TABLE VII. Volume Density of Lavas and Bombs of Swanose-jima and Nakano-shima.

Lava.		Volume Density of Bombs.
Locality.	Volume Density.	
Swanose-jima.		
Lava pieces recently projected, found at the vicinity of Trigonometrical Point.	2.76	2.57
	2.76	2.44
	2.69	2.43
	2.54	2.32
1813 (文化十年) lava flow, at Akazome-ura (赤染浦).	2.58	2.37
	2.27	1.75
Lava forming the wall of 1813 (文化十年) craterlet.	2.67	2.31 (mean.)
	2.56	
	2.60 (mean.)	
Nakano-shima.		
Lava forming the wall of the old crater.	2.60	2.67
	2.56	2.60
	2.58 (mean.)	2.46
		2.32
		2.10
		1.67
		2.30 (mean.)

Chapter VII. Heating Effect of the Submerged Lava Flows on the Sea Water.

44. Surface sea-water temperature before the eruption. The Kagoshima meteorological observatory carried on, from 1910 to 1912, the observation of the surface sea-water temperature at the quay of the Kagoshima harbour, the measurement having been made

once every day at 10 a.m. The 5-daily mean values during these three years are given in Table IX, from which it will be seen that the absolutely highest and lowest temperatures were respectively 29°.8 (in Aug. 1912) and 14°.4 C (in Feb. 1911 and 1912).

45. Annual variation of surface sea-water temperature before the eruption. Table VIII, which has been compiled from Table IX, gives the mean monthly values of the sea-water temperature at the quay of the Kagoshima harbour, for the years 1910–1912. The mean high temperatures of 27°.2, 28°.3, and 26°.6 C occurred respectively in July, August, and September, and the mean lowest temperatures of 15°.3, 15°.0, and 15°.3 C respectively in January, February, and March ; the extreme difference being 13°.3 C. The changes due to the annual variation must of course be taken account of in the consideration of the temperature increase of the sea-water around Sakura-jima caused by the inflow of the recent lava streams.

TABLE VIII. Mean Monthly Temperature of the Surface Sea-Water in Kagoshima Harbour, 1910–1912.

Year. / Month.	1910	1911	1912	Mean.	Year. / Month.	1910	1911	1912	Mean.
I	—	15°.3 C	15°.3 C	15°.3 C	VII	27.°3 C	27°.1 C	27°.3 C	27°.2 C
II	—	15°.0	14°.9	15°.0	VIII	27°.9	27°.5	29°.6	28°.3
III	—	15°.6	15°.0	15°.3	IX	25°.9	27°.1	26°.8	26°.6
IV	17°.2 C	18°.2	16°.4	17°.3	X	23°.4	23°.2	23°.3	23°.3
V	20°.4	19°.6	19°.8	19°.9	XI	20°.8	19°.8	20°.7	20°.4
VI	23°.0	22°.9	23°.7	23°.2	XII	17°.2	17°.0	18°.3	17°.5

TABLE IX. 5-daily Mean Temperature of the Surface Sea-water in Kagoshima Harbour, 1910–1912.

Date.		Year. 1910	1911	1912	Mean.
I	1– 5	—	16.1° C	15.9° C	16.0° C
	6–10	—	15.6	15.8	15.7
	11–15	—	15.3	15.4	15.3
	16–20	—	14.8	15.2	15.0
	21–25	—	15.1	15.4	15.2
	26–30	—	15.0	14.5	14.7
II	31– 4	—	15.3	14.4	14.8
	5– 9	—	14.9	14.9	14.9
	10–14	—	15.4	15.2	15.3
	15–19	—	15.6	14.8	15.2
	20–24	—	14.4	14.8	14.6
	25– 1	—	14.9	15.2	15.0
III	2– 6	—	14.8	15.3	15 0
	7–11	—	15.2	15.1	15.1
	12–16	—	15.7	14.8	15.2
	17–21	—	15.6	14.7	15.1
	22–26	—	15.6	14.6	15.1
	27–31	—	17.2	15.5	16.3
IV	1– 5	—	17.5	15.0	1.62
	6–10	15.9° C	18.1	14.9	16.3
	11–15	16.5	18.4	15.3	16.7
	16–20	17.0	18.0	16.9	17.3
	21–25	18.3	18.6	17.8	18.2
	26–30	18.2	18.7	18.7	18.5
V	1– 5	17.7	18.1	18.8	18.2
	6–10	20.5	18.4	19.3	19.4
	11–15	19.9	19.8	19.3	19.7
	16–20	20.5	19.6	20.6	20.2
V	21–25	21.6° C	20.6° C	20.1° C	20.8° C
	26–30	21.7	21.1	20.4	21.1
VI	31– 4	22.9	21.4	22.0	22.1
	5– 9	22.3	22.5	22.5	22.4
	10–14	21.7	22.5	23.9	22.4
	15–19	23.1	23.3	—	23.2
	20–24	23.6	22.6	27.5	24.6
	25–29	24.2	23.9	24.3	24.1
	30– 4	25.3	23.5	25.5	24.8
VII	5– 9	25.8	26.0	25.8	25.9
	10–14	27.0	27.3	26.1	26.8
	15–19	28.2	28.1	27.8	28.0
	20–24	28.6	28.9	28.2	28.6
	25–29	27.8	27.8	27.6	27.7
	30– 3	28.5	27.5	29.2	28.4
VIII	4– 8	28.1	27.7	29.7	28.5
	9–13	27.6	27.3	29.6	28.2
	14–18	27.5	26.9	29.6	28.0
	19–23	27.4	27.8	29.8	28.3
	24–28	28.1	27.8	29.5	28.5
	29– 2	29.1	27.3	29.1	28.5
IX	3– 7	27.7	27.6	29.2	28.2
	8–12	27.1	27.5	28.2	27.6
	13–17	27.4	27.3	26.1	26.9
	18–22	26.0	27.0	25.9	26.3
	23–27	26.0	26.5	25.3	25.9
	28– 2	25.5	26.2	23.8	25.2

TABLE IX. (*Continued.*)

