viz, from the 8th to the 16th, inclusive. On the remaining twenty-one days of this month 74 reports were received, or an average of 4 per day. The dates on which the reported number especially exceeded this average were: 13th, 16th, and 24th, 8; 17th and 18th, 7. The States from which auroras were reported by a large percentage of observers were: North Dakota, 18; South Dakota, 8; Wisconsin, 9. The States where the dates of auroras were most numerous were: Iowa, 6; Minnesota, 15.

CANADIAN DATA—THUNDERSTORMS AND AURORAS.

No thunderstorms reported.

Auroras were reported as follows: 1st, St. Andrews, N. B.; 2d, Father Point, Que., and Medicine Hat, Assin.; 16th, St. Andrews, N. B., Minnedosa, Man., and Prince Albert, Sask.; 17th, St. Andrews, N. B., Quebec, Que.; 18th, Sydney, N. S., Grand Manan, N. B., and Minnedosa, Man.; 19th, Quebec, Que.; 22d and 23d, Medicine Hat, Assin.; 25th, Qu'Appelle, Assin., and 26th, Father Point, Que.

METEOROLOGY AND MAGNETISM.

The movements of our atmosphere are to be studied primarily as problems in the mechanics and thermodynamics of moving gases and vapors, but our knowledge of the empirical relations between atmospheric phenomena and those of terrestrial magnetism has been elucidated by a few special students, and further study in this direction has been recognized by the Chief of the Weather Bureau as proper and desirable. As the subject of atmospheric electricity, including that of auroras and earth currents, has a small section in this REVIEW, Professor Bigelow has consented to contribute a section on terrestrial magnetism.

THE COMPARISON OF TEMPERATURE WITH MAGNETIC HORIZONTAL FORCE.

By Prof. F. H. BIGELOW.

In response to the request of the Chief of the Weather Bureau, the directors of the observatories at Toronto, Washington, and San Antonio have courteously undertaken to forward to the Bureau, as promptly as possible, certain data from their magnetograms, namely, the mean ordinates for the day from twenty-four hourly readings of the horizontal force, the declination, and the vertical force, uncorrected for instrumental errors and changes of temperature. On days exhibiting very disturbed magnetic conditions the hours and the values of the maximum and minimum ordinates are given.

The object in collecting these data is to institute a comparison between the crude magnetic readings, particularly of the bifilar, and the temperature changes at meteorological stations in the Northwest. Ultimately such comparisons will show how far unreduced magnetic observations may be available for determining the direction and the intensity of the temperature variations and other weather conditions before these become fully developed, as given by the isotherms and isobars of the daily weather maps. It has already been shown that weather and magnetism conform on the average to a normal type, but the problem of the synchronous changes from day to day is still under advisement as a practical feature in forecasting. The original data are presented on Chart V in a slightly reduced form, without further comment, thus offering the reader an opportunity for individual study.

The columns headed Calgary, Williston, and Sioux City give for each day, respectively, the mean of the 8 a. m. and 8 p. m. observations of temperature at the following groups of stations:

Calgary for Minnedosa, Qu'Appelle, Prince Albert, Swift Current, Medicine Hat, Battleford, Edmonton, Calgary.

Williston for Valentine, Yankton, Huron, Pierre, Moorhead, Bismarck, Williston.

Sioux City for Springfield, Mo., Kansas City, Wichita, Concordia, Omaha, Sioux City.

The average temperature for each group is reduced back to the origin, W. 115°, N. 55°, by a correction for eastward drift (see Amer. Jour. Sci., Dec., 1894). The first differences of these numbers are taken; then the monthly mean of the first differences for slope; then the variations on the slope; then these latter are added successively throughout the month and the accumulated sums give the ordinates of the curve for each group; the mean of these three groups is taken and gives the curve in the upper part of Chart V; the monthly mean of the ordinates is added with reverse sign to reduce to a true datum line. Thus, the eastward drift and the slope have been eliminated, and the variations reduced to a zero base line.

The magnetic data are treated in the same way as the temperatures. The curve as plotted is the mean of the ordinates of the three stations. It has been found that at least five magnetic observations are required to eliminate local conditions and to give a true value of the external impressed field, though seven are better. By inspecting the columns it will be seen that local variations disturb the curves in certain cases. Hence, as the data now exists, the comparison can give only partially accurate curves as to detail, though the main features may be expected to appear.

SPECIAL FEATURES OF THE NOVEMBER CURVES.

The slope for the temperature curves is zero; the reduction to the zero base line is $+9$; the factor for amplitude is 1. The San Antonio magnetic curve is reduced for amplitude by the factor $\frac{1}{5}$; for its slope $+1$ is added. The final means for the three stations are reduced by the factor $\frac{1}{2}$ for the dates November 13–19, inclusive, during which magnetic disturbances prevailed; the reduction of the magnetic curve to a zero base line is $+1$. The function between temperature and magnetic force is not a constant ratio, as is known by comparing winter and summer amplitudes; also, during disturbances, the swing of the magnetic variation is wider than that of the temperatures of the same period. As the object now is to bring out the facts of synchronism and not the amplitude function, we must resort to arbitrary factors till the nature of that function is known.

The 26.68 day period began November 23, 1858.

Disturbances were reported on the following dates: Toronto, November 12, 13; Washington, November 13, 14; San Antonio, November 13, 14, 15, 17, 19.

SUNSHINE AND CLOUDINESS.

GENERAL REMARKS.

The quantity of sunshine, and therefore of heat, received by the atmosphere is a fundamental factor in meteorology; the quantity received by the atmosphere as a whole is very nearly constant from year to year, but the proportion received by the surface of the earth depends largely upon the absorption by the atmosphere and varies with the distribution of cloudiness. The sunshine is now recorded automatically at about