

exploding away of the surface layers of the hill along the Eruption Crack ; and secondly, the gentle slope between the craterlets Nos. 1 and 4 was elevated in height, to the maximum amount of about 70 m, due at least to the accumulation of the lavas. The marked horizontality of the two new successive ground steps between the craterlets Nos. 1, 2, and 3, seems to have been produced by the upward overflow of the magma from the second and third eruption vents respectively.

The top outlines of the central peaks of Sakura-jima, namely, Kita-dake, Naka-dake, and Minami-dake, indicated in the views taken from Kagoshima, were not sensibly modified by the eruption of 1914. (See figs 9, 10, 11, and 36.)

Chapter IV. Blocking Up of Seto Strait.

36. Blocking up of Seto Strait. A portion of a small colline, 100 to 200 m in height, projecting toward S.S.E. from the southern shoulder of Nabe-yama, remains uncovered by the flowing material, with the remnants of smashed forest trees still standing on it. This forms, in fact, the boundary between the lava masses which spread to the south-east of Nabe-yama and descended into Seto Strait and those which, originating from the craterlets Nos. 1 to 5 situated to the west of the latter, ran mainly southwards and buried the villages of Waki and Arimra and extended 4 km further under the sea toward the S.S.W. The Seto strait lava issued, probably on the night of the 12th-13th, Jan. 1914, mostly from the craterlets Nos. 6, 6', 6'', and 7 situated in the Eruption Crack of Nabe-yama, and descended along the straight N.-S. valley running from the east foot of the latter, through the length of 2 km to the small plane ground of the village of Seto. From accounts

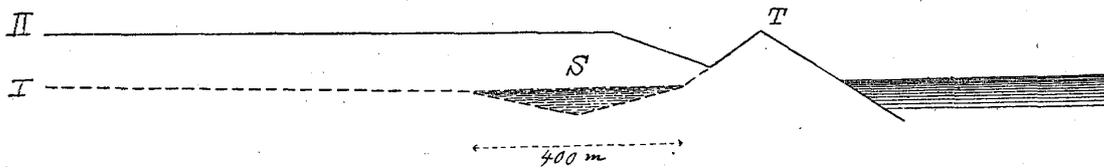
of the eye witnesses, it seems that the molten stream in question, which had buried under it the village of Seto, began to discharge itself into the bottom of the strait already at about 10 a.m. on the 13th. When seen 3 days later on, namely, on the afternoon of the 16th, the strait water was vigorously sending up dense white clouds of vapours. (See fig. 106.) The narrowest portion of the strait, about 600 m in length, 400 m in width, and at centre 29 to 40 fathoms in depth, was quickly reduced in dimension and finally blocked up on Jan. 29th, 1914, or 17 days after the commencement of the eruption; the accumulation of the submerged lava mass having then reached up to the water surface and converted the Sakura-jima island into a peninsula.

The blocking up of the Seto strait, which was certainly a remarkable event, was, in reality, a very natural consequence of the outflow of a large amount of lava, whose thickness exceeded, not rarely, 100 metres, which is double the minimum central channel depth of 29 fathoms or 53 metres. The further height increase of the lava filling the strait progressed at first rapidly, such that it rose 54 m above the sea surface, according to the estimation made from the photographs taken from a distance at the commencement of April, 1914; the hot rock mass, which pressed hard and partially crushed the former Ōsumi coast, rendering impassable the road along the latter at an elevation of 4.3 m above sea-level. (See fig. 107.) A new road, which was made 36 m above the old, was again brought in contact with the lavas at the end of September in the same year, when the elevation above the sea-level was estimated to be 101 m as stated below. Thus the average rate of the lava accumulation at the "strait" (isthmus) was at first approximately 3.5 m per day, reduced in the course of a few subsequent months to 0.3 m per day, as follows:—

Between the 14th and 29th, Jan. 1914.....3.5 m/day.
 ,, Jan. 29th and April 12th, 1914.....0.69 ,,
 ,, April 12th and Sept. 27th, 19140.3 ,,

Since September 1914, there was no remarkable alteration in the condition at the "strait"; the result of a simple triangulation executed on April 25th, 1915, with respect to the highest point of the Seto lava, being as follows:—the elevation above sea-level=105 m; the horizontal distance from the Ōsumi coast=170 m. (See fig. 92.)

Fig. 92. Diagram showing the Approximate N.S. Cross Section in April, 1915, of Seto "Strait" at its narrowest portion.



