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THE 1952 ERUPTION OF KILAUEA

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OPENING PHASE OF THE ERUPTION

Late in the evening of June 27, 1952, Kilauea Volcano resumed eruptive activity after a quiescence of nearly 18 years. The last previous eruption began on September 6 and ended on October 9, 1934.

The exact time of the outbreak is uncertain, but it appears to have been very close to 11:40 P.M. Continuous volcanic tremor commenced on the Volcano Observatory seismographs at 11:37:30 P.M., and it is probable that molten lava reached the surface within a very few minutes after that. At 11:35 on June 27, Mrs. John R. Fox was awake in the living room of her home on the northeastern rim of Kilauea Caldera, from which there is an excellent view of Halemaumau Crater. She noticed nothing unusual. About 11:40 she entered another room, the window of which was open, and almost immediately heard a loud whistling roar (probably caused by the escape of gas at Halemaumau). Alarmed, she returned immediately to the living room and saw a bright orange glow over Halemaumau.

At approximately 11:40 P.M., Col. B. W. Rushton, Commanding Officer of Kilauea Military Camp, pointed out a bright reddish glow in the direction of Halemaumau to John Forbes of the Volcano Observatory staff. This, Forbes immediately identified as caused by eruption of Kilauea. John and LaVieve Forbes went immediately to the Volcano Observatory at Uwekahuna, where they telephoned me at about 11:45.

At the time the Forbes reached the Observatory, the top of a huge lava fountain was clearly visible above the rim of Halemaumau at its southwestern edge. At the beginning of the eruption the floor of Halemaumau pit was approximately 800 feet below the level of the southwestern rim; therefore, this fountain must have been more than 800 feet high! By the time I reached the

Observatory, at about 11:55, the fountain itself was no longer visible, but scattered incandescent fragments still were being thrown above the rim, many of them landing outside the pit and bursting in flashes of red on the caldera floor southwest of Halemaumau.

After picking up the needed equipment, the Forbes' and I, accompanied by Cpl. Gordon Poulson of Kilauea Military Camp, proceeded immediately to Halemaumau by the road around the southwestern edge of the caldera. The fume cloud was so dense that visibility was very limited, and the fall of pumice on the road was so abundant that at times it nearly stopped the forward progress of the car. Some of the pumice blocks were as much as 10 inches across. Choking sulfur fumes were annoying but not serious so long as the car windows were kept closed.

We finally reached the southeastern rim of Halemaumau at 10 minutes past midnight. A continuous line of lava fountains, 2,600 feet in length, was playing along a fissure that extended in a northeast-southwest direction entirely across the floor of Halemaumau Crater and about 50 feet up the northeastern wall (Fig. 1-A). Most of the fountain jets ranged from 50 to 100 feet high, but at the foot of the southwestern wall was a fountain 400 feet high. Showers of liquid ejecta from the big fountain struck the adjacent wall and trickled down it in a fiery cascade. Several minor fountains, a few feet in height, were present also on the northern part of the floor in the vicinity of the 1934 cones (Fig. 1-A). Liquid lava was spreading from them as well as from the fountains along the main fissure and had already covered the entire floor of the crater.

The pool of lava was very fluid, and waves from the fountain chain swept entirely across its surface and up

