SEISMOMETRICAL OBSERVATIONS FOR THE YEAR 1890.

ABSTRACTED BY JOHN MILNE.

CONTENTS.

1.—SEISMIC DISTURBANCES AND THEIR FREQUENCY.

During the year 1890, the total number of Earthquakes which occurred in this country was 845. A glance at the accompanying map shows the distribution of these disturbances.

The Provinces most frequently disturbed, were Higo,* Mu-

* In Higo 297 earthquakes were recorded. These were shocks following the great earthquake of July 1889. This explains the greater Seismic frequency for the whole country compared with previous years. In Tokyo we had 93 earthquakes. Such a great Seismic frequency is partly due to the fact, as it is suggested in every annual report, that even very feeble earthquakes have been observed by means of delicate instruments set up in the Meteorological Central Observatory.

sashi, Shimozuke, Nemuro, Kazusa, Shimosa, Hitachi, Sagami, Iwaki, Iwashiro, Satsuma, Awa, Idzu, Suruga, Kōzuke, Kai, Mikawa, Izumo, Rikuzen, Bungo, Ise, Owari, Mino, Kushiro, Iwami, Bingo, Tōtomi, Rikuchiu, Mutsu, Ugo, Kii, Yechigo, Shinano, Yechizen, Toshima, Aki, Ishikari, and Suo. (The arrangement is according to the frequency).

Each of the above provinces experienced more than five earthquakes, while the others had less than five during the year. In the following no earthquakes were recorded :—Inaba (1, W.), Hoki (4, N.E.), Mimasaka (1, N.), Oki, Nagato (6, N.E.), Suo (6, W.), Sanuki, Awa (6, W.), Tosa (7, S.), Iyo (2, centre), Bungo (1, W.), Chikuzen (6, S.), Hizen (7, N.), Chikugo (4, N.), Satsuma (3, W.), Iki, Tsushima, Teshio (nearly the whole), Ishikari (little, N.), Kitami (6, N.), and several islands.

2.—Number of Earthquakes in each Season.

The following table gives the number of earthquakes recorded during each month 1890 :—

Month.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	ov.	Dec.	Total.	Average.
Frequency.	86	65	83	80	93	66	59	55	48	63	98	49	845	70.3

The maximum frequency occurred in November, while the minimum was in September. The following table gives the frequency in each of season :—

Seasons.	Spring. March, April, May.	Summer June, July, August.	Autumn Sept., Oct., Nov.	Winter Dec., Jan., Feb.	Total.	Average.
Frequency.	256	180	209	200	845	211.2

The maximum seismic frequency occurred in Spring, while the minimum was in Summer. If we divide a year into the hot and cold seasons we have :—

Seasons.	Hot (from April to Sept. inclusive.)	Cold (from Oct. to March inclusive.)	Total.	Average.
Frequency.....	401.....	444.....	845.....	422.5

3.—Number of Earthquakes in each Hour.

The following table shows earthquake frequency in each hour:—

Months. Hours.	FORENOON.												AFTERNOON.												Total.
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	
January ...	2	2	3	2	5	2	6	5	4	4	2	5	6	2	2	2	—	6	5	2	5	7	1	6	86
February...	3	3	3	3	5	5	5	2	1	3	5	2	1	1	—	2	1	1	2	—	4	2	7	4	65
March	1	1	6	3	4	5	1	3	3	6	4	6	2	5	6	3	3	1	5	3	4	1	2	5	83
April	2	4	4	6	1	4	4	3	1	1	1	4	2	5	4	6	5	4	2	1	4	3	4	5	80
May	1	2	3	3	2	3	2	4	7	3	5	4	4	9	5	4	5	1	2	7	3	8	4	2	93
June	3	1	1	5	4	5	2	5	1	2	4	7	1	2	2	4	1	2	1	4	—	3	3	3	66
July.....	2	2	9	2	1	3	2	1	2	2	5	1	—	1	3	7	1	4	3	—	—	1	4	2	59
August ...	2	1	3	3	3	1	1	1	—	4	3	1	1	3	6	3	2	2	2	—	—	1	3	5	55
September.	5	3	4	—	—	1	1	3	2	—	1	1	5	1	2	3	1	2	1	2	3	3	1	3	48
October ...	2	3	3	1	3	—	2	2	3	6	4	2	1	3	4	1	4	3	2	4	3	2	4	1	63
November .	11	6	5	4	2	2	4	3	3	3	3	—	5	7	2	5	3	—	4	9	3	4	5	5	98
December..	—	4	3	4	2	1	—	4	1	1	2	2	1	—	3	3	3	4	1	2	—	6	2	—	49
Total	34	32	47	36	32	32	30	36	28	38	35	34	30	41	43	40	33	29	28	36	32	43	36	40	845

From the above we see that the greatest number of earthquakes occurred between 2-3 a.m., and the next maximum frequency between 2-3 p.m. and between 9-10 p.m.; whereas the minimum was between 8-9 a.m. and between 6-7 p.m. and the next minimum between 5-6 p.m. If we took 6 o'clock as the limit between day and night, we should have at night a greater number of earthquakes than during the day by 11.

4.—Area of Seismic Disturbances and Intensity.

The area shaken by an earthquake varied from a mere local tract up to an area of several thousand square *ri*, depending chiefly on the intensity of the shock. In the following table, the number of earthquakes during the year has been classified according to the size of the area disturbed :—One square *ri* =5.9 sq. miles.

Area. Months.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total	Average.
Over 1,000 square *ri* ...	4	3	3	6	5	2	1	1	4	4	9	0	42	3.5
1,000—100 square *ri* ...	9	7	7	15	10	5	9	4	4	7	11	8	96	8.0
Under 100 square *ri* ...	73	55	73	59	78	59	49	50	40	52	78	41	707	58.9
Total	86	65	83	80	93	66	59	55	48	63	98	49	845	70.4

From the above we see that out of 845 earthquakes, 707 only disturbed areas less than 100 sq. *ri*, 96, areas of 100—1,000 sq. *ri*, and the remaining 42, areas of over 1,000 sq. *ri*. Among the last 42 earthquakes, 2 shook an area of over 5,000 sq. *ri* or about one fifth of the empire, and another shook over 9,000 sq. *ri* or about three-eighths of the empire.

5.—Number and Intensity of Earthquakes in each Province.

