

NOTES ON THE GREAT EARTHQUAKES  
OF JAPAN

BY

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During the last five years, whilst residing in Japan, I have endeavoured to collect together information respecting its earthquakes. Of the recent ones every resident has personal experience, and is enabled for himself to make many observations. With those which occurred in past times the records are more difficult to obtain, and they are only to be gathered together by first collecting and then perusing what appears to be a voluminous literature. In gathering together books on any special subject in Japan, many difficulties have to be encountered. Although booksellers are numerous, and their collections of works are at times overwhelmingly large, catalogues appear to be without existence, and a bookseller, whilst possessing the book for which you ask, may perhaps tell you that he never heard of it. Owing to this peculiar state of the book trade, it was many weeks before I obtained a single volume relating to earthquakes. However, by employing a man to visit various book stores in Yedo, by rummaging through libraries, by writing to the chief towns in various districts, and by calling at them myself when travelling, in time I gathered together a large number of the works which are contained in the following list. Of these many are in manuscript, and it may be that only single copies are extant.

Since commencing this catalogue, my intention of giving a full account of the earthquakes of Japan has in part been anticipated by the long and able paper upon the same subject by Dr. Naumann, entitled "Ueber Erdbeben und Vulcanausbrueche in Japan," published in "Mittheilungen der Deutschen Gesellschaft, für Natur- und Völkerkunde Ostasiens" August, 1878.

The substance of this excellent paper is derived from twenty of the books in the following list.

At the same time another valuable paper, entitled "Destructive Earthquakes in Japan," was read by Mr. T. Hattori. This, which may be regarded as the only classification of Japanese earthquakes which has appeared in English, may be found in the Transactions of the Asiatic Society of Japan, vol. vi. part ii. The books which were used by this writer are also to be found in the following list.

In addition to the papers of these two writers, more or less reference to the earthquakes of Japan is to be found in many local papers, and in nearly all the books which have been written upon this interesting country. These, however, are for the most part so small, and at the same time so numerous, that I shall refrain from making special mention of them.

The following is a catalogue of the books with which I am acquainted.

#### I.—EARTHQUAKE CALENDARS.

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|----------|----|--|
| 記代年震地    | 1. | <i>Ji-shin Nen-dai-ki.</i> Earthquake calendar.  |
| 記震地朝本    | 2. | <i>Hon-chô ji-shin-ki.</i> Descriptions of Japanese earthquakes.                                   |
| 考年曆震地大   | 3. | <i>Ôji-shin Teki-nen-kô.</i> Considerations about great earthquakes and their actual consequences. |
| 記代年震地大都京 | 4. | <i>Kiôto Ô-ji-shin Nen-dai-ki.</i> Calendar of great earthquakes in Kiôto.                         |
| 記震地陽諸    | 5. | <i>Shoyô Ji-shin-ki.</i> An account of the earthquakes which have occurred in different provinces. |
| 記代年震地大   | 6. | <i>Ô-ji-shin Nen-dai-ki.</i> Chronology of great earthquakes.                                      |
| 記日震地     | 7. | <i>Ji-shin Nîk-ki.</i> Journal of earthquakes.   |

#### II.—EARTHQUAKE MONOGRAPHS.

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|------------------|----|---|
| 川山震地大國濃信<br>圖之激崩 | 8. | <i>Shinano no kuni ô-ji-shin San-sen hô-geki no dsu.</i> The great earthquake which occurred in the province of Shinano, and an account of the destruction caused by mountains and rivers (1847). |
| 郡六激崩川犀州信<br>圖之蕩漂 | 9. | <i>Shin-shû Saigawa hô-geki Roku-gun Hiô-tô no dsu.</i> The destruction occasioned by the River Saigawa in Shin-shû or Shinano (1847).  |

- 震地大越信 10. *Shin-yetsu Ō-ji-shin*. The great earthquake of Shinshû and Yechigo (1847).
- 記震地大國諸 11. *Sho-koku ō-ji-shin ki*. Description of a great earthquake which extended over many provinces (1854).
- 誌聞見政安 12. *An-sei kem-bun shi*. Notices concerning occurrences which took place during the chronological period Ansei (1854-1859). This book gives an account of the devastations in different parts of Yedo, which were occasioned by the earthquake of the year 1855. It also contains records the fate of many of the unfortunate creatures who perished during this earthquake.
- 錄聞見政安 13. *An-sei kem-bun roku*. Historical record of events seen and heard during the chronological period Ansei. It chiefly relates the remarkable fate of many people during the great earthquake of Yedo (1855).
- 記震地州信 14. *Shin-shû ji-shin Ki*. Description of great earthquake of Shinshû (1847). It gives an account of devastations in the six districts of Shinshû, 1st, through the great earthquake; and, 2nd, through the inundations.
- 略大震地大 15. *Ō-ji-shin tai-riyaku*. Abridged description of a great earthquake. In this we chiefly find an account of the destruction of the buildings, streets, roads, of Kiôto, by the earthquake of the 13th of the sixth month, 1854 (7th July). It also contains report sent to the Shôgun by the respective Daimiôs on the destruction which took place in their provinces.
- 書拔集雜 16. *Zasshiû-bassho*. Extracts from a mixed collection of facts, containing—1st, the devastation in Shin-shû by the well-known earthquake; 2nd, number of the killed and wounded in various parts of the province; 3rd, reports from the Daimiôs to the Shôgun.
- 種之語俗世後震地 17. *Jishin-kôsei-zokugo-no-tane*. Contents: 1st, concerning the God of Zen-kô-ji; earthquake of Shin-shû explained in detail; 2nd, destructions which have occurred in Shin-shû by earthquakes, by fire, by inundations (with pictures); 3rd, the fate of the unfortunate inhabitants of the province; 4th, the inundations of the river Saigawa, and of the Chikumagawa.

- 上書御震地大 18. *Ôjishin-o-kaki-age*. Letter about the great earthquake, 1847. Reports to the Shôgun, and reports of the great Daimiôs of Shin-shû, concerning the great earthquake of 1847.
- 記震地州信 19. *Shin-shû Jishin-ki*. Detailed account concerning earthquake of Shin-shû.
- 記略災震江武 20. *Bu-kô Shin-sai riyak-ki*. Description of the disasters occasioned by the earthquake of Yedo.  
1st vol.—1st, destruction of portions of Yedo by the earthquakes, and then by fire; 2nd, the fate of many persons.  
2nd vol.—The fate of many persons.  
3rd vol.—Map of Yedo, in which the burned quarters of the city are marked.  
4th vol.—Contains the same accounts as mentioned in the 1st and 2nd volumes.
- 語物震地大花浪 21. *Rô-kuwa Ôji-shin monogatari*. Account of the Ôsaka earthquake.
- 震地大國之越 22. *Koshi no Kuni Ôji-shin*. Account of the great earthquake in Yechigo.
- 震地大倉鎌 23. *Kamakura Ôji-shin*. Great earthquake of Kamakura.
- 翰書 24. *A letter*. This gives an account of the earthquake in Shinano and Yechigo.
- 錄談奇震地 25. *Ji-shin Ki-dan-roku*. A record relating to the effects produced by the earthquake in the period Ansei.

### III.—BOOKS WHICH CONCERN EARTHQUAKES IN GENERAL.

- 考震地 26. *Ji-shin-kô*. Considerations concerning earthquakes. Especial reference is made to the earthquake of the year 1830.
- 說震地 27. *Ji-shin-setsu*. An opinion about earthquakes: 1st, concerning their origin (European theories); 2nd, examples of great earthquakes in America, Europe, and in Asia.
- 考動地 28. *Chi-dô-kô*. Considerations about the motion of the earth. Especial reference is made to the earthquake of the year 1847.
- 記震地國諸 29. *Sho-koku Ji-shin-ki*. Account of earthquakes in all countries.
- 說考雷震 30. *Shin-rai kô-setsu*. About the quaking of the earth and thunder. Especial reference is made to the earthquake of the year 1828.
- 要採災地 31. *Chi-sai sai-yô*. Collection of accounts about earthquakes, etc., in 18 volumes. In this, especial reference is made to the earthquake of the year 1847.