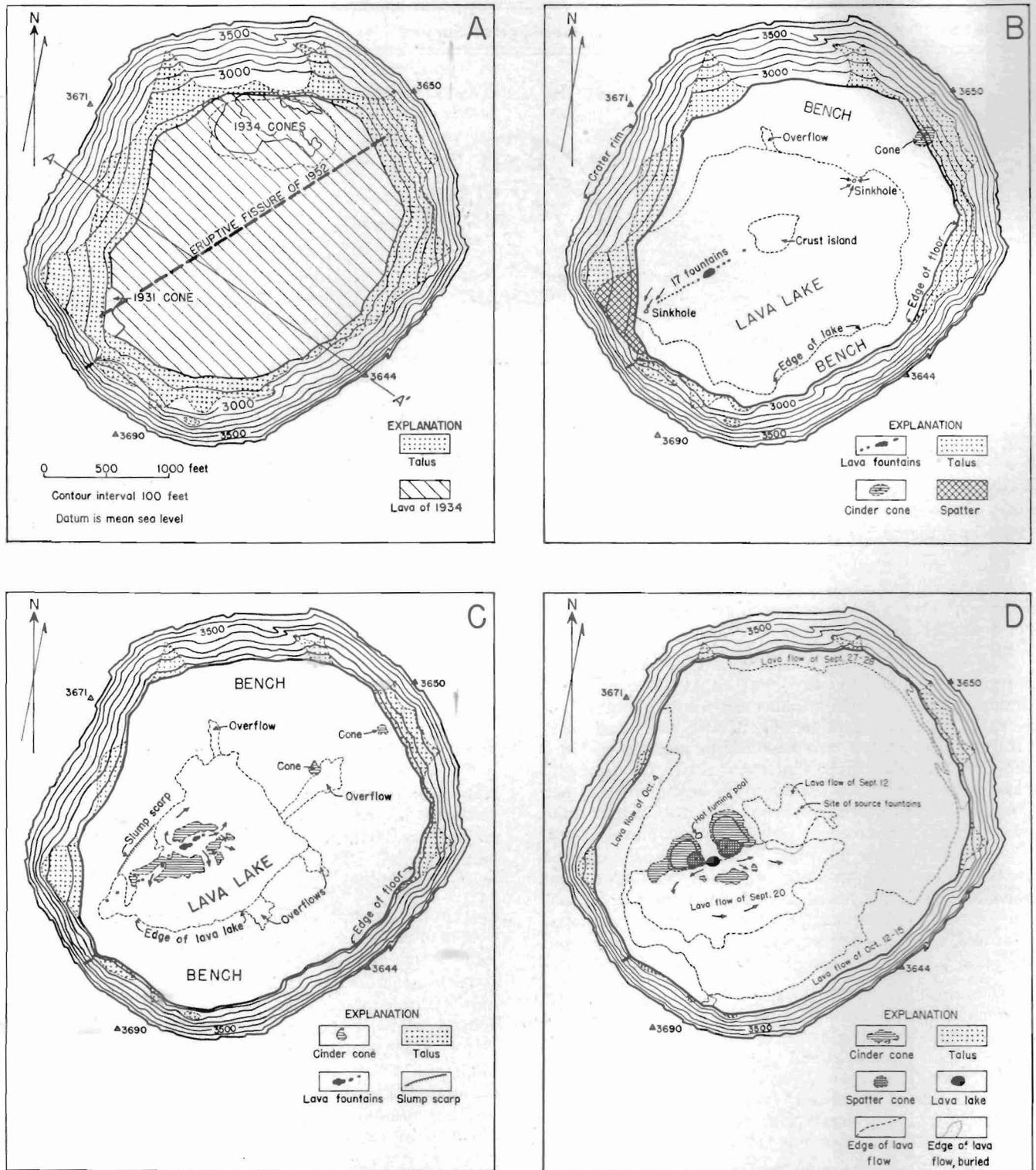


FIGURE 1. Maps of Halemaumau Crater, showing successive stages of the 1952 eruption. A. Conditions in mid-June, just before the eruption. The heavy dashed line shows the course of the fissure that opened to emit lava on the night of June 27. B. Conditions on June 30 at 1 P.M. C. Conditions on July 16. D. Conditions on October 21.

against the walls. Evanescent sinkholes developed near the edge of the pool, accompanied by small lava fountains. Each continued active for only a few minutes, then disappeared, to be replaced by another at some other point. Visibility in Halemaumau was poor because of the large amount of fume, but during brief glimpses of the northern part of the floor, the 1934 cones could not be seen. It is probable that they were already buried and that the liquid pool had attained a depth of more than 30 feet within the first half hour of the eruption. If so, the volume of lava extruded during that brief interval was at least 4,000,000 cubic yards.

The molten lava quickly crusted over, but movement of the underlying liquid tore the crust apart along myriads of lines which revealed the brightly glowing material beneath (Fig. 2). From time to time small whirlwinds moving across the lake picked up fragments of the hot crust 3 or 4 feet across, lifted them 15 or 20 feet into the air, and sent them spinning off across the surface.

The lava fountains continued to decrease rapidly in size. By 1:15 A.M. on June 28, the southwestern fountain was only 250 feet high, and by 3 o'clock it had shrunk to 100 feet (Fig. 3). At 3:15 this fountain and the southwestern part of the fountain chain for 150 feet from the wall had become inactive except for occasional very small bursts, and the next 150 feet of the fountain chain was very weak. At 4:00 the entire southwestern half of the fountain chain was totally inactive, and along the next quarter of the fissure the fountains were very small. Along the northeastern quarter of the fissure the fountains were still 50 to 75 feet high. By 4:10 the active fountains were nearly restricted to the northeasternmost eighth of the fissure, and volcanic tremor had nearly ceased recording on the seismographs. Activity had reached a very low ebb, and for a short time it looked as though the eruption might be ending.

THE PHASE OF THE LARGE LAVA LAKE

About 4:20 A.M. on June 28, small fountains resumed activity along the southwestern quarter of the fissure. These fountains were largely a mere bubbling of liquid lava, liberating very little gas, although abundant gas liberation continued at the northeastern fountains. At 5 A.M. activity was restricted to three blowing vents at the base of the northeast wall talus and the new small fountains in the southwestern part of the crater, with a few small, sporadic bursts along the intervening portion of the fissure. Very little fume was being given off. Daylight brought a clear view of the floor of the crater and confirmed the complete burial of the 1934 cones. The new lava fill was estimated to be about 50 feet thick and to have a volume of approximately 8,000,000 cubic yards.

At approximately 6 A.M. one of the small fountains near the southwestern edge of the crater floor began to grow in size. By 6:15 it was a strong dome-shaped fountain 25 feet across. The typical lava fountains are semi-explosive in nature, resembling a jet from a hose

playing spasmodically into the air, and liberate a cloud of gas. This fountain, however, was nonexplosive, with little gas liberation, and resembled half an orange placed flat side down on the surface of the lava lake, appearing somewhat like the dome of water that sometimes is observed above the aperture of a freely flowing artesian well. Crusts of the surrounding lava lake were drawn in toward the fountain and foundered around its edge. By 7:15 the fountain occasionally was reaching heights as great as 50 feet (Fig. 4).

