

GROUP III.—*Earthquakes which originated off the north-eastern coast of Honshu (Main Island).*

Eqke No. 4. July 20th 1898; 6h 46m 14s p.m.

Total duration = about 14m.

Observations at Meteorological Observatories:—

Ishinomaki	6h 38m 33s p.m.	Weak.	Houses shaken.
Fukushima	6. 37. 32	Slight.	Motion quick.
Akita	6. 39. 55	„	
Miyako	6. 41. 6	„	
Yamagata	6. 41. 10	„	
Tokyo	6. 41. 54	„	
Kofu	6. 42. 2	„	Duration long.
Mito	6. 42. 53	„	

(EW component).

The P.T., whose duration was 31s, consisted of very small vibrations.

(NS component).

The P.P. began with small vibrations of an average period of 3,2s, whose max. 2a was 0,09 mm in the EW and 0,05 mm in the NS component; with a series of still quicker and smaller waves superposed. At about 1m 50s from the commencement of the earthquake, there appeared slower vibrations, whose average period was 7,7s and whose max. 2a was 0,1 mm in each component. On these were superposed smaller waves of an average period of 2,5s.

The E.P. The motion consisted of vibrations with an average period of 3,2s, superposed on others with an average period of 5,4s.

Eqke No. 16. August 21st 1898; 0h 8m 22s a.m.

Total duration = about 45m,

Observations at Meteorological Observatories:—

Ishinomaki	.. ..	0h 5m 0s a.m.	Slight.	{ Only recorded by instrument.
Miyako	.. ..	0. 7. 35	..	{ Motion quick; followed by after shocks.
Aomori	.. ..	0. 8. 15	..	{ Only recorded by instrument.
Nemuro	.. ..	0. 9. 36	..	Motion gentle.
Tokyo	.. ..	0. 9. 39	..	

(NS component).

The 1st P.T., whose duration was 56s, consisted of very small vibrations of an average period of 1,1s, superposed on traces of slower waves of an average period of 8,0s. The beginning was well defined.

The 2nd P.T., whose duration was 1m 24s, consisted of well defined undulations of an average period of 10,5s, the max. 2a being 0,14 mm in the NS and 0,16 mm in the EW component. The superposed small vibrations were also larger than in the 1st P.T.

The P.P. commenced with slow undulations of an average period of 15,0s, whose max. 2a was 0,4 mm in the NS and 0,2 mm in the EW component; quicker waves with an average period of 7,7s being superposed. At about 4m 48s from the commencement of the earthquake the waves became simpler and regular, the average period being 7,5s.

The E.P. The average period deduced from two successive groups of 50 vibrations was as follows:—

$$\left. \begin{array}{l} 7,8s \\ 7,9 \end{array} \right\} \text{ (General mean)} \\ \qquad \qquad \qquad 7,9s.$$

Eqke No. 17. August 21st 1898; 1h 28m 44s a.m.

Total duration = 15m.

Observations at Meteorological Observatories:—

Aomori	1h 29m 10s a.m.	Slight.	} Only registered by instrument.
Kumagae	.. ..	1. 29. 29	„
Miyako	.. ..	1. 29. 32	„
Tokyo	.. ..	1. 29. 51	„

(NS component).

The P.T., whose duration was 54s, consisted of very small vibrations of an average period of 1,4s. The beginning as well as the end of this epoch was quite well marked.

The P.P. began with quick vibrations (max. $2a=0,02$ mm), superposed on slow undulations (max. $2a=0,05$ mm) of an average period of 17,2s. During the earlier part there were present quick small waves which were evidently of the same nature as those occurring in the P.T. From about 1h 29m 42s there predominated waves of an average period of 3,9s, superposed with small vibrations of an average period of 1,1s. From about 1h 31m 42s, the average period of the predominating waves was reduced to 6,9s.

The EW component diagram was obscured by the superposition of several lines.

Eqke No. 19. August 23rd 1898; about 8h 5m 17s a.m.

Total duration=5m.

Observations at Meteorological Observatories:—

Ishinomaki	.. ..	8h 2m 30s a.m.	Slight.	
Kofu	.. ..	8. 4. 15	„	Motion quick.
Miyako	.. ..	8. 4. 19	„	
Mito	.. ..	8. 4. 42	„	} Accompanied by vertical movements.
Kumagae	.. ..	8. 5. 9	„	

The P.T. lasted for about 56s and consisted of very small vibrations of an average period of 1,1s, superposed on others of an average period of 3,3s.

The P.P. consisted of comparatively regular vibrations of an average period of 4.6s. The max. 2a of 0.04 mm in each component occurred at 28s from the commencement of this epoch.

The E.P. The average period was about 4.2s.

Eqke No. 30. September 15th 1898; 7h 18m 37s p.m.

Total duration = 8½m.

Observations at Meteorological Observatories:—

Miyako	6h 58m 5s p.m.	Slight.
Yamagata	7. 0. 0	„
Aomori	7. 0. 0	„
Hakodate	7. 0. 0	„
Fukushima	7. 0. 35	„
Kumagae	7. 1. 25	„
Mito	7.19. 30	„

The P.T. lasted for about ? s.

The principal vibrations had an average period of 4.3s, these being superposed with others still smaller.

Eqke No. 31. September 16th 1898; 4h 48m 32s a.m.

Total duration = 17m.

