for only about 11 sec. after the above-mentioned large movement.

The eruption in question was followed 23.4 sec. after by a very small one of exactly the same character and of the total duration of 14.5 sec. In this second shaking, the time of commencement was 3.14.16 p.m., the motion being small and nearly uniform during the first 9.0 sec. Then there followed a single slow vibration consisting of the two displacements of 0.0007 and 0.0016 mm respectively away from, and toward to, the crater. The subsequent motion was very small.

At 1. 46. 26 p.m., on the same day, there was also a very small earthquake of the same sort; and of the total duration of 30 sec., a single conspicuous vibration (1st motion=0.0006 mm, 2nd motion=0.0009 mm) occurring about 9.5 sec. after the commencement.

## CHAPTER IX. REMARKS ON THE SEISMOGRAPHICAL OBSERVATIONS OF THE ASAMA-YAMA ERUPTIONS AT YUNO-TAIRA, ASHINO-TAIRA, AND THE ASAMA PASTURE GROUND.

**89. *Duration of motion of explosive Asama-yama eruptions.***

According to Table XV, the total duration of the longitudinal earthquake motion due to the strong Asama-yama explosive eruptions observed at the three stations of Yuno-taira, Ashino-taira, and the Asama Pasture Ground, was on the average roughly 100 to 150 sec., as follows:—

| | | | | | |
|---|---|---|---|---|---|
| Yuno-taira .... | 50 | to 260 | sec.; | mean, | 118 sec. |
| Ashino-taira .. | 70 | „ 116 | „ ; | „ , | 96 „ |
| Asama P. G. .. | 110 | „ 240 | „ ; | „ , | 156 „ |

The average duration of the principal portion was 25 sec. for Yuno-taira, 21 sec. for Ashino-taira, and 29 sec. for the Asama Pasture Ground. Again, the duration of the specially prominent

part varied at Yuno-taira from 8.2 to 19.7 sec., with the average of 15 sec., while the mean duration of the later small stage of the principal portion was at the same observing place about 10 sec. From these latter results for Yuno-taira, whose distance from the crater is only 2.3 km, we may probably infer that the mean durations of (i), the entire principal portion, (ii), the specially active part, (iii), the secondary active part, and (iv), the tail or after shakings, of the explosive process itself at the volcanic focus were not much different respectively from (i) 25 sec., (ii) 15 sec., (iii) 10 sec., and (iv) 90 sec.

**TABLE XV. THE TOTAL DURATION, AND THE DURATIONS OF THE PRELIMINARY PORTION AND PRINCIPAL PORTION OF THE EXPLOSIVE ERUPTIONS OF THE ASAMA-YAMA, OBSERVED AT YUNO-TAIRA, ASHINO-TAIRA, AND THE ASAMA PASTURE GROUND.**

[Longitudinal Component.]

| Explosion. | Prelim. Portion. | Total Duration. | Principal Portion. | Specially strong part. | Later and smaller stage of Princ. Portion. |
|---|---|---|---|---|---|
| | | **Yuno-taira.** | | | |
| | sec. | sec. | sec. | sec. | sec. |
| May 16th. | 0.26 | 95 | 28.2 | 16.2 | 12.0 |
| „ 27th. | — | 73 | 29.4 | 13.8 | 15.6 |
| „ 29th. | 0.16 | 88 | 36.1 | 22.8 (?) | — |
| June 13th. | — | 72 | 23.2 | 13.4 | 9.8 |
| „ 17th. | 0.37 | 115 | 33.8 | — | — |
| „ 18th. | — | 113 | 24.0 | 16.4 | 7.6 |
| „ 20th. | — | 94 | 11.0 | — | — |
| „ 24th. | — | 88 | 12.2 | — | — |
| „ 26th (8 a.m.) | 0.47 | 115 | 15.7 | 8.2 | 7.5 |
| „ 26th (11 p.m.) | 0.37 | 150 | 28.5 | 15.3 | 13.2 |
| July 7th (7 a.m.) | — | 78 | 12.4 | — | — |
| „ 7th (9 p.m.) | 0.47 | 126 | 14.6 | 11.3 | 3.3 |

| Explosion. | Prelim. Portion. | Total Duration. | Principal Portion. | Specially strong part. | Later and smaller stage of Princ. Portion. |
|---|---|---|---|---|---|
| | | | **Yuno-taira.** | | |
| | sec. | sec. | sec. | sec. | sec. |
| July 8th. | 0.29 | 50 | 22.2 | 13.1 | 9.1 |
| „ 13th. | 0.67 | 138 | 26.1 | 15.2 | 9.9 |
| „ 18th. | 0.29 | 148 | 25.6 | 15.2 | 10.4 |
| „ 19th. | 0.48 | 140 | 36.4 | — | — |
| Aug. 12th (7 p.m.) | — | 120 | 28.8 | 19.7 | 9.1 |
| „ 12th (11 p.m.) | 0.42 | 260 | — | — | — |
| May 5th (1914) | 0.55 | 171 | 40.0 | 12.7 | 27.3 |
| | | | **Ashino-taira.** | | |
| | sec. | sec. | sec. | sec. | sec |
| Sept. 21st. | 0.49 | 97 | 24.3 | — | — |
| Oct. 9th. | 0.52 | 70 | — | — | — |
| „ 15th. | 0.50 | 94 | — | — | — |
| „ 17th. | — | 116 | 21.8 | — | — |
| „ 22nd. | 1.0 | 104 | 16.2 | — | — |
| | | | Asama Pasture Ground. | | |
| | sec. | sec. | sec. | sec. | sec. |
| Sept. 21st. | 0.61 | 240 | 34.9 | — | — |
| Oct. 7th. | — | 130 | — | — | — |
| „ 17th. | — | 110 | 34.7 * | 33.4 | 11.3 |
| „ 22nd. | 1.6 | 120 | 25.3 | — | — |
| Nov. 14th. | 1.9 | 180 | 20.4 | — | — |

* Duration of the preliminary and principal portions.

