

Fig. 3.  $\circ$ , 1,000 kc./s., water, - 30 + 40 sand,  $\epsilon = 34.3$  per cent;  $\triangle$ , 500 kc./s., water, - 30 + 40 sand,  $\epsilon = 34.3$  per cent;  $\square$ , 1,000 kc./s., 0.05 N sodium chloride solution, - 30 + 40 sand,  $\epsilon = 34.3$  per cent

increase of frequency appears to change the curvature, increasing the extent of the sensitive range. In the case of the 0.05 N sodium chloride solution the curve is displaced in such a manner as to decrease the sensitive range, and at any particular fluid saturation this is an analogous situation to a high-frequency titration, in that changes in concentration are being measured at constant saturation.

Further investigations of this method of measuring fluid saturation in porous media are continuing with the aim of increasing the range of sensitivity by the use of higher frequencies.

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## GEOPHYSICS

### Unidentified Earth Tremors in Dominica, West Indies

TREMORS the origin of which has not been identified were recorded by our seismograph station at Roseau in the volcanic island of Dominica during September 1959, and have been recorded at irregular intervals ever since.

Each tremor consists of an approximately sinusoidal ground motion of 0.3-sec. period. The first swing is always down, the first and eighth swings are maxima and there are about twelve swings in all. The ground amplitude of these maxima varies from about 0.1 $\mu$ , which is the point at which the tremors become masked by the microseismic background, to 1.0 $\mu$ . They are quite unlike the tremors produced by near earthquakes or by explosions on land or at sea. Factories, quarries and other possible artificial sources for the tremors in Dominica have been investigated and eliminated.

The tremors tend to occur in bursts, numbering from two or three to several hundred tremors, which

may start at any hour of the day or night and continue for periods up to twelve hours. The average period between bursts has been seven days, but there is no evidence of periodicity.

We have operated three additional Willmore-Watts seismographs in Dominica for six weeks in January and February 1960 and have found that the tremors can be recorded only within a few kilometres of the town of Roseau. Because of long quiet periods between bursts of activity, useful recordings were obtained only of a burst of five tremors at one station 1 km. from the Roseau Station and at the Roseau Station itself. There is a possible correlation between the differences in arrival times and the ratios of the maximum amplitudes of the tremors at the two stations, which is consistent with each tremor having originated at a point source and having obeyed an inverse square law of attenuation. Assuming such an attenuation law the amplitudes at the two stations indicate that the sources lie close to a circle of about 5 km. diameter, the northern part of which passes through the town of Roseau. The differences in arrival times at the stations indicate a seismic velocity between 150 m./sec. and 740 m./sec. depending on the locations of the sources on the circle.

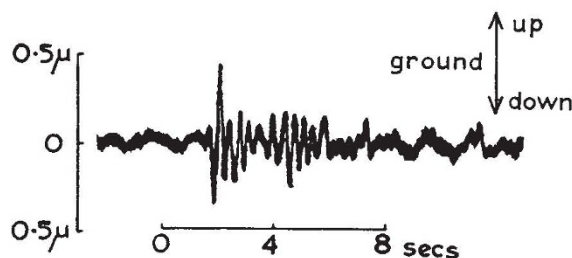


Fig. 1 Unidentified earth tremor recorded at the Seismic Research Unit's Seismograph Station at Roseau, Dominica, on September 11, 1959

The town of Roseau is situated on a delta of sand and gravel built by the Roseau River on the steeply shelving east coast of the island of Dominica. In such materials the velocity of longitudinal waves is about 750 m./sec. We have estimated the energy release at the source as about  $10^{14}$  ergs for the largest tremor recorded. The island contains several active thermal areas and ancient centres of eruption, but none is near the apparent sources of the tremors. We can find no evidence that these are related in any way to the volcanic activity of the island; but we cannot put forward an alternative explanation for their origin. We should be grateful to hear from others who have had experience of similar tremors.

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## CRYSTALLOGRAPHY

### Crystal Structure of Orthorhombic Cobalt Molybdate

IN petroleum refinery practice de-sulphurization is carried out by catalysts consisting of an  $\eta$ - or  $\gamma$ -type alumina impregnated with cobalt and molybdenum oxides. However, the nature of the cobalt and molybdenum compound or compounds present on