channels, the porosity was altered from 0·2 to 0·99. The curves measured for the frequency 5,000 Hz. are reproduced in Fig. 1. These curves correspond in the measured range to the theory of Rayleigh and Paris. For the above mentioned materials, curves were obtained in the specified frequency range, which have the form of the theoretical curves for small and intermediate porosities; cotton wool has curves corresponding to a large porosity.

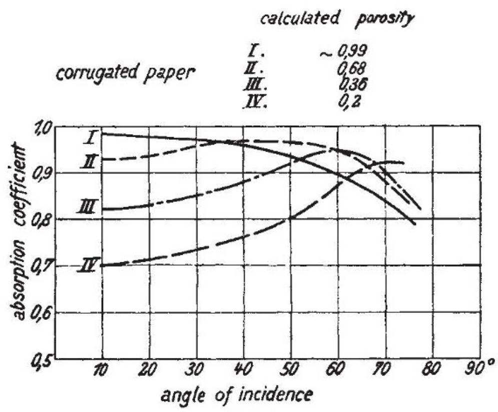

FIG. 1.

Secondly, the dependence of absorption upon frequency was tested. The acoustical impedance was measured for normal incidence in a tube with the help of an electrostatic vibrometer. Theory and experiment show, that the real part of the characteristic acoustical impedance (for infinite thickness) decreases with increasing frequency from a large value to a limit, while the imaginary part decreases to zero. The limit is given theoretically by the expression $\frac{Z_0}{P}$, where Z_0 = acoustical impedance of air and P = porosity. The characteristic limiting impedance of porous materials is always larger than that of air; it follows that a maximum must exist in the above mentioned curves showing the dependence of absorption on the angle of incidence, which is given by the relation $\cos\theta_{max.} = \frac{Z_0}{Z}$ (Z = impedance of the material). The absorption coefficient increases continuously to a limit and has, therefore, on account of porosity alone no maximum. Selective absorption is explained by interference due to limited thickness. This effect has also been investigated.

Details of this work will be published towards the end of this year in the *Elektrische Nachrichten-Technik.*

VIKTOR KÜHL.
ERWIN MEYER.
Heinrich-Hertz-Institut
für Schwingungsforschung,
Berlin NW 87.
Aug. 10.

[1] NATURE, 126, 9, 350, 880; 1930.

Efficiency of Geiger Counter and Absorption of Cosmic Rays

THE efficiency of a Geiger counter may be defined as the probability of excitation when the counter is traversed by a high speed electrified particle. A determination of the efficiency for cosmic rays may be obtained in the following way. Imagine three counters 1, 2, and 3, which are placed with their axes in the same plane and their centres in the same (vertical) line. Let n_{13} be the number of coincidences between 1 and 3 and n_{123} the number of triple coincidences. The efficiency of the counter 2 is then determined by $n_{123} : n_{13}$.

In the experimental arrangement the dimensions of the counters were 5 cm. × 20 cm.; the counters were filled with air at a pressure of 4–9 cm. of mercury. The central electrode was a steel wire treated with nitric acid. The counters were placed in a vertical plane with a distance of 15 cm. between their axes; lead blocks 7 cm. × 10 cm. × 20 cm. could be placed between the counters. Below and on the sides the whole arrangement was screened by 10 cm. of lead in most of the experiments. The method used for recording coincidences has been described previously.[1] It consists essentially in imparting the impulse delivered by the counter to the mirror of an oscillograph. When coincidences between two counters are recorded, the deflections of the two mirrors are crossed, so that when a coincidence occurs the actual deflection makes an angle of 45° with each of the single deflections. In the present experiment it was necessary to use four oscillographs in order to record coincidences between three counters. The deflections of the four mirrors were crossed in such a way that the three possible kinds of coincidences, namely, 1-2, 1-3, and 2-3, were all recorded on the same film.

The smallest time difference which can be detected by this method is 2×10^{-4} sec., corresponding to one-tenth of the duration of the impulse. The number of single impulses from each of the counters was about eighty per minute, the number varying somewhat with the experimental conditions. This gives for the number of accidental coincidences between two counters 0·05 per minute, and for the number of accidental triple coincidences $2{\cdot}4 \times 10^{-5}$ per minute. The number of coincidences actually observed was for neighbouring counters about five per minute and for triple coincidences one per minute. The corrections for accidental coincidences are thus very small.

When the counters were operated at a potential a few volts above the lower limit of the sensitive range of voltage, about half of the coincidences 1-3 were triple coincidences, or, what is the same, the efficiency of the counter 2 was 50 per cent. At a potential 30 volts higher the efficiency was 85 per cent. The statistical material was too small for giving accurate numerical values, but in all experiments the same general result was found, the efficiency approaching unity at the upper limit of the sensitive range of voltage.

The justification for considering the efficiency as a property of the counter and not of the exciting radiation lies in the fact that the results were only determined by the voltage of the counters, and not by the presence or absence of the lead absorbers between and on the sides of the counters. This result has some bearing on the problem of the nature of the cosmic rays. If the cosmic rays were of electromagnetic nature, it seems very difficult to account for the values of efficiency actually observed.

J. C. JACOBSEN.
University Institute for Theoretical Physics,
Copenhagen.
Sept. 5.

[1] NATURE, 128, 185; 1931.

Spectrum of Cosmic Radiation

WITH respect to the formula suggested by Dr. A. St. Skapski in NATURE of Sept. 24, p. 472, it is of interest to note that such a formula can be deduced from the classical equations of Maxwell without reference to wave mechanics (*Proc. Roy. Irish Acad.*, vol. 41, A, No. 2).

ARTHUR W. CONWAY.
University College, Dublin,
Sept. 27.