

Month.	Number of Eruptions.	
	Asama-yama.	Yake-dake.
July.	3	8
August.	3	1
September.	1	0
October.	2	0
November.	1	2
December.	6	3
<i>Sum.</i>	62	33

As is illustrated in Fig. 14, the maximum numbers of the Asama-yama explosions occurred in January and April, while those of the Yake-dake occurred in May, June, and July; the time distributions for the two volcanoes between December and August being symmetrically opposite to each other.

#### CHAPTER VIII. THE GREAT ERUPTION OF THE ASAMA-YAMA IN THE 3RD YEAR OF TEMMEI, 1783.

**46. Date of occurrence.** The series of the explosions of the Asama-yama in the 3rd year of the Temmei period, 1783, culminated in a tremendous catastrophe on Aug. 5th. It is a memorable circumstance that in the same year (on Feb. 5th) the great Calabrian earthquake also took place.

As shown in § 9 the frequency of the eruptions of the Asama-yama is subject to an annual variation, which indicates two maxima occurring respectively in April and in August.\* The Temmei eruption of the Asama-yama belonged to the latter epoch.

\* See also F. Omori: *Notes on the recent volcanic eruptions in Japan.* The Bulletin, Vol. II.

**47. *Weather at the time of eruption.*** In Yedo (Tokyo) it rained slightly on July 28th (1783). In the province of Kotsuke, which lies immediately to the E. of the Asama-yama, the weather was clear on July 31st and Aug. 1st; neither rainy nor windy on the night of Aug. 2nd; and fair on the 3rd. At Komoro, the weather was fair and calm during the three last days, the 3rd to 5th, Aug. At Satte, in the province of Musashi, there was no rainfall for more than ten days, from July 28th till Aug. 6th. In the provinces of Kaga and Etchu, about 120 to 170 km to the west of the volcano, there were rain falls which were very heavy from the morning of the 7th to the morning of the 8th, and which did not stop till the 11th, causing a devastating flood of the rivers, at Kanazawa, Daishoji, etc. Taking together these fragmentary records, it seems that, in the central part of Japan, the weather was dry and fair, or clear, during the one week preceding the final three days, 3rd to 5th, Aug.; while on these days it was fair and calm, in the vicinity of the volcano. Consequently there must have existed area of the high barometric pressure over the Asama-yama and the central district of Japan, during the latter part of the last and most violent stage of the eruption (p. 110). Immediately after the final catastrophe, however, there appeared a deep cyclone which passed some distance to the W. of the Asama-yama and caused considerable inundations in the provinces of Kaga and Etchu.

**48. *Course of eruption.*** The eruption, which altogether lasted 88 days, began on May 9th. On June 24th, detonations like distant thunders began to occur from about 7 am. On the next day, June 25th, between 10 am and noon, loud detonations were heard, accompanied by a strong explosion: the sounds also occurring on the next day (26th), between 4 and 6 pm. The

mountain then remained quiet for the next 20 days, till July 16th, when loud detonations occurred during the night; these being also excessive after the midnight of the next day (17th). After 8 days, on the 25th, the detonations continued from about 8 am till the noon, although the smoke emission was slight during the day; this marked the commencement of the last stage of the Temmei eruption, the explosions now occurring on the successive days. Thus on the next day (26th), at 4 pm, there were detonations accompanied by an explosion, which threw out smokes, toward the E., lasting till the evening; again, on the 27th, when it rained heavily, at 4 pm, there were detonations and emissions of smokes thrown toward the SE. The volcanic manifestations, which, so far, were not particularly violent, began to be greatly increased in force on the next day (28th), when, in fair weather, there occurred at about noon a powerful explosion, which was stronger than that on June 25th, and which threw the smokes toward the E. From about this time, the effects of the Asamayama eruption began to be felt in distant localities such as Yedo (Tokyo), where the ashes fell on July 28th, and where the people wondered how the houses and doors were shaken, while the ground was quiet and the water remained undisturbed. On July 29th, when the weather was fair in the morning and slightly rainy at about 10 am, the explosion (burning) began at 3 pm and continued very strong till 5 pm, being markedly more violent than on the preceding day. On the 30th, the explosions, which began at the noon, were excessively great between 2 and 8 pm, coming to a temporary end at 4 am of the next day. The eruptive activity continued to increase on the following two days, namely, July 31st and Aug. 1st.

