## TIME SERVICE OF CARLETON COLLEGE OBSERVATORY, AT NORTHFIELD, MINNESOTA.*

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The observatory of Carleton College is located at Northfield, Minn., forty miles south of St. Paul, on one of the main lines of the Chicago, Milwaukee and St. Paul Railway. It was built in 1878. Its latitude was determined by Professor B. F. Thomas in 1879, by a series of observations made with a Würdemann zenith telescope of two-inch aperture loaned to the Observatory for that purpose by Lieut. Edward Maguier, Chief Engineer of the Department of Dakota. He used the Talcott method and found the latitude to be 44° 27′ 41″±. In August, 1880, the work was done a second time by myself, using the same instrument and method, and observing forty pairs of stars from Sofford's catalogue on three different nights. After the proper reductions the latitude was found to be 44° 27′ 40.″8.

In October, 1880, by the aid and courtesy of the officer just named, and Lieut. O. B. Wheeler, of the Lake Survey Corps, the longitude of the observatory was determined. The Coast Survey meridian of St. Paul was used as the base of operation. Observations were taken at both points on two different nights and telegraphic signals were exchanged. Independent reduction of the observations showed the longitude of the Observatory to be $1^h\ 4^m\ 23^s.85$ west of Washington and 14.3 seconds west of the meridian of St. Paul.

### INSTRUMENTS.

The Observatory is furnished with the following instruments:

A Clark Equatorial, 8¼-inch aperture, 10½ feet, with complete mounting.

A Byrne Equatorial, 4.3-inch aperture, with portable mounting.

A Transit made by Fauth & Co., Washington; telescope of 3-inch aperture and 42-inch focal length with reversing apparatus.

Two Howard clocks with electric and magnetic attachments for use in regulating and sending time.

A Bond Siderial Chronometer with break-circuit and an ordinary Clark Chronograph.

### TIME SERVICE.

The time service of the Observatory began October 23, 1878, immediately after the clock was set and regulated, the N. W. Telegraph Company (now Western Union) having previously asked for time, and having built a line to the Observatory and furnished it with a telegraph office.

The electrical time-signals are given by the mean time clock which has a break-circuit attachment operated by a small wheel on the shaft carrying the seconds hand. This wheel, which contains thirty-one teeth, spaced to represent two seconds except three which give continuous seconds to mark the close of each minute. This clock is placed in a local circuit with appliances for cutting it into the main telegraph lines for daily, noon signals. By arrangement with the railroad companies the clock is put into line before twelve daily and thus give *three* full minute signals, the last stroke of the third minute being the time of twelve exactly.

Until recently the distribution of the time has been effected in the following manner:

The principal officers of five of the seven different railroads centering in St. Paul and Minneapolis were connected with the main office of the Chicago, Milwaukee, and St. Paul Railway either directly or at some intersecting point, and in this way our central mean time clock has daily operated all the main lines of these companies. The branch lines use the same time, having it repeated by hand. When the main lines are thus connected the clock has given its break-circuit signal distinctly over 1285 of wire in six different States and territories and ranging from Kansas City to St. Paul, Winona and McGregor in Iowa.

For a few weeks recently, the signal has been modified by reversing the points of the relay in the local circuit for the purpose of a make circuit signal on the main line. A five minute signal attachment has also been applied to the clock that time balls may be dropped at noon daily in connection with our railroad time service. Arrangements are already made to drop a time ball in each of the cities of St. Paul and Minneapolis, apparatus for the same being already in hand.

The five-minute attachment, as it is called, that aids in dropping these time-balls, is a plain disk attached to the train of the clock so as to revolve once in five minutes; a portion of the circumference representing fourteen seconds is cut away. This disk is placed in the local circuit and serves to keep it closed, and hence main lines open during fourteen seconds preceding the *sixtieth one* before noon. The interval gives opportunity to connect time-balls with electrical apparatus for dropping the same by the single twelve o'clock stroke from the clock. The dropping apparatus that I use for these balls is manufactured by Prof. H. S. Pritchett, of St. Louis. It is neat, simple and effective.

### DISTRIBUTION OF THE TIME.

The following railroad companies take the Northfield meridian time directly or indirectly, and use it over their lines without change.

| | Miles. |
|---|---|
| 1. C. M. and St. P. R'y, on its five divisions West of the Mississippi now embracing an aggregate length of | 2271 |
| 2. W. & St. Peter R'y, (branch of N. W. R'y,) uses both Northfield and Barabvo signals but runs on Northfield time West of the Missisippi | 484 |
| 3. St. P. M. & O. from Sioux city to Elroy Wis., on all its branches | 963 |
| 4. M. & St. L. R'y, from Minneapolis South | 260 |
| 5. Northern Pacific Railway to the end of its track | 680 |
| 6. St. P. M. & M. certainly to St. Vincent and (I think to Winnepeg) | 630 |
| 7. St. P. & Duluth | 153 |
| Making a total of | 5541 |

The last two companies named do not take time directly from the observatory but from jewelers in the city of St. Paul who receive our daily signals.

It will be seen readily by inspecting a map that the territory traversed by these great railroads embraces all of Minnesota and forts of Iowa, Nebraska, Dakota, Wisconsin, Montana, and probably the Province of Manitoba.

* Read before the A. A. A. S., Cincinnati, 1881.

## CHANGES IN MYA AND LUNATIA SINCE THE DEPOSITION OF THE NEW ENGLAND SHELL HEAPS.*

BY PROF. EDWARD S. MORSE.

This communication embraced a comparison between the shells peculiar to the ancient deposits made by the Indians along the coast of New England, and similar species living on the coast at the present time. Mr. Morse referred to similar comparisons which he had made in Japan, wherein he had found marked changes to have taken place; changes which showed that the proportions of the shells had greatly altered.

He had made a large number of measurements of shells from a few shell heaps of Maine and Massachusetts, and had obtained very interesting results. The common

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