I.....Original Seto (Sakura-jima) beach ground. II.....New lava accumulation.
 T.....Tobashira promontory (lower part of Sakkabira), Ōsumi.
 S.....Former sea surface at the Seto strait.

The variation with time of the height of the Seto strait lava is illustrated in fig. 95. The height (= h) in question can also be estimated roughly by comparison with that of the Sakkabira hill ($h' = 324.8$ m) from the pictures taken from sea respectively on Sept. 27th, 1914 (fig. 17), from a distance of 6 km to the S.S.W., at 1 m height, and on Sept. 29th, 1915, from a distance of 13 km to the S.W., at 4 m height. We have: $n h = h' + (n-1)d$, in which n is the ratio of the apparent height of Sakkabira to that of the Seto strait lava as measured from the photograph, and d the height below the visible horizon. The results of calculation are as follows:—

Height of Seto strait lava, on Sept. 27th, 1914=101 m.

,, ,, Sept. 29th, 1915=106

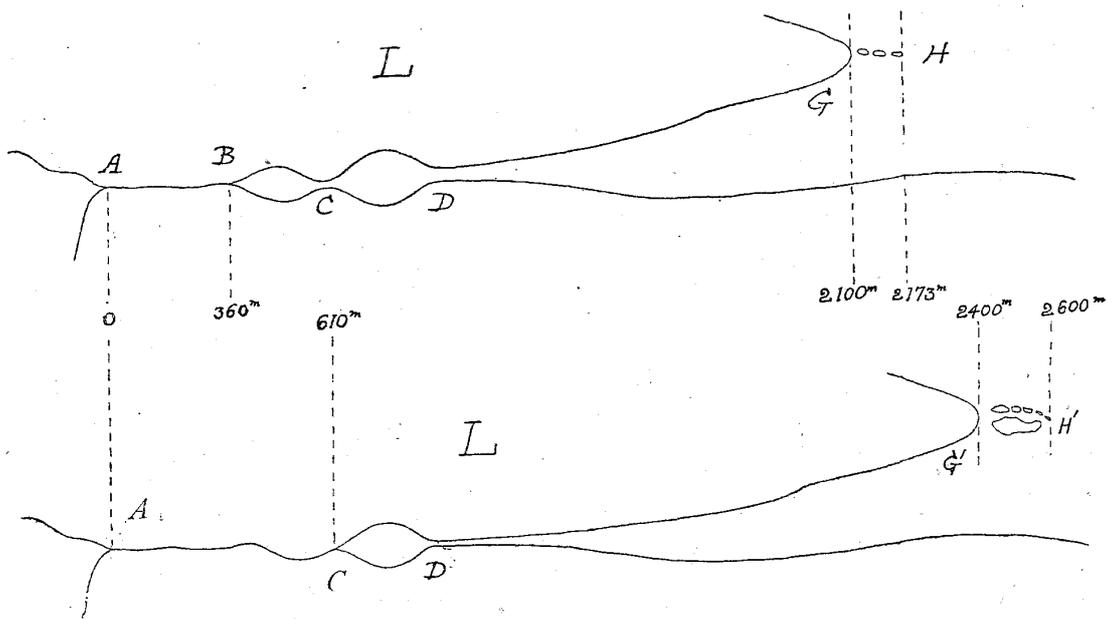
As stated before, the height in question was 105 m on April 25th,

1915; it follows therefore that the elevation of the Seto strait lava was not much increased during the course of the next 5 months.

37. Contact length. (See figs. 93, 94, and 96.) On April 12th, 1914, the contact AB of the Seto lava with the Ōsumi coast was 1200 feet in length, being continued on the east end to a hot water area BC, which was converted at low tide time to a pond 690 feet in length. In September of the same year, the latter was also almost entirely filled up, so that the contact became 1830 feet in

Fig. 93. Plans showing the Increase of the Contact Length and the Extension of the Seto "Strait" Lava Outflow.

The upper figure relates to the condition on April 12th, 1914.
The lower figure " " " " April 25th, 1915.



L.....Seto strait lava. AD.....Coast of Ōsumi.

