35. *On Volcanic Activities and Tilting of the Earth's Surface.*

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(Read May 21, 1942.—Received Sept. 20, 1942.)

1. Introduction.

That marked topographical deformations accompanied explosive volcanic activities were made clear in the case of a number of volcanoes from resurveys by triangulations and precise levellings. For example, during the activities in the Usu volcano,[1] Hokkaido, in 1910, Sakurazima[2] in 1914, Komagadake[3] in 1929, Miyake-sima[4] in 1940, and Asama[5] in recent years, large scale subsidences and elevations in the vicinity of these volcanoes were brought to light. Similar results were noticed by foreign investigators in the cases of Merapi,[6] Central Java, Kilauea,[7] Hawaii, etc.

Since these deformations appear at a point on the earth's surface as variations in the inclination of the ground, it seems reasonable to expect marked tiltings of the ground in volcanic regions as an usual accompaniment of volcanic activities.

Although these volcanoes do not all show the same characteristics in their eruptions, the marked deformations of the ground, namely, tilting of the earth's surface, that accompany them are a common feature. In the case of active volcanoes, however, continuous and precise observations of these tilts have not yet been made for a sufficient length of time to yield accurate knowledge with respect to the relation between volcanic activities and the variations in the inclination of the ground.

In the Hawaiian Volcano Observatory, T. A. Jaggar[8] has been

1) F. ÔMORI, *Bull. Imp. Earthq. Inv. Comm.*, 5 (1911~1913), 1.
2) F. ÔMORI, *Bull. Imp. Earthq. Inv. Comm.*, 8 (1914~1922), 323.
3) C. TSUBOI, *Bull. Earthq. Res. Inst.* 8 (1930), 298.
4) S. OMOTE, *Bull. Earthq. Res. Inst.* 20 (1942), 127.
5) Land Survey Department, *Bull. Earthq. Res. Inst.* 18 (1940), 463.
6) M. NEUMANN and M. HARTMANN, Mededelingen van Dienst van den Mijnbouw in Nederlandisch Indie.
C. E. STEHN, *Bull. Nether. Ind. Vol. Surv.* (1928~1940).
7) A. E. JONES, *Bull. Seis. Soc. Amer.*, 27 (1937), 113.
8) T. A. JAGGAR, *Volcano Letter*.

continuing tilt observations by means of Bosch-Omori seismographs since 1913.

Although severe eruptions occurred in Kilauea[9] in 1920 and 1932, no relation of the activities to the tilt of the ground could be established. Judging from Jaggar's reports, the instruments used for the purpose were too unduly affected by variations in air temperature to enable study of the ground tilts that accompany volcanic activities.

In the Asama Volcano Observatory, similar observations, by means of Ishimoto's clinographs have been made since 1934, the results of which have been reported in the Bulletin.[10] In this paper, the writer presents the results of tilt observations made during the last 8 years and some discussions on their correlations with volcanic activities.

2. Explosive Activities of Asama Volcano and the Intensity Scale of the Explosion.

It is doubtless well known that in the case of volcanoes, an earthquake is accompanied with an explosion, which we now call an explosion earthquake for convenience of description.

Fig. 1. a, is a seismogram of an explosion earthquake recorded at a distance of 4·5 km east of the Asama crater. Investigations of these explosion earthquakes show that the periods of the P, S, and surface waves, are all about 1·5 second. Whence it may be said that the periods of P and S waves of explosion earthquakes are markedly larger than those of ordinary volcanic earthquakes, in contrast to which, the phases of S waves of explosion earthquakes is not recognized so distinctly on their seismograms.

A very marked character of an explosion earthquake is that the surface waves are markedly dominant, its amplitude corresponding to five or ten times that of the P and S waves, the probable reason for which is that the hypocentre of an explosion earthquake is very shallow.

On the other hand, in the neighbourhood of the Asama volcano, there occur sometimes other kinds of earthquakes which do not accompany volcanic explosions, being mostly of very small intensity (see Fig. 1 b). The depths of these hypocentres are estimated at about two or three kilometres below the earth's surface. From the wave forms of this kind of earthquake on the seismograms, it is difficult to

9) T. A. JAGGAR and R. H. FINCH, *Bull. Seis. Soc. Amer.*, **19** (1929), 38.
10) R. TAKAHASI and T. MINAKAMI, *Bull. Earthq. Res. Inst.*, **15** (1937), 463. T. MINAKAMI, *Bull. Earthq. Res. Inst.*, **16** (1938), 372. *Proc. 6th Pac. Sci. Cong.*, (1939), 859.

distinguish it from those of an ordinary tectonic earthquake that is recorded near its epicentre. In other words, the phases of the P and S waves are distinctly recognized on the seismogram, their periods being about 0·2 second, much shorter than those of the former kind of earthquake. As seen on the seismogram, it is easy to distinguish the one from the other (see Figs. 1 a, b). F. Omori[11] noticed already

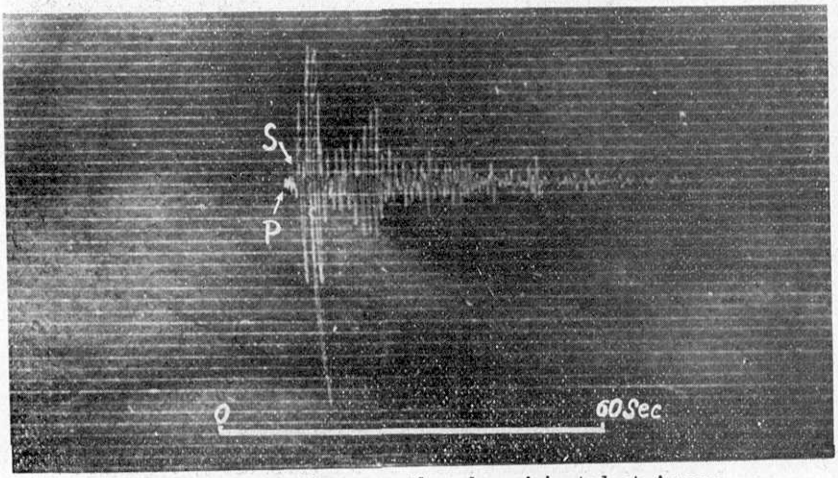

Fig. 1 a. An ordinary earthquake originated at Asama.

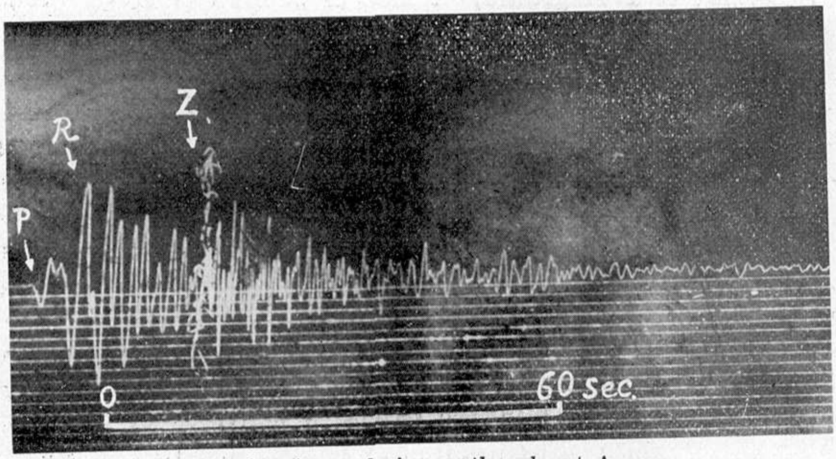

Fig. 1 b. An explosion earthquake at Asama.
R=surface wave, Z=sound wave.

the occurrence of these two kinds of the volcanic earthquakes at Asama in 1910∼1914.

These two kinds of volcanic earthquakes occur not only in the

11) F. Ômori, *Bull. Imp. Earthq. Inv. Comm.*, **6** (1912∼1914); **7** (1914∼1917).

Asama volcano of the "*vulkano* type" but also in Miyake-sima and Oosima of the "*strombolian* type". An example of these two kinds of earthquakes occurred at Miyake-sima at the time of its explosive activity of July 1940, (Fig. 2 a, b).

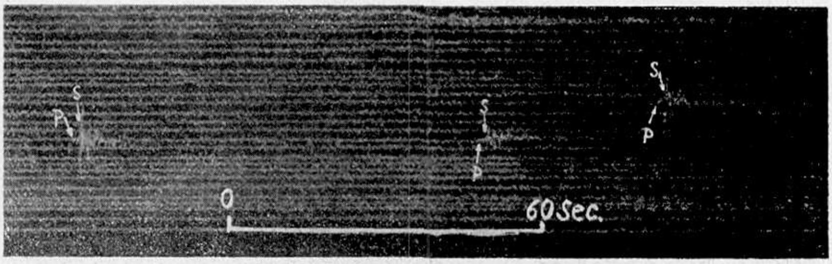

Fig. 2 a. Earthquakes originated at Miyake-sima.

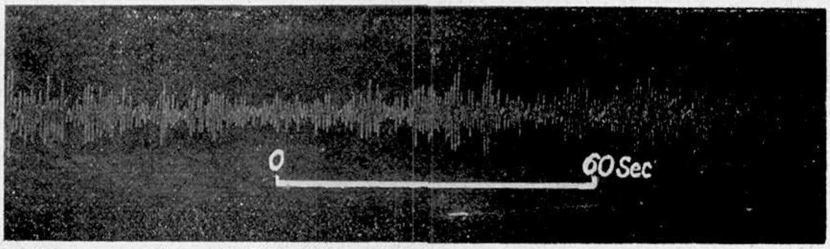

Fig. 2 b. Volcanic Pulsation caused by the eruptions of Miyake-sima.

According to T. Hagiwara,[12] a number of earthquakes of ordinary type occurred at depths of 3 or 4 km below the central part of Miyake-sima island. The explosions of the island at the time, which occurred at short intervals of a few seconds, continued for two weeks—a character common to eruptions of the *strombolian* type. In this activity of Miyake,[13] explosion earthquakes occurred with each individual explosive eruption at short intervals of a few seconds, with the result that on seismograms recorded at a distance of 4 km from the origin, these explosion earthquakes appeared as continuous waves of the pulsation type throughout the whole period of volcanic activity. The amplitudes of seismic waves of the continuous pulsations increased or decreased with changes in the intensity of explosion. The same phenomenon was observed in the explosive activities of *strombolian* type volcanos, namely, Kusatu-Sirane,[14] in 1937 and 1938, Oosima[15] in 1940, and Aso in 1932.[16]

12) T. HAGIWARA, *Bull. Earthq. Res. Inst.*, **19** (1941), 323.
13) T. MINAKAMI, *Bull. Earthq. Res. Inst.*, **19** (1941), 331.
14) T. MINAKAMI, *Bull. Earthq. Res. Inst.*, **17** (1939), 590.
15) M. TAKEHANA, *Kensin Zihô*, **11** (1940), 321.
16) K. SASSA, *Mem. Coll. Sci. Kyoto Imp. Univ.*, **18** [A] (1935), 256; **19** [A] (1936), 11.

Full discussion of the marked characters of these two kinds of volcanic earthquakes will be reserved for a later opportunity.

Since, in the activity of Asama, every explosion occurred with an interval of several hours, at least, and in most cases several days, it is easy to identify on the seismograms the corresponding earthquakes that accompanied the explosive eruptions. Reviewing the volcanic activities of Asama during the last ten years, it will be found that, although no explosions occurred in the years 1933 and 1934 at all, a number of severe and moderate explosions occurred during the period 1935～1942, in which there were several tens of times of ebb and flow in the activity.

At all events the volcano was generally active throughout the period just mentioned, the number of strong and moderate explosions totaling five hundred. From this large number, twenty explosions were selected for which the individual kinetic energies were estimated from studies of the mass of the ejecta and of the motion of flight of the ejecta, as reported in previous papers.[17]

According to these results, the severest explosion that occurred in this period had an energy of $1{\cdot}7\times10^{20}$ ergs and 567 atmospheric pressure at the instant of explosion, while explosions of such intensity as 10^{19} ergs occurred now and then.

In Volcano Asama, which is of typical *vulkano* type, the energy of an explosion reached 10^2 or 10^3 times that of Miyake, in 1940, or that of Oosima, in 1940, both of which are typical *Strombolian*.

Seismic observations were continuously made throughout the period with two pairs of two-horizontal seismographs at a distance of 4·5 km east of the crater, and all the explosion earthquakes recorded.

Constants of Seismograph.

I	Magnification	$V_0=100$
	Period	$T_0=5{\cdot}0$ sec.
II	Magnification	$V_0=360$
	Period	$T_0=1{\cdot}0$ sec.

These numerous explosion earthquakes were thus recorded at the same station by the same seismographs. Since these explosions occurred in the central crater of the volcano, their hypocentres and the

17) T. MINAKAMI, *Bull. Earthq. Res. Inst.*, 20 (1942), 65.

medium through which the seismic waves are propagated are nearly the same. A comparison of the seismograms of these explosion earthquakes shows that their wave forms markedly resemble one another, and that the amplitudes of the seismic waves, especially in the surface waves, depend on the intensity of the explosion, from all which it may be reasonably supposed that these explosion earthquakes occurred by means of almost the same mechanism, although their intensities differed.

In order to obtain an intensity scale of explosion, the kinetic energies of the twenty explosions just mentioned and the maximum amplitudes of the surface waves of the corresponding explosion earthquakes are taken, as the result of which these two quantities are found to be connected by a simple relation as expressed by the formula

$$E=[0{\cdot}03+4{\cdot}50\,A+0{\cdot}70\,A^2\pm0{\cdot}08]\times10^{19}\text{ ergs}, \tag{1}$$

where

E=energy of explosion,

A=maximum horizontal amplitude of surface wave (mm in unit),

$$A=(A^2_{EW}+A^2_{NS})^{\frac{1}{2}}.$$

The constant term in (1) is due to the solid friction of the various points in the seismographs and the dissipation of the seismic waves in the medium on their course from the origin to the station.

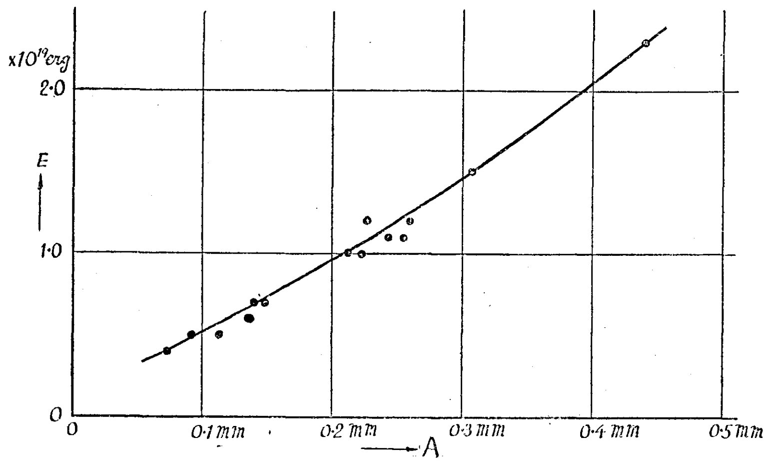

Fig. 3. Relation between an explosion energy and the maximum amplitude of the surface waves caused by the explosion.

Table I. Maximum amplitude of the surface wave and explosion energy.

		$A_{E\text{-}W}$	$A_{N\text{-}S}$	$\sqrt{A^2_{E\text{-}W}+A^2_{N\text{-}S}}=A$	E
1935					
April	20	0·370 mm	0·245 mm	0·440 mm	$2{\cdot}30\times10^{19}$ erg
May	16	0·195	0·117	0·227	1·20 〃
〃	22	0·065	0·065	0·092	0·50 〃
〃	27	0·150	0·151	0·212	1·00 〃
Sept.	16	0·115	0·094	0·148	0·70 〃
1936					
Feb.	7	0·100	0·098	0·140	0·70 〃
Mar.	7	0·184	0·186	0·260	1·20 〃
July	22	0·087	0·072	0·113	0·50 〃
Oct.	15	0·195	0·238	0·307	1·50 〃
1937					
Mar.	25	0·213	0·142	0·255	1·10 〃
April	6	0·106	0·085	0·136	0·60 〃
〃	16	0·410	0·370	0·552	4·20 〃
Sept.	3	0·200	0·138	0·243	1·10 〃
〃	10	0·055	0·050	0·074	0·40 〃
〃	26	0·160	0·156	0·223	1·00 〃
Nov.	6	0·090	0·104	0·137	0·60 〃

In Table 1, Fig. 3, are shown the kinetic energies of the explosions and the maximum amplitude of the surface waves of the corresponding earthquakes, by means of which relation (1) was determined.

The energy scale of the explosion being obtained, with its aid the energies of all the explosions that have occurred during the last seven years were determined from the results of seismic observations.

Naturally, explosion earthquakes of smaller intensity than 3×10^{17} ergs were not recorded by our seismographs, although rough estimates of the energies of these small explosions were frequently made by investigating the mass of ejecta, of which volcanic ash is the largest constituent, and of the height of the smoke of explosion. According to these investigations, the total energy of these small explosions which are impossible to obtain by scale (1), is only 20 per cent of the total energy of all the explosions that occurred. Although the explosions stronger than 3×10^{19} ergs occurred within the last seven years, the energies of these very strong explosions were obtained directly by investigations of the mass of ejecta and their motion of flight, consequently, the energies of explosions obtained with the aid of formula (1) are those ranging in intensity from 3×10^{17} ergs to 3×10^{19} ergs.

However, the intensity scale given by (1) contributed almost all the energy of the explosions that occurred.

Needless to say, it is possible to enlarge the range of the energy-scale (1) by using seismographs of higher sensibility, or by making the observations at a closer distance from the crater.

Table III A gives the energies of all the explosions obtained with the aid of scale formula (1), with the date and time of their occurrences.

Table III B gives the total energy for every ten days and for every month, in which those of small explosions obtained by field investigations[18] are included.

3. Tilt Observations.

A pair of silica clinographs is placed in a cave of massive natural lava at a distance of 4·2 km E and 6·0 km N of the crater, namely, the Nakano-sawa and the Oniosidasi stations respectively. Continuous observations were begun in 1934 at the former station and in 1936 at the latter. As the air temperature in these observation rooms has a small range of only $0°\pm1°$ throughout the year, the unfavourable effects of air temperature on the instruments are greatly reduced. The records of tilts are obtained on bromide paper. The sensibility of the instruments are so adjusted that 1 cm on the bromide paper represents one second of arc of tilt.

The results of tilt observations at these two stations are represented by the two components (E-W, N-S) of the tilt (Figs. 4, 5).

Judging from the structure of the ground, the Oniosidasi station is not so favourably situated for the present purpose as the one at

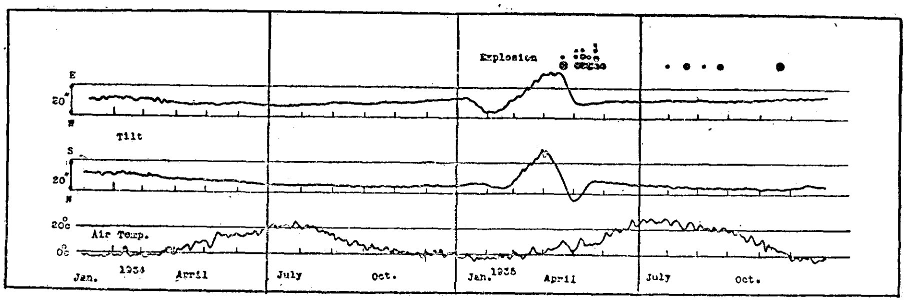

Fig. 4. (a). Tilting of the ground and occurrences of explosion in 1935.

18) T. MINAKAMI, *Bull. Earthq. Res. Inst.* 20 (1942), 93.

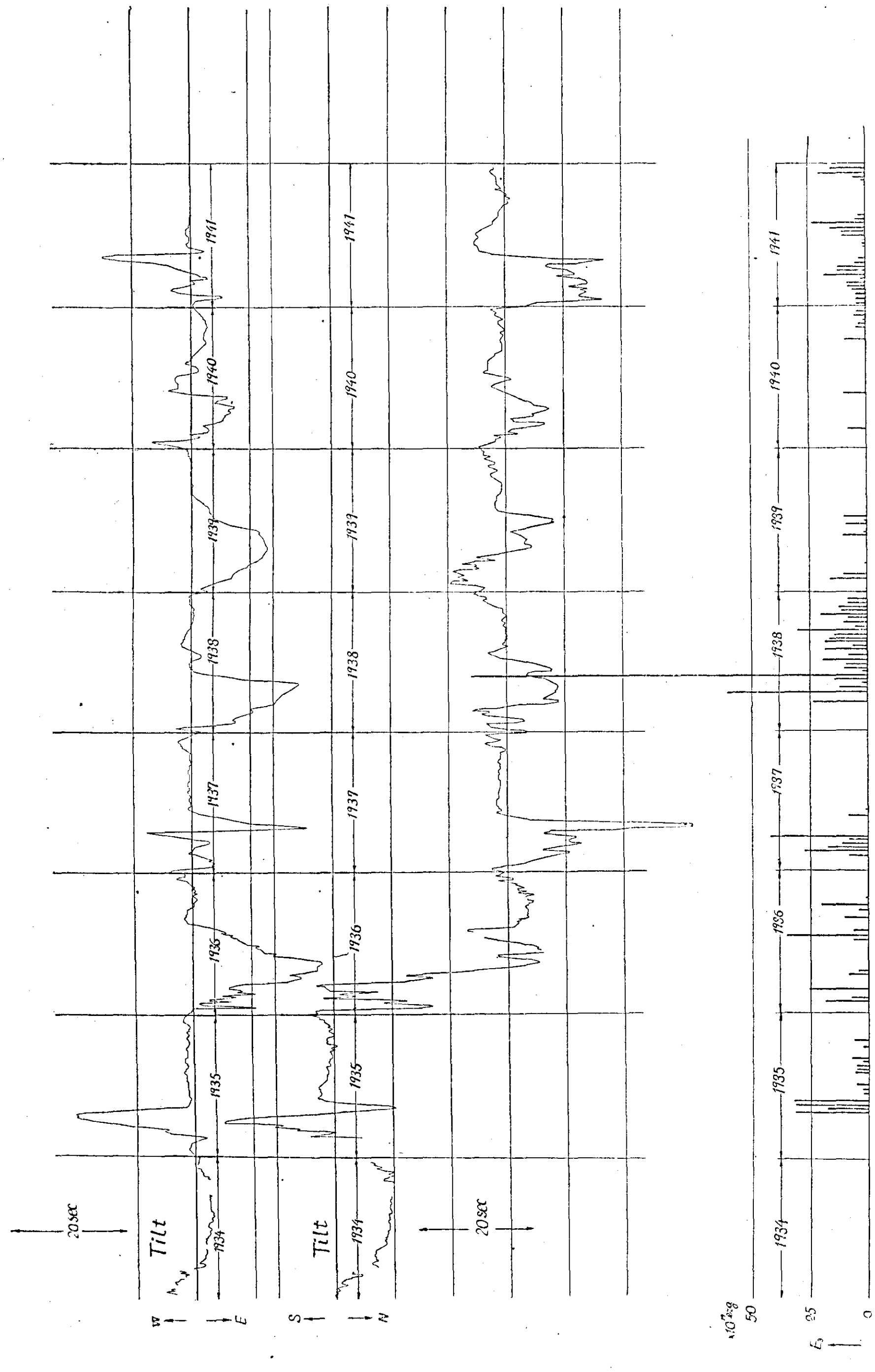

Fig. 4. (b). Tilting of the earth's surface at Nakanosawa, and the sum of the explosion energies for every ten days.

Nakanosawa. Besides, the Oniosidasi station lies at such an inconvenient place for the observers to reach that some parts of the observations were missed. For these reasons, the result at Nakanosawa forms the major part of the subject of the present study.

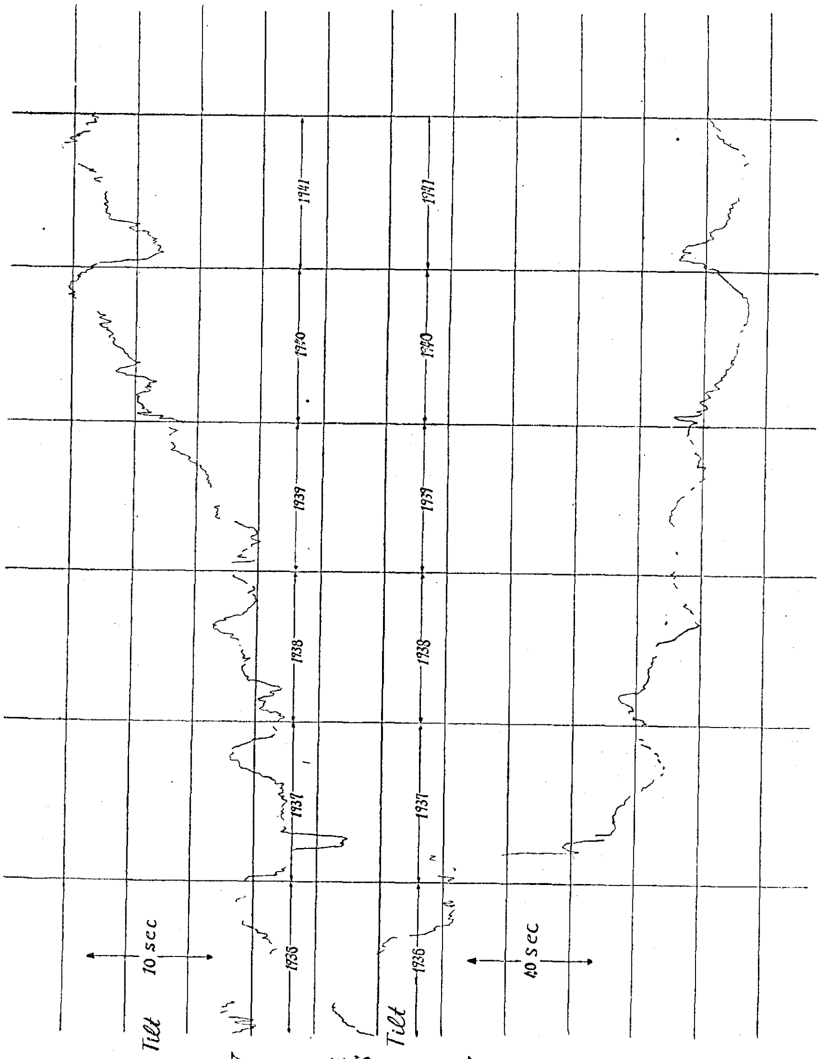

Fig. 5. Tilting at Oniosidasi during 1936~1941.

A glances at the variation curves of the tilt at Nakanosawa, Figs. 4, a, b show that the variations in 1934, in which no explosion occurred, are much smaller than those in other years, in which the volcano frequently showed explosive activities. However, during the quiescent period of 1934, small variations of 3 or 4 seconds of arc appeared in the winter season; and upon reviewing also carefully the original records for active periods we find the same kind of small variation in tilt during the winter season. Moreover, the annual variation in tilt in 1934 was also about 5·0 seconds of arc, so that notwithstanding the very quiescent condition of the volcano such seasonal and annual variations were observed.

Since, on the other hand, the marked variations in tilt observed during 1935~1938 and in 1941 amounted to 20 or 50 seconds of arc, in the matter of form and quantity, these abnormal variations in tilt are an outstanding feature compared with the seasonal and annual variations. As will be seen from Tables III A, B and Figs. 4, the explosions occurred as a swarm of ten or thirty explosions within one or three months. Looking backward on the progress of the two phenomena, we find that marked variations in tilt appeared associated with every one of these explosion-swarms. In comparing the times of occurrence of these two phenomena, we find the very marked fact that the 1st explosion of an explosion-swarm occurred one or one-and-half months after the appearence of an abnormal tilt. In some cases, the tilt began as an elevation in the direction of the crater and returned to the original level within two or three months. But, the directions of these tilts in question are not always in the same sense as those just mentioned. What generally characterizes them is that, within two or three months, the tilt curves mostly resume their original state, scarcely remaining as secular variation.

4. Character Number of Tilt.

A comparison of the tilt curves with the occurrence of explosion swarms (Figs. 4 a, b), suggests remarkable correlation of these two phenomena. In order to enable quantitative treatment of the problem, and to ascertain the relation more precisely, the degree of variability of tilt is defined in the following manner.

From the original records of tilt the reading of (θ'_n) at 12h every day is taken, in which the zero position of tilt is arbitrary, but since the daily variation in tilt is less than 0·2 second of arc, just enough of the effect is nullified to render attainment of the object by taking the readings at the same hour every day. And then, the mean value (θ_n) of the readings for three successive days are adopted.

$$\text{Readings at 12h} = \theta'_1,\ \theta'_2,\ \theta'_3, \ldots\ldots\ldots\ldots \theta'_n. \quad \text{(Table II)}$$

The mean values for three successive days are,

$$\theta_2 = \frac{1}{3}(\theta'_1 + \theta'_2 + \theta'_3)\ ,$$
$$\vdots \qquad \vdots$$
$$\theta_{3n-1} = \frac{1}{3}(\theta'_{3n-2} + \theta'_{3n-1} + \theta'_{3n})\ .$$

Moreover, the difference of the every other mean values (θ_n) are taken. Such as

$$\varDelta\theta_5 \quad = \theta_8 - \theta_2\ ,$$
$$\varDelta\theta_{11} \quad = \theta_{14} - \theta_8\ ,$$
$$\vdots \qquad \vdots$$
$$\varDelta\theta_{6n-1} = \theta_{6n+2} - \theta_{6n-4}\ .$$

By this procedure, small variations of the tilt of which the periods are one or two days, due to the rainfall and other causes, were reduced from the last result. Since these small variations in tilt are undoubtedly only a few seconds of arc, that is, only a few per cent of those that appear during volcanic activities, the final result is hardly affected by the procedure just mentioned, which last is done with the E-W and S-N components of the tilt. Neglecting the direction of tilt, the magnitude of variation alone of the tilt is considered in the following discussion.

