brilliant aurora presents at night. Arago, on consulting old records at the observatory, found that there were considerable magnetic disturbances that day in the magnetic needle kept for showing the diurnal variation, thus proving beyond question that the phenomenon observed by Dr. Usher was a veritable day aurora.

I find also in the account of the voyage of the Venus by M. de Tessan, that M. Cornulier, an intelligent officer in the French Navy, often observed on the coast of New Holland a particular direction in the cirrus clouds during the day, from which he was enabled always to announce a fine aurora australis at night. M. Cornulier, like M. Verdier, was convinced, from a study of the arrangement of the cirrus clouds, that in those reigons, auroras occur during nearly every day, and that the variation is only as to their brightness; they are often hid from view by clouds and storms. This remark agrees with the observations made under the direction of Captain Lefroy in Canada, at 13 different stations, and with others, collected by the Smithsonian Institution. It results from all these observations, that the aurora was seen on almost all clear nights, when the moon was not too bright, although not at all the stations. This is especially true during the months when the nights are longe t. From October to March, there is scarcely a night without a visible aurora; and they are most brilliant in the month o February. The tables show that auroras were seen during 201 nights in 1850, and 207 in 1851. It is also remarkable and natural, that the auroras should have been seen most frequently in the stations nearest the magnetic pole.

Recurring to the coëxistence of icy particles in the air with the auroras, we find striking proof on this point in the Canada observations. The tables give with exactness the weather before and after the auroras. The aurora was almost always preceded by a fall of rain or snow; it also often happened that a fall of one or the other succeeded the aurora. The appearance of lunar halos, a common prelude to auroras, is a proof of the presence in the atmosphere of these icy particles which make up the network illuminated by the electric current.

But the most important proof of the electrical origin of the aurora is that derived from its action on the magnetic needle. The observations by Arago at the observatory of Paris,* by Forster, Farquharson, and by all voyagers, establish the following conclusions:—

1. During the day preceding the night on which an aurora appears, the declination of the magnetic needle to the west is always augmented 10, 20 or 30 minutes, or more.

2 On the contrary, at the middle, and at the end of the exhibition, the needle deviates from its normal state to the east.

3. Finally, the needle often undergoes irregular perturbations during an aurora, amounting to several minutes.

It happens ordinarily that the maximum deviation of the needle during the day preceding the night of the aurora, is at noon, or half an hour after noon; and the deviation due to the disturbance may be 5 to 30 minutes or more, beyond that of the days before or following. Sometimes the maximum western deviation is at other hours in the morning, and it is probable that in such cases there is an aurora during the day. Arago cites several cases of this kind. Thus, on the 17th of August, 1828, the declination from 8½h. A.M till noon was 5′ above the mean of the month for the same hours; and on the same day, at 10h. P.M., Messrs. Coldstream and Foggo perceived feeble traces of an aurora which was probably the end of a day aurora. During the evening the needle was in its ordinary position.

The magnetic observation made in the regions near the pole confirm the influence on the needle. Thus at Reykinwik (64° 8′ 15″ N.) MM. Lottin and Bravais, having made numerous observations on the diurnal variation of the needle parallel with similar observations at Paris and Cherbourg, were struck with the almost continual disturbance of the needle. They at first attributed it to some movement in the earth: but afterwards, remarking the concordance of their observations with those of M. de Löwenörn made in 1786, 50 years before, they satisfied themselves that the effect was due to auroras invisible to them because of the continued presence of the sun above the horizon. M. Ginge, a Danish Missionary, made observations in 1786, 1787, continued through the 24 hours, which showed that the western declination was ordinarily strongest from 9 to 10 in the evening, and least at 9 to 10 in the morning, a fact which he attributed without hesitation to the aurora. This conclusion it confirmed by the very numerous and excellent observations of MM. Lottin and Bravais.

We thus see, that for a long period observations near the pole have shown that auroras must be more frequent than was supposed, and this is confirmed by the facts observed in Canada and the United States.

We therefore conclude, that the production of auroras, northern and southern, is the normal mode of neutralising the positive electricity of the atmosphere with the negative of the earth. This neutralisation should not take place in a manner very uniform or regular. It is evident that the variations in the mists or conducting capabilities of the atmosphere will be attended by variations in the facility of this neutralisation.

These differences will be evinced by the deviations or disturbances of the magnetic needle, which will be sensible at great distances from the poles, as in the temperate zone where they are often observed. The western deviation which in the middle latitudes usually precedes an aurora, indicates a large accumulation of electricity, due to a powerful condensation of vapours in the polar regions, which by facilitating the reunion of the two electricities, augment, the intensity of the terrestrial current passing in our hemisphere from the equator to the north, and consequently carries the needle more to the west. When the aurora is once visible, the current becomes less strong, because the light itself of the aurora is proof of the resistence (probabl due to the congelation of the particles of water suspended in the air that constitutes the mist) which the reunion of the two electricities encounters;* the needle will then retrograde to the east, as actually takes place.

In the higher latitudes, the disturbances of the needle are continual, because the slightest differences in the intensity of the electric discharges that take place in the polar regions should be there perceived. As to the observations of MM. Ginge, Löwenörn and Lottin, that the maximum deviation of the needle takes place from 8 to 10 o'clock in the evening, and the minimum at 9 to 10 in the morning, they were made only during some weeks in summer, and they prove only that at this season of the year, the greatest amount of condensation of

* Ann. de Ch. et de Phys., x. 120; xxx, 423; xxxvi, 398; xxxix, 369; xlii, 351; xlv, 403.

* It is clear that the mist when first formed should be a better conductor than when, afterwards, it consists only of icy particles.