5. *Evolution of Mihara Crater, Volcano Oshima, Izu, in the Course of its Activities since 1874.*

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Introduction

Mihara Crater, the summit crater of the central cone Mihara-yama of the volcano Oshima, Izu, had a big eruption starting on July 16, 1950 and running into the next year[1]. During the eruption the crater was quite unsteady, showing many changes in its inside features with fluctuations of the activity. The new cinder cone was changed in form and height, and its active vent was shifted; a number of spatter cones and lava fountains appeared and disappeared on the crater-floor, as well as temporary lava pools; the bottom of the central pit, together with its new filling, underwent a rise and fall, the rise bringing about a central upthrust-mound in place of the pit and the fall a new sink just at the site of the old pit; and as the eruption advanced, the crater-floor increased in height with accumulation of new lava flows and cinders, its rising being interrupted occasionally by the slight settling of the new deposit. The eruption ended with a remarkable explosion on June 28, 1951, finally leaving a central sink and a cinder cone respectively in the middle and the southern part of the crater-floor, which now stood nearly flat and a few meters high above the crest of the old, northern crater-rim.

In the middle of August, 1951, according to an indirect levelling survey carried out by A. Okada, the bottom of the central sink was estimated at a height of about 650 m, the crater-floor at 685 m, and the cinder cone at 740 m, all above sea-level. The central sink, nearly circular in outline and about 300 m in diameter, was identical with the former central pit, though much shallower than the latter. The cinder cone was truncated with a bowl-shaped crater about 50 m deep and 150 m

1) H. TSUYA, R. MORIMOTO and J. OSSAKA, "The 1950–1951 Eruptions of Mt. Mihara, Oshima Volcano, Seven Izu Islands, Japan". *Bull. Earthq. Res. Inst.*, **32** (1954), 35–66; *ibid.*, **32** (1954), 289–312; *ibid.*, **33** (1955), 79–106.

wide. Its northern side which rested on the southern part of the central sink, slid down as the latter sunk, being notched with many fissures and slump scarps. The bottom of the cinder-cone crater was covered with the debris that fell off the surrounding walls. The crater-floor outside the central sink was covered in its southern two third with the fragmentary ejecta (cinders and bombs) of the explosive eruptions in last June, while the rest of the floor was a sea of lavas (now broken mostly into blocks) left uncovered by these ejecta.

After a twenty eight months' quiescence, Mihara Crater started erupting again on Oct. 5, 1953, and continued active with repeated eruptions until Feb. 10, 1954. But this time, the activity was of a small scale, taking place within the confines of the cinder-cone crater, and did not much modify the general feature of the inside of Mihara Crater (Figs. 9, 10). After having this activity as an aftermath of the 1950-51 eruption, the crater was seen to have become quiet without leaving any sign of imminence of further material change in its general features. Therefore, from Jan. 25-Feb. 5, 1955, we carried out a topographic survey of the crater with the purpose of seeing the net results of the 1950-51 and 1953-54 eruptions and of preparing an accurate crater map which may be useful for investigating the development of the crater in company with its activities. This paper presents the result of the survey, together with an account of the development of the crater during the past eighty years, as given by comparing the new crater map with old ones.

Topography of Mihara Crater as surveyed in Jan.-Feb., 1955

A topographical survey of Mihara Crater was carried out in ten days ending Feb. 5, 1955, with the result as shown in the map of Fig. 8. A. Okada was in charge of the survey and was assisted by T. Watanabe in the work. The points of the survey are as follows:

(a) A base line A-B necessary for the triangulation of the crater was laid out on the northwestern part of the crater-floor between the points A and B, Fig. 1. The length of the base line, measured directly with a tape, was 247.92 m, and one end B of the line was 1.3 m higher in level than the other.

(b) Twenty six stations A, B, C....Y, Z were selected in and around the crater as trigonometric points for the first triangulation, and their positions (coordinates x, y) were determined by constructing an expansion net with A–B as the base line and by means of triangulation with the Wild transit. The trigonometric points were plotted on the plane table with scale, 1 : 3,000, and with a probable error of ± 0.8–1.2 m.

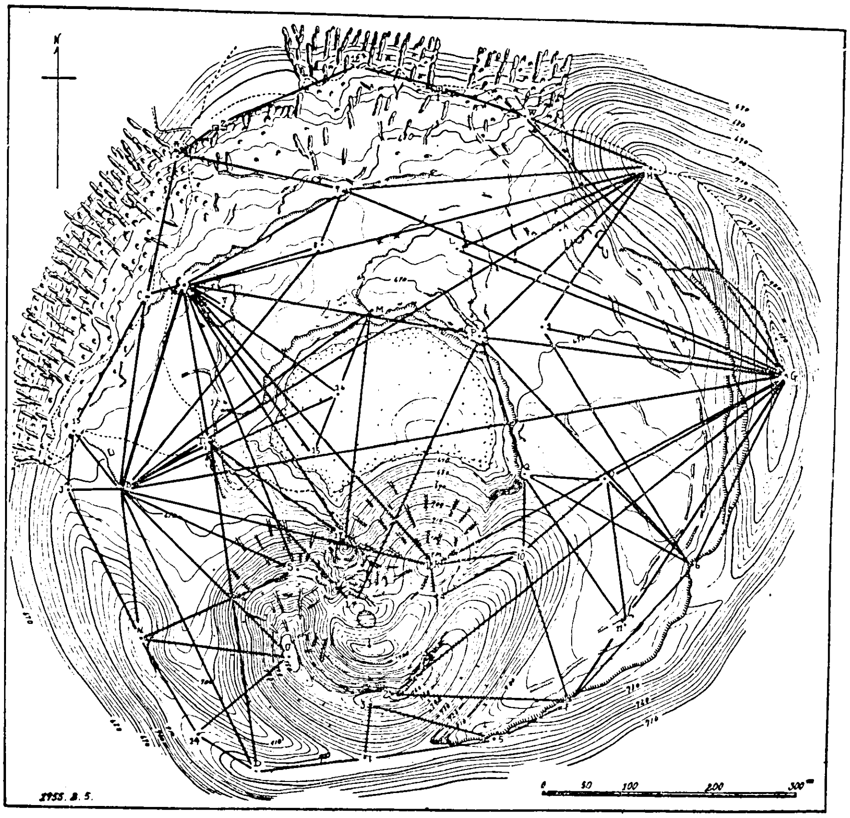

Fig. 1. Provisional triangulation net covering the Mihara crater.

(c) Seventeen additional survey-stations 1, 2, 3....17 were selected in the triangulation net, and their position was determined within a probable error of ± 1.0–1.5 m by means of an alidade with telescope.

(d) The station Z was used as the starting point of a levelling along the route Z-J-N-D-E-F-G-H-W-I-Z around the rim of the crater. It was an old survey-station, situated about 50 m northeast of the tea house (the former Kakô-jaya), on the old crater-rim left uncovered by the 1950–51 lava-flows. The height of the station was determined to be 672.6 m by means of an indirect levelling with the Wild transit[2]. On starting from the station and completing a circuit of the crater, the levelling showed a closing error amounting to 1.05 m[3]. The heights of the trigonometric points in the crater were calculated on the plane table with a stadia and by other means. The probable error of the heights thus calculated was within $\pm$60–90 cm.

(e) The station Z was taken as the origin of azimuth, its azimuth at the bench mark BM. O-10 being determined by an astronomical observation.

As shown by the new map (Fig. 8), the crater is divided topographically into three parts: the cinder cone in the south, the central sink in the middle, and the outer crater-floor surrounding the central sink on all sides but the south where the cinder cone stands. Having been formed by the 1950–51 eruptions, the general topographical features of these parts showed up immediately after the eruptions in August, 1951[4], although they have been modified a little since then, especially by the small 1953–54 eruptions.

The *cinder cone* is about 72 m in height above the flat ground adjacent to its east and west sides, and overtops by about 40 m the southern rim of the old crater-wall against which it has been banked, thus attaining the height of 762 m above sea-level. Before the 1950–51 eruptions, the crater-floor on which the cinder cone rests was 640 m above sea-level, and the crest of the southern rim of the crater-wall was 705 m. It follows, therefore, that the net height of the cinder cone formed by the 1950-51 and later eruptions is about 122 m, and the 1950–51 and later ejecta accumulated on the rim of the old crater-wall on the south side of the cinder cone are about 10 m in thickness. The cone does not differ much in form from that observed in August, 1951; that is, its outer slopes show a smooth conical surface on all sides except the north where, in addition to many slides and slump scarps, there is a pyramidal mound cut off from the main part of the cone by its slumping toward the central sink. At the closing stage of the 1950–51

2) The starting points of the survey were two bench marks previously set up by the Earthquake Research Institute: one (E.R.I. BM. O-10, height =557.7156 m above the sea) situated 60 m south of Goshinka-jaya on the northwest somma and the other (E.R.I. BM. O-11, height=538.5845 m above the sea) on the 1778 lava-flow on the left side of the new toll road leading from Goshinka-jaya to the crater.

3) The weather conditions at the time of the levelling work made it difficult to get more accurate results.

4) H. TSUYA, R. MORIMOTO and J. OSSAKA, The 1950-1951 Eruption of Mt. Mihara, Oshima Volcano, Seven Izu Islands, Japan. Part II. The 1950 eruption. B. Activity of the third period. *Bull. Earthq. Res. Inst.*, **33** (1955), 79.

eruptions, this mound moved up and down in accordance with the similar movement of the floor of the central sink, but now it is virtually at a standstill with its top (R in Fig. 1) at a height of about 755 m above sea-level. The central part of the cone has a crater of about 170 m in diameter, and its floor is occupied with a central cone formed by the 1953–54 eruptions. Between the southern wall of the crater and the central cone lies a crescent depression, about 54 m in depth below the upper edge of the crater-wall on its southeast side. The crater-wall, facing this depression, shows a steep slope varying from an almost perpendicular cliff at the upper edge to an inclination of about 50° near the base. The northern side of the crater is not enclosed with a continuous wall, but there are two wide and deep gaps in the wall: one on the east side and the other on the west side of the above-mentioned pyramidal mound. Besides, the inside of the northern crater-wall is largely covered with the northern slope of the 1953–54 central cone, which is joined to the pyramidal mound on its east side and to the western crater-wall on it west side.

The cinder cone is composed exclusively of fragmentary basaltic ejecta varying in size from bombs as large as several meters in diameter to cinders of lampilli grade. When the cone was surveyed in Feb., 1955, white vapors were being emitted from fumaroles studded here and there, particularly on its northwest part. At the same time, slumping of the northwestern slope of the cone and the northern slope of the pyramidal mound was still going on in the direction of the central sink. Thus, for example, the station S on the northwestern slope of the cone was found to have moved about 2 m in the course of the topographic survey.

The *central sink* or pit is a successor to the old central pit which, before being filled up with ejecta of the 1950–51 eruptions, was a circular cauldron, about 300 m across and 135 m deep. The present sink came into existence in July, 1951, immediately after a repetition of engulfment and upthrust of the lava-filled floor of the old central pit at the closing stage of the 1950–51 eruptions. Thus it occupies just the same position as the old central pit retaining its coaxial relation with the outer crater. Like the old pit, it is circular in outline and about 300 m in diameter, although its southern part is covered by the northern slope of the cinder cone. The semi-circular rim that surrounds the east, north and northwest sides of the sink is for the most part a precipitous cliff about 25 m high. The west side of the sink is deeply notched outward so as to form a large westward swell of the otherwise circular rim.

This part marks the site of the subsidiary vent which, in company with the main vent on the cinder cone, displayed an explosive emission of bombs and cinders on June 17, 1951[5]. It is probable that since then the vent has collapsed with the advance of engulfment of the central sink, resulting in the formation of the feature just mentioned. At the south where the sink is overlapped by the cinder cone, the rim of the former runs across the latter, forming a number of fissures and slump scarps. Thus the pyramidal mound, which represents the northern section of the cinder cone, stands inside of the south rim of the central sink. If the top of this mound is assumed to have been originally in the same level as the top of the south crater-rim of the cinder cone, it is inferred that the former has subsided about 25 m together with engulfment of the central sink. The floor of the sink, covered with a sea of block lava-flow came down from the crater of the cinder cone at the time of the 1953-54 eruptions, forms a flat ground about 664 m above sea-level and about 25 m below the upper edge of the surrounding rim; but it is hardly passable because of its whole surface being roughened with many small ridges and cracks.

