Chapter II. Activity Variation.

12. Commencement of eruption. Figs. 6 and 7 are the pictures of the eruptions from the two opposite sides of Sakura-jima taken by Mr. R. Higo, of Tarumizu, on the morning of Jan. 12th, 1914, respectively at about $10\frac{1}{4}$ and $10\frac{2}{3}$ a.m., or probably some 20 and 45 minutes after the very commencement of the eruption. The interesting sketches (figs. 44 and 45), made by Mr. S. Bando,

Approximate Views of Sakura-jima from the South immediately after the Commencement of the Eruption.

Fig. 44.

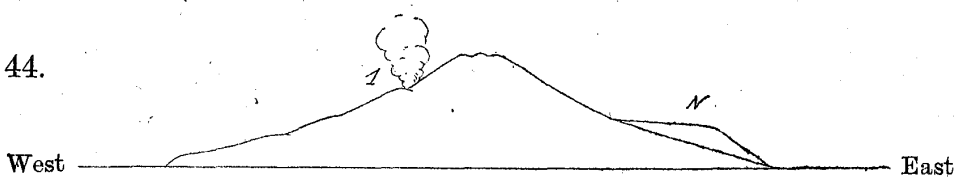
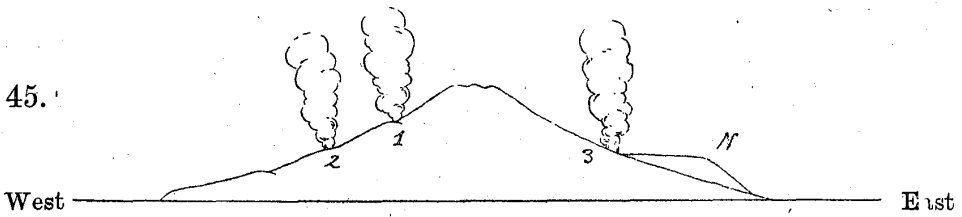


Fig. 45.



N.....Nabe-yama. 1, 2, and 3 indicate the order of outbursts, corresponding respectively to the craterlets Nos. 1 and 2 on the west side, and No. $\frac{1}{3}$ on the east side. (after Prof. F. Omori)

of Shibushi Middle School, give the *approximate* state of smoke emissions during the earlier stages of the eruption as observed by him from the south while proceeding on board the steamboat "Tatsu-maru" from Kagoshima to Furue, a town on the west coast of Ōsumi about 22 km to the S.S.E. of Sakura-jima. According to fig. 44 the first outburst which was accompanied by no detonative sound took place on the W. side from the highest No. 1 craterlet (situated to the north of Hikinohira, 570 m above sea-level), followed by the 2nd outburst from a craterlet at a lower

place, probably located in the neighbourhood of the Gongen shrine 400 m above sea-level. Then the eruption began from the highest No. 1 craterlet on the east side. In fig. 6 the smokes from the latter side, still from a single mouth, has ascended vertically about 1130 m, namely, has attained the height of about 1560 m above sea-level, while those on the W. side formed a vertical column about 1150 m in the E.–W. diameter and ascended already to a height over 5000 m. In fig. 7, the smokes from the east side forms a vertical column about 1300 m in the E.–W. diameter. So far Nabe-yama, shown at the right hand side of fig. 6, remained unaffected, the eruptions on the east side perhaps taking place principally from the craterlets Nos. 1 and 2, and on the west side from the openings, not much lower than the top of the above-mentioned hill, or over the height of some 330 m above sea-level. As yet the outbursts were not very explosive, the detonations having been heard in Kagoshima first at 3.30 p.m. (12th). Between $10\frac{2}{3}$ p.m., 12th, and 8 a.m., 13th, when the explosive action was at the climax, the smokes must have reached a height probably of about 10 km. From figs. 6 and 7 it will be observed that the ashes were carried toward the N.E. or E.N.E., as the front of the western smokes advanced to the right behind the eastern smoke column; the eruption zone, or the line joining the craterlets on both flanks of the mountain, making an angle of 45° with the direction connecting Tarumizu and Sakura-jima.

Fig. 8 is the view of Sakura-jima taken from the Shiroyama park in Kagoshima probably about one hour after the commencement of the eruption, showing the trapezium plateau of Hakamagoshi at the left-hand and the small islet of Karasu-jima (buried under the lava later on) at the right-hand side. On the front or the west mountain slope, the dense eruptive smokes rose vertically

in a column of the N.–S. diameter of some 900 and 1500 m respectively at base and top; there being projected from the craterlets a great many hot lava pieces with a white trailing tail of gas and vapour.

According to the accounts of the municipal officials and the school masters of Tarumizu, the houses in the villages of Arimra and Waki on the S.E. coast of Sakura-jima were burnt at 2 p.m. on the first day of the eruption. At the same time the whole space about Nabe-yama was enveloped in black smokes, it being supposed by some that the lava outflow did then began. From 4 p.m. on the same day burning lava pieces fell on the sea, splashing the water high into the air. The lava stream is supposed to have reached the sea already at 10 a.m. on the 13th. If so, the lava would have run down the distance of 2.3 km from the craterlets Nos. 1 and 2 to the coast at Arimra in the course of some 20 hours, with the average speed of 110 metres/hour. At Obama, a place on the coast of the province of Ōsumi at a distance of 4.7 km to the S.E. of the eastern No. 1 craterlet, forest undergrowths were put on fire at 4 p.m., 12th, from the precipitation of the burning stones; the conflagration was, however, put out after 1 hour by the fire brigade of the village.

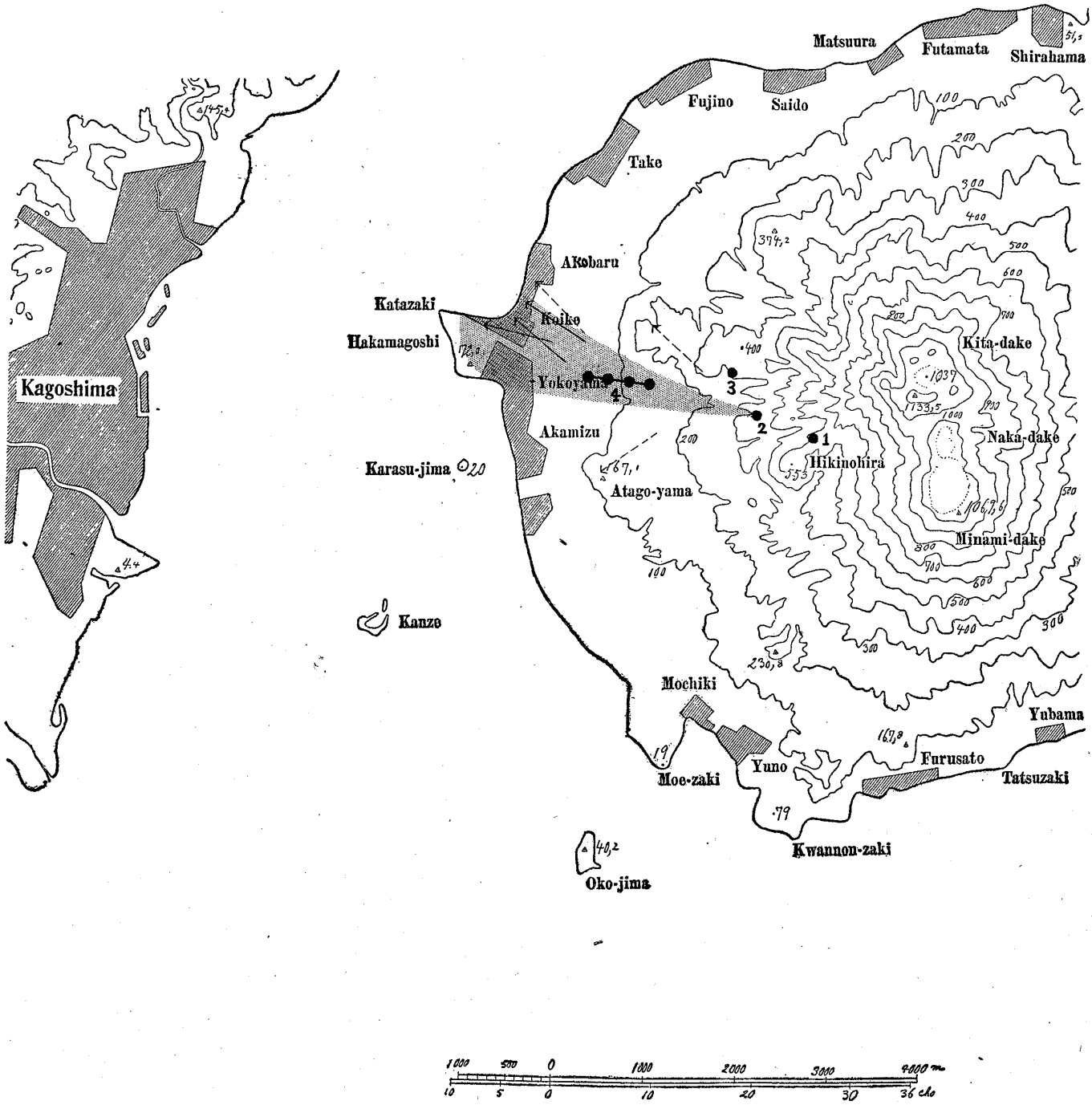
13. Eruption blasts. Unmistakable signs of the generation of volcanic blasts were observed on and around the plateau of Hakamagoshi. Thus, according to our observations on Jan. 19th, 1914, on the village ground inside the latter, the school house had entirely been destroyed and carried off somewhere in pieces, there remaining only the foundation timbers, immersed in a pool of water dammed by the lava stream. The beach at the S. side of Hakamagoshi was strewn with broken timbers. On the farm grounds at the top of Hakamagoshi 72 m above sea-level, there