At 6:30 a double fountain jet in a small cone built on the lower slope of the northeastern talus was spurting to heights of 30 to 40 feet and throwing occasional bursts of spatter as high as 60 feet. A sluggish lava stream issued through a breach in the southeastern wall of the conelet and ran down its side at a speed of about 5 miles an hour. Another small vent 50 feet farther northeast was spurting from time to time and sending a trickle of lava down the western side of the conelet. Both vents were roaring and liberating distinctly more blue fume than the southwestern fountain. Two small fountains about 200 feet southwest of the northeastern conelet were spurting sporadically.

Through the morning of June 28, the southwestern fountains gradually increased in size, and the northeastern fountains decreased. At 11 A.M. a small flow of aa was issuing from the northeasternmost vent of the northeast conelet. This single small flow, which continued for the balance of the day, was the only aa observed during the entire eruption. By noon the northeastern fountains had become very small, and the principal southwestern fountain had grown to about 75 feet high and 100 feet across at the base. It was no longer a dome-shaped fountain of gently rising liquid but, instead, was a typical semi-explosive, flinging fountain. Fifty feet northeast of it a new small fountain played nearly continuously, and 100 feet farther northeast another played spasmodically. Around the fountain group concentric waves spread out in the crust of the lake over a radius of 500 feet. A slump scarp 10 to 15 feet high had formed around most of the circumference of the lake, a few feet to 50 feet from its margin, owing to shrinkage of the central part of the lake.

At 3 P.M. the fountains near the southwestern wall had become small and sporadic, but a new fountain just northeast of them, about 300 feet from the southwest wall, was playing to an average height of 150 feet. The amount of gas being given off had increased greatly. The northeast fountains remained about the same as they had been at noon, but about 600 feet southwest of them a prominent sinkhole had developed. Lava streamed toward it from all directions. As it was drawn toward the sinkhole, the crust was broken and torn apart, and, as the fragments reached the sink, they tilted on edge and plunged beneath the surface. Small sporadic fountains played in the sinkhole.

At many other places on the lake the crust was rifted open from time to time, often repeatedly along the same line. There, also, crust fragments were drawn in, tilted up, and plunged under. Generally, this was followed by a row of tiny fountains, lasting only a few seconds, over the place where the crust fragments disappeared.

During the evening of June 28 the fountain 300 feet from the southwest wall continued to grow, until by midnight it was playing steadily to heights around 150 feet, with occasional flings reaching 300 feet. Late in the evening a very active sinkhole developed at the southwestern edge of the lake over the course of the eruptive fissure. A river of lava about 25 feet wide flowed into it from the area of the nearby fountains, and small edge fountains played sporadically in and around it. The northeast sinkhole continued active.

By midnight the vents at the northeast edge of the crater had built narrow-throated conelets and were blowing explosively with loud booming noises, and throwing showers of ejecta to a height of 150 feet. Banners of pale-blue flame 5 to 15 feet long played intermittently over the mouth of the conelets.

Activity continued much the same through June 29 and 30. By noon of June 29, the slump scarp around the edge of the lake had been reburied, and a bench of semi-solid pahoehoe crust was beginning to grow around the edge, gradually restricting the size of the central lava lake. The bench was at about the same level as the general surface of the lake, and as the level of the latter slowly rose during the succeeding days, repeated small overflows moved out across the bench from the edge of the lake, or from fractures within the bench itself. From time to time fragments as much as 150 feet across became detached from the bench and formed islands in the lake. These islands moved across the lake toward the fountains, presumably carried along by a return circulation in the lower part of the lake. They appeared, however, to be floating, rising and falling with the level of the liquid around them.

The two prominent sinkholes continued active. Directly following the engulfment of especially large or numerous crust fragments fountaining within the sinks increased notably. However, these sinkholes appeared to be primary fountain vents in their own right as well. Small sporadic fountains played within the sink even when crustal foundering was not marked, and, from time to time, sinking gave place entirely to fountain action.

On June 29, sporadic fountains played along most of the length of the eruptive fissure southwest of the northeast sinkhole. Along this line lava moved slowly inward and sank, dragging the crust with it and producing a puckered cicatrice extending all the way from the northeast sinkhole to the big southwestern fountain.

By the afternoon of June 29, the conelet at the northeastern edge of the lake had grown to a height of about 50 feet. At 12:30 A.M. on June 30, a small glowing spot appeared on the eastern wall of the conelet, apparently caused by melting of the cone wall from within, and a few minutes later a small pahoehoe flow started to issue from this aperture. At 1:00 the walls of the conelet collapsed, liberating a small flood of very hot lava from the interior of the conelet. At the same time the northeast fountains increased in size from scattered showers of ejecta barely visible above the rim of the conelet to a strong jet about 150 feet high. The conelet quickly commenced rebuilding and by late afternoon had again nearly sealed itself. Similar activity occurred

for the next several days, the cone alternately sealing nearly or completely over and reopening as the top, weakened by melting, collapsed. Occasional small flows spread over the crust bench near the conelet. The northeastern vents finally became inactive on July 6.

On June 30, a large fountain, averaging about 150 feet in height, was playing about 500 feet from the southwest edge of the lake, and on both sides of it along the line of the fissure were 16 smaller fountains (Fig. 1-B).

