

CHAPTER II. SAKURA-JIMA EARTHQUAKES OBSERVED IN NAGASAKI, OSAKA, AND TOKYO.

6. *Sakura-jima volcanic earthquakes observed in Nagasaki and Osaka.* Tables V and VI give the lists of the volcanic earthquakes attending the Sakura-jima eruption of Jan. 1914, observed instrumentally at the meteorological observatories of Nagasaki and Osaka, whose position were as follows:—

	Latitude.	Longitude.	Distance and Direction from the centre of Sakura-jima.
Nagasaki,	32° 44' 03" N.	129° 52' 31" E.	148 km., N. 30° W.
Osaka,	34° 39' N.	139° 26' E.	560 km., N. 51° E.

The principal registering instruments at the two places were Omori horizontal pendulum tromometers with E.W. and N.S. components; the pointer magnifications at Nagasaki being 20 and 120, and those at Osaka also 20 and 120. At Nagasaki, 44 of the volcanic earthquakes were observed in the course of the 12 days between the 9th and the 20th of January (1914), only the earthquake at 6½ P.M. on the 12th being there sensible and *rather moderate* in intensity. At Osaka, the number of the shocks recorded, which were all unfelt, was 13, the last occurring at 4 P.M. on the 13th.

As will be seen from Table VIII, the frequent occurrence of the earthquakes in Nagasaki came to an end at 9 A.M. on the 12th. This means that the frequency of the volcanic fore-shocks of the stronger class was much reduced at or immediately prior to the opening of the eruption. This inference, also to be drawn from the list of the earthquakes observed in Osaka, is in accordance with the seismographic observations at Kagoshima (§ 2).

The 6-hourly seismic number in Kagoshima, Nagasaki, and

TABLE VI. HOURLY NUMBER OF THE SAKURA-JIMA EARTHQUAKES
INSTRUMENTALLY REGISTERED AT THE NAGASAKI
METEOROLOGICAL OBSERVATORY. JAN. 1914.

Day. Hour.	9	10	11	12	13	14	15	16	17	18	19	20
0-1 A.M.			1	1								
1-2				1	2							
2-3												
3-4												
4-5			2									
5-6			1	1				2				
6-7				1								
7-8								1				
8-9				2				1				
9-10			1									
10-11												
11-12												
0-1 P.M.			2				1					
1-2							1					
2-3		1	1				1					
3-4												
4-5	1				2							
5-6			1									
6-7			1	1			1			1		
7-8		1	5									
8-9			2									
9-10			2									1
10-11			2									
11-12			1									
Sum.	1	2	22	7	4	0	4	4	0	1	0	1

Osaka, is given in Table VII. The course of the frequency variation in Nagasaki is much similar to that of the weak and strong shocks in Kagoshima. (See fig. 4.)

The violent shock at 6½ P.M., on the 12th, is to be regarded, not as a fore-shock, but as a great seismic disturbance probably caused by a stress relieving due to the Sakura-jima eruption at the completion of the explosive stage.

7. Tromometer observation in Tokyo. Several of the precursory earthquakes were recorded by the tromometers in Tokyo, the diagrams being, however, unfortunately confused by the pulsatory oscillations. Thus, for instance, the small disturbance at 10.03.18 A.M.; 0.32.32 P.M.; 0.48.44 P.M.; 3.00.33 P.M.; and 3.59.32 P.M. correspond respectively to the commencements of the principal portion of the strong or moderate Sakura-jima earthquakes, whose times of occurrence at the Kagoshima meteorological observatory were 9.57.45 A.M.; 0.27.11 P.M.; 0.43.00 P.M.; 2.54.50 P.M.; and 3.52.10 P.M. It is likely that, had the ground in Tokyo been entirely free from the pulsatory oscillations, most of the strong and moderate shocks about 40 in number, would have been clearly registered at the Seismological Institute (Tokyo), whose distance from the centre of the Sakura-jima is 958.6 km.