This is a manuscript work with many illustrations. Its contents are as follows :—

(1st Volume.)

*Shinshû Asama-yama-yake-bunsho.* The eruption of Mount Asamayama, in the third year Temmei (1784).

*Shin-shû ji-shin-ki.* An account of an earthquake in Shin-shû, 4th year of Kokwa (1847).

*Ô-ji-shin tai-riyaku.* A general description of the great earthquake, in the seventh year of Kayei (1855).

*Teibi-zasshû-bassho.* A collection of facts obtained from various books and persons, chiefly concerning the earthquake that occurred in the fourth year of Kokwa (1848), in *Shin-shû*.

*Ji-shin-setsu.* Ideas about earthquakes.

(2nd Volume.)

*Jishin-go Sezoku-gatari-no-shû.* Stories of the destruction, etc., that occurred after the earthquake in *Shin-shû*.

(3rd Volume.)

*Shin-shû-ô-jishin.* Part 3. An account of the great earthquake of Shin-shû.

*Ô-ji-shin o-kaki-age.* Reports about the earthquake in Shin-shû to the Shôgun.

(4th Volume.)

*Temmei-shinjô-hen-i-ki.* The eruption of Asamayama.

(5th Volume.)

A collection of extracts about earthquakes. This is a collection of facts extracted from books in which the accounts of earthquakes do not form the subject matter.

(6th Volume.)

Notes of the destruction, etc., caused by the great earthquake of Shin-shû. This is a continuation of the preceding volumes.

(7th Volume.)

This contains reports about the destruction, etc., in Yedo, after the earthquake of the second year of Ansei (1856).

(8th Volume.)

Continuation of Volume 7.

(9th Volume.)

Continuation of Volume 8.

(10th Volume.)

Description of the houses which were burned at the time of the Yedo earthquake in 1856.

(11th Volume.)

Continuation of Volume 10.

(12th Volume.)

*Ji-shin-kô.* Consideration on earthquakes, with some reports about special ones.

(13th Volume.)

*Hon-chô Ji-shin-kô.* Chronological table of earthquakes.

#### IV.—MISCELLANEOUS BOOKS.

記書本日 32. *Ni-hon-sho-ki* or *Ni-hon-gi.* Annals of Japan from the creation down to the reign of the Empress Ji-do Ten-nô (696 A.D.) In this reference is made to the earthquakes of the years 416, 599, 642, 676, 679, 685.

- 記本日續 33. *Zoku-Ni-hon-ki*. Annals of Japan from the accession of Mommu Ten-nô down to the end of the tenth year of Kuwam-mu Ten-nô (from 697 to 791).
- 史國集類 34. *Ruijû Koku-shi*. Collection of historical notices by Sugawara Michizane in the 9th century, of which only a portion is extant. This gives special accounts of earthquakes. Especial reference is made to those of the years 163, 797, 807, 819, 827, 829, 833, 887.
- 書漢後 35. *Go-kan-sho*.\* History of the after Han Dynasty (B. C. 25 to 250). This gives an account of a very early seismograph.
- 史外本日 36. *Ni-hon-guwai-shi*. Especial reference is made to the earthquake of the year 1576. History of the Military Families who strove for the possession of power from the 11 century down to modern time.
- 覽一代王 37. *Ô-dai ichi-ran*. (Translation in French.) It contains an account of the production of Fujiyama and lake Biwa. Especial reference is made to the earthquakes of the years 286, 684, 869, 1179, 1213, 1246, 1256, 1293, 1614, 1633, 1649, 1662, 1663, 1703, 1707.
- 譜臣豐 38. *Toyotomi-fu*. A history of Hideyoshi, commonly called Taico-sama. Especial reference is made to the earthquake of the year 1576.
- 錄實代三 39. *Sandai-Jitsuroku*. The records of the reigns of the three Emperors after Sei-wa, Yô-zei, and Kôkô. Especial reference is made to the earthquakes of the years 863, 864, 868, 869, 885.
- 記平太 30. *Taihei-ki*. A general history. Especial reference is made to the earthquake of the year 1331.
- 記代年朝本 41. *Honchô-nendai-ki*. Chronicles of Japan (1684). The upheaval of Fujiyama and the formation of Lake Biwa are mentioned. Especial reference is made to the earthquakes of the years 965, 968, 972, 1299, 1324, 1402, 1432, 1510, 1627, 1683.
- 記丈方 42. *Hôjôki*. The diary of a Priest. Especial reference is made to the earthquake of the year 1185.
- 記日舜梵 43. *Bonshun-nikki*. A journal.
- 談茶窓北 44. *Hokusô-sadan*. 4 volumes. A collection of strange events occurred in old days.

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\* This is a Chinese work.

- 記陵谷 45. *Kokuriyô-ki*. A collection of various writings. Especial reference is made to the earthquakes of the years 1707, 1614.
- 記之柴燒折 46. *Oritaki Shibanoki*. A miscellany.
- 語物家平 47. *Heike-monogatari*. A historical romance. Especial reference is made to the earthquake of the year 1185.
- 辨地天蒙訓 48. *Kummô-Tenchi-ben*. Phenomena of the universe.
- 記代年朝本類分 49. *Bunrui-Honchô-nendai-ki*. A historical calendar containing many special subjects.
- 陳聞或地天 50. *Tenchi-wakumon-chin*. Conversations on heaven and earth, 1709. Amongst other things, this gives accounts of earthquakes.
- 錄災三 51. *Sansai-roku*. The three misfortunes—earthquakes, fire, and waves. Especial reference is made to the earthquake of the year 1707; and the elevation of the eastern part of Japan, 1855.
- 表年平泰 52. *Taihei-nempiô*. Annals of the Tokugawa Shôguns. In this, especial reference is made to the earthquakes of the years 1633, 1645, 1649, 1651, 1662, 1663, 1664, 1703, 1707, 1723, 1725, 1751, 1757, 1771, 1782, 1810, 1811, 1813.
- 記遊東 53. *Tôyûki*. Travels in Eastern Japan.
- 表年江武 54. *Bukô-nempiô*. Calendar of Yedo. Especial reference is made to the earthquake of the year 1707.
- 解圖記代年 55. *Nendai-ki-dsukai*. General calendar. Illustrated with sketches.
- 鏡袖年千二 56. *Nisennen-sode-kagami*. General calendar.
- 傳術仙師大連日 57. *Nichiren-daishi-senjutsu-den*. On the art of becoming a Senin, or a man who is supposed to live 1000 years. By a priest called *Nichiren-daishi*.
- 繪圖才三漢和 58. *Wakan-san-sai-dsuye*. An encyclopædia.
- 志文天朝本 59. *Honchô-temmon-shi*. The Japanese astronomy.
- 礎帝皇 60. *Kôtei-so*. A work compiled from regulations of the emperors.
- 記書朝本 61. *Honchô shoki*. A history of Japan. In this, especial reference is made to the earthquake of the year 416.

- 集聞風政安 62. *Ansei Fûbunshû*. Collection of the reports of the events occurred in the year of Ansei. Especially about the wind and flood.
- 錄寶珍明天 63. *Temmei chimpôroku*. Description of the strange events occurred in the year of Temmei. Especially about the famine, the frequent fire and the burning of Asamayama.
- 意自地天 64. *Tenchi Jii*. Opinion about the heaven and the earth.

Many the books contained in the above list I have had translated and examples of these translations have from time to time appeared in the columns of the Japan Gazette. As typical of the various of books which are met with I may mention the Rokwa Ô Jishin Monogatari (see Japan Gazette May 5th 1881.) the Koshi no Kuni Ô Jishin (see Japan Gazette June 4th 1881.) and the Ô Jishin Nendaiki (see Japan Gazette June 18th 1881.)

