

6. Observation of Changes in the Inclination of the Earth's Surface at Mt. Tsukuba (Third Report).

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The writer, in his previous papers, described the changes in inclination of the earth's surface that were observed at Mt. Tsukuba with the silica tiltmeters during the period from 1935 to 1940¹⁾. Those observations were made in two rooms ("A" and "B" in Fig. 1) lying

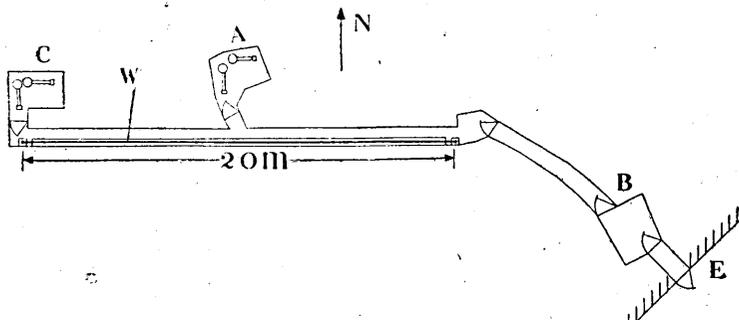


Fig. 1. Plan of the gallery. A, C Silica tiltmeter.
W Water-tube tiltmeter. E Entrance.

in the gallery that was bored horizontally through the mountain side. The observations, however, showed that the changes in inclination of room "A" and "B" differ entirely. The main object of the observation was to ascertain the changes in inclination related to the earthquake occurrence, but the foregoing result showed that the measurements of such kind is a very difficult matter.

On the other hand, it is well known that the crustal deformations were found successfully by the revision of the precise leveling. This success must be due to the sufficient length of the distance between bench marks. If, as shown in Fig. 2, we suppose that there

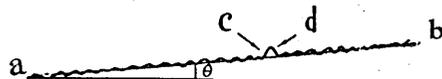


Fig. 2.

1) T. HAGIWARA, *Bull. Earthq. Res. Inst.*, 16 (1933), 366; 19 (1941), 218.

exist small disturbances superposing on the main inclination between "a" and "b" the inclination at points "c" or "d" will show a very large amount of inclination. The precise leveling measures the mean inclination angle between "a" and "b", while the silica tiltmeter registers such local disturbance as "c" or "d".

For this reason, a water-tube tiltmeter with a length of 20 m was installed along the gallery in EW direction and the comparisomal observation was commenced since 1943. Fig. 3 shows the water reservoir of the water-tube tiltmeter.

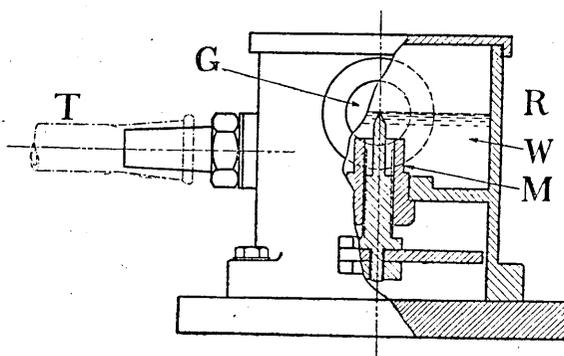


Fig. 3. Reading apparatus of the water-tube tiltmeter.

R Water reservoir. W Water. M Micrometer. G Glass window.
T Glass water-tube.

Two water reservoirs with such construction were installed separately at a distance of 20 m, and the water contained in them was connected by a glass tube with diameter of 2.5 cm. The change in inclination of the ground is obtained from the difference of reading in two micrometers, 0.0103" corresponding to 0.001 mm. The measurement was made twice a day. For the comparison, a pair of silica tiltmeters was installed in room "C" that was bored newly at a greater distance from the entrance of the gallery. The observation with the silica tiltmeters in room "A" was also continued.

Fig. 4 shows the observational results during the period from 1943 to 1948. In the case of large precipitation, the remarkable changes are recorded by all tiltmeters, but the amount and direction of them are not same with each another. If it is assumed that such disturbances are caused by the ground water near the very point, at which the instrument is installed, irregularity just mentioned may be explained. Although the water-tube tiltmeter is not free from disturbances due to the precipitation, the secular variation measured by this instrument

during a long period of time is far smaller compared to that of the silica tiltmeters in room "A" and "C". Its total variation is less than 1" since the beginning to the present. We may be able to say that the water-tube tiltmeter is more reliable than the silica tiltmeter for observing the secular changes in inclination.