TABLE VII. 6-HOURLY NUMBER OF THE SAKURA-JIMA EARTHQUAKES INSTRUMENTALLY REGISTERED IN NAGASAKI, OSAKA, AND KAGOSHIMA.

Date. Jan. 1914.	Nagasaki.	Osaka.	Kagoshima.		
			Unfelt.	Slight.	Weak, Strong, and Violent.
11th.	4 1 4 13	1 2 2 4	9 16 58 44	7 11 22 71	3 2 7 17

Date.	Nagasaki.	Osaka.	Kagoshima.		
			Unfelt.	Slight.	Weak, Strong, and Violent.
12th.	3	0	36	61	5
	3	3	53	58	5
	0	0	19	1	0
	1	2	0	1	1
13th.	2	1			
	0	0			
	2	0			
	0	0			
14th.	0				
	0				
	0				
	0				
15th.	0				
	0				
	3				
	1				
16th.	2				
	2				
	0				
	0				

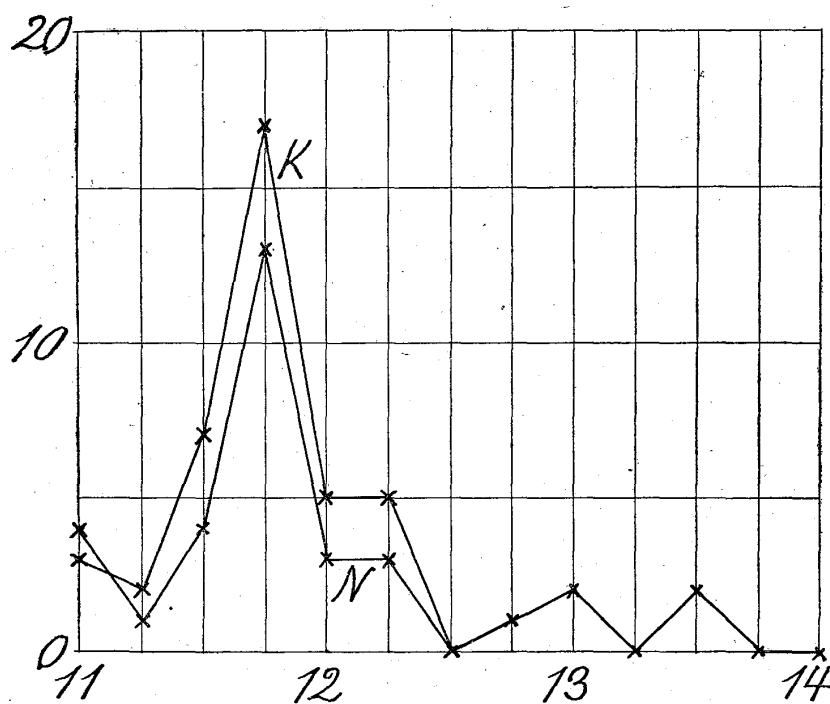


Fig. 4. 6-hourly Frequency Variation of the Sakura-jima Earthquakes tromometrically registered in Nagasaki (N) compared with that of the Sensible Shocks in Kagoshima (K). Jan., 11th to 14th, 1914.

TABLE VIII. LIST OF THE SAKURA-JIMA EARTHQUAKES OBSERVED AT
THE NAGASAKI METEOROLOGICAL OBSERVATORY, ON
JAN. 9TH—20TH, 1914.

