

apparatus for the two horizontal pendulums in the EW and NS directions. A great amount of labour, however, can be saved by causing the two horizontal pendulums to write on one and the same record-receiver.

For this purpose, one of the pendulums is to be constructed in the ordinary way (§3), while the other pendulum ought to have the shorter arm of the pointer bent at right angles to its longer arm.

II. HORIZONTAL PENDULUM OBSERVATIONS OF EARTHQUAKES, JULY 1898 TO DEC. 1899, HONGO, TOKYO.

6. *Number of earthquakes observed.*—As stated in Preface, 246 earthquakes were observed during $1\frac{1}{2}$ years between July 1898 and Dec. 1899. These are numbered 1 to 246 in order of date, their distribution into the groups being as follows :—

Group I	95 earthquakes
„ II	10 „
„ III	42 „
„ IV	21 „
„ V	3 „
„ VI	6 „
„ VII	5 „
„ VIII a	38 „
„ VIII b	10 „
„ VIII c	12 „
„ IX	4 „

7. *The instruments.*—All the observations, unless otherwise stated, were made in the “earthquake-proof house” in the University

compound, by means of the horizontal pendulum apparatus* A and B, of the following specification.

Horizontal pendulum A ; EW component apparatus, at Hongo:—

Period† of free oscillation=28 s.

Multiplication of the pointer=10.

Weight of the heavy cylinder=14 kg.

Length of the horizontal strut, or the distance between the centre of the heavy cylinder and the point of support=1 m.

Vertical distance between the points of support and of suspension=2,5 m.

Horizontal pendulum B ; NS component apparatus, at Hongo:—

Period of free oscillation=17 s.

Multiplication of the pointer=8,2.

In other respects B is exactly similar to A.

In the three cases of eqkes Nos. 234, 236 and 237, where the records from the apparatus A were not satisfactory I have substituted those from the newly constructed long-period horizontal pendulum C, also set up in the " earthquake-proof house," (described in § 2), of the following specification.

Horizontal pendulum C ; EW component apparatus, at Hongo:—

Period of free oscillation=120 s. †

Multiplication of the pointer=10.

Weight of the heavy cylinder= $7\frac{1}{2}$ kg.

Length of the horizontal strut=1 m.

Vertical distance between the points of support and of suspension=2,5 m.

* Described in Vol. XI of the Jour. Coll. Sc. Imp. Univ. Tokyo.

† The term *period* is used always in the sense of the *complete period*.

‡ In July 1900, the period was changed to 60,0 s.

In the discussions on the nature of the seismic movements proceeding from distant origins and of the non-seismic micro-pulsations of the ground, called *pulsatory oscillations*, I have referred, §§ 23 and 31, to the diagrams obtained from the horizontal pendulum D at Hitotsubashi, which is exactly of the form described in § 4 and has the following specification.

Horizontal pendulum D ; EW component apparatus, at Hitotsubashi:—

Period of free oscillation=29,7 s.

Multiplication of the pointer=8,4.

Weight of the heavy cylinder=6,4 kg.

Length of the horizontal strut=75 cm.

Vertical distance between the points of support and of suspension=75 cm.

8. *The character of the earthquake motion.*—Broadly speaking, the motion of an earthquake may be divided more or less definitely into three successive stages:—the *preliminary tremor*, the *principal portion* and the *end portion*, defined as follows.

The *preliminary tremor* of an earthquake consists essentially of vibrations of small amplitude and of very short, or comparatively short, period.

The *principal portion* denotes the most active part of an earthquake, which follows the preliminary tremor and which consists of movements of larger amplitude.

The *end portion* denotes the feeble finishing part of an earthquake, which follows the principal portion.

In cases of large earthquakes proceeding from distant origins, the preliminary tremor and the principal portion may each be further subdivided as follows.

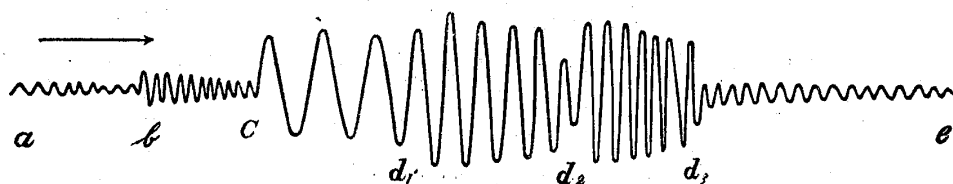
The *preliminary tremor* is made up of two distinct portions, which may be termed respectively the *1st preliminary*

tremor and the *2nd preliminary tremor*.—The 1st preliminary tremor denotes the earlier portion, and the 2nd preliminary tremor, the later portion of the preliminary tremor; the beginning of the latter being distinguished by a well marked increase of the amplitude and, in many cases, also by the appearance of slow undulations. In each of the two preliminary tremors, the period remains on the whole constant, the amplitude also remains generally constant or, as often happens, rather greater at the commencement than towards the end.

The *principal portion* is made up essentially of three successive parts, which may be termed respectively the *initial phase*, the *slow-period phase* and the *quick-period phase*.—The *initial phase* denotes the introductory part of the principal portion, which consists of a few slow undulations. The *slow-period phase* follows the initial phase and consists of a number of slow undulations. These two phases are distinguished from one another by the difference of amplitude and period. The *quick-period phase* occurs towards the end of the principal portion and consists of comparatively quick waves. The period remains constant in each of the two last phases.

In distant earthquakes the period remains essentially constant throughout the *end portion*. With earthquakes of near origins it may sometimes be different, since there exist, in these cases, various kinds of waves, some of which may gradually disappear towards the end.

The successive different stages of the earthquake motion are illustrated diagrammatically in the accompanying figure.