The relation to the earthquake occurrence will be discussed after making further observations.

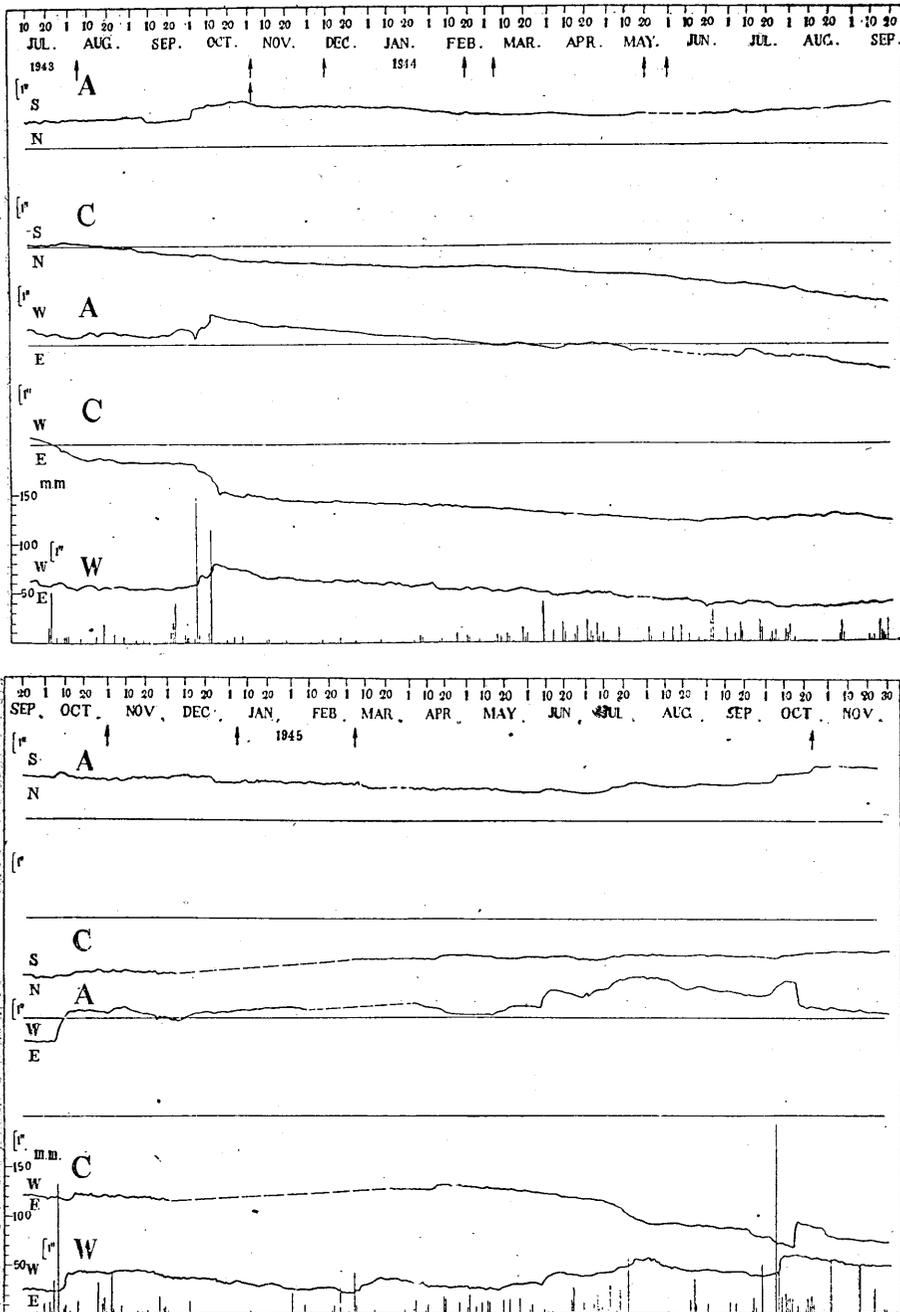


Fig. 4, a. A Changes in inclination in room "A".
 C Changes in inclination in room "C".
 W Changes in inclination measured by the water-tube tiltmeter.
 ↑ Fairly severe earthquake occurred in the neighbourhood of Mt. Tsukuba.
 Vertical lines drawn below show the precipitation in mm observed at 10 h on that day.

