

EARTHQUAKES FELT IN YOKOHAMA.

By J. E. PEREIRA.

[Read May 29th, 1889.]

The first portion of the following list of disturbances felt in Yokohama, namely from January 22nd, 1878, to December 31st, 1881, was extracted some years ago from an American publication by Professor J. Milne. This publication having been lost I regret that I am neither able to give its name or its author. The second portion of the list, namely from March 8th, 1885, to December 31st, 1889, is compiled by observations made by myself. Although for the last two or three years I have had a small seismograph at my house, all the shocks which have been recorded have been distinctly felt, and were practically recorded without its aid. Had I been provided with delicate and trustworthy instruments such as are used in Tokyo it is more than likely that many more disturbances might have been noted, which is a fact not to be overlooked when comparing the number of earthquakes felt in Yokohama with the number recorded in the capital.

DATE. 1878.	NUMBER.	TIME.
Jan. 22	2 shocks	{ 3.19 and 3.35 p.m.
Jan. 24	strong shock	3.30 p.m.
Feb. 5	light shock	3.27 p.m.
Feb. 11	shock	7.26 p.m.
Feb. 17	3 shocks	— a.m.

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DATE.	NUMBER.	TIME.
Feb. 19	light shock	1.16 p.m.
Feb. 23	2 shocks	— a.m.
Feb. 24	shock	9.45 a.m.
Feb. 25	strong shock	10.24 p.m.
Feb. 27	light shock	0.26 a.m.
Mar. 5	strong shock	3.00 p.m.
Mar. 6	light shock	2.06 p.m.
Mar. 7	light shock	10.25 p.m.
April 9	light shock	2.45 p.m.
April 28	light shock	4.05 p.m.
May 10	light shock	9.10 p.m.
May 11	light shock	7.14 a.m.
June 11	strong shock	0.15 p.m.
June 17	strong shock	5.20 a.m.
June 22	shock	12.00 noon.
June 28	strong shock	6.34 p.m.
July 5	light shock	4.39 a.m.
July 10	shock	0.46 a.m.
July 15	strong shock	3.45 p.m.
July 20	light shock	8.46 p.m.
Sept. 30	light shock	5.32 a.m.
Oct. 8	light shock	10.48 p.m.
Oct. 9	strong shock	1.20 p.m.
Oct. 17	shock	10.25 a.m.
Oct. 31	light shock	10.15 p.m.
Nov. 5	light shock	0.57 p.m.
Nov. 10	light shock	1.47 a.m.
Nov. 22	strong shock	11.12 p.m.
Nov. 26	strong shock	8.24 p.m.
Nov. 27	light shock	2.13 a.m.
Dec. 14	strong shock	10.37 a.m.
Dec. 24	strong shock	7.55 a.m.
1879.		
Jan. 3	shock	9.58 p.m.
Jan. 21	shock	3.40 a.m.
Jan. 23	light shock	1.45 a.m.
Jan. 26	light shock	4.00 p.m.
Jan. 27	strong shock	— a.m.
Jan. 28	light shock	1.00 a.m.
Feb. 2	strong shock	10.00 p.m.
Feb. 4	shock	10.00 p.m.
Feb. 27	strong shock	2.45 p.m.
Mar. 4	strong shock	4.44 p.m.
Mar. 4	shock	7.00 p.m.
Mar. 10	shock	4.35 p.m.