By the foregoing procedure, the following quantities are determined:

$$\varDelta\Theta_1 = (\varDelta\theta^2_{1,EW} + \varDelta\theta^2_{1,NS})^{\frac{1}{2}}\ ,$$
$$\vdots \qquad \vdots$$
$$\varDelta\Theta_m = (\varDelta\theta^2_{m,EW} + \varDelta\theta^2_{m,NS})^{\frac{1}{2}}\ .$$

Although by this proceedure, the effects of small variations in tilt that appear during such short intervals as 2 or 3 days were mostly reduced, the effects of long periods, such as the annual and seasonal variations, is contained more or less in the last value ($\varDelta\Theta_m$). For the foregoing discussion, moreover, it is desirable to bring out as clearly as possible only the tilts that are related to volcanic activity.

For this purpose, the variations in tilt $\varDelta\Theta_m$ during periods of volcanic quiescence are subtracted from those that occur during periods of volcanic activity, and the ratio of the residuals and the variation in tilt during periods of volcanic calm is taken.

That is,

$$K = \frac{[\varDelta\Theta_m]_a - [\varDelta\Theta_n]_c}{[\varDelta\Theta_n]_c} = k - 1\ ,$$

where

$$k=\frac{[\varDelta\Theta_m]_a}{[\varDelta\Theta_n]_c},$$

$[\varDelta\Theta_m]_a$ = value of active period,

$[\varDelta\Theta_n]_c$ = „ „ calm period (1934).

The quantity K defined above is a kind of character number representing the degree of variation in the tilt at the time of volcanic activity. These character numbers were obtained for every month (K_1), every half month (K_2), and every six days (K_3), from which results, the maximum values of the character numbers of a month, a half-month, and six days are 25·5, 32·0, and 52·6, respectively.

In Figs. 6, 7, and Tables III, IV, V will be found these values defined above, namely, $\varDelta\theta_{EW}$, $\varDelta\theta_{NS}$, $\varDelta\theta$, K, and the total explosion energy for every ten days E_3. By reviewing the figures of K and E, the correlation between the occurrence of the explosion swarm and the tilts of the earth's surface is made clearer than by comparing with the tilt curves themselves. That is, although the peaks of the energy of explosion swarms that correspond to every peak of the character numbers appear, the former do so one or two month later than the latter. In order to make everything certain, as done in the statistical investigations[19), 20)] of the occur-

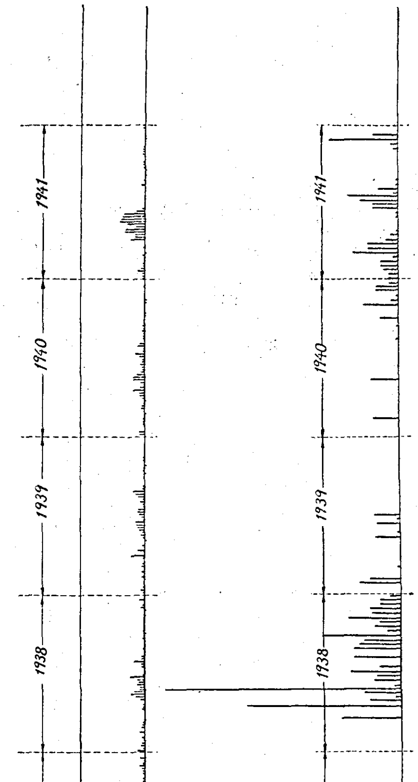

Fig. 7. Character numbers for every six days (K_3), and the sum of the explosion energies for every ten days.

19) T. Matuzawa, *Bull. Earthq. Res. Inst.* **14** (1936), 38.
20) C. Tsuboi, *Bull. Earthq. Res. Inst.* **19** (1941), 559.

Table V. The character numbers for every

$$K_1 = \frac{[\varDelta\theta_a]_m - [\varDelta\theta_c]_m}{[\varDelta\theta_c]_m},$$

$[\varDelta\theta_a]_m$ monthly variation of tilt at the period of volcanic activity.
$[\varDelta\theta_a]_{h.m.}$ semi-monthly variation of tilt at the period of volcanic activity.

		1934		1935		1936		1937	
		K_2	K_1	K_2	K_1	K_2	K_1	K_2	K_1
Jan.	a	0	0	+0·45	+0·6	+3·79	+4·0	+0·92	+3·6
	b	0		+0.35		+4·38		+2·60	
Feb.	a	0	0	+0·76	+1·6	+3·40	+3·4	+0·61	+0·9
	b	0		+2·05		+4·86		+1·67	
Mar.	a	0	0	+3·86	+3·3	+4·85	+3·0	+1·42	+1·4
	b	0		+3·35		+3·66		+1·77	
April	a	0	0	+10·88	+25·5	+8·19	+13·1	+5·13	+24·6
	b	0		+32·00		+8·01		+22·16	
May	a	0	0	+8·93	+5·4	+2·56	+5·9	+12·17	+13·6
	b	0		+1·56		+5·84		+8·34	
June	a	0	0	+0·22	+0·3	+6·94	+8.2	+0·64	+0·4
	b	0		+0·27		+7·62		−0·07	
July	a	0	0	+0·17	−0·1	+3·24	+2·9	−0·30	−0·3
	b	0		−0·60		+0·85		−0·51	
Aug.	a	0	0	+0·08	+0·5	+9·06	+8·4	−0·35	0·0
	b	0		+0·31		+1·84		−0·32	
Sept.	a	0	0	+0·49	+0·7	+0·29	+0·6	−0·22	+0·7
	b	0		+0·62		+0·79		+1·23	
Oct.	a	0	0	−0·48	+0·5	+0·08	+0·6	−0·14	+0·5
	b	0		+0·46		+0·64		−0·11	
Nov.	a	0	0	−0·33	+1·0	+0·17	+0·8	−0·03	+0·7
	b	0		+0·49		+0·48		+1·60	
Dec.	a	0	0	+0·25	+1·0	+1·82	+2.1	+1·73	+2·6
	b	0		+3·66		+4·83		+2·85	

month (K_1) and for a half month (K_2).

$$K_2 = \frac{[\Delta\Theta_a]_{h.m.} - [\Delta\Theta_c]_{h.m.}}{[\Delta\Theta_c]_{h.m.}}.$$

$[\Delta\Theta_c]_m$ monthly variation of tilt at the calm period.
$[\Delta\Theta_c]_{h.m.}$ semi-monthly variation of tilt at the calm period.

1938		1939		1940		1941			
K_2	K_1	K_2	K_1	K_2	K_1	K_2	K_1		
+3·77	+3 8	+1·40	+1·6	+1·75	+1·8	+9·20	+10·0	a	Jan.
+3·95		+1·46		+2·23		+15·4		b	
+2·90	+4·3	+0·75	+0·7	+0·80	+0·4	+6·20	+0·9	a	Feb.
+5·83		+1·53		+0·23		+5·10		b	
+1·03	+0·6	+1·36	+1·1	+2·07	+1 1	+3·10	+0·2	a	Mar.
+0·17		+0·79		+0 45		+4·90		b	
+0·10	+0·6	+2·90	+4·7	+1·81	+5·5	+7·00	+11·1	a	Apr.
+0·0		+1·23		+3·10		+11·1		b	
+5·43	+6·8	−0·22	+0·9	+2·93	+4·4	+17·80	+15·2	a	May
+5·43		+1·14		+5·30		+24·00		b	
+3·48	+5·7	+4·29	+4·6	+1·45	+2·2	+6·90	+4·8	a	June
+7·87		+0·13		+2·78		+1·03		b	
+0·18	+0·9	+3·48	+3·4	+4·05	+2·7	−0·28	−0·1	a	July
+1·09		+3·46		+2·36		−0·09		b	
+2·61	+2·0	+0·96	+3·4	+1·86	+2·0	+0·64	+0·8	a	Aug.
+0·45		+3 43		+0·08		+0·06		b	
+0·82	+0·9	+3·32	+2·1	+1·12	+1·2	−0·63	0·0	a	Sept.
+0·58		+0·12		+1·05		+0·29		b	
+0·15	0·0	+0·01	+0·3	+0·26	−0·1	+0·54	+0·8	a	Oct.
−0 01		+0·35		+0·54		+1·40		b	
−0 15	+0·5	−0·28	+0·6	−0·39	0·0	+5·30	+4·5	a	Nov.
+0·14		+0·69		−0·36		+0·70		b	
+0·81	+1·3	−0·23	−0·5	+0·02	+0·2	+0·40	+0·5	a	Dec.
+3·84				+1·61		+1·70		b	

rence of earthquakes and other phenomena, the following investigation from the standpoint of probability is made with respect to the occurrence of these two phenomena. The sum of the explosion energy E_1 for every month and the character number K_1 for every month, showed the relations of their occurrences to the variations in the increase and decrease with respect to time as shown in Fig. 8.

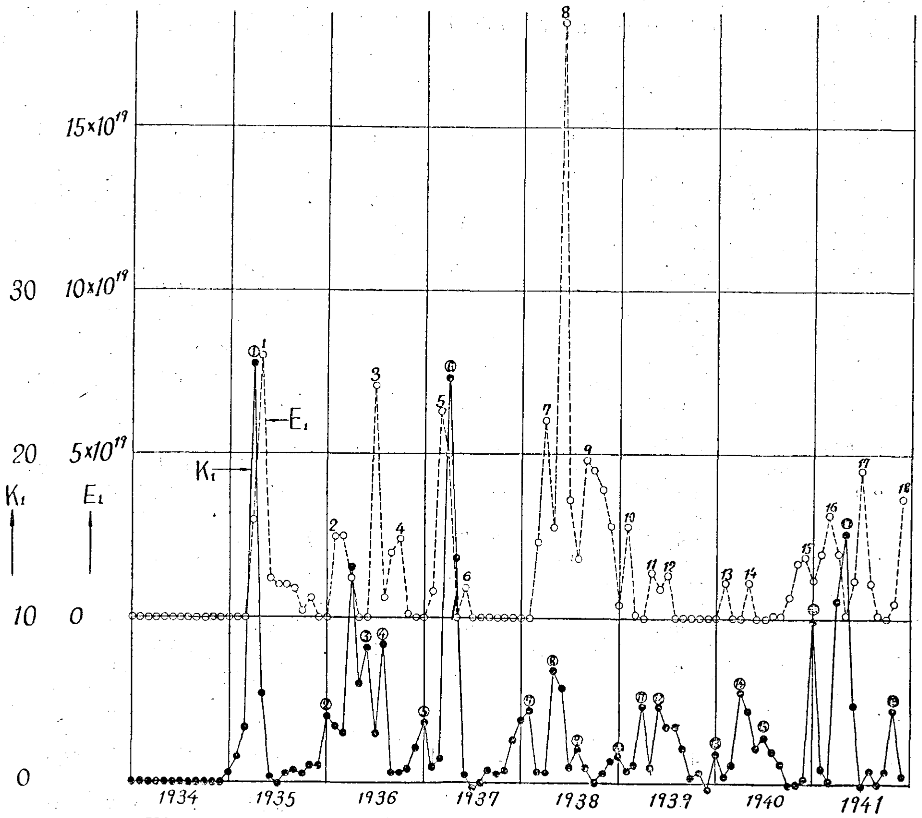

Fig. 8. Character number (K_1) for every month, and the sum of the explosion energies (E_1) for enery month.

In all the peaks of the energy curve and that of the character number, the relation of their appearence to the time were examined and found to be

a) The total number of peaks in E-curve=18,

b) " " K-curve=19,

c) The number of peaks of E, that appeared one month, or two months earlier than that of the K-curve=17, that is, the E peaks lagged behind the K peaks.

d) The number of peaks of E, which did not appear in the foregoing relation=1.

Now if the occurrences of the peaks in the K-curve are independent of the occurrences of the peaks in the E-curve, in other words, if the former is distributed at random with respect to the latter, then the probability p of a peak of K appearing one or two months before the occurrence of a peak of E is

$$p=2\times\frac{19}{12\times7}=\frac{19}{42},$$

and the probability q of the former not appearing in such a relation to the latter, is

$$q=1-p=\frac{23}{42}.$$

The probability that out of the total number of m peaks in the E-curve, r peaks will occur in a favourable case is

$$P=\frac{m!}{(m-r)!\,r!}p^{r}q^{m-r},$$

$$=1{\cdot}38\times10^{-5},$$

which is for

$$\begin{cases} m=18, \\ r=17. \end{cases}$$

The probability that more than r peaks will occur in a favourable case is

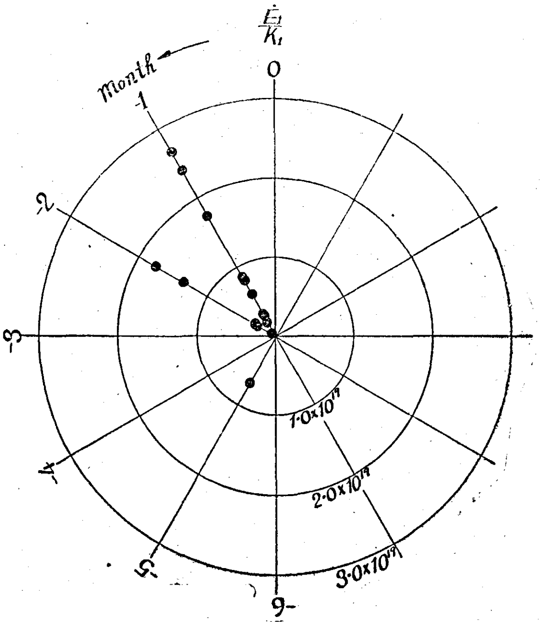

Fig. 9. a. The occurrence relation between a peak of the explosion energy and the peak of a corresponding character number for every month.

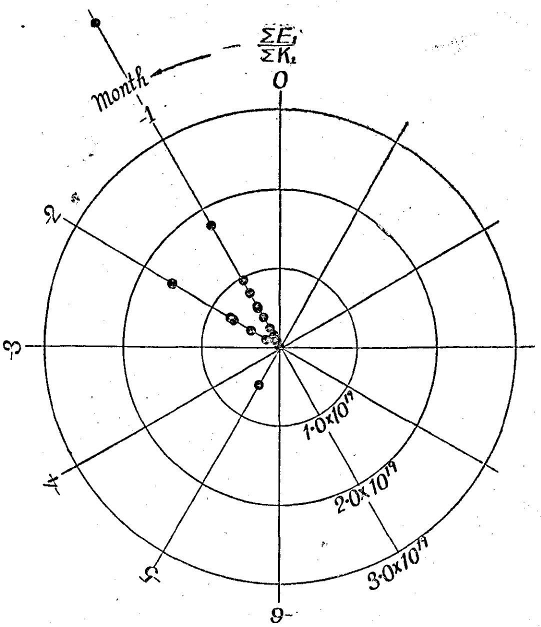

Fig. 9. b. The same relation for the sum of every swarm of these two quantities.

Table VI. Magnitudes and ratios of the corresponding peaks of E_1 and K_1, and ΣE_1 and ΣK_1.

n	E_1	K_1	$\frac{E_1}{K_1}$	ΣE_1	ΣK_1	$\frac{\Sigma E_1}{\Sigma K_1}$
	$\times 10^{19}$ erg		$\times 10^{19}$ erg	$\times 10^{19}$ erg		$\times 10^{19}$ erg
1	8·0	25·5	0·314	15·9	36·7	0·433
2	2·5	4·0	0·625	6·2	11·1	0·559
3	7·1	8·2	0·866	7·1	25·2	0·282
4	2·4	8·4	0·286	5·1	11·3	0·451
5	6·3	3·6	1·750	12·1	7·7	1·571
6	0·9	24·6	0·037	0·9	40·9	0·002
7	6·0	4·4	1·363	8·3	12·2	0·680
8	18·2	6·8	2·676	24·6	13·7	1·796
9	4·8	2·0	2·400	17·8	3·8	4·684
10	2·8	1·6	1·750	3·3	3·4	0·971
11	1·4	4·6	0·304	1·4	6·4	0·219
12	1·3	4·6	0·283	2·2	15·4	0·143
13	1·1	1·8	0·611	1·1	1·3	0·846
14	1·1	5·6	0·195	1·1	11·5	0·096
15	1·9	2·8	0·679	4·5	8·2	0·549
16	3·2	9·8	0·327	8·4	10·9	0·771
17	4·5	15·2	0·296	7·0	31·3	0·224
18	3·7	4·5	0·822	4·2	6·5	0·646

$$P' = \sum_{m-r}^{m} \frac{m!}{(m-r)!\,r!} p^r q^{m-r},$$

$$= 1{\cdot}42 \times 10^{-5},$$

which is for

$$\begin{cases} m = 18, \\ r = 17. \end{cases}$$

From calculations, the probability that the time distribution of peaks of the two kinds of curves is very small, provided they are regarded as being distributed in an entirely haphazard manner. In other words, it is natural to conclude that the time distributions of these two phenomena have a causal relation.

The phase lags, that is, the time difference in their occurrence and the ratios $\left(\frac{E_1}{K_1}\right)$ of the magnitude of the E_1-peaks to those of the corresponding K_1-peaks are shown in Fig. 9. a. and Table VI.

And, what has been done and shown in Fig. 9. b, Table VI, has been repeated in connexion with the total energy ΣE_1 of an explosion swarm and the sum ΣK_1 of a month's character numbers of the corresponding swarm.

As will be seen from these diagrams, in the two corresponding kinds of quantities, E_1 and K_1, or ΣE_1 and ΣK_1, their magnitude relations are not simple. To illustrate, although a very large number of strong explosions occurred in 1938, changes in the inclinations of the ground were not so marked as expected compared with what appeared during other periods. But it will be seen that in other years, values E_1 and K_1 are roughly proportional to each other, in other words, the ratio $\left(\frac{E_1}{K_1}\right)$ is nearly constant.

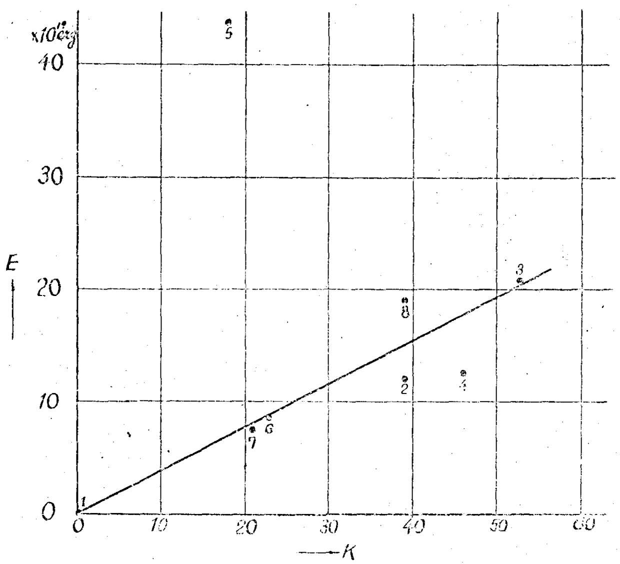

Fig. 10. Sums of the explosion energies and those of the monthly character numbers for every year.

$E=\Sigma E_1$, $K=\Sigma K_1$.

1 ; 1934, 2 ; 1935, 3 ; 1936, 4 ; 1937,
5 ; 1938, 6 ; 1939, 7 ; 1940, 8 ; 1941.

Fig. 10 shows the relation between the sum of the explosion energy for a year and the sum of the monthly character number for the same year during 1934∼1942. It will be seen from Fig. 10 that, except for 1938, the former quantity is almost proportional to the other.

5. Correlation between Explosion Energy and the Character Number of Tilt.

As just mentioned, it was made clear that corresponding to a remarkable tilt of the earth's surface, an explosion swarm occurred one or two months after the occurrence of the former phenomenon, and in addition, that the energy of a swarm is roughly proportional to the character number K of the corresponding tilt.

In order to investigate these two phenomena more precisely, the writer applied Tsuboi's method in solving the problem.

C. Tsuboi[21] showed that when two arbitrary kinds of quantities are given in time or space, the function for determining the relation of phase and magnitude between these two quantities is given by two kinds of Fourier's coefficients, which are determined by these quantities.

At first, the series of these quantities (K and E), which are given with respect to the same time interval, are expanded in Fourier's series, that is,

$$K(t)=a_0+a_1\cos t+\cdots\cdots\cdots\cdots+a_m\cos mt$$
$$+b_1\sin t+\cdots\cdots\cdots\cdots+b_m\sin mt, \quad (2)$$
$$E(t)=A_0+A_1\cos t+\cdots\cdots\cdots\cdots+A_m\cos mt$$
$$+B_1\sin t+\cdots\cdots\cdots\cdots+B_m\sin mt. \quad (3)$$

The correlation function $\varphi(\alpha)$, which determined the relation of these two kinds of quantity is expressed by the series.

$$\varphi(\alpha)=\frac{1}{\pi}\left[\frac{1}{2}\frac{A_0}{a_0}+\frac{a_1A_1+b_1B_1}{a_1^2+b_1^2}\cos\alpha+\cdots\cdots+\frac{a_mA_m+b_mB_m}{a_m^2+b_m^2}\cos m\alpha\right.$$
$$\left.+\frac{b_1A_1-a_1B_1}{a_1^2+b_1^2}\sin\alpha+\cdots\cdots+\frac{b_mA_m-a_mB_m}{a_m^2+b_m^2}\sin m\alpha\right]$$
$$=W(a_m, b_m, A_m, B_m)\times\frac{1}{\pi} \quad (4)$$

The function $\varphi(\alpha)$ in the present investigation is obtained from two time intervals, the one, 12 months from January to December 1935, and the other, 18 months from July 1940 to December 1941.

In these two intervals, the character numbers of the tilt and the sum of the energies are each taken for every half month, as shown in Figs. 11, 12, and Tables VII, VIII.

21) C. TSUBOI, *Bull. Earthq. Res. Inst.*, 19 (1941), 458.

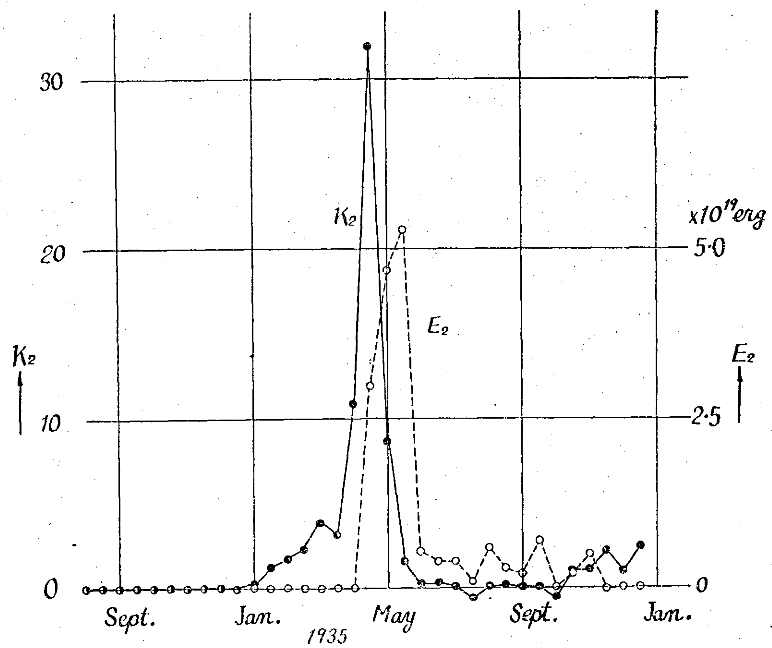

Fig. 11. Character number of the tilts for half a month, and the sum of the explosion energies for half a month during the period from August, 1934, to December, 1935.

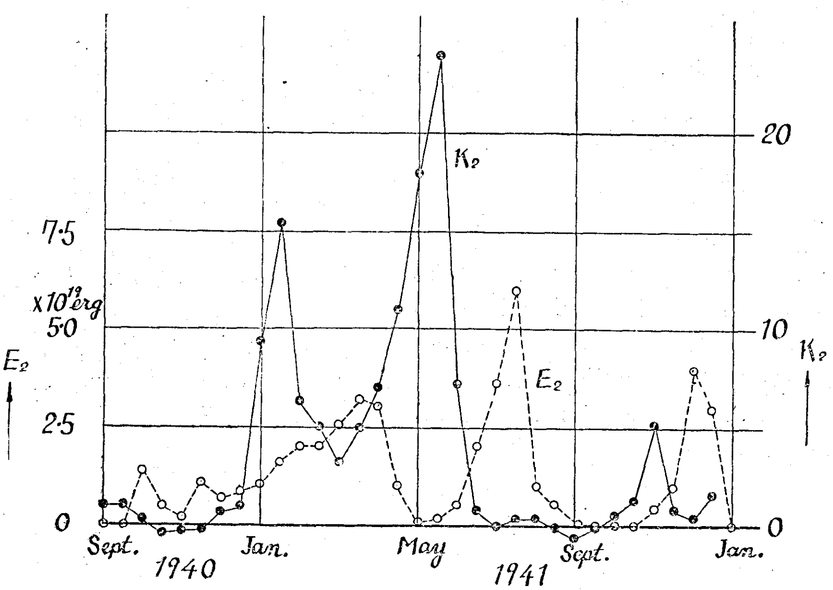

Fig. 12. Character number of the tilts for half a month, and the sum of the explosion energies for half a month during the period from September, 1940, to December, 1941.

Table VII. Semi-monthly character number (K_2) and sum of energies (E_2) for every half month during January and December, 1935.

date		K_2	E_2
1935			$\times 10^{19}$ erg
Jan.	a	+ 0·5	0
	b	+ 0·4	0
Feb.	a	+ 0·8	0
	b	+ 2 0	0
Mar.	a	+ 3·9	0
	b	+ 3 4	0
Apr.	a	+10 9	0
	b	+32·0	3·00
May	a	+ 8·9	4·70
	b	+ 1·6	5·34
June	a	+ 0·2	0·50
	b	+ 0·3	0·40
July	a	+ 0·2	0·80
	b	− 0 6	0·20
Aug.	a	+ 0 1	0·60
	b	+ 0·3	0·90
Sept.	a	+ 0·5	0·20
	b	+ 0·6	0·70
Oct.	a	− 0·5	0·02
	b	+ 0·5	0·20
Nov.	a	− 0·3	0·50
	b	+ 0·5	0·60
Dec.	a	+ 0·3	0·02
	b	+ 3·7	0·0

These quantities, given as distribution with respect to time, are expanded in Fourier's series.

The results of Fourier analyses are shown in Tables IX, X by the Fourier coefficients (A'_m, B'_m). These have the following relation with the Fourier coefficients (A_m, B_m) given in (3), namely, for the former case,

$$\left\{\begin{aligned} A_m &= A'_m \times \frac{2\pi}{360} \times 15\,, \\ B_m &= B'_m \times \frac{2\pi}{360} \times 15\,, \end{aligned}\right. \tag{5}$$

and for the latter case,

Table VIII. Semi-monthly character number (K_2), and sum of explosion energies (E_2) of every half month.

date		K_2	E_2
1940			$\times 10^{19}$ erg
July	a	+ 4·06	0
	b	+ 2·36	0
Aug.	a	+ 1·86	0
	b	+ 0·03	0
Sept.	a	+ 1·12	0
	b	+ 1·06	0
Oct.	a	+ 0·26	1·2
	b	− 0·54	0·2
Nov.	a	− 0·39	0·1
	b	− 0·36	0·8
Dec.	a	+ 0·02	0·4
	b	+ 1·61	0·6
1941			
Jan.	a	+ 9·20	0·5
	b	+15·40	1·2
Feb.	a	+ 6·20	1·0
	b	+ 5·10	1·0
Mar.	a	+ 3·10	1·5
	b	+ 4·90	1·7
Apr.	a	+ 7·00	1·5
	b	+11·10	0·5
May	a	+17·80	0
	b	+24·00	0·1
June	a	+ 6·90	0·2
	b	+ 1·03	1·0
July	a	− 0·23	1·8
	b	− 0·09	3·0
Aug.	a	+ 0·64	0·6
	b	+ 0·06	0·3
Sept.	a	− 0·63	0
	b	+ 0·29	0
Oct.	a	+ 0·54	0
	b	1·40	0
Nov.	a	+ 5·30	0·2
	b	+ 0·70	0·5
Dec.	a	+ 0·40	2·0
	b	+ 1·70	1·5

$$\begin{cases} A_m = A'_m \times \dfrac{2\pi}{360} \times 10\,, \\ \\ B_m = B'_m \times \dfrac{2\pi}{360} \times 10\,. \end{cases} \tag{6}$$

Consequently, the correlation function φ is expressed by

$$\varphi_1 = W(a_m, b_m, A_m, B_m) \times \frac{1}{\pi}$$

$$= \frac{1}{12} W(a_m, b_m, A'_m, B'_m)\,, \tag{7}$$

and

$$\varphi_2 = W(a_m, b_m, A_m, B_m) \times \frac{1}{\pi}$$

$$= \frac{1}{18} W(a_m, b_m, A'_m, B'_m)\,. \tag{8}$$

Since all the coefficients for determining the functions (φ_1, φ_2) are known, as shown in Tables IX, X, the values φ_1, and φ_2 are given by summations of series (7), (8).

