LETTERS TO THE EDITOR.

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The Flow of Thin Liquid Films.

WHILST observing the "Brownian" movement of particles of gamboge in water with the aid of a microscope (magnification, about 360 diams.), it occurred to me to press gently on the cover-glass of the slide, so as to cause a movement of the water containing the suspended matter, and to note the paths of these in the vicinity of some larger stationary masses, as one would then be approaching the condition set forth by the late Sir G. G. Stokes, namely, that liquids in thin films behave as frictionless fluids. The results fully confirmed the behaviour of such thin films of liquid. The moving particles, as they rushed by the stationary masses, showed no trace of eddy currents, passing along the edges of the obstacle and leaving it without any swirls, as shown in Fig. 1. The moving particles next to the obstacle had a high velocity, and were in greater numbers per unit area, than those further removed; the obstacle had no effect upon distantly removed portions of the liquid—they moved in straight lines. For very low velocities the course of the particles was exceedingly in accordance with the motion of a frictionless fluid. With high velocities, a cone of slow-moving liquid formed both in front and behind the obstacle, as shown in Fig. 2. When two masses are in the same line of flow, it is difficult to prevent a certain number of particles, mapping out a stream-line, from crossing over from one side to the other between the obstacles, as shown in Fig. 3. We have here a hydrodynamical analogy to the circuit of a Wheatstone bridge

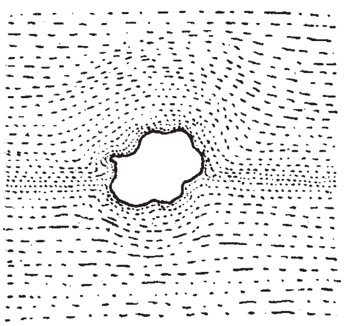

FIG. 1.

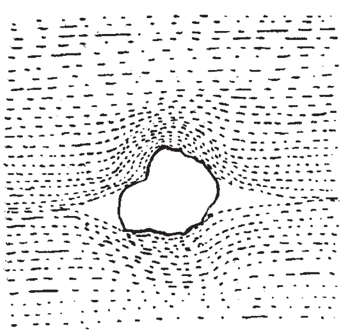

FIG. 2.

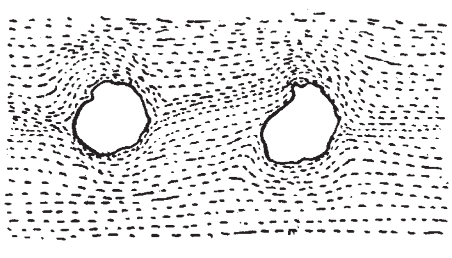

FIG. 3.

when determining the value of an unknown resistance. The liquid represents the metallic circuit, the particles of gamboge the current—or the corpuscles if preferred, the two obstacles the insulation between R_1, R_2 and R_3, R_4, and the fluid between them the galvanometer circuit. When equilibrium is established, no current flows through the galvanometer: no fluid passes across the intervening space between the two obstacles. Vary any one of the resistances, and equilibrium is upset, causing a current to flow through the galvanometer; cause an unbalanced pressure on one side or the other of the line joining the two obstacles, and a current of fluid flows from the place of greater to that of lesser pressure.

Very interesting effects are produced by introducing air bubbles into the liquid instead of solid obstacles. On pressing the cover-glass, the bubble appears to increase in size, while at the same time a rush of liquid passing it is noticed; on releasing the pressure, the bubble contracts, the liquid moving in the opposite direction. One of the most striking effects is seen when a bubble moves of its own accord through the liquid. The effect is difficult to produce, but well repays the effort. As before, gamboge is used to define the course of the surrounding fluid. As the bubble moves forward, the fluid next it is seen to be moving along its edge in the *same direction*, while at a little distance it is moving in the opposite direction to that in which the sphere moves. This effect is shown by the arrows in Fig. 4, the heavy arrow denoting the direction in which the sphere is moving. At the pole *c* the fluid seems to appear, passes with a high velocity to the pole *d via* the surface of the bubble, and disappears. The effect of the moving bubble on the surrounding liquid extends for a great distance compared with the case when the liquid is in motion and the obstacle stationary (*vide* ante).

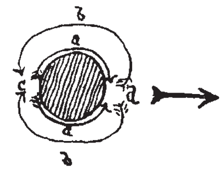

FIG. 4.

W. G. ROYAL-DAWSON.

4 Montague Street, London, W.C., March 6.

Water-Vapour on Mars.

I NOTE in NATURE of February 9 (p. 486) an account of a recent unsuccessful attempt to verify the existence of water-vapour on Mars, already demonstrated by means of other methods by Dr. Slipher and myself (see *The Astrophysical Journal*, vol. xxviii., p. 397, December, 1908, and Lowell Observatory Bulletins, Nos. 36, 43, and 49). Will you allow me to point out that the method employed by Director Campbell was proposed several years ago by Dr. Percival Lowell, and was actually tested by Dr. Slipher at the Lowell Observatory in 1905, with a result similar to that which Director Campbell has now obtained in his repetition of the experiment? The details may be found in Lowell Observatory Bulletin No. 17.

The reason for the failure perhaps lies in the insensitiveness of the method. The spectrum of a body no brighter than Mars cannot be obtained with the utmost fineness of detail under a high dispersion, because a relatively wide slit has to be used, or else a very long exposure must be given to the photographic plate, either of which is fatal to sharp definition of fine spectral lines. In these circumstances it is not easy to distinguish between the terrestrial and planetary components of a fine absorption line with the high dispersion which is absolutely necessary to the success of the experiment.

It still seems to me that the best method of measuring the Martian aqueous vapour which is at present available consists in the observation of the little *a* band with a spectrograph of low dispersion, which gives the band as a shading in which individual lines cannot be discriminated, but the integrated intensity of which can be measured photometrically. The method is also applicable to those diffuse bands discovered by Abney and Festing in nearly saturated aqueous vapour, which apparently are not composed of fine lines, but which are sometimes much more intense than the linear groups.

FRANK W. VERY.

Astrophysical Observatory, Westwood,
Massachusetts, March 6.

The Fox and the Fleas.

I HAVE just been told a very interesting story by Mr. James Day of this town. Many years ago he and his father, both then engaged in agriculture, were sitting with their backs to the straw-covered hurdles which had