The number and intensity of earthquakes in each Province during the year 1890 were as follows :—

Provinces.	Frequency.	Severe.	Moderate.	Feeble.
Higo	207	2	15	190
Musashi	101	4	37	60
Shimozuke	95	1	28	66
Shimosa	67	2	23	42
Kazusa	65	1	21	43

Provinces.	Frequency.	Severe.	Moderate.	Feeble.
Hitachi	63	4	31	28
Nemuro	54	—	10	44
Iwaki	48	7	26	15
Sagami	43	5	28	10
Mikawa	36	—	20	16
Mino	36	1	15	20
Iwashiro	35	—	17	18
Rikuzen	34	2	12	20
Satsuma	31	—	2	29
Owari	30	1	21	8
Suruga	29	4	7	18
Idsu	25	7	6	12
Ise	25	2	11	12
Awa	24	1	8	15
Kozuke	21	1	9	11
Izumo	21	7	4	10
Iwami	21	1	4	16
Kii	21	—	5	16
Bungo	20	—	5	15
Kushiro	20	—	16	4
Ugo	19	3	15	1
Shinano	17	2	11	4
Kai	16	1	8	7
Bingo	15	—	7	8
Rikuchiu	13	1	6	6
Mutsu	13	5	5	3
Totomi	13	—	4	9
Yechigo	12	1	7	4
Yechizen	10	1	5	4
Aki	10	—	4	6
Oshima	10	3	4	3
Hiuga	8	1	3	4
Uzen	8	—	4	4
Ishikari	8	—	2	6

Provinces.	Frequency.	Severe.	Moderate.	Feeble.
Bichiu	7	1	1	5
Chikugo	6	—	5	1
Suo	6	—	3	3
Iyo	6	1	2	3
Shiribeshi	6	—	4	2
Chishima	5	—	2	3
Omi	5	1	1	3
Shima	5	—	—	5
Bizen	5	—	5	—
Hoki	5	—	2	3
Iga	4	1	1	2
Wakasa	4	1	1	2
Kaga	4	—	1	3
Yechiu	4	—	1	3
Hizen	4	—	2	2
Hitaka	4	2	1	1
Iburi	3	—	—	3
Hida	3	—	1	2
Tango	3	1	—	2
Harima	3	1	1	1
Awa	3	—	3	—
Tosa	3	—	1	2
Buzen	3	1	1	1
Tokachi	2	—	—	2
Yamashiro	2	1	1	—
Osumi	2	—	—	2
Nagato	2	—	1	1
Mimasaka	2	—	1	1
Tanba	2	1	1	—
Yamato	2	1	—	1
Noto	2	—	1	1
Awaji	2	—	2	—
Kawachi	2	1	1	—
Izumi	1	1	—	—

Provinces.	Frequency.	Severe.	Moderate.	Feeble.
Settsu	1	1	—	—
Tajima	1	—	1	—
Inaba	1	—	1	—
Sado	1	—	—	1

Thus Higo had 207, Musashi 101, Shimozuke 95, Shimosa 67, Kazusa 65, Hitachi 63, and Nemuro 54 earthquakes this year, while Izumi, Settsu, Tajima, Inaba, and Sado had each of them only one earthquake respectively.

6.—Intensity of Earthquakes.

Of the 845 earthquakes in the year 1890, there were 49 severe disturbances, 264 which were moderate, and 532 which were feeble. Thus 6 per cent. of the total number of earthquakes in the year were severe, 31 per cent. moderate, and 63 feeble. The provinces shaken by severe shocks were as follows :—

No. of Earthquakes.	Provinces.
7	Iwaki, Idsu, Izumo ;
5	Sagami, Mutsu ;
4	Hitachi, Musashi, Suruga ;
3	Ugo, Oshima ;
2	Shimosa, Rikuzen, Hitaka, Shinano, Ise, Higo ;
1	Yechizen, Yechigo, Rikuchiu, Kozuke, Shimozuke, Kazusa, Awa, Kai, Mino, Owari, Iga, Omi, Yamashiro, Yamato, Kawachi, Izumi, Settsu, Harima, Tanba, Tango, Iwami, Bichiu, Wakasa, Iyo, Buzen, Hiuga.

Among the most severe earthquakes, we may count the one which occurred in Idsu and its neighbourhood on April 16th, the one in *Shin-yetsu* and neighbourhood on January 7th, the one in Gokinai on March 19th, the one in Hokkaido and *Sanriku* on November 17th, the one in Iwashiro and its neighbourhood on June 18th, the one in Mutsu and its neigh-

bourhood on November 7th, the one in Sagami and its neighbourhood on September 6th, the one in Izumo and its neighbourhood on January 30th, and lastly the one in Hiuga and its neighbourhood on October 10th. By these earthquakes, houses and buildings were damaged, stone lanterns and tombstones overthrown, articles on shelves thrown down, pendulum clocks stopped, and the area shaken was of vast extent.

7.—Table of Earthquakes (Monthly).

In the following table, provinces are classified according to frequency of earthquakes in each month. The days of occurrence and areas of severe earthquakes, together with the day, area, and provinces visited by the earthquake which shook the most extenives area in each month are given :—

JANUARY.

Seismic Frequency.		Severe Earthquakes.			Most Extensive Earthquake.		
Number of Earthquakes.	Provinces.	No.	Days.	Provinces.	Days.	Area.	Provinces.
16-15	Higo.	1	7th	Shinano, Yechigo.	7th	5,850 sq. *ri.*	Shinano, Yechigo, Kozuke, Shimozuke, Iwashiro, Iwaki, Hitachi, Shimosa, Kazusa, Musashi, Sagami, Kai, Suruga, Idsu, Totomi, Mikawa, Owari, Ise, Omi, Mino, Yechizen, Hida, Kaga, Yetchiu, Noto, Sado.
14-13	Izumo.	2	7th	Shinano.			
8-7	Iwami.	3	30th	Izumo, Iwami.			
6-5	Bingo, Musashi, Kazusa.	4	30th	Izumo.			
4-3	Shimosa, Mikawa, Sagami, Suruga, Shinano, Owari, Mino, Kii, Kaga, Yechigo, Ugo, Shimozuke, Aki, Nemuro.	5	30th	Izumo.			
		6	30th	Izumo.			
		7	30th	Izumo.			
		8	30th	Izumo.			
2-1	Hitachi, Kozuke, Kai, Iwaki, Iwashiro, Uzen, Idzu, Hida, Noto, Yechiu, Tango, Bichiu, Hoki, Awa, Rikuzen, Totomi, Ise, Omi, Tanba, Yechizen, Wakasa, Sado, Bizen, Suo, Iyo, Bungo, Hizen, Chikugo, Satsuma, Osumi.	9	30th	Izumo.			

FEBRUARY.

8-7	Higo.	1	20th	Bichiu.	21st	1,090 sq. *ri.*	Musashi, Sagami, Kozuke, Shimozuke, Hitachi, Shimosa.
6-5	Shimozuke, Kazusa, Musashi, Shimosa, Hitachi, Izumo, Satsuma.						
4-3	Iwaki, Sagami, Kii, Nemuro.						

