Fig. 2. Contours of constant electron concentration in units of 10^4 cm^{-3} as a function of altitude and magnetic latitude, with $w_0 = 15 \text{ m/sec}$ independent of altitude. Pertinent atmospheric parameters are given in Table 1. —, Contours of N (10^4 el./cm^3); ---, field lines

It seems that adjustment of the parameters within the bounds of the present uncertainties in them can produce the main features of the Appleton anomaly.

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PHYSICS

Sonoluminescence from Glycerine-Water Mixtures

THE sonoluminescence from glycerine-water mixtures extending over the full range of 0–100 per cent glycerine has been investigated. A specially distilled supply of glycerine of 99.9 per cent purity was obtained and the sample of volume 5 ml. was contained in a 15-ml. quartz beaker cooled by circulating cold water. Fresh tap water was used, as tests showed that this gave the same results as distilled water. Cavitation was produced by a magnetostrictive window-type transducer coupled to a titanium double quarter-wave velocity transformer, the system being adjusted to deliver a constant acoustic power of 10 W at a frequency of 21.5 kc/s over an area of 0.7 cm². The transducer was monitored by an oscilloscope and valve voltmeter connected to a crystal accelerometer pick-up fixed to the transducer. The sonoluminescence was measured by a 13-stage E.M.I. photomultiplier tube '6255B' sensitive from 1650 Å to 6500 Å, and the signal was detected by a high-impedance valve voltmeter.

The sonoluminescence from glycerine was found by Jarman¹ to be greater than that from any of 20 liquids he examined; but he also found that it was not possible to cavitate glycerine if it was free of water. It is noteworthy that glycerine is very hygroscopic, ordinary commercial glycerine containing up to 2 per cent water. Negishi² found that 50 per cent glycerine luminesced with considerable brightness. In the work recorded here sonoluminescence was found to be time-dependent,

Fig. 1. Sonoluminescence from glycerine-water mixtures

relaxation and hysteresis effects being observed. Therefore the procedure was adopted of measuring the signal after 15 sec of cavitation when it was reasonably steady and reproducible. For all samples between 0 and 90 per cent glycerine, the temperature did not rise above 23°C from 19°C initially. For 100 per cent glycerine the rise was from 19°C to 28°C despite a fast flow of cooling water. This is due to the appreciable heat generated through viscosity, especially in the immediate neighbourhood of the cavitation bubbles³; also the thermal conductivity of glycerine is only about half that of water. It is to be expected that this heating of the bubbles through viscous energy dissipation will produce a higher temperature of the bubbles' contents and hence greater sonoluminescence from glycerine than water. The possible correlation of viscosity with sonoluminescence is indicated by the results shown in Fig. 1, which also records the viscosity of glycerine-water mixtures⁴.

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Tension Waves in a Highly Viscous Liquid

EXPERIMENTS have been carried out in which tension waves are propagated in a vertical column of concentrated sugar solution (syrup). For this purpose apparatus similar to that previously described by us¹ was used. The viscosity of the liquid was 1025 P.

Briefly, the liquid was contained in a vertical brass tube fitted with a steel piston at its lower end and the upper end open. A positive pressure wave was generated in the liquid by firing a lead bullet of 0.22 in. calibre so as to strike the lower end of the piston normally at its centre. When this pressure wave reached the upper free surface it was reflected as a wave of tension. The pressure changes in the liquid were recorded by means of a horizontal steel pressure bar inserted into a 'porthole' below the liquid surface.

A large number of records was taken using a piston of length 2 cm and the highest value of tension recorded was