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

WILLIAM W. PAYNE.

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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clam (Mya) from the shell heaps of Goose Island, Maine; Ipswich, Mass., and Marblehead, Mass., in comparison with recent forms of the same species collected in the immediate vicinity of these ancient deposits, showed that the ancient specimens were higher in comparison with their length than the recent specimens.

A comparison of the common beach cockle (Lunatia) from the shell heaps of Marblehead, Mass., showed that the present form had a more depressed spire than the recent forms living on the shore to-day, and this variation was in accordance with observations he had made on similar species in Japan.

AMERICAN COAL FIELDS.

The areas of the anthracite coal fields, confined to a few counties of our State, are so well defined that we need be in no doubt as to their extent; and this limited area admonishes us that we should carefully husband our inheritance, and not waste it. The fact is well established, that for every ton shipped to market, two are wasted. The loss in the operations of mining, the pillars left to support the roofs of the mines, the loss in preparation, each contributes to this great aggregate. How to prevent these losses, by use of improved machinery, and by more thorough methods of working the mines, should be the study of our mining superintendents and engineers. Several suggestions with a view to a partial remedy, present themselves.

First.—The owning of the land by the operators would make them careful to mine all the coals. As tenants for a limited term of years, their object is merely to take out that coal, and in such a manner as will cost them little, and bring them much.

Second.—If the lands are to be leased, the term should be long enough to enable them to mine all the coal beds covered by the lease.

Third.—The lease should contain clauses subjecting the methods of mining, ventilation and drainage to the supervision of the owner's mining engineers; limiting the lengths of "breasts" to seventy yards or less; forbidding the use of monkey rolls, or the rebreaking of the coal; providing for the dumping in separate heaps of the coal dirt and the slate and rock.

Fourth.—We need larger collieries, and fewer of them, with perfected machinery, for hoisting, pumping and breaking.

Fifth.—More capital is required to open the mines for extensive and exhaustive working, by driving the gangways to the extreme ends of the territory, and then mining towards the outlet, so as to obviate the necessity of retracing our steps and robbing the pillars.

In Schuylkill county we are specialists. We are dependent upon one substance: coal is king. There is no gold, silver, lead, copper, or other valuable metals. Though we have good iron ores, they are so disseminated as not to furnish us one workable bed. Yet we largely help Pennsylvania to furnish nearly halt the iron manufactured in the United States. We have a large farming area well cultivated by our industrious and frugal German farmers. Our convenient location to the great markets of the Atlantic seaboard, our canals and abundant railroad facilities, our great commodity, always give a promise and an attitude among the great countries of our grand old commonwealth, which we are ever proud to realize.—*Geology of Schuylkill County, by P. W. Scheafer. Pottsville, Pa.*

The latest addition to microscope stands is the swinging sub-stage. This American invention has been adopted by most of the English manufacturers. In the last number of the *Journal of the R. M. S.* we find the value of the swinging sub-stages disputed by Mr. Crouch, and that Mr. Stevenson concurred in this view, and described them as useless incumbrances and unsuitable for use with certain apparatus, which is essential to the display of some objects,

ASTRONOMY.

COMET C (SCHÄBERLE), 1881.

This comet has been observed here since the 16th of July. When first seen it was large, round and bright, and slightly condensed at the centre, being very plainly visible in a 1¼-inch telescope. On the morning of the 19th it had increased sensibly in brightness; a faint tail could be traced for a distance of fully 15′, pointing in a northwesterly direction; on the above date its position was obtainee from θ (*Theta*) *Aurigas* in the following manner: Thd comet and star were separated too far to be both seen in the field of the telescope together, the comet was also too far north of the star for both objects to be seen at once in the finder. One of the wires in the finder eye-piece was made parallel with the meridian, and then the star, which preceded the comet, was brought into the field and its passage of the wire obtained; the telescope was then carefully moved northward in declination until the comet, entered the field when its passage of the wire was observed; in this manner the difference of R. A. was obtained; the difference of declination was then estimated. From a mean of several passages of the star and comet its position on July 18th at 15h. 40m., Nashville mean time, was found to be R. A. 5h. 52m. 52sec., and Decl. 40° 15′. The R. A. will be very little out, but the declination may be over a minute in error.

Its position was obtained in the same manner on the 20th (A. M.), using the same star at 3h. 35m., R. A. 5h. 53m. 54sec., Decl. + 40° 42′, with probably several minutes of error in the declination. On July 24, at 15 hours, the comet was visible to the naked eye, appearing about as bright as a sixth magnitude star (Prof. Swift, of the Warner Observatory, saw it with the unaided eye as early as the morning of the 23d).

On the 28th a small star-like nucleus was visible with the telescope.

Aug. 3 (A. M.), it was very easily visible with the naked eye, traces of the tail being seen without a telescope. A naked eye comparison with comet B showed C to be the brighter. Comparing it with a six magnitude star it was of the same brightness, but, covering a larger area, it was more noticeable than the star. The tail, in the telescope, was long and slender and straight as a shaft.

Aug. 4 (A. M.), the comet was quite conspicuous with the unaided eye, the tail stretching out for some distance. In the telescope the nucleus was small, round and pale, and star-like in form, Turning the telescope from comet C to comet B, the two were identical in brightness, but B was slightly broader about the head and tail, and the nucleus was not so distinct; but considering the low altitude of C it must have been really much brighter than B.

On August 14 it was visible in the evening after sunset, being quite plainly visible to the naked eye, with its tail streaming upwards for several degrees. In the telescope it was many times brighter than comet B.

21 inst., in the evening, the comet was as bright to the eye as a 3½ mag. star. It appeared very graceful, straight and slender in the telescope. On this occasion I obtained its position with the aid of a ring micrometer, referring the comet to *Psi ursæ minoris.*

1881, August 21 ds., 14.1m. Washington, m. t. { a=11h. 08m. 08.5s.
This was the *apparent position.* { δ=+45° 13′ 42″

22 inst., evening, its tail could be traced with the telescope for a distance of about 6°, and was visible to the naked eye for about the same distance. A faint lightish stripe was visible on this date, extending from near the head to a degree or so along the middle of the tail. The following side of the comet's head and tail were distinctly defined, the sky appearing quite dark up to the very body of the comet, but the preceding side was ill-defined and blended, the sky being whitish for some distance from the comet; there also appeared to be a diffused sort of short tail running out some 10′ or so from the n. p. side