Date.	Year.	1910	1911	1912	Mean.	Date.	Year.	1910	1911	1912	Mean.
X	3– 7	24.6° C	24.9° C	24.2° C	24.6° C	XI	17–21	20.3° C	19.8° C	19.8° C	20.0° C
	8–12	23.7	23.7	23.4	23.6		22–26	20.2	18.6	19.2	19.3
	13–1	23.3	23.2	23.1	23.2		27– 1	19.4	18.3	19.3	19.0
	18–22	22.9	22.7	22.9	22.8	XII	2– 6	18.2	18.2	19.0	18.5
	23–27	22.6	21.8	22.9	22.4		7–11	17.6	17.6	18.4	17.9
	28– 1	22.3	21.3	22.7	22.1		12–16	17.1	16.8	18.5	17.5
XI	2– 6	22.0	21.2	22.4	21.9		17–21	16.8	16.7	18.3	17.3
	7–11	21.3	20.1	21.6	21.0		22–26	16.4	16.3	18.3	17.0
	12–16	21.4	20.3	21.0	20.9		27–31	16.4	15.9	17.5	16.6

46. Surface sea-water temperature in and outside the harbour of Kagoshima. From the comparative list in Table X based on my observations carried on in 1914 and 1915, it will be seen that, so far as the measurements in Jan., April, May, Sept., and Oct. are concerned, the surface sea-water temperature at the quay was nearly equal to those in and just outside the harbour, in Kagoshima Strait, and along the N.W. coast of Sakura-jima.

TABLE X. Comparison of Surface Sea-Water Temperatures in and out of the Kagoshima Harbour.

Date. \ Place.	Quay.	Within the Harbour.	Without the Harbour.	In Kagoshima Strait.	Coast of Take and Fujino. (Sakura-jima.)
Jan. 16th, 1914.	18.°0 C				
„ 18th, „	—	—	—	—	16.°7 C
„ 23rd, „	—	—	—	—	17.2
April 8th, „	16.5	—	17.°0 C	16.°8 C*	—
„ 9th, „	16.4	—	—	16.5	—
„ 11th „	—	16.°6 C*	17.0	16.6*	16.6*
„ 12th, „	—	16.5	16.5*	17.2	—

TABLE X. (*Continued.*)

Date. \ Place.	Quay.	Within the Harbour.	Without the Harbour.	In Kagoshima Strait.	Coast of Take and Fujino. (Sakura-jima.)
April 15th, 1914.	—	—	16.7° C	16.7° C	—
„ 17th, „	16.5° C	—	—	16.4	—
Sept. 23rd, „	—	26.0°* C	25.6°	26.1*	—
Oct. 1st, „	—	24.5	25.0	25.0*	24.5° C
„ 3rd, „	—	24.7	24.8	24.9*	25.0
April 29th, 1915.	—	—	—	17.3*	—
„ 30th, „	—	17.4*	16.6*	16.6*	—
May 5th, „	—	17.7	18.2	18.5	18.8
„ 6th, „	—	17.1*	17.6*	17.6*	—

(*).....Mean of two or more observations.

The tables given at the end of this Chapter contain the results of the measurements of the surface sea-water temperature, which I have carried on around Sakura-jima on the different occasions after the eruption of 1914.

47. Surface sea-water temperature in Kagoshima harbour before and after the eruption. In Table XI are given the sea-water temperatures measured at the quay of, or in, the harbour of Kagoshima after the eruption of 1914; the figures enclosed in brackets being the corresponding temperatures taken from the list (Table IX) of the 5-daily means observed at the quay during 1910, 1911, and 1912. It seems that the water in the harbour was, in the latter half of January 1914, some $1°\frac{1}{2}$ or 2°C warmer than in the similar epoch in the 3 previous years. The water temperature during April, Sept., and Oct., in 1914, was almost exactly identical to that in the ordinary years. Again, in April and May, 1915, there was no indication whatever of any unusual heating effect on the harbour water to be traced to the eruption. It is superflous to remark that the indication of high values of the water temperature in Sept. 1914 was due to the annual variation of the latter considered in § 45.

TABLE XI. Comparison of Surface Sea-water Temperatures in Kagoshima Harbour before and after the Eruption of 1914.
(The mean temperature in 1910-12 is enclosed in brackets.)

Day.	1914.				1915.	
	Jan.	April.	Sept.	Oct.	April.	May.
1				24.°5 C		
2				(24.9)		
3				24.7		
4						
5						17.°7 C (18.°8)
6						17.°4*
7						
8		16.°5 C (16.°3)				
9		16.4				
10						
11		16.6*				
12		16.5 (16.°5)				
13						
14						
15		16.7 (17.°0)				
16	18.°0 C (15.°2)					
17		16.5 (17.°2)				
18	16.7* (15.°0)					
19						
20						
21						
22						
23	17.2 (15.°2)		26.°0* (26.°1)			
24						
25						
26						
27						
28						
29					17.°3* (18.°3)	
30					17.4*	
31		—	—		—	

(*), Mean deduced from two or more measurements.

48. Sea water temperature below the surface. The following table gives the results of the measurement of the sea water

temperature at and below the surface made by the author in conjunction with Mr. Y. Katsuno, of the Kagoshima meteorological observatory, with a deep-sea thermometer, on April 15th, 1914.

Place of Observation.	Water Depth.	Temperature at Bottom.	Corresponding Surface Temperature.
(i) Middle of Kagoshima Strait.	16 fathoms.	18°.0 C	17°.8 C
(ii) Kagoshima Strait, ½ km from the lava coast, near the new Karasu-jima Bay.	28	18°.5	20°.0 ; 20°.4
(iii) Near the lava coast, in the new Karasu-jima Bay.	27½	23°.0	24°.5 ; 26°.0 ; 27°.0 ; 30°.5
(iv) Near to (iii).	1	19°.5	21°.0
(v) 100 m off the new lava coast of Arimra, where gases bubbled up from the submerged lava mass.	18	18°.5	18°.7

In (i), (ii), and (v), the water temperature at the bottom, 16 to 28 fathoms in depth, was materially the same as that at the surface; probably due in the first two cases, to the existence of sufficient tidal currents, and in the last to the convection movements among the sea water. In (iii), where the heating effect of the lavas was marked, the bottom temperature was of course much lower than the surface one; the difference being already clear at the depth of 1 fathom as in (iv). On April 12th, 1914, the sea surface in the shallow Yubama (Yunohama) bay, close to the Arimra lava terminus, was high in temperature and sufficiently warm for the swimmer, who could, however, feel with feet much colder water below.

