CHAPTER VII. LEVEL CHANGE AND HORIZONTAL DISPLACEMENT OF THE GROUND CAUSED BY THE SAKURA-JIMA ERUPTION OF 1914.

52. Precise leveling. The first Military Survey precise leveling in the S.W. part of Kyushu, from the tide gauge station of Hososhima (province of Hyuga) to the cities of Kagoshima (province of Satsuma) and Sashiki (province of Higo) were carried on 20 to 22 years before the recent Sakura-jima outburst, namely, between Dec. 1891 and Jan. 1895, and was supplemented with the measurements at the N.W. coast of Kagoshima Bay in 1900. After the eruption, to investigate the phenomenon of the apparent elevation of the sea-level which became manifest in March (1914), the Imperial Earthquake Investigation Committee requested the Military Survey to make a new determination of the heights of the different bench-marks about Kagoshima Bay. This was readily responded to in a very complete manner, and the re-examination of the levelings was executed in 1914–15, in the following order :—

(i) July and August, 1914. A distance of about 22 km from Ijuin (B.M. 2457) at the middle of the Satsuma peninsula to the city of Kagoshima (B.M. 2468) ; then a distance of about 104 km along the coast of the N. part of Kagoshima Bay (B.M. 2468 to B.M. 2794, and thence to B.M. 2512).

(ii). Dec. 1914 to Jan. 1915. From the N.E. corner of Kagoshima Bay (B.M. 2794) along the total distance of 157 km, through the city of Miyasaki up to the tide gauge station of Hososhima, in the province of Hyuga.

(iii) Feb. 1915. Again, through the distance of 49 km from

the city of Kagoshima (B.M. 2468) along the coast to the N.E. corner of the bay (B.M. 2794).

(iv) Feb. to May, 1915. From Ijuin (B.M. 2457) along the N.W. coast of the peninsula of Satsuma, through a length of about 83 km, to Sashiki, in the province of Higo (B.M. 2865).

According to the first leveling survey, in which the B.M. 2457, at the town of Ijuin in the middle of the Satsuma peninsula, was assumed to have suffered no height alteration, the B.M. 2469, in the city of Kagoshima, was found to have been depressed 0.24 m. The tide gauge reading at the Kagoshima harbour, however, indicated already in March-April 1914 an apparent increase in the height of sea-level of 0.4 metre over that in the corresponding months in 1903–1905, or about 0.16 m greater than the amount of the depression of the ground above mentioned. Hence the Ijuin B.M. 2457 could not be regarded as a steady point, and the 2nd leveling measurement was resumed in Dec. 1914 and Jan. 1915, connecting Kagoshima Bay with the tide gauge station of Hososhima far up on the E. coast of Kyushu. As the result of this extensive survey referred to the old measurements in Dec. 1894 and Jan. 1895, it was established that, in July and August, 1914, the depression of the Ijuin B.M. 2457 itself amounted to 0.165 m, and consequently the depression of the B.M. 2469 in the Kagoshima city to 0.407 m. The 4th series of leveling observations connected Ijuin with Sashiki on the W. coast of the province of Higo. The results of the 1st, 2nd, and 3rd surveys are given in Tables XXXVIII and XL.

53. Works done by Government Kyushu Railways. At the present author's request, Mr. H. Nagao, Director of the Kyushu Imperial Government Railways, also instituted the re-examination of the heights of the different bench-marks set up along the railway

lines about Kagoshima Bay ; the surveys having been carried on between April 4th and May 15th, 1915, for a length of 41 miles on the main line from Yoshimatsu to Kagoshima, and of 19 miles from the latter city to the Yunomoto station on the Sendai line. The dates of the previous leveling measurements, with which the results of the new determinations have been compared, are as follows :—

Yoshimatsu-Kokbu   Section........July 1899 to May 1900.

Kokbu-Kagoshima   „   ....Sept. 1897 to May 1898.

Kagoshima-Yunomoto   „   ....July 1912 to July 1913.

The new levelings of the bench-marks along the length of 6 miles between Yoshimatsu and the next southward station of Kurino indicated only a height difference under $\frac{1}{2}$ inch ($=1\frac{1}{8}$ cm) when compared to the results of those made in 1911, which amount may be regarded to be within the error of the survey. Consequently the station of Yoshimatsu may be regarded to have been practically unchanged in height before and after the recent eruption of Sakura-jima.

It will be observed that the Kyushu Government Railways' survey between Kokbu and Yoshimatsu supplements the works of the Military Survey for a length of about 27 miles northwards from the north coast of Kagoshima Bay. As will be seen from the following table, which gives the amount of the depression of the different railway stations within the region under consideration and the neighbouring bench-marks, the results obtained by the Kyushu Gov. Railways, though probably inferior in accuracy to those of the Military Survey, are fairly trustworthy. The graphical illustrations are given in fig. 45.

TABLE XXXIV. HEIGHT CHANGES ALONG KYUSHU RAILWAY LINES.

Railway Line.	Bench-Mark or Station.	Amount of Depression* according to Leveling Survey of	
		Kyushu Gov. R.	Mil. Survey.
Main Line.	Mil. Survey B.M., 2481	-620^{mm}	-577^{mm}
	Kajiki Station.	-600	——
	Mil. Surv. B.M., 2480	-565	-560
	„ 2479	-554	-536
	„ 2477	-630	-608
	Shigetomi Station.	-685	——
	Mil. Surv. B.M., 2476	-715	-703
	„ 2475	-761	-776
	„ 2474	-852	-894
	„ 2473	-745	-770
	„ 2472	-649	-658
	„ 2471	-496	-527
	„ 2470	-402	-446
	Kagoshima Station.	-353	——
	Mil. Surv. B.M., 2469	-347	-407
Sendai Line.	Take Station.	-231	——
	Manjuishi Station.	-103	——
	Ijuin Station.	$+9$	——
	Kyushu Gov. Railways B.M., 29	-3	——
	Mil. Surv. B.M., 2456	-49	-126
	„ 2455	-55	-150

* $-$, when depressed; $+$, when elevated.

54. Discrepancy between amounts of ground depression and apparent sea-level elevation. According to the leveling measurements of the Mil. Survey, the depression since Feb. 1892 of the B.M. 2469 on the strand street of Kagoshima amounted to 0.407 metre in July

1914, which was increased to 0.411 metre in Feb. 1915. According to the tide gauge observations, however, the mean sea-level in the latter month was 2.25 *shaku*, or 0.682 metre, higher than in the corresponding month in 1903–1905. (See § 46.) Similarly, the apparent elevation of the mean sea-level during the four subsequent months, March to June, 1915, was 0.185 *shaku*, or 0.561 metre. Again, the height increase of the spring-tide flood level in March to December, 1914, varied mostly from 1.5 *shaku* $=0.455$ metre to 2.9 *shaku* $=0.85$ metre (§ 45), with the average of 1.68 *shaku* or 0.51 metre, which may be regarded as approximately representing the amount of increase in the height of mean sea-level for the two middle months of the year, namely, July and August, 1914. It thus seems that the height increase of the mean sea-level, which, of course, might have been influenced by various circumstances, was some 0.15 metre greater than the amount of the depression of the ground brought out by the leveling survey. As, however, the tide range after the eruption was identical with that before it (§ 45), there is to be assumed no special irregularity of the tidal motion in the bay, which might produce such an elevation of sea surface over the amount due to the depression of the ground. On the contrary I believe the
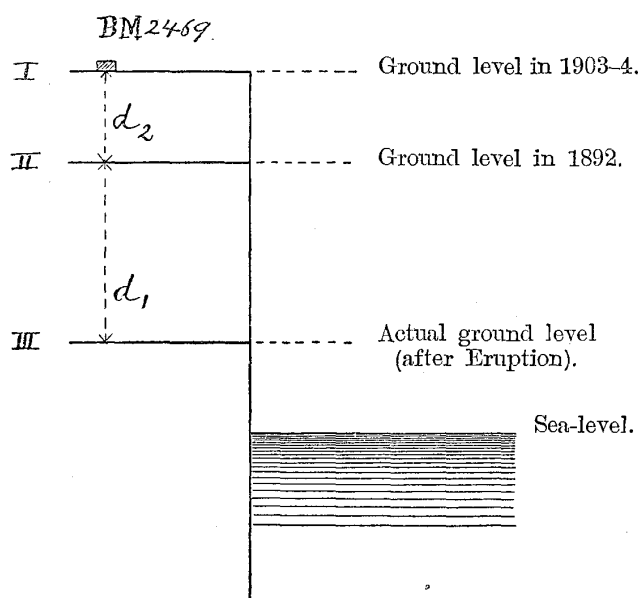

Fig. 40. Diagram illustrating the relation of the heights of sea-level at Kagoshima after and immediately before the eruption of 1914 to that in 1894.

apparent elevation of the sea-level to be entirely due to the depression of the ground, the discrepancy in the results of the two measuring processes being caused by the gradual elevation of the ground level for several years preceding the recent eruption. Thus, the ground surface (B.M. 2469), which was in the level II (fig. 40) in 1892, occupied an elevated position I in 1903–4, but was lowered to the position III after the recent eruption. If d_2 be the elevation of the ground since 1892, and d_1 be the depression of the ground after the eruption compared to the position in the same year, and if r_2 and r_1 be the tide gauge reading respectively after the eruption and in 1903–4, we have :—

$$r_2 - r_1 = d_1 + d_2$$

In other words, the apparent elevation of sea-level ($= r_2 - r_1$), is greater than the depression of the ground ($= d_1$) referred to 1892 ; the difference between these two, namely, d_2, denoting the amount of the elevation of the ground between 1892 and 1903–4. (See also § 49.) In the following table, the means of the daily highest and lowest tide levels during the 31 days, from May 12th to June 12th, in 1909, when the tide gauge readings were made for some special purpose, are compared with those in 1903 and 1904. It follows that the apparent May-June sea-level in 1909 was about 0.2 *shaku* $= 0.06$ metre lower than that in 1903–4, tending to indicate that the ground was being elevated before the eruption.

