—Continued.

is on the south side of Nunivak Island, about 12 miles from Cape Mohican, the western extremity of the island. It is on the east side of the mouth of a small stream that empties into a bight in the shore line, the first one to the eastward of the cape where a landing is possible. The astronomical station is marked by a concrete pier 16 by 24 inches in section, and about 3 feet high.

St. Lawrence Island.—The magnetic station was 12.9 meters due north of the astronomical station at Northeast Cape. It is on a sand dune about 120 meters west of the high-water mark, and on the shore of a salt lagoon, about halfway between the north and south points of the cape.

St. Michael.—Five stations were occupied in order to develop the local disturbance which had been previously noted in the vicinity. Station I is 68½ feet due south of the astronomical station, which is marked by a concrete pier. Station II is 24 feet nearly east from Station I, and is marked by a 4 by 4 stake. This is probably the point occupied in 1900. Station III is 117¼ feet to the east of the astronomical station. Station Mesa, which is best suited for future observations, is about a quarter of a mile due north of the astronomical station and 80 feet north of the middle of the board walk leading from the main east and west street near the astronomical station, past the Russian churches and the shipyard. It is marked by a 2 by 4 pine stake. The station Hill Top is just east of the yellow house of the land office, north of the shipyard, and near the board walk. It is about 1 000 feet from Mesa.

Sitka Magnetic Observatory.—In the absolute building. For description of the observatory, see Appendix No. 5. Report for 1902.

ARIZONA.

Ash Fork, Yavapai County.—The station is in the open space southeast of town, on the west building line of Second street, and 113.5 feet south of Mr. Foley's house. The station is marked by a red-sandstone post 2 feet long, dressed to 5 inches square on top, and projecting 4 inches above ground. The highest point of the railroad water tank bears 17° 17′.2 east of true north. The east gable of Mr. C. H. Clark's house bears 63° 25′.3 west of true north. The north gable of Mr. Kelley's house bears 86° 40′.3 west of true north.

Benson, Cochise County.—The station is on the grounds of the Industrial School, in line with the north side of the building, and 195.4 feet from the northeast corner of the building. The station is marked by a post of black marble 28 by 5 by 5 inches, set so as to project 2 inches above ground, and lettered on top U. S. C. & G. S. 1903. The bell on the public school bears 85° 16′.0 east of true north. The light switch at the railroad station bears 51° 08′.7 east of true north. The northeast corner of the Industrial School building bears 76° 31′.2 west of true north.

Bowie, Cochise County.—The station is at the rear of the railroad hotel, about 300 feet from the yard fence, almost on a line between the east end of the hotel and the schoolhouse, and in line with the west side of the schoolhouse. The station is marked by a large rock about 19 by 23 inches on top and 16 inches thick, sunk about 12 inches into the ground, and roughly lettered U. S. C. & G. S., 1903. The west gable of Mr. Anderson's house bears 48° 10′.9 east of true south. The east gable of the railroad warehouse bears 23° 38′.4 west of true north. The southwest gable of Mr. McCarthy's house bears 73° 24′.4 east of true south.

Casa Grande, Pinal County.—The station is in the rear of Casa Grande Hotel, in line with the northwest side of the hotel, and also with the rear end of a near-by church. It is 88.7 feet from the fence to the southwest, and 110.9 feet from the north corner of Mr. Madonado's yard. It is marked by a small peg about 1 foot long projecting 1 inch above ground. Mr. R. F. Witting's windmill bears 67° 17′.5 west of true south. The east gable of the depot bears 37° 38′.7 east of true north. The south gable of a church bears 52° 58′.9 east of true south.

Clifton, Graham County.—The station is on the baseball ground, about in line with the east end of the grand stand and 42 feet from the northeast corner of the same. The station is marked by a 5-inch iron bolt driven a little below the surface of the ground. The flag pole on the McFate Building bears 0° 17′.3 east of true south. The flag pole on the Chinese joss house bears 53° 01′.3 west of true north. The east edge of Mr. Collin's house bears 17° 39′.3 east of true south.

Cochise, Cochise County.—The station is on the west side of the railroad, approximately in line with both the north side of the depot and the west side of the schoolhouse, and 162 feet from the

Descriptions of Stations—Continued.

ARIZONA—Continued.

northwest corner of the schoolhouse. The station is marked by a redwood post, 26 by 6 by 6 inches, projecting 4 inches above ground. The flag pole on Kinnard Lee restaurant bears 25° 16′.4 east of true south. The north gable of Mr. Wiley Morgan's house bears 40° 26′.6 west of true south. The south gable of the railroad warehouse bears 58° 05′.6 east of true north.

Congress Junction, Yavapai County.—The station is in the open space northeast of the hotel, and is 438.8 feet from the northeast corner of the corral surrounding the hotel. The station is marked by a granite post 18 by 4 by 4 inches, which is diamond-shaped on top and has a drill hole to mark the exact point. A distant mountain peak bears 44° 53′.3 west of true south. The east gable of Jackman Hotel bears 47° 46′.3 west of true south. The highest chimney on a mill at Congress bears 8° 43′.2 west of true north.

Crittenden, Santa Cruz County.—The station is in the open space south of Smith's Hotel and about 400 feet west of the railroad. It is south of two green-elder trees, being 38.5 feet from the west tree and 35.8 feet from the east tree. The station is marked by an undressed blue limestone 1.6 by 2 feet on top and about 14 inches thick, set so as to project 4 inches above ground. Mr. A. S. Henderson's windmill bears 3° 25′.7 east of true south. The east gable of Smith's Hotel bears 26° 28′.3 east of true north. The railroad water tank bears 66° 41′.2 east of true north.

Douglas, Cochise County.—The station is at the intersection of the circular and the south walks in the "Plaza," and is 91.5 feet from the hydrant in the center and 58.9 feet from the south fence. The station is marked by a hickory tent peg driven about 3 inches below the ground. The cupola of Mr. Long's store bears 61° 00′.9 west of true north. The flag pole of the custom-house bears 73° 00′.7 west of true south. The cupola of the Library Hall bears 73° 09′.6 west of true north.

Duncan, Graham County.—The station is located at the north end of Main street, 126.3 feet from the southeast corner of the post-office and about 3 feet from the row of trees on the east side of Main street. The station is marked by a limestone rock, about 14 by 12 by 6 inches, buried 3 inches below the ground. The west edge of the schoolhouse bears 55° 09′.5 west of true south. The north gable of Mr. John Evans's house bears 43° 26′.4 west of true north. The Geological Survey monument on Vanderbilt Mountain bears 34° 38′.1 east of true north.

Flagstaff, Coconino County.—The station is on the Normal School grounds, 392.5 feet northeast of the main building, 17.7 feet south of a pine tree, and 16 feet southwest of a second pine tree, which is 8 feet from the first. Three secondary stations, "A," "B," and "C," are distant 351.5 feet, 258.9 feet, and 329.8 feet, respectively, from the primary station. The bearings of the secondary stations are: "A," 30° 21′.8 west of true north; "B," 70° 03′.7 east of true north; and "C," 20° 08′.7 west of true south. From the primary station the pole on Weatherford Hotel bears 38° 20′.2 east of true north. The spire of the Methodist Church bears 39° 41′.2 east of true north. The spire of the court-house bears 43° 28′.7 east of true north. The meridian line is marked by a cross cut on the top step of the main entrance to the building and by a red-sandstone post set 200 feet north of that point.

Florence, Pinal County.—The station is in the southwest corner of the court-house square, 8.05 feet north and east of the south meridian stone, which is 44.8 feet from the south fence, 28.1 feet from the west fence, and 143.9 feet from the southwest corner of the court-house. The meridian line is 240.5 feet long, each end being marked by a cross on a rough stone sunk about 4 inches below ground. The flagstaff on the schoolhouse bears 20° 38′.9 east of true north. The Presbyterian church spire bears 5° 33′.7 east of true north. The highest point of Superstition Mountain bears 1° 52′.9 west of true north.

Fort Thomas, Graham County.—The station is on the south side of the railroad 441.5 feet from the south rail of the main track and in line with the west end of the depot and the south wall of an old adobe building. The station is marked by a rock 10 by 12 inches on top and 6 inches thick, buried about 4 inches below ground. The highest point of Turnbull Mountain bears 81° 58′.0 west of true north. The railroad water tank bears 35° 37′.9 west of true north. The gable of the porch of the post commander's residence bears 10° 37′.5 west of true south.

Globe, Gila County.—The station is on the public school grounds, 41.8 feet from the west fence and 82.2 feet from the north fence. The station is marked by a hickory peg about 12 inches long driven nearly flush with the ground. The west gable of Mr. Alonzo Bailey's house bears 62° 33′.8 east

Descriptions of Stations—Continued.

ARIZONA—Continued.

of true north. The west gable of Doctor Nisel's house bears 78° 32′.6 east of true north. The northwest edge of the schoolhouse bears 52° 52′.0 east of true north.

Gila Bend, Maricopa County.—The station is approximately in line with the east end of Kendall Hotel and 105.4 feet from the northwest corner of the hotel. It is also 140.3 feet from the northeast corner of a small iron-sheathed cottage and is about in line with the north side of the cottage. The station is marked by a tent peg about 14 inches long driven nearly flush with the ground. The west edge of the west chimney of the depot bears 16° 12′.4 east of true south. The belfry of the schoolhouse bears 77° 59′.0 west of true north. The north edge of the east oil tank bears 64° 50′.7 east of true south.

Grand Canyon, Coconino County.—The station is about 425 feet east of the main entrance to the hotel, and is marked by a wooden stub. It is about 40 feet from the edge of the canyon. It is 30 feet west of a tree, 35 feet southwest of a second tree, and 31 feet southeast of a third tree. The mark used was a rock on the other side of the chasm, and about 8 miles distant. This mark bears 19° 00′.8 east of true north. The perpendicular edge of a projecting rock just north of the hotel bears 45° 46′.7 west of true north.

Hackberry, Mohave County.—The station is in the open space southwest of the Post-Office, and is 310 feet from the southwest corner of Mrs. Logan's house. The station is marked by an irregular shaped stone about 2 feet long projecting several inches above ground. The small projection on the right-hand side of a distant mountain peak bears 5° 59′.8 east of true south. The east gable of the railroad station bears 28° 10′.7 east of true north. The southwest corner of the Post-Office bears 53° 28′.2 east of true north.

Holbrook, Navajo County.—The station is in the open space southwest of the Hotel Brunswick, 326 feet from the northeast corner of the public school, and 257 feet from the southwest corner of the hotel yard. The station is marked by a sandstone post 30 by 6 by 6 inches. The point of a ledge of rock 3 miles distant bears 38° 06′.5 west of true south. The pole on the court-house bears 44° 48′.5 east of true north. The railroad water tank bears 76° 01′.0 east of true north.

Hot Springs Junction, Maricopa County.—The station is 325.5 feet north of the northwest corner of the main part of the hotel. The station is marked by a wooden stub, 24 by 4 by 4 inches, projecting a few inches above ground. The west gable of the hotel bears 2° 01′.0 west of true south. The north gable of a residence bears 41° 53′.5 west of true south. The west gable of the depot bears 10° 36′.0 east of true south.

Jerome Junction, Yavapai County.—The station is 261 feet west of the northeast corner of the hotel, and 408.5 feet from the railroad station. The station is marked by a wooden post 24 by 8 by 8 inches sunk nearly flush with the ground, and having a small nail to mark the exact point. The north gable of Mr. J. H. Brown's house bears 46° 01′.6 east of true south. A distant mountain peak bears 70° 47′.6 west of true north. The west gable of the railroad station bears 71° 49′.9 east of true north.

Kingman, Mohave County.—The station is in the open space northwest of the court-house, being distant 266 feet from the northwest corner of the court-house. The station is marked by a granite post 24 by 4 by 4 inches, projecting a few inches above ground. The pole on the public school bears 3° 33′.2 east of true south. The chimney on the Methodist church bears 54° 21′.7 east of true south. The summit of a distant mountain peak bears 88° 26′.3 west of true south.

Kirkland, Yavapai County.—The station is in an open lot east of the hotel, 208.5 feet south of a post which is 296.5 feet east of the hotel. The station is marked by a stone 2 feet long, of irregular shape below ground, but triangular (8 by 8 by 8 inches) above ground. The middle sash of the east window of Mr. Albert Roodey's house bears 34° 19′.8 west of true south. The south gable of the hotel bears 88° 15′.2 west of true north. The summit of the Antelope peak bears 13° 45′.7 east of true south.

Maricopa, Pinal County.—The station was located at the approximate center of Mr. Perry M. Williams's quarter section, and about 225 yards from the south end of Williams's Hotel. The station is marked by a pine post 5 inches square and projecting about 20 inches above ground. The cone of a distant mountain bears 8° 31′.1 east of true south. The small gable of Williams's Hotel bears 2° 00′.5 east of true north. The southwest edge of the chimney of Mr. Edward's store bears 11° 47′.3 east of true north.

Descriptions of Stations—Continued.

ARIZONA—Continued.

Mayer, Yavapai County.—The station is 467 feet almost due north from the northwest corner of the railroad station, and is 26 feet south of a clump of 4 trees. The station is marked by a granite post, 24 by 6 by 6 inches, projecting 3 inches above ground. The pole on the railroad station bears 5° 17′.9 west of true south. The highest point of the water tank bears 18° 21′.9 west of true south. The pole on the public school bears 84° 25′.9 west of true south.

Mohawk Summit, Yuma County.—The station is on the north side of the railroad, 348.5 feet from the track and a little east of north from the telegraph office, in the center of the west circle of an old Mexican playground. The station is marked by a tent peg driven flush with the ground. The notch in the mountain several miles distant and seen just west of the first telegraph pole east of station bears 11° 37′.4 west of true south. The southeast edge of the chimney on the depot bears 20° 08′.4 west of true south. The highest point of a distant mountain peak bears 77° 21′.6 west of true north.

Naco, Cochise County.—The station is on the coursing grounds just east of Hotel Naco and is a little north and east of the center of the grounds, being 144.3 feet from the east fence, measuring in line with the north side of the oil house. It is also in line with the west side of Madding Opera House. The station is marked by a tent peg driven a little below the surface of the ground. The flag pole of Madding Opera House bears 0° 05′.3 west of true north. The flag pole on the Copper Queen warehouse bears 5° 57′.7 west of true south. The flag pole of the custom-house bears 45° 55′.1 west of true south.

Navajo, Apache County.—The station is in the open space northwest of the depot, 350 feet from the northwest corner of the depot and 249 feet from the corner of a yard. The station is marked by a sandstone post, 30 by 8 by 5 inches, projecting a few inches above ground. The west gable of the depot bears 68° 27′.5 east of true south. The north gable of Mr. Lynch's store bears 75° 40′.5 east of true north.

Nogales, Santa Cruz County.—The station is a little north of west from the railroad oil tank and is in line with the north edge of Capt. J. J. Noon's house and 78.05 feet from its northeast corner. The station is marked by a rough stone about 8 by 10 inches on top and 8 inches thick, sunk a little below ground. An international boundary post bears 14° 24′.5 east of true south. The cross on the Catholic church bears 12° 48′.7 east of true south. Bald Mountain in the Santarita Mountains bears 12° 34′.7 east of true north.

Peach Springs, Mohave County.—The station is on the open lot southwest of Mr. J. L. Nelson's house, and is 600 feet north of the railroad station and 220.5 feet from the southwest corner of Mr. Nelson's house. The station is marked by a stone, 24 by 5 by 5 inches, projecting a few inches above ground and lettered on the side U. S. The east gable of the railroad station dwelling house bears 9° 47′.6 west of true south. The most prominent projection of a distant mountain peak bears 87° 15′.4 west of true north. The highest point of a water tank bears 68° 45′.4 east of true south.

Phoenix, Maricopa County.—Observations were made at seven stations in the Indian School Government reservation in order to test this locality as a desirable location for a magnetic observatory. The primary station "A" is marked by a red sandstone post, about 28 by 5 by 5 inches, lettered on top U. S. C. & G. S. 1903, and set so as to project about 3 inches above ground. From station "A" the spire on the Boy's Dormitory at the Indian School bears 83° 08′.3 west of true south; a windmill bears 69° 32′.5 east of true north, and a second windmill bears 84° 43′.3 east of true south. The six secondary stations "B" 1, 2, 3, 3a, and 4 were located as follows: Station 1 is 424 feet west and south of station "A" on the line passing through "A" and the spire of the Boy's Dormitory. Stations "B" 3a and 3 are on the prolongation of this line to the east of "A" and are distant from "A" 28, 380.5 and 415 feet, respectively. Stations 2 and 4 are on a straight line passing through "A" at right angles to the above line, "2" being 436 feet north, and "4," 413 feet south of "A."

Prescott, Yavapai County.—The station is on a hill west of town, and is about midway between the Catholic cemetery and Mr. P. L. Kastner's house. It is 248.8 feet from the northeast corner of Mr. Kastner's yard and 22.9 feet north of an oak tree. The station is marked by a granite post, 33 by 8 by 8 inches, lettered on top U. S. C. & G. S. and set so as to project 1 inch above ground. The highest point of the court-house tower bears 55° 03′.0 east of true south. The Methodist church spire bears 35° 33′.0 west of true south. The cross on the Catholic church bears 84° 06′.5 east of true north.

Red Rock, Pinal County.—The station is about 6.5 feet south of the center of the west side of the

Descriptions of Stations—Continued.

ARIZONA—Continued.

SW. ¼ sec. 4. The station is marked by a rough granite post about 1 foot square on top and projecting about 2 inches above ground. The target of the railroad switch bears 7° 14′.9 west of true north. The southeast gable of the depot bears 48° 11′.7 east of true north. The highest point of Sugar Loaf Mountain peak bears 82° 49′.3 west of true south.

San Carlos, Gila County.—The station is 97.1 feet west of the Trader's store, in line with the south side of the store, and in line with the east end of the west section of the Indian Agency building. The station is marked by a sandstone post about 1 foot square and buried about 4 inches below ground. The chimney on the hospital steward's house bears 17° 14′.4 east of true north. The flagpole on the Indian Agency building bears 23° 34′.0 west of true south. The flagstaff at the army post bears 15° 54′.5 east of true north.

Seligman, Yavapai County.—The station is in the field northeast of Cottage Hotel, 215.5 feet from the northeast corner of the hotel and 133.5 feet from the northeast corner of Mr. L. D. Gale's yard. The station is marked by a stone, 24 by 5 by 3 inches, projecting a few inches above ground. The highest point of the water tank bears 5° 09′.6 west of true south. The pole on the Post-Office bears 29° 26′.4 east of true south. The scale on the water tower bears 11° 27′.4 east of true south. Two secondary stations "A" and "B" were established on the line of the first azimuth mark, "A" being 311 feet north, and "B" 259.5 feet south of the primary station.

Sentinel, Maricopa County.—The station is on the north side of the railroad, 347.7 feet from the north rail of the north track and in line with the east fence of the section master's premises and 229.2 feet from the northeast corner of the same. The station is marked by a post, 24 by 4 by 3 inches, set nearly flush with the ground. The east edge of the chimney of the depot bears 8° 20′.8 east of true south. The railroad water tank bears 43° 04′.2 east of true south. The west gable of the freight house bears 21° 59′.5 west of true south.

Solomonsville, Graham County.—The station is on the court-house grounds, 69.9 feet from the east fence, 74 feet from the north fence, and 173.8 feet from the northeast corner of the court-house. The station is marked by a stone, 24 by 9 by 2½ inches, buried 22 inches in the ground. The meridian line is marked by a similar stone set 373.6 feet south of the station. The cupola of the Catholic Church bears 74° 57′.3 east of true south. The cupola of the Methodist Church bears 46° 16′.4 east of true south. The cupola of the court-house bears 45° 57′.6 west of true south.

Tombstone, Cochise County.—The station is approximately in the middle of Allen street extended and 51 feet southwest from the southwest corner of the county hospital yard. The station is marked by a tent peg surrounded and covered by rough rock. The flag pole of the public school bears 71° 28′.2 east of true south. The cupola of the court-house bears 55° 53′.0 east of true south. The flag pole on the city hall bears 76° 01′.5 east of true south.

Tucson, Pima County.—The station is near the southwest corner of the university campus, 108.5 feet from the west fence and 157.4 feet from the south fence. The station is the south end of a meridian line 927.5 feet long, established by Professor Smith, of the University of Arizona, in February, 1901. Each end of the meridian line is marked by a dark stone, 7 inches square on top and 5 feet long, projecting 3 inches above ground. From the south meridian stone the north stone bears 0° 00′.3 west of true north, the north tower of the main building of the university bears 57° 19′.0 east of true north, and the tower of the public school building bears 55° 43′.4 west of true south.

Wellton, Yuma County.—The station is on the north side of the railroad, 376.8 feet from the north rail of the main track and about in line with the east edge of the railroad chemical house and 390.8 feet from the northeast corner of the chemical house. The station is marked by a pine stub, 2 by 3 by 28 inches, driven 21 inches into the ground. The southeast edge of the main chimney of the telegraph office bears 10° 20′.5 west of true south. The south end of the freight house bears 35° 44′.2 west of true south. A railroad water tank bears 15° 36′.1 east of true south.

Williams, Coconino County.—The station is in the open space southeast of the public school, being about 500 feet from the school building and 400 feet from the nearest house. The station is marked by a red stone post, 24 by 5 by 4 inches, set so as to project 6 inches above ground. The spire of the public school bears 73° 39′.4 west of true north. The spire of the Catholic Church bears 79° 35′.4 west of true north. The railroad water tank bears 00° 50′.4 west of true north.

Descriptions of Stations—Continued.

ARIZONA—Continued.

Winslow, Navajo County.—The station is in the open space south of the depot, and is 621 feet from the southeast corner of the west part of the depot. The station is marked by a stone, 30 by 14 by 8 inches, projecting 4 inches above ground. San Francisco Mountain Peak bears 68° 48′.3 west of true north. The pole on Hotel Navajo bears 7° 50′.2 east of true north. The pole at the railroad station bears 23° 02′.2 east of true north.

Yuma, Yuma County.—The station is near the middle of the large adobe corral and south of the longitude station, which is on the north side of the corral. It is 83.2 feet from the south wall and 143.9 feet from the east wall of the corral. The station is marked by a hickory peg about 14 inches long driven 2 inches below the ground. An iron pin in an adjacent hill (said to be a meridian mark) bears 0° 02′.3 west of true south. The base of the vane on the Weather Bureau building bears 26° 42′.9 east of true north. The northeast edge of the north chimney on Mrs. Taggart's house bears 81° 23′.7 east of true south.

ARKANSAS.

Hardy, Sharp County.—The station is located near the north edge of the street running east and west south of the public school grounds. It is 152.4 feet from the southwest corner of the schoolhouse and 52.6 feet from the northeast corner of a fenced lot southwest of the station. The station is marked by a block of limestone about 2 feet long, trimmed to 6 by 6 inches on the top, roughly lettered U. S. C. S., and set so as to project about 5 inches above the ground. The west edge of the chimney on Mr. A. M. Jordan's residence bears 14° 50′.2 west of true south. The northeast corner of the east part of Mr. Clem Endicott's residence bears 20° 25′.1 west of true south. The right-hand edge of the chimney on Mrs. Smalley's residence bears 54° 34′.7 east of true south.

Marion, Crittenden County.—The station is located on the north side of the road running west from Marion and southwest of the colored Baptist Church. It is 78.9 feet from the southwest corner of the church and 94.4 feet from the southeast corner of the churchyard. The station is marked by a block of limestone about 16 by 8 by 6 inches, sunk 1 inch below the ground, and roughly lettered on the top U. S. The right-hand edge of the chimney on the schoolhouse bears 84° 44′.7 east of true south. The right-hand edge of the east chimney on the railroad depot bears 88° 13′.7 east of true north. The right-hand edge of the smokestack on Mr. Tom Course's cotton mill bears 54° 24′.3 east of true south.

COLORADO.

La Junta, Otero County.—The station is in the court-house yard, 147½ feet in a northeasterly direction from the northeast corner of the court-house and 44.9 feet west of the curbstone on the adjoining street. It is marked by a 3-inch terra-cotta pipe set flush with the ground. The mark used was the spire on the Christian church, which bears 20° 55′.0 west of true south. Another church spire bears 89° 16′.5 west of true north. The public school spire bears 6° 50′.5 east of true south.

Las Animas, Bent County.—The station of 1888 being no longer available, a new station was established in the northwest corner of the public park at the southeast corner of Vigil avenue and Tenth street. It is 170.3 feet from Vigil avenue and 147 feet from Tenth street and is marked by a stone post, 8 inches square on top, set flush with the ground. The Baptist Church steeple bears 33° 04′.1 west of true south, the southeast corner of the court-house bears 35° 17′.1 west of true south, and the west gable of the Swedish Church bears 23° 06′.1 east of true north.

Thatcher, Las Animas County.—The station is in the open space northwest of the railroad station, 521 feet from the signal pole and 258.8 feet from the southwest corner of C. A. Schrum's store. It is marked by a stone post, 6 inches square, set flush with the ground. The mark used was the signal pole at the railroad station, which bears 65° 55′.5 east of true south. The southwest corner of C. A. Schrum's store bears 86° 02′.0 east of true south. The west chimney on a ranch house bears 72° 18′.5 west of true north.

Trinidad, Las Animas County.—The station of 1888 was reoccupied. It is in the high school yard, nearly opposite the Methodist Church on Maple street. It is 59 feet 1 inch from the northeast corner of the school building, 65 feet 2 inches from the inner edge of the sidewalk on Maple street, and 16 feet 9 inches from the inner edge of the north fence.

Descriptions of Stations—Continued.

COLORADO—Continued.

The old station being no longer suitable for magnetic observations, a new one was established on a high knoll southeast of the town. It is about 30 feet from the west, north, and east sides of the knoll and is marked by a granite post, 6 by 8 inches on top, projecting about 8 inches above ground. The mark used was Simpson's Rest Monument, which bears 35° 54′.8 west of true north. The pole on the court-house bears 54° 25′.8 west of true north. The spire on the public school bears 70° 02′.8 west of true north.

DISTRICT OF COLUMBIA.

Washington.—The small magnetic observatory in the yard adjoining the Coast and Geodetic Survey Office.

FLORIDA.

Arcadia, De Soto County.—The station is in the second street west of the railroad and in front of the property owned by Mr. B. Johnson. It is on a line with the south side of Mr. Johnson's house, 54.6 feet from the southeast corner of his yard, and 59.3 feet from the northeast corner. The station is marked by a marble post, 30 by 6 by 6 inches, lettered on top U. S. C. & G. S., 1903, and sunk 4 inches below ground. The spire of the Methodist Church bears 12° 14′.3 east of true north. The spire of the Baptist Church bears 28° 34′.5 east of true north. The flagstaff on the First National Bank building bears 45° 38′.9 east of true north.

Bartow, Polk County.—The station is on the parade ground of South Florida Military Institute, 179.7 feet from the southwest corner of the barracks, 46 feet from the west fence, and 41.9 feet from the south fence. The station is marked by a marble post, 30 by 6 by 6 inches, set flush with the ground, and lettered on top U. S. C. & G. S., 1903. The east edge of the city water tower bears 2° 02′.5 east of true north. The edge of the northwest corner of the superintendent's residence bears 21° 39′.7 east of true north.

Brooksville, Hernando County.—The station is located southwest of the court-house square in Orange street, 19.3 feet from the west side of the street, 40.4 feet from the east side of the street, and 75 feet from the south line of Broad street. The station is marked by a limestone post, 30 by 6 by 6 inches, sunk 2 inches below the ground, and lettered on top U. S. C. & G. S., 1903. The steeple of the schoolhouse bears 7° 48′.3 west of true south. The tower on Mr. W. C. Croom's residence bears 40° 12′.7 east of true south. The spire of the Episcopal Church bears 45° 29′.1 east of true south.

Dade City, Pasco County.—The station was located in the Baptist Church lot, 93.4 feet from the northeast corner of the church, 38 feet from the east fence and 25.6 feet from the north fence. The station is marked by a limestone post, 32 by 6 by 6 inches, lettered on top U. S. C. & G. S. 1903, and set flush with the ground. The spire of the Methodist Church bears 73° 49′.6 east of true south. The north gable of the Methodist parsonage bears 67° 29′.9 east of true south. The edge of the northwest corner of the schoolhouse bears 36° 48′.1 west of true south.

Deland, Volusia County.—The station is in the athletic park of "J. B. Stetson University," 40 feet from the north fence of the park and 101.3 feet from the west post of the entrance to the park. The station is marked by a brown limestone post, 34 by 7 by 5 inches, lettered on top U. S. C. & G. S., 1903, and sunk 3 inches below the ground. The Baptist Church spire bears 13° 12′.6 east of true south. The dome of Elizabeth Hall bears 36° 08′.4 east of true south. The dome of Chaudoin Hall bears 74° 16′.3 east of true south.

