

A NOTE ON OLD CHINESE EARTHQUAKES.

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Although China is not noted for its volcanoes, yet parts of it are subject to frequent and violent shakings. In Japan, earthquakes occur much oftener on the Pacific than on the Japan Sea side. Of the destructive ones recorded in Japan, about 57 per cent. took place on the Pacific side, 28 per cent. on the Japan sea side, and the remaining 15 per cent. in the central regions of the country. There is no peculiarity of a similar kind in the earthquake distribution of China, the activity being greater in certain interior provinces than along the coast, though near the latter we have a chain of active volcanoes extending from the Kuriles to the Philippines.

In Vol. X. of the *Trans. Seis. Soc. of Japan*, there is a paper on Earthquakes in China, by Dr. Macgowan. It is a great misfortune that his original catalogue of Chinese earthquakes was destroyed by fire during a riot, as such compilations are by no means easy to obtain. It is certainly difficult in this country to obtain the necessary materials, and I have succeeded in collecting from histories and chronicles only those shocks which happened previous to 1644, the year of the downfall of the last Min dynasty. Altogether these amounted to 908 shocks or groups of shocks. Although nearly all of these have their precise dates given, I shall not make a statistical classification with regards to seasons, etc., as such work is not likely to give interesting results. Of these about 400 were at the capitals of the former dynasties and were probably small.

The number of earthquakes recorded increases as the time approaches the present, but, in the case of China, we must also remember that it was only since the Ghen and Min periods that the empire assumed the extent it has now-a-days. The old Chinese believed in the super-natural or moral causes of earthquakes, and the old records of earthquakes are almost invariably accompanied with notices of contemporaneous outbursts of wars, bad actions or deaths of emperors or other great personages, changes of dynasties, etc., the idea being to show that they were forerunners or consequences of some political events. In one particular instance, a severe shock occurred about the city of Chōan (now Si-ngn, Shense) on Feb. 22nd, 1128, which was then being besieged. The defenders were struck with panic, and the besiegers, profiting by the moment, captured the city.

Chōkō's seismometer, which is described in one of the old histories and illustrated in Professor John Milne's "Earthquakes," was invented in the year 132 A.D., would seem to show that the Chinese had a distinct conception of earthquake motion, particularly as to the existence of a direction of movements. Many of the shocks are described as having been preceded or accompanied by sounds. These are mostly characterized as being like thunder, and in a few cases, when weak, compared to the beating of drums. Sometimes shocks are stated as having come from certain directions.

Some of the shocks were very extensive,—covering three or four provinces, *i.e.*, about double of whole Japan. The most violent earthquake recorded in Chinese history took place on Feb. 2nd, 1556. This shook the three provinces of Shanse, Shense, and Honan, in which more than 830,000 people were killed. The meizoseismal area was a narrow zone, stretching E.-W., along the river Wei-ho (in Shensē), a tributary of the Hoang-ho, and included the south-western corner of Shense. Ground-cracks were formed and water ejected from them together with mud and fish. At some places the soil was

depressed, carrying down habitations and castles, whilst, at others it was contorted into mounds and hills, and roaring sounds were heard among the mountains. The shock was initiated by detonations like thunders, and shakings continued for many days. It will be observed that this description is similar to that of the Japan earthquake of 1891, which seems to be much smaller than the above. This great shock was not foretold by previous shocks but was followed by disturbances during the next two years. Contemporaneously with this, there was no destructive earthquake in Japan.

Examples of the meizoseismal area occupying an elongated valley tract are not uncommon. Thus, the great earthquake on September 25th, 1303, which shook the province of Shanse and destroyed some 100,000 houses, was in the valley of the river Fuen-ho, a tributary of the Hoang-ho running from north to south. Again, that of August 18th, 1561, which shook the northern portions of the provinces Kansu, Shense, and Shanse, was in the valley of the river Tsing-chooi, another tributary of the Hoang-ho running from south to north. It seems that in such cases the disturbed area was generally extended in direction perpendicular to the meizoseismal zone.

Speaking generally, earthquakes are more frequent in the provinces to the north of the Yang-tze-kiang and in the province of Yünnan at the south-west corner of the empire. Especially the three northern provinces of Kansu, Shense, and Shanse have often been seats of extensive and violent earthquakes. Destructive ones are not uncommon, and of the 395 shocks which happened during the Min period, (1371-1644), there were 50 distinctly stated to have caused destruction of life and buildings. From this we may suppose that a destructive shock will happen on an average every 5 years in one part or other of China. These 50 shocks were distributed as follows: 17 in Kansu; 12 in Yünnan; 2 in Shense; 2 in Shanse; 2 in Szechen; 3 in Shantung; 1 in Chekiang; 1 in Kweichow; 1 in Hoope; and 1 in Shense and western Kansu; 1 in Shense,