F. Omori:—

TABLE XXXV. MEAN DAILY HEIGHT OF SEA-LEVEL
AT KAGOSHIMA.

May–June, in 1903-4 and 1909.

Date. \ Year.	1903.	1904.	1909.	Date. \ Year.	1903.	1904.	1909.
	shaku	shaku	shaku		shaku	shaku	shaku
May 12	5.0	5.6	5.2	May 28	4.9	5.4	5.3
13	5.5	5.3	5.6	29	5.0	5.3	5.2
14	5.3	5.0	5.5	30	5.0	5.3	5.4
15	5.2	5.0	5.7	31	5.1	5.2	4.9
16	5.1	4.9	6.1	June 1	5.2	5.1	5.0
17	5.1	5.0	5.5	2	5.6	5.3	4.8
18	5.4	4.8	5.4	3	5.8	5.5	4.8
19	5.4	4.9	5.4	4	5.8	5.8	4.9
20	5.5	5.2	5.0	5	5.5	6.0	4.9
21	5.7	5.4	4.8	6	5.3	6.3	4.8
22	5.6	5.4	4.7	7	5.3	6.4	4.8
23	5.4	5.6	4.7	8	5.1	6.4	5.0
24	5.3	5.7	4.8	9	5.1	5.8	5.1
25	5.0	5.5	5.2	10	5.1	5.6	5.2
26	5.0	5.5	5.5	11	5.0	5.8	5.3
27	4.9	5.4	5.5	12	5.0	5.7	5.9

Mean............5.37   5.18

55. Depression of ground about Sakura-jima. In fig. 42, which embodies all the results of the leveling surveys made by the Military Survey contained in Table XL as well as those of the Kyushu Gov. Railways for the Yoshimatsu-Kokbu section, the curves of depression of 50, 100, 300, and 500 mm, have been drawn by interpolations. In the first place, it will be noticed that for a time interval of 21 years between 1894 and 1915 there was no change, or there has been a slight depression of the ground less than 50 mm, for a length of about 135 km from the tide gauge station of Hososhima on the coast of Hyuga till within the N.E. boundary

of the province of Ōsumi, at a distance of only about 15 km from the N.E. coast of Kagoshima Bay. On the contrary, to the N.W. of Sakura-jima there have been depressions of the ground to the amount of about 100 mm along the N.W. coast of Satsuma, and continued to the town of Sashiki, in the province of Higo, where the leveling re-examination ended; it being likely that the depression extends further some distance to the sea bottom area to the west of Kyushu. The entire amount of the depression in the last mentioned region may not be due directly to the recent eruption of Sakura-jima.

The two depression lines of 300 and 500 mm run close to the coast of the N. portion of Kagoshima Bay, having a comparatively greater landward extension in the N. and W. directions. These two curves have more or less definitely two axes of symmetry in the directions respectively of E.-W. and N.N.E.-S.S.W. The point of their intersection, which may be regarded as indicating the position of the locality of the greatest depression of the ground, is under the sea to the N. of Sakura-jima, off the coast of Shirahama.

The dimensions of the different lines of equal depression are as follows :—

500 mm Curve :   Min. Diameter = 13½ km ; Max. Diameter = 20 km.
300   „   :   Min. Diameter = 19 km ; Max. Diameter = 25 km.
100   „   :   Min. Radius = 14 km ; Max. Radius = 32 km.
50   „   :   Min. Radius = 17 km.

Again, the areas enclosed within the different lines of equal depression are as follows :—

Area within the 500 mm Curve = 477 sq. km.
Area between the 500 and 300 mm Curves = 236 sq. km.
  „   „   „ 300 and 100 mm   „   = 2610 „ (*apprx.*).

F. Omori:—

The total area enclosed by the 100 mm curve is about 3370 sq. km. The form of the deformed earth surface along the E.-W. diameter will be approximately as is illustrated in fig. 41, in which the maximum amount of the depression is assumed to be at least 3 metres, this supposition being probable enough according to what has been stated in § 58. The approximate volumes of depression are as follows :—

Depression Volume within the 500 mm Curve.............0.64 c. km.

,,   ,,   between the 500 and 300 mm Curves....0.11 ,,

,,   ,,   ,,   ,, 300 and 100 mm ,, ...0.52 ,,

The depth of the depression considered above, which is based
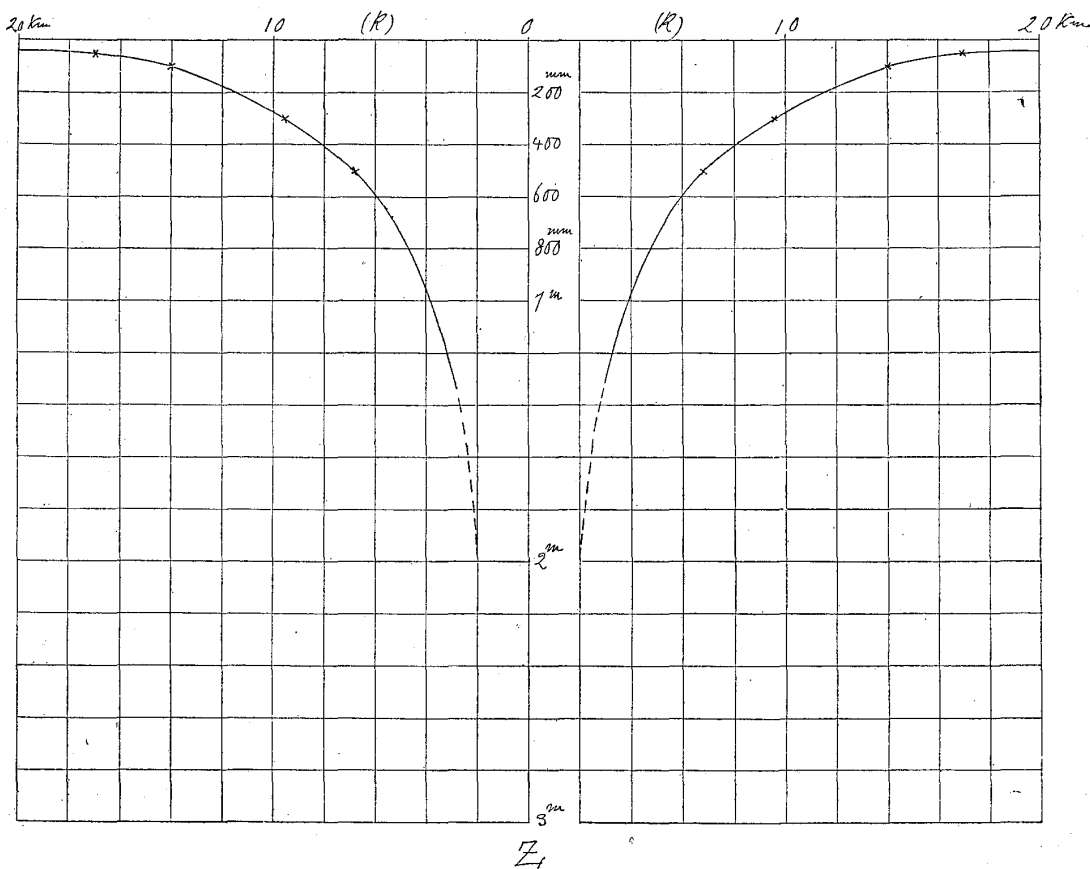
Fig. 41. Level Change caused by Sakura-jima Eruption of 1914 : Section representing the amount of Depression of the ground in an E.W. direction at varying radial distances (R) from the centre. Depression is measured downwards along the axis oz.

Pl. XXIX.

Fig. 42. Map showing the Differences in Height of the Bench-Marks in
S. Kyushu before and after the Sakura-jima Eruption of 1914.

圖覽一動異高量點準水部南州九

(Results of the precise levelings carried on by the Military Survey, supplemented
with that by the Gov. Kyushu Railways.)

Curves are lines of equal depression respectively of 500; 300; 100;
and 50 mm. The figures in red denote the height change:
(−), depression; (+), elevation. The number
enclosed in brackets is that of a B.M.

