The increase of the number of atmospherics received does not correspond with the number of atmospherics produced but with an improvement in the propagation of the long waves over a great distance.

The same ionospheric phenomenon is obvious as an opposite effect in the short-wave spectrum. M. Jouaust, secretary of the Comité Français de Radiotélégraphie scientifique, was the first to emphasize the interest² of the study of sudden fading in short-wave commercial traffic; they have since been observed on different continents. They coincide with the increase of atmospherics on long waves³.

The study of atmospherics has now acquired a new interest. It seems certain that some peculiarities of these records are closely associated, in time, with ionospheric perturbations, which, at least in part, are the direct consequence of solar eruptions.

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Jan. 4.

¹ Bureau, R., "Électricité atmosphérique et parasites atmosphériques", Communication faite à l'Association Internationale de Magnétisme et Électricité terrestres, Assemblée d'Edimbourg Septembre 1936. Document n°44.

² "Rapport sur certains phénomènes d'évanouissements", 1935.

³ Bureau, R., and Maire, J., "Anomalies Ionosphériques à début brusque", *C.R. Acad. Sci.*, **203**, 1276 (1936).

rest. Therefore we can associate with a single particle-observer P more than one *linear* reference system. This arbitrariness, however, disappears in the three-dimensional case, where we impose a geometry on a reference system. For the papers of Engstrom and Zorn² and of Robertson³ show that we can associate at most a single Euclidean reference system with P . Hence it would seem that we are able to dispense with both the concept of the rigid measuring rod and that of the isochronous clock in this case, or, to put the matter the other way around, we have established an ideal criterion by which to test both the rigidity of material rods and the isochronism of material clocks.

The statement in my paper⁴ which Synge criticizes should be taken to refer to the *relative* readings of the clocks of P and P' .

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Dec. 4.

¹ Synge, J. L., *NATURE*, **138**, 28 (1936).

² Engstrom and Zorn, *Phys. Rev.*, **49**, 701 (1936).

³ Robertson, H. P., *Phys. Rev.*, **49**, 755 (1936).

⁴ Page, Leigh, *Phys. Rev.*, **49**, 254 (1936).

Equivalent Particle-Observers

IN A letter to *NATURE*, Prof. Synge has pointed out¹ that the condition of equivalence of two distant particle-observers does not completely define the time-scale of either, and that *any* two distant particle-observers may be provided with clocks which satisfy the condition of equivalence and make the relative velocity of the two equal to zero. Synge concludes that the relativistic theories developed by Milne and by me fail to dispense with both the concept of rigid bodies and the concept of absolute clocks.

My approach to the relativistic kinematics differs from Milne's in that he employs the concept of equivalence to establish reference systems consisting of dense aggregates of synchronous particle-observers relatively at rest. Now Synge's analysis of the time-scales of two equivalent particle-observers whose world-lines do not intersect shows that all successive time intervals $F_{n+2, n+3} - F_{n, n+1} = 2k$ (Synge's notation) must be the same if the observers have no relative velocity. As k is the distance r between the particle-observers divided by the velocity c of light, this means that the time-scale of either observer is divided uniquely into successive intervals of magnitude $2r/c$, but that the subdivision of any one of these intervals into smaller intervals is arbitrary. As the distance r between the two observers is made smaller, however, the smallest interval $2r/c$ uniquely determined becomes proportionately smaller. Hence, even the smallest time intervals on the clocks of a dense assemblage of synchronous particle-observers constituting a reference system are completely determined.

Now consider two particle-observers P' and P'' whose world-lines cross, but neither of which intersects the world-line of P . As Synge indicates, with one pair of clocks we can make P and P' synchronous and relatively at rest, whereas with another pair we can make P and P'' synchronous and relatively at

Microscopic Examination of Fog-, Cloud- and Rain-Droplets

OF the many methods proposed hitherto for the measurement of the size and concentration of droplets in fogs and clouds, none can be considered as quite satisfactory. The extensively used method of diffraction rings (corona) can be applied only in the relatively rare case of isodisperse fogs. The photographic method devised by Findeisen¹ is rather complicated, and can scarcely be used in field work. The direct measurement of the droplets collected on greased wires or on glass slides is hampered by very rapid evaporation of the droplets and distortion of their spherical shape. The method proposed recently by Hagemann², namely, collecting the droplets on a thin layer of castor oil and photographing them during their fall through the layer, has many disadvantages and can be used only for droplets with a radius less than 5μ .

After having tried unsuccessfully many different methods, we discovered that quite satisfactory results can be obtained by collecting the droplets on glass slides coated with a freshly melted mixture of vaseline and light mineral oil. The proportion of the ingredients depends on the temperature of the air (about 1:3 at 20°C., 1:5 at 0°C., and so on).

This mixture has the property of instantly enveloping the water droplets as they settle with a thin film, which practically prevents both evaporation of the droplets and condensation of vapour on them, without affecting their spherical shape. The droplets thus collected on the slides can be preserved in a damp atmosphere for many hours without showing any perceptible diminution in size. The only condition which has to be observed is that the temperature at which the droplets are kept and measured is equal to or below that at which they were collected or, at any rate, does not exceed it by more than a few degrees. The smallest droplets, distinguishable only with a microscope objective of the highest resolving power, can be examined in this way, as well as rain-droplets of 2-3 mm. diameter. The thickness of the vaseline layer must, however, be greater than the diameter of the droplets.