49. Heating of the sea water due to the eastern lava field. As described in § 39, the surface sea-water temperature at the two ends of the contact line of the Seto "strait" (isthmus) lava was high, the difference over that in Kagoshima Strait being approxi-

mately 73.°5 C in April 1914, and 62°.5 to 71°.6 C in Sept. 1914 and April 1915, as follows:—

Date.	Temperature at E. end of Seto Contact Line.	Temperature at W. end of Seto Contact Line.
April 12th, 1914.	73°.5 C+T_o	—
Sept. 25th, „	62°.5 +T_o	66°.4 C+T_o
April 25th, 1915.	64°.7 +T_o	71°.6 +T_o

(T_o=Corresponding temperature of the surface sea-water in Kagoshima Strait.)

The temperature excess for the Seto strait, while still unclosed, on Jan. 23rd, 1914, was 32° C; and that for the Ushine bay, or the portion of the sea enclosed between the Seto "strait" lava stream and the Ushine coast of Ōsumi, was brought down to 8°.1 to 10°.5 in April 1914 and May 1915, although spots of higher temperatures existed quite close to some of the new lava islets. From these facts, we can easily suppose that the area of the marked increase in the water temperature must have been limited in extension, and, as will be seen from Table XII (i), the sea water around the north-western coast of Sakura-jima was practically uniform in temperature from Kagoshima to Komen and Uranomae, in April 1914; to Ōmoe-zaki and Krokami or Nagasaki-hana, in Oct. 1914—May 1915; the radial distances from Seto to the limit of the constant temperature being in these two epochs respectively only about $5\frac{1}{2}$ and 3 (or even $1\frac{1}{2}$) km. On Jan. 23rd and April 11th, 1914, the amounts of the increase of the temperature at the neighbourhood of Moe-jima, Ōmoe-zaki, and Krokami, over that at the Kagoshima strait were 2°.3 and 1°.1 to 3°.0 respectively.

Turning our attention to the sea around the S.W. and S. coast of Sakura-jima, we see, from Table XII (ii), that on Jan. 24th, 1914, the temperature off the Cape Moe-zaki was 12° C higher than

in Kagoshima Strait. In April 1914 to April 1915, the difference was reduced to 0°.8 to 2°.1 C; while the corresponding quantity for the sea-water off Kwannon-zaki and Furusato during the same time interval, was only slightly larger, namely, 1°.0 to 3°.8 C. According to the observations on April 29th, 1915, the temperature was practically uniform throughout the whole sea route between Furusato and Kagoshima. Again, the temperature along the S.W. coast of Sakkabira (Ōsumi) was, in April 1914, from 14°.5 to 19°.3 C higher than that in Kagoshima Strait; this difference being reduced in April 1915 to only about 2°.0. With regard to the temperature distribution off the S. coast of Sakura-jima, the islet of Oko-jima and the cape of Moe-zaki seem to have formed the boundary of the area of warmer water, its radial distance from the Arimra lavas being about 5 to $5\frac{1}{2}$ km.

On the whole, the heating effect of the lavas in question was more powerful and lasting than those on the western side, owing to their long-sustained activity, progress, and remarkable submarine extension. The influence of the latter circumstance can well be seen from the observations on Sept. 25th, 1914, illustrated in fig. 118. Thus, the temperature, which was on that day 27°.3 to 27°.9 at the coast between Tarumizu and Arazaki, was increased to 29°.7 at a distance of $\frac{1}{2}$ km to the S.W. of the islet of Eno-shima, this locality being quite close to the southern end of the submerged lava streams. Thence, across over the latter, the temperature was gradually increased to 57° or 57°.5 along the lava coast itself.

In fig. 118 is indicated the approximate areas for April, 1914, in which the temperature of the surface sea-water was decidedly higher, say, by 2° or so, than that in Kagoshima Strait; these forming a sort of semi-circular ring about the south-eastern half of Sakura-jima, of maximum distance of 3 to $3\frac{1}{2}$ km from the original

coast of Arimra. besides a detachment about the W. and S. coasts of the Yokoyama lava area.

TABLE XII. Comparison of Surface Water Temperatures in different parts of the sea around Sakura-jima.

(I.) From Kagoshima Harbour to Krokami and Seto off the N. Coast of Sakura-jima.

Date.	Sea Area of No Temperature Variation, stretching from Kagoshima Harbour to	Temperature Increase at Moe-jima, Ōmoe-zaki, or Krokami.	Temperature Increase near Seto.
Jan. 23rd, 1914.	... ...	2°.3 C	32°.0 C {Seto Strait still unclosed.
April 11th, „	Komen and Uranomae.	1°.1—3°.0	8°.1 {In the new Ushine Bay.
Oct. 2nd, „	Moe-jima, Ōmoe-zaki, Krokami.	—	—
May 4th, 1915.	Komen, Ōmoe-zaki, Krokami.	—	10°.5 (*Do.*)
„ 5th, „	Komen, Ōmoe-zaki, Nagasaki-hana.	—	25°.1 {Close to new lava islets.

(II.) From Kagoshima Harbour to Furusato and Seto off the S. Coast of Sakura-jima.