Fig. 46. Map showing the Direction of the Volcanic Blasts on the Western Eruption Field.

Red arrow...Direction of the blast.

Do., dotted···Direction of lava block projection.

The thin red shade indicates the district where the blasts were strong. The red dots 1 2, 3 and 4 mark the positions of the western craterlets Nos. 1, 2, 3 and 4.



were found, besides a considerable quantity of timbers shattered from the houses, a great number of large uprooted mandarin-orange trees which had been carried westwards by the blasts through an upslope distance of 300 m or more from the village of Yokoyama situated below at the east foot of the plateau in question. (See fig. 37.) The sugar-canes on Hakamagoshi were found entirely thrown down, mostly outwards or away from the centre of the disturbance, although the cases of the contrary direction were also not wanting.

On the N. slope of Hakamagoshi, the majority of the trees were standing, even though burnt and charred. On the N.E. corner and on the E. side, however, the trees were mostly overthrown, the demarcation of the damaged and undamaged regions being quite sharp. At the south portion of the E. side slope of Hakamagoshi several slender trees were standing. It thus seems that in the region under consideration the volcanic blasts were directed principally against the N.E. corner of Hakamagoshi and toward the adjacent village of Koike. On the ground about the latter, the destruction was general and the tree trunks were mostly overthrown or broken toward the old fort ground of Gion-no-su at the mouth of the Inari river at the north end of the city of Kagoshima, and a factory building near Prince Shimazu's Iso mansion, or midway between these, i.e., in the directions varying from N.73°W. to N.52°W. These two limiting directions point, if produced backwards, respectively to the western No.1 craterlet and the lowest active craterlet behind Hakamagoshi. Several trees, whose bark remained intact even on the side facing the source of disturbance, were found overthrown toward the Gion-no-su, very probably by the volcanic blasts. On the fields behind the village of Koike and at the N.E.

base of Hakamagoshi, the trees were found overthrown mostly away from the Minami-dake. A large camphor tree, about 3 feet in diameter, which had stood in the ground of a shrine at the boundary of Koike and Akobaru, was overthrown toward N.55°E., which direction, if produced backwards, points to the uppermost of the craterlet series lying to the S.W. of the hill group above Akobaru, (the craterlet No.4 in fig.2, in the preceding Number of the Bulletin). Again, at the mandarin-orange grove to the N. of the cemetery in Akobaru, the trees, completely stripped of bark on the side facing S.E., were overthrown toward the opposite direction, namely, toward the N.39°W., which, if produced backwards, passes through the lowest of the craterlets belonging to the series above noted. (See fig. 46.)

On the top of Atago-yama, 166 m in height, situated 2.0 km to the S.E. of Hakamagoshi, the large tree trunks were uniformly overthrown or broken in the direction of the islet of Kanze, namely, toward S. 57° W.; this direction prolonged backwards points toward the lava source at the S.W. foot of the 400 m hill (the craterlet No.3 in the map, fig.2, in the preceding Number of the Bulletin.) The trees were completely stripped of bark on the side facing the centre of disturbance by the impact with the lava projectiles. The Atago shrine itself was destroyed and carried somewhere by the stones and the blasts, leaving behind no trace at all. For the width of about 100 m along the foot of the steep S.W. slope of Atago-yama the trees were found overthrown.

At the vicinity of the cemetery in the beach ground of Akamizu, the young pine trees about 9 feet in height were burnt and partially charred, but not broken or uprooted. A similar effect was also observed at the base of the lava outflow to the north of Nojiri.

On the eastern eruption field, distinct trace of the blast can be recognized neither on the plain districts of Krokami to the north of Nabe-yama, nor even on the slope grounds above the village of Furusato and immediately below the craterlet No. 1. It is hereby to be remarked that the different craterlets on the east side are located on elevated positions constituting ridges, while those on the west side were formed on the whole along the trough of a V-shaped radial valley opening westwards. This last circumstance has probably allowed the partial westward concentration of the explosive effects, resulting in the formation of the eruption blasts which swept against Hakamagoshi and the vicinity, and whose direction was there essentially identical with that of the projection of the lava blocks from the craterlets concerned.

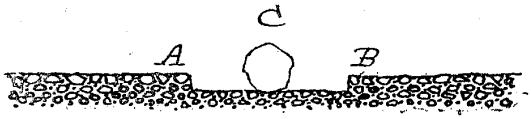
14. Holes produced by the impact of lava blocks. On the flat beach to the N. of Hakamagoshi, where the ground was not much covered by large pumice pieces, the conical holes formed by the impact of the projected lava blocks were very numerous, their space distribution being such that, in one instance, about 75 were counted in a rectangular area 83 m in length and 64 m in width, with the average of one in every 70 sq. m. The diameter of the holes was from $1\frac{1}{3}$ to 3 m. On the field at the back of the village of Koike and on the N.E. base of Hakamagoshi, the conical holes were very numerous, being literally consecutive one with the other. At the boundary of the village districts of Koike and Akobaru there were no conical holes to be observed, having been, if any, hidden from view by the layer of pumice blocks, from a few inches to 1 foot or more in dimension, which accumulated to the thickness of 2 to $2\frac{1}{2}$ feet. (See fig. 56.) On the top ground of Hakamagoshi there were a great many holes, the largest of which had the diameter of 8 m

and the depth of $1\frac{1}{2}$ m. On the hilly grounds above the villages of Akobaru and Take, conical holes of maximum diameter of $3\frac{1}{2}$ m were formed on the new pumice layer, whose depth was 0.54 m. On the ground in the vicinity of the cemetery of Akamizu, to the south of Hakamagoshi, there were no conical holes formed by the falling stones.

At the foot of Nabe-yama, behind the village of Krokami, there were several conical holes formed on the pumice and ash field, the maximum diameter being about 2 m.

Small lava pieces falling on the ground covered by a hardened layer of pumice produced a splashing about of the latter, which according to what was observed in April 1914 below the eastern No. 1 craterlet, resulted in the formation of shallow uniform-

Fig. 47.



depth holes. Thus in one case, (fig. 47), the fallen rock fragment C was 6 inches in size, while the hole A B was 1 inch in depth and 2 feet in diameter.