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DATE,	NUMBER.	TIME.
Mar. 10	2 shocks	{ 9.32 and 9.45 p.m.
April 14	light shock	9.20 a.m.
May 2	2 shocks	{ 2.45 and 2.50 a.m.
May 20	shock	11.28 p.m.
June 12	light shock	9.24 a.m.
July 18	2 shocks	3.45 p.m.
July 24	shock	8.15 p.m.
Aug. 6	strong shock	8.27 p.m.
Aug. 28	light shock	8.36 p.m.
Oct. 17	2 shocks	{ 1.30 and 2.17 p.m.
Oct. 18	strong shock	1.52 p.m.
Oct. 25	light shock	0.40 a.m.
Oct. 30	light shock	9.44 a.m.
Nov. 15	2 shocks	{ 9.39 and 9.40 a.m.
Dec. 3	strong shock	7.09 a.m.
1880.		
Jan. 6	light shock	4.28 p.m.
Jan. 19	light shock	1.00 a.m.
Feb. 12	light shock	9.00 p.m.
Feb. 22	strong shock	5.03 a.m.
Feb. 25	light shock	6.40 p.m.
Mar. 5	light shock	4.40 p.m.
Mar. 21	light shock	4.39 a.m.
Mar. 29	shock	5.25 p.m.
Mar. 31	light shock	11.16 a.m.
April 14	strong shock	4.10 a.m.
April 25	light shock	11.04 a.m.
April 27	strong shock	9.50 a.m.
May 14	light shock	10.00 p.m.
May 23	light shock	2.30 p.m.
June 5	light shock	5.12 p.m.
June 7	light shock	9.50 p.m.
June 10	strong shock	1.20 p.m.
July 15	strong shock	4.00 a.m.
July 19	light shock	11.55 a.m.
July 19	strong shock	8.24 p.m.
July 25	strong shock	2.05 p.m.
Aug. 6	strong shock	9.27 a.m.
Aug. 7	light shock	1.20 p.m.
Aug. 13	strong shock	4.50 a.m.
Aug. 23	3 shocks	4.26 a.m.

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DATE.	NUMBER.	TIME.
Aug. 30	light shock	11.16 p.m.
Oct. 2	light shock	3.11 p.m.
Nov. 3	strong shock	5.43 a.m.
Nov. 10	strong shock	1.00 a.m.
Nov. 12	strong shock	6.30 p.m.
Dec. 20	strong shock	10.40 p.m.
Dec. 23	strong shock	10.57 p.m.
Dec. 28	strong shock	1.30 a.m.
1881.		
Jan. 7	light shock	6.24 a.m.
Jan. 20	light shock	0.15 a.m.
Jan. 24	strong shock	5.52 a.m.
Jan. 24	shock	9.30 a.m.
Jan. 27	light shock	4.00 p.m.
Feb. 7	light shock	4.00 p.m.
Feb. 12	strong shock	2.40 a.m.
Feb. 12	light shock	2.00 p.m.
Feb. 28	strong shock	3.14 p.m.
Mar. 8	strong shock	0.17 p.m.
Mar. 14	light shock	4.15 a.m.
Mar. 15	light shock	0.26 p.m.
Mar. 16	light shock	6.00 a.m.
Mar. 16	light shock	3.00 p.m.
Mar. 17	light shock	2.40 a.m.
Mar. 17	strong shock	4.50 a.m.
Mar. 29	light shock	11.20 p.m.
April 11	light shock	10.00 a.m.
April 18	strong shock	8.00 a.m.
April 26	shock	8.27 p.m.
May 3	light shock	2.13 a.m.
May 24	strong shock	1.20 p.m.
June 18	strong shock	10.27 a.m.
July 20	light shock	3.30 p.m.
July 25	shock	11.35 p.m.
Sept. 3	light shock	10.30 a.m.
Oct. 25	light shock	9.25 p.m.
Dec. 29	light shock	1.00 a.m.
Dec. 31	2 shocks	0.25 p.m.