**90.** ***Duration of preliminary portion in longitudinal component.*** The preliminary portion is in the present cases made up of only one small outward movement, always very small and less than 0.0051 mm, whose average duration was 0.40 sec. for Yuno-taira, 0.63 sec. for Ashino-taira, and 1.4 sec. for the Asama Pasture Ground, the approximate horizontal distances of these three

places from the crater centre being 2,300; 4,850; and 6,350 m, respectively. If we assume a linear relation of the form $x^{km} = ky$ sec., between the horizontal radial distance (x) and the duration (y) of the preliminary portion, we get the following values of the constant k:

for Yuno-taira ..... k=5.8
„ Ashino-taira ..... k=7.7
„ Asama Pasture Ground ..... k=4.5

As the average from the results for the three places, we may take k=6, the assumed equation becoming.

$$x^{km} = 6\,y \text{ sec.}, \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

which relation is of course a very rough one, as the distance x is simply the horizontal distance from the crater centre. It is not clear why the very first, or preliminary, portion is directed outwards. It may be that the motion in question corresponds to the 2nd and large displacement of the "initial vibration" transmitted along the path of the quickest propagation, that corresponding to the 1st displacement of the same vibration being obliterated on account of the smallness of magnitude or some other circumstances.

**91. *Initial vibration.*** The "initial vibration" (§ 32) forms always a quite prominent feature at the commencement of the longitudinal component principal portion of the *strong* detonative explosions, and its period seems not to vary among the three observing stations of Yuno-taira, Ashino-taira, and the Asama Pasture Ground. It is clearly indicated also in some of the diagrams of the *strong* non-detonative eruptions. In the following table are given, for the "initial vibration" at the different places, the 1st displacement ($=a_1$) and the 2nd displacement ($=a_2$); their durations, namely, what may be taken as the 1st half-period

and the 2nd half-period; the ratio of $a_2/a_1$; and the complete period T.

**TABLE XVI. ELEMENTS OF THE "INITIAL VIBRATION."**

| Eruption. (1913) | Range of Motion. | | | Vibration Period. | | |
|---|---|---|---|---|---|---|
| | 1st Displ't $=a_1$ | 2nd displ't $=a_2$ | Ratio: $\frac{a_2}{a_1}$ | 1st half Period. | 2nd half Period. | Sum = T. |
| | | | Yuno-taira. | | | |
| | mm | mm | | sec. | sec. | sec. |
| May 16th. | 0.070 | 0.102 | 1.46 | — | — | 1.52 |
| „ 27th. | 0.045 | 0.062 | 1.38 | — | — | 1.3 |
| „ 29th. | 0.048 | 0.098 | 2.05 | — | — | 2.6 |
| June 13th. | (Small) | (Small) | — | — | — | — |
| „ 17th. | 0.053 | 0.110 | 2.08 | 1.0 | 1.8 | 2.8 |
| „ 18th. | (Small) | (Small) | — | — | — | — |
| „ 20th. | 0.010 | 0.025 | 2.50 | — | — | — |
| „ 24th. | 0.014 | 0.040 | 2.85 | — | — | 1.8 |
| „ 25th. | 0.001 | 0.0034 | — | — | — | 2.7 |
| „ 26th.(1) | 0.021 | 0.0403 | 1.92 | — | — | 1.74 |
| „ „ (2) | 0.064 | 0.093 | 1.46 | — | — | 2.3 |
| July 1st. | 0.0097 | 0.043 | 4.43 | — | — | 2.0 |
| „ 7th.(3) | 0.017 | 0.037 | 2.18 | 0.7 | 0.78 | 1.48 |
| „ „ (4) | 0.036 | 0.080 | 2.22 | — | — | 1.61 |
| „ 8th. | 0.046 | 0.088 | 1.91 | — | — | 1.95 |
| „ 13th. | 0.053 | 0.123 | 2.32 | 1.3 | 1.7 | 3.0 |
| „ 18th. | 0.054 | 0.116 | 2.15 | — | — | 2.2 |
| „ 19th. | 0.104 | 0.127 | 1.22 | — | — | 1.75 |
| Aug. 12th.(5) | 0.029 | 0.050 | 1.73 | — | — | 1.6 |
| „ „ (6) | 0.125 | 0.217 | 1.74 | 1.15 | 2.0 | 3.2 |
| „ 15th. | 0.010 | 0.034 | 3.40 | — | — | 2.1 |
| May 5th (1914). | 0.081 | 0.143 | 1.77 | — | — | 2.16 |

| Eruption. (1913) | Range of Motion. | | | Vibration Period. | | |
|---|---|---|---|---|---|---|
| | 1st Displ't $=a_1$ | 2nd Displ't $=a_2$ | Ratio: $\frac{a_2}{a_1}$ | 1st half Period. | 2nd half Period. | Sum = T. |
| | | | Ashino-taira. | | | |
| | mm | mm | | sec. | sec. | sec. |
| Sept. 21st. | 0.030 | 0.077 | 2.57 | 0.97 | 1.22 | 2.2 |
| Oct. 9th. | 0.0045 | 0.0175 | 3.89 | 1.06 | 1.21 | 2.3 |
| „ 15th. | 0.009 | 0.035 | 3.89 | 1.05 | 1.15 | 2.2 |
| „ 17th. | — | — | — | 1.5** | 1.2 | 2.7 |
| „ 22nd. | 0.0012 | 0.0069 | 5.75 | 0.9 | 1.3 | 2.2 |
| | | | Asama Pasture Ground. | | | |
| Sept. 21st. | 0.035 | 0.043 | 1.23 | 0.66 | 1.12 | 1.8 |
| Oct. 17th. | 0.0062 | 0.0206 | 3.32 | 1.27** | 1.26 | 2.54 |
| „ 22nd. | 0.0018 | 0.0099 | 5.50 | 1.44 | 1.69 | 3.1 |
| Nov. 14th. | 0.038 | 0.063 | 1.66 | — | — | 3.05 |
| „ 20th. | 0.005 | 0.019 | 3.80 | — | — | 2.5 |

(1) At 8.09.40 a.m. (2) At 11.41.59 p.m. (3) At 7.10.32. a.m. (4) At 9.46.53 p.m. (5) At 7.45.08 p.m. (6) At 11.20.33 p.m. ** Including the preliminary portion.

According to Table XVI, the 2nd, or outward, displacement ($a_2$) was, for Yuno-taira, greater than the 1st, or inward, displacement ($a_1$), in the average ratio of 2.1 : 1. For Ashino-taira and the Asama Pasture Ground, this ratio was greater, being 4.0 or 3.1. The complete period of the "initial vibration" at Yuno-taira was with a few exceptions included between 1.6 and 2.8 sec., the average value being 2.1 sec. At Ashino-taira, it was very uniform, being in the 4 out of the 5 cases, 2.2 or 2.3 sec., with the average of 2.3 sec. Finally, at the Asama Pasture Ground, the period varied between 1.8 and 3.1 sec., with the average of 2.6 sec. The total average, deduced from the observations at the three stations, is 2.2 sec., this being, according to

my assumption explained in § 32, the time interval taken by the actual outbursting, or the initial breaking process of the explosion. Again, the approximate average value of the 1st half-period was 0.9 sec., while that of the 2nd half-period was 1.3 sec., which, according to the same assumption are respectively the approximate time interval of the upward push or shock of the explosive force, and that of the quickly following formation of the eruptive aperture by the exploding gases. The slow-period large displacements succeeding the "initial vibration" may also be due to the propagation of the state of the deformation and ultimate rupture of the lava mass at the moment of the explosion.