The *outer crater-floor*, which surrounds the east, north and west sides of the central sink, is about 675 m in height above sea-level at the north near the old crater-rim, and rises gradually southwards, attaining a height of about 700 m at the east and west base of the cinder cone. On an average it is about 45 m higher than the old floor which, before the 1950-51 eruptions, was about 645 m in height above the sea. This shows that the 1950-51 lava-flows, together with a little fragmentary ejecta, have accumulated 45 m deep on the old floor. The surface of the floor in its northern part is rugged with lava broken into pieces, presenting a succession of small elevations and depressions, while it is rather smooth in its southern part, being covered with cinders and bombs, the deposit of which gradually thickens toward the cinder cone. About 150 m south of the northern crater-rim is a crescent escarpment, several meters high and concentric with the central sink, in the surface lava covering the crater-floor. This is just above the old cliff which, running along the inner margin of the northern crater-rim, has been buried beneath the new lava filling up the crater on this side. It is probable that the lava on the north side of the escarpment was less liable to the settling than that on the opposite side during and after the 1950-51 eruptions, because the former rested on the solid ground of the

5) H. TSUYA, R. MORIMOTO and J. OSSAKA, *op. cit.*, Pl. XIX, Fig. 125 (b).

old crater-rim. The eastern and western sections of the crater-floor have less relief, being covered with fragmentary ejecta (cinders and bombs), the deposit of which thickens southwards towards the base of the cinder cone. There remains none of the spatter cones with which the crater-floor had been pinnacled here and there during the 1950–51 eruptions.

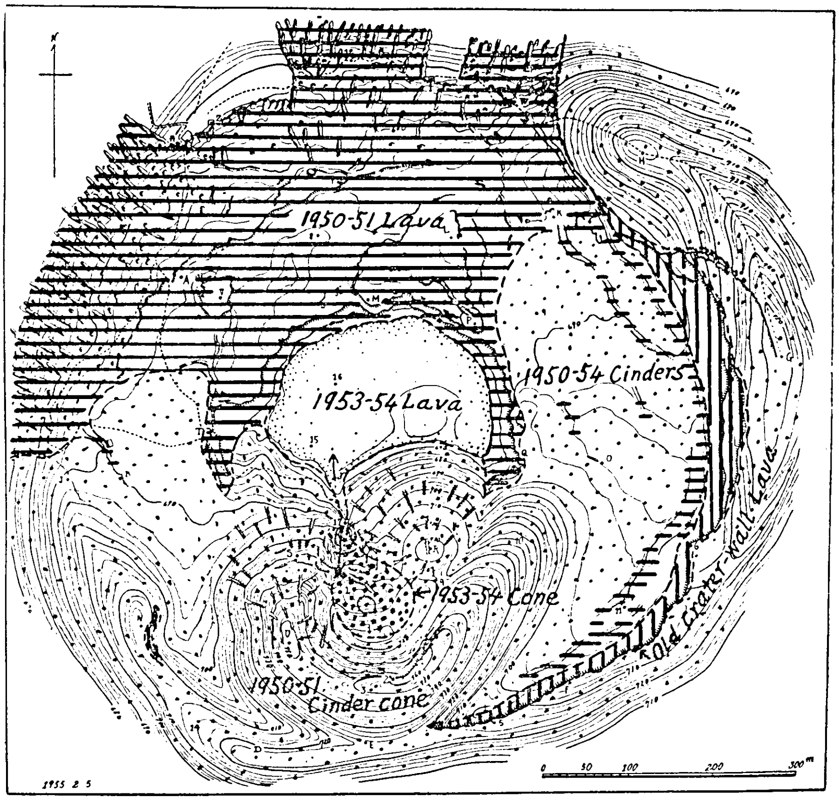

Fig. 2. Distribution of new ejecta in the Mihara crater.

Before the recent eruptions the crater was surrounded with an almost perpendicular cliff varying in height from about 100 m on the east side to 5 m on the north-northwest. At present the upper half of the cliff on the east and southeast sides only is seen as it was, remaining uncovered with new ejecta, and along the base of the present cliff is a narrow, cinder-covered lava bench a few meters high, left behind in the sinking of the general crater-floor.

Table I. Heights of the provisional trigonometric stations set in and around the Mihara crater. (in m. above sea-level)

Primary stations*	(1955)	(1950)	(1937)**	(1924)***
A	688.6			
B	689.9			
C	889.8			
D	721.1			
E	722.6		[706.0]	[715.0]
F	736.5		[726.0]	[732.0]
G	755.8	752.0	755.5	755.0
H	716.7		[717.0]	[725.0]
I	671.6	671.0		
J	690.2		[687.0]	682.9
K	688.0			
L	687.8			
M	694.8			
N	716.4		711.21	[718.0]
O	686.6			
P	694.5			
Q	690.3			
R	734.1			
S	719.9			
T	688.3			
U	750.3			
V	695.0			
W	680.1			
X	—			
Y	674.0			
Z	672.6	672.0	677.71	678.3
Secondary stations*				
1	726			
2	762			
3	752			
4	720			
5	726			
6	727			
7	686			
8	684			
9	689			
10	714			
11	695			
12	671			
13	687			
14	716			
15	662			
16	662			
17	693			

* Cf. Fig. 1.

** R. Takahasi and T. Nagata, Geophysical Studies of Volcano Mihara, Ooshima Island, *Bull. Earthq. Res. Inst.*, **15** (1937), 440.

*** S. Nakamura, Topographic Survey of Volcano Mihara, Oosima Island, Izu, *Report Earthq. Invest. Com.*, **100** B (1925), 73.

The figures in square brackets are the approximate heights read from the crater maps of the respective authors.

The outer rim of the crater is higher on the east and southeast than on the north and northwest. Thus the heights of the crater-rim are as shown in Table I, in which they are compared with those of old. The station G of the 1955 survey is not exactly in the same position as that of the 1951 survey, so that the former shows a much higher level than the latter. Besides, our levelling stations on the crater-rim do not coincide exactly with those set by Takahasi and Nagata in 1937 and by Nakamura in 1924. Thus the figures shown under the columns (1937) and (1924) in the table are the heights of the points which may be checked on the 1937 and 1924 crater-maps as lying very close to our levelling stations. The figures in square brackets represent the approximate heights as obtained by reading the contour-lines on the maps. Under these circumstances, nothing definite can be said as to a vertical displacement of the crater-rim, which might have occurred within the the years 1924-1937 and 1937--1955. But, supposing that the crater-rim had not been subjected to any vertical displacement, it has been built up by the accumulation of the 1950-51 and later ejecta. Thus the east crater-rim (G-H) is covered with the ash and sand to depth of scores of centimeters; the southeast, south and west crater-rim (F-E-D-N-J) is covered with the cinders and bombs to a depth of about 3 m; and the northwest and north crater-rim (J-Z-I-W) is covered with the 1950-51 lava-flows 2-5 m thick, excepting the small portions (Z and I) where the almost flat ground of the old crater-rim is exposed as it was before the 1950-51 eruptions. As shown in Table I, the height of the old crater-rim at the levelling station Z is about 672 m above the sea, according to our survey in 1951 and 1955; it is about 5 m lower than that observed by Takahasi and Nagata in 1937 and by Nakamura in 1924 at a point not far from Z. This level difference may be too large to be regarded as having been brought about by a vertical displacement of the crater-rim; but rather it may largely be laid to the circumstance that, unlike ours, the levellings by Takahasi and Nagata and by Nakamura were, carried out on the assumption that their base stations on Kengaminé (G) were 755.25 m and 755.0 m above sea-level respectively.

Topographic changes caused by the 1953-54 eruptions of Mihara Crater

After the cessation of the 1950-51 eruptions in July, 1951, the Mihara crater had been dormant for 27 months until October, 1953, when it resumed an eruptive activity. Thus, during the dormant period, nothing other than little fumarolic gases, if any, was seen issuing from the crater, although the ground heat in the crater was still as high as 700°C in March, 1953, and local shocks and volcanic tremors were recorded at times at the Oshima Meteorological Observatory[6].

The eruptive activity which began on Oct. 5, 1953, continued for about 4 months with recurrent eruptions in the following five periods[7].

(1) The first period: Oct. 5—Oct. 12, 1953.
(2) The second period: Nov. 9—Nov. 13, 1953.
(3) The third period: Dec. 1—Dec. 18, 1953.
(4) The fourth period: Dec. 28, 1953—Jan. 16, 1954.
(5) The fifth period: Jan. 27—Feb. 8, 1954.

The eruption of the first period, which began on Oct. 5, at about 8h 32 m, was a recurrent, explosive ejection of incandescent lava pieces and cinders from a new vent, about 1.5 m in diameter, bored by the first explosion in the middle of the west wall of the cinder-cone crater. The daily occurrence of the eruption was as follows.

Oct. 5. 8h 32 m. Commencement of the eruption.
9h 30 m—11h. Explosions at intervals of about twenty minutes.
15h. Two or three explosions.
16h 30 m—evening hours. Recurrence of explosions with ejection of incandescent lava, each lasting twenty to thirty minutes.

Oct. 6. Recurrence of explosions with ejection of incandescent lava at intervals of about twenty minutes. The active vent was seen to have been enlarged to an opening as large as 6 m in diameter. The explosions were accompanied by emission of black ash-clouds, besides cinders rising up to about 70 m in the air above the vent.

Oct. 7. 9h 17 m—9h 24 m. The most vigorous eruption phase in the period, with explosions repeated in rapid succession and audible at the Motomura Meteorological Observatory. Black eruption clouds were seen rising several hundred meters high in the sky above the vent, besides cinders thrown up to a height of about 150 m.

Oct. 10. Three small explosions, of which the biggest occurred at 17h.

Oct. 11. Two explosions. 10h 40 m. Two explosions.

Oct. 12. Repeated explosions extending over twenty hours from the early morning to the evening hours, with the culmination of the activity at 15h–17h.
19h 30 m. The eruption suddenly came to an end.

Oct. 13. A large volume of white vapor cloud was rising continuously from the new vent.

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6) Kisho Yoran (The Geophysical Review), Central Meteorological Observatory, the Aug. (1950) issue et seq. (in Japanese).

7) As to the history of the eruptions in these periods, references have been made to the Kisho Yoran (the Oct., Nov. and Dec. issues, 1953; the Jan. and Feb. issues, 1954) and also to Mr. S. Watanabe's record of daily observation of the eruptions. Our thanks are due to Mr. Watanabe for the generosity he showed us in submitting his manuscript for reference.

From this day on the volcano was quiet until Nov. 9, when its eruptive activity of the second period broke out again in the crater of the cinder cone.

Nov. 9. 14h. The crater of the cinder cone split its west wall at a point about 30m east of the Oct. vent, and gave a new vent for five days to explosions accompanying spurting jets of incandescent lava, which flowed down into the central sink only.

Nov. 11–12. The eruption was almost continuous throughout these days, displaying spurting jets of incandescent lava, with repeated explosions.
Oct. 12, about 7h 40 m, explosions were heard at intervals of about thirty minutes at Goshinka-jaya (tea house) on the northwest somma; 9h 50m—11h, bombs as large as a human head were being thrown up to a height of 30m and smaller cinders to a height of 100 m. The same day, in the evening hours, lava was seen pouring out of the active vent, forming a flow, about 72m in length and 8m in breadth.

Nov. 13. The eruptive activity declined with subsidence of both explosion and lava ejection, although spouting of a large volume of white vapor clouds was still going on.

During the remainder of the month of November, solfataric activity continued with rise and fall of emission of the vapor clouds (Fig. 11). On Nov. 21, the pyramidal mound on the north of the cinder-cone crater was seen to have been fissured in various directions, in company with a subsidence of the ground along its northern base. On and after Nov. 29, the solfataric activity seemed to have been intensified until Dec. 1, when the eruption of the third period began.

Dec. 1. 7h 30m. A heavy explosion with emission of dark brownish ash and vapor clouds from the Nov. vent near the centre of the cinder-cone crater. From this time on similar explosions were recurrent until Dec. 18, sometimes accompanying cinder ejections. At the climax of the eruption, the ash and vapor clouds were thrown up in the air as high as 900 m above the vent, with flings of bombs and cinders up to a height of about 200 m.

Dec. 3. Almost continuous, big explosions. They were heard intermittently even at Goshinka-jaya.

Dec. 5. 9h 30m—16h 20m. Explosive emission of reddish-gray ash and vapor clouds at intervals of about forty minutes.
15h. The eruption clouds, bent to the north wind, overcast the sky above the village of Mabushi on the southern coast of the island.

