

completely. It is rather hard for the "explanation" of magnetism.

The kinetic energy of molecules is the natural source of the radiation, but the connection between them and the electrification is very obscure, and how the electrons get knocked off is harder still, and what they are is hardest of all. Larmor thinks they run through the ether like knots on a string. If they do, as they may, *how* do they do it? Connections are wanted.

OLIVER HEAVISIDE.

### Leonid Meteors, 1902. A Forecast.

THE historical interest which attaches to the Leonid star showers naturally renders the near approach of mid-November a subject of paramount importance to meteor observers. Nor is expectation lessened on the present occasion by the moderate though somewhat unexpected brilliance of the Leonid display witnessed last year in America on the morning of November 15. The question must naturally occur to many, will there be a revival of the phenomenon in the November of 1902, and if so, will it make its appearance in a less or a more intensified form than in the previous year? Generally speaking, the prospects of a star shower on the night of November 15 this year are very good. An analysis made by the writer of the conditions under which last year's shower appeared, and also of those connected with the more brilliant meteoric spectacles of the past, shows that the event of November 15, 1901, is likely to be much surpassed by the meteoric phenomenon of 1902. The display falls due on the night of November 15 on the present occasion, and not on that of November 14 as was the case last year and was duly predicted by the writer (*Daily Chronicle*, November 14), though the maximum occurred somewhat later on that night than had been expected. The first phase of the shower will take place, however, at an hour not very well suited for its observation in western Europe, the time of its maximum being November 15d. 10h. 45m. G.M.T., when the radiant will be not much more than just above the horizon. Meteors from a radiant in full activity as it emerges above the horizon afford an interesting spectacle, however, and though their numbers must in consequence be seriously diminished, they somewhat atone for their paucity by often long, and rapid flights across the heavens. This first appearance of the shower will of course be best observed in places situated at least a few hours to the east of Greenwich, though it ought not to escape observation in our less favoured localities. This early display promises to vie in brilliancy with that observed on the western slopes of the Pacific in 1901, if atmospheric conditions turn out favourable in those places best suited for its observation on the night of November 15, and in all places where the radiant will be above the horizon at the time of its maximum it ought to render shooting stars pretty abundant during the early hours of that night.

The second maximum of the Leonid display has been calculated to take place on November 15d. 18h. 45m., and promises to be the richest display of the night, though the time of its highest brilliancy will scarcely enable observers to obtain the most satisfactory view of it on this side of the Atlantic, as the increasing twilight between six and seven o'clock in the morning must somewhat impede observation. Along the eastern coast of America, on the other hand, the shower is likely to prove an attractive spectacle to observers, and its full strength can better and more accurately be subjected to calculation than with us, as its maximum will occur there at about two o'clock (local time) on the morning of November 16. Though that hour is rather early for its best observation, as the Leonid radiant is most favourably situated for purposes of meteoric observation in any place at about 4 o'clock in the morning (local time), yet on the present occasion at no other place can a better and more systematic watch be maintained for the anticipated star shower than along the Atlantic side of the American continent. Passengers on vessels crossing the Atlantic will no doubt find themselves specially favoured with opportunities for observing the phenomenon, as has been the case in previous star showers, such as that of 1868. The calculations made with respect to this meteor display go to prove that it will decline rather rapidly after 18h. 45m. on the night of November 15, the maximum showing a tendency to occur rather before than after the time indicated, and on this account shooting stars are very likely to appear in unusual numbers to European observers throughout the night in question. As has been already stated, the shower expected in

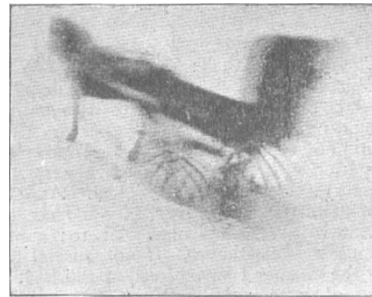
the present year gives considerable promise of surpassing in intensity that of 1901. Indeed, the calculated strength of the former is from ten to fifteen times that of the latter, but the presence of a full moon throughout the night of November 15 has not been taken into account in the determination of the foregoing comparison, and this circumstance must detract considerably from the relative splendour of the meteoric epoch of the present year. The full moon will probably obliterate the close of this year's shower, the end of which has been timed to take place on November 16d. 2h. 30m., and is generally of too weak a character to require any special consideration. It may be added that the foregoing calculations have been based on the assumption that the maximum of the Leonid shower of 1866 occurred at 1h. 15m. on the morning of November 14, G.M.T.

JOHN R. HENRY.

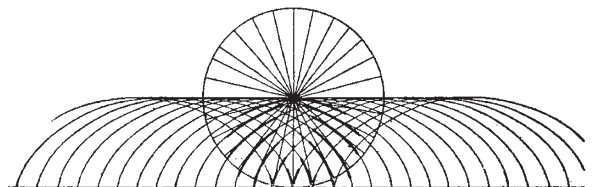
20 Rathmines Road, Dublin, November 3.

### Curvature of Wheel Spokes in Photographs.

MANY people must have noticed the curious curved appearance presented in a photograph by the spokes of a moving vehicle. It is well known that the envelope of a diameter of a circle rolling along a straight line is a cycloid of half the dimensions of the cycloid traced by a point on the circumference. The part of the moving spoke which makes the strongest impression on the photographic plate will be where it intersects the consecutive position, so that the photograph really gives us



a small piece of the envelope of each spoke. The effect may be compared to the ordinary caustics of reflection or refraction. The accompanying photograph shows, not only the curvature of the spokes, but also the cusps of the envelopes of the spokes the ends of which have touched the ground during the exposure. In the diagram, the envelopes for a circle with fourteen equidistant diameters are drawn, and the parts of the envelopes which have



been put in strongly indicate the appearance that would be presented in a photograph, supposing that three spokes had touched the ground during the exposure. The spokes on the upper half of the moving wheel leave no impression on the plate, because their points of ultimate intersection lie *outside* the spokes themselves.

R. M. MILNE.

Royal Military Academy, Woolwich, S.E.

### The Turkestan Earthquake of August 22.

INFORMATION received in India leaves no room for doubt that the earthquake of August 22, which left such conspicuous traces on the seismographs of Europe, had its origin in Central Asia. The representative of the Indian Government at Kashgar reports that there was a severe earthquake there at 8 a.m. on August 22, which lasted one-and-half minutes. Repeated