Seismic Frequency.		Severe Earthquakes.			Most Extensive Earthquakes.		
Number of Earthquakes.	Provinces.	No.	Days.	Provinces.	Days.	Area.	Provinces.
2-1	Awa, Suruga, Kai, Bizen, Bichiu, Bingo, Hoki, Iwami, Kozuke, Iwashiro, Rikuzen, Ugo, Yechigo, Mino, Mikawa, Owari, Omi, Yamashiro, Mimasaku, Aki, Shiribeshi, Ishikari, Kushiro, Buzen.						
				MARCH.			
40 39	Higo.	1	6th	Higo.	19th	4,310 sq. *ri.*	Yamashiro, Yamato, Kawachi, Izumi, Settsu, Iga, Omi, Ise, Owari, Mino, Yechizen, Shinano, Mikawa, Totomi, Suruga, Kai, Shima, Kii, Awaji, Harima, Tanba, Wakasa, Tango, Tajima, Inaba, Mimasaka, Bizen, Bichiu.
6-5	Musashi, Shimozuke.	2	6th	Higo.			
4-3	Hitachi, Kuzusa, Shimosa, Iwaki, Owari, Ise, Nemuro.	3	19th	Yamashiro, Yamato, Kawachi, Izumi, Settsu, Omi, Mino, Owari, Ise, Iga, Harima, Tanba, Tango, Wakasa, Yechizen.			
2-1	Sagami, Suruga, Mikawa, Mino, Omi, Bizen, Mutsu, Rikuzen, Iwashiro, Kozuke, Awa, Idsu, Totomi, Shima, Shinano, Hida, Yechiu, Kaga, Yechizen, Wakasa, Yamashiro, Iga, Kii, Kawachi, Izumi, Settsu, Awaji, Harima, Tanba, Tango, Tajima, Inaba, Bichiu, Iwami, Hiuga, Bungo, Chikugo, Kushiro, Tokatsu, Chishima, Hitaka, Ishikari, Iburi, Toshima.	4	28th	Iwashiro, Hitachi.			
		5	31st	Hitaka.			

		APRIL.			
16-15	Higo, Musashi.	1	16th	Idsu, Suruga, Sagami, Musashi, Kazusa, Awa.	16th	4,740 sq. *ri.*	Idsu, Suruga, Sagami, Musashi, Kazusa, Awa, Shimosa, Hitachi, Shimozuke, Kozuke, Kai, Totomi, Mikawa, Owari, Iwashiro, Iwaki, Shinano, Hida, Mino, Ise.
14-13	Idsu.	2	17th	Idsu, Sagami, Musashi.			
12-11	Sagami.	3	17th	Idsu, Suruga, Sagami.			
10-9	Kazusa, Shimosa, Awa.	4	17th	Idsu.			
8-7	Suruga.						
6-5	Shimozuke, Iwashiro, Mino, Totomi, Hitachi, Mikawa, Owari, Nemuro.						
4-3	Kai, Iwami, Shinano, Kozuke, Bungo.						
2-1	Aki, Bingo, Iwaki, Ugo, Mutsu, Uzen, Rikuchiu, Rikuzen, Ise, Kii, Bichiu, Suo, Nemuro, Kushiro, Chishima, Bungo, Satsuma, Iyo.						
		MAY.			
34-33	Higo.	1	1st	Idsu.	24th	2,020 sq. *ri.*	Hitachi, Shimosa, Kazusa, Awa, Shimozuke, Musashi, Kai, Sagami, Kazusa, Iwaki.
14-13	Musashi.	2	15th	Idsu.			
10-9	Satsuma.	3	16th	Shimosa.			
8-7	Hitachi, Nemuro.	4	21st	Shimozuke, Kozuke.			
6-5	Shimozuke, Shimosa, Iwaki, Iwashiro.	5	25th	Iwaki.			
4-3	Kazusa, Sagami, Idsu, Mikawa, Mino.						
2-1	Kozuke, Rikuzen, Suruga, Awa, Kai, Owari, Shinano, Yechigo, Uzen, Mutsu, Nagato, Kushiro, Oshima, Ishikari, Bungo, Chikugo, Hizen.						

JUNE.

Seismic Frequency.		Severe Earthquakes.			Most Extensive Earthquakes.		
Number of Earthquakes.	Provinces.	No.	Days.	Provinces.	Days.	Area.	Provinces.
26-25	Higo.	1	3rd	Iyo.	18th	5,370 sq. *ri.*	Iwaki, Rikuzen, Uzen, Ugo, Rikuchiu, Mutsu, Iwashiro, Kozuke, Shimozuke, Hitachi, Shimosa, Kazusa, Musashi.
6-5	Nemuro, Musashi.	2	7th	Mutsu.			
4-3	Hitachi, Rikuzen, Owari, Mikawa, Bungo, Satsuma, Kushiro.	3	18th	Iwaki, Rikuzen.			
2-1	Shimozuke, Iwashiro, Iwaki, Rikuchiu, Mutsu, Uzen, Aki, Suo, Shimosa, Kazusa, Awa, Sagami, Kozuke, Yechigo, Ugo, Shinano, Mino, Ise, Bungo, Nagato, Oshima, Hitaka, Tokachi, Chishima, Iyo, Buzen, Chikugo, Hiuga.	4	29th	Buzen.			

JULY.

20-19	Higo.	1	3rd	Suruga.	19th	2,010 sq. *ri.*	Hitachi, Iwaki, Iwashiro, Shimozuke, Kozuke, Musashi, Shimosa, Kazusa.
12-11	Musashi, Shimozuke.	2	19th	Hitachi.			
6-5	Hitachi, Shimosa.						
4-3	Sagami, Bungo, Satsuma.						
2-1	Kazusa, Iwaki, Ise, Idsu, Suruga, Kozuke, Iwashiro, Yechigo, Kii, Aki, Suo, Iwami, Hizen, Buzen, Hiuga, Chishima.						

AUGUST.

20-19 8-7 6-5 4-3 2-1	Higo. Musashi. Shimozuke. Shimosa, Hitachi, Nemuro, Satsuma. Kazusa, Iwaki, Suruga, Mikawa, Totomi, Shinano, Kai, Idsu, Sagami, Awa, Rikuzen, Owari, Ise, Yamato, Kii, Harima, Mino, Vechizen, Yechiu, Wakasa, Bingo, Iwami, Suo, Bungo.	1	5th	Idsu.	5th	1,600 sq. *ri.*	Idsu, Awa, Kazusa, Musashi, Sagami, Kai, Suruga, Shinano, Totomi, Mikawa, Owari, Mino.

SEPTEMBER.

14-13 8-7 6-5 4-3 2-1	Higo. Shimozuke. Kazusa, Hitachi, Shimosa, Musashi. Kozuke, Sagami, Awa, Iwaki, Iwashiro, Nemuro. Idsu, Suruga, Mikawa, Owari, Ise, Yechigo, Rikuchiu, Rikuzen, Mutsu, Ugo, Uzen, Kai, Totomi, Shinano, Mino, Shima, Kawachi, Kii, Satsuma, Ishikari.	1 2	6th 30th	Sagami, Musashi, Suruga, Kai. Shimosa, Hitachi, Iwaki.	6th	3,030 sq. *ri.*	Sagami, Suruga, Kai, Musashi, Awa, Kazusa, Shimosa, Hitachi, Shimozuke, Kozuke, Shinano, Idsu, Totomi.