The first of these books is simply a series of anecdotes of the various events which took place at the time of the great earthquake which took place in Ôsaka in 1707, and is not unlike many of the popular accounts of earthquakes we meet with in European Countries. Here and there a scrap of valuable information may be met with. As a whole however it may be considered as a good example of the literature which has to be waded through without recompense, unless it be the amusement derived from the oddity of the incidents which are recorded and the drollness of the narrator's style.

In the Koshi no Kuni Ô Jishin however, which is an account of the Great Earthquake in Yechigo in 1829, we obtain many facts of considerable value. Many of the phenomena which are supposed to precede an earthquake are referred to, such as mirage, shooting stars &c., we have also in the account of this shock an excellent example of the manner in which a large shock is usually accompanied by a number of smaller shakings, which probably indicate the gradual setting down of the ground into a stable position after the preceeding great disturbance.

The last of the three books which is the Calendar of Earthquakes is an example of a group of books for which



Japan is probably more or less peculiar. These earthquake calendars are to a great extent as they must necessarily be, but repetitions of each other. The differences in them are chiefly with regard to the emphasis which they lay upon particular shocks,—thus the Calendar Ô Jishin Nendaiki describes in considerable detail the shock of 1854. Here and there when comparing different calendars it would appear from the near coincidence in some of the dates that the same earthquake was being referred to. In such cases more or less confusion is occasioned, and some of the errors which have crept into my list of the great earthquakes of Japan which is given subsequently may perhaps be traced to this cause. Until quite recently for the want of proper tables wherewith to translate Japanese dates into European, work involving this process has resulted in numerous errors. Since the publication by the late Mr. Bramsen of a set of Chronological Tables, difficulties of this description however have been overcome.

Although the greater number of these earthquakes were probably severe ones, in the 4th column of the following catalogue I have indicated their relative intensities by the numbers I or II, those marked II being the most severe. If the writer of the records from which these intensities are judged of, was situated near the centre of a shock no doubt his description would in all cases convey the idea of a shock of great intensity, and in this way shocks which were comparatively small might be mistaken for shocks of extreme severity. On the other hand if he were at a distance from the center of a large shock it might be argued that he would describe it as having been small. Although it is possible for errors to have arisen in this manner it is hardly probable, because whenever a large shock occurred the news of the devastations it had occasioned would most certainly be spread and talked about over a large area. And mistakes in the descriptions of large shocks would therefore not be so likely to occur as in the description of small shocks.

However if mistakes have occurred in this manner, because only two degrees of intensity have been employed,

rather than some greater number, the errors will be comparatively small.

Sometimes writers may object to intensity being considered at all, but when they look over the list I have given and see examples of shocks which lasted 20 days, 70 days and even 200 days, they can not surely class these periods of seismic activity as being equivalent to a shaking which only continued for perhaps a few minutes. However, as the same general results which I wish to show are to be obtained whether intensity is considered or only the number of recorded earthquakes are counted, this subject is not of great importance.

In some cases it is definitely stated in the accounts that there was more or less continuous shaking for a certain period of days apparently shewing a continuation of one great seismic effort. At other times from the quick succession of dates given on which shocks occurred, it is evident that these shakings were the result of one prolonged effort.

Number	European Date			Intensity	Japanese Date				
	Year	Month	Day		Day	Month	Year		
1	B.C. 295	..	..	..	..	..	5	Kôrei Tennô	Lake Bewa and Fujiyama formed.
2	A.D. 82	..	..	..	..	..	..	....	Chikubushima in lake Bewa was formed.
3	295?	..	..	..	..	..	..	....	Ômi.
4	369	3	4	..	..	..	..	....	Idzu. Shakings lasted 3 days.
5	412 to 453	..	..	..	24	7	..	Ingiô Tennô	
6	416	..	..	..	14	7	5	„	Nanto.
7	575	9	5	..	..	..	..	....	Idzu. Mountains cracked and trees fell down.
8	599	5	28	..	27	4	7	Suiko Tennô	Nanto?
9	600	6	16	..	..	..	..		
10	642	11	8	..	8	10	1	Kokioku Tennô	Nanto?

Number	European Date			Intensity	Japanese Date				
	Year	Month	Day		Day	Month	Year		
11	642	11	24	..	24	10	1	....	Nanto.
12	675	12	2	..	10	11	4	Hakuhô	
13	676	12	14	..	..	11	4	..	Nanto.
14	677	11	11	..	..	..	..	..	Nanto.
15	..	12	23	..	..	..	..	..	
16	678	7	19	I	14	6	6	..	Nanto.
17	679	1	10	..	..	12	7	..	
18	682	9	19	..	12	8	11	..	
19	..	9	24	I	17	8	11	..	
20	684	11	16	..	4	10	13	..	
21	685	11	26	II	14	10	13	..	Idzu. In Tosa an area of 5,000,000 tsubo sank.
22	686	11	10	..	..	..	..	..	
23	687	1	9	I	10	12	14	..	Nanto. Shock from west.
24	690	12	13	..	7	11	19	..	
25	692	12	..	..	..	..	..	..	
26	701	5	6	I	24	3	1	Daihô	Tamba, 3 days shaking.
27	707	7	8	I	5	6	4	Keiun	Nanto.
28	788	7	1	..	..	..	..		
29	715	6	30	I	25	5	1	Reiki	Tôtômi.
30	..	7	31	II	23	6	1	..	
31	734	5	14	II	7	4	6	Tembio	Nanto (wide spread)
32	744	1	26	..	7	1	16	..	Nanto and Mino.
33	774	6	19	II	..	5	16	..	Higo.
34	744	7	17	..	..	..	..		
35	745	2	15	..	..	..	..		
36	745	6	5	II	..	..	..	....	[hours. Mino. Shaking for 60

Number	European Date			Intensity	Japanese Date				
	Year	Month	Day		Day	Month	Year		
37	745	6	22	..	18	5	17	Tembio	
38	762	5	30	II	3	5	6	Tembio-hôji.	Hida, Mino, Shinano.
39	797	9	9	..	14	8	16	Yen-riaku	Kioto.
40	806	..	..	..	..	..	..	....	Sarusawa in Nanto.
41	807	6	14	I	..	5	2	Daido	Kioto.
42	807	7	12	..	..	..	..		
43	818	8	10	II	..	..	..	...	Sagami, Musashi, Hitachi, Kôtsuke, Shimo-tsuke.
44	818	8	7?	..	..	7	9	Kônin	
45	827	8	7	II	12	7	4	Tenchô	Kioto.
46	827	8	30	..	5	8	4	..	
47	827	9	25	..	1	9	4	..	
48	827	10	25	..	2	10	4	..	
49	827	12	7	..	15	11	4	..	During the intermediate days there were many severe shocks.
50	827	12	23	..	2	12	4	..	
51	828	2	23	II	5	2	..	..	Kioto. On several of the intermediate days there were severe shocks.
52	..	3	22	..	4	3	..	..	
53	..	7	18	..	3	6	..	..	
54	..	12	<sup>2</sup> or 3	..	22	10	5	..	Kioto.
55	829	4	7	I	1	3	6	..	Kioto.
56	830	1	30	II	3	1	7	..	Dewa (Akita &c.) Shakings for 25 days and cracks of from 200 to 300 ft in length were formed.
57	833	3	16	I	24	2	10	..	Kioto.