Eau Gallie, Brevard County.—The old station at Eau Gallie not being available a new station was located in the street about two blocks northeast of the depot. It is 48.6 feet from the southwest corner of Mrs. Barbour's yard, 66.7 feet from a pine tree west of south and 72.7 feet from a palmetto north of east. The station is marked by a limestone post, 27 by 7 by 5 inches, lettered on top U. S. C. & G. S. 1903, and sunk 3 inches below ground. The edge of the southeast corner of Indian River Inn bears 22° 56′.4 east of true south. The edge of the southeast corner of Hotel Granada bears 0° 18′.4 east of true north. The south gable of Mr. Gleason's house bears 40° 18′.1 west of true north.

Homosassa, Citrus County.—The station is near the Homosassa River, in the yard adjoining Mr. B. F. Dutton's residence, and is 18 feet from the fence west of south and 55.1 feet from the corner of the fence east of south. The station is marked by a limestone post, 37 by 6 by 6 inches, lettered

Descriptions of Stations—Continued.

FLORIDA—Continued.

on top U. S. C. & G. S. 1903, and set so as to project 2 inches above the ground. The point on the west end of Mrs. H. J. Castner's house bears 35° 11′.5 west of true north. The base of the flag pole on Mrs. Castner's boathouse bears 28° 35′.2 west of true north. The point on the east end of Mr. Dutton's boathouse bears 34° 34′.1 east of true north.

Inverness, Citrus County.—The station was located in Osceola street, near its intersection with Dampier street, 40.4 feet from the west side of Osceola street and 69.2 feet from the north side of Dampier street. The station is marked by a limestone post, 36 by 6 by 6 inches, sunk 2 inches below the ground, and lettered on top U. S. C. & G. S. 1903. The steeple of the court-house bears 60° 00′.2 east of true south. The highest point of the railroad water tank bears 74° 03′.1 east of true south. Spire of Cumberland Presbyterian Church bears 33° 17′.4 west of true south.

Jupiter, Dade County.—The old station at Fort Jupiter being no longer available a new station was located on the north side of Jupiter Inlet, about 10 rods from mean low water of the Atlantic Ocean, 74.5 feet from mean low water of Jupiter Inlet Bay, and 35 feet from a palmetto west of north. The station is marked by a limestone post, 25 by 7 by 5 inches, lettered on top U. S. C. & G. S. 1903, and sunk 6 inches below the surface. Jupiter Inlet light-house bears 69° 10′.0 west of true north. The east gable of Mr. C. R. Carlin's house bears 70° 53′.6 west of true south.

Key West, Monroe County.—The station of 1896 was reoccupied. It is north of the hospital building in the United States barracks grounds, 79 feet 2 inches from the northeast edge of the brick pier at the northeast corner of the hospital porch, 98 feet 6 inches from the northwest edge of the brick pier at the northwest corner of the hospital porch and 66 feet 5 inches from the inside of the wooden fence on the north side of the grounds. The mark used was the northwest tower of the armory, which bears 1° 28′.1 east of true south. To test for local disturbance a second station was occupied about 130 feet north of the first in prolongation of the line from the azimuth mark.

Kissimmee, Osceola County.—The station is in Dakin avenue, near its intersection with Mitchell street, and about four blocks northwest of the depot. It is 24.3 feet from the fence on the southwest and 12.7 feet from the south line of Mitchell street. The station is marked by a marble post, 30 by 6 by 6 inches, lettered on top U. S. C. & G. S. 1903, and sunk 4 inches below ground. The court-house spire bears 42° 43′.2 west of true south. The point of the water tower at the Kissimmee Hotel bears 41° 44′.3 east of true south. The spire of the Methodist Church bears 59° 19′.4 east of true north.

Lake City, Columbia County.—The station established at Lake City in 1900 was reoccupied. It is located on the Catholic Church lot and is 111.2 feet from the northwest corner of the church and 81 feet from the west edge of the street on the west. The station is marked by a marble post, 26 by 6 by 6 inches, set flush with the ground, and lettered on top U. S. C. & G. S. 1903. The small point over the north dial of the court-house clock bears 89° 42′.3 east of true north. The point of the round porch in the rear of Mrs. Small's residence bears 33° 10′.0 west of true south. The south gable of Mr. R. T. Boozer's residence bears 57° 28′.5 west of true north.

Live Oak, Suwanee County.—The station is located in Fourth street, about 80 yards east of Wolfe's Pond, in the section of the city which is called "Wolfe's Quarters." It is 55.5 feet from the northwest corner of Mr. Murphy's yard and 40 feet from the east side of Fourth street. The station is marked by a marble post, 27 by 6 by 6 inches, sunk 3 inches below the ground, and lettered on top U. S. C. & G. S. 1903. The spire of the Methodist Church bears 76° 17′.4 west of true south. The spire of the Christian Church bears 71° 53′.3 west of true south. The east edge of the city water tower bears 13° 34′.7 east of true south.

Mayo, Lafayette County.—The station is located in the street one and one-half blocks east and about five blocks south of the court-house. It is 47.3 feet south of a pine tree, 58.6 feet from the northeast corner of Mr. M. J. Sandford's yard, and 129.8 feet from the northwest corner of Mr. O. M. Sears's yard. The station is marked by a marble post, 26 by 6 by 6 inches, sunk 3 inches below the ground, and lettered on top U. S. C. & G. S. 1903. The steeple of the court-house bears 16° 08′.0 west of true north. The left edge of the chimney on the house owned by the Misses Elliott bears 26° 19′.8 west of true north. The west edge of the west chimney on Mr. R. E. Wadsworth's residence bears 0° 28′.8 east of true north.

Miami, Dade County.—The station is on the site of old Fort Dallas, on grounds owned by Mr. Tuttle and leased by the Seminole Club. It is 32.2 feet north of a poinciana tree, 71.8 feet southeast of

Descriptions of Stations—Continued.

FLORIDA—Continued.

the flag pole, and 24.5 feet from an hibiscus north of west. The station is marked by a limestone post, 18 by 7 by 7 inches, set level with the ground, and lettered on top U. S. C. & G. S. 1903. The north edge of the city water tower bears 88° 31′.9 west of true north. The spire of the Presbyterian Church bears 20° 35′.0 east of true north. The edge of the southeast corner of Royal Palm Hotel bears 68° 20′.7 east of true north.

Ocala, Marion County.—The station is on the grounds of Howard Academy, 244.2 feet from the southwest corner of the school building, and 61.7 feet from the south fence of the school grounds. It is marked by a limestone post, 37 by 7 by 6 inches, set flush with the ground, and lettered on top U. S. C. & G. S. 1903. The flagstaff of Ocala House bears 77° 40′.1 east of true south. The highest point of the city water tower bears 73° 22′.3 east of true south. The highest point of the water tower at Fawcett's cotton gin bears 34° 40′.8 west of true south.

Orlando, Orange County.—The station is on the north side of Lake Eola, in Robinson avenue, and at the foot of Broadway. It is 13.2 feet from the fence inclosing the lake, 78.1 feet from the southeast corner of Mr. Charles Horner's yard, and 68.4 feet from the north line of Robinson avenue. The station is marked by a cement block, 18 by 8 by 8 inches, marked on top by a cross and sunk 5 inches below ground. The spire of the Presbyterian Church bears 37° 42′.7 west of true south. The spire of the Baptist Church bears 43° 26′.6 west of true south. The flagstaff on the Kedney Building bears 59° 46′.2 west of true south.

Punta Gorda, De Soto County.—The station is in the park extending along Charlotte Harbor and at the foot of Gill street. It is 94.1 feet from the northeast corner of Doctor Burlard's yard, 103.1 feet from the northwest corner of Mr. J. H. Farrington's yard, and 52.5 feet from a palmetto north of east. The station is marked by a marble post 30 by 6 by 6 inches, lettered on top U. S. C. & G. S. 1903, and sunk 5 inches below the ground. The east gable of the Phosphate Company's warehouse bears 85° 01′.2 west of true north. The flagstaff of Punta Gorda Hotel bears 56° 02′.1 east of true north. The steeple of the schoolhouse bears 81° 49′.7 east of true south.

Starke, Bedford County.—The station is in the street about three blocks west and one block south of the depot, and is 15.7 feet from the west side of the street and 59.5 feet from the northwest corner of Dr. N. C. Berry's stable. It is marked by a limestone post, 40 by 9 by 5 inches, roughly lettered on top U. S. and set flush with the ground. The steeple of the court-house bears 23° 21′.5 west of true south. The steeple of the schoolhouse bears 8° 51′.3 west of true south. The south edge of the chimney on Mr. J. W. White's residence bears 87° 51′.4 west of true south.

St. Petersburg, Hillsboro County.—The station is in the northwestern part of the city near the eastern end of Indiana avenue. It is 42.8 feet south of the southeast corner of Mr. H. W. Plunket's garden, 43.8 feet from a pine tree north of east, and 57.4 feet from a pine tree east of south. The station is marked by a limestone post, 34 by 6 by 6 inches, lettered on top U. S. C. & G. S. 1903, and sunk 2 inches below the ground. The flagstaff of the city high school bears 24° 11′.4 east of true south. The center of the cross on the Episcopal Church bears 46° 35′.9 east of true south. The spire of the Presbyterian Church bears 84° 23′.5 east of true south.

Sumterville, Sumter County.—The station is on the court-house square 16 feet southeast of an oak tree, 83.7 feet from the northwest corner of the court-house, and 107.5 feet from the southwest corner of the court-house. The station is marked by a marble post, 36 by 5 by 5 inches, lettered on top U. S. C. & G. S. 1903, and sunk 2 inches below the ground. The spire of the Methodist Church bears 76° 29′.9 east of true south. The spire of the Baptist Church bears 23° 45′.1 west of true north.

Tampa, Hillsboro County.—The station is in West Tampa, in West Ninth avenue, about 64 paces from the south bank of Hillsboro River. It is 72.7 feet from a pine tree south of west, and 81.5 feet from a pine tree east of south. The station is marked by a marble post, 30 by 6 by 6 inches, lettered on top U. S. C. & G. S., 1903, and sunk 4 inches below ground. The dome of the court-house bears 36° 57′.7 east of true south. The Methodist Church spire bears 47° 22′.2 east of true south. The north edge of a steel water tower bears 78° 49′.1 west of true south.

Tarpon Springs, Hillsboro County.—The station is on the public school grounds, 119 feet from the southeast corner of the schoolhouse, 78.2 feet from the south fence, and 19.5 feet from the east fence of the school yard. The station is marked by a limestone post, 32 by 6 by 6 inches, set flush with the

Descriptions of Stations—Continued.

FLORIDA—Continued.

ground and lettered on top U. S. C. & G. S. 1903. The flagstaff on Mr. H. B. Webster's residence bears 39° 09′.9 west of true north. The left-hand edge of the chimney on Mr. L. S. Style's residence bears 25° 23′.1 west of true south. The edge of the northeast corner of the Methodist Church bears 10° 12′.2 east of true south.

Tavares, Lake County.—The station is in Alfred street and west of Joannah avenue. It is on a line with the rear fence of an adjoining yard, 39.1 feet from the northwest corner of the yard and 104 feet from the red oak tree south of east. The station is marked by a marble post, 36 by 5 by 5 inches, lettered on top U. S. C. & G. S. 1903 and sunk 4 inches below the ground. The steeple of the schoolhouse bears 31° 12′.3 east of true north. The steeple of the court-house bears 19° 24′.4 west of true south.

Titusville, Brevard County.—The station is on the public school grounds, 220.5 feet from the northeast corner of the schoolhouse, 75.5 feet north of a palmetto, and 32.4 feet from a small oak tree west of north. The station is marked by a limestone post, 27 by 7 by 5 inches, lettered on top U. S. C. & G. S. 1903 and sunk 3 inches below ground. The spire of the Catholic Church bears 16° 36′ west of true north. The spire of the Episcopal Church bears 72° 28′.3 west of true north. The spire of the colored Methodist Church bears 67° 40′ west of true south.

GEORGIA.

Cuthbert, Randolph County.—The station is located in the first street east of Court street and north of Cleburne street. It is 143 feet from the south side of Cleburne street and 145.8 feet east of a pine tree. The station is marked by a limestone post, 27 by 8 by 6 inches, sunk 2 inches below the ground and lettered on top U. S. C. & G. S. 1903. The west edge of a large chimney of a house on Mr. James Rawles's plantation bears 2° 11′.9 east of true north. The spire of the Methodist Church bears 51° 10′ west of true south. The east edge of the city water tower bears 7° 14′.9 east of true south.

Irwinville, Irwin County.—The station is in the first street south of Irwin avenue and is southeast of the Baptist Church. It is 42.5 feet from the north line of the street and 80.5 feet from the southeast corner of the church. The station is marked by a nail driven into the end of a hard pine post. This post measures 27 by 8 by 5 inches and was sunk 3 inches below the ground. The steeple of the county jail bears 82° 57′.8 west of true south. The north edge of the north chimney of the court-house bears 80° 53′.5 west of true north. The northeast corner of the house owned by Mr. Boney Hogan bears 28° 06′.6 west of true north.

Savannah, Chatham County.—The old station on Hutchinson's Island was no longer suitable, and a new station was located on an embankment about 50 yards south of the Back River and in the same range as the one previously used, viz, the range of the spires of the Exchange and the Presbyterian Church. The station is marked by a copper nail in the center of the end of a pine post, which was 32 by 4 by 3 inches and was set 3 inches below ground. The spires of the Exchange and the Presbyterian Church bear 21° 18′.5 west of true south. The spire of the Post-Office building bears 22° 41′.2 west of true south. The spire on the Sailors' Home bears 10° 24′.6 west of true south.

Valdosta, Lowndes County.—The station is in the main division of the Valdosta Cemetery, 60.3 feet from the south fence, 12 feet south of an old pine stump, and 58.1 feet east of the nearest occupied lot of the cemetery. The station is marked by a marble post, 31 by 6 by 6 inches, sunk 2 inches below the ground and lettered on top U. S. C. & G. S. 1903. The tower on Dr. J. C. Wilson's residence bears 62° 44′.2 east of true south. The south edge of the largest chimney on Mrs. Kneller's residence bears 88° 00′.4 east of true south. The east edge of the east chimney on Mr. Byrd Belote's residence bears 26° 47′.6 west of true south.

HAWAII.

Honolulu Magnetic Observatory, Oahu Island.—The observatory is about 12½ miles west of Honolulu and about ¼ mile south of railway station Sisal on the Oahu Railway. The observatory is described in Appendix 5, Report for 1902.

Descriptions of Stations—Continued.

KANSAS.

Abilene, Dickinson County.—The station is on the grounds of St. Joseph's College, 333 feet slightly east of south from the southeast corner of the college building and 293 feet west of the west fence of the road on the east. The station is marked by a limestone post, 36 by 7 by 7 inches, projecting 3 inches above ground, and lettered on top U. S. C. & G. S., 1902. The flagstaff on Garfield School bears 1° 20′.2 west of true south. The west side of the standpipe bears 9° 05′.8 west of true south. The east side of the water tank in Abilene Cemetery bears 27° 04′.7 west of true south.

Alma, Wabaunsee County.—The station is in the northeast corner of the Public School grounds, 137.7 feet from the northeast corner of the schoolhouse, 76.2 feet from the east fence, and 79.2 feet from the north fence. The station is marked by a limestone post 32 inches long and dressed to 6 inches square on top and lettered U. S. C. & G. S. 1902. The center of the cross on the Catholic Church bears 0° 29′.1 east of true south. The Evangelical Church spire bears 29° 59′.4 east of true south. The Methodist Church spire bears 18° 44′.5 east of true south.

Anthony, Harper County.—The station is in the northeast corner of the court-house yard. It is 12 feet from the north fence, 44.7 feet from the east fence, and 150 feet from the northeast corner of the court-house. A stone was to be set by the county surveyor to mark the spot. The mark used was the spire on the public school and bears 27° 49′.6 east of true south. The Methodist Church spire bears 32° 12′.6 west of true north.

Ashland, Clark County.—The station is in an open lot northeast of the court-house. It is 24 feet from the street line to the south and 74 feet from the building line of the street to the west. It is marked by a stone projecting a few inches above ground. The mark used was the spire on J. W. Workman's house and bears 71° 01′.4 east of true south. The court-house spire bears 48° 28′.1 west of true south. The public school spire bears 19° 06′.9 west of true north.

Atchison, Atchison County.—The station is in the northeast pasture of the Soldiers Orphans' Home farm and is 135 feet southwest of a cucumber tree, 63 feet west of an oak tree, and 76 feet east of a black oak tree. The station is marked by a sandstone post, 34 by 6 by 6 inches, projecting 3 inches above ground and lettered U. S. C. & G. S. 1902. The flagstaff of the Orphans' Home bears 27° 01′.9 west of true south. The chimney on Mr. John Taylor's house bears 0° 30′.2 west of true south. The flagstaff on the schoolhouse bears 37° 51′.5 east of true north.

Baldwin, Douglas County.—Observations were made in the absolute house of the magnetic observatory, or at a point outside the observatory in line with the azimuth mark. The mark used was the flagstaff on Science Hall of Baker University, which bears 48° 20′.6 west of true north.

Belleville, Republic County.—The station is in the court-house yard, 43.5 feet from the north fence, 116.8 feet from the west fence, and 130.3 feet from the northwest corner of the court-house. The station is marked by a marble slab, 24 by 8 by 8 inches, lettered U. S. C. & G. S. 1902 and set so as to project 4 inches above ground. The spire of the Methodist Church bears 5° 11′.4 west of true south. The spire of the Presbyterian Church bears 68° 40′.4 east of true north.

Beloit, Mitchell County.—The station is in the southeast corner of the court-house yard, 163.8 feet from the southeast corner of the court-house, 20 feet from the south fence, and 87.8 feet from the east side of the sidewalk on the east side of the street east of the station. The station is marked by a marble post, which is dressed to 3 by 3 inches at the top and projects a few inches above ground. The spire of the United Brethern Church bears 15° 15′.3 west of true north. The spire of the Methodist Church bears 23° 32′.3 west of true north. The spire of the Baptist Church bears 11° 17′.7 east of true north.

Bird City, Cheyenne County.—The station is on the public school grounds, and is exactly in line with the south side of a church on the next block east and is 169.5 feet slightly west of north from the northwest corner of the schoolhouse. The station is marked by a limestone post, 36 by 6 by 6 inches, set flush with the ground and lettered on top U. S. C. & G. S. 1902. The center of the first windmill visible to the right of the schoolhouse bears 0° 15′.9 east of true south. The center of a windmill west of south and about 3 miles distant bears 21° 27′.6 west of true south.

Colby, Thomas County.—The station is in the southwest corner of the court-house yard, 47 feet from the south fence, 38 feet from the west fence, and 100.3 feet from the southwest corner of the court-house. The station is marked by a wooden stub 2 feet long sunk flush with the ground. The highest point of the water tower bears 65° 32′.3 west of true south. The spire of the schoolhouse bears 88° 45′.3 west of true south. The spire of the Baptist Church bears 68° 53′.7 west of true north.

Descriptions of Stations—Continued.

KANSAS—Continued.

Coldwater, Comanche County.—The station is in the southwest corner of the court-house yard, 155 feet from the southwest corner of the court-house, being in line with the south row of trees and 9.7 feet east of the west row. The station is marked by a stone post, 24 by 6 by 6 inches, set so as to project a few inches above ground. The chimney of Mr. W. T. Holland's residence bears 11° 36′.9 east of true south. The east gable of the railroad station bears 29° 13′.1 west of true south. The highest chimney on Doctor Merrihew's house bears 41° 07′.4 east of true south.

Coolidge, Hamilton County.—The station of 1878 called Sargent was reoccupied as nearly as could be determined. The town of Sargent was abandoned in the early eighties and a new one located about three-fourths mile farther west. The magnetic station is on the lot of Mrs. Johnson, 126.5 feet from the northeast corner of her house and 135 feet from the road. It is marked by a stone post 5 inches square projecting about 8 inches above ground. The mark used was the north gable of the house of J. Fritz, which bears 0° 36′.7 west of true south. The spire on the railroad water tank bears 86° 04′.7 west of true south. The Presbyterian Church spire bears 56° 06′.3 west of true north.

Emporia, Lyon County.—Observations were made in the grounds of the college of Emporia, near their southwest corner. The station is 493 feet from the southwest corner of Stuart Hall to the northeast, 42 feet from a wire fence (at the inner edge of the semicircular drive) to the west, 104½ feet from the south fence (wire), and 15.2 feet from an elm tree (at the edge of the grove to the south) almost directly south. The station is marked by a marble (or very hard limestone) post about 2½ feet long, 10 or 11 inches square at the bottom, and tapering gradually to about 7 inches square to the top. The corners are cut off symmetrically, making the top eight-sided. The stone is sunk with its top flush with the surface of the ground, and its top is lettered U. S. C. & G. S. 1902. The central hole marks the spot above which the instruments were centered. The sun being under the clouds continually during the occupation of the station, no sun observations were made. The old station occupied in 1888 was found to be no longer suitable.

Erie, Neosho County.—The station was established on the county poor farm, near its northwest corner. It is 107 feet from the west fence (osage hedge) and 296 feet from the north fence (osage hedge). The station is marked by a limestone sunk with its top flush with the surface of the ground and lettered U. S. C. & G. S. 1902. The point over which observations were made being indicated by a drill hole at the center of the top. The stone is about 2½ feet long and its top is 6 by 8 inches. The extreme west point of west chimney on poor house used as mark bears 4° 50′.9 east of true south. Apex of cupola on Catholic Church at St. Paul, Kans. (distant about 7 miles), bears 36° 32′.3 east of true south. West gable of John Blaine's barn, about 1½ mile distant, bears 82° 27′.7 east of true south.

Eureka, Greenwood County.—The observations were made in the city cemetery, near its northeast corner, in one of the "alleys" running north and south and near one of the drives running east and west. The station is 270 feet from the north fence (wire) and 214½ feet from the east fence (wood). It is also distant 2.6 feet from the west edge of the alley in which it is located (width of alley 6 feet) and 1.9 feet from the south edge of the drive immediately to the north. It is marked by a limestone post about 7 by 10 inches at the top, and 2½ feet long, sunk with its top flush with the surface of the ground. The stone is lettered U. S. C. & G. S. 1902, the spot above which the instruments were placed being indicated by a central circular hole. The mark used was the (vertical) bisection of the angle formed by frame of windmill on Wilson's farm and bears 4° 46′.4 east of true north. Apex of academy tower bears 58° 11′.7 west of true north. Extreme upper and right point of city standpipe or water reservoir bears 54° 19′ west of true north.

Fort Scott, Bourbon County.—The observations were made in Bridal Veil Park, near its southwestern corner. The station is 51 feet from the west fence of the park and 159 feet from the south fence. The location is marked by a limestone monument about 6 by 8 inches by 3 feet, sunk with its top almost flush with the ground, and lettered U. S. C. & G. S. 1902, a drill hole indicating the spot over which the observations were made. The place is known to Mr. Higgins, the manager of the park. The mark or range used was the southeast corner of highest chimney on (red) farmhouse beyond the pump and bears 7° 03′.4 west of true north. The western (inner) gable of north building of ice plant in the park bears 65° 00′.6 east of true north. The right edge (eastern as seen from station) of large smokestack on Missouri Pacific shops bears 14° 58′.8 east of true north.

Descriptions of Stations—Continued.

KANSAS—Continued.

Fredonia, Wilson County.—The station was established in the Fredonia cemetery near its northwest corner and in the driveway. It is 83½ feet from the north fence and 166½ feet from the west fence. It is also 6.2 feet from the south edge of the limestone fence surrounding the lot marked Smith, and containing the monument A. A. Smith, and is 1.9 feet east of the line of the west edge of this fence. The station is marked by a limestone post 2½ feet in length and 7 by 8 inches at the top, approximately, sunk with its top about 5 inches below the surface of the ground. The top of the stone is lettered U. S. C. & G. S. 1902, a central hole marking the spot over which the instruments were placed. The mark used was the spire on Thomas Singleton's residence, and bears 1° 18′.6 east of true north. Base of court-house spire bears 8° 12′ west of true north. Base of spire of Presbyterian Church bears 1° 08′.6 east of true north.

Girard, Crawford County.—Observations were made in Frank Higgin's park, just northwest of the city, and in the northeast portion of the park. The station is 72 feet from the east fence and 412 feet from the north fence. It is marked by a limestone post 6 by 6 inches at the top and about 3 feet long, sunk with its top flush with the surface of the ground and lettered U. S. C. & G. S. 1902. A drill hole marks the spot over which the instruments were set. The mark used was the extreme western (right) point of the chimney of James McFarland's house, just south of the park, and bears 2° 10′.9 east of true south.

Goodland, Sherman County.—The station is south of the court-house yard, being distant 13.3 feet from the south yard fence and 75.9 feet from the line of the east fence. It is marked by a wooden stub sunk flush with the ground. The pole on the First National Bank bears 39° 49′.5 west of true south. The spire of the Methodist Church bears 59° 36′.0 west of true south. The pole on the schoolhouse bears 84° 55′.0 west of true north. The spire of the Congregational Church bears 31° 40′.0 west of true south.

Greensburg, Kiowa County.—The station is in the open block which is bounded on the north by Florida street and on the east by Sycamore street. It is 6 feet west of the building line of Sycamore street and on the north line of an alley. The station is marked by a stone 24 by 8 by 4 inches projecting a few inches above ground. The spire of the United Brethren Church bears 71° 50′.3 west of true south. The spire of the Methodist Church bears 51° 17′.2 west of true north.

Hill City, Graham County.—The station is in the northwest corner of the court-house yard, 55 feet from the west fence, 39.5 feet from the north fence, and 100.5 feet from the northwest corner of the court-house. The station is marked by a stone about 2 feet long, of irregular shape, sunk nearly flush with the ground, and having a cross to mark the exact point. A similar stone, set near the south fence, marks the meridian. The spire of the Christian Church bears 73° 16′.4 west of true south. The pole on the bank building bears 16° 51′.9 west of true south.

Howard, Elk County.—Observations were made in the city cemetery near the southwest corner. The station is 127 feet from the south fence of the cemetery and 438½ feet from the east fence. It is also 58.6 feet from the monument of M. T. Crinok to the west, 38.9 feet from the monument of J. Newby to east northeast, and 76.9 feet from the monument of M. Stroud, slightly east of north. The station is in one of the north and south roads of the cemetery, and is marked by a limestone post 7 by 8 inches at the top and 2½ feet long, sunk with its top about 3 inches below the surface of the ground. The post is lettered U. S. C. & G. S. 1902, and the spot over which the instruments were set is indicated by a central circular hole in the top. The mark used was rod on Atchison, Topeka and Santa Fe water tank, and bears 8° 24′.4 east of true north. The extreme right (northeast) point of chimney on house on farm immediately north of cemetery (Shelby's), bears 5° 17′.2 west of true north. South gable on farm barn (Shelby's) bears 18° 21′.3 west of true north.

Hoxie, Sheridan County.—The station is in the northeast corner of the court-house yard, 94.2 feet from the north fence, 98.5 feet from the east fence, and 80.8 feet from the northeast corner of the court-house. The station is marked by a stone 8 by 6 inches on top. The mark used was the spire above the bell on the schoolhouse. This mark bears 86° 47′.2 east of true south.

Hugoton, Stevens County.—The station is in the northeast corner of an open lot south of the schoolhouse grounds, being 30 feet from the north fence, 39 feet from the east fence, and 162 feet from the northeast corner of Mr. T. J. Thornburgh's store. The station is marked by a wooden stub sunk flush with the ground. The spire of the court-house bears 77° 09′.2 west of true south.

Descriptions of Stations—Continued.

KANSAS—Continued.

Independence, Montgomery County.—The station is in one of the crossroads in the southwest portion of Mount Hope cemetery. It is 228 feet from the south fence (hedge) and 197 feet from the west fence (hedge). It is also 6.9 feet from the northwest (nearest) corner of the sandstone fence surrounding the lot (Jackson's) to the southeast and 7.3 feet from the nearest point of the upper smoothed portion of the sandstone fence surrounding the lot to the southwest. The station is marked by a buff sandstone post 8 by 8 inches by 2½ feet, sunk with its top 2½ inches below the surface of the ground. The stone is lettered U. S. C. & G. S. 1902, a half-inch hole marking the spot over which the observations were made. The mark used was the spire on the fire-engine house and bears 2° 48′.3 west of true south. The center of cross on cupola of Catholic Church bears 11° 49′.9 east of true south. The court-house spire bears 3° 41′.4 east of true south.

Liberal, Seward County.—The old station of 1900 was not available. The new station was located in the northeast section of the park around the hotel, 31 feet from the street on the north, and 121.2 feet from the street on the west. The station is marked by a wooden stub nearly flush with the ground, having a nail to mark the precise point. The highest point of the railroad water tank bears 29° 25′.1 east of true south.

