polished to a high degree: special attention was paid to the regions near the edges being as bright as those near the centre. The other filed coin was brought into contact with 'Plasticene', which tarnished its surface immediately. This was more satisfactory than oxidation by heating, since the risk of deforming the coin was eliminated. The remaining coin was dull and needed no attention.

The filed and normal coins were placed in pairs on the same neutral background and illuminated by a parallel beam of light from a carbon arc. Four filters were used: Ilford Nos. 204, 304, 404 (red, blue, green) and one neutral-tinted plate. Nineteen observers were told that the respective pairs consisted of reputedly equal coins, and each put down his result for eight observations: four each for perpendicular and oblique illumination. All observations were carried out *along* the reflected beam.

It is found that, in the case of oblique lighting, the bright coin appears to be the larger in all cases except for the filed coins illuminated by neutral light. This general result is to be expected on account of irradiation. The observations for perpendicular incidence are much less convincing: in the case of the filed coins, the dull appeared to be the larger in all except blue light, and there the difference is too small to defy confirmation. It is to be expected that the scales would tip in favour of the dull coin, since another set of experiments to be published in detail elsewhere demonstrated the independence of the effect on the colour of the filter. Moreover, in the instances where the dull coin in general appeared to be the larger, the filed coin showed the effect in a much more pronounced way than the normal threepenny bit. This is rather remarkable since perpendicular illumination might be expected sensibly to diminish the appearance of unevenness of the normal coin, as all shadows are greatly reduced.

The fact that the filed coin is much more effective in giving the illusion of size indicates that an explanation of the phenomenon may have to be rejected if it is based on the way light is reflected from the coins. This applies not only to Prof. Hartridge's note but also to that of Mr. Phelps[3].

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[1] *Nature*, **156**, 118 (1945).
[2] *Nature*, **155**, 672 (1945).
[3] *Nature*, **156**, 269 (1945).

Measurement of Ultrasonic Velocities in Extended Solids

FOR extended solids, the ultrasonic frequencies to be used for any reasonable propagation of the waves through them must be low, say, 500 kilocycles and less, for the vibrations of higher frequencies will be excessively damped. For determination of velocities at higher frequencies, a method based on the Debye–Sears ultrasonic diffraction of light has already been indicated[1], and in the following we will describe the method found for the lower frequencies.

Two quartz crystals, T and R, X-cut and of equal thickness, were attached to the opposite ends of a 2 ft. column (3 in. × 3 in.) of cement-sand concrete. The ultrasonic vibrations (frequency 300 kc./sec.) were sent by T and received by R after their propagation in the solid. The voltage developed at R by piezo-electric action was fed to the input of a vacuum-tube ultrasonic detector specially made for the purpose (employing two stages of radio-frequency amplification followed by one of rectification and one of D.C. amplification), such that the presence of an input voltage at the grid of the first valve gave a change in the steady plate-current of the last valve. The vibrations at T were produced by a conventional Hartley-type transmitting circuit. The voltages tending to reach the input of the detector were of two origins, one of ultrasonic origin from R, and the other due to the electromagnetic waves coming from the transmitting circuit. By exposing the screened lead coming from the crystal R, or exposing the grid of the first valve under controlled conditions, it could be arranged that the voltage due to the electromagnetic waves was much greater than that of ultrasonic origin, but not so much as to prevent the possibility of the indication of the latter. The change in the plate-current of the last valve of the ultrasonic detector was due to the vector sum of the two voltages, and by varying the frequency of the transmitting circuit (tuning of the detector system being adjusted simultaneously) through a small region, say, 5,000 cycles or less, so that the change of frequency did not go beyond the resonance region of the crystals, a maximum and minimum of the plate-current could be produced. Evidently the maximum occurred when both voltages were in phase, and the minimum when they were in anti-phase. Now the phase of the electromagnetic waves reaching the ultrasonic detector was only negligibly changed, if at all, in this small variation of frequency due to their long wave-length (1,000 metres) as compared to the distance between the transmitting circuit and the ultrasonic detector (a few feet). So, for the minimum of plate current the phase of the voltage of ultrasonic origin had changed sign. This indicated that the number of ultrasonic wave-lengths in the solid column had changed by half a wave-length.

Let f be the length of the column, f_1 and λ_1 the frequency and wave-length for maximum current, and f_2 and λ_2 for minimum current, and v the velocity of ultrasonics, assumed the same for both frequencies. Then

$$l = n\lambda_1 = (n \pm \tfrac{1}{2})\,\lambda_2$$

or

$$l = n\frac{v}{f_1} = (n \pm \tfrac{1}{2})\frac{v}{f_2}.$$

From which

$$v = 2l(f_1 \sim f_2).$$

Taking v as about 6,000 m./sec., l as 2 ft., $f_1 \sim f_2$ is about 5,000 cycles/sec., which can be easily measured by modern technique.

The region of resonance frequencies of the quartz can be easily made to contain this frequency interval, as was the case in our experiments. For lower frequencies, the thickness of the quartz is comparable to its other dimensions, and so by the coupling of the different resonance frequencies, the resonance frequency region is made sufficiently broad.

It is hoped to publish the full details of the apparatus and the quantitative results obtained in due course.

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[1] Parshad, R., *Curr. Sci.*, **13**, 14 (1944).