21. *Tripartite Observation of Microseisms at Sakata.*

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(Read July 17, 1956—Received Sept. 30, 1956)

In Japan tripartite observations of microseisms had been carried out in the neighbourhood of Tokyo, but seldom at other places until the authors, in February 1956, set up three temporary stations in the northern part of the city of Sakata in Yamagata Prefecture (Fig. 1). The stations were the Syōryō Primary School, the pump house of the water service and the dwelling house of a citizen. The positions and mutual distances of these stations are shown in Fig. 2.

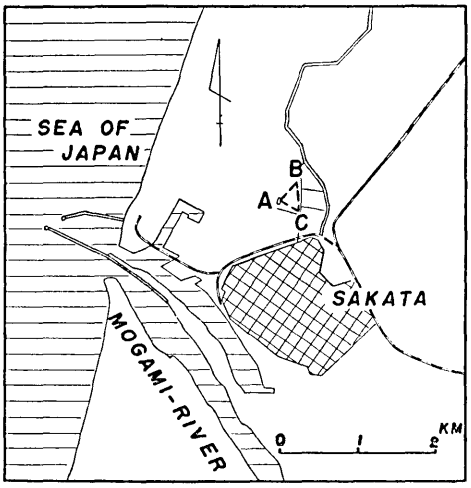

Fig. 1. Position of the tripartite observation.

The instruments used for the observations were designed by one of the authors and published in this journal.[1] But some points were improved, and two of these were changed at the suspention of the pendulum. The instrumental constants at the three stations were equal: $T_0=10$ sec., $V=800$, and critical damping.

The data available to study were mostly got on Feb. 5, when microseisms became large and the weather was light snow with a wind of over 15 m/s (Fig. 3).

The method of investigation was similar to that described in papers written by one of the authors with R. Ikegami.

The direction of propagation of microseisms was deduced as an average from east as shown in Fig. 4. The mean value of velocity of

1) F. KISHINOUYE, *Bull. Earthq. Res. Inst.*, **20** (1942), 215-219.
2) R. IKEGAMI and F. KISHINOUYE, *Ditto*, **27** (1949), 75-80.

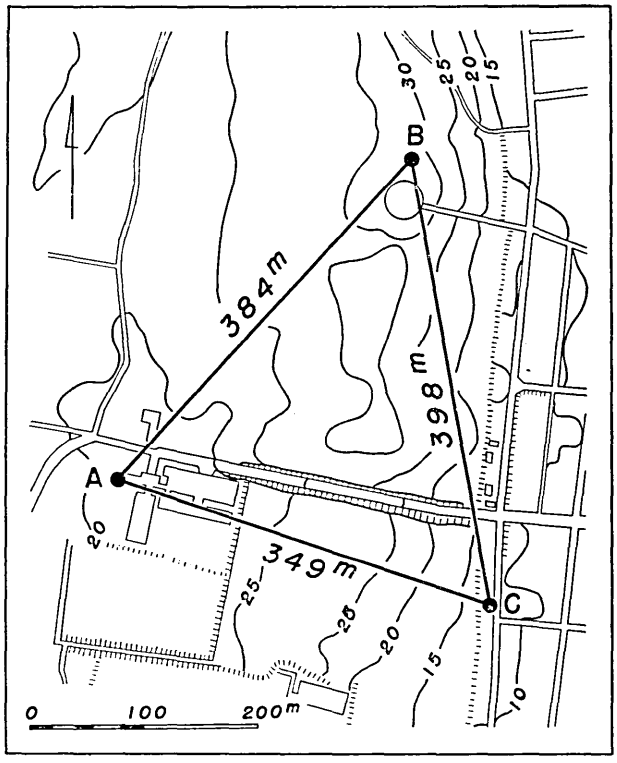

Fig. 2. Map of the tripartite stations.

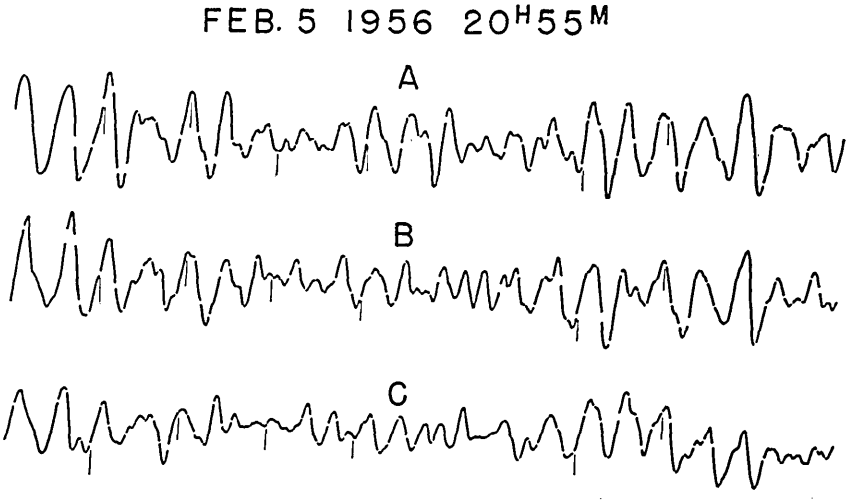

Fig. 3. Record of tripartite observation.

