82. Land Deformations in the South-eastern Part of Tōtōmi.

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(Comm. July 12, 1943.)

It is well known that when a destructive regional earthquake occurs in a seabed nearby, certain peninsulas on the Pacific side of Japan tilt sharply with a northerly dip, whereas in the years that intervene between two such earthquakes they tilt slowly with a southerly dip, the magnitude of the tilt being of the order of $10^{-6}$ in the former case and $10^{-7}$ per annum in the latter. What is noteworthy is that during the few years that preceded the Kwantō earthquake of 1923, one of the peninsulas, namely, the Miura peninsula, tilted in a different way, that is to say, with a northerly dip, but slowly at a comparatively large rate. Since the question, whether or not such characteristics are manifested also in peninsular land blocks that lie between the Idu and Kii peninsulas, may be important in investigating the destructive regional earthquakes that originate off the Pacific coast of Tōkaidō, the writer investigated the matter with the present note as the result.

The littoral that joins the two promontories, Onmae-zaki on the east and Irako-misaki on the west, being for the most part, low, flat land, skirted with wide sandy beaches, it does not lend itself readily to estimations of vertical changes in land-level, acute or chronic, when it is less than a metre. Assuming that the mean sea-level has lowered as much as 200 metres, there ought to appear towards the south-eastern corner of the province of Tōtōmi, a peninsula, about 50 km long and 30 km wide, projecting SSE, in good contrast with the Idu peninsula which, under the same assumption, should not increase so much in size (Fig. 1). The land block that forms the south-eastern part of the province of Tōtōmi and which is contiguous with the peninsula just assumed, is for the most part younger Tertiary, the two together forming another Tertiary peninsula on the Pacific side of Japan. It is just this structural and topographic feature of the district that led us to examine it in the same way that was done in the ease of the Bō-Sō, Miura, Idu, Kii, and Muroto peninsulas.

There are two lines of levels available for determining the chronic tilt of the land block in question, one of which links Kakegawa on the south with Iida on the north, via Mori and Akihayama, and the other Okitu on the east with Okazaki on the west, via Siduoka, Kakegawa, and Hamamatsu, B.-M. No. 141 at Kakegawa being the junction. Since the former line was run in 1902 and again in 1933,
and the latter in 1900 and 1931, the interval of time covered by both the earlier and later surveys turns out to be 31 years in each case, although there is a difference of two years at the start. Strictly speaking, the difference of these two years should be taken into account in our study, but in the absence of any active telluric disturbances in the district during that period, they are disregarded (Fig. 2). The tilt has then been worked out from data based on these surveys and relating particularly to bench-marks that are within a distance of 35 km from Kakegawa, it being possible to assume that they are situated on the Tertiary block in question. With Miyabe's method of computation it worked out to a tilt of $3.2 \times 10^{-7}$ per annum, dipping south-eastwards and with the axis passing through Kakegawa or thereabouts. It is likely that the block extends into Onmae-zaki or even farther into the supposed peninsula; there being evidences that land near the promontory subsided as much as 30 or 40 cm during the recent three or four decades of years.

On the other hand, it is likely that the said block underwent northward tilts as direct accompaniments of the regional earthquakes of 1854 and 1707 that occurred respectively off the coast of Ōkaidō and Nankaidō. We have evidences that with the 1854 earthquake the land probably upheaved as much as a metre at Itozawa in Onmae-zaki and Širowa, about 3 km west of it, while at Yokosuka, about 25 km WNW of Onmae-zaki, the total upheaval of land associated with the 1707 and 1854 earthquakes might possibly have exceeded a metre, but not more than two. In the town of Yokosuka, which at present is about 2 km from the sea-shore, and which formerly was a good sea-port, and had possibly ample sea-water even at low tide, it is said that owing to the sea-bottom having arisen as the result of 1707 earthquake, it became no more a port (Fig. 3).

More reliable evidences, however, are furnished by clusters of

tubular perforations noticeable on the face of the Tertiary rocks that stand in front of the sea at Onmae-zaki. The holes were bored by molluscs, of which Lithophaga curta forms the majority. The animals bore these rocks as their abode, for the most part, along the line of mean sea-level, such that when an upheaval takes place accompanying a regional earthquake, zones of such holes rise to be exposed to the air, and withstanding weathering for long periods of time, serve as indicators of former beach lines. At Onmae-zaki, these zones are found at two different heights, one about 50 cm above mean sea-level and the other about 160 cm. The lower zone would indicate the beach line immediately before the 1854 earthquake, and the higher that before the 1707 earthquake. With due allowance for chronic depression undergone since the 1854 earthquake, the upheaval associated with this earthquake works out to 80–100 cm. It thus comes out that the tilts associated with the earthquakes of 1707 and 1854 were respectively of the values as much as $3.7 \times 10^{-6}$ and $(3.4 \sim 2.7) \times 10^{-6}$, had their axes been the same as that of the chronic tilt above mentioned.

It will thus be seen that the littoral of the province of Totomi is very favourably situated for investigating the relation between land deformations, chronic or acute, and the destructive regional earthquakes that occur off the Pacific coast of Tokaidō. For further study, it is naturally desirable, firstly, to extend our lines of levels to as far as

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Onmae-zaki, and secondly, to establish there a mareographic station for systematic observations of sea-level.