Table IX. Fourier coefficients of K_2, E_2 and φ of the 1st case.

K_2				E_2				$12\pi\times\varphi$			
cosine term		sine term		cosine term		sine term		cosine term		sine term	
a_0	+3·888			A'_0	$\times 10^{19}$ +0·710			α_0	$\pi\times 10^{19}$ +0·092		$\pi\times 10^{19}$
a_1	−1·578	b_1	+4 264	A'_1	−0·892	B'_1	+0·181	α_1	+0·10[illegible]	β_1	−0·170
a_2	−2·363	b_2	−3·704	A'_2	+0·045	B'_2	−0·603	α_2	+0·110	β_2	−0·082
a_3	+3·500	b_3	−0 812	A'_3	−0·073	B'_3	+0·692	α_3	−0·062	β_3	−0·183
a_4	−1·296	b_4	+2 230	A'_4	−0·761	B'_4	−0·501	α_4	−0·020	β_4	−0 352
a_5	−1·274	b_5	−2 349	A'_5	+0·503	B'_5	+0·059	α_5	−0·112	β_5	−0·152
a_6	+2·650	b_6	+0·100	A'_6	−0·141	B'_6	+0·428	α_6	−0·047	β_6	−0·164
a_7	−0·965	b_7	+1·868	A'_7	−0·028	B'_7	−0·581	α_7	−0·241	β_7	−0·134
a_8	−0·887	b_8	−1·580	A'_8	+0·154	B'_8	+0·530	α_8	−0·295	β_8	+0·071
a_9	+1·733	b_9	−0·295	A'_9	+0·623	B'_9	−0·294	α_9	+0·375	β_9	+0·104
a_{10}	−0·386	b_{10}	+1·378	A'_{10}	+0·017	B'_{10}	−0·120	α_{10}	−0 034	β_{10}	+0·011
a_{11}	−0 315	b_{11}	−0·986	A'_{11}	+0·263	B'_{11}	+0·188	α_{11}	−0·054	β_{11}	+0 161
a_{12}	+0 821			A'_{12}	+0·183			α_{12}	+0·220		

Table X. Fourier coefficients of E_2, K_2 and φ_2 for the second case.

K_2				E_2				$18\times\varphi_2$			
cosine term		sine term		cosine term		sine term		cosine term		sine term	
					$\times10^{19}$		$\times10^{19}$		$\pi\times10^{19}$		$\pi\times10^{19}$
a_0	+3·675			A'_0	+0·625			α_0	+0 035		
a_1	−4·182	b_1	−0·706	A'_1	−0·341	B'_1	−0·154	α_1	+0 080	β_1	−0·022
a_2	+2 993	b_2	+1·164	A'_2	+0 153	B'_2	−0·068	α_2	+0 037	β_2	+0·037
a_3	+1·065	b_3	−1·426	A'_3	+0·233	B'_3	+0 207	α_3	−0 015	β_3	−0 174
a_4	−2·875	b_4	+1·185	A'_4	+0·459	B'_4	−0 419	α_4	−0 188	β_4	−0·058
a_5	+2·720	b_5	−0·756	A'_5	−0·180	B'_5	−0·181	α_5	−0 045	β_5	+0·079
a_6	−1·950	b_6	+0·481	A'_6	+0 203	B'_6	+0·140	α_6	−0 082	β_6	+0·092
a_7	−0·046	b_7	+0 969	A'_7	+0·176	B'_7	−0 171	α_7	−0·185	β_7	+0 173
a_8	+1·043	b_8	−0·134	A'_8	+0·049	B'_8	−0 194	α_8	+0 070	β_8	+0·176
a_9	−1·556	b_9	+0·828	A'_9	−0·117	B'_9	−0 122	α_9	+0·026	β_9	−0·092
a_{10}	+0·993	b_{10}	+0·064	A'_{10}	+0·196	B'_{10}	−0 011	α_{10}	+0 196	β_{10}	+0·024
a_{11}	−0 006	b_{11}	−0·000	A'_{11}	+0·107	B'_{11}	−0 103	α_{11}	+1·111	β_{11}	+1·111
a_{12}	−0·333	b_{12}	+0·395	A'_{12}	−0 075	B'_{12}	−0 101	α_{12}	−0 056	β_{12}	−0·240
a_{13}	+1·055	b_{13}	−0·450	A'_{13}	−0·048	B'_{13}	−0 007	α_{13}	−0 036	β_{13}	+0·022
a_{14}	−0 486	b_{14}	+0·176	A'_{14}	+0·051	B'_{14}	−0 058	α_{14}	−0·131	β_{14}	−0·071
a_{15}	+0·074	b_{15}	−0·146	A'_{15}	+0·117	B'_{15}	−0 130	α_{15}	+1 077	β_{15}	−0 269
a_{16}	+0·115	b_{16}	−0 256	A'_{16}	−0·109	B'_{16}	−0 005	α_{16}	−0·139	β_{16}	+0·368
a_{17}	−0·826	b_{17}	+0·136	A'_{17}	−0·017	B'_{17}	+0 058	α_{17}	+0·059	β_{17}	+0 071
a_{18}	+0·125			A'_{18}	+0·047	B'_{18}		α_{18}	+0·375		

In these two cases, the summations were carried out to the 3rd, 6th, and 9th orders of harmonics for the first case and to the 3rd, 6th, and 9th orders of the harmonics for the second case.

From the summations shown in Fig 13 and Tables XI, XII, it will be seen that when the summations are done up to the higher harmonics, fluctuations of small periods appear.

In determinating the correlation function, there arises the question of the degree of the order of the harmonics that should be taken in the summation for the present purpose. Obviously, the result given by summation of the lower order harmonics is equivalent to the result summed up to the higher orders, in which the small fluctuations are smoothed out.

Judging from the nature of the phenomena in the present discussion, if the outline of the form of the correlation function and the order of the magnitude are determined, it may be satisfactory for the purpose to execute the following summation.

On the other hand, as already mentioned, it will be seen from

Fig. 13 that the occurrences of explosions are most markedly affected by tilts that occurred one or two months previously, while tilts more than 4 months old have no effect on the occurrence of explosions.

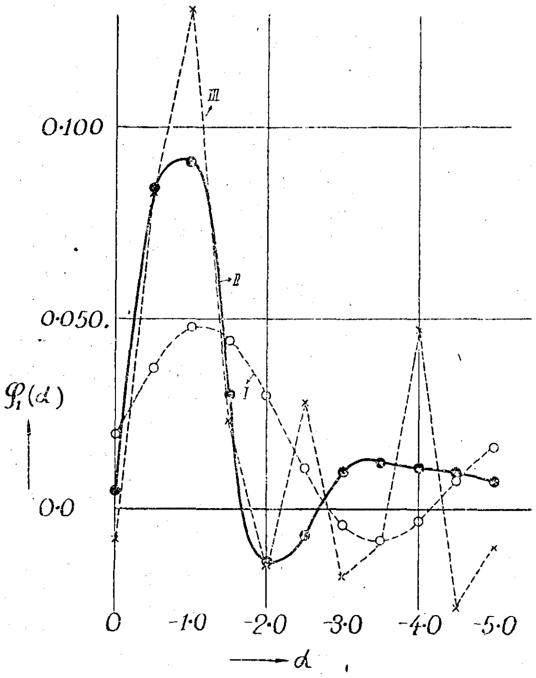

Fig. 13. Correlation function $\varphi_1(\alpha)$.
I......Summation up to 3rd order.
II......Summation up to 6th order.
III......Summation up to 9th order.

It may therefore, be sufficient for the present purpose if the correlation function be given within a range of five months prior to the occurrence of the explosion.

In doing so, the weight function φ_1 for the former case is given by summing up to the 6th order harmonics and φ_2 for the second case by summing up to the 9th order of harmonics. Obviously, summation up to the 6th order of the harmonics in φ_1 is equivalent

Table XI. Correlation function $\varphi_1(\alpha)$.

α (month)	I	II	III
0	+0·020	+0·005	−0 007
−0·5	+0·038	+0·086	+0 081
−1·0	+0·048	+0·092	+0 130
−1·5	+0·045	+0·030	+0·025
−2·0	+0·030	−0·013	−0 013
−2·5	+0·012	−0·006	+0 030
−3·0	+0·003	+0·011	−0·016
−3·5	−0·007	+0 013	−0·008
−4·0	−0·000	+0·012	+0 050
−4·5	+0·009	+0·011	+0·024
−5 0	+0·018	+0·009	−0·008

I = Summation up to the 3rd order of harmonics.
II = Summation up to the 6th order of harmonics.
III = Summation up to the 9th order of harmonics.

Table XII. Correlation function $\varphi_2(\alpha)$.

α	I	II	III
0	+0·010	−0·013	−0·018
−0·5	+0·009	−0·003	−0·019
−1·0	+0·012	+0·013	+0·007
−1·5	+0·019	+0·031	+0·046
−2·0	+0·023	+0·038	+0·056
−2·5	+0·024	+0·027	+0·021
−3·0	+0·007	+0·006	−0·019
−3·5	−0·007	−0·014	−0·020
−4·0	−0·014	−0·021	+0·003
−4·5	−0·010	−0·016	+0·003
−5·0	−0·001	−0·005	−0·011

I = Summation up to the 3rd order of harmonics.
II = Summation up to the 6th order of harmonics.
III = Summation up to the 9th order of harmonics.

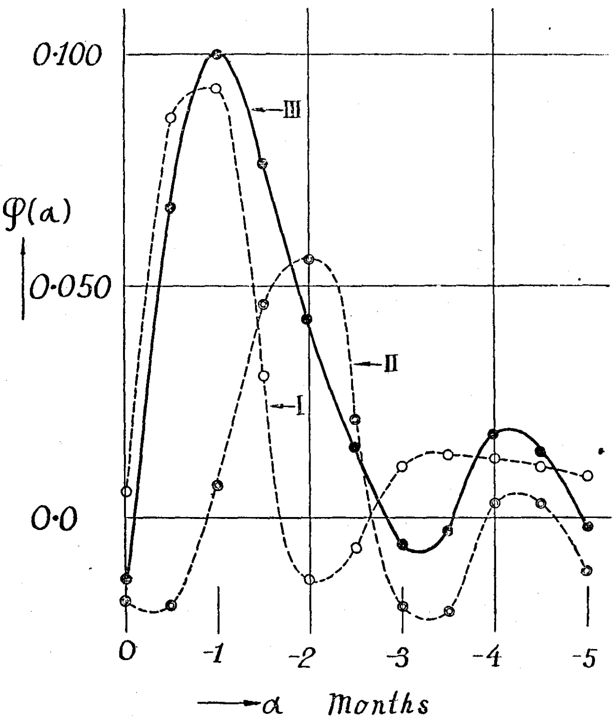

Fig. 14. Correlation function.
I......$\varphi_1(\alpha)$.
II......$\varphi_2(\alpha)$.
III......$\varphi_1(\alpha)+\varphi_2(\alpha)$.

Table XIII.
Mean Correlation function
$\varphi_0(\alpha)$.

α (months)	φ_0 (α)
0	$-0{\cdot}0065\times10^{19}$
$-0{\cdot}5$	$+0{\cdot}0335$ 〃
$-1{\cdot}0$	$+0{\cdot}0500$ 〃
$-1{\cdot}5$	$+0{\cdot}0385$ 〃
$-2{\cdot}0$	$+0{\cdot}0215$ 〃
$-2{\cdot}5$	$+0{\cdot}0075$ 〃
$-3{\cdot}0$	$-0{\cdot}0030$ 〃
$-3{\cdot}5$	$-0{\cdot}0015$ 〃
$-4{\cdot}0$	$+0{\cdot}0090$ 〃
$-4{\cdot}5$	$+0{\cdot}0070$ 〃
$-5{\cdot}0$	$-0{\cdot}0010$ 〃

to that up to the 9th order of harmonics in φ_2.

In these two correlation functions φ_1 and φ_2, the former covers the case in which the tilt that occurred one month prior to the occurrence of the explosion is mostly affected, and the latter in which the tilt that occurred two months ago most affects the explosion.

Now, in order to render adaptable the correlation function φ_0 in these two extreme cases by using the mean values of φ_1 and φ_2, we use

$$\varphi_0=\frac{1}{2}(\varphi_1+\varphi_2)\,.$$

The correlation function φ_0 is shown in Fig. 14 and Table XIII. The correlation function, above defined, is in other words an anticipation function for the volcanic activity of the Asama volcano.

6. Volcanic Activity Expected from the Anticipation Function (φ_0).

It is possible to anticipate the occurrence of explosions, one after the other, by means of the anticipation function φ_0 and by continuous observations of tilts, the coming occurrence of the explosion being given by the integration,

$$E(t_0)=\int_{-2\pi}^{0}K(t_0+\alpha)\,\varphi'(\alpha)\,d\alpha\,. \qquad (9)$$

As an example, the anticipation function is applied to the occurrences of explosions of Asama for the period from January to August, 1942.

Since the anticipation function (φ_0) has an effective value only in that domain within two and half months prior to time t_0, and vanishes in the domain prior to more than 3 months, it is possible almost to write the intergration in the form of the following summation,

$$E(t_0)=\sum K(t_0+\alpha)\varphi'(\alpha)\Delta\alpha$$

$$\varphi'(\alpha)\Delta\alpha=\varphi_0(\alpha) \qquad \text{given from (5), (6),}$$

$$\varphi_0(\alpha)\doteqdot 0, \qquad \alpha=0,$$

$$\varphi_0(\alpha)\not\doteqdot 0, \qquad -2{\cdot}5 \text{ months}\leqq\alpha<-0{\cdot}5\text{m onth},$$

$$\varphi_0(\alpha)\doteqdot 0, \qquad \alpha<-3{\cdot}0 \text{ months},$$

$$E(t_0)\doteqdot K(t_0+\alpha_{-0\cdot5m})\varphi_0(\alpha_{-0\cdot5m})+K(t_0+\alpha_{-1\cdot0m})\varphi_0(\alpha_{-1\cdot0m})$$
$$+K(t_0+\alpha_{-1\cdot5m})\varphi_0(\alpha_{-1\cdot5m})+K(t_0+\alpha_{-2\cdot0m})\varphi_0(\alpha_{-2\cdot0m})$$
$$+K(t_0+\alpha_{-2\cdot5m})\varphi_0(\alpha_{-2\cdot5m}), \qquad (10)$$

where

$E(t_0)=$ sum of explosion energy for the comming half month.

Since all the quantities given on the right hand side of (10) are known half a month prior to time t_0, $E(t_0)$, the sum of the explosion energy for the coming half month is determined.

In this manner, by means of the half month character number of the interval from October 1941 to August 1942, an outline of the explosion-energy distribution for the period from January to August 1942 is calculated.

Since, unfortunately, the clinograph of the E-W component at the Nakanosawa station was destroyed in May, 1942, observations of the tilt of that component was missed during May and July, 1942, the character number during these months being obtained by assuming that magnitude of the variations in the tilts of the E-W component were the same as those of the N-S component. Judging from the tilt observations for a number of years, this assumption may not seriously affect the results.

Fig. 15 shows the marked variations in inclination of the earth's surface at Nakanosawa during the period from April to July, 1942; photographs of the original records of the tilts for that period are shown in Figs 18～25.

It is interesting to compare the explosion energy calculated by the foregoing method with the volcanic activity which actually occurred in that period.

Table XIV gives the semi-monthly character number of the tilt and the sum of the explosion energy for every half month during the period from January to July, 1942.

These two results, the one calculated and the other actually occurred, are shown together in Fig. 16, in addition to which an example of the calculation is given in Table XV.

As will be seen from Table XV and Fig. 16, these two results, in their outline at least, satisfactorily agree. Upon examining these

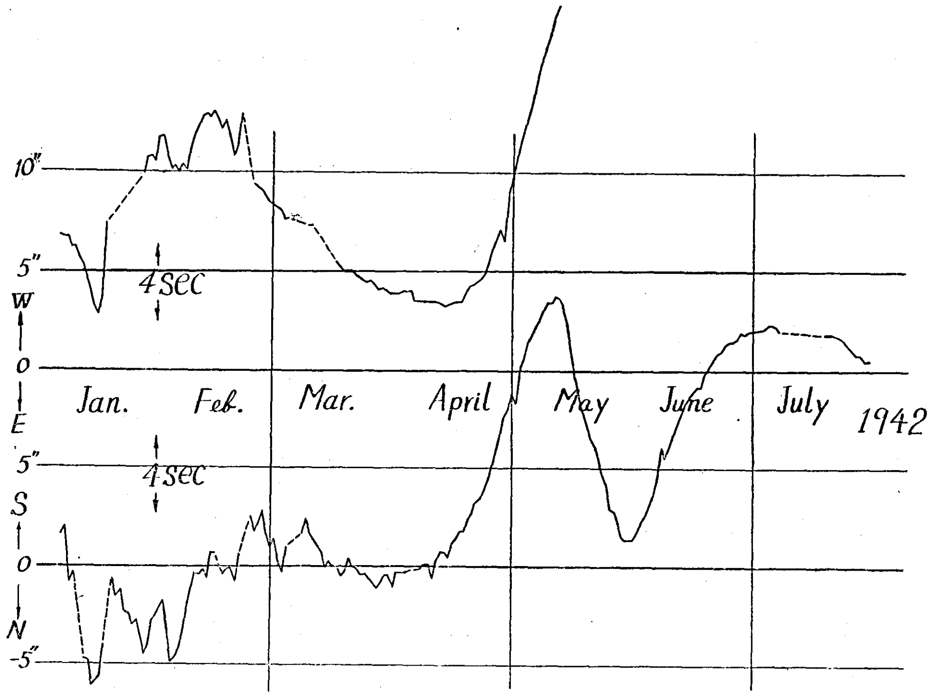

Fig. 15. Tilting at Nakanosawa for the period from January to July, 1942.

Table XIV. Explosion energy occurred during January and July, 1942, and the semi-monthly character number.

		E_2	K_2
Jan.	a	0 30×10[19] erg	3 00
	b	0·16 ″	3·18
Feb.	a	0·22 ″	2·02
	b	0 45 ″	2·17
Mar.	a	0·52 ″	0·56
	b	0·21 ″	0·41
Apr.	a	0·44 ″	3 11
	b	0·18 ″	21·56
May	a	0 95 ″	24·00
	b	1·90 ″	17·50
June	a	3·00 ″	19·50
	b	0·51 ″	16·00
July	a	0 40 ″	0·60
	b	0·29 ″	0·01

two results in detail, it will be found that the maximum value of the energy anticipated occurs half a month later than the actual occurrence.

One cause of this is that it depends on the time interval taken for the summation of explosion energy. On the other hand, as already mentioned, the differences in the appearance of the E and K peaks with respect to time are mostly one and a half month, but one month in some cases and two months in others. The anticipation function is determined by taking the mean value of φ_1 and φ_2, of which φ_1 corresponds to the former case and φ_2 to the latter.

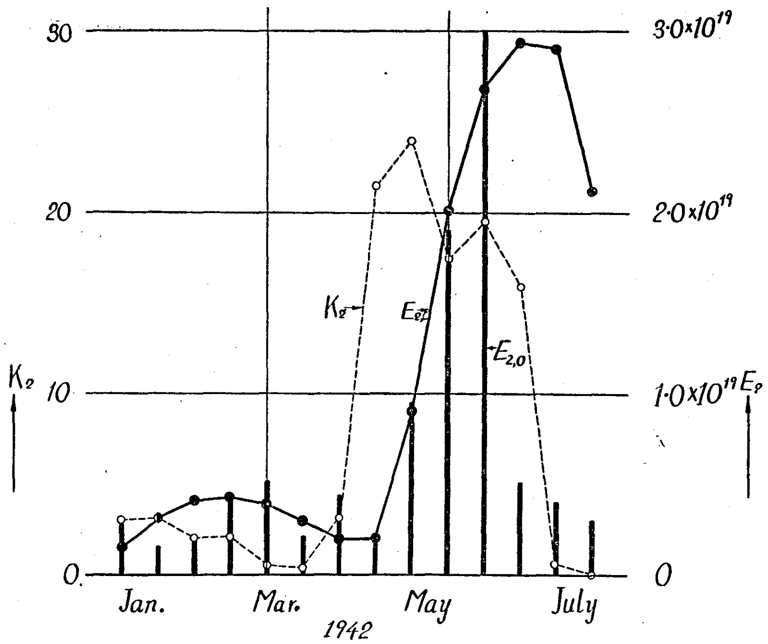

Fig. 16. ○……Character number (K_2) for half a month.
●……The explosion energy calculated ($E_{2,c}$) by $\varphi_0(\alpha)$ for every half month.
▮…… Energy of explosions ($E_{2,o}$) that have occurred in that period.

In other words, the anticipation function φ_0 is determined for a domain large enough to contain these two extreme cases together. On the other hand, in the other volcanic activities during 1935 and 1941, the magnitude of volcanic activity calculated by the function φ_0 is less in some cases and larger in others than that of the volcanic activity which occurred, so that it may be necessary to take two kinds of safety factors, according to the purposes in view, namely,

Table XV. An example of application of anticipation function.

		K_2	$K_2(t_0+\alpha)\times$					$(E_2)_c$	$(E_2)_0$
			$\varphi(-0{\cdot}5)$	$\varphi(-1{\cdot}0)$	$\varphi(-1{\cdot}5)$	$\varphi(-2{\cdot}0)$	$\varphi(-2{\cdot}5)$		
1941									
Oct.	a	−0 48							
	b	+0·45							
Nov.	a	−0·33							
	b	+0·49							
Dec.	a	+0·25							
	b	+3·75							
1942								$\times 10^{19}$ erg	$\times 10^{19}$ erg
Jan.	a	+3·00	0·126	0·013	0 019	−0·007	0·003	0·154	0·30
	b	+3·18	0·100	0·188	0·009	+0·011	−0·002	0·306 〃	0·16 〃
Feb.	a	+2·02	0·106	0·150	0·144	0·005	0·004	0·409 〃	0·22 〃
	b	+2·17	0·068	0·159	0·116	0·081	0·002	0·426 〃	0 45 〃
Mar.	a	+0·56	0·071	0·101	0 122	0·065	0·028	0·387 〃	0·52 〃
	b	+0·41	0·019	0·109	0·078	0·069	0 023	0·298 〃	0·21 〃
Apr.	a	+3·11	0·014	0·028	0·083	0·044	0·024	0·194 〃	0 44 〃
	b	+21·56	0·104	0·021	0·021	0·047	0·015	0·208 〃	0·18 〃
May	a	+24·00	0·720	0·156	0·016	0·012	0·016	0·900 〃	0·95 〃
	b	+17·50	0·800	1·078	0·120	0·069	0·004	2·011 〃	1·90 〃
June	a	+19·50	0·585	1·200	0·830	0·067	0·003	2·685 〃	3·00 〃
	b	+16·00	0·650	0·875	0·925	0·465	0·023	2·938 〃	0·50 〃
July	a	+0 60	0·535	0·975	0·675	0·517	0·162	2·917 〃	0·40 〃
	b	+0·01	0·020	0·800	0·750	0·375	0·180	2·125 〃	0·30 〃
Aug.	a		0.00	0·030	0·620	0·420	0·130	1·200 〃	
	b				0·023	0·345	0·146		
Sept.	a					0·013	0·120		
	b						0·005		

$$E_o = C \times E_c = C \sum K(t_0+\alpha)\,\varphi_0(\alpha)\ ,$$

where C = safety factor,

$C=3$ for one of the purposes,

$C=\dfrac{1}{3}$ for the other,

E_o ; actual explosion energy as occurred,

E_c ; explosion energy obtained by calculation.

At any rate, it is possible to give the maximum and minimum range of magnitude of explosion energy for a period of half a month or two months before its occurrence.

Although, in the present investigations, the character numbers of the tilts were derived from observations at only one station, it is desirable to use the results, at least, of two or three stations; and it may also be necessary to determine more precisely the seasonal and annual variations and other small fluctuations of the tilts that appear even during the calm period of the volcano.

This could be realized by continuous observations of the tilt at three or four new stations. At the begining of October, 1942, the tilt observations were begun at the new station of Gippa-yama, the first somma of the volcano, so that the anticipation function may be given more precisely.

In comparing the two results of tilt at the Nakanosawa and the Oniosidasi stations, although the marked variations in the tilt related to the volcanic activities appeared almost simultaneously at these two stations, in the directions of tilt and amount, they differ considerably. It may also be pointed out that the secular variations in the tilt do not harmonise sufficiently with the topographical deformations given by the precise levellings[22] done in 1935 and 1939, from which it will be seen that the volcano is formed of numbers of small blocks, and that when the volcanoes are active these blocks move at random according to their underground structure. Seeing that the tilt, which is the differential coefficient of the topographical deformations in the region consisting of a large number of blocks, the discrepancy shown by the topographical surveys may be only natural.

7. Conclusion.

The foregoing results summarized are

(1) In the recent explosive activities of Volcano Asama, the total mass of ejecta and the velocity at the time of its ejection were estimated for twenty strong and moderate explosions, from which result, the kinetic energies of these explosions were determined.

The relation between these kinetic energies and the maximum amplitudes of the surface waves caused by the corresponding explosion was determined, by the use of which relation, all the explosions that occurred during the period from 1935 to 1941 are expressed by their energies.

(2) From tilt observations made at the foot of the volcano, the extent of the variations in the tilt were expressed by character numbers.

22) *loc. cit.* 5)

(3) The relation with respect to time between the occurrence of the explosion swarms and the marked changes in the inclination of the ground are examined from the standpoint of probability.

(4) The correlation between these two phenomena was quantitatively studied with the aid of the weight function.

(5) For the interval from January to August, 1942, the volcanic activity anticipated by the weight function, in other words, the anticipation function, was compared with the actual phenomena, as the results of which, some light was thrown on the possibility of anticipating volcanic activities.

In conclusion, the writer wishes to express his sincere thanks to the director of our Institute for encouragements given him throughout the course of this study, and to Professor C. Tsuboi for his valuable advices and his interest in this study. His thanks are also due to the Department of Education, to the Hattori Hôkôkai, and to the Foundation for the Promotion of Scientific and Industrial Research of Japan for grants received to enable the prosecution of these studies.