In the days immediately succeeding the eruption there were found, at the outside base of Hakamagoshi, more than 20 dead horses and pigs, which had been driven out of the villages of Yokoyama and Koike burnt and otherwise destroyed and there struck by burning lava fragments or suffocated by hot eruption blasts. On Jan. 19th, 1914, there was found a large stiffened dead eel on the dried sea-beach, while, on the lower portion of the S. slope of Hakamagoshi, where the soil was moist, there were great many dead toads, all stiffened and dried up in a climbing posture, having probably been scorched by the volcanic heat. On the inner side

of Hakamagoshi, several dead pigs were found among the burnt remnants of the houses of Yokoyama.

15. Pumice. On the débris-covered grounds about the villages of Koike and Akobaru, to the N.E. of Hakamagoshi, larger lava blocks were found to form the upper layers, while small pumice pieces, sands, and ashes formed the lower layers. This would indicate that the finer constituents of the volcanic ejecta were given out during the earlier stages of the eruption, followed by the coarser fragments later on ; it being these latter which set on fire the houses of the neighbouring villages. The houses in Yokoyama and Koike situated near Hakamagoshi were being burnt already on the 12th, at about $6\frac{1}{2}$ p.m., while at the more distant villages of Take and Fujino several houses were burnt on the night of the 13th.

On Jan. 18th, 1914, the floating pumice area in Kagoshima Bay encountered by the torpedo-boat destroyers *Shiratsuyu* and *Ikazuchi* to the N.W. of Sakura-jima was about 3 miles in length and $1\frac{1}{2}$ miles in width.

On the morning of Jan. 19th, 1914, the wind being easterly, there was a slight precipitation of ashes in the city of Kagoshima, which rendered the air very dusky, the detonative sounds also being there perceived quite intensely. At $10\frac{1}{2}$ a.m., when the author and his party started on a tour in the bay on board the training vessel *Nishiki Maru*, the floating pumice filled the harbour and covered the outside sea surface for several miles, completely surrounding the two torpedo-boat destroyers lying there at anchor. Landing on Sakura-jima and coming back to Koike at $4\frac{1}{2}$ p.m., it was found that a layer of pumice about 10 inches in thickness had completely blocked up the coast from the base of Hakamagoshi to the vicinity of the villages of Fujino and Saido at

the N.W. part of the island. The efforts of 4 stout students were perfectly ineffective to drive through the area of pumice a small boat, in which we had come in the morning, so that it was partly pushed by men standing in the water and partly pulled with a rope from the steamer, until we were finally enabled to embark the latter. Where the accumulation was comparatively thin and broken by the undulatory motion of the sea, fish often jumped up and, remaining on surface of the pumice layer, could not again get into the water.

At the beach the floating pumice often proved deceitful to the horses and even to the men, who, on account of the difficulty of recognizing the demarcation between land and water, trod sometimes into the latter.

16. Eruptive sounds. In the earlier days of the eruption the volcanic sounds occurred of course at close intervals. In the city of Kagoshima, which is situated westwards at the minimum distance of about 5 km from the lowest (nearest) craterlet on the western side, the sounds were sometimes very loud and like the booming of guns, constituting what may be termed a sound shock, namely, a strong air disturbance which caused marked shakings of the houses. At other times, the sounds were like the rushing of winds, accompanied by movements more or less. There were also cases, in which the sound waves ceased to be audible, and yet caused some shakings of the *shojis*, or paper-covered sliding doors in Japanese houses. The duration of the sounds, which was usually quite short, was in several instances more or less lengthened, up to about 40 sec.

The perception of the eruptive sounds in Kagoshima depended, like the precipitation of the ashes, much on the state of the weathers. Thus the easterly winds invariably brought in the

city some diffusion of the volcanic dusts and an increase both in the intensity and the frequency of the detonations, causing alarm each time to the panic-stricken inhabitants. At Tarumizu and other places in the province of Ōsumi, situated eastwards from the volcano, the sounds were heard much more intensely than in Kagoshima. The following table contains only a fragmentary list of the sounds which I have accidentally perceived in Kagoshima or Tarumizu on Jan. 17th, 19th, and 21st–26th, 1914.

TABLE I. Observation of Volcanic Sounds.

Place of Observation.	Date (1914).	Time of Occurrence.	Remarks.
Satsumaya Hotel, Kagoshima.	Jan. 17.	10.42.13 p.m.	Strong detonation.
		11.20.20	Air shakings.
Do.	Jan. 19.	8.48.45 p.m.	Very loud sound shock.
		8.49.33	*Do.*
		8.55.42	Rushing sound, not very loud.
		9.05.52	Booming sound, not very loud.
		9.06.25	,, ,,
		9.08.28	,, ,,
		9.09.44	,, ,,
		9.10.08	*Shojis* shaken, accompanied by no sound.
		9.10.39	Sound, faint.
		9.12.12	,, , ,,
		9.13.05	,, , very faint.
		9.37.20	Sound rather loud, long in duration.

TABLE I. (*Continued.*)

Place of Observation.	Date (1914).	Time of Occurrence.	Remarks.
Satsumaya Hotel, Kagoshima.	Jan. 19.	9.41.10 p.m.	Loud sound, continued for 40 sec.
		9.43.54	Very loud, but short in duration.
		10.16.00	Sound.
		10.25.20	*Shojis* shaken, without sound.
		10.28.29	,, ,,
		10.29.53	,, ,,
		10.39.37 p.m.	,, ,,
		10.40.48	*Shojis* shaken, followed by dull sound.
		10.52.51 p.m.	Sharp loud sound.
		11.08.20	Strong air shakings, without sound.
		11.38.48	Rather loud, with some shaking effects.
Girls' Normal School, Kagoshima.	Jan. 21.	3.13.12 p.m.	Loud sound.
Satsumaya Hotel, Kagoshima.	*Do.*	6.57.36 p.m.	Loud rushing sound, accompanied by shaking of *shojis*.
		7.03.27	*Do.*
		10.14.29 p.m.	Very loud detonation.
		10.34.05 p.m.	Faint rushing sound, with slight shaking effect.
		10.34.30	Rushing sound.
		10.34.40	*Do.*
		10.34.55	*Do.*, continued for 5 sec.
		10.35.20	*Do.*
		10.35.30	*Shojis* faintly shaken.

TABLE I. *(Continued.)*

Place of Observation.	Date (1914).	Time of Occurrence.	Remarks.
Satsumaya Hotel, Kagoshima.	Jan. 21.	10.35.46 p.m.	*Shojis* faintly shaken.
		10.39.10 p.m.	Slight rushing sound; *shojis* shaken once.
		10.41.08	*Do.*
	Jan. 22.	7.33.06 a.m.	Loud booming sound, shaking *shojis*.
		7.34.34	Feeble sound, shaking *shojis*.
		7.47.54 p.m.	Loud detonation.
		10.50.30	*Do.*
	Jan. 23.	2.20.37 a.m.	Loud booming sound.
	Jan. 24.	7.16.30 a.m.	Detonation, causing shaking of *shojis*.
Tarumizu Municipal Office.	*Do.*	3.19.03 p.m.	A very loud booming detonation, which though said not to be rare in Tarumizu, was the strongest I have so far experienced, there being also sharp shaking effects. This sound due to an explosion from one of the eastern craterlets, was also loudly perceived in Kagoshima.
Satsumaya Hotel, Kagoshima.	*Do.*	6.55.51 p.m.	Shaking of *shojis*, with no sound.
		11.07.10	Some shakings of *shojis* with no noise; followed by another after a short interval.
Kagoshima Harbour.	Jan. 25.	6.34.28 a.m.	*Shojis* shaken; no sound.
		11.10.57	Loud detonation due to an explosion on the western side.
Satsumaya Hotel, Kagoshima.	Jan. 26.	9.01.01 a.m.	Strong detonation, with shaking effects. This sound was also perceived at Miyazaki, where soon after black clouds were observed on the S.W. sky.