OCTOBER.

Seismic Frequency.		Severe Earthquakes.			Most Extensive Earthquakes.		
Number of Earthquakes.	Provinces.	No.	Day.	Provinces.	Day.	Area.	Provinces.
10-9	Shimozuke.	1	10th	Hiuga.	6th	3,400 sq. *ri.*	Hitachi, Kazusa, Shimosa, Awa, Musashi, Sagami, Shimozuke, Kozuke, Iwaki, Iwashiro, Rikuzen.
8-7	Musashi, Shimosa.	2	12th	Oshima.			
6-5	Higo, Hitachi, Kazusa, Iwaki, Yechizen.	3	15th	Iwaki.			
4-3	Sagami, Iwashiro, Awa, Rikuzen, Bungo, Hiuga.						
2-1	Kozuke, Kai, Shinano, Yechigo, Ugo, Rikuchiu, Mutsu, Totomi, Mikawa, Mino, Ise, Wakasa, Bingo, Iwami, Nemuro, Toshima, Ishikari, Kushiro, Awa, Tosa, Iyo, Chikugo, Osumi, Satsuma.						

NOVEMBER.

12-11	Shimozuke.	1	4th	Shimosa.	17th	9,190 sq. *ri.*	Mutsu, Rikuchiu, Oshima, Hitaka, Tokachi, Iburi, Ugo, Rokuzen, Iwashiro, Iwaki, Hitachi, Shimozuke, Shimosa, Musashi, Kazusa, Shiribeshi, Ishi-
10-9	Musashi, Hitachi, Iwaki, Nemuro.	2	5th	Iwaki.			
		3	5th	Iwaki.			
8-7	Shimosa, Kazusa, Iwashiro, Rikuzen.	4	5th	Iwaki.			
		5	7th	Mutsu, Ugo, Oshima.			
6-5	Higo, Ugo, Rikuchiu, Owari, Mino, Oshima, Kushiro.	6	7th				
		7	12th	Mutsu, Ugo.			
4-3	Mutsu, Mikawa, Ise, Sagami, Kozuke, Shirebeshi, Ishikari,	8	14th	Hitachi.			
		9	17th	Sagami, Musashi.			

	Hitaka, Iburi, Awa, Shinano, Suruga, Totomi, Iga, Shima, Omi, Kii, Yechizen, Harima, Awaji, Idsu, Kai, Uzen, Bungo, Awa, Tosa.	10 11	27th 29th	Hitaka, Oshima, Mutsu, Rikuchiu. Mutsu. Ugo.			kari, Kushiro, Nemuro, Kitami, Teshio.

DECEMBER.

8-7 6-5 4-3 2-1	Nemuro, Ise. Owari, Kii, Shimozuke, Higo. Mikawa, Mino, Shima, Iga, Sagami, Musashi, Shimosa, Suruga, Iwashiro, Iwaki, Riukuzen, Kazusa, Awa, Hitachi, Rikuchiu, Yechigo, Idsu, Shinano, Yechizen, Bingo, Izumo, Iwami, Hoki, Kushiro, Satsuma, Bungo, Awa.	1	20th	Ise.	18th	720 sq. *ri.*	Mikawa. Owari, Mino, Ise, Shima, Iga.

8.—Notes on Special Earthquakes.

The following short accounts only refer to the most notable earthquakes or to characteristic ones which occurred during the year 1890 :—

1. The earthquake on January 7th occurred at 3.43 p.m. The area affected on that day was very wide, extending from Iwashiro, Iwaki, Hitachi, Shimosa, and Kazusa in the east, to Ise, Omi, and Yechizen in the west, and reaching far out into the sea towards the south and north. The area therefore included 26 provinces. Among the rest, Shinano (3½, N.W.) Yechigo (little, W.), which cover an area of 360 sq. *ri*, were severely disturbed ; especially an area of 30 sq. *ri* extending to several *guns* of Kami-Mizuuchi, Higashi-Chikuma, Kita-Akumo, and Saragumi was most severely shaken and suffered great damage. A report from the Nagano Observatory says that the disturbed area extended from Hijiri-yama in the east, to Aogai-tōge in the west, and from Ikuzaka-mura in the south to Mushikura-yama in the north, chiefly extending along the river Sai more than at the east-west. It is said that during this earthquake, in Ikuzaka, Higashi-Chikuma-gōri, buildings and godowns were greatly damaged, mountains gave way, roads were destroyed, and tombstones nearly overthrown ; that in Hirotsu, Kita-Akumogōri, earth slipped from houses, and buildings were inclined, articles were thrown down, doors overthrown, and land on the mountain-side was fissured like the markings on the shell of a tortoise; that in Shinoda, Saragumi-gōri, rents were made in walls, and sometimes stone lanterns and tombstones overthrown ; that in Tsuwa and Oyama, Kami-Mizuuchi-gōri, articles were knocked down, slight cracks were made in walls, and people fled out of doors, but in the latter, a great number of godowns suffered, rents were made in walls, sometimes even moving their positions, and in some spots water burst out on the surface of the earth or a long fissure was made generally running from South-West to the North-east, the exact direction depending

on the nature of the ground. In Kita-Ogawa, Kami-Mizuuchi-gōri, there were shiftings of rocks, roads buried, gravestones thrown over, cracks made in walls of godowns; the beams of a house were shaken off and articles were knocked down. In the Nagano Observatory near the spot most severely shaken, the pendulum clock was stopped. Besides this, in Higashi-Chikuma-gori, Minami and Kita-Akumo-gōri, Saragumigori, Kami and Shimo-Mizuuchi-gōri, Kami and Shimo-Takaigōri, and Uyeshina-gōri, people fled out of doors and articles were overthrown. In some spots in Yechigo, it is said hanging clocks were shaken down, pendulum clocks stopped, and a part of the walls broken down. Among the moderately shaken areas may be mentioned Shinano (6½, S.) Mino (2, N.E.), Hida (9, E.), Yechiu (9, E.), Noto (4, E.), Yechigo (7, S.W.), Iwashiro (1, S.W.), Kōzuke, Shimozuke (1½, W.), Musashi (4, N.W.), and Kai (7, N.), amounting to an area of 2,310 sq. *ri*; and among the areas of feeble shock may be mentioned Musashi (6, E.), Sagami, Izu, Suruga, Tōtomi, Mikawa, Owari, Kaga, Sado, Kai (3, S.), Ise (4, N.), Omi (3, E.), Mino (8, S.W.), Yechizen (8, E.), Hida (1, W.), Noto (6, W.), Hitachi (6, W.), Yechigo (3, N.E.), Iwashiro (5, centre), Iwaki (1, S.W.), Shimozuke (8½, E.), Shimoza (7, W.), and Kazusa, (4, W.), amounting to an area of 3,180 sq. *ri*. The total area affected was 8,850 sq. *ri*. As to the nature of the motion, we had reports saying that the horizontal motion was most general, whereas the up and down motion was felt in but few of the shaken areas. Among the areas shaken most severely we have Kami-Takai-gōri, Shinano; and Nish-Kubiki-gori, Yechigo. Among the moderately or feebly shaken areas, we may mention Kami-Ina-gōri, Shinano; Nish-Chikuma-gōri, Shinano; Minami-Kanbaragōri, Yechigo; Tone-gōri, Kozuke, and Hokkai-gōri, Mikawa. The motion was generally slow in all places, excepting in the neighbourhoods of the severely shaken districts. The direction of the motion was generally towards the origin of the disturb-