- | | | | | |
|---------|-------------------------|-----------------------|-------------------------------------|---------------------|
| a | Beginning of the eqke. | cd ₃ | Principal portion. | |
| ac..... | Preliminary tremor. | } | cd ₁ | Initial phase. |
| ab..... | 1st preliminary tremor. | | d ₁ d ₂ | Slow-period phase. |
| bc..... | 2nd „ „ | | d ₂ d ₃ | Quick-period phase. |
| | | d ₃ e..... | End portion. | |

9. *The analysis of the seismograms.*—I have analyzed each of the diagrams of the 246 earthquakes on the supposition that the waves recorded are *horizontal movements* and not tiltings of the ground*; that is, the range of motion or double amplitude, denoted by 2a, was in each case deduced by dividing the actual trace on the seismogram by the multiplication ratio of the pointer of the instrument. If the reader wants to consider the movements as due to the tilting, he can at once obtain the magnitude of the recorded trace by multiplying the results I give by the multiplication ratio of the pointer.

10. *Tables.*—I shall now give Tables embodying the chief results obtained from the measurements of the 246 earthquakes.

Table I gives the list of the earthquakes.

Tables II, III, IV, V, VI, VII, VIII, IX and X give, respectively for the earthquakes of the Groups I, II, III, IV, V, VI, VII, VIII and IX, some or all of the following elements of motion.—

Date and time of occurrence ;

Total duration ;

Durations of the 1st and 2nd preliminary tremors and of the principal portion ;

* See §§ 21-27.

Average period of waves in the 1st and 2nd preliminary tremors, the principal portion and the end portion ;

Maximum range of motion, or double amplitude, in the 1st and 2nd preliminary tremors and the principal portion.

With respect to the 1st and 2nd preliminary tremors, I have given separately the average period for the two series of the slower and the quicker waves, which exist one superposed upon the other.

Table II is divided into two portions [A] and [B]; [A] including those earthquakes whose durations varied between $\frac{3}{4}$ h and 4hs, and [B] the rest of the Group I.

11. *Terminology.*—I use the terms *waves*, *vibrations* and *undulations* all in the same sense of periodic movements, with this distinction: *vibrations* denote waves with quicker period, while *undulations* denote those with slower period.

TABLE I.—LIST OF 246 EARTHQUAKES OBSERVED AT HONGO,
TOKYO, JULY 1898 TO DEC. 1899, WITH ŌMORI'S
HORIZONTAL PENDULUM APPARATUS.

No.	Group.	Date.	Time of occurrence. *				Total duration.		
			h	m	s		h	m	s
1	VIII a	July 14th 1898.	7.	8.	59	p. m.	0.	2.	30
2	I	" 15th "	2.	6.	14	a. m.	1.	4.	0
3	IV	" " "	5.	10.	22	a. m.	0.	6.	0
4	III	" 20th "	6.	46.	14	p. m.	0.	14.	0
5	IX	" 25th "	6.	18.	2	a. m.	0.	30.	0
6	VIII c	" " "	6.	37.	57	a. m.	0.	0.	41
7	VIII a	" " "	0.	17.	4	p. m.	0.	11.	0
8	VIII a	" 27th "	2.	35.	2	a. m.	0.	10.	0
9	VII	Aug. 1st "	2.	12.	21	p. m.	0.	6.	0
10	VIII a	" 7th "	11.	2.	56	p. m.	0.	3.	0
11	I	" 8th "	4.	57.	35	p. m.	1.	20.	0
12	VI	" 10th "	10.	0.	50	p. m.	0.	9.	30
13	VIII a	" 11th "	5.	40.	37	p. m.	(?)		
14	VI	" 12th "	8.	38.	42	a. m.	0.	30.	0
15	VIII c	" 17th "	4.	26.	50	p. m.	0.	1.	0
16	III	" 21st "	0.	8.	22	a. m.	0.	45.	0
17	III	" " "	1.	28.	44	a. m.	0.	15.	0
18	IV	" 22nd "	11.	31.	53	p. m.	0.	6.	20
19	III	" 23rd "	8.	5.	17	a. m.	0.	5.	0
20	IV	" " "	11.	42.	53	a. m.	0.	3.	24
21	IV	" " "	11.	47.	17	a. m.	0.	8.	0
22	I	Sept. 1st "	5.	0.	57	a. m.	1.	45.	0
23	I	" " "	6.	2.	17	p. m.	0.	50.	0
24	I	" 4th "	0.	26.	58	a. m.	0.	36.	0
25	VIII a	" " "	3.	53.	21	p. m.	0.	1.	45
26	VIII a	" 5th "	4.	47.	35	p. m.	0.	1.	30
27	VIII a	" 7th "	1.	6.	38	p. m.	0.	0.	48
28	VIII b	" 11th "	10.	3.	32	p. m.	0.	1.	7
29	I	" 14th "	3.	2.	10	a. m.	1.	0.	0
30	III	" 15th "	7.	18.	37	p. m.	0.	8.	30

* The time is given in the First Normal Japan Time, namely that of long. 135° E.