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Date.	Time.	Direction.	Day of Moon.	High Tide.	Remarks.
1885.					
Mar. 8	9.00 a.m.	—	23	10.13 a.m.	—
Mar. 12	1.00 p.m.	—	27	2.40 p.m.	Strong—22 seconds.
Mar. 15	2.30 a.m.	—	30	5.40 a.m.	—
June 15	1.40 a.m.	S.E.-N.W.	4	7.06 a.m.	32 seconds—Strong.
Sept. 22	2.30 a.m.	—	15	4.27 a.m.	—
Sept. 23	5.00 a.m.	—	16	5.06 a.m.	—
Sept. 26	12.04 p.m.	—	19	7.03 p.m.	Strong.
Sept. 28	5.25 a.m.	—	21	7.56 a.m.	15 seconds.
Oct. 7	—	—	2	—	—
Oct. 11	5.30 a.m.	—	6	7.19 a.m.	—
Oct. 15	8.35 p.m.	—	10	10.09 p.m.	About 12 seconds.
Oct. 16	7.00 a.m.	—	11	10.36 a.m.	Gale from north.
Oct. 20	1.00 a.m.	—	15	2.50 a.m.	—
Oct. 26	10.40 p.m.	—	21	7.14 p.m.	About 20 seconds.
Nov. 4	1.51 a.m.	—	30	3.20 a.m.	—
Dec. 7	1.00 p.m.	—	2	6.20 p.m.	—
Dec. 19	6.30 p.m.	—	14	3.27 p.m.	About 12 seconds.
Dec. 28	10.09 p.m.	—	23	10.54 p.m.	About 8 seconds.
1886.					
Jan. 4	8.35 a.m.	—	29	5.05 a.m.	—
Jan. 31	7.20 a.m.	—	27	2.42 a.m.	Lasted about 7 seconds.
Feb. 19	4.00 a.m.	—	16	5.54 a.m.	—
Feb. 24	7.30 a.m.	—	21	9.32 a.m.	Very strong.
Feb. 25	5.00 a.m.	—	22	10.15 a.m.	—
Mar. 1	7.30 a.m.	—	26	2.00 a.m.	—
Mar. 2	5.10 a.m.	—	27	3.20 a.m.	22 seconds.
Mar. 2	2.30 p.m.	—	27	3.55 p.m.	—
Mar. 13	6.30 p.m.	—	9	10.39 p.m.	—
Mar. 26	6.00 a.m.	—	22	9.43 a.m.	10 seconds.
Apr. 13	5.45 a.m.	—	11	—	15 seconds—rainy.
Apr. 29	1.30 p.m.	—	27	2.22 p.m.	Northerly gale—cold.
May 4	5.10 a.m.	—	1	5.48 a.m.	Rainy—north wind.
May 8	10.15 p.m.	—	5	8.41 p.m.	2 shocks—25 seconds.
May 16	9.08 a.m.	—	13	4.05 a.m.	—
May 18	8.00 p.m.	—	15	6.01 p.m.	Rainy.
May 22	5.40 a.m.	—	19	8.18 a.m.	Easterly gale.

