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miles from the latter. Camp was pitched and the signal lights were posted, but owing to bad weather observations were not begun until October 16. At Calvary station it was found necessary, in order to avoid cutting, to build a superstructure thirty feet high on top of the tripod already erected there; this made the elevation of the signal light one hundred and five feet. Work at Sisson station was finished November 5, and the party soon after disbanded.

The statistics of the season are:

Number of tripod and scaffold signals erected (1 of 80 feet, 2 of 75 feet, 1 of 105 feet)	4
Number of primary stations occupied	3
Number of secondary stations occupied	2
Number of observations for horizontal directions	1853

Assistant John B. Weir was on duty with the party during the season; Mr. F. P. Bacon served as recorder, and Mr. E. E. Torrey as foreman from July 1 to October 17, at which date he was sent to join Assistant Mosman's party. Mr. Fairfield acknowledges the interest shown by all the members of his party in bringing the work to a successful close, and refers especially to the value of the services rendered by Mr. Weir.

During the winter, Mr. Fairfield was occupied at the office in completing the records and results of his field operations. Upon finishing that work, he was first assigned to regular duty in the office and then transferred to the party of Assistant Henry Mitchell.

Geodetic operations—Continuation of the reconnaissance and triangulation of the State of Indiana.—Reference was made in the last annual report to the resumption of geodetic operations in the State of Indiana by Prof. J. L. Campbell, Acting Assistant, at the opening of the season in 1885. Twenty days in the month of June in that year were occupied in the location of station O and M (one of the stations of the third quadrilateral north of the Ohio River) and in the construction of a tripod and tower at that station.

During July, August, and part of September four stations were occupied for the extension of the triangulation, namely: Six Mile, Haystack, Lutz, and O and M. At the two latter stations observing tripods and scaffolds forty and forty-five feet in height were required; at the two former the observations were made from the ground. Stations Six Mile and Haystack, and also the advanced stations Bartle and Summit of the last quadrilateral of the reconnaissance, are on spurs of "The Knobs," while stations Lutz and O and M, with a new advanced station (x), not yet fully determined, are on the dividing ridge between the waters of Silver Creek, west, and the Ohio River, east.

The elevations of the stations occupied above sea-level, as determined approximately by referring them to the nearest railway stations, and by means of the railway profiles, access to which was accorded to Professor Campbell, are as follows: Six Mile, nine hundred and thirty-seven feet; Haystack, nine hundred and seventeen feet; Lutz, six hundred and five feet; and O and M, six hundred and ninety-nine feet. Each station was referred also in location to the section corners of the Government Land Surveys.

At the four stations occupied fifteen principal angles were measured. For the determination of these angles the number of observations made was one hundred and eighty-two and the number of pointings one thousand and ninety-two.

Field-work was suspended September 15. . . . December, Professor Campbell occupied five days in reconnaissance for a new station north of O and M, and in May, 1886, he was authorized to use a small unexpended balance of the allotment for his work to continue the reconnaissance.

Prof. J. M. Coulter served as recorder in the party. It was but for a brief season that the reconnaissance could be prosecuted in June, 1886, the work being closed under instructions June 30, in consequence of the failure of the House Appropriations Committee to insert the usual item for aid to State surveys in the Sundry Civil Expenses bill.

Determinations of gravity at Ann Arbor, Mich., and at Madison, Wis.—Reference was made under the heading of Section II to the plan for carrying on gravitation work during the fiscal year as outlined in instructions received by Assistant Charles S. Peirce in July, 1885, and to his selection of stations at Ann Arbor, Mich., and Madison, Wis., among others, for swinging the two

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invariable reversible pendulums, one a yard, the other a meter in length. After being oscillated at the western stations, these pendulums were remeasured and oscillated at the Smithsonian Institution.

Reductions of the observations at Ann Arbor were carried towards completion, and reductions of those at Madison begun. At both of these stations time signals were kindly supplied by the Directors of the Observatories.

Magnetic observations at Detroit, Mich.—Reference has been already made in this report to the occupation of a number of stations by Subassistant James B. Bayler for the determination of the magnetic elements, this duty being executed under instructions issued in July, 1885. At Detroit, Mich., a station was selected in the grounds of the Harper Hospital, at which observations were made for magnetic declination, dip, and intensity. A comparison of Mr. Bayler's results with those obtained at Detroit by the U. S. Lake Survey at various periods between 1859 and 1876 will furnish additional data for the value of the secular change of the magnetic elements in this locality.

Geodetic operations—Continuation of the triangulation of the State of Wisconsin.—Prof. John E. Davies, Acting Assistant, has transmitted his report of field-work in advancing the triangulation of the State of Wisconsin during the fiscal year. He has taken occasion in this report to review the history of the origin and progress of the survey under his charge, stating the considerations which led to the adoption of the scheme according to which the work has been developed.

Professor Davies reports the completion of the connection of his triangulation with that of the U. S. Lake Survey at stations Erin, Delafield, and Lebanon, and remarks that while the work was one of considerably greater difficulty than he had anticipated, it proved very satisfactory, the results showing that the triangulation of the State, as far as he had carried it, agreed well with that executed by the U. S. Engineers with much more refined appliances.

The work of the season of 1885, which began July 7, was somewhat retarded by the loss of all the records and papers of former years in the fire at the University of Wisconsin the previous winter.

It was found necessary also to revisit many of the stations and to rebuild some of the signals. A tripod and scaffold signal was begun at Medina station, and preparations made for the re-occupation of station Pleasant Springs in order to get measurements upon Harmony and Janesville stations, which had not been selected when Pleasant Springs was first occupied. Very variable weather with violent storms prevailed during the month, and delayed the completion of the work at Pleasant Springs till August 1. In August, in anticipation of the occupation of Medina station, near Marshall, Dana County, Wisconsin, a tripod and scaffold signal sixty-five feet in height was built at Reeseville, and one of seventy feet at Minnesota Junction, one of the latitude stations of the U. S. Lake Survey.

Observations were continued at Medina station till September 5, when the party was transferred to Lowell, near Reeseville, Dodge County. Field operations were closed for the season at Lowell station, September 14. Professor Davies reports the following statistics:

Number of signals erected and repaired.....	7
Number of tripod and scaffold signals erected.....	3
Number of separate measurements of angles.....	129
Number of repetitions.....	1548

In June, 1886, he took up a reconnaissance for extending the triangulation westward from stations Minnesota Junction, Lebanon, and Delafield.

Observations for latitude at Madison, Wis.—Reference was made in the annual report of the Superintendent for 1873 to the determination of a point in the grounds of the University at Madison by observations of latitude and longitude, the observations being made by Assistant F. Blake. At that time the Madison Observatory had not been established. Soon after its operations began it was found that a discrepancy existed between the latitude as determined by observations with the instruments of the Observatory and the latitude of the Coast Survey station as referred by the measurement to that of the Observatory. This discrepancy may be due to a want of the best determinations of star places in some of the pairs observed for latitude, or to some errors in the values of the instrumental constants employed in the reductions. It was

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