Year.	(i) Number of Sensible Shocks.	(ii) Number of Unfelt Shakings.	Sum.	Ratio: $\frac{ii}{i}$	Mean Ratio.
1911	57	321	378	5.6	
1912	124	563	687	4.5	
1913	6	28	34	4.7	4.6
1914	11	37	48	3.4	
1915	44	65	109	1.5	
1916	64	165	229	2 6	2.1

CHAPTER III. DURATION OF THE VOLCANIC DISTURBANCES.

8. *Duration of preliminary tremor of A-type earthquake.* According to the Yuno-taira observations during the 6 years, 1911 to 1916, the number of cases of the duration (y) of the preliminary tremor of the A type, or non-eruptive, volcanic earthquakes above and below 0.5 sec. were as follows:—

Interval.	Year.	Number of cases, $0.0 < y < 0.5$ sec.		Number of cases, $0.5 < y < 1.0$ sec.		Ratio: N_1/N_2
I	1911	111		46		
	1912	321	Sum. $447 = N_1$	123	Sum. $173 = N_2$	2.6
	1913	15		4		
II	1914	30		15		
	1915	54	$145 = N_1$	25	$84 = N_2$	1.7
	1916	61		44		

Thus, during the (I) epoch, 1911 to 1913, when the eruptive activity was very high, the earthquakes of y under 0.5 sec. were about 2.6 times more numerous than those of y between 0.5 and 1.0 sec. During the (II) epoch, 1914 to 1916, when the eruptive activity was quickly reduced to zero, the ratio in question became 1.7 : 1. It is likely that with the decline of the eruptive activity the earthquakes tend to originate at greater depths below, or at greater radial distances from, the crater.

9. Duration of preliminary tremor of A-type earthquake. (*Cont.*) Table IV gives the number of cases corresponding to the different lengths of the duration of the preliminary tremor of the non-eruptive, or A-type, volcanic earthquakes observed during the four years, 1914 to 1916, at the station of Yuno-taira, 2.3 km. horizontally distant from the crater centre, and 0.58 km. below the mountain top. In the majority of cases the duration was included between 0.0 and 0.8 sec. Confining our attention to the six years, 1911–1916, when the earthquakes were sufficiently numerous, we see that the mean value of the duration of the preliminary tremor ($=y$), varied between 0.57 and 0.64 sec., giving the general average of 0.62 sec., as shown below.

Year.	y = Duration of Prel. Tremor.	Number of cases from which the mean has been deduced.
1911	sec. 0 64	188
1912	0.64	541
1913	0.42	22
1914	0.43	46
1915	0.57	89
1916	0·57	117

The distance ($=x$), corresponding to the duration 0.62 sec. ($=y$), of the Yuno-taira seismological observatory from the mean centre of the volcanic earthquakes under consideration is, according to the results given in the Bulletin, Vol. IX, part 1, found to be 3.7 km.; giving, for the position of the mean centre, supposed to be right under the crater, a depth of about 3.4 km. below the present crater bottom, or 1.4 km. below the level of the mountain base at Komoro.

The tromometer observation in January and February 1911 at Ashino-taira at the radial distance of 4.85 km. from the centre of the volcano, gave $y=0.96$ sec. for the mean value of the duration of the preliminary tremor of the 18 A-type earthquakes. This gives the value of 5.8 km. for the distance ($=x$) between the mean earthquake origin and Ashino-taira. As the latter place is about 1.13 km. lower than the mountain top, the position of the mean earthquake centre corresponds to a depth of 4.2 km. below the latter, or some 2.2 km. below the level of the mountain base. Combining this result with the preceding, we are led to the conclusion that the mean earthquake centre exists at about $3\frac{3}{4}$ km. below the top of the Asama-yama.

10. *Duration of preliminary stage of eruptive disturbance.* Table V gives the number of cases corresponding to the different lengths of the duration of the preliminary small portion of the earth-shaking caused by the eruptions in 1913 observed at Yuno-taira. In 378 out of the total of 470 cases, the duration was included between 1.1 and 3.7 sec., giving the general average of 2.5 sec. (See fig. 6.) This is not much different from the mean values for the two preceding years, 1911 and 1912, which were 2.2 and 3.0 sec. respectively.

The duration of the preliminary small portion in question,

which is quite different from the " preliminary tremor " for the A-type seismic shock and denotes the real preparatory stage of an eruption, was in 1913 about $\frac{1}{8}$th or $\frac{1}{10}$th of the mean total duration of the eruptive disturbances.