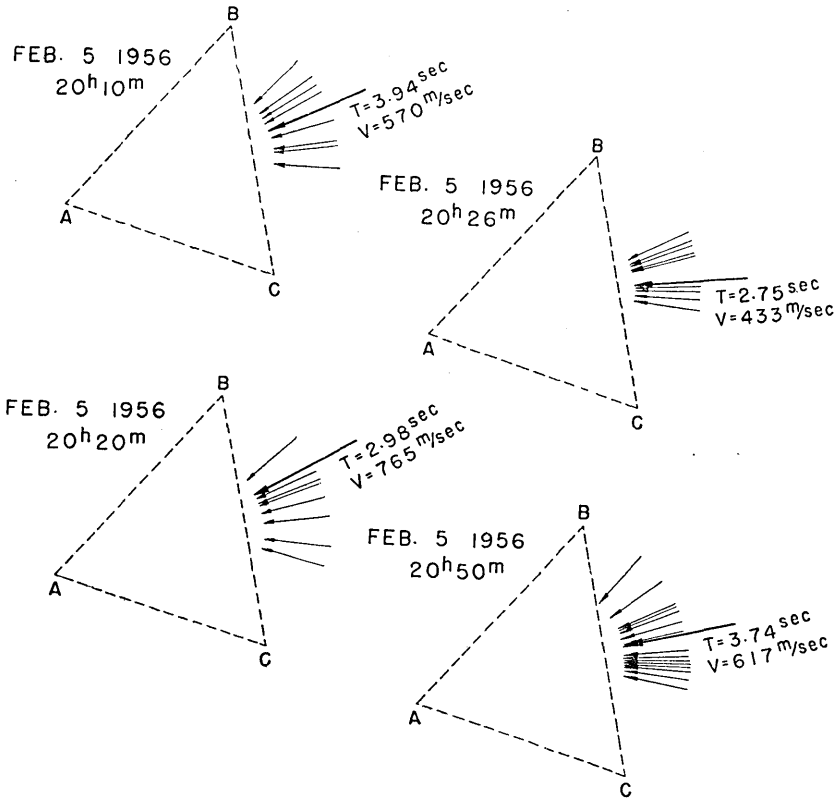

Fig. 4. Tripartite observations.

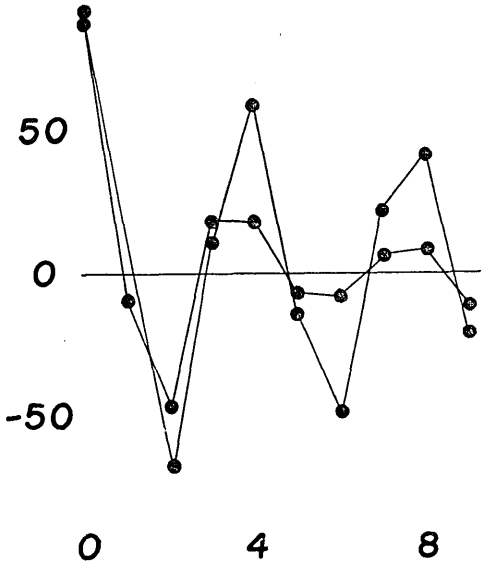

Fig. 5. Autocorrelation of period of microseisms at Sakata.

propagation was calculated as 750 m/s. The relation between velocity and period of vibration was not clear in the observation because the variation of period was small.

The method of autocorrelation was applied to study the period of microseisms. The values were obtaiend simply by the expression,

