LETTERS TO THE EDITORS

GEOPHYSICS

Formation of the Sporadic E Layer in the Temperate Zones

In a recent communication Heisler and Whitehead¹ noted that the fraction of time the critical frequency of the sporadic E layer (f_oE_s) exceeded 5 Mc/s. depended on the horizontal component of the Earth's magnetic field, increasing as the horizontal component increased. This relationship is consistent with sporadic E formation arising from a vertical gradient of horizontal movement of the neutral air. In a region where the gyro-frequency of the ions, ω_{Hi} , is less than their collision frequency, ν_i , it is possible to show that, if there is no vertical electric current and the net horizontal current is zero (a horizontal current at one height being cancelled by a reverse current at some other height), the vertical velocity of ions and electrons is given approximately by:

$$V_z \sim \frac{-\omega_{Hi} \cos \theta}{\nu_i} \cdot \Delta U_y$$

where θ is the dip angle and ΔU_y is the departure of the horizontal wind velocity at right angles to the Earth's magnetic field from the mean value in the region. A thin layer of ionization will form where V_z is zero but where the vertical gradient of V_z is large. The probability of such formation depends on $\omega_{Hi} \cos \theta$, which is proportional to the horizontal component of the Earth's magnetic field.

Thus the global distribution of E_s in the temperate zones may be explained.

A more detailed analysis shows that at the height at which an E_s layer is already formed, ΔU_y , and hence V_z , remain nearly zero, independent of the horizontal winds. Thus the E_s layer continues to form at the same height. This explains the persistence of the E_s layer even when the horizontal winds leading to its original formation might be expected to have changed.

The detailed analysis will be presented elsewhere.

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¹ Heisler, L. H., and Whitehead, J. D., *Nature*, 187, 676 (1960).

Telluric Current Micropulsations on Arctic Drifting Station Charlie

TELLURIC current recording equipment was operated on Arctic Drifting Station Charlie during the epoch October 15–December 31, 1959. The station was located on a 4-mile by 7-mile ice floe of quite uniform thickness, the thickness averaging perhaps 10 ft. The electrodes consisted of 8-ft. by 2-in. lead strips prepared from electric cable sheathing. Electrode pairs were cut from continuous lengths of

Fig. 1. Telluric current, Arctic Drifting Station Charlie, December 11, 1959

sheathing to assure identity of material in the two electrodes. No difficulty was experienced with contact potentials. The d.c. voltage never exceeded a few millivolts and was very steady. The electrodes were suspended in the sea just below the ice at a spacing of 1.082 km. The relatively long spacing was necessary because of the low mV./km. values experienced over the highly conducting sea water.

On December 11, 1959, micropulsations of less than 1-sec. period were recorded for an interval of more than 2 hr. On this date the floe was located at 75° 57' N. and 171° 01' W., which corresponds to geomagnetic co-ordinates of 70° 55' N. and 222° 33' E. During the afternoon of this day (0200–0240 U.T.) a very sensitive recorder, 2 mV. full scale on the 1.082 km. spaced electrodes, was operated to search for micropulsations. Even though this was a very quiet period, based on normal recording, it was necessary to return the pen to scale several times by inserting a voltage in the electrode lines. This trace is presented as Fig. 1. A slight widening of the trace is evident, but the effect is so small as to be inconclusive as an indication of the occurrence of micropulsations.

On returning to the laboratory in the evening a quiet auroral arc was observed. The arc extended to the horizons and passed through the zenith. The normal sensitivity telluric current recorders were essentially quiet, the normal condition during such an auroral display. The high-sensitivity recorder was reconnected to the electrodes and the trace of Fig. 2 recorded. It is impossible even on the original trace to discern the individual fluctuations. However, the upward motions of the pen were counted by visual observation for six 1-min. intervals, extended over an hour of the activity. These counts gave 70, 70, 70, 67, 68, and 70 cycles per minute. It was also noted that the rate of fluctuation tended to be very uniform throughout the activity. The amplitude of the pulsations ranged from 0.05 to 0.10 mV./km. The circumstances of the experiment assure beyond any reasonable doubt that these were natural micropulsations and not variations introduced by the instrumentation.

No previous record of telluric current micropulsations of this short period has come to my attention.