●━━━━● Bench-Mark.
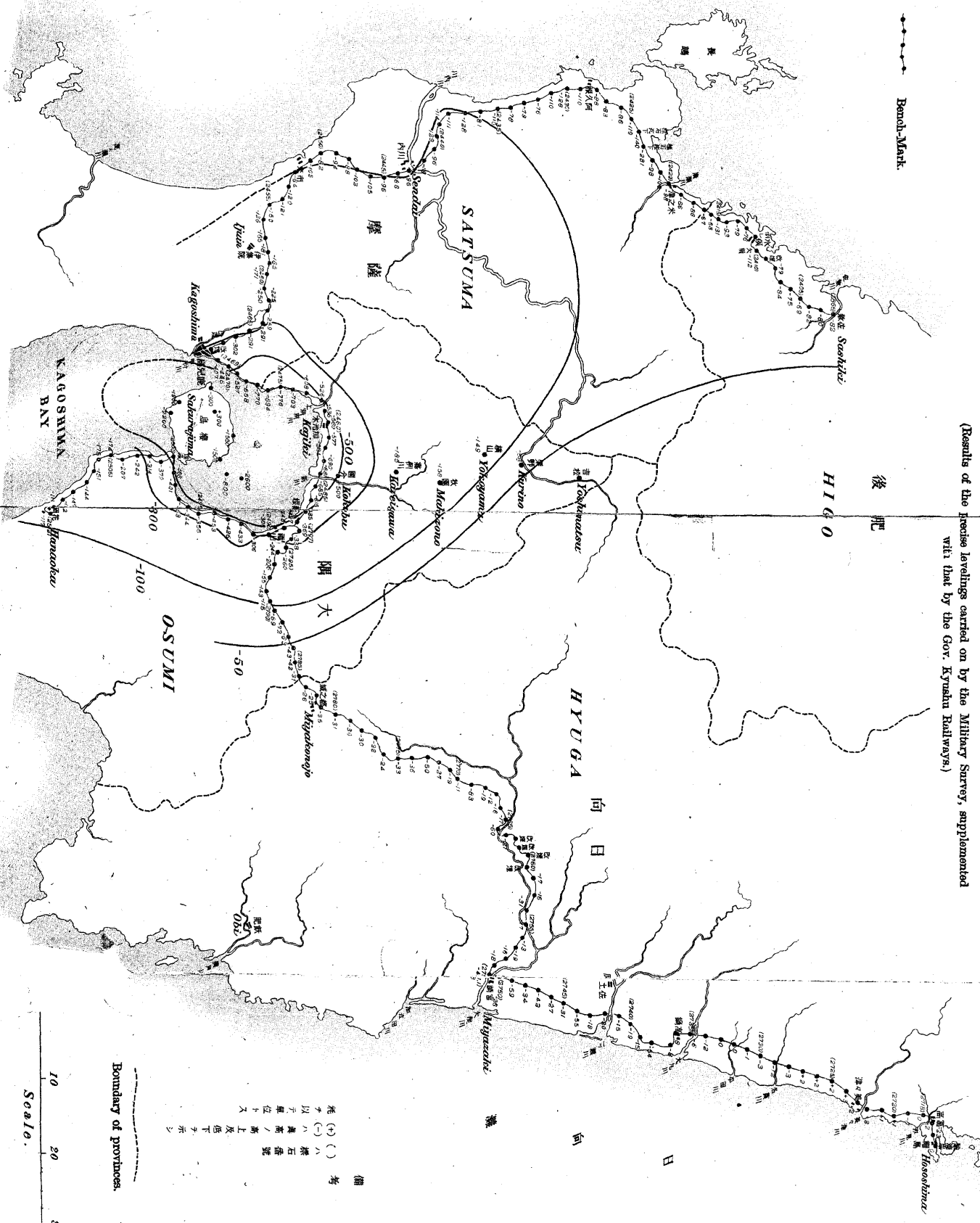
- - - - - Boundary of provinces.

Scale.
10   20   30 Km.

SATSUMA

薩摩

HIGO

肥 後

HYUGA

向 日

OSUMI

KAGOSHIMA
BAY

KAGOSHIMA BAY

Kagoshima

Sakurajima

Kokubu

Kajiki

Yokogawa

Makizono

Kurino

Yoshimatsu

Takeno

Miyakonojo

Miyazaki

Hanaoka

Hanaokeu

Osii

Special

Ijuin

Sendai

Scchiki

Fig. 48 Map showing the Depression and Elevation of the Ground
produced in Sakura-jima and Vicinity after the Eruption of 1914.

(Based on the precise levelings and triangulations carried on by the Military Survey.)
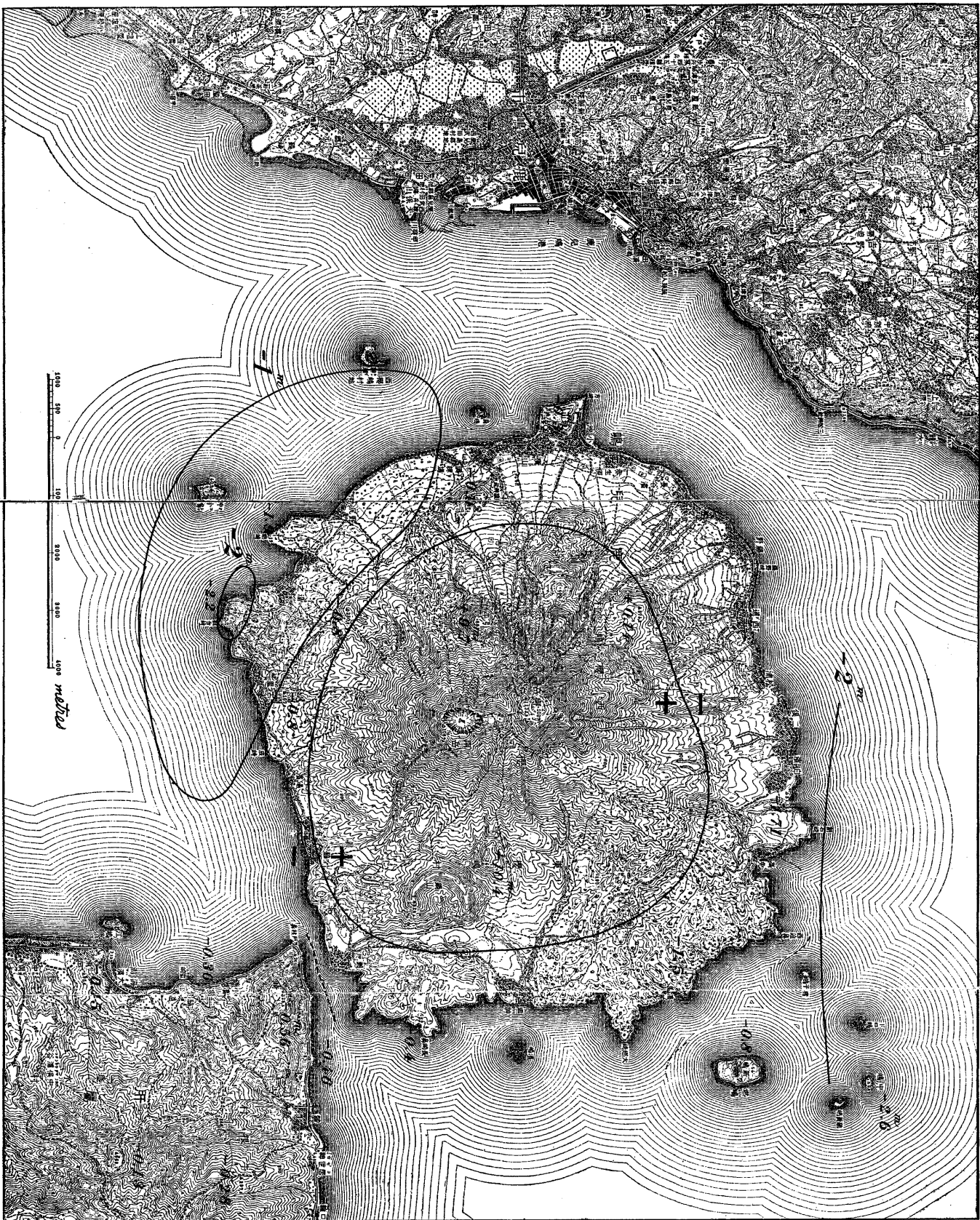
The closed curve covering the central and greater portion of Sakura-jima marks the
boundary of the elevated area.

The other curves are the depression lines of 2 and 1 metres.

Pl. XXX.

simply on the results of the leveling surveys, must be increased by about 0.15 metre (§ 54), at least for the 500 mm curve, to bring the estimation up to the condition immediately previous to the eruption of 1914. This gives 0.82 c. km for the total depression volume within the 300 mm curve, and 1.35 c. km for that within the 100 mm curve. As a portion of the depression between the 300 and 100 mm curves may be supposed to be also the effect of the eruption, we may take 1 c. km, in round number, for the approximate total depression volume due to the latter. This is within a quite reasonable limit, being a little less than half of the aggregate volume, $=2.2$ c. km , of the lava outflows and the pumice and ash ejection in the recent eruption.

The position of the point of the maximum depression, which lies under the sea to the north of Sakura-jima, probably coincides with that of the principal centre of the underground lava reservoir. The latter, as a whole, may extend under the area including the northern part of Kagoshima Bay and the surrounding tract, where the depression of the ground has been more or less marked, or an irregular circle about 45 km in diameter. It is likely that the particular portion of the lava reservoir, which supplies magma to the two active volcanoes of Sakura-jima and Kirishima, are situated not necessarily under these volcanoes themselves, but rather at the region midway between them, which thus ought to be a place specially sensitive to the subsidence. The existence of the lake of Toya behind Usu, of the lake of Shikotsu behind Tarumai, (both in Hokkaido), and of the lake of Ikeda behind Kaimon (Satsuma) seem to be the result of some analogous relation of the position of the lava reservoir and the actual eruptive vent.

56. On the limit of subsidence. For the sake of reference, let us see first what took place, in connection with the subject of the

subsidence, on the occasion of the several recent outbursts of Ōshima (Izu) and Asama. In the case of the latter volcano, the molten lava mass at the bottom of the crater, whose previous depth was 120 m, was gradually elevated through a vertical distance of about 100 m, until at the end of 1911, when the eruptive action reached its climax, it was almost on the point of flowing out and running down the mountain slope. Since then, in consequence of the decline of the volcanic activity, the crater bottom began to be depressed, so that at the present time it is at a depth of some 80 m. Again, in the Ōshima eruptions of March–April and Sept.–October, 1912, the lavas which flowed out at the crater bottom, accumulated to heights respectively of 33 and 63 m above the original plane of the latter. After the end of these eruptive epochs, however, remarkable subsidences took place, whereby the central portion of the lava area fell down through the vertical distances of 30 to 60 m, leaving behind terraces along the inner base of the crater wall. From examples like these, it seems natural that a settlement of the Sakura-jima district should follow the exceptionally abundant recent outflow of lava and emission of ash and pumice, whose aggregate amount is equal to 1/12th of the total volume of the island, and which, if distributed uniformly over the whole area of the latter, would have a thickness of about 31 m. Even supposing the extension of the lava reservoir to be great, it seems inevitable that there should be formed a vacant cavity underneath, or, at the least, a space filled with comparatively loose rocky material, such that the volcanic region in question would form virtually a sort of a rocky arch or bridge over the inside magma ; its vertical deflection, which constitutes the subsidence phenomenon, reaching a certain limiting amount, after which a recovery ought to take place, provided the volcanic force happen again to be augmented.

