

On the Cause of the Tajima Earthquake of 1925

By

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(With Plates I & II.)

On the 23rd of May, 1925, at 11h. 10m. 49s. the boundary district of the two provinces of Tajima and Tango on the coast of the Sea of Japan was visited by a severe earthquake, the damage being particularly heavy near the mouth of the River Maruyama so that in the town of Tsuiyama, lying where the river discharges into Tsuiyama Cove, practically half the number of houses were shaken down while fire destroyed the rest. In the hamlets of Seto, Tai, Kei, Hanya, Kojima and Momoshima earthquake and fire destroyed nearly everything. At Kinosaki, the celebrated spa of this region, all that could be seen remaining were a few ruined houses, fire having consumed the rest.

At Toyo-oka on the upper course of the river, all houses that were on soft, filled-in ground near the railway station were demolished, but of the remaining houses the loss suffered was due to fire rather than the earthquake, the proportion of the total being 65% of the original number so that fire claimed 1383 houses in all. On the other hand losses suffered by the other hamlets in the vicinity were remarkably small. Towards the neighbouring province of Tango, and also at places lying on Kumihama Bay, the losses were quite heavy, but the region that received the severe damage was an area comprised within an imaginary circle of radius 8 km. described with Tsuiyama Cove as centre. This would leave the town of Toyo-oka as an isolated spot outside of the circle, but the reason for the heavy damage to this town has been given at the beginning of this paragraph.

Detailed reports received from the affected districts being in accord with Dr. Imamura's results of observations at the Seismological Institute of the Imperial University, Tokyo, in pointing to the vicinity of the outlet of the Maruyama River as the origin, the writer decided to make field investigations on the spot, and, accordingly, left Tokyo for the scene of the disaster on the 26th of May in company with Dr. Imamura,

Dr. S. Tsuboi and Mr. Suzuki. On the following day we inspected the town of Toyo-oka as well as Kinosaki and environs, while the 28th found us exploring the shores of Tsuiyama Cove and vicinity, where, eventually, on the top of a hill at Tai on the eastern side of the bay, we discovered seismic fault-lines fully exposed to view. The next day, joined by Mr. T. Matuzawa and his party of University students, a thorough examination of this district was made when it was found that there were two parallel fault-lines, and after satisfying ourselves that this was the origin of the present earthquake, we named it the "Tai Fault."

Topography of Tsuiyama Cove and Environ.

This region is hilly land with rhyolitic tuff as its foundation, and volcanic rocks such as rhyolite or basalt as overlying ones. Mt. Kuruidake 560 metres high, to the left of the river, as well as Moriageyama 426 m. high seen rising towards the west of Seto, together with the other neighbouring peaks, are of rhyolite. The region lying on the right of Maruyama River is chiefly tuff, with outcrops here and there of volcanic rocks, the celebrated basalt cave Genbudō on the river bank being a conspicuous example. Along the river bank the heights of the hills scarcely reach 200 m., but as one proceeds eastwards they suddenly increase to 300 and 400 m. The latter all rise sharply from the sea, forming steep cliffs, on whose sides may be seen layers