Number	European Date			Intensity	Japanese Date				
	Year	Month	Day		Day	Month	Year		
58	836	5	7	I	20	5	3	Showa	Kioto.
59	841	3	5 or 7	II	11 or 13	2	8	„	Shinano. In one evening 94 shocks. Felt in Idzu.
60	850	10	5	II	26	8	..	....	Kioto. from N. W.
61	850	11	12	..	..	..	..	....	Dewa.
62	„	11	..	..	..	10	3	Kashô	
63	855	6	22	I	5	5	2	Saikô	Nanto.
64	856	4	9	..	..	..	..		
65	856	4	13	II	..	3	3	„	Kioto, Yamashiro, Ya- mato, Kawachi, Idzu- mi, Settsu.
66	856	4	16	..	8	3	3	Buntoku Tennô	
67	„	5	11	..	..	..	..	„	
68	857	4	9	..	..	..	..	„	
69	857	8	1	I	8	7	..	„	Kioto.
70	863	6	29	II	10	6	5	Jôgan	Etchiu, Echigo, shaking for 2 days.
71	864	11	14	I	12	10	6	„	Kioto.
72	868	7	30	II	8	7	10	„	Harima. Several shocks during the next 13 days.
73	868	8	31	..	10	8	10	„	Harima. Several shocks during the next 19 days.
74	868	9	26	..	7	9	10	„	Harima.
75	869	7	9	II	26	5	11	„	Oshiu, Rikuzen.
76	872	12	28	I	22	11	..	„	Kioto.
77	„	1	4	..	29	11	..	„	Kioto.
78	872	10	10	I	..	9	..	„	Kioto.
79	„	11	8	..	..	..	..	„	
80	873	5	14	I	14	4	15	„	Kioto.
81	875	2	8	I	29	12	16	„	Kioto.
82	875	3	23	I	12	2	..	„	Kioto.

Number	European Date			Intensity	Japanese Date				
	Year	Month	Day		Day	Month	Year		
83	875	3	29	..	18	2	..	Jôgan	Kioto.
84	877	4	27	I	11	3	19	„	Kioto.
85	877	11	2	I	17	10	1	Genkei	Kioto.
86	878	10	28	II	29	9	2	„	Nanto (Sagami, Musashi, Awa, Kadzusa, Shimosa, Hitachi, Kôtsuke, Shimotsuke.
87	879	4	17	I	22	3	3	„	Kioto.
88	879	10	16	..	27	9	3	„	
89	880	5	14	II	2	4	4	„	Kioto, Idzumo. 3 shocks, shaking lasted 7 days.
90	880	6	1	..	20	4	4	„	
91	880	11	9	..	4	10	4	„	
92	880	11	7	..	..	..	..	„	
93	880	1	7	..	4	12	4	„	Idzumo.
94	881	1	28	I	25	12	4	„	Kioto. Many severe shocks during the following 29 days.
95	881	2	8	..	6	1	..	„	Kioto. Several shocks during the next 10 days
96	881	10	15	..	19	9	..	„	Kioto. Shocks for 2 or 3 days.
97	885	5	31	I	14	4	1	Ninwa	Kioto? 2 days after another shock.
98	886	1	28	..	20	12	1	„	Kioto?
99	886	7	20	..	15	6	2	„	Kioto.
100	887	7	24	II	1	7	3	„	Kioto. Next day also shocks.
101	„	7	29	..	6	7	3	„	
102	887	8	22	..	30	7	3	„	Kioto, Settsu, the shaking lasting several hours. For the following 24 days up to the 19th day of the 9th month there were shakings.
103	887	9	15	..	24	8	3	„	
104	888	9	12	..	..	..	..		

Number	European Date			Intensity	Japanese Date				
	Year	Month	Day		Day	Month	Year		
105	902	8	29	I	24	7	2	Yengi	Kioto.
106	934	7	11	II	27	5	4	Shôhei	Kioto, 2 shocks. Shocks on next 2 days and also on the 22d.
107	934	7	17	..	3	6	4		
108	938	5	17	II	15	4	1	Tengio	Kioto. The shaking lasted 14 days.
109	938	7	2	..	3	6	1	„	Kioto. Heavy shock.
110	„	7	19	..	20	6	1	„	Kioto. Heavy shock.
111	938	6	26	..	26	5	..	„	Kioto.
112	939	4	23	II	2	4	..	„	Kioto.
113	940	5	15	..	..	..	..		
114	965	10	18	I	21	9	2	Kôhō	Kioto.
115	965	10	27	..	1	10	2	„	Kioto.
116	968	8	29	II	3	8	1	Auwa	Kioto.
117	972	3	31	..	14	2	3	Tenroku	Kioto.
118	973	10	25	II	27	9	1	Tenyen	Kioto.
119	976	5	12	II	11	4	..	„	Kioto.
120	976	7	17	..	18	6	1	Jôgen	Kioto. Very severe shaking. On the next day 19 shocks and for the next 10 or 11 days there were from 5 to 15 shocks per day, altogether there was much shaking for 3 months.
121	977	2	27	I	4	2	2	„	Kioto, 5 days after much shaking.
122	977	7	14	..	..	..	..		Severe earthquakes continued 300 days.
123	984	12	3	I	8	11	2	Yeikan	Kioto.
124	994	11	29	I	24	10	..	„	Kioto.
125	996	..	..	I	26	..	..	„	Kioto.

Number	European Date			Intensity	Japanese Date				
	Year	Month	Day		Day	Month	Year		
126	1015	11	20	I	6	10	4	Chôwa	Kioto.
127	1015	12	19	I	6	11	4	,,	Kioto.
128	1024	4	21	I	11	3	1	Manju	Kioto.
129	1024	4	28	I	18	3	..	,,	Kioto?
130	1025	12	29	I	..	12	..	,,	Kioto?
131	1026	1	27	..	..	..	..	,,	
132	1027	4	11	..	2	3	4	,,	
133	1032	4	17	..	5	3	5	Chôgen	
134	1040	10	16	I	8	9	1	Chôkin	Kioto.
135	1040	12	13	..	..	..	..		Kioto.
136	1041	8	<sup>7</sup> or 27	I	..	..	..		Owari, Tôtômi.
137	1042	7	7	..	..	..	..		
138	1060	7	18	I	18	6	3	Kôhei	Kioto?
139	1061	5	27	II	6	5	4	,,	Kioto.
140	1065	5	2	I	24	3	..	,,	Kioto.
141	1065	6	13	..	7	5	1	Jireki	Kioto?
142	1070	11	25	II	20	10	2	Yenkiu	Kioto, shaking lasted 3 days.
143	1091	9	22	II	7	8	5	Kanji	Kioto.
144	1092	12	11	I	10	11	..	,,	Kioto?
145	1093	3	11	II	14	2	..	,,	Kioto.
146	1096	12	8	II	21	11	..	Yeichô	Kioto?
147	1096	12	11	..	24	11	..	,,	
148	1096	12	24	II	7	12	.	,,	
149	1097	1	6	..	20	12	..	Jôtoku	
150	1099	2	16	II	24	1	..	Kowa	Kioto.
151	1103	6	29	I	22	4	..	,,	Kioto, a few shocks [afterwards.]



Number	European Date			Intensity	Japanese Date				
	Year	Month	Day		Day	Month	Year		
152	1103	6	7	..	1	5	..	Kowa	
153	1111	5	6	I	27	3	..	Tenyei	Kioto.
154	1135	5	2	I	18	3	..	Hôen	Kioto.
155	1137	8	3	I	15	7	..	„	Kioto.
156	1155	9	3	I	5	8	..	Kinju	Kioto.
157	1164	3	19	I	26	2	..	Chôkan	Kioto.
158	1169	1	28	I	29	12	..	Kaô	Kioto.
159	1176	5	18	I	8	4	..	Augen	Kioto.
160	1177	6	6	..	..	..	..	Jishiô	
161	1177	11	19	I	27	10	..	„	Kioto.
162	1177	12	2	..	..	..	..	„	
163	1179	12	7	I	7	11	..	„	Kioto.
164	1183	10	31	I	14	10	..	Juyei	Kioto.
165	1184	2	5	..	22	12	..	Gen-riaku	Kioto.
166	1185	7	18	II	20	6	..	Bungi	Kioto.
167	1191	7	<sup>8</sup> / <sub>9</sub>	..	<sup>8</sup> / <sub>9</sub>	<sup>7</sup> / <sub>7</sub>	..	Kenkiu	Kioto. Shaking lasted 3 months.
168	1187	11	13	..	12	10	..	Bunji	
169	1187	11	20	I	..	..	..	„	Kioto.
170	1194	12	19	I	27	8	..	Kenkiu	Kioto.
171	1213	6	11	I	21	5	1	Kempô	Kamakura.
172	1215	9	16	II	21	8	3	„	Kamakura.
173	1215	9	30	..	6	9	3	„	Kamakura. For 10 days after there were shak-
174	1224	5	27	I	8	5	..	Gennin	Kioto. [ings.
175	1234	10	10	I	16	9	..	Bun-riaku	Kioto.
176	1235	5	1	II	13	4	..	Katei	Kioto.
177	1235	5	16	..	28	4	..	„	Kioto.