In the following §§, are given remarks respecting the comparison of the longitudinal and the transverse components, the period of the vibrations (the "initial vibration" excepted), etc.

**92. *Observation at Asama Pasture Ground of strong explosions of* 1913.** The duration of the preliminary portion varied in the transverse component, between 0.62 and 2.5 sec., with the average of 2.1 sec., being 1.1 sec. longer than that in the longitudinal component. The duration of the principal portion varied between 22 and 36 sec., with the averages of 32 and 27 sec. respectively for the longitudinal and the transverse components.

The mean value of the different group periods (Table XVII), deduced from the longitudinal and transverse components, are:— (i) 4.4 sec.; (ii) 2.46 sec.; (iii) 1.0 sec.; (iv) 0.36 sec.

| Group. | Average Period. | Max. 2a (Longit. Compt.) | Max. 2a (Transv. Compt.) |
|---|---|---|---|
| i | 4.4 sec. | 0.035 mm. | — mm. |
| ii | 2.46 | 0.122 | 0.106 |
| iii | 1.0 | 0.073 | 0.073 |
| iv | 0.36 | 0.032 | 0.028 |

Of these four groups, the (iii) occurred most frequently, while the (ii) corresponded to the vibrations with the greatest 2a. The time interval between the earthquake commencement and the occurrence of the absolutely maximum 2a was 3.1 to 7.7 sec. in the longitudinal, and 7.8 to 17.5 sec. in the transverse component; the average values in these two directions being respectively 6.1 and 12.5 sec., as follows:—

| Explosion. | Longitudinal Component. | Transverse Component. |
|---|---|---|
| September 21st. | 3.1 sec. | 11.1 sec. |
| October 15th. | — | 17.5 |
| October 17th. | 7.5 | 8.9 |
| October 22nd. | 7.7 | 7.8 |
| November 14th. | — | 17.2 |
| | *Mean*, 6.1 sec. | *Mean*, 12.5 sec. |

Thus the interval in question was about 5.4 sec. longer in the transverse than in the longitudinal component. The duration of the earlier portion of the earthquake motion free from the mixture of quick vibrations was:—

| Explosion. | (1) Longitudinal Component. | (2) Transverse Component. |
|---|---|---|
| October 22nd. | 4.4 sec. | 4.5 sec. |
| September 21st. | 6.9 | 13.6 |
| October 17th. | 10.3 | 8.8 |
| | *Mean*, 7.2 sec. | *Mean*, 9.0 sec. |

Thus the quick superposed vibrations occurred about 2.0 sec. earlier in the longitudinal than in the transverse component.

**TABLE XVII. STRONG EXPLOSIONS IN 1913 OBSERVED AT THE ASAMA PASTURE GROUND: PERIODS.***

(The 2a corresponding to a given period is enclosed in brackets.)

| Longitudinal Component. | | Transverse Component. | |
|---|---|---|---|
| sec. mm. | mm. | sec. | sec. mm. |
| 4.4 (0.035) | 1.47 (0.024) | 4.4 | 1.60 (0.013) |
| | 1.40 (0.011) | | 1.44 (0.052) |
| mm. | 1.30 (0.007) | mm. | 1.30 (0.058) |
| 2.65 (0.112) | 1.05 | 2.60 (0.078) | 1.16 (0.048) |
| 2.56 (0.122) | 1.02 | 2.60 (0.058) | 1.10 (0.015) |
| 2.40 (0.087) | 1.00 (0.007) | 2.57 (0.035) | 1.10 (0.012) |
| 2.20 (0.042) | 0.97 (0.046) | 2.53 (0.069) | 1.05 (0.009) |
| **2.45** | 0.96 (0.015) | 2.48 (0.106) | 1.05 (0.068) |
| | 0.80 (0.073) | 2.00 (0.010) | 1.03 (0.017) |
| 0.36 | 0.78 (0.031) | **2.46** | 1.03 (0.023) |
| mm. | 0.74 (0.012) | mm. | 1.03 (0.072) |
| 0.25 (0.031) | 0.71 (0.072) | 0.50 (0.013) | 1.00 (0.030) |
| 0.27 (0.028) | 0.70 (0.020) | 0.48 (0.009) | 0.98 (0.073) |
| 0.22 (0.032) | 0.61 | 0.29 (0.028) | 0.93 (0.024) |
| **0.28** | **0.97** | **0.42** | 0.92 (0.049) |
| | | | 0.89 (0.022) |
| | | | 0.83 (0.009) |
| | | | 0.81 (0.035) |
| | | | 0.79 (0.066) |
| | | | 0.70 (0.017) |
| | | | **1.04** |

* Exclusive of the "initial vibration." Mean values are printed in gothic figures.

**93. *Strong explosions in 1913 observed at Ashino-taira.*** *Duration.* The duration of the preliminary portion varied in the longitudinal motion between 0.49 and 1.0 sec., and in the transverse between 1.2 and 1.9 sec., with the mean values respectively of 0.63 and 1.6 sec.; it being about 1.0 sec. longer in the latter than in the former component. Again, the duration of the principal

portion varied between 15.4 and 24.3 sec., giving for the longitudinal and transverse components the mean values respectively of 20.8 and 18.1 sec.

In the explosions of Sept. 21st and Oct. 22nd, the durations of the specially strong portion in the transverse component were 5.6 and 8.3 sec., giving the mean of 7 sec. Again, in the explosions of Sept. 21st, Oct. 9th and 22nd, the superposition of the quick vibrations in the longitudinal component began respectively 6.1 sec., 5.6 sec., and 4.4 sec. after the commencement, giving the mean interval of 5.4 sec.