Mankato, Jewell County.—The station is in the southeast corner of the court-house yard, 114.4 feet from the southeast corner of the court-house, and 52 feet and 14.6 feet from the east and the south fences, respectively. The station is marked by a stone 24 by 6 by 3 inches, set so as to project 3 inches above ground. The mark used was the spire on the county jail, and bears 70° 50′.3 east of true south. The meridian was marked by planting the north stone a few feet within the north fence of the court-house yard.

Meade, Meade County.—The station is near the center of an open square to the south of the court-house, bounded on the west, north, and east by Fowler, Carthage, and Meade Center avenues, respectively. It is 97.6 feet from the south small iron post at the southeast corner of the square and 246.2 feet from a point 2 feet east of the iron post at the northeast corner. It is marked by a stone 4 inches square on top, projecting a few inches above ground. The mark used was the highest chimney on Tom Johnson's house, and bears 13° 43′.8 west of true south.

Medicine Lodge, Barber County.—The station is in the southeast corner of the court-house yard, 31 feet from the east fence and 11.5 feet from the south fence and 229.8 feet from the southeast corner of the court-house. It is marked by a stone 6 by 6 inches on top, projecting a few inches above ground. The mark used was a marble block in the south edge of the Masonic Temple (second from the top) and bears 70° 15′.2 west of true south. The cross on a church bears 74° 34′.2 west of true south.

Minneapolis, Ottawa County.—The station is in the southwest corner of the court-house yard and is marked by a granite post. The meridian line was marked by a similar post set close to the sidewalk on the north side of the square. The spire of the Lutheran Church bears 86° 58′.5 east of true south. The spire of the Free Methodist Church bears 86° 36′.5 east of true north. The spire of the Presbyterian church bears 63° 08′.5 east of true south.

Observations were also made at a provisional station which is on the bluff east of the Santa Fe Railroad station and about one-fourth of a mile from the court-house. This station was not marked permanently, but is in the northeast corner of the field adjoining an abandoned cemetery, 50 feet from the north fence and 40 feet from the east fence.

Mound City, Linn County.—The station is located in the southwestern portion of the grounds of the stone schoolhouse. It is 131 feet from the southeast (nearest) corner of the schoolhouse, 149.5 feet from the southeast corner of the wing running north and south, and 89 feet from the fence on the east. The station is marked by a 3-foot limestone post with cross section 8 by 8 inches sunk with its top flush with the surface of the ground. The point over which the observations were made is indicated by a circular hole in the center of the top of the monument. The top is lettered U. S. C. & G. S. 1902. The south (smaller) spire on the court-house bears 40° 11′.3 east of true north. The north spire on court-house bears 38° 20′.1 east of true north. The Baptist Church spire bears 26° 57′.7 east of true north.

Norton, Norton County.—The station is in the southeast corner of the court-house yard, 24.0 feet from the south fence, 41.7 feet from the east fence, and 92.8 feet from the southeast corner of the

Descriptions of Stations—Continued.

KANSAS—Continued.

court-house. It is marked by a marble post 24 by 6 by 6 inches, set so as to project 3 inches above ground. A similar stone was placed near the north fence to mark the meridian. From the south stone the chimney on a distant farmhouse bears 15° 02′.9 east of true south, and the center line of Sach, Brown & Bridegroom's store bears 67° 31′.1 west of true south.

Oberlin, Decatur County.—The station is in the southeast corner of the public-school grounds, 46.3 feet from the east fence, 30.8 feet from the south fence, and 118 feet from the southeast corner of the schoolhouse. The station is marked by a large rock sunk nearly flush with the ground and having a drill hole to mark the exact point. The spire of the Methodist Church bears 14° 24′.0 west of true south. The ball on the Baptist Church bears 12° 09′.5 west of true south. The spire of the Catholic Church bears 61° 13′.0 east of true north. The meridian was marked by setting a stone near the north fence of the school yard.

Osborne, Osborne County.—The station is in the court-house yard, 400 feet west of the court-house and 72.6 feet from a row of trees on the north and 29.1 feet from a row of trees on the west. The station is marked by a stone 30 by 6 by 6 inches, set so as to project 2 inches above ground. The spire of the Methodist Church bears 76° 12′.7 east of true north. The spire of the Congregational Church bears 78° 06′.8 east of true south. The spire of the Free Baptist Church bears 75° 27′.3 east of true south.

Oskaloosa, Jefferson County.—The station is in the public school grounds 119 feet from the northwest corner of the main part of the school building, 149.6 feet from the northeast corner of Mr. William Jenkins's house, and 229.6 feet from the southwest corner of Dr. M. S. McCreight's house. The station is marked by a stone 34 by 7 by 7 inches, sunk 3 inches below the ground and lettered on top U. S. C. & G. S. 1902. The chimney on Mr. Sherm McIntosh's farmhouse bears 4° 26′.8 east of true south. The eastern gable of Mr. Charles Taylor's barn bears 28° 21′.8 west of true north. The west gable of Mr. W. D. Ross's house bears 76° 01′.7 east of true north.

Oswego, Labette County.—The station is in the city park, in the oval clearing whose outer portion is intended for a bicycle track. In an easterly-westerly direction it is at about the center of the clearing, and in a northerly-southerly direction about one-third the length of the oval from the south end. From the three largest oak trees near the oval the station is distant as follows: From a tree to the east, slightly south, 101 feet; from a tree to the south, slightly west, 109 feet; from a tree to the northwest 149 feet. The station is 457 feet from the center of the watering trough near the north edge of the park (nearly in the line connecting the station with the last-mentioned tree to northwest) and 493 feet (still in nearly the same line) to the log rail at the brink of the precipice terminating the park on the north. The station is marked by a limestone post sunk with its top flush with the surface of the ground and resting below on solid rock. The post is over 2 feet long and its top measures 6 by 8 inches and is lettered U. S. C. & G. S. 1902, a central circular hole marking the spot over which the observations were made.

Ottawa, Franklin County.—The station is located in Forest Park about 500 yards northwest of the main entrance. The stake that was placed to mark the station of 1900 could not be found. A new site was chosen a few feet from the presumed location of the former station. This spot is south of the new race track and southeast of the new grand stand, measures 184 feet and 233.4 feet, respectively, from the posts at the southeast and southwest corners of the grand stand. It also measures 63.4 feet from an elm tree on the west, 76.5 feet from an oak tree on the east, and 48.1 feet from a hickory tree to the southwest. The spot is marked by a limestone post measuring 32 by 8 by 8 inches and sunk with its top flush with the surface of the ground and lettered U. S. C. & G. S. 1902. A one-fourth-inch hole drilled in the top of the stone indicates the precise spot. The mark or range used was the west edge of a chimney on the Santa Fe Hospital, 1½ miles distant, and bears 16° 52′.0 east of true north. The northeast corner of the boys' clubhouse bears 73° 52′.3 west of true north and the north edge of base of capstone on the middle gatepost at the entrance to the park bears 36° 16′.3 east of true south.

Paola, Miami County.—The station is located in the southeast corner of the grounds of the schoolhouse known as the "Seminary." The station is distant 26.5 feet from the south fence (wire) of the school yard, 69.8 feet from the east fence, 112 feet from the southeast corner of the schoolhouse (brick), and 151.6 feet from the southwest corner. The station is marked by a limestone monument,

Descriptions of Stations—Continued.

KANSAS—Continued.

6 by 6 inches, sunk with the top flush with the surface of the ground, and lettered U. S. C. & G. S. 1902. The mark used—court-house spire—bears 2° 11′.7 west of true north. The east side of chimney of house on McCulloch place, 2 miles to southwest, bears 33° 10′.8 west of true south. East corner of front of Mallory Opera House bears 12° 00′.4 east of true north.

Phillipsburg, Phillips County.—The station is in the southwest corner of the court-house yard, 51.8 feet from the west fence, 46.2 feet from the south fence, and 53.5 feet from the southwest corner of the court-house. The station is marked by a stone, 24 by 6 by 6 inches, set so as to project 4 inches above ground. The mark used was the spire of the Methodist Church, which bears 16° 44′.9 west of true south. The meridian line was marked, the north stone being set 38.5 feet from the north fence of the court-house yard.

Sedan, Chautauqua County.—Observations were made in the northwest corner of the court-house yard, the station being 53 feet from the north fence and 68½ feet from the west fence. The station is marked by a block of buff sandstone, about 13 by 12 by 16 inches, sunk with its top flush with the surface of the ground and resting on sandstone rock, with a little dirt for leveling, below. The spot over which the observations were made is marked by a hole in the center of the top. The southeast (extreme right) corner of platform supporting Dr. Kortright's water tank (elevated) bears 7° 45′.7 east of true north. Center of apex of spire on Baptist Church bears 71° 55′.7 east of true south. Extreme right point (northwest corner of cap) of south chimney on Marion Stephens's house bears 68° 45′.6 west of true south.

Smith Center, Smith County.—The station is in the northwest corner of the court-house yard, 63.9 feet from the north fence, 53 feet from the west fence, and 148.7 feet from the northwest corner of the court-house. The station is marked by a stone 2 feet long and 6 inches square on top. The spire of the Christian Church bears 36° 29′.2 west of true north. The spire of the Methodist Church bears 4° 26′.2 west of true north. The spire of the schoolhouse bears 89° 47′.7 east of true south.

Stockton, Rooks County.—The station is in the southwest corner of the court-house yard, 56.5 feet from the south fence, 58.5 feet from the west fence, and 85 feet from the southwest corner of the western part of the court-house. The station is marked by a stone 22 by 18 by 10 inches set nearly flush with the ground. The spire of the Christian Church bears 11° 00′.3 east of true south. The spire of the Methodist Church bears 5° 04′.7 west of true south. The spire of the schoolhouse bears 64° 21′.7 west of true south.

Syracuse, Hamilton County.—The station is in the open lot south of the public school grounds, 293 feet from the southwest corner of the school building, nearly in line to the Presbyterian Church spire. It is marked by a stone post 4 by 6 inches on top, projecting about 6 inches above ground. The mark used was the Presbyterian Church spire, which bears 24° 36′.1 west of true south. The cross on the Episcopal Church bears 27° 01′.4 east of true south. The coping at the southwest corner of the schoolhouse bears 26° 18′.1 east of true north.

Topeka, Shawnee County.—The station is in the southwest corner of the campus of Washburn College, 75.9 feet from the south fence, and 89.6 feet from the west fence. The station is marked by a limestone post, 38 by 7 by 7 inches, sunk 30 inches into the ground, and lettered on top U. S. C. & G. S. 1902. The cupola on Science Hall bears 43° 52′.0 east of true north. The tip of the library tower bears 39° 02′.0 east of true north. The east edge of the north chimney on Holbrook Hall bears 24° 13′.6 east of true north.

Troy, Doniphan County.—The station is within the race course of the old fair grounds and is 141.6 feet north of the north corner of the octagonal part of a large barn, 129.6 feet north of the north corner of the rectangular part of the barn and 102.7 feet from the fence on the northwest. The station is marked by a sandstone post, 32 by 8 by 6 inches projecting 2 inches above ground, and lettered on top U. S. C. & G. S. 1902. The mark used was a telegraph pole on a hill to the northwest, and it bears 55° 42′.8 west of true north.

Wellington, Sumner County.—The station is in an open lot bounded on the north by Harvey avenue, on the south by Lincoln avenue, and on the east by Woodland avenue; about 1 mile from the court house. It is 142 feet from the west fence, 71.2 feet from the north fence, 124.7 feet from a row of trees to the west, and 50.2 feet from a row of trees to the north. The station is marked by a stone

Descriptions of Stations—Continued.

KANSAS—Continued.

6 by 6 inches with drill hole. The mark used was the court-house spire, and bears 64° 48′.1 west of true north. The spire on the Third Ward public school bears 87° 25′.9 west of true south.

Winfield, Cowley County.—The station is in the northwest corner of the campus of Southwest Kansas College, 330.5 feet from the northwest corner of the college building, 117 feet from the porch of the house on the north side of the road, and 28.4 feet from a pine tree to the southwest. The station is marked by a limestone post, 36 by 8 by 7 inches, set flush with the ground, and lettered on top U. S. C. & G. S. 1902. The spire of the central tower of Central school bears 49° 04′.0 west of true south. The spire of the Lutheran Church bears 4° 56′.8 west of true south.

Yates Center, Woodson County.—The station is in the cemetery, north of the city, near its northeast corner in one of the North and South roads. It is 159½ feet from the east fence and 219½ feet from the north fence (both wire). It is also 28.8 feet from the northeast corner of the small sandstone fence surrounding the lot containing the monument of R. L. Ohler to south-southwest, 60.7 feet from the northwest corner of the base of monument of A. E. Spencer, slightly east of south, and 59.8 feet from the northwest corner of the monument of P. S. Lossing to east-southeast. The station is marked by a limestone post 6 by 7 inches at the top and 2½ feet long, with a very broad base, sunk with its top about 3 inches below the surface of the ground. The post is lettered U. S. C. & G. S. 1902. A central hole marks the spot over which the observations were made. The mark used was the right edge (not border) of raised central portion of Wall's house, three-fourths to 1 mile distant, and bears 9° 09′.2 west of true south. Extreme right point of highest chimney on H. Sharp's house, about one-fourth of a mile distant, bears 29° 18′.8 east of true south. Extreme right point of westernmost chimney on Pacific Hotel bears 18° 41′.2 west of true south.

LOUISIANA.

Amite, Tangipahoa Parish.—The station of 1896 is now covered by a shed, so a new station was selected a little north of the old one. It is in the court-house grounds, 17.5 feet from the east fence and 43.5 feet from the north fence. It is marked by the top of a bottle set in cement. A similar mark was set near the fence on the south side of the grounds, 296.7 feet from the first and bearing 30° 35′.6 west of true south. The Baptist Church spire bears 63° 10′.8 east of true north.

Baton Rouge, East Baton Rouge Parish.—The station of 1896 is no longer available. A new station was therefore selected, about 750 feet south and 350 feet west of the old station, on the grounds of the new State University. It is south of the east barracks and just west of the main road through the grounds, and is marked by a limestone post 6 by 9½ inches, set with its top even with the surface of the ground. A similar stone, 522½ feet distant, near the south fence of the grounds, marks the south end of a meridian line of which the magnetic station is the north end.

Clinton, East Feliciana Parish.—The station is inside the race track at the fair grounds, about a mile north of the court-house. A south meridian mark was placed 195 feet due south of the magnetic station and about 2 feet from the inner fence of the race track. It consists of a 4-inch terra-cotta pipe set in cement. The pipe is filled with cement and the neck of a bottle marks the center. The north end of the meridian line was marked in a similar manner, and is also just inside the inner fence of the race track. The two marks are about 800 feet apart, and are to the east of the center of the space inclosed by the race track.

Convent, St. James Parish.—The station is in the southwest corner of a lot owned by Henry Himel, 31 feet from the west fence and 49 feet from the south fence. It is marked with a 4-inch terra-cotta pipe set in cement. The pipe is filled with cement and the center marked with the neck of a bottle. This is the south end of a meridian line 437½ feet long. The north end is similarly marked and is near the north fence of the lot owned by Lewis Le Bourgeois.

Covington, St. Tammany Parish.—Observations were made over the south stone of the meridian line established by the State geologist. The line is described in his report as follows: General location: On land of Judge James L. Thompson, about one-third mile northward of the cemetery, near the first slight angle or deflection to the westward of the Holmesville road; the old Massy Baker grant. Monuments: N is a marble post 6 by 8 by 30 inches, set in concrete and projecting two or three inches above the surface of the ground. About 7 feet due north is a granite marker 5 by 12 by 13 inches,

Descriptions of Stations—Continued.

LOUISIANA—Continued.

likewise set in concrete. These are near the edge of a thin pine woods on the east edge of an old rice field. A wire fence passes between the two. S is of marble and similarly set, 1 203 feet south of N. The granite marker is 6.2 feet to the south. These are close to the Holmesville road, just over the fence.

Donaldsonville, Ascension Parish.—The station of 1896 is no longer available, so a new one was located in the lot just north of the old station, on the east side of Church street, near the entrance to the Catholic cemetery. It is 27 feet from the street fence and 28½ feet from the south fence of the lot. A meridian line was marked by two 3-inch terra-cotta pipes set in cement with the neck of a bottle in the center of each. One is 314 feet due south of the magnetic station near the cemetery fence. The other is 54½ feet due north of the station close to the east fence of Church street. From the magnetic station the cross on the tomb of Joseph Laudry bears 24° 49′.1 west of true south, the spire of the old convent bears 22° 24′.4 west of true north, and the spire of the new church bears 17° 26′.1 east of true north.

Edgard, St. John Baptist Parish.—The station is in the northeast corner of the court-house grounds, 62.7 feet from the north fence and 48.7 feet from the east fence. It is marked by a 4-inch terra-cotta pipe set in cement with the neck of a bottle in the center. A mark was cut on the brick wall forming the base of an iron fence, about 560 feet due north of the station, thus defining the true meridian. The following true bearings were determined: South finial on large store near levee 22° 00′.8 west of north. North finial on same store 19° 45′.8 west of north. Catholic Church spire 48° 58′.7 east of true north.

Franklin, St. Mary Parish.—A meridian line had been established at this place in 1902 by Dr. G. D. Harris, of the State Geological Survey. It is in a pasture across Bayou Teche, opposite the wharves. Part of this pasture is now used as a race track. The meridian line is marked by two sandstone posts about 8 inches square with a hole filled with lead in the center of the top of each. The south stone is about 160 feet from the bayou and close to a fence. The north stone is 554½ feet from the south stone and about 100 feet north, and somewhat more than 100 feet east of the inner fence of the race track. The north stone marks the magnetic station. From it the flag pole on the jail bears 37° 10′.5 west of true south.

Greensburg, St. Helena Parish.—The station is on the grounds of the Norvilla Collegiate Institute, west of the south end of the building. It is 150 feet south of the north line of the lot and 30 feet east of the west line. It is marked by the neck of a bottle set in cement, and is the north end of a meridian line 488 feet long. The south end is similarly marked.

Hahnville, St. Charles Parish.—The station is on the court-house grounds in the rear of the jail inclosure. Two 6-inch fire-clay pipes were set in cement with the neck of a bottle in the center of each to mark the true meridian passing through the magnetic station. One is near the north fence and 112 feet from the northwest corner of the grounds. The other is in the southwest corner of the grounds, 40 feet from the west fence and 25 feet from the south fence. The magnetic station is 202.8 feet from the north mark and 123.6 feet from the south mark and exactly in the line between them.

Houma, Terrebonne Parish.—A meridian line had been established at this place in 1902 by Dr. G. D. Harris, of the State geological survey. It is in the lot back of the Catholic Cemetery, between Grinage and Goode streets. It is marked by three marble posts 6 inches square, set in cement. The north stone is very near the south fence of the cemetery and 145 feet from the west fence of the lot. The south stone is about 70 feet north of a ditch at the south end of the lot. The middle stone is 267 feet from the south stone and 242½ feet from the north stone. The magnetic station was over the south meridian mark. The finial of the cupola of the convent bears 85° 27′.2 east of true south.

Napoleonville, Assumption Parish.—The station is on the property of John B. Foley, just outside the town limits, southeast of the town on the road running just inside the levee along Bayou La Fourche. The station is on the lawn about half way between the road fence and the house, and about 18 feet north of the driveway. Two marble posts 5 inches square set in cement and projecting about 2 inches above the surface of the ground mark the true meridian passing through the magnetic station. One stone is 261.4 feet north of the station near the road fence; the other is 141.1 south of the station near a line fence.

Descriptions of Stations—Continued.

LOUISIANA—Continued.

New Roads, Pointe Coupee Parish.—The station is in the yard adjoining the residence of Dr. A. P. Fillostre, about one-third of a mile west of the court-house. It is on the lawn to the north and west of the house, and is marked by a 4-inch terra-cotta pipe in cement. The pipe is filled with cement and the cente marked with the neck of a bottle. It is 19 feet from the north fence and 24½ feet west of the fence around the house. A similar mark was placed 403 feet due south of the magnetic station and close to the front fence, thus defining the true meridian.

St. Francisville, West Feliciana Parish.—The station is about three-fourths of a mile east of the court-house, on the Pecan Grove plantation belonging to Judge W. W. Leake. It is on the edge of a field in front of the house, near a gully where the land is not likely to be plowed, 42 feet southwest of a cedar and about 200 feet from the fence on the east side of the field. It is marked with a 4-inch terra cotta pipe set in cement. The pipe is filled with cement and the center marked by the neck of a bottle. A similar mark was placed in the fence line, 479 feet due south, thus defining the true meridian. The mark used was the gable of an old mill, which bears 16° 01′.9 west of true south.

Thibodaux, La Fourche Parish.—The station is on the north side of Bayou La Fourche in the lot just west of the house of Judge Beattie. This house is opposite the bridge from Thibodaux and near the Texas and Pacific depot. A meridian line was established at this place in 1902 by Dr. G. D. Harris, of the State Geological Survey. It is marked by three marble posts, 6 inches square, set in cement. The south stone is on the slope of the levee. The next one is across the road from the levee, just inside the fence inclosing Judge Beattie's land. The north stone is close to a line fence and about 700 feet from the south stone. The magnetic station is 129.1 feet due south of the north stone.

MARYLAND.

Baltimore, Baltimore City County.—The station of 1895 was reoccupied as closely as the meager description would permit. It is in the extreme southeastern part of Fort McHenry, between a locust tree and the sea wall, 40 feet from the tree and 41⅓ feet from a cross cut in the top of the sea wall. The station is marked by a stone slab about 4 by 12 inches on top, set flush with the ground and having a cross chiseled in the top. The mark used was the Lazaretto Point light-house, which bears 80° 17′.2 east of true north. The cupola of the city building bears 37° 20′.8 east of true north. A secondary station was occupied 32¾ feet from the principal station, in line to the city building cupola. It was marked by a small stone about 4 by 5 inches on top.

Boyds, Montgomery County.—The station is in the western corner of Mrs. Boyd's pasture, about 325 yards northeast of the railroad station. It is 52⅓ feet from the fence along the chestnut grove and 94½ feet from the fence along the lane to the Boyd homestead. It is marked by a locust post about 6 inches in diameter projecting about 4 inches above ground. A copper nail marks the exact point. The mark used was the ball on the front end of the cupola of the railroad station, which bears 28° 13′.1 west of true south. The cupola on Mrs. Boyd's horse stable bears 62° 58′.1 east of true south.

Cheltenham, Prince George County.—The station is in the west wing of the absolute building of the Coast and Geodetic Survey Magnetic Observatory at Cheltenham. The observatory is described in Appendix 5, Report for 1902.

Dawsonville, Montgomery County.—The station is in Mr. Laurence Allnutt's lot, just south of his house, and west of the road passing the house. It is 120½ feet from the road fence and 167⅓ feet from the southeast corner of Mr. Allnutt's barn. It is marked by a locust post about 6 inches in diameter, projecting about 3 inches above ground and having a copper nail in the top. The mark used was the front peak of the roof of M. G. Darby's store, just below the shingles. This mark bears 14° 11′.8 east of true south. The south end of the peak of the cupola of Mr. Allnutt's barn bears 4° 26′.2 west of true north.

Linden, Montgomery County.—The base station of the magnetic survey of Maryland was reoccupied. It is in the middle of Prof. M. H. Doolittle's rear garden, 94.1 feet from the northeast corner and 84.1 feet from the northwest corner of frame dwelling house. It is marked by a sandstone post 6 inches square, projecting 6 inches above ground. The extreme tip of the Chevy Chase standpipe bears 39° 15′.7 west of true south. The tip of the tower on Major Lawrence's house bears 66° 46′.8 west of true south.

Descriptions of Stations—Continued.

MARYLAND—Continued.

Rockville, Montgomery County.—The station of 1900 was reoccupied. It is in the southwest part of the Academy grounds, 41 feet from the south fence and 93 feet from the west fence. It is the south end of a meridian line established in 1900, and is marked by a stone post projecting about 6 inches above ground and surmounted by a brass cup lettered U. S. C. & G. S. The north end is about 85 yards distant and is similarly marked. The mark used was the ball on the court-house cupola, which bears 66° 33′.5 east of true north.

Upper Marlboro, Prince George County.—The station occupied by L. A. Bauer in 1896 in the magnetic survey of Maryland was reoccupied. It is in the southeast corner of the court-house grounds, down in the hollow, 13.9 feet west of a maple tree and 88 feet from the southeast corner of the court-house. It is marked by a hickory tent peg driven almost flush with the ground. The mark used was the west end of the ridge of a small frame shack about 350 yards distant, which bears 62° 36′.6 east of true south.

MICHIGAN.

Harbor Point, near Harbor Springs, Emmet County.—The station is south-southwest of Harbor Springs, near the southwest corner of the inclosed grounds around Harbor Point light-house. The station is marked by a tent peg, which is 48 feet 2 inches from the south fence, 64 feet 3 inches from the west fence, and 173 feet from the southwest corner of the vestibule of the light-house. The tower of a private cottage about 250 yards distant bears 75° 28′.7 west of true north.

Houghton, Houghton County.—The station is in Hubbell's field, about one-third of a mile south-southwest of the grounds of the Houghton College of Mines, and near the students' triangulation station No. 9. The triangulation station is marked by a 2-inch iron pipe about 2 feet long, sunk flush with the ground. The magnetic station is marked by a brass screw in the center of a wooden stub, which was set 1 inch below the ground. The magnetic station is 31 feet 7 inches south and west of the triangulation station and in line with the tower of Engineering Hall, which bears 13° 11′.2 east of true north.

Mackinac Straits, Mackinac County.—Observations were made at four stations, "A," "B," "C," and "D," on the ice in Mackinac Straits. Station "A" was located upon the ice midway between the two points of the peninsulas at the Mackinac Straits. Station "B" was located on the ice near Round Island. Station "C" was located on the ice about one-third of the way from Mackinaw City towards Round Island. Station "D" was located on the ice about 5 miles east of Mackinaw City.

Mackinac Island, Mackinac County.—Station I (west side of parade grounds). The nearness of buildings and water pipes made the station of 1880 no longer available, and a new station was located 25⅓ feet slightly south and east of the old station. The new station is on the west side of the parade grounds, 148 feet from southwest corner of a frame building, and 103.5 feet from the east post of the back gate of the fence around the cottage west of the one occupied by the superintendent. The station is marked by an irregular shaped limestone rock jutting out flush with the surface, the apex of a triangular corner being the precise point used. The lower northeast corner of the middle block house bears 59° 08′.6 east of true south. The lower southwest edge of the powder magazine bears 60° 43′.6 east of true north. The lower northwest edge of the powder magazine bears 59° 30′.4 east of true north.

Station II (east side of parade grounds). This station is in the line connecting the Lake Survey triangulation stone near the fence at the northeast corner of the parade grounds with the north edge of the stone foundation of the east blockhouse erected in 1780. The precise point is 132⅔ feet from the middle of the stone, also 166⅔ feet from the southeast corner of a one-story frame dwelling and 199 feet from the northwest edge of the small powder magazine. The station is marked by the middle one of 5 stakes driven flush with the ground. The lower northwest corner of the powder magazine bears 57° 59′.3 east of true south. The central pole at Fort Holmes bears 11° 44′.8 east of true north. The north corner of the blockhouse bears 24° 05′.9 east of true south. Observations were also made at a provisional station, which was 50 feet from a large iron roller, in order to determine the magnitude of the effect of the roller.

Station III, "Brow Station." This station is on the brow of the hill on the east side of the town, and is in front of and next to the second last cottage before entering the park around the fort. The

Descriptions of Stations—Continued.

MICHIGAN—Continued.

station is marked by a 1-inch square hole chiselled in the natural limestone rock jutting out of the ground flush with the surface. It is 38¾ feet from the fence post of the boundary line between the nearest two cottages, 41 feet from the east gate post of the cottage which is the farthest to the east, 17 feet from the last post of the railing along the brow of the hill and 34 feet from the nearest one of a clump of pines west of the station. Round Island light-house bears 9° 31′.6 west of true south. Bois Blanc light-house bears 72° 55′.1 east of true south. The cross on the Catholic Church at Round Island bears 34° 48′.0 east of true south.

Station IV (Pointe aux Pins). This station is at the extreme north end of Mackinac Island in a small clearing about 50 yards south of where the beach boulevard turns eastward, about 15 yards from the middle of the road and about 30 yards from the water. The station is marked by a tent peg driven flush with the ground; directly behind the peg was sunk a bottle, with neck downwards. A blazed pine tree on the west side of the boulevard is 87 feet distant and bears 41° west of true south. A blazed pine tree on the east side of the boulevard 27 feet distant bears 72° west of true north. A tamarack tree 31 feet distant bears 18° east of true north. The mark used was St. Ignace water tower, and bears 75° 10′.4 west of true south.

