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each night at the several stations, and as soon as the telegraph line was available for the use of the observers, which was generally at 9 p. m., the clock at Harvard Observatory was connected in the main telegraph circuit, and clock signals were sent to the Observatories at Albany and Washington for five minutes. Meanwhile the clocks at those places were adjusted in their respective local telegraph circuits, for the purpose of recording their clock signals upon the chronograph while receiving clock signals from Harvard Observatory.

At the expiration of five minutes, the Harvard clock was disconnected from the main telegraph circuit, and adjusted in its local circuit; the Dudley Observatory clock being meanwhile placed in the main circuit, and its signals recorded at Cambridge and Washington for five minutes. In a similar manner the clocks at coast survey station Seaton, and at the Naval Observatory at Washington, were compared by telegraph with the clocks at Cambridge and Albany.

Immediately after the first set of clock comparisons were completed between the several observatories, each night, a second series of observations were made for determining the clock corrections. This usually required about an hour and a half, after which a second set of clock comparisons followed, thus furnishing the data for ascertaining the rate of each clock from the observatories, and also from the clock comparisons.

The requisite observations at Harvard Observatory were made by Professor Winlock and his assistant, Mr. George M. Searle. The instrument used for determining the clock corrections was a forty-eight-inch Troughton & Simms transit, (Coast Survey, No. 8,) having an aperture of two and three-quarter inches.

While the longitude experiments were in progress, Mr. Searle visited Washington and made several series of observations for determining the personal equation between himself and Assistants Dean and Goodfellow, and Professor Newcomb of the Naval Observatory. On his return northward, Mr. Searle passed several days at Albany, but the weather proving unfavorable only a few observations were made for personal equation between himself and Professor Hough.

Near the close of August, Assistant Dean, with Professors Hough and Newcomb, joined Professor Winlock, at Cambridge, and made the final observations for personal equation.

The operations here noticed will be again alluded to under the heads of Section II and Section III.

Latitude observations at Manomet, near Plymouth, Massachusetts.—These observations were commenced by Assistant C. O. Boutelle, on the 27th of June, his party having been previously employed at another station in this section. Sixty-seven pairs of stars were observed for latitude, on thirty nights, with an average of six observations to each pair. In connection with these, observations were made on twenty-seven nights in July and August, for local time. The value of the scale divisions of the level of transit No. 10 was carefully determined, and observations were made to find the correction for irregularity in the form of the pivots. To find the value of the micrometer of zenith telescope No. V, five western elongations of Polaris were observed by one hundred and sixty-three readings, and the value of level A was determined in terms of the micrometer by two hundred and forty observations on six days. Assistant Boutelle was aided in the latitude and other geodetic observations at Manomet by Messrs. F. H. Agnew and C. S. Peirce. Sub-Assistant J. W. Donn also joined the party in July, and rendered good service by making the first reduction of apparent places for all the stars used for latitude. My first visit of inspection was made to this party, and I was highly gratified at the vigor and ability manifest in its conduct.

Magnetic observations at Manomet and at Nantucket, Massachusetts.—At Manomet station ten determinations of magnetic dip were made by the party of Assistant Boutelle, on four days in August, by two hundred and eight observations. Half-hourly readings of maxima and minima were taken on six days, for variation of the needle, and observations of deflection and vibration were made on three days, to determine the horizontal intensity.

The magnetic elements were determined by Mr. Boutelle also at Nantucket, in June, using, as in the observations just alluded to, declinometer No. 3, and dip circle No. 8. At Nantucket, (Cliff station,) ninety half-hourly readings were taken on four days, for variation. Six determinations of the magnetic dip were made, on two days, by ninety-six observations, and two days were employed in determining the horizontal intensity.

Assistant Boutelle was very efficiently aided in these and in the other operations here reported

by Mr. F. H. Agnew. The observations for magnetic dip at Manomet, were made by Mr. C. S. Peirce, as well as the larger part of the other magnetic observations at that station.

Hydrography of Duxbury Harbor, Massachusetts.—The soundings made near Duxbury define the two channels, one of which passes up the east side of the bay to the vicinity of Powder Point, the other branching from the main channel off Clark's Island, and running towards the west shore of the bay. The work was done at low water. Tidal observations were made during twenty-six days of the month of November.

This survey was made by Sub-Assistant Horace Anderson, aided by Messrs. C. P. Dillaway and R. B. Palfrey. The following is a summary of the hydrographic statistics:

Miles run in sounding	75
Angles	455
Number of soundings	7,453

Mr. Anderson had been previously engaged in the northern part of this section, and also in Section VIII.

The work done near Duxbury connects with the hydrography of Plymouth Harbor, which was surveyed in 1857.

Latitude observations at Nantucket, Massachusetts.—After closing at Farmington, Maine, the series of observations for latitude, mentioned in the last annual report, Assistant Boutelle transferred his party to Nantucket, the southern end of the arc of about $3^{\circ}.3'$ of the meridian, the length of which was to result from close determinations of the latitude of the two places named. A proper site for the temporary observatory was found in the garden of Peter Folger, esq., at a point about midway between Nantucket Cliff and South Towered Church, two of the stations of the triangulation. Stone blocks not being procurable in the vicinity, Mr. Boutelle mounted the transit instrument upon a short section of a ship's mast, imbedded three feet in the sandy soil, and placed the zenith telescope upon a portable wooden stand, contrived by him for this purpose. He reports that the changes in azimuth and level resulting from that arrangement are not greater than those incident to the use of stone blocks. Seventy-one pairs of stars were selected for observation at Nantucket. One set of thirty-nine pairs were observed from the 26th of November until the 5th of December, the remaining thirty-two pairs from the 7th until the 26th of December, 1866. In all, four hundred and eleven observations were recorded for the latitude, and in connection with them observations were made on seventeen nights of the same period, for local time. After the 8th of December the latitude observations at Nantucket were continued by Mr. F. H. Agnew, the attention of Assistant Boutelle being requisite at Calais, Maine, in connection with the determination of difference of longitude by means of the Atlantic cable, reference to which was made in the last annual report. Observations for time during the same period were continued by Mr. C. B. Boutelle.

The computed latitude of the station near Nantucket, resulting from these observations, is $41^{\circ} 17' 14''.17$, of which Assistant Boutelle reports the probable error to be only $0''.10$.

During the winter and early spring the records of observations which had accumulated in this party were duplicated, and the field computations were made.

The geodetic observations at Nantucket requisite for connecting the latitude station with the chain of primary triangles were taken up in May of the present year. Mr. Boutelle erected at Nantucket Cliff an observing tripod and scaffold twenty-two feet high, and posted heliotropes at Indian Hill and Shootflying Hill. Primary and secondary angles were here measured, and the stations South Towered Church, Folger, and Sankaty Head Light were also occupied. Twenty angles were measured at these stations upon nineteen objects, by seven hundred and twenty observations. The height of the primary station and of the astronomical observatory were determined by leveling. Twenty consecutive tides were observed for determining the plane of mean level of the sea, to which the heights were referred.

A comparison of the effects of lateral refraction, with reference to the differing character of the lines observed, is thus concluded in the report of Assistant Boutelle: "Generally it has been my experience, that when a geodetic line passes near the surface over varying depths and temperatures, clear vision throughout its length will rarely be obtained, and lateral refraction will surely be encountered. One of the lines here alluded to passed within twenty feet of the water on Tucker-nuck Shoal, though the ends of the line were respectively eighty-one and a half and two hundred and sixty-five feet above the sea level.

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