The time interval between the moment of appearance of the eruption flash from among the lower craterlets on the western side and that of arrival of the detonative sound, observed on the evening of Jan. 18th, 1914, at the Satsumaya hotel (situated at the foot of Shiroyama Park in Kagoshima), was 17.6 sec. on the average. As the air temperature at the time in question was about 6°.5 C, for which the velocity of sound propagation in air is 336.5 m/sec., the above time interval corresponds to the path length of 336.5× 17.6=5920 m, which is very nearly the distance of the place of observation from the lowest craterlet of the eruption fissure (No. 4) above Hakamagoshi. According to a photograph of the Sakura-jima mountain I took on the same evening from the coast of Kagoshima at the vicinity of the railway station, at about 9 p.m., this same craterlet was the only one which gave a conspicuous luminous effect on the sensitive plate, although the outbursts from the higher vents were also very beautiful to look at. It is thus evident that on the 18th of January, or one week after the commencement of the eruption, if not earlier, the principal centre of the volcanic activity on the western side was restricted to the lowest craterlet.

The outbursts from the lower eastern craterlets continued to give out detonative sounds even at the end of 1914. Thus, on Oct. 2nd, 1914, while the author was staying at Komen, an eruptive sound with some shaking effect was perceived at 10.40 p.m., the duration being 5 sec.

With respect to the eruptions from the eastern craterlets Nos. 3, 4, and 7, I have witnessed from Krokami and the islet of Moe-jima several times, on Oct. 2nd, 1914, that the emission of thin white smokes was generally accompanied by a very loud detonation, while the outbursts of black smokes caused only low sounds.

Sakura-jima Eruption of 1914 : the Craterlets on the Western Eruption Field. (F. Omori, photo.)

Fig. 48. A small Secondary Craterlet formed at a height of 370 m above sea-level, near the head of a valley above the village of Take. (March, 1914.)

Fig. 49. Explosion Craterlet No. 1 seen from the west where the rim is lowest. The remainder of the small funnel-shaped hole (1') is shown near the right hand end of the craterlet. (Sept. 1914. F. Omori, photo.)

Sakura-jima Eruption of 1914 : W. Side Lava Source Region. (April, 1915. F. Omori, photo.)

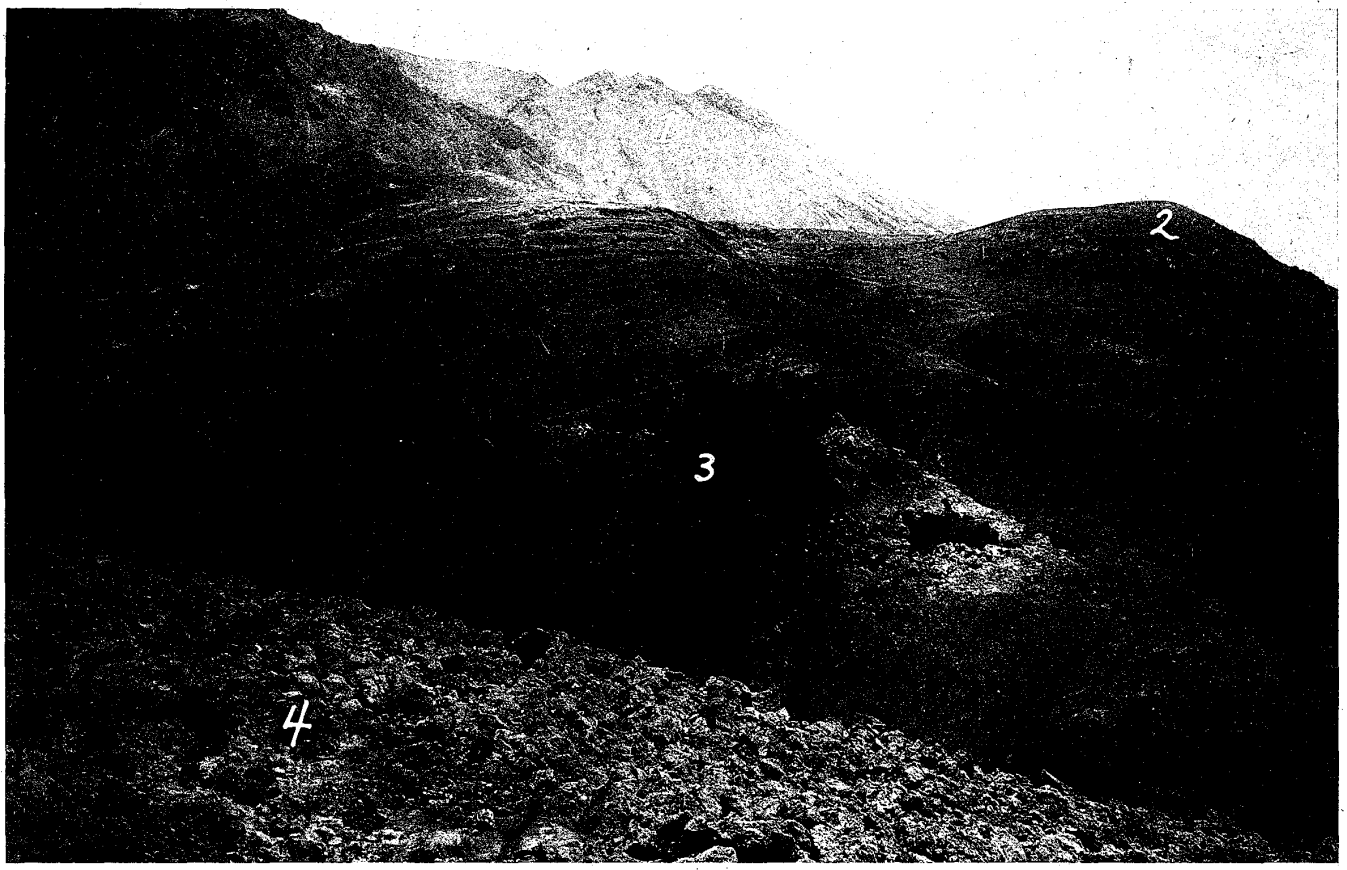


Fig. 50. View taken from the top of Yokomine Hill (4) of the disturbed area above the curved and broken lava outlet (3). Minami-dake (1) is shown on the back ground and Hikinohira (2) on the right-hand side.

Fig. 51. Broken-up Lava Source (3), viewed from the eastern or higher slope. On the back ground is shown Yokomine Hill (5) with some smokes issuing from top.

Sakura-jima Eruption of 1914 : the W. Side Lava Outflow.

Fig. 52. Curved Lava Source (shown at the left-hand side) 400 m above sea-level, whence the downward flow took place along the S. base of Yokomine Hill shown at the right-hand side. (April, 1915. F. Omori, photo.)

