ed observations is in this amply exemplified, as it must be remembered that the charts on which ships are navigated have the declination curves laid off on them, and have a fixed amount to be applied as an annual increase or decrease to the declination laid down, but this annual correction is a fluctuating quantity hence unless corrected from time to time errors would soon accumulate.

The diurnal or first periodic range in declination has at Toronto an amplitude of from eight to ten minutes of arc, the needle moving rapidly from an extreme easterly position about 7 to 9 a.m., to an extreme westerly one at 2 p.m., returning though with a minor curve westwards, and generally remaining to the east of the mean position all night. The other elements have also a regular daily fluctuation.

Disturbances are sudden and irregular fluctuations of the magnet, some of which seem to be comparatively local, whilst others are practically universal; changes of a similar character and almost similar amounts occuring at Zika Wei, in China; at Toronto; at Kew, in Great Briton; and at Melbourne, Australia, at almost the same instant of time. Of the causes of these irregular movements, or as they were christened by Baron Humboldt, magnetic storms, little can at present be said that is not conjecture. This much may however, be safely asserted, that all the greater disturbances when their mean effects are taken for a sufficient period of time, have a character of periodicity. This was first suggested by General Sabine in his comments on the observations at the Toronto observatory for the years 1841, 1842, and further comparisons have elicited the fact that the disturbances (speaking of the declination) are more frequent at the equinoxes than at the solstices, and occur most frequently at night the proportion of those occuring at night, to those in the day being approximately ::8 : 5 These disturbances have also a regular period approximately eleven years, a maximum occurring between 1848 and 1853, with 1843 and 1856 as the years of minimum disturbance increasing again to a maximum in 1860. Such regular fluctuations in the amount of disturbance preclude the idea that these differences are accidental.

Additional evidence of the existence of this eleven year period may be found in M. Arago's observations taken in the year 1821 to 1830, showing minimum daily range in 1823 and maximum in 1829. 1882-3 is also expected to be year of maximum disturbance, and accordingly we have already had a disturbance far greater than has been observed for many years.

The progressive increase in the range of the diurnal variation concurrently with an increase in the number and values of disturbed observations at places widely apart, suggests the idea that they proceed from some common cause, and though we cannot at present say by what physical agency these disturbancies are produced, still since we find that variations like the regular diurnal variations have also a diurnal law, and since the sun is at least a primary source of all magnetic variations which depend on local time it is natural to inquire whether the sun has any periodical variation having a coincident epoch.

Now, Mons. Schwabe's investigations extending from 1826 onwards seem to show an affection of the solar atmosphere, whose periods of maxima and minima exactly coincide with those of the magnetic disturbances and the extent of the diurnal range of the needle. In Humbold's cosmos will be found a table containing the results of M. Schwabe's observations of sun spots from 1826 to 1850, and in Walker's treatise on terrestrial magnetism the same table extended up to 1864, and from this we find that the following are the minima years: 1833, 1843, 1856 and 1866.

Another singular point is on record which adds to the weight of proof that the condition of the sun's outer envelope bears its counterpart in the magnetic condition of the earth. It was witnessed on September 1, 1859, by Mr. Carrington at Redhill, England, while observing the sun's disc. He was taking observations of the forms and positions of the solar spots, the sun's image being projected on a plate of glass, coated with distemper of a pale straw color, at a distance, and under a power which presented a picture of about 11 inches in diameter. Suddenly within the area of the largest group there broke out two patches of intensely bright white light. The outburst after increasing for some seconds rapidly died away, the whole duration of the phenomenon being not more than five minutes. In this interval the two patches had traversed a space of about 35,000 miles. On visiting the observatory at Kew a few days later he found that at the instant when he had observed the phenomenon the three magnetic elements were simultaneously disturbed, the time of duration of the disturbance being about ten minutes.

The above incident taken with the almost exact coincidence between the periods and turning points in three classes of phenomena so widely different as the magnetic disturbances, the diurnal range and the frequency