already referred to. The phenomenon is thus of a complicated nature which it is hoped further to investigate.

GILBERT D. WEST

Military College of Science,
Shrivenham,
near Swindon, Wilts.

[1] *Nature*, **159**, 132 (1947).

[2] Raleigh, "Sound", **2**, 202, describes a somewhat similar phenomenon.

A REPETITION of the demonstration described by Prof. G. D. West in *Nature*[1] showed that it works particularly well with a wide test-tube of length suitable for a 256-fork (even the small laboratory pattern), and having at the closed end a central hole of diameter less than 1 mm., shaped rather like the small aperture of a Helmholtz resonator. By performing the experiment with the aid of a projection lantern, both this effect and a reverse effect not mentioned by Prof. West can readily be shown to a large class. On bringing the tuning fork near the open end of the tube, a puff of smoke is seen to issue from the hole in the closed end, followed by a steady stream of smoke so long as the vibrating tuning fork is held in position. Under the same conditions, a puff of clear fresh air can be seen to enter the tube from outside, followed by a steady stream of fresh air. This is precisely what one would expect, for the closed end of the tube is a pressure antinode, and the so-called 'steady pressure' of sound is in reality a differential effect in which the compressional phase preponderates over the rarefactional phase, the alternating emergence and intake of gas observed at the orifice taking place so rapidly that the eye sees what appears to be a steady stream of gas flowing simultaneously in both directions at the orifice.

The existence of a pressure antinode at the closed end of a resonance tube can also be clearly demonstrated by an arrangement devised by me in 1937 and hitherto unpublished. A glass tube is closed at one end by a clear glass disk about 1 mm. thick. The open end of this tube is attached by 'Plasticene' to the mouth of a loud-speaker (disk type) actuated by an oscillator of variable frequency. The glass disk is found to vibrate perceptibly for certain frequencies of the oscillator, and if a long-focus convex lens is attached by wax peripherally to the glass disk, the resonant states in the tube can be detected by observation in sodium light of the disappearance or enfeeblement of the Newton's rings formed between the lens and disk. With this arrangement, up to eight harmonics of the fundamental frequency of the tube can be detected.

Quite recently another simple device has been found to be very sensitive for the detection of resonance and the existence of an antinode of pressure at the closed end of a cylindrical tube. The closed end is formed by attaching a thin 'Cellophane' sheet to one end of the tube (a 'Cellophane' jam-pot cover serves admirably). The 'Cellophane' is applied wet, and on drying it is quite taut and vibrates vigorously when a suitable tuning fork is held opposite the open end of the tube. If a small quantity of silver sand is dropped on to the 'Cellophane' membrane and the tube is of variable length, the adjustment for resonance can be accurately determined, either by the intensity of the clearly audible patter of the sand on the membrane, or visibly by observation of the movement of the sand. This effect is not to be confused with the corresponding effect in which sand on thin tissue paper attached to a ring is used for detecting antinodes of motion in an organ pipe. The sand on 'Cellophane' detector can be employed effectively in the lantern to demonstrate resonance, when the motion of the sand can be seen and the patter of the sand is audible even in a large lecture room.

In conclusion, it may be mentioned that any of these methods can be used for demonstrating the existence of the 'interference hyperbolæ' around the end of a tuning fork, for the effects described cease as soon as the interference regions fall on the axis of the tube. Either the Newton's rings detector or that using 'Cellophane'-sand can be used with advantage in a laboratory method for the determination of the velocity of sound. The latter detector has been applied successfully for this purpose in this laboratory by my colleague, Dr. E. L. Yates. In the original form of the apparatus, one end of the tube was closed by a loud-speaker element operated by an oscillator at fixed frequency (1,600 cycles per second). The receiver was a hollow cylinder fitting closely in the tube and closed at the near end by a thin copper membrane. The other end of the cylinder was connected to a straight brass tube ending in a rubber listening tube. By noting the position of an indicator on the brass tube for a number of successive resonances, the wave-length of the sound waves could be determined, and hence the velocity. In its modified form, the bottom end of the glass tube is closed by a 'Cellophane'-sand detector and the loud-speaker element (deaf-aid type) is attached to the end of the brass tube. With this arrangement the wave-length can be determined with much greater accuracy, the audible patter of the sand giving sharp response at resonance when the oscillator is operating at minimum output.

ROBERT W. LAWSON

Department of Physics,
University of Sheffield.

Dec. 24.

[1] *Nature*, **158**, 755 (1946).

"The 'Squares' Method for Potential Problems"

THE review by Prof. G. Temple in *Nature* of November 23 is more than generous to my recently published book on "Relaxation Methods", and with my fellow-workers I am grateful for his praise ; but a slip in its penultimate paragraph will, I fear, cause misunderstanding if it is not corrected. It is not the relaxation technique but the technique employed, for example, by Shortley and Weller of Ohio State University (who have attributed it to Liebmann, 1918) that "consists in systematically working over the lattice and everywhere replacing the original approximate values of f by the means of its values at the neighbouring corner points".

For brevity this systematic process may be described as 'scanning', since Wiener (among others) in the United States has suggested that the methods of television might be employed to speed up the mean-value computations. It finds no place in the technique of relaxation methods, in which (excepting in the final presentation of results) values of f are *not* recorded at lattice points. Instead, the values recorded are those of 'residuals' defined (in Prof. Temple's notation) by

$$F_P = f_A + f_B + f_C + f_D - 4f_P$$