*Period.* As shown in Table XVIII, the mean values of the different group periods averaged from the longitudinal and transverse components are (i) 2.5 sec., (ii) 1.17 sec., and (iii) 0.35 sec. The vibrations of the group (ii) occurred most frequently, while those of the group (i) had the greatest 2a.

| Longitudinal Component. | | Transverse Component. | |
|---|---|---|---|
| Average T. | Max. 2a. | Average T. | Max. 2a. |
| 2.40 sec. | 0.093 mm. | 2.50 sec. | 0.064 mm. |
| 1.18 | 0.034 | 1.15 | 0.038 |
| 0.34 | 0.020 | 0.38 | — |

The period of the *pulsatory oscillations*, or the free vibrations before and after the earthquakes was 3.6 sec. (max. 2a=0.0012 mm) in the longitudinal and 3.8 sec. in the transverse component.

*Maximum vibration.* The time intervals between the commencement of the earthquake and the occurrence of the maximum vibration in the longitudinal component of the explosions of Oct. 9th and 22nd were 7.4 and 7.0 sec.; while in the transverse components of the explosions of Sept. 21st and Oct. 17th, the intervals were 6.2 and 10.1 sec.

**TABLE XVIII. STRONG ASAMA-YAMA EXPLOSIONS IN 1913 OBSERVED AT ASHINO-TAIRA: PERIODS.***

(The 2a corresponding to a given period is enclosed within brackets.)

| Longitudinal Component. | | Transverse Component. | |
|---|---|---|---|
| sec. | mm. | sec. | mm. |
| 3.2 | (0.0663) | 2.9 | (0.064) |
| 2.6 | (0.021) | 2.8 | (0.0206) |
| 2.43 | (0.093) | 1.9 | (0.0012) |
| 2.1 | (0.0042) | **2.5** | |
| 1.9 | (0.0275) | 1.6 | (0.008) |
| **2.4** | | 1.4 | |
| 1.47 | (0.0024) | 1.35 | (0.038) |
| 1.45 | (0.0048) | 1.30 | (0.0053) |
| 1.40 | (0.011) | 1.20 | |
| 1.20 | (0.0018) | 1.12 | (0.0011) |
| 1.05 | | 1.01 | (0.0206) |
| 1.04 | (0.034) | 0.90 | (0.0028) |
| 0.98 | | 0.87 | (0.014) |
| 0.88 | (0.0218) | 0.73 | |
| **1.18** | | **1.15** | |
| 0.36 | (0.020) | 0.38 | |
| 0.31 | (0.0175) | | |
| **0.34** | | | |

* Exclusive of the "initial vibration." Mean values are printed in gothic figures.

**94.** ***Strong explosions observed at Yuno-taira.*** The superposition of smaller movements on the "initial" and succeeding slow vibrations in the longitudinal component appeared a few seconds after the earthquake commencement; this interval being, in two of the cases, 2.3 and 3.4 sec. respectively. The time difference between the earthquake commencement and the

occurrence of the absolutely maximum motion in the longitudinal component was from 8.0 to 12.3 sec., with the mean value of 10.2 sec., as follows :—

8.0 sec.
9.2
9.9
11.8
12.3
} *Mean*, 10.2 sec.

The maximum 2a of the "quick tremors" was 0.077 mm.

The periods of vibrations (Table XIX) in the principal and end portions of the longitudinal component of the earthquake motion due to the different explosions can more or less distinctly be divided into five groups, of the following mean values :—

(i) T=5.3 sec. (max. 2a=0.19 mm)
(ii) „=2.1 „ ( „ =0.048)
(iii) „=1.3 „ ( „ =0.130)
(iv) T=0.74 sec. (max. 2a=0.083 mm)
(v) „=0.37 „ ( „ =0.053)

**TABLE XIX. STRONG EXPLOSIONS IN 1913 AND 1914 OBSERVED AT YUNO-TAIRA : PERIODS.* (LONGITUDINAL COMPONENT.)**

(The 2a corresponding to a given period is enclosed within brackets.)

| (i) | | (ii) | | (iii) | | sec. | |
|---|---|---|---|---|---|---|---|
| sec. | mm | sec. | mm | sec. | mm | 1.34 | mm |
| 6.5 | (0.171) | 2.3 | (0.048) | 1.60 | (0.0025) | 1.36 | (0.021) |
| 5.8 | (0.140) | 2.3 | | 1.60 | (0.011) | 1.33 | (0.022) |
| 4.9 | (0.055) | 2.2 | (0.0065) | 1.50 | (0.085) | 1.30 | (0.039) |
| 4.6 | (0.134) | 1.9 | | 1.47 | (0.059) | 1.28 | (0.041) |
| 4.5 | (0.114) | 1.85 | (0.0058) | 1.45 | | 1.24 | (0.118) |
| — | (0.190) | **2.1** | | 1.41 | | 1.26 | |
| **5.3** | | | | 1.40 | (0.0018) | 1.20 | (0.084) |

| sec. | | sec. | mm | sec. | | sec. | mm |
|---|---|---|---|---|---|---|---|
| 1.20 | | 0.85 | (0.009) | 0.65 | mm | 0.40 | (0.019) |
| 1.16 | mm | 0.84 | (0.0046) | 0.63 | (0.0134) | 0.40 | |
| 1.14 | (0.046) | 0.82 | (0.012) | 0.61 | | 0.40 | |
| 1.14 | (0.017) | 0.81 | | 0.60 | (0.0036) | 0.39 | |
| 1.12 | | 0.80 | (0.062) | 0.59 | (0.083) | 0.38 | (0.026) |
| 1.12 | (0.031) | 0.80 | | 0.58 | (0.028) | 0.37 | (0.0174) |
| 1.11 | (0.030) | 0.79 | | 0.53 | (0.0028) | 0.36 | (0.050) |
| 1.10 | (0.031) | 0.78 | (0.044) | **0.73** | | 0.36 | (0.0096) |
| 1.10 | (0.023) | 0.78 | (0.0014) | | | 0.36 | (0.017) |
| 1.10 | | 0.77 | (0.0027) | | (v) | 0.35 | (0.021) |
| 1.05 | (0.105) | 0.75 | | sec. | mm | 0.34 | (0.008) |
| 1.00 | (0.003) | 0.75 | (0.023) | 0.47 | (0.0248) | 0.33 | (0.053) |
| **1.3** | | 0.72 | (0.005) | 0.45 | (0.009) | 0.29 | (0.0012) |
| | | 0.71 | (0.0162) | 0.44 | (0.028) | 0.27 | (0.014) |
| | (iv) | 0.70 | (0.0113) | 0.44 | (0.037) | 0.27 | (0.029) |
| sec. | mm | 0.70 | | 0.44 | | 0.27 | (0.053) |
| 0.93 | (0.019) | 0.70 | | 0.40 | (0.045) | 0.26 | (0.025) |
| 0.89 | (0.041) | 0.65 | (0.026) | 0.40 | | **0.37** | |

* Exclusive of the "initial vibration." Mean values are printed in gothic figures.

