CANADIAN DATA—THUNDERSTORMS AND AURORAS.

Auroras were reported as follows: 1st, Quebec and Port Arthur. 4th, Quebec and Winnipeg. 6th, Father Point; Quebec, and Edmonton. 8th, Winnipeg and Battleford. 10th, Quebec. 11th, Minnedosa and Battleford. 12th, Charlottetown, Rockliffe, Toronto, White River, Kingston, Port Stanley, Saugeen, Parry Sound, Winnipeg, Qu'Appelle, and Prince Albert. 13th, Toronto, Port Stanley, Port Arthur, Edmonton, and Battleford. 14th, Grand Manan, Father Point, Quebec, Montreal, Port Arthur, and Esquimault. 15th, Father Point, Quebec, Rockliffe, and Winnipeg. 16th, Winnipeg, Minnedosa, and Prince Albert. 17th, Port Arthur, Minnedosa, Qu'-Appelle, Prince Albert, and Battleford. 18th, Father Point, Quebec, and Kingston. 21st, Father Point. 23d, Minnedosa and Medicine Hat. 25th, Winnipeg. 26th, Rockliffe. 27th, Edmonton. 28th, Quebec. 29th, Sydney and Swift Current.

Thunderstorms were reported as follows: 3d, Hamilton and Bermuda. 8th, Esquimault. 23d, Bermuda. 25th, Grand Manan. 26th, Charlottetown. 27th, Port Stanley. 28th, Halifax, Grand Manan, and Yarmouth.

INLAND NAVIGATION.

The *extreme and average stages of water* in the rivers during the current month are given in Table VII, from which it appears that no river has attained the danger point and that almost, without exception, the stages of water have been remarkably low. The lowest waters reported, as referred to the low water mark that is ordinarily adopted as the zero of the gauge, was at Vicksburg, where the Mississippi reached 5 feet below zero at the close of the month. In general there was a steady decline throughout the month in all the rivers tributary to the Mississippi.

Ice in rivers.—The Red River of the North was frozen so that navigation closed on the 29th, the earliest date on record.

METEOROLOGY AND MAGNETISM.

By Prof FRANK H. BIGELOW.

An attempt was made, during the year October 1, 1894, to September 31, 1895, to exhibit the synchronous variations of the magnetic and the meteorological elements, using the horizontal component of the magnetic force alone, and with the least possible labor of computation. During the year beginning with October 1, 1895, the same comparison will be continued, but the total deflecting magnetic forces will be computed, employing the data supplied by the observatories at Washington and Toronto which is all that is available. At least five observatories, at quite widely separated stations, would be necessary in order to give a correct mean value of the impressed deflecting field, and to eliminate the terms due to the local conditions of the earth, the atmosphere and the instruments. In must be steadily borne in mind that we are not to expect a perfectly harmonious system of fluctuating curves, because if that were the case either the magnetic forces would be the only ones determining the pressure and the temperature changes in the atmosphere, or else the magnetic variations would be the direct product of antecedent temperature changes. This latter supposition is excluded by the facts (1) that the temperatures of the northwest, as employed, are observed 2,000 miles away from the instruments, and are not synchronous with local variation in the free atmosphere, and (2) that the magnetic observations are made in rooms maintained at a very uniform temperature. The former supposition is also untenable, because in that case the equatorial radiation from the sun and the convectional system of atmospheric currents, which are the chief meteorological phenomena, would have to be ignored. It is therefore evident that the actual temperatures and pressures of the northwest, and to a subordinate degree those occurring in other districts, are mixed products of the equatorial and the polar fields of force that extend to the earth from the sun. The immediate problems in the physics of the atmosphere are to learn (1) the methods of the transformation of these two kinds of solar energy, and (2) the proportional parts of each that ultimately appear in the so-called highs and lows of the air. Neither of these are easy to solve with our present limited knowledge, but it is hoped that before long some definite contribution may be communicated, as deduced from the data in hand. Meanwhile it will be of profit to publish the accessible data in convenient form for study by those who are disposed to investigate these subjects, and without comment on the meaning to be drawn from the same.

In Bulletin No. 2, U. S. Weather Bureau, 1892, Notes on a New Method for the Discussion of Magnetic Observations, the adopted form of computation was explained, and experience in its use has confirmed the first favorable impression as to its simplicity and fruitfulness. Since it is not possible to reproduce in the WEATHER REVIEW each step in the computation, the following account of the details may be profitable:

First. The values of the horizontal force H, the declination D, the vertical force V, for Washington and Toronto, are written down and the means taken. These appear as H, D, V in the table on Chart V.

Second. In order to eliminate the slow change in the magnetic elements which is constantly going on at each station as a part of the secular variation, the mean values of H, D, V for the first fifteen days of the month, also for the last fifteen days of the month, are taken, and assumed to be the true values for the 8th and 24th days, respectively. Then the variation in two weeks shown by these values, assumed to have held good for the whole month, is distributed proportionally to the time throughout the month, forming a set of numbers which are the simplest available means for the several days, as a system of reference points. This is preferred to the means arbitrarily selected called "quiet" days. The difference between the given values H, D, V and the computed H_0 D_0 V_0 gives the residuals ΔH, ΔD, ΔV, which are not exhibited. For such stations, however, as report their results in C. G. S. units, $\Delta H = dx$, $\Delta D \tan H_0 = dy$, $\Delta V = dz$. The transference from ΔD to dy can be done very quickly, by constructing a simple auxiliary table in which for these stations $10' = 0.00050$ C. G. S., second differences being of no importance. The units are the 5th decimal dyne, C. G. S. system.

Third. $\sigma = \sqrt{dx^2 + dy^2}$; $s = \sqrt{dx^2 + dy^2 + dz^2}$;

$$\tan \beta = \frac{dy}{dx}; \quad \tan \alpha = \frac{dz}{\sigma};$$

Practically a diagram scale is used in which one entry with dx and dy, gives σ and β, and a second entry with σ and dz, gives s and α, where s is the total deflecting vector, σ its horizontal component, α the altitude from the plane of the horizon, and β the azimuth in the horizon from the magnetic north point of the station through the west, thus following the usual convention of counting westerly declination angle as positive. I have preferred to use station magnetic instead of geographical meridians, on account of simplicity of computation and directness of interpretation of the magnetic phenomena.

Fourth. The pressures and temperatures are treated in the same way as H, D, V, and the ΔP and ΔT are derived by subtraction from the values computed from the means of the first and last halves of the month.

Fifth. The lines in the diagrams represent the changes in the horizontal component σ, the total vector s, the pressure inverted, and the temperature. A study of the angles α and β will disclose the parts of space from which the deflecting forces approach the station of observation.