Date.	Sea Area of approximately No Temperature Variation, stretching from Kagoshima Harbour to	Temperature Increase at		
		Nojiri; Moe-zaki.	Kwannon-zaki; Furusato.	Coast of Ōsumi (Sakkabira).
Jan. 24th, 1914.	... ...	About 12° C.	—	—
April 9th, „	Oko-jima.	0°.8—1°.4	1°.3—2°.0 C	—
„ 12th, „	... ...	{1°.5 0°.3—1°.0	2°.5—3°.8	14°.5—18°.0 C.
„ 15th, „	... ...	—	1°.9—3°.2	19°.3
„ 17th, „	... ...	1°.1—2.°1	—	—
April 25th, 1915.	... ...	—	1°.0—2°.0 apprx.	2°.0 apprx
„ 29th, „	Furusato.	0°.0	0°.0	—

50. Surface sea-water temperature along the border of the western lava field. (Table XIII.) Any marked heating effect of the western lava field, whose progressive movement was practically

brought to end in the course of a few weeks after the commencement of the eruption, and which had no extensive submergence on account of the shallowness of the strait water, seems to have been limited to the immediate neighbourhood of the lava coast. Thus, according to the observations made in April 1914 to May 1915, the water temperature at the N.W. corner of Hakamagoshi, 600 m distant from the N. lava coast, was always almost exactly equal to that at the middle of Kagoshima Strait. Again, on April 15th, 1914, the temperature at a distance of 500 m from the W. coast of the lava field was 20°.4, indicating an increase of nearly 4° over that of the mid-strait water. As the temperature close to the same coast on the 17th of that month was 25°.0, or nearly 9° higher than at the centre of the strait, we may suppose the heating effect, even in the narrowest part of the latter, to have been reduced probably at a distance of less than 1 km from the lava coast already to a degree equal to that in the Kagoshima harbour.

The highest water temperature of 40° C was observed on April 9th, 1914, over the submerged lava boundary at the S.W. end; this being about 23°.3 higher than at the middle of the strait. The temperature was also high, with the maximum indication of 35°.7, on the 15th of the same month in the Karasu-jima bay on the S.W. coast of the lava field, amounting to an increase of 19°.0 over that of the outside sea water. According to the measurement on April 29th, 1915, the extra heating effect in the same portion of the sea was completely cancelled, while the highest temperature in a long narrow inlet of length = 550 ft., and of mouth opening = 60 ft., at the bottom of the bay in question, was only 25°.3, or 8°.3 higher than in the strait. These comparisons indicate that, in the course of the 1 year between April 1914 and April 1915, the temperature of water at the S.W. or warmest portion of the lava coast

was reduced by the amount of about 11° to 15° C. Along the W. lava coast, the temperature decrease during the same time interval was approximately 9° C.

TABLE XIII. Comparison of Surface Sea-water Temperature in Kagoshima Strait with that along the Coast of the Western Lava Field.

Date.	Middle of Kagoshima Strait.	Beach at N.W. Corner of Hakamagoshi.	Along the Border of the Lava Field.
April 8th, 1914.	16.7* C	16.5 C	—
„ 9th, „	16.7*	—	Close to the S.W. end ‡: 17°.5; 17°.0; 26°.0; 35°.2; 35°.0; 38°.0; 40°.0 C.
„ 15th, „	16.7	—	500 m from the W. coast: 20°.4; 20°.0. Along the chord of the bay at S.W. coast: 24°.5; 26°.0; 27°.0; 30°.5; 35°.7.
„ 17th, „	16.4	—	Close to the W. coast ‡: 20°.0; 25°.0.
Sept. 23rd, „	26.1*	26.0	—
April 29th, 1915.	17.0*	—	In the long narrow islet near the site of the former Karasu-jima: 18°.7; 20°.3; 21°.8; 23°.5; 24°.5; 24°.8; 25°.0; 25°.3.
„ 30th, „	16.9*	16.7*	Close to the W. coast ‡: 16°.3; 16°.4; 16°.5.
May 6th, „	17.6*	17.5	—

(*).....Mean deduced from two or more measurements.
(‡).....Over the submerged lava boundary.

51. Temperature of hot spring, etc. For the sake of comparison I give next the results of the temperature measurements made of the hot springs or warm beach rivulets at Furusato and Yunohama (Yubama).

(A) Observations at Furusato.

(i.) *Hot spring of Furusato.* This is located at the beach and is in communication with the sea water in some way, so that the rise and fall of its level is governed by those of the

tide. It had previous to the recent eruption a temperature of about 44° to 46°C. According to the measurements made after the commencement of the eruption the hot-spring temperature was as follows :—

Jan. 20th, 1914. ... ... 44° C
„ 24th, „ ... ... 43° C (Air temp.=13° C).

(ii.) *Hot-water well.* The well is situated close above the last-mentioned hot spring, and the water, which has a salty and carbonic-acid taste, is about 3 metres in depth, and rises and falls in relation to the tide. The hot-water temperature, after the eruption, was as follows :—

	Well Tempr.	Air Tempr.	Sea-Water Tempr.
April 21st, 1915 ; 10½ a.m.	46°.6 C	18°.5 C	20°.5 C
„ 27th, „ ; —	45°.3	18°.0 15°.3	21°.2
„ 28th, „ ; 8.20 a.m.	45°.8	21°.7	

(B) Observations at Yunohama (Yubama, or Moto-Arimra).

(iii.) *Beach rivulets.* At Yunohama warm waters with a highly carbonic acid taste were bubbling up from many points in the sandy beach, sometimes resulting in a shallow streamlet 1 foot or so in width. The temperature was as follows :—

Sept. 27th, 1914.... ... ... 45°.5 C
April 21st, 1915.... ... ... 37°.5
43°.0
„ 27th, „ (1½ p.m.)... ... ... 39°.7

(iv.) *Hot-water well.* The warm water in a well near the beach, 4 metres deep, had the temperature of 35° to 36° C :—

April 21st, 1915. ... ... 35°.3 C (Air temp.=19°.0 C).
„ 27th, „ ... ... 35°.0 („ 22°.5).

(v.) *Water issuing from under lavas.* At the time of the author's visit to Sakura-jima in Sept. 1914, there was along the

beach a small rivulet issuing from two caves or tunnels, 1 metre in diameter, at the foot of a transverse branch of the lava stream, whose water was hot and had a salty and carbonic acid taste. The temperature was :—

Sept. 27th, 1914. ... ... 60°.8 ; 62°.0 C.

At the time of my visit in April 1915, the rivulet in question did no longer exist, having been buried under the advancing "2nd stage" lava streams.

