

46TH CONGRESS, }
3d Session. }

SENATE.

{ Ex. Doc.
No. 12.

REPORT OF THE SUPERINTENDENT

OF THE

U. S. COAST AND GEODETIC SURVEY

SHOWING

THE PROGRESS OF THE WORK

DURING THE

FISCAL YEAR ENDING WITH

JUNE, 1880.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1882.

TEXAS TECHNOLOGICAL
APR 7 1955
COLLEGE

P 237

JUN 11 1880

Smith's results show that at five the error in position was less than one second. At Tuna Valley the error was about four seconds; and at Genesee Valley somewhat less than two and a half seconds. At the two other stations occupied the error found was less than one second and a half.

Assistant Smith was aided in the field by Mr. F. H. Parsons.

The work was specially facilitated by the personal co-operation of Mr. C. M. Gere, a member of the Pennsylvania Commission. Having previously passed along the boundary, that gentleman preceded the party of Mr. Smith, and set up piers and floors at all the stations. The difficulties, delays, and expense thus avoided were very considerable. Mr. Gere, by reason of weather suitable for the astronomical work, was unable to keep more than one station ahead of the observer. Including the time needful in the transfer and adjustment of instruments at the nine stations, all the work was accomplished in forty-four days.

Geodetic operations in New Jersey.—In May, 1879, Prof. Edward A. Bowser readjusted the signals at Mount Rose, Pickles, Mount Olive, and Bald Hill, and then resumed the measurement of horizontal angles at Mount Horeb, where he had closed for the season at the end of October in the preceding year. By the transfer of a heliotrope from one to another of the outlying stations, the work at Horeb Station was successfully continued. Early in July a tripod was built at Mount Olive, and that station was occupied with the theodolite in the latter part of the month after the completion of angular measurements at Mount Horeb. At intervals in August and September reconnaissance was extended northward and two points of the Blue Mountain ridge were added to the scheme of triangulation. One of these (High Point) is near the northwestern corner of the State, and adjacent to the New York boundary line. In that quarter the scheme was perfected by the selection of a third point to the eastward and not far from the State boundary.

From Mount Horeb six primary signals were observed upon, and as many subsidiary points. At Mount Olive angular measurements were recorded on five outlying primary stations, and on six subsidiary objects. The statistics of the field work are:

Stations occupied	2
Angles measured	20
Number of observations	399

¶ The triangulation was closed for the season on the 19th of September, 1879.

Triangulation of the Delaware River below Philadelphia.—After the completion of the special survey of the Delaware at Philadelphia, of which mention was made in my last annual report, the triangulation of the river was extended below the city, and as far as Chester, by Assistant R. M. Bache. His party was employed in that service during the autumn of 1879.

In prosecuting this work along the Delaware, all the difficulties incident to the occupation of the banks by structures put up in recent years were encountered. Seven platform signals from forty to fifty feet high were found necessary to bring into view the points needful for defining shore lines the directions and relations of which have been sensibly changed in the march of improvement. One point only of the original triangulation of this part of the Delaware could be identified, and with that the work here under notice was only connected. In addition to a system of quadrilaterals restricted to points along the water lines, four stations were occupied at distances averaging a mile and a half from the banks. These positions will serve future uses in topographical surveying, and for such purposes the triangulation is ample, as will be seen by the following synopsis of statistics:

Stations occupied	23
Angles measured	125
Points determined	62
Number of observations	11,484

Pendulum observations.—The pendulum operations instituted for ascertaining vertical attraction near the Allegheny Mountains, and commenced in 1878 by Assistant C. S. Peirce at Allegheny Observatory, have been completed by occupying a station at Ebensburg in Cambria County, Pennsylvania, and a station at York in the same State. In careful determinations of the difference of longitude between Ebensburg and Allegheny, Assistant Peirce was aided by an observer who acted at the last-named place under the supervision of Prof. S. P. Langley, director of the Observatory.

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For the purposes of the pendulum experiments, time was telegraphed daily, and thus the observations made for time at Ebensburg were supplemented. The latitude of the station there was determined by observations with a sextant. At that station Mr. Peirce was aided by Messrs. Henry Farquhar and Marcus Baker. The first-named aid made the observations at York under the supervision of Assistant Peirce.

At both of the stations in Pennsylvania extensive series of observations were recorded for the purpose of studying the statical and dynamical flexure of variously modified pendulum supports, and the influence of these modifications upon the period of oscillation of the pendulum. The results will be given hereafter in a separate paper by Assistant Peirce. In the course of the season experiments were made by substituting for the ordinary knife edge of the pendulum small steel cylinders. This method, proposed in a previous report by Assistant Peirce, had been independently recommended by M. Yvon Villarceau, but the trials made by Mr. Peirce proved that the friction was increased by that method of swinging the pendulum.

The measurement of the acceleration of gravity made by Assistant Peirce at Paris, France, revealed a disagreement with the measures obtained by Borda and Biot. For the investigation of the discrepancy, Mr. Peirce again visited Paris, with the sanction of the honorable Secretary of the Treasury, and by theoretical and experimental studies demonstrated from principles not known in their times that the results obtained by the two celebrated physicists were subject to certain very large corrections. These, when properly applied, brought their results into perfect accord with results already reported by Assistant Peirce, who read a memoir upon the subject before the Academy of Science of the Institute of France. The paper was printed in the Comptes Rendus for the 14th of June, 1880, and on its reference to a committee the conclusions of Assistant Peirce received the approval of the Academy.

Operations for the comparison of the meter with a wave length of light have been provisionally completed, yet certain parts of the work require verification—in particular the comparison of decimeters with the meter has been only partly made. In connection with this subject Assistant Peirce has published, with my approval, in the American Journal of Mathematics, a memoir upon certain apparitions which appear in diffraction spectra. These were shown to be consequences of eccentricity in the screw used in ruling the diffraction plates. By another observer the subject was treated in a paper presented to the American Association for the Advancement of Science at their last meeting in Boston.

Geodetic operations in Pennsylvania.—Prof. Lewis M. Haupt at the opening of the fiscal year employed his field party in the erection of signals and in examining and permanently marking the stations to be observed on in the course of the season. Near Reading, in Berks County, a station was occupied, and from it angular measurements were made on three points previously occupied to the northward.

To the southward and westward four other positions were completed in angular measurements so as to extend the work through Lancaster County to the immediate vicinity of the Susquehanna River. At Rawlinsville, in the lower part of the last-named county, a junction was made with stations of the coast triangulation near the head of Chesapeake Bay. From the records of the field work which closed in September, 1879, the Computing Division of the office has added five additional entries in the register of geographical positions.

In July the weather was unfavorable, but was much more satisfactory in August and September. The statistics of the work are:

Stations occupied	4
Signals observed on	24
Directions to subsidiary objects	133
Number of observations	3,010

The field report of Professor Haupt was accompanied by complete descriptions of the stations, sketches of the horizon at each, record of the results of observed angles, and topographical sketches of the sites occupied by the theodolite.

Topography of Cape May, N. J.—This work was taken up at the opening of the fiscal year by Assistant C. M. Bache, who remained in the field until the 20th of November.

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