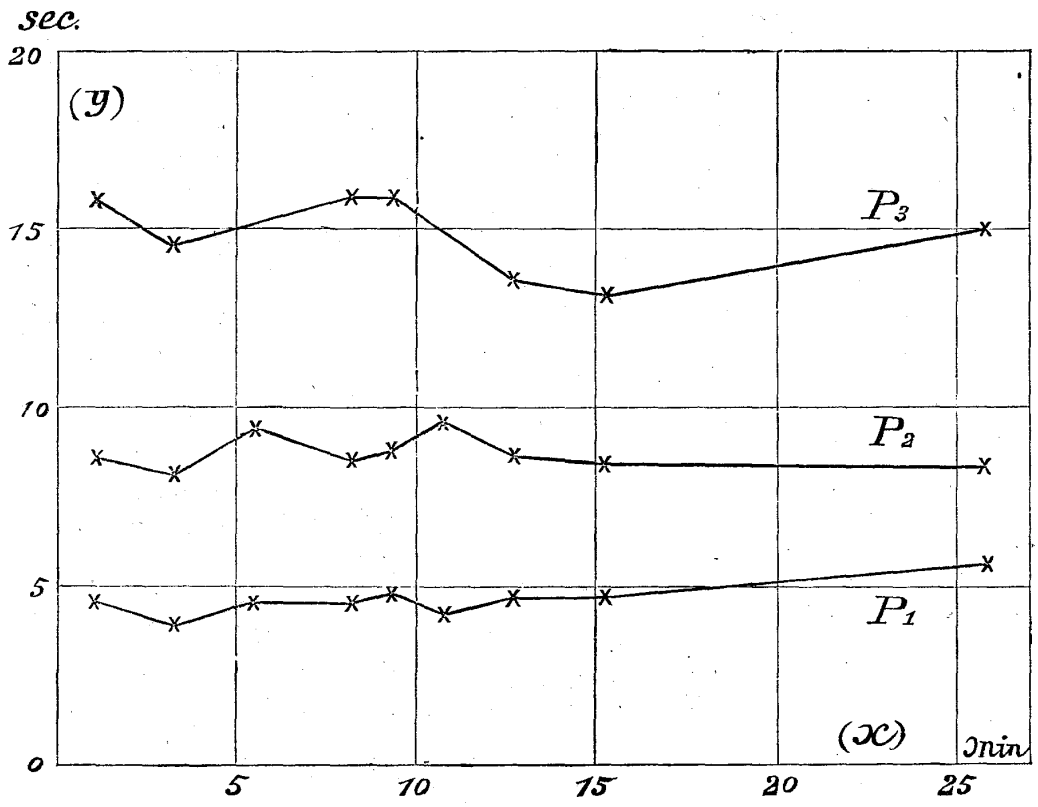
Fig. 2.




$x$ = Duration of total preliminary tremor.
$y$ = Period of vibration.

## V. Relative Magnitudes of the Maximum Movements in the Different Stages of the Earthquake Motion.

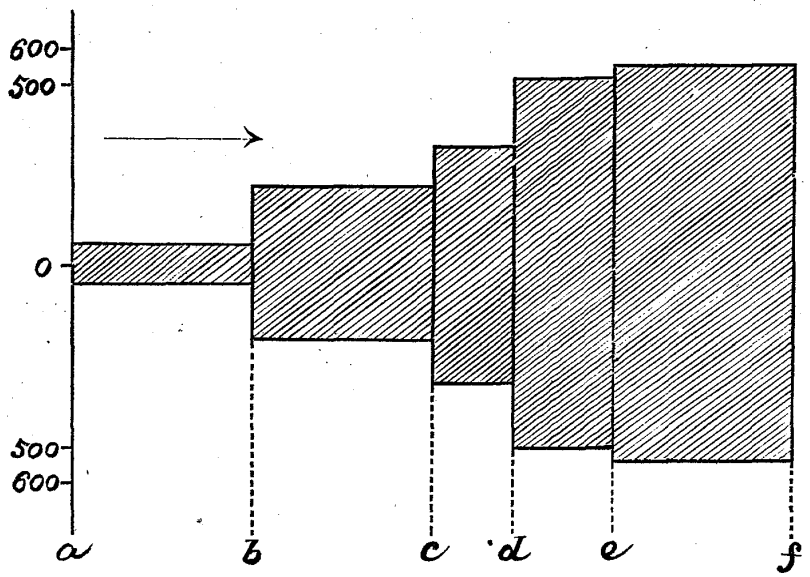
§ 8. (a) *Distant earthquakes observed at Hitotsubashi.* The 1st and the 2nd preliminary tremors and the successive parts of the principal portion of the earthquake motion are characterized by the difference of amplitude as well as by that of period. The following mean values of the relative magnitudes of the maximum motions in