From the above it seems that the hot spring at Furusato, whose temperature was not much different from 45° C both before and after the eruption, was not affected by the latter at all. It may be that the new production of, or a change in, hot springs and fumaroles, which often, if not always, precedes or accompanies a strong volcanic outburst, is sometimes quite localized and limited to the immediate neighbourhood of the zone of craterlets or their extensions; the village of Furusato being situated comparatively far out of the centres of the recent volcanic disturbances. The temperature of the Furusato hot spring was the same as that of the well close by ; the warm waters in the beach of Yunohama (Yubama) also having a nearly equal temperature.

TABLE XIV. Surface Water Temperature measured in different parts of the Sea around Sakura-jima.

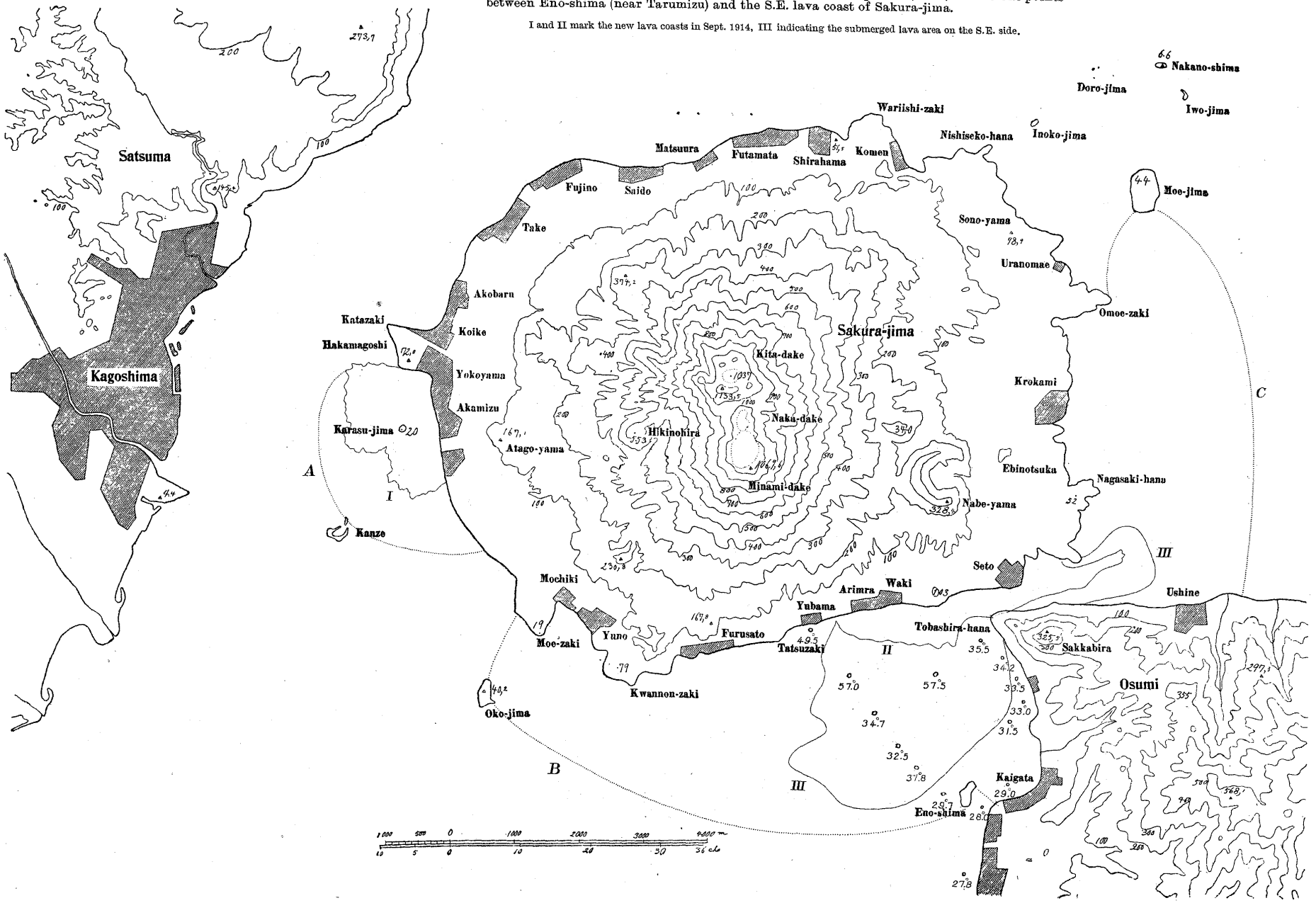
Jan. 16th, 1914, to May 16th, 1915.

Time.	Sea-water Temperature.	Locality.
	January 16th, 1914.	
2.00 p.m.	18.0° C	At the quay, Kagoshima.
3.30	35.0	Near the North entrance of Seto Strait.

Fig. 118. Map of Sakura-jima showing the Sea Area, the Temperature of whose Surface Water was affected by the Eruption of 1914.

The red curves A, B, and C mark the approximate boundary of the sea-surface whose temperature was, in Jan.–April, 1914, higher than in the preceding ordinary years. The red figures indicate in centigrade the surface-water temperature on Sept. 20th, 1914, at different points between Eno-shima (near Tarumizu) and the S.E. lava coast of Sakura-jima.

I and II mark the new lava coasts in Sept. 1914, III indicating the submerged lava area on the S.E. side.



Time.	Sea-water Temperature.	Locality.
	Jan. 18th, 1914	
10 a.m.	16.7° C 16.6 (air : 17.5°)	Coast of Take.
	Jan. 23rd, 1914.	
11.30 a.m.	17.2°	Coast of Fujino.
	19.5	Between Moe-jima and Ōmoe-zaki.
	19.5	In Krokami Bay.
	26.0 32.5 49.0 ..... 46.5 45.5	At the N. entrance of Seto Strait.
	Jan. 24th, 1914.	
	29.5°	At the coast of Nojiri.
	April 8th, 1914.	
8.15 a.m.	16.5° (air : 11.8°)	At the quay, Kagoshima.
	17.0	Outside the harbour.
	16.5	In Kagoshima Strait.
8.30	17.0	,,
8.40	16.5 (air : 11.8°)	,,
8.45	16.7	Near the Hakamagoshi coast.
,,	17.0	,, ,,
8.52	16.5 (air : 12.0°)	At Hakamagoshi beach.
6.05 p.m.	16.5 (air : 11.5°)	At a small distance from the Hakamagoshi coast.
6.12.	17.0	Middle of Kagoshima Strait.
	April 9th, 1914.	
8.00 a.m.	16.4° (air : 13.5°)	At the quay, Kagoshima.
8.30	16.5	Middle of Kagoshima Strait.