Dec. 6. 12h 30m—15h 10m. Explosive emission of a large mass of reddish-gray ash and vapors at intervals of about one hour. About 10h 30m, an eruption occurred with ejection of lava clots so large so that their flight through the air up to a height of about 200m above the vent could be vividly seen from Goshinka-jaya. The same day, the northwestern slope of the pyramidal mound was seen to have partly slid down like a land slide, and at the same time the ground adjacent to the north base of the mound showed a subsidence of 5m or so, by eye-measurement.

Dec. 8. During the morning hours, explosions occurred at intervals of about two hours; in the afternoon, a small explosion at 13h 20m and a bigger explosion at 14h 30m.

Dec. 9. 9h—10h 30m. A big explosive eruption was repeated during these hours, accompanying ash and cinders that fell like heavy rain on the nearby ground with rustling noises.

Dec. 10. Almost continuous eruption throughout the day.

Dec. 14. During the morning hours, volcanic ash fell in the country northwest of the volcano, as far as the Motomura Meteorological Observatory.

Dec. 15. Recurrent explosions with noises like thunder and puffs of black ash-cloud.

Dec. 16. The Motomura Meteorological Observatory had a slight fall of volcanic ash in the evening.

Dec. 17. 9h—14h. The eruption was going in full swing, with repeated ejections of cinders and bombs. The ejecta were being thrown out as far as the southwest side of the cinder cone over its southwest crater-wall, which appeared to have badly engulfed.

Dec. 18. The most spectacular display of the eruption of the third period, at intervals of about twenty minutes. About 19h 30m, the eruption was still more thriving; repeated explosions were heard at Motomura village on the northwest coast of the island.

Dec. 19. The eruption seemed to have stopped late last night or early this morning. Thus, this day from 8h on, only a large volume of white vapors was seen rising quietly from the volcano.

After the eruption of the third period, its vent was found to have become a hollow, about 20 m in depth and 25 m in diameter, being united with the Oct. vent, and at the same time a considerable part of the southwest wall of the host crater was seen to have broke down, resulting in the formation of a deep notch in the wall (Fig. 13).

The eruption of the fourth period began on Dec. 28, at about 18h, and developed as follows.

Dec. 28. 18h. By this time the eruption began at the bottom of the cinder-cone crater and went on with almost incessant explosions, which at times could be heard at Motomura.

Dec. 29. 2h 30m. Explosions had become inaudible at Motomura, but lava ejection appeared to be still more increasing. This day, on visiting the scence of the eruption, it was found that explosive ejections of incandescent lava were taking place incessantly at two newly-opened vents lying close to each other in the middle of the cinder-cone crater. The two vents were vying with each other in activity, throwing out bombs and cinders in and around the host crater. Besides, black ash-clouds were seen rising from near the the vents.

Dec. 30. Almost continuous eruption throughout the day, with ejection of a large volume of cinders, presumably the largest ever observed in the present eruptions.

Dec. 31. Eurption has become intermittent with explosions at intervals of about thirty minutes.

Jan. 1, 1954. Eruption lasting for five to eight minutes occurred at intervals of thirty to forty minutes. A large bow-shaped depression which had been formed on the north slope of the pyramidal mound was sending forth a little white vapor.

Jan. 4. 7h—10h. Explosions reporting a violent eruption were heard at Motomura.

Jan. 5. A visit to the scene of the eruption showed that the most active vent about 40 m across was situated in the middle of the cinder-cone crater, incessantly spurting lava in the form of fire pillars about 80 m high, and the second active one was the vent of last Nov. and Dec., displaying jets of incandescent lava to smaller heights.

Jan. 6. 8h 30 m. From this time on short-lived explosive eruptions were recurrent at intervals of about one and a half hours. At the moment of one of the eruptions the vent of 40 m diameter was observed becoming full of incandescent lava and ejecting its pieces up to a height more than 200 m. Some of the large-sized lava pieces were thrown out more than 300 m away on the outside of the outer old cone.

Jan. 7–8. Repeated eruptions accompanying explosions at intervals of thirty to forty minutes. A large volume of lava was ejected as cinders and bombs: they were thrown out as far as 400 m away; the northwest side of the cinder cone, which had once been demolished badly by sliding toward the central sink, was built up again by accumulation of the new ejecta (Fig. 12).

Jan. 9. The activity became a little weaker than on the preceding two days, thus repeating ejection of a smaller quantity of lava at longer intervals, forty to fifty minutes.

Jan. 10. The activity culminated in an explosive eruption four or five times in four hours from 8h to 12h.

Jan. 12–15. Throughout these three days, there was again a great increase of activity; incandescent lava was thrown out almost continuously not only from the most active vent in the middle of the cinder-cone crater but also from two neighbouring, less active vents; spectacular lava fountains were displayed, besides spurting jets, each of which was seen lasting for several minutes like a magnificient fire pillar; on Jan. 14–15, some of the explosions that occurred in company with the eruptions were so loud as to be clearly heard at Tomisaki in the Boso peninsula, 50 km northeast of Oshima.

Jan. 16. Emission of white vapors only continued throughout the day.

Emission of white vapors without any accompanying explosion continued eleven days ending on Jan. 27, when the eruption of the fifth period came in with full drive to attain the climax of the activity since last October.

Jan. 27. 11h 30m. Cinder ejections started again from two vents in ths middle of the cinder-cone crater, forming continuous fire jets more than 200 m high; the ejections occurred in succession at intervals of about five seconds; not a few cinders were thrown up to a height ranging from 550 m to 1000 m and fell more than 500 m away on the southwest side of the old outer cone. 13h 30. About this time incandescent lava pouring out of the active vents began to flow down onto the floor of the central sink, forming a fire river 5m wide, that ran northwards through the gap in the north wall of the cinder-cone crater (the deep notch between the pyramidal mound and the northwest wall of the crater). 17h 30 m. The lava flow was found to have covered the greater part of the floor of the central sink, its amount of filling over the floor being about 50 m.

Jan. 28-31. The eruptive activity continued throughout these days, but it became weaker each successive day, with occasional lulls of the eruption.

Feb. 1. The lava flow into the central sink was still going on, besides repeated explosive eruptions throwing lava pieces up to a height of about 100 m and within a distance of 150 m.

Feb. 2. Explosive eruption from a vent about 10 m across was repeated at intervals of two seconds.

Feb. 3. Explosive eruption lasting for about 10 minutes was repeated several times. The height of the cinder jets was within 130 m (Fig. 13).

Feb. 4-8. During these days, explosive eruptions were repeated with cinder ejections up to a height of about 150 m.

The eruption which began in the crater of the 1950-51 cone the morning of Oct. 5, 1953, finished its apparent surface activity on Feb. 8, 1954, after five periods (63 days in all) of explosive ejections of pyroclastics (ash, lapilli and bombs) and including a few days of outflowing lava. Since the close of the eruption, both vapor and fume have been issuing continuously, but with fluctuation in their volume, from the ground in and around the crater of the cinder cone. Thus, in Feb., 1955, the inside of the crater was seen to have been cleared of both fumaroles and solfataras, while its surrounding wall, particularly the northwest wall, was studded with them, being covered in a cloud of vapor (Fig. 17-20).

In contrast with the 1950-51 eruptions in which the whole floor of the Mihara crater took part, the 1953-54 eruptions were displayed only within the crater of the cinder cone formed by the preceding activity, consisting mainly of explosive ejections of pyroclastics from small vents in the crater, although they were accompanied by a lava flow pouring into the central sink. Furthermore, compared with the 1950-51 activity, the present eruptions were very much weaker in the intensity of explosion, as inferred from the smaller range of spread of the ejected pyroclastics. Thus the great part of these materials, excepting the ashes carried away by the wind, has accumulated in and about the cinder-cone crater to build up its floor with a new crater-cone on the one hand and to rebuild its surrounding wall on the other, part of which was greatly demolished in the course of the present activity (Fig. 16).

The formation of a new cone in the cinder-cone crater, together with the filling of the central sink with new lava, are the most remarkable topographic changes resulted from the present activity in the Mihara crater, with the exception of a small increase in height of the cinder cone due to accumulation of new pyroclastic ejecta. The new crater-cone is about 100 m in diameter at its base and 20 m in relative height, thus coming to about 50,000 m^3 in volume. It has a circular craterlet, about 25 m in diameter, on the south side of its top. In the wall of the craterlet is exposed a lava sheet indicating that the new cone was formed not merely by accumulation of pyroclastics but, partly at least, by the lava flow which had become stagnant before running away into the central sink. The north side of the new cone is a steep slope facing on another craterlet which forms a circular opening about 30 m across at the outlet of the cinder-cone crater to the adjacent central sink. On the south of the new cone remains a small part of the floor of the cinder-cone crater, forming a crescentic depression, the bottom of which is about 708 m in height above sea-level and about 30 m higher than the floor of the same crater before the present activity. This level change of the crater-floor being taken into consideration, besides the formation of the new cone, the total volume of the new ejecta which have built up the floor is estimated to be about 72,500 m^3 inclusive of the volume of the new cone.

The new lava which poured over the floor of the central sink spread completely over the surface of the floor and extended itself up on the bounding talus slopes (Fig. 15). Before the present activity, the central sink was a bowl-shaped depression floored with the 1950–51 lava, and its floor showed a gentle slope descending towards the bottom of its central part, where it was about 656 m in height above sea-level and about 45 m below the upper edge of the surrounding walls. After solidification of the new fill, the floor has become almost flat, being built up to a height of about 662 m above sea-level. Thus the new lava floor is 16 m thick in the centre over the lowest point of the 1950–51 lava floor; it is 260 m long and 170 m wide at its greatest dimensions, with its long axis lying in a east-west direction, and covers a space of approximately 35,000 m^2. The volume of the new lava is about 215,476 m^3.

The total volume of the new ejecta may not be very much greater than 288,000 m^3 (sum of the new fills of the central sink and the cinder-cone crater), even if the pyroclastic ejecta that fell outside of the cinder cone were taken into account. It puts the present eruptions at grade

III of Tsuya's intensity scale of volcanic eruption[8], as against grade V of the same scale for the 1950–51 eruptions. The present activity was very much smaller in all respects than the preceding 1950–51 activity, suggesting that the former was an aftermath of the latter.

Topographic changes of Mihara Crater in the last eighty years

Since 1876 there have been ten eruptions of the Mihara crater, listed in the following chronological order:

1. Dec. 27, 1876—Feb. 6. 1877. Small eruptions[9].
2. Dec. 1910, 10 days about the 8th. Small explosions.
3. Feb. 23—June 10, 1912. The first period of activity in the big Meiji-Taishô eruptions[10].
   Sept. 16—Oct. 29, 1912. The second period of activity in the same eruptions.
   Jan. 14—25, 1913. The third period of activity in the same eruptions.
4. May 18—July 5, 1919. Eruptions[11].
5. Dec. 9, 1922—Jan. 30, 1923. Eruptions[12].
6. Aug. 11, 1938. A small activity[13].
7. Sept., 1939. A small activity.
8. Aug. 19, 20, 1940. Small explosions[14].
9. July 16—Sept. 23, 1950. The first period of activity in the big Shôwa eruptions[15].

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8) H. TSUYA, Geological and Petrological Studies of Volcano Fuji, V. 5. On the 1717 eruption of Volcano Fuji. *Bull. Earthq. Res. Inst.*, **33** (1955), 379.

9) E. NAUMANN, Die Vulcaninsel Ooshima und ihre jungste Eruption, *Zeit. Deut. Geol. Gesell.* **29** (1877), 364.

J. MILNE, The Volcanoes of Japan, *Trans. Seis. Soc., Japan,* **9** (1886), 75.

10) F. OMORI, Preliminary Report on the Eruption of Volcano Oshima, *Report Earthq. Invest. Com.*, **81** (1905), (in Japanese).

S. NAKAMURA, The Eruption of Volcano Oshima, Izu, *Toyo Gakugei Zasshi*, **29** (1912), 225 and 270 (in Japanese).

11) F. OMORI, The Eruption of Volcano Oshima, Izu, *ibid.*, **37** (1919), 99, 150, and 247 (in Japanese).

12) F. OMORI, The Eruption of Volcano Oshima, Izu, *ibid.*, **40** (1923), No. 497, 139; No. 498, 142; No. 499, 141 (in Japanese).

13) T. NAGATA, Recent Activity of Mihara-yama, Volcano Oshima, *Bull. Volc. Soc., Japan*, **4** (1939), 192 (in Japanese).