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Date.	Time.	Direction.	Day of Moon.	High Tide.	Remarks.
1886.					
June 4	7.00 a.m.	—	3	6.39 a.m.	Rainy.
June 11	1.00 a.m.	—	10	—	Rainy.
June 13	6.20 a.m.	—	12	2.37 a.m.	Gale from S.W.
June 14	6.20 p.m.	—	13	4.08 p.m.	} Rain.
June 14	6.50 p.m.	—	13	4.08 p.m.	
July 20	4.45 p.m.	—	19	8.30 p.m.	Light (Thunder).
Sept. 20	11.00 a.m.	—	22	9.32 a.m.	Rainy.
Sept. 21	8.30 a.m.	—	23	10.17 a.m.	Cloudy.
Oct. 22	4.00 a.m.	—	26	—	Very light.
Oct. 25	10.00 p.m.	—	29	3.33 a.m.	—
Oct. 31	3.00 a.m.	—	5	8.01 a.m.	Northerly wind.
Nov. 1	5.00 a.m.	—	6	8.40 a.m.	—
Nov. 13	4.00 p.m.	—	17	6.42 p.m.	Fine weather.
Nov. 15	6.00 a.m.	—	19	7.37 a.m.	—
Dec. 4	2.90 p.m.	—	10	11.21 a.m.	—
Dec. 26	5.50 p.m.	—	2	6.28 p.m.	—
Dec. 29	11.05 a.m.	—	5	8.05 a.m.	Fine weather.
Jan. 15	6.55 p.m.	N.E.-S.W.	21	9.55 p.m.	Very strong, 22 seconds.
1887.					
Jan. 15	7.00 p.m.	N.E.-S.W.	21	9.55 p.m.	Light.
Jan. 15	8.00 p.m.	N.E.-S.W.	21	9.55 p.m.	Light.
Jan. 16	10.18 p.m.	N.E.-S.W.	22	10.46 p.m.	Light.
Jan. 16	10.28 p.m.	N.E.-S.W.	22	10.46 p.m.	Light.
Jan. 17	5.00 p.m.	—	23	11.43 p.m.	Light (Very cold).
Jan. 23	10.00 p.m.	N.N.W.-S.S.E.	30	5.39 p.m.	Light, raining.
Feb. 2	5.35 a.m.	E.-W.	10	11.25 a.m.	Light.
Feb. 2	2.30 p.m.	—	10	11.25 a.m.	Light.
Feb. 5	2.50 a.m.	—	13	2.21 a.m.	Light (Freezing).
Feb. 26	4.00 a.m.	S.W.-N.E.	5	7.53 a.m.	Light.
Mar. 2	5.20 p.m.	S.-N.	9	10.20 p.m.	Light.
Mar. 10	1.30 p.m.	—	16	6.17 p.m.	Light.
Mar. 20	11.48 p.m.	—	27	2.28 a.m.	Light (Fine weather).
Mar. 21	8.26 a.m.	—	28	3.34 a.m.	Light.
June 28	11.00 p.m.	—	8	11.08 p.m.	—
June 29	2.00 a.m.	—	9	—	Close weather.
June 30	8.05 a.m.	—	10	—	Raining.
July 2	3.00 p.m.	—	12	2.57 p.m.	Very rainy.
July 22	8.22 p.m.	E.S.E.-W.N.W.	4	6.51 p.m.	10 seconds, strong.
Sept. 2	5.48 p.m.	N.-S.	15	6.03 p.m.	—
Sept. 5	3.22 p.m.	N.E.-S.W.	18	7.38 p.m.	30 seconds, strong.

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Date.	Time.	Direction.	Day of Moon.	High Tide.	Remarks.
1886.					
Sept. 6	8.10 a.m.	—	19	7.55 a.m.	Light.
Sept. 25	8.55 a.m.	—	9	11.18 a.m.	Fine weather.
Dec. 16	8.30 a.m.	—	3	6.22 a.m.	10 seconds.
Dec. 17	11.40 p.m.	—	4	7.31 p.m.	8 seconds.
1888.					
Feb. 2	1.06 a.m.	E.-W.	21	8.42 a.m.	8 seconds (very cold weather.
Feb. 5	12.53 a.m.	—	24	11.27 p.m.	Northerly gale.
Feb. 10	3.34 p.m.	—	30	4.55 p.m.	—
Feb. 10	6.32 p.m.	—	30	4.55 p.m.	—
Mar. 1	10.30 p.m.	—	20	8.02 p.m.	Very light (rainy).
Mar. 9	4.58 a.m.	N.W.-S.E.	28	3.04 a.m.	Very light (rain).
Mar. 16	6.00 a.m.	E.-W.	5	8.00 a.m.	—
Mar. 16	7.00 a.m.	N.W.-S.E.	5	8.00 a.m.	—
Mar. 17	8.00 p.m.	W.-E.	6	8.46 p.m.	Light.
Apr. 6	2.30 p.m.	N.E.-S.W.	26	2.03 p.m.	Light.
Apr. 29	10.03 a.m.	E.-W.?	19	7.38 a.m.	25 seconds,
May 13	4.55 a.m.	E.-W.	3	7.03 a.m.	6 or 7 seconds.
May 22	6.30 a.m.	N.-S.	12	2.09 a.m.	22 seconds?
May 24	9.45 a.m.	N.-S.	14	4.09 a.m.	—
May 24	10.55 a.m.	N.-S.	14	4.09 a.m.	—
May 27	a.m.	N.-S.	17	6.33 a.m.	Cloudy.
June 3	7.55 a.m.	N.E.-S.W.	24	noon	Long shocks.
June 12	9.00 p.m.	E.S.E.-W.N.W.	4	7.33 p.m.	Vertical movement, light.
June 18	2.24 p.m.	N.-S.	10	noon	Long (rainy.)
June 19	6.30 a.m.	N.N.W.-S.S.E.	11	0.23 a.m.	—
June 24	11.05 p.m.	E.-W.	16	5.57 p.m.	Very light.
July 2	4.55 a.m.	N.W.-S.E.	24	midnight	—
July 12	1.30 a.m.	N.-S.	4	7.37 a.m.	Intense heat.
Aug. 1	9.30 p.m.	N.E.-S.W.	24	midnight	S.W. gale.
Sept. 5	a.m.	N.W.-S.E.	30	5.00 a.m.	—
Sept. 11	8.35 a.m.	N.-S.	6	9.01 a.m.	Explosion (underground).
Sept. 18	2.45 a.m.	N.N.W.-S.S.E.	13	4.17 a.m.	—
Sept. 28	7.15 a.m.	—	23	10.15 a.m.	—
Oct. 9	12.55 a.m.	E.-W.	5	7.57 a.m.	—
Oct. 20	6.23 a.m.	N.W.-S.E.	16	5.57 a.m.	Raining.
Nov. 2	2.00 p.m.	N.W.-S.E.	30	4.21 p.m.	Light.
Nov. 2	10.00 p.m.	—	30	4.21 p.m.	Light.
Nov. 3	12.48 a.m.	N.W.-S.E.	1	4.43 a.m.	About 10 seconds.
Nov. 3	8.11 a.m.	N.W.-S.E.	1	4.43 a.m.	About 12 seconds.
Nov. 10	1.45 p.m.	N.W.-S.E.	8	10.04 a.m.	—
Nov. 24	2.00 a.m.	W.N.W.-E.S.E.	22	8.45 a.m.	—