Time.	Contact Line.	Steaming Pond.	Front End of Lava Outflow.	New Lava Islets.
April 1914.	AB	BC	G	H
April 1915.	AC	CD	G'	H'

The numbers indicate in metres the distances of the points B, G, H, and C, G', H' from the western end A of the contact line.

length, with a new adjacent pond CD on the east end. Since then the extension of the Seto "strait" contact was only slightly increased, being, on April 25th, 1915, of the length of 2000 feet, continued to the pond CD, 840 feet in length. The average daily rate in 1914 of the increase of the contact length was 5.0 m in February and March, and 1.2 m in April to September, further reduced to 0.24 m in Sept. 1914 to April 1915, as follows:—

Jan. 29th to April 12th, 1914.....	5.0 metres/day.
April 12th to Sept. 25th, ,,	1.2 ,,
Sept. 25th, 1914, to April 25th, 1915.....	0.24 ,,

38. Extension of Seto strait lava. (See figs. 93, 97, and 103.)

The total extension, that is to say, the direct distance between the western or Sakkabira end of the Seto "strait" and the eastern extremity of the lava outflow opposite the coast of the village of Ushine, was in April, 1914, about 6840 feet, while the new lava islets at the apex extended for a further distance of 240 feet. The total length was increased to 7280 ft. on Sept. 25th, 1914, and to 7950 ft. on April 25th, 1915; in other words, the Seto lava stream progressed, during the interval of the 12 months between April 1914 and April 1915, about 1100 ft. eastwards, giving the following rate of linear elongation:—

April 14th to Sept. 25th, 1914,.....	0.82 m per day.
Sept. 25th, 1914, to April 25th, 1915....	0.97 ,,

Thus the average change rate in the total length remained, between April 1914 and April 1915, nearly steady and equal to 0.9 m per day; while that during the first 3 months, between Jan. 13th and April 14th, 1914, was of course much higher and equal to 23 m per day approximately. The slow progressive movement of the lava has thus been continued already for $1\frac{1}{2}$ years.

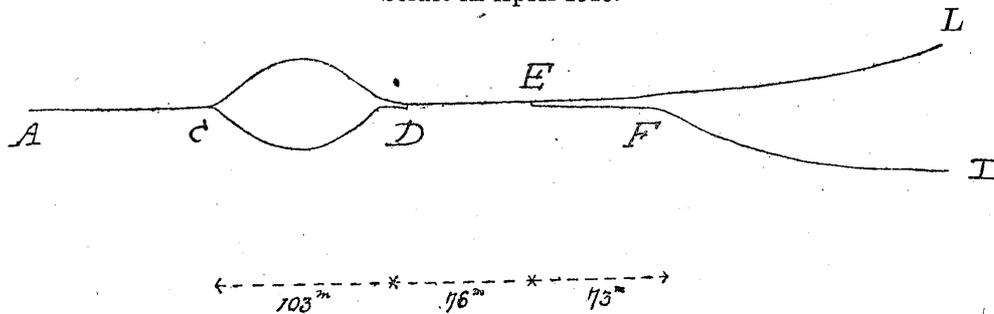
A fact of special interest is in connection with the small

detached rocky masses or islands, which are none others than the "lava islets" each with a peculiar cleavage canal (Chapter V). In April 1914, the islets, which had been formed at the apex of the lava outflow, stretched, in the direction of the prolongation of the latter, for a space of 240 feet. In April 1915, however, the corresponding distance was increased to 690 feet. This fact leads to the conclusion that the islets in question stand on the front submerged base of the lava stream, whose gradual forward movement was probably the cause of the increasing distance between the foremost islet and the promontory.

39. Current and water temperature at Seto "strait." On April 12th, 1914, at 4 p.m., the temperature of the sea-water along the Ōsumi coast was $21^{\circ}.0$ C. at the mouth, and $25^{\circ}.5$ at the mid-length of the Ushine bay*, being increased up to $52^{\circ}.0$ at the head of the latter. In the steaming pond BC (fig. 93) the water temperature varied between 62° and 73° C., while the maximum value of 90° C. was verified at its source B. When observed at a little past 4 p.m., just after the time of the lowest tide, a slight current was issuing out from the latter point, suggesting the existence of a possible water communication through the masses of the lava filling the "strait." This supposition was, however, obviously not true, as will be seen from the facts observed on Sept. 25th of the same year. On that day, at 2-3 p.m., when the tide was falling, hot waters of $90^{\circ}.6$ to $93^{\circ}.7$ C. in temperature were streaming close to the coast of Ōsumi out of the foot of the western or Tarumizu side of the Seto lava. At the same time, there was also an outflow of water on its eastern or Ushine side. Again, at the source of the steaming pond adjacent to the eastern end of the contact line, hot waters of $88^{\circ}.5$ C. was

* The bay newly formed between the Seto strait lava promontory and the Ushine (Ōsumi) coast.