Table II.
Readings of tilts at the Nakanosawa station during 1934 and 1941.
Readings are measured from the new standard line on the records for each year.
(eastward tilt; increase in reading)
(southward tilt; increase in reading)

1934	Jan.		Feb.		Mar.		Apr.	
	E-W	N-S	E-W	N-S	E-W	N-S	E-W	N-S
	"	"	"	"	"	"	"	"
1	+ 1·1	+2·05		− 0 1	+ 2·2	− 2·9	− 0·4	− 5·3
2	+ 1·2	+1·55		− 1·2	+ 1·8	− 3·6	− 1·0	− 5 4
3	+ 1·2	+0·90			+ 1·6	− 3·8	− 0·0	− 4·8
4	+ 1·4	+ 0·9		− 1·5	+ 1·0	− 3·1	− 0·5	− 5·2
5	+ 2·1	+ 1·7	+ 3·5	+ 0·4	+ 1·5	− 3 1	− 1·1	− 5·7
6	+ 1·8	+ 1·9	+ 3·7	+ 0·5	+ 2·5	− 1·9	− 1·3	− 5·9
7	+ 4·0	+ 2·2	+ 4·0	+ 0·7	+ 2·5	− 1·5	− 1·5	− 5·8
8	+ 2·0	+ 1·2	+ 3·6	+ 0·2	+ 2·6	− 2·7	− 0·8	− 5·6
9	+ 3·0	+ 1·7	+ 3·1		+ 1·8		− 1·2	− 5·8
10	+ 3·1	+ 1·5	+ 3·3	+ 0·3	+ 2·1	− 3·2	− 1·4	− 6·0
11	+ 2·9	+ 0·3	+ 4·0	+ 0·9	+ 3·9	− 2·2	− 1·5	− 6·1
12	+ 3·7	+ 1·3	+ 3·3	+ 0 4	+ 3·1	− 2·8	− 1·5	− 6·2

(*to be continued.*)

Table II. (*Continued.*)

1934	Jan.		Feb.		Mar.		Apr.	
	E-W	N-S	E-W	N-S	E-W	N-S	E-W	N-S
	″	″	″	″	″	″	″	″
13	+ 4·2	+ 2·1	+ 3·1	+ 0·5	+ 2·4	− 3·5	− 1·5	− 6·2
14	+ 4·3	+ 2·5	+ 3·2	− 0 2	+ 2·0	− 3·9		− 6 2
15	+ 4·5	+ 2·3	+ 2·3	− 0·9	+ 1·5	− 4·2	− 1 6	− 6·2
16	+ 4·4	+ 1·0	+ 3·2	+ 0·2	+ 0·6	− 4·5	− 1 5	− 6·0
17	+ 3·3	+ 0·5	+ 3·5	− 0·1	+ 0·4	− 4·6	− 1·6	− 6·0
18	+ 3·5	+ 0·8	+ 3·2		+ 1 0	− 4·2	− 1·6	− 5 9
19	+ 4·6	+ 0·5	+ 1·8		+ 0·2	− 4 8	− 1·6	− 5·9
20	+ 3·3	+ 0 1	+ 2·8	− 0 6	− 0·5	− 5·9	− 1·5	− 5·8
21	+ 3·6	+ 1·3	+ 2·8	− 2 2	− 0·8	− 6·4	− 1 6	− 5·9
22	+ 4·6	+ 1 0	+ 3·1	− 2 9	− 1 0	− 6·6	− 1·6	− 5·8
23	+ 4·7	+ 1·5	+ 3·0		− 1·3	− 6·6	− 1·7	− 5·9
24	+ 4·4	+ 1·3	+ 3·2	− 1·8	− 1·3	− 6 2	− 1·7	− 5 9
25	+ 3·6	+ 1·4	+ 2·1	− 2·0	− 1·3	− 6 0	− 1·7	− 5·9
26	+ 3 7	+ 1 4	+ 1·8	− 2·9	− 1 4	− 6·1	− 1·7	− 5·9
27	+ 3·9	+ 1·4	+ 1 5	− 3·7	− 1·6	− 6·1	− 1·7	− 5·8
23	+ 4·1	+ 1·2	+ 2·3	− 3·2	− 1·6	− 6·2	− 1·7	− 5·8
29	+ 4·7	+ 1·4			− 1·7	− 6·2	− 1·8	− 5·9
30	+ 4·9				− 1·6	− 6·2	− 1·8	− 5 9
31	+ 4·0				− 0 8	− 5·6		

1934	May		June		July		Aug.	
	E-W	N-S	E-W	N-S	E-W	N-S	E-W	N-S
	″	″	″	″	″	″	″	″
1	− 1·8	− 5·9	− 1 5	− 7·4	− 2·3	− 8·5		− 8·8
2	− 1 9	− 6·1	− 1·7	− 7·6	− 2·0	− 8·5	− 3·0	− 8·8
3	− 1·8	− 6·1	− 1·9	− 7·8	− 2·0	− 8·6	− 3·0	− 8·8
4	− 1·8	− 6·0	− 2·0	− 7·9	− 1 9	− 8·5	− 2·9	− 8·8
5	− 1·7	− 5 9	− 1·9	− 8·1	− 1·9	− 8 6	− 2·9	− 8·8
6	− 1·7	− 5·9	− 1 9	− 7·9	− 2·0	− 8·6	− 3·0	− 8·9
7	− 1·7	− 5·9	− 1·8	− 7·9	− 2·0	− 8·6	− 3·2	− 8·8
8	− 1·6	− 5·9	− 2·1	− 8·0	− 2 1	− 8·7	− 3 1	− 8·9
9	− 1·6	− 6·0	− 2·3	− 7·9	− 2·2	− 8·7	− 3·0	− 8·9
10	− 1·8	− 6·1	− 2 3	− 7·9	− 2·2	− 8·8	− 2·9	− 8·9
11	− 2·2	− 6·2	− 2·3	− 7·8	− 2·2	− 8·8	− 2·8	− 9·0
12	− 2·5	− 6·2	− 2·3	− 8·0	− 2·2	− 8·8	− 2·7	− 9·2
13	− 2·5	− 6·3	− 2·5	− 8·1	− 2·2	− 8·8	− 2·8	− 9·4
14	− 2·5	− 6·8	− 2·4	− 8·1	− 2·4	− 8·8	− 2 7	− 9·5
15	− 2·5	− 6·6	− 2·4	− 8·1	− 2·7	− 8·7	− 2 6	− 9·5

(*to be continued.*)

Table II. (*Continued.*)

1934	May		June		July		Aug.	
	E-W	N-S	E-W	N-S	E-W	N-S	E-W	N-S
	″	″	″	″	″	″	″	″
16	− 1·9	− 6·7	− 2·4	− 8·2	− 2·8	− 8·7	− 2·5	− 9·5
17	− 1·5	− 6·7		− 8·1	− 2·8	− 8·9	− 2·5	− 9·4
18	− 1·1	− 6·9		− 8·2	− 2·8	− 8·7	− 2·6	− 9·4
19	− 1·8	− 7·1	− 2·4	− 8·1	− 2·8	− 8·7	− 2·5	− 9·3
20	− 1·7	− 7·3	− 2·4	− 8·2	− 2·7	− 8·8	− 2·5	− 9·2
21	− 1·5	− 7·4	− 2·3	− 8·3		− 8·7	− 2·6	− 9·2
22	− 1·6	− 7·4	− 2·3	− 8·4	− 2·6	− 8·6	− 2·6	− 9·1
23	− 1·6	− 7·5	− 2·4	− 8·5	− 2·6	− 8·5	− 2·5	− 9·1
24	− 1·5	− 7·5	− 2·5	− 8·5	− 2·8	− 8·5	− 2·6	− 9·1
25	− 1·5	− 7·5	− 2·5	− 8·5	− 2·8	− 8·4	− 2·5	− 9·2
26	− 1·5	− 7·5	− 2·5	− 8·5	− 2·8	− 8·4	− 2·6	− 9·1
27	− 1·8	− 7·6	− 2·6	− 8·5	− 2·8	− 8·4	− 2·6	− 9·2
28	− 1·7	− 7·6	− 2·6	− 8·6	− 2·9	− 8·6	− 2·5	− 9·1
29	− 1·7	− 7·6	− 2·4	− 8·6	− 3·2	− 8·8	− 2·4	− 9·1
30	− 1·7	− 7·6	− 2·4	− 8·5	− 3·1	− 8·8	− 2·6	− 9·1
31	− 1·5	− 7·4				− 8·8	− 2·5	− 9·1

1934	Sept.		Oct.		Nov.		Dec.	
	E-W	N-S	E-W	N-S	E-W	N-S	E-W	N-S
	″	″	″	″	″	″	″	″
1	− 2·4	− 9·1	− 2·1	−10·2	− 2·2	−10·1	− 0·2	− 8·4
2	− 2·5	− 9·1	− 2·3	−10·1	− 1·7	−10·5	+ 0·0	− 8·1
3	− 2·4	− 9·2	− 2·1	−10·3	− 2·3	−10·5	− 0·0	
4	− 2·4	− 9·1	− 2·3	−10·2	− 2·0	− 9·5	− 0·1	
5	− 2·7	− 9·3	− 2·5	−10·3	− 2·0		− 0·0	
6		− 9·4	− 2·6	−10·4	− 2·0	− 8·0	− 0·2	
7		− 9·5	− 2·7	−10·3	− 2·1	− 8·9	− 0·2	
8		− 9·5	− 2·3	−10·4	− 2·3		− 0·2	− 7·7
9	− 2·4	− 9·3	− 2·5	−10·5	− 1·8		− 0·4	− 7·5
10	− 2·3	− 9·2	− 2·5	−10·4	− 1·3	− 8·0	− 0·4	− 8·0
11	− 2·3	− 9·3	− 2·6	−10·6	− 1·2	− 9·3	− 0·6	
12	− 2·4	− 9·2	− 2·4	−10·6	− 1·3		− 0·5	
13	− 2·4	− 9·2	− 2·3	−10·6	− 1·2	− 8·5	− 0·3	
14	− 2·6	− 9·2	− 2·1	−10·7	− 1·3	−10·3	− 0·4	− 7·4
15	− 2·7	− 9·2	− 2·2	−10·7	− 1·3	−10·4	− 0·4	
16	− 2·3	− 9·2	− 2·1	−10·7	− 1·1		− 0·4	
17	− 2·3	− 9·3	− 2·0	−10·7	− 1·1		− 0·4	
18	− 2·3	− 9·3	− 1·9	−10·7	− 1·1	−10·0	− 0·7	− 0·7

(*to be continued.*)

Table II. (*Continued.*)

1934	Sept.		Oct.		Nov.		Dec.	
	E-W	N-S	E-W	N-S	E-W	N-S	E-W	N-S
	″	″	″	″	″	″	″	″
19	− 2·3	− 9·5	− 1·9	−10·8	− 1·1	−10·7	− 0·8	− 8·9
20	− 1·9	− 9·5	− 1·8	−10·7	− 1·2	−10·1	− 0·5	− 8·0
21	− 2·0	− 9·5	− 1·7	−10·9	− 1·0	− 8·9	− 0·6	− 6·9
22	− 2·1	− 9·5	− 1·8	−10·7	− 0·8	− 8·9	− 0·5	
23	− 2·0	− 9·4	− 2·0	−10·6	− 0·8	− 9·6	− 0·6	
24	− 1·9	− 9·5	− 2·0	−10·5	− 0·8	− 9·5	− 0·8	
25	− 2·1	− 9·5	− 2·1	−10·4	− 0·8	−10·2	− 0·5	− 7·0
26	− 2·5	− 9·4	− 2·1	−10·3	− 0·8	−10·6	− 0·4	− 7·3
27	− 2·9	− 9·3	− 2·2	−10·6	− 1·0	−10·8	− 0·2	− 7·3
28			− 2·1	−10·3	− 1·0	−10·9	± 0·0	
29			− 2·2	−10·3	− 0·5	− 9·0	− 0·2	
30			− 2·3	−10·3	− 0·2	− 8·4	± 0·0	− 6·8
31			− 2·1	−10·1				

1935	Jan.		Feb.		Mar.		Apr.	
	E-W	N-S	E-W	N-S	E-W	N-S	E-W	N-S
	″	″	″	″	″	″	″	″
1	− 0·4	+ 3·5	+ 3·2	− 0·8	+ 0·4	+ 1·2	+17·0	+18·5
2	− 1·4	+ 3·6	+ 6·0	− 0·8	+ 1·6	+ 2·2	+18·4	+18·7
3	+ 1·2	+ 3·7	+ 1·0	− 1·0	+ 2·2	+ 2·6	+19·3	+19·7
4	+ 0·6	+ 3·2	− 2·0	− 1·2	+ 2·2	+ 2·2	+19·2	+21·1
5	+ 0·5	+ 2·5	− 1·0	− 1·4	+ 3·5	+ 3·9	+18·4	+20·2
6	+ 0·8	+ 1·8		− 1·0	+ 4·4	+ 6·3	+18·9	+19·7
7	+ 0·4	+ 1·8		0·0	+ 4·6	+ 7·3	+19·2	+19·5
8	− 1·5	+ 1·7		+ 1·0	+ 4·6	+ 9·8	+19·2	+18·8
9	− 3·2	+ 1·6		+ 1·1	+ 5·2	+ 9·1	+19·4	+18·3
10	− 1·0	+ 1·2		+ 1·3	+ 5·0	+ 6·7	+19·6	+17·7
11	− 0·9	+ 1·2	− 6·2	+ 1·3	+ 3·8	+ 6·7	+18·6	+16·9
12	− 0·8	+ 0·2	− 6·2	+ 0·5	+ 4·7	+ 9·1	+18·4	+16·2
13	− 0·7	+ 0·1	− 7·3	+ 0·6	+ 6·9	+ 8·6	+18·5	+15·1
14	− 0·2	− 0·5	− 7·3	+ 1·1	+ 7·9	+ 9·3	+19·0	+13·8
15	− 0·2	− 0·4	− 5·1	− 1·8	+ 8·8	+10·5	+19·6	+11·6
16	− 0·9	− 0·9	− 3·5	− 3·0	+ 9·4	+11·3	+19·8	+ 9·8
17	− 1·5	− 2·2	− 3·0	− 2·4	+10·1	+12·0	+20·1	+ 7·9
18	+ 1·9	− 1·5	− 1·1	− 0·3	+11·3	+12·7	+19·0	+ 6·0
19	− 2·2	− 1·5	− 1·0	− 0·2	+10·2	+11·1	+17·6	+ 4·7
20	− 2·5	− 1·6	− 1·7	+ 1·1	+10·4	+10·2	+16·4	+ 1·3
21	− 2·7		+ 0·2	+ 2·4	+10·8	+10·2	+14·6	− 1·3

(*to be continued.*)

Table II. (*Continued.*)

1935	Jan.		Feb.		Mar.		Apr.	
	E-W	N-S	E-W	N-S	E-W	N-S	E-W	N-S
	″	″	″	″	″	″	″	″
22	− 1·0	− 1·8	− 0·0	+ 2·4	+11·8	+11·3	+12·6	− 3·5
23	− 0·5	− 1·9	− 0·2	+ 2·4	+12·6	+13·5		− 4·9
24	± 0·0	− 1·7	+ 1·6	+ 4·7	+13·0	+14·4	+10·8	− 6·0
25	+ 1·1	− 1·0	+ 1·6	+ 5·0	+12·6	+13·5	+ 9·4	− 7·3
26	+ 1·4	− 0·8	+ 0·5	+ 4·3	+14·0	+15·0	+ 8·0	− 8·1
27	+ 1·6	− 0·3	+ 0·2	+ 2·8	+15·9	+18·7	+ 5·8	− 8·5
28	+ 2·0	± 0·0	+ 0·0	+ 1·9	+16·7	+21·3	+ 4·9	− 9·1
29	+ 2·5	+ 0·3			+16·1	+22·5	+ 4·0	− 9·4
30	+ 2·5	+ 0·9			+15·4	+21·1	+ 3·2	− 9·3
31	+ 3·0	+ 0·4			+15·8	+19·7		

1935	May		June		July		Aug.	
	E-W	N-S	E-W	N-S	E-W	N-S	E-W	N-S
	″	″	″	″	″	″	″	″
1	+ 2·7	− 8·5	+ 2·5	+ 2·5	+ 3·6	+ 1·0	+ 4·0	− 0·3
2	+ 2·2	− 8·3	+ 2·6	+ 2·3	+ 3·6	+ 1·1	+ 4·0	− 0·5
3	+ 1·8	− 7·9	+ 2·5	+ 2·3	+ 3·7	+ 0·9	+ 3·9	− 0·3
4	+ 1·7	− 7·1	+ 2·5	+ 2·3	+ 3·6	+ 0·9	+ 3·8	− 0·3
5	+ 1·6	− 5·8	+ 2·6	+ 2·3	+ 3·5	+ 0·9	+ 3·8	− 0·3
6	+ 1·6	− 5·0	+ 2·6	+ 2·2	+ 3·5	+ 0·7	+ 3·8	− 0·1
7	+ 1·5	− 4·0	+ 2·7	+ 2·6	+ 3·4	+ 0·4	+ 3·9	− 0·2
8	+ 1·7	− 2·8	+ 2·8	+ 2·5	+ 3·3	+ 0·6	+ 4·0	− 0·1
9	+ 1·8	− 2·2	+ 2·8	+ 2·5	+ 3·6	+ 0·5	+ 4·0	− 0·1
10	+ 1·8	− 1·5	+ 2·8	+ 2·5	+ 3·6	+ 0·5	+ 3·8	− 0·2
11	+ 1·6	− 0·6	+ 2·8	+ 2·3	+ 3·6	+ 0·5	+ 3·8	− 0·1
12	+ 1·6	− 0·1	+ 2·6	+ 2·3	+ 3·6	+ 0·3	+ 3·7	− 0·1
13	+ 1·4	− 0·3	+ 2·6	+ 2·3	+ 3·7	+ 0·2	+ 3·6	− 0·2
14	+ 1·4	+ 0·6	+ 3·0	+ 2·3	+ 3·6	+ 0·3	+ 3·6	− 0·4
15	+ 1·5	+ 1·1	+ 3·0	+ 2·3	+ 3·5	+ 0·3	+ 3·5	− 0·7
16	+ 1·4	+ 1·3	+ 3·0	+ 2·5	+ 3·5	+ 0·1	+ 3·5	− 0·7
17	+ 1·4	+ 1·7	+ 3·1	+ 2·1	+ 3·4	+ 0·1	+ 3·6	− 1·1
18	+ 1·4	+ 2·2	+ 3·0	+ 2·3	+ 3·4	+ 0·1	+ 3·5	− 1·1
19	+ 1·5	+ 2·5	+ 3·1	+ 2·2	+ 3·4	+ 0·1	+ 3·5	− 1·1
20	+ 1·6	+ 2·5	+ 3·2	+ 2·5	+ 3·4	+ 0·3	+ 3·5	− 1·1
21	+ 1·6	+ 2·7	+ 3·2	+ 2·4	+ 3·5	+ 0·1	+ 3·6	− 1·1
22	+ 1·7	+ 2·9	+ 3·2	+ 2·3	+ 3·5	+ 0·2	+ 3·6	− 1·0
23	+ 1·6	+ 2·8	+ 3·4	+ 2·4	+ 3·6	+ 0·3	+ 3·6	− 1·0
24	+ 1·8	+ 2·9	+ 3·5	+ 2·3	+ 3·7	− 0·1	+ 3·7	− 0·9

(*to be continued.*)

Table II. (*Continued.*)

1935	May		June		July		Aug.	
	E-W	N-S	E-W	N-S	E-W	N-S	E-W	N-S
	″	″	″	″	″	″	″	″
25	+ 2·3	+ 3·0	+ 3·1	+ 2·1	+ 3·6	− 0·3	+ 3·7	− 0·9
26	+ 2·4	+ 3·1	+ 3 6	+ 2·1	+ 3·6	− 0·2	+ 3·8	− 1·0
27	+ 2·4	+ 3·1	+ 3·6	+ 2·0	+ 3·6	− 0·1	+ 3·8	− 1·1
28	+ 2·4	+ 3·0	+ 3·6	+ 1·9	+ 3·6	− 0·2	+ 3·7	− 1·2
29	+ 2·4	+ 2·9	+ 3·6	+ 2·0	+ 3·6	− 0·2	+ 3·7	− 1·1
30	+ 2·4	+ 2·9	+ 3·5	+ 1·3	+ 3·7	− 0·1	+ 3·8	− 1·4
31	+ 2·5	+ 2·7			+ 3·8	− 0·3	+ 3·8	− 1·4

1935	Sept.		Oct.		Nov.		Dec.	
	E-W	N-S	E-W	N-S	E-W	N-S	E-W	N-S
	″	″	″	″	″	″	″	″
1	+ 3·6	− 1·3	+ 3·4	− 2·4	+ 3·5	− 3·6	+ 3·0	− 3·1
2	+ 3·6	− 1·3	+ 3·3	− 2·5	+ 3·2	− 3·7	+ 2·4	− 2·5
3	+ 3·6	− 1·7	+ 3·4	− 2·4	+ 3·4	− 3·7	+ 3·1	− 3·2
4	+ 3·6	− 2·0	+ 3·5	− 2·7	+ 3·2	− 3·7	+ 3·3	− 2·8
5	+ 3·6	− 2·0	+ 3·2	− 2·6	+ 3·2	− 3·5	+ 3·3	− 2·5
6	+ 3·6	− 1·9	+ 3·2	− 2·5	+ 2·8	− 3·5	+ 3·3	− 2·5
7	+ 3·4	− 1·9	+ 3·2	− 2·4	+ 3·2	− 3·4	+ 3·4	− 2·6
8	+ 3·6	− 2·1	+ 3·3	− 2·1	+ 3·2	− 2·9	+ 2·7	− 2·8
9	+ 3·6	− 2·3	+ 3·2	− 1·8	+ 3·0	− 2·9	+ 2·6	− 3·1
10	+ 3·6	− 2·2	+ 3·2	− 1·9	+ 2·8	− 3·3	+ 3·2	− 3·1
11	+ 3·7	− 2·2	+ 3·0	− 1·9	+ 3·4	− 3·0	+ 3·4	− 2·6
12	+ 3·7	− 2·1	+ 3·0	− 1·9	+ 4·0	− 2·4	+ 3·9	− 2·5
13	+ 3·5	− 2·3	+ 3·1	− 2·0	+ 3·5	− 2·5	+ 4·2	− 2·1
14	+ 3·6	− 2·3	+ 3·0	− 2·0	+ 3·5	− 3·5	+ 4·4	− 2·0
15	+ 3·4	− 1·9	+ 3·0	− 1·9	+ 3·0	− 3·2	+ 4·1	− 2·4
16	+ 3·4	− 2·1	+ 2·8	− 2·1	+ 2·6	− 3·3	+ 4·1	− 2·2
17	+ 3·4	− 2·1	+ 2·9	− 2·1	+ 2·9	− 3·9	+ 3·7	− 1·5
18	+ 3·3	− 1·9	+ 2·9	− 2·2	+ 3·4	− 4·3	+ 3·0	− 2·7
19	+ 3·2	− 2·1	+ 2·8	− 1·9	+ 3·6	− 4·0	+ 4·0	− 2·3
20	+ 3·2	− 2·0	+ 2 8	− 1·9	+ 3·0	− 3·1	+ 4·0	− 1·2
21	+ 3·2	− 1·9	+ 3·0	− 1·9	+ 3·6	− 3·1	+ 3·6	− 0·9
22	+ 3·3	− 1·9	+ 3·0	− 1·9	+ 3·4	− 2·8	+ 3·6	− 1·1
23	+ 3·2	− 1·9	+ 3·2	− 2·1	+ 2·8	− 3·0	+ 4·2	− 1·3
24	+ 3·0	− 1·9	+ 3·3	− 2·4	+ 2·8	− 3·9	+ 4·2	− 1·3
25	+ 3·2	− 2·5	+ 3·2	− 2·6	+ 2·7	− 3·6	+ 3·4	− 0 6
26	+ 3·3	− 2·8	+ 3·3	− 2·7	+ 2·4	− 3·0	+ 3·4	− 0·7
27	+ 3·6	− 2·5	+ 3·0	− 2·5	+ 2·5	− 2·8	+ 3 0	− 1·3

(*to be continued.*)

Table II. (*Continued.*)

1935	Sept.		Oct.		Nov.		Dec.	
	E-W	N-S	E-W	N-S	E-W	N-S	E-W	N-S
	″	″	″	″	″	″	″	″
28	+ 3·8	− 2·2	+ 3·1	− 2·5	+ 2·9	− 3·1	+ 2·4	− 0·9
29	+ 3·6	− 2·3	+ 3·2	− 2·8	+ 2·6	− 3·1	+ 2·4	− 2·3
30	+ 3·3	− 2·1	+ 3·4	− 3·2	+ 3·1	− 3·2	+ 2·4	− 2·5
31			+ 3·4	− 3·4			+ 3·0	− 2·5

1936	Jan.		Feb.		Mar.		Apr.	
	E-W	N-S	E-W	N-S	E-W	N-S	E-W	N-S
	″	″	″	″	″	″	″	″
1	− 2·0	+ 2·4	− 5·0	− 3·5	− 9·0	− 0·2	−18·9	−11·3
2	− 2·4	+ 3·4	− 4·5	− 0·9	− 8·9	+ 2·1	−19·2	−10·8
3	− 3·2	+ 3·6	− 4·9	+ 1·2	− 7·0	+ 2·4	−20·6	−13·3
4	− 2·8	+ 2·1	− 5·9	+ 2·7	− 6·4	+ 1·7	−21·3	−14·6
5	− 1·6	+ 2·6	− 9·2	+ 1·6	− 9·4	+ 0·5	−20·2	−15·8
6	− 2·9	− 1·1	− 9·0	− 0·6	− 8·4	+ 3·0	−21·3	−14·4
7	− 4·8	− 3·2	− 9·5	− 0·9	− 8·9	+ 3·0	−21·8	−15·8
8	− 4·5	−10·5	−11·9	− 1·4	−10·2	+ 2·8	−21·8	−17·5
9	− 5·1	−13·0			−12·1	+ 3·1	−22·3	−19·2
10	−12·3	−14·0	− 9·7	− 3·6	−11·6	− 1·0	−22·6	−20·3
11	−11·8	−15·0	− 9·8	− 3·8	− 9·8	− 0·2	−22·6	−21·9
12	−12·7	−14·6	− 8·9	− 2·9	−11·0	+ 0·2	−22·7	−22·8
13	−14·3	−16·4	− 6·5	− 1·0	−13·6	− 3·3	−22·8	−23·2
14	−13·4	−18·4	− 8·1	+ 0·7	−15·8	− 7·3	−23·2	−23·4
15	−12·5	−16·5	− 9·7	− 1·4	−18·1	−11·4	−23·5	−23·9
16	−11·1	−17·9	− 9·7	− 1·9	−18·7	−12·1	−23·6	−24·4
17	− 8·1	−14·9	−10·8	− 3·4	−18·4	−11·6	−23·6	−25·3
18	− 4·9		−12·8	− 7·8	−18·9	−12·7	−23·6	−25·3
19	− 4·0	−11·3	−14·1		−19·8	−15·6	−23·7	−26·6
20	− 5·2	− 9·7	−13·1	− 7·7	−18·9	−11·9	−23·7	−27·9
21	− 2·6	−11·9	−11·9	− 4·9	−19·0	−11·5	−23·6	−28·7
22	− 1·8	− 9·1	− 9·3	+ 2·2	−19·7	−13·3	−23·8	−29·2
23	− 4·2	− 8·9	− 9·3	+ 4·1	−20·2	−14·3	−23·8	−29·9
24	− 3·1	− 8·2	−11·2	+ 1·6	−20·6	−15·6	−23·7	−31·1
25	− 3·5	− 7·8	−11·9	+ 0·2	−20·9	−17·4	−23·8	−31·3
26	− 8·9	−10·5	− 9·7	+ 1·0	−20·5	−19·0	−24·0	−31·8
27		−14·1	− 9·5	+ 2·1	−19·7	−14·2	−24·1	−32·2
28	− 7·6	−12·2	− 9·3	+ 1·8	−20·4	−14·1	−24·0	−32·8
29	− 9·7	−11·7	− 9·6	− 0·4	−21·0	−16·1	−24·2	−33·1
30	−11·3	−13·5			−21·5	−17·4	−24·2	−33·4
31	− 6·2	−11·6			−19·0	−15·2		

(*to be continued.*)

Table II. (*Continued.*)

1936	May		June		July		Aug.	
	E-W	N-S	E-W	N-S	E-W	N-S	E-W	N-S
	"	"	"	"	"	"	"	"
1	−24·3	−33·9			−10·1	−28·9	− 6·3	−23·2
2	−24·5	−34·5	−17·9	−32·5	−10·1	−28·7	− 5·6	−30·7
3	−24·3	−34·8	−15·2	−33·1	−10·5	−27·8	− 5·3	−30·8
4	−24·4	−34·8	−14·8	−32·0	−10·3	−27·7	− 4·9	−30·7
5	−24·1	−35·0	−13·2	−35·8	−10·1	−27·3	− 4·5	−30·8
6	−24·0	−35·4	−14·8	−35·5	− 9·8	−25·8	− 4·3	−30·9
7	−24·1	−35·5	−14·7	−35·8	− 9·7	−26·3	− 4·1	−31·1
8	−24·2	−34·9	−14·5	−34·7	− 9·6	−26·1	− 3·8	−31·3
9	−24·1	−34·9	−14·2	−35·1	− 9·4	−26·0	− 3·1	−31·3
10	−24·1	−34·6	−14·0	−35·2	− 9·1	−25·5	− 2·8	−31·4
11	−23·8	−34·6	−13·8	−35·3	− 8·9	−25·3	− 2·5	−31·3
12	−23·5	−34·5	−13·6	−35·2	− 8·8	−25·2	− 2·3	−31·5
13	−23·0	−34·3	−13·3	−35·0	− 8·3	−25·1	− 2·0	−31·5
14	−22·6	−33·2	−13·3	−34·9	− 8·2	−25·0	− 1·7	−31·6
15	−22·0	−33·1	−13·1	−35·0	− 8·2	−24·9	− 1·5	−31·8
16	−21·4	−32·4	−12·9	−34·8	− 8·1	−24·8	− 1·3	−31·9
17	−20·8	−31·6	−12·7	−34·6	− 7·8	−24·9	− 1·2	−32·0
18	−20·3	−30·7	−12·5	−34·3	− 8·5	−25·1	− 1·2	−31·6
19	−19·4	−30·0		−34·0	− 7·8	−25·0	− 1·2	−31·6
20	−18·4	−29·5	−12·0	−33·2	− 7·7	−24·9	− 1·2	−31·5
21	−17·8	−28·8	−11·6	−33·0	− 7·8	−24·8	− 1·3	−31·8
22	−17·0	−28·5	−11·4	−32·7	− 7·8	−24·7	− 1·2	−32·3
23	−17·4	−28·3	−11·4	−32·7	− 7·7	−24·0	− 1·0	−32·1
24	−16·0	−28·0	−11·2	−32·5	− 7·6	−24·1	− 1·1	−32·1
25	−15·8	−28·1	−11·0	−31·5	− 7·6	−23·8	− 1·2	−32·2
26	−16·3	−28·8	−10·9	−31·1	− 7·4	−23·8	− 1·1	−31·9
27	−16·3	−30·5	−10·9	−30·7	− 7·2	−23·0	− 1·0	−31·9
28	−16·1	−32·6	−10·6	−29·8	− 7·1	−23·0	− 1·0	−32·8
29	−12·1	−31·6	−10·4	−29·3	− 6·8	−23·2	− 0·9	−32·0
30	−14·6	−35·4	−10·2	−29·2	− 6·5	−23·3	− 1·0	−33·7
31		−36·8			− 6·5	−23·4	− 0·9	−33·6

1936	Sept.		Oct.		Nov.		Dec.	
	E-W	N-S	E-W	N-S	E-W	N-S	E-W	N-S
	"	"	"	"	"	"	"	"
1	− 0·9	−33·5	− 2·1	−33·6	− 2·6	−31·4	− 0·1	−29·9
2	− 1·1	−33·3	− 2·1	−33·6	− 2·7	−32·3	− 1·1	−29·4
3	− 1·1	−33·1	− 2·1	−33·4	− 1·7	−34·1	− 1·8	−31·3

(*to be continued.*)

Table II. *(Continued.)*

1936	Sept.		Oct.		Nov.		Dec.	
	E-W	N-S	E-W	N-S	E-W	N-S	E-W	N-S
	″	″	″	″	″	″	″	″
4	−1·1	−33·2	−2·2		−1·7	−33·2	+1·2	−31·7
5	−1·1	−33·2	−2·4	−33·8	−2·2	−31·5	+0·9	−31·7
6	−1·2	−33·3	−2·4	−34·1	−1·8	−30·8	+0·7	−30·9
7	−1·2	−38·3	−2·1	−34·3	−1·8	−32·9	+1·0	−30·0
8	−1·2	−33·4	−2·1	−34·2	−2·6	−31·8	+1·4	−29·7
9	−1·1	−33·3	−2·3	−33·4	−2·3	−30·6	+0·8	−29·7
10	−1·1	−33·3	−2·5	−33·3	−1·1	−32·6	+1·3	−28·9
11	−1·2	−33·4	−2·6	−33·5	−0·9	−33·7	+1·0	−28·2
12	−1·3	−33·4	−2·6	−33·5	−2·0	−33·0	+0·5	−27·0
13	−1·3	−33·4	−2·6	−33·3	−2·3	−31·7	−0·1	−28·5
14	−1·4	−33·3	−2·2	−33·4	−1·3	−32·3	−0·1	−28·7
15	−1·3	−33·5	−2·5		−1·3	−32·5	+0·1	−28·6
16	−1·4	−33·4	−2·4		−1·6	−31·9	+0·2	−28·8
17	−1·4	−33·5	−2·6		−1·7	−31·9	−0·2	−28·8
18	−1·6	−33·4	−2·3	−33·4	−1·6	−31·3	+0·3	−28·6
19	−1·5	−33·5	−2·4	−32·8	−2·1	−30·8	−0·1	−28·9
20	−1·5	−33·4	−2·6	−32·9	−2·0	−30·1	−0·2	−29·0
21	−1·6	−33·3	−2·6	−33·1	−0·4	−33·0	+0·6	−29·8
22	−1·6	−33·3	−2·4	−32·9	−0·9	−31·5	+0·9	−29·4
23	−1·7	−33·1	−2·6	−35·1	−1·9	−30·5	+1·0	−28·8
24	−1·8	−33·2	−1·5	−35·8	−0·1	−30·5	+1·3	−29·0
25	−1·9	−33·2	−1·7	−34·9	−0·3	−30·4	+1·2	−28·7
26	−1·9	−33·3	−2·1	−33·5	+0·4	−30·7	+1·3	−27·0
27	−2·1	−33·1	−2·6	−32·3	−0·9	−30·2	+1·3	−27·0
28	−2·1	−32·7	−2·6	−33·6	−1·9	−28·3	+1·3	−27·7
29	−2·1	−33·2	−1·9	−32·9	−1·3	−27·0	+1·4	−27·2
30	−2·1	−33·3	−2·3	−32·3	−0·7	−28·4	+1·3	−27·3
31			−2·6	−31·8			+1·3	−27·2

1937	Jan.		Feb.		Mar.		Apr.	
	E-W	N-S	E-W	N-S	E-W	N-S	E-W	N-S
	″	″	″	″	″	″	″	″
1		−16·5	−0·2	−28·0	+2·6	−30·5	+4·1	
2	+4·6	−17·5	−1·3	−27·9	+2·6	−30·3	+4·3	−31·4
3	+4·4	−17·4	−0·7	−27·8	+2·5	−30·4	+4·2	−31·8
4	+4·5	−16·7	+0·9	−27·7	+2·5	−31·1	+4·4	−31·0
5	+4·3	−16·1	−1·0	−26·9	+2·5	−31·7	+4·8	−30·3
6	+3·7	−16·6	−2·3	−28·5	+2·5	−31·8	+5·5	−29·7

(to be continued.)