57. Triangulation: horizontal displacement. The triangulation surveys in 1898 and in 1914 (see § 58) also revealed remarkable effects of the recent eruption in the production of the considerable horizontal displacements of the different trigonometrical points in Sakura-jima and along the coast of Kagoshima Bay. As will be observed from Table XXXVI and the map (fig. 44), the displacements at the three places of Atago-yama, Gohonmatsu, and Hatane, in the S.W. part of Sakura-jima, were 2.04 to 3.62 m, and directed towards the south or S. slightly W. On the contrary, at the three places of Hakama-goshi, Isodaira, and Kamano, at the W. and N. parts of the island, the displacements, which varied from 1.08 to 4.52 m (absolute maximum), were directed toward the N. approximately or toward the N.E. Thus the N. and S. portions of Sakura-jima have after the recent eruption been displaced outwards in contrary directions, and it appears that the disturbance, whether horizontal or vertical, probably attained the maximum intensity along an axis AA situated between the two series of stations at distances reciprocally proportional to the amount of the displacement at the latter. This zone, so far as is indicated in the map, practically coincides with the western half of the " fissure line " of the present eruption (the line II II, in fig. 2), suggesting the following process in the topographical change: (i), previous to the eruption, the upheaval was most marked along the zone AA and its eastern prolongation, the different points on the N. and S. portions of the island being pulled inwards or centrally; (ii), at the outbreak, causing the formation of several craterlets and " eruptive cracks," the stress along the zone AA was partially relieved, and the different places on both sides of the latter rebounded back outwards; and, (iii), the subsequent partial settling down of the mountain mass, and the formation of the principal centre of maximum depression

to the N., and of a secondary centre to the S.W., of Sakura-jima, have augmented the above-supposed outward motion and resulted in the formation of the horizontal displacement in question.

Along the coast of Ōsumi, to the S.E. of Sakura-jima, the displacement was slight and less than 0.34 m. On the other hand, the displacements at different places along the N.W. coast of the bay, from Kagoshima to Kajiki, were much larger, varying from 0.53 to 0.95 m. These, as well as the large displacements at the W. and N. parts of Sakura-jima, converge more or less toward an elliptical area BB, which may be taken as roughly indicating the area of the greatest depression. A secondary area of depression seems to exist to the S.W. of Sakura-jima. The position of the area BB is fairly in harmony with fig. 42, which indicates the results deduced from the precise levelings.

To sum up:—Sakura-jima and the neighbouring districts underwent after the eruption a general depression from the up-heaved level attained before the outburst, in such a way that the inner area of the island did not fully regain its original height, but retained a certain amount of the elevation (when compared to the state in 1898), separating the two centres of depression on the N. and S. sides.

58. Triangulation: height difference. The alterations in height in Sakura-jima itself, where there is no bench-mark net, can not be ascertained by the method of precise leveling. Much light has, how-ever, been thrown on the vertical as well as horizontal displacements in the principal area concerned from the measurements carried on by the Military Survey in Oct.–Dec., 1914, which relates to the 1, 15, 21, and 1 trigonometrical points respectively of the 1st, 2nd, 3rd, and 4th orders, in the island of Sakura-jima and the neighbouring coast districts. The height differences between the new determina-

tions and the old ones, made in 1898, are given in Table XXXIX.

Amongst the others, the height differences suffered by the 7 third-order trigonometrical points in Sakura-jima are as follows.

TABLE XXXVI. HEIGHT CHANGE AND HORIZONTAL DISPLACEMENT OF TRIGONOMETRICAL POINTS IN SAKURA-JIMA DUE TO THE ERUPTION OF 1914.

Trigonometrical Point.		Locality.	Height		Height * Difference.	Horizontal Displacement. (Amount, and Direction.)	
			in 1898.	in 1914.			
Hakamagoshi	(袴 腰)	Hakamagoshi.	*metre.* 71.97	*metre.* 71.65	*metre.* −0.32	*metre.* 1.08	N6°W
Atago-Yama	(愛宕山)	W. part of Island.	167.05	166.16	−0.89	2.04	S23°W
Gohonmatsu	(五本松)	S.W. part of Island, near Yuno	230.83	230.03	−0.80	3.62	S14°W
Hatane	(畑 根)	S. part of Island, near Furusato	167.76	166.95	−0.81	3.07	SW
Isodaira	(磯 平)	N. coast of Island, near Shirahama	51.48	49.77	−1.71	2.62	N65°E
Sono-Yama	(園 山)	N.E. part of Island, near Ōmoe-zaki	78.90	77.40	−1.50	—	—
Kamano	(鹿馬野)	N.W. part of Island.	374.24	374.38	+0.14	4.52	N6°E

(*) −, when depressed; +, when elevated.

All of the trigonometrical points (stone marks) in question were not injured by the volcanic eruption, but found intact under cover of pumice and ash, whose thickness reached the maximum amount of 1.4 m at Kamano. The trigonometrical points on the summits of the Minami-dake and Kita-dake were unfortunately destroyed during the outburst, their sites having been broken off by the strong earthquake shocks.

The topographical surveys have also brought to light marked height differences of some hill tops and capes in Sakura-jima and several neighbouring islets, as indicated in Table XXXIX.

According to Table XXXVII, the Oko-jima station (5), is a new 3rd class trigonometrical point set up close to the old one destroyed

TABLE XXXVII. HEIGHT CHANGE OF SUBORDINATE SURVEY STATIONS IN SAKURA-JIMA BEFORE AND AFTER THE ERUPTION of 1914.

Locality.*	Height		Height Difference.
	in 1898.	in 1914.	
(1) Top of Hikinohira (引之平)	*metre.* 553	*metre.* 562.7	*metre.* + 9.7 ‡
(2) „ „ Gongen-Yama, near Nabe-yama.‡	340	350.4	+10.4 ‡
(3) Top of Nakano-shima (中ノ島).	6.6	3.9	− 2.7
(4) „ „ Moe-jima (燃島).	44	43.2	− 0.8
(5) Flat top of Oko-jima, off the S.W. coast of Island.	40.2	38.7	− 1.5
(6) Moe-zaki promontory, S.W. part of Island.	19	17.1	− 1.9
(7) Kwannon-zaki promontory, S.W. part of Island.	79	76.8	− 2.2

* (3) and (5) are new trigonometrical points whose sites are slightly different from the former ones.   ‡ Including the accumulation of pumice and ash. See the text.

by accident some time previously. As the site, however, is the flat top of the islet,[1] the height difference between the two points must be slight, and the discrepancy of 1.5 metres between the new and old height measurements may be regarded as approximately representing the amount of the depression of the ground. Again, the position of the new Nakano-shima station (3), is slightly different from the former one, but like the latter refers to the highest point in the islet; the difference of 2.7 m between the old and new heights may therefore denote also the approximate amount of the depression. The stations of Moe-jima (4), Moe-zaki (6), and Kwannon-zaki (7), are not trigonometrical points, but are the highest sites in the localities concerned, where the precipitation of ashes on the occasion of the recent eruption was from a few inches up to about 1 foot; the amounts of the depression at these three places are consequently to be regarded as being roughly accurate.

---

(1) Used as a battery ground by Prince Shimazu, *daimyo* of Satsuma, in the engagement with the British fleet in 1863.

The measurements on the Hikinohira (1) and Gongen-yama (2), which relate also not to trigonometrical points, but to the summits of the respective hills, indicate each an apparent height *increase* of about 10 metres. For these stations, sufficiently near to the craterlets, it is of course necessary to take into consideration the amount of the precipitation of ash and pumice. Now, on the N. flank of Nabe-yama and at the base of Gongen-yama opposite the latter, the accumulation of the volcanic ejecta, chiefly pumice, was about 3 metres in thickness, being probably greater than that on the top of Gongen-yama itself, which stands northwards and a little out of the way of the main course of the zone of ash-precipitation. Making a due allowance in this connection, the summit of the last-named hill seems to have been elevated at least some 7½ metres. As regards Hikinohira, it is true that the hill is quite near to No. 1 craterlet on the W., or Yoko-yama, side. But the total amount of the ash and pumice emitted from the craterlets on this side must be much smaller than that given out from the craterlets on the E. or Nabe-yama, side, and I am inclined to believe the accumulation on the top of Hikinohira to be a few metres. From this it follows that the hill in question must have been elevated also at least a few metres.

The errors in the height measurements of the trigonometrical points given in Table XXXVI are believed to be less than 0.1 metre. Those in the topographical measurements given in Table XXXVII may be much larger, but probably under 1 metre. On the whole, the results contained in these two tables are mutually consistent. Thus the depression in the N. and N.E. parts of Sakura-jima are 1.50 to 1.71 metres, while that of the Anei islets of Moe-jima and Nakano-shima are 0.8 to 2.7 metres. Again, the depression at the S. and W. parts of the island was about 0.8 or

0.9 metre, while that of the two S.W. promontories and of Oko-jima off these latter was from about 1.5 to 2.2 metres.

That the districts about the new craterlets, more especially the tops of the side cones or domes like Hikinohira and Gongen-yama, should suffer an upheaval in consequence of the powerful eruption is probable enough, as noted in § 57. The trigonometrical point on the top of Kamano-yama, 374 m in height, in the N.W. part of the island, also indicates a slight upheaval of 0.14 m. As is illustrated in fig. 43, in which the curves have been drawn by interpolations, there lies a submarine area of the depression greater than 2 metres to the N. of Sakura-jima, while the depression lines of 1 and 2 metres cover the S.W. corner of the island and the adjacent sea-bottom portion. The line, along which neither upheaval nor depression took place, is an oval, $7\frac{1}{2}$ km in diameter which runs at an average distance of about $1\frac{1}{2}$ km from and inside the coast, except at the S.E. part where it touches the latter. Inside and along this curve of no height change, which includes Nabe-yama and Gongen-yama on the east, and Hikinohira, the 400-metre hill (above Akobaru), and Kamano-yama on the west, the ground seems to have been more or less upheaved, representing the residual effect of the elevation, whose amount had probably been much greater just before the volcanic outburst and maximum at the immediate neighbourhoods of the new craterlets. On the other hand, there is no positive fact indicating an elevation of the central peaks or main old craters.