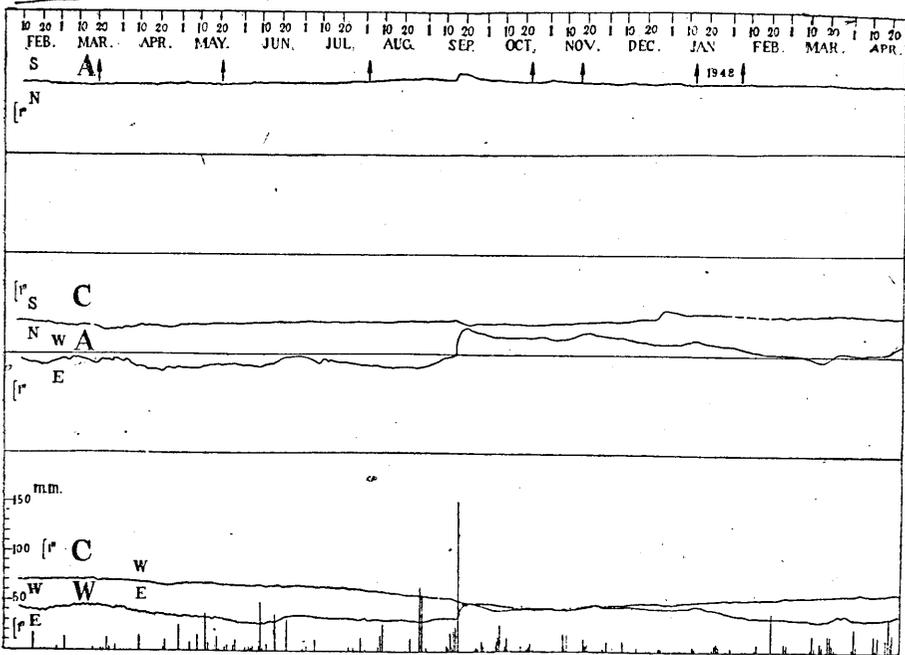
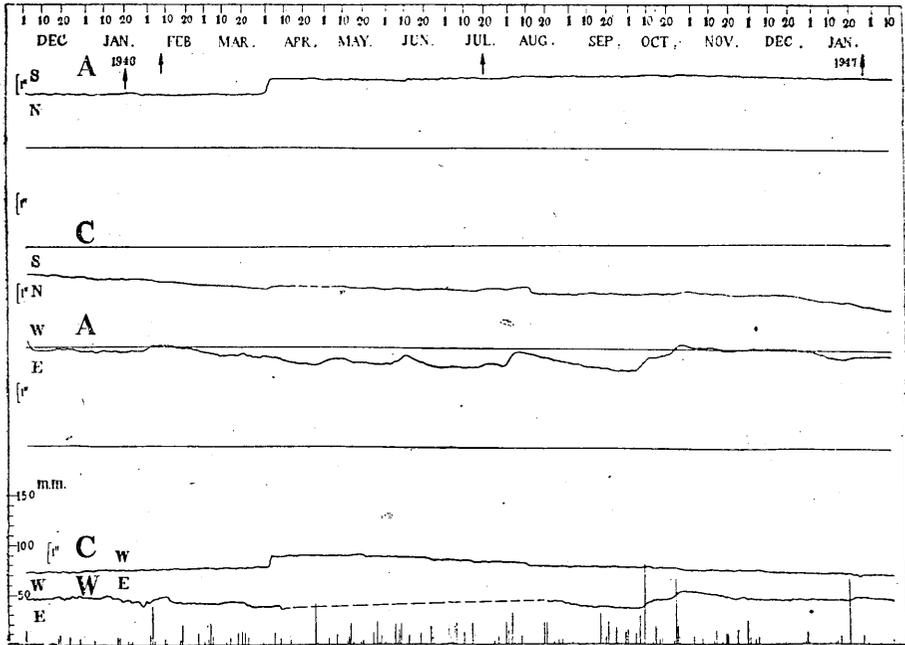


Fig. 4, b.