Early on June 29, a crust island about 150 feet across became detached from the marginal bench at the northern edge of the lake and moved slowly southward. On the evening of June 30, the island reached the main fountain area, about 800 feet northeast of the southwest sinkhole (Fig. 1-B). About 6:30 P.M. it moved over the northeasternmost small fountain and immediately started to disappear, partly by crumbling away at its edges and partly by foundering and being overflowed by fluid lava. The disintegration of the large island produced two small islands, which assumed positions just east and northwest of the principal fountain. By the night of July 1, these islands appeared to be grounded. Instead of rising and falling with the surrounding liquid, as they had previously, they remained essentially stationary. The liquid lava around them rose and fell with the surges from the fountains, alternately exposing and concealing a brightly glowing band at their bases.

The crust bench had gradually widened until by the afternoon of June 30 it was encroaching on the northeast sinkhole. On the afternoon of July 1, the sinkhole ceased to function and was replaced by a constant fountain 75 to 150 feet high. Spatter from this fountain accumulated on adjacent portions of the crust bench, and a small cone began to grow around the fountain. On July 2, the conelet was widely breached on the eastern side, and small flows from the fountains were moving over the bench nearby. On July 3, the conelet was about 20 feet high and possessed a rounded shape resembling that of a bee-hive. By July 4, the cone was nearly sealed in, and after that time it exhibited no more fountain activity.

On the morning of July 2, the activity of the southwestern sinkhole was weak. At 10:55 A.M. it suddenly reversed and became a large fountain that grew in size until, at 11:30, it was throwing ejecta regularly to a height of 200 feet and, rarely, as much as 300 feet (Fig. 5). At the same time, the central fountains increased in activity and became explosive, throwing rocket-like bursts as high as 250 feet. These bursts were accompanied by loud detonations. By mid-afternoon a large lava flow about 10 feet thick, was moving eastward from the southwest fountain along the base of the crater wall, and another was advancing northeastward between a pressure ridge on the crust bench and the central fountains. By 2:30 P.M. the whole central portion of the lake appeared to be heating up, and at 3:30 overflows from the lake were spreading over the marginal bench all around the northern and western sides. At 3:40 the southwest fountain abruptly stopped, then

sputured up briefly three times—the last spurt occurring at 3:45. It remained inactive for the remainder of the afternoon. At 7 P.M. its site was overflowed by a southwestward spreading of the lava lake. About 9 P.M. the sinkhole resumed sluggish activity.

At 5:30 A.M. on July 3, the southwest sinkhole again suddenly became a fountain which grew rapidly to a height of 400 feet. Again, as on the previous day, the central fountains became noisily explosive. The strong fountaining lasted until about 7 A.M., then died down until all activity was very weak. By 7:30 the southwest sinkhole was again in sluggish operation, and the central fountains were gradually regaining their former size. Conditions continued much the same for the remainder of the day.

Weak sporadic fountaining began again at the southwest sinkhole at 10:15 P.M. By 10:40 the height of the fountain had increased to 100 feet, and by 11:45 it had reached 400 feet. Ranger Elroy Bohlin reported that the fountain continued big until 3:30 A.M. on July 4, playing steadily, like a jet of water from a hose, to heights of about 400 feet. Occasional bursts went above the rim of the pit—a height of more than 600 feet. Pumice fell on the road at the southwestern edge of the caldera. This was the strongest fountain activity after the first few hours of the eruption. As in the previous spasms, the central fountains were very noisy, sending long rocket-like strings of molten lava high into the air. The whole central lake and part of the marginal bench were inundated by new flows. At 3:30 both the big southwest fountain and the central fountains suddenly died down, nearly disappearing within a few minutes.

Through the morning of July 4, the southwest sinkhole was alternately moderately active and sluggish. About 3 P.M. it again became a fountain, which, by 3:30, was reaching heights similar to those of the night before. Again, the central fountains also became very active, shooting long string-like "rockets" as high as 250 feet, with loud detonations. Balloon-like balls of lava as much as 20 feet in diameter rose in the central fountain pits until they appeared to be almost detached from the underlying lava, then burst to release a large puff of pale-brown gas. The strong activity was short lived, and by 4:15 P.M. activity had returned to normal. Still another flare-up of the southwestern fountain occurred at 4 A.M. on July 5, but the fountain reached a height of only 200 feet. After that, no further big increases of the southwest fountain occurred, though for several days conditions there alternated between sinkhole and fountain activity.

The bench of semi-solid pahoehoe around the edge of the crater gradually widened, decreasing the area of the central lake of fluid lava (Fig. 1-B). On the morning of June 28, the lake extended from wall to wall of the crater and had an area of approximately 100 acres. By July 1, the bench at the north side ranged from 400 to 700 feet wide, and the area of the lava lake had been reduced to 68 acres.

CONE-BUILDING PHASE

During the first few days of the eruption, the deep pool of fluid lava around the central fountains offered no place for the accumulation of fountain ejecta, and cone building was impossible. By the night of June 30, however, there appears to have been a sufficient accumulation of pasty material in the lower part of the lake to support the crust islands on the two sides of the fountains. Spatter from the fountains accumulated on the islands, initiating the cone-building phase of the eruption. Building was slow at first, and by the morning of July 5 the island just west of the central fountain had been built up to a height of only 25 feet, partly because the underlying material was not strong enough to support it and allowed it to sink to some extent as it built up. Further evidence of the mobile character of the lake bottom is seen in the gradual southwestward shifting of the island along the edge of the fountain chain.

