LETTERS TO THE EDITORS

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Ground and Cloud Scatter of Electromagnetic Radiation

In former communications, the scattered echoes observed with high-power pulses have been described^{1,2}. On a frequency above the vertical-incidence critical frequency there are normally short-lived echoes produced by direct scatter from ionic clouds in region *E*, and a patch of long-delayed diffuse echoes which has been assumed to be produced by energy which has been reflected obliquely from region *F* and scattered on its way down to the ground.

Although the rapid reduction in amplitude with increase of frequency suggests that the long-distance scatter is produced by the clouds in region *E*, it has been difficult to prove that the scatter is not, in fact, at the ground. Using the known theory of oblique transmission, it is possible to calculate the shortest possible delay-time from the *h'f* curve on either assumption as to the origin of scatter. The difference is not large, but recent experiments in which both have been simultaneously observed have definitely shown that cloud-scatter is responsible.

The first experiments were made using a fixed frequency of 8.8 Mc./s. A typical record of the observed variation of delay-time (in units of kilometres of equivalent height) is shown in Fig. 1, together with the calculated values.

It has since been made possible to vary the frequency of the transmitter, so that the equivalent of an *h'f* curve is possible: A typical example is shown in Fig. 2.

Fig. 1. Scatter delay on 8.8 Mc./s., Oct. 3, 1943. $\times$, Observed scatter delays; —, calculated delay for cloud scatter; - - -, calculated delay for ground scatter.

Fig. 2. Scatter *h'f* curve, 1110–1123 G.M.T., Jan. 4, 1944. $\times$, Observed scatter delays; —, calculated delay for cloud scatter; - - -, calculated delay for ground scatter.

It will be observed that in both cases the agreement with calculated values shows that the scatter is in fact from the ionic clouds, and the original theory is entirely vindicated. It is not proved that ground-scatter does not exist, because it would be mixed in with the cloud-scatter from lower-angle transmission; but the fact that there is no noticeable increase of amplitude at the delay corresponding to the ground-scatter shows that the cloud-scatter is predominant. The cloud-scatter will be less at higher frequencies, so that eventually the ground-scatter will predominate; but this is not likely to be the case until frequencies greater than about 30 Mc./s. are used, where ionic scatter becomes unimportant because of the lack of *F*-region transmission.

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¹ Eckersley, T. L., *NATURE*, **143**, 33 (1939).

² Eckersley, T. L., *J. Inst. Elect. Eng.*, **86**, 658 (1940).

Effect of Temperature upon the Mechanical Properties of Rubber-like Materials

IN the course of investigations into the mechanical properties of natural and synthetic rubber intended for use in anti-vibration devices, variations of a large order were encountered. As these variations seemed largely dependent upon temperature, a preliminary detailed examination in the region of 5–40° C. has been made. Using a mechanical vibrator somewhat similar to that employed by Gehman¹ and working at 20–60 c.p.s., measurements of dynamic elastic compression modulus and associated resilience were made by the well-known resonance method. A