The periods most frequently occurring were (iv) and (v). The magnitudes of the max. 2a's corresponding to the different groups were, excepting (ii), in order of the lengths of period, namely, greatest for (i) and least for (v).

The periods occurring in some of the transverse component diagrams indicated the mean values of 1.4 and 2.6 sec., as follows:

| Sec. | mm | | | |
|---|---|---|---|---|
| 1.52 | (2a=0.063) | | 2.9 sec. | |
| 1.50 | | | | |
| 1.45 | (0.004 mm) | Mean, 1.4 sec. | 2.2 ,, | Mean, 2.6 sec. |
| 1.44 | (0.054 ,, ) | | | |
| 1.18 | | | | |

In the explosions of July 13th and 19th, the maximum vibration in the transverse direction occurred respectively 8.5 and 6.5 sec. after the commencement of the earthquake.

**95. *Strong non-explosive eruption of Nov. 20th*, 1913, *observed at Asama Pasture Ground.*** The duration of the preliminary portion was 1.6 sec. longer in the transverse than in the longitudinal component. The duration of the principal portion was also 9.4 sec. longer in the former than in the latter.

The quick vibrations began to appear 5.6 sec. after the earthquake commencement, or 3.6 sec. after the end of the 1st displacement of the "initial vibration." Again, the absolutely maximum movements in the longitudinal and the transverse components occurred respectively 12.3 and 10.9 sec. after the earthquake commencement.

The periods of vibration in the principal and end portions, can be divided in 3 distinct groups, (Table XX), their mean values, averaged from the longitudinal and transverse components, being (i) 2.2 sec.; (ii) 1.1 sec.; and (iii) 0.23 sec. The (ii) period occurred most frequently, while the (i) period corresponded to the greatest range of motion.

**TABLE XX. NON-EXPLOSIVE ERUPTION OF NOV. 20TH, 1913, OBSERVED AT THE ASAMA PASTURE GROUND: PERIODS.***

(The 2a corresponding to a given period is enclosed within brackets)

| Longitudinal Component. | Transverse Component. |
|---|---|
| sec. mm | (i′) |
| 3.3 (0.053) | sec. mm |
| 3.3 (Pendulum period?) | 2.20 (0.040) |
| | 1.48 (0.146) |
| (i) | **1.84** |
| 2.4 (0.21) | |
| | (ii′) |
| (ii) | 1.40 (0.051) |
| 1.20 (0.011) | 1.30 (0.012) |
| 1.06 (0.048) | 1.07 (0.094) |
| 0.82 (0.062) | 1.03 (0.038) |
| **1.03** | 0.93 (0.100) |
| | **1.15** |
| (iii) | |
| 0.26 (0.032) | (iii′) |
| | 0.20 |
| | 0.18 (0.011) |
| | **0.19** |

* Exclusive of the "initial vibration." Mean values are printed in gothic figures.

**96. *Strong non-explosive eruptions observed at Yuno-taira: longitudinal component.*** The duration of the preliminary small portion in the different strong non-explosive eruptions was as follows:—

| sec. | | mm | sec. | | mm |
|---|---|---|---|---|---|
| 1.5 | (max. | 2a=0.0027) | 47.7 | (max. | 2a=0.0067) |
| 2.0 | ( ,, | 0.034) | 56.6 | ( ,, | 0.021) |
| 2.3 | ( ,, | 0.048) | | | |
| 3.2 | ( ,, | 0.023) | | | |

Mean, 2.3 sec.

In the 1st four cases, the duration in question varied between 1.5 and 3.2 sec., with the average of 2.3 sec.; while in the two remaining cases, it was very long, being about 50 and 60 sec. respectively. Again, the total duration of the principal portion varied between 13.1 sec. and 43.6 sec., with the average of 24.2 sec., while the duration of the specially active part varied between 9.0 and 11.2 sec., with the average of 9.9 sec., as indicated below:—

| Principal Portion. | Specially active part. |
|---|---|
| 13.1 sec. | 9.0 sec. |
| 13.4 „ | 9.4 „ |
| 21.1 „ | 11.2 „ |
| 25.0 „ | Mean, 9.9 sec. |
| 28.7 „ | |
| 43.6 „ | |
| Mean, 24.2 sec. | |

The greatest 2a of the "initial vibration," which was distinctly indicated in three of the cases, was 0.043 mm; the T being 1.08 to 2.1 sec., as follows:—

| | | | | | |
|---|---|---|---|---|---|
| T=2.1 sec.; | 1st motion | =0.010 mm, | 2nd motion | =0.034 mm |
| 2.0 „ | „ | 0.0097 „ | „ | 0.043 „ |
| 1.08 „ | „ | 0.0052 „ | „ | 0.012 „ |

As will be seen from Table XXI, the periods most frequently occurring in the preliminary portion, the principal portion, and the end portion varied between 1 and 1.5 sec., the average values being respectively 1.21; 1.26; and 1.21 sec. Taking together the three different phases of motion, we obtain the following mean values of period:—(i), 0.32 sec. (max. 2a=0.022 mm); (ii), 0.75 sec. (max. 2a=0.015 mm); (iii), 1.24 sec. (max. 2a=0.048 mm); (iv), 1.85 sec. (max. 2a=0.0067 mm).

