the split echo represented on the oscillograph screen in the usual way. Then, when receiving with this polarimeter aerial, A will be enhanced and B reduced to zero and vice versa, according as the goniometer search coil is switched, say, from a $+45°$ position to a $-45°$ position, and the pulses A and B will 'see-saw' as the search coil of the goniometer is rapidly switched from $+45°$ to $-45°$.

In testing this arrangement, the expected results were immediately shown in a most striking way. The transmission was on a 60 m. wave from Writtle, near

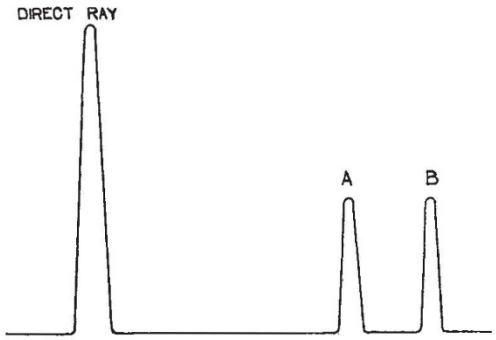

FIG. 1.

Chelmsford, to Broomfield, at a distance of 2·8 km., in which a series of pulses at a frequency of about 100 a second were sent out.

Split echoes were observed in the F layer reflections. With the aerials set up in the proper manner, switching the goniometer coil obliterated, in turn, first A and then B, producing the 'see-saw' effect expected. The results prove quite definitely that the two components are polarised in opposite directions. A knowledge of the adjustments made enables us to state that the most bent echo A is right-hand circularly polarised, looking along the ray in the direction of transmission, and the least bent echo B is left-hand circularly polarised. The arrangement enables one to examine the polarisation of each echo individually. So far as we have observed, the daytime echoes are normally right-hand circularly polarised.

This is in accordance with the view that in daytime on this wave the attenuation of the echo occurs mainly in the E layer, where according to theory the attenuation of the left-hand polarised ray should be more than twice as great as the right-hand polarised ray. This conclusion is confirmed by the observation that F_2, that is, a double reflection from the F layer, appears before the left-hand circularly polarised F_1. The arrangement should be of great help in interpreting the complex echoes that are often observed.

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Evidence of a Penetrating Radiation from Thunderstorms

WE have recently carried out experiments which suggest that a penetrating radiation is emitted by charged thunderclouds. In the arrangement used, one pen of an electric chronograph was actuated by a Geiger-Müller counter, another pen by a chronometer marking half-seconds, and a third by the atmospherics received from lightning flashes on a two-valve amplifier. The records have been examined to see whether the kicks of the counter and the flashes showed any significant time relations.

It appears that, during certain distant storms, the number of coincidences between counter-kicks and flashes is considerably more than can be ascribed to chance. Analysis of the distribution of counter-kicks in time around flashes shows that the number of kicks occurring in the particular interval of $\frac{1}{100}$ sec. which is centred on a flash exceeds the chance expectation by a factor which in the case of seven different storms varied from 3·3 to 11·4. In one case in which the counter was completely shielded by 20 cm. of iron the factor was 8·0.

Precautions were taken and tests were made to exclude spurious coincidences due to the interaction of the atmospheric and the counter amplifiers with each other, or to the direct action of the atmospheric Hertzian wave upon the counter amplifier. The seven storms which gave systematic coincidences were all at distances of 30-60 km. away; overhead storms did not show them. The results thus indicate that a thunderstorm emits some form of penetrating radiation at the moment of occurrence of a lightning flash, that this is emitted upwards and not downwards, and is received at distant points by some action such as that of the earth's magnetic field upon electrified particles.

To examine whether thunderclouds can produce such radiation *before* they are discharged by lightning, we have analysed the records of 21 distant thunderstorms (3200 flashes). The number of kicks of the counter was determined in the intervals 1, 2, and 5 sec. before and after the occurrence of each flash. The storms which gave systematic coincidences also show an excess of the order of 10 per cent in the forward as compared with the backward intervals. The probable error in the total count was 3 per cent. The other storms, which did not give systematic coincidences, show no significant effect here either, for they give a forward defect of 1 per cent while the probable error in the count is 2 per cent.

The geographical distribution of the storms which showed these effects is not easy to determine with certainty since what has been referred to as a storm is actually a record of several storms in different places. What information we have on this point suggests that the effective storms lay to the east of the meridian through the station.

Observations on overhead thunderstorms provided further evidence of the screening effect on the ordinary fine weather penetrating radiation which has already been reported by one of us.[1]

The experiments were made at the University of the Witwatersrand, Johannesburg. We wish to thank Prof. H. H. Paine for many kindnesses and to acknowledge the financial assistance of the South African Research Grant Board.

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J. P. T. VILJOEN.

University of Cape Town,
July 20.

[1] Schonland, *Proc. Roy. Soc.*, A, **130**, 37; 1930.

Viscosity of Nitrobenzene

WITH the intention of carrying out measurements of the viscosity of liquids, we have studied recently different experimental methods, and have come to the conclusion that, for relative measurements, the oscillating disc method permits of very great accuracy. Therefore we determine first the logarithmic decrement by registering the oscillations on bromide paper. The amplitude of the deflections could afterwards be measured with no great difficulty to 0·1 mm.

It seemed to us of great interest to investigate