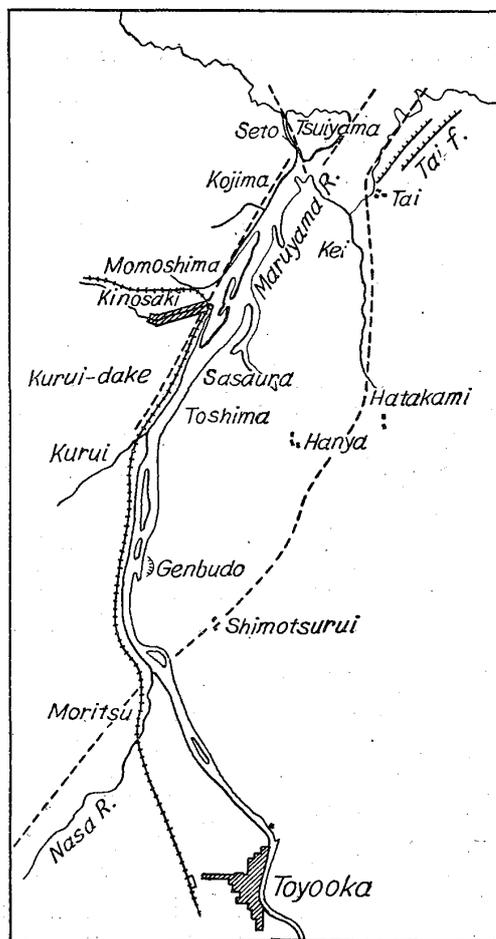


Fig. 1.

of tuff traversed by numerous faults, and the way in which the blocks lying between the faults are tilted, exhibit, even within small areas, signs of great crustal changes having taken place after the layers were deposited.

On this coast there are two indentations due to tectonic depression

the one on the east being Kumihama Cove, and the other on the west Tsuiyama Cove. The former no longer retains its previous shape, its mouth now being almost blocked by a very picturesque sand-bar, while the latter bay is, not only smaller in size, but is more simple in structure, its precipitous scarps being evidences of past depression. In shape, this cove is rectangular and indents itself obliquely in a N.N.E. to S.S.W. direction, its length being about 1.6 km. and the breadth of 0.7 to 1.1 km. The depth at the mouth is 20 m., while at the middle it is quite shallow, being only 5 m. The head of the cove forms the sandy beach of Kei, where the base of the hill which comes quite close to it, checks the waves and shows how recently the sandy beach came into existence. A noticeable feature of Tsuiyama Cove is that owing to its rectangular shape, its two opposite shores, consisting of steep slopes, run in a parallel direction, and that the tops of these slopes are as yet quite level with hardly a small erosion valley developed on them, all of which are eloquent testimony of the quite recent formation of these fault-scarps.

At Tsuiyama Port on the western side of the cove, not only are the hills facing the cove very precipitous, but the western side of the hamlet is also separated from the adjacent hamlet of Seto by a narrow channel, making Tsuiyama a virtual island. This channel is nothing but a fault-line, both the island on one side and the shore opposite being steep slopes. Again on going up the Maruyama River from Tsuiyama, the range of hills on the western side are also very precipitous and one promptly notices that the base of the hills lies almost in a straight line. On viewing this region from the summit of a hill a little to the north of it, its steep slopes are found to have smooth surface, whereas on the tops of the hills just behind them, erosion valleys have developed, the two making an interesting contrast and showing in a vivid manner that the steep sides of the former are fault-scarps.

On examining next the eastern shore of Tsuiyama Cove although, as previously stated, the hill Hachiganaru lying to the north of the hamlet of Tai, shows precipitous fault-scarps for a distance of nearly 1 km. along the bay, it probably joins the steep slopes forming the right bank of the Kei River which flows into the cove, and then continues in a long straight line towards the south. Like the Maruyama River, the valley of the Kei River shows every indication of its being a fault origin.

Dr. Ozawa who visited this locality soon after the writer, on pushing investigations further southwards, found that this fault-line

prolonged itself still further, appearing at the hamlet of Shimo-Tsurui on the eastern bank of the Maruyama River and going southwestwards, joined the tectonic valley of the Nasa River. His opinion that the block lying between this fault-line and the Maruyama River subsided within comparatively recent times deserves consideration. (The broken lines shown on Fig. 1. are old fault-lines as distinguished from the new seismic ones just formed in connection with the present earthquake.)