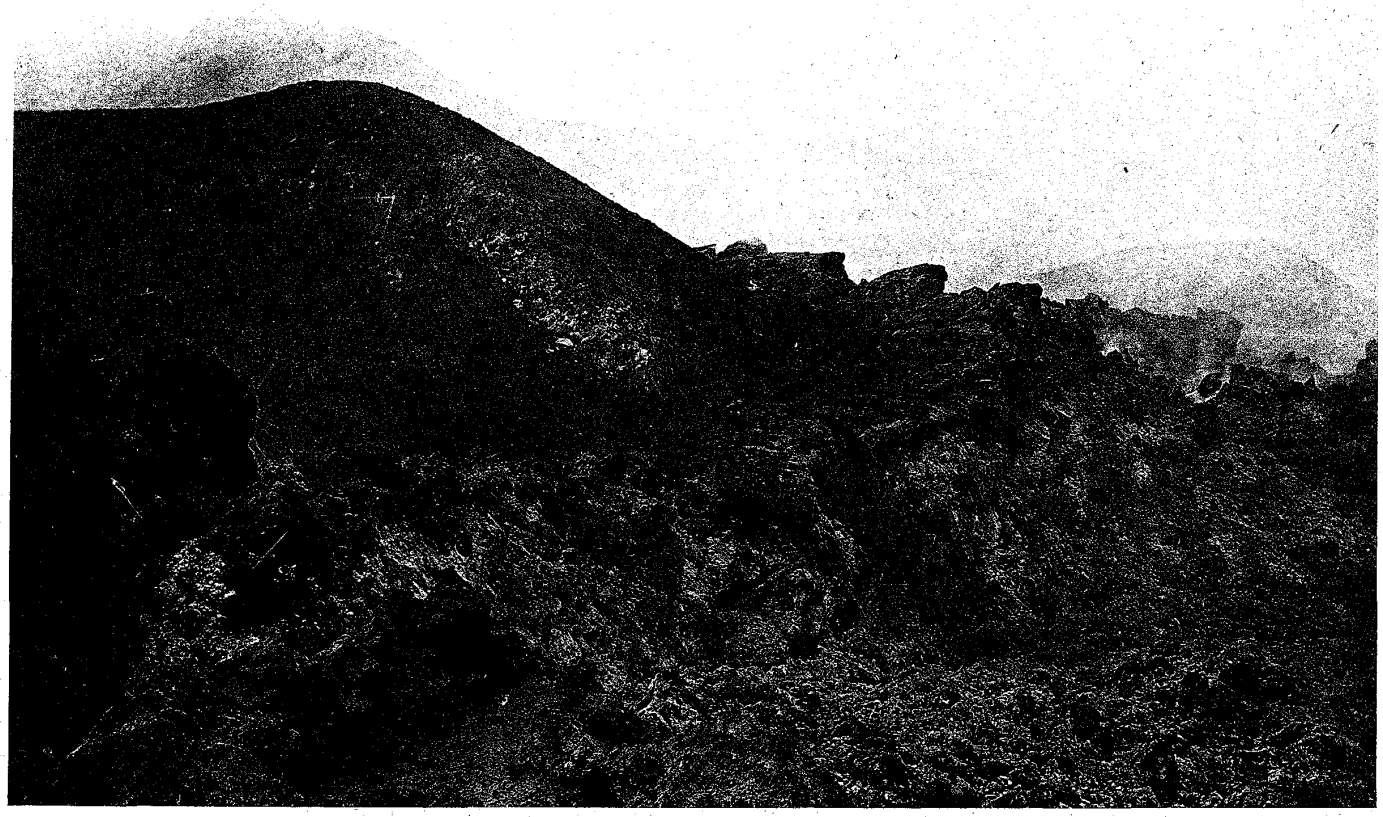


Fig. 53. Lower course of the same lava flow, showing the Depression along the middle course and the formation of Lava Terrace along the base, shown at the left-hand side. (March 22nd, 1914. K. Ueda, photo.)

Sakura-jima Eruption of 1914 : the Western Lava Field.

Fig. 54. Lowest Series of Craterlets (×) formed among the lava field, viewed from the N. margin at the base of Yokomine Hill. (April 1915.)

(F. Omori, photo.)

Fig. 55. Trees in the temple ground at the top of Atago-yama smashed by the impact of the lava fragments projected from the craterlets. The wooden shrine building was destroyed and swept off by the volcanic blast, leaving no trace behind. (April, 1914.)

Sakura-jima Eruption of 1914 : the Western Lava Stream. (Jan. 19th, 1914. F. Omori, photo.)

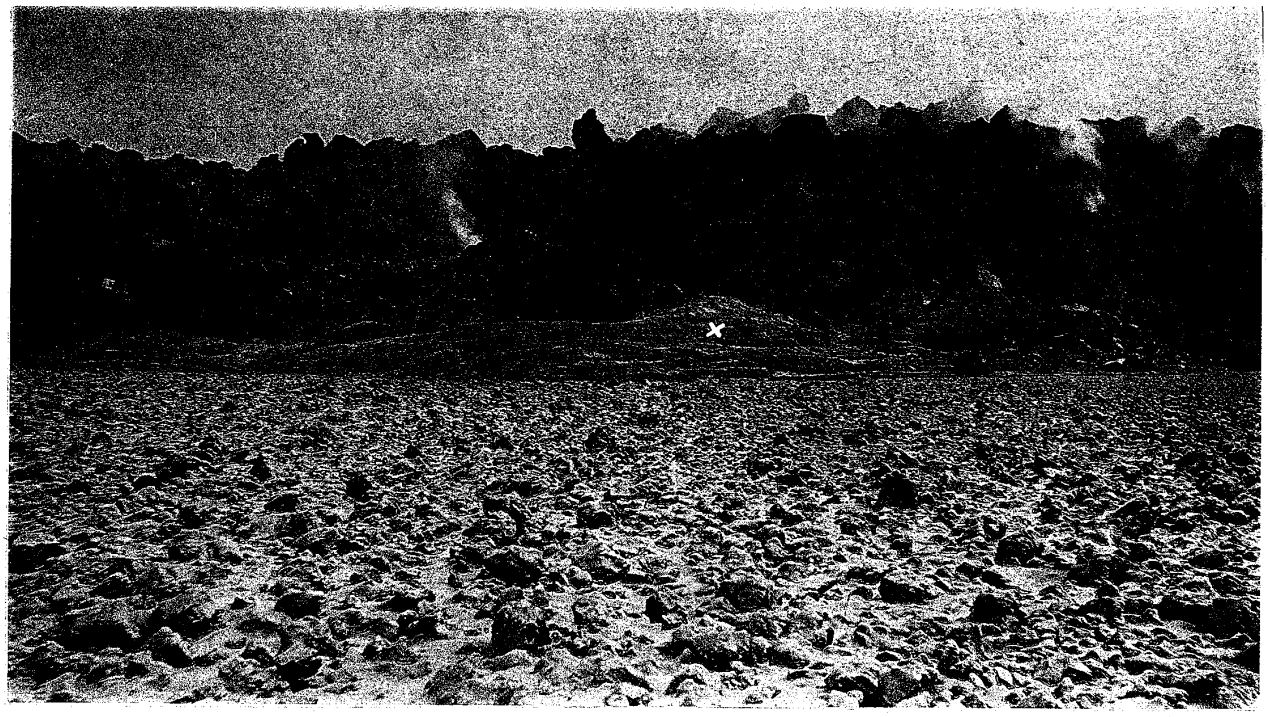


Fig. 56. The W. end of the lava flow above the village of Akobaru, showing the soil (×) forced up along the front base. In the fore-ground the pumice pieces covered the ground to a thickness of 2 feet.

Fig. 57. The N.W. corner of the same lava flow, showing large rock pieces which fell down the sloping side. Amongst the others a large parallelopipedal block, with a crevice along an edge (×), still preserved redhot condition inside.

Sakura jima Eruption of 1914 : the Western Lava Flow. (Jan. 19th, 1914. F. Omori, photo.)