the different stages of the motion have been deduced from the 84 earthquakes of Group I:—

Max. 2a in 1st preliminary tremor = 100,
„ 2nd „ „ = 412,
„ 1st phase of princ. portion = 647,
„ 2nd phase „ = 1020,
„ 3rd phase „ = 1090.

Thus the motion in the 1st preliminary tremor is much smaller than those in the other stages; while the motion in the 2nd preliminary tremor does not much differ from that in the 1st phase of the principal portion. The motion is greatest and nearly equal in the 2nd and 3rd phases of the latter portion.

Fig. 3.




*ab*.....1st Prel. Tremor.
*bc*.....2nd „ „
*cd*.....1st phase of Princ. Portion.
*de*.....2nd „ „ „
*ef*.....3rd „ „ „

(b) *Distant earthquakes observed at Hongō.* For the sake of reference, I give here the mean values of the relative magnitudes of the maximum movements in the different stages of the distant earthquakes observed at Hongō in 1898–1899 (the *Publications*, No 5):—

Max. 2a in 1st preliminary tremor = 100,
„ 2nd „ „ = 613,
„ 1st phase of princ. portion = 1290,
„ 2nd phase „ = 1720,
„ 3rd phase „ = 550.

These results for Hongō are to be regarded as being only approximate, the data utilized being less complete than those for Hitotsubashi, considered above.

§ 9. *Earthquakes of Groups II—VIII, observed at Hitotsubashi.*

The following table gives, for the different earthquakes of comparatively near origin, or those of Groups II to VIII, the maximum range of motion in the preliminary tremor and that in the principal portion, arranged according to the magnitude of the former and conveniently divided into groups.

## TABLE XIX.

MAX. 2a IN THE PREL. TREMOR AND THE PRINCIPAL PORTION. GROUPS II—VIII.

| Eq. No. | Max. 2a in Prel. tremor. | | Max. 2a in Princ. Portion. | |
|---|---|---|---|---|
| | mm | | mm | |
| 18 | 0,01 | | 0,31 | |
| 100 | 0,02 | | 0,13 | |
| 263 | 0,03 | *Mean* | 0,30 | *Mean* |
| 37 | 0,04 | **0,03** | 0,44 | **0,48** |
| 66 | 0,04 | | 0,30 | |
| 180 | 0,04 | | 1,50 | |
| 247 | 0,04 | | 0,12 | |
| 14 | 0,06 | | 0,80 | |
| 70 | 0,06 | | 0,40 | |
| 177 | 0,06 | *Mean* | 1,03 | *Mean* |
| 247 | 0,06 | **0,06** | 0,16 | **0,56** |
| 145 | 0,06 | | 0,56 | |
| 70 | 0,06 | | 0,40 | |
| 139 | 0,09 | | 0,20 | |
| 144 | 0,09 | *Mean* | 0,56 | *Mean* |
| 69 | 0,10 | **0,10** | 0,65 | **0,59** |
| 160 | 0,10 | | 0,66 | |
| 106 | 0,11 | | 0,90 | |
| 50 | 0,19 | | 0,70 | |
| 59 | 0,31 | *Mean* | 1,80 | *Mean* |
| 245 | 0,24 | **0,27** | 2,05 | **1,40** |
| 77 | 0,33 | | 1,03 | |
| 230 | 0,90 | | 3,90 | |

Thus it will be seen that a large motion in the preliminary tremor always corresponds to a large motion in the principal portion. This result has a practical importance, because we are, by the observation of the commencement of an earthquake, enabled to foretell at once the relative magnitude of the subsequent motion. The discussion of this point in cases of strong macro-seismic motion shall be reserved for another occasion.