59. Well-water at Futamata. In connection with the phenomenon of the depression of the ground is of interest the difference which came to exist in the level of water of four wells in the village of Futamata at the N. coast of Sakura-jima, situated about 70 metres from the beach and about 7 metres in depth. Before the

eruption, the wells used to be dried at low tide times, while since 1915 there is water to a depth of 5 or 6 feet even on such occasions. Again, the wells at the village of Saido have still their water level some 5 feet higher than that before the eruption. It is probable that these wells have a communication with the neighbouring sea, the apparent elevation of their water level being in reality the effect of the depression of the ground.

60. Comparison of eruption of Sakura-jima with that of Usu. On the occasion of the Usu eruption in 1910, nearly 50 craterlets were formed on the northern flank, the outbursts consisting in the explosive emission of ash and rock fragments, attended by no exposure or outflow of red hot lava. The eruption was accompanied by remarkable disturbances of the ground, which not only produced a new mountain elevated to the height of 600 feet above the level of the adjacent Lake Toya, but also affected the whole district about the volcano, causing a rise of 0.36 m even at the coast of Volcano Bay.* It is likely that the mountain mass including the two old domes of Ō-Usu and Ko-Usu also acquired some height increase : in fact, the level change was mainly a phenomenon of upheaval. In the Sakura-jima eruption of 1914, there were formed a great number of craterlets, whence issued a vast quantity of ash, pumice, and molten lava ; followed, at the cessation of the active outbursts, by a general depression of the ground of Sakura-jima and adjacent districts, to the maximum amount of at least 1.7 m at the northern part of the island and of 1 m or more at the N. W. coast of Kagoshima Bay (§ 58). The opposite manifestations of level change in the Usu and Sakura-jima eruptions, which are by no means incompatible to each other, are to be regarded as expressing the two principal successive phases in the process of an energetic

* See the Bulletin Vol. V, Nos. 1 and 3.

outburst from a small volcano. Thus, in the case of Usu the elevation was probably the result of an application of an upward pressure from below in consequence of the volcanic effort to force up the magma. The long accumulated volcanic force of Sakura-jima, however, had probably been causing, for several decades of years, a continued upheaval of the neighbouring districts (§ 49), until the outflow of lava in the great eruption of 1914 created a sort of vacant space below the latter and induced the settlement of the ground. Both Usu and Sakura-jima, which are very small in volume and height, are powerful in volcanic efforts; this being the reason of the occurrence of the remarkable elevation or depression accompanying their outbursts.

TABLE XXXVIII. HEIGHT CHANGE OF BENCH-MARKS BETWEEN JULY-AUG., 1914 AND FEB. 1915.

* *Minus*, when depressed; *plus*, when elevated.

Bench-Mark.					Height in		Difference.*
Locality.				No.	July–Aug., 1914.	Feb., 1915.	
[Aira County, Province of Ōsumi]					metre	metre	metre
Fukuyama.	福 山 村	福 山	鳥 越	2793	380.744	380.744	±0.000
,,	,,	,,	野 平	2794	337.010	337.008	−0.002
,,	,,	,,	舊城平	2795	254.205	254.195	−0.010
,,	,,		中ノ平	2796	164.267	164.249	−0.018
Shikine.	敷 根 村	麓	垂 水	2797	88.223	88.205	−0.018
,,	,,	,,	宇 都	2488	56.847	56.826	−0.021
,,	,,	,,	節句田	2487	3.002	2.974	−0.028
Hi. Kokbu.	東國分村	湊	竿 富	2486	2.624	2.585	−0.039
,,	,,	小	西 山	2485	4.862	4.813	−0.049
Ni. Kokbu.	西國分村	住 吉		2484	2.939	2.890	−0.049
,,	,,	野久美田		2483	11.610	11.561	−0.049
,,	,,	小 濱		2482	15.434	15.386	−0.048
Kajiki.	加治木町	日木山	龍 口	2481	46.258	46.220	−0.038

Pl. XXXII.

鹿児島線ニ至ル鹿見島停車場區間吉松停車場ヨリ鹿見島停車場區間鹿見島桜島噴火前後地盤昇沈圖

Mileage.

(I) Height before Eruption.

(II) Height after Eruption.

Amount of Depression.

Height before	Height after	Depression
738.81	738.81	0
738.28	738.28	0
739.48	739.47	0.01
749.37	749.36	0.01
751.50	751.48	0.02
747.29	747.25	0.04
753.30	753.26	0.04
712.79	712.76	0.03
614.20	614.23	+0.03
614.08	614.10	+0.02
613.54	613.55	+0.01
611.95	611.79	0.16
611.93	611.91	0.04
611.95	611.70	0.25
569.87	569.65	0.22
569.87	569.80	0.07
552.55	552.44	0.11
540.28	540.34	+0.06
462.54	462.33	0.21
23.60	22.28	1.32
23.60	22.42	1.18
23.60	22.59	1.01
52.81	51.08	1.73
41.81	40.01	1.80
153.29	151.26	2.03
28.61	26.78	1.83
27.29	25.37	1.92
27.29	25.40	1.89
32.09	30.27	1.82
17.91	16.31	1.60
23.77	21.88	1.89
23.77	21.83	1.94
21.77	19.67	2.10
16.52	14.62	1.90
16.72	14.65	2.07
39.50	37.15	2.35
21.46	19.13	2.33
19.34	16.83	2.51
22.77	19.97	2.80
19.10	16.65	2.45
46.98	44.53	2.45
37.96	35.83	2.13
33.50	31.87	1.63
9.47	8.25	1.22
9.47	8.36	1.11
8.63	7.49	1.14

Yoshimatsu Station

Kurino Station

Yokogawa Station

Makizono Station

Kareigawa Station

Kokubu Station

Kajiki Station

Shigetomi Station

Kagoshima Station

Fig. 43. Diagram showing the Height Changes along the Kyushu Railway Line, between Yoshimatsu and Kagoshima, before and after the Sakura-jima Eruption of 1914.

(*)....Bench-Mark of the Military Survey.

(1) and (2)....Heights at a railway station before and after the Sakura-jima Eruption of 1914.

I....Height before Eruption.   II....Height after Eruption.
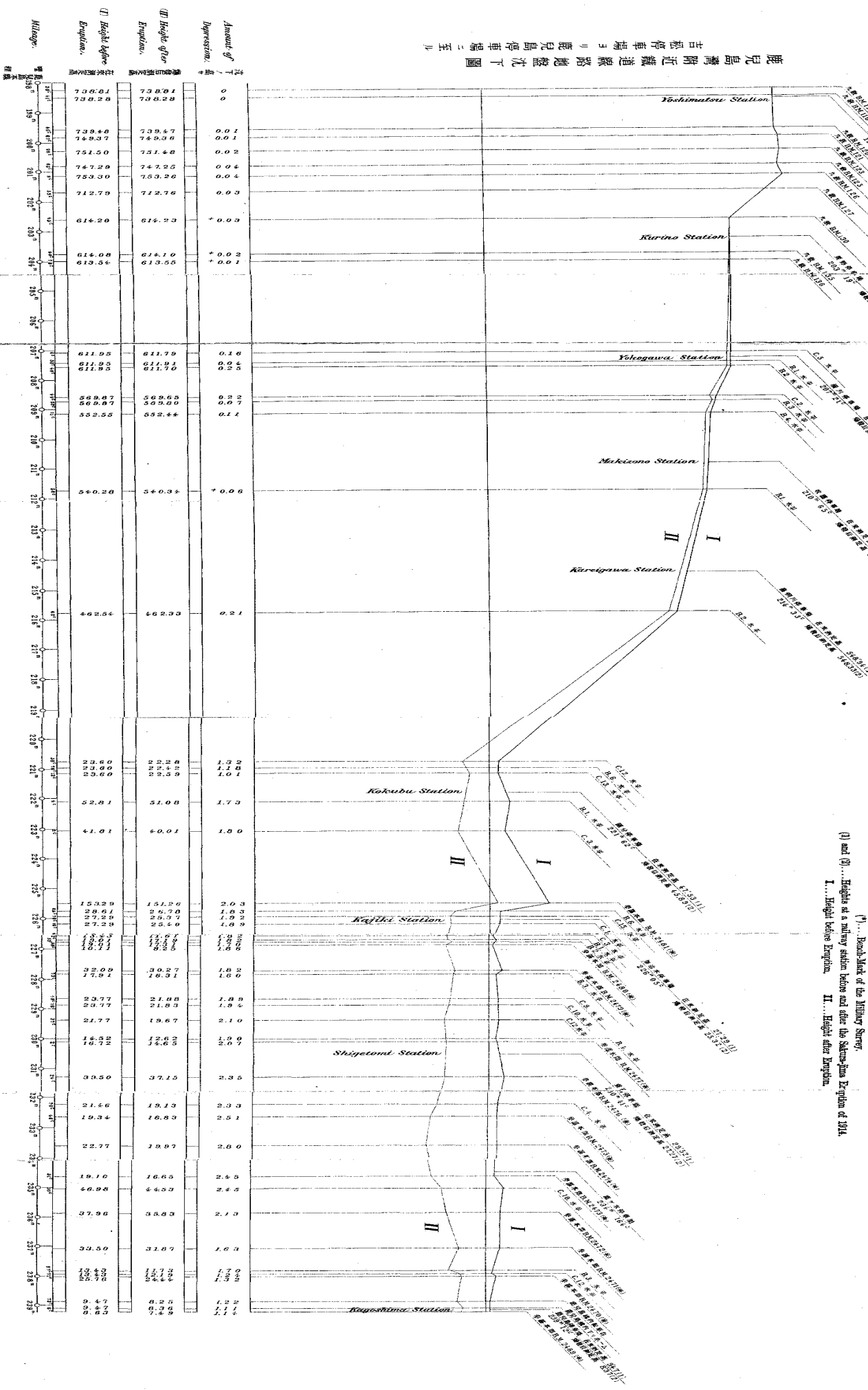
TABLE XXXVIII. *(Cont.)*