Observations at Meteorological Observatories:—

Mito	4h 48m 25s a.m.	Weak.	Motion quick; accompanied by vertical motion.
Maebashi	4. 48. 29	„	
Kumagae	4. 48. 40	„	Duration long.
Choshi	4. 47. 0	Slight.	
Yamagata	4. 47. 10	„	
Fukushima	4. 47. 24	„	Motion gentle.
Ishinomaki	4. 47. 30	„	
Yokohama	4. 48. 18	„	Motion gentle.
Tokyo	4. 48. 23	„	„

Yokosuka	4h 48m 58s a.m.	Slight.
Kofu	4. 50. 00 (?)	„
Matsumoto	4. 36. 00 (?)	„
Utsunomiya	4. 49. 20	„

The P.T. lasted for about 27s.

The P.P. The max. 2a was 0,4 mm in the EW and 0,5 mm in the NS component. The motion consisted of quick vibrations, superposed more or less definitely on traces of slower ones of an average period of 5,3s.

The E.P. The average period deduced from three successive series of 40 vibrations, counted from $3\frac{1}{2}$ m after the beginning of the earthquake, was as follows:—

$$\left. \begin{array}{l} 3,5s \\ 3,9 \\ 5,5 \end{array} \right\} \begin{array}{l} \text{(General mean)} \\ 4,3s. \end{array}$$

Eqke No. 36. September 26th 1898; 10h 27m 44s a.m.

Total duration=about 12m.

Observations at Meteorological Observatories:—

Fukushima	10h 25m 20s a.m.	Slight.	Motion quick.
Ishinomaki	10. 25. 30	„	
Utsunomiya	10. 28. 0	„	
Tokyo	10. 28. 43	„	
Kofu	10. 30. 20	„	
Kumagae	10. 37. 22	„	

(EW component).

The P.T. lasted for 32s.

The P.P. The motion consisted at first of small vibrations of an average period of 2,6s, superposed on others of an average period of 5,9s. The max. 2a was 0,05 mm.

The E.P. Near the end the average period was 3,9s.

(NS component).

The P.T. lasted for 32s.

The P.P. The max. 2a was about 0,05 mm.

Eqke No. 53. November 8th 1898; 2h 56m 47s a.m.

Total duration = 18m.

Observations at Meteorological Observatories:—

Fukushima	2h 57m 30s a.m.	Weak.	Houses shaken.
Mito	2. 58. 30	"	Motion quick; houses shaken.
Tokyo	2. 59. 5	"	
Choshi	2. 56. 36	Slight.	
Fukui	2. 58. 47	"	
Maebashi	2. 58. 58	"	Motion quick.
Kumagae	2. 59. 0	"	"
Utsunomiya	3. 0. 0	Weak.	Motion gentle.
Yokohama	3. 1. 30	Slight.	"
Miyako	3. 0. 49	"	

The P.T., whose duration was 19s, consisted of small vibrations of an average period of about 1,4s, superposed with still quicker ones.

The P.P., whose duration was 3m 50s, consisted of vibrations of an average period of 3,1s, whose max. 2a was 0,8 mm in the EW and 1,4 mm in NS component; still quicker ones of an average period of about 0,8s being superposed. From about 2h 57m 33s waves of an average period of 9,3s became prominent, superposed with some small vibrations. 30s later on the waves became well defined and free from superpositions and had an average period of 3,8s; their maximum of 0,7 mm in the EW and 0,45 mm in the NS component occurring at 3h 0m 17s.

P.O. There were very small but distinct traces of P.O. Their average period, deduced from two successive groups of vibrations immediately after the earthquake, was as follows:—

4,2s (meaned from 70 vibrations),

4,2 („ „ 200 „).

Eqke No. 68. December 7th, 1898; 9h 12m 50s a.m.

Total duration=10m.

Observations at Meteorological Observatories:—

Fukushima 9h 13m 2s a.m. Slight.

The P.T., whose duration was about 44s, consisted of very quick small vibrations.

The P.P. consisted of vibrations of an average period of 7,2s, superposed with smaller waves. The max. 2a was 0,08 mm in the EW and 0,06 mm in the NS component.

P.O. The max. 2a was 0,05 mm in each component, and the average period, measured 2 hours before the earthquake, was 6,7s.

Eqke No. 70. December 13th 1898; 1h 34m 48s a.m.

Total duration=about 19m.

Observations at Meteorological Observatories:—

Hakodate 1h 33m 27s a.m. Slight. Motion gentle.

Aomori 1. 35. 0 „ Motion quick.

Tokyo 1. 35. 38 „

(EW component).

The 1st P.T., whose duration was 81s, consisted of extremely slight traces of waves of an average period of 6,8s, superposed with very small vibrations.

The 2nd P.T., whose duration was 42s, had an average period of about 2,5s (?); the max. 2a being 0,08 mm.

The P.P., whose duration was 5½m, began with well pronounced vibrations of an average period of 3,7s, whose max. 2a was 0,25 mm. After 2m 15s there appeared another group of waves, which commenced with a max. 2a of 0,35 mm and had an average period of 7,0s.

The E.P. The average period was about 5,8s.
(NS component).

The P.P. In the earlier portion the motion consisted of vibrations of an average period of 8,5s, superposed with smaller ones of an average period of 3,2s. The max. 2a was 0,3 mm.

P.O. There were slight traces of P.O., whose average period was 3,9s.

Eqke No. 71. December 14th 1898; 3h 27m 15s p.m.

Total duration = 1m 10s.

Observations at Meteorological Observatories:—

Ishinomaki	.. ..	3h 19m 42s p.m.	Slight.
Mito	.. ..	3. 25. 58	„
Tokyo	.. ..	3. 26. 9	„
Utsunomiya	.. ..	3. 27. 0	„
Fukushima	.. ..	3. 27. 0	„
Maebashi	.. ..	3. 27. 9	„

The diagram was obscured by very powerful P.O., whose max. 2a was 0,15 mm in each component, and whose average period was 5,4s.