14) T. NAGATA, A Geomagnetic Study of Minor Activities of Volcano Mihara, Oshima Island, August 1940, *Bull. Earthq. Res. Inst.*, **19** (1941), 402.

15) H. TSUYA, R. MORIMOTO and J OSSAKA, The 1950–51 Eruptions of Mt. Mihara, Oshima Volcano, Seven Izu Islands, Japan, *Bull. Earthq. Res. Inst.*, **32** (1954), 35; 289; **33** (1955), 79.

Feb. 4—March 31, 1951. The second period of activity in the same eruptions.

April 1—June 28, 1951. The third period of activity in the same eruptions.

10. Oct. 5, 1953—Feb. 8, 1954. The eruptions to which references have been made in the preceding chapter of this paper.

Of the above-listed eruptions, four (nos. 2, 6, 7, 8)[16] have been purely explosive activity of short duration, each being accompanied by ejection of a small quantity of ash and cinders, but without causing any material change in the configuration of the crater floor, while the other six (nos. 1, 3, 4, 5, 9, 10) have been periods of explosive and effusive activity of longer duration, each accompanied by a remarkable change in the configuration of the crater-floor. Thus the topographical evolution of the Mihara crater since 1876 is as shown in Figs. 3-4.

The crater has a permanent conduit pit (central sink) in the middle of its floor. In the 1912–13 and 1950–51 eruptions, lava filled the pit, overflowed its rim to build up the surrounding crater-floor, and the overflow was at each time followed by subsidence of the floor of the pit. In 1876, when a new cinder cone called Naumann's cone (N in Fig. 3a; Nm in Fig. 7) was formed in the southwest corner of the crater, any depression suggestive of the conduit was absent in the middle of the crater-floor[17]. After the 1876 activity, the crater was quiet without showing any activity mentioned either as an explosion or an eruption, until Dec., 1910, when a few days' eruptive activity occurred. But in this period of relative quiescence, the middle of the crater had changed into a large depression representing the conduit pit. Thus, in 1896, near the middle of the crater-floor was found a depression surrounded by steep walls and exposing red-hot molten lava in a pit at its bottom[18]; in 1907, the depression was found to have been enlarged by collapse at its rim, resulting in a central pit, about 160 m across, surrounded by terraced walls[19].

In Dec., 1910, the central pit of the crater showed a minor activity

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16) Besides these, similar minor activities have been mentioned as occurred in Oct., and Dec., 1933, and in Sept., 1939.

17) Nothing is known about the state of the Mihara crater in 1870, when a minor eruption continued four days, and in about a century preceding it.

18) N. YAMASAKI, Report on the Volcano Oshima, *Report Earthq. Invest. Com.*, **9** (1896), (in Japanese).

19) S. NAKAMURA, T. TERADA and D. ISHITANI, Oshima, its Past and Present. *Jour. Geogr. Soc., Tokyo*, **20** (1908), 682 (in Japanese).

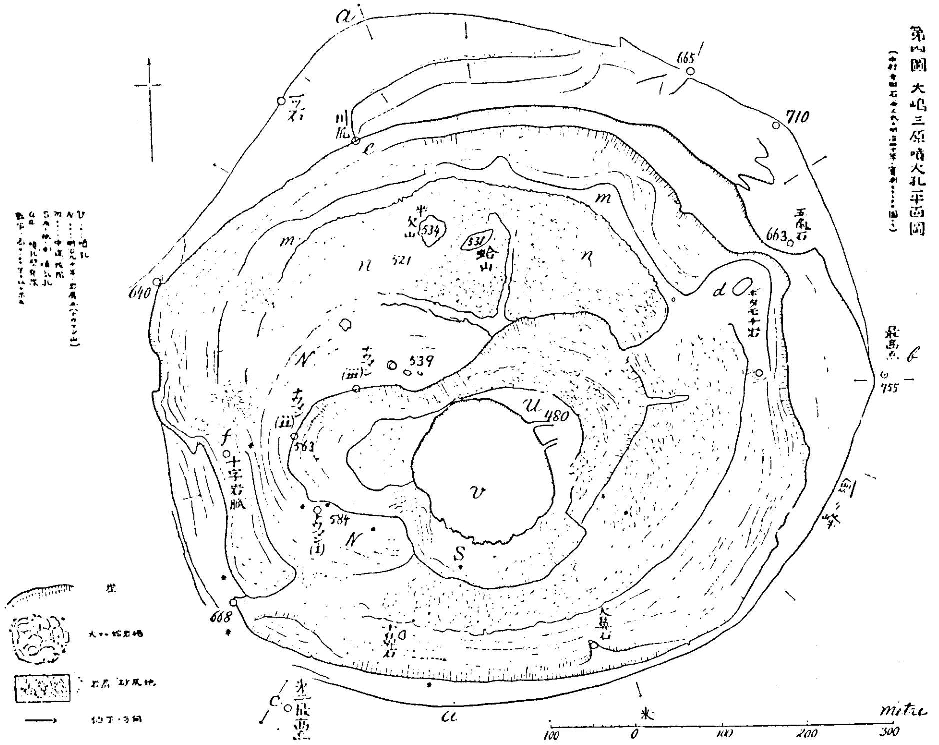

Fig. 3 a. Map of the Mihara crater, 1907, by Nakamura, Terada and Ishitani.

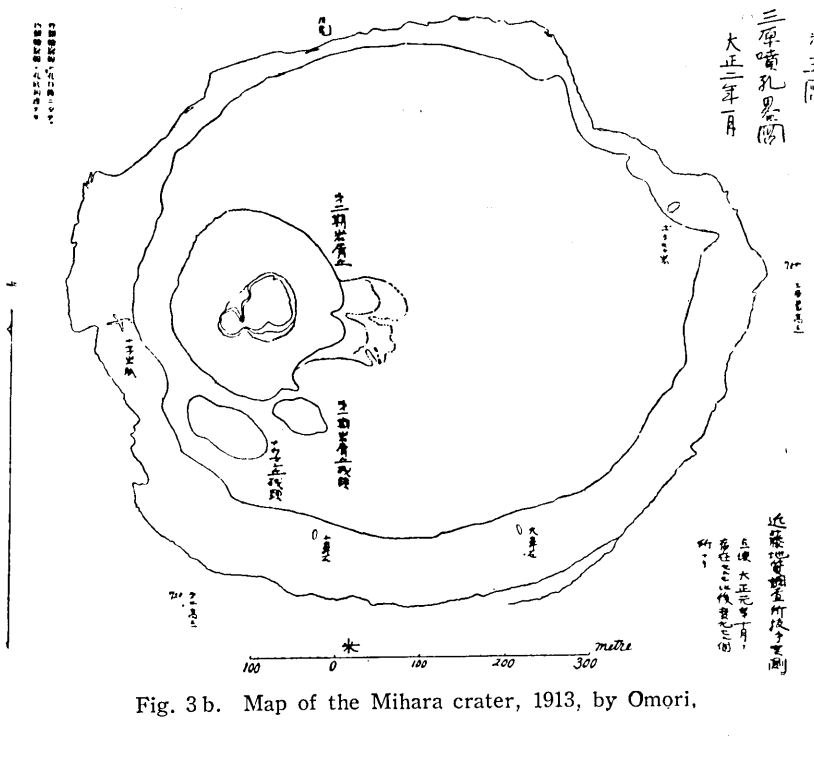

Fig. 3 b. Map of the Mihara crater, 1913, by Omori.

lasting for about ten days, and in its bottom was found a new cinder cone, about 60 m in diameter at the base, besides exposures of red-hot lava. It is inferred that by this time the bottom of the central pit was being built up with new lava rising from below, in company with minor eruptions in the pit. Two years later, the activity of the crater culminated in the big Meiji-Taishô eruptions, through which the configuration of its floor underwent a complete change.

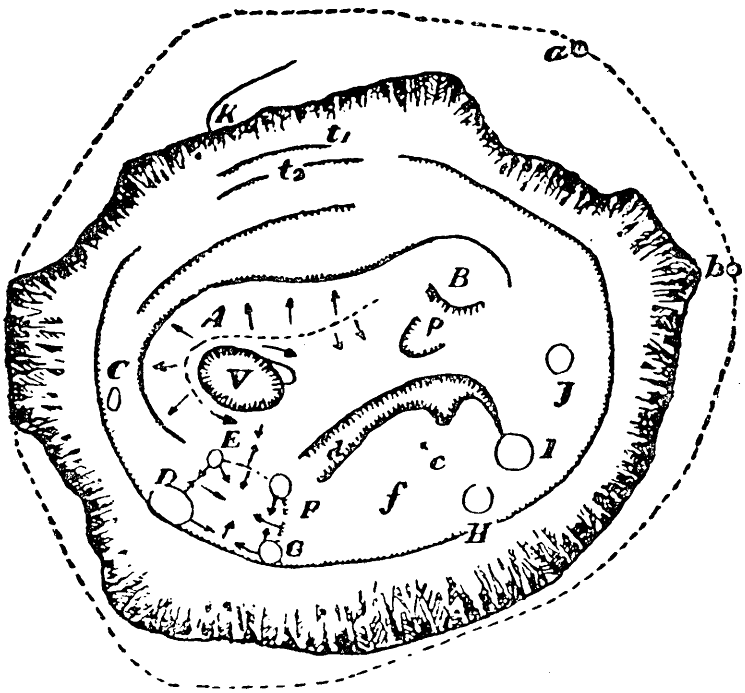

Fig. 3 c. Map of the Mihara crater, 1916, by Tsuboi.

The Meiji-Taishô eruptions occurred successively in three periods, Feb. 23—June 10, 1912, Sept. 16—Oct. 29, 1912, and Jan. 14–25, 1913. The activity of the first period began at the bottom of the central pit, both with explosive ejection of cinders and effusion of incandescent lava rising from the underlying conduit. Thus, early in that period, the new ejecta filled the central pit and the effluent lava overflowed the rim of the pit to build up the floor of the outer crater, and then a new cinder cone (Nk in Fig. 7) was formed on the crater-floor near the southwest side of the former central pit. The activity of the first period was followed by a subsidence, about 27 m in level, which occurred at the middle of the crater-floor in July 27–29, 1912, in company with the squeezing out of a little lava at the crater-floor and a minor ejection of cinders at the new cone.

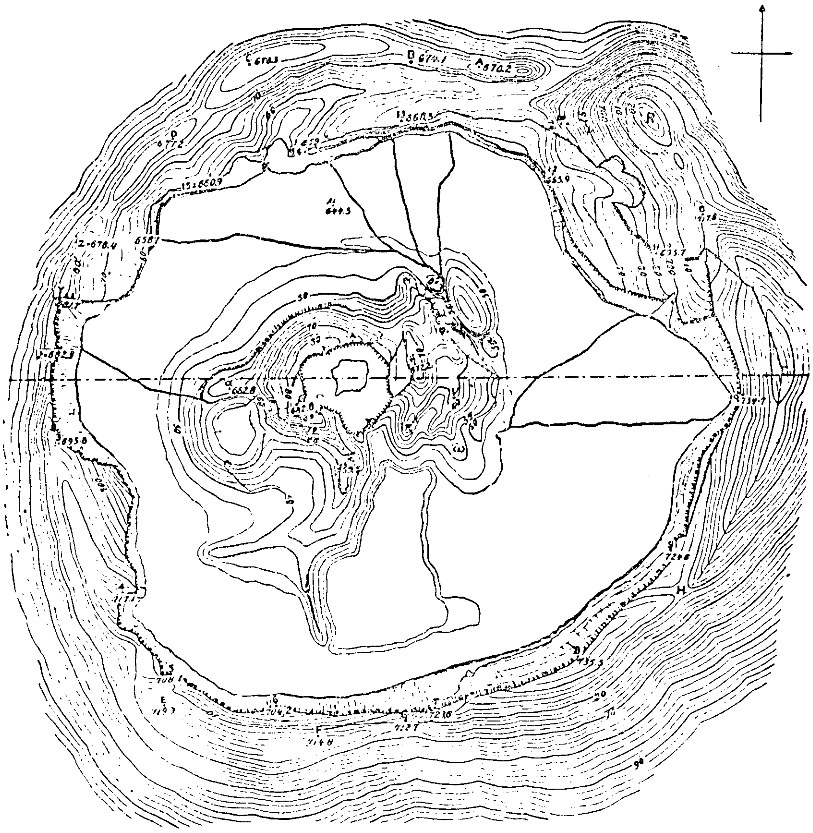

Fig. 3 d. Map of the Mihara crater, 1924, by Nakamura.