Date and Time of Eqke. Comm't. in Nagasaki.	Compt.	Duration of Prel. Tremor.	Total. Duration	Date and Time of Eqke. Comm't. in Nagasaki.	Compt.	Duration of Prel. Tremor.	Total. Duration
Jan. 9th.				Jan. 11th.			
^{h m s} 4 14 17 P.M.	E.W.		^{m s} 2 23	^{h m s} 9 08 14 P.M.	N.S.		
Jan. 10th.				10 25 36	"		
2 13 48 P.M.	"		1 02	10 56 26	"		
7 04 23	"			11 30 47	"		
Jan. 11th.				Jan. 12th.			
0 09 31 A.M.	"		2 42	0 40 21 A.M.	"		
4 02 48	"		19	1 32 10	"		
4 27 29	"		4 12	5 49 44	"		
5 59 12	N.S.		5 02	6 03 00	"		
" " " *	E.W.	17 ^s	4 00	8 27 31	"		
9 57 44	N.S.			8 39 35	"		
0 27 48 P.M.	"			6 28 37 P.M.†	"	7 ^s	51 ^m 7 ^s
0 43 06	"			Jan. 13th.			
2 55 09	"			1 02 38 A.M.	E.W.		51
5 24 17	"			4 09 38 P.M.	N.S.		4 40
6 25 09	"			" " "	E.W.		4 50
7 21 16	"			4 46 20	N.S.		1 53
7 30 17	"			" " "	E.W.		4 13
7 42 26	"			Jan. 15th.	"		
7 51 17	"			0 56 16 P.M.	"		
7 59 43	"			1 44 42	"		
8 11 59	"			2 04 04	"		
8 23 38	"			6 09 21	"		
9 00 00	"						

* Max. $2a=0.042$ mm., $T=9.0$ sec., Time of Occurrence=5.59 45 A.M.

† Max. $2a=9.04$ " , $T=6.0$ " , " =6.28.44 P.M.

Date and Time of Eqke. Comm't. in Nagasaki.	Compt.	Duration of Prel. Tremor.	Total. Duration	Date and Time of Eqke. Comm't. in Nagasaki.	Compt.	Duration of Prel. Tremor.	Total. Duration
Jan. 16th.				Jan. 18th.			
5 ^h 13 ^m 32 ^s A.M.	E.W.		2 ^m 10 ^s	6 ^h 57 ^m 13 ^s P.M.	E.W.		1 ^m 53 ^s
5 56 11	"			Jan. 20th.			
7 02 05	"			9 06 14 P.M.	"		7 07
8 03 32	"			" " "	N.S.		6 39

TABLE IX. LIST OF THE SAKURA-JIMA EARTHQUAKES OBSERVED
AT THE OSAKA METEOROLOGICAL OBSERVATORY, ON
JAN. 11TH—13TH, 1914.

Date and Time of Eqke. Commencement in Osaka.	Duration of Preliminary Tremor.	Total Duration.	Maximum Motion.		
			Time of Occurrence.	2a	T
Jan. 11th.					
4 ^h 04 ^m 49 ^s A.M.	1 ^m 13 ^s	13 ^m 04 ^s	4 ^h 06 ^m 29 ^s A.M.	0.024 ^{mm}	4.8 ^{sec.}
6 00 57	1 12	15 00	6 04 52	0.054	6.2
10 04 21	1 14	18 50	10 08 21	0.072	7.2
0 49 46 P.M.	1 12	12 30	0 53 39 P.M.	0.044	6.2
3 02 23	1 12	10 15	3 05 51	0.040	6.2
6 30 29	1 12	10 20	6 33 12	0.034	4.0
8 30 31	1 13	10 5	8 31 02	0.040	4.8
9 15 49	1 14	8 35	9 18 51	0.060	5.0
10 30 51	1 12	9 25	10 51 31	0.032	4.8
Jan. 12th.					
6 10 28 A.M.	1 12	10 30	6 13 30 A.M.	0.054	4.0
8 31 05	1 13	12 15	8 37 40	0.044	5.2
6 29 28 P.M.	1 10	{ 79 51 81 50	{ 6 33 24 P.M. 6 33 59	{ 7.494 8.394	{ 6.2 7.2*
Jan. 13th.					
4 11 55 P.M.		6 9	4 14 45 P.M.	0.014	4.1

* This refers to the E.W. component, all the others relating to the N.S. component.