On Aug. 2nd, the weather was fair, and the eruption reached

its maximum violence ; the mountain burned fiercely from 6 to 12 pm, and projected a large quantity of stones and sands on the Maikake-yama, which was converted literally into a sheet of fire ; the scene being rendered yet more dismal by the incessant discharges of lightnings from among the dark smokes. The eruption, which stopped for a time in the morning of the 3rd, resumed its violent manifestations from 2 to 10 pm, covering the Kiba-yama with red-hot stones of various sizes, such that the burning fire, extended to the mountain base. On that day, the detonations were heard in Yedo (Tokyo) from about 5 pm. The next day, the 4th, on which the weather was fair, the explosions began with detonations at 8 am and caused such an excessive fall of ashes, between 1 and 4 pm, even to places at considerable distances from the volcano, as, for instance, to oblige the people at the town of Fukaya, in the province of Musashi, to use lanterns for enabling them to walk in the streets. Toward the evening, the darkness caused by the precipitation of ashes became again profound, while the detonations and thunders were so intense as to shake down the doors and shoji, of course rendering the people utterly incapable to enjoy slumber. In the extremity of terror, many had recourse to prayers, and even to fantastic practices of shooting guns against the heavens, or of wildly beating drums and bells, accompanied by shrieks. On the 4th the eruption was stronger than on the 3rd, sending a series of loud detonations to Yedo, where the precipitation of ashes began in the morning and became so thick in the evening as to resemble a snow fall.

On Aug. 5th, the day of the final great catastrophe, the weather was fair. The outbursts, which began at 4 am, became extremely violent from 8 to 11 am, causing even in Yedo a par-

tial darkness from 10 am to noon. It was at a little after 10 o'clock on the morning that a huge mass of burnt rocks, molten lava, and hot mud, descended out with a deafening detonation from the crater and precipitated itself down the northern (i.e. Kotsuke side) flank of the mountain, thence rushing into the valley of the Azuma-gawa, one of the tributaries of the Tone-gawa.

According to what has been described above, the course of the eruption phenomena consisted of the following four stages:—

Commencement .....	May 9.	} Successive difference	.....	
2nd stage outbursts .....	June 24-26.			46 days.
3rd „ „ .....	July 16-17.			22
4th „ „ .....	July 25-Aug. 5.			9

Thus the time differences between the commencements of the successive stages were respectively 46, 22, and 9 days; the intensity of the eruption increasing with the progress of the phenomena, while the intervals of rest between the epochs of activity were successively reduced in duration. The outflow of the lava mass had already begun a few days before the final great disaster.

**49. *Oni-oshidashi or lava flow.*** The great lava flow of 1783, popularly termed “Oni-oshidashi” (Devil's Outflow), which forms an imposing object of spectacle covering the northern flank of the Asama-yama, descended in the form of an inverted fun into the Rokuriga-hara plain. As will be seen from Fig. 44, which is a view of the mountain taken from the vicinity of the Wakasare Cottage, near the Ko-Asama, about 4 km to the ENE of the crater, there is at the NNE base of the volcano a tongue-like protuberance of reddish rocks, known as the “Butai” (Stage), which, with a uniform thickness of about 60 metres, descends at a gentle

angle of inclination. This "Butai," about 1 km in length and 0.5 km in width, whose surface is perfectly flat, is nothing other than an old lava flow, whose date of formation may be several thousand years prior to the Temmei period. Now the "Oni-oshidashi," or the great lava masses of the eruption in the latter epoch, were, in their downward courses, separated into two portions at the head of the "Butai," the main stream being directed toward the NNW, while the smaller branch, directed north-eastwards, stopped at a little distance to the NE of the point of the bifurcation. Of course, the "Oni-oshidashi" were pushed down, not all at once, but apparently in at least three separate issues. The masses of the lava, dark in colour, show very little sign of weathering and still presents a quite fresh appearance, although already 129 years in existence; there being almost absolutely no vegetation covering them, and the rocks preserving their fantastic shapes (Figs. 46 and 57).

