A more detailed account of these calculations will be given in the *Acta Physica Hungarica*.

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Wave Hypothesis of Moving Irregularities in the Ionosphere

THE existence of moving irregularities in ionospheric regions has been demonstrated by a number of workers using a wide variety of radio techniques[1], and information regarding their properties is accumulating rapidly. The motions are frequently described in terms of 'winds'; but, as has been repeatedly stressed, the observations need not imply any large-scale movement of the atmosphere. Indeed a number of fairly general considerations can be advanced in support of an alternative view, that a propagated wave-like disturbance is the cause. At the suggestion of Mr. J. A. Ratcliffe, I have begun a theoretical examination of the magneto-hydrodynamic effects involved in such an interpretation.

It is found that travelling atmospheric disturbances, governed by pressure oscillations and gravitational forces, will be accompanied by electromagnetic oscillations which can, under special resonant conditions, become large. The corresponding amplification of the associated electron motions would render such disturbances particularly susceptible to detection by radio methods. Gravity tends to confine the movement of these disturbances to the horizontal plane, though a vertical component is introduced by the effects of cross-conductivities and temperature inhomogeneities. If these, and similar complications, are neglected, it is found that conditions are particularly favourable for disturbances of quasi-period

$$\tau \sim 2\pi \sqrt{2/\gamma(\gamma - 1)}\, C/g, \qquad (1)$$

and group speed

$$V_G \sim C \sqrt{(\gamma - 1)/2\gamma}, \qquad (2)$$

in which γ is the ratio of specific heats, C the speed of sound, and g the acceleration due to gravity. No preferred directions of travel relative to the earth's magnetic field appear at this stage, but they can be introduced, in some circumstances, by taking detailed account of electron motions and cross-conductivity effects.

It is natural to associate these resonant oscillations with the large-scale F_2-region disturbances observed by Munro[2], in which the numerical density of electrons may change by as much as 25 per cent. They appear to have a fundamental motion in the horizontal plane, with a secondary vertical component superimposed, in agreement with the theoretical predictions. Again, the larger amplitudes and shorter fractional durations (relative to τ), associated by Munro with longer periods, receive plausible explanation in terms of varying resonance conditions.

If typical values for these disturbances, say, $\tau \sim 25$ min. and $V_G \sim 7$ km./min., are inserted directly in (1) and (2), the estimates $\gamma \sim 1{\cdot}1$ and $C \sim 35$ km./min. result. The corresponding temperature ($\sim$ 1,000° K.) is in good agreement with other estimates for this region, but the specific heat ratio is appreciably lower than one would expect from the usual considerations. Martyn[3], however, was led to a similar result when considering the bounding of ionospheric disturbances, and he pointed out that low values of γ might well occur in regions where ionization was taking place. In any event, (1) and (2) do not take into account a number of factors which will be operative in practice, and so should only be considered as order-of-magnitude relations; as such, they appear to be quite satisfactory.

Favourable conditions are also obtained when

$$\tau \sim 2\pi \sqrt{2/\gamma}\, C/g, \quad V_G \sim C/\sqrt{2\gamma}, \qquad (3)$$

but these values do not appear to correspond to any disturbances so far reported.

No detailed analysis of the higher-frequency radio-star and E-region fluctuations has been undertaken as yet; but they appear amenable to a wave interpretation, and many of their properties can be profitably discussed on this basis.

In view of its potentialities and initial successes, the wave hypothesis might well be kept in mind when further analyses of the experimental data are undertaken.

This investigation, which is continuing, is supported by the National Research Council of Canada through a special scholarship. Full details are to be published at a later date.

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Measurement of Temperatures of Metal/Mould Interfaces

MANY workers have attempted to observe metal/mould interface temperatures in metal castings by means of thermocouples with sheathed hot-junctions. However, since the temperature gradient in the refractory sheath is high, such measurements are liable to considerable error. We have therefore made measurements on an experimental steel casting with an unsheathed platinum / platinum - 13 per cent rhodium hot junction, the metal of the casting being used as intermediate metal; the two wires were simply pushed through the mould wall some 0·3 cm. apart. The technique has the following advantages: (i) it eliminates errors due to the temperature gradient across the sheath; (ii) it minimizes thermal lag; (iii) it ensures accurate location of the hot junction at the metal/mould interface, since the hot junction is formed at the points where the molten metal comes into contact with the thermocouple wires.