The Recent Magnetic and Electrical Disturbances.

By DR. C. CHREE, F.R.S.

THE recent magnetic and electrical disturbances have been remarkable for both their intensity and their persistence. Magnetic disturbance went on without any considerable interlude from shortly after 13h. (G.M.T.) on May 13 to 4h. or 5h. of May 17. This was followed by notable disturbances on May 19 and following days. There was, however, a distinctly quieter interval between May 17 and 19. Thus the storm was really less persistent than one presenting very similar features which began late on November 11, 1882, and continued practically without a break for nine or ten days.

As regards aurora, much depends on the season of the year, the age of the moon, and the amount of cloud. In the North of Scotland, the principal auroral region of the United Kingdom, twilight lasts so long in May that the chance of aurora being visible is but small. During the recent magnetic storm, aurora, if not generally brilliant, has been seen in a number of places. At Cambridge, aurora was seen to rise as high as the zenith on the night of May 13, and in the early morning of May 15 aurora was observed with a bright red colour. Aurora was also reported from London and other stations in southern England, where it is a rare event even at the equinoxes. Large earth-currents have been observed in the Post Office telegraph system at stations in England, Scotland, and Ireland.

The magnetic disturbances recorded at all the magnetic observatories have been of a quite exceptional nature. They reached a climax on the night of May 14-15. Almost all large magnetic storms show shorter-period oscillations superposed on changes having a more or less persistent direction for a considerable time. But the extent to which short-period oscillations prevail varies much in different storms. Also in many cases, while the disturbance of the horizontal components is considerable, the vertical force (*V*) shows little disturbance, and rapid oscillations of any size in that element are very rare. During the recent

disturbances the persistence and size of the short-period oscillations were remarkable, and during the night of May 14-15 this characteristic was shared by *V* to a quite exceptional extent. The magnetic storm of November, 1882, already referred to, also showed this phenomenon, so that, though rare, it is not absolutely unique. The year 1882, it may be noted, like 1921, was not characterised as a whole by abnormal sun-spot development.

The storm has received unusual attention in the newspapers. The writer of a leading article on the subject in the *Times* of May 19 has referred to the difficulty of providing the large store of energy required, seeing no alternative to the acceptance of the estimate made many years ago by Lord Kelvin other than the giving up of the principle of the conservation of energy. As the storm considered by Lord Kelvin was very trifling compared with the recent one, the conservation of energy may appear in a hopeless case. It may thus comfort the general reader to know that a recent estimate by Prof. S. Chapman gives a result which is nearly one million-million-million times less than Lord Kelvin's. When Lord Kelvin made his estimate his position resembled that of an eighteenth-century engineer consulted as to the possibility of warming London by burning coal in the Midlands. The better the engineer of that epoch, the deeper the pessimism to be expected. But the modern engineer, familiar with high-tension electrical transmission, whatever he might think of the scheme as a financial proposition, would not consider its realisation fatal to the conservation of energy.

If, as some modern theorists have suggested, atmospheric electric potential at the earth's surface should show some response to magnetic disturbance, the morning of May 15 was the time when the phenomenon should have declared itself. Unfortunately, some rain fell that morning in London, and a decisive answer to the question must be sought elsewhere.

The Recent Large Sun-spot Group.

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THE large sun-spot which appeared on May 8 is remarkable in several respects. The sun-spot cycle reached its maximum in 1917, and the occurrence of a large group some four years later, though by no means unique, is a matter of interest apart from its association with an intense magnetic storm. The spot group has been photographed daily at Greenwich, and reproductions of some of the photographs are given. Fig. 1 shows the disc of the sun on May 13, on which day the magnetic storm commenced. Fig. 2 illustrates

the group in detail and the considerable changes taking place in a few days. The most interesting features of the group are (a) its position exactly on the sun's equator; (b) its abnormal development; (c) its position at the time of the magnetic storm.

(a) It is a well-established fact that the change in latitude of the sun-spots is cyclical in the same eleven-year period as their frequency. Soon after the commencement of a new cycle, spots appear mainly about latitude 25° north and south of