The "Oni-oshidashi" lava masses terminate, both at the sides and the bases, in a perfectly abrupt manner, forming a nicely cut slope of about  $40^\circ$  inclination, which runs straight for a considerable distance, and whose height varies from 30 to 50 metres. (See Figs. 45 and 46). The area covered by the "Oni-oshidashi" is approximately a triangle, 3 km in height and 6 km along the base. If we assume the mean thickness of the lava layer to be 30 metres, which is probably not in excess of the actual value, the total volume comes out to be about 0.3 cubic km, this being equivalent to nearly 30 times the size of the present crater of the Asama-yama. The "Oni-oshidashi," which did not flow down further enough to reach the villages, caused no damage to life and buildings.

**50. Great volcanic avalanche.** The great torrent of volcanic

matters, whose initial velocity must have been very high, probably not under 50 miles per hour, caused enormous damage in all the villages at the N. base of the Asama-yama and those situated along the Azuma-gawa, which runs from west to east at the north of the volcano. The principal course of descent of this terrible avalanch was along the deeply cut ravines, which run from the foot of the Asama-yama toward the N. or NNE to the Azuma-gawa, and in which Kamahara, Koshuku, Fukurokura, and other villages were situated. The Kamahara-mura, consisting of 93 houses, suffered the most direct shock of the avalanch, and was entirely buried by it, losing 477 out of the total population of 597. The Koshuku-mura, consisting of 60 houses, situated to the east of the above named village was also swept away, losing 149 out of the population of 290. Of the places in the higher part of the valley, the two villages of Saikubo and Omae were wholly destroyed, losing 54 and 27 respectively out of the populations of 160 and 452. The volcanic avalanch blocked the Azuma-gawa for a time, producing a temporary decrease of water in the lower course. The accumulated water soon broke, probably at about 11 am, through the dam of the débris and, together with the steaming volcanic matters, rushed down the river, thence passing into the large stream of the Tone-gawa, along which houses were swept away even at Kodama county, province of Musashi, distant along the rivers about 90 km from the Kamahara-mura. The following list gives the approximate distances from the last named village of, and the time of arrival of the volcanic deluge, as we may call it, at the different places along the Tone-gawa.

TABLE XXIX. TIME OF ARRIVAL OF THE VOLCANIC DELUGE AT THE DIFFERENT PLACES.

Place.	Approximate time of arrival of Volcanic Deluge.	Approximate distance from Kamahara-mura, along the rivers.
Maebashi.	8th; 2 pm.	75 km.
Tama-mura (Kotsuke).	<i>Do.</i>	90
Akaiwa ( <i>Do.</i> ).	8th; 3 pm.	130
Satte (Musashi).	,, ; 4 pm.	166
Koga (Shimosa).	9th; { At 8 am, furnitures, etc., began to flow down past the town.	157
Kanamachi (Musashi).	,, { Water began to become turbid from the morning.	210

The velocity of flow of the volcanic deluge along the Azumagawa and the Tone-gawa, was, as far as the vicinity of Maebashi and Tama-mura, about 30 km (19 miles) per hour, while that along the Tone-gawa below the last-named locality and then along the Gongendo-gawa (a bifarcation of the Tone-gawa) down to Satte, was about 40 km (25 miles) per hour. (See Fig. 40.) A part of the deluge passed from the Tone-gawa into the narrow branch stream of Yedo-gawa, the turbid water arriving at Kanamachi already in the morning of the 9th. It was, however, first in the evening of the 11th, or nearly  $3\frac{1}{2}$  days after the descent of the volcanic avalanche, that furnitures and broken pieces of the houses began to flow down past the same town. The muddy and sulphurous streams finally ran into the Pacific and also into the Tokyo Bay, causing the sea waters along the coasts to become turbid. The inhabitants in the beach districts of Yedo were taken by panic for two days.

So far as can be ascertained the number of the houses entirely buried by the volcanic avalanche and those swept away by

the subsequent deluge, was 1061, involving the loss of 1162 human lives.