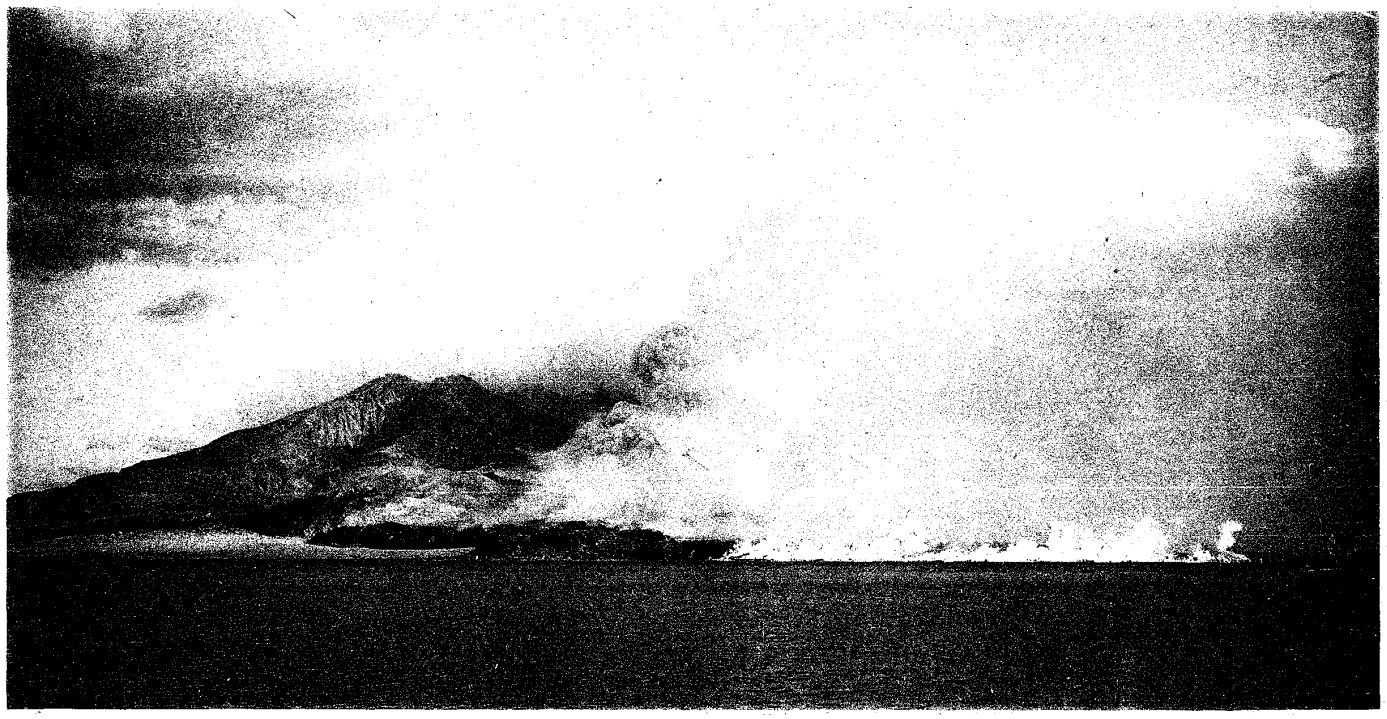


Fig. 58. View of Sakura-jima from the W., showing at the right-hand side white water vapours rising from the lava area which extended into sea.

Fig. 59. Hakamagoshi Lava Stream; vapours being sent up from the neighbouring heated water surface. On the beach there were found several dead horses and great quantity of broken house timbers.

17. Small earthquake shocks. Within a limited space at the N.W. base of the Akobaru branch lava flow to the N.E. of Hakamagoshi there were felt, at the time of my visit to Sakura-jima on Jan. 19th, 1914, a very frequent series of small tremors like that caused by the falling of a heavy weight on the ground. These were quite sharp in character, often causing people standing at the foot of the lava masses to involuntarily recede backwards. The shocks were extremely local and evidently of a very shallow origin, having been not felt on the neighbouring low hill group or in the vicinity of Hakamagoshi.

The phenomena of local earthquakes were also observed on the eastern eruption field. Thus, on April 23rd, 1915, I felt the shocks of extremely quick nature at the sloping ground to the S. of the craterlets Nos. 3 and 4, as follows :—

0. 20. 24 p.m.; duration=2 sec., with sound.

4. 15. 10 p.m.; duration=7 sec., with sound.

Again, on April 24th, 1915, an earthquake of this type was felt on the S. flank of Nabe-yama at 10.28.58 a.m. The following table gives a fragmental list of the earthquakes which I have accidentally experienced in Sakura-jima or Kagoshima on Jan. 18th, 19th, and 23rd–26th, 1914.

TABLE II. Observation of Local Earthquakes.

Locality.	Date (1914).	Time of Occurrence.	Remarks.
Close to the N.W. boundary of Hakamagoshi Lava Stream.	Jan. 18th.	h m s 2.33.10 p.m.	Sound and shock like that caused by the fall of a heavy body on ground.
		2.36.50	*Do.*
		2.46.50	Tremors of ground, accompanied by sounds like distant thunders, continued till 2.48.20 p.m.
		3.23.05	Same as the next one.

TABLE II. (*Continued*)

Locality.	Date (1914).	Time of Occurrence.	Remarks.
Close to the N.W. end base of Akobaru Lava Branch.	Jan. 19th.	1.39.20 p.m.	Sound followed by sharp tremors like that caused by the falling of a heavy body on ground.
		1.49.05	*Do.*
		1.52.06	Two booming sounds, with an interval of 1 second between.
		1.54.15	Same as the shock at 1.39.20 p.m.
		1.56.08	Two rumbling sounds, with ½ sec. interval.
		1.57.38	Same as the shock at 1.39.20 p.m.
		1.59.58	,,
		2.01.03	,, (faint).
		2.02.22	,, (,,).
		2.04.34	,, (,,).
		2.08.45	,, (very faint).
		2.12.37	,, (faint).
,,	,,	3.21.26 p.m.	,,
		3.23.24	,,
Kagoshima city.	,,	8.42.23 p.m.	,, Duration = 3 sec.
	Jan. 23rd.	8.49.26 a.m.	Slight horizontal shaking in radial direction.
	Jan. 24th.	5.27.00 a.m.	Slight shock, shaking windows.
	Jan. 25th.	1.02.19 a.m.	Strong booming sound, followed by sharp tremors; Duration = 5 sec.
		1.10.07 ,,	*Do.*
		4.49.34 ,,	*Do.* Motion parallel to the direction joining Sakura-jima with Kagoshima.
		4.53.24 ,,	Faint booming sound, followed by tremors.
	Jan. 26th.	5.58.49 a.m.	Strong booming sound, followed by sharp tremors; Duration = 7 sec.

18. Activity in Jan. 1914. In this and the succeeding three § § I give some notes respecting the activity of the different craterlets based on my personal observations during my four trips to Sakura-jima, undertaken in Jan. 16th–26th, April 7th–20th, and Sept. 21st to Oct. 5th, in 1914, and April 18th to May 7th, 1915. The principal outbursts from the western craterlets were brought practically to end about the 25th of Jan. 1914, or approximately in 2 weeks from the commencement of the eruption.

Jan. 16th. On the afternoon of the 4th day after the commencement of the outburst, the greatest activity on the western eruption field was shown by the No. 1 craterlet, while gray masses of dense smokes like cotton balls were also ejected from the mouth a little below. The front of the main lava stream, which had been at $10\frac{1}{2}$ a.m. on the 15th about 100 m distant from the beach line to the S. of Hakamagoshi, and had reached the coast probably on the afternoon of the same day, was vigorously evaporating the sea water and sending up columns of white steam. (See figs. 58 and 127.) From time to time explosions of brownish-red smokes took place from different points of the cracked surfaces of the lava flows. A fairly active explosion vent situated some distance behind Hakamagoshi had been of this type till about noon, on the 15th.

Jan. 18th. The activity on the western side, which had been much reduced on the morning, became high from about 11.30 a.m., the detonations and smoke eruptions being again much intensified. The main lava stream was on the afternoon of the 18th already so far advanced that its front came nearly in contact with the islet of Karasu-jima, while its N. side approached to within 100 metres of the base of Hakamagoshi.

Jan. 20th. On the morning, the emission of the white steam from the advancing end of the western lava field was very much in-

creased, due doubtless to the further advance of the latter into the sea. The front side of the lava flow was submerged to such a degree that only the upper edge remained above water. The islet of Karasu-jima was already covered up by the lava and its position could not be identified easily. Off the new lava coast of Furusato and Arimra the water was turbid and ashy green in colour, and the sea surface gave out vapours like thin fogs from the streak lines due to the currents of heated waters.

Jan. 21st. The eruption smokes ascended to the height of about 3,300 m above sea-level; in Kagoshima the detonations and shaking effects becoming again strong from about 5 p.m.

Jan. 22nd. In Kagoshima, it was again ashy and dusky, the detonations being loud.

Jan. 23rd. The western craterlets, whose eruptive energy was greatly reduced, ceased to make continuous outbursts. The two upper craterlets became extinct from this date. The white vapours rising from the lower portion of the lava area reached to the height of 300 m. In the vicinity of Krokami the thick smoke emissions caused a copious precipitation of mud rain, namely, the ashes mixed with the moisture contained in the volcanic clouds. The moist ashes were highly acidic in nature such that a bluish silk handkerchief, which I had put around my neck in order to keep off the dust, was turned reddish in colour, in consequence of the accumulation of the raining mud upon the shoulders.

At Krokami and Yokoyama the gases had no smell of sulphuretted hydrogen or sulphurous acid. There was no blackening of a silver watch even when kept close to the lava streams.