The earthquake motion consisted of small quick vibrations, whose max. 2a was 0,09 mm in the EW and 0,04 mm in the NS component.

Eqke No. 85. February 1st 1899; 1h 34m 55s a.m.

Total duration = 54m.

Observations at Meteorological Observatories:—

Matsumoto	.. ..	1h 35m 4s a.m.	Slight.
Aomori	.. ..	1. 36. 30	„ Motion gentle.
Yamagata	.. ..	1. 37. 0	„
Miyako	.. ..	1. 37. 2	„
Mito	.. ..	1. 37. 8	„
Tokyo	.. ..	1. 37. 42	„
Fukushima	.. ..	1. 37. 51	„ Motion gentle.
Kumagae	.. ..	1. 37. 54	„
Yokohama	.. ..	1. 39. 52	„

(EW component).

The P.T., whose duration was 1m 5s, consisted of small vibrations of an average period of 2,5s, superposed on slower waves of an average period of 7,0s. The small superpositions were present also during the first 7m 15s of the P.P.

The P.P. which lasted for 10m 30s, began with two slow undulations of an average period of 20,5s, whose max. 2a was 1,0 mm. During the next 2m 12s, the motion consisted essentially of vibrations (max. 2a = 0,75 mm) of an average period of 11,0s. Again during the next 1m 11s the predominating waves were quicker and had an average period of 5s. These were followed by vibrations of an average period of 9,0s, superposed more or less definitely on slower ones of an average period of 13,3s. The absolute max. 2a of 0,75 mm (period 9,1s) occurred at 6m 0s from the beginning of the earthquake and formed the very last vibration of the most active portion.

The E.P. The average period deduced from two successive groups of 50 vibrations was as follows :—

$$\left. \begin{array}{l} 8,8s \\ 9,6 \end{array} \right\} \begin{array}{l} \text{(General mean)} \\ 9,2s. \end{array}$$

(NS component).

The P.T. lasted for 1m 4s.

The P.P. The max. 2a was 0,7 mm.

Eqke No. 89. February 13th 1899; 4h 29m 49s a.m.

This was a very small earthquake.

Observations at Meteorological Observatories :—

Ishinomaki	.. ..	5h 11m 50s a.m.	Weak.	
Tokyo	.. ..	5. 15. 7	Slight.	
Fukushima	.. ..	5. 16. 0	„	Houses shaken.
Miyako	.. ..	5. 20. 14	„	Motion quick.

Eqke No. 90. February 20th 1899; 7h 37m 58s a.m.

Total duration=about 5m.

Observations at Meteorological Observatories:—

Tokyo	..	..	..	4h 47m 1s a.m.	Slight.	
Yamagata	..	..	..	7. 47. 40	„	
Kumagae	..	..	..	7. 47. 8	„	
Mito	..	..	..	7. 47. 50	Weak.	Motion quick.
Utsunomiya	..	..	..	7. 48. 28	Slight.	Motion gentle.
Fukushima	..	..	..	7. 49. 5	„	Houses shaken.
Ishinomaki	..	..	..	7. 49. 23	„	

The 1st P.T. lasted for 27,7s and consisted of very small quick vibrations.

The 2nd P.T., whose duration was 4s, also consisted of small vibrations.

The P.P., whose duration was 26s, consisted of small vibrations; the max. 2a of 0,08 mm in the EW and 0,06 mm in the NS component occurring at the commencement of this epoch.

P.O. There were slight traces of P.O. whose average period was 5,8s.

Eqke No. 94. February 28th 1899; 11h 15m 40s p.m.

Total duration=about 5m.

Observations at Meteorological Observatories:—

Kofu	..	..	..	11h 15m 55s p.m.	Slight.
Tokyo	..	..	..	11. 16. 6	„
Mito	..	..	..	11. 16. 45	„
Maebashi	..	..	..	11. 17. 41	„

The P.T., whose duration was 53s, consisted of small quick vibrations superposed on traces of slow undulations.

The P.P., whose duration was 13s, began with a well defined motion of 0,1 mm towards E and 0,05 mm towards S. In the EW component the max. 2a of 0,12 mm occurred at 5s from the beginning of the P.P.; while

in the NS component the max. 2a of 0,1 mm occurred at 2,2s and also at 5s after the same moment.

Eqke No. 103. March 16th 1899; 4h 49m 14s a.m.

Total duration = 27m.

Observations at Meteorological Observatories:—

Yokohama	.. ..	4h 28m 0s a.m.	Slight.	
Tokyo	.. ..	4. 50. 27	„	
Mito..	.. ..	4. 50. 53	„	Motion gentle.
Kofu	.. ..	4. 52. 15	„	
Utsunomiya	.. ..	4. 52. 20	„	
Miyako	.. ..	4. 54. 34	„	
Nagano	.. ..	4. 51. 29	„	
Fukushima	.. ..	4. 53. 23	„	

The P.T., whose duration was 1m 36s, consisted of very small vibrations of an average period of 2,4s.

The P.P., whose duration was 7m, consisted of slow waves of an average period of 8,7s, superposed with quicker vibrations. The max. 2a's of 0,28 mm in the EW and of 0,24 mm in the NS component occurred respectively at 3m 45s and 4m 36s from the commencement of the earthquake. In the later part of this epoch the motion consisted of vibrations of an average period of 6,4s, superposed here and there with small movements of an average period of 3,3s.

The E.P. The average period was 7,0s.

Eqke No. 105. March 20th 1899; 3h 25m 47s a.m.

Total duration = 21m.

Observations at Meteorological Observatories:—

Miyako	.. ..	3h 24m 43s a.m.	Slight.
Hakodate..	.. ..	3. 25. 57	„

(EW component).