Fig. 94. Plan showing the condition of the Contact Line at Seto Strait in April 1915.



EL.....Seto strait lava. A (west)-I (east).....Coast of Ōsumi.
 AC.....Contact line. CD.....Steaming pond.
 DE.....Beach which was dried up at low tide time.

streaming out from among the lava masses with a velocity of about 0.3 m per sec.; while, at its outlet channel, about 2 m in width and 0.3 m in depth, the water with a temperature of $68.^{\circ}5$ C. was flowing out at the rate of about 0.45 m per sec.

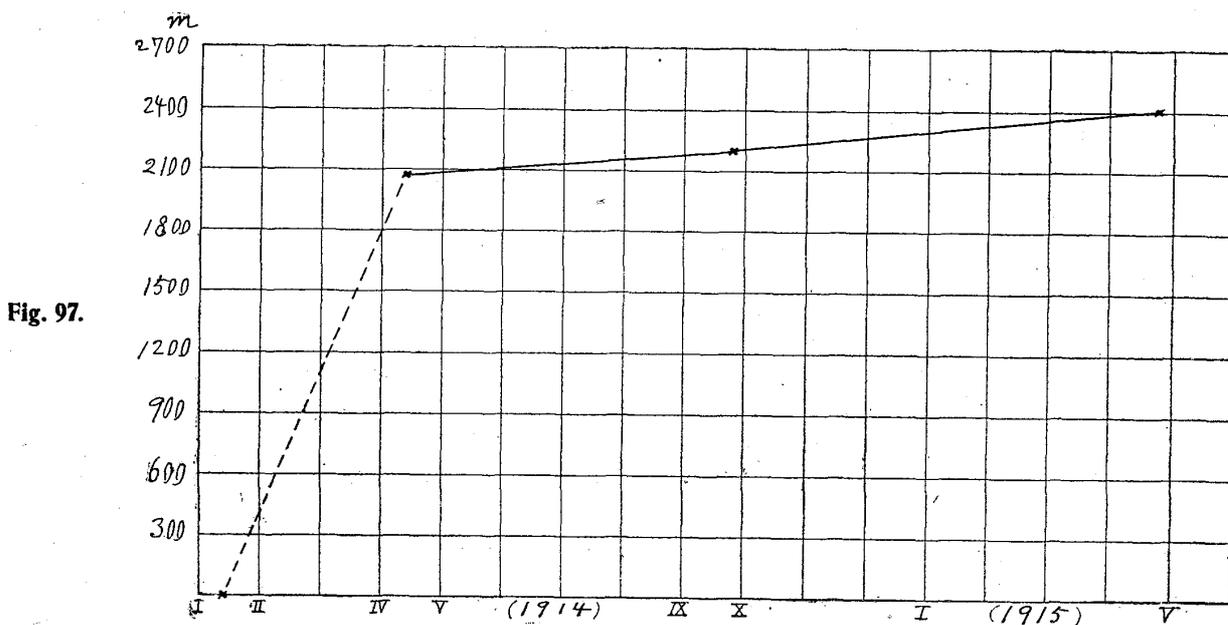
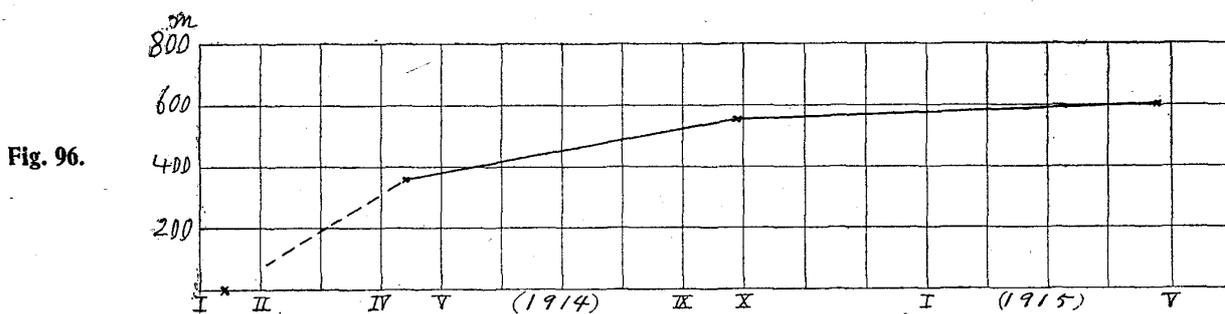
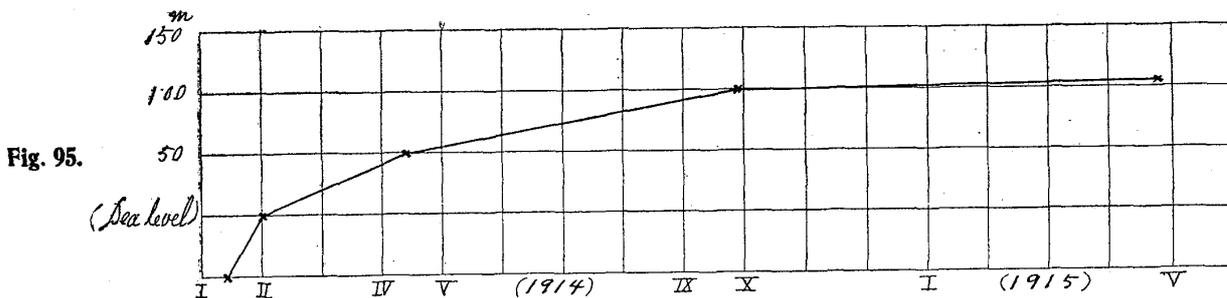
Observations made on April 25th, 1915. (I.) Eastern End of the Contact Line. (See fig. 94.) At 2 p. m., (air temperature= $17.^{\circ}5$ C.), when the tide was rising, the steaming pond CD, 340 ft. long and 160 ft. wide, was completely isolated from the external water body of the Ushine bay by the contact, at DE, of the sandy beach of the Ōsumi coast with the lava promontory L for the length of 250 ft., continued further to a narrow canal EF for 240 ft. At the head C of the pond CD, hot waters issued from among the lava masses and were flowing down or eastwards, the temperatures at the different points being $82.^{\circ}0$; $81.^{\circ}7$; $78.^{\circ}5$; $77.^{\circ}5$ C., etc. At the same time, there was at the lower end D of the pond, narrowed into a sort of small inlet, 4 m in length and 1 m in width, an inward or westward flux of water, whose velocity was 0.3 m per sec., the temperature being 75° to $72.^{\circ}5$ C. At the point between C and D diametrically opposite the side of the lava mass the water temperature was only $63.^{\circ}0$ C. In the canal EF, the water temperature