ance, but sometimes it was at right angles to it or indefinite. As to the duration of the motion it is said that in the severely affected regions the shock had a short duration, while in the feebly affected districts the duration was relatively long. The severe earthquakes were followed by several feeble shocks; one shock took place at 3.48 p.m. on the same day and it was felt in 17 provinces, viz., Shinano, Kai, Hida, Yechiu, Kaga, Noto, Yechigo (7, W.), Kozuke (nearly the whole), Musashi (6, W.), Sagami (7, N.), Izu (little, N.), Suruga (nearly the whole), Tōtōmi (4, N.), Mikawa (6, N.), Owari (7, N.), Mino (8, N.E.), and Yechizen (3, W.), occupying an area of 3,730 sq. *ri*; and it is said that though feeble, Yena-gōri, Mino; and Shimo-Ina-gōri, Shinano, were affected by this earthquake even more severely than by the foregoing one.

2. The earthquake on March 19th, which occurred at 3.15 a.m.—This earthquake was felt in 31 provinces, Go-Kinai*, Omi, Wakasa, Tango, Tanba, Tajima, Harima, Inaba, Bizen, Iga, Ise, Shima, Kii, Yechizen, Mino, Owari, Mikawa, Kaga, Hida, Tōtōmi, Awaji, Yechiu (7, W.,) Shinano (6, S.W.), Kai (3, W.), Suruga (5, W.), Mimasaka (5, E.), and Bichiu (2, E.), covering an area of 4,110 sq. *ri*. It especially was felt in 15 provinces Yamashiro, Kawachi, Settsu, Wakasa, Omi, Iga, Tango (15, E.), Tanba (9, E.), Harima (2, E.), Izumi (3, N.), Yamato (4, N.), Ise (5, N.), Mino (7, S.W.), and Yechizen (7, S.), occupying an area of 1,360 sq. *ri*; moderately in the provinces Mikawa, Shima, Awaji, Tango (5, W.), Tajima (7, E.), Harima (6, centre), Tanba (1, W.), Izumi (7, S.), Kii (7, N.), Yamato (6, S.), Ise (5, S.), Owari (1, S.), Tōtōmi (3, W.), Shinano (1, W.), Hida (5, S.W.), and Yechizen (3, N.), occupying an area of 1,620 sq. *ri*; and feebly in provinces Bizen; Inaba (9, S.E.), Kaga (2, N.E.), Yechiu (7, W.), Hida (5, N.E.), Shinano (5. centre), Kai (3, W.), Suruga (5, W.), Tōtōmi (7, E.), Kii (3, S.), Tajima (3, W.), Mimasaka (5, E.), Bichiu (2, E.) and Harima

* The five provinces of Yamashiro, Yamato, Kawachi, Izumi, Settsu, being the Imperial domain.

(2, W.), amounting to an area of 1,130 square *ri*. It is said that in the last mentioned areas, here and there, there were persons who felt no shocks at all. As to the nature of the motion, we were informed that a little up and down motion was felt in each of the shaken areas, but it seems that it was generally horizontal. In may places roaring sounds were heard, and also feeble shocks were felt every two or three minutes. Thus we see that the areas affected by this earthquake were very extensive, fortunately however, causing no damage.

3. The earthquake on April 16th, which occurred at 9.30 p.m:—On this day an earthquake was felt in 20 provinces: Izu, Suruga, Sagami, Musashi, Kazusa, Awa, Shimosa, Hitachi, Shimozuke, Kozuke, Kai, Tōtomi, Mikawa, Owari. Iwaki (9, S.), Iwashiro (6, S.E.), Shinano (9, S.), Hida (5, S.E.), Mino (7, E.), and Ise (1, N.E.). Among the severely shaken areas may be mentioned Idzu, Suruga (1, E.), Sagami (8, S.), Musashi (1, S.), Kazusa (4, S.W.), and Awa, amounting to an area of 290 sq. *ri*. Among others, Shimoda and Miyakeshima in the province of Izu were most severely affected. In the latter, a shock began with a thundering noise heard at about half-past nine in the evening. Its direction was south-east; and by the shaking, which was up and down, back and forth, doors fell down, articles on shelves were knocked over, braziers were upset, pendulum clocks stopped, and the sea-shore gave way, destroying Okubo-hama, Kanzaki, burying roads, and thereby stopping traffic. Besides this, in several other villages many roads were destroyed and cracks were made on the surface of the earth; which are said to have extended towards the south-east. In Miyake-shima, after this earthquake, light shocks frequently happened every ten minutes for some fifty times. Severe shocks occurred on the 17th at 1 a.m., and at 6 a.m., but the number of shocks gradually decreased to once every 20 minutes or every hour. On the 18th they occurred about once in two hours. Again, among the mode-

rately shaken areas may be mentioned Suruga (9, W.), Tōtomi, Kai, Sagami (2, N.), Musashi (9, N.), Kazusa (6, N.E.), Shimosa, Hitachi (7, S.), Shimozuke (2, S.), Kozuke (2, S.), Shinano (3, S.E.), and Mikawa (6, E.), amounting to an area of 2,150 sq. *ri*. Among the feebly shaken areas may be mentioned, Kozuke (8, N.), Shimozuke (8, N.), Hitachi (3, N.), Iwaki (9, S.), Iwashiro (6, S.E.), Shinano (5, centre), Hida (5, S.E.) Mino (7, E.), Mikawa (4, W.), Owari, and Ise, (1, N.E.), occupying an area of 2,300 sq. *ri*. The total area shaken was 4,740 sq. *ri*.

