PAPERS COMMUNICATED

1. *On the Block Movements that Preceded and Accompanied the Severe Tokyo Earthquake of May 21, 1928 — Active Faults Across the City of Tokyo.*

By Akitune IMAMURA, M.I.A.

Seismological Institute, Tokyo Imperial University.

(Comm. Jan. 12, 1931.)

While it is well known that the destructive Kwanto earthquake of 1923 was associated with conspicuous topographic changes in the main block constituting the Kwanto district, it is perhaps not so well known that Tokyo city and neighbourhood underwent similar changes, though on a much smaller scale. The change was a depression having for its centre the eastern side of the Sumida-gawa river (Fig. 1).

That this change was associated with the great 1923 earthquake is evident from the series of precise levels that were repeatedly run over the benchmark routes, which are here laid out more profusely than in any other part of the country; and also from the fact that no earthquake of any great size has occurred in this region and neighbourhood within, say, a circumference with a radius of 40 kms., during the interval between the pre-seismic survey made in 1918 and that made soon after the great earthquake in 1923. There are indications that the change in question is owing, besides the general changes of topography in the Kwanto district, largely to settling of the surface ground as a consequence of the violent earth-shaking at the time; local disturbance of base rock, if there was any, having been so small as to be masked by the changes just mentioned.

Two lines of levels have been run since then, one in the beginning of 1926 and the other in the beginning of 1930, the results of which

Fig. 1.

Figures with — sign indicate subsidence in cm.

the Military Land Survey have kindly placed at my disposal, and from which I find that the changes in land-level that have occurred bear a close relation to the severe Tokyo earthquake of May 21, 1928.

Fig. 2 shows changes that occurred during the 2.3 years that intervened between Nov. 1923 and Jan. 1926, and Fig. 3 those that occurred during the four years from Jan. 1926 to March 1930.

Fig. 2.

Figures with + or - sign indicate height change between Nov. 1923 and Jan. 1926 in cm.

Fig. 3.

Figures with + or - sign indicate height change between Jan. 1926 and Feb. 1930 in cm.

It will be observed that a depression of extraordinary size as compared with the secular variations of land-level hitherto experienced there, occurred during both intervals, and that each exhibit a zone of maximum depression meridionally across the middle of that section of the city lying eastwards of the Sumida-gawa river. That these changes, the later one in particular, indicate subsidence of a particular block, the *Kôtô block*, with faults EE' and FF' as its boundaries, will be seen more clearly from profile diagrams of the change, Figs. 4 and 5.

The earthquake in question, which occurred on May 21, 1928, at 1 h. 29 m., and which caused some damage in the regions bordering the lower courses of the rivers Edo-gawa and Naka-gawa, ranks next in magnitude to the semi-destructive earthquake of Jan. 15, 1924. Its record as obtained at our Institute is as follows: duration of the preliminary tremors 7.8 sec., amplitude and period of maximum motion 21.5 mm. and 1.8 sec., respectively.

The foregoing data, together with observations at Kamakura (d.p.t. 9.6 sec), Misaki (d.p.t. 10.2 sec.), Kiyosumi (d.p.t. 10.3 sec.) and at Togane (d.p.t. 9.2 sec.), give as the epicentre a point at the mouth

Fig. 4.

Fig. 5.

of the Edo-gawa river, some 6 kms. south-east from the centre of the depression above mentioned.

My studies in the subject lead me to the conclusion that this earthquake is in some way related to the change shown in Figs. 3 and 5, the reasons for which are, first, that the topographic changes are too great (max. depression of so much as 56 cm. at bench-mark 3378) to be attributed solely to secular variation usual for this region, which is less than 1.8 cms. per annum even at the bench-mark that underwent

the greatest depression ; and, secondly, that among earthquakes which have occurred in the corresponding period within a distance of 40 kms., the one under discussion stands unique not only in its great size, but also in its proximity to the affected area in question.

It is possible that this earthquake was closely related also to the change shown in Figs. 2 and 4. Here again the change is too great to be regarded as being wholly due to secular variation of the kind usual to this district, although it would be difficult to exclude the last-mentioned as a possible supplemental cause in a small way. Yet, seeing that no earthquake of any considerable magnitude (showing an amplitude at Tokyo of 1 mm.) has occurred in the corresponding period anywhere within 40 kms. of the depressed area in question, the changes might not have been associated with any earthquake of violence, but might have been instead the harbinger of the earthquake of May 21, 1928. This last alternative hypothesis finds some support in the similarity of the change with that which accompanied the 1928 earthquake as previously mentioned, the characteristic feature of the changes shown in Figs. 2 and 4 indicating to a certain extent the pre-seismic strain undergone by *the Kôtô block* and the two adjacent blocks in virtue of the downward stress applied to the central block.

The great Edo earthquake of 1855 might have had its origin in *the Kôtô block* with its active centre slightly northward. As future activities along the above-mentioned faults are highly probable, unremitting attention should be focussed on this zone with the view of finding, among other things, the means whereby Tokyo can be spared from the horrors of another earthquake disaster.