Time.	Sea-water Temperature.	Locality.
	April 9th, 1914. (*Cont.*)	
8.50 a.m.	16.8° C (air : 13.5° C)	Between Oko-jima and the lava area.
9.00	17.9	At Moe-zaki.
9.10	17.8	At Kwannon-zaki.
9.15	18.0	*Do.*
9.20	18.0 (air : 13.5°)	Further on.
9.40	18.0	In Furusato Bay (20°.5 to 21°.0 at Furusato beach, owing to the existence of the hot spring there.)
4.20 p.m.	18.5	Furusato, near the lava area.
	18.5 (air : 13.2°)	„ , near the beach.
	18.0	At Kwannon-zaki.
	18.0	„ „
	17.3	At Moe-zaki.
	17.3	Off the coast of Nojiri.
	17.3 (air : 11.0°)	Off the coast between Nojiri and Akamizu.
	17.5° ; 17.0° ; 26.0° ; 35.2° ; 40.0° ; 35.0° ; 38.0°, etc.	Quite close to the S.W. boundary of the western lava area.
	17.0	A short distance off the western lava coast.
	April 11th, 1914 ; from Kagoshima to Krokami and Seto, and back.	
7.40 a.m.	16.5° (air : 12.5°)	In Harbour of Kagoshima.
	17.0	Just outside the harbour.
	16.5	Middle of Kagoshima Strait.
	16.4	Off the coast of Take.
	16.6	„ „ Fujino.
	16.5	About 500 m off the coast of Saido.
	16.5	„ 200 m „ „ Shirahama.
	16.4	At Wariishi-zaki.
	16.6	50 m off the Nishiseko cape.
	16.6	Quite close to the Uranomae cape.
	17.7	In Krokami Bay. (Hereafter, falling tide.

Time.	Sea-water Temperature.	Locality.
April 11th, 1914; from Kagoshima to Krokami and Seto. (*Cont.*)		
9.45 a.m.	18.1° C	At Krokami beach.
3.00 p.m.	18.7	Between Krokami and Nagasaki-hana.
	21.6	In the inlet between the Ushine coast and the new lava promontory to the east of the former Seto strait.
3.30	2.45 (air : 16.7°)	
(Hereafter strong W. winds set in.)		
4.00 p.m.	19.5°	At the inside or W. coast of Moe-jima.
	18.6	Coast of Moe-jima, at the N. end.
	17.6	Between Moe-jima and Nishiseko-hana.
	16.7	Off the coast of Komen.
	16.7	At Wariishi-zaki.
	16.7	Off the coast of Saido.
	16.7	Off the coast of Fujino.
	16.5	Between Take and Iso (Kagoshima).
	16.7	,, Hakamagoshi and Kagoshima.
	16.6	Outside the Kagoshima harbour.
6.00 p.m.	16.7 (air : 12.2°)	In the Kagoshima harbour.
April 12th, 1914; from Kagoshima to Furusato, Seto, and Ushine, and back.		
8.30 a.m.	16.5° (air : 15.0°)	In the harbour of Kagoshima. (Falling tide.)
	16.5	Outside the harbour.
	17.2	Middle of Kagoshima Strait.
	17.5	Between Kanze and the western lava area.
	18.0	At Moe-zaki.
	19.4	500 m from the coast, between Moe-zaki and Kawnnon-zaki.
10.00	19.0	At Kwannon-zaki.
	19.1	*Do.*
	21.0	In the Furusato bay.
10.30	21.7 (air : 10.7°)	At Furusato beach.
	20.0	,, ,,

Time.	Sea-water Temperature.	Locality.
April 12th, 1914; from Kagoshima to Furusato, Seto, and Ushine. (*Cont.*)		
	21.5° C	100 m off the lava coast of Arimra.
	31.5	Further on, close to the coast.
	34.5	At the Ōsumi coast.
4.00 p.m.	21.0	Coast of Ushine: mouth of new Ushine Bay.
	25.5	,, ,, : mid-length ,,
	52.0	,, ,, : head ,,
4.45	31.0 (air: 21.0°)	Sakkabira Bay.
	18.0	Off the coast of Arimra.
	19.5	Yubama, at the end of the E. lava area.
6.30	17.5	Between Kanze and the western lava area.
7.00	16.5	At the entrance of Kagoshima Harbour.
April 15th, 1914.		
9.00 a.m.	16.7° (air: 14.5°)	Just outside the harbour of Kagoshima.
	16.7	Middle of Kagoshima Strait.
	17.4	Near the coast of the western lava field.
	17.8	,, ,, ,,
	20.4	About 500 m off the western lava coast.
	20.0	,, ,,
	24.5; 26.0°; 27.0°; 30.5°; 35.7°; etc.	At points on the chord, or line joining the two ends of new Karasu-jima Bay.
	18.5	At Kwannon-zaki.
	20.0	At the coast of Furusato.
	18.7	100 m off the coast of Arimra.
Noon.	36.0	In new Ushine Bay.
3.30 p.m.	27.0	50 m off the coast of Arimra.
	18.7 (air: 18.0°)	At Kwannon-zaki.
April 17th, 1914.		
8.00 a.m.	16.5° (air: 11.4°)	Kagoshima Harbour, at the quay.
	16.4	Middle of Kagoshima Strait.

