shown in Figs. 1 and 2, from 207 to 430 individuals to each point.

The curve calculated by the formula is perfectly symmetrical whereas the experimental one may or may not be. It is not necessarily a natural attribute of the population to produce a skew curve. The degree of skewness can be shown to vary from none to considerable when the temperature is varied at which a population of beetles is fumigated. Skewness of the experimental data is of little consequence in the present connexion; if the fit is good between 50 and 100 per cent the skewness at the lower end of the curve may be disregarded.

Two factors affect precision in any method for estimating high percentages of mortality. First, the sharper the distinction between living and dead individuals, the easier it is to determine where the toxicity curve will probably reach 100 per cent. Secondly, since an *S*-shaped curve is asymptotic at high percentages, estimates of complete kill by any method involving a consideration of the course of toxicity, must be calculated at a figure slightly less than 100 per cent. The point chosen may vary with the method used. The author has found the 99·0 per cent values calculated by his formula to represent very good estimates of the 'maximum non-lethal dose'.

H. H. SHEPARD.

University of Minnesota,
St. Paul, Minn.
July 12.

---

[1] Bliss, C. I., *Science*, **79**, 38–39, 409–410; 1934.

## State of the Earth's Central Core

IT would be premature to discuss at length the identification of *S* waves through the earth's core, announced by L. Bastings[1], until the complete paper is available. Nevertheless, the failure of previous investigators to detect these waves with any confidence invites comment. If the waves are real, this result must be due either to their smallness and indistinctness, or to their nearness to others that must theoretically exist. The earthquake considered by Bastings has been also used by Miss I. Lehmann[2]; in her first paper, the *P′* waves are considered, while the later one gives a diagram showing the readings of all from *P′* to *SS*, at distances from 160° to 170°. The actual seismograms must be mainly the same as those read by Bastings. She proceeded by reading all the more striking movements without reference to their interpretation and afterwards comparing them with the theoretical times. Inspection of her diagram gives no impression that any movements besides the two branches of *P′*, *PP*, *SKS*, *PPP*, *SKKS*, *SKSP*, *PPS*, and *SS* are capable of being traced over this range of distance, and even of these, *SKS* and *SKSP* show such a scatter from any smooth curve as to make the identifications doubtful. Presumably they are real but small or with indefinite commencements. She finds *PPS* early in comparison with Gutenberg's times, and this may be what Bastings has identified as $S_1'$. The difference between the observed times of this pulse and Gutenberg's calculated times for *PPS* may, however, arise from the errors of Gutenberg's times, which are reasonably good but still require some correction, and at present I am inclined to think that the pulse read is really *PPS*.

It appears that the existence or otherwise of *S* waves through the core will have to depend on the possibility of separating them from *PPS*, and must await more definite information about the latter. In our recent revision of the tables, Mr. K. E. Bullen and I found anomalies in *PS* that have not yet received interpretation, and these will probably be intensified in *PPS*.

The lack of rigidity in the core does not rest wholly on the past failure of seismologists to identify *S* waves through it. If the rigidity of the core stood in the same ratio to the bulk modulus as holds for the shell, the earth's tidal yielding would be much less than it is, but the actual bodily tide is consistent with fluidity of the core[3]. If Bastings's interpretation is correct, it will be necessary to suppose that the core is elasticoviscous, behaving as a solid for stresses with periods of a few seconds but as a liquid for a period of 12 hours; and it remains to be seen whether such a constitution would not give an impossible amount of tidal friction.

HAROLD JEFFREYS.

St. John's College,
Cambridge.

---

[1] NATURE, **134**, 216, Aug. 11, 1934.

[2] *Gerlands Beiträge z. Geophysik*, **26**, 402–412; 1930. *Verhandl. d. 5 Tagung d. Balt. Geodät. Komm.*, 192–212; 1931.

[3] "The Earth", 239; 1929. *Mon. Not. Roy. Ast. Soc., Geoph. Suppl.*, 1, 371–383; 1926.

## Magnetron Oscillations

IN a recent issue of NATURE[1], Dr. K. Posthumus has reported the production, by means of the split anode magnetron, of short-wave oscillations, which he suggests are of a new type. The oscillations occurred when the magnetic field strength exceeded the critical cut-off value and were characterised by an inverse relationship between frequency and optimum magnetic field strength.

It would appear that these oscillations are identical with the so-called 'dynatron' oscillations which I have discussed in a recent paper[2]. For relatively low frequencies it has been shown that the performance of such an oscillator can be predicted from the observed static characteristics, at least in the case of a two-segment anode. At high frequencies (corresponding to wave-lengths of the order of 1 metre) the dynamic characteristics differ from the static 'dynatron' characteristics due to electron inertia. At such frequencies two important effects occur: (1) the bombardment of the cathode[3] by some of the electrons the energy of which is increased by the change of electric field during their transit; and (2) the time of transit can be controlled by adjusting the ratio of $V_a$ to $H$ as described by Dr. Posthumus, so that many of the electrons reach the anode with radial velocities less than those corresponding to static conditions. Due to these effects, the anode current and the efficiency may both exceed the values predicted from the static characteristics.

The equation for a two-segment magnetron given by Dr. Posthumus becomes, in terms of wave-length instead of frequency,

$$\lambda = 300\,\pi\, r_a^2\, H/V_a \text{ (practical units).}$$

Combining this with the equation

$$H = \sqrt{181\ V_a}/2r_a$$

defining the critical magnetic field strength, we obtain

$$\lambda_0 = 6{\cdot}4 \times 10^3\, r_a/V_a^{\frac{1}{2}} = 3{\cdot}2 \times 10^3\, d_a/V_a^{\frac{1}{2}}$$

for the minimum wave-length in terms of anode