**TABLE XXI. STRONG NON-EXPLOSIVE ERUPTIONS IN 1913, OBSERVED AT YUNO-TAIRA: PERIODS.* (LONGITUDINAL COMPONENT.)**

(The 2a corresponding to a given period is enclosed within brackets.)

| Preliminary Portion. | Principal Portion. | End Portion. |
|---|---|---|
| sec. mm | sec. mm | sec. |
| 0.23 (0.0013) | 0.30 (0.016) | 0.23 |
| 0.31 (0.0004) | 0.23 | 0.27 |
| 0.39 | 0.45 (0.009) | 0.36 |
| 0.42 | 0.24 (0.011) | 0.44 |
| **0.34** | 0.27 (0.022) | **0.33** |
| | **3.0** | |
| 0.61 (0.0023) | 0.71 (0.0033) | mm<br>0.58 (0.0015) |
| 0.73 | 0.80 (0.015) | 0.64 (0.004) |
| | 0.90 (0.008) | 0.67 |
| 0.99 (0.0010) | 0.94 | 0.76 (0.0059) |
| 1.2 (0.0008) | **0.84** | 0.77 |
| 1.3 (0.0024) | | 0.82 |
| 1.35 (0.0040) | 1.00 (0.016) | **0.71** |
| **1.21** | 1.10 (0.021) | |
| | 1.14 (0.026) | 0.97 |
| | 1.18 (0.009) | 1.04 |
| | 1.19 (0.013) | 1.08 (0.0037) |
| | 1.20 (0.0027) | 1.24 (0.0041) |
| | 1.23 (0.023) | 1.25 |
| | 1.27 (0.0047) | 1.27 |
| | 1.34 (0.021) | 1.35 (0.0021) |
| | 1.45 (0.023) | 1.50 |
| | 1.55 (0.031) | **1.21** |
| | 1.54 (0.048) | |
| | **1.26** | 1.80 (0.0019) |
| | 1.90 (0.0067) | |

* Exclusive of the "initial vibration." Mean values are printed in gothic figures.

**97. *Small non-explosive eruptions and volcanic tremors on Oct. 2nd, 1912: longitudinal component.*** As indicated in the accompanying table, the duration of the principal portion of the non-explosive eruptions varied between 5.7 and 18.6 sec., with the mean value of 10.7 sec.; while that of the preliminary phase was comparatively long and varied between 4.2 and 8.8 sec., with the mean value of 5.8 sec. Thus the preliminary phase lasted on the average about half as long as the principal portion.

| Duration of Preliminary Portion. | Duration of Principal Portion. |
|---|---|
| 4.2 sec. | 5.7 sec. 9.4 sec. |
| 4.3 | 8.0 10.4 |
| 4.5 | 8.1 10.6 |
| 4.7 | 8.4 11.6 |
| 5.4 | 9.0 12.8 |
| 5.6 | 9.0 14.4 |
| 5.6 | 9.0 15.0 |
| 6.6 | 18.6 |
| 6.9 | *Mean*, **10.7** sec. |
| 7.0 | |
| 8.8 | |
| *Mean*, **5.8** sec. | |

The different periods occurring in the *small eruptions*, which may be grouped into 3 divisions (Table XXII), give the average values practically identical with those in the *volcanic tremors*, as follows:—

Small Eruptions ....(i) 1.32 sec.; (ii) 0.91 sec.; (iii) 0.46 sec.
Volcanic Tremors.... 1.25 „ ; 0.91 „ ; 0.41 „

In the cases of the small eruptions, the greatest vibrations (max. $2a = 0.0283$ mm) belonged to the group (i). In the volcanic

tremors, the largest vibrations (max. 2a=0.0068 or 0.0067 mm) belonged to the two groups (i) and (ii).

**TABLE XXII. SMALL ERUPTIONS AND VOLCANIC TREMORS ON OCT. 2ND, 1912, OBSERVED AT YUNO-TAIRA ; PERIODS. (LONGITUDINAL COMPONENT).**

(The 2a corresponding to a given period is enclosed within brackets).

| Non-explosive Eruptions (Prel. Tremor, Princ. Portion, Tail). | | | | Volcanic Tremors. | |
|---|---|---|---|---|---|
| sec. mm | sec. mm | sec. mm | sec. mm | sec. mm | sec. mm |
| 1.39 (0.0044) | 1.10 (0.0068) | 0.58 (0.0102) | 0.46 | 1.32 (0.0047) | 0.55 (0.0036) |
| 1.37 (0.0283) | 1.06 | 0.58 | 0.46 | 1.32 | 0.50 (0.0047) |
| 1.35 (0.0089) | 1.04 (0.0102) | 0.58 | 0.46 | 1.30 (0.0042) | 0.49 (0.0041) |
| 1.32 (0.0037) | 1.04 | 0.57 (0.0040) | 0.44 (0.0093) | 1.29 (0.0068) | 0.49 |
| 1.27 (0.0235) | 1.03 | 0.56 (0.0012) | 0.42 | 1.26 (0.0037) | 0.46 (0.0014) |
| 1.27 | 1.01 | 0.56 | 0.41 (0.0068) | 1.24 (0.0067) | 0.45 (0.0021) |
| 1.27 | 0.92 (0.0096) | 0.55 (0.0125) | 0.40 (0.0017) | 1.23 (0.0056) | 0.38 (0.0009) |
| **1.32** sec. | 0.92 | 0.53 (0.0049) | 0.40 | 1.19 (0.0039) | 0.34 (0.0017) |
| | 0.89 | 0.53 | 0.40 | 1.18 (0.0042) | 0.32 (0.0009) |
| | 0.89 (0.0009) | 0.52 (0.0246) | 0.40 | 1.17 (0.0089) | 0.32 (0.0017) |
| | 0.82 (0.0008) | 0.52 | 0.36 (0.0129) | **1.25** sec. | 0.29 (0.0025) |
| | 0.72 (0.0008) | 0.48 (0.0093) | 0.36 | | 0.27 (0.0017) |
| | 0.70 (0.0035) | 0.48 | 0.36 | 1.00 (0.0027) | **0.41** sec. |
| | 0.64 (0.0008) | 0.47 (0.0164) | 0.36 | 0.97 (0.0034) | |
| | **0.91** sec. | 0.47 | 0.35 (0.0041) | 0.96 (0.0033) | |
| | | 0.46 (0.0030) | 0.33 (0.0081) | 0.95 (0.0046) | |
| | | | 0.31 (0.0078) | 0.95 | |
| | | | **0.46** sec. | 0.94 (0.0055) | |
| | | | | 0.93 (0.0067) | |
| | | | | 0.92 (0.0037) | |
| | | | | 0.88 (0.0057) | |
| | | | | 0.85 (0.0047) | |
| | | | | 0.84 (0.0060) | |
| | | | | 0.83 (0.0044) | |
| | | | | 0.82 (0.0049) | |
| | | | | **0.91** sec. | |

**98. *Small eruptions in* 1911-1912 *observed at Yuno-taira.*** Table XXIII gives the total duration, and the durations of the preliminary tremor and of the principal portion in the longitudinal and transverse components of the 17 small eruptions observed at

Yuno-taira in the summer months of 1911 and 1912, arranged in order of time length.