4. The earthquake on November 17th occurred at about 9h. 31′ a.m. The area affected on the day was the greatest area shaken in 1890, extending from Hokkaido in the north, to Shimozuke, Musashi, and Kazusa in the south. Among the severely shaken areas may be mentioned Toshima (2, E.), Iburi (little, S.E.), Hitaka (8, S.), Tokatsu (2, S.), Mutsu (4, E.), and Rikuchiu (1, N.E.), occupying an area of 880 sq. *ri*; among the moderately shaken areas may be mentioned Mutsu (6, W.), Rikuchiu (9, S,W.), Ugo (5, N.E.), Rikuzen (6, N.E.). Toshima (8, W.), Shiribeshi (7, S.), Iburi (nearly the whole), Hitaka (2, N.), Ishikari (4, S.), Takatsu (8, N.), Kushiro (6, S.E), and Nemuro (1, S.), occupying an area of 4,230 sq. *ri*; among the feebly shaken areas may be mentioned Nemuro (8, centre), Kushiro (4, N.W.), Kitami (3, S.), Ishikari (6, N.), Teshio (little, S.), Shiribeshi (3, N.), Ugo (5, S.W.), Rikuzen (4, S.W.), Uzen (nearly the whole), Iwashiro (8, E.), Iwaki, Hitachi, Shimosa, Shimozuke (nearly the whole), Musashi (3, E.), and Kazusa (4, N.), occupying an area of 4,080 sq. *ri*. Thus the total area shaken was 9,190 sq. *ri*, beneath the ocean, Eastward from Rikuchu and Mutsu and Hokkaido.

Earthquake Observations made at the Meteorological Central Observatory, Tokyo.

During the year 1890, the number of earthquakes observed

at the Meteorological Central Observatory was 93. The following table shows at a glance the date, direction, intensity, etc., of these earthquakes :—

9.—TABLE OF EARTHQUAKES OBSERVED IN TOKYO DURING THE YEAR 1890.

Date.	Time of Occurrence.	Duration.	Horizontal Motion.				Vertical Motion.
			Direction.	Max. Range in mm.	Max. Vel. per Sec. in mm.	Max. Accel. per Sec. in mm.	Max. Amplitude in mm.
Jan.	h. m. s.	m. s.					
7th	7 44 37 a.m.	40	S.N.	little	—	—	—
7th	3 43 25 p.m.	5 0	S.E. to N.W.	2.0	2.9	8.6	—
12th	4 15 33 a.m.	—	—	little	—	—	—
29th	11 28 3 p.m.	57	E. to W.	0.3	1.3	11.3	—
30th	8 35 31 a.m.	—	—	little	—	—	—
Feb.							
13th	9 48 16 p.m.	30	E. to W.	0.2	3.1	9.6	—
18th	5 31 10 a.m.	—	—	little	—	—	—
	9 50 6 a.m.	—	—	little	—	—	—
21st	2 44 13 a.m.	40	E. to W.	little	—	—	—
24th	0 47 2 a.m.	30	S.E. to N.W.	0.2	0.8	6.4	—
Mar.							
7th	4 21 12 a.m.	20	E. to W.	0.2	1.3	16.9	—
11th	11 7 2 a.m.	30	—	little	—	—	—
	7 53 49 p.m.	1 0	E.S.E. to W.N.W.	0.4	6.3	198.4	—
18th	3 16 40 p.m.	20	—	little	—	—	—
26th	6 57 55 a.m.	—	—	little	—	—	—
28th	2 22 37 p.m.	—	—	little	—	—	—
April.							
5th	0 20 0 p.m.	—	—	little	—	—	—
11th	3 8 2 a.m.	1 5	E. to W.	0.4	1.4	9.8	—
16th	9 34 47 p.m.	7 0	S.E. to N.W.	22.4	24.3	52.7	0.2
	11 40 3 p.m.	—	—	little	—	—	—
April.							
17th	4 56 45 a.m.	8 0	S.E. to N.W	7.8	6.4	10.5	little
	5 11 3 a.m.	—	—	little	—	—	—
	6 42 36 a.m.	6 30	S.E. to N.W.	3.3	3.0	5.4	—
	3 31 38 p.m.	—	—	little	—	—	—
	10 25 18 p.m.	3 30	S.E. to N.W.	1.2	1.5	3.7	—
18th	5 38 37 p.m.	—	—	little	—	—	—
	7 15 57 p.m.	—	—	little	—	—	—
	11 3 0 p.m.	—	—	little	—	—	—
19th	9 45 52 p.m.	—	—	little	—	—	—
	1 7 37 p.m.	—	—	little	—	—	—
27th	8 31 48 p.m.	—	—	little	—	—	—

Date.	Time of Occurrence.	Duration.	Horizontal Motion.				Vertical Motion.
			Direction.	Max. Range in mm.	Max. Vel. per Sec. in mm	Max. Accel. per Sec. in mm.	Max. Amplitude in mm.
May.							
1st	3 56 25 a.m.	—	—	little	—	—	—
	8 38 50 a.m.	—	—	little	—	—	—
	7 40 10 p.m.	—	—	little	—	—	—
	9 59 21 p.m.	—	—	little	—	—	—
4th	2 29 17 p.m.	1 45	S.N.	0.2	0.4	0.2	—
7th	10 4 38 a.m.	20	E.W.	little	—	—	—
8th	8 35 56 a.m.	1 0	S.W. to N.E.	0.3	1.2	9.6	—
10th	6 49 23 a.m.	10	S.W.	little	—	—	—
15th	2 36 9 p.m.	5 30	N.W. to S.E.	0.9	1.3	3.8	—
21st	0 9 54 p.m.	35	E.W.	0.2	1.6	2.6	—
24th	1 39 33 p.m.	1 30	N.W. to S.E.	0.3	1.9	24.1	—
25th	8 54 45 a.m.	—	—	little	—	—	—
27th	6 49 40 p.m.	—	—	little	—	—	—
31st	8 42 25 p.m.	—	—	little	—	—	—
June.							
7th	11 29 53 a.m.	—	—	little	—	—	—
15th	4 30 15 p.m.	12	E.W.	little	—	—	—
18th	1 45 22 p.m.	3 0	N.E. to S.W.	0.6	1 5	7.5	little
26th	9 3 13 a.m.	—	—	little	—	—	—
28th	5 0 40 a.m.	50	S.E. to N.W.	0.7	3.1	27.5	—
July.							
2nd	2 15 9 a.m.	—	—	little	—	—	—
3rd	11 5 55 p.m.	—	—	little	—	—	—
8th	2 50 30 p.m.	20	N.E. to S.W.	0.3	1.0	6.7	—
9th	9 53 1 p.m.	1 0	W.N.W. to E.S.E	0.3	0.6	2.4	—
11th	9 1 5 a.m.	—	—	little	—	—	—
14th	4 10 49 p.m.	50	S.N.	little	—	—	—
15th	8 15 51 p.m.	20	S.W.	0.3	3.1	64.1	—
18th	0 35 46 a.m.	10	S.W.	little	—	—	—
July.	h. m. s.	m.s.					
19th	4 18 50 p.m.	50	W.N.W. to E.S.E.	0.2	1.6	25.6	little
20th	9 15 45 p.m.	—	—	little	—	—	—
25th	3 51 13 a.m.	—	—	little	—	—	—
	2 57 25 p.m.	—	—	little	—	—	—
Aug.							
2nd	11 6 35 p.m.	1 8	S.N.	0.2	0.5	2.7	—
4th	9 38 14 a.m.	—	—	little	—	—	—
5th	1 46 21 p.m.	2 14	S.E. to N.W.	0.3	0.6	2.4	—
7th	7 27 13 a.m.	—	—	little	—	—	—
11th	1 43 45 p.m.	—	—	little	—	—	—
21st	6 5 16 p.m.	—	—	little	—	—	—
29th	11 34 31 a.m.	—	—	little	—	—	—

