8. *A Study on the Propagation of Microseismic Waves. Part II.*

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1. We intend to solve the nature of microseisms under the assumption that microseisms are progressive waves, for their nature has not yet been ascertained in Japan and the other countries. We have already conducted the observations of microseismic waves since November, 1948 in Tôkyô, and some of the results were published.[1] From the last investigation we obtained the results of the microseisms which have the predominant period of 4 seconds in the winter season, but the microseismic storms which may be caused by the typhoons from summer to autumn have not yet been investigated by us.

For the purpose of studying the microseisms of the latter sort, we planned to observe microseisms at another place, where we have the tripartite stations situated more distantly than in the last case.

We will report in this paper a few of the results obtained, but these results did not enable us to solve the questions. Therefore we regret to say that we can not report the conclusive results in this paper.

2. We were able to use the yard of Tôkyô Astronomical Observatory through the good offices of Dr. Y. Hagihara, Mr. K. Tuzi and Mr. S. Nakano, and set up temporary stations at three places A, B and C as in Fig. 1. These three stations formed an equilateral triangle, the side of it being 285 metres.

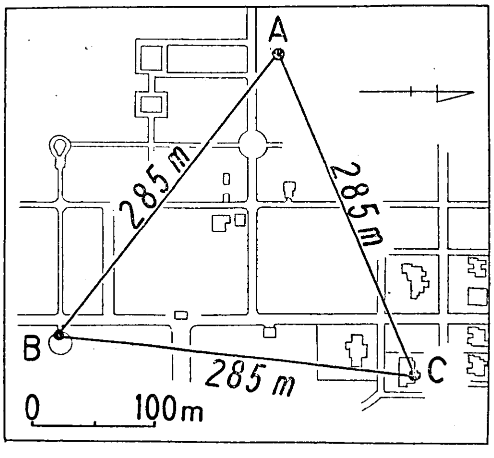

Fig. 1. Positions of temporary stations (At Tôkyô Astronomical Observatory.)

1) R. IKEGAMI and F. KISHINOUYE, *Bull. Earthq. Res. Inst.*, 27 (1949), 75.

A tromometer was set up in NS-component at every station, and adjusted in the same conditions as in the last case. Every station was connected with wires, and electrical time-marks were sent out every one second from the main station (A).

3. In this paper we will report the results obtained from the observations of microseisms on October 26, 27, 28 and 29 in 1949. During these days, a typhoon (named Patricia) was sweeping from the eastern sea of Formosa to the eastern sea of Hokkaidô along Japan Islands. The track of this typhoon is shown in Fig. 2 by a bold line.

In Tôkyô the amplitudes of microseismic waves began to increase in the afternoon of Oct. 27, and became the largest in the afternoon of Oct. 28, when the center of this typhoon was passing off the eastern coast of Tôhoku district, Japan, and this condition continued until the typhoon died down.

The microseismic data obtained in this period were analysed by the same procedures as the last ones, and the mean time differences, that is to say, the mean of the differences in times of arrival between the station A and B, B and C, and A and C, were computed. These results are shown in Table I, and the bearings of wave propagation determined by these mean time differences are shown in Table II and in Fig. 2 by the arrows.

Table I.

	Oct. 26, 1949, 15*h* 26*m*.	Oct. 26, 15*h* 37*m*.	Oct. 27, 12*h* 25*m*.	Oct. 28, 17*h* 08*m*.	Oct. 29, 16*h* 43*m*.
A-B	0.054 sec.	0.159 sec.	0.042 sec.	−0.663 sec.	0.117 sec.
A-C	−0.364	−0.418	0.291	−0.807	−0.706
B-C	−0.418	−0.577	0.275	−0.145	−0.825

Table II.

	Oct. 26, 1949, 15*h* 26*m*.	Oct. 26, 15*h* 37*m*.	Oct. 27, 12*h* 25*m*.	Oct. 28, 17*h* 08*m*.	Oct. 29, 16*h* 43*m*.
Bearings	N 35° E	N 21° E	S 47° W	N 85° E	N 30° E
Velocities	626 m/sec.	478 m/sec.	877 m/sec.	329 m/sec.	318 m/sec.
Periods	3.9 sec.	3.5 sec.	2.9 sec.	6.6 sec.	5.9 sec.

