

moisture take place, as should be the case, at times just preceding and following the setting of the sun, and at least 7 or 8 hours after its rising. In the observations of Lieutenant Hood, made in the voyage of Captain Franklin, between the 1st of February and the 31st of May, the greatest declination took place at 8 and 9 o'clock in the morning, and the least at an hour after noon. Thus, as is seen, the times of the maxima and minima are widely variable in those high latitudes, where there are great differences in the length of the day, and also in temperature, and therefore considerable electric disturbances of the air.

It is a singular fact, sometimes noticed, that when an observer is in the midst of an aurora, so to speak, the action on the needle may be null. This was remarked by Mr. Forster, at Port Bowen, beyond 65° N., the latitude of Forts Franklin and Enterprise, where Dr. Richardson had on the contrary observed the action of the needle. In fact, a needle in the interior of the circle formed by the aurora about the magnetic pole, is no longer under the influence of the currents which circulate around it and not above or below, and it ought therefore to experience only a variable and irregular action.

I have said that the aurora was probably of daily occurrence, and varied only in intensity. These differences in intensity are the reason for its being not always perceptible, and also for its less frequency remote from the magnetic poles. As to the differences of number for each month, they are attributable to two causes—but especially to the unequal length of the nights, for there should be fewer in the shorter nights. Thus in May, June and July the fewest are seen, because the days are the longest, while in the nine others, and especially in March, September and October, they are most numerous. This preeminence of these three months above others, of still shorter days, can be due only to this, that the auroras are most frequent at the times of the equinoxes, and especially the autumnal equinox. This is readily understood if we consider that the vernal equinox is the time when the sun transfers to the northern hemisphere its powerful influence either direct or indirect in the development of electricity; and that the autumnal should be followed with a large condensation of the vapours accumulated in the atmosphere during the months of summer—a condensation which, as already explained, facilitates the neutralisation of the two electricities, developed in large quantities during the summer, and augments consequently the intensity of the discharge at the pole.

It has been pretended that in the appearances of the aurora borealis there are secular variations; in other words, that there are epochs comprising a certain number of years during which auroras are particularly frequent, and others in which they are rare. This opinion does not appear to me to be based on documents sufficiently exact to be admitted. There may be a difference in different years, as there is a difference in temperature and humidity. But this is far from making out a periodicity in auroras: to establish such a periodicity, there ought to be the collected observations of a century, from observers at least as good, and as favourably situated with reference to the magnetic poles, as those now engaged: and this we have not. We need not therefore dwell longer on this point, only remarking that if really such a periodicity exists, it might be connected with the change in the magnetic poles, which are the centers of the aurora, and which according to the surface about them would more or less facilitate the electric circulation; for it is evident that the naked soil would afford more ready circulation than a surface covered with a great

thickness of ice. But, I repeat it, the fact of the periodicity is far from proved.

Recapitulation.—1. All observations agree in demonstrating that the aurora borealis is a phenomenon taking place in our atmosphere, and that it consists in the production of a luminous ring whose centre is the magnetic pole, and having a diameter more or less large.

2. Experiment demonstrates that in causing in highly rarified air the reunion of the two electricities near the pole of an artificial magnet, a small ring of light is produced similar to that which constitutes the aurora, and having a like movement of rotation.

3. The aurora is consequently due to electric discharges taking place in the upper regions between the positive electricity of the atmosphere and the negative electricity of the earth—the electricities being separated by the direct or indirect action of the sun, principally in the equatorial regions.

4. As these electric discharges take place constantly, though with varying intensity, depending on the state of the atmosphere, the aurora should be a daily phenomenon, more or less intense, and consequently visible at greater or less distances, and only when the night is clear—which accords precisely with observation.

5. The phenomena that attend the aurora, such as the presence and form of the *cirre-stratus* clouds, and especially the disturbances of the magnetic needle, are of a kind to demonstrate the truth of the electric origin attributed by the author to the aurora—an hypothesis with which these phenomena correspond even in their minutest details.

6. The aurora australis, according to the few observations on it which have been made, presents exactly the same phenomena as the aurora borealis, and is explained in the same manner.

Result of the Astronomer Royal's Recent Pendulum Experiments; Harton Pit, South Shields.

Addressed by Professor Airey to Mr. James Mather.

Royal Observatory, Greenwich, Dec. 2, 1854.

MY DEAR SIR,—It will be, I am sure, matter of satisfaction to you to know that the result of the computations of the pendulum vibrations gives the highest confidence in the certainty of the results to be deduced from them. The comparison of the rates of the pendulums before and after their interchanges shows, that there is no evidence of their having undergone any mechanical change whatever, and almost positive evidence against their having undergone any change amounting, in its effect on their vibrations, to 1-20th part of a vibration in a day. The immediate result of the computations is this, supposing that a clock was adjusted to go true time at the top of the mine, it would gain 24 seconds per day at the bottom. Or it may be stated thus, that gravity is greater at the bottom of the mine than at the top by 1-19190th part. To go a little further into the interpretation. If there had been no coal measures or rocks of any kind between the top and the bottom, but merely an imaginary stand to support the pendulums, the gravity at the top would have been less than at the bottom by 1-8400th part nearly. But it is less by only 1-19200th part. And what is the cause of the difference? It is the attraction of the shell of matter, whose thickness is included between the