The activities of the second and third periods were displayed in a similar manner as the preceding one, but with eruptions of successively shorter duration. The overflow of lava on the crater-floor, together with the building up of a cinder cone (O in Fig. 7), were followed each time by the subsidence of the crater-floor.

By the Meiji-Taishoô eruptions, the old crater-floor was covered with the new lava, about 100 m in thickness, and the old central pit became invisible, although the repeated subsidences of the crater-floor during the activity must have been a feature tending to the formation of a new central pit. Figs. 3 b and 3 c show the configuration of the crater-floor as observed in Jan., 1913 and July, 1916[20] respectively.

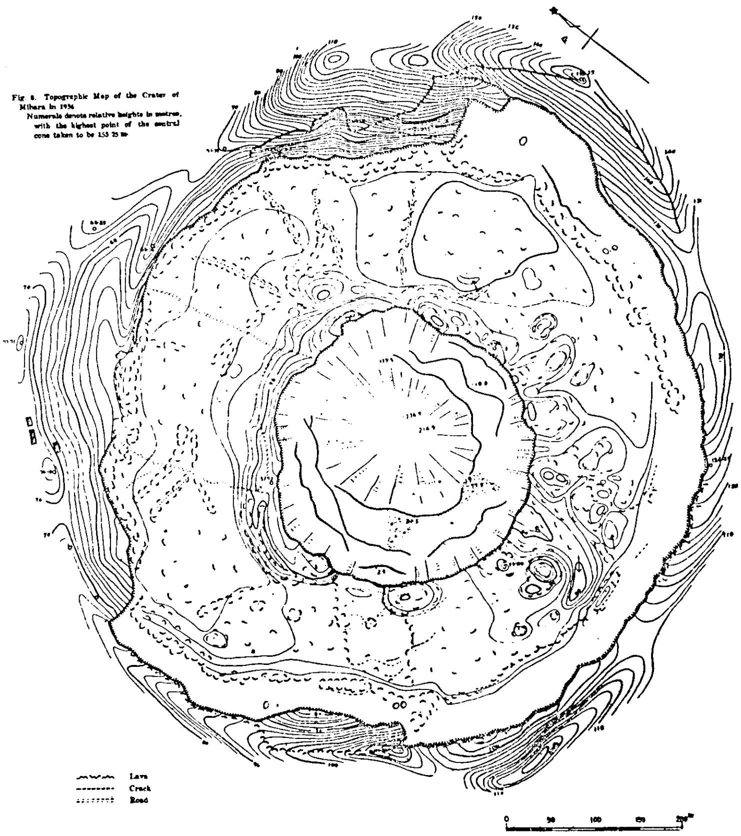

Fig. 3 e. Map of the Mihara crater, 1936, by Takahasi and Nagata.

The eruptions of 1919 and 1922–23 were both of very much smaller intensity than the foregoing, so that they might be regarded as an aftermath. The 1919 activity was a purely explosive one which occurred intermittently during eight months from May to Dec., with ejection of cinders from a new vent opened near the northeast base of the 1912 cone (O_1, O_2 in Fig. 7). About the new vent was formed a cinder cone (O_3 in Fig. 7), the southern half of which was demolished soon afterward by collapse due to the subsidence of the crater-floor on which it

20) S. TSUBOI, Volcano Oshima, Izu, *Jour. Coll. Sc., Imp. Univ., Tokyo*, **43** (1920), 33.

lay. This subsidence seems to have been guided by the northern rim of the old central pit, acting as the first step towards the development of a new central pit in the same place as the old one. The activity of Dec., 1921,—Jan., 1922, consisted of both repeated explosive ejections of cinders and outpouring of lava from the 1919 vent. As the result

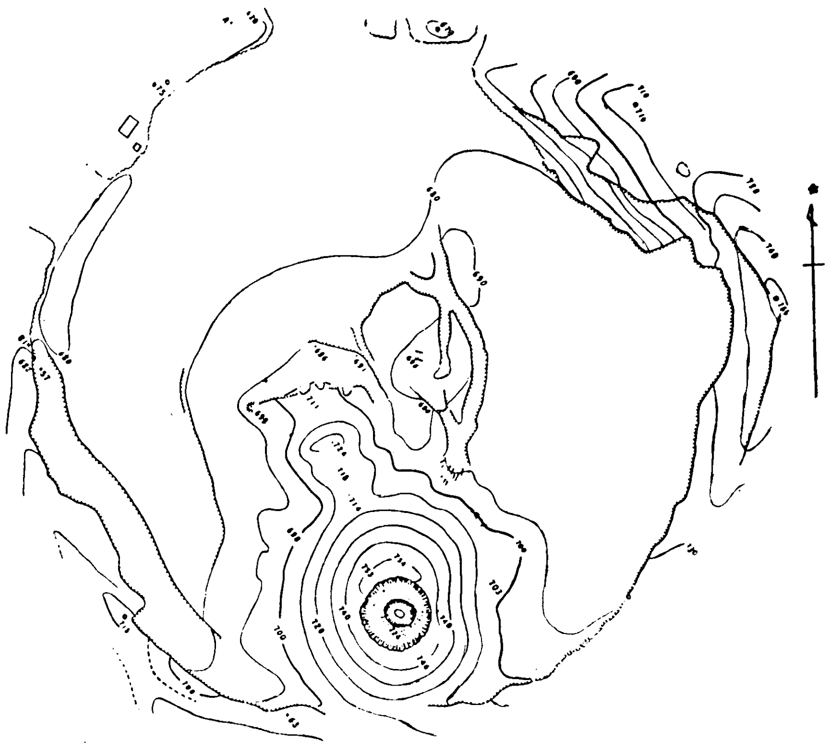

Fig. 3f. Map of the Mihara crater, in Sept., 1950, by Takahasi.

of the activity, the 1919 cone was restored from its half-demolished form (O_4 in Fig. 7), and the surrounding crater-floor was covered with new lava about 16 m thick. But soon afterwards, the crater-floor began to subside and its middle part in particular started a subsidence tending to the formation of a new central pit (*Vn* in Fig. 7) as the successor to the old one. Thus, in July, 1924, when a precise topographic survey of the crater was carried out, it was found that the whole surface of the crater-floor had subsided about 10 m and its middle part, including the southeastern half of the 1921–22 cone, had changed into a pit about 100 m across and more than 100 m deep (Fig. 3 d)[21].

Since 1924 the central pit has been growing rapidly in diameter as well as in depth for several years. Thus in May, 1933, when a descent to the bottom of the pit was tried by a reporter of the Yomiuri (newspaper), the pit was found to have become a circular cauldron about 250 m across and a little more than 400 m deep[22]. The widening of the pit must have been occasioned by collapse of its surrounding walls and the deepening by subsidence of its bottom in accordance with the withdrawal of underlying conduit lava, seeing that neither explosion nor eruption capable of bringing about the enlargement of the pit had occurred during the interval between 1924 and 1933. The crater of this period might be regarded as having reached one of the stages of minimum activity, although faint fumes and vapor were usually rising from the pit, and incandescent lava, sparkling at times with small explosions, was exposed at the bottom of the pit. Even in such a stage of quiescence, the walls of the pit were being extended by cracking and slumping of the lava at the edge, and the blocks of the wall, which have dropped down step by step, were accumulating in the form of a steep talus covering the marginal part of the floor of the pit. But the debris thus accumulated in the pit are, as a matter of course, very much smaller in volume than the missing part of the pit walls, the volume of which may be estimated by comparing the dimensions of the 1924 and 1933 pits. Accordingly it is inferred that most of the missing part of the pit walls has been engulfed into the depth of the pit, with the subsidence of its floor. The 1924 pit showed a rounded pentagonal outline in plan while the 1933 pit an almost circular outline. The tendency to circularity by collapse, like the tendency to circularity by upbuilding, must be occasioned by a highly centralized volcano conduit.

In 1936, when a precise topographic survey of the crater was again carried out, the central pit was measured to be about 300 m in diameter and in depth[23] (Fig. 3 e). Since then the floor of the pit had been still rising step by step, until 1950 when the pit, together with the outer crater-floor, underwent a complete change as reported by Tsuya and

21) S. NAKAMURA, Topographic Survey of Volcano Mihara, Oshima, Izu, *Report Earthq. Invest. Com.*, **100** B (1925), 73 (in Japanese).

22) This expedition to the pit was for the recovery of dead bodies, which proved all in vain. In a steel cage, the reporter went alone to the bottom and landed on a rock shelf, about 210 m below the upper edge of the pit rim, at about a half of the depth of the pit.

23) R. TAKAHASI and T. NAGATA, Geophysical Studies of Volcano Mihara, Oshima Island, *Bull. Earthq. Res. Inst.*, **15** (1937), 441.

others in previous papers (Fig. 3 f). Thus the depth of the pit was 289.6 m in Nov., 1936; 298.7 m in Aug., 1937; 255 m in Aug., 1938; 250 m in Oct., 1938; 220 m in Sept. 3 and 218 m on Sept. 16, 1939[24]; and about 150 m just before the beginning of the recent big eruptions on July 16, 1950. During these years the pit had remained virtually unchanged in diameter, being about 300 m across early in July, 1950, as it was in 1936. Accordingly, it is inferred that the remarkable rise of the pit

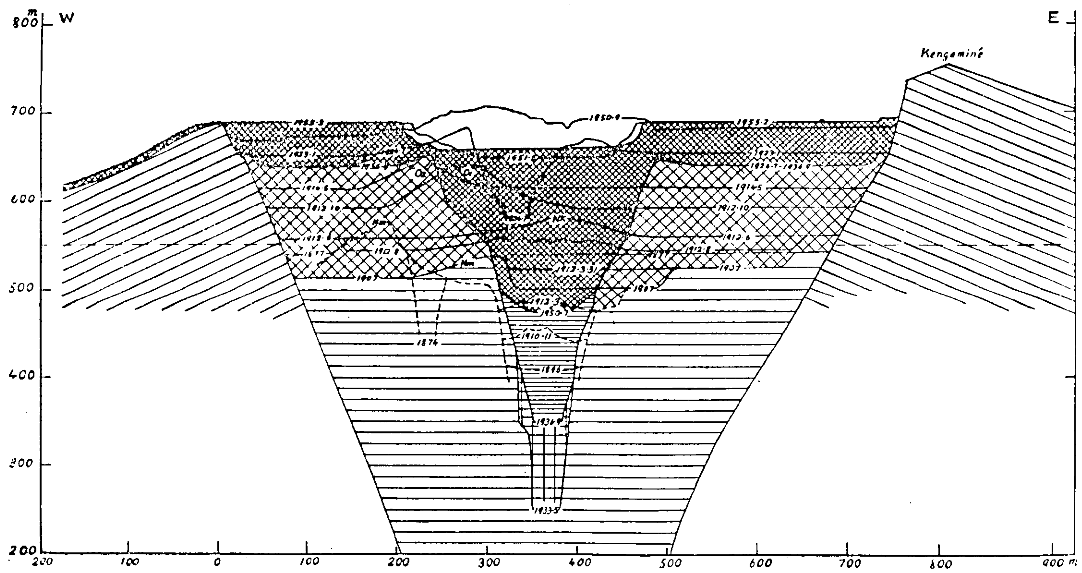

Fig. 4. Section across the Mihara crater, showing the upbuilding of its floor since 1874.

floor in the period was not due to the accumulation of debris produced by collapse of the surrounding walls, which must have been trifling if any, but was caused mainly by the upward movement of the underlying conduit lava, which must have been accelerated in accordance with the increase of gas potential of the lava. The minor explosive activities of 1938, 1939 and 1940 might be regarded as a signal that the eruptivity of the lava in the pit was increasing year by year.

Reviewing the activity of the Mihara crater since 1876, the 1876 eruption may be regarded as representing a phase in the first one of the cycles of activity, in each of which the central pit of the crater

24) T. NAGATA, A Geomagnetic Study of the Minor Activities of Volcano Mihara, Oshima Island, *Bull. Earthq. Res., Inst.*, **19** (1941), 402.

became full of lava and other ejecta and disappeared from view for a while; the eruptions of 1912–13 and 1950–51 are the second and third cycles of activity respectively, being followed by the 1919 and 1922–23 eruptions and the 1953–54 eruptions as the aftermaths of their respective cycles. It may have been by mere chance that the interval between the first and second cycles (36 years) is nearly equal to that between the second and third cycles (38 years).