Number	European Date			Intensity	Japanese Date				
	Year	Month	Day		Day	Month	Year		
178	1237	6	24	I	1	6	..	Katei	Kioto.
179	1241	3	20	II	7	2	2	Ninji	Kioto? 5 strong shocks.
180	1245	6	20	I	25	5	..	Kwan-gen	Kioto, and on the 3 following days. Kioto.
181	„	7	3	..	8	6	..		
182	„	8	19	..	26	7	..		Kioto.
183	1247	1	13	I	5	20	..	Hôji	Kioto.
184	1254	7	4	..	..	..	..	Kenchô	Kioto.
185	1254	7	5	I	19	5	6	„	Kioto.
186	1257	8	28	..	..	..	..	Shôka	
187	1257	10	1	II	23	8	1	„	Kamakura. Many cracks formed in the earth. From some of these blue flames came out.
188	1257	10	19	..	..	..	..	„	
189	1268	6	15	I	4	5	..	Bunyei	Kioto.
190	1293	5	24	..	..	..	..	Yeinin	
191	1293	5	20	II	13	4	1	„	Kamakura, 30,000 people were killed. Kioto and Ôsaka, 10,000 people were killed.
192	1299	5	25	II	25	4	1	Shôan	
193	1302	6	1	I	5	5	..	Kengen	Kioto.
194	1305	4	3	I	9	3	..	Kagen	Kioto.
195	1317	2	21	II	..	..	..	Bumpô	Kioto.
196	„	3	21	..	..	1	1	„	Kioto.
197	1317	4	15	..	3	3	1	„	Kioto.
198	1324	11	26	II	..	11	1	Shôchiu	Ômi.
199	„	12	24	..	..	..	..		
200	1331	7	28	II	3	7	1	Genkô	Kishiu.
201	1331	8	19	..	..	..	..	„	Part of the peak of Fuji-yama fell in.
202	1334	9	25	..	27	8	1	Kembu	

Number	European Date			Intensity	Japanese Date				
	Year	Month	Day		Day	Month	Year		
203	1335	1	8	..	13	12	1	Kembu	
204	1338	8	5	I	19	7	1	Rekiô	Kioto, 3 days after a second shock.
205	1350	6	28	I	23	5	..	Kannô	Kioto.
206	„	8	5	..	2	7	..	„	Kioto.
207	1351	3	15	I	19	2	2	„	Kioto.
208	1351	4	13	..	17	3	2	„	Kioto.
209	„	5	7	..	11	4	2	„	Kioto.
210	1356	7	30	I	3	7	..	Yembun	Kioto.
211	1358	10	7	II	4	9	..	„	Kioto.
212	1360	7	22	II	..	6	5	„	Shaking lasted 12 days. A sea wave rose on the Island of Awajima. Shaking continued for many days.
213	„	8	20	..	..	..	..		
214	1361	7	22	..	20	6	1	Kôan	Kioto.
215	1362	6	9	I	17	5	..	Jôji	Kioto.
216	1369	8	29	I	27	7	..	Ôan	Kioto.
217	1376	5	14	I	25	4	..	Yeiwa	Kioto.
218	1377	6	6	..	..	..	..	„	
219	1391	11	11	I	15	10	..	Meitoku	Kioto.
220	1402	2	..	II	..	..	9	Ôyei	Severe earthquakes.
221	1403	1	..	..	..	..	..	„	
222	1403	8	6	..	..	..	..	„	
223	1406	1	..	I	..	1	..	„	Kioto.
224	„	2	27	..	..	..	..	„	
225	1407	2	12	I	5	1	..	„	Kioto.
226	1407	3	1	..	..	..	..	„	

Number	European Date			Intensity	Japanese Date				
	Year	Month	Day		Day	Month	Year		
227	1408	4	1	..	..	..	..	Ôyei	
228	1410	2	24	I	21	1	..	„	
229	1411	3	1	..	..	..	..	„	
230	1411	4	1	..	..	..	..	„	
231	1419	10	28	II	..	1	26	„	Sagami, Musashi, Awa, Kadzusa, Shimosa, Hitachi, Kôtsuke, Shimotsuke.
232	„	11	26	..	..	..	..	„	
233	1423	4	20	I	..	3	30	„	Kioto.
234	„	5	18	..	..	..	..	„	
235	1425	12	14	I	5	11	..	„	Kioto, 3 shocks.
236	1432	10	10	II	16	9	4	Yeikio	Kioto?
237	1433	5	29	II	11	5	5	„	Kioto and Kamakura.
238	„	10	29	..	16	9	..	„	Kamakura and Kioto. In 24 hours 30 shocks. Movements for 20 days.
239	1434	12	13	..	..	12	..	„	
240	1434	11	16	..	..	..	..	„	
241	1435	1	9	II	..	..	.	„	
242	„	2	7	..	..	..	..	„	Kamakura?
243	1440	10	3	I	8	9	12	„	Kamakura?
244	1442	3	1	I	21	1	..	„	Kioto.
245	1443	6	7	I	..	6	..	„	Kioto?
246	„	8	4	..	..	..	..	„	
247	1444	5	14	I	27	4	..	„	
248	1448	..	.	I	..	..	..	„	Three times large earthquakes.
249	1449	5	7	II	10	4	1	Hôtoku	Kioto. Shaking lasted 4 or 5 days.

Number	European Date			Intensity	Japanese Date				
	Year	Month	Day		Day	Month	Year		
250	1453	9	15	I	13	8	..	Kôtoku	Kioto. Shaking lasted 3 days.
251	1454?	..	..	I	10	..	..	„	Kioto.
252	1456	2	6	I	30	12	1	Kôshô	Kioto.
253	1460	2	3	I	..	2	1	Kanshō	
254	„	3	31	..	..	..	..	„	
255	1460	11	19	..	7	10	..	„	Kioto?
256	1467	2	3	I	29	12	1	Bunshō	Kioto?
257	1493	11	18	I	..	..	..	Meiō	Kioto.
258	1493	11	17	..	..	10	2	„	
259	1494	6	10	..	7	5	3	„	Kioto.
260	1495	9	14	..	15	8	3	„	
261	1495	9	12	I	..	..	..	„	Kamakura.
262	1496	9	25	..	..	..	..	„	
263	1498	6	30	II	11	6	7	„	All Japan.
264	„	9	5	..	19	8	7	„	Many shocks. Heavy sea waves came in on Ise and Kii.
265	1510	9	10	II	7	8	7	Yeishō	Kioto, Yamashiro, Mikawa, Yamato, Kawachi, Idzumi, Settsu.
266	1510	10	1	..	28	8	7	„	In Totomi a piece of land more than 2 miles long was washed away. 10,000 lives were lost.
267	1511	9	9	..	..	..	..	„	Settsu. Shaking for 25 days.
268	1512	9	23	I	..	..	..	„	Kioto.
269	1512	6	21	..	..	6	9	„	
270	1514	5	2	I	8	4	11	„	Kioto.
271	1533	3	6	I	13	3	..		Kioto.
272	1545								