Bench-Mark.				Height in		Difference.
Locality.			No.	July-Aug., 1914.	Feb., 1915.	
				metre	metre	metre
Kajiki.	加治木町	木 田	向江町 2480	2.644	2.612	—0.032
,,	,,	,,	別府川 2479	9.361	9.329	—0.032
Chōsa.	帖 佐 村		東餅田 2478	9.694	9.661	—0.033
Shigetomi.	重 富 村	脇 元	渡 瀬 2477	4.586	4.549	—0.037
,,	,,	,,	尾 崎 2476	11.441	11.401	—0.040
[Kagoshima County, Province of Satsuma]						
Yoshino.	吉 野 村	吉 野	水ヶ谷 2475	5.244	5.201	—0.043
,,	,,	,,	吉 野 2474	6.198	6.143	—0.055
,,	,,	,,	,, 2473	5.180	5.135	—0.045
,,	,,	,,	,, 2472	11.027	10.984	—0.043
,,	,,	,,	,, 2471	9.807	9.780	—0.027
,,	,,	,,	,, 2470	7.525	7.512	—0.013
[Kagoshima City]						
Ogawa-machi.	小 川 町		2469	2.340	2.336	—0.004
Hirano-machi.	平 野 町		2468	4.360	4.370	+0.010

TABLE XXXIX. HEIGHTS OF TRIGONOMETRICAL POINTS OF 2ND, 3RD, AND 4TH ORDERS IN SAKURA-JIMA AND VICINITY, BEFORE AND AFTER THE ERUPTION OF 1914.

‡ *Minus*, when depressed; *plus*, when elevated.

* Trigonometrical Point set up at a new site near the old one destroyed by the eruption.

Trigonometrical Point.		Height in		Dif-ference.‡
Order.	Locality.	1898.	1914.	
	[Sakura-jima and Neighbouring Islets.]	metre	metre	metre
III	Hakamagoshi. 袴腰 (城山)	71.97	71.65	—0.32
,,	Atago-yama. 愛宕山	167.05	166.16	—0.89
IV	Islet of Kanze. 神瀬	7.10	2.89	*
II	Oko-jima (Off Moe-zaki). 沖小島 (燃崎附近)	40.17	38.65	*
,,	Heta-Kojima. 邊田小島	124.33	123.27	—1.07

TABLE XXXIX. *(Cont.)*

Trigonometrical Point.		Height in		Dif-
Order.	Locality.	1898.	1914.	ference.
		metre	metre	metre
II	Nakano-Shima. 中之島	6.59	3.94	*
III	Isodaira (near Shirahama). 磯平(白濱附近)	51.48	49.77	−1.71
,,	Take-yama (Maruzuka, near Komen). 竹山 (丸塚)	78.87	77.38	*
,,	Kamano (above Fujino). 鹿馬野 (藤野附近)	374.24	{ 374.38 375.34	+0.14
II	Kita-dake (Mitake), or N. Peak. 御岳	1132.69	1110.23	*
III	Minami-dake, or S. Peak. 南岳	1069.58	1059.75	*
,,	Inuzuka-yama (Yobinotsuka). 黑髪, 呼之塚, 犬塚山	328.42	122.28	*
,,	Gohonmatsu (near Yuno). 湯之, 字五本松	230.83	230.03	−0.80
,,	Hatane (near Furusato). 古里, 畑根	167.76	166.95	−0.81
	[Kimotsuki County, Province of Ōsumi.]			
II	Sakkabira (Hayasaki). 海潟, 字早崎	325.49	324.77	−0.72
III	Nishi-Kawatoko (near Fumoto). 牛根麓, 字ヤシキノ原	297.33	296.89	−0.44
,,	Yaguragi (near Kaigata). 海潟, 字櫓木	568.06	567.77	−0.29
,,	Terasono (near Kaigata). 海潟, 字寺園	95.60	95.29	−0.31
,,	Takanohira (Ichiki). 大字市木, 字高ノ平	574.80	574.53	−0.27
,,	Kamiseko (Ichiki). 同上, 字上迫	83.90	83.76	−0.14
II	Takaki (Ichiki). 大字高城, 字平松	123.40	123.18	−0.22
III	Ōtonokuchi (Ushine). 牛根, 大字麓, 大戸ノ口	319.82	349.43	−0.39
II	Bisago-dake (Ushine). 鷦岳, 字三方崩	885.25	884.98	−0.27
	[Aira County, Province of Ōsumi.]			
II	Kawara (Shimizu-mura). 姶㞟郡清水村, 大字川原	229.38	229.23	−0.15
,,	Sojinno-oka (Fukuyama). 福山, 字惣陣平	483.71	483.43	−0.28
,,	Fukuchi (Fukuyama). 同上, 字福地	563.49	563.17	−0.32
,,	Neko-dake (Kajiki). 加治木町, 字猫嶽	189.59	189.04	−0.55
	[Kagoshima County, Province of Satsuma.]			
III	Gōto (Take). 西武田村, 大字武, 字郷戸	123.35	123.05	−0.30
,,	Tempōzan (Kagoshima). 鹿兒島市, 天保山	4.44	4.09	−0.35
,,	Naka-Ōtsuka. 鹿兒島郡中郡宇村, 大字中, 字中大塚	104.15	103.87	−0.28
II	Tagami (near Takeda). 西武田村, 大字田上	126.25	126.11	−0.14
,,	Inuseko (Ishiki-mura). 伊敷村, 大字犬迫	190.25	189.92	−0.33
,,	Motona (Yoshida-mura). 吉田村, 大字本名	486.50	——	——
I	Hirakamioka (Yoshida-mura). 大字宮ノ浦, 字底内	552.52	551.64	−0.88

TABLE XXXIX. *(Cont.)*

		Height in		Dif-ference.
Order.	Locality.	1898.	1914.	
		metre	metre	metre
III	Furuyashiki (Yoshino-mura). 吉野村,大字岡ノ原,字古屋敷	162.40	{ 161.96 / 161.29	−0.44
„	Kami-Komegami (Yoshino-mura). 大字吉野,上米神	273.68	272.89	−0.79
„	Akiyama (Yoshino-mura). 同 上,字瀧ノ神平	145.41	{ 144.91 (1) / 143.48 (2)	{ −0.50 / *
II	Sakamoto (Yoshino-mura). 同 上,字坂元	160.87	159.98	*

(1) Before the re-setting; (2) after the re-setting.

TABLE XL. HEIGHTS OF BENCH-MARKS BEFORE AND AFTER THE ERUPTION OF 1914.

(The difference is *minus*, when depressed, and *plus*. when elevated.)

* Bench-mark re-set.

Locality.		No.	Before Eruption.		After Eruption.		Difference.
			Month, Year.	Height.	Month, Year.	Height.	
[Province of Hyuga.]				metre		metre	metre
Hososhima.	東臼杵郡細島町,字伊勢町	4	X, 1894	2.526	I, 1915	2.526	0.000
Tomitaka.	„ 富高村, 日知屋, 古 田	4.1	„	1.606	„	1.583	−0.023
„	„ „ „ 江 瓦	4.2	„	3.692	„	3.690	−0.002
„	„ „ 財光寺, ケ堂川	2718	„	6.352	„	6.352	0.000
Iwawaki.	„ 岩脇村, 平 岩 赤 岩	2719	„	3.436	„	3.435	−0.001
„	„ „ „ 宮ノ上	2720	„	18.558	„	18.559	+0.001
„	„ „ „ 石ノ田	2721	„	6.551	„	6.552	+0.001
„	„ „ 幸 脇, 番匣ノ後	2722	„	47.592	„	47.595	+0.003
Mimitsu.	兒湯郡, 美々津町 , 高 松 北石並	2723	„	5.929	„	5.931	+0.002
„	„ „ „ 松ノ本	2724	„	35.763	„	35.766	+0.003
Tsuno.	„ 都農村, 川 北 寺迫北原	2725	„	28.454	„	28.456	+0.002
„	„ „ „ 心見往還	2726	„	21.484	„	21.486	+0.002
„	„ „ „ 境ケ谷	2727	„	36.030	„	36.032	+0.002
„	„ „ „ 都農新町	2728	„	29.844	„	29.841	−0.003
Kawanami.	„ 川南村, 川 南 中猪久保	2729	„	48.811	„	48.799	−0.012
„	„ „ „ 東 原	2730	„	54.841	„	54.838	−0.003

TABLE XL. (Cont.)

