of 1911. My intention was less to explain the particular phenomenon of this summer than to direct the attention of meteorologists to a new point of view. In so far I succeeded, for a series of letters in NATURE devoted attention to this point. The fullest treatment was contained in a letter from Mr. L. G. Schultz in the issue of March 14.

I should like to reply briefly to this letter, which, owing to university holidays, I have only lately seen. According to my views, his interesting observation, that for both the middle and end of the year 1911 the state of the weather in South America was diametrically opposite to that in Europe (extremely dry summer in the north with rainy winter in the south, and extremely dry summer in the south with rainy winter in the north) does not contradict my attempt at explanation, but rather proves its correctness.

With normal ultra-violet radiation from the sun, *i.e.* with normal production of condensation nuclei, the water vapour formed in the north or south hemisphere will condense again on the same hemisphere if the necessary conditions are brought about by cooling and alterations of pressure. With abnormally small production of nuclei rain will probably not cease all over the earth, as Mr. Schultz seems to conclude, for the evaporated water must come down somewhere or other, but the occurrence of condensation will be rendered more difficult. Consequently it is possible that the water evaporated on the summer half of the earth will first find the required preliminary conditions for condensation on the colder winter half, and so come down there.

In other words, if the abnormal weather of 1911 was conditioned by the decrease of ultra-violet radiation from the sun, then the abnormal dryness on the summer hemisphere had to be accompanied by abnormal rainfall on the winter hemisphere. This is exactly what Mr. Schultz has shown beyond doubt occurred not only for the period of the northern summer, but also for the period of the southern summer. Accordingly, the period of abnormally low ultra-violet radiation of the sun extended over the whole of the year 1911. CARL RAMSAUER.

Radiologisches Institut, Heidelberg, May 30.

Alleged Ultra-violet Rays from Filament Lamps.

IN the note referring to the proposed electric lighting in the House of Commons by metal filament lamps, in NATURE of June 6 (p. 352), it is stated that "The present proposal is to use metallic filament lamps enclosed in holophane globes behind amber-coloured glass to cut off completely all ultra-violet rays." Investigations made in America and in Germany show that the ultra-violet rays from such lamps are insignificant, and are far less than in daylight giving the same illumination, and probably less than with some kinds of incandescent gas mantles.

Both physicists and electrical engineers would be interested to learn if there is any foundation for the allegation that metal filament lamps emit any appreciable ultra-violet rays or any rays which are injurious to eyesight. A. P. TROTTER.

June 8, 1912.

Earthquake of May 23.

REFERRING to the second paragraph of Fr. Sidgreaves's letter (NATURE, June 6), I think that in the reading of seismograms it is often very difficult to determine which is the first long wave from a distant earthquake. In the case of shocks which are powerful enough to give a definite impetus to the seismograph at the inception of each of the two preliminary phases, it would seem easier to determine the distance of the epicentre by means of the time elapsing between the arrival of the first and of the second phase. On May 23, by this method, both horizontal booms here gave the origin at 73.8° (8200 km., roughly), which would not be far from Burmah.

F. EDWARD NORRIS.

Woodbridge Hill, Guildford, June 8.

SOLAR HALOS AND MOCK SUNS.

THERE have been recently many observations of optical phenomena in the atmosphere which can usually be identified with the halos of 22° and 46° radius or with the allied and complementary arcs and mock suns. A brief description of the principal phenomena which can be attributed to reflection and refraction of the sunlight by ice-crystals may therefore be of interest. Full accounts of such phenomena and of the theoretical explanation of their production are given in the classical memoir on halos by Bravais, in the third volume of Mascart's "Optics" and in the third part of Pernter's "Meteorological Optics."

Ice-crystals are mainly hexagonal, and may be divided into two main classes, plates or stars with short axes and needles or prisms with long axes. The resulting optical prisms have angles of 60° or 90° for the most part. The 22° halo is formed by light which has passed through those prisms of 60°, the right cross sections of which pass through the sun. The prisms must be in the position in which the rays to the sun and to the observer make equal angles with the faces, and this is possible, for yellow light, only for prisms on a cone of 21° 50′ angular radius. The 46° halo is produced in a similar way by prisms of 90°.

If there is a preponderance of crystals floating with faces vertical, the reflection of light from these faces will give rise to a horizontal circle of light passing through the sun; and at points on this circle where the light is reinforced by refracted light, there will be unusual brilliance or mock suns. Hence the name mock sun ring. Two of the mock suns are formed by light refracted through prisms of 60°. They are at 22° from the sun when it is on the horizon, and their distance increases with the altitude of the sun. The mock suns produced by prisms of 90° are similarly at 46° or more from the sun, according to its altitude.

The arcs of contact or tangent-arcs of the 22° halo are produced by refraction through prisms of 60° floating with their axes horizontal. If the sun's altitude is less than 29°, the upper and lower arcs are distinct, but for greater altitudes they are joined to form the elliptic halo circumscribing the ordinary 22° halo.

The arcs of contact of the 46° halo are formed, according to Galle and Pernter, by refraction through crystals with vertical axes oscillating about the equilibrium position; according to Bravais and Mascart by simple refraction through crystals with one face horizontal. In the former case the arc is not part of a circle, but always touches the 46° halo; in the latter it forms part of