These results, except the bearings on Oct. 26, show that microseismic waves came apparently from the center of this typhoon. They suggest that the dominant microseismic waves caused by deep depression such as that of a

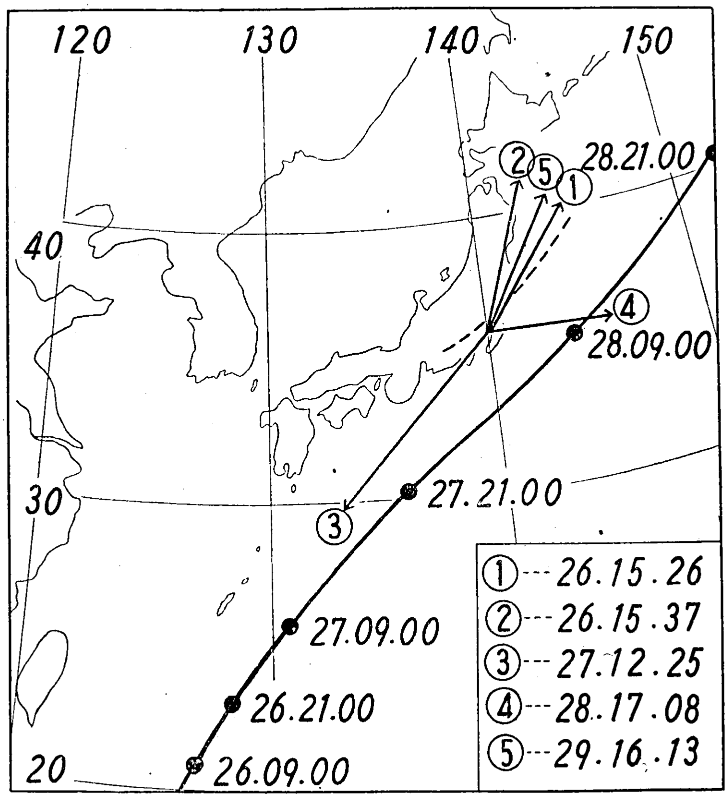

Fig. 2. Track of a typhoon (named Patricia) and bearings of microseisms on Oct. 26, 27, 28 and 29 in 1949. Dotted line shows position of a cold front on Oct. 26, at 15 *h* 30 *m*, 1949.

typhoon may be transmitted from their source. On Oct. 26, however, the bearings did not point to the center of this typhoon but to the opposite direction, namely, the bearings were N 35° E at 15*h* 26*m* and N 21° E at 15*h* 37*m*. We consider that this result suggests a substantially important problem about the cause and source of microseisms.

Judging from the weather map on Oct. 26, a few cold fronts passed over Tôhoku district from Japan Sea for the Pacific, and at about 15*h* 30*m* one of those passed over the eastern sea of Tôhoku district. On the other hand, the results of observations of sea waves and swells at a point on the Pacific (145° E, 39° N), where an observation-ship belonging to the Central Meteorological Observatory, Japan, makes oceanic observations unceasingly, reported that sea waves and swells became rough from 10 A.M. on Oct. 26 and these conditions continued till 4 P.M.

On Oct. 26 the typhoon (Patricia) was at about 24° N and 128° E, and the atmospheric pressure of her center was c. 960 millibar. In such weather conditions as mentioned above, it is noteworthy that the bearings of microseismic waves in Tôkyô pointed rather to the cold front than to the centre of that typhoon.

We must consider that the increase in amplitudes of microseismic waves in Tôkyô is caused rather by the rage of the northern sea of Bôsô Peninsula than by a distant southern typhoon, because it is already well known that the amplitudes of microseisms in Tôkyô become very large, when the Pacific Ocean of the north of Bôsô Peninsula is raging.

It is noticeable that our results are analogous to L. Don Leet's conclusions obtained by his investigations of microseisms at Harvard.[2]

4. The values of the velocity and the period of microseisms computed from these data are shown in Table II. The velocity varies from 318 to 877 metres per second, and the period from 2.9 to 6.6 seconds. The relation between the velocity and the period is shown in Fig. 3.