Diagrams illustrating the Increase in the Height, the Contact Length, and the Total Extension of the Seto "Strait" Lava.
(Jan. 1914 to May 1915.)

Fig. 95. Height of the Seto "Strait" Lava above sea-level.

Fig. 96. Length of the former Coast of Ōsumi in Contact with the Seto "Strait" Lava.

Fig. 97. Extension of the Seto "Strait" Lava between its E.N.E. Front Edge and the Sakkabira Promontory.



was 53° C. at E and 57° C. at F ; while at the opening, or mouth, of the Ushine bay, the temperature was reduced to 20.8° C. (II.) Western End of the Contact Line. (See fig. 98.) At 5 p.m., (air temperature= $15^{\circ}.0$ C.), when the tide was still rising, the water temperature along the west end margin (AB) of the Seto strait lava was 87.5 to 89° C. at the Ōsumi coast, and $83^{\circ}.5$ to 83° at the points p_1 and p_2 respectively at distances of 7 and 29 m

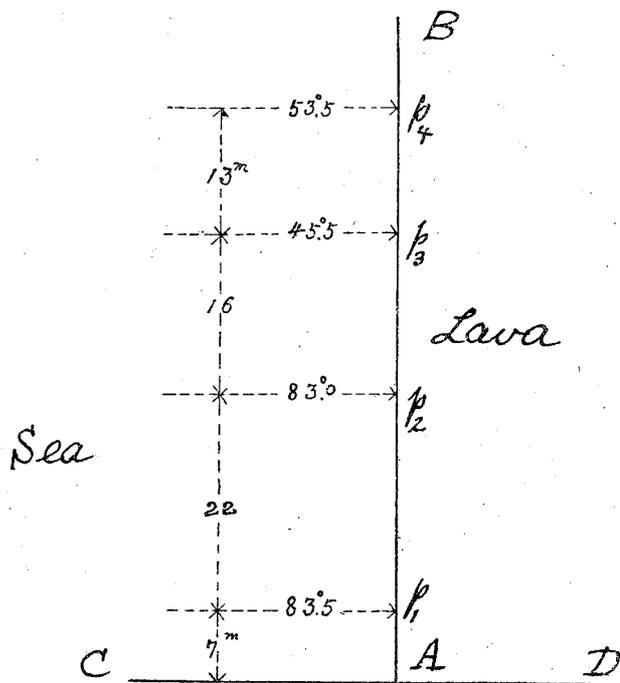


Fig. 98. Sea-water temperature along the Lava margin at the W. End of the Contact Line. CD.....Coast of Ōsumi.

from the latter along the lava border. At the points p_3 and p_4 at the further successive distances of 15 and 13 m, the temperature was from $45^{\circ}.5$ to $53^{\circ}.5$ C. Thus, the water temperature was high and above 80° C. along the lava side for the length of about 40 metres from the old coast. At a southward distance of about 500 m along the latter from the Tobashirahana, or the western

junction of the Seto "strait" lava and the Ōsumi coast, the temperature was reduced to 20.0° C.

According to the observations described above, the slight currents of hot waters at the Seto "strait" (isthmus) took place at a low tide time simultaneously from the two opposite ends of the Contact Line and directed outwards, or away from the centre of the latter. More correctly it may be said that the currents under consideration were simply the hot waters permeating the

interior heated portion of the lava mass caused to run out gradually when the sea-surface got lowered in level.

The manifestation of a very high sea-water temperature, of maximum value of $93^{\circ}.7$ C., at the two ends of the Seto strait contact line probably depended, amongst the others, on the notable accumulation of hot lava masses combined with the special closed nature of the small bay or inlet formed by the junction of the latter with the coast of Ōsumi. According to the observations made on April 25th, 1915, the temperature along the western margin of the "strait" (isthmus) decreased to some 50° C. already with a distance of roughly 30 m from the contact line, or former coast of Ōsumi. It is likely that the general heating effect on the sea-water at Seto was not materially different from that at those portions of the Arimura lava field, where the progressive movement of the new coast was active, and where the water indicated a temperature of nearly 60° C. in Sept. 1914.

The sea water temperatures measured at both ends of the Seto strait contact line on the three different occasions are compared in the following table :—

Place.	Date.	April 12, 1914.	Sept. 25, 1914.	April 25, 1915.
At W. end of Contact Line.		—	$93^{\circ}.7$ C ($84^{\circ}.3$ C)	$89^{\circ}.2$ C ($87^{\circ}.2$ C)
" E. "		$90^{\circ}.0$ C	$88^{\circ}.5$ ($79^{\circ}.1$)	$82^{\circ}.0$ ($80^{\circ}.2$)
{ In the outlet (short small canal) of Steaming Pond at E. end of Contact Line.		$52^{\circ}.0$	$68^{\circ}.5$ ($59^{\circ}.1$)	$57^{\circ}.0$ ($55^{\circ}.2$)
At the mouth of Ushine Bay.		$21^{\circ}.0$	—	$20^{\circ}.8$ ($19^{\circ}.0$)

To make a strict temperature comparison, the influence of the annual variation must be taken into account. According to Chapter VII, the mean daily sea-surface temperatures in the Kagoshima harbour, corresponding to April 12th and 25th, and Sept. 25th, were in 1910–1912 respectively $16.^{\circ}5$, $18.^{\circ}3$, and $25.^{\circ}9$ C; being

Sakura-jima Eruption of 1914. (Sept., 1915. F. Omori, photo.)



Fig. 99. Lava Vault formed at the bottom of the Eastern Craterlet No. 4. (4), Craterlet No. 4. (4'), Craterlet No. 4'. (L), Lava field.

Sakura-jima Eruption of 1914 : the Lava Sources on the Eastern Eruption Field.



Fig. 100. U-shaped Lava Source immediately below the Craterlet No. 4'.

(April, 1915. F. Omori, photo.)



Fig. 101. A Depression Cavity at the bottom of the Eastern Branch of the Nabe-yama Eruption Crack.

Sakura-jima Eruption of 1914. (April, 1915. F. Omori, photo)



Fig. 102. The most eastern Craterlet (Lava Source) No. 7, formed at the lowest end of the Nabe-yama Eruption Crack, with the lava field extending toward the S. E.