Bench-Mark.					No.	Before Eruption.		After Eruption.		Difference.
Locality.						Month, Year.	Height.	Month, Year.	Height.	
							metre		metre	metre
[Porvince of Hyuga.]										
Kawanami.	兒湯郡,	川南村,	平　田,	野稻尾	2731	X, 1894	52.988	I, 1915	52.987	−0.001
,,	,,	,,	川　南,	仲　原	2732	,,	24.761	,,	24.761	0.000
Uwae.	,,	上江村,	持　田,	番野地	2733	XI, 1894	61.412	,,	61.412	0.000
,,	,,	,,	,,	計　塚	2734	,,	46.500	,,	46.488	−0.012
,,	,,	,,	,,	小丸出口	2735	,,	4.833	,,	4.827	−0.006
Takanabe.	,,	高鍋町,	南高鍋,	筬	2736	,,	4.442	,,	4.434	−0.008
,,	,,	,,	,,	茂廣毛平	2737	,,	10.536	,,	10.528	−0.008
,,	,,	,,	,,	前牟田	2738	,,	11.207	,,	11.153	−0.054
Tonda.	,,	富田村,	日　置,	六反田	2739	,,	10.955	,,	10.940	−0.015
,,	,,	,,	上富田,	越馬場	2740	,,	5.541	,,	5.522	−0.019
,,	,,	,,	下富田,	軍　瀨	2741	,,	3.481	,,	3.466	−0.015
Hirose.	宮崎郡,	廣瀨村,	下田島,	福　島	2742	,,	3.039	,,	3.019	−0.020
,,	,,	,,	,,	井手牟田	2743	,,	11.854	,,	11.836	−0.018
Hirose.	,,	,,	下那珂,	馬場下	2744	,,	8.753	,,	8.698	−0.055
Sumiyoshi.	,,	住吉村,	島ノ内,	成　尾	2745	,,	8.077	,,	8.046	−0.031
,,	,,	,,	,,	内　添	2746	,,	12.405	,,	12.378	−0.027
,,	,,	,,	芳　士,	蓮ヶ池	2747	,,	9.759	,,	9.717	−0.042
,,	,,	大宮村,	花ヶ島,	赤江町	2748	,,	7.936	,,	7.902	−0.034
Miyazaki.	,,	宮崎町,	江平町,	河　骨	2749	,,	7.508	,,	7.449	−0.059
,,	,,	,,	上別府,	春　田	2750	,,	5.462	,,	5.436	−0.026
Oyodo.	,,	大淀村,	太　田,	南小路	2751.1	,,	5.752	XII, 1914	5.704	−0.048
,,	,,	,,	,,	堂ノ下	2751	,,	7.760	,,	7.742	−0.018
,,	,,	,,	大　塚,	宮　田	2752	,,	7.216	,,	7.200	−0.016
Ikime.	,,	生目村,	小　松,	口ノ坪	2753	XII, 1894	8.548	,,	8.529	−0.019
,,	,,	,,	柏　原,	高　後	2754	,,	22.850	,,	22.837	−0.013
,,	,,	,,	富　吉,	山　下	2755	,,	13.509	,,	13.492	−0.017
Takaoka.	東諸縣郡,	高岡村,	花　見,	竹ノ内	2756	,,	16.539	,,	16.508	−0.031
,,	,,	,,	,,	粟　野	2757	,,	16.260	,,	16.244	−0.016
,,	,,	,,	五　町,	顯本瀨	2758	,,	14.263	,,	14.246	−0.017
,,	,,	,,	浦ノ名,	河原田	2759	,,	19.924	,,	20.119	*
,,	,,	,,	,,	赤　谷	2760	,,	19.365	,,	19.600	*

TABLE XL. (*Cont.*)

Bench-Mark.				No.	Before Eruption.		After Eruption.		Difference.
Locality.					Month, Year.	Height.	Month, Year.	Height.	
						metre		metre	metre
[Province of Hyuga.]									
Takaoka.	東諸縣郡,	高岡村,	浦ノ名,	早面流	2761	XII, 1894	25.416	XII, 1914	26.101	*
,,	,,	,,	,,	宇 都	2762	,,	35.530	I, 1915	35.788	*
,,	,,	,,	,,	小 峰	2763	,,	31.254	,,	31.233	−0.021
,,	,,	,,	內 山,	去 川	2764	,,	43.504	,,	43.444	−0.060
Takajo.	北諸縣郡,	高城村,	四家村,	本八重	2765	,,	113.321	,,	113.304	−0.017
Takaoka.	東諸縣郡,	高岡村,	內 山,	和 石	2766	,,	204.646	,,	204.630	−0.016
Takajo.	北諸縣郡,	高城村,	四家村,	榛ヶ野	2767	,,	147.595	,,	147.583	−0.012
,,	,,	,,	,,	蓑 野	2768	,,	153.877	,,	153.858	−0.019
,,	,,	,,	,,	,,	2769	,,	170.432	,,	170.349	−0.083
,,	,,	,,	有水村,	大 丸	2770	,,	196.857	,,	196.846	−0.011
,,	,,	,,	,,	市ノ野	2771	,,	175.994	,,	175.975	−0.019
,,	,,	,,	,,	松 元	2772	,,	143.349	,,	143.322	−0.027
,,	,,	,,	石山村,	鳥井原	2773	,,	131.178	,,	131.128	−0.050
,,	,,	,,	,,	石亀岩	2774	,,	128.652	,,	128.616	−0,036
,,	,,	,,	穗嶹坊村,	和 田	2775	,,	144.201	,,	144.168	−0.033
,,	,,	,,	櫻木村,	弓網工	2776	,,	140.024	,,	140.000	−0.024
Okimizu.	,,	沖水村,	高木村,	出 口	2777	,,	136.417	,,	136.395	−0.022
,,	,,	,,	,,	大圓松	2778	,,	141.961	XII, 1914	141.931	−0.030
,,	,,	,,	川東村,	三本松	2779	,,	142.631	,,	142.601	−0.030
,,	,,	,,	,,	松 原	2780	,,	144.765	,,	144.734	−0.031
Miyakonojo.	,,	都城町,	中 町,	中 町	2781	I, 1895	143.905	,,	143.870	−0.035
Isoichi.	,,	五十市村,	五十町,	瀨戸ノ上	2782	II, 1911	143.171	,,	143.146	−0.025
,,	,,	,,	,,	油 田	2783	I, 1895	150.964	,,	150.938	−0.026
[Province of Ōsumi.]									
Sueyoshi.	囎唹郡,	末吉村,	深 川,	中崎道	2784	,,	192.311	,,	192.280	−0.031
,,	,,	,,	,,	堂薗野久尾	2785	,,	231.472	,,	231.430	−0.042
,,	,,	,,	,,	東坂ノ上	2786	,,	241.916	,,	241.873	−0.043
,,	,,	,,	,,	阿ツ田	2787	,,	274.615	,,	274.552	−0.063
,,	,,	,,	,,	舊驛所	2788	,,	292.737	,.	292.665	−0.072
,,	,,	,,	諏訪方,	大角豆ヶ迫	2789	,,	292.235	,,	292.146	−0.089
Fukuyama.	姶�郡,	福山村,	佳例川,	柴 健	2790	,,	297.909	,,	297.794	−0.115

TABLE XL. (Cont.)

Bench-Mark.					No.	Before Eruption.		After Eruption.		Difference.
Locality.						Month, Year.	Height.	Month, Year.	Height.	
[Province of Ōsumi.]							metre		metre	metre
Tsuneyoshi.	囎唹郡,	恒吉村,	坂　本,	鳩ヶ山	2791	I, 1895	308.005	XII, 1914	307.862	−0.143
Fukuyama.	姶良郡.	福山村,	佳例川,	花建原	2792	,,	367.470	,,	367.315	−0.155
,,	,,	,,	福　山,	鳥　越	2793	,,	380.950	,,	380.744	−0.206
,,	,,	,,	,,	野　平	2794	,,	337.254	VIII, 1914	337.010	−0.244
,,	,,	,,	,,	葛城平	2795	,,	254.465	,,	254.205	−0.260
,,	,,	,,	,,	中ノ平	2796	,,	164.605	,,	164.267	−0.338
Shikine.	,,	敷根村,	麓,	垂　水	2797	,,	88.592	,,	88.223	−0.369
,,	,,	,,	,,	宇　都	2488	II, 1892	57.274	,,	56.847	−0.427
,,	,,	,,	,,	節句田	2487	,,	3.487	,,	3.002	−0.485
Higashi Kokbu.	,,	東國分村,	湊,	竿　富	2486	IV, 1892	3.240	,,	2.624	−0.616
,,	,,	,,	小,	西　山	2485	,,	5.547	,,	4.862	−0.685
Nishi Kokbu.	,,	西國分村,	住　吉,	——	2484	,,	3.620	,,	2.939	−0.681
,,	,,	,,	野久美田,	——	2483	,,	12.300	VII, 1914	11.610	−0.690
,,	,,	,,	小　濱,	——	2482	III, 1900	16.118	,,	15.434	−0.684
Kajiki.	,,	加治木町,	日木山,	龍　口	2481	,,	46.835	,,	46.258	−0.577
,,	,,	,,	木　田,	向江町	2480	,,	3.204	,,	2.644	−0.560
,,	,,	,,	,,	別府川	2479	,,	9.897	,,	9.361	−0.536
Chōsa.	,,	帖佐村,	——	東餅田	2478	,,	10.220	,,	9.694	−0.526
Shigetomi.	,,	重富村,	脇　元,	渡　瀬	2477	,,	5.194	,.	4.586	−0.608
,,	,,	,,	,,	尾　崎	2476	,,	12.144	,,	11.441	−0.703
[Province of Satsuma.]										
Yoshino.	鹿兒島郡,	吉野村,	吉　野,	水ケ谷	2475	,,	6.020	,,	5.244	−0.776
,,	,,	,,	,,	,,	2474	,,	7.092	,,	6.198	−0.894
,,	,,	,,	,,	,,	2473	IV, 1892	5.950	,,	5.180	−0.770
,,	,,	,,	,,	,,	2472	,,	11.685	VI, 1914	11.027	−0.658
,,	,,	,,	,,	,,	2471	,,	10.334	,,	9.807	−0.527
,,	,,	,,	,,	,,	2470	,,	7.971	,,	7.525	−0.446
Ogawa-machi.	鹿兒島市,	小川町,	——	——	2469	II, 1892	2.747	,.	2.340	−0.407
Hirano-machi.	,,	平野町,	——	——	2468	,,	4.598	,,	4.360	*
Sonta-machi.	,,	草牟田町,	——	——	2467	,,	7.449	,,	7.395	*
Ishiki.	鹿兒嶋郡,	伊敷町,	上伊敷,	脇園ノ迫	2466	IV, 1892	14.219	,,	13.917	−0.302

TABLE XL. (*Cont.*)