Table II. (*Continued.*)

1937	Jan.		Feb.		Mar.		Apr.	
	E-W	N-S	E-W	N-S	E-W	N-S	E-W	N-S
	″	″	″	″	″	″	″	″
7	+ 4·1	−17·4	− 3·0	−30·0	+ 2·0	−32·3	+ 6·2	−30·0
8	+ 4·9	−18·2	− 3·1	−31·1	+ 1·7	−33·3	+ 6·6	
9	+ 4·7	−17·7	− 1·7	−30·6	+ 1·6	−34·1	+ 6·8	
10	+ 3·9	−16·6	− 0·5	−29·5	+ 1·4	−33·9	+ 6·7	
11	+ 3·8	−17·7	− 0·6	−29·5	+ 0·7	−33·8	+ 8·3	−29·6
12	− 3·2	−18·6	− 0·5	−30·3	+ 0·8	−35·3	+ 8·3	−28·7
13	+ 0·8	−19·4	− 0·0	−31·3	+ 0·5	−34·1	+ 8·6	−29·3
14	+ 0·3	−19·5	− 0·8	−32·2	+ 0·4	−33·7	+ 8·6	−30·0
15	+ 0·2	−20·5	+ 0·8	−33·0	+ 0·1	−34·1	+ 8·4	−30·8
16	− 0·7	−21·2	+1·00	−32·1	− 0·2	−34·9	+ 7·9	−31·3
17	− 1·1	−21·0	+1·65	−32·0	− 0·6	−34·5	+ 7·3	−32·6
18	− 2·4	−22·3	+2·30	−32·2	− 0·7	−31·3	+ 6·5	−34·5
19	− 2·4	−23·2	+ 2·6	−28·1	− 0·7	−32·9	+ 5·3	−36·3
20	− 2·8	−23·2	+ 2·6	−28·0	− 0·7	−31·6	+ 3·4	−37·2
21	− [illegible]·3	−24·5	+ 2·8	−28·5	− 0·6	−32·5	+ 3·5	−39·1
22	− 3·3	−24·3	+ 3·7	−27·7	− 0·5	−32·0	+ 3·3	−41·5
23	− 3·3	−25·6	+ 3·1	−27·0	− 0·4	−32·0	− 2·5	−46·8
24	− 2·8	−25·0	+ 2·0	−28·3	+ 0·2	−32·8	− 5·0	−45·8
25	− 3·0	−25·0	+ 1·8	−29·3	− 0·4	−33·9	− 7·8	−47·8
26	− 1·5	−27·0	+ 2·0	−29·4	+ 0·8	−34·9	− 9·8	−52·6
27	− 2·3	−26·6	+ 2·0	−30·0	+ 2·1	−31·8	−11·5	−51·3
28	− 0·6	−26·2	+ 2·5	−30·5	+ 2·2	−30·7	−13·3	−54·0
29	− 1·7	−26·9			+ 3·5	−30·7	−14·5	−55·4
30	− 1·9	−27·7			+ 4·4	−30·8	−15·2	−56·4
31	− 2·1	−28·4			+ 4·7	−31·8		

1937	May		June		July		Aug.	
	E-W	N-S	E-W	N-S	E-W	N-S	E-W	N-S
	″	″	″	″	″	″	″	″
1	−16·2	−56·8		−20·7	+ 3·6	−20·4	+ 4·2	−21·4
2	−16·7	−57·0		−20·6	+ 3·7	−20·6	+ 4·4	−21·4
3	−17·2	−56·0		−20·5	+ 3·7	−20·6	+ 4·5	−21·4
4	−17·0	−54·8	+ 2·3		+ 3·8	−20·7	+ 4·5	−21·3
5	−15·9	−53·0	+ 2·5		+ 3·8	−20·6	+ 4·5	−21·5
6	−15·0	−50·6	+ 2·7		+ 3·9	−20·5	+ 4·5	−21·6
7	−13·8	−47·5	+ 3·2	−21·1	+ 4·1	−20·7	+ 4·4	−21·6
8	−17·0	−44·5	+ 3·3	−21·2	+ 4·2	−21·0	+ 4·3	−21·6
9	−11·6	−41·8	+ 3·4	−21·0	+ 4·1	−21·0	+ 4·2	−21·7

(*to be continued.*)

Table II. (*Continued.*)

1937	May		June		July		Aug.	
	E-W	N-S	E-W	N-S	E-W	N-S	E-W	N-S
	″	″	″	″	″	″	″	″
10	−11·6	−38·9	+ 3·4	−20·4	+ 4·0	−21·0	+ 4·1	−21·7
11	− 9·5	−36·4	+ 3·6	−20·6	+ 3·9	−21·0	+ 4·3	−21·7
12	− 8·3	−34·0	+ 3·6	−20·7	+ 3·9	−20·9	+ 4·3	−21·6
13	− 6·9	−32·5	+ 3·7	−20·7	+ 3·9	−21·0	+ 4·3	−21·7
14	− 5·8	−31·4	+ 3·9	−20·6	+ 3·9	−20·9	+ 4·4	−21·8
15	− 5·7	−30·7	+ 4·0	−20·8	+ 3·9	−21·0	+ 4·4	−21·7
16	− 5·9	−29·0	+ 4·1	−20·5	+ 3·8	−20·9	+ 4·4	−21·6
17	− 5·7	−28·0	+ 3·7	−20·6	+ 3·8	−21·0	+ 4·4	−21·6
18	− 5·6	−26·5	+ 3·8	−20·8	+ 4·0	−21·1	+ 4·5	−21·7
19	− 5·3	−25·0	+ 3·9	−20·6	+ 3·9	−21·2	+ 4·6	−21·7
20	− 5·2	−24·3	+ 3·9	−20·7	+ 3·9	−21·3	+ 4·5	−21·8
21	− 4·3	−23·9	+ 4·0	−20·6	+ 3·9	−21·2	+ 4·6	−21·8
22	− 4·3	−23·6	+ 4·0	−20·6	+ 4·1	−21·2	+ 4·6	−22·0
23	− 3·7	−22·7	+ 3·8	−20·5	+ 4·1	−21·2	+ 4·5	−21·9
24	− 3·0	−22·0	+ 3·6	−20·5	+ 4·0	−21·2	+ 4·5	−21·9
25	− 2·5	−21·9	+ 3·7	−20·5	+ 4·1	−21·2	+ 4·4	−21·8
26	− 1·8	−21·7	+ 3·9	−20·6	+ 4·4	−21·5	+ 4·6	−21·6
27	− 1·1	−21·7	+ 3·9	−20·7	+ 4·4	−21·5	+ 4·4	−21·8
28	− 0·5	−21·5	+ 3·9	−20·8	+ 4·3	−21·4	+ 4·6	−21·8
29	− 0·8	−20·5	+ 3·8	−20·7	+ 4·2	−21·5	+ 4·5	−21·8
30	− 0·2	−20·5	+ 3·6	−20·5	+ 4·3	−21·4	+ 4·5	−21·6
31	+ 0.4	−20·7			+ 4·2	−21·4	+ 4·6	−21·5

1937	Sept.		Oct.		Nov.		Dec.	
	E-W	N-S	E-W	N-S	E-W	N-S	E-W	N-S
	″	″	″	″	″	″	″	″
1	+ 4·6	−21·5	+ 4·8	−22·3	+ 4·9	−21·6	+ 7·6	−23·3
2	+ 4·5	−21·8	+ 4·8	−22·3	+ 4·9	−21·7	+ 7·0	−23·6
3	+ 4·5	−21·8	+ 4·5	−22·2	+ 4·8	−21·7	+ 7·7	−23·6
4	+ 4·5	−21·7	+ 4·6	−22·2	+ 4·8	−21·5	+ 8·3	−23·2
5	+ 4·3	−21·7	− 4·8	−22·3	+ 4·9	−21·6	+ 8·4	−22·7
6	+ 4·3	−21·4	+ 4·8	−22·3	+ 4·7	−21·8	+ 8·4	−21·7
7	+ 4·3	−22·0	+ 4·5	−22·3	+ 4·8	−21·9	+ 7·6	−21·1
8	+ 4·4	−22·0	+ 4·2	−21·8	+ 5·0	−22·0	+ 7·4	−21·0
9	+ 4·7	−22·0	+ 4·3	−21·9	+ 5·9	−23·3	+ 7·4	−20·8
10	+ 4·6	−22·0	+ 4·5	−21·9	+ 5·8	−23·5	+ 7·9	−21·5
11	+ 4·6	−26·0	+ 4·8	−22·3	+ 6·3	−23·8	+ 7·3	−22·3
12	+ 4·4	−21·8	+ 4·7	−22·5	+ 5·9	−23·7	+ 7·6	−23·1

(*to be continued.*)

Table II. (*Continued.*)

1937	Sept.		Oct.		Nov.		Dec.	
	E-W	N-S	E-W	N-S	E-W	N-S	E-W	N-S
	″	″	″	″	″	″	″	″
13	+ 4·4	−21·8	+ 4·5	−22·3	+ 5·8	−23·3	+ 7·4	−22·7
14	+ 4·4	−21·8	+ 4·4	−22·1	+ 5·5	−23·0	+ 7·2	−21·3
15	+ 4·4	−21·8	+ 4·5	−22·1	+ 5·5	−22·6	+ 7·0	−22·0
16	+ 4·3	−21·8	+ 4·3	−22·1	+ 6·1	−23·0	+ 7·0	−22·5
17	+ 4·6	−21·8	+ 4·4	−22·0	+ 6·6	−23·4	+ 6·8	−21·0
18	+ 4·7	−22·0	+ 4·2	−22·9	+ 6·0	−23·0	+ 6·6	−21·0
19	+ 4·8	−22·3	+ 4·0	−24·0	+ 6·6	−24·0	+ 6·5	−21·9
20	+ 5·0	−22·3	+ 4·6	−23·5	+ 7·3	−22·9	+ 6·4	−23·2
21	+ 5·0	−22·4	+ 4·7	−23·5	+ 7·4	−21·8	+ 6·3	−22·3
22	+ 4·9	−22·4	+ 4·8	−22·3	+ 6·6	−20·6	+ 5·8	−22·0
23	+ 4·4	−22·1	+ 4·5	−22·0	+ 7·5	−21·4	+ 6·0	−23·5
24	+ 4·6	−22·1	+ 4·6	−22·0	+ 6·6	−20·5	+ 6·0	−23·5
25	+ 4·5	−22·2	+ 4·9	−22·4	+ 7·5	−21·3	+ 5·9	−23·5
26	+ 4·6	−22·1	+ 4·8	−22·2	+ 7·7	−21·0	+ 5·7	−26·5
27	+ 4·5	−22·2	+ 4·8	−22·2	+ 7·9	−21·1	+ 5·4	−25·0
28	+ 4·4	−23·3	+ 4·8	−22·2	+ 7·7	−21·1	+ 5·7	−23·6
29	+ 4·6	−22·3	+ 4·8	−22·1	+ 7·0	−21·0	+ 4·5	−27·6
30	+ 4·6	−22·3	+ 4·8	−22·2	+ 7·5	−21·1	+ 5·1	−29·7
31			+ 4·8	−22·2			+ 5·2	−31·0

1938	Jan.		Feb.		Mar.		Apr.	
	E-W	N-S	E-W	N-S	E-W	N-S	E-W	N-S
	″	″	″	″	″	″	″	″
1	+ 5·2	−30·2	+ 0·5	−28·2	− 2·4	−32·5	− 5·3	−37·7
2	+ 5·3	−31·9	+ 0·0	−25·5	− 2·5	−31·8	− 5·5	−38·0
3	+ 5·6	−31·2	+ 0·2	−22·5	− 3·3	−33·3	− 5·2	−38·1
4	+ 7·6	−27·9	+ 1·0	−22·3	− 3·6	−35·7	− 5·4	−38·2
5	+ 9·3	−25·2	+ 0·5	−23·6	− 4·0	−35·3	− 5·4	−38·0
6	+10 3	−24·6	+ 0·5	−23·6	− 4·0	−36·0	− 5·5	−37·9
7	+ 8·8	−25·2	+ 0·4	−23·6	− 4·1	−36·9	− 5·5	−37·9
8	+ 9·0	−27·0	− 0·3	−23·7	− 4·2	−37·5	− 5·6	
9	+ 9·6	−24·8	− 0·6	−23·9	− 4·6	−37·0	− 5·7	−37·6
10	+ 9·9	−24·3	+ 0·0	−23·8	− 4·6	−36·0	− 5·5	−37·9
11	+10·1	−24·9	+ 0·5	−22·2	− 4·5	−35·5	− 5·9	−37·3
12	+ 7·9	−25·8	+ 0·2	−22·9	− 4·5	−34·8	− 6·0	−37·3
13	+ 8·2	−25·1	− 0·3	−28·0	− 4·4	−35·1	− 6·0	−37·3
14	+ 8·5	−23·9	− 1·4	−24·7	− 4·2	−35·1	− 6·1	−37·3
15	+ 7·1	−24·5	− 1·6	−26·7	− 4·5	−34·0	− 6·4	−37·2

(*to be continued.*)

Table II. (*Continued.*)

1938	Jan.		Feb.		Mar.		Apr.	
	E-W	N-S	E-W	N-S	E-W	N-S	E-W	N-S
	″	″	″	″	″	″	″	″
16	+ 6·0	−26·2	− 1·6	−27·4	− 4·5	−33·1	− 6·4	−37·2
17	+ 6·0	−25·9	− 1·8	−28·7	− 4·4	−33·5	− 6·5	−37·2
18	+ 6·1	−24·9	− 2·0	−28·8	− 4·1	−33·8	− 6·1	−37·8
19	+ 4·2	−27·1	− 1·9	−28·7	− 4·3	−34·3	− 6·3	−37·8
20	+ 2·4	−29·5	− 1·8	−28·9	− 4·6	−35·0	− 6·2	−37·8
21	+ 1·5	−30·8	− 1·7	−29·0	− 4·6	−35·6	− 6·3	−37·6
22	+ 0·9	−31·6	− 1·5	−29·1	− 4·8	−36·1	− 0·5	−37·7
23	+ 0·9	−31·2	− 1·7	−28·6	− 4·7	−36·4	− 6·4	−37·6
24	+ 0·3	−28·8	− 1·1	−29·7	− 4·9	−35·8	− 6·6	−37·8
25	+ 0·9	−28·5	− 1·3	−29·9	− 5·1	−37·0	− 6·8	−37·6
26	+ 0·4	−28·6	− 0·9	−29·7	− 5·0	−36·1	− 6·8	−37·6
27	+ 0·2	−28·5	− 1·0	−29·0	− 5·0	−36·5	− 7·1	−37·6
28	+ 1·1	−28·0	− 1·8	−28·6	− 4·9	−36·7	− 7·0	−37·5
29	+ 1·7	−27·5			− 5·0	−36·9	− 7·0	−37·4
30	+ 1·5	−27·4			− 5·1	−37·4	− 6·9	−37·8
31	+ 0·7	−26·6			− 5·2	−37·3		

1938	May		June		July		Aug.	
	E-W	N-S	E-W	N-S	E-W	N-S	E-W	N-S
	″	″	″	″	″	″	″	″
1	− 7·1	−37·7	+10·1	−37·2	+10·9	−29·3	+12·3	−30·3
2	− 7·1	−37·6	+10·5	−37·2	+10·9	−29·3	+12·5	−30·3
3	− 7·0	−37·3	+11·5	−37·3	+10·9	−29·1	+12·7	−30·6
4	− 7·0	−37·0	+11·0	−37·3	+10·7	−28·8	+13·5	−31·0
5	− 7·0	−36·8	+11·3	−37·5	+10·6	−28·3	+14·0	−31·0
6	− 7·0	−36·7	+11·4	−37·5	+10·5	−23·3	+14·2	−30·9
7	− 6·8	−35·9	+11·6	−37·4	+10·7	−28·2	+14·4	−30·9
8	− 6·3	−35·0	+11·8	−37·3	+10·7	−28·0	+14·5	−30·7
9	− 5·5	−33·6	+12·3	−36·6	+10·8	−28·0	+14·4	−30·6
10	− 4·8	−32·5	+12·5	−35·8	+10·9	−28·0	+14·5	−30·7
11	− 3·9	−33·0	+12·7	−36·6	+10·9	−28·0	+14·5	−30·7
12	− 2·7	−32·9	+12·9	−36·5	+11·0	−28·0	+14·7	−30·6
13	− 1·6	−32·7	+12·9	−36·5	+10·9	−28·0	+15·1	−30·8
14	− 0·2	−32·5	+13·0	−36·5	+10·8	−27·8	+15·1	−30·8
15	+ 1·2	−32·3	+13·0	−36·5	+10·8	−27·8	+15·3	−30·9
16	+ 2·6	−32·2	+13·2	−36·5	+10·8	−27·8	+15·3	−31·0
17	+ 2·0	−32·5	+13·3	−35·0	+10·7	−28·0	+15·3	+31·0
18	+ 3·2	−32·8	+13·3	−34·9	+11·0	−28·4	+15·2	+31·0

(*to be continued.*)

Table II. (*Continued.*)

1938	May E–W	May N–S	June E–W	June N–S	July E–W	July N–S	Aug. E–W	Aug. N–S
	"	"	"	"	"	"	"	"
19	+ 4·0	−33·5	+13·4	−34·9	+11·1	−28·5	+15·1	+31·1
20	+ 4·7	−34·2	+12·5	−34·4	+11·1	−28·8	+15·2	+31·1
21	+ 5·9	−34·3	+12·0	−33·8	+10·9	−28·8	+15·1	+31·3
22	+ 5·1	−34·8	+11·5	−33·5	+10·7	−29·1	+15·1	+31·1
23	+ 6·7	−35·2	+11·4	−33·1	+10·5	−29·3	+15·0	+31·1
24	+ 7·3	−35·3	+11·2	−33·2	+10·7	−29·5	+15·0	+31·1
25	+ 7·4	−35·2	+11·3	−33·0	+10·9	−29·8	+15·0	+31·3
26	+ 7·5	−35·3	+11·5	−31·4	+11·3	−30·1	+15·0	+31·2
27	+ 8·0	−37·1	+11·2	−31·4	+11·2	−30·3	+14·1	+31·2
28	+ 8·5	−37·3	+11·1	−31·3	+11·2	−30·2	+15·1	+31·3
29	+ 9·2	−37·2	+11·0	−29·4	+11·6	−30·4	+15·0	+31·2
30	+10·2	−37·3	+11·2	−29·1	+11·9	+30·3	+14·8	+31·2
31	+10·1	−37·1			+12·1	+30·4	+14·8	+31·2

1938	Sept. E–W	Sept. N–S	Oct. E–W	Oct. N–S	Nov. E–W	Nov. N–S	Dec. E–W	Dec. N–S
	"	"	"	"	"	"	"	"
1	+14·8	−31·4	+14·5	−31·8	+15·3	−31·5	+14·1	−29·1
2	+15·0	−31·5	+14·6	−31·9	+14·5		+14·2	−30·2
3	+15·2	−31·5	+14·8	−31·7	+13·5		+14·1	−30·6
4	+15·2	−31·6	+14·8	−31·4	+12·5		+14·3	−29·9
5	+15·2	−31·7	+14·8	−31·5	+13·5	−32·3	+14·4	−29·1
6	+15·1	−31·7	+15·0	−31·6	+13·3	−32·2	+14·8	−29·8
7	+15·0	−31·8	+14·8	−31·5	+13·2	−32·4	+15·2	−29·8
8	+15·2	−31·9	+14·9	−31·8	+13·2	−31·6	+15·4	−29·2
9	+15·0	−32·0	+14·8	−31·7	+13·0	−31·8	+15·4	−28·6
10	+15·2	−31·9	+14·6	−31·5	+13·1	−31·7	+15·4	−29·4
11	+14·9	−31·8	+14·7	−31·6	+13·3	−31·6	+15·4	−29·0
12	+14·9	−31·6	+14·8	−31·4	+13·2	−31·6	+15·5	−28·5
13	+14·9	−31·5	+14·8	−31·6	+13·3	−31·1	+15·5	−28·2
14	+14·7	−31·4	+14·7	−31·8	+13·4	−30·8	+15·5	−28·7
15	+14·8	−31·7	+14·8	−32·0	+13·8	−30·9	+15·8	−28·7
16	+14·9	−31·7	+14·5	−31·7	+13·0	−30·4	+15·6	−28·2
17	+14·8	−31·7	+15·1	−32·7	+12·8	−30·4	+15·3	−28·4
18	+14·7	−31·7	+15·0	−32·9	+12·8	−30·8	+15·6	−28·0
19	+14·7	−31·9	+14·8	−32·7	+13·1	−30·6	+15·5	−28·8
20	+14·6	−31·8	+14·6	−31·9	+13·2	−30·1	+15·7	−28·8
21	+14·6	−31·8	+14·4	−31·7	+12·9	−30·2	+15·7	−27·8

(*to be continued.*)

Table II. (*Continued.*)

1938	Sept.		Oct.		Nov.		Dec.	
	E-W	N-S	E-W	N-S	E-W	N-S	E-W	N-S
	″	″	″	″	″	″	″	″
22	+14·5	−31·6	+14·6	−31·7	+13·0	−30·9	+15·2	−27·8
23	+14·4	−31·6	+14·5	−31·7	+14·0	−30·6	+15·2	−28·9
24	+14·4	−31·7	+14·5	−31·6	+14·2	−30·3	+15·2	−27·9
25	+14·5	−31·8	+14·5	−31·4	+14·2	−30·5	+15·2	−28·7
26	+14·9	−32·0	+14·5	−31·5	+14·1	−30·6	+13·1	−28·4
27	+14·9	−32·0	+15·0	−32·0	+14·2	−30·2	+13·1	−28·6
28	+15·0	−32·0	+14·7	−31·9	+14·4	−29·8	+13·1	−28·5
29	+14·9	−32·0	+14·4	−31·8	+14·3	−29·2	+12·6	−30·0
30	+14·9	−31·9	+15·3	−31·5	+14·1	−29·1	+12·5	−29·7
31			+15·3	−31·5			+12·5	−30·5

1939	Jan.		Feb.		Mar.		Apr.	
	E-W	N-S	E-W	N-S	E-W	N-S	E-W	N-S
	″	″	″	″	″	″	″	″
1	+12·5	−31·3	+ 7·5	−28·3	+ 4·8	−27·9	+ 0·4	−33·0
2	+12·1	−31·4	+ 6·9	−28·0	+ 4·8	−29·7	+ 0·3	−33·9
3	+12·5	−33·3	+ 7·0	−27·6	+ 4·6	−29·2	+ 0·2	−34·3
4	+13·3	−31·5	+ 7·0	−27·5	+ 4·4	−30·3	+ 0·1	−35·4
5	+12·9	−32·3	+ 6·9	−27·0	+ 4·0	−31·3	− 0·2	−35·5
6	+14·3	−30·2	+ 7·0	−26·9	+ 4·0	−80·5	− 0·1	−35·4
7	+14·3	−28·6	+ 6·7	−26·3	+ 4·5	−31·0		
8	+14·3	−27·5	+ 0·6	−26·3	+ 2·8	−32·1		
9	+14·3	−27·2	+ 6·7	−26·1	+ 2·4	−32·6		
10	+13·0	−26·7	+ 7·1	−26·1	+ 2·1	−32·2	+ 0·0	−34·7
11	+12·4	−26·7	+ 7·1	−25·2	+ 1·7	−33·2	+ 0·1	−35·1
12	+11·8	−26·7	+ 7·0	−26·3	+ 1·6	−34·5	+ 0·1	−35·4
13	+12·6	−25·9	+ 6·3	−26·3	+ 1·5	−31·2	+ 0·0	−85·8
14	+12·9	−25·5	+ 5·7	−26·2	+ 1·0	−30·3	− 0·1	−36·2
15	+12·8	−26·3	+ 5·9	−27·3	+ 1·1	−20·4	− 0·1	−35·8
16	+11·3	−27·3	+ 5·8	−27·5	+ 1·0	−30·2	− 0·1	−36·9
17	+10·5	−27·8	+ 5·8	−27·5		−29·4	+ 0·0	−37·0
18	+10·5	−27·4	+ 5·6	−30·5		−29·4	+ 0·0	−37·5
19	+ 9·6	−28·3	+ 5·2	−30·7		−29·4	+ 0·0	−37·8
20	+ 9·2	−29·0	+ 4·9	−30·5			+ 0·2	−38·0
21	+ 8·7	−68·1	+ 4·8	−30·8			+ 0·1	−38·0
22	+ 8·8	−27·5	+ 4·5	−29·0			+ 0·0	−38·2
23	+ 8·6	−28·1	+ 4·4	−28·8	+ 2·0	−30·0	+ 0·1	−38·6
24	+ 8·3	−28·2	+ 4·4	−29·1	+ 1·7	−29·8	+ 0·0	−88·7

(*to be continued.*)

Table II. (*Continued.*)

1939	Jan.		Feb.		Mar.		Apr.	
	E–W	N–S	E–W	N–S	E–W	N–S	E–W	N–S
	″	″	″	″	″	″	″	″
25	+ 8·3	−27·2	+ 4·5	−30·3	+ 1·4	−31·1	+ 0·0	−38·4
26	+ 8·4	−27·0	+ 4·2	−31·8	+ 0·9	−31·6	+ 0·1	−38·2
27	+ 8·0	−27·3	+ 4·0	−27·9	+ 0·6	−30·4	+ 0·1	−38·2
28	+ 7·5	−27·7	+ 4·3	−27·8	+ 0·7	−30·1	+ 0·0	−38·7
29	+ 7·7	−27·5			+ 0·9	−30·5	+ 0·0	−37·7
30	+ 7·5	−26·5			+ 0·8	−32·2	+ 0·0	−38·5
31	+ 7·5	−28·4			+ 0·5	−32·9		