During the next few days, as the islands grew in height, they occasionally became unstable. The lower portion on the side toward the fountain was prevented from building and even was eaten away by the fluid lava surging against it. As the upper portion accumulated more and more spatter, the face toward the fountain became very steep, or even overhanging. Sometimes this unstable condition was relieved by a slumping off of the steep face, but at other times the entire island leaned slowly fountainward, rocked majestically in the surge, and eventually rolled slowly over.

On the afternoon of July 7, an arcuate rampart of spatter 150 feet long and 20 feet high had formed on the east side of the principal fountain, and a similar one appeared on the southwest side. By July 9, the substratum of the lake had become sufficiently firm to consistently support the accumulations of spatter that grew around the fountains, and the true phase of cone building began. By July 10, the cone surrounding the main central fountain was 30 to 50 feet high, and lava streams were spilling through gaps in it eastward and northward. The average height of the fountain within the cone was about 50 feet, but some bursts went as high as 200 feet. Southwest of the main fountain, smaller fountains were building a row of low spatter cones.

On July 5, a steep-sided wall of spatter (a so-called lava ring) started to form around the edge of the lava lake, and by July 6, the lake stood about 10 feet above the surrounding bench. At the southwestern edge of the crater floor a small, nearly circular lake 300 feet across behaved somewhat independently from the main lake. This lake was fed by the large southwest fountain at the site of the former sinkhole and a group of smaller associated fountains. Usually, the latter were arranged along an arc, concave to the northeast, extending northwestward about 75 feet from the large fountain. The southwest lake was enclosed in its own lava ring and, on the morning of July 6, stood about 10 feet above the level of the main lake.

Occasional overflows of both the main lake and the southwest lake sent tongues of lava onto the marginal bench. These overflows gradually raised the level of the

bench. As the eruption progressed, it became evident, however, that only a small part of the rise of the marginal bench was the result of overflow of lava onto its surface. Even when no overflow occurred, the bench rose at a rate approximately equal to the rise of the central lava lake. Obviously, the rise of the bench must have been caused largely by the addition of plastic material beneath it. This may have resulted from an isostatic adjustment whereby the increasing depth of the lake caused the still mobile substratum to flow outward and elevate the bench—a process that was really nothing more than the tendency of a fluid mass, however viscous, to assume a uniform surface level.

On July 12, the cone around the main central fountain was about 60 feet high, and lava rivers spilled from it both eastward and westward to feed the main lava lake. Another cone was forming around a slightly smaller fountain about 300 feet farther southwest. From this cone a lava stream escaped southward, then turned northeastward to join the lava from the larger fountain (Fig. 1-C). The southwestern pool was a true independent lava lake with a constant sinkhole at its northeastern edge around a permanent fountain, and a gradual outward movement of the lava all over the surface from the source fountains to the edge. Occasional crustal foundering and marked downflow occurred at various points all around the rim, followed by evanescent rim fountains.

Over the next few days, the two central cones grew in diameter until, by July 14, they coalesced, though the southern fountain pit remained isolated from the larger northern one. On July 17, the wall between the two pits broke down, and the central cone became a single structure having a fountain pit elongated southwestward and containing both the large central fountains. Flows continued to spill from it southward, westward, northeastward and eastward, feeding the surrounding lava lake (Fig. 6). The lake had an area of 30 acres and was very active. Currents of lava moved outward from the gaps in the cone to the edge of the lake, where they plunged downward, carrying with them fragments of the crust. Crustal engulfment occurred occasionally over all the lake surface but was commonest at two general locations, namely, at the edge of the lake, and along lines where flows from different gaps in the cone merged. The engulfment of each large crust fragment was followed by small short-lived fountains. At the edge of the lake the accumulation of spatter from these fountains built the lava ring, which, in succeeding weeks, confined the liquid of the lake at a level as much as 20 feet above the adjacent marginal bench.

On July 15, a small fountain at the northern edge of the southwest lake had built a beehive-shaped cone 30 feet high. The southwest fountains had, however, become very weak, and on July 16 the main lake overflowed into the southwest lake (Fig. 1-C). The southwest fountains again became strong on July 18, and continued active until July 22. On July 23, however, they became small and sporadic, and after July 24 they disappeared altogether, leaving the south lake as a lobe of the main lake fed by lava streaming southward from the central fountains.

A general overflow of the main lava lake began at 12:15 on July 20, and continued until midnight. Flows moved outward across the bench to, or nearly to, the crater walls on the northwest, north, and northeast sides, completing the obliteration of the cones at the former northeast sinkhole and the foot of the northeast talus, which had been partly destroyed already by collapse and burial by new lava.

On July 29, several small flows issued along the edge of the bench at, or close to, the wall of the crater. The molten lava apparently rose along the boundary of the new lava plug in the bottom of the crater. These were the first of several similar flows at intervals during most of the remainder of the eruption.