Number	European Date			Intensity	Japanese Date				
	Year	Month	Year		Day	Month	Year		
273	1556	3	22	I	..	..	..	....	Kioto.
274	„	3	19	..	..	2	2	Kôji	
275	1557	7	5	I	..	7	..	...	Kioto.
276	„	9	2	..	..	..	..		
277	1586	2	8	II	19	11	13	Tenshō	Kioto. Shaking lasted 100 days.
278	1589	3	17	II	..	2	17	„	Suruga, Totomi.
279	„	4	14	..	..	..	..		
280	1595	8	17	..	12	7	..	....	Kioto, Yomashiro, Yamato, Omi, Tamba, Kawaji, Settsu, 9 days previously there had been shaking.
281	1596	8	5	II	12	7	1	Keichō	Kioto and Ōsaka. Many cracks in the ground.
282	1605	winter	..	..	..	..	..	„	
283	1614	11	28	I	25	10	19	„	Kioto.
284	1618	3	..	..	..	..	..	....	Eastern provinces.
285	1627	2	26	I	11	1	4	Kanyei	Kioto.
286	1628	2	6	..	..	..	..	„	
287	1629	1	24	I	..	..	..	„	Kioto? Shocks.
288	1633	2	28	II	20	1	10	„	Odawara.
289	1647	6	15	II	13	5	4	Shōhō	Yedo.
290	1648	6	13	II	22	4	1	Keian	Hakone.
291	1649	3	17	II	5	2	2	„	Idzu.
292	„	7	29	..	20	6	2	„	Yedo.
293	1650	4	23	I	23	3	3	„	Sagami, Musashi, Awa, Kadzusa, Shimosa, Hitachi, Kotsuke, Shimotsuke.
294	1662	6	16	II	1	5	2	Kambun	Kioto, Ōmi.
295	„	12	11					„	

Number	European Date			Intensity	Japanese Date				
	Year	Month	Day		Day	Month	Year		
296	1663	12	9	..	..	11	2	Kambun	
297	„	6	7	..	..	..	..	„	
298	„	8	27	II	25	7	3	„	Matsumaye (Yezo).
299	1664	1	4	..	6	12	3	„	Kioto.
300	1665	2	11	II	27	12	4	„	Yechigo.
301	1683	..	..	..	..	..	..	...	Yedo and Shimotsuke.
302	„	..	..	..	..	..	..	....	Ôsumi.
303	„	6	16	II	22	5	3	Tenwa	Nikkô and Yedo.
304	1684	5	19	..	..	..	..	....	Nikkô and Yedo.
305	„	11	..	..	..	..	..		
306	„	12	..	..	..	..	..		
307	1694	6	19	II	27	5	..	....	Akita and Dewa.
308	1703	12	30	II	22	11	16	Genroku	Yedo, Odawara, Sagami, Musashi, Awa, Kadzusa, Shimosa, Hitachi, Kôtsuke, Shimotsuke. It lasted 200 days. In Awa, 100,000 persons were killed.
309	1704	9	2	..	4	8	..	Hôyei	Yedo. A large sea wave.
310	„	12	19	..	..	..	..	„	Eastern provinces. Earthquakes lasted 200 days.
311	1706	10	21	I	15	9	3	„	Yedo?
312	1707	10	28	II	4	10	..	....	Tôkaidô. Heavy earthquake, sea wave, eruption of Fuji.
313	„	7	17	..	18	6	..	....	Sarugamata.
314	„	11	15	..	..	..	..	....	Ôsaka. Heavy earthquake and sea wave.
315	„	11	27	..	4	11	..	....	Ôsaka, Kii, Mikawa, Tôtômi, Ise.
316	1723	12	17	I	20	11	8	Kiuhô	Kiushiu.
317	1725	10	30	II	25	9	10	„	[shocks. Nagasaki. In 24 hours 80

Number	European Date			Intensity	Japanese Date				
	Year	Month	Day		Day	Month	Year		
318	1726	4	1	II	29	2	..	Kiohō	Yechizen.
319	„	4	20	..	19	3	..	„	Yechizen.
320	1727	5	9	..	..	..	..	„	Yechizen.
321	1733	11	2	..	..	..	..	„	Nagasaki.
322	1751	3	24	II	25	4	..	Hōreki	Kioto. Shocks from Feb. 26 to Sept. 19.
323	„	5	20	..	25	4	..	„	Yechigo. 30 shocks in 1 night, and 16,300 people were killed.
324	1752	4	13	..	..	..	..	„	Kioto.
325	„	6	7	..	..	..	..	„	Yechigo, Takata.
326	1756	8	25	I	30	7	6	„	Ōmi.
327	1766	3	6	II	28	1	3	Meiwa	Ōshiu, Awomori and Suruga.
328	1771	6	14	I	2	5	..	„	Yedo.
329	„	7	13	..	2	6	8	„	Yedo.
330	1782	8	22	II	14	7	2	Temmei	Yedo.
331	„	8	23	..	15	7	2	„	Yedo and Odawara. Next day 16 shocks.
332	„	9	14	..	4	8	2	„	Yedo, sea wave.
333	1783	3	4	I	2	2	3	„	Yedo. Eruption of Asama.
334	„	9	..	..	..	..	..	„	Eastern provinces.
335	1792	3	23	I	..	2	4	Kuansei	Hizen. Many cracks in the ground, and hot water came out.
336	„	4	20	..	..	..	..	„	
337	1794	2	..	..	..	..	..	„	
338	„	11	25	I	3	11	..	„	Yedo.
339	1803	12	28	II	15	11	3	Kiowa	Sado.



Number	European Date			Intensity	Japanese Date				
	Year	Month	Year		Day	Month	Year		
340	1804	7	7	II	..	6	1	Bunka	Dewa. During the month there were many shocks. Cracks were formed in the ground and muddy water came out.
341	1804	8	5	..	..	..	..	..	
342	1805	..	..	..	..	..	..	..	Dewa. Same as above.
343	1809	4	5	II	21	2	6	..	Shinshiu. Lasted for 3 days.
344	..	4	8	..	24	2	6	..	
345	1810	2	4	I	1	1	7	..	Sado. Lasted for 3 days.
346	1812	12	7	II	4	11	9	..	Yedo, Kanagawa.
347	1819	8	2	II	12	6	2	Bunsei	Kioto, Ise, Mino.
348	1822	2	7	..	16	1	5	..	Ôshiu and Yezo. 150 shocks were counted.
349	..	2	10	..	19	1	5	..	Ôshiu and Yezo. 150 shocks were counted.
350	..	7	29	II	12	6	5	..	Ômi.
351	1823	7	19	..	..	..	..	..	Kioto and Ôsaka.
352	1828	12	18	II	12	11	11	..	In Yechigo. 30,000 people died and sea wave came in on Kiushiu.
353	1830	8	19	II	2	7	1	Tempô	Kioto. The shaking lasted 2 months,—sometimes there were 2 or 3 shocks per hour.
354	1831	8	9	..	..	..	..	..	Kioto.
355	1834	2	..	..	..	..	..	..	
356	1835	2	..	II	..	..	..	..	Fujiyama shaking.
357	..	7	21	..	26	6	..	..	Rikuzen and Rikuchiu. —Sendai, sea wave.
358	1847	5	8	II	24	3	4	Kôkwa	Shinshiu Zenkôji. 2,700 persons were killed.
359	1848	4	27	..	..	..	..	....	Shinshiu, Zenkôji.
360	1853	3	11	I	2	2	6	Kayei	Odawara (Sagami).

Number	European Date			Intensity	Japanese Date				
	Year	Month	Year		Day	Month	Year		
361	1854	12	23	II	4	11	1	Ansei	Shikoku, Suruga, Totomi, Mikawa, Ise, Iga, Settsu, Inaba, sea wave.
362	1855	11	11	II	2	10	2	„	Yedo.
363	„	7	27	..	..	..	..	„	Ise, Nanto.
364	„	12	13 <sup>2</sup> <sub>12</sub>	..	..	..	..	„	Yedo, Ôsaka, Ise, Kii &c.
365	1866	3	12		28	1	..	Keiô	Harima and Tamba.
366	1872	3	13	II	5	2	5	Meiji	Iwami, Inaba, Hôki.

NOTE. All earthquakes for which no locality is given, from the manner in which they are recorded, probably occurred at Kioto. Those for which no intensity is given are earthquakes about which there is no written description. Here intensity is reckoned as I.