Bench-Mark.					Before Eruption.		After Eruption.		Difference.
Locality.				No.	Month, Year.	Height.	Month, Year.	Height.	
						metre		metre	metre
Ishiki.	鹿兒嶋郡,	伊敷町,	上伊敷, 野稻ヶ原	2465	IV, 1892	17.888	VI, 1914	17.597	−0.291
,,	,,	,,	小山田, 關ノ平	2464	,,	26.805	,,	26.514	−0.291
,,	,,	,,	,, アブミ坂	2463	,,	66.070	,,	65.811	−0.259
,,	,,	,,	,, 内　門	2462	,,	105.638	,,	105.413	−0.225
,,	,,	,,	,, ヤケ山	2461	,,	143.587	,,	143.337	−0.250
Shimo-Ijuin.	日置郡,	下伊集院町,	麥生田, 笹　原	2460	II, 1892	101.299	,,	101.128	−0.171
,,	,,	,,	下神殿, 永　山	2459	,,	104.868	,,	104.683	−0.185
,,	,,	,,	,, 樋ノ原	2458	,,	82.074	,,	81.893	−0.181
,,	,,	,,	野　田, 崩　下	2457	,,	64.514	,,	64.349	−0.165
,,	,,	,,	苗代川, 樋　掛	2456	,,	55.996	II, 1915	55.870	−0.126
Higashi-Ichiku.	,,	東市來村,	長　里, 古　川	2455	,,	30.053	,,	29.903	−0.150
,,	,,	,,	湯　田, 溝　下	2454	,,	31.625	,,	31.504	−0.121
Nishi-Ichiku.	,,	西市來村,	大　里, 上池田	2453	,,	6.636	,,	6.516	−0.120
,,	,,	,,	,, 西　村	2452	,,	4.560	III, 1915	4.476	−0.084
,,	,,	,,	湊　町, 市口町	2451	,,	2.721	,,	2.616	−0.105
Kushikino.	,,	串木野村,	下　名, 西前床	2450	,,	13.135	,,	13.053	−0.082
,,	,,	,,	,, コブ下	2449	,,	5.828	,,	5.734	−0.094
,,	,,	,,	下　名, 野下口	2448	,,	38.108	,,	38.020	−0.088
,,	,,	,,	,, 山神下	2447	I, 1892	75.950	,,	75.847	−0.103
Kumanojo.	薩摩郡,	隈之城村,	西　手, 木　場	2446	,,	35.210	,,	35.105	−0.105
,,	,,	,,	東　手, 仁禮木	2445	,,	13.481	,,	13.385	−0.096
,,	,,	,,	西　手, 後牟田	2444	,,	9.415	,,	9.328	−0.087
,,	,,	,,	向　田, 新　町	2443	II, 1900	5.871	,,	5.775	−0.096
Hi.-Mizuhiki.	,,	東水引村,	宮　内, 城ノ後	2442	I, 1892	5.120	,,	5.001	−0.119
,,	,,	,,	五　代, 小野原	2441	,,	13.946	,,	13.850	−0.096
Nishi-Mizuhiki.	,,	西水引村,	小　倉, 栫,	2440	,,	5.161	,,	5.032	−0.129
,,	,,	,,	草　道, 井手平	2439	,,	4.360	,,	4.246	−0.114
,,	,,	,,	綱　津, 五反田	2438	,,	4.064	,,	3.953	−0.111
Takaki.	,,	高城村,	湯　田, 火神山	2437	,,	3.864	,,	3.736	−0.128
,,	,,	,,	西　方, 古野岡	2436	,,	24.828	,,	24.747	−0.081
,,	,,	,,	,, 濱　田	2435	,,	3.897	,,	3.787	−0.110

[Province of Satsuma.]

TABLE XL. (*Cont.*)

Bench-Mark.						Before Eruption.		After Eruption.		Difference.
Locality.					No.	Month, Year.	Height.	Month, Year.	Height.	
[Province of Satsuma.]							metre		metre	metre
Akune.	出水郡,	阿久根村,	大 川,	磯 邊	2434	I, 1892	19.217	III, 1915	19.139	−0.078
,,	,,	,,	,,	鳥井ヶ段	2433	,,	11.280	,,	11.201	−0.079
,,	,,	,,	,,	春 田	2432	.,	15.324	,,	15.248	−0.076
,,	,,	,,	,,	牟田平	2431	,,	6.322	,,	6.212	−0.110
,,	,,	,,	西 目,	高之口	2430	,,	4.818	,,	4.690	−0.128
,,	,,	,,	波 留,	建 石	2429	,,	2.684	,,	2.574	−0.110
,,	,,	,,	赤瀬川,	下ノ田	2428	,,	18.858	,,	18.772	−0.086
,,	,,	,,	,,	大山口	2427	,,	27.688	,,	27.605	−0.083
,,	,,	,,	折 口,	岩 掛	2426	,,	14.959	,,	14.873	−0.086
Noda.	,,	野田村,	下 名,	垣 内	2425	,,	4.661	,,	4.545	−0.119
,,	,,	,,	,,	田ノ神丸	2424	,,	17.036	IV, 1915	16.896	−0.140
Naka-Izumi.	,,	中出水村,	莊,	田ノ神	2423	,,	7.029	,,	6.748	−0.281
Takaono.	,,	高尾野村,	下水流,	アザミ原	2422	,,	5.100	,,	5.002	−0.098
Naka-Izumi.	,,	中出水村,	下知識,	西新藏	2421	,,	4.309	,,	4.203	−0.106
,,	,,	,,	,,	原 圍	2420	,,	3.832	,,	3.734	−0.098
,,	,,	,,	下鯖淵,	坪ノ屋敷	2419	,,	7.403	,,	7.337	−0.066
,,	,,	,,	,,	下針原	2418	,,	4.885	,,	4.799	−0.086
,,	,,	,,	,,	鹽 屋	2417	,,	9.525	,,	9.458	−0.067
[Province of Higo.]										
Minamata.	葦北郡,	水俣町,	袋,	一ツ橋	2416	,,	43.105	,,	43.037	−0.068
,,	,,	,,	,,	薄 月	2415	,,	5.720	,,	5.589	−0.131
,,	,,	,,	月 浦,	前 田	2414	,,	14.110	,,	14.017	−0.093
,,	,,	,,	濱,	百 間	2413	,,	1.976	,,	1.897	−0.079
,,	,,	,,	陣 内,	陣 町	2412	XII, 1891	3.999	,,	3.923	−0.076
,,	,,	,,	,,	雲雀田	2411	,,	35.800	V, 1915	32.618	*
,,	,,	,,	小津奈木,	前 田	2410	,,	8.064	IV, 1915	7.952	−0.112
Tsunaki.	,,	津奈木村,	岩 城,	櫻 田	2409	,,	59.828	V, 1915	9.086	*
,,	,,	,,	津奈木,	神 前	2408	,,	21.548	IV, 1915	21.469	−0.079
,,	,,	,,	千 代,	千代原	2407	,,	73.208	V, 1915	73.124	−0.084
Yunoura.	,,	湯浦村,	湯 浦,	斧田迫	2406	,,	160.030	,,	159.955	−0.075
,,	,,	,,	,,	山 川	2405	,,	12.546	IV, 1915	12.477	−0.069

TABLE XL. *(Cont.)*

Bench-Mark.				No.	Before Eruption. Month, Year.	Before Eruption. Height.	After Eruption. Month, Year.	After Eruption. Height.	Difference.
Locality.						metre		metre	metre
[Province of Higo.]									
Yunoura.	葦北郡，	湯浦村， 湯　浦，	湯　治	2404	XII, 1891	67.030	IV, 1915	66.948	−0.082
Sashiki.	„	佐敷村， 花　岡，	淵ノ本	2403	„	8.540	„	8.469	−0.080
„	„	„　　　　„	宇　戸	2865	IX, 1891	7.251	„	7.169?	−0.082
[Province of Ōsumi.]									
Shikine.	姶瓦郡，	敷根村，　麓，	垂　水	2797	I, 1895	88.592	VIII,1914	88.223	−0.369
Fukuyama.	„	福山村， 福　山，	塚　田	2489	II,1892	2.602	„	2.254	−0.348
„	„	„　　　　„	熊ノ谷	2490	„	6.060	„	5.759	−0.301
„	„	„　　　　„	元屋敷	2491	„	2.928	„	2.622	−0.306
Ushine.	肝屬郡，	牛根村，　境，	磯，	2492	„	9.735	„	9.302	−0.433
„	„	„　　　　„	磯　口	2493	„	6.672	„	6.246	−0.426
„	„	„　　　　„	境　崎	2494	„	14.661	„	14.208	−0.453
„	„	„　　 二　川，	磯口平	2495	„	2.516	„	2.160	−0.356
„	„	„　　　 麓，	圖　師	2496	„	8.758	„	8.414	−0.344
„	„	„　　　　„	前　田	2497	„	5.820	VII, 1914	5.457	−0.363
„	„	„　　　　„	„	2498	„	4.449	„	4.048	−0.401
„	„	„　　　　„	磯，	2499	„	8.708	„	8.240	−0.468
Tarumizu.	„	垂水村， 海　潟，	大　谷	2500 (A)	„	4.261	„	12.276	*
„	„	„　　　　„	門ノ口	2501	„	6.443	„	6.064	−0.379
„	„	„　　　　„	天神山	2502	„	3.334	„	3.020	−0.314
„	„	„　　 中　俣，	脇田下	2503	„	3.188	„	2.946	−0.242
„	„	垂水村， 田　神，	川　崎	2504	„	4.355	„	4.148	−0.207
„	„	„　　 濱　平，	黑　瀨	2505	„	3.190	„	3.016	−0.174
„	„	„　　 柊　原，	鬼　山	2506	„	5.671	IX, 1914	5.496	−0.175
„	„	„　　　　„	上ノ濱	2507	„	3.936	„	3.785	−0.151
Shinjo.	„	新城村， 新　城，	南　方	2508	V, 1892	3.781	„	3.637	−0.144
„	„	„　　　　„	口ノ坪	2509	„	4.270	„	4.123	−0.147
„	„	„　　　　„	海馬場	2510	„	7.753	„	7.641	−0.112
Hanaoka.	„	花岡村， 木　谷，	糸　田	2511	„	17.562	„	17.451	−0.111
„	„	„　　　　„	南　迫	2512	„	128.413	„	128.296	−0.117