

## 44. On the Period and the Amplitude of Microseismic Movement.

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The word 'microseisms' includes many kinds of continuous earth oscillations. but in this paper microseisms of period between 3 and 10 sec are discussed. F. Omori<sup>1)</sup> divided the microseisms at Hongō, Tokyo, in three classes with the periods of oscillations;  $q$ : 2.9 sec.,  $Q_1$ : 4.5 sec.,  $Q_2$ : 7.5 sec. And many investigators classified the oscillations by weather or other conditions at the time when the microseisms occurred<sup>2)</sup>. But as the relation between the conditions and microseisms might not be clear, the writer studied the period and amplitude of microseisms in order to classify them.

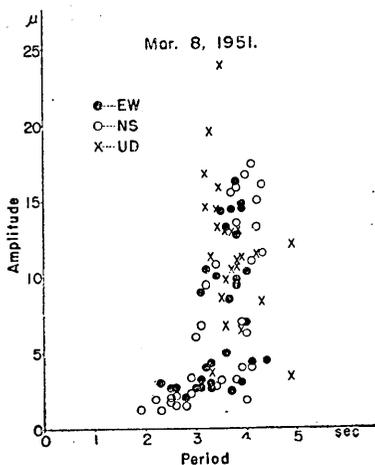


Fig. 1.

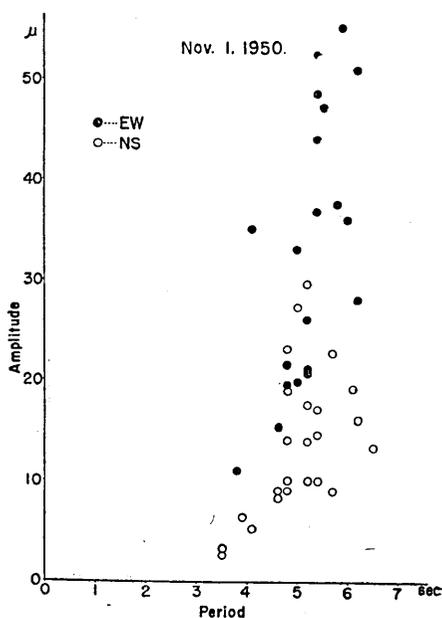


Fig. 2.

- 1) F. OMORI, *Bull. Earthq. Inv. Comm.*, **3** (1909), 1-35.
- 2) B. GUTENBERG, *Die seismische Bodennunruhe*, Berlin, 1924.  
M. H. GILMORE, *Trans. Amer. Geophys. Un.*, **27** (1946), 466-473.

The records of microseisms used in this study were obtained with the portable trometers designed by the writer<sup>3)</sup> for the recording of microseisms set at the Tokyo University, Hongō, at the Koishikawa Botanical Garden, and

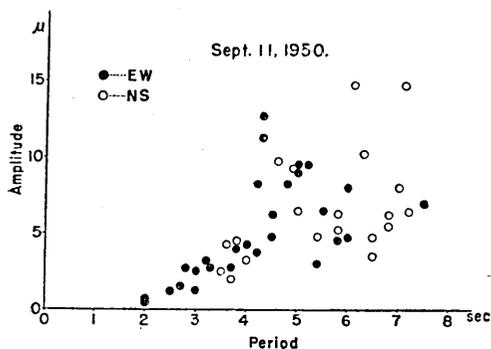
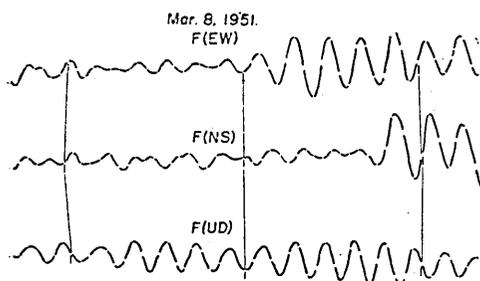
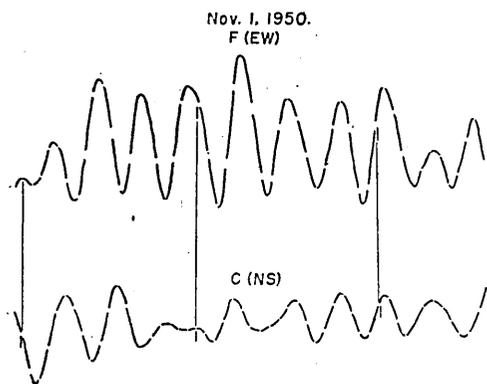


Fig. 3.

Fig. 4. ( $\frac{1}{3}$  the actual)Fig. 5. ( $\frac{1}{3}$  the actual)

at the Tokyo Astronomical Observatory, Mitaka, for the investigation on the propagation of microseismic waves<sup>4)</sup>.

From these records, correlation diagrams of period and amplitude were made. The diagrams were classified into three kinds, example of which are shown in Figs. 1, 2, and 3. The portions of seismograms which correspond to Figs. 1, 2 and 3 are inserted as Figs. 4, 5 and 6. The frequency-distributions of periods of microseisms can also be classified (Figs. 7, 8 and 9) as above. The characteristics of the classes are as follows:

Microseisms of the 1st kind are almost regular in form of oscillation, period of oscillation being 3-4 sec., and the double amplitudes less than  $20\mu$ .

Microseisms of the 2nd kind Figs. 2, 5 and 8 are regular and large oscillations with the frequency-distribution of periods sharp and maximum at about 6 sec. Amplitudes of microseisms of the 1st and 2nd kinds vary as if the ground resonated at the period of 4 sec. or 6 sec..

