

(5) That the equilibrium value of the secondary radiation is lower in elements of high atomic number may be explained by their greater absorption, if we assume that the rate of production is roughly the same in all elements; which seems plausible from the experiments on the absorption of the primary rays.

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<sup>1</sup> B. Rossi, *Phys. Z.*, **33**, 304, 1932.

<sup>2</sup> B. Rossi, *Atti. R. Acad. Naz. Lincei*, in the press.

<sup>3</sup> B. Rossi, *Z. Phys.*, **82**, 151; 1933.

### Penetrating Radiation from Thunderclouds

IN their recent paper<sup>1</sup> B. F. J. Schonland and J. P. T. Viljoen throw doubts on the ability of ionisation methods to detect the penetrating radiation from thunderclouds. However, this method has been in use at this station during the thunderstorm season October 1932–April 1933 with practically the same results as those obtained by Schonland and Viljoen. The order of the effect was about 1 per cent, as in their case, but storms had an effect when less than 30 km. distant. Storms less than 15 km. distant did not appear to have any effect and no appreciable diminution in the ionisation was observable from the majority of overhead storms. An important effect noted was that storms to the west of the station had more effect on the ionisation than those to the east, a fact which tends to confirm the electron spray hypothesis. The closer distance of approach of the storms, too, probably finds an explanation in this hypothesis as put forward by Hulbert<sup>2</sup>, for the station is practically located on the magnetic equator.

Some evidence of a diurnal variation of 1–2 per cent in the radiation was also found (altitude of station 11,000 ft.) and practically in phase with the diurnal variation of the atmospheric potential gradient. Whether this is only a coincidence or due to a maximum of thunderstorm activity in the Amazon basin is yet to be proved, but investigations are in progress to endeavour to elucidate this point.

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<sup>1</sup> *Proc. Roy. Soc. A.*, May, 1933.

<sup>2</sup> *Phys. Rev.*, **37**, 1; 1931.

### Recording Wireless Echoes at the Transmitting Station

IN their communication to NATURE of May 6, p. 657, Prof. S. K. Mitra and H. Rakshit claim to have succeeded in recording wireless echoes by the method of Breit and Tuve, with the receiver at the transmitting station.

Since April 1931<sup>1</sup> I have been using an apparatus I devised which permits such recording, without the difficulty mentioned by these authors of an apparent diminution of echoes as the receiver is brought near the transmitter. My device consists of a transmitter with a valve of, say, 100 watts, modulated by alternating current (commercial 50-cycle power supply) to transmit periodic signals of, say, 1/1000 sec. duration. The receiver, placed in the same room, is

provided by a two-stage screen-grid high-frequency amplifier, one stage detector (for plate characteristic) and a final one-stage continuous current amplifier. The observations are made by a cathode ray oscillograph, the spot of which is deflected along the time axis by the same alternating current. The detector valve is made to oscillate on a frequency little different from that of the transmitter: then beat curves are observed on the oscillograms corresponding to the reflected wave trains (Fig. 1): the position of the beat curves is a measure of the reflection height.\*

In my experiments I have never observed any increase of echoes amplitude by increasing the distance between the two stations (up to 500 m.): this

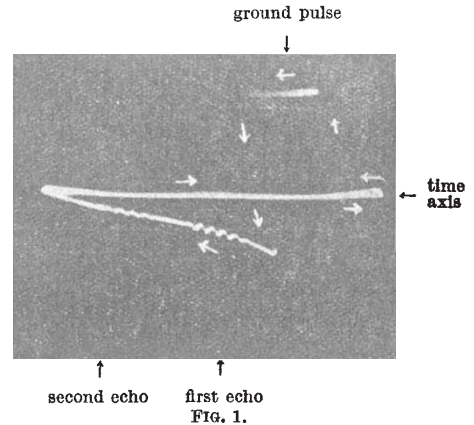


FIG. 1.

confirms the opinion of R. A. Watson Watt and L. Bainbridge-Bell<sup>2</sup> that the diminution observed by Mitra and Rakshit is due to the overloading of the receiver by the ground-pulse.

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\* For synchronisation between transmitter and receiver, the beat curves show by their movement the continuous phase variations, which the echoes sometimes present.

<sup>1</sup> *Nuovo Cimento*, p. 258; 1931. *Rendiconti Accademia Lincei*, vol. 16, p. 40; 1932.

<sup>2</sup> NATURE, **131**, 657, May 6, 1933.

### Spin and Statistics of the Neutron

THE experiments of Stern show that the magnetic momentum of the proton is greater than it should be if the proton were an elementary particle. Therefore the proton may be considered as 'consisting' of a neutron and a positron. If the Anderson positron is identical with the Dirac-Oppenheimer anti-electron, then according to the symmetry of the positive and negative electricity in Dirac's theory of 'holes', the positron should have a spin momentum of  $\frac{1}{2}$  and should obey Fermi statistics. (This view may be confirmed by the fact that Dirac's theory of 'holes' in all probability gives an explanation of the continuous  $\beta$ -spectrum, especially of the sharp upper limit.) This leads at once to the conclusion that, contrary to the present hypothesis, the neutron should have an integral spin momentum and should obey Bose statistics.

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