$$\varphi(\tau)=\frac{1}{N}\sum_{k=1}^{N} x_{k+j}\bar{x}_k .$$

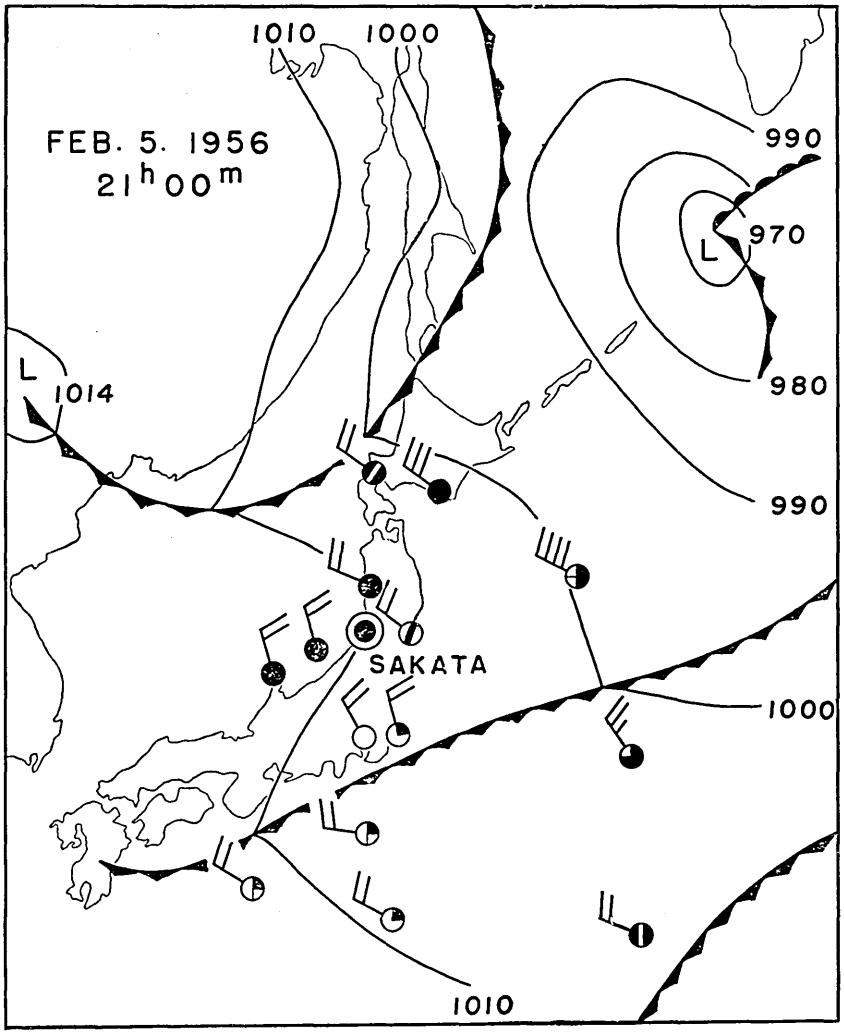

Fig. 6. Weather chart at the time of the observations.

The period of microseisms at Sakata was 4.0 sec as seen in Fig. 5.

The relation between microseisms at Sakata and other places and typhoons or cyclones had been studied by one of the authors and J. Kuroyanagi.[3)]

Typhoon No. 14 of 1954 (Sept. 18–19) passed off the Pacific coast of Japan. Microseisms were not recognized until the typhoon approached the Kwantō District. The amplitude became large as the typhoon went north off the coast of Sendai which is east of Sakata, and after then decayed slowly. In the other example, typhoon No. 22 of 1955 (Sept. 30–Oct. 1) came over the Japan Sea after passing Kyūshū Island, when amplitude of microseisms became measurable on seismograms at Sakata. The centre of the typhoon went north along the Japan Mainland and over the Japan Sea. So the centre passed near Sakata, but amplitude was maximum when the centre passed Hokkaidō and reached the Northern Pacific Ocean.

A similar relation had been obtained at Tokyo. Namely, microseisms become large when the centre of a cyclone is off the northeastern coast of Japan, and the direction of propagation of microseisms is from the northeast.

The weather chart at the time of the observation of microseisms is shown in Fig. 6. As seen in the chart, the microseisms might be grown by discontinuity of atmosphere. The authors take notice of strong winds off the coast of Northeastern Japan.

From the above data, they deduced microseisms at Sakata, as well as at Tokyo, are caused by sea waves off the northeastern coast of Japan, and are propagated along the sea bed to the land.

Amplitude of microseisms is considered to depend on the surface geology of the station. So the authors are studying the relation between the amplitude and the subsoil of the observation place.

The authors express their thanks to the staff of the Office of Sakata City for the aid in the study, also to Mr. H. Takahashi and Mr. T. Saitō for their help in observations in the face of a cold snow storm, and to Miss M. Kotaka for her assistance in preparing this paper.

3) I. SHIDA and J. KUROYANAGI, *Bull. Yamagata Univ. Natur. Sci.*, **4** (1956), 209–219.

21. 酒田に於ける土地の脈動の三点観測

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1956年2月，山形県酒田市において脈動の三点観測を行つた．

脈動の伝播方向は東からで，その速度は色々な値が出たが，平均として 750 m/s であつた．その周期は，自己相関係数の方法によつて求めた結果 4.0 秒であつた．

気圧と脈動の関係は，天気図を見ると不連続線によつて東北地方の沖に風速の大きい所があるから，そこで海の波が風で起され，その海の波が海底に脈動を起し，それが地面を伝つたと考えられる．このことは以前山形又は酒田において台風の中心が日本海又は陸上にあつた時より，太平洋上に行つた時のほうが大きかつたことと一致する．更に東京における台風と脈動の関係についての研究ともよく合う．この観測は脈動の原因を探ぐる一資料であろう．