The 1st P.T., whose duration was 64s, consisted of very small vibrations of an average period of 2,1s.

The 2nd P.T. lasted for 77s. The amplitude remained nearly constant throughout this epoch, the max. 2a being 0,05 mm in each component. Near the commencement the average period was 2,4s, while towards the end it was 4,9s.

The P.P., whose duration was 4m 40s, began with 7 vibrations which together occupied 36,8s and had an average period of 5,3s. Then followed the most active group of 8 waves, whose max. 2a was 0,15 mm and whose average period was 4s. The succeeding waves had an average period of 5,0s.

The E.P. was somewhat obscured by small P.O., whose average period, measured immediately before the earthquake was 3,5s. (NS component).

The max. 2a was 0,06 mm.

Eqke No. 106. March 20th 1899; 4h 12m 29s p.m.

Total duration = 16m.

Observations at Meteorological Observatories:—

Ishinomaki	.. ..	4h 7m 57s p.m.	Slight.
Miyako	.. ..	4. 12. 36	„
Hakodate	.. ..	4. 13. 20	„
Mito	.. ..	4. 14. 20	„ Motion gentle.

The P.T., whose duration was about 32s, consisted of very small vibrations.

The P.P. lasted about 4½m. At about 1m 29s from the commencement of the earthquake, there appeared the most active group of waves, which together occupied 1m 52s and had an average period of 3,8s. The max. 2a was 0,15 mm in the EW and 0,12 mm in the NS component.

Eqke No. 108. March 22nd 1899; 7h 22m 36s p.m.

Total duration = 23m.

Observations at Meteorological Observatories :—

Ishinomaki	7h 22m 17s p.m.	Weak.	Houses shaken.
Fukushima	7. 23. 50	"	{ Followed by after- shocks.
Maebashi	7. 21. 59	Slight.	Motion gentle.
Yamagata	7. 22. 0	"	
Mito	7. 22. 45	"	Motion quick.
Miyako	7. 22. 56	"	
Tokyo	7. 23. 0	"	Motion slow.
Nagano	7. 23. 6	"	
Kumagae	7. 23. 29	"	
Utsunomiya	7. 23. 38	"	Motion slow.
Matsumoto	7. 23. 47	"	
Hikone	7. 23. 50	"	Motion gentle.
Yokohama	7. 23. 53	"	
Kofu	7. 24. 16	"	

The P.T., whose duration was 34s, consisted of very small vibrations.

The P.P. lasted about $4\frac{1}{2}$ m. During the first 2m, the motion was superposed with small movements of an average period of about 1,8s; there being in the earlier part some traces of still quicker vibrations. The max. 2a of the vibrations, which occurred at the commencement of the P.P., was 0,45 mm in the EW and 0,3 mm in the NS component. From about 7h 23m 24s there appeared 19 large well defined vibrations of an average period of 6,7s, their max. 2a which occurred at 7h 24m 20s being 0,52 mm in the EW and 0,3 mm in the NS component. These were followed by waves of an average period of 3s.

The E.P. The principal average period, deduced from two successive groups of 50 vibrations, in the EW component, was as follows :—

$$\left. \begin{array}{l} 7,1s \\ 8,0 \end{array} \right\} \begin{array}{l} \text{(General mean)} \\ 7,6s. \end{array}$$

Eqhe No. 120. April 9th 1899; 5h 42m 22s a.m.

Total duration = 18m.

Observations at Meteorological Observatories :—

Miyako	5h 40m 0s a.m.	Slight.
Fukushima	5. 41. 5	„
Mito	5. 42. 52	„
Yokohama	5. 42. 59	„
Ishinomaki	5. 43. 11	„
Utsunomiya	5. 43. 34	„
Tokyo	5. 42. 58	„

(EW component).

The P.T., whose duration was about 30s (?), consisted of very small vibrations.

The P.P., whose duration was 12m, began gradually. For the first 1m 30s, the motion consisted of small vibrations of an average period of 3,3s (mixed with still smaller ones), superposed on slower waves of an average period of 9,0s. Then followed, for 1m 30s, thirteen well defined vibrations of an average period of 6,9s, whose max. (abs.) 2a of 0,1 mm occurred at 2½m after the commencement of the earthquake. The motion then showed a series of alternations of maximum and minimum groups, the average period being 9,0s.

The E.P. was confused by slight P.O.

P.O. The average period, measured before the earthquake, was 3,7s.
(NS component).

The sharp conical point of the horizontal strut of the pendulum had been broken and accordingly the natural period of oscillation of the latter was reduced to about 6s. Consequently the diagram was not satisfactory, the pendulum having been, during the earthquake, thrown into its own motion.

Eqlee No. 122. April 13th 1899; 4h 29m 57s a.m.

Total duration = 2m 30s.

Observations at Meteorological Observatories :—

Yokohama	4h 25m 11s a.m.	Slight.	Motion quick.
Ishinomaki	4. 26. 11	„	

Utsunomiya	.. ..	4h 29m 30s a.m.	Slight.	Motion quick.
Maebashi	.. ..	4. 30. 8	„	„
Tokyo	.. ..	4. 30. 44	„	
Mito	.. ..	4. 30. 55	„	Motion quick.
Miyako	.. ..	4. 32. 28	„	
Choshi	.. ..	4. 33. 8	„	
Fukushima	.. ..	4. 37. 15	„	Motion quick.

The commencement was confused by small P.O. The duration of the P.T. was approximately 14s.

The P.P. consisted of quick vibrations, the max. 2a being 0,12 mm in the EW and 0,05 mm in the NS component.

Eqke No. 125. April 16th 1899; 2h 27m 28s p.m.

Total duration=17m.

