Letters to the Editor

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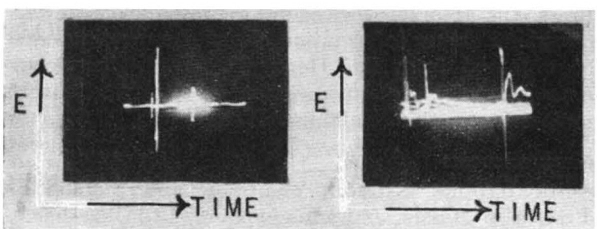
NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 974.

The Lightning Flash as Source of an Atmospheric

DURING the last few years we have made, on the roof of King's College, London, a series of observations on the rapid variations of the earth's electric field associated with thundercloud discharges, using a Wilson sphere as the conductor exposed to the earth's field, and a cathode ray oscillograph, with photographic registration, as the recording instrument[1]. In this way we have been able to follow the evolution of an atmospheric wave-form from the discontinuous change of field associated with near flashes to the type of radiation field, with its high-frequency detail, observed at greater distances. These experiments, together with allied investigations carried out at the Slough Radio Research Station of the National Physical Laboratory, were described at the recent meeting of the International Scientific Radio Union in London (September 1934).



(a) (b)

FIG. 1.

The observations have, however, more than radiotelegraphic interest, for they yield information relating to the nature of a thundercloud discharge. In the older measurements made using the relatively sluggish capillary electrometer, the effect of a net change of field was shown by a single discontinuity on the photographic record. With the string electrometer (as used here by Dr. J. T. Henderson and one of the writers) or cathode ray oscillograph, it is found that, while the most frequent type of discharge is one which takes place in a single 'step', the next most frequent type is one consisting of two or three components. The existence of these component 'steps' obviously indicates that a thundercloud moment is frequently destroyed in a series of partial discharges.

Now if atmospherics originate in lightning flashes, we might expect them to have the same tendency to occur in groups, and this is indeed found to be the case, the order of magnitude of the time intervals between successive components being the same as that observed in the net change observations made on near discharges. Two examples of such grouping are shown in the accompanying records. Fig. 1(*a*) shows a cathode ray oscillographic record of the electric field *E* during a group of three component disturbances, the wave-forms being unresolved because the time-base stroke is relatively slow (0·1 sec.). Fig. 1(*b*) shows another group of three discharges with a repeating time-base of 0·005 sec. duration. Here the atmospheric wave-forms are delineated and it is seen that the components of the group have very similar wave-forms.

It is obvious that this grouping of the net change 'steps' and atmospheric impulses of similar wave-form is to be correlated with the multiple flashes recorded by Walter and others using a moving camera. We may not, perhaps, be able to classify a thundercloud discharge as a relaxation oscillator, but the intermittent type of discharge appears similar to the familiar periodic sparking of a Wimshurst machine, steadily driven, to which a small Leyden jar is connected.

An interesting feature of the multiple flashes (and the resulting multiple atmospherics) is that a relatively big component discharge is very frequently associated with a relatively long succeeding interval, and vice versa; and in the case of many multiple flashes, the interval between any two successive partial discharges is actually proportional to the magnitude of the first partial discharge. The significance of this would appear to be as follows. We must regard the charge pouring into the head of the channel as reaching a certain critical value before a partial discharge takes place. Whatever be the (variable) amount lost in a component discharge, it appears to be replenished at a constant rate until the same critical value is again reached. An analogous effect would be provided, in the Wimshurst machine experiment cited above, by some agency which, when a spark was in progress, quenched it after a short interval of time which varied from spark to spark.

These experiments, like the allied investigations at Slough, have been carried out as part of the programme of the Radio Research Board of the Department of Scientific and Industrial Research.

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[1] Chapman, NATURE, 131, 620, April 29, 1933.

The Mass of the Neutron

THE mass of the neutron is considered by Chadwick[1] to be above 1·003 and probably to lie between 1·003 and 1·008. He gives the most probable value as determined by bombardment of boron by α-particles as 1·0067. The validity of this value rests on the assumption that γ-rays are not emitted in the process. Curie and Joliot[2] give a much higher (1·012) and Lawrence and others[3] a much lower (1·0002) value.

On the basis of the values of Fig. 1, and the mass data of Aston and Bainbridge, it seems that a probable lower limit of 1·0052 can be set for the mass of the neutron, by the use of a different