Marquette, Marquette County.—The station of 1891 was reoccupied. It is on the United States reservation and near its western boundary, and about 800 feet northwest of the light-house. It is on the summit of a knoll just north of the life-saving station. It is marked by a small terra cotta-pipe sunk flush with the ground. This pipe is 248.5 feet from the northwest corner of the life-saving station, 104.5 feet from the western boundary of the reservation, and is about 10 feet east of a small pine tree. The mark used was a whistle which bears 21° 55′.2 west of true south.

Round Island, Mackinac County.—The station is on the north side of the island, about one-third of a mile west of Round Island light-house, in a small clearing, in which is a small dilapidated shed. It is about 8 yards from the shore, 36 feet 9 inches from the northwest corner of the shed, 39 feet from the northeast corner of the shed, and 28 feet 4 inches from a blazed balsam south-southwest of station. The station is marked by a brass screw in the center of a tamarack post, 4 inches in diameter and 12 inches long, sunk 1 inch below ground, and having pieces of a broken glass bottle packed around it. The cross on the Catholic Church at Mackinac Island bears 2° 57′.9 east of true north. The central pole at Fort Holmes bears 6° 23′.5 west of true north. The spire of the Episcopal Church at Mackinac Island bears 13° 55′.2 west of true north.

Sault Ste. Marie, Chippewa County.—Station I (new Fort Brady). The station is in the large field which is west and south of the administration building at the new site of Fort Brady. It is 94 paces south of a small brick powder magazine, being almost in line with the east wall of the magazine, and is 69 paces from the wooden fence along the road south of the station. The station is marked by a limestone post 42 by 8 by 6½ inches, set flush with the ground and lettered on top U. S. C. & G. S. 1902. The highest point of a water tower, about 250 yards distant, bears 76° 41′.2 east of true south. The iron flagstaff on the east side of the parade grounds bears 74° 23′.8 east of true north.

Station II (old Fort Brady). The station of 1891 was not available, Fort Brady having been moved to a new site and the old site used for a park or as residence property. In order to determine the approximate secular variation, observations were made as near the old station as possible. The point used was marked by a cross chiseled in a natural limestone rock, flush with the surface of the ground. The cross of the spire of St. Mary's Church bears 63° 45′.5 east of true north.

MINNESOTA.

Duluth, St. Louis County.—Station I (near station of 1891). The station of 1891 being no longer available, a new station was selected as near the old one as possible. The new station is in the rear of the lot in front of Pearson's Boat Construction Company's house, about 15 feet from the lake and 124 feet along the shore from the west gatepost of the back fence of Mr. J. Prior's yard. This station is about 130 feet from the station of 1891, and was marked by a wooden stake. The Masonic Temple bears 15° 24′.5 west of true north. The highest point of the house at the end of the pier bears 42° 42′.6 east of true north.

Station II (Minnesota Point). This station is on Minnesota Point, near the United States life-saving alarm post on the north lake shore, being distant from this post 72 feet in a direction about 23°

Descriptions of Stations—Continued.

MINNESOTA—Continued.

east of magnetic south. It is on top of the sand dune along the north shore, about 50 yards from the north shore line and about 60 yards from the south shore line. The station was marked by a wooden stake. The cupola of Patterson's Hotel at West Superior bears 3° 44′.1 west of true south.

Station III (Meteorological station). A station was located about 15 yards south of the meteorological station on the high hill back of town, about in the middle of the large rock jutting out of the ground.

MISSISSIPPI.

Charleston, Tallahatchie County.—The station is located in the vacant lot adjoining the Masonic Hall, 126.5 feet from the southwest corner of that building, 68.8 feet southeast of a large oak tree, and approximately 80 feet from the east side of Main street. The station is marked by a limestone post, 34 by 6 by 6 inches, sunk 2 inches below the ground and lettered on top U. S. C. & G. S. 1903. The dome of the court-house bears 5° 11′.4 east of true south. The left-hand edge of the east chimney on Mrs. M. A. Saunder's residence bears 23° 20′.5 west of true south. The spire of the Methodist Church bears 41° 31′.9 west of true south.

Greenwood, Leflore County.—The station is in the northern part of the old cemetery, 111.4 feet from the north fence and 76.6 feet southwest of a large sweet-gum tree. The station is marked by a limestone post, 34 by 6 by 6 inches, set flush with the ground and lettered on top U. S. C. & G. S. 1903. The highest point of the city water tower bears 87° 01′.2 east of true south. The cross on the Catholic Church bears 65° 37′.4 east of true north. The spire of the Christian Church bears 50° 31′.8 east of true north.

Hernando, De Soto County.—The station is located on the grounds of Randall University School, about 100 yards west of the schoolhouse, 85.2 feet from the south fence, and 56.7 feet southwest of a large oak tree. The station is marked by a limestone post, 32 by 6 by 8 inches, set flush with the ground and lettered on the top U. S. C. & G. S. 1903. The point of the railroad water tower bears 84° 20′.2 east of true south. The point of the small tower on the south part of the court-house bears 67° 01′.8 west of true north.

Mississippi City, Harrison County.—The station of 1896 could not be occupied conveniently, and a new station was established 2.75 meters east of the old one. The new station is 75 feet east of the fence on the west side of the land owned by Mr. Murphy and 72 feet north of the fence which borders the road along the beach.

Sardis, Panola County.—The station is located in Rosehill Cemetery, 105.4 feet from the west fence and 71.9 feet from the south fence. The station is marked by a limestone post, 34 by 6 by 6 inches, sunk 1 inch below the ground and lettered on top U. S. C. & G. S. 1903. The west edge of the city water tower bears 12° 12′.4 west of true south. The point of the tower of the American Cotton Company's cotton gin bears 23° 37′.2 west of true south. The west gable of Mr. Thomas Taylor's residence bears 26° 28′.8 east of true north.

Ship Island, Harrison County.—The station was located on the sand hill at the west end of the island, 59.7 meters east-northeast of the light-house. No permanent mark was made, as the sand hill is shifting continually.

NEBRASKA.

Beatrice, Gage County.—The station is within and near the north end of the race track in Linden Tree Park, being distant 91.5 feet from the fence to the north and 104.5 feet from the fence to the east. The station is marked by a limestone post, 36 by 6 by 6 inches, projecting 1 inch above ground and lettered on top U. S. C. & G. S. 1902. The court-house spire bears 80° 15′.3 east of true north. The spire just to the right of the park entrance bears 89° 19′.7 east of true south. The right edge of a large barn on a hill to the west bears 83° 43′.8 west of true south.

Benkelman, Dundy County.—The station is in the northwest corner of the school grounds, 151.5 feet from the northwest corner of the schoolhouse and about 12 feet from the line of the street on the west. The station is marked by a limestone post, 36 by 6 by 6 inches, projecting 1 inch above ground and lettered on top U. S. C. & G. S. 1902. The highest part of the railroad water tank bears 11° 45′.4 west of true south. The spire of the Presbyterian Church bears 29° 43′.1 west of true south.

Descriptions of Stations—Continued.

NEBRASKA—Continued.

Culbertson, Hitchcock County.—The station is located in the old court-house grounds, 131 feet from the southwest corner of the old court-house, 40.5 feet from the west side of the grounds, and 76.2 feet from the south side of the grounds. The station is marked by a limestone post, 40 by 6 by 6 inches, set so as to project 1 inch above ground and lettered on top U. S. C. & G. S. 1902. The cupola of the bank building bears 6° 03′.8 east of true south. The Baptist Church spire bears 56° 45′.9 east of true south. The Evangelical Church spire bears 36° 08′.1 west of true south.

Elwood, Gosper County.—The station is in the northwest part of the court-house yard, 51.3 feet from the edge of the board walk on the west side of the yard, 59.9 feet from the edge of the board walk on the north side of the yard, and 101.5 feet from the northwest corner of the court-house. The station is marked by a limestone post, 40 by 6 by 6 inches, projecting 1½ inches above ground and lettered on top U. S. C. & G. S. 1902. The right-hand edge of the chimney on a distant farmhouse bears 2° 27′.1 west of true south. The right-hand edge of the chimney on Mr. M. A. Stoughton's house bears 48° 12′.9 west of true south.

Fairbury, Jefferson County.—The station is on the east side of the high-school grounds, 126.1 feet east and slightly south of the southeast corner of the main building, 56.1 feet south of the southeast corner of a small brick outhouse, and 56.3 feet from the northeast corner of a frame school building. The station is marked by a limestone post, 30 by 6 by 6 inches, set flush with the ground and lettered on top U. S. C. & G. S. 1902. The base of the pole on the court-house bears 29° 20′.4 west of true south. The Baptist Church spire bears 12° 52′.4 west of true south. The Christian Church spire bears 4° 20′.6 east of true south.

Geneva, Fillmore County.—The station is on the grounds of the Nebraska State Industrial School for Girls. It is southwest of the main building and is 130 feet north of the drive leading from the public road to the main building, 12 feet southwest of a small cedar tree and 17.5 feet northwest of a second cedar tree. The station is marked by a limestone post, 42 by 6 by 6 inches, projecting 1½ inches above ground, and lettered on top U. S. C. & G. S. 1902. The flag-staff on the court-house bears 39° 07′.5 east of true south. The east edge of the city standpipe bears 31°22′.1 east of true south.

Grant, Perkins County.—The station is in the public road about one-fourth of a mile north of the court-house. It is 19.1 feet from the fence on the west side of the road and 178.2 feet from the last hydrant in Central avenue. The station is marked by a limestone post, 36 by 6 by 6 inches, set flush with the ground, and lettered on top U. S. C. & G. S. 1902. The Methodist Church spire bears 18° 11′.1 west of true south. The highest point of the railroad water tank bears 1° 41′.3 west of true south. The Congregational Church spire bears 23° 15′.5 east of true south.

Hastings, Adams County.—The station is on the grounds of Hastings College, 127 feet west of the southwest corner of the extension of the building used as a dormitory, 72.1 feet southeast of a telephone pole, and 45.7 feet northwest of a silver maple tree. The station is marked by a limestone post, 36 by 6 by 6 inches, projecting 2½ inches above ground, and lettered on top U. S. C. & G. S. 1902. The base of the pole on East Ward School bears 33° 25′.7 west of true south. The center of the statue on the court-house bears 68° 45′.9 west of true south. The flagstaff on the High School building bears 80° 08′.8 west of true north.

Hayes Center, Hayes County.—The station is on the grounds of the county court-house, 249.8 feet northeast of the northwest corner of the court-house and about 43 feet from the east and 50 feet from the north side of the grounds. The station is marked by a limestone post, 40 by 6 by 6 inches, projecting 2 inches above ground, and lettered on top U. S. C. & G. S. 1902. The flag pole on the "Republican" printing office bears 61° 26′.9 west of true south. The spire of the Methodist Church bears 65° 18′.6 west of true north.

Holdrege, Phelps County.—The station is on the grounds of the East School, 97.5 feet east of the brick sidewalk on the west side of the grounds, 17.6 feet southwest of a small sycamore tree, and 14.7 feet southeast of a small elm tree. The station is marked by a limestone post, 40 by 6 by 6 inches, projecting 1 inch above ground, and lettered on top U. S. C. & G. S. 1902. The base of the flag pole on the City Hall bears 57° 37′.5 west of true south. The flag pole on Hampton Hotel bears 76° 31′.1 west of true south.

Imperial, Chase County.—The station is on the court-house grounds, 128.2 feet north of the northwest corner of the north stone vault and 30.1 feet south of the fence on the north side of the grounds. The station is marked by a limestone post, 40 by 6 by 6 inches, projecting 2 inches above the ground

Descriptions of Stations—Continued.

NEBRASKA—Continued.

and lettered on top U. S. C. & G. S. 1902. The right-hand edge of the first chimney visible west of the court-house bears 0° 13′.5 west of true south. The right-hand edge of the chimney on the most distant house visible to the southwest bears 55° 34′.0 west of true south.

Indianola, Red Willow County.—The station is on the site of the old county court-house, 37.2 feet from the hedge on the north side of the grounds, and 100.1 feet from the northeast corner of the old court-house. The station is marked by a limestone post, 40 by 6 by 6 inches, sunk 38 inches into the ground, and lettered on top U. S. C. & G. S. 1902. The Congregational Church spire bears 00° 51′.6 west of true south. The Catholic Church spire bears 33° 58′.6 west of true south.

Kearney, Buffalo County.—The station is in the northwest corner of the grounds of the Whittier School, 17.5 feet and 24.3 feet from two maple trees on the north and 41.7 feet east of a maple tree on the west. The station is marked by a limestone post, 36 by 6 by 6 inches, set nearly flush with the ground, and lettered on top U. S. C. & G. S. 1902. The lower spire of the Presbyterian Church bears 6° 45′.1 west of true south. The southwest corner of the High School building bears 25° 39′.9 east of true south.

Lincoln, Lancaster County.—The station established in 1900 was reoccupied, although it is probable that it is no longer suitable because of local disturbances. This station is on the south end of the athletic field of the State University of Nebraska, 100.9 feet west of the stone walk at the west end of the main building and 69.8 feet north of the fence at the south end of the athletic field. The station is marked by a sandstone post 6 inches square, lettered on top U. S. C. & G. S., and sunk even with the surface of the ground. The mark used was the east edge of an iron smokestack and bears 16° 32′.8 west of true north.

North Platte, Lincoln County.—The station is in the northwest part of the Second Ward School grounds, 27.3 feet from the north fence, 62 feet from the west fence, and 101.7 feet from the northwest corner of the schoolhouse foundation. The station is marked by a limestone post, 36 by 6 by 6 inches, sunk flush with the ground, and lettered on top U. S. C. & G. S. 1902. The middle rod on the cupola of a distant dwelling house bears 64° 40′.6 west of true north. The left edge of the chimney of a house about 200 yards distant bears 25° 36′.0 west of true north.

Ogallala, Keith County.—The station established in 1900 was reoccupied. It is on the roadside about a quarter of a mile north of the court-house near a turn of the road and in line with the middle of the street running north and south on the east side of the court-house grounds. The station is marked by a stone, 36 by 6 by 6 inches, projecting one-half inch above ground, and lettered on top U. S. C. & G. S. The spire of the court-house bears 2° 07′.0 east of true south. The spire of the Congregational Church bears 18° 34′.8 west of true south.

Stockville, Frontier County.—The station is on the public school grounds, 34 feet from the east side of the street on the west and 152 feet north of the line of the north end of the schoolhouse. It is marked by a limestone post, 36 by 6 by 6 inches, projecting 1½ inches above ground, and lettered on top U. S. C. & G. S. 1902. The east edge of the court-house bears 4° 33′.2 east of true south. The Methodist Church spire bears 17° 36′.0 west of true south.

Tecumseh, Johnson County.—The station is on the fair ground and is north of the race track, being 149.9 feet from the northeast corner of the amphitheater, 42.4 feet north of the fence along the race track, and 90.9 feet south of the north fence of the fair ground. The station is marked by a limestone post, 42 inches long and 6 inches square on top, lettered U. S. C. & G. S. 1902, and projecting 4 inches above ground. The base of the pole on the court-house bears 29° 41′.2 east of true south. The center of a distant windmill bears 16° 25′.4 east of true south. The right edge of the city standpipe bears 35° 49′.5 east of true south. For the purpose of comparing different instruments a secondary station was located about 25 feet from the original station and in line with the pole on the court-house. Simultaneous observations by two observers were made at the two stations.

Wahoo, Saunders County.—The station is on the grounds of Luther Academy, 146.4 feet southeast of the southeast corner of the east building used as a dormitory, 37.2 feet northwest of an elm tree, and 31 feet northeast of a walnut tree. The station is marked by a limestone post, 40 by 6 by 6 inches, set nearly flush with the ground, and lettered on top U. S. C. & G. S. 1902. The Methodist Church spire bears 40° 22′.6 east of true south. The Presbyterian Church spire bears 37° 21′.3 east of true south.

Descriptions of Stations—Continued.

NEVADA.

Hot Spring, Esmeralda County.—The station is about 8 meters northwest of the triangulation station. It is on the north side of Woodruff's Hot Spring, which is about 40 miles east of the north end of Walker Lake, at the east end of a large soda and borax flat extending 10 or 12 miles eastward from Dead Horse Well. It is at the northwest end of the oblique boundary between the counties of Nye and Esmeralda.

Mill, Esmeralda County.—The station is 15 meters from the triangulation station, in line to Basalt or Pilot Cone, which was used as a mark. It is near an old mill about 3½ miles northwest of Woodruff's Hot Spring and half a mile north and near the east end of the large alkali flat extending 10 or 12 miles to the eastward of Dead Horse Well.

Tonopah (Butler), Nye County.—The station is 10 feet due south of the astronomical station. The latter is on the west side of Main street, about 120 feet south of Oddie avenue, and just west of the office of the Tonopah Miner. It is marked by two blocks of stone standing about 3 feet out of ground. A drill hole marks the station and the south end of a meridian line 1 113.9 meters long. The north meridian stone, 7 inches square, projects about 1½ feet above ground and is on the farthest of the near ridges.

NEW JERSEY.

Burlington Island, Burlington County.—The station is in Burlington Island Park on Burlington Island, being about 300 feet southeast of a farm house, about 450 feet a little north of west from the dancing hall and about 300 feet east of the telegraph wires running north and south. The station is marked by a brown sandstone monument, 28 inches long and 6 by 10 inches at the top, which is lettered U. S. C. & G. S. 1902, and projects 1 inch above the ground. The cross on St. Mark's Church spire in Burlington, N. J., bears 28° 33′.5 west of true south. The Methodist Church spire in Bristol, Pa., bears 17° 21′.2 west of true north. The second west brick chimney of McNeal's foundry on the farther bank of the Delaware River, bears 35° 24′.0 east of true south.

NEW MEXICO.

Deming, Luna County.—The station is 219.2 feet south of the track on the railroad's main line and 122.2 feet from the southwest corner of the road master's yard. The station is marked by a limestone block, 12 by 6 by 6 inches, sunk 3 or 4 inches below the ground. The flag pole on the Bank Hotel bears 31° 51′.9 west of true south. A distant windmill bears 31° 33′.1 west of true north. The railroad water tank bears 81° 23′.5 east of true north.

Folsom, Union County.—The station is in the open space northwest of the post-office, near a small canyon and 273 feet from the northeast corner of Mr. Odell's store. It is marked by a stone post 5 inches square projecting several inches above ground. The mark used was the pole on the public school, which bears 6° 03′.0 west of true south. The spire on the railroad water tank bears 35° 47′.0 west of true south. The northeast corner of Mr. Odell's store bears 12° 47′.0 east of true south.

Hachita, Grant County.—The station is on the south side of the El Paso Southwestern Railroad, in line with the west side of the telegraph operator's house and in line with the northwest edge of the railroad water tank, and the northwest edge of Mr. Windom's saloon. The station is marked by a hickory peg 12 inches long flush with the ground. The northwest edge of the railroad water tank bears 89° 21′.8 east of true north. The west gable of the depot bears 64° 07′.4 east of true north. The railroad section house bears 66° 37′.2 west of true north.

Laguna, Valencia County.—The station is on a bluff about 800 feet east of the railroad station and is marked by a stone 16 by 16 by 12 inches. The astronomical observations were made at a secondary station which is 17.2 feet from the northeast corner and 36.2 feet from the northwest corner of Captain Marmon's house. This astronomical station is marked by a 2-inch iron pipe 2 feet long, driven flush with the ground. From the magnetic station, the astronomical station, distant 371.5 feet, bears 61° 51′.3 west of true south. The south gable of Bibo's house bears 83° 07′.0 west of true north. The highest projection of a distant mountain peak bears 35° 29′.0 west of true south.

Lordsburg, Grant County.—The station is in the vacant space on the south side of the railroad, being south of the Methodist Church, 232.1 feet from the southeast corner of the adobe across the street from Mrs. Marble's house, and nearly in line with this adobe and the cupola of the church. The

Descriptions of Stations—Continued.

NEW MEXICO—Continued.

station is marked by a limestone post, 24 by 11 by 4 inches, sunk about 18 inches into the ground. The cupola of the Campbellite Church bears 57° 09′.5 east of true north. The railroad water tank bears 13° 30′.9 west of true north. Mr. Smith's windmill at Shakespeare bears 51° 13′.6 west of true south.

Rodeo, Grant County.—The station is on the south side of the railroad, 252.5 feet from the northeast corner of the depot and in line with the east end of the depot. The station is marked by a peg about 23 inches long, projecting 4 inches above ground, and having a small nail to mark the exact point. The center of the roof of the section house bears 19° 32′.7 east of true north. A windmill about 1½ miles distant bears 30° 21′.1 east of true south. A windmill 3 miles distant bears 66° 33′.3 west of true south.

Separ, Grant County.—The station is on the north side of the railroad, about 235 feet from the railroad track, 82.6 feet from the fence around the railroad property, and in line with the eastern end of the freight house. The station is marked by a pine peg, 14 by 2 by 2 inches, projecting about 4 inches above ground. "Cooks Peak" bears 65° 10′.7 east of true north. The center of the roof of the railroad water tank bears 20° 14′.4 east of true south. The eastern edge of the freight house bears 35° 22′.3 west of true south.

NEW YORK.

Crane Neck 2, Long Island.—The station is identical with the triangulation station on Crane Neck, on land belonging to Gen. E. N. Spinola. The best way to get to it by land is to take the Crane Neck road from Setauket village to General Spinola's house, which is at the end of the road; from thence there is a road to the station, which is on a bare top of a hill and is marked by a terra-cotta pipe. The station is 90 feet east of a north-and-south fence line, and is 120 feet south of a growth of cedars at the base of the hill. The mark used was Old Field Point light-house, which bears 66° 50′.5 east of true north.

Lightning, Long Island.—The station is the triangulation station "Lightning." This station is on the brink of the bluff line on the north coast of Long Island and is east of Old Field Point light-house. It is north of Millers Place village, and is reached by taking the shore road at that village. It is northeast of a shanty lying west of the shore road, and north of an old orchard lying east of the shore road. It is on the north edge of a growth of cedars which surround the shanty, shore road, and old orchard. The station is about 60 feet above the sea level. The mark used was Old Field Point light-house and bears 83° 55′.9 west of true north.

OHIO.

Batavia, Clermont County.—The station is in the northwest corner of the old part of Union Cemetery, being 50 feet east of the west fence of the cemetery, 35 feet north of the center of a driveway, 10 feet from a fir tree and 21 feet west of a second fir tree. It is marked by two marble monuments, one set directly over the other, each being 18 by 6 by 6 inches. The top of the upper stone is 3 inches above ground and is lettered U. S. C. & G. S. 1903. The spire of the Methodist Church, 1 mile distant, bears 71° 33′.8 west of true south. The City Hall tower bears 54° 02′.1 west of true south. The spire of the court-house bears 66° 42′.6 west of true south.

Centerville, Montgomery County.—The station is in the northern part of the Centerville Cemetery, being 2 feet north of the south edge of the most northern 10-foot alley and 10 feet west of the north end of a 4-foot alley, where it intersects the aforesaid 10-foot alley. It is 13.7 feet from the northeast corner of the base of the Gule Norris monument, 27.9 feet from the northeast corner of the base of the Joseph Manuel monument, and 10.2 feet from the north corner of the northeast corner stone of the Lamme lot. The station is marked by a limestone post 33 by 8 by 8 inches, the top of which is 1 inch below the general surface and is lettered U.'S. C. & G. S. 1903. The smokestack at the Centerville quarry, about 1 mile distant, bears 68° 48′.5 east of true north. The flag pole on the schoolhouse of district No. 5 bears 32° 29′.0 west of true north.

Cincinnati, Hamilton County.—Burnet Wood Park, Cincinnati University. The station is in the grounds of the Cincinnati University, in the Burnet Wood Park. It is south of the athletic field, on some high ground overlooking the same, being 58.2 feet from a tree to the southeast and 48 feet from a second tree to the west. It is marked by a limestone monument 3 feet long and 6 inches square at

Descriptions of Stations—Continued.

OHIO—Continued.

the top, which projects 1 inch above the ground and is lettered U. S. C. & G. S. 1903. The main tower of McMicken Hall bears 42° 07′.2 west of true north. The spire on the fire house bears 50° 53′.8 west of true south. The southwest spire of St. George's Church bears 60° 50′.9 east of true south.

Cincinnati, Hamilton County.—Mount Lookout, Cincinnati Observatory. The station is in Kilgore's first subdivision, lot 88 or 89, about 300 feet north of the northeast corner of the Cincinnati Observatory building on Mount Lookout. The station is not marked. The water tower, 2 miles distant, bears 34° 01′.9 west of true north. A church spire in Madisonville bears 39° 38′.2 east of true north.

Eaton, Preble County.—The station is in the southeast part of the pasture of the Preble County Infirmary, being about 200 feet from the east fence line and 150 feet from the south fence line. It is marked by a limestone 3 feet long and 6 inches square at the top, which is 1½ inches above ground and is lettered U. S. C. & G. S. 1903. The court-house tower, almost 2 miles distant, bears 21° 46′.5 east of true south. The tower on the west end of the infirmary bears 65° 12′.5 west of true south. The tower on the public school bears 27° 22′.3 east of true south.

Georgetown, Brown County.—The station is on the east side of the Fair Grounds, being 66 feet east of the fence about the circular display grounds, 53 feet northeast of a beech tree and 38 feet southeast of a second tree. It is marked by a marble monument 18 by 6 by 6 inches, set flush with the ground and lettered U. S. C. & G. S. 1903. The center of the dome of the court-house bears 52° 09′.7 east of true north. The spire of the Presbyterian Church bears 75° 44′.0 east of true north. The tower on the schoolhouse bears 12° 32′.0 east of true north.

Hamilton, Butler County.—The station is in the grounds of the Butler County Infirmary, being on the lawn about 300 feet southwest of the southwest corner of the main infirmary building, 75 feet from a fence corner to the northwest, 75 feet from the avenue leading to the infirmary, and 95 feet from the county road leading to Hamilton. The station is marked by a limestone 3 feet long and 6 inches square at the top, which is 1 inch above ground and is lettered U. S. C. & G. S. The spire of St. Joseph's Catholic Church, 1 mile distant, bears 85° 16′.3 west of true south. The court-house tower bears 68° 49′.4 west of true north. The tower on the Fourth Ward schoolhouse bears 87° 43′.7 west of true north.

Hillsboro, Highland County.—The station is in a reserve portion of Hillsboro Cemetery, being about 240 feet northwest from the main entrance and 53, 44, and 56 feet, respectively, from maple trees on the north and east edges of the reserve. The station is marked by a granite monument 32 inches long and 5 by 6 inches at the top, which is flush with the ground and lettered U. S. C. & G. S. 1903. The spire of Washington School, 1 mile distant, bears 16° 32′.6 west of true south. The highest part of Arthur's monument bears 35° 13′.9 east of true north. The standpipe bears 50° 26′.5 west of true south.

Jackson, Jackson County.—The station is in the eastern part of G. A. R. Circle, Section A, Fairmount Cemetery, on some high ground between Monument and Summit avenues. The distance from the station to the northwest corner of the base of the Ramsey monument is 47.1 feet; to the center of Dr. Jacob's corner stone is 11 feet, and to the northeast corner of the base of the Sternberger monument is 60.2 feet. The station is marked by a sandstone monument 3 feet long and 5 by 8 inches at the top, which projects one-half inch above ground and is lettered U. S. C. & G. S. 1903. The new public school tower bears 41° 12′.4 west of true south. The chimney at the pump station of the waterworks bears 9° 07′.1 east of true south. The court-house tower bears 60° 23′.8 west of true south.

Lebanon, Warren County.—The station is in the southeastern part of the pasture of the Warren County Infirmary, being about 175 feet north of the south fence line of the pasture and 14.2 feet a little to the west of south from the Warren County meridian line south stone. The station is marked by a limestone 3 feet long and 6 inches square at the top, which projects above the general surface 1 inch and is lettered U. S. C. & G. S. 1903. The standpipe, 1 mile distant, bears 9° 46′.8 east of true north. The court-house spire bears 9° 23′.3 west of true north. The city hall spire bears 24° 47′.1 west of true north.

Descriptions of Stations—Continued.

OHIO—Continued.

London, Madison County.—The station is located in the eastern end of the pasture of the Madison County Children's Home, being 300 feet or more from the south fence line, the same distance from the east fence line, and almost 250 feet from the north fence line. The station is 130 feet, more or less, from an oak to the northeast, and 150 feet from a second oak to the east. The station is marked by a limestone 3 feet long and 6 inches square at the top, which projects three-fourths of an inch above ground and is lettered U. S. C. & G. S. 1903. The court-house tower, 2 miles distant, bears 00° 24′.4 west of true south. The waterworks standpipe bears 7° 42′.7 west of true south.