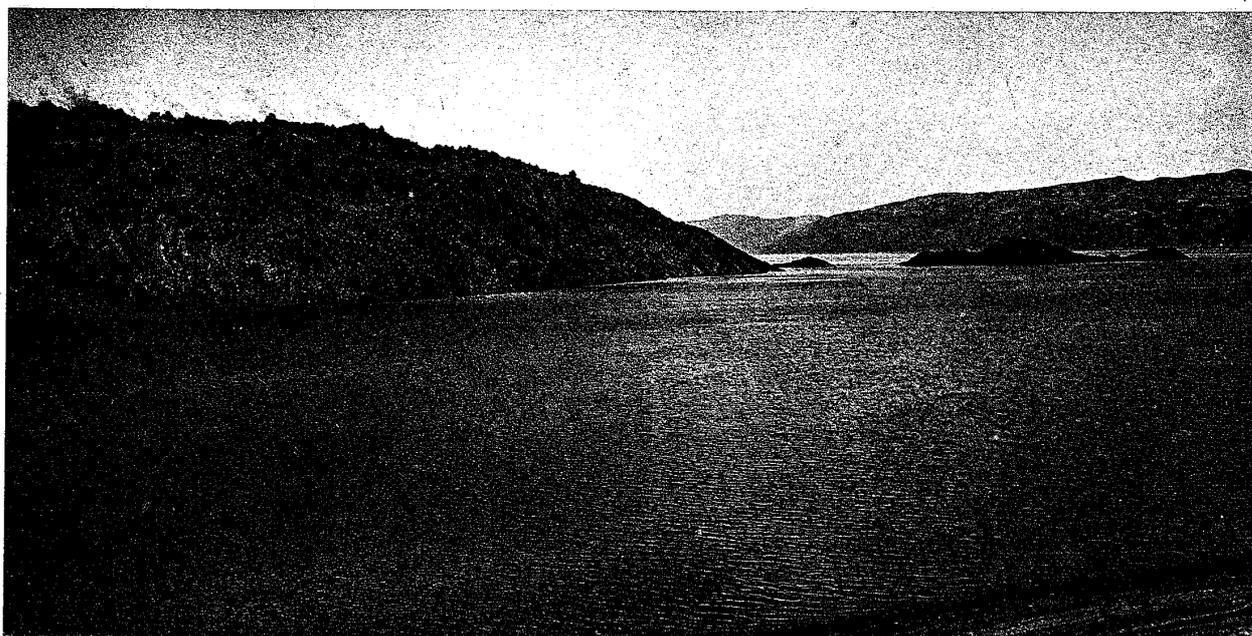


Fig. 103. The eastern end of the lava flow which has filled up the Seto Strait, seen from the coast of Ushine (Ōsumi). The new lava islets of Ushine-jima group are also shown.

Sakura-jima Eruption of 1914 : the Western Lava Field, showing the Steaming Circle.



Fig. 104. General view of the lava field, taken from Kita-dake, showing the Steaming Circle at the front and the Hakamagoshi (2) and the hills above Akobaru and Koike at the right-hand side. (1), Lava Source No. 3. (Jan. 3rd, 1915. K. Ueda, photo.)



Fig. 105. The N.W. portion of the lava field, looked down from Hakamagoshi. (April, 1915. F. Omori, photo.)

Seto Strait after the Sakura jima Eruption of 1914 : (F. Omori, photo.)



Fig. 106. Condition 4 days after the commencement of the eruption : the lava, which had flowed down into the bottom of the strait between Ōsumi (left, obscured by smokes) and Sakura-jima (right) was vigorously evaporating the water. (Jan. 16th, 1914.)