The Tai Fault. The so-called "Tai Fault" consists of two nearly parallel fault-lines on the summit of Hachiganaru hill. Their directions are parallel to the old steep fault-scarps facing the Tsuiyama cove the upper edges of the faults being plainly visible and extending for a distance of nearly 1600 m. The distance between the two lines at its widest part is about 400 m. As shown on the topographical map attached, although the two sides of this hill are very precipitous, upon gaining the summit we find that the top is quite level like a plateau, with indications that it is a remnant of an old peneplain. On the flat surface on the summit of this mountain we found patches of well cultivated ground at heights of about 100 m., where there were being cultivated lilies and willows, the latter being the material for the willow wicker-baskets, the making of which is an important industry of this neighbourhood. This hill-top consists of two parallel ridges, rising from either side of a shallow valley. The fault-lines pass these ridges, one over each ridge, and are visible at the surface. The western fault-line originates from the shore of the bay in the south and continuing upwards, has caused landslides at the top of the steep slopes from whence it passes into Mitano Plateau. On its way northwestwards from here it has caused several clefts and disappearing for a short distance, bends slightly eastwards, and after reaching the plateau it appears again in a most conspicuous manner, that is to say it has caused over ten clefts both large and small, and in one case between two clefts an area some 30 m. wide has sunken in several steps. The width of these clefts ranged all the way from 20 to 30 cm., and the ground lying between the clefts gradually changed in their relative vertical displacements, in amount as well as in sense, so that in going along the fault line we found the subsidence to be on one side of the line at one time, and then on the other side at another, in veritable see-saw fashion. Although the horizontal movements in one case exceeded 6 cm., its effects were clearly discernible in the disordered rows of the young seedlings in the willow field. As to the cleft of which

there were several, the main one caused subsidence on its left hand side, the subsidence reaching its maximum at Noboritate, from whence the fault line clearly extended into the tuff beds composing this locality, eventually losing itself on the top of the hill towards the west of Kanji.

As regards the eastern fault-line, it first shows itself on the southern end of the western scarp of Dōyama Hill, which is behind the hamlet of Tai, and skirting the vicinity of the triangulation mark, goes on to Sasayama and then reaches Hachiganaru, showing itself conspicuously all the way. Although this line does not show many clefts or the trench like conditions of the western fault-line, the subsidences throughout the line follow closely the main characteristics of the other fault-line. We might add that a branch of the main fault-line in passing through a lily field at Hachiganaru has left there an excellent example of horizontal displacement. To the north of Hachiganaru, the fault appears in two separate lines, the westerly one passing through a mulberry field, where the vertical dislocation varies from 60 to 80 cm., and in some places reaching as much as one metre, thus showing the greatest change in the whole line.

Thus the present Tai fault showed itself in two planes almost parallel to the old fault-scarp that faces Tsuiyama Cove and following the very same manner in which the old block subsided on the occasion of the formation of the cove itself, the intervening block subsided towards the west. Undoubtedly this region was the seat of great crustal movements in the past, of which the present one is only a recrudescence.

In addition to the foregoing, clefts were met with on the base of the hills near Tai, while in the hamlet of Momoshima to the north of Kinosaki, in the bases of the hills there were clefts accompanied by small undulations of the ground, but these were caused as a result of the difference between the vibrational periods of the soft soil on one side and that of the adjoining hard ground on the other due to the earthquake motion. To the north of Momoshima this caused wavy undulations in the surface of the dried paddy-fields. Between Kinosaki and Tsuiyama, there were many clefts cutting in the road and fields, while there have been observed here and there sand-cones ejecting water and sand, just as one usually sees in the case of destructive earthquakes.

After the writer returned to Tokyo, newspapers reported the discovery of a big fault at Kongaku Valley near Seto, but Dr. Ozawa's examination proved it to be merely a huge landslide.



The Tai fault 1 : 18.750 (Yamasaki).



Tsuiyama Cove with Hachiganaru Hill in the background with steep fault scarps facing the cove. The lighter shaded part is the landslide caused by the present earthquake.



The willow field on the summit of Hachiganaru Hill.
The fault is seen in the foreground.

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