The enormity of the calamity caused by the great volcanic avalanch is attested by a small Kwannon Temple (Fig. 42) at the Kamahara-mura, which village was, as already mentioned, entirely buried under the mud. This temple, built before the Temmei period, stood on the top of a high steep hill situated to the west of the above-named village, its front stone stair having originally consisted of 120 steps. Of these, the lower 105 steps were buried by the volcanic avalanch, so that now-a-days only 15 steps are remaining. As each of the latter is, on the average, 16.4 cm in thickness, the total height of the 105 buried steps would be about 17.2 metres, denoting the thickness of the mud layer at this locality. In front of the temple there stands a stone monument, erected 32 years after the catastrophe, namely, in 1815, recording the names of the 477 villagers killed by the great avalanch.

In Fig. 43 is shown a bell, which, as can be ascertained from the inscriptions on its side, belonged to the Jorin-ji, a Buddhist temple in the Koshuku-mura, and which had been cast in 1776, namely, 7 years before the fatal eruption of the Asamayama. The bell-tower, together with the other temple buildings, was destroyed by the volcanic avalanch, and the bell itself was swept away and lay hidden underground for 127 years, till 1910. In the latter year the bell was discovered, after the great floods, from the bed of the Azuma-gawa at a place called Kawarayu, about 10 km below the original locality. The bell, which is of bronze, looks just as fresh as if it were newly made; only the deformation of its side and the absence of the "ryuzu" (hanging) tell the history of this interesting object.

**51. Ashes and stones.** Although the Temmei eruption con-

tinued for nearly three months, it was from the 3rd to the morning of the 6th, in August, that the ashes fell even to such distant places as Yedo (Tokyo) and Choshi; the volcanic "hairs" also coming down on those days at the different places. Thus, in the city of Maebashi, although the weather was on Aug. 6th quiet and cloudless, the sky was misty and there came down pure white hairy substances of length of 4 to 12 inches. In Yedo, the sky cleared, on the 5th from about the noon, the sands, however, continuing to be thrown; at 2 pm there were again the detonations and then began to fall down white or reddish horse-hair like substances, whose length varied from 2 to 12 inches. On Aug. 5th, at 2 pm, *mud rain* fell at Karuizawa, Sakamoto, and Isobe, places which lie at short distances toward the SE from the Asama-yama. On the preceding day, at 10 am, there were also mud rain at Kiryu, which is 73 km to the E. of the Asama-yama.

Fig. 31 indicates the district within which the ashes fell to an amount of more than 1 inch. It will be observed that the ash-area formed a sort of narrow spherical triangle, with its apex at the Asama-yama, gradually augmenting the width with the increasing distance toward the ESE. On the Pacific coast, the Kasumiga-ura and the Rokugo-gawa districts formed respectively the northern and southern boundaries. In the places at short distances from the volcano, the ashes were mixed with a large amount of stone fragments.

An idea of the immensity of the quantity of the fallen ashes may be obtained from the fact that in the city of Takasaki, at the radial distance of 44 km from the Asama-yama, the ashes accumulated to a thickness of about 6 inches, thereby 5 houses being crushed down. At the town of Sakamoto (Usui county, province of Kotsuke), 18 km to the S70° E from the volcano, the