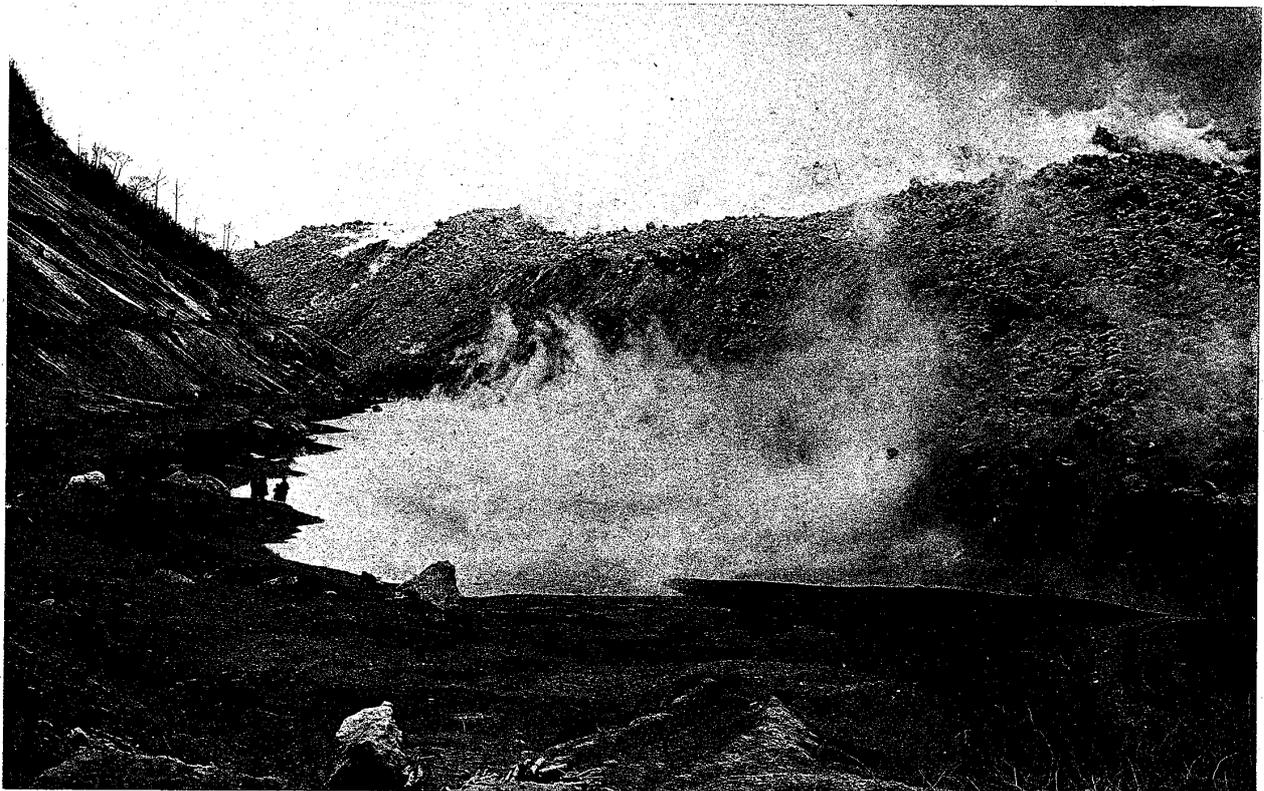


Fig. 107. 3 months after : the strait completely filled up by lava, whose elevation was 50 m above sea-level, and which was steadily pressing against the coast of Ōsumi (left). The steaming pond was a portion of sea isolated at a low-tide time. (April, 1914.)

1.°8 and 9.°4 C higher for the two latter days than for the first. Applying provisionally these corrections to the temperature observations at Seto on Sept. 25th, 1914, and on April 25th, 1915, we get the results enclosed in brackets, which may be compared to the different quantities for April 12th, 1914. It will be seen that the corrected sea-water temperatures along the different parts of the Seto strait lava did not much vary between Sept. 1914 and April 1915, the maximum value being about 80° C. This is about 10° C lower than the corresponding temperature of 90° C for April 1914, probably indicating the decline in the heating capacity of the lava mass in question during the 5 subsequent months.

Chapter V. New Lava Islets.

40. New lava islets. (See figs. 114 to 117.) The recent eruption was not followed by a formation of new islands of more or less considerable dimensions, as was the case with the Sakura-jima catastrophe of 1779. There appeared, however, a number of isolated massive rocks or islets, off the different new promontories of the 1st stage lava area. These islets, of which there is one on the Arimra or S.E. side and several are at the Ushine end of the Seto strait lava, are each rather a group of rocks composed of two parallelly arranged halves, either completely or partially separated by a well cut central cleavage crack or canal, the lavas at whose two side are curved outwards. I give next a short description of these new lava islets as examined in April 1915, their positions being indicated in fig. 2 of the preceding Number of the Bulletin.

The Arimra-jima* (fig. 108) is about 12 m high and 16 m

* Provisional denomination. *Jima* or *shima* means island or islet.