Concerning the waves, the following expression is established, i. e., $L=vT$, where L stands for the wave length, v for the velocity, and T for the period. If we put $L=$ 2.2 km. into this expression, the above mentioned relation between the velocity and the period applies well to this expression as shown by the curve in Fig. 3. One of the writers[3] found a similar relation in the dispersion curves of the surface waves on the occasion of his experiment on the ice of Lake Haruna, and K. SASSA[4] presented a similar relation in his paper on the seismic prospectings at Nagoya and Tottori. These relations found out by them were those of group velocity, and in these cases this relation can be explained theoretically. But we must consider that the relation found out by us was that of phase velocity, and in this case this relation can not yet be

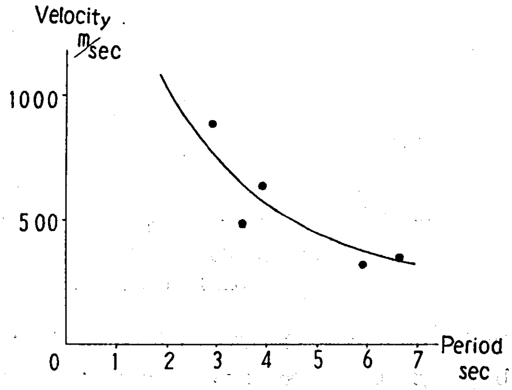

Fig. 3. Relation between measured mean velocity and period.

2) L. DON LEET, *Bull. Seism. Soc. Amr.*, 38 (1948), 173.
3) F. KISHINOUYE, *Bull. Earthq. Res. Inst.*, 21 (1943), 304.
4) K. SASSA and others, *Disaster Prevention Res. Inst., Kyôto Univ.*, 2 (1949), 3.

explained theoretically. In consequence, our results will present a question to theorists.

The values of velocity obtained this time were remarkably smaller than the values obtained last time, viz., 2.4 km/sec. The cause of this difference passes our comprehension now, but perhaps this may be due to the geological difference of the ground. These results attract our attentions, and we will continue our investigations to solve these questions.

The cost of this investigation was defrayed from the Scientific Research Expenditure of the Department of Education.

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8. 土地の脈動の傳播性の研究（第2報）

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脈動の傳播性その他の性質に關しての研究は多いが末だ尙多くの疑點を殘している．これらの疑點のいくらかでも解決したいと考えて三點觀測網を構成して研究して來た．前報[1]では冬季一般に大きくなる脈動について研究したので今回は夏から秋にかけて平常は脈動の小さい時季に，颱風等の强い低氣壓に原因があると考えられている大振幅の脈動についてその傳播性や傳播方向を調べる目的で，東京天文臺の構内を借用し，ここで三邊夫々285米の所謂 Tripartite Stations, A, B, C を構成して同時觀測を實施した．（第1圖）．

今回の實驗は前回とは異つた場所でより大きい三角形を作り得た事，及び脈動發生の季節が異つている事等が前回の場合と異つている．

今回の觀測では1949年10月26, 27, 28, 29日の4日間にわたつて颱風（Patricia）が臺灣東方海上から本州太平洋岸沖を北上し北海道北東方に去るまでの間に於てその進行につれて發生する脈動について研究し得た．その結果は次の通りである．

i) 颱風が臺灣東方にあつた26日には本邦三陸沖は寒冷前線の通過のため荒れていた．この日の脈動の傳播方向は一樣に，颱風の方向を示さず，むしろ荒れている三陸沖の方向を示した．（第2圖）．今迄に房總半島以北の海の荒れている時東京での脈動が常に大きくなる事はよく知られている事實であるが颱風が發生している場合でも，房總，三陸方面の海が荒れている場合には，脈動の發生は後者により多く影響されるらしいと云う事は注目すべき結果であつて，今後の研究によつて一層明らかになると思う．

ii) 颱風が九州南東方から北上して北海道北東方にぬけた27, 28, 29日には脈動は夫々その颱風の方向より傳播して來るような結果を得た．

iii) 第II表に示す如く週期は約3秒から7秒に，速度は約300米/秒から900米/秒に變化し，それら兩者の關係を圖に示すと第3圖の如くなる．この關係は $L=vT$ なる式に於て L（波長）=2.2粁としたときの v（速度）と T（週期）の關係に略一致しているようである．この結果は求めた速度が位相速度であると考える以上理論的な說明がつかぬ問題であつて，今後尙よく調べて見たいと考えている．尙速度は前回では約2.4粁/秒であつたのに今回の値がこれに比して著しく小である原因は觀測した地點が異なるためか或は他に原因があるのかも今後の問題に殘されている．