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Date.	Time.	Direction.	Day of Moon.	High Tide.	Remarks.
1888.					
Nov. 24	2.05 a.m.	W.N.W.-E.S.E.	22	8.45 a.m.	—
Dec. 3	12.30 p.m.	W.N.W.-E.S.E.	1	5.21 p.m.	—
1889.					
Jan. 1	3.00 p.m.	N.-S.	1	4.44 p.m.	Cloudy weather.
Jan. 1	7.15 p.m.	N.W.-S.E.	1	4.44 p.m.	Cloudy weather.
Jan. 3	8.00 a.m.	N.E.-S.W.	3	6.03 a.m.	Cloudy weather.
Feb. 18	6.09 a.m.	S.W.-N.E.	19	7.06 a.m.	Very strong— 30 sec'ds; beautiful weather.
Feb. 19	3.10 a.m.	—	20	7.41 a.m.	Light weather.
Feb. 21	5.57 a.m.	—	22	8.58 a.m.	Light weather.
Mar. 4	7.08 a.m.	N.W.-S.E.	4	7.06 a.m.	Two light shocks.
Mar. 28	1.50 a.m.	S.E.-N.W.	28	2.46 a.m.	S.-west wind.
Mar. 28	7.23 p.m.	N.-S.	28	3.24 p.m.	Very light.
Mar. 31	6.45 a.m.	—	1	5.30 a.m.	Raining.
Apr. 3	4.26 p.m.	N.-S.	4	7.28 p.m.	— [(rain).
Apr. 6	6.45 a.m.	—	7	8.45 a.m.	Very light
Apr. 18	10.30 a.m.	S.S.E.-N.N.W.	19	6.53 a.m.	—
Apr. 18	3.30 p.m.	S.S.E.-N.N.W.	19	7.13 p.m.	—
Apr. 19	1.30 a.m.	—	20	7.34 a.m.	Raining.
Apr. 28	4.00 a.m.	—	29	4.22 a.m.	Light.
May 8	5.15 a.m.	—	9	10.27 a.m.	Light.
May 12	10.35 a.m.	S.E.-N.W.	13	2.08 p.m.	—
May 30	10.30 p.m.	—	2	6.04 p.m.	Very light.
June 14	3.05 a.m.	S.E.-N.W.	17	5.24 a.m.	Very light.
June 16	2.30 p.m.	N.E.-S.W.	19	7.29 p.m.	—
June 20	9.53 p.m.	S.E.-N.W.	23	11.03 p.m.	—
July 3	5.38 p.m.	N.-S.	6	8.41 p.m.	— [conds.
July 18	10.30 p.m.	S.E.-N.W.	21	9.41 p.m.	About 20 sec.
Aug. 2	10.20 a.m.	S.E.-N.W.	6	8.04 a.m.	Vertical.
Aug. 5	7.37 a.m.	N.E.-S.W.	9	10.51 a.m.	Long (1 min.)
Sept. 16	6.45 a.m.	N.E.-S.W.	22	9.23 a.m.	—
Oct. 10	6.50 a.m.	—	16	6.01 a.m.	Light.
Oct. 13	10.55 p.m.	E.-W.	19	7.58 p.m.	—
Oct. 14	11.20 p.m.	—	20	8.30 p.m.	Very light.
Oct. 28	2.15 a.m.	N.-S.	5	7.28 a.m.	Vertical.
Oct. 31	7.05 a.m.	S.E.-N.W.	8	9.52 a.m.	—
Nov. 29	8.45 a.m.	—	7	9.50 a.m.	Very light.
Nov. 29	9.15 p.m.	—	7	10.20 p.m.	Very light.
Dec. 17	6.00 a.m.	—	25	11.06 a.m.	Very light.
Dec. 28	7.55 p.m.	E.N.E.-W.S.W.	7	10.06 p.m.	—
Dec. 28	10.30 p.m.	N.-S.	7	10.06 p.m.	—
Dec. 31	1.10 p.m.	E.-W.	10	0.32 p.m.	Very long (about 2 mins.)