Date,	Time of Occurrence.	Duration.	Horizontal Motion.				Vertical Motion.
			Direction.	Max. Range in mm.	Max. Vel. per Sec. in mm.	Max. Accel. per Sec. in mm.	Max. Amplitude in mm.
Sept.							
5th	7 57 19 p.m.	3 0	S.N.	0.8	1.0	2.5	—
6th	0 11 55 a.m.	1 40	S.S.W. to N.N.E.	0.6	1.9	12.0	—
17th	6 20 57 p.m.	55	S.W. to N.E.	0.2	1.0	10.0	—
30th	7 24 54 p.m.	2 0	S.N.	0.2	0.6	3.6	—
Oct.							
6th	4 36 50 p.m.	2 45	E.N.E. to W.S.W.	0.7	1.6	7.3	—
10th	9 33 30 a.m.	—	S.N.	little	—	—	—
12th	9 45 30 a.m.	—	S.N.	little	—	—	—
16th	4 5 47 a.m.	30	—	little	—	—	—
17th	8 35 18 p.m.	36	E.W.	little	—	—	—
19th	2 33 45 p.m.	30	E.W.	0.3	4.7	147.3	—
	8 34 14 p.m.	—	—	little	—	—	—
29th	10 36 51 p.m.	15	E.W.	little	—	—	—
Nov.							
2nd	9 30 30 a.m.	—	—	little	—	—	—
5th	0 44 29 a.m.	30	E.W.	little	—	—	—
14th	2 21 17 a.m.	1 6	S.E. to N.W.	0.3	1.6	17.1	little
16th	3 8 6 p.m.	30	E.W.	little	—	—	—
17th	9 31 38 a.m.	50	E.W.	little	—	—	—
22nd	10 50 31 p.m.	—	—	little	—	—	—
25th	7 1 0 p.m.	1 0	S.W. to N.E.	0.2	3.1	96.1	—
27th	0 24 39 a.m.	15	S.E. to N.W.	little	—	—	—
	7 33 48 p.m.	—	—	little	—	—	—
29th	7 30 40 p.m.	—	—	little	—	—	—
Dec.							
11th	5 34 53 p.m.	30	S.E. to N.W.	0.2	2.1	44.1	—
24th	7 22 27 a.m.	—	—	little	—	—	—

10.—Earthquake frequency per Month.

During the year 1890, the number of earthquakes in each month was as follows:—

Months.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Frequency.	5	5	6	15	14	5	13	7	4	8	10	2	93

From the above it is seen that the maximum frequency occurred in April, and the minimum was in December.

11.—Earthquake frequency per Season.

Year.	Spring.	Summer.	Autumn.	Winter.	Average.
1890	35	24	22	12	23

The maximum frequency was in spring, while the minimum was in winter.

12.—Frequency during Hot and Cold Periods.

Year.	Hot.	Cold.	Average.
1890	36	57	46

From the above it is seen that the average number of earthquakes during both periods was 46, and we had in the hot period a greater number of earthquakes than during the cold period by 21.

13.—Hourly frequency of Earthquakes.

The number of earthquakes in each hour during the year will be found from the following table :—

	Forenoon.												Afternoon.												
Mths.	Hs. 0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	Total.
Jan.	—	—	—	—	1	—	—	1	1	—	—	—	—	—	—	1	—	—	—	—	—	—	—	1	5
Feb.	1	—	1	—	—	1	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1	—	5
March	—	—	—	—	1	—	1	—	—	—	—	1	—	—	1	1	—	—	—	1	—	—	—	—	6
April	—	—	—	1	1	1	1	—	—	1	—	—	1	1	—	1	—	1	—	1	1	1	1	2	15
May	—	—	1	—	—	—	1	—	3	—	1	—	1	1	2	—	—	—	1	1	1	1	—	—	14
June	—	—	—	—	—	1	—	—	—	1	—	1	—	1	—	—	1	—	—	—	—	—	—	—	5
July	1	—	1	1	—	—	—	—	—	1	—	—	—	—	2	—	2	—	—	—	1	2	—	1	12
Aug.	—	—	—	—	—	—	—	1	—	1	—	1	—	2	—	—	—	—	1	—	—	—	—	1	7
Sept.	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	2	—	—	—	—	4
Oct.	—	—	—	—	1	—	—	—	—	2	—	—	—	—	1	—	1	—	—	—	2	—	1	—	8
Nov.	2	—	1	—	—	—	—	—	2	—	—	—	—	—	—	1	—	—	—	3	—	—	1	—	10
Dec.	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	2
Total.	5	—	3	3	4	3	3	3	4	9	1	3	2	5	6	4	4	2	3	8	5	5	3	5	93

We see from the above that the maximum frequency was between 9—10 a.m. and no earthquake between 1—2 a.m.

14.—Intensity of Earthquakes.

Of the 95 earthquakes which took place in the year 1890, we will describe the most notable :—

			Horizontal Motion.			Vertical Motion.	
Date.	Time of Occurrence.	Duration.	Max. range in m.m.	Max. Vel. per Sec. in m.m.	Max. Accel. per Sec. in m.m.	Max. Amplitude in m.m.	
April	h. m. s.	m. s.					
16th ...	9 30 47 p.m.	7 0	22.4 in 2.9 sec.	24.3	52.7	0.2 in 0.6 sec.	
17th ...	4 56 45 a.m.	8 0	7.8 in 3.8 sec.	6.4	10.5	little	
	6 42 26 a.m.	6 30	3.3 in 3.4 sec.	3.0	5.4	—	
Jan.							
7th ...	3 43 25 p.m.	5 0	2.0 in 3 sec.	2.9	6.6	—	
April							
17th ...	10 25 15 p.m.	3 30	1.2 in 2.5 sec.	1.5	3.7	—	
May							
15th ...	2 36 9 p.m.	5 30	0.9 in 2.2 sec.	1.3	3.8	—	

From the above it is seen that the most severe earthquake during the year occurred at 9h. 34′ 47″ p.m. on April 16th, and had a range 22.4 mm. The origin of this earthquake must have been somewhere in Shimoda in the province of Idsu and Miyakeshima. In the neighbourhood around these localities roads were destroyed, rents were made in the ground, articles fell down or were knocked over, pendulum clocks were stopped, &c. The next shocks were those which occurred on April 17th. During the day there were three. They probably had the same origin as the one preceding them. The earthquake of January 7th took its origin somewhere in Shinano. Kami Mizuuchi, Higashi Chikuma, Kita Akumo and and Sarakumi, were most severely shaken and suffered much damage. The earthquake of May 15th had its origin somewhere in Shimoda, Izu. This district was severely affected, but no damage was done. Among other earthquakes the shocks of long duratiou were those which occurred at 4h. 56′ 45″ a.m.; on April 17th, at 9h. 34′ 47″ p.m.; on April 16th, at 6h. 42′ 36″ a.m.; on April 17th, at 2h. 36′ 9″ p.m.; on May 15th, at 3h. 43′ 25″ p.m.; on January 7th, each having a duration of 8′, 7′, 6′ 30″, 5′ 30″, and 5′ respectively. All the remaining shocks had a duration of less than 4 minutes. There was only

one earthquake which had a range greater than 20 mm., no earthquakes had a range greater than 10 mm., 4 earthquakes which had ranges, 1 to 10 mm., 28 were less than 1 mm., and the remaining 60 were so feeble that measurement was impossible.