No.	Group.	Date.	Time of occurrence.			Total duration.			
			h	m	s	h	m	s	
31	III	Sept. 16th 1898	4.	48.	32	a. m.	0.	17.	0
32	IV	" " "	8.	32.	40	a. m.	0.	12.	0
33	I	" 22nd "	9.	26.	11	p. m.	3.	0.	0
34	II	" 24th "	9.	14.	42	a. m.	(?)		
35	I	" 25th "	9.	22.	46	p. m.	0.	30.	0
36	III	" 26th "	10.	27.	44	a. m.	0.	12.	0
37	IV	" 27th "	10.	19.	52	a. m.	0.	16.	0
38	VIII a	" 28th "	1.	40.	49	a. m.	0.	10.	0
39	IV	" " "	7.	53.	40	a. m.	0.	9.	0
40	I	Oct. 1st "	1.	29.	12	a. m.	0.	4.	0
41	VIII a	" 6th "	4.	52.	22	a. m.	0.	1.	15
42	II	" 7th "	11.	1.	36	a. m.	0.	37.	0
43	I	" 10th "	7.	35.	39	a. m.	0.	48.	0
44	I	" 12th "	1.	45.	38	a. m.	2.	30.	0
45	I	" 19th "	4.	27.	48	a. m.	0.	39.	0
46	VIII a	" 20th "	3.	15.	46	p. m.	0.	1.	14
47	I	" 22nd "	9.	2.	42	a. m.	1.	7.	0
48	I	" " "	10.	35.	53	p. m.	0.	20.	0
49	VIII a	" 26th "	10.	30.	14	a. m.	0.	2.	44
50	I	Nov. 2nd "	8.	43.	15	p. m.	0.	17.	0
51	I	" 5th "	8.	48.	45	p. m.	0.	15.	0
52	VIII c	" 6th "	9.	0.	50	a. m.	0.	15.	0
53	III	" 7th "	2.	56.	47	a. m.	0.	18.	0
54	VIII a	" 12th "	2.	42.	40	a. m.	0.	2.	0
55	VIII a	" " "	9.	42.	25	a. m.	0.	12.	0
56	VII	" 13th "	11.	33.	3	a. m.	0.	13.	0
57	I	" 14th "	4.	5.	23	p. m.	0.	40.	
58	I	" 17th "	9.	54.	53	p. m.	2.	30.	0
59	VIII a	" 20th "	3.	42.	4	a. m.	0.	1.	30
60	VIII b	" 21st "	9.	5.	53	a. m.	(?)		

HORIZONTAL PENDULUM OBSERVATIONS OF EARTHQUAKES.

17

No.	Group.	Date.	Time of occurrence.			Total duration.			
			h	m	s	h	m	s	
61	I	Nov. 22nd 1898	8.	20.	3	p. m.	1.	13.	10
62	VIII a	" 28th "	7.	2.	34	a. m.	0.	2.	0
63	IV	" " "	10.	56.	10	p. m.	(?)		
64	I	" 30th "	7.	31.	18	a. m.	0.	17.	0
65	I	Dec. 1st "	9.	53.	53	p. m.	0.	33.	0
66	VI	" 4th "	1.	45.	32	a. m.	0.	19.	0
67	VIII a	" 5th "	0.	47.	53	a. m.	0.	3.	0
68	III	" 7th "	9.	12.	50	a. m.	0.	10.	0
69	I	" 11th "	3.	39.	22	p. m.	1.	18.	0
70	III	" 13th "	1.	34.	48	a. m.	0.	19.	0
71	III	" 14th "	3.	27.	15	p. m.	0.	1.	10
72	VIII b	" 19th "	0.	0.	15	p. m.	0.	1.	10
73	VIII a	" 25th "	0.	46.	56	a. m.	0.	3.	0
74	VIII c	" 27th "	4.	43.	42	p. m.	0.	0.	42
75	VIII c	" 29th "	4.	12.		a. m.	0.	3.	0
76	I	" 30th "	11.	23.	49	p. m.	0.	13.	0
77	VIII a	Jan. 1st 1899	1.	49.	45	a. m.	0.	2.	30
78	VIII c	" 5th "	9.	1.	3	a. m.	0.	0.	50
79	VIII b	" 8th "	1.	11.	21	a. m.	0.	2.	35
80	VIII a	" 14th "	11.	30.	42	a. m.	0.	0.	30
81	VII	" 22nd "	8.	4.	3	a. m.	0.	13.	0
82	I	" 23rd "	11.	9.	57	a. m.	0.	27.	0
83	VIII a	" " "	2.	55.	38	p. m.	0.	0.	40
84	I	" 27th "	10.	47.	32	p. m.	0.	7.	30
85	III	Feb. 1st "	1.	34.	55	a. m.	0.	54.	0
86	I	" " "	2.	52.	43	p. m.	0.	26.	0
87	VII	" 6th "	4.	7.	54	a. m.	0.	8.	0
88	I	" 11th "	4.	52.	3	p. m.	0.	27.	0
89	III	" 13th "	4.	29.	49	a. m.	(?)		
90	III	" 20th "	7.	37.	58	a. m.	0.	5.	0