Oxford, Butler County.—The station is in the southwestern corner of the grounds of the Western College for Women, being about 1 200 feet west of the main college building, 1 000 feet north of the Oxford County cemetery, 50.4 feet northeast of a certain tree, and 115.7 feet southeast of a second tree. The station is marked by a limestone 3 feet long and 6 inches square at the top, which projects 1¼ inches above ground, and is lettered U. S. C. & G. S. 1903. The tower of the Oxford public school, 1 mile distant, bears 62° 00′.2 west of true north. The vane on the tower of the Western College bears 79° 07′.9 east of true north. The flag pole on the east tower of Miami University bears 32° 18′.2 west of true north.

Springfield, Clark County.—The station is in the grounds of the I. O. O. F. Home, on a projecting point of elevation, about 500 feet southeast of the main building. The station is marked by a limestone 3 feet long and 6 inches square at the top, which is flush with the ground, and is lettered U. S. C. & G. S. 1903. A distant church steeple bears 2° 34′.7 east of true south. St. Raphael's Catholic Church steeple bears 19° 22′.5 west of true south. The spire of the I. O. O. F. Home bears 43° 19′.9 west of true north.

Troy, Miami County.—The station is in the northeast portion of the pasture of the Miami County Children's Home, being one-fourth of a mile southeast of the Home buildings and 100 feet or more south of the north fence line of the pasture. The station is marked by a limestone 3 feet long and 6 inches square at the top, which projects three-fourths of an inch above the surface, and is lettered U. S. C. & G. S. 1903. The spire of the Lutheran Church in Casstown, 2 miles distant, bears 00° 06′.8 west of true north. The tower of the Dye schoolhouse bears 74° 13′.3 east of true north.

Urbana, Champaign County.—The station is in the Oakdale cemetery, in section 68, at the south junction of a 5-foot alley with the first 15-foot driveway south of and parallel to Stone avenue. The station is in the aforesaid alley, and between lots 94 and 95, being 12.5 feet from a maple tree to the southwest, 3 feet from the west corner stake of the 5-foot alley, 45.6 feet from the southeast corner of the base of the Whetsel monument, 37.6 feet from the southeast corner of the base of the Mumford monument, and 36.4 feet from the southwest corner of the base of the Rawlings monument. The station is marked by a limestone 3 feet long and 6 inches square at the top, which is flush with the surface, and lettered U. S. C. & G. S. 1903. The tall brick chimney of the Urbana Woolen Mills, 2 miles distant, bears 74° 30′.5 west of true north. The southwest edge of the Young monument bears 41° 21′.2 east of true south.

Waverly, Pike County.—The station is in the northwest corner of Waverly cemetery, on the west edge of the roadway running almost north and south parallel to and near the west boundary of the cemetery. The station is about 50 feet from the north fence line of the cemetery. It is marked by a flagstone 3 feet long and 2½ by 15 inches at the top, which is flush with the ground and lettered U. S. C. & G. S. 1903. The spire on the court-house bears 5° 04′.0 east of true north. The highest point of the water tank of the D. S. Railway bears 73° 37′.8. west of true south. The spire of the Catholic Church bears 30° 08′.7 east of true north.

West Union, Adams County.—The station is in the I. O. O. F. Cemetery, on the west edge of a circular reserve. It is 28.5 feet west of a maple tree in the center of this reserve, 16.7 feet east from the southeast corner stone of the F. C. S. lot, and 43.2 feet south of the southwest corner of the base of Ensign Campbell's monument. The station is marked by two marble monuments, one set directly over the other, each being 18 by 6 by 6 inches. The top of the upper stone is 1 inch above the ground and is lettered U. S. C. & G. S. 1903. The spire of the Methodist Church bears 75° 53′.8 west of true south and is three-fourths of a mile distant. The court-house tower bears 74°.19′.6 west of true south. The center tower of the grand stand at the fair grounds bears 71° 02′.1 west of true north.

Descriptions of Stations—Continued.

OHIO—Continued.

Wilberforce, Greene County.—The station is in the eastern part of the pasture belonging to the Wilberforce University, being about 400 feet a little east of southeast from Arnett Hall and about 600 feet north of the University barn. The station is marked by a limestone 3 feet long and 6 inches square at the top, which is flush with the ground and lettered U. S. C. & G. S. 1903. The tower of the Arnett Hall bears 84° 05′.2 west of true north. The spire of the Shorter Hall bears 50° 12′.9 west of true north.

Wilmington, Clinton County.—The station is in the southwestern part of the Wilmington College grounds, being in the southeastern corner of a grassy field, used as an athletic field. It is 63 feet from an elm tree which bears SSW. 32.6 feet from a small maple which bears SE. by S. 36.5 feet from a second small maple tree which bears east by south, and 83. 5 feet from an oak which bears east by south. It is about 300 feet a little south of southwest from the southwest corner of the main college building. The station is marked by a limestone 3 feet long and 6 inches square at the top, which is flush with the ground and is lettered U. S. C. & G. S. 1903. The tower of the town hall, 1 mile distant, bears 71° 41′.3 west of true north. The spire of the electric-light tower bears 77° 18′.4 west of true north. The flag pole on Wilmington College tower bears 20° 47′.9 east of true north.

OKLAHOMA.

Guymon, Beaver County.—The station is on the east side of the railroad, in line with the north end of the depot, and 227.7 feet from the northeast corner. It is marked by a brick set endwise and flush with the ground. The mark used was the south gable of the section house, which bears 27° 52′.8 east of true north. The tip of the railroad water tank bears 14° 30′.4 west of true north. The northeast edge of "Woodman's Hall" bears 21° 46′.4 west of true north.

PENNSYLVANIA.

Allegheny, Allegheny County.—The station is in the public park south of the new Allegheny Observatory. It is marked by a stone 2 feet long and 6 inches square at the top, set flush with the ground, and 229.4 feet south of the south wall of the front stairway to the main entrance of the observatory. A church spire about 2½ miles away bears 30° 57′.9 west of true south.

Allentown, Lehigh County.—The station is in the northwestern part of the Highland Cemetery, on the north side of the path between lots 934 and 902, being 32.6, 50.7, 10.8, 11.7, 34.1, and 26.1 feet, respectively, from the maple tree at the northwest corner of lot 933, the center of the face of the gravestone to Jacob Keyser on lot 937, the southwest corner of lot 935, the northwest corner of lot 903, the maple tree at the southwest corner of lot 901, and the southwest corner of lot 933. The station is marked by 5 by 7 inch sandstone monument lettered U. S. C. & G. S. 1902, and set flush with the ground. The mark used was the ball on the spire of Zion's Reform Church, about 1½ miles distant, which bears 60° 24′.9 east of true south. The Washington schoolhouse tower bears 87° 43′.2 east of true south, and the Fifth Ward schoolhouse tower bears 75° 23′.8 east of true south.

Bedford, Bedford County.—The meridian line established by the county surveyor in 1877 back of the court-house was tested, and it was found that the south stone bore from the north stone 0° 03′.6 west of true south. As this point is not suitable for magnetic observations, the magnetic station was located on the grounds of the Arandale Hotel, in the large field back of the hotel, and about 200 feet from the brook, and across it. It is about 150 feet east of the line of the first two apple trees and 152, 173.6, and 181.8 feet, respectively, from the nearest three apple trees. It is marked by a marble stone 3 feet long and 9.5 inches square at the top, which is flush with the surface and lettered U. S. C. & G. S. 1902. The cross on the spire of the Methodist Episcopal Church bears 17° 51′.1 west of true north. The spire of the Catholic Church bears 12° 12′.5 west of true north.

Bloomsburg, Columbia County.—The station is on the property of the Sixth District State Normal School, or "Bloomsburg Normal School," being 114 feet from the west fence and 49.4 feet from the north fence. The station is marked by a marble post, 48 by 3¼ by 4¼ inches at the top, set projecting 3 inches, and lettered U. S. C. & G. S. 1902. The mark used was the Presbyterian Church spire, which bears 27° 31′.2 west of true south. The tip of the tower of the town hall bears 32° 38′.8 west of true south. The tip of the tower of the High School bears 52° 03′.8 west of true south.

Descriptions of Stations—Continued.

PENNSYLVANIA—Continued.

Brookville, Jefferson County.—The station is west of the county meridian, in the town reserve for church purposes. It is 175 feet more or less northwest of the Free Methodist Church, and about 13 feet northeast, 9 feet southeast, 38 feet west, and 35 feet northwest, respectively, of four large oak trees. The station is marked by a white marble post, 8 by 8 inches, set flush with the ground, and lettered U. S. C. & G. S. 1902. The mark used was the spire of the Methodist Church, which bears 2° 26′.9 east of true south. The Catholic Church spire bears 21° 41′.1 west of true south. The tip of the tower of the court-house bears 6° 39′.4 west of true south. Declination observations were made also over the south stone of the county meridian line.

Butler, Butler County.—The station is in the North Side Cemetery, on Monument avenue, between blocks 17 and 18. It is 2.5 feet from the north edge of the avenue, 67.4 feet from the southeast corner of block 17, and 64.7 feet from the southwest corner of block 17. The place is marked by a piece of Cleveland sandstone 3 feet long and 6 inches square, set flush with the ground, and lettered U. S. C. & G. S. 1902. The mark used was the court-house spire, which bears 6° 06′.5 east of true south. The Presbyterian Church spire bears 19° 22′.4 east of true south. The tip of the Berg monument bears 22° 23′.0 west of true north.

Clarion, Clarion County.—The station is at the south stone of the county meridian line, established by the United States Geological Survey, in the park opposite the court-house. The center of the clock dial on the court-house bears 7° 05′.7 west of true south. The old Presbyterian Church steeple bears 77° 55′.5 west of true south. Declination observations were also made at the north end of the meridian line, showing a large local disturbance.

Coudersport, Potter County.—The station is in the Eulalia Cemetery, in the grass path to the east of the Armstrong lot. It is 2.4 feet from the point of the northwest corner stone of the lot east of the Armstrong lot and 2.8 feet northeast from the point of the letter A on top of the northeast corner stone of the Armstrong lot. It is also 18.1 feet northeast of the northeast corner of the base of the Armstrong monument. The station is marked by an oak post 8 inches square, set flush with the surface of the ground and with a copper rivet on its top, which is lettered U. S. C. & G. S. 1902. The mark used was the Catholic Church spire, which bears 71° 48′.0 east of true north. The brick stack of the Pentaning tannery bears 61° 28′.3 west of true south.

Curwensville, Clearfield County.—The station is in Oak Hill Cemetery, almost in the west line of Robert Neeper's lot, being 26.4 feet from the southeast corner of the southeast marker of J. Hartshorn's lot, 11.8 feet from the southwest corner of the base of the Bilger monument, and 16.5 feet from the southwest corner of the southeast corner stone of the Bilger lot. The station is marked by a sandstone post 5 inches square, set flush with the ground, and lettered U. S. C. & G. S. 1902. The mark used was the higher steeple of the Methodist Church, which bears 30° 29′.1 west of true south. The tip of the tower of the Patton graded school bears 35° 13′.3 west of true south. The north gable point of John Robinson's house bears 57° 58′.2 east of true south.

Danville, Montour County.—The station is in the Reform Church Cemetery, on the south edge of the grass-covered east and west main road, being 1 foot north of the north line of the third lot from the west side of the cemetery, 80 feet from the west fence, 110 feet from the south fence, and 34.7 feet south of the southwest corner of the base of the Berger monument. The station is marked by a granite post 6 by 6 inches at the top, set flush with the ground, and lettered U. S. C. & G. S. 1902. The mark used was the Grove Presbyterian Church spire, which bears 84° 48′.2 west of true north. The tip of the tower of the State asylum main building bears 0° 46′.9 west of true south. The tip of the tower of the German Catholic Church bears 78° 22′.5 west of true north.

Doylestown, Bucks County.—The station is in the northern part of the grounds of the National Farm School, almost in the line of the memorial elms planted on the west side of the institution road leading from the public highway to the main building. It is some 190 or 200 feet from the center line of the public road to the north, 18.5 feet west of the center line of the institution road, and is 8.9, 37.7, 49.9, and 31.7 feet, respectively, from elms planted in memory of Mrs. J. Miller, Alex. Reinstine, Milton Mayers, and F. Greenburg. The station is marked by a 6 by 6 inch marble monument, lettered U. S. C. & G. S. 1902, and projecting 6 inches above the ground. The mark used was the gable point on the southeast side of a large barn on a distant knoll, which bears 33° 15′.6 west of true

Descriptions of Stations—Continued.

PENNSYLVANIA—Continued.

north. The base of flag pole on the main institution building bears 47° 17′.1 west of true south. The northwest edge of the east brick chimney on Burpee's Seed Company warehouse bears 85° 10′.1 east of true south. Declination observations were made also over the south stone of the county meridian line, showing considerable local disturbance.

East Emporium, Cameron County.—The station is in the Wiley Cemetery, 47.6 feet a little north of west from the northwest corner of the base of the Colson monument, 57.4 feet northwest of the northwest corner of the water table of the Dr. S. S. Smith vault, and 2.5 feet from the center of the marker at the northeast corner of the "W" lot. The station is marked by a 4 by 8 inch flagstone, marked U. S. C. & G. S. 1902, and projecting 2 inches above the ground. The mark used was the tip of the bell tower of Shippen Township school, which bears 57° 24′.0 west of true north. The south gable point of the house of Mark German bears 77° 19′.0 east of true north. The large stack of Brady's furnace bears 78° 44′.1 west of true north.

East Mauchchunk, Carbon County.—The station is in Evergreen Cemetery, at the north corner of lot 69, at the junction of three 4-foot paths, being 90¾ feet from the northwest corner of the base of the Mack monument, and 92 feet from the northeast corner of the base of the Bowman monument. The station is marked by a stone post 5½ by 5½ inches, set flush with the ground, the top being rounded off and lettered U. S. C. & G. S. 1902. The mark used was the Lutheran Church spire in Upper Mauchchunk, which bears 13° 44′.5 west of true south. The iron chimney of the power station bears 38° 46′.8 west of true south.

Easton, Northampton County.—The station is in the western part of the Lafayette College athletic grounds, inside the 14-foot track. It is probably 700 feet northwest from Bache's station of 1841, which was "in yard south of Lafayette College." The distances to the center of the track are, on the north 148 feet, on the east 295 feet, and on the west 70 feet. The station is marked by a marble monument, 6 inches square, lettered U. S. C. & G. S. 1902, and set one-half inch below the surface of the ground. The mark used was the spire of St. Mark's Church, which bears 37° 25′.9 west of true south. The west tower on Pasanosa Inn bears 28° 26′.5 east of true north. The ball on chapel clock tower bears 53° 35′.4 east of true south.

East Stroudsburg, Monroe County.—The station is in Prospect Cemetery, about 650 feet southwest of the entrance gate, and on about the highest point of the main east and west road. It is 44 feet from the bottom of the letter T in the main name on the Brutzman monument, 40.4 feet from the top of the letter A in the main name on the Dereamer monument, and 21.7 feet from the first small dogwood tree to the southwest. The station is marked by a marble monument, about 7½ inches square at the top, set flush with the ground, and lettered U. S. C. & G. S. 1902. The mark used was the Methodist Church spire in Stroudsburg, which bears 81° 46′.8 west of true south. The base of flag pole on State normal school bears 8° 12′.9 east of true north. The Stroudsburg court-house tower bears 86° 17′.3 west of true south.

Elulalia post-office, or Sheffield Junction, Forest County.—The station is in the grounds about Elulalia or Howe Township school, being southwest of the schoolhouse, 53.6 feet from the northwest corner of the school and 45.2 feet from the southwest corner of the same. It is about 60 feet north of the Standard Oil Company's pipe line. The station is marked by a white marble post 8 inches square on the top, which is lettered U. S. C. & G. S. 1902 and set flush with the ground. The mark used was the east point of the Pittsburg and Western Railway station roof, which bears 38° 54′.8 east of true south. The east gable point of the Sandford house bears 34° 53′.3 east of true south.

Greensburg, Westmoreland County.—The station of 1901 was reoccupied. It is the south stone of the meridian line established at that time in the field back of the east wing of the county home. This line is marked by two marble posts 6 inches square and lettered U. S. C. & G. S. S. M. (or N. M). The south stone is about 90 feet from the hedge fence and about 200 feet from the wooden fence along the road at the back of the home. The north stone is about 350 feet from the south stone. The right edge of a school building about a mile distant bears 69° 03′.3 east of true north.

Honesdale, Wayne County.—The station is on the property of Henry Z. Russell, on Irving Cliff, some 320 feet above general elevation of the town, and about 1 400 feet northeast of the court-house. It is east of the Lackawaxen River on a projection of red shale overhanging the river, and about in

Descriptions of Stations—Continued.

PENNSYLVANIA—Continued.

line of the railway water tank and the flag pole on Irving Cliff. The station is marked by a 1-inch square stub about 8 inches long. Five holes were drilled in the rock ledge as reference marks, the station being 25.9 feet in a northeasterly direction from one of these holes drilled in the surface of the ledge and 36.9 feet in a southwesterly direction from a second hole drilled in the face of the ledge. The mark used was the Bethany Church steeple, about 3½ miles distant, which bears 35° 56′.0 west of true north. The Episcopal Church spire in Honesdale bears 24° 40′.5 west of true south. The German Catholic Church tower in Honesdale bears 5° 18′.8 west of true south. Declination observations were made also over the south stone of the county meridian line in the court-house grounds.

Keating, Clinton County.—The station is in the yard of the Keating School, being 36.2 feet southwest from the northwest corner of the schoolhouse, 38.5 feet from the southwest corner of the same, 31 feet north of a pine tree, and 24 feet east of a blazed tree. The station is marked by a 4 by 8 inch flagstone, set flush with the ground and lettered U. S. C. & G. S. 1902. The mark used was the north gable point of the store near the station, which bears 37° 26′.2 east of true south. The tip of the Philadelphia and Erie Railway tank bears 2° 59′.9 west of true south. The center of the west end tie bolt in the upper south corner of the west truss of the Philadelphia and Erie Railway bridge bears 68° 16′.2 east of true south.

Kittanning, Armstrong County.—The station is on the reservoir grounds of the water company and is in the meridian line established by the United States Geological Survey. The station is marked by a copper nail in the top of a stub, which is 24.5 feet south of the north stone of the meridian line, 28.5 feet from the north fence, and 50.8 feet from the east fence. The mark used was the spire of the Lutheran Church, seen just to the right of a large brick chimney, and bears 54° 28′.4 west of true south.

Meadville, Crawford County.—The station is in St. Bridget's Catholic Cemetery, in the prospective addition, east of the older portion, being 75.1 feet from the northeast corner of the base of the Garry monument and 96.6 feet from the northeast corner of the base of the Lyons monument. The station is marked by a white marble stone 7½ inches by 7⅜ inches at the top, which is lettered U. S. C. & G. S. 1902, and projects 1 inch above ground. The mark used was the State Street Church tower, which bears 17° 19′.5 west of true north. The Presbyterian Church spire bears 18° 03′.3 west of true north. The tower of Allegheny College bears 18° 46′.5 west of true north.

Mercer, Mercer County.—The station is in the cemetery at the south side of a road and to the north of the Pearson lot, being 42.9 feet from the northwest corner of the base of the Wallace monument, 42.1 feet from the base of the James McKee monument, and 37.6 feet from the base of the Howard monument. The station is marked by a white marble stone, 6 inches square at the top, which is flush with the ground and lettered U. S. C. & G. S. 1902. The mark used was the Methodist Church tower, which bears 21° 29′.2 east of true north. The court-house tower bears 5° 57′.6 west of true north. The high school tower bears 19° 19′.7 east of true north. Declination observations were made also over the south stone of the county meridian line in the court-house grounds.

Milford, Pike County.—The station is in the Milford Cemetery, almost in the straight line joining the Beam and Kleinhaus monuments, between which it is located, being 40.5 feet from the center of a star on the south face of the Kleinhaus monument, 46.6 feet from the top of the "A" in the main name on the Beam monument, about 85 feet east of the Baker vault and 4 feet north of the edge of the main cemetery road. It is marked by a copper rivet set in a cedar post 4½ inches in diameter, set flush with the ground. The mark used was the south gable point of the Villa Inn, which bears 31° 08′.5 east of true north. The south gable point of Doctor Reed's residence bears 26° 08′.4 east of true north. The south gable point of Doctor De Place's residence bears 36° 24′.3 east of true north. Observations for declination were made also at the south stone of the county meridian, showing a large local disturbance.

Montrose, Susquehanna County.—The station is the south stone of the county meridian line. It is about 300 feet northeast from the court-house, in the public square. The meridian line is marked by two granite posts, 6½ by 10 inches at the top and projecting 2 feet above ground. The mark used was the south gable point of a small frame house to the northwest, which bears 30° 51′.5 west of true north. The court-house tower bears 58° 55′.8 west of true south.

Descriptions of Stations—Continued.

PENNSYLVANIA—Continued.

Newcastle, Lawrence County.—The station is in Graceland Cemetery, in the reserve, and in the approximate center of a large circular plat some 250 yards west of the sexton's house. It is 7.1 feet northeast of the center stake of the circular reserve plat and 71.7 feet northwest from the northwest corner of the base of the monument on the southeastern edge of the same plat. The station is marked by a black marble stone 8½ inches square, chamfered at the top, which is lettered U. S. C. & G. S. 1902, and projects 1.5 inches. The Methodist Church spire in Groton bears 19° 22′.4 west of true south. The spire of the cemetery chapel bears 74° 26′.6 west of true north. The south gable point of the McKee house bears 1° 35′.9 west of true north.

Penbryn or Carpenter Post-office, Lycoming County.—The station is in the school grounds of the Carpenter school, being 40.8 feet northwest from the northeast corner of the school foundation and 41.8 feet from the northwest corner of the school foundation. Six holes were drilled as reference marks in the outcroppings of red shale. The station is 5.5 feet southeast of one of these drill holes and 5 feet northwest of a second. The chimney of the Kiff house about 2½ miles distant bears 29° 36′.1 east of true north. The west gable of the Northern Central Railway station bears 6° 40′.5 east of true north.

Ridgway, Elk County.—The station is in the Catholic Cemetery in the path to the south of lot 89 and is 2.7 feet northeast of the northwest corner of the lot southeast of lot 89 and 2.2 feet southeast of the southwest corner of the lot east of lot 89. The station is marked by a white marble post 5 by 7 inches, set flush with the ground and lettered U. S. C. & G. S. 1902. The mark used was the spire on the residence of N. T. Arnold which bears 62° 40′.5 west of true south. The north gable point of the Elk County General Hospital bears 46° 12′.7 east of true south. The Lutheran Church tower bears 5° 46′.6 east of true south. Declination observations were made also at the north end of the county meridian line, showing considerable local disturbance.

Rocky Grove (Franklin), Venango County.—The station is in Franklin Cemetery, in a path between lots 16 and 17 of section S, being 3 feet from the southwest corner of lot 17 and 2.8 feet from the southeast corner of lot 16. The station is marked by a blue marble stone 5¾ inches square at the top, which is lettered U. S. C. & G. S. 1902 and projects 1½ inches. The mark used was the north gable point of H. F. James's residence, which bears 84° 16′.5 east of true north. The southeast corner of the hospital bears 37° 53′.3 west of true south. The east gable of the F. Mitchell vault bears 28° 14′.5 east of true south.

Satterfield, Sullivan County.—The station is in the yard about the Satterfield school, in what is known as Cherry Flats, Cherry Township, being 71.5 feet northeast of the northeast corner of the foundation of the school building, 48.6 feet a little south of east from a maple tree, and 66 feet a little south of west from a second maple tree. The station is marked by a marble post, 6 by 6 inches, projecting 1 inch, and lettered U. S. C. & G. S. 1902. The north gable point on P. Hennessy's barn bears 31° 25′.7 west of true south. The flag pole at Liken's Colliery bears 24° 36′.3 east of true south. The north gable point of M. Waldron's house bears 4° 37′.9 east of true south.

Scranton, Lackawanna County.—A meridian line was located in Nay-Aug Park, to be used as a county meridian line. It is marked by granite posts 5½ feet long, dressed to 1 foot square for 1 foot from the top. The two stones are about 544 feet apart on opposite sides of Nay-Aug Creek, the line joining them passing over the tunnel of the Delaware, Lackawanna and Western Railroad. The north stone projects about 8 inches above ground, and has a top in the form of a flat pyramid, a drill hole at the apex marking the exact point. It is 800 or 900 feet southeast from the merry-go-round. The south stone projects about 1 foot above ground, and has a north and south groove in its top surface. It is capped by a bronze plate. Magnetic observations were made at the north stone. From it the tower tip to the right of the chimney on L. A. Watress's mansion bears 81° 09′.0 east of true north.

Silver Lake, Susquehanna County.—The station is on the Rose Bros. property. The station is in the orchard to the southeast of the Rose house, and almost in line of the westernmost row of apple trees, being between the ninth and tenth trees, counting from the north end of the row. The station is marked by a marble monument 6 by 6 inches, set with the top somewhat below the general surface of the ground, and lettered U. S. C. & G. S. 1902. The west gable point of the Casville house bears 65° 22′.6

Descriptions of Stations—Continued.

PENNSYLVANIA—Continued.

east of true north. The north gable point of the Rose sawmill bears 63° 59′.3 east of true south. The south gable point of the Rose house bears 55° 17′.7 west of true north.

Slate Run, Lycoming County.—The station is in a cemetery reserve, across the creek from the railway station, on the Tomb property. The station is 55.9 feet northeast of a blazed pine, 24.7 feet a little north of east from the southeast corner of the base of the Dan Sander monument, 22.8 feet a little east of south from the southeast corner of the base of the Tomb monument, 54.4 feet southwest of a blazed pine and 76.1 feet northwest of a double apple tree. The station is marked by a copper rivet set in a 1 by 1 by 30 inch stake, driven flush with the ground and surrounded by a cairn of stone. The mark used was the spire of the Methodist Church, which bears 32° 47′.5 east of true north. The southwest corner of the Slate Run schoolhouse bears 62° 43′.7 east of true south.

Smethport, McKean County.—The station is located in the approximate center of the Oak Hill Cemetery, in the grass footpath at the northeast corner of the Williams lot. It is 12.1 feet northeast of the northeast corner of the base of the Williams monument and 42.5 feet a little south of west from the southwest corner of the base of the Thomm monument. A sandstone slate marker, 5¼ inches square, tapering to 1½ inches square, lettered U. S. C. S. and projecting 2½ inches above ground, marks the station. The mark used was the court-house tower, about three-fourths of a mile distant, which bears 58° 25′.3 west of true north. The Episcopal Church spire bears 58° 40′.9 west of true north. The west gable point on Coombs's barn bears 50° 45′.9 east of true south.

Somerset, Somerset County.—The station of 1901 was reoccupied. It is in the court-house yard at a wooden post midway and in line between the north and south monuments of the county meridian line. The station is 20.5 feet east of the west fence of the court-house yard and 66 feet from the south meridian monument. The left edge of Mr. Dice Woy's house bears 35° 03′.7 east of true north.

Tionesta, Forest County.—The station is in the Riverside Cemetery of the I. O. O. F., at the intersection of the main avenues of the cemetery, being at the northeast corner of lot 42, section D, belonging to Robert Hunter. It is 30.3 feet from the northeast corner of the base of the Hunter monumen', 24.7 feet from the northwest corner of the base of the Wenk monument and 72 feet from the northwest corner of the base of the Robinson monument. The station is marked by a marble post 5¼ inches square at the top, which is flush with the ground and lettered U. S. C. & G. S. 1902. The mark used was the east gable of J. F. Proper's house, which bears 7° 42′.6 east of true south. The north gable of Q. Jamieson's house bears 10° 51′.6 west of true south. The west gable point of Mrs. Kennison's house bears 33° 42′.3 east of true north.

Towanda, Bradford County.—The station is in Oak Hill Cemetery, in the third triangular grass-plat on the east side of the cemetery, counting from the entrance gate. It is 99.3 feet northwest of the northwest corner of the base of the Putnam monument, and 87 feet a little south of west from the northwest corner of the base of the Pratt monument. The station is marked by a marble post 6 by 6 inches, projecting 2 inches and lettered U. S. C. & G. S. 1902. The mark used was the Hornbrook Church steeple, which bears 24° 53′.5 west of true north. The Methodist Church spire in North Towanda bears 7° 55′.0 west of true north. The north gable point on George H. Wood's house bears 76° 03′.1 east of true south.

Tunkhannock, Wyoming County.—The station is in Sunnyside Cemetery on a piece of reserve ground at the center of the cemetery, being 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. The mark used was the cross on the Methodist Church spire, which bears 88° 06′.6 west of true south. The court-house tower bears 89° 04′.0 west of true south. The west gable point on Charles Lane's house bears 83° 04′.1 east of true north.

Warren, Warren County.—The station is in the Oakland Cemetery of the I. O. O. F. It is in the center of a path between lots 24 and 23, belonging to J. R. Bowers and L. P. Rogers, respectively. The station is 31 feet southeast of the southeast corner of the base of the Eddy monument, 61.1 feet west of the southwest corner of the base of the Burgie monument and 34.4 feet northeast of the northwest corner of the base of the Boon Magee monument. The station is marked by a white marble post, 5 inches square at the top, which is three-fourths inch below the general surface and lettered U. S. C.