Observations at Meteorological Observatories:—

Utsunomiya	.. ..	2h 27m 20s p.m.	Slight.	Motion quick.
Fukushima	.. ..	2. 27. 27	„	Houses shaken.
Yamagata	.. ..	2. 27. 56	„	
Choshi	.. ..	2. 28. 0	„	
Kofu	.. ..	2. 28. 10	„	
Mito	.. ..	2. 28. 16	„	Motion quick.
Yokohama	.. ..	2. 28. 20	„	Motion gentle.
Ishinomaki	.. ..	2. 28. 34	„	
Miyako	.. ..	2. 29. 18	„	Motion gentle.
Tokyo	.. ..	2. 28. 14	„	

(NS component).

The P.T., whose duration was 23s, consisted of small quick vibrations.

The P.P. lasted for 4m 40s and consisted for the first 47s of quick vibrations, whose max. 2a of 0,1 mm occurred near the commencement. After this, the motion consisted of vibrations of an average period of 1,7s superposed on slower ones of an average period of 3,3s. These latter

became prominent first from 1m 46s after the beginning of the earthquake: their max. 2a was 0,1 mm.

(EW component).

The P.T. lasted for 23s.

The P.P. consisted at first of quick vibrations superposed on waves of an average period of 2,6s, whose max. 2a of 0,2 mm occurred at 38s from the beginning of the earthquake.

The E.P. The average period was 3,5s.

Eqke No. 128. April 19th 1899; 3h 13m 6s (?) p.m.

Total duration = 2m 20s.

Observations at Meteorological Observatories:—

Fukushima	3h 33m 40s p.m.	Slight.	
Utsunomiya	3. 34. 5	„	Motion quick.
Mito	3. 34. 30	„	„
Choshi	3. 34. 45	„	
Tokyo	3. 34. 49	„	
Yokohama	3. 34. 56	„	
Matsumoto	3. 36. 32	„	

The beginning was confused by P.O. The P.T. lasted, however, for about 9s.

The P.P. The motion consisted of quick vibrations, the max. 2a being 0,04 mm in the EW and 0,02 mm in the NS component.

The E.P. In the EW component, there existed traces of vibrations of an average period of 1,6s.

Eqke No. 148. June 15th 1899; 3h 49m 41s p.m.

Total duration = 25m.

Observations at Meteorological Observatories:—

Aomori	3h 49m 0s p.m.	Weak.	
Ishinomaki	3. 48. 39	Slight.	Motion gentle.

Miyako	3h 48m 51s p.m.	Slight.
Akita	3. 49. 30	„
Mito	3. 49. 42	„
Fukushima	3. 50. 18	„
Tokyo	3. 50. 59	„

(EW component).

The P.T. lasted for 1m 18s. Towards the end the motion consisted of well defined vibrations of an average period of 3,0s, superposed with still smaller ones.

The P.P. lasted for about 8m. During the first 1m 46s the motion was small (max. $2a=0,15$ mm) and consisted of vibrations of an average period of 2,7s, superposed more or less definitely on traces of slower ones. Then took place the max. (abs.) $2a$ of 0,25 mm, followed by 13 well defined vibrations, which gave an average period of 7,3s. Towards the end waves of an average period of 3,6s were prominent.

The E.P. Towards the very end, the average period was 9,2s.

(NS component).

The max. $2a$ was 0,2 mm.

Eqke No. 150. June 17th 1899; 10h 9m 35s a.m.

Total duration = 1h 19m.

Observations at Meteorological Observatories :—

Ishinomaki	9h 41m 15s a.m.	Slight.
Fukushima	10. 8. 58	„
Nemuro	10. 9. 30	„
Mito	10.10. 0	„
Miyako	10.10. 49	„ Motion quick.
Aomori	10.11. 0	„
Mito	10.12. 15	„
Tokyo	10.12. 45	„

(NS component).

The P.T., whose duration was 2m 32s, consisted of waves of an

average period of 7,2s, superposed with vibrations of an average period of 2,9s and also with other still smaller ones. The max. 2a of 0,05 mm occurred at 8s from the commencement.

The P.P., whose duration was 7m, was especially active during the first 3m. It began with a well demarked 2a of 0,12 mm and became large at the 3rd vibration whose 2a was 0,4 mm. The max. 2a of 0,58 mm occurred at 10h 10m 38s. The waves had an average period of 8,9s, superposed with others of an average period of 5,5s.

The E.P. The average period was 7,4s.

(EW component).

The P.T. lasted for 2m 32s.

The P.P. The motion began with a displacement of 0,22 mm and became large at the 3rd vibration whose 2a was 0,45 mm. During the next 2m 33s the motion remained on the whole nearly constant, the max. 2a of 0,58 mm occurring at 10h 12m 12s.

Eqke No. 151. June 18th 1899; 1h 52m 27s p.m.

Total duration = 24m.

Observations at Meteorological Observatories:—

Fukushima	.. ..	1h 53m 30s p.m.	Slight.
Miyako	.. .. .	1. 54. 53	„
Tokyo	.. .. .	1. 54. 55	„

(NS component).

The P.T. lasted for about 1m 43s and consisted of extremely small vibrations.

The P.P., whose duration was 4m 10s, began with a displacement of 0,1 mm. For the first 1m 2s the motion remained small and consisted of vibrations of an average period of 3,7s, superposed with other still smaller ones. Then there followed 5 well defined slower vibrations of an average period of 5,7s, the last having the max. (abs.) 2a of 0,11 mm.

The E.P. Towards the very end, the average period was 6,9s.

(EW component).