The building up of the floor of the Mihara crater since 1876 is shown in Fig. 4. The second cycle of activity added lava about 120 m thick to the floor of the crater (100 m in 1912–13 and 20 m in 1923). The volume of the lava is estimated to be approximately about $36\times10^6\,m^3$. The third and recent cycle of activity added lava about 30 m thick to the 1924 floor of the crater. The volume of this lava is about $15\times10^6\,m^3$. In addition to this, lava amounting to about $7\times10^6\,m^3$ flowed away outside the crater during the 1950–51 eruptions. The rise and fall of the bottom of the central pit since 1876 is shown in Fig. 5, in which

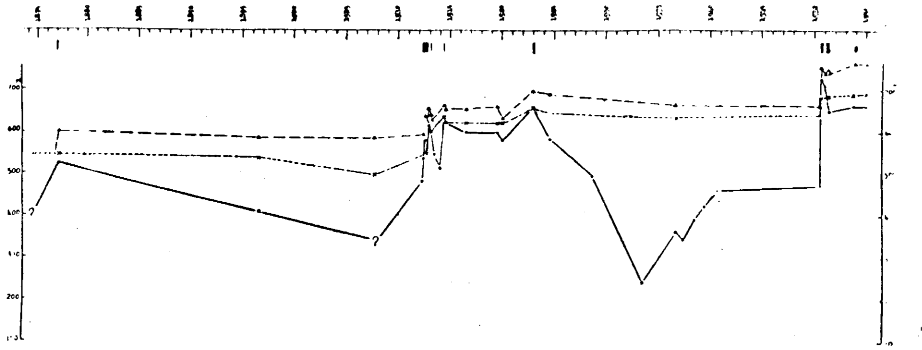

Fig. 5. Diagram of level changes of the bottom of the central pit (dots), floor of the outer crater (crosses) and top of cinder cones (solid triangles) in the Mihara crater 1874–1955, in meters above sea-level.

the dates of the known eruptions are also represented, together with curves showing the changes in height of the outer crater-floor and the crater cones respectively. It may be worthy of notice that, so far as the second and third cycles of activity are concerned, the eruptive activity began each time in such a stage that the bottom of the central pit came up to a height of about 300 m above sea-level. Assuming that a hypothetical centre of activity is at a certain depth; for example 700 m below sea-level, in the lava column below the bottom of the pit, it may be said that an eruptive activity of such a magnitude as the second and third cycles begins when the lava at the hypothetical centre of activity gets sufficient energy (gas pressure and temperature) to break through the lava column 1000 m high. In Fig. 6, the rise and fall of the floor of Halemaumau, the central pit of the Kilauea crater, Hawaii[25], is shown for comparison. Both the Mihara and Halemaumau craters appear to have entered upon a new cycle of activity since 1924.

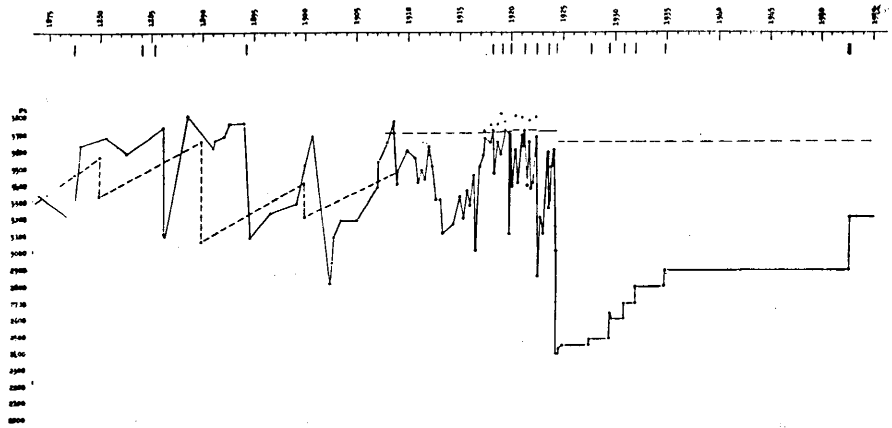

Fig. 6. Diagram of level change of the bottom of the Halemaumau pit, Kilauea 1875–1955, in feet above sea-level. The level change 1875–1905 is shown by two different curves: one (chain line) by Jagger and the other (full line) by O. H. Hitchcock (Hawaii and its Volcanoes, 1911). Horizontal chain lines: height of the caldera floor. Solid triangles: height of spatter or cinder cones.

The evolution of the Mihara crater is shown diagrammatically in Fig. 7. Repeated birth and demolition of cinder cones in the crater are also a characteristic of the volcano since 1876. Most of the cinder cones were formed either on the rim of the central pit or on the crater-floor outside the pit. It is inferred that, when the central pit is closed with a cork of solidified lava, the underlying fluid lava rises sideways through cracks in the surrounding walls, until it can break through the outer crater-floor, resulting in the formation of a cinder cone about its vent. In case of the pit being open and floored with fluid lava, this lava will be able to rise freely in the pit, with or without explosive eruptions. Besides, even if a cinder cone was once formed in the central pit, it would be either bemolished or covered soon afterwards by the lava rising in the pit, as in the case of a cone formed in the earlier phase of the 1912–13 eruptions.

25) T. A. JAGGER, Origin and Development of Craters, *Geol. Soc. Amer.*, Memoir **21** (1942).

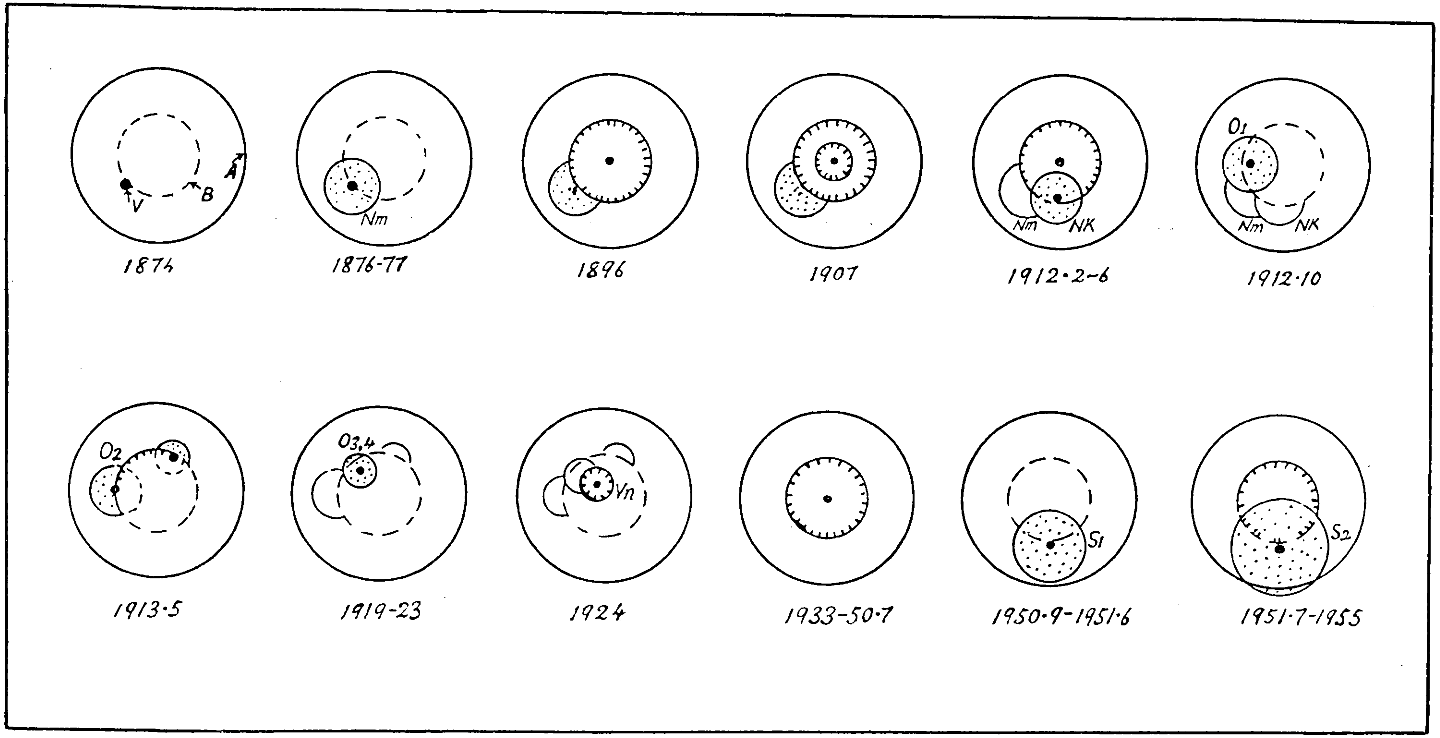

Fig. 7. Diagram showing evolution of the Mihara crater since 1874. A: Rim of the outer crater. B. Rim of the central pit (supposed pit in chain line and actival pit in full line) Nm: Naumann's cone. Nk: Nakamura's cone. $O_{1\sim4}$: Omori's cones. Vn: Nakamura's vent. $S_{1\sim2}$: Showa cones. V: Active vent.

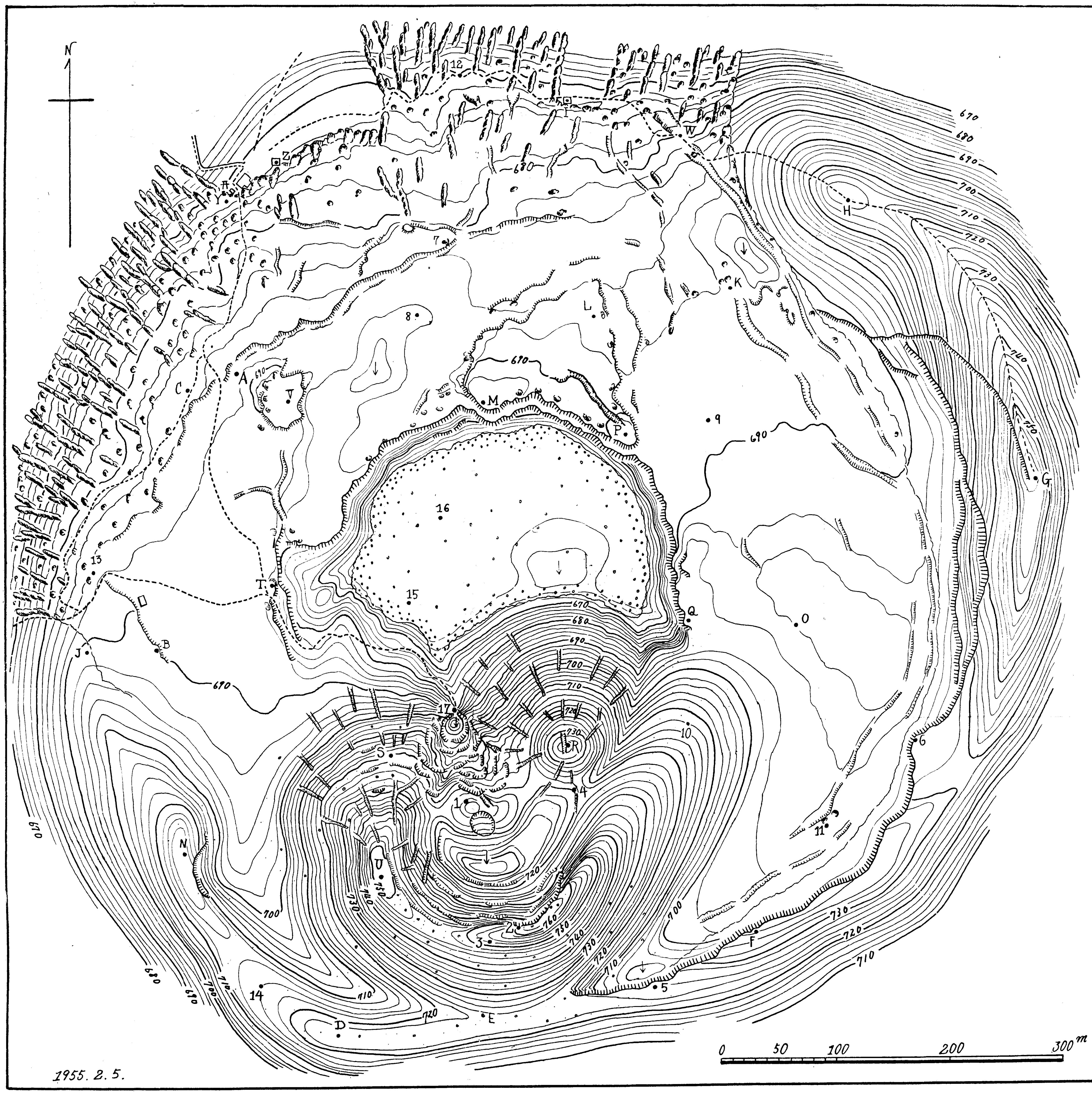

Fig. 8. Topographic map of the Mihara crater in 1955.