Discriptions of Stations—Continued.

PENNSYLVANIA—Continued.

& G. S. 1902. The mark used was the court-house tower, which bears 16° 27′.0 west of true north. The iron stack of the Briggs-Ellis Refinery bears 31° 05′.9 east of true north. The large brick stack at the center of the Cornplanter Refinery bears 76° 03′.3 east of true south. Declination observations were made also over the south stone of the county meridian line, showing considerable local disturbance.

Waynesburg, Greene County.—The station is at the north stone of the county meridian line established in 1850. This north stone is about 300 feet north of Waynesburg College and the city public school, in the street running north and south and just west of the court-house. The spire of the Presbyterian Church just to the left of the court-house bears 6° 25′.0 east of true south. The spire of the Baptist Church bears 44° 38′.5 west of true south. The tip of the highest monument in the cemetery to the northwest bears 27° 03′.8 west of true north. The south stone is in the sidewalk near the northwest corner of the court-house yard, and bears 0° 34′.8 west of true south.

Wellsboro, Tioga County.—The station is in the public square on the west side of the United States Geological Survey meridian line, being 120.08 feet from the south monument and 231 93 feet from the north monument. The station is not marked by any stone. The mark used was the southeast edge of main chimney on H. B. Packer's residence, which bears 42° 07′.3 west of true north. The north monument of the meridian line bears 12° 18′.9 east of true north and the south monument bears 24° 19′.6 east of true south. Declination observations were made also over the south monument of the meridian line.

Westover, Clearfield County.—The station is in the cemetery adjacent to the Baptist Church in a north and south path between the Mitchell and Rishel lots, being 21.7 feet north of the west corner of the base of the Rishel monument, and 27.7 feet southeast of the southeast corner of the Tubbs monument. The station is marked by a copper rivet set in a hard-wood post 2 inches square, set flush with the ground. The mark used was the steeple of the Ashurite Church, which bears 57° 11′.0 west of true south. The steeple of the Baptist Church bears 69° 13′.8 west of true north. The west gable of the house of Ellis Westover bears 76° 24′.8 east of true north.

Wilkesbarre, Lucerne County.—The station is in Ashley Cemetery in a path between two lots off the main road, being 38.8 feet southwest of the southwest corner of the base of the Auman monument, 41 feet north of the northeast corner of the base of the O'Connell monument and 39.8 feet southeast of the south corner of the base of the Biggs monument. The station is marked by a marble post 6 by 6 inches at the top, set flush with the ground and lettered U. S. C. & G. S. 1902. The spire of St. Leo's Church in Ashley bears 74° 40′.2 east of true south. The Methodist Episcopal Church spire bears 56° 46′.6 east of true north. The Presbyterian Church spire in Ashley bears 64° 14′.9 east of true south.

PHILIPPINE ISLANDS.

Bolinao, Luzon.—This is the station Clear of the local triangulation. The mark used was the station Swim, which bears 89° 26′.9 west of true south.

Capiz, Panay.—The station is on the plaza in front of the Capiz Church. It is the station East Base of the local triangulation and is 139.3 meters from the astronomical station, which bears 83° 07′.0 west of true south.

Cebu, Cebu. —No description.

Halsey Harbor, Culion.—The station is on the most southeasterly point on an island. It is on a large rock which is just awash at high water and is marked by a drill hole in the rock. It is the station Push of the local triangulation. The mark used was the astronomical station, which bears 10° 22′.3 east of true south.

Masbate, Masbate.—The station is in the extreme northwestern portion of the town, between the Wright and Sherwood houses. It is 43.1 meters nearly south of the astronomical station, 55.9 meters from the west corner of the Sherwood house and 12.1 meters northeast of the post at the northeast corner of the Wright house.

Misamis, Mindanao.—The station is on a point of sand due south of the astronomical station and about 10 or 12 meters from low water line.

Tabaco, Luzon.—This is the station South Base of the local triangulation. The mark used was the station Quatro, which bears 56° 27′.3 east of true north.

Descriptions of Stations—Continued.

PORTO RICO.

Aibonita.—Magnetic observations were made as near as possible to the station of 1901. The new station is on a hill about 1 mile south of Aibonita, and is about 100 feet northeast of an old house and 10 feet southwest of a large rock, which is about 7 feet long and 3 feet wide, and has a small cross chiseled on its top. The spire of the cathedral at Aibonita bears 16° 18′.7 west of true north.

Kaguas.—The station is about 2½ miles from Caguas on a hillside opposite "Camineros Peon No. 11, Kms. 31–33," and about 50 paces from the middle of the military road from Ponce to San Juan. The spire of the Catholic Cathedral in Caguas bears 8° 14′.3 east of true south. The middle of the ridge of the roof of the "Camineros" bears 67° 42′.7 west of true south.

Cueva.—The station is line between Cueva △ and Palominos △, being 14 feet from the Cueva signal. The Cueva △ is on meadow land owned by Tomas Lopez, about 25 feet south of the highest point of a prominent hill on Cueva Point. It is about 20 meters north of a small leaning tree and about 8 meters east and north of a ledge of rock. The Cueva △ is marked by a cement block, 18 by 4 by 4 inches, set in the ground. Palominos △ bears 81° 35′.2 east of true south.

Goat.—The station is near Goat △, on the southeast coast of Porto Rico, on Cabra de Tierra Point, on east side of Ensenada Honda Harbor. The station is about 10 feet above sea level, on a line between Goat △ and Port Mulas light-house, being about 70 yards from Goat △ toward the light-house. It is about 20 yards from the shore line on the east side of the point. Port Mulas light-house bears 69° 56′.5 east of true south.

Mayaguez.—The station is in the open field in front of the United States Military Hospital (1898), 76 paces from the front face of the hospital, 8 paces from the hedge fence on the west, and 47 paces from the wire fence on the south. (The station was not marked because of lack of time.) The flagstaff of the barracks just above the last joint, bears 10° 56′.0 west of true north.

Obispo Cayo.—The station is on the northeast shore of Obispo Cayo, about 10 paces from the water and 12 feet from high-water mark. It is about the middle of an opening in the mangroves, which extend for about 60 feet along the beach. All of the horizon from Cape San Juan light-house to Palominos Island is visible from the station. Cape San Juan light-house bears 1° 55′.4 east of true north.

Palominos Island.—The station is on the west slope of Palominos Island, about 60 feet from the summit of the island. It is about 110 feet from Palominos △ (1900), on the line toward Cape San Juan light-house, and in the only cow path that leads around the west slope of the island. The center of the light tower at Cape San Juan light-house was used as a mark and bears 54° 41′.8 west of true north.

Porto Rico Magnetic Observatory, Vieques Island.—In connection with the establishment of a temporary magnetic observatory in Fort Isabel, a station for absolute observations was established on the hill east of the fort, about half way up. Later it was decided to make the absolute observations for the observatory work inside the fort in a room adjoining the one in which the magnetograph was mounted, but to refer them to the "hill" station.

Scorpion Point, Culebra Island.—The station is on the extreme end of Scorpion Point, about 25 feet from Scorpion △ (1900), and on a line with Soldado △ (1900). The station is on the south side of the point and is about 10 feet above sea level. Soldado △ (1900) bears 45° 18′.7 east of true south.

SOUTH CAROLINA.

Florence, Florence County.—The old station in the Florence National Cemetery being no longer suitable, a new station was located 68.5 feet from the west wall of the cemetery, 51.1 feet southeast of an oak tree, and 34.6 feet from a hickory tree, east of south. The station was marked by a copper nail in the center of a hard pine block, 15 by 6 by 6 inches, which was sunk 1 inch below the ground. The spire of the Baptist Church bears 50° 44′.7 west of true north. The south gable of Mr. J. W. McCowen's house bears 66° 22′.0 west of true north. The southwest corner of the Southern Cotton Oil Company's main building bears 82° 36′.5 west of true north.

Hampton, Hampton County.—The station is on the public school grounds, 144 feet from the southwest corner of the schoolhouse, 64.7 feet from the fence on the northwest, and 36.1 feet from the fence on the southwest. The station is marked by a limestone post, 36 by 6 by 5 inches, set flush with

Descriptions of Stations—Continued.

SOUTH CAROLINA—Continued.

the ground and lettered on top U. S. C. & G. S. 1903. The west gable of the belfry of the Baptist Church bears 78° 14′.8 east of true south. The edge of the northwest corner of Mr. W. H. Maudlin's house bears 65° 14′.8 east of true north. The right-hand edge of the chimney on Hoover Brother's store bears 11° 07′.8 east of true north.

Orangeburg, Orangeburg County.—The station is on the campus of the "South Carolina College for Colored People," 208 feet south of the southwest corner of the central main part of Morrill Hall, and 17.8 feet from the west fence of the campus. The station is marked by a granite post, 34 by 7 by 5 inches, having a cross on top and set flush with the ground. The spire of the Methodist Church bears 62° 25′.9 west of true south. The north gable of Mr. Bryant's house bears 35° 30′.9 east of true south. The edge of the southeast corner of Bradham Hall bears 28° 47′.6 east of true north.

Sumter, Sumter County.—The station is on the parade ground of "Sumter Military Academy," 156 feet from the southeast corner of the school building, 68.4 feet north of a large oak tree, and 40.2 feet from the fence on the east. The station is marked by a marble post, 22 by 8 by 8 inches, set flush with the ground and lettered on top U. S. C. & G. S. 1903. The base of the flagstaff on the opera house bears 22° 22′.0 east of true south. The north edge of the city water tower bears 57° 07′.0 east of true south. The west gable of Mr. H. J. Barnett's house bears 31° 26′.8 east of true north.

TENNESSEE.

Iron Mountain Furnace Tract, Stewart County.—The tract is about 8 miles west of Dover and 6 miles east of Fort Henry. The magnetic station is on a ridge about 100 meters northwest of the southeast corner of the so-called Steele line, which was run eastward (?) from the Mississippi River as the parallel of 36° 30′.

TEXAS.

Amarillo, Potter County.—The station of 1899 is no longer available. A new station was therefore established near the southeast corner of the schoolhouse (college) grounds, 37.9 feet from the east fence and 42.5 feet from the south fence. A meridian line was established and marked by two stones. The south meridian stone is 62.1 feet a little north of west from the magnetic station. It is about 7 by 10 inches on top and is lettered U. S. C. & G. S. 1902. The north stone is 6 inches square on top and is 449.8 feet from the south stone. Drill holes in the center of each stone define the meridian.

In December, 1902, observations were made over the south meridian stone. The mark used was the cupola of Mr. Bricker's house, and bears 3° 40′.2 west of true north. The north gable of Mr. Pierson's house bears 2° 43′.2 east of true south.

Anderson, Grimes County.—The station is located near the middle of the grounds surrounding the school building (and masonic hall combined), and is on a line with the south wall of the south wing of the building, to the west of the building, 144.5 feet from the building and 174 feet from the fence bounding the grounds on the west. The station is marked by a rather irregular slab of limestone, 18 by 18 inches and 4 inches thick, set edgewise into the ground, level with the surface. The exact spot is marked by a hole drilled near the middle of the rock. The Methodist Church spire bears 28° 34′.0 east of true south, and the middle spire of the court-house bears 39° 46′.8 east of true south.

Athens, Henderson County.—The station is located near the north boundary of the public school grounds, 67 feet from the north fence, 231.1 feet from the east fence, and 173 feet from the schoolhouse. The station is marked by an irregular block of red sandstone, about 20 inches long, trimmed to 5 by 8 inches on the top and lettered U. S. C. & G. S. 1902. It is sunk flush with the ground so that only the rectangular top shows. The spire of the Methodist Church was used as mark and bears 36° 47′.9 east of true north.

Bellville, Austin County.—The station is located near the middle of the west end of the high school grounds, 49.8 feet from the south fence and 55 feet from the west fence. The station is marked by a large block of limestone, 30 inches long, sunk flush with the ground, and the top trimmed down to about 9 by 13 inches, lettered U. S. C. & G. S. 1902. A drill hole in the center of the top marks the exact spot. The rod on the Methodist Church bears 36° 17′.4 west of true south and the cross on the Episcopal Church bears 12° 05′.1 east of true north.

Descriptions of Stations—Continued.

TEXAS—Continued.

Bovina, Parmer County.—The station is on the south side of the railroad, about 290 feet from track of main line, and 113.1 feet from the northeast corner of Merdfelder's store, and in line with the store front. It is marked by a hardwood stake, 20 inches long, driven 18 inches into the ground. The mark used was the iron water tank about half a mile distant and bears 9° 59′.5 east of true south. The west gable of the railroad station bears 6° 29′.7 west of true north.

Caldwell, Burleson County.—The station is near the west corner of the public school grounds, 134.3 feet from the northeast and 120.2 feet from the southeast fence. The school buildings are frame, the grounds large and open, about two acres, and situated on the western outskirts of the town. The soil contains a large amount of a low grade of iron ore, but none was struck in digging the hole for the monument. At other places a layer of some 10 to 12 inches in thickness crops out. The station is marked by a block of limestone 6 by 12 inches, set almost flush with the ground, and lettered U. S. C. & G. S. 1902. The spire of the Baptist Church was used as mark, its bearing being 69° 55′.6 east of true south. The spire of the Methodist Church bears 81° 45′.2 east of true south.

Cameron, Milam County.—The station is located near the northeast corner of an open block known as "City Park." This block is three blocks north and one block east of the court-house square, and is not fenced. Station is marked by a limestone post, about 8 by 8 by 36 inches, set in the ground so as to project 3 or 4 inches and lettered on top U. S. C. & G. S. 1902. The spire of the Christian Church bears 80° 32′.5 west of true south.

Canadian, Hemphill County.—The station is near the northwest corner of the court-house square, 41.9 feet from the north fence and 57.9 feet from the west fence. It is marked by a pitch pine peg 18 inches long. The mark used was the Union Church cupola and bears 28° 57′.2 east of true south. The windmill on Isaac Brothers' ranch bears 67° 44′.0 west of true north. The northwest edge of the court-house bears 54° 27′.9 east of true south.

Canyon, Randall County.—The station is near the northwest corner of the first square north of the court-house. It is marked by a sandstone, 6 by 6 by 36 inches, showing about 4 inches above ground and lettered U. S. C. & G. S. 1902. This is the north end of a meridian line 526 feet long, the south end of which is marked by a similar stone buried with its top 3 inches below the surface of the ground. The mark used was the north gable of John Rusk's house and bears 3° 09′.2 west of true south. The court-house cupola bears 15° 49′.0 east of true south.

Center, Shelby County.—The station is located on the west side of the public school grounds, comprising one whole block northwest of the court-house. The station is marked by a small hole drilled in the center of a squared post of seasoned white oak, 26 inches long, set so as to project about 1 inch from the ground. Distance of the station from the line of west fence is 27.5 feet (no fence around the grounds at present). Distance from a black-jack tree, standing on the west side of the grounds and nearly in line with the north side of the schoolhouse, is 27 feet. The mark used is the spire of the Christian Church and bears 24° 52′.1 west of true north.

Channing, Hartley County.—The station is near the southeast corner of the court-house square and 17.0 feet south of the south stone of a meridian line 274.6 feet long. This stone is about 10 by 11 inches on top and lettered U. S. C. & G. S. 1902. From the station the cupola of the Methodist Episcopal Church bears 4° 43′.3 west of true north. The schoolhouse belfry bears 48° 03′.7 east of true north.

Childress, Childress County.—The station is south of the court-house, nearly on line with the west side, and 196.5 feet from the southwest corner. It is marked by a bodark post, showing 3 inches above ground. The mark used was the south gable of Burshon's house and bears 7° 20′.5 west of true north. The Cumberland Presbyterian Church spire bears 43° 20′.0 west of true south and the southeast edge of the jail bears 86° 51′.0 west of true south.

Clarendon, Donley County.—The station is on the northeast side of the court-house grounds, 101.6 feet from the nearest point of the court-house, 116.4 feet from the southeast fence, and 40.1 feet from the northeast fence. It is marked by a limestone post, 8 by 8 by 28 inches, projecting about 2 inches above ground and lettered U. S. C. & G. S. 1902. This is the north end of a meridian line 647.9 feet long, the south end of which is to the rear of the public school building (southwest side) and is marked by a white limestone post, about 6 by 8 by 28 inches, projecting about 2 inches above

Descriptions of Stations—Continued.

TEXAS—Continued.

ground. The mark used was the Methodist Episcopal College cupola and bears 71° 24′.3 west of true north. The north edge of the belfry on the Baptist Church bears 74° 40′.9 east of true south.

Claude, Armstrong County.—The station is rear the east corner of the court-house square, 57.4 feet from the southeast fence, 57.9 feet from the northeast fence, and 98.7 feet from the east corner of the court-house. It is marked by a bodark post projecting about 2 inches above ground. This is the north end of a meridian line 334 feet long, the south end of which is similarly marked. The mark used was the Methodist Episcopal Church cupola and bears 41° 19′.1 west of true south. The jail cupola bears 49° 54′.8 west of true north.

Conroe, Montgomery County.—The station is near the southwest corner of the schoolhouse grounds (not inclosed). These grounds comprise one whole block in the northwest portion of the town. The schoolhouse is a two-story frame building on brick piers. The magnetic station is 75.7 feet from the southwest corner of the schoolhouse, almost due south of this corner and in line with a small pin-oak tree standing about 25 feet from the schoolhouse. Distance of the station from the tree is 51.4 feet. The station is marked by an irregular block of sandstone, about 14 inches each way, set a little below the surface of the ground and with a small hole near the center to mark the exact spot. The Methodist Church spire bears 33° 16′.5 west of true south.

Crowell, Foard County.—The station is in the northeast corner of the court-house square, 23.8 feet from the east fence, 32 feet from the north fence, and 112.6 feet from the northeast corner of the court-house. It is marked by a limestone post, 5 by 10 by 42 inches, lettered U. S. C. & G. S. 1902, and showing about 8 inches above ground. This is the north end of a meridian line about 350 feet long, the south end of which is similarly marked. The mark used was the south gable of J. A. Wright's house, and bears 7° 47′.0 east of true north. The Baptist Church spire bears 75° 50′.9 east of true north.

Dalhart, Dallam County.—The station is on the vacant lot south of Hotel Dalhart, in line with the rear of the hotel, and 82 6 feet from the southwest corner. It is marked by a rough stone nearly round, 18 inches in diameter and about 8 inches thick, with a drill hole to mark the exact spot. The mark used was the west gable of the residence of C. E. Williams, and bears 32° 39′.0 east of true south. The southeast edge of the schoolhouse bears 47° 56′.2 west of true south.

Dimmitt, Castro County.—The station is on the north side of the court-house grounds (octagonal), 11.6 feet from the north fence, 12.7 feet from the northeast fence, and 125.1 feet from the northeast corner of the court-house. It is marked by a limestone post, roughly 8 inches square on top and 19 inches long, projecting about an inch above ground. This is the north end of a meridian line 292.0 feet long, the south end of which is near the south side of the grounds and is marked by a similar stone. The mark used was Harvey Cash's house, west chimney, and bears 32° 00′.6 east of true north. The schoolhouse chimney bears 54° 58′.0 west of true south.

Dumas, Moore County.—The station is in the southeast corner of the court-house square, 38.4 feet from the east fence and 34.1 feet from the south fence. It is marked by a sandstone post about 8 by 10 inches on top and 7 inches thick, buried about an inch below the surface of the ground. A drill hole in the center marks the station and the south end of a meridian line 266 feet long. The north end is marked by a half-inch iron pipe projecting about a foot above ground. The mark used was the east chimney on Robert Aikins's house, and bears 10° 08′.8 west of true south.

Emma, Crosby County.—The station is in the southeast corner of the court-house grounds, 45.5 feet from the south fence, 68.4 feet from the east fence, 62.2 feet from the southeast corner of court-house, and 204.8 feet from the north fence. It is marked by a stone post, 6 by 9 by 18 inches, set flush with the ground, and lettered U. S. on top. This is the south end of a meridian line 300 feet long, the north end of which is marked by a piece of iron pipe about 2½ feet long driven flush with the ground. The mark used was G. S. Benedict's windmill, and bears 41° 28′.2 east of true south. The east gable of the Methodist Episcopal parsonage bears 88° 18′.7 west of true south.

Floydada, Floyd County.—The station is in the northwest corner of the court-house square, 36 feet from the north fence, 41.6 feet from the west fence, and 124.2 feet from the northwest corner of the court-house. It is marked by a hard limestone about 4 by 10 by 26 inches, showing about an inch above ground. This is the north end of a meridian line 262.8 feet long, the south end of which is similarly marked. The mark used was the cupola on the Methodist Episcopal Church, and bears 1° 48′.0 west of true north. The north gable of the Harkey Hotel bears 26° 10′.4 east of true south.

Descriptions of Stations—Continued.

TEXAS—Continued.

Franklin, Robertson County.—The station is near the southwest corner of the public school grounds, 90 feet from the south fence and 85.5 feet from the west fence. It is marked by a limestone 4 by 6 by 36 inches in size, sunk into the ground, and lettered U. S. C. & G. S. 1902. The spire of the negro Methodist Church bears 20° 13′.4 west of true south, and the spire of the Christian Church bears 66° 40′.7 west of true north. The school building is a large wooden one, on the east end of town, and is surrounded by spacious grounds.

Gatesville, Coryell County.—The station is on the west side of the public school grounds, 219.8 feet west of the northwest corner of the schoolhouse, and 77.5 feet south from a black-jack tree standing nearly in line with the south side of the schoolhouse. The station is marked by a limestone rock 8 by 8 by 30 inches, set nearly flush with the ground, and lettered on top U. S. C. & G. S., 1902. The ball on central spire of court-house bears 37° 40′.5 west of north. The tip of the galvanized iron ventilator on middle of roof of county jail bears 50° 41′.8 west of north.

Georgetown, Williamson County.—The station is near the northwest corner of the athletic grounds, forming part of the grounds surrounding the old main building of the Southwestern University. Distance from west fence is 71.7 feet, from north fence 161 feet, from university building about 119 yards. The building is now used by the preparatory department of the university. The station is marked by a block of limestone, set flush with the ground, about 9 by 12 inches on top and 20 inches long, and lettered U. S. C. & G. S. 1902. The largest spire on the new main building of Southwestern University bears 73° 26′.8 east of true south.

Hansford, Hansford County.—The station is in the court-house square 38.3 feet from the west fence, 70.4 feet from the north fence, and 83.9 feet from the northwest corner of the court-house. It is marked by a sandstone 5 by 6 by 22 inches, projecting 2 inches above ground. It is the south end of a meridian line about 600 feet long. The north end is in line with the telephone poles to A. E. Powers's. The mark used was S. G. Ward's windmill, and bears 42° 38′.6 west of true south. Wallace McKay's windmill bears 33° 47′.1 east of true north.

Hartley, Hartley County.—The station is near the southwest corner of the schoolhouse grounds, 12 feet from the south fence, and 27.2 feet from the west fence. It is marked by a limestone rock about 7 by 10 inches on top and 7 inches thick, set flush with the ground. A drill-hole in the center marks the exact point, and also the south end of a meridian line about 300 feet long. The north end is marked by a similar stone. The mark used was the chimney on the railroad station, and bears 2° 15′.0 east of true north. Mrs. Seybold's windmill bears 88° 43′.6 east of true north.

Henderson, Rusk County.—The station is on the north side of the public school grounds, in line with the east (front) edge of the front porch, 36.1 feet from the north fence inclosing the school grounds. Distance from nearest part of schoolhouse, about 135 feet. The station is marked by a small hole drilled in the center of a slab of marble 2 by 6 by 18 inches, flush with the ground, this being the only piece of nonmagnetic rock obtainable. The rock is a rejected tombstone lettered G. G. on the side (not visible as set). The mark used is the spire of the Southern Presbyterian Church, and bears 1° 35′.3 east of true south. The tip of the cupola on M. Kangerga's residence bears 84° 56′.5 east of true north.

Hereford, Deaf Smith County.—The station is near the southwest corner of the court-house square, 42.1 feet from the west fence, 45 feet from the south fence, and 137.4 feet from the southwest corner of the court-house. It is marked by a brown sandstone 8 by 8 by 30 inches, showing about 5 inches above ground and lettered U. S. C. & G. S. 1902. This is the south end of a meridian line 276.3 feet long, the north end of which is marked by a similar stone (not lettered). The mark used was the railroad water tank, and bears 17° 37′.2 east of true south. The east gable of Tygrett Hotel (Ritchie House) bears 56° 32′.4 west of true south.

Higgins, Lipscomb County.—The station is near the center of the schoolhouse grounds, 80.9 feet from the north edge of the east wing, 85.5 feet from the west edge of the north wing of the school building, and 25.2 feet from the west corner of the boys' privy. It is marked by a small hickory peg. The mark used was the Higgins Hotel windmill, and bears 29° 07′.4 east of true south. The west gable of William Nation's house bears 68° 41′.1 west of true south. The Methodist Episcopal Church cupola bears 59° 15′.1 east of true south.

Descriptions of Stations—Continued.

TEXAS—Continued.

Houston, Harris County.—The station of 1890 on the old Fair Grounds is no longer available, so a new station was located in the Fifth Ward in the northeast corner of the Cascara School grounds, 21.4 feet from the east fence and 19.7 feet from the north fence. The tip of the galvanized-iron ventilator flue on the west wing of the schoolhouse bears 44° 22′.6 west of true south. The station is marked by a limestone post 6 by 8 by 29 inches, sunk flush with the surface of the ground and lettered U S C & G S 1902.

Jacksonville, Cherokee County.—The station is near the northwest corner of the park surrounding the public school. It is 66.6 feet from the west fence and 164.6 feet from the north fence. Distance from schoolhouse about 700 to 800 feet (estimated). The station is marked by a rough block of sandstone about 14 by 14 by 5 inches, set flush with the ground, the exact spot being marked by a hole near the middle of the rock. The Baptist Church spire (lower end of the wood rod, which leans considerably at the top) was used as mark and bears 28° 53′.5 west of true south.

Jefferson, Marion County.—The station is near the middle of the open block known as the "park," the northeast corner of which is occupied by the public school building. The station is in line with the southwest corner of the school yard and the V-shaped trough (between the two gables) of the roof of a house diagonally opposite, about 115 feet from the corner. The station is marked by a slab of sandstone 3 by 10 by 24 inches, set flush with the ground and lettered roughly U. S. C. S. The flagpole on the post-office, three blocks away, bears 89° 17′.4 east of true south. The spire of the Presbyterian Church (300 feet away) bears 0° 33′.2 east of true north.

Kaufman, Kaufman County.—The station of 1901 was reoccupied. It is at the north end of the public school grounds, 53.7 feet from the north fence and 116.1 feet from the west fence. It is marked by a gray sandstone post 6 inches square, lettered on top U. S. C. & G. S., sunk flush with the surface of the ground. A drill hole in the post marks the exact point and the north end of a meridian line 401.1 feet long. The south end is marked in a similar manner. The mark or range used was the center of the ball on the Baptist Church spire, and bears 20° 00′.6 west of true north. The old schoolhouse (wood) has been replaced by a new one since the station was occupied in 1901. The new building is "brick veneered," having a wooden frame and the walls filled out with a single layer of brick, thus making a 4-inch brick wall. The nearest corner (northeast) of the building is about 144 feet from the magnetic station.

Lagrange, Fayette County.—The station of 1890 was reoccupied. It is in the southwest corner of the court-house grounds, 36.5 feet from the south fence and 40.3 feet from the west fence. It is marked by a drill hole in the top of a sandstone post 8 inches square on top, and projecting about 4 inches above ground. The pole on the cupola of the Masonic Hall bears 65°15′.2 east of true north. As the court-house grounds are no longer suitable for magnetic observations, a second station was located near the southeast corner of an unoccupied square, known as the City Park. The station is 94½ feet from the south fence and 61½ feet from the east fence and is marked by a limestone post 7 by 10 inches on top, set flush with the ground and lettered U. S. C. & G. S. 1902. The mark used was the cross on the Episcopal Church, and bears 13° 08′.4 west of true north.

Lefors, Gray County.—The station is near the southeast corner of the court-house square, 120.4 feet from the southeast corner of the court-house. It is marked by an oak peg driven nearly flush with the ground. The mark used was the east chimney on Mrs. Anna Zweig's house, and bears 34° 56′.5 east of true north. The southwest edge of the court-house bears 57° 37′.2 west of true north, and the northeast edge bears 34° 40′.1 west of true north.

Liberty, Liberty County.—The station is on the schoolhouse grounds, which comprise one block in the western part of town. Distance of the station from north fence is 16.8 feet, from east fence 17.5 feet. Approximate distance from schoolhouse is 110 feet. The station is marked by a limestone post 6 by 8 by 30 inches, sunk flush with the ground and marked thus: U. S. C. & G. S. 1902. The mark used is the head of the statue of Justice on the court-house, about one-fourth mile distant, and bears 87° 55′.4 east of true south.