Having seen the enormous work which has been done by Mr. Mallet in gathering together earthquake records from all countries and then having read the interesting results and deductions which he has drawn from them, it becomes difficult to effect an escape from the conclusion which he has expressed, near the end of his report on the facts and theory of earthquake Phenomena (see Report of British Association 1858. p. 104) namely "that a further expenditure of labour in earthquake catalogues of the character hitherto compiled and alone possible from the data to have been compiled, is now a waste of scientific time and labour."

It was therefore with considerable doubt lest I should only be collecting useless materials that I worked when compiling the above catalogue. However since completing the catalogue several features have shewn themselves so prominently that I now venture to present them to those interested in seismic phenomena.

### *I. The Occurrence of Earthquakes in relation to the Seasons.*

The following table No. I has been drawn up in a similar manner to those given by Mr. Mallet in his report on earthquakes to the British Association in 1858. It shows the distribution of earthquakes in various months and seasons during the centuries in which they occurred. As a result it will be seen that the greatest number have been recorded for June & July and the smallest number in January and April, whilst the number during the summer months greatly exceeds the number for the winter months.

As this latter result is antagonistic to the general result obtained by Mr. Mallet when examining the records of the chief seismic areas of the world, I append a second table compiled from Mr. Mallet's results for purposes of comparison.



TABLE II.

OCCURRENCE OF EARTHQUAKES IN VARIOUS DISTRICTS WITH REGARD TO SEASONS.

	1	Japan.	
	2	Scandinavia and Iceland.	
	3	British Isles and Northern Isles.	
	4	Spanish Peninsula.	
	5	Belgium, France and Holland.	
	6	Rhone Basin.	
	7	Switzerland and Rhine Basin.	
	8	Danube Basin.	
	9	Italy, Sicily, Sardinia and Malta.	
	10	Supplemental table to column 9.	
	11	Algeria and Northern Africa.	
	12	Turco-Hellenic Territory, Syria, Aegen Isles and Levant.	
	13	United States and Canada.	
	14	Mexico and Central America.	
	15	Antilles.	
	16	Cuba.	
	17	Chili and La Plata Basin.	
	18	Northern Zone of Asia.	
Winter Months	165		
Summer Months	188		

Looking at this latter table we see that in Mexico and Chili the same number of earthquakes have been observed in summer as in winter. Whilst in the remaining 16 localities if we except Japan, the Turco-Hellenic district and the Antilles there have been in the 13 districts which remain, more earthquakes during the winter months than during the summer. This is to say that out of 18 seismic areas there are five exceptions to the rule that earthquakes are more frequent in winter than they are in summer.

No doubt as has already been pointed out in Mr. Mallet's report this may in part be due to the varying position of the earth with regard to the sun, during these seasons. As one of the consequences of this varying of position there is a change in barometric pressure, the pressure being less in summer than in winter and the greater differences in pressure being observed in low latitudes.

Now if we look at the exceptions to the rule it will be observed that they are one and all countries which lie in comparatively low latitudes, whereas 8 of the areas (viz. Iceland and Scandinavia, Britain, Belgium and France, the Rhine basin, Switzerland, the Danube basin, the United States and Canada, the Northern Zone of Asia), out of the 13 districts which follow the rule, lie in comparatively high latitudes when the change in pressure is not so great between the seasons and therefore where the difference in barometric pressure between winter and summer is not so observable.

This would seem to indicate that it is not to variations in atmospheric pressure or greater heat upon the surface of our globe towards which we must look in order to explain why more earthquakes have been observed in winter than in summer.

As an explanation of this phenomena I should be inclined to think that the reason of our finding more earthquakes during the winter months than there are during the summer months in the records from the particular countries instanced, rather than being due to some ill understood connection between our planet and the sun, might in part be attributed to a want of observation in summer time as compared with winter time.

In countries in latitudes like the eight I have mentioned and I think I might add Italy and Spain, during the summer months as compared with the winter months the inhabitants probably spend a large portion of their time out of doors. The further north we go the more noticeable does this become.

In Iceland I have seen people making hay at almost midnight. This being the case, many earthquakes which would have been felt had the people been in doors pass by unnoticed. In Japan from my experiences this is remarkably the case.

From this I should say that in the records of 10 out of the 13 areas which follow the rule we ought naturally to expect to find that the records for the winter months exceed the summer months.

Of the remaining 8 districts which are all in low latitudes where people live as much out of doors at one season as the other, we ought not to expect to find any particular rule with regard to season. And if we look at them we shall see that such is the case.

In Japan, the Turco-Hellenic Territory, and the Antilles there are the greater number in summer.

In Chilli and Mexico the number in summer and winter is equal.

In Spain, Algeria and Cuba the greatest number of records are in winter.

As a further confirmation of this supposition if we take the 13 districts apparently following the winter rule, and compare together only those earthquakes which occurred say previously to the 18th century which was a time when people were in all probability more out of doors than they even are at present we shall find that for the Rhine basin and for the supplemental table to the Italian earthquakes that instead of being the greater number of earthquakes in winter there were the greater number in summer. The rule is in fact inverted and the further we go back to times when large cities were scarce and people were more out of doors than they are at present, the less and less striking becomes the deduction that more earthquakes have occurred in winter than in summer, until at last if we take the sum total of all the earthquakes which have

been recorded for Europe, the adjacent parts of Asia and of Africa during and previous to the 7th century we find that the greater number occurred in summer and not in winter.

It may be objected that all the records are those of severe earthquakes and therefore that they would be noticed as much by persons out of doors as by persons in doors. This however unless we have proof of the effects they produced is difficult to substantiate. For my own part I find that earthquakes occur which if I am in doors appear to be alarmingly severe and which have been sufficiently intense to swing pictures and cause the whole house to rattle violently, whilst the same disturbances have not been noticed by those who were out of doors.

These remarks have been made not because I am disinclined to believe in the general results which Mr. Mallet has arrived at, but simply for the purpose of showing that objections to his results are a possibility and that before his conclusions can be fairly established it will be necessary for us to collect together a large series of records from various countries which records have been made instrumentally. So far as careful observation of small shocks has gone during the past few years, in countries like Japan, New Zealand and Peru it would seem that earthquakes are more numerous during the winter or cold months of the year, and that Mr. Mallet's conclusions are therefore probably correct. By winter in New Zealand and Peru I here mean the months which in Japan are summer.

## *II. General distribution of Seismic Energy with regard to time.*

Amongst the more important results which Mr. Mallet has pointed out are perhaps those relating to the distribution of seismic energy in time and space. If we look over the many tables which Mr. Mallet gives showing the periodicity of earthquakes in various countries or the general table showing the periodicity of them when gathered together as a curve of total energy it would seem that almost everywhere seismic



energy has been upon the increase especially during the last three centuries.

Our knowledge of terrestrial physics would lead us to an opposite conclusion, and we should expect that seismic energy was dying out rather than increasing. Mr. Mallet points out to us that such expectations are probably correct ones, and that the rapid increase in the number of earthquakes in later years is due to the greater number of observations which have been recorded whilst the apparent absence of earthquakes in early-times is due to an absence of their records,—in fact records of earthquakes have increased with the advancement of mankind.

Mr. Mallet from his evidence therefore concludes that there has been a uniformity in the occurrence of earthquakes, a view which is as he himself observes contradictory to the evidence.

Mr. Mallet even goes further in opposition to his evidence and suggests that if we could only see back beyond the limit of man's history, seismic energy might be found to be a slowly decreasing force.

When we consider that Mr. Mallet has brought together a series of observations commencing 2000 years before the Christian era, that we shall ever be able to push our observations back to periods much earlier seems hopeless, and therefore from what Mr. Mallet has done it would appear hopeless to deduce any direct proof of this decadence which we so naturally expect.

In the case of Japan however I think we have an example which very fairly demonstrates these expectations.

In order to examine the results given in the above catalogue I have gathered them together in the following table in a manner similar to that given by Mr. Mallet.