On the eastern eruption field, the "chimney," from which on the 16th the white smokes had been vigorously ejected horizontally towards the downslope, was already much reduced in

activity, vapours rising diffusedly and feebly upwards. Looking from the top of the old lava moraine forming the N. boundary of the Krokami plain, there were, besides the one above mentioned, smoke issues from five other sources, respectively corresponding to the craterlets Nos. 1, 2, 3 (or 3 and 4 together), 5, and 6; the outbursts from the craterlets Nos. 3 and 6 being active and emitting red hot lava from among the black smokes.

Jan. 24th. Close to the west boundary side of the eastern lava field, which was at a distance of about $\frac{1}{3}$ km from the E. end of the village of Furusato, a strong disgustful smell of chlorine was perceived on the slope ground, from the beach up to the height of 300 m. Especially for the width of about 10 metres from the base of the side lava moraine, the ash-layer covering the ground was at places moist and had thin yellow incrustations These circumstances were not verified on the western eruption fields, except near the lava sources in the vicinity of Hikinohira.

Looking from the sea off the south coast of Sakura-jima, the eastern No. 1 craterlet was observed to issue feebly some white smokes, clearly indicating the hardened source of the lava stream which had flowed out from its lower edge. The smokes from the other eastern craterlets ascended to the height of about 3000 m above sea-level.

Jan. 25th. The western large No. 1 craterlet was perfectly quiet, only thin bluish-white smokes being feebly thrown up.

1९. Activity in April, 1914. In the beginning of April 1914, namely, 3 months after the commencement of the eruption, the outbursts, now limited to the eastern side alone, took place from the craterlets Nos. 2, 3, 4, 5, 6″, and 7. (See figs. 79 and 82.)

April 9th. The lower parts of the side and front of the eastern (Arimra) lava outflows were almost constantly crumbling

down with considerable violence and loud sounds. In the ground to the east of Furusato, the smell of chlorine was excessive as in the preceding January. At 0.14.50 p.m. was witnessed from a near distance a loud detonative explosion from the eastern craterlet No. 2, when the lava fragments were thrown out like flying birds, some of these taking 8 sec. in descending from the height to which they were projected and which would approximately be about 250 m. This explosion was said to be louder than any heard at Furusato during the several preceding weeks. One of the eruptions from the craterlet No. 3 threw out lava fragments with steam tails simultaneously radiating from among the smoke masses, as is

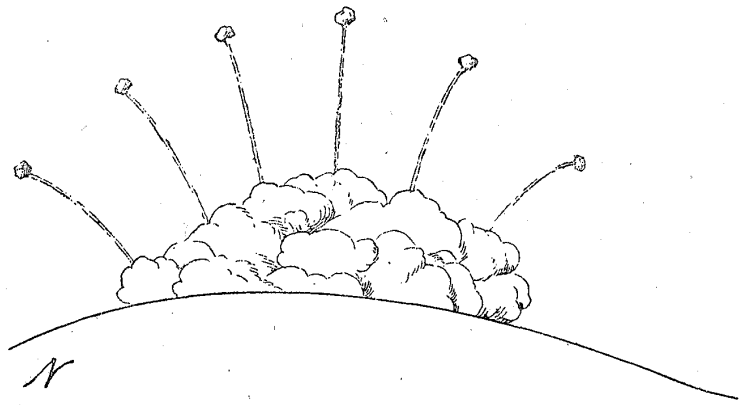


Fig. 60. A small outburst from the eastern No. 4 craterlet: projection of lava blocks trailing a tail of gas and vapour. N...Nabe-yama top.

sketched in fig. 60. On the evening several faint but distinct eruption sounds were heard in Kagoshima.

April 10th. In Kagoshima the sky was cloudy on account of the ashes thrown out from Sakura-jima. The sounds were slight but almost incessantly heard in Kagoshima, often lightly shaking the shojis.

April 18th. In Kagoshima there was a slight precipitation of ashes, faint rumbling sounds being heard since the morning.

20. Activity in Sept. 1914. In Sept. 1914, or 8 months after

the commencement of the eruption, the eastern craterlet No. 4 remained comparatively most active, the craterlets Nos. 3, 5, 6″, and 7, on the same side exhibiting also occasional outbursts. (See figs. 86 and 87.)

The coast side or the advancing front of the lava field in the Arimra district crumbled down with rustling noise from time to time in much the same manner as in the preceding April; the black rock masses here and there visible being the new lavas forced out of the cracks of the older flows.

Sept. 22nd. In Kagoshima, between 8 and 9 p.m., low rumbling sounds were heard twice. During the night, the eruptions on the eastern side rendered the sky slightly luminous so that the outline of the mountain seen from the west was just discernible.

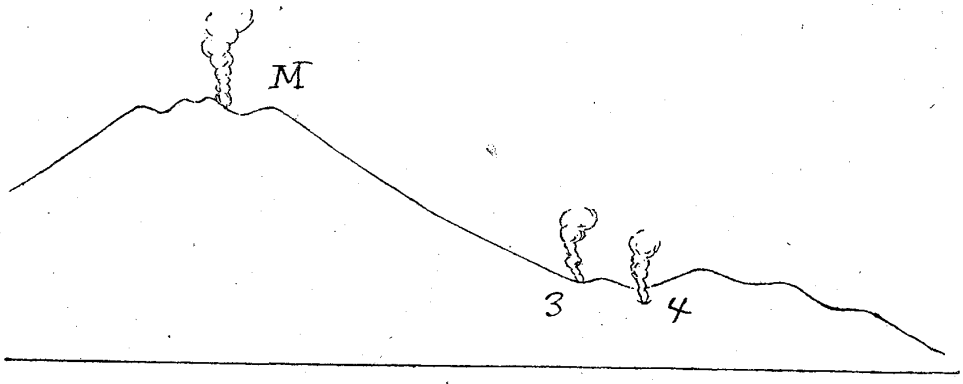


Fig. 61. Outline of Sakura-jima seen from the South, on Sept. 24th, 1914, indicating smoke issues from Minami-dake (M), and the eastern craterlets Nos. 3 and 4, when the latter remained quiet.

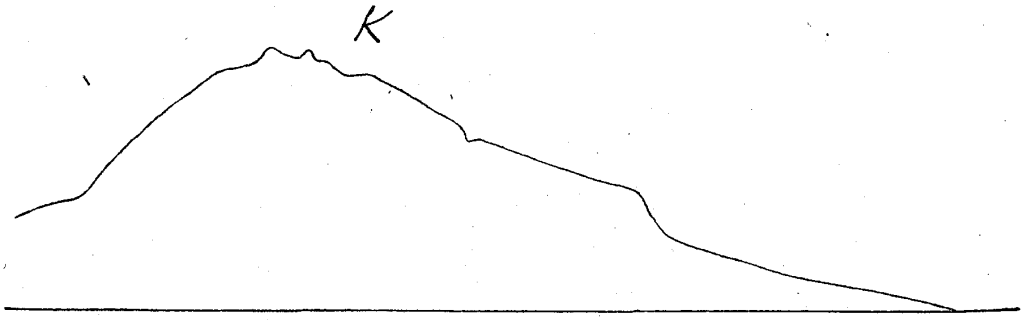


Fig. 62. Outline of Sakura-jima seen from the North. (K... Kita-dake.)

Sept. 23rd. While the author was standing on the top of Hikinohira, rushing sounds were heard at 1.23.20–24.10 p.m., and also at 1.31.20–31.40 p.m. The smell of sulphurous acid and other gases became much weaker than in the preceding April.

Sept. 24th. It was cloudy, perfectly calm, and sultry. While looking toward Sakura-jima from the upper story of the hotel Nagamine, in the town of Tarumizu, I observed at 5.45 p.m. a moderate-sized gray smoke-column rising from the craterlet No. 7 at the S.E. base of Nabe-yama, situated at the height of 140 m above sea-level; the booming sound, of 3 sec. duration, was fairly loud, yet caused no shaking of the shojis (paper-covered sliding doors in Japanese houses). By the time when the sound was heard at Tarumizu, which ought to be about 26 sec. after the moment of occurrence of the outburst at the origin as stated below, the smokes rose to an elevation equivalent to the four-fifths of the mountain height, namely, some 860 m. Hence the average velocity of the smoke ascent in question was approximately 28 metres per sec. From Tarumizu dull red fires began to be seen at 6.23 p.m. about the craterlets Nos. 3 and 4, and during the evening the eruptions from these were like gigantic fireworks. The craterlet No. 4 (lower) was very active, while the craterlet No. 3 (upper) was feeble and often became completely dark. The rushing sound caused by the air disturbances reached the place I was sitting on the average 26.4 sec. after the first moment of appearance of the luminous outburst at the craterlet No. 4. As the distance to the latter was 9450 m, the mean propagation velocity of the sounds comes out to be 358 m/sec., the air temperature at the time being about 24° C.