Fig. 6.   Variation in the Duration of the " Initial Stage " of the B-type Disturbance, or Eruption, in 1913, observed at Yuno-taira (Asama-yama).

x = Duration of the " initial stage," in interval of 0.5 sec.
y = Number of cases corresponding to x.
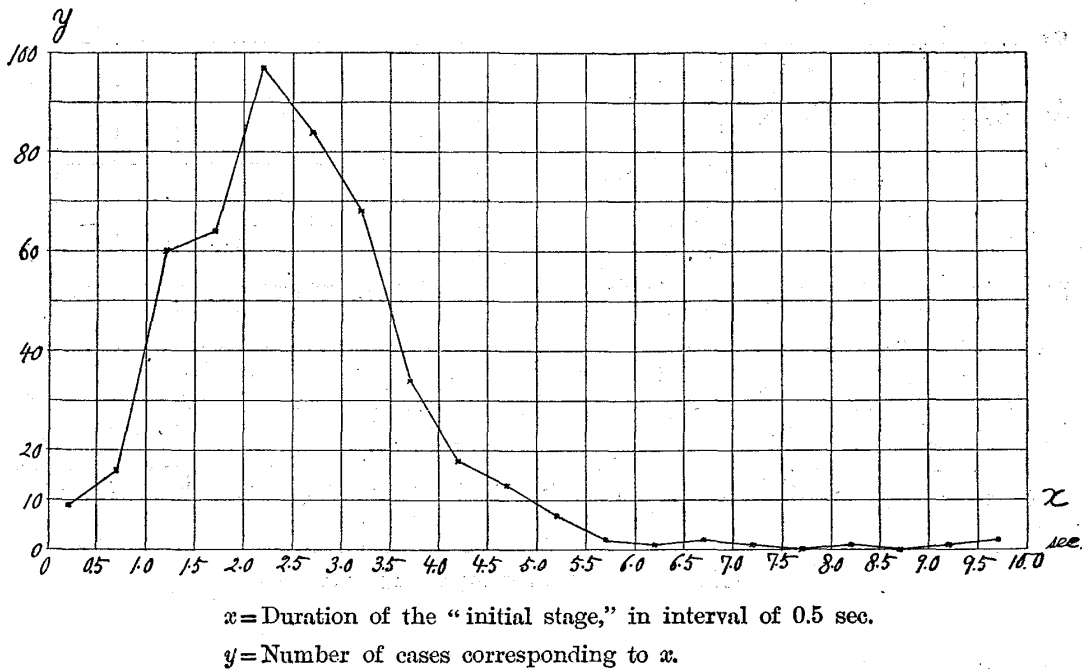
11. *Total duration of eruptive shaking.*   Table VI gives the number of cases corresponding to the different lengths of the total duration of the earth-shaking caused by an eruption of the Asama-yama in May to August, 1913. The duration, which varied between 4 and 260 sec., was included for the greater part, namely, in 2,292 out of 2,650 eruptions, within the limits of 11 and 35 sec. ; the greatest frequency corresponding to the cases of 13 to 25 sec. (See fig. 7.) The general mean value comes out to be 24.6 sec., being about 8 sec. shorter than the corresponding value

of 33 sec. for the two previous years 1911 and 1912. Thus the mean duration of the B-type shakings, which approximately represents that of the eruptions themselves, was apparently reduced a little in 1913, corresponding to an enormous frequency increase of the eruptive volcanic disturbances in that year.

Fig. 7. Variation in the Total Duration of the B-type Disturbance, or Eruption, in 1913, observed at Yuno-taira (Asama-yama).
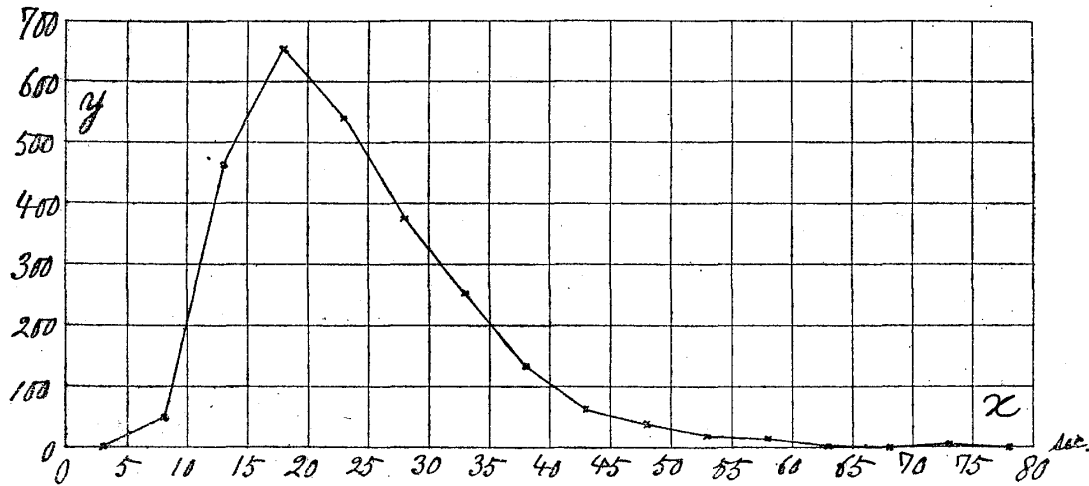
x = Total Duration, in intervals of 5 sec.