No.	Group.	Date.	Time of occurrence.				Total duration.		
			h	m	s		h	m	s
91	VIII c	Feb. 21st 1899	1.	11.	5	a. m.	(?)		
92	IV	" 22nd "	8.	2.	18	a. m.	0.	16.	0
93	I	" 28th "	11.	48.	55	a. m.	1.	30.	0
94	III	" " "	11.	16.	0	p. m.	0.	5.	0
95	I	March 3rd "	9.	50.	2	a. m.	0.	20.	0
96	VIII a	" 6th "	8.	11.	40	p. m.	0.	6.	0
97	I	" " "	11.	36.	8	p. m.	0.	25.	0
98	I	" 7th "	4.	39.	50	a. m.	1.	0.	0
99	V	" " "	9.	55.	29	a. m.	1.	30.	0
100	V	" " "	3.	42.	50	p. m.	0.	9.	0
101	VIII c	" 13th "	10.	51.	53	p. m.	0.	0.	30
102	I	" 15th "	6.	9.	14	a. m.	0.	21.	0
103	III	" 16th "	4.	49.	14	a. m.	0.	27.	0
104	VIII a	" " "	8.	54.		p. m.	(?)		
105	III	" 20th "	3.	25.	47	a. m.	0.	21.	0
106	III	" " "	4.	12.	29.	p. m.	0.	16.	0
107	I	" 21st "	11.	35.	44.	p. m.	0.	44.	0
108	III	" 22nd "	7.	22.	36.	p. m.	0.	23.	0
109	IV	" " "	8.	22.	2.	p. m.	0.	5.	0
110	I	" 23rd "	8.	30.	59.	p. m.	0.	23.	0
111	I	" " "	9.	23.	14	p. m.	0.	28.	0
112	VI	" 24th "	1.	2.	35	p. m.	1.	9.	0
113	I	" " "	0.	29.	5	a. m.			
114	VIII a	" " "	6.	39.	40	p. m.	0.	4.	30
115	IV	" 26th "	6.	46.	45	a. m.	0.	15.	0
116	VIII c	" 29th "	11.	42.	14	p. m.	0.	3.	30
117	VIII a	April 2nd "	11.	1.	7	p. m.	0.	5.	30
118	VIII a	" 5th "	1.	0.	53	p. m.	0.	9.	0
119	V	" 6th "	8.	30.	22	a. m.	0.	19.	0
120	III	" 9th "	5.	42.	22	p. m.	0.	18.	0

No.	Group.	Date.	Time of occurrence.				Total duration.		
			h	m	s		h	m	s
121	VIII b	April 11th 1899	10.	5.	45	a. m.	0.	1.	0
122	III	" 13th "	4.	29.	57	a. m.	0.	2.	30
123	IV	" 15th "	0.	40.	26	a. m.	0.	7.	0
124	VIII a	" " "	7.	25.	30	p. m.	0.	33.	0
125	III	" 16th "	2.	27.	28	p. m.	0.	17.	0
126	I	" " "	11.	1.	34	p. m.	1.	5.	0
127	I	" 17th "	10.	46.	50	a. m.	1.	57.	0
128	III	" 19th "	3.	13.	6	p. m.	0.	2.	30
129	VIII b	" 20th "	5.	0.	31	p. m.	0.	0.	50
130	I	" 23rd "	0.	15.	2	a. m.	0.	3.	0
131	VIII a	" 24th "	6.	36.	59	a. m.	0.	5.	0
132	VIII a	May 2nd "	1.	2.	22	a. m.	0.	6.	0
133	I	" " "	11.	36.	47	p. m.	1.	0.	0
134	VIII a	" 4th "	10.	27.	28	a. m.	0.	1.	0
135	VIII a	" 6th "	2.	8.	34	p. m.	0.	2.	0
136	II	" 8th "	0.	28.	54	p. m.	1.	20.	0
137	VIII b	" 11th "	5.	59.	12	a. m.	0.	6.	0
138	I	" 14th "	10.	56.	31	p. m.	0.	24.	0
139	I	" 15th "	9.	57.	53	p. m.	0.	37.	0
140	I	" 18th "	4.	1.	45	a. m.	0.	30.	0
141	I	" 26th "	11.	38.	28	p. m.	0.	13.	0
142	II	June 5th "	3.	46.	32	a. m.	0.	25.	0
143	I	" " "	1.	37.	43	p. m.	2.	0.	0
144	VIII b	" 10th "	10.	36.	56	p. m.	0.	5.	0
145	I	" " "	3.	35.	20	p. m.	0.	33.	0
146	I	" 13th "	4.	31.	18	a. m.	0.	26.	0
147	I	" 14th "	8.	27.	46	p. m.	1.	24.	0
148	III	" 15th "	3.	49.	41	p. m.	0.	25.	0
149	I	" 16th "	2.	49.	10	p. m.	0.	25.	0
150	III	" 17th "	10.	9.	35	a. m.	1.	19.	0

No.	Group.	Date.	Time of occurrence.	Total duration.
			h m s	h m s
151	III	June 18th 1899	1. 52. 27 p. m.	0. 24. 0
152	I	" 19th "	9. 2. 22 p. m.	0. 31. 0
153	I	" 24th "	11. 46. 3 a. m.	0. 15. 0
154	I	" 25th "	1. 12. 28 a. m.	0. 33. 0
155	I	" " "	2. 25. 42 a. m.	0. 36. 0
156	I	July 4th "	0. 44. 11 a. m.	0. 24. 0
157	VIII a	" 7th "	5. 12. 49 a. m.	0. 5. 0
158	VIII c	" " "	6. 32. 16 a. m.	0. 1. 0
159	VIII a	" " "	6. 53. 17 a. m.	0. 8. 0
160	II	" 11th "	7. 15. 44 a. m.	0. 25. 0
161	II	" " "	4. 40. 7 p. m.	1. 20. 0
162	I	" 12th "	11. 56. 26 p. m.	1. 25. 0
163	I	" 14th "	9. 6. 3 p. m.	3. 0. 0
164	II	" " "	11. 21. 0 a. m.	1. 37. 0
165	I	" " "	1. 59. 23 p. m.	2. 2. 0
166	I	" " "	7. 48. 2 p. m.	0. 29. 0
167	III	" 18th "	1. 59. 0 a. m.	0. 20. 0
168	I	" 21st "	7. 25. 55 a. m.	0. 18. 0
169	I	" 24th "	10. 23. 33 a. m.	1. 45. 0
170	VIII a	" 27th "	2. 1. 5 p. m.	0. 8. 0
171	I	" 29th "	6. 23. 18 a. m.	0. 20. 0
172	I	" 30th "	4. 44. 6 a. m.	0. 41. 0
173	I	" 31st "	1. 30. 11 a. m.	0. 22. 0
174	IV	Aug. 1st "	9. 39. 57 a. m.	0. 6. 0
175	IV	" 3rd "	1. 34. 52 a. m.	0. 10. 0
176	III	" " "	6. 52. 57 p. m.	0. 20. 0
177	I	" 4th "	1. 50. 2 p. m.	2. 19. 0
178	IV	" 5th "	9. 18. 53 a. m.	0. 8. 0
179	VIII a	" 7th "	6. 11. 22 p. m.	0. 5. 0
180	VIII a	" 8th "	9. 53. 41 p. m.	0. 5. 0

