45TH CONGRESS, 2d Session. } SENATE. { EX. DOC. No. 12.

REPORT OF THE SUPERINTENDENT

OF THE

UNITED STATES COAST SURVEY

SHOWING

THE PROGRESS OF THE WORK

FOR THE

FISCAL YEAR ENDING WITH

JUNE, 1877.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1880.

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theodolite by the use of a platform so contrived as to be easily removed from one and mounted on another house-top. Ground-stations were marked as usual to insure identification if the point should be needed at any future time. Of the fifty-two stations at which angles were measured, fifteen were on houses. The triangulation was completed on the 28th of November, and the work comprises the following in statistics:

Signals erected	54
Stations occupied	5
Angles measured	320
Observations with theodolite	5,668

Before leaving the vicinity of Taunton River, Mr. Harrison traced and added to the plane-table survey of the previous season several miles of the line of the Old Colony Railroad, to make the road appear continuous on the sheets aboye Fall River, the parts omitted in the survey being somewhat beyond the limit adopted for the detailed topography.

In preceding seasons most of the topographical details of the shores of Narragansett Bay were mapped by Assistant Harrison. Soon after the completion of that work Prof. N. S. Shaler, of Harvard College, made a special study of the geology of this part of the coast, and in doing so relied on the results of the plane-table survey. He thus refers to the advantage which the topographical representation afforded for his researches: "So perfectly has the topographer caught the expression of the surface of the country, that by studying the map of Aquidneck or Rhode Island, I have been able to determine the position of geological *faults* and the general character and dip of the rock even before visiting the localities, and at points where the uneducated eye would perceive no variety in the character of the surface. Most of the satisfaction and success which I have had in my work is due to the excellence of the plane-table survey."

SECTION II.

ATLANTIC COAST, AND SEAPORTS OF CONNECTICUT, NEW YORK, NEW JERSEY, PENNSYLVANIA, AND DELAWARE, INCLUDING BAYS AND RIVERS. (SKETCHES NOS. 4 AND 5.)

Topography of the vicinity of New Haven, Conn.—The detailed survey of the vicinity of New Haven has been extended by parties working under the charge of Assistant R. M. Bache. For the purposes of the plane-table work twenty-six points were determined by triangulation. On the eastern side of the harbor the details of topography were filled in to include the vicinity of Lake Saltonstall. From West Haven, on the opposite side of the harbor, the plane-table work was continued northward to the limit reached in other parts of the survey. Field operations were discontinued late in November, 1876, but were resumed at the opening of spring. The survey was steadily prosecuted until the end of the fiscal year, and is yet in progress. At the end of June the statistics of work added to the previous survey were:

Shore-line of rivers and creeks (miles)	77
Road (miles)	123
Area of topography (square miles)	39

An aggregate of about forty miles was run in lines traced with the spirit-level.

Pendulum experiments.—The work which has been prosecuted by Assistant C. S. Peirce was resumed at New York on the 1st of February, 1877. For determining the flexure of the pendulum stand numerous measures were made during February and March. Experiments with the automatic relay were then commenced, and the force of gravity was ascertained on the Repsold stand. These operations were continued until the middle of May, and similar experiments were made upon another form of support.

Subassistant Edwin Smith, under the direction of Mr. Peirce, commenced time observations early in March, and these were repeated on thirty-one nights preceding the end of June. In April a very extensive series of measures of the length of the pendulum was made, and at intervals these were repeated in May and June. At the same time optical measures of wave-lengths were recorded in good weather for the determination of a standard of length.

In the latter part of the fiscal year Assistant Peirce made a full set of experiments with the pendulum, uniform with a set which he had made in Europe for ascertaining the force of gravity. Of the operations here noticed further mention will be made in my next annual report.

Triangulation.—At the opening of the fiscal year Assistant Richard D. Cutts relinquished the charge of the Coast Survey exhibit which he had arranged as part of the International Exposition at Philadelphia, and early in July, 1876, resumed field-work in this section. At South Adams he found that the residents of that vicinity had opened a road to the summit of Greylock Mountain, and thus his party was enabled to proceed at once to the primary station which would have been occupied last season if facilities for reaching it had then existed. A temporary observatory was set up, the instruments were mounted, and camp was pitched on the summit of Greylock by the 12th of July. Between that date and September 9 the requisite horizontal and vertical angles were measured. Heliotropes were employed at Mount Tom, on Monadnock, on Greenwich Hill, on Helderberg, and at Prospect Mountain. The lines to these several stations vary from 38 to 62 miles in their distances from Greylock.

During August the work was retarded by causes that are somewhat common in other districts in that month, but which especially affected the atmosphere in the valley of the Hudson. A drought prevailed, and consequently continuous haze, and the smoke from furnaces at Troy and elsewhere along the river became, to an unusual degree, a hinderance to progress in recording the observations. The heliotropes could be seen only after a north or northwest wind or a rain storm from the west, the effect of which was to clear the air of the valley.

From Greylock, Assistant Cutts transferred his party to Helderberg, a summit 1,824 feet above tide, and about seventeen miles westward of Albany. Observations were begun at that station in the middle of September and were concluded on the 15th of November. In cloudy weather, generally, the heliotropes proved ineffective, but under clouds the atmosphere occasionally became such as to bring into view the distant signal-poles, when, at the same time, the heliotropes could not be seen. To the westward observations were made on the signal of a station in Otsego County, about thirty-six miles distant from Helderberg.

Assistant Cutts was aided in the field by Mr. J. F. Pratt. The following are statistics of the triangulation:

Primary stations occupied	2
Horizontal angles measured	26
Number of observations	1,317
Vertical angles measured	14
Number of measurements	415

In reference to means for ascertaining the heights of the triangulation-points above the sea, Assistant Cutts remarks in his report:

"As it was very desirable that the leveling should start from a correct base, connected directly with tidewater, the altitude above mean tide of the station-mark on Mount Rafinesque was determined, in the course of the season, by a line of spirit-levels forward and back. By means of this base, the heights of Monadnock and Mount Tom, of the primary triangulation to the eastward, could be checked, and the heights of stations in the interior of the country could be determined with unusual accuracy. The spirit-leveling up the Hudson River, by the Coast Survey, as far as Stuyvesant's Landing, was accepted as correct. From the bench-mark at the Landing to the bench-mark at Lansingburg the leveling done by Mr. R. H. Talcott (the mean of three separate and close lines of levels) for the improvement of the Hudson River was accepted as equally correct; and from the bench-mark at Lansingburg to the station-mark on Mount Rafinesque, the leveling was done under my direction by George R. Talcott, an experienced observer."

The original records of this work, and of the triangulation, have been duplicated and deposited in the office, with abstracts of angles and computations showing the lengths of triangle-sides, the heights of stations above mean tide, and the resulting values of the coefficient of refraction.

While at this station, and generally during the season, Assistant Cutts maintained correspondence with the several observers who have been accepted for the work of determining geodetic

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