1939	May		June		July		Aug.	
	E–W	N–S	E–W	N–S	E–W	N–S	E–W	N–S
	″	″	″	″	″	″	″	″
1	+ 0·3	−37·2	+ 1·9	−34·8	+ 8·3	−41·2	+ 7·9	−31·3
2	− 0·0	−37·4	+ 3·1	−34·9	+ 8·4	−41·0	+ 8·0	−31·2
3	+ 0·1	−37·3	+ 3·1	−35·3	+ 8·4	−40·7	+ 8·2	−31·4
4	+ 0·1	−37·5	+ 3·2	−35·4	+ 8·4	−40·5	+ 8·1	−31·4
5	+ 0·2	−37·6	+ 3·2	−35·8	+ 8·3	−40·3	+ 8·1	−31·2
6	+ 0·1	−37·5	+ 3·5	−35·9	+ 8·3	−40·1	+ 8·3	−31·2
7	+ 0·4	−37·5	+ 3·5	−36·2	+ 8·4	−39·8	+ 8·7	−31·2
8	+ 0·1	−37·6	+ 3·5	−36·4	+ 8·5	−39·3	+ 9·0	−31·0
9	+ 0·1	−37·6	+ 4·0	−36·6	+ 8·6	−39·2	+ 8·9	−30·6
10	+ 0·1	−37·6	+ 4·3	−36·6	+ 8·6	−38·7	+ 9·1	−30·8
11	+ 0·2	−37·8	+ 4·5	−36·8	+ 8·5	−38·4	+ 9·3	−31·0
12	+ 0·1	−37·7	+ 4·7	−36·9	+ 8·5	−37·8	+ 9·4	−31·0
13	+ 0·0	−37·8	+ 4·9	−37·4	+ 8·5	−37·8	+ 9·4	−31·0
14	+ 0·5	−37·5	+ 5·3	−37·6	+ 8·7	−37·2	+ 9·5	−31·0
15	+ 0·2	−37·6	+ 5·4	−37·9	+ 8·5	−36·7	+ 9·5	−30·9
16	+ 0·0	−36·8	+ 5·7	−38·2	+ 8·5	−36·7	+ 9·6	−31·1
17	− 0·5	−37·0	+ 6·1	−38·6	+ 8·3	−36·3	+ 9·9	−31·0
18	− 0·5	−36·9	+ 6·2	−38·9	+ 8·2	−35·5	+ 9·8	−31·2
19	− 0·7	−36·8	+ 6·4	−38·9	+ 8·2	−34·8	+10·0	−31·4
20	− 0·6	−36·9	+ 6·7	−39·4	+ 8·3	−34·5	+10·3	−31·1
21	− 0·9	−36·4	+ 6·9	−39·5	+ 8·1	−34·1	+10·3	−30·9
22	− 0·6	−36·4	+ 6·9	−39·5	+ 8·1	−33·1	+10·4	−30·8
23	− 1·4	−36·2	+ 6·8	−39·7	+ 8·2	−32·7	+10·8	−30·9
24	− 0·2	−36·1	+ 7·5	−41·0	+ 8·2	−32·4	+11·5	−30·8
25	+ 0·0	−35·9	+ 7·5	−41·2	+ 8·2	−32·2	+11·0	−30·8
26	+ 0·0	−35·1	+ 7·7	−41·5	+ 8·2	−32·2	+10·6	−30·9
27	+ 0·2	−34·6	+ 7·8	−41·5	+ 7·9	−31·2	+10·6	−30·8

(*to be continued.*)

Table II. (*Continued.*)

1939	May		June		July		Aug.	
	E–W	N–S	E–W	N–S	E–W	N–S	E–W	N–S
	″	″	″	″	″	″	″	″
28	+ 0·7	−35·0	+ 8·0	−41·4	+ 7·9	−31·3	+10·6	−30·9
29	+ 0·9	−34·9	+ 8·0	−41·3	+ 8·0	−31·2	+10·6	−30·8
30	+ 1·2	−34·6	+ 8·3	−41·2	+ 7·9	−31·2	+10·6	−31·0
31	+ 1·6	−34·8			+ 8·0	−31·3	+10·7	−31·0

1939	Sept.		Oct.		Nov.		Dec.	
	E–W	N–S	E–W	N–S	E–W	N–S	E–W	N–S
	″	″	″	″	″	″	″	″
1	+10·7	−30·7	+10·4	−31·0		−27·8		−29·0
2	+10·7	−30·9	+10·4	−31·0		−28·8		−28·7
3	+10·6	−30·8	+10·4	−31·2		−30·1		−28·5
4	+10·6	−30·9	+10·5	−31·3		−30·0		−28·2
5	+10·6	−30·8	+10·5	−31·2		−29·8		−28·2
6	+10·8	−31·9	+10·5	−31·2		−29·9		−28·2
7	+10·7	−30·7	+10·6	−31·0		−29·9		−28·1
8	+10·7	−30·9	+10·7	−30·9		−29·7		−28·3
9	+10·7	−31·1	+10·7	−30·9		−29·6		
10	+10·8	−30·9	+10·7	−30·8		−30·7		
11	+10·8	−32·0	+10·6	−30·7		−30·8		
12	+10·8	−30·9	+10·6	−30·8		−30·6		−26·7
13	+10·7	−30·9	+10·5	−30·9		−30·4		−27·2
14	+10·8	−31·0		−31·0		−29·6		−27·0
15	+10·9	−30·9		−31·1		−29·2		−26·1
16	+10·8	−30·9		−31·1		−29·3		−26·0
17	+10·8	−32·0		−31·0		−29·2		−27·2
18	+10·8	−30·8		−30·8		−29·6		−26·5
19	+10·6	−30·7		−30·6		−29·7		−27·3
20	+10·7	−30·8		−30·6		−28·8		−26·9
21	+10·8	−30·7		−30·6		−28·8		
22	+10·8	−30·9		−30·6		−28·9		
23	+10·8	−30·9		−30·6		−28·7		
24	+10·8	−31·0		−30·3		−29·0		
25	+10·8	−30·9		−30·1		−29·1		
26	+10·7	−31·0		−30·0		−29·9		
27	+10·8	−30·9		−29·9		−28·7		
28	+10·7	−30·7		−29·9		−28·8		
29	+10·8	−30·9		−29·8		−28·2		
30	+10·6	−30·9		−29·7		−28·4		−26·9
31				−29·9				−27·1

(*to be continued.*)

Table II. (*Continued.*)

1940	Jan.		Feb.		Mar.		Apr.	
	E-W	N-S	E-W	N-S	E-W	N-S	E-W	N-S
	"	"	"	"	"	"	"	"
1		− 2·7	+11·7	− 4·3	+ 7·5	− 7·7	+ 3·7	− 9·1
2	+ 9·5	− 3·7	+11·1	− 4·6	+ 7·3	− 8·3	+ 3·1	− 8·4
3	+ 9·6	− 2·9	+ 9·8	− 6·0	+ 7·9	− 9·0	+ 3·0	− 9·1
4	+ 9·7	− 3·6	+ 9·1	− 5·6	+ 7·8	− 9·4	+ 2·8	− 9·6
5	+ 9·8	− 3·0	+ 9·1	− 5·0	+ 7·5	−10·8	+ 2·9	−10·5
6	+ 9·9	− 2·6	+ 8·1	− 4·7	+ 6·9	−11·3	+ 3·2	−10·6
7	+10·1	− 2·3	+ 9·1	− 4·9	+ 7·1	−12·0	+ 3·1	−10·0
8	+10·1	− 3·9	+ 9·0	− 5·7	+ 5·8	−12·5	+ 2·8	− 9·3
9	+10·2	− 4·8	+ 9·0	− 4·6	+ 5·5	−12·6	+ 2·6	− 9·8
10	+10·3	− 6·9	+ 9·9	− 4·0	+ 5·5	−12·5	+ 2·6	−10·8
11	+10·5	− 7·6	+10·6	− 4·3	+ 5·4	−12·1	+ 2·8	−10·0
12	+10·7	− 7·9	+10·6	− 4·9	+ 5·1	−11·6	+ 2·5	−10·5
13	+11·0	− 9·6	+ 9·5	− 6·4	+ 5·6	−10·0	+ 2·4	−10·9
14	+11·1	−11·4	+ 8·7	− 8·5	+ 5·1	− 8·9	+ 2·3	−11·2
15	+11·3	−11·2	+ 7·7	− 9·6	+ 4·7	− 9·3	+ 2·3	−11·4
16	+11·4	− 9·6	+ 7·7	− 9·2	+ 4·9	− 9·1	+ 2·2	−11·8
17	+11·6	− 8·3	+ 7·3	− 8·1	+ 3·8	− 7·3	+ 2·2	−11·8
18	+13·9	− 9·2	+ 6·8	− 7·9	+ 4·0	− 6·7	+ 2·3	−12·1
19	+16·0	− 8·4	+ 7·0	− 6·0	+ 3·9	− 6·5	+ 2·2	−12·3
20	+17·0	− 6·3	+ 7·3	− 6·6	+ 4·2	− 6·2	+ 2·2	−12·4
21	+17·0	− 6·0	+ 7·1	− 7·2	+ 4·4	− 7·1	+ 2·0	−12·6
22	+17·6	− 6·1	+ 7·2	− 8·1	+ 4·7	− 8·3	+ 2·0	−12·7
23	+15·2	− 5·0	+ 7·1	− 7·0	+ 4·6	− 6·7	+ 2·7	−12·7
24	+13·2	− 6·0	+ 7·0	− 6·2	+ 5·1	− 6·4	+ 3·2	−12·0
25	+14·2	− 4·7	+ 6·9	− 6·1	+ 4·7	− 5·7	+ 3·6	−11·3
26	+14·6	− 5·2	+ 6·9	− 7·6	+ 4·6	− 6·8	+ 4·1	−10·5
27	+13·8	− 5·3	+ 6·9	− 7·8	+ 4·4	− 7·6	+ 4·4	− 9·7
28	+13·0	− 5·2	+ 6·8	− 7·5	+ 4·1	− 8·2	+ 4·6	− 9·5
29	+12·7	− 5·0	+ 7·4	− 8·1	+ 3·9	− 7·2	+ 5·1	− 9·2
30	+12·0	− 4·9			+ 4·1	− 7·2	+ 5·2	− 9·1
31	+11·9	− 5·0			+ 3·7	− 8·1		

1940	May		June		July		Aug.	
	E-W	N-S	E-W	N-S	E-W	N-S	E-W	N-S
	"	"	"	"	"	"	"	"
1	+ 5·3	− 9·1	+12·2	− 2·0	+11·8	− 3·6	+ 8·8	+ 1·1
2	+ 5·2	− 9·3	+12·5	− 1·7	+11·9	− 3·7	+ 9·0	+ 1·2
3	+ 5·2	− 9·2	+12·8	− 1·5	+11·7	− 3·7	+ 9·1	+ 1·2

(*to be continued.*)

Table II. (*Continued.*)

1940	May		Juue		July		Aug.	
	E-W	N-S	E-W	N-S	E-W	N-S	E-W	N-S
	"	"	"	"	"	"	"	"
4	+ 5·1	− 9·2	+13·1	− 1·3	+11·4	− 3·7	+ 9·6	+ 0·9
5	+ 4·9	− 9·1	+12·9	− 1·3	+11·2	− 3·5	+ 9·9	+ 1·2
6	+ 4·7	− 9·3	+12·3	− 1·0	+10·9	− 3·3	+ 9·9	+ 1·8
7	+ 4·5	− 9·0	+12·0	− 0·9	+10·5	− 3·0	+ 9·8	+ 1·1
8	+ 4·2	− 9·0	+11·6	− 0·9	+10·3	− 3·6	+ 8·6	+ 0·9
9	+ 4·1	− 9·0	+11·5	− 0·9	+10·0	− 2·6	+ 8·8	+ 0·7
10	+ 3·7	− 8·6	+11·3	− 0·8	+ 9·8	− 2·1	+ 7·8	+ 0·9
11	+ 3·6	− 8·4	+11·2	− 1·1	+ 9·5	− 1·9	+ 8·8	+ 0·9
12	+ 3·6	− 8·4	+11·3	− 1·2	+ 9·5	− 1·6	+ 8·8	+ 0·9
13	+ 3·5	− 8·3	+11·2	− 1·3	+ 9·2	− 1·3	+ 8·9	+ 1·0
14	+ 2·7	− 7·9	+11·5	− 1·3	+ 9·1	− 0·9	+ 8·8	+ 1·0
15	+ 2·8	− 7·9	+11·9	− 1·4	+ 8·8	− 0·1	+ 8·7	+ 1·0
16	+ 3·2	− 7·7	+11·9	− 1·5	+ 8·5	+ 0·9	+ 8·8	+ 0·9
17	+ 4·2	− 7·4	+12·0	− 1·3	+ 8·5	+ 1·7	+ 9·0	+ 0·9
18	+ 5·1	− 7·2	+12·1	− 1·4	+ 8·1	+ 1·7	+ 9·1	+ 0·9
19	+ 5·8	− 7·2	+12·1	− 1·4	+ 7·9	+ 1·7	+ 9·0	+ 0·8
20	+ 6·9	− 6·9	+12·1	− 1·5	+ 7·8	+ 1·7	+ 8·8	+ 0·7
21	+ 8·1	− 6·5	+12·0	− 1·6	+ 7·5	+ 1·7	+ 8·8	+ 0·8
22	+ 9·2	− 5·9	+12·2	− 1·9	+ 7·4	+ 1·6	+ 8·5	+ 0·8
23	+ 9·6	− 5·4	+12·2	− 2·2	+ 7·4	+ 1·4	+ 8·6	+ 0·9
24	+ 9·8	− 4·9	+12·1	− 2·2	+ 7·7	+ 1·3	+ 8·6	+ 0·8
25	+10·0	− 4·5	+12·0	− 2·9	+ 7·7	+ 1·2	+ 8·7	+ 0·8
26	+10·0	− 3·9	+12·0	− 3·1	+ 7·6	+ 1·1	+ 8·6	+ 0·7
27	+10·3	− 3·7	+11·9	− 3·3	+ 7·6	+ 1·2	+ 8·4	+ 0·7
28	+10·7	− 3·4	+11·9	− 3·4	+ 7·8	+ 1·0	+ 8·4	+ 0·5
29	+11·2	− 3·0	+11·8	− 3·6	+ 7·8	+ 1·1	+ 8·3	+ 0·8
30	+11·6	− 2·2	+11·9	− 3·6	+ 7·8	+ 1·1	+ 8·4	+ 0·8
31	+11·8	− 2·3			+ 8·4	+ 1·1	+ 8·3	+ 0·9

1940	Sept.		Oct.		Nov.		Dec.	
	E-W	N-S	E-W	N-S	E-W	N-S	E-W	N-S
	"	"	"	"	"	"	"	"
1	+ 8·5	+ 0·8	+ 6·9	+ 0·4	+ 6·7	+ 1·1	+ 7·4	+ 1·4
2	+ 8·4	+ 0·7	+ 6·9	+ 0·3	+ 6·7	+ 1·1	+ 7·6	+ 1·3
3	+ 8·4	+ 0·6	+ 7·1	+ 0·3	+ 6·6	+ 1·1	+ 7·7	+ 1·4
4	+ 8·2	+ 0·5	+ 7·1	+ 0·5	+ 6·6	+ 1·2	+ 7·9	+ 1·8
5	+ 8·0	+ 0·5	+ 7·1	+ 0·3	+ 6·9	+ 1·3	+ 7·8	+ 2·1
6	+ 8·0	+ 0·6	+ 7·2	+ 0·2	+ 6·5	+ 1·2	+ 8·1	+ 1·7

(*to be continued.*)

Table II. (*Continued.*)

1940	Sept.		Oct.		Nov.		Dec.	
	E-W	N-S	E-W	N-S	E-W	N-S	E-W	N-S
	″	″	″	″	″	″	″	″
7	+ 8·0	+ 0·6	+ 7·2	+ 0·2	+ 6·4	+ 1·0	+ 8·0	+ 2 4
8	+ 8·0	+ 0·6	+ 7·1	+ 0·3	+ 6·6	+ 1·1	+ 7·5	+ 2·5
9	+ 7·8	+ 0·5	+ 6·7	+ 0·5	+ 6·5	+ 0·9	+ 7·9	+ 2·3
10	+ 7·6	+ 0·5	+ 6·8	+ 0·5	+ 6·6	+ 0·1	+ 8·1	+ 1·7
11	+ 7·5	+ 0·2	+ 6·7	+ 0·7	+ 6·6	+ 0·3	+ 8·2	+ 2·0
12	+ 7·6	+ 0·3	+ 6·7	+ 0·9	+ 6·7	+ 0·4	+ 8·4	+ 2·1
13	+ 7·4	+ 0·1	+ 6·7	+ 0·8	+ 6·9	+ 0·4	+ 8·5	+ 2·1
14	+ 7·5	− 0·1	+ 6·9	+ 0·8	+ 7·0	+ 4·7	+ 8·3	+ 2·1
15	+ 7·6	− 0·1	+ 7·0	+ 0·8	+ 7·0	+ 0·6	+ 8·4	+ 2·4
16	+ 7·5	− 0·1	+ 7·0	+ 0·5	+ 6·9	+ 0·7	+ 8·5	+ 2·5
17	+ 7·4	− 0·1	+ 6·9	+ 0·8	+ 6·8	+ 1·0	+ 8·6	+ 2·5
18	+ 7·4	+ 0·1	+ 6·8	+ 0·8	+ 6·8	+ 1·0	+ 8·3	+ 2·4
19	+ 7·1	+ 0·3	+ 7·0	+ 0·8	+ 6·8	+ 0·7	+ 8·5	+ 2·3
20	+ 7·2	+ 0·4	+ 7·0	+ 0·6	+ 6·8	+ 1·1	+ 8·8	+ 2·8
21	+ 7·1	+ 0·4	+ 7·0	+ 0·5	+ 6·8	+ 1·0	+ 8·9	+ 3·0
22	+ 7·0	+ 0·3	+ 6·9	+ 0·7	+ 6·8	+ 1·0	+ 9·0	+ 3·2
23	+ 6·9	+ 0·2	+ 6·8	+ 0·7	+ 6·9	+ 1·7	+ 8·5	+ 4·0
24	+ 6·9	+ 0·3	+ 6·7	+ 0·8	+ 6·8	+ 1·7	+ 8·2	+ 3·8
25	+ 6·9	+ 0·2	+ 6·9	+ 0·6	+ 6·9	+ 1·4	+ 8·6	+ 2·7
26	+ 7·0	+ 0·4	+ 6·1	+ 0·5	+ 6·8	+ 1·8	+ 9·0	+ 3·0
27	+ 6·1	+ 0·5	+ 7·0	+ 0·4	+ 7·1	+ 0·9	+ 9·0	+ 3·2
28	+ 7·1	+ 0·6	+ 6·9	+ 0·5	+ 7·5	+ 1·4	+ 9·2	+ 3·0
29	+ 7·1	+ 0·4	+ 6·8	+ 0·3	+ 7·4	+ 1·7	+ 9·2	+ 3·6
30	+ 8·0	+ 0·3	+ 6·6	+ 0·3	+ 7·2	+ 2·3	+ 9·6	+ 4·1
31			+ 6·6	+ 0·9			+ 9·4	+ 4·7

1941	Jan.		Feb.		Mar.		Apr.	
	E-W	N-S	E-W	N-S	E-W	N-S	E-W	N-S
	″	″	″	″	″	″	″	″
1	+ 9·7	+ 4·6	+ 9·2	−13·3	+12·2	−11·0	+16·6	− 6·9
2	+ 9·8	+ 4·5	+ 9·0	−10·8	+12·5	−10·8	+17·0	− 6·0
3	+ 9·5	+ 6·0	+11·2	−10·1	+12·4	−10·4	+17·3	− 5·1
4	+ 9·5	+ 5·9	+11·8	−10·3	+12·7	−10·2	+17·6	− 6·3
5	+ 9·6	+ 5·8	+11·6	−10·3	+14·0	− 7·8	+17·4	− 7·7
6	+ 9·8	+ 5·3	+10·9	−11·3	+14·3	− 6·2	+17·8	− 7·6
7	+ 9·5	+ 5·8	+10·8	−12·1	+13·4	− 6·5	+18·3	− 8·7
8	+ 9·1	+ 4·5	+12·9	−11·5	+12·7	− 8·3	+19·0	− 7·6
9	+ 9·1	+ 2·2	+14·7	− 8·9	+12·8	− 8·9	+19·4	− 6·4

(*to be continued.*)

Table II. (*Continued.*)

1941	Jan.		Feb.		Mar.		Apr.	
	E–W	N–S	E–W	N–S	E–W	N–S	E–W	N–S
	″	″	″	″	″	″	″	″
10	+ 8·9	+ 1·0	+13·8	− 9·3	+12·6	− 8·2	+19·5	− 6·5
11	+ 9·3	+ 0·0	+14·6	− 9·4	+12·0	− 8·8	+19·6	− 6·7
12	+ 9·6	− 0·3	+14·0	− 9·3	+11·5	− 9·5	+20·2	− 6·9
13	+ 9·5	− 0·3	+15·3	−10·2	+11·4	−11·0	+20·5	− 6·7
14	+ 8·3	− 0·5	+15·5	− 9·1	+11·2	−10·5	+21·0	− 6·3
15	+ 7·6	− 1·2	+15·1	− 9·3	+11·3	−10·7	+21·6	− 6·4
16	+ 7·2	− 0·8	+15·2	− 8·8	+11·3	−10·4	+22·0	− 6·0
17	+ 6·7	− 2·5	+14·2	− 9·6	+11·5	−10·4	+22·7	− 5·8
18	+ 7·0	− 2·3	+14·1	−10·2	+11·5	−10·4	+23·2	− 5·4
19	+ 6·7	− 2·2	+14·5	−10·3	+11·7	−10·2	+24·0	− 4·9
20	+ 6·3	− 3·0	+14·5	−10·4	+12·1	−10·3	+24·8	− 4·7
21	+ 5·7	− 4·7	+14·3	−10·4	+12·5	−10·1	+25·5	− 4·2
22	+ 4·8	− 4·7	+14·1	−10·5	+12·8	− 9·7	+26·1	− 4·7
23	+ 4·6	− 5·5	+14·0	−10·6	+13·1	− 9·6	+26·9	− 3·0
24	+ 4·4	− 6·6	+13·7	−10·5	+13·3	− 9·3	+27·7	− 2·5
25	+ 4·3	− 8·7	+14·4	− 9·4	+14·1	− 9·9	+28·7	− 2·3
26	+ 4·2	−10·2	+14·0	− 8·8	+14·6	− 9·4	+29·4	− 2·4
27	+ 3·9	−11·7	+13·3	− 9·2	+14·6	− 8·5	+30·0	− 2·7
28	+ 7·2	−13·6	+12·4	−10·2	+15·4	− 8·5	+30·4	− 2·5
29	+ 9·1	−14·3			+15·6	− 8·4	+30·8	− 2·4
30	+ 9·4	−15·9			+16·1	− 8·0	+31·3	− 2·4
31	+ 9·5	−16·7			+16·1	− 7·2		

1941	May		June		July		Aug.	
	E–W	N–S	E–W	N–S	E–W	N–S	E–W	N–S
	″	″	″	″	″	″	″	″
1	+32·0	− 2·5	+22·2	+ 7·1	+24·0	+10·3	+23·4	+ 9·6
2	+32·7	− 2·6	+22·2	+ 7·6	+24·0	+10·3	+23·5	+ 9·4
3	+33·4	− 2·9	+22·6	+ 8·0	+24·1	+10·3	+23·5	+ 9·5
4	+34·0	− 3·3	+22·8	+ 8·4	+24·1	+10·1		+ 9·4
5	+34·4	− 4·3	+23·0	+ 8·8	+24·0	+10·0		+ 9·4
6	+34·6	− 5·8	+22·9	+ 9·1	+24·0	+10·1		+ 9·3
7	+34·8	− 7·1	+22·9	+ 9·4	+24·1	+10·1		+ 9·2
8	+34·2	− 8·4	+22·6	+ 9·5	+24·0	+10·0		+ 8·8
9	+33·1	− 9·2	+22·9	+ 9·7	+24·0	+10·1		+ 8·6
10	+31·7	−10·3	+23·0	+ 9·4	+24·0	+10·1		+ 8·6
11	+30·3	−11·6	+23·1	+ 9·4	+24·0	+10·2		+ 8·5
12	+28·8	−12·6	+23·1	+ 9·5	+23·9	+10·2		+ 8·4

(*to be continued.*)

Table II. (*Continued.*)

1941	May		June		July		Aug.	
	E-W	N-S	E-W	N-S	E-W	N-S	E-W	N-S
	"	"	"	"	"	"	"	"
13	+27·4	−13·0	+23·6	+10·1	+23·8	+10·2		+ 8·4
14	+25·9	−12·8	+23·4	+10·4	+23·7	+10·2		+ 8·3
15	+24·5	−12·2	+23·7	+10·2	+23·4	+10·2		+ 8·1
16	+23·0	−10·6	+23·7	+10·2	+23·6	+10·2		+ 8·1
17	+21·7	− 9·8	+23·8	+10·3	+23·6	+10·5		+ 8·2
18	+20·3	− 8·8	+23·8	+10·3	+23·4	+10·5		+ 8·3
19	+19·5	− 7·6	+23·7	+10·3	+23·4	+10·6		+ 8·2
20	+19·1	− 6·3	+28·8	+10·4	+23·6	+10·5		+ 8·3
21	+18·5	− 5·0	+23·7	+10·5	+23·4	+10·4		+ 8·3
22	+18·2	− 3·8	+23·7	+10·5	+22·7	+10·3		+ 8·3
23	+18·5	− 2·5	+23·8	+10·6	+23·4	+10·2		+ 8·0
24	+18·7	− 0·8	+23·9	+10·7	+23·2	+10·1		+ 8·0
25	+19·2	+ 0·2	+24·0	+10·7	+23·3	+ 9·9		+ 7·9
26	+19·9	+ 1·5	+24·0	+10·7	+23·3	+ 9·8		+ 7·9
27	+20·7	+ 2·4	+23·9	+10·6	+23·5	+ 9·8		+ 8·0
28	+21·4	+ 3·5	+23·9	+10·6	+23·6	+ 9·7		+ 7·9
29	+21·9	+ 4·9	+23·9	+10·4	+23·6	+ 9·7		+ 7·9
30	+22·2	+ 5·9	+23·9	+10·4	+23·5	+ 9·6		+ 7·9
31	+22·3	+ 6·6			+23·5	+ 9·7		+ 7·9

1941	Sept.		Oct.		Nov.		Dec.	
	E-W	N-S	E-W	N-S	E-W	N-S	E-W	N-S
	"	"	"	"	"	"	"	"
1		+ 7·8	+15·0	+ 7·2	+19·7	+ 7·3	+15·7	+ 8·3
2		+ 7·7	+14·9	+ 7·1	+17·0	+ 6·9	+15·8	+ 8·4
3		+ 7·7	+14·8	+ 7·2	+14·3	+ 7·7	+15·8	+ 8·6
4		+ 7·8	+14·7	+ 7·0	+14·0	+ 7·9	+15·5	+ 8·8
5		+ 7·9	+14·7	+ 6·9	+13·2	+ 7·9	+15·5	+ 9·3
6		+ 7·7	+14·6	+ 6·6	+11·8	+ 7·9	+15·6	+ 8·8
7		+ 7·6	+14·5	+ 6·4	+10·2	+ 7·8	+15·7	+ 8·8
8		+ 7·6	+14·7	+ 6·2	+ 9·2	+ 7·1	+15·6	+ 8·9
9		+ 7·7	+14·8	+ 6·4	+ 7·6	+ 6·6	+15·5	+ 8·9
10		+ 7·6	+14·9	+ 6·6	+ 9·1	+ 6·8	+15·6	+ 9·7
11		+ 7·7	+14·9	+ 6·7	+12·4	+ 6·9	+17·3	+ 8·8
12		+ 7·8	+15·0	+ 6·3	+14·9	+ 7·1	+16·1	+ 9·1
13		+ 7·6	+15·1	+ 6·5	+15·0	+ 7·2	+15·8	+ 9·2
14		+ 7·6	+14·8	+ 6·4	+15·2	+ 7·4	+15·7	+ 9·2
15		+ 7·6	+13·9	+ 6·5	+15·4	+ 7·7	+15·7	+ 9·2

(*to be continued.*)

Table II. (*Continued.*)

1941	Sept.		Oct.		Nov.		Dec.	
	E-W	N-S	E-W	N-S	E-W	N-S	E-W	N-S
	"	"	"	"	"	"	"	"
16		+ 7·5	+13·0		+15·4	+ 7·4	+15·7	+ 9·5
17		+ 7·5	+13·0	+ 6·0	+15·5	+ 7·4	+15·6	+10·0
18		+ 7·7	+12·7	+ 6·2	+15·6	+ 7·4	+15·7	+ 9·7
19		+ 7·8	+12·4	+ 6·1	+15·7	+ 8·7	+15·9	+ 9·8
20		+ 7·8	+12·8	+ 5·9	+15·8	+ 8·8	+16·4	+10·5
21		+ 7·5	+13·2	+ 6·0	+15·9	+ 8·2	+17·2	+10·4
22		+ 7·5	+13·6	+ 6·0	+15·7	+ 7·8	+16·5	+10·7
23		+ 7·4	+13·8	+ 7·0	+15·8	+ 8·1	+15·8	+10·7
24		+ 7·3	+13·4	+ 7·0	+15·6	+ 8·2	+15·6	+10·7
25		+ 7·3	+13·4	+ 7·0	+15·5	+ 9·4	+15·6	+ 9·7
26		+ 7·2	+13·0	+ 7·4	+15·4	+ 9·2	+15·4	+10·0
27		+ 7·2	+12·4	+ 7·0	+15·3	+ 9·5	+15·3	+10·3
28		+ 7·2	+11·8	+ 6·5	+15·6	+ 9·2	+15·3	+ 9·5
29		+ 7·3	+12·7	+ 6·5	+15·6	+ 7·7	+15·3	+ 9·5
30		+ 7·2	+14·7	+ 6·5	+15·6	+ 8·1	+15·2	+ 9·4
31			+16·7	+ 6·5			+15·2	+ 9·4

Table III. A. The stronger explosions than 10^{18} erg in their energy.