No.	Group.	Date.	Time of occurrence.				Total duration.		
			h	m	s		h	m	s
181	II	Aug. 10th 1899	4.	59.	51	a. m.	0.	13.	0
182	III	" 13th "	2.	26.	17	p. m.	0.	7.	0
183	VI	" " "	8.	0.	2	p. m.	0.	4.	0
184	III	" 14th "	8.	48.	24	a. m.	0.	7.	0
185	I	" " "	8.	55.	20	p. m.	0.	6.	30
186	I	" 18th "	5.	46.	32	a. m.	1.	10.	0
187	I	" 21st "	1.	11.	44	a. m.	0.	22.	0
188	I	" 25th "	0.	20.	7	a. m.	1.	10.	0
189	I	" 26th "	7.	7.	11	a. m.	0.	20.	0
190	I	" " "	1.	58.	29	p. m.	0.	20.	0
191	VIII b	Sept. 2nd "	3.	15.	45	a. m.	0.	9.	0
192	VIII a	" 3rd "	10.	7.	54	p. m.	0.	5.	0
193	I	" 4th "	9.	31.	59	a. m.	3.	0.	0
194	III	" 9th "	9.	46.		a. m.	0.	15.	0
195	III	" " "	11.	0.	34	a. m.	0.	42.	0
196	I	" 11th "	3.	14.	16	a. m.	3.	0.	0
197	I	" " "	6.	50.	58	a. m.	4.	0.	0
198	I	" " "	8.	44.	35	p. m.	0.	19.	0
199	III	" 13th "	11.	5.	56	p. m.	0.	14.	0
200	I	" 17th "	10.	1.	8	p. m.	2.	0.	0
201	I	" 20th "	11.	24.	27	a. m.	1.	15.	0
202	I	" 23rd "	8.	26.	22	p. m.	0.	24.	0
203	I	" " "	11.	8.	45	p. m.	0.	28.	0
204	IV	" 27th "	1.	57.	39	a. m.	0.	4.	30
205	I	" 28th "	3.	58.	14	p. m.	0.	19.	0
206	I	" 29th "	8.	40.	28	p. m.	0.	17.	0
207	I	" 30th "	2.	11.	0	a. m.	2.	0.	0
208	III	Oct. 1st "	11.	55.	22	a. m.	0.	24.	0
209	IV	" 3rd "	6.	28.	3	p. m.	0.	6.	0
210	I	" 4th "	5.	56.	22	p. m.	1.	5.	0

No.	Group.	Date.	Time of occurrence.			Total duration.		
			h	m	s	h	m	s
211	I	Oct. 5th 1899	5.	24.	49	a. m.	(?)	
212	IX	" 7th "	0.	59.	38	a. m.	(?)	
213	VIII b	" 10th "	1.	12.	43	a. m.	0.	8. 0
214	VIII a	" " "	6.	17.	54	a. m.	0.	5. 0
215	IV	" " "	6.	47.	26	p. m.	0.	3. 0
216	IX	" 11th "	2.	17.	20	p. m.	0.	14. 0
217	I	" 14th "	0.	38.	5	a. m.	1.	39. 0
218	I	" " "	2.	55.	24	a. m.	2.	15. 0
219	I	" 17th "	5.	32.	56	p. m.	(?)	
220	I	" 19th "	6.	28.	59	p. m.	2.	0. 0
221	III	" 21 st "	10.	8.	9	p. m.	0.	8. 0
222	I	" 24th "	1.	3.	29	p. m.	2.	36. 0
223	III	" 29th "	11.	18.	47	p. m.	0.	3. 0
224	III	Nov. 3rd "	1.	39.	21	p. m.	0.	29. 0
225	IX	" 6th "	0.	34.	0	a. m.	0.	20. 0
226	III	" " "	7.	53.	47	p. m.	0.	20. 0
227	VIII c	" 7th "	4.	48.	50	p. m.	0.	1. 20
228	II	" 10th "	8.	58.	25	p. m.	1.	0. 0
229	III	" 11th "	2.	40.	24	a. m.	1.	0. 0
230	III	" " "	7.	10.	0	a. m.	0.	35. 0
231	I	" 12th "	7.	27.	13	a. m.	1.	10. 0
232	II	" 18th "	4.	23.	8	p. m.	0.	33. 0
233	VII	" 21 st "	6.	56.	29	p. m.	0.	20. 0
234	I	" 23rd "	6.	52.	39	p. m.	4.	0. 0
235	I	" 24th "	7.	2.	1	p. m.	2.	0. 0
236	VI	" 25th "	3.	45.	24	a. m.	}	2. 13. 0
237	VI	" " "	3.	58.	48	a. m.		
238	I	Dec. 4th "	9.	32.	1	a. m.	0.	40. 0
239	III	" 10th "	11.	22.	21	p. m.*	1.	0. 0
240	III	" 12th "	3.	43.	27	p. m.	0.	16. 0

No.	Group.	Date.	Time of occurrence.	Total duration.
241	VIII c	Dec. 14th 1899	^h 2. ^m 29. ^s 36 a. m.	^h 0. ^m 2. ^s 30
242	IV	" 20th "	10. 46. 29 a. m.	0. 13. 0
243	I	" 24th "	8. 52. 35 p. m.	0 10. 0
244	I	" 25th "	6. 8. 45 a. m.	(?)
245	I	" 28th "	3. 34. 43 a. m.	0. 25. 0
246	IV	" 31st "	9. 40. 17 a. m.	0. 3. 30

TABLE II.—DISTANT EARTHQUAKES (GROUP I).