In the second column of this table will be seen the number of earthquakes which have occurred in Japan during each century, the centuries being marked in the first column. In columns 3 to 18 inclusive are given the number of earthquakes which have occurred during different centuries in the various countries and districts mentioned at the head of each column. These which are extracted from Mr. Mallet's Report are given for the sake of comparison with the Japanese earthquakes. If we commence with the 7th century in the column for Japan we see that a great increase in the number of earthquakes as we come towards the present time is not so observable as it is in all the other columns.

The explanation for this probably lies in the fact that Japan has practiced civilized arts for a longer period than many of the European and other countries mentioned in the table.

If we remember that whilst many countries were in a state of semibarbarism Japan was probably almost as far advanced as she is at present and that writing was practiced at an early age, the explanation of this is apparent, or in short, records were kept in Japan whilst none were kept in many parts of Europe.

In Japan no doubt the records of later years have been more perfect than they were in early times, but this although so potent an effacer of what was probably the true state of natural phenomena in the case of Europe, has not quite obliterated the truth in Japan, for instead of an apparent increase of seismic energy since early times, it shows a slight decrease.

To draw up a table of Earthquakes such as the one which has just been given and then after the inspection of it to draw conclusions as to whether there has been an increase or decrease in seismic energy, although similar to that which had been done by previous writers, is hardly a just method of reasoning. The earthquakes which are mentioned are for the whole of Japan, and represent a collection of places some of which are 1000 miles apart. When we consider that many earthquakes which occurred at one end of this line were never felt at the other, in order to justly estimate the periodicity of seismic

phenomena it would seem that we ought either to take some particular seismic area or else the whole world.

In the catalogue that I have given, it will be observed that the greater number of Earthquakes are recorded for the following five places, Nara, Kioto and Osaka (which are close together,) Kamakura and Yedo. The reason for this probably lies in the fact that these five places were successively made the capital of Japan. Kioto become the capital about 791. Kamakura about 1063 and Yedo in 1592.

As Yedo only became an important place, about the end of the 16th century, before this date we can not expect to find many records. Similar remarks apply to Kamakura and Kioto.

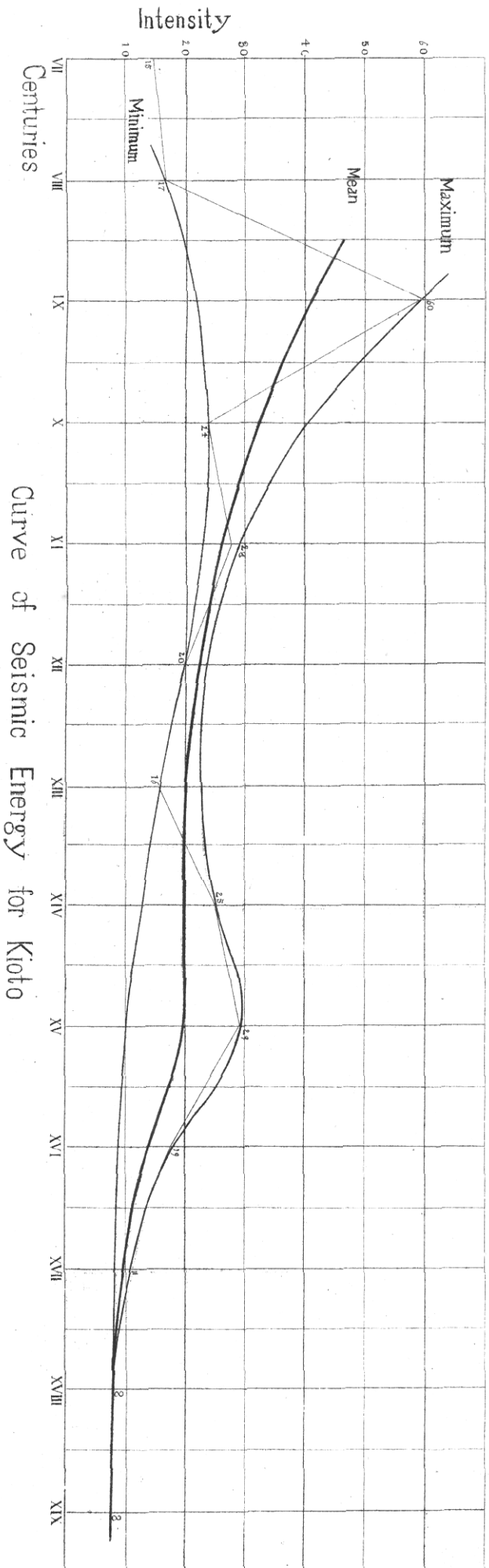
However as Kioto and Nara are situated in the same district, any of the recorded earthquakes, which as has already been pointed out, are chiefly the large ones, which affected the one must surely have affected the other. As we have the greatest number of records given for Kioto, I have taken this place and the surrounding district as representing a seismic area.

I have also attempted to give some weight to the relative intensities of the earthquakes, giving as I have explained before, a double value for those which are recorded in detail.

Adding up the various observations for the Kioto district, in this way I obtain values for the seismic energy in this region since the 7th century.

In order to show the variation in seismic activity of this district I have plotted a curve (see accompanying plate) with ordinates equal to the values given for the Kioto earthquakes during succeeding centuries. The upper points of this ascending and descending line are joined by a free curve. The lower points are similarly joined. The points of bisection of ordinates drawn between these two curves are taken as points in a curve to show the true secular change in seismic energy.

By looking at the wavy line it will be seen that the intervals between maxima and minima are closer together in early times than they are in later times.



Thus between the VIII century and the XI century, points of maximum and minimum seismic efforts occurred at times a century apart. Whilst later on from the XI to the XV century they were at intervals of 300 years apart.

With a wavy line representing the distribution of energy at intervals of  $33\frac{1}{3}$  years apart, a similar result was shown.

From 666—933, the intervals were  $33\frac{1}{3}$  years.

933—1460, the intervals were generally 66 years apart, only a few being 33 years.

1460—1800th, the intervals were 133 years, 100 years, a few  $66\frac{2}{3}$  years and the rest  $33\frac{1}{3}$  years apart.

By plotting the earthquakes for all Japan in periods of 50 years, the same general result was obtained, namely that the intervals between points of maximum intensity during the last 1200 years, have in a most decided manner, become farther and farther apart.

By looking at either the wavy line or the resultant curve it will be seen that since the IX century down to the present time there has been a decided decrease in seismic energy. From the IX century down to the XV century this decrease is represented by a regular curve. At this point however the decrease became slightly more rapid and is represented by a second curve.

Numerically, as taken from the plate the decrease from the IX century to the present time may be represented by the following numbers.

Century		Century	
IX	17.5	XV	6.75
X	13.5	XVI	3.75
XI	10	XVII	1.75
XII	8	XVIII	1
XIII	7	XIX	1
XIV	6.75		

From this it appears that the rate at which seismic energy decreased during the last 500 years was about the same as that at which it decreased during 500 years previous to this period.

If the lists for the Italian and Turco-Heilenic districts which I have quoted from Mr. Mallet, could be similarly analysed and the earthquakes of any particular district picked out from the others, it is very probable that a similar decrease in seismic energy might be observed. For other countries however, like England, France or Spain I do not think that we could hope to obtain any such result.

When a body is heated to a high temperatures its rate of cooling is at first extremely rapid but subsequently becomes less and less. Now the contraction of a body as it cools, is for low temperatures approximately proportional to its loss of heat, and this law is also probably true for contraction as it takes place from high temperatures. Now Japan is a country which is full of volcanos and in consequence is extremely hot and consequently the changes which are dependent upon loss of heat are in consequence very rapid as compared with a country like France or England where visible volcanic energy has for so many years been extinct.

In the former country volcanic energy and consequently seismic energy with which it is so often associated, is at a stage when its fluctuations are well marked, whilst in the latter countries they have settled to a state of constancy.

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*If instead of calculating ordinates for my curve in which intensity has been considered, simply the number of Earthquakes which I have given are counted, a very similar result will be obtained, and it may also be remarked that a curve for the Earthquakes of the whole of Japan, shows characters very markedly, like those of the Kyoto curve.*