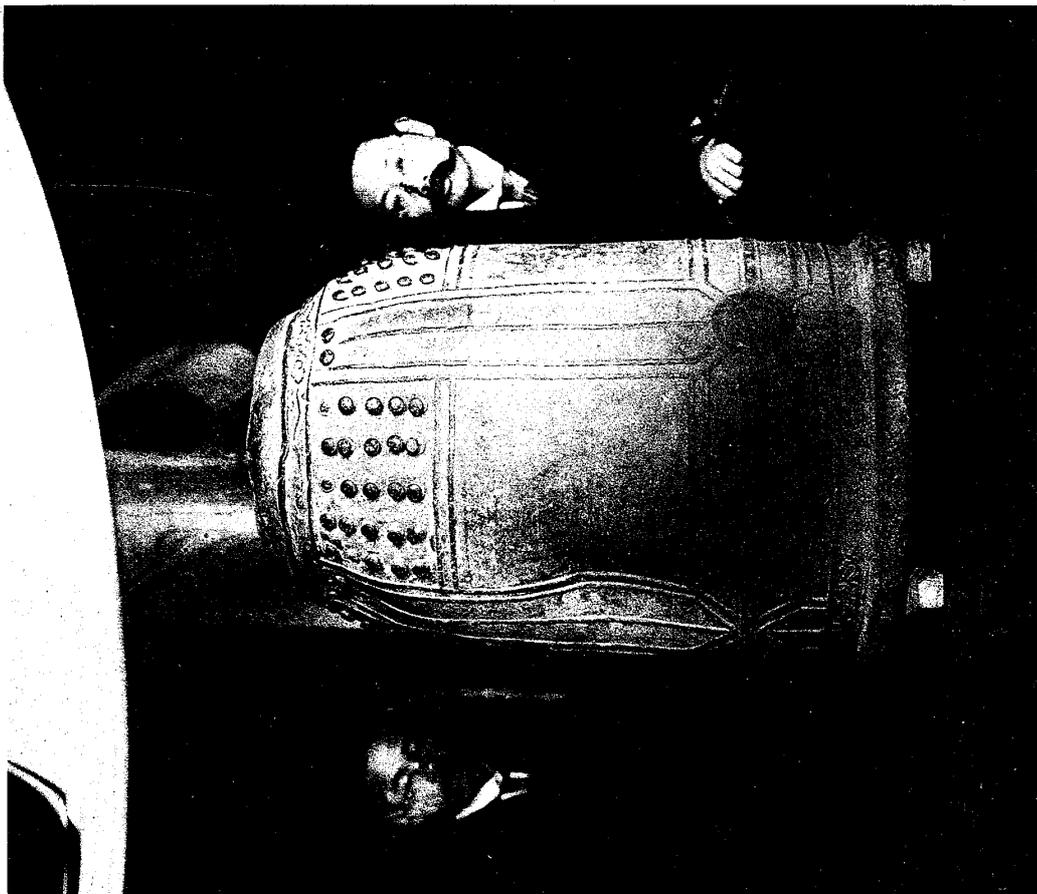
precipitation of the sand and stones was so heavy that 59 out of the 172 houses were entirely crushed down, while the 103 others were greatly damaged. At the town of Karuizawa, 11 km to the NE of the volcano, the débris accumulation amounted to 4 or 5 feet, and 51 out of the 186 houses were burnt on Aug. 4th, at 10 pm, in consequence of the fires caught from the red hot bombs ; of the other houses, 70 were crushed down, and the remaining 65 were much damaged, by the stones and sands. Although there must have been numerous volcanic earthquakes of the Asama-yama origin during this prolonged period of the eruption, yet none of them seems to have been particularly strong ; certainly there was no house destroyed by the seismic shocks.

The district covered by the ashes (Fig. 31) is about 220 km in length, and about 100 km in width (base), the area being approximately 11,000 sq. km. Now the amount of precipitation of the ashes was 5 or 6 inches at the radial distance of 50 km, decreasing to 2 inches at Choshi and 1 inch in Yedo. If we assume the mean thickness of the accumulation of the ashes within the area under consideration to be 2 inches, the total volume of the stones, sand, and ashes ejected by the explosions would be 0.7 cubic kilometre, or, in round number, some 0.9 kilometre cube. The magnitude of this quantity, which does not include the volume of the great volcanic avalanche, will be realized when we remember that the volume of the present Asama-yama crater is only about 1/24th of a cubic kilometre.

At Komoro, which lies 13 km to the SW of the volcano, there were witnessed several explosions since June 25th (1783), accompanied, however, by no precipitation of ashes. On Aug. 3rd, from about the noon the detonations became loud, and the explosions strong, causing sounds like that of stormy winds. The



**Fig. 42. The Kannon Temple at Kamahara, built before the Temmei period. The front stone stair, which consisted originally of 120 steps, had the lower 105 buried by the Volcanic Avalanch of 1783, there remaining since then only 15 steps.**



**Fig. 43. Bell of the Jorinji Temple. The temple and bell-tower were entirely destroyed by the Volcanic Avalanch of 1783, and this bell which remained buried under the mud for 127 years, was discovered in 1910 from the bed of the Azuma-gawa. (T. Kato, photo.)**



Fig. 44. View of the north-eastern side of the Asama-yama,

taken from the vicinity of the Wakasare cottage, about 4 km to the ENE of the Ko-Asama. The long flat tongue-like protuberance extending from the centre of the figure to the right-hand end is the old lava flow called the "Butai" (Stage). The "Oni-Oshidashi" or the great lava flow of 1783 descended from the top of the Asama-yama along the right-hand, or N., side to the head of the "Butai." (F. Omori, photo.)