Abbreviations.*
 { 1st P. T. 1st preliminary tremor.
 2nd P. T. 2nd " "
 P. T. Total " "
 P. P. Principal portion.
 E. P. End portion.

[A] Earthquakes whose durations varied between $\frac{1}{4}$ h and 4hs.

No.	Date.	Time of occurrence.	Duration of				Average period in						Max. range of motion in										
			Total eqke.	1st P. T.		2nd P. T.		1st P. T.		2nd P. T.		E. P.	1st P. T.		2nd P. T.		Initial ph.		Slow-per. ph.		Quick-per. ph.		
				m. s	m. s	m. s	m. s	Slower waves.	Quicker waves.	Slower waves.	Quicker waves.		Slower waves.	Quicker waves.	Slower waves.	Quicker waves.	mm	mm	mm	mm	mm	mm	mm
2	July 15, 1898	2 6.14 a.m.	1.4	7.21	7.14	14.35	7.54	m. s	3.1	5.0	8.8	3.1	s	21.2	10.5	0.02	0.02	0.13	0.10	0.25	0.25	0.85	0.55
11	Aug. 8, "	4.57.35 p.m.	1.20	—	—	6.56	17.0	m. s	—	4.2	—	—	s	—	10.5	—	—	—	—	—	—	—	—
22	Sept. 1, "	5. 0.57 a.m.	1.45	8.43	4.41	13.24	11.33	m. s	—	4.4	—	—	s	27.3	12.1	0.25	0.20	0.40	0.45	3.2	3.2	0.26	—
28	" "	6. 2.17 p.m.	0.50	—	—	3.15	12.54	m. s	—	4.2	—	—	s	{21.0 {15.0	{9.6 {4.8	0.24	0.35	—	—	—	—	—	—
29	" "	3. 2.10 a.m.	1.0	8.26	10.26	18.52	10.34	m. s	—	5.7	24.6	6.9	s	25.0	19.0	—	—	—	—	—	—	—	—
38	" "	9.26.11 p.m.	3.0	5.37	4.18	9.55	18.30	m. s	—	4.4	13.6	5.4	s	{16.2 {14.3	18.3	0.12	—	0.28	—	1.9	1.9	—	—
48	Oct. 10, "	7.35.39 a.m.	0.48	—	—	—	—	m. s	—	—	—	—	s	22.0	—	—	—	—	—	—	—	—	—
44	" "	1.45.38 a.m.	2.30	6.0	3.7	9.7	10.44	m. s	—	8.4	16.8	7.2	s	{37.5 {25.0	7.3	0.2	0.2	0.5	0.5	0.8	0.75	—	—
47	" "	9. 2.42 a.m.	1.7	—	—	9.52	8.0	m. s	—	7.9	—	—	s	20.0	8.9	—	—	—	—	—	—	—	—
58	Nov. 17, "	9.54.53 p.m.	2.30	4.15	2.0	6.15	10.35	m. s	—	8.4	25.2	7.1	s	21.7	13.4	0.12	0.12	1.0	0.55	0.8	0.15	—	—
61	" "	8.20. 3 p.m.	1.13	—	—	6.30	—	m. s	—	—	—	—	s	—	12.0	—	—	—	—	—	—	—	—
69	Dec. 11, "	3.39.32 p.m.	1.18	9.54	9.10	19.4	—	m. s	—	6.7	—	7.7	s	18.1	8.0	—	—	0.02	0.05	0.05	0.06	—	—
98	Feb. 28, 1899	11.48.55 a.m.	1.30	—	—	7.0	23.0	m. s	—	7.3	—	—	s	—	—	—	—	—	—	0.16	0.22	—	—
98	March 7, "	4.39.50 a.m.	1.0	—	—	22.20	18.0	m. s	—	—	—	—	s	—	8.7	—	—	—	—	0.06	0.06	—	—
107	" "	11.35.44 p.m.	0.44	—	—	4.13	9.46	m. s	—	7.8	—	—	s	25.4	8.3	—	—	—	—	0.36	0.28	—	—
126	April 16, "	11. 1.34 p.m.	1.5	—	—	17.35	26.0	m. s	—	8.4	—	—	s	—	9.0	—	—	—	—	0.1	0.05	—	—
127	" "	10.46.50 a.m.	1.57	9.17	9.38	18.55	29.26	m. s	—	6.8	—	8.0	s	29.0	9.2	0.04	0.03	0.07	0.07	—	—	—	—
133	May 2, "	11.36.47 p.m.	1.0	—	—	5.31	16.0	m. s	—	7.2	—	—	s	—	8.8	—	—	—	—	0.09	0.08	—	—
143	June 5, "	1.37.43 p.m.	2.0	17.35	17.21	34.56	—	m. s	—	8.1	—	10.8	s	23.7	18.2	—	—	0.03	0.04	—	—	—	—
147	" "	8.27.46 p.m.	1.24	8.24	7.43	16.7	—	m. s	—	4.9	—	7.3	s	27.0	17.7	—	—	—	—	0.04	0.05	—	—

* Same abbreviations are used in other Tables.