From the preceding facts we may conclude that severe earthquakes were few in number, about 90 per cent. of them being feeble.

15.—Direction of Earthquakes.

The principal direction of motion of the 93 earthquakes this year were as follows:—

Year:	S. to N.	S.S.W. to N.N.E.	S.W. to N.E.	W.S.W. to E.N.E.	E. to W.	E.S.E. to W.N.W.	S.E. to N.W.	S.S.E. to N.N.W.	Unknown.
1890	8	1	5	1	17	3	13	—	45

Earthquake motion was therefore chiefly E.W., and after that S.E. to N.W. They occurred least in the directions S.S.W. to N.N.E., and W.S.W. to E.N.E., the next being S.S.E. to N.N.W.

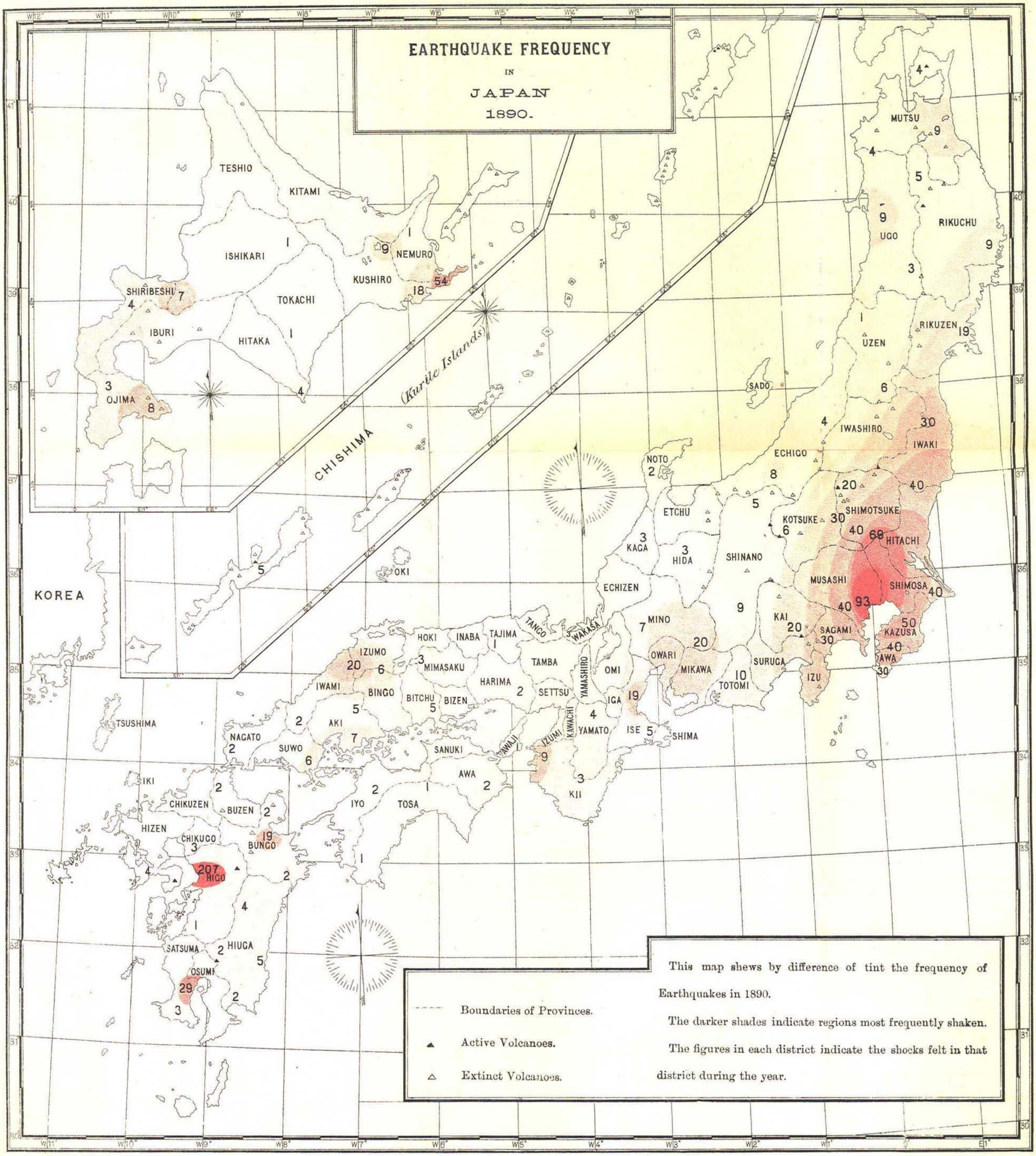
16.—Nature of Earthquakes.

An earthquake may have a horizontal or vertical motion; and the motion may be rapid or slow. In the following table we show the nature of the earthquakes in 1890:—

Nature. Months.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Conbination of horizontal and vertical motion.....	—	—	—	2	—	—	1	—	—	—	1	—	 5
Horizontal motion ...	2	2	2	3	5	1	3	2	4	2	1	1	28
Unknown	3	3	4	10	9	3	8	5	—	6	8	1	60
Rapid	—	1	1	—	2	1	3	1	1	4	2	1	17
Slow	3	1	—	5	5	2	3	1	3	2	4	—	29
Unknown	2	3	5	10	7	2	6	5	—	2	4	1	47

Thus of 93 earthquakes, 28 were horizontal, 5 were combination of horizontal and vertical, and 60 were not definite, being very feeble. The number of slow earthquakes exceeded that of rapid ones by 12, while 47 were so feeble that it was difficult to determine their period of vibration.

EARTHQUAKE FREQUENCY
IN
JAPAN
1890.



This map shews by difference of tint the frequency of Earthquakes in 1890.

The darker shades indicate regions most frequently shaken.

The figures in each district indicate the shocks felt in that district during the year.

Boundaries of Provinces.

▲ Active Volcanoes.

△ Extinct Volcanoes.