Kundt's tube phenomenon, where nodes and antinodes are formed by the stationary longitudinal vibrations of the enclosed gas The protuberances were shining spots formed by the bulging out of the zinc locally. The effect was photographed and is reproduced in Fig. 1 after enlargement. The distances between the successive nodes were measured directly on the zinc bar by means of a microscope.

As the reproduction shows, these nodes and antinodes are at extraordinarily regular intervals. The mean value of the distance between consecutive nodes came out to be 0·141 cm.

Now the velocity of longitudinal waves or the velocity of sound in a material is given by

$$V = \sqrt{E/\rho}$$

where E is Young's modulus and ρ the density of the material. But the velocity V of the longitudinal waves is also given by

$$V = n\lambda$$

Therefore, $n^2\lambda^2 = E/\rho$

Substituting the values of E and ρ for zinc and of λ as found from actual measurement, we get the value for frequency

$$n = \sqrt{\frac{8 \cdot 7 \times 10^{11}}{7 \cdot 1 \times (0 \cdot 282)^2}}$$
$$= 1 \cdot 24 \times 10^6$$

This high frequency, of the order of a million, is probably due to the impact of zinc crystals in the bar during the course of alternate compression and extension in the act of vibration.

The frequency of transverse vibration of the zinc bar had been varied from nearly 78 to about 27 and the appearance reproduced in Fig. 1 was formed during the course of this variation. The thickness of the bar was 0·066 cm.

We made a few attempts to reproduce the phenomenon noted here, but have not been successful so far. It is possible that there is a critical frequency of the transverse vibration of a given bar for which the longitudinal vibration excited is the strongest, depending on the size of the metal crystals contained in the bar. It may be noted here that it is well known that metallic zinc contains ordinarily well-developed crystals.

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Characteristics of the Ionosphere

IN the course of recent experiments[1] on the structure of the ionosphere, we have found that not two only but several[2] 'layers' exist in which there is either a maximum, or a tendency towards a maximum, of ionic density. Since any complete theory of the structure of the upper atmosphere or of the transmission of radio waves through it must take these facts into account, it is thought that a brief summary of the results will be of interest. Certain observations concerning abrupt variations of ionisation will also be described. In all these experiments transmission was at normal incidence to the layers.

(1) It has been found that in addition to the E region at a height of 100–120 km. and the F region from 190 to 300 km. there is an intermediate reflecting region, which we shall refer to as the M region. The data indicate that the average height of the M region is approximately 150 km. but that on some days it may be so high as 180 km. while on other days it may be so low as 130 km. The M region has been found on a number of occasions before noon during December of last year and January and February of this year. The data usually indicate that when this region is found there is a well-defined maximum of ionic density and that it is separated from the E and F regions by ionisation minima.

In order to observe the M region, it is necessary that the frequency used be great enough to permit penetration of the E region, but small enough to give reflection from the M region. The M region can, therefore, be observed only so long as its maximum of ionic density exceeds that of the E region below it.

As the maximum ionic densities of the E and M regions have been found to be of the same order of magnitude during the times when they are both observed, and as the maxima do not vary at the same rate with time, it is reasonable to assume that the M region maximum is normally present but that it is shielded by the E region except for a few hours in the middle of the day.

(2) The ionisation in the F region does not increase uniformly with height but has often been found to have a step-like structure[3]. This indicates that there is a tendency for the formation of several ionisation maxima in the F region. Occasionally two maxima have actually been found, but ordinarily these subregions overlap and the ionisation increases in a series of 'steps'. At times the 'treads' of this step-like structure are strikingly level, indicating remarkably abrupt ionic density gradients at heights near 200, 240 and 280 km. This type of phenomenon has been found only during daylight hours, and it may be said that if the steps are present at night they are very difficult to find. These facts suggest that the formation of these subregions depends upon the ionising activity of the sun.

(3) Throughout the daylight hours during the past winter the ionisation of the F region has often been found to vary in an erratic manner. The maximum ionic density exhibits abrupt changes which are often so great as 25–50 per cent within time intervals of 15–30 minutes. These changes suggest that there may be some variable source of ionisation, cosmic or solar in nature, the effect of which is superimposed upon a normally steady ionising effect due to the sun. The time of maximum ionisation seems to occur near noon, but the maximum is not at all well-defined, since the ionic density has about the same average value from 9.00 a.m. until 3.00 p.m. (winter and spring at Deal, N.J., latitude 40° N.).

(4) The ionisation of the E region increases with time in a uniform manner, attaining a maximum near noon. The abrupt changes found in the F region are not normally present in the E region.

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[1] The method used was that previously described in the *Proc. Inst. Radio Eng.*, July, 1932.

[2] This had previously been suspected for days of magnetic storms (*loc. cit.*, p. 1145).

[3] T. L. Eckersley also has concluded that the F region may be stratified. See *J. Inst. Elec. Eng.*, vol. 71, September, 1932.