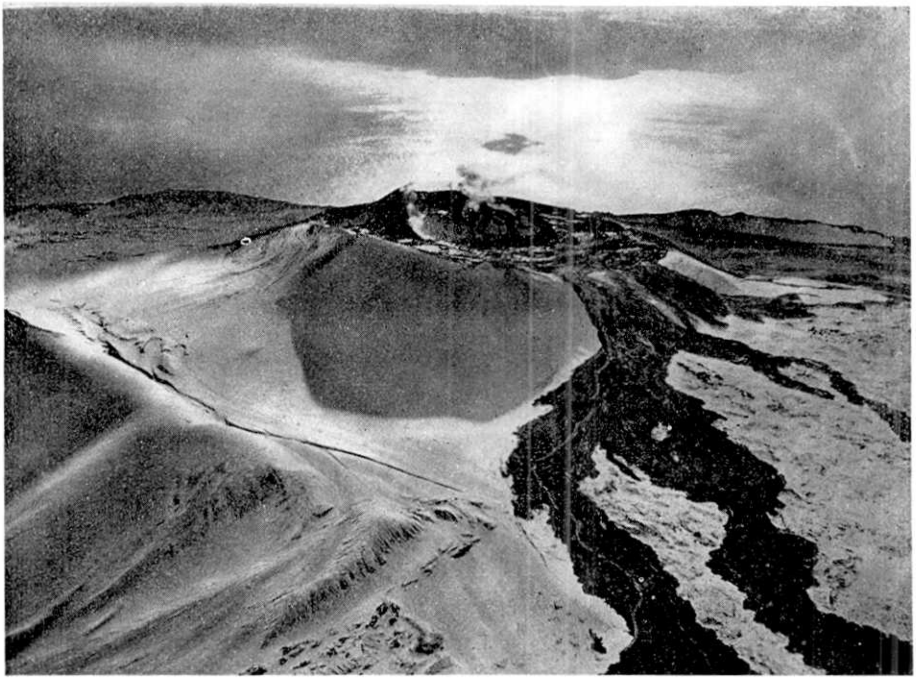

Fig. 9. Aerial photograph of Volcano Mihara, looking southwest, Jan., 1955. Lower right (dark), the 1950–51 lava flows. Upper right and left, the somma. In the background, the Bay of Sagami. Photo the Asahi.

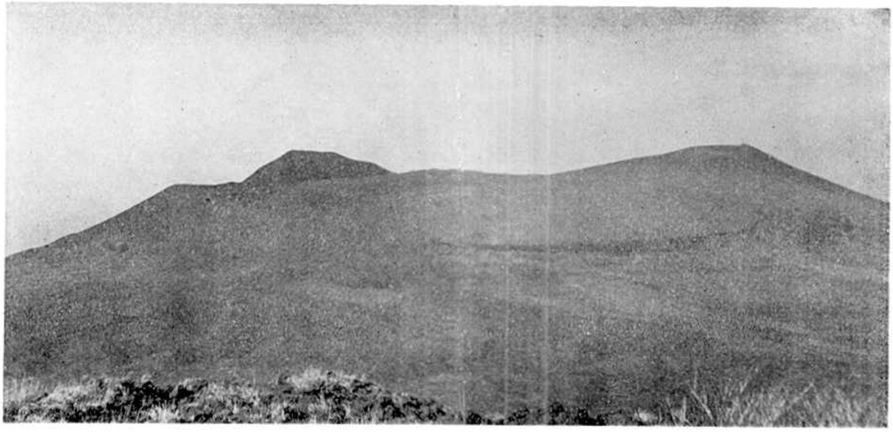

Fig. 10. Volcano Mihara, looking northwest from Mt. Shiroishi, the highest peak in the southeast somma, Feb. 2, 1955. Centre left, the 1951 cinder cone. Photo T. Watanabe.

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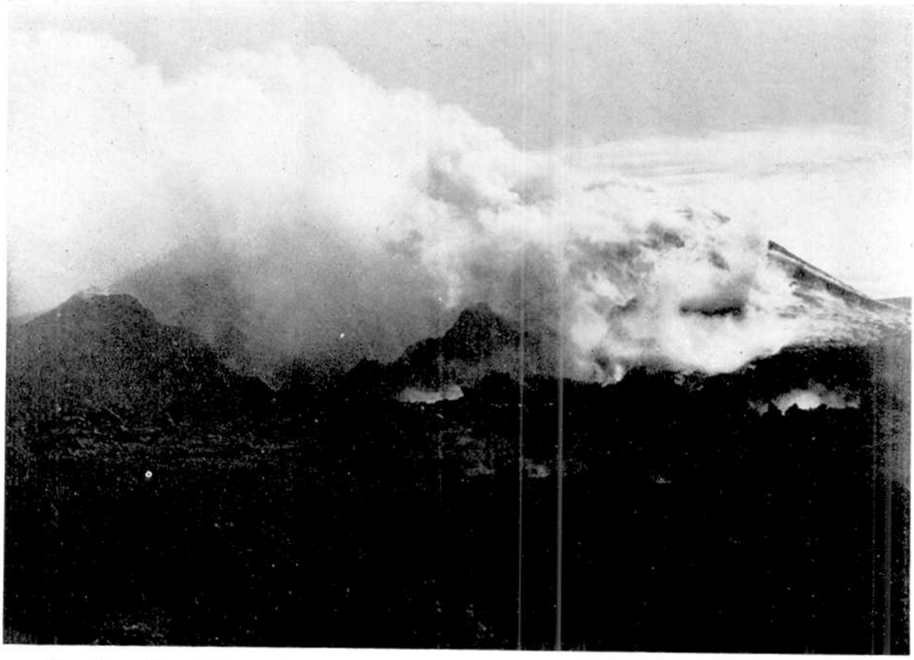

Fig. 11. The 1951 cinder cone and its crater in the Mihara crater, looking south, Nov. 18, 1953. Photo S. Watanabe.

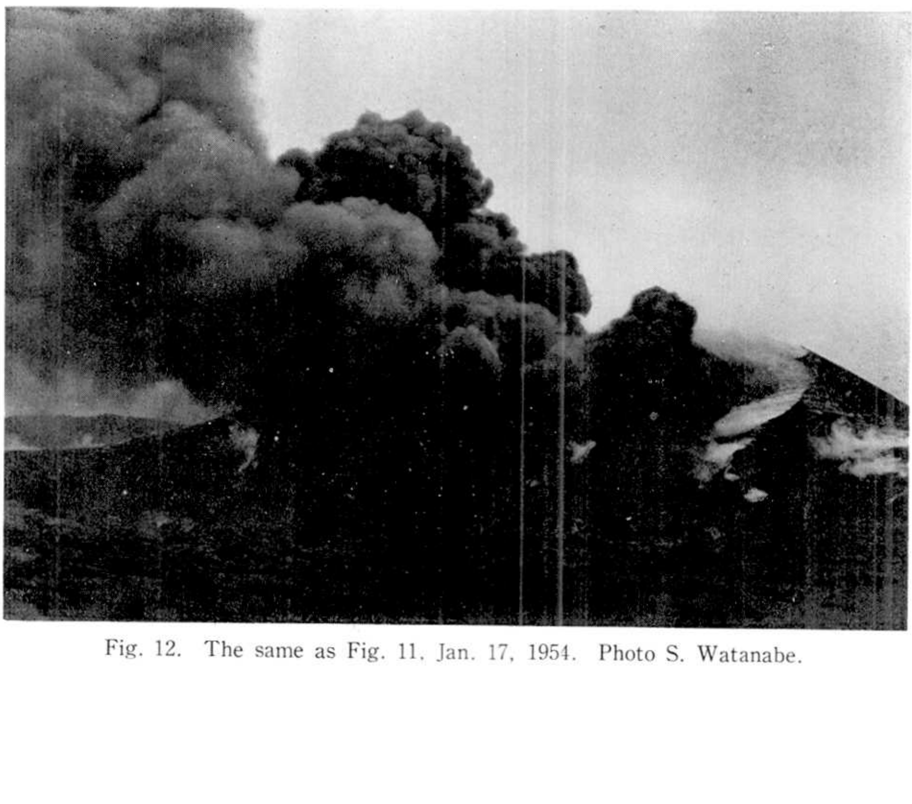

Fig. 12. The same as Fig. 11, Jan. 17, 1954. Photo S. Watanabe.

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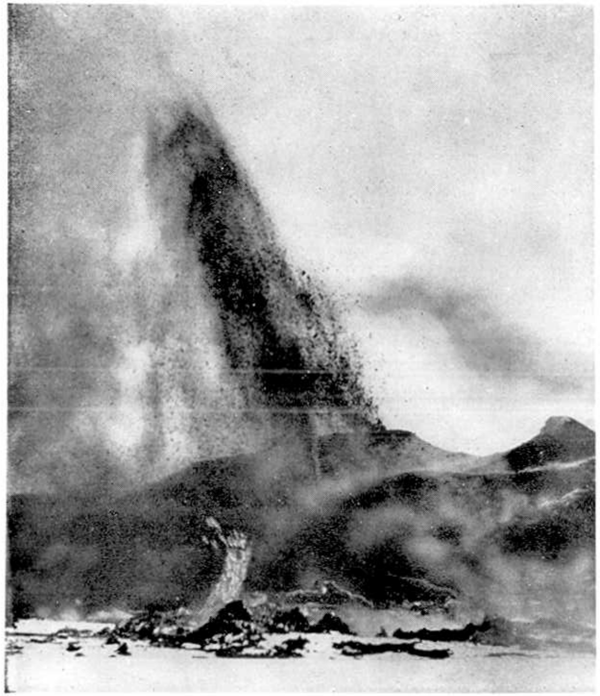

Fig. 13. Strombolian eruption in the crater of the 1951 cinder cone, Mihara crater, looking south, Feb., 1954. Photo The Asahi.

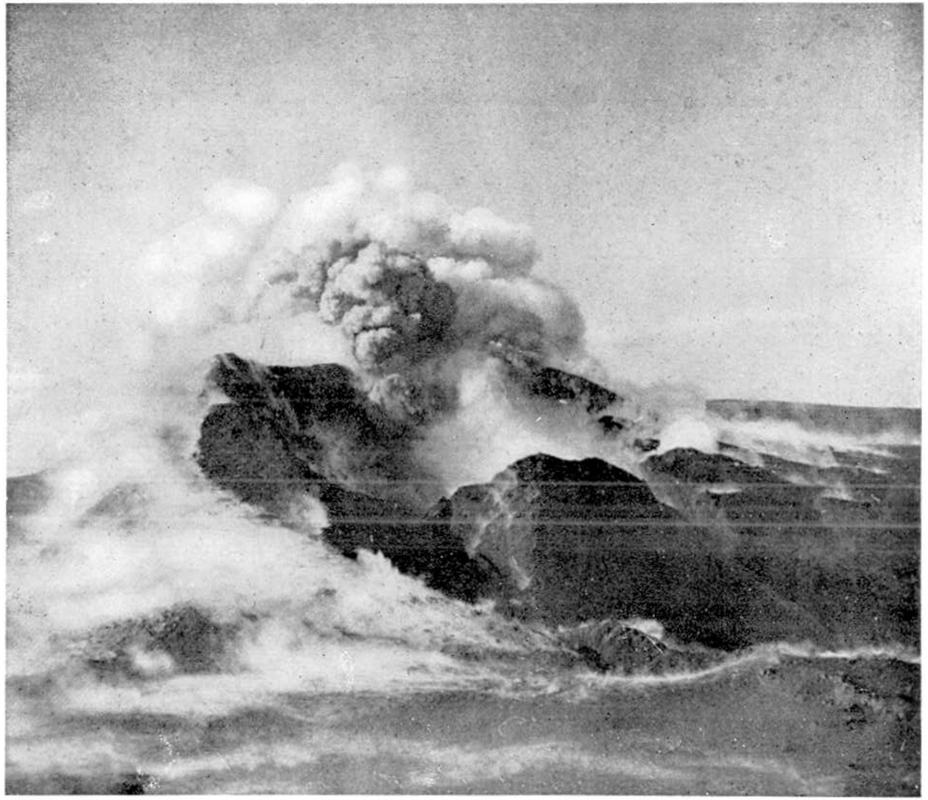

Fig. 14. The 1951 cinder cone in the Mihara crater, looking southwest from Kengaminé, the east rim of the outer crater, Dec., 1954. Photo The Asahi.