**TABLE XXIII. SMALL ERUPTIONS IN 1911-1912 observed at Yuno-taira: Duration.**

| Total Duration. | Duration of Prel. Tremor. | | Duration of Princ. Portion. | |
|---|---|---|---|---|
| | Longitudinal. | Transverse. | Longitudinal. | Transverse. |
| 15 sec. | 0.7 sec. | 3.4 sec. | 4.6 sec. | 8.7 sec. |
| 20 | 1.3 | 4.2 | 9.5 | 8.8 |
| 25 | 2.0 | 4.8 | 10.0 | 12.8 |
| 26 | 3.1 | 5.3 | 11.3 | 14.6 |
| 28 | 3.8 | 6.1 | 11.5 | 15.0 |
| 30 | 3.9 | 18.2 | 13.2 | 15.8 |
| 40 | 4.6 | | 14.0 | |
| 43 | 5.0 | | 14.6 | |
| 45 | 5.1 | | 15.0 | |
| 54 | 5.8 | | 18.3 | |
| 60 | 6.0 | | 18.6 | |
| 65 | 6.6 | | 19.2 | |
| 65 | 9.0 | | 19.8 | |
| 68 | 16.8 | | | |
| 73 | | | | |
| 80 | | | | |
| Mean, **46** | **5.3** | **7.0** | **13.8** | **12.6** |

According to the above table, the total duration of the disturbances varied mostly from 25 to 70 sec., with the mean value of 46 sec.; while the duration of the principal portion was limited generally between about 9 and 20 sec., with the mean of about 13 sec. The latter may be taken as indicating the average length of time, during which the smokes continued to be emitted vigorously in the small outbursts under consideration. The duration of the

**TABLE XXIV. SMALL ERUPTIONS IN 1911 AND 1912 OBSERVED AT YUNO-TAIRA: PERIODS.**

(The 2a corresponding to a given period is enclosed within brackets.)

| Longitudinal Component. | | | | | | Transv. Compt. | |
|---|---|---|---|---|---|---|---|
| (i) | | (ii) | | (iii) | | ($i_1$) | |
| sec. | mm. | sec. | mm. | sec. | mm. | sec. | mm. |
| 1.7 | (0.001) | 0.95 | (0.015) | 0.52 | | 1.4 | (0.0033) |
| 1.6 | (0.006) | 0.94 | (0.002) | 0.47 | (0.0028) | 1.25 | (0.014) |
| 1.6 | | 0.93 | (0.0026) | 0.47 | | 1.2 | |
| 1.6 | | 0.92 | | 0.44 | | **1.28** | |
| 1.5 | (0.013) | 0.91 | | 0.43 | | | |
| 1.5 | | 0.90 | (0.018) | 0.40 | (0.017) | ($ii_1$) | |
| 1.4 | (0.0025) | 0.90 | | 0.40 | | mm. | |
| 1.4 | | 0.87 | (0.0052) | 0.40 | | 0.91 | (0.0036) |
| 1.4 | | 0.87 | | 0.38 | | 0.88 | (0.005) |
| 1.35 | (0.0046) | 0.86 | (0.0036) | 0.37 | | 0.80 | (0.021) |
| 1.32 | (0.022) | 0.82 | (0.0023) | 0.35 | | 0.79 | (0.018) |
| 1.20 | (0.019) | 0.82 | | 0.33 | | 0.78 | (0.0035) |
| 1.20 | | 0.80 | (0.013) | 0.30 | | 0.77 | (0.030) |
| 1.20 | | 0.80 | | 0.26 | | 0.72 | (0.014) |
| 1.10 | (0.023) | 0.80 | | **0.39** | | 0.72 | |
| 1.08 | | 0.78 | (0.0031) | | | 0.67 | (0.004) |
| **1.38** | | 0.76 | (0.0036) | | | 0.65 | (0.0018) |
| | | 0.75 | (0.031) | | | 0.58 | |
| | | 0.74 | (0.007) | | | 0.54 | |
| | | 0.74 | | | | 0.53 | (0.017) |
| | | 0.72 | (0.0025) | | | **0.72** | |
| | | 0.71 | | | | | |
| | | 0.66 | | | | | |
| | | 0.65 | (0.0026) | | | | |
| | | 0.65 | | | | | |
| | | 0.63 | (0.0013) | | | | |
| | | 0.60 | | | | | |
| | | **0.80** | | | | | |

preliminary tremor, which is in the present instances to be regarded as mainly denoting the interval of the premonitary phase of the eruption, varied within wide limits, namely, from 0.7 sec. up to 18.2 sec.; the discrepancy of 1.7 sec. between the average values in the longitudinal and the transverse directions, namely, 5.3 and 7.0 sec., being probably due to the difference in the propagation velocity of the two component waves.

The periods of vibrations occurring in the different cases were, arranged according to descending order of magnitude, as in Table XXIV; the mean values of the different groups being, for the longitudinal component, 1.38 sec. (max. $2a=0.023$ mm), 0.80 sec. (max. $2a=0.031$ mm), 0.39 sec. (max. $2a=0.017$ mm), and, for the transverse component, 1.28 sec. (max. $2a=0.014$ mm), 0.72 sec. (max. $2a=0.030$ mm).

**99.** ***Average vibration periods at different places.*** In Table XXV are collected the average values of the different group periods occurring in the seismograms of the various Asama-yama eruptions observed at Yuno-taira, the Asama Pasture Ground, and Ashino-taira; those in the records of the ordinary or distant earthquakes (Chapter XI) obtained at the two former places being also given, for the sake of reference.

**TABLE XXV. AVERAGE VIBRATION PERIODS AT THE DIFFERENT OBSERVING PLACES. (L)....LONGITUDINAL. (T)....TRANSVERSE.**

Periods of frequent occurrence are printed in thick letters, while those corresponding to large 2a are indicated with *asterisks*.

