Letters to the Editor.

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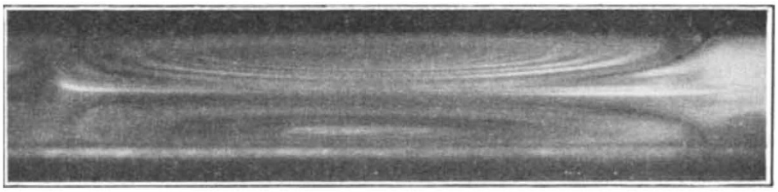
Phenomena in a Sounding Tube.

From the recent papers by Mr. P. S. H. Henry [1] and others, it appears that interest is being taken in the phenomena which occur in a sounding tube. It may be well to direct attention to some results I have obtained, publication of which will shortly take place, having been delayed by illness.

Direction of circulation at the centre→



Node Direction of circulation at the wall← Antinode

Fig. 1.—Node to antinode circulation in dust-free air.

There are two main phenomena which have been hitherto undetected in experimental work on Kundt's tube, one of which takes place in the absence of all dust and is a free circulation of the air, while the other is caused by the presence of dust particles. In general, particles of dust of the size and mass used are much too massive to act as tracing points for the air motion, but behave rather as obstacles over which the vibrating air washes, although they may partake to some extent of the motion. Particles of smoke, however, can be shown to take up the full motion of the vibrating air for ordinary acoustic frequencies, although with supersonic frequencies they do not, a point on which investigations are being carried out here. At a frequency of 1200 per second, for example, the ratio of the amplitude (or velocity) of the smoke particle to that of the air is 0·9996.

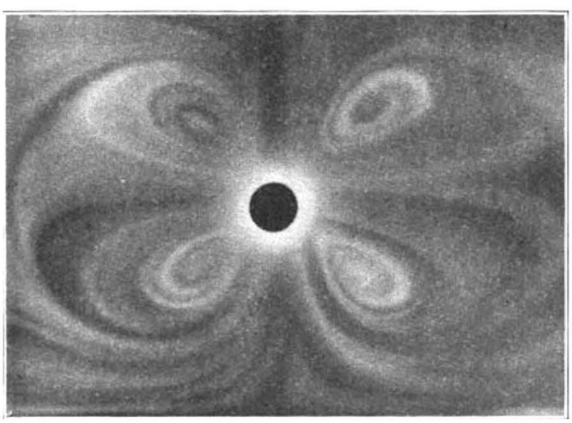


Fig. 2.—Vortex system formed round a sphere by vibrating air. The obstacle has been emphasised: otherwise the picture is an untouched print. The vertical band extending above the obstacle is a shadow, not a material bar.

Using smoke in a tube containing air set in vibration by a valve-maintained diaphragm,[2] a perfectly regular circulation of air, from antinode to node along the walls and returning down the centre of the tube, has been detected. The nature of the circulation can be clearly seen from the photograph reproduced in Fig. 1, which represents part of a long tube of 3·5 cm. diameter, the wave-length being 56·6 cm. A circulation of this kind was predicted by Lord Rayleigh,[3] who believed that something of the kind had been seen by Dvorak. What Dvorak saw, however, was a motion of large particles of quite a different nature, as will be made clear in the forthcoming publication. The lines of flow of the motion shown in Fig. 1 agree pretty closely with those that can be computed from Rayleigh's formula, the main difference being that the distance from the wall to the surface at which the direction of flow reverses is found experimentally to be 0·33 times the radius, while according to Rayleigh's calculation the figure comes out to be 0·293.

The other new phenomenon is the motion of the air caused by the presence of an obstacle, and hence by a particle of dust, the inertia of which is sufficient for there to be a large motion of the surrounding air relative to it. When certain critical conditions, suggested by application of the principle of dynamical similarity, are satisfied, a vortex system of the type represented in Fig. 2 is formed round a spherical obstacle; a similar system, modified in the general way to be expected, has been detected round a cylindrical obstacle. This is believed to be the first example of a vortex system generated by a vibrating fluid.

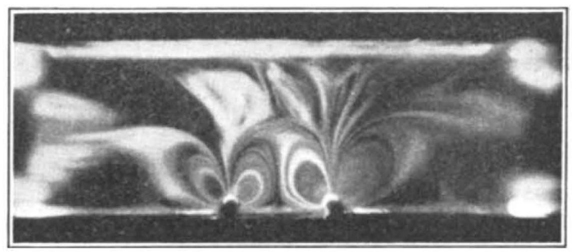


Fig. 3.—Method of formation of dust ridges by means of vortices.

Such vortices are the cause of the ridge systems which form in an excited Kundt's tube, the general method of formation of the ridges being illustrated in Fig. 3, where two cylindrical obstacles, lying on the floor of a flat tube, are shown in equilibrium. It has been found that a combination of the general circulation and of the vortex motion caused by particles can account for practically all the phenomena which take place in a dust tube.

E. N. da C. Andrade.

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[1] *Proceedings Physical Society*, vol. 43, part 3, No. 238.
[2] Nature, Nov. 9, 1929.
[3] "Collected Papers", vol. 2, p. 239.

Determination of the Molecular Weight of Insulin.

At the suggestion of Dr. H. Jensen, of the Johns Hopkins University, Baltimore, an ultracentrifugal investigation of insulin has been carried out in my laboratory by Mr. B. Sjögren. A quantity of 0·25 gm. crystalline insulin was kindly put at my disposal by Dr. Jensen, and this small sample proved sufficient