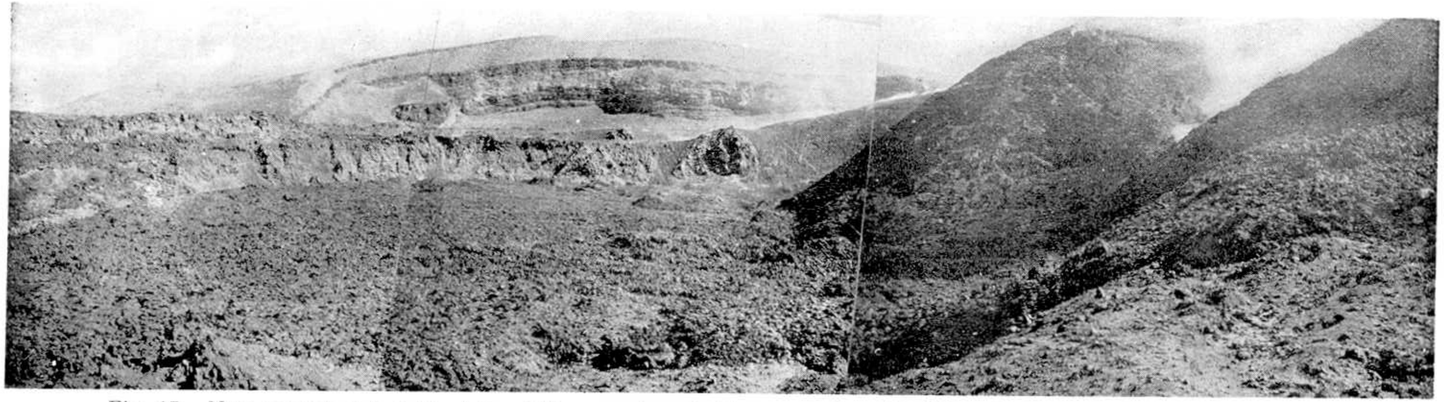

Fig. 15. New central sink (pit) of the Mihara crater, looking east, Jan. 28, 1955. Right, the 1951 cinder cone. In the background, Kengaminé, the east rim of the crater. Photo T. Watanabe.

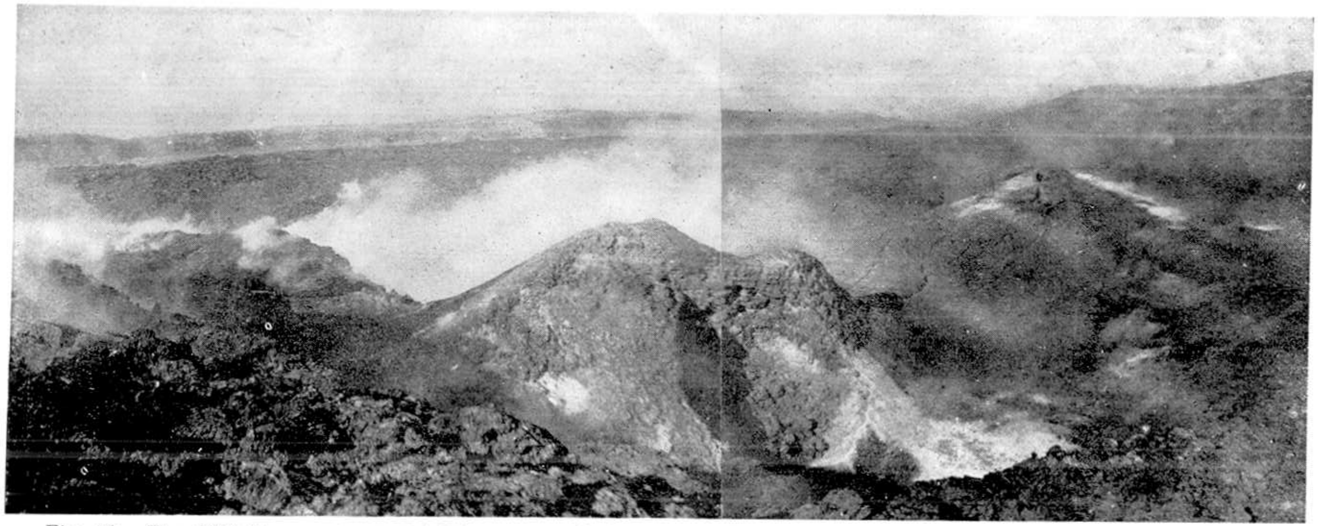

Fig. 16. The 1953-54 cone (centre) in the crater of the 1951 cinder cone, looking down from its top, Jan. 28, 1955. Photo T. Watanabe.

[Bull. Earthq. Res. Inst., Vol. XXXIV, Pl. VII.]

Fig. 17. The 1951 cinder cone, in the Mihara crater, looking south from the outer crater-floor, Jan. 26, 1955.
Photo T. Watanabe.

Fig. 18. South rim of the crater of the 1951 cinder cone, Jan. 28, 1955. Photo T. Watanabe.

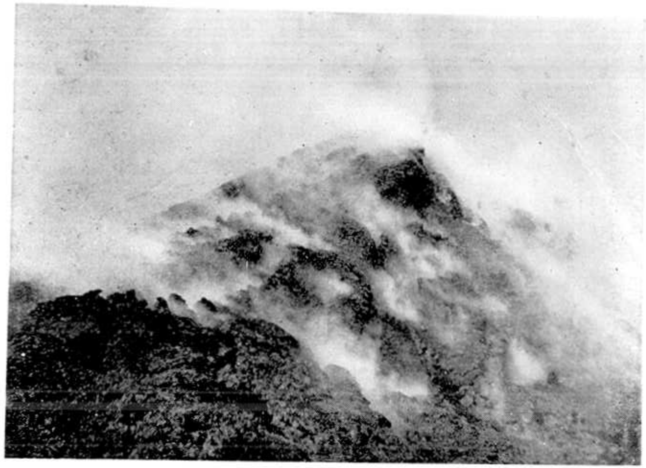

Fig. 19. Northwest rim of the crater of the 1951 cinder cone, Jan. 28, 1955. Photo T. Watanabe.

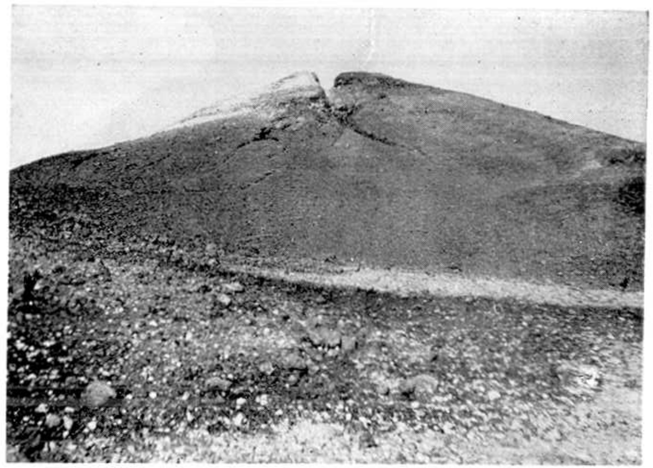

Fig. 20. Pyramidal mound in the northeast rim of the crater of the 1951 cinder cone, Jan. 28, 1955.
Photo T. Watanabe.

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5. 伊豆大島三原山噴火口の明治 7 年以後の活動に伴う地形変化

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伊豆大島三原山噴火口の昭和 25・26 年噴火後の新しい地形を知るため，昭和 30 年 1 月 25 日から約 10 日間にわたつて，その地形測量を行つた．その結果は第 1 表及び第 8 図に示す通りである．

この三原火口の新しい地形は主に昭和 25・26 年の大噴火によつてできたものであるが，昭和 28・29 年の小噴火によつて多少変化した部分をもふくんでいる．すなわち，昭和 28 年 10 月 5 日から翌 29 年 2 月 8 日に至る間の 5 期間に，同火口内の昭和 25・26 年噴石丘の火口に於いて，小爆発噴火がくり返し起つた結果，同噴石丘が約 20 m 高くなつたのみでなく，その火口内に熔岩と噴石とから成る小新丘ができ，また三原火口中央陥落孔に新熔岩が流れ出し，その孔底に約 15 m の厚さに堆積した．これらの新噴出物の総量は約 $28\times10^4\,m^3$ に過ぎず，昭和 28・29 年噴火が噴火強度階の III に当たり，昭和 25・26 年噴火の 100 分の 1 程度のものであることを示す．

三原火口の明治初年以来の噴火活動を見ると，明治 45 年–大正 3 年，昭和 25・26 年の各大噴火の際には，その中央孔が一旦熔岩で埋まつて消滅し，比較的活動の静穏な期間には，中央孔が出現している．明治 3 年及び明治 9・10 年の噴火は記録によると大規模のものではなかつたようであるが，当時火口底に中央孔が開口していなかつたことから考へると，一つの主要な活動期を代表するもので，或は余り遠くない過去（記録では約 30 年さかのぼる弘化 3 年まで噴火がない）の大噴火の余噴かも知れない．明治 10 年噴火後，明治・大正の噴火が始まるまでは活動の比較的静穏な期間で，中央孔が形成されていた．明治・大正噴火によつて消滅した中央孔は大正 12 年頃まで再び現れず，同年以後次第に現れ始めたのであつて，大正 9 年，大正 12 年などに起つた小噴火は前の大噴火の余噴と考へられるものである．その後，昭和 25・26 年噴火に至るまでは，再び活動の比較的静穏な期間で，昭和 8 年には中央孔の底の深さ約 400 m にも達していた．昭和 13 年 8 月，昭和 14 年 9 月，昭和 15 年 8 月などに起つた短時間の爆発はこの中央孔の底が次第に上昇しつつあつた時に起つたものである．このような三原火口中央孔の消長から見ると，同火口の明治初年以来の活動は明治 10 年までを第 1 期，明治 45 年–大正 12 年を第 2 期，昭和 25 年以降を第 3 期の各活動輪廻と考えることができる．第 1 期輪廻の初めは明かでないが，仮りに 1876 年とすれば，それから第 2 期輪廻当初の 1912 年までは 36 年，第2 期から第 3 期までは 38 年経過している．昭和 28・29 年噴火は昭和 25・26 年噴火の余噴で，第 3 期輪廻の続きと考えられる．現在の中央孔の外側火口底からの深さは未だ 15 m 内外に過ぎないので，尚第 3 期活動の余力が残つており，時に爆発的噴火を繰返すものと考えられる．

三原火口中央孔の深さの変化（第 5 図）を見ると，その底が海抜 300 m 内外以上に達した時に噴火活動が起つている．比較のためにキラウエアのハレマウマウについて作つた同様の図（第 6 図）を見ると，その底が海抜約 2400 ft 以上にある時に，噴火活動が頻繁に行われている．この事実は，噴火中心が火口管の或る特定の深さの所にあると仮定すると，そこから孔底までの火口管（即ち熔岩柱）の高さが噴火を起すために十分な熱とガス圧との集積に都合のよい所に相当することを示すものかも知れない．

三原火口の噴火では，噴石丘が中央孔の縁辺，特にその南西側に形成されることが多い．噴石丘が形成されるのはストロムボリ式の噴石活動が相当期間の間くり返される場合である．中央孔の底が固まつた熔岩で閉塞されている時に，その下方の火口管内の熔岩が噴火を起すに足るガス圧に達すると，その熔岩は孔壁の熔岩の割目に沿つて上昇し，孔底よりもはるかに高い所に達してから爆発的に噴出して噴石丘を形成する．孔底が開放されて，そこから活動熔岩が自由に上昇する場合には，孔底に一旦噴石丘ができても，上昇する熔岩に埋まり或は孔底の昇降運動によつて破壊されて残らない．昭和 25・26 年の噴火によつて出来た新噴石丘は中央孔の南壁上に中心をもち，外側旧火口の南壁を蔽つて，その上に更に約 40 m も高くそびえるまで成長したが，その北半は中央孔の陥落に伴つて，その孔底に向つて崩壊している．