The P.P. began with a displacement of 0,1 mm. During the first 1m 21s the motion was small and consisted of small vibrations of an average period of 2,4s, superposed on others of an average period of 4,7s. Then there followed the most active part of the motion, which lasted for 5m and whose max. 2a of 0,13 mm occurred at 2m 0s from the commencement.

Eqke No 167. July 18th 1899; 1h 59m 0s a.m.

Total duration=20m.

Observations at Meteorological Observatories :—

Kumagae	.. ..	1h 7m 48s a.m.	Slight.	
Fukui	.. ..	1. 58. 16	„	
Fukushima	.. ..	1. 58. 10	„	
Choshi	.. ..	1. 58. 25	„	
Matsumoto	.. ..	1. 58. 41	„	
Nagoya	.. ..	1. 59. 5	„	
Tokyo	.. ..	1. 59. 7	„	
Mito	.. ..	1. 59. 40	„	Motion quick.
Yokohama	.. ..	2. 0. 45	„	
Utsunomiya	.. ..	2. 1. 20	„	Motion gentle.
Tokyo	.. ..	2. 1. 48	„	„

(EW component).

The P.T., whose duration was 11,6s, began with a displacement of 0,04 mm towards E and 0,05 mm towards S.

The P.P. began with a displacement of 0,1 mm in the EW and 0,05 mm in the NS component. For the first 33s the motion remained sensibly constant and consisted of vibrations of an average period of 2,1s, superposed with small quick ones. Then there followed, for 1m 8s, well defined slower vibrations of an average period of 8,5s, whose amplitude remained sensibly constant; the max. 2a was 0,15 mm in the EW and 0,09 mm in the NS component.—The superposed small vibrations ceased almost completely at 1m 12s from the commencement of the earthquake. 32s later

on, however, these vibrations (max. $2a=0,15$ mm) again appeared, the motion remaining small for about 6s, when the max. (abs.) $2a$ above noted took place. Perhaps there was a second shock the motion consisting, during the next 1m 25s, of small vibrations superposed more or less distinctly on slower ones of an average period of 5,0s. Then there followed vibrations of an average period of 7,5s, superposed with others of an average period of 3,8s; the max. $2a$ during this part of motion being 0,15 mm in the EW and 0,14 mm in the NS component.

The E.P. The principal average period was 7,1s.

Eqke No. 176. August 3rd 1899; 6h 52m 57s p.m.

Total duration=20m.

Observations at Meteorological Observatories:—

Mito	.. .. .	6h 51m 31s p.m.	Rather strong.	Houses shaken.
Ishinomaki	.. .. .	6. 54. 28	„	„
Maebashi	.. .. .	6. 51. 6	Weak.	Motion gentle.
Fukushima	.. .. .	6. 51. 17	Rather weak.	Houses shaken.
Miyako	.. .. .	6. 51. 18	„	Duration long.
Yokohama	.. .. .	6. 52. 13	„	Motion quick.
Akita	.. .. .	6. 58. 0	„	Doors shaken.
Yamagata	.. .. .	6. 51. 10	Slight.	
Utsunomiya	.. .. .	6. 51. 20	„	Motion gentle.
Tokyo	.. .. .	6. 51. 54	„	„
Kumagae	.. .. .	6. 52. 2	„	„
Nemuro	.. .. .	6. 52. 17	„	„
Iida	.. .. .	6. 53. 51	„	Duration short.

The P.T., whose duration was 33s, consisted of small quick vibrations. In the NS component the amplitude remained nearly constant. But in the EW component there was a prominent max. $2a$ of 0,07 mm at 10s from the beginning, and a second max. $2a$ of 0,06 mm 8s later on.

The P.P. began with a displacement of 0,2 mm towards E and 0,15 mm towards S, followed by the counter movement (max.) of 0,4 mm towards W and 0,45 mm towards N. During the first 1m 20s, quick

vibrations were superposed on slower ones of an average period of 3,2s. For the next 1m 50s, the predominating average period was 6,9s, the max. 2a during this part of motion being 0,3 mm in the EW and 0,33 mm in the NS component. Then followed quicker waves of an average period of 3,2s.

The E.P. The motion consisted of vibrations of an average period of 3,8s superposed more or less distinctly on slower ones of an average period of 8,2s.

Eqke No. 182. August 13th 1899; 2h 26m 17s p.m.

Total duration=7m.

Observations at Meteorological Observatories:—

Kamagae	2h 25m 18s p.m.	Slight.
Mito	2. 25. 45	”
Ishinomaki	2. 26. 30	”
Tokyo	2. 26. 41	”
Maebashi	2. 27. 2	”
Yokohama	2. 27. 18	”
Fukushima	2. 28. 8	”
Miyako	2. 28. 6	”
Akita	2. 29. 46	”

The P.T. lasted for 15s.

The P.P. consisted of small quick vibrations. The max. 2a was 0,06 mm in the EW and 0,05 mm in the NS component.

The E.P. The average period was about 3s.

Eqke No. 184. August 14th 1898; 8h 48m 24s a.m.

Total duration=7m.

Observations at Meteorological Observatories:—

Fukushima	8h 46m 18s (?) a.m.	Slight.	Houses shaken.
Kumagae	8. 47. 48	”	
Tokyo	8. 49. 3	”	
Mito	8. 48. 14	”	

The P.T. lasted for 14s.

The P.P. There were two maximum movements, of which the first took place at the commencement of this epoch and was 0,03 mm in the EW and 0,01 mm in the NS component. The second maximum occurred 8s later on and was 0,07 mm in the EW and 0,02 mm in the NS component. During the first 30s the motion consisted of quick period vibrations. Then there appeared slower movements of an average period of 2,0s.

The E.P. Towards the end, the average period was about 4,4s.

Eqke No. 194. September 9th 1899; about 9h 46m a.m.