Time.	Sea-water Temperature.	Locality.
	April 17th, 1914. (*Cont.*)	
2.30 p.m.	18.5° C	At Nojiri, sea beach.
	17.5	At the mouth of Nojiri Bay.
	20.0–25.0°	Along the coast of the western lava area, over the submerged portion.
	September 23rd, 1914.	
7.30 a.m.	25.6° (air : 23.0°)	In Kagoshima Harbour, at the pier. (Falling tide.)
	25.6	Just outside the harbour.
	25.5	Middle of Kagoshima Strait.
	25.8	,,
	25.8 (air : 21.0°)	,,
	25.6	Near Hakamagoshi.
	26.0	At Hakamagoshi beach.
5.00 p.m.	26.5	Middle of Kagoshima Strait. (Rising tide.)
	26.5 (air : 22.0°)	,,
	26.4	,,
	26.5	Near the Kagoshima coast.
	26.3	In Kagoshima Harbour.
	September 25th, 1914; from Tarumizu to Seto, and back.	
Noon.	27.3° (air : 28.6°)	At Tarumizu; beach, of 1 foot water depth. (Falling tide.)
	27.5	,, ; at 35 m from beach.
	27.3	,, ; at 100 m ,,
	27.5	200 m off the coast of Shiroyama-hana.
0.30 p.m.	27.8	At Ara-zaki. (The course of the boat was hereafter directed straight to the W. end of the Arimra lava field).
	29.7	500 m off the west side of Eno-shima.
1.05	31.8	Just past Eno-shima.
1.12	32.5	Midway between Eno-shima and the new Arimra lave coast.
1.21	34.7	About 400 m off the projecting lava coast of Arimra.
1.23½	40.7	A little further on.
1.28½	30.0	Still a little further on.

Time.	Sea-water Temperature.	Locality.
September 25th, 1914 ; from Tarumizu to Seto, and back. (*Cont.*)		
1.31½ p.m.	57.0° C	About 70 m from the lava coast of Yunohama.
	44.0	Further on.
	49.5	In the Yunohama bay.
(The course was hereafter directed east towards the Sakkabira bay.)		
	57.5	Over the submerged lava outflow, where gases were bubbling up.
	52.0	100 m off the lava coast.
1.58	37.5	200 „ „
2.03	44.5	At the mouth of an inlet.
2.17	35.5	In the Sakkabira bay: 500 m from the Ōsumi coast and 300 m from the lava boundary.
2.21	34.2	At the Sakkabira anchorage (coast of Ōsumi), about 500 m from the lava.)
(The course directed from Sakkabira straight to Tarumizu.)		
3.35	33.5°	Quite close to the coast. (Falling tide.)
	33.0	Along the coast, 100 m further southward.
4.01	31.5	Off the cape of Hijiri-zaki.
4.15	29.0	Between the Eno-shima and Kaigata.
	28.0	At the S. entrance of the Eno-shima channel.
4.52	27.9	Close to Ara-zaki.
5.15	27.2 - (air : 24.7°)	At Tarumizu, beach.
September 26th, 1914.		
2.00 p.m.	28.5° (air : 26.5°)	At Ushine, 9 metres from the beach.
September 27th, 1914 ; from Tarumizu straight to Yunohama, and back.		
7.45 a.m.	26.7° (air : 21.5°)	At Tarumizu, 300 m from the shore. (Falling tide.)
7.50	26.3	
8.00	27.1	Near the Ara-zaki.
8.09	27.7	Past the Ara-zaki.
8.20	27.8	Approaching Eno-shima, on the west side.
8.27	28.3	Outside the islet of Eno-shima.

Time.	Sea-water Temperature.	Locality.
September 27th, 1914; from Tarumizu to Yunohama, and back. (*Cont.*)		
8.40 a.m.	32.5° C	Beyond Eno-shima.
8.44	33.7	A little further on.
8.50	29.7	About 800 m from the Arimra lava coast.
9.01	30.1	In the Yubama bay.
4.00 p.m.	60.0	„ „ „ , where the water was steaming.
4.48	28.5	Off the west side of Eno-shima.
5.04	28.7	Just beyond Eno-shima.
5.38	27.7 (air : 21.6°)	At Ara-zaki.
6.00	27.4 (air : 21.7°)	At Tarumizu.
October 1st, 1914.		
8.40 a.m.	24.5° (air : 18.8°)	In Kagoshima Harbour.
	25.0	Just outside the harbour.
8.50	25.0	Between the Iso coast and Hakamagoshi.
9.00	25.0	„ „ „ „
9.20	24.5	300 m off the coast of Take.
October 2nd, 1914; from Komen to Krokami, and back.		
7.14 a.m.	24.5° (air : 19.5°)	In Komen Bay.
7.21	24.7	Off the coast of Komen.
7.32	24.1	Further on.
8.45	25.0	In Krokami Bay.
1.53 p.m.	25.5 (air : 24.5°)	„ „ (Rising tide.)
2.15	25.5	At Omoe-zaki.
4.40	25.5 (air : 23.7°)	Between Komen and Moe-jima.
5.05	25.2	At the entrance of Komen Bay.
October 3rd, 1914.		
10.40 a.m.	25.0° (air : 23.0°)	Akobaru, at beach.
10.56	24.9	Middle of Kagoshima Strait.
11.04	24.9	„

Time.	Sea-water Temperature.	Locality.
	October 3rd, 1914. (*Cont.*)	
11.14 a.m.	24.8° C	Outside the Kagoshima harbour.
11.19	24.7	In the Kagoshima harbour.
	April 25th, 1915 ; from Furusato to Seto and Ushine, and back.	
8.00 a.m.	19.0° (air : 16.5°)	At coast, between Furusato and Yubama.
8.05	18.0 (air : 11.5°)	At the entrance of Yubama bay.
	18.0	Close to the S.W. corner of the lava area.
	18.5	Further on, about 100 m from the lava coast.
	30.0° ; 28.0°	In a small inlet.
	41.0° ; 38.5° (air : 16.8°)	In a small triangular pond, (width=100 m, length=200 m) at the bottom of the above mentioned inlet.
	39.0°	In a bay (diameter=300 m).
10.20	20.0° ; 21.5°	30 m off the lava coast of Arimra.
Noon.	19.0	At the coast of Ōsumi, $\frac{1}{2}$ km south of the former Seto strait.
3.00 p.m.	20.8° (air : 20.0°)	Coast of Ushine (Fumoto), not far from the mouth of the inlet formed between the latter and the lava promontory.
6.15	40.0°	About 50 m off the extreme point of the maximum protuberance of the Arimra "2nd stage" lava outflow.
	April 29th, 1915 ; from Furusato to Kagoshima Harbour.	
7.25 a.m.	17.5° (air : 20.5°)	Off the coast of Furusato.
7.40	17.5	At Kwannon-zaki.
8.55	17.5 (air : 18.5°)	Off the west coast of Oko-jima.
9.30	17.5	Between Oko-jima and Nojiri.
11.40	17.2	Off Akamizu, near the S.W. projecting corner of the lava area.
11.50	17.6	At the last mentioned projecting corner.
Noon.	18.7 (1) 20.3 (2) 21.8 (3) 23.5 (4)	In a long narrow inlet (width=60 ft., length=550 ft.) near the place where Karasu-jima formerly existed : from the mouth (1) successively to the head (8) of the small bay.