TABLE V.—EARTHQUAKES WHICH ORIGINATED OFF THE COASTS
OF THE PROVINCES OF HITACHI AND IWAKI.
(GROUP IV).

No.	Date.	Time of occurrence.	Duration of			Average period		Max. range of motion.	
			Total eqke.	P. T.	P. P.	P. P.	E. P.	(EW)	(NS)
3	July 15, 1898	^{h m s} 5.10.22 a.m.	^{m s} 6. 0	^{m s} 0.19	^{m s} 0.21	^s 1,1	—	mm mm 0,16 0,20	
18	Aug. 22, "	11.31.53 p.m.	6.20	0.17	—	{1,0 3,0	—	0,05 0,04	
20	" 23, "	11.42.53 a.m.	3.24	—	—	—	2,0	— —	
21	" " "	11.47.17 a.m.	8. 0	0.17	0.49	3,6	3,3	0,04 0,04	
32	Sept. 16, "	8.32.40 a.m.	12. 0	0.16	—	—	3,8	0,3 0,3	
37	" 27, "	10.19.52 a.m.	16. 0	0.58	—	—	5,7	0,04 0,02	
39	" 28, "	7.53.40 a.m.	9. 0	0.30	—	{0,8 2,2	3,8	very small	
63	Nov. 28, "	10.56.10 p.m.	—	—	—	—	—	"	
92	Feb. 22, 1899	8. 2.18 a.m.	16. 0	^s 1st P.T. 13,4 2nd P.T. 8,0	3.50	{6,7 3,8	{6,7 3,8	0,65 0,45	
109	March 22, "	8.22. 2 p.m.	5. 0	—	—	—	—	very small	
115	" 26, "	6.46.45 a.m.	15. 0	0.16	4. 0	{8,5 6,0 3,2	7,0	0,6 0,6	
123	April 15, "	0.40.26 a.m.	7. 0	1. 2	—	{4,8 3,4	3,4	0,04 0,05	
174	Aug. 1, "	9.39.57 a.m.	6. 0	0. 7	1. 5	—	—	0,15 0,13	
175	" 3, "	1.34.52 a.m.	10. 0	0.17	0.45	—	{5,0 2,8	0,18 0,14	
178	" 5, "	9.18.53 a.m.	8. 0	0.26	0.40	—	3,3	0,1 0,05	
183	" 13, "	8. 0. 2 p.m.	4. 0	0.15	—	—	—	— 0,07	
204	Sept. 27, "	1.57.39 a.m.	4.30	0. 7	0.20	—	—	0,15 0,08	
209	Oct. 3, "	6.28. 3 p.m.	6. 0	0. 6	—	—	3,3	0,04 0,03	
215	" 10, "	6.47.26 p.m.	3. 0	0.23	0.25	6,5	1,9	0,12 0,14	
242	Dec. 20, "	10.46.29 a.m.	13. 0	0.24	—	1,5	4,1	0,17 0,44	
246	" 31, "	9.40.17 a.m.	3.30	?	—	—	—	— 0,3	

TABLE IX.—LOCAL EARTHQUAKES. (GROUP VIII).

[IX a] Local earthquakes observed at several places. (Sub-group VIII a).

No.	Date.		Time of occurrence.	Duration of			Average period		Max. range of motion.	
				Total eqke.	P. T.	P. P.	P. P.	E. P.	(EW)	(NS)
1	July	14, 1898	^{h m s} 7. 8.59 p.m.	^{m s} 2.30	^{m s} 0. 8	^{m s} 0.20	—	1,9	0,15	0,15
7	"	25, "	0.17. 4 p.m.	11. 0	0.11	0.57	1,2	{1,8 4,9	1,4	—
8	"	27, "	2.35. 2 a.m.	10. 0	0.17	—	{12,0 2,4	3,4	0,09	0,07
10	Aug.	7, "	11. 2.56 p.m.	3. 0	0.14	0.25	1,4	1,2	0,2	0,15
13	"	11, "	5.40.37 p.m.	—	—	—	—	—	—	—
25	Sept.	4, "	3.53.21 p.m.	1.45	0. 4	—	—	—	—	—
26	"	5, "	4.47.35 p.m.	1.30	0. 7	—	0,8	—	0,13	0,06
27	"	7, "	1. 6.38 p.m.	0.48	—	—	—	—	—	—
38	"	28, "	1.40.49 a.m.	10. 0	0. 9	1.27	{0,63 2,0	{2,8 4,5	0,9	1,1
41	Oct.	6, "	4.52.22 a.m.	1.15	0. 6	—	—	15,0	small	
46	"	20, "	3.15.46 p.m.	1.14	0. 8	0.15	0,49	0,6	0,02	0,02
49	"	26, "	10.30.14 a.m.	2.44	0.16	—	—	—	0,07	0,05
54	Nov.	12, "	2.42.40 a.m.	2. 0	0. 9	0.19	1,1	1,5	0,14	0,15
55	"	" "	9.42.25 a.m.	12. 0	0.10	0.34	2,8	{2,3 7,0	—	0,12
59	"	20, "	3.42. 4 a.m.	1.30	0. 6	0. 7	—	1,0	0,10	0,07
62	"	28, "	7. 2.34 a.m.	2.10	0. 9	0.30	—	{1,1 4,8	—	0,1
67	Dec.	5, "	0.47.53 a.m.	3. 0	0. 7	0.26	—	—	0,2	0,22
73	"	25, "	0.46.56 a.m.	3. 0	0.10	0.35	—	—	—	0,04
77	Jan.	1, 1899	1.49.45 a.m.	2.30	0. 7	0.20	—	—	0,14	0,07
80	"	14, "	11.30.42 a.m.	0.30	—	—	—	—	0,1	0,14
83	"	23, "	2.55.39 p.m.	0.40	—	—	—	—	0,05	0,07
96	March	6, "	8.11.40 p.m.	6. 0	0.11	—	1,1	2,2	—	0,04
104	"	16, "	8.54. p.m.	?	—	—	—	—	—	—
114	"	24, "	6.39.40 p.m.	4.30	0. 9	—	2,4	—	0,15	0,2
117	April	2, "	11. 1. 7 p.m.	5.30	0. 6	0. 9	—	—	1,1	0,06

TABLE IX.—[IX a] CONT.