Total duration = about 15m.

This earthquake was observed at no Meteorological Observatory, but probably belongs, as the following earthquake No. 195, to the group III. The motion showed traces of vibrations of an average period of 9,3s.

Eqke No. 195. September 9th 1899; 11h 0m 34s a.m.

Total duration = 42m.

Observations at Meteorological Observatories:—

Akita	..	..	..	10h 55m 32s a.m.	Slight.
Mito	..	..	..	11. 3. 7	„

(EW component).

The commencement was somewhat obscure owing to the presence of slight P.O. The motion was almost completely free from superposed quick vibrations.

The P.T. lasted for about 42s. The average period was 8,4s.

The P.P. lasted for about 12m. For the first 2m 30s the motion consisted of slow undulations of an average period of 22s, superposed with vibrations of an average period of 9,3s; the amplitude remained nearly uniform, the max. 2a being 0,6 mm. Then there followed, for 2m 41s, quicker vibrations of an average period of 8,9s, the first of which had a max. 2a of 0,8 mm. For the next 38s the motion was most active and had

a max. (abs.) $2a$ of 0,9 mm, the average period being 8,6s. Towards the end the average period was 7,2s.

The E.P. The average period deduced from three successive groups of 50 vibrations, was as follows:—

$$\left. \begin{array}{l} 8,4s \text{ (at the commencement),} \\ 8,4 \\ 8,4 \text{ (at the end).} \end{array} \right\} \begin{array}{l} \text{(General mean)} \\ 8,4s. \end{array}$$

The NS component diagram was not satisfactory.

Eqke No. 199. September 13th 1899; 11h 6m 56s p.m.

Total duration = 14m.

Observations at Meteorological Observatories:—

Fukushima	.. ..	11h 2m 25s p.m.	Slight.	
Tokyo	.. ..	11. 6. 29	„	
Mito	.. ..	11. 6. 34	„	Doors shaken.
Kumagae	.. ..	11. 7. 34	„	
Yokohama	.. ..	11. 7. 52	„	
Choshi	.. ..	11. 16. 55	„	

The P.T., whose duration was 30s, consisted of very small movements.

The P.P., whose duration was 3m 44s, consisted during the first 1m 30s, of very quick small vibrations (max. $2a=0,12$ mm in the EW and 0,1 mm in the NS component), superposed on slower waves of an average period of 6,9s (max. $2a=0,1$ mm in the EW and 0,14 mm in the NS component). Then there followed well defined vibrations of an average period of 5,1s; the max. (abs.) $2a$, which occurred at 2m 30s from the beginning of the earthquake, being 0,15 mm in the EW and 0,2 mm in the NS component.

The motion showed a series of alternations of maximum and minimum groups, the 2nd, 3rd, 4th, 5th and 6th maximum $2a$'s occurring, in the NS

component, respectively at 1m 28s, 2m 44s, 3m 40s, 4m 37s and 5m 36s after the 1st (abs.) maximum motion.

The E.P. The average period was 3,8s.

Eqke No. 208. October 1st 1899; 11h 55m 22s a.m.

Total duration = 24m.

Observations at Meteorological Observatories:—

Ishinomaki	.. ..	11h 29m 55s a.m.	Slight.	
Mito	.. ..	11. 40. 0	„	
Miyako	.. ..	11. 40. 24	„	
Fukushima	.. ..	11. 41. 52	„	Houses shaken.
Matsuyama	.. ..	11. 53. 0	„	

The commencement was obscured by the existence of slight P.O. The P.T. lasted, however, for about 2m 32s and consisted of small vibrations of an average period of 2,2s.

The P.P. began with the max. 2a of 0,07 mm in the EW and 0,06 mm in the NS component. For the first 1m 14s the average period was 10,6s, while during the next 1m 10s it was 7,8s.

Eqke No. 221. October 21st 1899; 10h 8m 9s p.m.

Total duration = 8m.

Observations at Meteorological Observatories:—

Miyako	.. ..	10h 5m 6s p.m.	Strong.	{ Motion quick, accompanied by vertical movements; houses shaken.
Akita	10. 6. 15	Slight.		Accompanied by vert. mot.
Aomori	.. ..	10. 7. 30	„	
Ishinomaki	.. ..	10. 3. 31	„	
Tokyo	.. ..	10. 8. 41	„	
Fukushima	.. ..	10. 13. 9	„	

The motion was small, the max. 2a being 0,04 mm in each component.

The commencement and end of the motion was obscured by the existence of slight P.O.

Eqke No. 223. October 29th 1899; 11h 18m 47s p.m.

Total duration=about 3m.

Observations at Meteorological Observatories:—

Fukushima 11h 20m 13s p.m. Slight.

The P.T. lasted for about 12s.

The P.P. consisted of small quick vibrations. The motion was confused by strong P.O.

P.O. began to appear about 7 hours before the earthquake, the max. 2a being 0,07 mm in each component. The average period was 4,6s.

Eqke No. 224. November 3rd 1899; 1h 39m 21s p.m.

Total duration=29m.

Observations at Meteorological Observatories:—

Fukushima 1h 35m 6s p.m. Slight.

(NS component).

The motion was small during the first 40s. For the next 2m 15s the waves were well pronounced and had an average period of 6,1s, the max. 2a being 0,04 mm. For the next 1m 40s the motion was again small and had an average period of 11,1s. Then there followed the group of the most active vibrations, which lasted for 4m 22s and had an average period of 6,6s, the max. 2a being 0,05 mm. After this the motion became small.

(EW component).

The P.T. lasted for about 4m 50s and consisted of very small vibrations of an average period of 4,3s superposed on slower waves of an average period of 7,5s. The max. 2a was 0,03 mm.