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Shanse, and Honan; 1 in Shantung, Pechili, Shanse and Shense; 1 in eastern Kansu, Shense, and southern Shanse; 1 along the coasts of the Pekin Gulf and the Yellow Sea; 4 along the coast of the Pekin Gulf. Thus a destructive shock on an average occurred, during these times, in Kansu every 16 years, and in Yünnan every 23 years. As a matter of fact the shocks did not occur at regular intervals, but were more or less in groups. Now Kansu has been the seat of steady and comparatively uniform seismic activity, and the period seems to recur at rather regular intervals; namely, 11 shocks during the Ghen period and 28 during the Min period, which may fairly be considered as being local to the province. These were grouped as in the following table:—

KANSU.			
Period.	Successive Intervals. Years.	Number of Shocks.	Intensity.
1276	34	2	3
1310	18	4	4
1328	—	5	6
(No earthquake during this interval, probably record wanting).			
1376	64	3	4
1440	36	1	2
1476	22	4	6
1498	44	3	4
1542	23	3	4
1565	33	4	6
1598	28	5	10
1626	15	4	7
1641	—	1	1
Average	32	—	—

In the above list, the "periods" were obtained by taking the means of the years of several shocks which happened within a few years of each other, and the figures representing the "intensity" by summing the corresponding intensities taken as 1 or 2 according to the degree of violence of the shocks, though probably all were severe. No such series of periods recurring after tolerably regular intervals can be observed with earthquakes in other provinces. It might be that the periods, if

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existing, were too long and therefore difficult of being recognized. In the following list are given the numbers and intensities of the shocks essentially local to the three most disturbed provinces of Kansu, Shanse, and Yünnan which happened during the Ghen and Min periods, divided into half-centuries or about:—

	Kansu.		Shanse.		Yünnan.	
	Number.	Intensity.	Number.	Intensity.	Number.	Intensity.
1265-1300	2	3	11	13	0	0
1300-1333	9	10	11	13	2	3
(No earthquake during this interval, or record wanting).						
1371-1400	3	4	9	10	2	2
1400-1450	1	2	0	0	0	0
1450-1500	6	9	4	6	3	5
1500-1550	4	5	5	6	16	24
1550-1600	7	12	4	7	1	2
1600-1642	7	12	5	5	6	7

It will be seen from the above that a maximum of seismic activity occurred in Shanse in the latter part of the 13th and in the 14th, while in Yünnan it occurred in the first half of the 16th centuries. Generally there is no coincidence in times of occurrence of maxima in different parts of China, neither is there any between those in China and Japan. In the latter country, great earthquakes in its different parts sometimes occurred within a few years of each other, so that the whole of Japan may form a single seismic zone, while the northern and the south-western parts of China form distinct seismic regions. The shocks in Yünnan were mostly local. The most disturbed of the coast provinces are Pechili and Shantung, where destructive shocks have sometimes occurred. In the provinces of Chekiang, Fookien, and Kwangtung, shocks were rare, and of the 17 in these provinces which happened during the Min period none are positively stated to have caused destruction of life and buildings. The areas shaken in these cases were mostly along the coast and very rarely extended inland. Probably the origins might have existed in the Formosa Channel, Fookien has been the most frequently disturbed

province of the three. The four interior provinces of Kiangsi, Hunan, Kwangsi, and Kweichow are the least disturbed regions in China.

The city of Nankin was shaken 30 times during 70 years between 345 and 414 (Eastern-Shin period), and about 110 times during 273 years between 1372 and 1644 (Min period), so that as earthquakes happened on the average in these two epochs respectively every 2·3 and 2·5 years. If, however, we count all the shocks in the same year as forming one group, then there were in the same two epochs respectively one group of shocks every 3·5 and 7·5 years on the average. From facts like the above we cannot deduce any conclusion as to the question whether there has been any decrease in the seismic activity during these centuries. But we should be rather inclined to believe that there may have been some such decrease at Nankin, especially considering the extremely turbulent condition of the former epoch. None of these shocks seem to have been destructive, and sometimes it is particularly stated that houses moved and made cracking sounds, etc. In the year 1425, there were 42 shocks in Nankin, and 8 or 10 during each of the two following years. The city of Peking was shaken 88 times during 237 years between 1403 and 1639, or on average there was one shock every 2·7 years. Of these 88 shocks, 12 were severe, though not destructive. The one in 1266 (Ghen period) was sufficiently strong to cause some damage to walls, while another, a few years before, caused (in the vicinity of the city) landslips in mountains and depressions of ground, and many people were killed. Probably the neighbourhood of Peking is more largely shaken than that of Nankin. Thus there were, during 163 years between 1476 and 1638, 18 shocks around the Peking and the Leaoton gulfs, of which 6 were destructive; while there were during 168 years between 1477 and 1644, 21 shocks about the mouth of the Yang-tze-kiang of which only one was destructive. We append

below the numbers of shocks which occurred at some of the older capitals :—

At Rakuyo (now Honan, in Honan), 53 shocks during 103 years (92—194), and 13 shocks during 46 years (269—314).

At Chōan (now Singan, Shense), 36 shocks during 261 years (619—879).

At Rin-an (now Hangchow, Chekiang), 27 shocks during 193 years (1029—1221).