Lindenau, Dewitt County.—The station of 1901 was reoccupied. It is about a quarter of a mile east of the post-office, in the prairie southeast of the house of Charles Wild, and a little west of a clump of live-oak trees. It is marked by a limestone post 4 by 12 inches on top, lettered U. S. C. S. 1901,

Descriptions of Stations—Continued.

TEXAS—Continued.

and projecting 3 inches above ground. The mark or range used was the spire of the court-house at Cuero, 5.9 miles distant, and bears 61° 06′.7 east of true south. The south rod on Mr. Wild's residence bears 81° 48′.6 west of true north.

Lipscomb, Lipscomb County.—The station is in the court-house square, 65.3 feet from the east fence and 19.7 feet from the south fence, and is marked by a rough limestone about 5 by 5 inches on top, set flush with the ground. The mark used was the bell on the schoolhouse, and bears 13° 24′.8 west of true south. The southeast edge of the court-house bears 85° 39′.8 west of true south. The west gable of S. W. Mugg's house bears 69° 23′.5 east of true north.

Livingston, Polk County.—The station is near the northwest corner of the public school grounds, 16.2 feet from the north fence and 60.3 feet from the west fence. The schoolhouse is a large frame building, distant from the station about 110 feet. The station is marked by a limestone rock 8 by 8 by 32 inches, set flush with the ground and marked U. S. C. & G. S. 1902. The mark used was the spire of the Presbyterian Church, and bears 39° 26′.5 east of true north. The rod on the belfry of the schoolhouse bears 54° 22′.5 east of true south.

Lubbock, Lubbock County.—The station is in the southeast corner of the court-house square, 32.9 feet from the south fence, 49.7 feet from the east fence, and 97.1 feet from the southeast corner of the court-house. It is marked by a white limestone rock about 12 by 12 by 18 inches, set nearly flush with the ground. This is the east end of an east-and-west line 276.2 feet long. The west end is marked by a small nail in the top of a cedar post 26 inches long, set flush with the ground. The mark used was the north gable of J. T. Beal's house, and bears 6° 33′.7 west of true south. The south gable of R. M. Clayton's house bears 24° 26′.1 east of true north.

Lufkin, Angelina County.—The station is near the northwest corner of the grounds surrounding the new brick schoolhouse, about 197 feet from the nearest corner of the schoolhouse, 32½ feet from the line of the north fence, and 34½ feet from that of the west fence. No fences are built at present, hence no exact distances can be given. The station is marked by a limestone 26 inches long and cut to 3 by 7 inches on top, set in the ground so as to project about one-half inch, and lettered U. S. C. S. 1902. The spire of the Baptist Church was used as mark, and bears 20° 23′.0 west of true south. The pole on the top of the cupola of the old wooden Methodist Church bears 3° 13′.2 east of true south.

McKinney, Collin County.—The station is near the southeast corner of the public school grounds, which comprise a lot of some 6 to 7 acres in the western part of town. Distance of the station from the south fence is 86.7 feet; from east fence is 96.3 feet. The schoolhouse is over 300 feet from the station. The station is marked by a marble monument 33 inches long, 6 by 6 inches on top, sunk into the ground so as to project about 3 inches, and lettered on top as follows: U. S. C. & G. S. 1902. The spire of the Southern Presbyterian Church bears 50° 25′.1 east of true north. The rod on the cupola of Mr. Jesse Shain's residence bears 60° 10′.6 east of true north.

Madisonville, Madison County.—The station is located on the public school grounds in the eastern portion of town. Distance from the east fence surrounding the school grounds 136 feet; from the south fence 54.8 feet. Approximate distance from the schoolhouse is 115 feet. The station is marked by a post of petrified wood (silicated) about 5 inches in diameter and 32 inches long. A small hole in the top of the post marks the exact spot. The central spire of the court-house bears 58° 11′.6 west of true south.

Matador, Motley County.—A meridian line 358.9 feet long was established in the court-house grounds. It is marked by two bodark posts projecting about 4 inches above ground. The south post is nearly in line with the north front of Masonic Hall. The magnetic station is near the northwest corner of the court-house square, 9 feet south of the north end of the meridian line, and is marked by a bodark peg driven flush with the ground. The south gable of M. L. Patton's house bears 0° 36′.9 west of true north.

Memphis, Hall County.—The station of 1900 was reoccupied. It is in the grounds adjacent to the Presbyterian Church, 79.6 feet from the southwest corner and 60 feet from the middle one of the three southeast corners of the church. It is marked by a hickory peg. A meridian line 1 215.3 feet long was established and marked by two bodark posts set flush with the ground. The north post is

Descriptions of Stations—Continued.

TEXAS—Continued.

322.5 feet from the magnetic station. The south post is 87.4 feet north of the outer fence around the yard of J. M. Ballew's residence. From the magnetic station the south post bears 3° 08′.5 east of true south. The court-house cupola bears 19° 13′.1 east of true north.

Meridian, Bosque County.—The station is located near the southwest corner of the public school grounds, 226 feet from the southwest corner of the schoolhouse 89.2 feet from the fence on the south side of the street passing south of the schoolhouse grounds and 68.6 feet from a large wooden shed or "tabernacle" which occupies the middle of the western portion of the school grounds. A galvanized iron cistern (capacity about 1 200 gallons) stands about 110 feet southeast of the station. The station is marked by a white limestone post 5½ by 8½ by 36 inches in size, sunk almost flush with the ground and lettered U. S. C. & G. S. 1902. The spire of the court-house (about one-eighth mile distant) bears 38° 32′.9 west of true south. Baptist Church spire bears 40° 51′.5 east of true south. Presbyterian Church spire bears 34° 45′.4 west of true south.

Miami, Roberts County.—The station is near the south corner of the court-house square, 14.1 feet from the southeast fence, 14.2 feet from the southwest fence and 39.6 feet from the south end of a meridian line 317.3 feet long. The south meridian stone is 7 by 7 by 27 inches, projecting about two inches above ground and lettered U. S. C. & G. S. 1902. The north stone is about 6 by 6 inches on top and projects about 4 inches above ground. From the magnetic station the Presbyterian Church cupola bears 44° 13′.9 west of true south.

Mineola, Wood County.—The station of 1888 is no longer available. A new site was therefore selected on the city fair grounds, located in the western part of town. The station is near the middle of the southern part of the fair grounds and is located most conveniently with reference to the second block (counting from the south) of the row bounding the fair grounds on the east. The distance of the station from the west fence inclosing this block is 244½ feet. Distance (northward) from the line of the south fence inclosing the block is 80 feet. The station is marked by a limestone post 7 by 8 by 25 inches, sunk in the ground so as to project about 1 inch, and lettered U. S. C. & G. S. 1902 on top. The spire of the Christian Church (about three blocks distant) was used as a mark and bears 16° 26′.5 east of true south. The spire of the Baptist Church bears 59° 39′.1 east of true south.

Mobeetie, Wheeler County.—The station is in the southeast part of the court-house square, 98½ feet from the southeast corner of the court-house. It is 0.3 foot north of the south end of the meridian line, 260.9 feet long, marked by a large hard limestone rock of irregular shape with a drill hole on top. The north end of the meridian line is marked by a hard limestone about 20 inches long and 6 inches square on top. The mark used was the hotel chimney and bears 3° 13′.1 west of true north. The school-house belfry bears 85° 29′.6 east of true north.

Mount Pleasant, Titus County.—The station is located near the southwest corner of the public school grounds. Distance from the south fence is 14.2 feet, from the west fence 12.3 feet. Distance of station from nearest corner of schoolhouse is about 100 feet. The station is marked by a limestone rock 6 by 8 by 24 inches, set flush with the ground and lettered on top U. S. C. & G. S. 1902. The spire of the Baptist Church was used as a mark and bears 6° 39′.9 west of true south.

Ochiltree, Ochiltree County.—The station is near the southeast corner of the court-house square, 125.8 feet from the southeast corner of the court-house. It is marked by a white sandstone 6 by 6 by 26 inches, projecting about 6 inches above ground and lettered U. S. C. S. It is the south end of a meridian line 332½ feet long. The north end is marked by a similar stone (not lettered). The mark used was the chimney on C. H. McKee's house, and bears 22° 45′.1 west of true north.

Paducah, Cottle County.—The station is in the northeast corner of the court-house square, 19.6 feet from the north fence, 17 feet from the east fence, and 98.5 feet from the northeast corner of the court-house. It is marked by a bodark post about 3 inches in diameter, projecting 2 inches above ground. This is the south end of a meridian line about 450 feet long, the north end of which is similarly marked. The Methodist Episcopal Church cupola bears 64° 56′.4 west of true south. The jail cupola bears 18° 06′.1 east of true north.

Palestine, Anderson County.—The station is located on the grounds of the Second Ward school, in the northern part of town. Distance from west fence is 13.3 feet, from south fence, 14.4 feet. The soil contains considerable iron in the form of irregular lumps of low-grade ore. What is called

Descriptions of Stations—Continued.

TEXAS—Continued.

"gravel" contains enough iron to adhere to the larger magnets with the dip circle. The station is marked by a limestone post 8 by 8 by 26 inches, firmly set in hard clay soil flush with the surface. The rock is lettered U. S. C. & G. S. 1902. The spire of the Presbyterian Church was used as mark and bears 51° 14′.6 east of true south. The spire of the Howard Avenue Methodist Church bears 16° 35′.5 west of true south.

Pampa, Gray County.—The station is in the inclosed lot northeast of the hotel, 18.3 feet from the southeast fence, 80.5 feet from the northeast fence and 137.5 feet from the east corner of the hotel. It is marked by a hard wooden post 3 inches square projecting about an inch above ground. The mark used was the south gable of the postmaster's house, and bears 60° 01′.4 east of true north. The north edge of the railroad water tank bears 3° 38′.3 west of true south. The south gable of Johnson Commercial Company's store bears 29° 31′.2 west of true north.

Panhandle, Carson County.—The station is in the southeast corner of the court-house grounds, 12.6 feet from the east fence and 14.3 feet from the south fence. It is marked by a small peg driven flush with the ground. The mark used was Mrs. V. C. Nelson's windmill (2 miles distant), and bears 4° 44′.0 west of true south. The Methodist Episcopal Church spire bears 85° 27′.6 east of true north. The railroad water tank bears 20° 33′.3 east of true south.

Paris, Lamar County.—The station is located on the grounds of the West Paris public school, near the southeast corner. The schoolhouse is about three-fourths mile west of the Texas Midland and Santa Fe depot. The schoolhouse grounds are not fenced. The station is located with reference to the school building, being placed in line with the east wall of the building and 167.2 feet from the southeast corner. Distance of the station from plank walls surrounding boys' closets, 51 feet. Station is marked by a red granite post 3 feet long, 6 by 6 inches on top, marked U. S. C. & G. S. 1902, and set so as to project about 3 inches above the ground. The tip of the ventilator (wood) on Mr. M. Brame's barn bears 9° 23′.3 west of true south.

Plainview, Hale County.—The station is in the southwest corner of the court-house square, 91.8 feet from the southwest corner of the court-house, 37.2 feet from the south fence, 71.4 feet from the west fence, and 14.3 feet north of the south end of a meridian line 259.9 feet long. The south end is marked by a sandstone about 5 by 10 by 22 inches, showing about 2 inches above ground. The north end is marked by a sandstone about 5 by 6 by 24 inches showing about 2 inches above ground and lettered U. S. C. & G. S. 1902. From the magnetic station the middle chimney on S. S. Rhea's house bears 14° 45′.0 east of true south.

Plemons, Hutchinson County.—The station is near the southeast corner of the court-house square, 210.2 feet from the southeast corner of the court-house. It is marked by a rough sandstone about 16 by 18 inches on top and 8 inches thick, buried a little below the surface of the ground. A drill hole marks the exact point and also the south end of a meridian line 288.2 feet long. The north end is marked by a sandstone about 8 by 18 inches on top and 12 inches thick, projecting about 2 inches above ground, set on the north line of the court-house square. The mark used was the chimney on J. A. Whittenberg's house and bears 0° 40′.2 west of true north. The southeast edge of the jail bears 22° 01′.2 east of true north.

Quanah, Hardeman County.—The station is near the northwest corner of the court-house square, 47.8 feet from the north fence and 51.7 feet from the west fence. It is marked by a limestone rock 8½ by 17 by 24 inches, set flush with the ground. The mark used was the spire of the Christian Church and bears 15° 04′.0 west of true south. The Methodist Episcopal Church spire bears 73° 37′.0 west of true north and the Baptist Church spire bears 58° 09′.0 east of true south.

San Antonio, Bexar County.—The station is on J. M. Vance's ranch near the site where the variation observatory stood. It is about 25 yards from the northeast corner of the absolute house and 12½ yards from the center of the foundation of the west variation pier, the precise point being marked by a stake. The mark used was the tip of spire of church in San Antonio about 4 to 5 miles distant, and bears 35° 46′.8 east of true south.

San Marcos, Hays County.—The station is located near the northeast corner of the public school grounds, 15.1 feet from the line of the north fence, and 25.3 feet from that of the east fence. There are no fences, but rows of cedar posts mark the line. The station is marked by a rather coarse block

Descriptions of Stations—Continued.

TEXAS—Continued.

of limestone, 12 by 12 inches on top and 20 inches long, set into the ground so as to project about 4 inches. The spire of the Methodist Church bears 23° 59′.6 west of true south.

Silverton, Briscoe County.—The station is near the southwest corner of the court-house grounds, 83.8 feet from the south fence, 54.3 feet from the west fence, and 50.3 feet from the southwest corner of the court-house. It is marked by a small peg. The mark used was the east chimney on T. A. Northcut's house and bears 4° 03′.7 west of true south. The Methodist Episcopal Church spire bears 83° 21′.5 west of true south. The Presbyterian Church cupola bears 29° 57′.7 west of true north.

Stratford, Sherman County.—The magnetic station is near the southeast corner of the court-house square, 148.5 feet from the southeast corner of the court-house. It is marked by a sandstone 9½ by 10½ by 24 inches, set so as to project about 4 inches above ground, and lettered U. S. C. & G. S. 1902. It is the south end of a meridian line, about 324 feet long, the north end of which is marked by a similar stone.

Sulphur Springs, Hopkins County.—The station is located near the west side of the large open lot surrounding what is known as East College, a public school building in the eastern part of town, on College street. The station is in line with west wall of the schoolhouse and 108.8 feet from its northwest corner. Distance of station from the nearest street (west side) is 80 to 100 feet. There are no fences. A large post oak tree standing in line with the west wall of the schoolhouse is 19.4 feet north of the station. The station is marked by a limestone rock 6 by 8 by 20 inches. The rock is lettered U. S. C. & G. S. 1902 on top and is set flush with the ground. The spire of the county court-house bears 87° 07′.3 west of true south. The spire of the First Baptist Church bears 76° 55′.2 west of true south.

Tascosa, Oldham County.—The magnetic station is in the court-house square, 25.3 feet from the south fence and 30.3 feet from the east fence. A meridian line 255.2 feet long was established, and marked with two stones having a drill hole in the center of the top. The south stone is 2 inches east of the magnetic station, and is roughly 6 inches square. The north stone is about 1 foot from the north fence, and is roughly 4½ by 6½ inches on top. The mark used was the schoolhouse cupola and bears 21° 11′.8 east of true north. The west gable of J. H. McGee's house bears 80° 17′.8 east of true north.

Texline, Dallam County.—The station is outside the court-house inclosure, near the southeast corner. It is 82.4 feet from the fence, and in line with the southeast side of the court-house. It is marked by a buggy spoke driven into the ground. The south gable of W. J. Tod's ranch house bears 14° 36′.8 west of true north. The southeast edge of the jail bears 11° 28′.1 east of true north.

Trinity, Trinity County.—The station is located near the northwest corner of the public school grounds 22.1 feet from the north fence and 44.6 feet from the west fence. The distance of the station from the nearest corner of the schoolhouse is about 111 feet. The station is marked by a block of limestone, 7 by 9 by 32 inches, sunk flush with the ground and marked U. S. C. & G. S. 1902. A drill hole in the center of the rock marks the exact spot. The top of the spire (not the rod) on the Methodist Church was used as mark, and bears 22° 49′.4 east of true north. The north rod on Mr. Parks' dwelling house bears 89° 33′.4 east of true north. Both marks are about two blocks distant from the station.

Tulia, Swisher County.—The station is near the southeast corner of the court-house square, about 25 feet from the east and south sides (square not fenced). It is marked by a limestone, about 4 by 10 by 36 inches, showing about 8 inches above ground and lettered U. S. C. & G. S. 1902. This is the south end of a meridian line about 275 feet long, the north end of which is marked by a similar stone (not lettered) set about flush with the ground. The mark used was the north flue on Mrs. Caldwell's house, and bears 0° 30′.6 west of true south.

Waco, McLennan County.—The station is located on the grounds of the Fifth Ward public school in East Waco. The station is near the north corner of the grounds, 35.5 feet from the northeast fence and 60.3 feet from the northwest fence, and about 114 feet from the nearest corner of the school building. The station is marked by a limestone post, 36 by 6 by 8 inches, set nearly flush with the ground and marked on the top U. S. C. & G. S. 1902. The spire on the chapel of the negro college, about 3 blocks to the east, was used as mark, and bears 78° 17′.4 east of true north. The spire of the old cotton mill bears 69° 24′.5 east of true south.

Descriptions of Stations—Continued.

TEXAS—Continued.

Waxahachie, Ellis County.—The station is located about 50 feet from the north boundary of the new Trinity University grounds (not yet fenced). The station is exactly in line with the east wall of the north wing of the main university building, and the distance from the northwest corner is 247.2 feet. The station is marked by a limestone rock, about 20 inches long and 8 by 10 inches at the top, set exactly flush with the ground and marked U. S. C. & G. S. 1902. A similar stone, somewhat smaller and unmarked, except with a drill hole in the center, marks the south end of a meridian line 342 feet long, of which the magnetic station is the north end. The flag pole of the court-house (about 1¼ miles distant) bears 11° 32′.9 east of true south.

Wellington, Collingsworth County.—The station is near the center of the street at the intersection of the first street west and the second street south of the court-house. It is marked by a limestone post, about 7 by 9 by 32 inches, set flush with the ground and lettered U. S. C. & G. S. 1902. This is the south end of a meridian line 728.2 feet long; the north end is similarly marked, except that the stone is not lettered. The mark used was the north gable of W. A. Hunter's house, and bears 1° 52′.0 east of true south. The northwest edge of the court-house bears 11° 27′.7 east of true north.

VIRGINIA.

Bland, Bland County.—The station is in the south corner of the court-house yard, being 116.7 feet south of the south corner of the court-house building, and 20 and 42 feet respectively from the southeast and southwest fence lines. It is marked by a stone 30 inches long, projecting a few inches above ground. The schoolhouse spire bears 27° 02′.8 west of true north. The spire of the Lutheran Church bears 79° 50′.4 east of true north. The spire of the Methodist Church bears 15° 37′.8 east of true south.

Bowling Green, Caroline County.—The station is in the open lot west of the Lawn Hotel, being 212.8 feet west of the northwest corner of the ell of the hotel. The station is marked by a piece of terra-cotta pipe, 3 feet long and 6 inches in diameter, projecting 3 inches above ground. The ball on the spire of the seminary bears 27° 25′.8 west of true south. The spire of Calvert Church bears 1° 29′.8 west of true south.

Clintwood, Dickenson County.—The station is in the court-house yard, being 93 feet from the northernmost point of the Childress House, 96.3 feet from the easternmost point of the court-house, and 59.7 feet from the southernmost point of the Helton House. The station is marked by a stone 2 feet long, 5 inches square on top, which is almost flush with the ground. The spire on the Methodist Episcopal Church bears 66° 00′.3 east of true north.

Hanover, Hanover County.—The station is in the field north of the court-house grounds, being 216¾ feet a little east of north from the boundary stone at the northeast corner of the court-house grounds. The station is marked by a wooden post 30 inches long and 6 inches in diameter, projecting 3 inches above ground. The northeast corner of the jail bears 18° 10′.1 east of true south. The Episcopal Church spire bears 65° 22′.1 west of true north.

Jonesville, Lee County.—The station is east of the southeast corner of the public school building, in the school yard, being 31.8 feet from the south fence and 51.9 feet from the east fence. The station is marked by a stone 2½ feet long and 6 by 8 inches at the top, which projects 3 inches above the surface. The court-house spire bears 49° 56′.9 east of true south. The spire of the Baptist Church bears 35° 00′.6 west of true south. The spire of the Presbyterian Church bears 41° 21′.1 west of true south. The spire of the Methodist Church bears 87° 36′.4 east of true south.

Lebanon, Russell County.—The station is in the yard of the Old Dominion College, being somewhat north of the college building, 19 feet east of the middle of the walk leading from the main road to the college building, 28.7 feet northwest of a maple tree, and 44.4 feet south of the north line of the college grounds. The station is marked by a wooden stub, flush with the ground. The court-house spire bears 78° 24′.0 east of true north.

Pulaski, Pulaski County.—The station in the court-house yard established in June, 1902, was reoccupied. As this place is not well suited for magnetic observations a new station was located in the southeast corner of the spacious lawn around the Maple Shade Inn. This station is 221 feet from the southeast corner of the hotel, 161 feet 2 inches from the east fence, and 86 feet 5 inches from the

Descriptions of Stations—Continued.

VIRGINIA—Continued.

south fence. It is marked by a stone post 6 inches square set with its top nearly flush with the ground. The mark used was the north spire on a house which bears 57° 31′.7 west of true south. A church spire bears 77° 19′.5 west of true south. The southwest corner of the hotel bears 53° 46′.0 west of true north.

Shack Mills, Buchanan County.—The station is in the yard south of and in front of the house of Mr. B. Ratliff, being 37.5 feet from the west fence line, 28.8 feet from the east fence line, 29.1 feet from the south fence line, and 84.2 feet from the southeast corner of the Ratliff house. The station is marked by a stone 6 by 12 by 16 inches, sunk nearly flush with the ground. The southeast corner of the Ratliff house bears 15° 48′.4 west of true north.

Spottsylvania, Spottsylvania County.—The station is in the orchard west of Historic Hotel, being 232 feet a little north of west from the inner corner of hotel building. The station is marked by a cedar post 24 inches long and 5 inches in diameter, sunk nearly flush with the ground. The inner corner of the Historic Hotel bears 83° 54′.7 east of true south. The western corner of Harris and Crismond's store (the post-office) bears 61° 15′.8 east of true north. The east chimney of R. M. Waller's house bears 52° 29′.2 west of true north.

Wise, Wise County.—The station is in the public school yard, southwest of the school building, being 74.3 feet from the southeast fence line, 78.6 feet from the west corner of the school building, and 77.7 feet from the south corner of the same building. It is marked by a stone 2 feet long and 6 inches square at the top, which projects 4 inches above ground. The spire on W. H. Roberts's house bears 69° 59′.4 west of true north. The spire of the court-house bears 53° 44′.4 west of true north.

Wytheville, Wythe County.—In 1898 a meridian line was established at Wytheville and magnetic observations were made over the south monument, a white limestone on a hill back of Boyd's Hotel. The north end of the line is near the railroad, opposite the Mountain View Hotel, and is marked by a blue limestone. The station of 1902 is 54.2 feet from the south monument in line to the lightning rod on J. C. Allison's house, which bears 33° 02′ east of true north.

WASHINGTON.

Seattle, King County.—On account of the stringing of electric wires over it, the station of 1900 is no longer suited for magnetic observations. A new station was therefore established on the grounds of the University of Washington, about 600 feet north of the Administration Building, about the same distance east of the 1900 station, 315 feet from the southwest corner of the gymnasium, and 20 feet west of the path between the Administration and Gymnasium buildings. The station is marked by a fir stub, 20 by 4 by 4 inches, projecting 3 inches above ground. The highest spire of the Administration Building bears 28° 29′.1 west of true south. The northwest corner of the ladies' dormitory bears 39° 49′.9 east of true south. The southwest corner of the men's dormitory bears 50° 58′.4 east of true south.

WISCONSIN.

Milwaukee, Milwaukee County.—The station of 1888, near the North Point light-house, could not be reoccupied because of recent improvements to the light-house grounds. The new station is 18 feet 8 inches from the old station, in the direction of the azimuth line to the tower of the waterworks. The new station is located as follows: It is in Lake Park, back of North Point light-house, 76.5 feet from the northwest corner of the light keeper's tool house, and 74.25 feet from the stone marking the northwest corner of the light keeper's grounds. The station is marked by a brass disk 4 inches square and ⅛ inch thick, nailed to the top of a wooden stake, the whole having been sunk 2 inches below the grass sod. The city waterworks tower bears 44° 01′.0 west of true south. The flag pole of the street-car pavilion bears 0° 11′.5 east of true north. The small tower on Mr. W. C. Middleton's residence bears 21° 06′.8 west of true north.

CANADA.

Fort William, Ontario.—Station I (Mission Grounds). The station is in the field back of the main building and the Church of the Jesuit Indian Mission. The station was marked by a brass screw in the end of a wooden stake. The middle of the ball at the bottom of the cross on the Mission Church bears 64° 57′.6 west of true north.

Descriptions of Stations—Concluded.

CANADA—Continued.

Station II (near an old fort). The station is in the field west of the large brick schoolhouse, and is probably about 60 rods west of the site of the old fort. It is 140 paces from and about 30° west of magnetic north from the northwest corner of the schoolhouse. A water tank about 80 rods distant bears 39° 26′.4 east of true south.

Union, British Columbia.—The station is on an alluvial spit covered with grass and bushes, about 75 feet west of high-water mark. The station is about 650 feet nearly north of the Union Mine Company's coke ovens and about the same distance from the railroad on the south and west. The chimney at the coke ovens bears 19° 49′.2 west of true south. A church spire in Comox bears 18° 51′.8 west of true north.

Victoria, British Columbia.—The station is on the southeastern edge of the city, about 500 feet in a southwesterly direction from the flag pole in Doctor Millin's yard and 12 feet from the edge of the bluff overlooking the beach, between Holland Point and Finlayson Point. The station is marked by a 2 by 4 fir stub, set flush with the ground. The flag pole in Doctor Millin's yard bears 65° 03′.3 east of true north. Race Rocks Lighthouse bears 43° 18′.8 west of true south.

CUBA.

Baracoa.—The station is on the point of land at the east side of the entrance to Baracoa Harbor. It is in the field between the old fort and the old barracks, 56 paces from the southwest corner of the barracks, 61 paces from the northwest corner of the barracks, and 100 paces from the beach of the Atlantic Ocean immediately north of the station. The wall of the fort about 300 feet distant bears 69° 49′.5 west of true south.

Gibara.—The station is on the hill back of town, and is in the middle line of North Lopez street extended, and 32.5 feet west of the crumbled-down wall connecting the blockhouses on the hill. The middle of the round projection of the first blockhouse northeast of station bears 7° 13′.2 east of true north.

Habana.—Two stations were occupied at Habana. The first station was the absolute observing house of the magnetic observatory Colege de Belen. The range or mark used was a distant church which bears 80° 10′.5 west of true south. The second station is near a villa belonging to the college and about 3 kilometers south of the college. The station is on the highest part of the hill back of the villa, and is marked by a cross cut on a rock which projects but slightly above ground. The tower of Colege de Belen bears 0° 06′.9 west of true north. The center of Morro Castle light-house bears 4° 30′.5 west of true north.

Santiago de Cuba.—The station is about 3 yards from the west edge of the highest point of a prominent limestone hill immediately south of the custom-house. The cross on San Francisco Church bears 24° 34′.4 east of true north.

SANTO DOMINGO.

Santo Domingo City.—The station is about ten minutes walk to the right from the landing, and is on the top of a small hill. A flag pole about 1 mile distant bears 16° 09′.6 east of true south.

San Pedro de Macoris.—The station is about ten minutes' walk from the landing, and is along the shore to the right. It is in a large field east of the Hospicio San Antonio, about 40 to 50 paces from the road and near the stump of a cocoanut tree. The spire of a small church about 80 rods distant bears 18° 10′.3 west of true north.

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APPENDIX No. 6.

REPORT 1903.

CHANNEL AND HARBOR SWEEP.

Description by D. B. WAINWRIGHT,
Assistant, Coast and Geodetic Survey.

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CHANNEL AND HARBOR SWEEP.

Description by D. B. WAINWRIGHT, *Assistant, Coast and Geodetic Survey.*

This apparatus was designed in the Coast and Geodetic Survey to discover with certainty all those dangerous obstructions to navigation in channels and anchorages which are liable on account of their peculiar form and limited area to escape detection even in the most elaborate hydrographic survey.