The total number of earthquakes in the foregoing list is 285, of which 189 were also recorded in Tokio. There were, therefore 96 disturbances, or about 33 per cent. of the whole, which, so far as Tokio is concerned, were peculiar to Yokohama.

The number of earthquakes for the years 1886-1889, according to the above list is one hundred and thirty-six, divided as follows:—

	Shocks.		Shocks.
In 1886	34	In 1888	38
In 1887	26	In 1889	38
Total.....		136	

These shocks were distributed among the twelve months of the year in the following proportion:—

	Shocks.		Shocks.
In January	12	In July	7
In February	14	In August	3
In March	18	In September	11
In April	10	In October	10
In May	13	In November	12
In June	16	In December	10
Total.....		136	

	Shocks.	
During the 1st quarter of the moon	37	
During the 2nd quarter of the moon.....	31	
During the 3rd quarter of the moon	38	
During the 4th quarter of the moon	30	
Total.....		136

Dividing the day in two parts, one from midnight to midday, and the other from noon to midnight:—

- 78 earthquakes occurred between midnight and noon.
- 58 earthquakes occurred between noon and midnight.

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(Mostly occurred between 3 and 9 a.m.)

The last 136 earthquakes are distributed among the days of the moon as follows:—

Date of Moon.	Number of Days of each date.	Number of Shocks.
1	5 days	7
2	2 days	2
3	4 days	4

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Date of Moon.	Number of Days of each date.	Number of Shocks.
4	6 days	6
5	7 days	8
6	5 days	5
7	3 days	5
8	3 days	3
9	6 days	6
10	6 days	7
11	2 days	2
12	3 days	3
13	5 days	6
14	1 day	2
15	2 days	2
16	5 days	5
17	3 days	3
18	1 day	1
19	9 days	10
20	4 days	4
21	4 days	6
22	7 days	9
23	4 days	4
24	4 days	5
25	1 day	1
26	3 days	3
27	3 days	4
28	3 days	4
29	3 days	3
30	4 days	6

Total 136

The direction of 68 earthquakes observed during 1886-1889 were the following :—

N.E.-S.W.	=	16	} Therefore shocks came most frequently from S.E. and S.W. and oc- curred as a rule within 2 hours before or after high tide.
N.N.W.-S.S.E.	=	4	
E.-W.	=	10	
N.-S.	=	15	
E.S.E.-W.N.W.	=	5	
N.W.-S.E.	=	18	