Activity continued essentially the same until August 7. The average size of the central fountains decreased to about 40 feet, but their explosiveness increased somewhat, and occasional explosive bursts reached great heights. Northrup Castle reported that, about midnight on August 5, one explosive burst from the northerly of the two fountains reached a level above the rim of the crater. Similar bursts were observed at 7:45 P.M. on August 6, and 8:30 P.M. on August 7. These bursts reached a height of about 550 feet. The greater explosiveness may have resulted from some increase in viscosity of the escaping lava. A gradual decrease in the amount of lava being poured out caused a retreat of the margins of the lava lake, which, between August 1 and 7, moved inward 50 to 75 feet.

The cone reached its maximum development early in August. On August 11, it was 65 feet high and approximately 800 feet in basal diameter.

DECLINING PHASE OF THE ERUPTION

There now began a period of fluctuating but gradually decreasing lava output. An apparent decrease in the amount of superheat in the lava caused a tendency to increased viscosity and clogging of the vents. On August 9, the southern gap in the cone became clogged, and the north and northeast lava rivers increased greatly in volume, plunging over spectacular cascades as much as 20 feet high. On August 11, the south river became re-established, and the east river was blocked by a partial collapse of the adjacent cone wall. By August 12, the east river was flowing again, but the northeast river had, in turn, been choked off. On August 13, the west and south rivers became inactive. Cessation of the south river was followed by draining of the southern lobe of the lava lake, leaving a broad basin about 20 feet deep with a nearly flat irregular floor. On August 18, lava overflowed the south wall of the cone and re-established the south river, refilling the basin.

Late in the evening of August 18, the northern of the two central fountains decreased greatly in size, and by midnight it showed no signs of activity. It returned early on August 19, but remained small for several days. By August 22, both fountains averaged about 20 feet high, with some showers of glowing ejecta reaching heights of 200 feet.

On August 23, lava was no longer flowing from the central cone, and the lava lake surrounding the cone had become inactive. The two fountains were small and sporadic, throwing showers of glowing fragments as high as 150 feet. Around themselves they had built beehive-shaped conelets of spatter 20 feet high within the crater of the cinder cone, and a nearly circular lava lake about 120 feet in diameter had formed nearly between the two conelets. This condition persisted throughout the remainder of the eruption (Figs. 1-D, 7).

By August 25, activity had become very weak, but on August 29 it began to regain its strength. In early September, it was again spectacular; loud roaring and whistling gas release accompanied explosive bursts that threw showers of glowing cinders to heights of 150 to 200 feet. On the night of September 2, small glowing spots appeared on the floor north and east of the central cinder cone, and by the morning of September 3 two flows were issuing at those localities and spreading sluggishly over the adjacent floor. The northerly flow was fed by a tiny fountain spurting 5 or 6 feet into the air about 400 feet north of the north central conelet.

From September 1 to 18, the more northerly of the two central vents was the more active, and its conelet gradually grew to a height of 50 feet, overtopping the rim of the surrounding cinder cone. Throughout this period the lava at the surface of the small lava lake flowed slowly from the north to the south edge, where it sank, producing fountains 10 to 15 feet high against the south bank. On September 19, the activity of the two conelets became reversed, with the southern one the more active. Simultaneously, the lava in the lake reversed its movement, rising at the southern edge to flow northward and sink along the north bank. Spatter from the edge fountains and occasional small overflows had built up a low, flat cone around the lake, the surface of which stood about 20 feet higher than the surrounding floor of the crater of the cinder cone.

At 1:45 A.M. on September 20, lava started to spill over the southern rim of the lake. The overflow increased rapidly in volume, breaking down the southern wall of the lava cone containing the lake and sending a big flow over the southern part of the floor of Halemaumau. At 10:12 A.M. the northeastern rim of the lake also was overflowed, and a second flow spread out to coalesce with the first one east of the cinder cone. The northeastern overflow lasted only a few hours, but the southern one continued until about midnight. This was the most voluminous single outpouring of lava after August 22.

On September 22, the northern central vent again become dominant, and again the circulation in the lava lake reversed, returning to its first direction of movement from north to south. Explosive activity at the southern conelet ceased entirely, and for the remainder of the eruption the conelet fumed quietly.

The northern conelet gradually built up to a height of 65 feet, and by September 26 its top was nearly sealed over. On that afternoon, at about 4 o'clock, the top and part of the northeastern side of the conelet suddenly

were blown off. Charles Bell reported that three or four explosive bursts of ejecta reached heights of about 400 feet. This was accompanied and followed by violent oscillation of the lava in the lake, the level of which rapidly dropped about 15 feet. Within a few minutes both the lake and the conelet had returned to their normal state of activity, with bursts from the conelet reaching heights of 100 to 150 feet.

A similar series of events occurred on the evening of September 27. At 8:35 P.M. a series of about a dozen violent blasts that threw incandescent cinder to a maximum height of about 550 feet suddenly commenced at the north conelet. The surface of the lava lake surged violently, and following the explosions its level gradually dropped about 15 feet, revealing glowing grottoes hung with fringes of stalactites in the banks. As on the previous day, activity returned to normal within a few minutes.