Time.	Sea-water Temperature.	Locality.
April 29th, 1915 ; from Furusato to Kagoshima Harbour. (*Cont.*)		
Noon.	24.5° C (5) 24.8 (6) 25.0 (7) 25.3 (8) ..... (air : 22.5°)	(See the above remark.)
0.10 p.m.	16.5	Again at the mouth of the new Karasu-jima bay.
0.20	17.6	Middle of Kagoshima Strait.
0.40	17.0	,,
May 4th, 1915 ; from Komen to the New Lava Islets, and back.		
6.30 a.m.	17.4° (air : 13.0°)	Komen, beach. (Rising tide.)
6.40	17.0	In Komen Bay.
7.00	17.2	Beyond Nishiseko-hana.
7.03	17.0	Off the coast of Moto-Komen.
7.55	17.0	At Moto-Komen anchorage.
8.07	17.2	At the Uranomae cape.
8.25	17.2	At Ōmoe-zaki.
8.40	17.5	In Krokami Bay.
1.50 p.m.	19.7 (air : 21.8°)	Between Krokami and Nagasaki-hana. (Hereafter, falling tide.)
2.10	19.0	Off Nagasaki-hana.
2.20	22.7	Among the new lava islets.
2.30	23.0	,, ,, ,,
4.15	18.2 (air : 18.5°)	Outside the area of the new lava islets.
4.50	18.0 (air : 18.0°)	Off Omoe-zaki.
5.05	17.5 17.7	Off the Uranomae cape.
5.35	17.9 (air : 14.0°)	Off Hirabana.
5.40	17.7	Off Nishiseko-hana.
April 30th, 1915 ; from Kagoshima Harbour to Hakamagoshi, and back.		
8.00 a.m.	16.4° (air : 18.5°)	In Kagoshima Harbour.
8.10	16.6 (air : 14.3°)	Outside the harbour.

Time.	Sea-water Temperature.	Locality.
April 30th, 1915 ; from Kagoshima to Hakamagoshi and back. (*Cont.*)		
8.40 a.m.	16.6° C	Middle of Kagoshima Strait.
9.00	16.5	Near Hakamagoshi.
9.05	16.3	*Do.*, in still water.
9.10	16.4	Over the submerged lava area, in a small bay
9.20	16.5	Near Hakamagoshi, over the submerged lava area.
9.30	16.5	At Hakamagoshi, beach.
5.15 p.m.	16.9	,, ,,
5.35	17.6	Mid-Strait, in rising tide current.
5.40	16.8	Outside the rising tide current.
,,	16.9	,, ,,
5.45	16.8	Middle of Kagoshima Strait.
6.00	16.5	Outside the harbour.
6.15	18.0 (air : 14.0°)	In the Kagoshima harbour.
,,	17.8	,, ,,
May 5th, 1915 ; from Komen to the New Ushine Lava Islets Group, thence to Kagoshima Harbour.		
6.00 a.m.	16.9° (air : 14.5°)	Off the coast of Komen.
8.10	22.0 (air : 25.0°)	Among the new lava islets off Ushine.
9.45	43.5 (air : 18.8°)	Alongside a new islet at the extremity of the lava stream.
10.15	18.5 (air : 19.0°)	Off Nagasaki-hana.
11.05	18.5 (air : 19.5°)	Close to Ōmoe-zaki.
11.20	18.5	Off the coast of Uranomae.
11.40	19.2 (air : 20.4°)	Off Nishiseko-hana.
0.25 p.m.	18.3 (air : 21.4°)	Off the coast of Shirahama.
0.50	18.8	,, Saido.
1.15	18.8 (air : 16.8°)	Off the coast, between Fujino and Take.
1.50	18.5 (air : 17.5°)	In the Kagoshima strait, off the coast of Iso.
2.15	18.2	Outside the Kagoshima harbour
2.18	17.7 (air : 18.0°)	In Harbour.

Time.	Sea-water Temperature.	Locality.
May 6th, 1915 ; from Kagoshima Harbour to Hakamagoshi, and back.		
7.20 a.m.	16.5° C (air : 18.5°)	In Harbour of Kagoshima. (Rising tide.)
7.30	16.5 (air : 15.0°)	Just within the harbour entrance.
7.35	16.7	Outside the harbour.
7.45	17.2	Middle of Kagoshima Strait.
8.00	17.2 (air : 16.0°)	„ „
8.25	17.2 (air : 16.0°)	In Kagoshima Strait, about 600 m from the lava coast.
9.15	17.5 (air : 18.0°)	Hakamagoshi beach.
4.30 p.m.	18.6 (air : 16.8°)	Mid-Strait. (Hereafter falling tide.)
4.48	18.5	Outside the harbour.
4.55	18.2	In Harbour.

Chapter VIII. Second Stage Lava Outflow.

52. 2nd stage lava flow and its median furrow. (See fig. 119, and also the map on Pl. IX. in the preceding Number of the Bulletin.) The lava streams which began to issue from the different eastern craterlets soon after the commencement of the eruption may be regarded as composing the *1st stage outflow*, and continued to move downwards or outwards with rapidly decreasing rate for about 12 months till the end of 1914. The outflow buried during this time interval the villages of Seto, Arimra, and Waki, and the whole S.E. portion of the island, the southern boundary of the area above water projecting about 850 metres beyond the former sea coast. At the end of March and the beginning of April in 1915, namely $1\frac{1}{4}$ years after the commencement of the eruption in January 1914, there took place what may be termed the *2nd stage outflow* of lava, which has been carried on quietly and, not directly