Date		Time		E	Date		Time		E
1935		h	m	$\times 10^{19}$ erg	1935		h	m	$\times 10^{19}$ erg
April	20	16	20	2·30	May	23	4	25	0·10
	22	5	30	0·40		23	19	11	0·40
May	5	8	47	0·80		24	15	05	0·10
	5	11	18	0·40		24	18	0	0·10
	6	19	50	0·40		25	14	25	0·10
	11	2	36	0·60		26	3	20	0·10
	11	4	13	0·85		26	14	30	0·40
	11	6	27	0·95		27	18	16	1·00
	11	8	0	0·10	June	16	20	30	0·10
	14	8	26	0·40		23	19	40	0·10
	16	21	15	1·20	July	2	11	43	0·40
	20	4	04	0·95	Aug.	4	7	30	0·50
	20	8	30	0·10		17	16	50	0·40
	21	16	13	0·10		28	8	10	0·40
	22	11	23	0·50	Sept.	19	16	00	0·70
	22	18	25	0·10	Oct.	20	9	00	0·20
					Nov.	7	12	08	0·60

(*to be continued.*)

Table III. A. (*Continued.*)

Date		Time h	Time m	*E* ×10[19] erg	Date		Time h	Time m	*E* ×10[19] erg
1936					1938				
Feb.	7	13	47	1·50	Mar.	25	0	16	2·30
	10	10	03	0·40	April	20	3	47	5·00
	11	11	54	0·10		24	14	28	0·10
	15	15	55	1·50	May	1	10	07	1·00
Mar.	6	16	10	0·90		20	5	30	0·10
	7	10	32	1·20		21	17	36	1·40
	7	12	41	0·40		22	21	43	0·10
April	20	1	21	0·80	June	7	6	20	17·00
	23	8	16	0·40		19	14	50	0·10
July	20	9	40	0·40		28	7	55	0·10
	21	9	50	0·80		30	13	36	0·80
	23	1	30	0·70	July	3	11	29	0·10
	24	13	40	0·60		8	15	15	0·80
	25	14	44	0·10		16	13	01	1·10
	27	1	00	0·50		18	17	28	0·70
	27	5	26	0·40		21	18	45	0·70
	29	9	12	2·20		29	6	40	0·10
	29	9	29	0·10	Aug.	14	10		0·10
Aug.	4	4	18	0·50		18	19	40	0·80
Sept.	19	6	16	1·40		19	7	17	0·80
	20	19	30	0·30		21	8	45	0·10
Oct.	1	10	30	0·40	Sept.	3	7	41	0·40
	15	7	28	1·40		3	12	11	0·50
	17	9	34	1·00		3	15	50	0·10
Nov.	4	14	20	0·10		4	10		0·60
						12	11	17	0·10
1937						20	3	03	0·10
Feb.	27	20	40	0·80		20	7	26	0·40
Mar.	1	22	35	2·30		26	13	43	1·00
	4	4	40	0·10		26	14	57	0·10
	7	4	00	0·10		30	5	52	0·10
	10	8	55	0·10	Oct.	4	20	25	1·00
	12	12	10	0·70		6	0	31	1·00
	18	5	50	0·70		10	7	57	0·60
	25	16	11	1·10		19	23	36	0·20
April	5	19	25	0·10		27	10	15	0·10
	6	20	14	0·60		28	5	14	0·10
	16	0		4·20		30	17	43	0·10
June	7	4	39	0·70	Nov.	5	21	43	0·15

(*to be continued.*)

Table III. A. (*Continued.*)

Date		Time h	m	E	Date		Time h	m	E
1938				×10¹⁹ erg	1940				×10¹⁹ erg
Nov.	6	0	34	0·35	Nov.	13	13	00	0·10
	15	16	48	0·70		17			0·30
	15	17	14	1·30		19	14	43	0·50
	25	15	40	0·10	Dec.	19	8	46	0·20
	28	20	37	0·75		21	3	15	0·40
Dec.	2	2	38	0·30		25	20	36	0·10
	4	22	48	0·25	1941				
	17	16	52	0·45	April	1	6	08	0·70
	28	23	16	0·50	June	24	6	16	0·10
1939						24	10	52	0·90
Jan.	2	0	0	0·40	July	9	23	30	0·10
Feb.	2	21	48	1·50		13	13	06	1·00
	15	9	14	2·60		21	19	58	0·40
May	24	11	05	0·90		25	8	37	0·90
June	9	6	15	0·10	Aug.	14	10	47	0·90
	25	0	48	0·80		19	23	36	0·80
July	14	21	06	0·85		25	14	48	0·10
1940					Nov.	20	12	23	0·10
Feb.	27	4	32	1·00		20	15	35	0·10
May	25	12	31	0·25	Dec.	4	22	18	0·90
	30	6	04	0·85		5	4	36	1·00
Oct.	14	17	30	1·20		7	17	55	0·80

Table III. B. Sums of explosion energy for every ten days (E_3) and every month (E_1).

	I	II	III	sum		I	II	III	sum
1934	×10¹⁹ erg	×10¹⁹ erg	×10¹⁹ erg	×10¹⁹ erg	1934	×10¹⁹ erg	×10¹⁹ erg	×10¹⁹ erg	×10¹⁹ erg
Jan.	0	0	0	0	Nov.	0	0	0	0
Feb.	0	0	0	0	Dec.	0	0	0	0
Mar.	0	0	0	0					
April	0	0	0	0	1935				
May	0	0	0	0	Jan.	0	0	0	0
June	0	0	0	0	Feb.	0	0	0	0
July	0	0	0	0	Mar.	0	0	0	0
Aug.	0	0	0	0	April	0	2·3	0·7	3·0
Sept.	0	0	0	0	May	1·7	5·3	2·9	9·9
Oct.	0	0	0	0	June	0	0·7	0·2	0·9

(*to be continued.*)

Table III. B. (*Continued.*)

	I	II	III	sum		I	II	III	sum
1935	$\times 10^{19}$ erg	$\times 10^{19}$ erg	$\times 10^{19}$ erg	$\times 10^{19}$ erg	1938	$\times 10^{19}$ erg	$\times 10^{19}$ erg	$\times 10^{19}$ erg	$\times 10^{19}$ erg
July	0·8	0·2	0	1·0	May	1·2	0·2	1·4	2·8
Aug.	0·5	0·4	0·5	1·4	June	17·0	0·2	1·0	18·2
Sept.	0·2	0·7	0	0·9	July	0·9	1·9	0·8	3·6
Oct.	0	0·2	0	0·2	Aug.	0	1·8	0	1·8
Nov.	0·6	0	0	0·6	Sept.	1·8	1·6	1·4	4·8
Dec.	0	0	0	0·0	Oct.	3·0	0·5	1·0	4·5
					Nov.	0·8	2·0	1·1	3·9
1936					Dec.	1·2	0·8	0·8	2·8
Jan.	0	0	0	0					
Feb.	1·8	0·7	0	2·5	1939				
Mar.	2·5	0	0	2·5	Jan.	0·4	0	0	0·4
April	0	0·8	0·4	1·2	Feb.	1·6	1·2	0	2·8
May	0	0	0	0	Mar.	0	0·1	0	0·1
June	0	0	0	0	April	0	0	0	0
July	0	0·6	6·5	7·1	May	0	0·2	1·2	1·4
Aug.	0·6	0	0	0·6	June	0·1	0	0·8	0·7
Sept.	0	2·0	0	2·0	July	0·2	1·1	0	1·3
Oct.	0·4	2·0	0	2·4	Aug.	0	0	0	0
Nov.	0·1	0	0	0·1	Sept.	0	0	0	0
Dec.	0	0	0	0	Oct.	0	0	0	0
					Nov.	0	0	0	0
1937					Dec.	0	0	0	0
Jan.	0	0	0	0					
Feb.	0	0	0·8	0·8	1940				
Mar.	2·7	2·5	1·1	6·3	Jan.	0	0	0	0
April	0·8	4·2	0	5·0	Feb.	0	0·1	1·0	1·1
May	0	0	0	0	Mar.	0	0	0	0
June	0·8	0	0·1	0·9	April	0	0	0	0
July	0	0	0	0	May	0	0	1·1	1·1
Aug.	0	0	0	0	June	0	0	0	0
Sept.	0	0	0	0	July	0	0	0	0
Oct.	0	0	0	0	Aug.	0	0·1	0	0·1
Nov.	0	0	0	0	Sept.	0	0	0·1	0·1
Dec.	0	0	0	0	Oct.	0	1·2	0·2	1·4
					Nov.	0	0·4	0·5	0·9
1938					Dec.	0·1	0·4	0·4	0·9
Jan.	0	0	0	0					
Feb.	0	0	0	0	1941				
Mar.	0	0	2·3	2·3	Jan.	0·5	0·5	0·7	1·7
April	0	0	6·0	6·0	Feb.	0·6	0·7	0·7	2·0

(*to be continued.*)

Table III. B. *(Continued.)*

	I	II	III	sum		I	II	III	sum
1941	$\times 10^{19}$ erg	$\times 10^{19}$ erg	$\times 10^{19}$ erg	$\times 10^{19}$ erg	1941	$\times 10^{19}$ erg	$\times 10^{19}$ erg	$\times 10^{19}$ erg	$\times 10^{19}$ erg
Mar.	0·2	1·8	1·2	3·2	Aug.	0·2	0·4	0·1	0·7
April	1·2	0·5	0·3	2·0	Sept.	0·1	0	0	0·1
May	0·1	0	0	0·1	Oct.	0	0	0	0
June	0·1	0·1	1·0	1·2	Nov.	0	0·2	0·3	0·5
July	1·0	1·5	2·0	4·5	Dec.	2·7	1·0	0	3·7

Table IV. Results of tilt observations at Nakanosawa and character number (K_3).

Date		$(\Delta\theta_n)_{EW}$	$(\Delta\theta_n)_{NS}$	$(\Delta\theta^2_{EW}+\theta^2_{NS})^{\frac{1}{2}} = \Delta\Theta$	$K_3=(k-1)$
1934		″	″	″	
Jan.	1	−0·80	+0·90	1·20	+0·1
	2	−1·46	+0·47	1·53	+0·3
	3	−2·17	+0·26	2·19	+0·8
	4	+0·87	−0·56	1·03	−0·1
	5	0·0	+0·01	0·01	−1·0
Feb.	1	−0·39	+1·79	1·83	+0·4
	2	+0·39	−1·13	1·19	−0·1
	3	+0·10	+0·84	0·84	−0·3
	4	−0·10	+2·31	2·31	+0·8
	5	+0·10	−0·29	0·28	−0·8
Mar.	1	−0·81	−1·12	1·38	+0·1
	2	−0·31	+0·71	0·78	−0·4
	3	+1·00		1·25	0·0
	4	+1·85	+1·70	2·51	+1·0
	5	+0·04	−0·27	0·27	−0·8
Apr.	1	−0·41	−0·41	0·58	+1·0
	2	+0·51	+0·38	0·63	+1·2
	3	+0·12	−0·09	0·14	−0·5
	4	+0·06	−0·07	0·09	−1·0
	5	+0·11	−0·04	0·12	−0·7
May	1	−0·03	−0·06	0·07	−1·0
	2	+0·10	+0·26	0·36	−0·4
	3	+0·50	+0·58	0·81	+0·9
	4	+0·12	+0·72	0·73	+0·7
	5	0·0	+0·17	0·17	−0·6
June	1	+0·22	+0·30	0·39	+0·2

(to be continued.)

Table IV. *(Continued.)*

Date		$(\Delta\theta_n)_{E\cdot W}$	$(\Delta\theta_n)_{N\cdot S}$	$(\Delta\theta^2_{EW}+\theta^2_{NS})^{\frac{1}{2}}$ $=\Delta\Theta$	$K_3=(k-1)$
1934		"	"	"	
June	2	+0·35	−0·06	0·35	+0·1
	3	+0·13	+0·28	0·32	+0·0
	4	−0·08	+0·26	0·27	−0·1
	5	+0·18	+0·18	0·25	−0·2
July	1	−0·55	0·0	0·55	+0·2
	2	+0·21	+0·18	0·27	+0·4
	3	+0·57	+0·02	0·57	+0·3
	4	−0·46	−0·18	0·49	+1·1
	5	+0·36	−0·03	0·36	−0·2
Aug.	1	+0·04	+0·20	0·20	−0·1
	2	+0·01	+0·15	0·14	−0·4
	3	−0·39	+0·54	0·66	+1·8
	4	−0·05	+0·17	0·17	−0·3
	5	−0·01	−0·01	0·01	−1·0
Sept.	1	−0·12	−0·01	0·12	−0·5
	2	+0·04	+0·29	0·31	+0·3
	3	+0·14	−0·24	0·28	+0·3
	4	+0·16	−0·12	0·20	−0·1
	5	+0·20	+0·10	0·22	0·0
Oct.	1	+0·24	+0·17	0·30	−0·2
	2	−0·22	+0·26	0·35	−0·1
	3	+0·37	−0·14	0·40	0·0
	4	−0·31	−0·31	0·45	+0·1
	5	+0·36	+0·35	0·50	+0·3
Nov.	1	+0·20	−1·00	1·04	+0·1
	2	−0·65	−1·35	1·50	+0·6
	3	−0·27	+0·73	0·78	−0·2
	4	−0·31	−0·25	0·40	−0·6
	5	−0·01	+1·12	1·12	+0·2
Dec.	1	+0·31	+0·39	0·50	0·0
	2	+0·08	−1·00	1·00	+1·0
	3	+0·08	+0·15	0·17	−0·7
	4	+0·11	−0·17	0·20	−0·6
	5	+0·51	+0·31	0·60	+0·2
1935					
Jan.	1	+1·26	+0·80	1·50	+0·2
	2	+1·00	+1·70	2·00	+0·7

(to be continued.)

Table IV. (*Continued.*)

Date		$(\Delta\theta_n)_{E\text{-}W}$	$(\Delta\theta_n)_{N\text{-}S}$	$(\Delta\theta^2_{EW}+\theta^2_{NS})^{\frac{1}{2}} = \Delta\Theta$	$K_3=(k-1)$
1935		″	″	″	
Jan.	3	+2·10	+2·35	3·16	+1·6
	4	−1·00	−0·31	1·05	−0·2
	5	−2·28	−2·22	3·21	+1·6
Feb.	1	−1·60	+1·60	2·42	+0·9
	2	−2·10	+2·40	3·20	+1·5
	3	−2·31	+3·60	4·50	+2·5
	4	−4·03	−4·80	6·26	+3·8
	5	+0·08	+0·46	0·46	−0·5
Mar.	1	−5·09	−3·93	6·42	+4·2
	2	−0·97	−2·24	2·44	+1·0
	3	−5·38	−3·84	6·51	+4·2
	4	−2·24	−1·53	2·71	+1·2
	5	−3·02	−7·60	8·18	+5·6
Apr.	1	−3·05	+0·76	3·14	+9·8
	2	−0·04	+3·40	3·40	+10·4
	3	−0·76	+9·03	9·06	+30·1
	4	+7·90	+12·71	14·96	+50·4
	5	+7·73	+4·47	8·93	+29·7
May	1	+2·37	−3·29	4·05	+8·4
	2	−0·04	−5·25	5·25	+10·2
	3	+0·26	−2·44	2·44	+4·7
	4	−0·24	−1·14	1·17	+1·7
	5	−0·78	−0·08	0·78	+0·8
June	1	−0·08	+0·64	0·64	+1·1
	2	−0·30	−0·15	0·36	+0·2
	3	−0·24	+0·13	0·28	−0·1
	4	−0·22	−0·07	0·22	−0·3
	5	−0·36	+0·40	0·54	+1·7
July	1	−0·01	+1·07	1·07	+1·4
	2	+0·06	+0·42	0·42	−0·1
	3	−0·11	+0·31	0·32	−0·7
	4	−0·03	−0·04	0·05	−1·0
	5	−0·13	+0·40	0·42	−0·1
Aug.	1	−0·26	+0·21	0·33	+0·4
	2	−0·15	−0·24	0·28	+0·2
	3	−0·01	+0·47	0·47	+1·0
	4	−0·09	+0·45	0·45	+0·9
	5	−0·16	+0·02	0·17	−0·3

(*to be continued.*)

Table IV. (*Continued.*)

Date		$(\Delta\theta_n)_{E\cdot W}$	$(\Delta\theta_n)_{N\cdot S}$	$(\Delta\theta^2_{EW}+\theta^2_{NS})^{\frac{1}{2}}$ $=\Delta\Theta$	$K_3(=k-1)$
1935		″	″	″	
Sept.	1	+0·03	+0·65	0·65	+2·0
	2	+0·09	+0·07	0·11	−1·0
	3	+0·31	−0·16	0·35	+0·6
	4	−0·16	+0·60	0·62	+1·9
	5	+0·03	+0·18	0·19	−0·2
Oct.	1	+0·08	−0·31	0·32	−0·7
	2	+0·20	−0·13	0·25	−0·4
	3	+0·20	−0·07	0·22	−0·5
	4	−0·35	+0·69	0·78	+0·9
	5	−0·18	+0·98	1·00	+1·5
Nov.	1	+0·33	−0·33	0·45	−0·5
	2	−0·64	−0·27	0·69	−0·3
	3	−0·67	+0·84	1·08	+0·1
	4	+1·69	−0·31	1·72	+0·8
	5	−0·19	−0·56	0·59	−0·4
Dec.	1	−0·27	−0·31	0·41	−0·2
	2	−1·06	−0·44	1·15	+1·3
	3	+0·51	−0·11	0·52	0·0
	4	0·0	−1·22	1·22	+1·4
	5	+0·89	+1·58	1·81	+1·6
1936					
Jan.	1	+2·30	+1·21	2·59	+1·2
	2	+8·61	+5·01	9·95	+7·3
	3	−9·50	−6·42	11·40	+8·5
	4	+0·20	+0·10	0·24	−1·0
	5	+1·12	−5·61	5·71	+3·7
Feb.	1	+4·91	−2·20	5·37	+3·2
	2	−2·30	−1·91	2·98	+1·3
	3	+5·52	+6·60	8·59	+5·7
	4	−2·43	−8·58	8·93	+5·9
	5	−2·80	−0·62	2·83	+1·1
Mar.	1	−2·85	−0·50	2·87	+1·3
	2	+2·40	+2·10	3·12	+1·5
	3	+7·89	+11·80	14·20	+10·4
	4	+1·48	+2·25	2·75	+1·2
	5	+0·80	+1·48	1·70	+0·4
Apr.	1	−0·30	−1·31	1·33	+3·6

(*to be continued.*)

Table IV. (*Continued.*)

Date		$(\Delta\theta_n)_{E\cdot W}$	$(\Delta\theta_n)_{N\cdot S}$	$(\Delta\theta^2_{EW}+\theta^2_{NS})^{\frac{1}{2}} = \Delta\Theta$	$K_3=(k-1)$
1936		″	″	″	
Apr.	2	+1·78	+6·72	6·94	+22·4
	3	+1·08	+3·95	4·15	+13·3
	4	+0·10	+4·78	4·78	+15·2
	5	+0·43	+3·41	3·42	+10·4
May	1	+0·21	+2·18	2·21	+4·1
	2	−0·32	−0·18	0·36	−0·2
	3	−2·58	−2·29	3·47	+7·1
	4	−4·00	−3·89	5·59	+12·0
	5	−0·61	+3·08	3·16	+6·3
June	1	−4·38	+4·30	6·16	+18·9
	2	−0·57	−0·62	0·84	+1·7
	3	−1·00	−0·89	1·34	+3·3
	4	−1·42	−2·10	2·52	+7·1
	5	−1·03	−3·08	3·26	+9·5
July	1	−0·29	−2·29	2·32	+4·2
	2	−1·22	−1·80	2·16	+3·8
	3	−1·03		1·41	+2·1
	4	−0·09		0·14	−1·0
	5	−1·00	−0·73	1·23	+1·7
Aug.	1	−2·03	+6·28	6·51	+26·7
	2	−2·10	+0·60	2·19	+8·3
	3	−1·29	+0·41	1·36	+4·8
	4	−0·10	+0·40	0·41	+0·7
	5	+0·02	+0·60	0·60	+1·6
Sept.	1	+0·10	+0·39	0·40	+0·8
	2	0·0	+0·12	0·12	−0·5
	3	+0·29	+0·23	0·37	+0·7
	4	+0·19	−0·29	0·36	+0·7
	5	+0·52	−0·20	0·54	+1·5
Oct.	1	+0·10	+0·59	0·61	+0·5
	2	+0·29	−0·19	0·36	+0·1
	3	0·0	0·0	0·0	−1·0
	4	0·0	+1·39	1·39	+2·5
	5	−0·11	−0·78	0·81	+1·0
Nov.	1	−0·38	+0·32	0·50	−0·5
	2	0·0	−1·50	1·50	+0·6
	3	−0·61	+0·49	0·79	−0·2
	4	−0·29	−0·68	0·76	−0·2

(*to be continued.*)

Table IV. (*Continued.*)

Date		$(\Delta\theta_n)_{E\text{-}W}$	$(\Delta\theta_n)_{N\text{-}S}$	$(\Delta\theta^2_{EW}+\theta^2_{NS})^{\frac{1}{2}} = \Delta\Theta$	$K_3=(k-1)$
1936		″	″	″	
Nov.	5	−0·25	−1·82	1·83	+0·9
Dec.	1	−0·21	+1·10	1·15	+1·2
	2	−1·79	−1·41	2·31	+3·5
	3	+1·08	−0·68	1·30	+1·6
	4	−0·41	+0·67	0·81	+0·6
	5	−0·83	−2·20	2·36	+3·6
1937					
Jan.	1	+0·88	−1·04	1·36	+0·1
	2	+1·70	+1·87	2·53	+1·1
	3	+4·44	+3·63	5·73	+3·8
	4	+0·95	+3·00	3·15	+1·7
	5	−1·13	+2·49	2·73	+1·3
Feb.	1	−1·11	+0·01	1·11	−0·1
	2	−0·27	+2·08	2·09	+0·6
	3	−1·87	+2·36	3·01	+1·3
	4	−1·46	−3·81	4·08	+2·2
	5	+0·24	+2·09	2·10	+0·6
Mar.	1	+0·50	+2·05	2·11	+0·7
	2	+1·51	+2·14	2·62	+1·1
	3	+1·29	−3·37	3·61	+1·9
	4	−0·93	+2·27	2·45	+1·0
	5	−3·20	−2·45	4·03	+2·2
Apr.	1	−1·22	−1·31	1·79	+5·2
	2	−2·90		4·08	+13·0
	3	+2·08	+1·28	2·41	+7·3
	4	+9·43		13·30	+44·7
	5	+12·41	+9·43	15·59	+52·6
May	1	−0·40	−5·81	5·82	+12·3
	2	−6·89	−6·02	9·15	+20·3
	3	−3·01	−6·83	7·46	+16·3
	4	−2·13	−5·47	5·87	+12·7
	5	−2·98	−1·73	3·35	+6·8
June	1		+0·20	0·28	−0·1
	2	−1·02	−0·30	1·06	+2·4
	3	−0·33	+0·19	0·38	+0·2
	4	+0·07	−0·24	0·25	−0·2
	5	+0·06	+0·13	0·14	−0·5

(*to be continued.*)

Table IV. (*Continued.*)

Date		$(\Delta\theta_n)_{E\text{-}W}$	$(\Delta\theta_n)_{N\text{-}S}$	$(\Delta\theta^2_{EW}+\theta^2_{NS})^{\frac{1}{2}}$ $=\Delta\Theta$	$K_3=(k-1)$
1937		"	"	"	
July	1	−0·09	−0·07	0·11	−0·8
	2	−0·62	+0·35	0·71	+0·6
	3	−0·14	+0·06	0·15	−0·7
	4	−0·17	+0·19	0·25	−0·4
	5	−0·20	+0·24	0·30	−0·3
Aug.	1	−0·23	−0·04	0·23	0·0
	2	+0·30	+0·29	0·41	+0·7
	3	−0·20	−0·05	0·21	−0·1
	4	−0·19	+0·25	0·31	+0·3
	5	+0·05	−0·09	0·10	−0·8
Sept.	1	+0·03	−0·04	0·05	−0·6
	2	−0·08	+0·25	0·26	+0·2
	3	−0·02	−0·21	0·21	+0·0
	4	−0·62	+0·56	0·84	+2·9
	5	+0·49	−0·16	0·52	+1·4
Oct.	1	−0·15	−0·24	0·28	−0·3
	2	+0·31	−0·29	0·42	+0·1
	3	−0·08	+0·18	0·20	−0·5
	4	+0·70	+0·99	1·21	+2·0
	5	−0·23	−0·76	0·79	+1·0
Nov.	1	−0·33	+0·74	0·80	−0·2
	2	−0·82	−0·45	0·94	+0·0
	3	−1·48	−0·03	1·48	+0·6
	4	−0·61	−1·80	1·90	+1·0
	5	+0·26	+2·38	2·52	+1·7
Dec.	1	−0·04	−2·55	2·55	+4·1
	2	+0·30	+1·04	1·08	+1·1
	3	+0·79	+0·47	0·92	+0·8
	4	−0·30	+2·53	2·55	+4·1
	5	+1·30		1·78	+2·5
1938					
Jan.	1	−4·10	−5·42	6·80	+4·7
	2	+1·13	−1·67	2·02	+0·7
	3	+3·97	+3·25	5·03	+3·2
	4	+3·72	−1·47	4·00	+2·4
	5	−0·35	+0·35	0·49	−0·6
Feb.	1	+0·24	−3·81	3·82	+2·0

(*to be continued.*)

Table IV. (*Continued.*)

Date		$(\Delta\theta_n)_{E\text{-}W}$	$(\Delta\theta_n)_{N\text{-}S}$	$(\Delta\theta^2_{EW}+\theta^2_{NS})^{\frac{1}{2}} = \Delta\Theta$	$K_3=(k-1)$
1938		″	″	″	
Feb.	2	+0·35	−0·89	0·95	−0·3
	3	+2·02	+6·05	6·38	+3·9
	4				
	5	+1·35	+3·11	3·39	+1·6
Mar.	1	+1·56	+3·62	3·74	+2·2
	2	+0·08	−2·41	2·41	+0·9
	3	+0·62	+0·20	0·65	−0·5
	4	+0·04	+1·60	1·60	+0·3
	5	+0·32	+1·01	1·05	−0·2
Apr.	1	+0·16	+0·16	0·22	−0·2
	2	+0·53	+0·53	0·74	+1·5
	3	+0·18	+0·50	0·53	+0·8
	4	+0·50	−0·14	0·52	+0·7
	5	+0·29	+0·05	0·30	+0·0
May	1	−0·20	−1·88	1·89	+3·4
	2	−0·91	−3·16	3·29	+6·7
	3	−5·71	+0·81	5·72	+12·3
	4	−3·37	+1·75	3·80	+7·8
	5	−0·50	+1·95	1·96	+3·6
June	1	−1·33	+0·27	1·36	+3·4
	2	−1·38	−0·98	1·69	+4·5
	3	−0·49	−1·58	1·66	+4·4
	4		−1·82	1·82	+4·9
	5	+0·28	−3·84	3·85	+11·4
July	1	+0·47	−0·96	1·07	+1·4
	2	+0·30	−0·31	0·43	−0·3
	3	+0·01	+0·26	0·26	−0·4
	4	+0·23	+12·5	1·27	+1·8
	5	−1·17	+0·85	1·45	+2·2
Aug.	1	−2·03	+0·59	2·11	+8·0
	2	−0·66	−0·28	0·71	+2·0
	3	−0·71	+0·34	0·79	+2·4
	4	+0·26	+0·12	0·29	+0·2
	5	+0·11	+0·09	0·14	−0·4
Sept.	1	−0·38	−0·37	0·53	+1·4
	2	−0·28	+0·30	0·42	+0·9
	3	+0·20		0·28	+0·3
	4	+0·31	−0·03	0·31	+0·4

(*to be cuntinued.*)

Table IV. (*Continued.*)