The apparatus was first used on the Coast and Geodetic Survey steamer *Blake* in the fall of 1902 in searching for the Brooklyn Rock in New Bedford Harbor, Massachusetts, a pinnacle rock on which the U. S. cruiser *Brooklyn* had struck. The result of this work and the experience with the apparatus on other vessels of the Survey and in various localities shows that it satisfies all the conditions required of it. The following description of the apparatus will enable anyone familiar with hydrographic work to install and use it without difficulty.

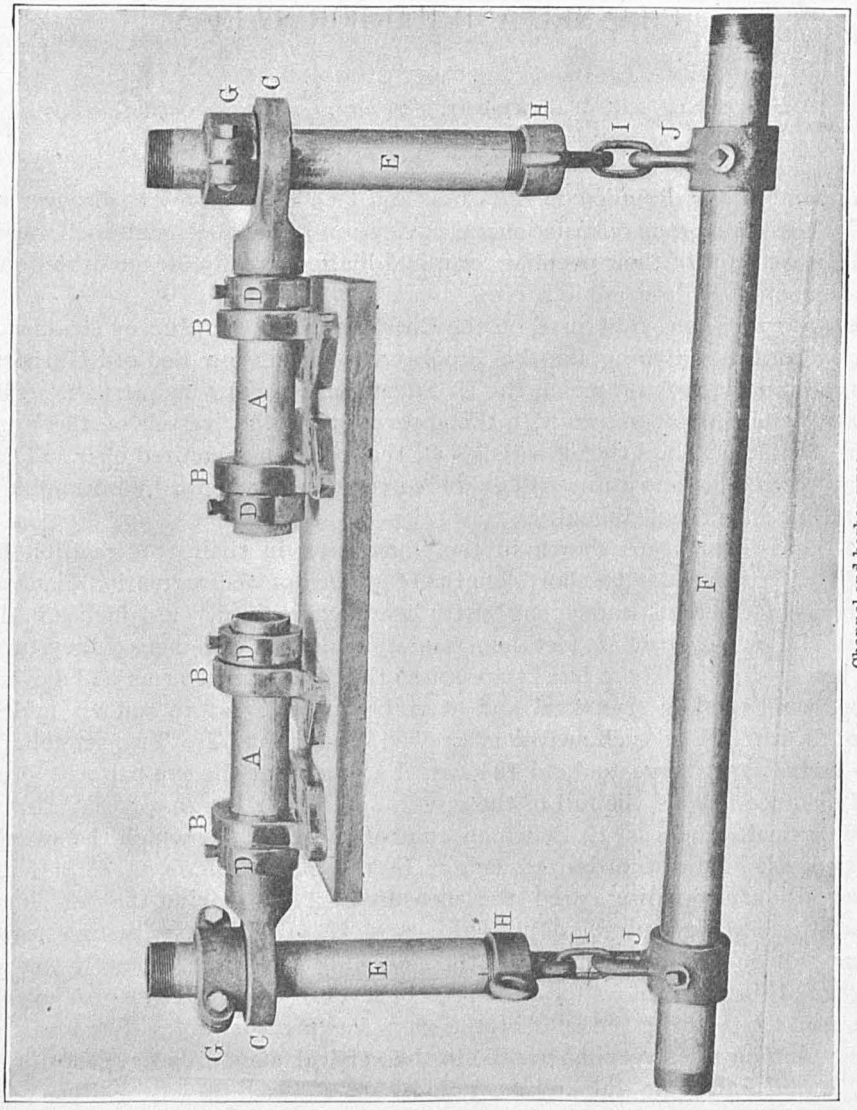
The brass fittings are shown in the illustration in their true relation by being attached for this purpose to short lengths of piping of the regulation diameter. All the piping is of the kind known as "extra heavy galvanized," 2½ inches in diameter. A, A, are the swivel arms, 4 feet long and threaded at one end. They turn in the journal blocks B, B. These blocks are set so that the swivel arms will be horizontal when the vessel is on an even keel and at right angles to a fore and aft midship line. To the outboard end of each swivel is screwed an eye cap, C. Two set collars, D, D, on each swivel arm serve to hold the swivel arm so that the eye cap will project the required distance beyond the rail of the vessel.

The vertical standards, E, E, which control the depth at which the sweeping bar F is carried, are held at the desired height by the clamp collars G, G. If the sweep is used at ordinary sounding speed, the measurement for placing the set rings should start from the lower eye of the double link caps, H, H, the latter being screwed on to the lower ends of the standards, since the sweeping bar will rise nearly to their level when dragged through the water at a speed of several knots. The upper eyes of these caps are used for securing the ends of the guys leading forward. The lower eyes are used for attaching the sweeping bar, F, to the vertical standards by means of breaking links, I, I, and the single link collars, J, J.

On the *Blake* there was fitted on the taffrail of the vessel a strongback, 8 inches by 8 inches, of spruce timber, 28 feet long, shored up to relieve the rail from some of the weight.

To raise and lower the apparatus a whip was seized to the lower end of each vertical standard and passed through a single block seized or bolted to the strongback. The distance between the blocks should be the same as that between the eye caps on the ends of the swivel arms.

Two guys are led forward from each standard—one of five-eighths inch wire rope is attached to the upper eye of the double-link cap, and the other, of 2-inch manila, used to prevent flexure, is seized on at a point midway between the deck and the lower end of the standard.



The link collars on the sweeping bar are clamped equally distant from its ends and separated by a distance equal to that separating the starboard and port eye caps.

To prevent the possibility of the parts of the breaking links separating, the pins are headed over.

To commence the work of sweeping, the frame is lowered by means of the whips. As this progresses the standards gradually slide down through the eyes of the swivel

arms until brought up by the clamp collars, which then support the sweeping bar at the required depth. The forward guys are then hauled in until the standards are vertical and made fast; the wire guys to the forward bitts and the rope guys to cleats amidship. The whips are also made fast to the after bitts.

To provide for excessive strains on the standards in the case of striking an obstruction, a 1½-inch manila rope is bent onto each wire guy outboard near the bow and carried to the bitts and made fast. The forward ends of the wire guys are then slacked off a fathom or more.

To prevent excessive vibrations of the standards, and also to prevent any tendency of their lower ends swinging toward the sides of the vessel and deforming the shape of the frame, a diagonal guy was attached to the top of each standard, carried across the deck, and made fast to a cleat near the rail.

PIPING FOR APPARATUS.

Two pieces 2½-inch extra heavy galvanized iron pipe, cut to 4-foot lengths, one end of each threaded.

Twelve pieces of same kind of pipe cut to 16-foot lengths, both ends threaded (3 or more spare pieces included).

Twelve 2½-inch couplings (4 or more spare couplings included).

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APPENDIX No. 7.

REPORT 1903.

GEOGRAPHIC NAMES IN ALASKA.

Compiled by G. R. PUTNAM,
Assistant, Coast and Geodetic Survey.

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GEOGRAPHIC NAMES IN ALASKA.

NATIVE NAMES FOR LOCALITIES ON ST. GEORGE ISLAND, BERING SEA.

Compiled by G. R. PUTNAM, *Assistant, Coast and Geodetic Survey.*

The accompanying names for localities on this island were obtained from Peter Rosansof, a native and long-time resident of the Pribilof Islands, who is fairly familiar with the English as well as the Russian and Aleut languages. In most cases the names were verified by other natives on St. George Island, though in a number of instances this developed slight differences of pronunciation. Some Russian names are also included, for the most part those that are given on the maps. In some of the native names Russian and Aleut words are combined, which is accounted for by the fact that these islands were under Russian control for nearly a century. The words are spelled phonetically to represent the pronunciation heard as nearly as possible. Webster's Dictionary is followed in the marking of the vowels, as in the following examples: fāte, ăm, făther, ēve, ĕnd, īce, ĭll, ōld, ŏdd, ūse. The accent indicates the emphasized syllable. In some of the Aleutian words there are two syllables with about equal emphasis. After each word is indicated, whether it is of Russian or Aleut origin, its general meaning, the locality to which the word applies, and the reason for its application, if any. An interesting feature of these place names is that in almost every case they have some direct signification, having reference to the natural location, its connection with the pursuits of the natives, with their traditions, or with the animals frequenting the islands. St. George, in common with the other islands of the Pribilof group, was found uninhabited at the time of its discovery by the Russians, in 1786. Natives of the Aleutian Islands were brought here from time to time to work in the sealing business, and there are at present about 200 living on St. Paul and 100 on St. George. During the Russian occupation they became largely Russianized in customs and civilization. At present they are taught English in the schools, and the Russian language is seldom used except in their church services. Among themselves they speak Aleut almost exclusively.

Ăckän′-ūng′tä (Aleut, end point), west point of island.

Agĭs′äm-kŏvĕrūshkä′ (Aleut-Russian, watch place hill; the Aleuts use the Russian word koverushka, meaning loaf, for hill), large round topped hill back of Staraya Artil rookery.

Ägĭs′-chŭckä′ (Aleut, hollow near the watch place), depression on bluff line just east of High Bluff.

Ägĭs′ōgh (Aleut, the watch place), bluff overlooking Zapadni rookery.

Älgä-änätōrōl′ōg (Aleut, signifying a place where the seals do not go up) North rookery; the Aleut name being due to the ridge near the center of this rookery where there are no seals.

Äl′gän-ūdä (Aleut, seal bay), the small bight immediately in front of Zapadni rookery; seals may be seen in the water almost always.

Alōgh′-kōverūshkä′ (Aleut-Russian, middle hill), the rocky summit south of Gull Hill, the northern of the two hills called "Sealion Hills" on the maps.

Änägchŭcknūn′a (Aleut, difficult trail), bluff extending to watch house East rookery, and overlooking eastern end of rookery; so called because it is very difficult to ascend this bluff.

Än′ägchŭcknūn′am-än′yi (Aleut, lake near Anagchucknuna), the larger of the two little lakes on East rookery.

Än′ägchŭcknūn′ŭm-älgärā′lōgrāy (Aleut, the rookery at Anagchucknunum), East rookery, Anagchucknunum being Aleut name of bluff along eastern part of this rookery.

Ănăn′ŏng-ūtc′ha (Aleut, Ananong's shelf), prominent isolated bluff northeast of Fox Castle, rising sharply from the depression surrounding it on the land side; so called because some native of this name here gathered eggs; in former times custom among the natives set apart certain localities for the use of certain individuals in hunting birds, birds' eggs, foxes, etc., and the rights to these places were always respected by the other natives.

Än′ĭm-äl′gerā (Aleut, seal lake), lake on ridge south of Little East rookery; the seals formerly extended as far back as this lake (more than one-third of a mile from the shore) according to native tradition.

Ănŭckäsēl′ogh (Aleut) lake immediately north of Ulakiya.

Ätchō′-kōverūshkä′ (Aleut-Russian, lower hill), the low round topped hill between the village and Tolstoi Point; "Gull Hill" on the maps.

Chä′ginä (Aleut, crack) cleft in bluff between Dalnoi Point and Suskaralogh.

Chŭnŭng′ŭm-al′gerā (Aleut, seal hollow), rocky stretch along bank above shore, between East and Little East rookeries.

Dăl′noi Meess (Russian, far point), west point of island.

Drăvnoi′ (Russian, wooded), the bight southwest of Garden Cove, so called because of the amount of drift-wood found on the beach.

Ēgănŭt′a (Aleut, high bluff), the highest bluff on the island, 1012 feet in elevation at the highest point, and plainly visible from St. Paul Island on a clear day; marked High Bluff on Stanley-Brown's and Elliott's maps.

Ēgănŭt′a-kōverūshka′ (Aleut-Russian, hill near Eganuta), hill south of High Bluff, "Maynard's Hill", on the maps.

Ēgĭthrōtōgh (Aleut, water-fall), the cascade (dry most of summer) at southeast point of island, marked "Cascade" on both Stanley-Brown's and Elliott's maps.

Ēsŏ′gĕm-ūngä′ (Aleut, hair seal trail), talus slide descending to the shore line from the depression east of Fox Castle. Hair seals are found on the rocks west of the base of this slide, and natives can pass up and down here when hunting them. This is the only point on the western part of the island where it appears possible to reach the shore with safety from the plateau above.

Găvärūsh′ka (Russian, red-legged gull), largest lake near the Zapadni trail, so called from the large number of gulls frequenting it.

Hŏl′ŏstiăk-rāl′ōg (Russian-Aleut, holostiak or bachelor rookery), low valley at west end of North rookery, now occupied by breeding seals, but formerly only frequented by the holostiaka according to native tradition.

Hŏl′ŏstiăk-rālōm-kĭyä′ (Russian-Aleut, ridge where holostiaks are taken), ridge at west end of North rookery, just west of terminal rock (painted white). Holostiaks or bachelor seals were formerly driven from this ridge.

Ĭkoum′-ūngä (Aleut, fox trail), slight depression on edge of bluffs just east of small stream, about one-third of way from Red Bluffs to Cascade; so called because the foxes here have a trail going down some distance over the edge of the bluff, where they go to get eggs and birds.

Ĭkoum′-ūngä′-kōberūshkä′ (Aleut-Russian, hill near Ikoum-unga), round-topped hill about midway between Ulakiya and Red Bluffs.

Ĭt′kĭdägū′lä (Aleut, dropping), low point northeast of Garden Cove, half way to Sea-lion Point, so called because in driving sea-lions they would drop off the low bluff here down to the beach, and natives would hug close to the bank to allow them to pass over their heads. Two natives have been killed here by being crushed by sea-lions.

Kägä'lōgh (Aleut, stern of ship), east point of island.

Kăm'ĭnä (Russian, rocky place), rocky stretch along bank above shore between East and Little East rookeries.

Kä'wä-när'ä (Aleut, sea-lions' bidarra or boat), prominent high ledge projecting from shore line about middle of East rookery, occupied by numerous sea-lions.

Kĭmĭlōgchĭl'ogh (Aleut, living place in the autumn), elevation on bluff line on south shore, at point marked "Red Bluffs" on former maps; so called because there was formerly a barrabara or native house here, where some natives lived during the season for fox-trapping.

Kō'dōgh (Aleut, gulch), the deep ravine extending up from Garden Cove.

Kōlōghō (Aleut, choked or full), the bight southwest of Garden Cove, so called because of the amount of drift-wood found on the beach.

Kōrĭŭm-än'yi (Aleut, red-legged gull lake), largest lake near the Zapadni trail, so called from large number of gulls frequenting it.

Kōs'ĕrä-än'äg (Aleut, upper lake), lake on the ridge immediately southeast of the village; so called because it is above the marshy hollow back of the village, where there was formerly a lake.

Krâd'ĭgy (Aleut), prominent mass of rocks near west end of island, known as "Fox Castle".

Krâg'lūcht'ĕn (Aleut, squealing), rocky point slightly elevated at west end of Little East rookery, so called from the noise made by the pup seals on the rocks beneath.

Krâg'lūcht'en-äng'ten-älgärāl'ōgrāy' (Aleut, the rookery at Kragluchten), Little East rookery, Kragluchten being Aleut name of the point at west end of this rookery.

Krä'känkrĭng'a (Aleut, facing the east), the small bay known as Garden Cove.

My'ăk (Aleut, pile of rocks or landmark), remarkable crag 471 feet in elevation, standing in front of a bluff (Ananongutcha) and visible along almost the entire north shore of the island. The same word (Myak) is applied by the natives to the numerous cairns or piles of rocks erected by them over the island, which serve as guide posts to them when caught out in thick and foggy weather, as frequently happens.

Nārō'am-än'yi (Aleut, Atka natives' lake), lake north of Zapadni, so called from Atka natives having lived in the vicinity.

Nārō'am-ūngä' (Aleut, Atka natives' trail), the flat bluff just east of high ridge at Rush Point. The tradition is that natives of Atka who had been taken to St. Paul Island by the Russians, left St. Paul in their bidarkas, intending to return to Atka. They landed on the beach below this point, not knowing where they were, and hauled their bidarkas up on the bluff and spent the night on top. They then went to Zapadni where they lived for a time, and were later taken to Atka by the Russians. This place does not appear to offer a safe place of descent at present.

Nīyăn'-kīyä' (Aleut, ridge), the prominent ridge on bluff line at southeast point of island; "Water Fall Pt." on Elliott's map.

Nūmä'den-älgärāl'ōgrāy' (Aleut, southwesterly rookery), Zapadni Rookery.

Propäs'tcky (Russian, perished), low grassy point half way between Tolstoi Point and Garden Cove, so called because here dead sea-lions have been found on shore. Called Sea-lion Point on Stanley-Brown's and Elliott's maps.

Prōpäs'tchy-kōverūshkä' (Russian, hill near Propastchy).

Sämlälōch-kīyä' (Aleut, ridge where eggs are gathered), the great ridge extending in an oblique direction across the west end of the island, between Fox Castle and High Bluff; the bluffs at each end of this ridge are covered with myriads of birds, as are all the shore bluffs of the island.

Sämlä'lōgh-chŭckä' (Aleut, hollow where eggs are gathered), remarkable depression or low shelf on the bluff line between Ananong-utcha and the High Bluff; the natives let themselves down with ropes over the edge of this bluff to gather birds' eggs.

Stär'āya Artil' (Russian, old camp), Staraya Artil rookery.

Stē'păn-ūtch'ä (Aleut, Stepan's shelf), high ridge on bluff line south of Tolstoi point, so called because here Stepan, a native, gathered eggs, this ridge being reserved for him.

Sŭskārā'lōgh (Aleut, place where they get whales), first point east of Dalnoi Point, on northwest shore, visible from village; so called because whales are said to have been cut up by the natives on the shore below this bluff, and carried away in bidarkas.

Täkäm'gĭä (Aleut), northeast point of North rookery.

Tăn̆ŏgtŭck'ăn-älgärāl'ōgrāy (Aleut, old village rookery), Staraya Artil rookery.

Tănŏgtŭck'ăn-ăn'yi (Aleut, old village lake), small lake near Staraya Artil rookery and but a short distance west of the old Russian village whose ruins may still be seen.

Tĕnrā'rŭm-ăny'i (Aleut, bear lake), larger lake near Zapadni trail and south of west end of North rookery; a polar bear was once driven here by the natives, and became mired in the bog which surrounds the lake.

Tōl'stoi (Russian, thick), east point of island.

Tŏn'ka-meess (Russian), narrow point at west end of East rookery.

Tūg'ŭnā'rarō'lōgh (Aleut, dead sea-lion place), low grassy point half way between Tolstoi Point and Garden Cove, so called because here dead sea-lions have been found on the shore. Called Sea-lion Point on Stanley-Brown's and Elliott's maps.

Tūg'ŭnārarō'lōgh-kōverŭshkă' (Aleut-Russian, hill near Tugunararologh), the southern of the two Sealion Hills.

Ūl'ăkīyă' (Aleut, high house), the principal hill on the island, southwest from the village; the old native houses had rounded roofs similar to the shape of this hill. Spelled Oolakaiya on Stanley-Brown's map.

Ūl'ărăkărthă' (Aleut, point opposite house), point on shore line near rock No. 12, East rookery; the watch house formerly stood back of this, near a little lake.

Ūmăn'ăgū'lan-ăn'yi (Aleut, lake near Umanagula), large lake, surrounded by many smaller ones, northeast of Red Bluffs.

Ūmăn'ăngūl'a (Aleut, cannot be seen), the precipitous bluffs extending along the south shore from Cascade Point to Red Bluffs; so called because they are not visible from the village or from Zapadni.

Yăg'ăn-ūdă' (Aleut, wooded bay), on southwest shore just east of Dalnoi Point; so called because there is drift-wood on the beach.

Yăr'ăm-ănătū'ŭlūg (Aleut, narrow point), rocky point at west end of East rookery.

Zăp'ădni (Russian, westerly), Zapadni Rookery.

Zăp'ădni (Russian, western), the open bay on southwest side of island.

ADDENDA.

MAGNETIC OBSERVATIONS. OHIO. J. A. FLEMING. C. J. HOUSTON.

Stations occupied.

Batavia.	Hillsboro.	Troy.
Centerville.	Jackson.	Urbana.
Cincinnati Observatory.	Lebanon.	Waverly.
Cincinnati University.	London.	West Union.
Eaton.	Oxford.	Wilberforce.
Georgetown.	Springfield.	Wilmington.
Hamilton.		

The extension of the magnetic survey in Ohio was assigned to C. J. Houston, Computer, and he reported to J. A. Fleming, Aid, for instructions, on April 20. Magnetic observations were made at Jackson, Waverly, Hillsboro, Georgetown, West Union, Batavia, and at the Cincinnati Observatory by Mr. Houston, under Mr. Fleming's direction, and Mr. Houston then made observations at the remaining stations named above.

The work closed on June 30.

The report of this work was received on November 18, 1903, too late to insert it in its proper place.

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ALPHABETICAL INDEX.

(Exclusive of Appendices 3 to 7.)

[For table of contents see p. 5. Tabular index of field work on p. 27.]

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T.

U.

V.

W.

Y.

Z.

O

UNITED STATES

COAST AND GEODETIC SURVEY

SKETCH OF GENERAL PROGRESS

JUNE 30 1903

Eastern Sheet

Scale 5,000,000

Statute Miles

50 40 30 20 10 0 50 100 150 200

105° 100° 95° 90° 85° 80° 75° 70° 65°

50° 45° 40° 35° 30° 25°

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
RHODE ISLAND
CONNECTICUT
INDIAN TERRITORY

LAKE SUPERIOR
LAKE MICHIGAN
LAKE HURON
LAKE ERIE
LAKE ONTARIO

ATLANTIC OCEAN
GULF OF MEXICO

Bismarck, Fargo, Grand Forks, Duluth, Aberdeen, Watertown, St. Paul, St. Peters, Bellefourche, Deadwood, Pierre, Chamberlain, Sioux Falls, Yankton, Sioux City, Alliance, Columbus, Omaha, North Platte, Tulesburg, Lincoln, Des Moines, Davenport, Rock Island, Peoria, Hookuk, Quincy, Springfield, Atchison, Topeka, Kansas City, Colby, Scott, Dodge City, Wichita, Guthrie, Amarillo, Little Rock, Memphis, Helena, Texarkana, Greenville, Dallas, Fort Worth, Shreveport, Waco, Austin, Houston, Port Arthur, Galveston, San Antonio, Eagle Pass, Fort Lavaca, Rockport, Corpus Christi, Laredo, Vicksburg, Jackson, Natchez, Baton Rouge, NEW ORLEANS, Mobile, Pensacola, Tallahassee, Apalachicola, Key West, Tampa, Punta Gorda, Miami, Cape Canaveral, Nassau, Chicago, Milwaukee, Madison, Dubuque, Grand Rapids, Lansing, Saginaw, Detroit, Toledo, Cleveland, Fort Wayne, Logansport, Indianapolis, Terre Haute, Evansville, Cairo, Nashville, Louisville, Frankfort, Lexington, Cincinnati, Columbus, Zanesville, Wheeling, Pittsburg, Harrisburg, Williamsport, Erie, Buffalo, Rochester, Toronto, Ottawa, Montreal, Quebec, Ogdensburg, Albany, Syracuse, Utica, Boston, Springfield, Providence, Hartford, New Haven, New York, Poughkeepsie, Portland, Augusta, Bangor, St. John, Cape Sable, Cape Cod, Cape Hatteras, Raleigh, Newberne, Norfolk, Richmond, Petersburg, Lynchburg, Charleston, Washington, Baltimore, Philadelphia, Atlantic City, Wilmington, Columbia, Georgetown, Charleston, Augusta, Atlanta, Macon, Savannah, Montgomery, Birmingham, Brunswick, Fernandina, Jacksonville, St. Augustine, Key West

Axes of the Gulf Stream. Warmest Band

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

ANDRÉW B. GRAHAM PHOTO-LITHO WASHINGTON, D.C.


WASHINGTON
OREGON
CALIFORNIA
NEVADA
IDAHO
MONTANA
WYOMING
UTAH
COLORADO
ARIZONA
NEW MEXICO
NORTH DAKOTA
SOUTH DAKOTA
NEBRASKA
KANSAS
OKLAHOMA
INDIAN TER.
TEXAS
MINNESOTA
IOWA
MISSOURI
ARKANSAS
LOUISIANA
WISCONSIN
ILLINOIS
MISSISSIPPI
LAKE SUPERIOR
LOWER CALIFORNIA
PACIFIC OCEAN
GULF
Cape Flattery
Cape Mendocino
Pt. Conception
Guadalupe I.
Cerros I.
Seattle
Tacoma
Portland
Salem
Spokane
Boise
Helena
Great Falls
Salt Lake City
Ogden
Denver
Cheyenne
Santa Fe
Albuquerque
Bismarck
Pierre
St. Paul
Des Moines
Omaha
Lincoln
Topeka
Kansas City
Guthrie
Little Rock
Memphis
Dallas
Fort Worth
Austin
Galveston
Baton Rouge
New Orleans
Santa Barbara
Chihuahua
Guaymas
Phoenix
Tucson
Tombstone
El Paso
Laredo
Eagle Pass
Springfield
125°
120°
115°
110°
105°
100°
95°
90°
50°
45°
40°
35°
30°
25°

UNITED STATES
COAST AND GEODETIC SURVEY

SKETCH OF GENERAL PROGRESS

JUNE 30 1903

Western Sheet

Scale 5,000,000

Statute Miles

50 40 30 20 10 0 50 100 150 200

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

ANDREW B. GRAHAM, PHOTO-LITHO WASHINGTON D.C.

GENERAL PROGRESS SKETCH

ALASKA

June 30, 1903

Topography shown thus

Hydrography shown thus

Deep Sea Soundings ·····

Statute Miles

100 75 50 25 0 100 200 300 400 500

Nautical Miles

100 75 50 25 0 100 200 300 400 500

ARCTIC OCEAN
Wrangell I
Herald I
Point Barrow
Sea Horse Is
Icy Cape
Mackenzie River
Cape Lisburne
Point Hope
EASTERN SIBERIA
Kotzebue Sound
Choris Peninsula
Arctic Circle
Yukon River
Rampart City
Tanana
Dawson
East Cape
Cape Prof Wales
Teller
Port Clarence
BERING STRAIT
Plover Bay
Gulf of Anadir
Nome
Nulato
Mt McKinley
ALASKA
Golovnin Bay
Unalaklik
St Michaels
Norton Sound
Anvik
Valdez
St Lawrence I
Andreafski
Russian Mission
Kolmakof
Kenai
Yakutat
Yakutat Bay
Middleton I
Lituya Bay
Juneau
Sitka
Wrangell
Chapel
Port Simpson
Dixon Entrance
Fraser River
St Mathew I
Nunivak I
Hagmeister I
Bristol Bay
Alaska Peninsula
Afognak
Kadiak I
GULF OF ALASKA
Queen Charlotte Is
Victoria
Vancouver
Seattle
Tacoma
FUCA STR
Neeah Bay
Vancouver I
Cape Flattery
Columbia River
BERING SEA
St Paul I
Pribilof Is
St George I
Port Moller
Semidi Is
Chirikof I
Aamak I
Shumagin Is
Sannak I
ALEUTIAN ISLAND
Attu I
Akutan Pass
Unalaska
Unalaska I
Umnak
Kyska I
Amchitka I
Atka I
Adakh I
NORTH PACIFIC OCEAN

E. from Greenwich 180° 170° 160° 150° 140° 130° W from Greenwich

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GENERAL PROGRESS SKETCH

PHILIPPINE ISLANDS

Latitude determinations
Longitude " (telegraphic)
Azimuth "
Tidal observations
Magnetic declination observations
Triangulation
Topography
Hydrography

C. Bojeador
Aparri
Port Currimao
Pt.
Pt.
Pt.
Lingayen Gulf
Port Santo Tomas
Port Sual
Sta. Cruz
Iba
Subic
Manila
Mariveles
Atimonan
Balayan
Batangas
Boac
Calapan
Pasacao
Tabaco
Albay Gulf
Lagaspi
Gubat
San Bernardino Strait
Ramblon
Palanog
Maabate
Catbalogan
Calbayog
Halsey Hbr.
Capiz
PANAY
Cartagan
Ormoc
Dumaguete
Bohol
Loon
Surigao
Misamis
Iligan
Cagayan
Zamboanga
Jolo Archipelago
LUZON
MINDORO
SAMAR
LEYTE
CEBU
NEGROS
PARAGUA
JOLO SEA
MINDANAO
BORNEO

HAWAIIAN ISLANDS

(Hawaiian Government Surveys also shown.)

Triangulation
Topography
Hydrography
Deep Sea Sdgs.

Niihau
KAUAI
OAHU
Honolulu
Pearl Harbor
Kaunakakai
MOLOKAI
Kahului
LANAI
MAUI
Lahaina
Kahoolawe
HAWAII
Hilo

PORTO RICO

Primary triangulation
Secondary and tertiary triangulation
Topography
Hydrography

Desecheo I.
Mayaguez
Mona I.
Ponce
Guanica Bay
Cabo Rojo
Aguadilla Har.
Fajardo
Culebra I.
St. Thomas
Vieques I.

West of Greenwich
East of Greenwich

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