the results were the same as those using tap water, that is, a tension wave could be transmitted. Secondly, a number of experiments were performed by arranging for a steady stream of small nitrogen bubbles to rise in ordinary tap water past the inner end of the pressure bar. The rate of production of these bubbles could be varied from about one bubble per sec to a fast turbulent rate. With a slow rate of bubble production the results were like those for ordinary water. With a fast bubble rate, however, the records showed that no stress wave, either of compression or of tension, was propagated.

In another type of experiment the effects accompanying wave propagation across a plane interface between two liquids which do not mix were investigated. For this purpose water occupied the tube to a level of 5 cm above the pressure bar and about 50 cm^3 of lubricating oil were then added. In this way records of events in the water at 5 cm below the water–oil interface were obtained. One would expect the upward wave of compression to be transmitted across this interface, but the behaviour of the downward wave of tension is not as predictable. The results showed, however, that a tension wave was propagated downwards.

It is hoped that further experiments on these lines will shed more light on the 'cavitation threshold' of liquids, that is, on the maximum tension that can be built up before cavitation sets in.

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GEOPHYSICS

Collision Frequency in the Ionosphere and Solar Activity

IN a recent publication, Belrose and Hewitt[1] have produced evidence for a variation in collision frequency with solar activity in the lowest ionosphere (at about 60 km height). In this communication we direct attention to similar results which we have obtained for a somewhat higher altitude (about 110 km).

In 1960–62 we carried out a series of vertical incidence absorption measurements using pulse signals on frequencies in the range 1·9–4·0 Mc/s. The measurements were made near local noon and at this time the absorption on 1·9 Mc/s was always predominantly 'non-deviative' (D-region). Simultaneously with those on 1·9 Mc/s, absorption measurements were also made on 2 frequencies just below, and 2 frequencies just above, the normal region E critical frequency (foE). At these latter frequencies the observed absorption was predominantly of the 'deviative' type associated with considerable group retardation. Expanded scale ionograms were available at the times of these measurements and from these the appropriate E-layer electron density/height profiles were calculated. These $N(h)$ profiles and the experimental measurements of absorption on the 5 frequencies were then used to calculate a best-fit collision frequency/height profile. Reliable results were obtained on 47 days during the whole period of the measurements, and it was found that theory and experiment could only be satisfactorily reconciled if the collisional frequency at E-layer heights varied by quite a large factor from day to day.

Fig. 1 shows the daily values of ν at a true height of 110 km, deduced from this work, plotted against the 10-cm solar radio wave flux. It will be seen that there is a fairly clear positive correlation between the two parameters. The slope of the best line to fit in Fig. 1 represents a change of about 1 per cent in ν at 110 km per unit change in the flux φ. We consider that part of this apparent change in ν with solar activity may be due to a change in D-region ionization with solar activity and the true change is probably smaller than the figure quoted.

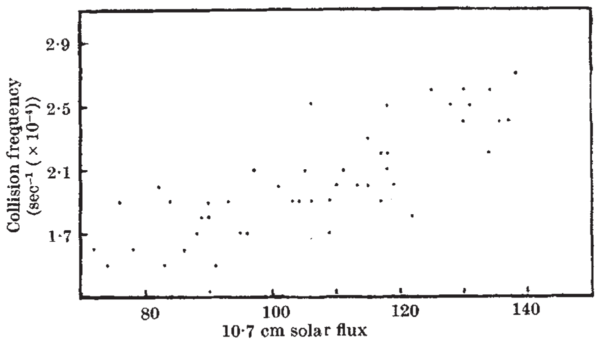

Fig. 1. Variation of collision frequency at 110 km with the 10·7 cm solar flux

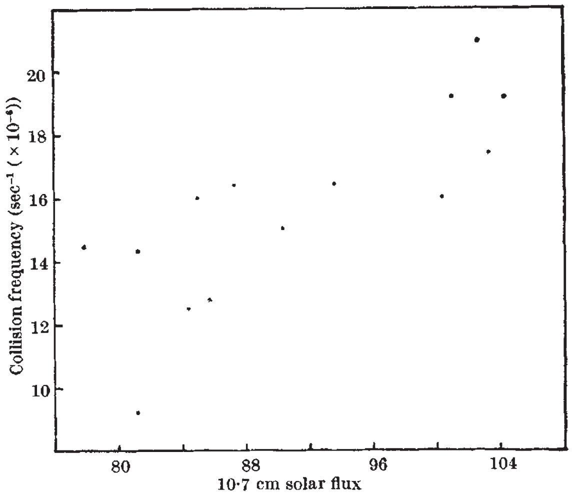

Fig. 2. Variation of collision frequency at 59·5 km with the 10·7 cm solar flux (ref. 1)

In Fig. 2 the values of ν given by Belrose and Hewitt for a height of 59·5 km are also plotted against 10 cm solar flux. The rate of increase of ν at this height is about 2 per cent per unit change in φ. The first published evidence for a dependence of ν on solar activity was given by Schlapp[2], and his results indicate that at a height of about 110 km ν changes by rather less than 1 per cent per unit change in φ.

Some data on collision-frequency measurements made in India have been published by Ramana and Rao[3] and provide supporting evidence for this dependence of ν on solar activity. These workers give values of ν at the peak of the E layer for each month in the period March 1958–November 1959. We have made some first-order corrections to these results to give estimates of ν at a fixed height, and find that for an altitude of about 105 km there is again evidence for an increase in collision frequency with solar activity of the same order of magnitude as that deduced here.

There are thus three independent sets of data showing a significant positive dependence of the E-layer electron collision frequency on solar activity. Various authors have suggested modifications of the usual Appleton–Hartree magneto-ionic theory to take account of the dependence of the collisional cross-section on the electron energy. Consideration of the collision frequencies deduced from the present work indicates that at 110 km the electron temperature at noon may exceed the neutral gas temperature by a factor of about two.

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