3) F. KISHINOUE, *Bull. Earthq. Res. Inst.*, **20** (1942), 215-219.

4) R. IKEGAMI and F. KISHINOUE, *ditto*, **27** (1949), 75-80.

Microseisms of the 3rd kind (Figs. 3, 6 and 9) are irregular in form and the frequency-distribution of periods is not sharp. Microseisms of this kind may be mixed oscillations of those of the 1st and 2nd kinds. The amplitudes may have a somewhat linear relation with the periods.

In all cases the prevailing periods varied in a small amount. For instance, the

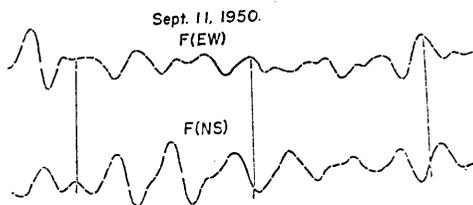


Fig. 6. ( $\frac{1}{3}$  the actual)

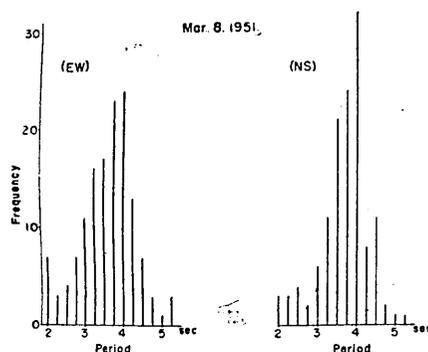


Fig. 7.

period of the 2nd kind changed between 5 and 6 sec. in the data used in this study. The cause of the variation is yet unknown.

Looking at the frequency-distribution of periods, two periods, 4 sec. and 6 sec. can be found at any rate, and for the 1st kind only the 4 sec period and for the 2nd kind the 6 sec period were prevailing. For the 3rd kind both periods occurred simultaneously.

Concerning the change of periods of microseisms, R. Ikegami and the writer<sup>5)</sup> have obtained the following results: Microseisms of 4 sec period were observed when the centre of cyclones were on the sea to the south of Tokyo. When the sea to the northeast of Tokyo was very rough, the period and amplitude of microseisms became large at

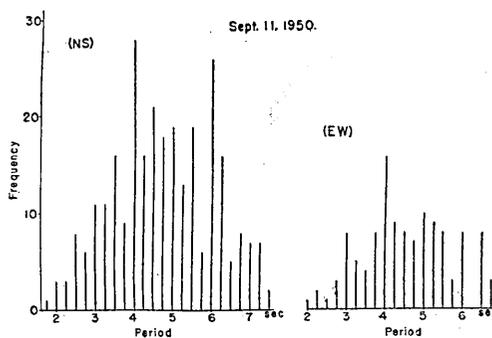


Fig. 8.

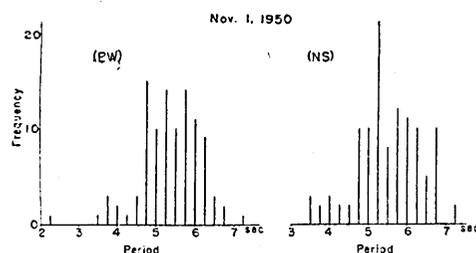


Fig. 9.

5, R. IKEGAMI and F. KISHINOUE, *Bull. Earthq. Res. Inst.*, **29** (1951), 305-312.  
R. IKEGAMI, *ditto*, 313-325.

Tokyo. And the variation of their periods was found to be in some relation with the velocity of propagation<sup>6)</sup>.

From the above results, microseisms seem to be combined with two kinds of oscillations of periods 4 sec and 6 sec. It is remarkable that the periods of microseisms are almost always definite everywhere in the world. Recently the periods came to be considered as one half of the periods of sea waves<sup>7)</sup>. The theory may be favourable, for winds and waves can be regarded as uniform everywhere and sea waves caused by winds may be similar in periods. But the writer has been informed that at some place microseisms of other periods occurs<sup>8)</sup>. If it is true, microseisms may be considered as proper oscillations of the ground excited by meteorological or oceanic conditions, otherwise oscillation of the ground due to proper oscillations of sea waves. Then the writer must attend to such conditions concerning the study of the origin of microseisms.

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#### 44. 土地の脈動の周期と振幅について

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東京附近の観測について土地の脈動を調べ、周期と振幅との関係や周期の頻度分布を見ると、4秒周期のもの、6秒周期のものと、4秒と6秒と同時に含むものに分けられた。其等を第一種、第二種、第三種の脈動と名付けた。第一種と第二種は夫々4秒又は6秒に於て振幅が大きく、土地の自己振動が此等の周期に、共振したように見える規則正しい振動である。第三種は振幅が周期に凡そ比例し、振動記象の形も周期の頻度分布も他の種と明らかにちがう。

6) R. IKEGAMI and F. KISHINOUE, *Bull. Earthq. Res. Inst.*, **28** (1950), 118.

7) M. S. LONGUET-HIGGINS *Phil. Trans. Roy. Soc. London*, **243** (1950), 1-35.

8) At the symposium on microseisms at the general meeting of the Seism. Soc., Japan, on May 24, 1951, Dr. T. Hirono of the Central Met. Obs. of Japan, reported that the periods of microseisms at Onahama, Fukushima, are always only 2 sec.