| Eruption. | Observing Place. | | i | ii | iii | iv | v | vi |
|---|---|---|---|---|---|---|---|---|
| | | | sec. | sec. | sec. | sec. | sec. | sec. |
| Strong Explosion. | Yuno-taira | L .... | — | 5.3* | 2.1 | **1.3*** | **0.74*** | 0.37 |
| | | T .... | — | — | 2.5? | **1.4** | — | — |
| | Asama Pasture Ground | L .... | — | 4.4 | **2.45*** | — | **0.97*** | 0.35 |
| | | T .... | — | 4.4 | **2.46*** | — | **1.04*** | |
| | Ashino-taira | L .... | — | — | **2.4*** | **1.18** | — | 0.35 |
| | | T .... | — | — | **2.5*** | **1.15** | — | |
| Strong Non-Explosive Eruption. | Yuno-taira | L .... | — | — | 1.85 | **1.23*** | **0.74** | 0.33 |
| | | T .... | | | | | | |
| | Asama Pasture Ground | L .... | — | — | 2.4* | **1.03** | — | 0.23 |
| | | T .... | — | — | 2.02* | **1.15** | — | |
| Small Eruptions (1911—1912). | Yuno-taira | L .... | — | — | — | 1.38 | **0.80*** | 0.39 |
| | | T .... | — | — | — | 1.28 | **0.72*** | — |
| Small Eruptions and Volc. Tremors. (Oct. 2nd, 1912.) | *Do.* | L .... | — | — | — | **1.32*** | **0.91** | **0.46** |
| | | T .... | — | — | — | **1.25*** | **0.91** | 0.51 |
| Ordinary Earthquakes. | Yuno-taira. | L .... | 26.4 | 6.0 | 2.2 | — | 0.95 | 0.38 |
| | Asama P. G. | L .... | — | 5.4 | — | — | 0.76 | 0.28 |

According to Table XXV, the vibrations composing the earthquake movements caused by the eruptions of the Asama-yama, whether explosive or non-explosive, seem to be essentially of equal periods at the different observing places; there being no material difference in this respect between the longitudinal and the transverse components. The periods can evidently be classified into the five groups, ii, iii, iv, v, and vi, whose general average values are as follows:—

(ii) 4.9 sec.
(iii) 2.3 „
(iv) 1.23 „
(v) 0.85 sec.
(vi) 0.37 „

The period most frequently occurring are (v) and (iv), and then (iii), while all these three groups correspond to the large values of 2a. Further, it seems probable from the table, that the different periods occurring in the cases of the eruptions, and others much longer, are to be found in the diagrams of ordinary, or non-volcanic, earthquakes observed on, or at the base of, the Asama-yama. The various periods considered above must, therefore, be assumed to be characteristic of the mass of the volcano, including the region surrounding it. The period (ii) is identical in nature with the pulsatory oscillations, while (iii) is evidently identical with the period of the "initial vibration" (§ 91). Thus the duration of the eruptive process at the moment of the outburst seems to be regulated by the proper oscillations of the mountain system itself. The quick vibrations of period (vi) of about $\frac{1}{3}$ sec., which occurred some interval after the "initial vibration," may possibly be the surface waves caused by the latter and the succeeding large movements attending the actual explosion. The time interval between the first appearance of those minute movements and the earthquake commencement seems to be different for the three places of observation. (See Chapter XIV.)

As may be noticed from Table XXV, there is no fundamental difference in the values of the various periods between the longitudinal and the transverse components. In a few cases, however, the period of the vibrations occurring at the commencement of the transverse component was half of that in the corresponding epoch of the longitudinal, a property which is often found to be the case of the movements in the two directions in question.

**100.** ***Direction of preliminary portion and "initial vibration."*** The average durations of the preliminary portion of the small eruptions and volcanic micro-tremors on Oct. 2nd, 1912, and

of the other small eruptions considered in Chapter VIII, were respectively 5.3 and 5.8 sec., those of the strong non-explosive eruptions being sometimes much longer. The preliminary portion in these cases are quite different in nature from the ordinary preliminary tremor. The preliminary portion, or the exceedingly small outward displacement at the very commencement of the explosive eruptions, seem to be almost entirely longitudinal in nature. Thus, in the three explosions of July 7th and 13th, 1913, and of May 5th, 1914, observed at Yuno-taira, the directions of the motion in question were respectively N70° W, S88° W, and S85° W, giving the mean of about N85° W, while the crater is approximately towards the N20° E from the observatory. Again, in each of the eruptions of July 7th and Nov. 20th, 1913, observed at Yuno-taira, the direction of the preliminary portion was nearly longitudinal.

The direction of the 1st displacement of the "initial vibration" was also accurately or very nearly longitudinal in the cases of the 4 explosions observed at the Asama Pasture Ground. In the 3 cases of the explosions of July 7th and 19th, 1913, and of May 5th, 1914, the direction in question were respectively toward N63° E, N70° E, and N86° E, giving the mean of N73° E, or the direction of the crater.

**101.** ***Small slow regular vibrations on Aug. 12th,*** **1913.** (Fig. 48.) For $13\frac{1}{2}$ min. between $1^h\ 26\frac{2}{3}^m$ and $1^h\ 40\frac{1}{4}^m$ p.m., on Aug. 12th, 1913, the tromometer diagrams indicated an unbroken series of perfectly regular small vibrations, which were not due to a direct explosion or earthquake shock, but must have been the result of a gradual accumulation of some internal volcanic tension composing a forerunner of the subsequent strong explosions. According to this assumption the movements under consideration were

nothing else than one of the types of the natural vibrations of the top portion of the Asama-yama, or the surface rocky material resting on the lava reservoir, which was thrown into a state of free oscillations by the incessant or frequent applications of impulsive pressure from within, just in the same manner as a bridge truss of long span is caused to vibrate with a gradually increasing amplitude by the running of a man or the slow passage of a train over it.

*Tromometer Diagram*: *Longitudinal Component.* The motion, which was at first small, with the average period of 1.24 sec., was gradually increased in the course of about 130 sec. to 2a= 0.0028 mm, with the average period of 1.34 sec.; thence decreasing to a minimum in about 32 sec. For the next $2\frac{1}{4}$ min. the motion presented a series of smaller vibration groups at an average interval of about 29 sec., the mean value of the average periods measured in the maximum and minimum parts being respectively 1.17 and 1.16 sec. as follows.

| Maximum Part:— | | Minimum Part:— | |
|---|---|---|---|
| T=1.16 sec. | (max. 2a=0.0018 mm) | T=1.20 sec. | (max. 2a=0.0014 mm) |
| 1.15 „ | ( „ 0.0025) | 1.13 „ | ( „ 0.0011) |
| 1.27 „ | ( „ 0.0018) | 1.17 „ | ( „ 0.0011) |
| 1.08 „ | ( „ 0.0018) | 1.13 „ | ( „ 0.0007) |

In the later portion, the elements of the well defined motion was as follows: T=1.13 sec., 2a=0.0015 mm.

In the tremor-recorder diagram (magnification=100), the motion was only slightly indicated in the longitudinal direction, but distinctly in the transverse direction. The average period in the principal part of the latter component was 1.27 sec. It may be remarked that the period of the regular vibration in question was the same as that of the group (iv) in § 99.