

NOTE ON THE
San Francisco Earthquake of April 18, 1906.

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The different horizontal and vertical micro-seismographs in the Seismological Institute, Tokyo, indicated on the night of April, 18, 1906, a very great disturbance due to a distant origin, which was soon identified with the great San Francisco earthquake. One of the east-west component seismograms is reproduced in the accompanying Plate; the particulars of the Omori Horizontal Pendulum by which the record was obtained being as follows:—

Weight of the heavy mass = 16.5 kg.

Vertical height between the point of suspension and the point of support = 1 metre.

Length of the strut, or the horizontal distance between the point of support and the centre of the heavy bob = 0.75 metre.

Natural period of oscillation of the horizontal pendulum = 41.5 sec.

Multiplication ratio of the writing index = 30.

The time of commencement in Tokyo of the earthquake was 10^h 24^m 35^s p.m. (Japan Standard Time, or the time of long. 135° E. of Greenwich); the total duration being about 5 hours. The duration (= y_1) of the "1st preliminary tremor" was 9^m 49^s, from which the approximate arcual distance (= x) between the origin of the earthquake and the observing place may be calculated,* as follows:—

$$x^{\text{km}} = 17.1 y_1^{\text{sec.}} - 1360^{\text{km}} = 8700^{\text{km.}}$$

* See the *Publications of the Earthquake Inv. Com. in Foreign Languages*, No. 5., p. 63.

If we assume the central point of the epifocal region to be off the coast of San Francisco, say, at *lat.* 37° N, *long.* 124° W, then the arcual distance between Tokyo and the origin of disturbance comes out to be about 8200^{km} .

The 1st displacement of the well-defined horizontal vibration at the very commencement of the "2nd preliminary tremor" was 2.2 mm, directed towards S 27° W; the 2nd displacement, which was much greater, being 4.6 mm, directed towards NE. It will be observed that the directions of these displacements are approximately equal to the direction of the great circle joining Tokyo with the origin of disturbance, namely, SW—NE.

At about $0^{\text{h}} 31^{\text{m}}$ a.m., on the 19th, namely, $2^{\text{h}} 6^{\text{m}} 35^{\text{s}}$ after the commencement of the disturbance, there began vibrations which correspond to the same earthquake motion propagated along the major arc of the earth, namely, which was propagated from the centre in a south-western direction, through South America, the Atlantic, and the Indian Ocean.

The time ($=t_0$) of occurrence at the origin of the earthquake may approximately be calculated, from the observations made in Tokyo, by the following formula:—

$$t_0 = t - 1.165 y_1 ,$$

where y_1 has the same meaning as before, and t denotes the time of earthquake occurrence observed in Tokyo; $1.165 y_1 = 11^{\text{m}} 30^{\text{s}}$ being the time interval taken by the very first tremors of the earthquake in travelling the distance between Tokyo and the origin of disturbance. We thus find that the time of occurrence at the origin of the shock was about $10^{\text{h}} 13^{\text{m}} 5^{\text{s}}$ p.m. (in Japan Time), or $5^{\text{h}} 13^{\text{m}} 5^{\text{s}}$ a.m. in Western States Time (time of 120° W). The time of earthquake occurrence at San Francisco itself was probably about $5^{\text{h}} 13^{\text{m}} 30^{\text{s}}$ a.m.

The earthquake has been recorded with horizontal pendulums at several other places in Japan. The time ($=t$) of occurrence of the motion and the duration ($=y_1$) of the 1st preliminary tremor at some of the different stations were as follows:—

Mizusawa (province of Rikuchu): $t=10^{\text{h}}.24^{\text{m}}.07^{\text{s}}$; $y_1=9.07^{\text{m}}.5$
Osaka $t=10.24.24$; $y_1=9.49$
Kobe $t=10.24.23$; $y_1=9.56$

TOKYO.

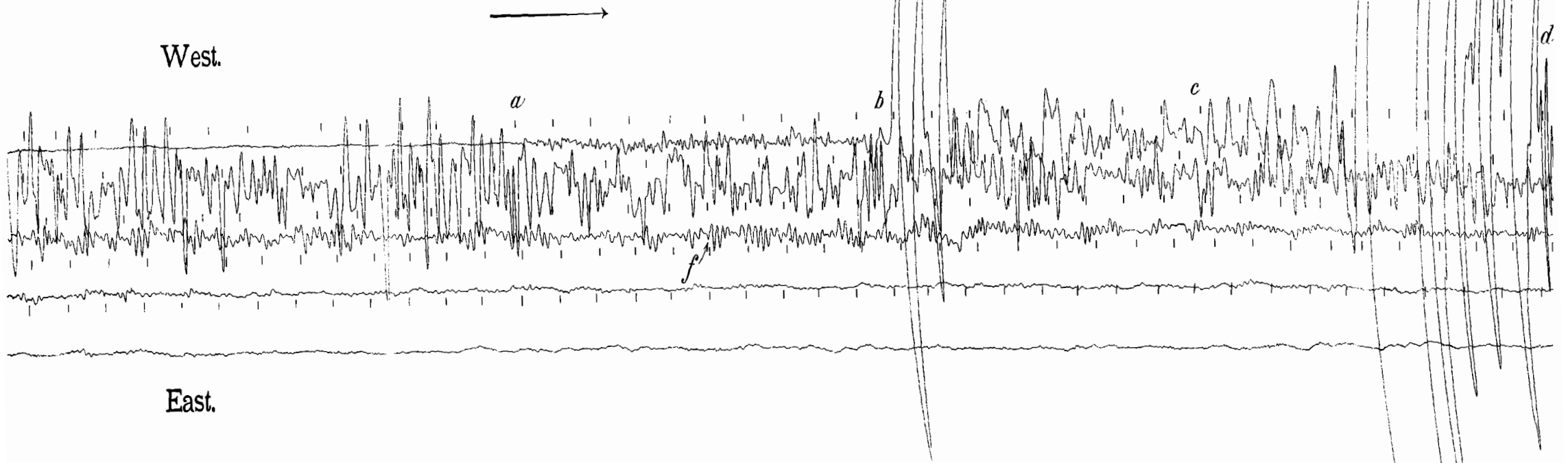
APRIL 25, 1906.

San Francisco Earthquake of April 18th, 1906.

Observed at Hongo, Tokyo, with Omori's Horizontal Pendulum.

E W Component; Multiplication=30.

Time of earthquake occurrence in Tokyo: 10^h 24^m 35^s P. M. (Time of long. 135° E.)



- a* Commencement of the earthquake.
- ab* 1st Preliminary Tremor.
- bc* 2nd " "
- cd* 1st and 2nd Phases of Principal Portion.
- de* 3rd phase " " "
- f* Earthquake Motion propagated along the major arc of the earth.

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