Sept. 25th. The weather was rainy and calm. Looking from Tarumizu, the craterlet No. 3 was seen from about 11 a.m. to emit

up continuously white smokes with rushing sounds, while the craterlet No. 3 was very inactive and at times became completely quiet. The craterlet No. 7, situated at the S.E. base of Nabe-yama, made an outburst at 8.52 a.m. which caused a loud booming sound, 2 sec. in duration. An explosion from the same craterlet at about 8 a.m. had been stronger, and caused a shock to the shojis, giving out a smoke column of the diameter equal to that of the top of Nabe-yama. At about $4\frac{1}{2}$ p.m. took place an abundant smoke emission from the craterlet No. 5, situated in the western branch of the Nabe-yama eruption crack, lasting for $\frac{1}{2}$ hour.

Sept. 26th. Occasional explosions took place from the two craterlets in the lower part of the eastern branch of the Nabe-yama Eruption Crack, from whose end a black lava stream was still flowing out. Seen during the night the stronger eruptions from the No. 4 craterlet sent up the red hot lava pieces at least through the height of 350 m, the horizontal radius of projection being about $\frac{1}{3}$ km.

Sept. 27th. The day was fine and quiet. Ascending from the Yunohama (or Yubama) beach along the W. boundary of the lava area, it was noticed that the bad smell of chlorine was much less than in the preceding April. Reaching at 9.40 a.m. a level nearly equal in altitude to the tob of Nabe-yama, where we were 800 m distant from the craterlet No. 3, it was observed that the latter was often making puffing noises like those of a locomotive ascending a slope, whose frequency was as follows :—

35 puffs in 25 sec.
50 ,, 35
73 ,, 60
} .....*Mean*, 1 puff in 0.76 sec.

The mean interval between the successive puffs was thus 0.76 sec. When the smokes were steadily issuing from the craterlet in

question, it caused no puffing sound. While the author was standing at the beach of Yunohama, at 3.09 and 3.45 p.m. two strong booming sounds were heard, which were perceived also at Tarumizu as detonations with some shaking effects. During the evening it was observed from Tarumizu that the craterlet No. 3 made no outburst, while the craterlet No. 4 was less active than in the preceding night.

Sept. 28th. The weather was clear and perfectly calm. At 8.24 and 8.25 a.m., I observed from Tarumizu two strong fine smoke eruptions from the craterlet No. 4, accompanied by faint sound. The time required by the smoke column, which ascended vertically, in reaching the height equal to that of the Sakura-jima mountain was 46 sec. in the first, and 48 sec. in the second case. The average velocity of the smoke ascent was thus approximately 19 m/sec.

Sept. 30th. In Kagoshima, a booming sound was heard at 9.53 p.m.

Oct. 2nd. While going on a small boat from Komen to Krokami, and again coming back along the N.E. coast of Sakura-jima, I have observed eruptions from the craterlet No. 7 at the E. base of Nabe-yama, which took place as follows:—8.20 a.m. (twice); 8.29 a.m.; 2.18 p.m.; 2.41 p.m.

21. Condition in April and May, 1915. On April 22nd, 1915, the eastern volcanic vents were found completely quiet, except that there was only a slight issue of smokes from the upper part of the inside wall of the No. 3 craterlet, while the wall of the No. 4 craterlet almost constantly crumbled down, causing an uprush of brownish dusts. The air was highly flickering below the latter craterlet, namely, just above the head of the black lava source situated at the lower neighbourhood. From the small eruptive

hole lying between the craterlets Nos. 1 and 2, and to the S. of the Canal Zone between these two, there was a copious issue of gases with a strong pungent smell.

Small outbursts on May 5, 1915. For the first time during my 4th visit to Sakura-jima, since April 18th (1915), there occurred on the 5th of May a series of small non-detonative outbursts from the No. 4 craterlet, which I have observed from a small boat at the vicinity of Krokami, the time of appearance above the Nabe-yama top of the successive smoke masses being as follows : —

Time of occurrence.	Interval.
10.29.50 a.m.	
	... ... 55 sec.
30.45	
	 35
31.20	
	 40
32.00	
	... ...160*
34.40	
	 43
35.23	
	 37
36.00	
	 35
36.35	
	 53
37.28	
	... ... 77*
38.45	
	 60
39.45	
	 30
40.15	
	 20
40.35	
	 37

Time of occurrence.	Interval.
10.41.12 a.m.	
	... ... 68* sec.
42.20	
	 50
43.10	
	 18
(Strong) 43.28	
	 32
44.00	
	... ... 95*
45.35	
	 67
46.42	
	 38
47.20	
	 60
48.20	
	 45
49.05	
	 27
49.32	
	 43
50.15	
	... ... 70*
51.25	
	 65

Time of occurrence.	Interval.
10.52.30 a.m.	
	... ... 35 sec.
53.05	
	 47
53.52	
	 43
54.35	
	 50
55.25	
	... ...108*
57.13	
(A pause.)	

Time of occurrence.	Interval.
11.08.45 a.m.	
	... ...103 sec.
10.28	
(A pause.)	
16.50	
(A pause.)	
11.55.20 a.m.	
(A pause.)	
0.02.40 p.m.	

Thus the outbursts, which occurred frequently for 27 min. 23 sec., between 10.29.50 (commencement) and 10.57.13 a.m. at successive intervals of 18 to 160 sec., became thereafter much reduced in activity and were separated by long pauses of 6 to $38\frac{1}{2}$ min., till the final termination at 0.02.40 p.m. The time interval between the successive moments of the appearance of the smoke masses, which reached a maximum length after some half a dozen repetitions (marked with an *asterisk* in the preceding list), varied between 18 and 77 sec., with the mean of 46 sec., being longer, namely, 95 to 160 sec., only in 4 cases.

The smokes, which were not properly dark, but light red in colour in consequence of the mixture of the red dusts falling from the craterlet's side, ascended to the maximum height of only about 700 m above sea-level; the explosions being strong enough just to shoot the "cauliflower" clouds above the Nabe-yama top.

22. Summary. The order of succession of the activity of the different eastern craterlets was in short as follows:—

No. 1'. The "chimney" was probably the earliest in the manifestation of activity. The steady issue of the white smokes,

which was still maintained on Jan. 16th, 1914, has come to an end a few days later. On Jan. 23rd, 1914, the smokes were being given out very feebly.

No. 1. This highest explosion craterlet was the first on the E. side to make the real outburst, its activity continuing for 4 or 5 days. On Jan. 23rd, 1914 it was giving forth smokes feebly.

No. 2. The double craterlet was making strong eruptions even in March-April, 1914. The activity was found completely reduced in Sept.-Oct. of the same year.

Nos. 3 and 4. When seen on Jan. 23rd, 1914, the No. 3 craterlet was the most active among the different craterlets. In the following March-April, the two craterlets Nos. 3 and 4 were still making very energetic outbursts almost continuously. In Sept. and Oct. of the same year, these made explosions from time to time, the No. 4 being then the more active one.

No. 5. On Jan. 23rd, 1914, the No. 5 craterlet was found to be one of the most active craterlets. It continued to make occasional eruptions till Sept. and Oct., 1914.

No. 6. This seems to have displayed its activity only during the earlier days of the eruption.

Nos. 6″ and 7. These two craterlets, one of which already existed, like those above mentioned, at the time of my first visit to Sakura-jima on Jan. 16th, 1914, preserved its activity together with the craterlets Nos. 3 and 4 till the very last epoch in the course of the present eruption, occasional slight explosions occurring even in March and April, 1915. The lava flow from the two craterlets Nos. 4 and 7 probably took place more or less till the middle of 1914.