No.	Date.	Time of occurrence.	Duration of			Average period		Max. range of motion.	
			Total eqke	P. T.	P. P.	P. P.	E. P.	(EW)	(NS)
118	April 5, 1899	1. 0.53 ^{h m s} p.m.	9. 0 ^{m s}	0.20 ^{m s}	1.33 ^{m s}	{ ^s 3,1 2,2	— ^s	— mm	— mm
124	" 15, "	7.25.30 p.m.	33. 0	0.13	7.30	{ ^s 5,5 2,9	{7,3 3,9	1,7	1,6
131	" 24, "	6.36.59 a.m.	5. 0	{ ^s 1st P.T. 3,6 2nd P.T. 6,7	0.40	—	1,4	0,2	0,05
132	May 2, "	1. 2.22 a.m.	6. 0	0.13	0.14	—	{ ^s 3,7 1,9	0,15	0,15
134	" 4, "	10.27.28 a.m.	1. 0	0. 6	—	—	—	0,04	0,02
135	" 6, "	2. 8.34 p.m.	2. 0	0. 6	0.20	—	1,2	0,45	0,55
157	July 7, "	5.12.49 a.m.	5. 0	0. 9	0.20	—	2,2	0,42	0,4
158	" " "	6.32.16 a.m.	1. 0	0. 4	—	—	—	0,1	0,05
159	" " "	6.53.17 a.m.	8. 0	{ ^s 1st P.T. 3,0 2nd P.T. 7,5	—	—	—	0,95	0,7
170	" 27, "	2. 1. 5 p.m.	8. 0	0. 9	0.15	—	—	0,24	0,24
179	Aug. 7, "	6.11.22 p.m.	5. 0	0. 7	0.30	—	—	0,22	0,2
180	" 8, "	9.53.41 p.m.	5. 0	0. 9	0.20	—	—	0,15	0,05
192	Sept. 3, "	10. 7.54 p.m.	5. 0	0. 9	0.16	—	—	0,12	0,07
214	Oct. 10, "	6.17.54 a.m.	5. 0	0.10	0.17	—	1,8	0,22	0,16

[IX b] Local earthquakes observed in Tokyo and at one other place. (Sub-group VIII b).

28	Sept. 11, 1898	10. 3.32 ^{h m s} p.m.	1. 7 ^{m s}	0.16 ^{m s}	— ^{m s}	— ^s	— ^s	0,08	0,03
60	Nov. 21, "	9. 5.53 a.m.	—	—	—	—	—	very small	
72	Dec. 19, "	0. 0.15 p.m.	1.10	0. 4	0.14	0,53	—	0,08	0,04
79	Jan. 8, 1899	1.12.21 a.m.	2.35	0. 3	—	—	0,68	0,02	0,02
121	April 11, "	10. 5.45 a.m.	1. 0	0.18	0. 5	—	—	0,16	—
129	" 20, "	5. 0.31 p.m.	0.50	0. 9	0. 8	—	—	0,16	0,08
137	May 11, "	5.59.12 a.m.	6. 0	0. 8	0.20	—	7,2	0,05	0,01
144	June 10, "	10.36.56 p.m.	5. 0	0. 8	—	{ ^s 8,3 3,0	—	0,06	0,07
191	Sept. 2, "	3.15.45 a.m.	9. 0	3.20	—	5,3	—	0,03	0,04
213	Oct. 10, "	1.12.43 a.m.	8. 0	?	—	6,0	5,1	0,05	0,04

[IX c] Local earthquakes observed in Tokyo.
(Sub-group VIII c).

No.	Date.	Time of occurrence.	Duration of			Average period		Max. range of motion.	
			Total eqke	P. T.	P. P.	P. P.	E. P.	(EW)	(NS)
		<small>h m s</small>	<small>m s</small>	<small>m s</small>	<small>m s</small>	<small>s</small>	<small>s</small>	<small>mm</small>	<small>mm</small>
6	July 25, 1898	6.37.57 a.m.	0.41	0.6	—	9.4	—	0.06	0.03
15	Aug. 17, "	4.26.50 p.m.	1.0	0.7	—	1.5	—	0.12	0.04
52	Nov. 6, "	9.05.0 a.m.	15.0	0.42	2.20	4.8	4.5	0.06	0.06
74	Dec. 27, "	4.43.42 p.m.	0.42	0.10	—	—	—	0.08	0.03
75	" 29, "	4.12. a.m.	3.0	0.20	—	—	2.5	0.04	0.02
78	Jan. 5, 1899	9.1.3 a.m.	0.50	0.9	—	4.4	—	0.1	0.15
91	Feb. 21, "	1.11.5 a.m.	—	—	—	—	—	very small	
101	March 13, "	10.51.53 p.m.	0.30	0.6	—	—	—	0.05	0.01
116	" 29, "	11.42.14 p.m.	3.30	0.19	—	—	4.0	0.04	0.01
227	Nov. 7, "	4.48.50 p.m.	1.20	0.8	—	—	—	0.08	0.10
241	Dec. 14, "	2.29.36 a.m.	2.30	0.15	—	—	—	—	—