The P.P. which lasted 6m 6s began with the max. (abs.) 2a of 0,13 mm and had an average period of 8,1s.

Eqke No. 226. November 6th 1899; 7h 53m 47s p.m.

Total duration = 20m.

Observations at Meteorological Observatories:—

Fukushima 7h 54m 46s p.m. Slight.

(EW component).

The P.T., whose duration was 2m 0s, consisted of small vibrations of an average period of about 2,8s, superposed on undulations of an average period of 10,0s.

The P.P. lasted 8m. The max. 2a of 0,05 mm occurred at the commencement, but the motion remained sensibly constant in amplitude throughout this epoch. In the earlier part the average period was 4,8s; in the later part it was 7,1s.

(NS component).

The max. 2a was 0,05 mm.

P.O. The vibrations were very small. Their average period, measured a few hours before the earthquake, was 4,2s.

Eqke No. 229. November 11th 1899; 2h 40m 24s a.m.

Total duration = 1h.

Observations at Meteorological Observatories:—

Hakodate	.. ..	2h 39m 14s a.m.	Weak.	Motion quick.
Aomori	.. ..	2. 40. 0	„	
Miyako	.. ..	2. 43. 16	„	Duration long.
Fukushima	.. ..	2. 18. 36	Slight.	
Mito	.. ..	2. 39. 40	„	
Tokyo	.. ..	2. 40. 45	„	
Kushiro	.. ..	2. 41. 12	„	Motion quick.
Kumagae	.. ..	2. 41. 49	„	
Yokohama	.. ..	2. 41. 56	„	Motion quick.
Akita	.. ..	2. 42. 30	„	
Kofu	.. ..	2. 47. 30	„	Motion quick.
Ishinomaki	.. ..	2. 51. 5	„	Houses shaken.

(EW component).

The P.T., whose duration was 1m 19s, began with very small movements. The motion consisted of vibrations of an average period of 3,9s, superposed with extremely small waves.

The P.P., whose duration was 9m, consisted during the first 2m 3s of well defined vibrations (max. $2a=0,4$ mm) whose average period was 2,9s. During the next 3m 9s, the motion was most active; the max. $2a$ being 0,55 mm and the average period 4,2s. After this there appeared smaller and slower vibrations of an average period of 7,0s, mixed with others of an average period of 5,3s.

The E.P. The average period was 6,8s.

(NS component).

The P.P. lasted for 1m 8s.

The P.P. The motion was most active during the first 4m 40s, the predominating average period being 3,4s. The max. $2a$ of 0,85 mm occurred at 3m 8s from the beginning of the earthquake.

Eqke No. 230. November 11th 1899; 7h 10m 0s a.m.

Total duration=35m.

Observations at Meteorological Observatories :—

Aomori	.. .. .	7h 10m 20s a.m.	Slight.
Fukushima	.. .. .	7. 6. 29	„
Miyako	.. .. .	7. 13. 28	„

(EW component).

The P.T., whose duration was 1m 30s, consisted of small vibrations of an average period of 7,9s.

The P.P., whose duration was 7m 10s, consisted during the first 1m 28s of small vibrations (max. $2a=0,08$ mm) of an average period of 5,9s. During the next 3m 3s, the motion was most active; the max. $2a$ being 0,15 mm and the average period 6,1s. In the earlier and the later parts of this epoch there were also traces of small vibrations of an average period of 2,7s.

The E.P. consisted of regular vibrations of an average period of 8,1s.
(NS component).

The max. 2a was 0,15 mm.

Eqke No. 239. December 10th 1899; 11h 22m 21s p.m.

Total duration=1h.

Observations at Meteorological Observatories:—

Tokyo	.. .. .	11h 22m 19s p.m.	Slight.
Mito	.. .. .	11. 22. 30	„
Yokosuka	.. .. .	11. 22. 30	„
Maebashi	.. .. .	11. 22. 39	„
Kofu	.. .. .	11. 26. 21	„ Motion quick.

(EW component).

The P.T., whose duration was 1m 12s, consisted of small quick movements superposed on traces of slower vibrations of an average period of 3,8s.

The P.P. consisted for the first 1m 25s of quick vibrations (max. 2a = 0,1 mm) superposed on slow undulations of an average period of 17,0s, of which the first had a max. 2a of 0,5 mm. The superposed small vibrations then disappeared, and for the next 1m 20s the motion consisted of well defined vibrations (max. 2a = 0,15 mm) of an average period of 3,0s. During the next 3m 50s, the average period was 4,9s (max. 2a = 0,25 mm). On all these latter vibrations traces of waves of an average period of about 10s were superposed more or less definitely. Later on the average period was 9,3s.

The E.P. Towards the very end the average period was 8,3s.

(NS component).

The P.T. lasted for 1m 5s. There were traces of waves of an average period of 8,1s (?)

The P.P. commenced with small quick movements superposed on slow undulations of an average period of 19s whose second vibration had the

max. $2a$ of 0,55 mm. The various periods which occurred during the P.P. were as follows:—

quickest vibrations (max. $2a=0,2$ mm);
 4,9s (max. $2a=0,25$ mm);
 10,8 (max. $2a=0,25$ mm).

Eqte No. 240. December 12th 1899; 3h 43m 27s p.m.

Total duration=16m.

Observations at Meteorological Observatories:—

Fukushima	.. ..	3h 43m 8s p.m.	Slight.
Tokyo	.. ..	3. 43. 51	„
Mito	.. ..	3. 45. 15	„

The P.T. lasted for about 35s (?). The commencement of the motion was confused by slight P.O.

The P.P. The average period was 7,8s, and the max. $2a$ was 0,04 mm in each component.