Date		$(\Delta\theta_n)_{E\cdot W}$	$(\Delta\theta_n)_{N\cdot S}$	$(\Delta\theta^2_{EW}+\theta^2_{NS})^{\frac{1}{2}} = \Delta\Theta$	$K_3=(k-1)$
1938		″	″	″	
Sept.	5	−0·42	+0·30	0·52	+1·4
Oct.	1	+0·11	−0·47	0·47	+0·2
	2	+0·10	+0·08	0·13	−0·7
	3	−0·09	+0·60	0·61	+0·5
	4	+0·30	−0·49	0·50	+0·3
	5	−0·22	+0·20	0·23	−0·4
Nov.	1	+0·64	+0·77	1·00	−0·1
	2	+0·40	−0·71	0·75	−0·3
	3	−0·03	−1·03	1·07	+0·1
	4	+0·34	−0·29	0·45	−0·5
	5	−1·06	−0·23	1·08	+0·1
Dec.	1	0·0	+0·06	0·06	−0·9
	2		−1·49	2·10	+3·2
	3	−0·23	−0·83	0·86	+0·7
	4	−0·26	+0·23	0·35	−0·3
	5	+2·45	+0·35	2·48	+3·9
1939					
Jan.	1	−1·93	−4·23	4·65	+2·9
	2		−1·92	2·69	+1·3
	3	+3·60	+2·93	4·64	+2·9
	4	+0·94	−1·61	1·87	+0·6
	5	+0·93	+1·10	1·44	+0·2
Feb.	1	+0·54	−1·76	1·84	+0·4
	2	+0·42	−0·21	0·47	−0·6
	3	+1·10	+4·29	4·43	+2·4
	4	+0·82	−0·16	0·84	−0·3
	5	+0·06	−3·47	3·47	+1·7
Mar.	1	−0·16	−1·63	1·64	+0·3
	2	+2·14	+3·54	4·14	+2·3
	3	+1·29	−1·99	2·37	+0·9
	4	+1·72	−2·00	2·65	
	5	+0·45	+2·07	2·12	+0·7
Apr.	1	+0·67	+3·53	3·59	+11·3
	2				
	3	+0·09	+1·67	1·67	+4·7
	4	+0·04	+0·36	0·36	+0·2
	5	−0·07	−0·98	0·98	+2·4

(*to be continued.*)

Table IV. (*Continued.*)

Date		$(\Delta\theta_n)_{E\text{-}W}$	$(\Delta\theta_n)_{N\text{-}S}$	$(\Delta\theta^2_{EW}+\theta^2_{NS})^{\frac{1}{2}} = \Delta\Theta$	$K_3=(k-1)$
1939		″	″	″	
May	1	−0·06	+0·25	0·26	−0·4
	2	−0·01	+0·07	0·07	−0·8
	3	−0·33	−0·93	0·99	+1·3
	4	+0·67	−1·53	1·65	+2·8
	5	−1·13	−0·36	1·18	+1·8
June	1	−0·50	+1·31	1·40	+3·5
	2	−1·52	+1·15	1·91	+5·1
	3	−1·42	+1·74	2·25	+6·2
	4	−1·16	+2·10	2·40	+6·7
	5	−0·74	−0·01	0·74	+1·4
July	1	−0·07	−1·39	1·39	+2·1
	2	−0·15	−2·15	2·16	+3·8
	3	−0·09	−2·67	2·67	+4·9
	4	−0·21	−2·64	2·64	+4·9
	5	+0·29	−1·01	1·05	+1·3
Aug.	1	−0·43	−0·07	0·44	+0·9
	2	−1·02	−0·19	1·04	+3·4
	3	−0·48	+0·06	0·48	+1·1
	4	−1·40	−0·18	1·41	+5·1
	5	−1·04	−1·80	1·80	+6·7
Sept.	1	−0·08	+2·14	2·14	+8·9
	2	−0·11	+0·38	0·40	+0·8
	3	−0·03	−0·34	0·34	+0·6
	4	+0·07	−0·29	0·30	+0·4
	5	+0·10	−0·11	0·15	−0·3
Oct.	1	+0·20	+0·37	0·42	+0·1
	2	−0·10	−0·42	0·43	+0·1
	3	−0·14	+0·15	0·21	−0·1
	4	+0·47	−0·46	0·64	+0·6
	5	−0·70	−0·69	0·97	+1·4
Nov.	1	−0·14	+0·15	0·21	−0·8
	2	+0·42	+0·44	0·62	−0·4
	3	−1·10	−1·12	1·57	+0·7
	4	−1·17	−1·15	1·61	+0·7
	5	+0·50	−0·48	0·67	−0·3
Dec.	1	−0·24	−0·25	0·35	−0·3
	2	+0·31	−0·32	0·45	−0·1
	3	+0·36	+0·35	0·49	−0·1

(*to be continued.*)

Table IV. (*Continued.*)

Date		$(\Delta\theta_u)_{EW}$	$(\Delta\theta_u)_{NS}$	$(\Delta\theta^2_{EW}+\theta^2_{NS})^{\frac{1}{2}}$ $=\Delta\Theta$	$K_3=(k-1)$
1939		″	″	″	
Dec.	4	+0·45	+0·20	0·49	0·0
	5	+0·54	+0·45	0·71	+0·4
1940					
Jan.	1		−0·55	0·55	−0·5
	2	−1·02	+5·55	5·64	+3·8
	3	−5·97	−4·60	7·54	+5·3
	4	+1·42	−0·88	1·67	+0·4
	5	+1·20	−0·64	1·36	+0·1
Feb.	1	+2·91	−0·29	2·92	+1·3
	2	+1·87	+0·22	1·88	+0·5
	3	−0·12	+2·12	2·12	+0·6
	4	+0·76	−1·49	1·67	+0·3
	5	+0·22	+0·57	0·61	−0·5
Mar.	1	−0·73	+1·74	1·89	+0·5
	2	+2·03	+4·70	5·12	+3·1
	3	+0·90	+3·48	3·59	+1·9
	4	+0·27	−1·87	1·89	+0·5
	5	+0·05	+0·35	0·35	−0·7
Apr.	1	+0·45	+0·82	0·94	+2·2
	2	+0·51	+1·46	1·55	+4·3
	3	+0·20	+1·30	1·32	+3·5
	4	−2·91	+0·04	2·91	+9·0
	5	−0·20	−1·30	1·32	+3·5
May	1	+0·88	−0·22	0·91	+1·1
	2	+1·37	−0·92	1·65	+2·8
	3	−3·94	−1·16	4·11	+9·6
	4	−3·18	−2·84	4·26	+8·9
	5	−2·05	−2·03	2·88	+5·7
June	1	+0·20	−1·08	1·10	+2·7
	2	+0·63	+0·31	0·70	+1·2
	3	−0·75	+0·19	0·77	+1·5
	4	+0·05	+1·42	1·42	+3·6
	5	+0·14	+0·92	0·93	+2·0
July	1	+1·31	−0·52	1·41	+2·1
	2	+1·30	−1·55	2·02	+3·5
	3	+1·39	−3·32	3·60	+7·0
	4	+0·25	+0·47	0·52	+0·2

(*to be continued.*)

Table IV. (*Continued*)

Date		$(\Delta\theta_n)_{E\cdot W}$	$(\Delta\theta_n)_{N\cdot S}$	$(\Delta\theta^2_{EW}+\theta^2_{NS})^{\frac{1}{2}} = \Delta\Theta$	$K_3=(k-1)$
1940		"	"	"	
July	5	−0·67	+0·10	0·68	+0·5
Aug.	1	−1·53	−0·25	1·55	+5·4
	2	+1·01	+0·43	1·10	+3·7
	3	−0·20	+0·05	0·21	−0·1
	4	+0·34	+0·04	0·34	+0·5
	5	+0·35	0·0	0·35	+0·5
Sept.	1	+0·26	+0·40	0·48	+1·2
	2	+0·50	+0·21	0·54	+1·5
	3	+0·14	+0·37	0·40	+0·8
	4	+0·50	−0·27	0·57	+1·6
	5	−0·45	−0·18	0·49	+1·2
Oct.	1	−0·57	+0·13	0·59	+0·5
	2	+0·41	−0·38	0·56	+0·4
	3	−0·18	+0·02	0·18	−0·5
	4	+0·05	−0·04	0·06	−0·8
	5	+0·10	+0·37	0·38	0·0
Nov.	1	+0·17	−0·83	0·85	−0·1
	2	+0·01	+0·76	0·76	−0·2
	3	−0·31	−0·31	0·44	−0·5
	4	+0·08	−0·47	0·48	−0·5
	5	−0·53	−0·13	0·55	−0·4
Dec.	1	−0·47	−0·40	0·62	+0·2
	2	−0·25	−0·27	0·37	−0·3
	3	−0·53	−0·47	0·71	−0·4
	4	−0·20	−0·90	0·92	+0·8
	5	−0·34	−0·15	0·36	−0·3
1941					
Jan.	1	+1·48	+2·82	3·17	+1·7
	2	+4·42	+3·36	5·57	+4·7
	3	+6·19	+3·30	7·00	+5·9
	4	+1·53	+7·69	7·84	+6·6
	5	−14·73	−0·45	14·75	+12·3
Feb.	1	−3·02	−0·57	3·07	+1·4
	2	−2·48	−1·28	2·79	+1·2
	3	+0·85	+0·81	1·19	−0·1
	4	−0·53	−1·23	1·34	+8·4
	5	+2·57	+2·55	3·62	+1·8

(*to be continued.*)

Table IV. (*Continued.*)

Date		$(\Delta\theta_n)_{EW}$	$(\Delta\theta_n)_{NS}$	$(\Delta\theta^2_{EW}+\theta^2_{NS})^{\frac{1}{2}} = \Delta\Theta$	$K_3=(k-1)$
1941		$''$	$''$	$''$	
Mar.	1	+0·48	+0·30	0·57	−0·5
	2	+1·00	−0·80	1·28	0·0
	3	+1·09	+1·88	2·17	+0·7
	4	+0·63	−0·72	0·96	−0·2
	5	+2·37	−1·33	2·72	+1·2
Apr.	1	−2·11	−2·65	3·39	+10·6
	2	−1·99	+1·02	2·24	+6·7
	3	−2·25	+0·38	2·28	+6·8
	4	−3·95	−3·02	4·97	+16·1
	5	−4·45	−1·66	4·75	+15·3
May	1	−3·49	+0·48	3·52	+7·2
	2	+0·37	+6·40	6·41	+13·9
	3	+8·53	+2·57	8·91	+19·7
	4	+5·90	−5·85	8·31	+18·3
	5	−2·10	−7·47	7·76	+17·0
June	1	−1·71	−5·08	5·36	+16·3
	2	−0·39	−2·00	2·04	+5·6
	3	−0·78	−0·45	0·90	+1·9
	4	−0·17	−0·40	0·43	+0·4
	5	−0·21	−0·27	0·34	+0·1
July	1	−0·04	+0·22	0·22	−0·5
	2	+0·39	−0·10	0·40	−0·1
	3	+0·18	−0·32	0·37	−0·2
	4	+0·10	+0·64	0·65	+0·4
	5	−0·10	+0·27	0·29	−0·4
Aug.	1	0·0	+0·48	0·48	+1·0
	2	−0·70	+0·73	1·02	+3·3
	3	+0·10	+0·10	0·14	−0·4
	4	+0·30	+0·30	0·45	+0·9
	5	+0·20	+0·21	0·29	+0·3
Sept.	1	−0·04	−0·05	0·07	−0·7
	2	+0·09	+0·10	0·12	−0·4
	3	+0·03	+0·04	0·06	−0·7
	4	+0·35	+0·31	0·43	+1·0
	5	−0·27	+0·30	0·42	+0·9
Oct.	1	+0·40	+0·42	0·59	+0·5
	2	−0·36	−0·37	0·52	+0·3
	3	+2·35	+0·37	2·37	+4·9

(*to be continued.*)

Table IV. (*Continued.*)

Date		$(\Delta\theta_n)_{E\text{-}W}$	$(\Delta\theta_n)_{N\text{-}S}$	$(\Delta\theta^2_{EW}+\theta^2_{NS})^{\frac{1}{2}}$ $=\Delta\Theta$	$K_3=(k-1)$
1941		″	″	″	
Oct.	4	−0·89	−0·90	1·26	+2·2
	5	−0·47	+0·50	0·70	+0·8
Nov.	1	−4·81	−1·40	5·00	+4·5
	2	+8·02	+1·66	8·19	+8·0
	3	−6·21	+1·14	6·32	+5·9
	4	−0·55	−0·60	0·84	−0·1
	5	+0·05	−0·33	0·33	−0·6
Dec.	1	+0·08	−0·60	0·61	+0·2
	2	+0·20	−0·27	0·34	−0·4
	3	−0·31	−0·37	0·48	−0·1
	4	−0·04	−1·03	1·03	+1·1
	5	+0·37	+1·22	1·28	+1·5

35. 火山活動と地表傾斜變動

地震研究所 水 上 武

昭和 9 年より昭和 17 年に至る約 9 ケ年間に於ける淺間火山の活動と地表傾斜變動との關係に就いて研究した結果である.

先づ淺間火山の大小 16 の爆發に就いてその噴出物の量と噴出速度の調査より，個々の爆發のエネルギーを求めた．この詳細については前に報告した．他方同火山の火口東方 4 粁の位置に於いて上記の期間を通じて，同じ地震計を以つて爆發に伴ひ發生する爆發地震を觀測した．爆發地震の一つの特徴として表面波が極めて顯著に現はれる事を指摘出來る．この表面波の最大振幅とその爆發のエネルギーの關係を 20 個の爆發に就いて調べた結果，略直線に近い二次曲線を以つて現はす事が出來た．この關係と，爆發地震の觀測結果を用ひて同期間に發生した總べての爆發をエネルギーを以つて表した．爆發の發生狀態を見ると昭和 10 年より 17 年に至る火山活動期に於いて爆發は 10 回乃至 30 回位の群をなして 2，3 ケ月に亘つて發生し，然る後比較的平穩な數ケ月が續き再び爆發の群が發生してゐる．この樣な爆發群はこの期間に 18 回發生した．

然るに一方地表傾斜變化の觀測結果を見ると以上の爆發群の發生に關係して著しい傾斜變化が發生する事が明かとなつた．この地表傾斜變化に於いて，季節變化，日變化等の火山活動に無關係な小變化を除くために平穩期に於ける傾斜變化と比較して火山活動に關係する變化を表はすための傾斜變化特性數を定めた．この特性數を一月，半月及び $1/5$ ケ月に對する値を求めた．

今爆發のエネルギーの每月の和と月平均特性數を時間に就いてその消長發生關係を見ると爆發エネルギーの曲線に於いて前述の如く 18 の極大値がありそれに對應して特性數曲線が 19 の極大値を示して居る．而もエネルギーの極大値の 1 ケ月乃至 2 ケ月前に特性數の極大値のあるものが 18 個の中 17 個である．この分布を偶然の分布としてその確率を調べて見ると僅かに 10^{-5} に過ぎない．即ち兩者は偶然の發生分布を示すものでは無く因果關係の存在を示すものに外ならない．

そこで，兩者の發生關係を坪井博士の重價平均の函數を使用して更に精しく調べてた．即ち昭和 10 年 1 月より 12 月に至る期間と昭和 15 年 7 月より昭和 16 年 12 月期間に於いて重價平均函數を定めた．その結果任意の一ケ月中に發生する火山爆發の大體のエネルギーは傾斜特性數の 1 ケ月前，2 ケ月前及び 3 ケ月前の値を以つて表はし得る事が判つた．即ち將來の火山活動を推定するに有效なる豫測函數が決定されたのである．この函數を實際に昭和 17 年 1 月より 7 月に至る期間の火山活動に應用して見た結果傾向としては實際に發生した爆發の發生と極めて近似する結果を得た．然しながらこの函數を最近 8 ケ年の活動の發生に適用して見るとこの函數より計算されるものは實際に發生したエネルギーの 3 倍と $1/3$ との間の値を取ると云ふ結果を得た．

今後火山周圍の多數の適當の場所に於ける傾斜變動の結果を使用し且平穩期に於ける觀測を更に加へる事により，更に兩者の關係を精密に表現し得るものと考へられる．

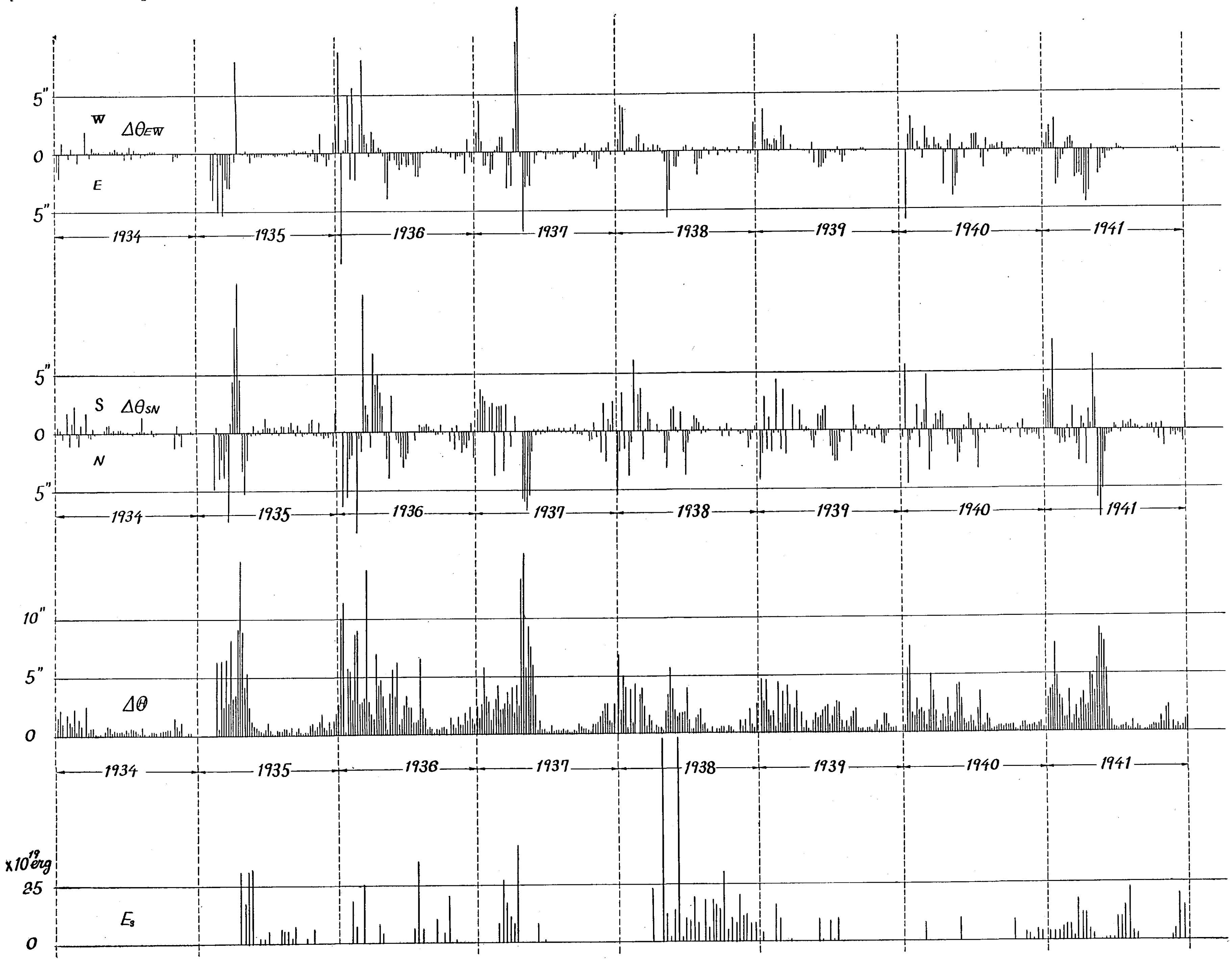

Fig. 6. Result of tilt observation at Nakanosawa.

$\Delta\theta_{EW}$, $\Delta\theta_{SN}$: variation in tilt in the two components.

$\Delta\Theta = (\Delta\theta^2_{EW} + \Delta\theta^2_{SN})^{\frac{1}{2}}$

E_3=sum of explosion energies for every ten days.

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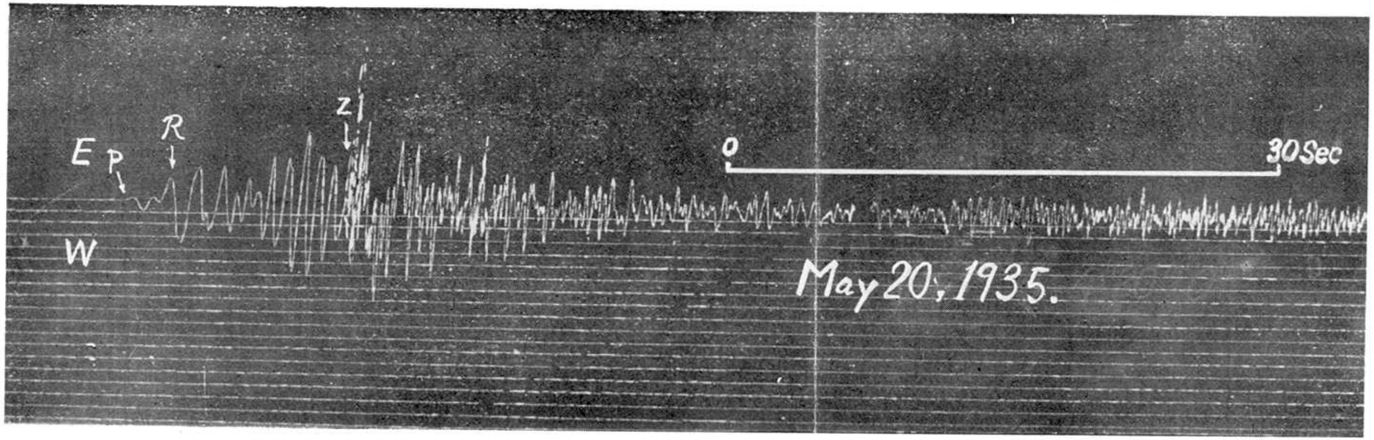

Fig. 17. a.

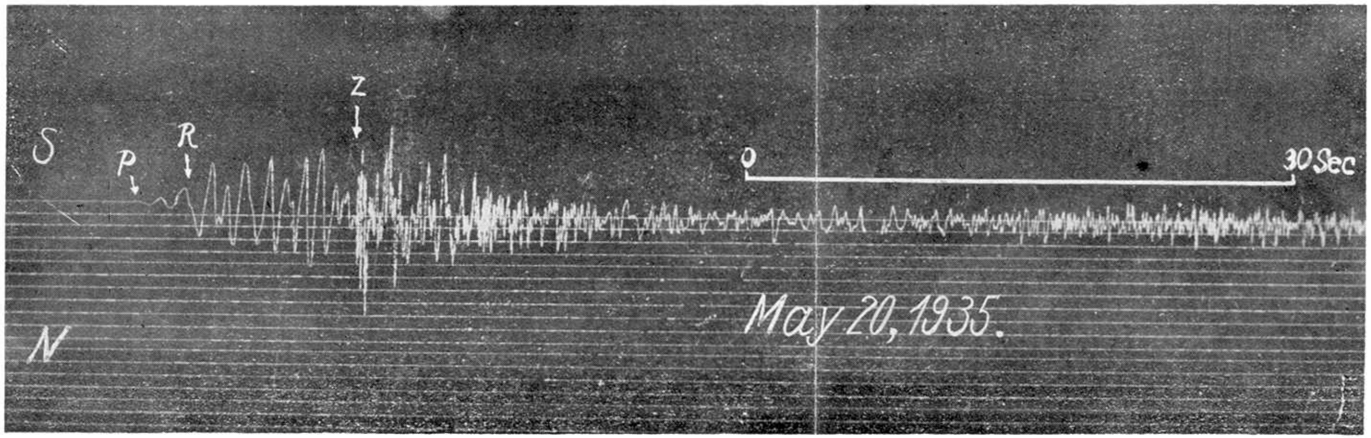

Fig. 17. b.

Explosion earthquake.

P=logitudinal wave, R=surface wave. Z=air wave.

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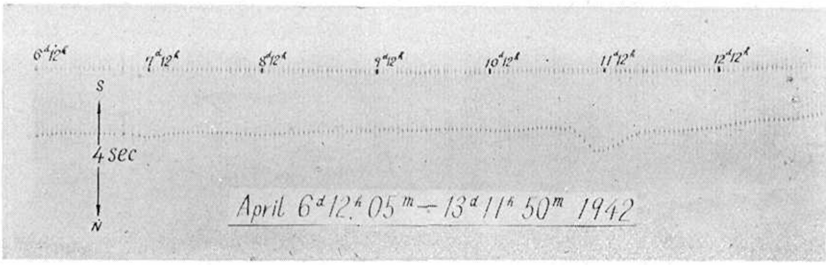

Fig. 18.

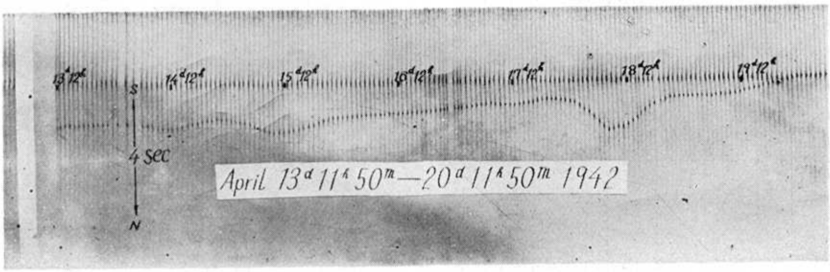

Fig. 19.

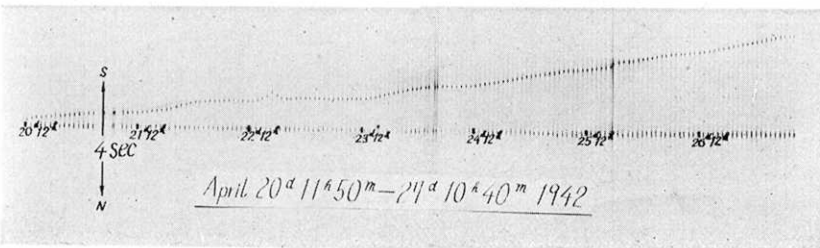

Fig. 20.

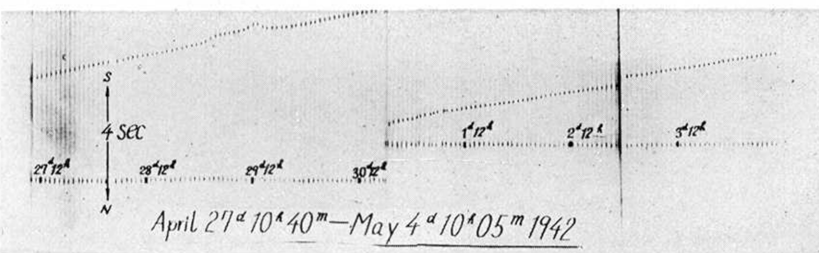

Fig. 21.

Fig. 18~21. Records of clinograph at Nakanosawa.

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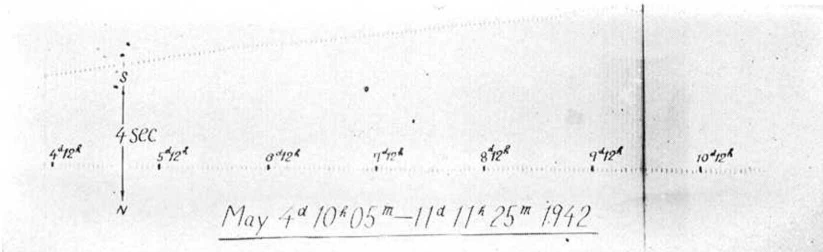

Fig. 22.

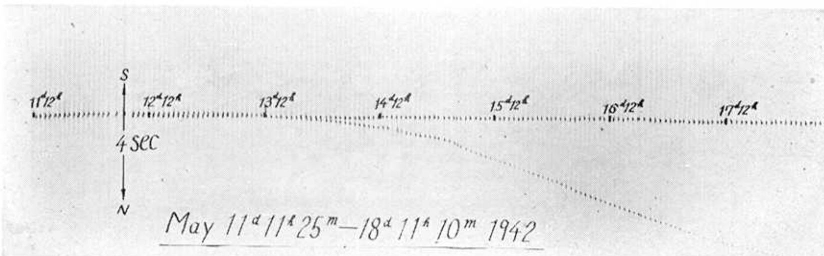

Fig. 23.

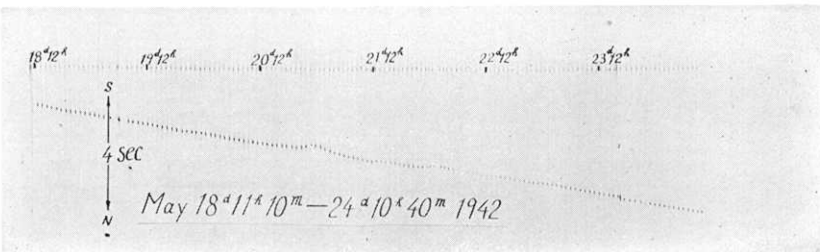

Fig. 24.

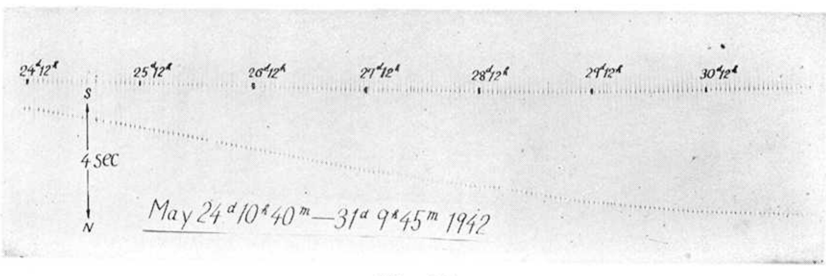

Fig. 25.

Fig. 22～25. Records of clinograph at Nakanosawa.