Throughout the month of September, small flows continued to issue from time to time on the floor of Halemaumau outside the central cinder cone. These welled up quietly, with very small fountains at their vents, or none at all, and very little evidence of gas liberation. Two on September 4 have already been mentioned. On September 5, another appeared on the floor northwest of the cinder cone, and still another issued at the foot of the western wall of Halemaumau. Small flows issued on the floor southeast of the cone on September 8, northeast of the cone on September 12, at the western wall on September 16, both northwest and northeast of the cone on September 17, and at the foot of the northwestern wall on September 27. On the night of October 3, a flow broke out at the foot of the southwestern wall of Halemaumau and spread rapidly around the edge of the crater floor for a distance of 2,200 feet. The final edge flow of the eruption broke out at the foot of the southeastern wall of Halemaumau on the afternoon of October 12 and continued until October 15, eventually extending halfway around the crater, a distance of 4,600 feet (Fig. 1-D).

During the first half of October, the lava lake and the north central conelet continued active, the latter throwing frequent sporadic showers of glowing ejecta to heights of 50 to 100 and, rarely, 200 feet. On the afternoon of October 5, a series of explosive bursts similar to those of September 25 and 27 reached a height of 450 feet. Surface circulation in the lava lake continued from north to south. Fountains up to 15 feet high formed along the southern bank, where crusts were being carried down by the descending liquid, and other smaller fountains appeared from time to time at the northern edge.

Throughout the last two weeks of October, the northern conelet was largely sealed over, and only occasional small bursts of glowing fragments could be seen. The cloud of gas liberated at the conelet became markedly more conspicuous, denser, and white in color, in contrast to the thin, bluish fume liberated in earlier stages with a more open vent. At night, banners of pale blue or yellowish flame as long as 25 feet flickered over the conelet.

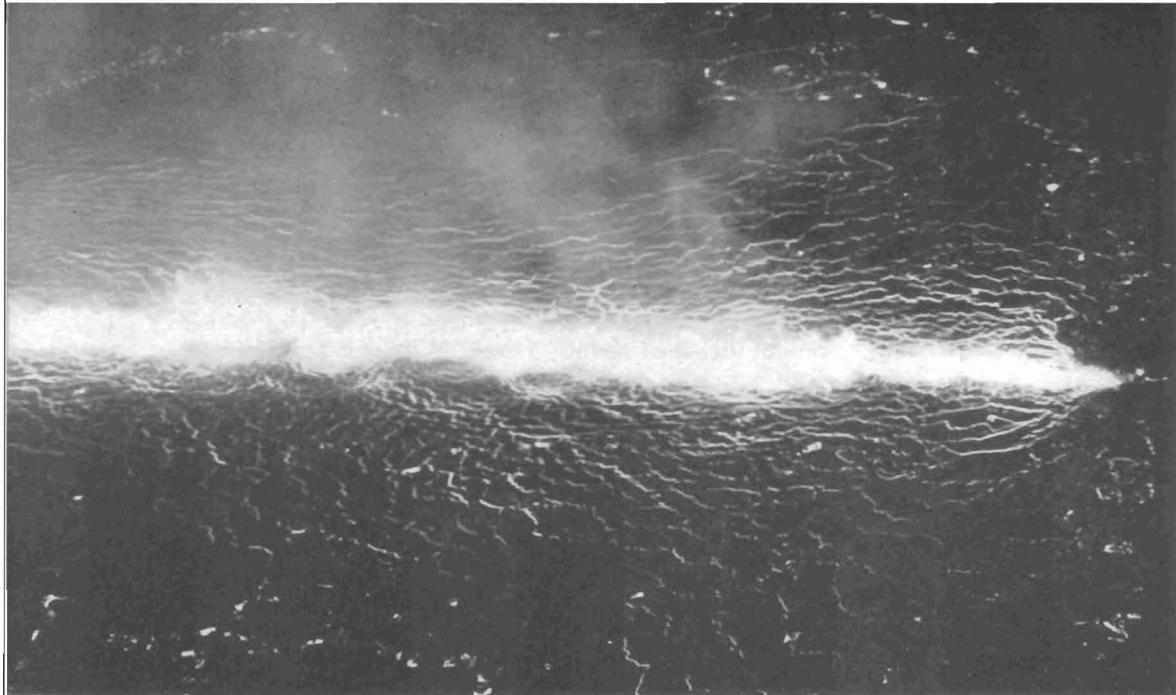


FIGURE 2. Lava fountains along the fissure in the north-eastern portion of Halemaumau and brightly glowing cracks in the thin crust of the liquid lava lake, at 3 A.M. on June 28. The fountains range from about 20 to 50 feet high. Waves in the liquid can be seen near the fountains. Photo by C. K. Wentworth.