Fig. 45. View of the "Oni-Oshidashi," or great Lava Flow of 1783,  
taken from the "Butai" (Stage). (F. Omori, photo. Dec. 24th, 1911.)



Fig. 46. A near view of the "Oni-Oshidashi," or great Lava Flow of 1783, taken from the "Butai" (Stage), showing at the front the end slope of the Wakasare Branch. The End Slope is 50 metres in height. (F. Omori, photo. Dec. 24th, 1911.)



Fig. 48. The great crack through the SW wall of the crater, photographed on June 26th, 1911, by T. Kato. (The former conditions of this same crack are illustrated in Figs. 58 and 59.)



Fig. 47. The newly built Asama-yama Seismological Observatory, located at Nagamine, near Yuno-taira, at the height of about 1900 metres above sea-level, or 540 metres below the top of the mountain.

explosions were intensified at the midnight of the 4th. On the next day, the people found it impossible to hear each other's voices, on account of the incessant shakings of the houses mingling with the rushing noises of the fierce smoke emanations, as well as the detonations like discharges of guns; the smoke column, emitting numerous lightnings, rose high into the sky and then was blown toward the NE. As there was no precipitation of the ashes or sands at Komoro, the people did not flee from their houses, and were able to perceive clearly the conditions of the eruption during the three last days and nights, when an entirely fair weather prevailed in that place. At Kutsukake, a small town 9 km to the S40°E of the Asama-yama, the amount of precipitation of the volcanic materials was small, causing no special damage to the cultivated fields; which last effect was limited to the western boundary of the village territory of Karui-zawa.

**52. Sounds.** The detonations of the Asama-yama doubtless reached to considerable distances, although requisite records are wanting. In the city of Kanazawa (province of Kaga), the shakings due to sound waves, which were felt there since about July 19th, became specially strong on the 3rd, 4th, and 5th, Aug., that the women and children lived on the streets. At the town of Daishoji, in the same province, strong shakings were felt from July 28th to Aug. 5th.

**53. Why the Asama-yama eruption of 1783 was excessively disastrous?** As stated before (Chapter II), the frequency of the eruptions of the Asama-yama during the known historical period presents a series of fluctuations of about  $63\frac{1}{2}$  years. Confining our attention to the later epochs, we see that the mountain was quiet and made no special outburst during the 35 years between

the eruption in 1669 and that on Feb. 5th, 1704. Then followed a period of the activity of 29 years, including 16 eruptions, the last of which occurred on July 30th, 1733. Thereafter the Asama-yama became again unusually quiet, there being, in the course of the next 50 years ending with the 3rd year of the Temmei period (1783), only two explosions in 1754, one in 1776, and a few in 1777, which were all small. Especially, during the 2 or 3 years immediately preceding the terrible Temmei disaster, the smoke had entirely ceased to be issued from the crater, whose bottom had gradually been raised up almost to the level with the mountain top itself. It will thus be observed that the Temmei eruption was the result of the outburst of the volcanic energy accumulated during the course of long years; the crater bottom, raised up by means of the powerful underground explosive force, having kept the stress till the last stage. Moreover, as the crater was extremely shallow, an immense mass of molten and burning rocks and mud was finally ejected out of it, causing the dreadful volcanic avalanch.

#### CHAPTER IX. SEISMOGRAPHICAL OBSERVATIONS AT ASHINO-TAIRA ON THE ASAMA-YAMA.

**54. *Object of the seismographical observations.*** The tremometer observations made during the Usu-san eruption in July-August, 1910, at the immediate vicinity of one of the most active of the newly formed craterlets, indicated the existence, besides numerous small earthquakes, of the micro-tremors, or those minute quick movements of the ground whose period was about 0.5 sec.\* The interesting features of this latter sort of motion are that the

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\* The *Bulletin*, Vol. V, No. 1.