y = Number of cases corresponding to x.

TABLE IV. NUMBER OF CASES CORRESPONDING TO THE DIFFERENT
LENGTHS OF THE DURATION $(=y)$ OF THE PRELIMINARY TREMOR
OF A-TYPE EARTHQUAKES, OBSERVED AT YUNO-TAIRA
(ASAMA-YAMA), 1913—1916.

Year. \ y	1913	1914	1915	1916
0.0—0.2 sec.	12	15	13	13
0.3	1	5	9	11
0.4	2	4	13	12
0.5	—	6	19	25
0.6	3	4	11	19
0.7	—	5	4	17
0.8	—	4	8	6
0.9	1	1	2	2
1.0	—	1	—	—
1.1	1	—	—	—
1.2	—	—	4	3
1.3	—	—	1	8
1.4	—	1	1	1
1.5	—	—	1	—
1.6	—	—	1	—
1.7	—	—	1	—
1.8	1	—	—	—
1.9	—	—	1	—
2.6	1	—	—	—
Sum.	22	46	89	117
Mean y	0.42 sec.	0.43 sec.	0.57 sec.	0.57 sec.

TABLE V.   DURATION OF PRELIMINARY TREMOR OF THE
EARTHQUAKE MOTION CAUSED BY ERUPTION,
OBSERVED AT YUNO-TAIRA (ASAMA-
YAMA), 1913.

Duration.	Number of Earthquakes.	Duration.	Number of Earthquakes.	Duration.	Number of Earthquakes.
0.0 sec.	1	2.5 sec.	16	4.9 sec.	1
0.2	1	2.6	19		
0.3	3	2.7	14	5.0	4
0.4	4	2.8	16	5.1	—
0.5	2	2.9	19	5.2	1
0.6	4			5.3	2
0.7	2	3.0	14	5.4	—
0.8	2	3.1	11	5.5	1
0.9	6	3.2	16	5.6	—
		3.3	9	5.7	—
1.0	6	3.4	8	5.8	1
1.1	10	3.5	6	5.9	—
1.2	16	3.6	5		
1.3	20	3.7	10	6.0	1
1.4	8	3.8	6	6.6	1
1.5	11	3.9	7	6.9	1
1.6	12				
1.7	14	4.0	4	7.4	1
1.8	12	4.1	—		
1.9	15	4.2	3	8.3	1
		4.3	5		
2.0	23	4.4	6	9.4	1
2.1	22	4.5	4	9.5	1
2.2	13	4.6	3	9.7	1
2.3	18	4.7	2		
2.4	21	4.8	3		

TABLE VI. TOTAL DURATION OF THE EARTHQUAKE MOTION CAUSED BY ERUPTION, OBSERVED AT YUNO-TAIRA (ASAMA-YAMA), MAY TO AUGUST, 1913.

Duration.	Number of Cases.	Duration.	Number of Cases.	Duration.	Number of Cases.
1 sec.	—	31 sec.	80	61 sec.	1
2	—	32	64	64	1
3	—	33	47		
4	1	34	33	71	1
5	—	35	48	72	1
6	3	36	29	73	1
7	5	37	24	75	3
8	7	38	22		
9	16	39	30		
10	19	40	30	83	1
				85	1
11	52	41	19	88	2
12	76	42	9	90	2
13	113	43	14		
14	113	44	14	94	1
15	111	45	9	95	1
16	129	46	7	100	1
17	118	47	9		
18	151	48	6		
19	116	49	6	113	1
20	141	50	12	115	1
				120	3
21	123	51	6	137	1
22	100	52	4	138	1
23	112	53	2	140	1
24	107	54	7	148	1
25	100	55	1	150	2
26	86	56	4		
27	69	57	4	240	2
28	81	58	1	260	1
29	68	59	2		
30	72	60	5	Total Number.	2650