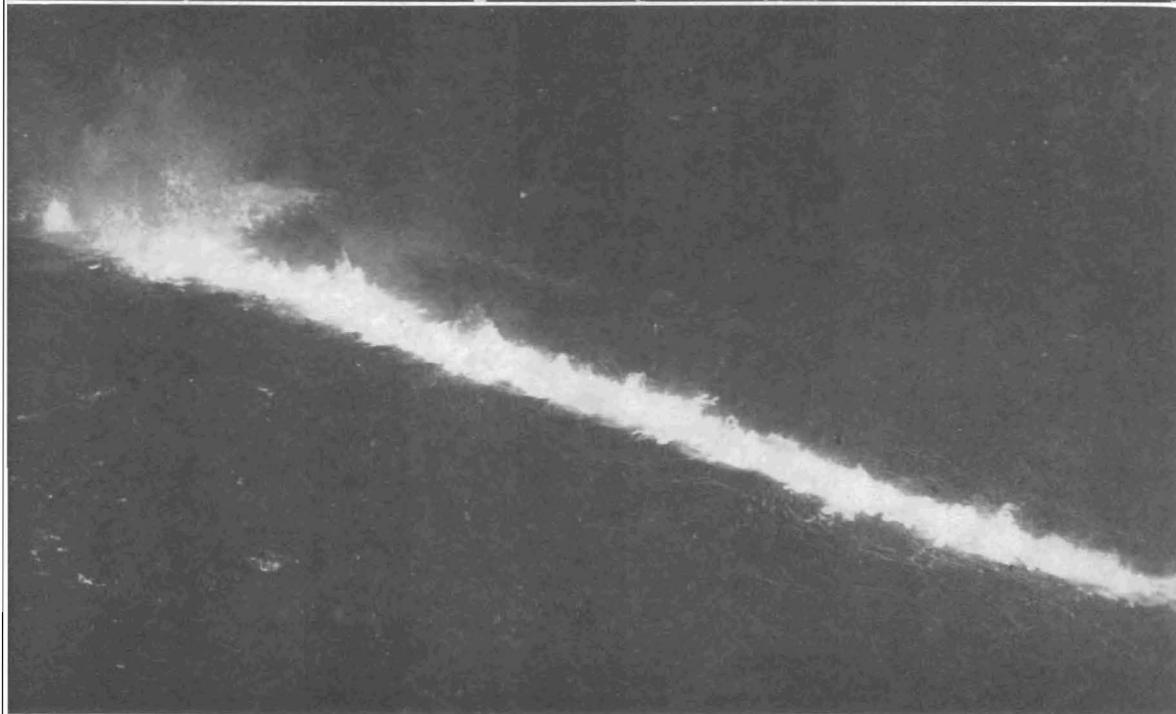


FIGURE 3. Lava fountains along the fissure across the southwestern portion of the floor of Halemaumau, at 2:15 A.M. on June 28. The large fountain at the left-hand edge is the big southwestern fountain, which had then decreased in height to about 150 feet.

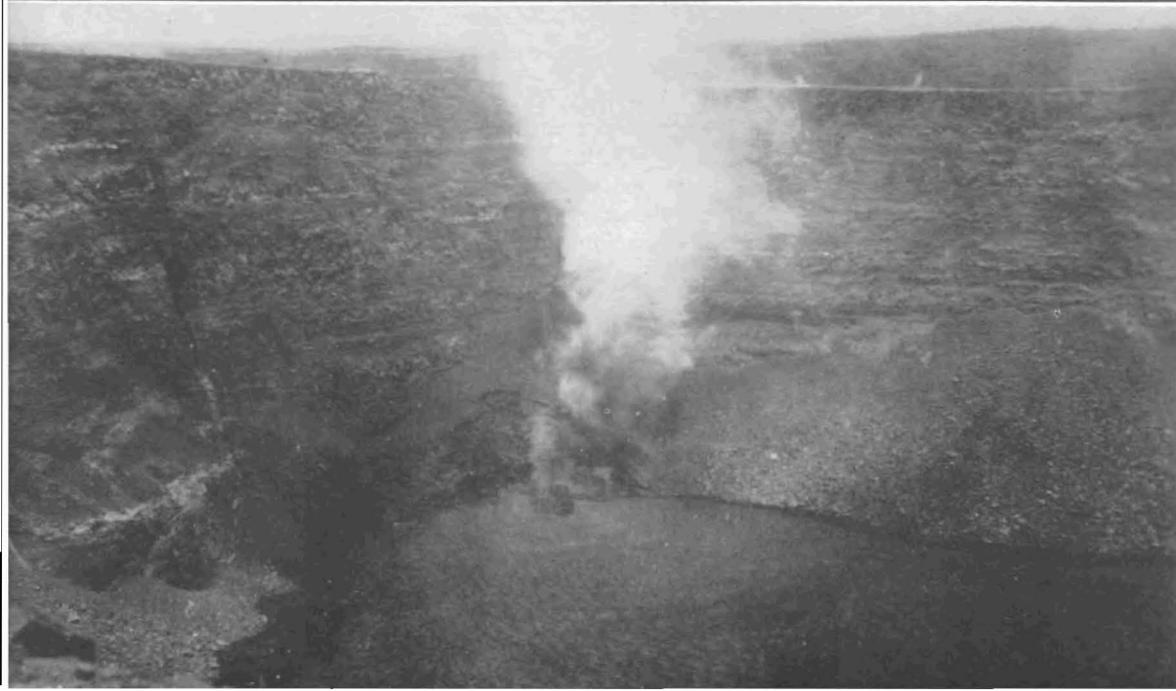


FIGURE 4. The lake of liquid lava and the fountain at the southwestern edge of Halemaumau at 7:20 A.M. on June 28. The fountain is about 50 feet high. Waves in the lake are clearly visible.

FIGURE 5. Lava fountain about 150 feet high at the southwestern edge of Halemaumau, at 11:15 A.M., July 2.

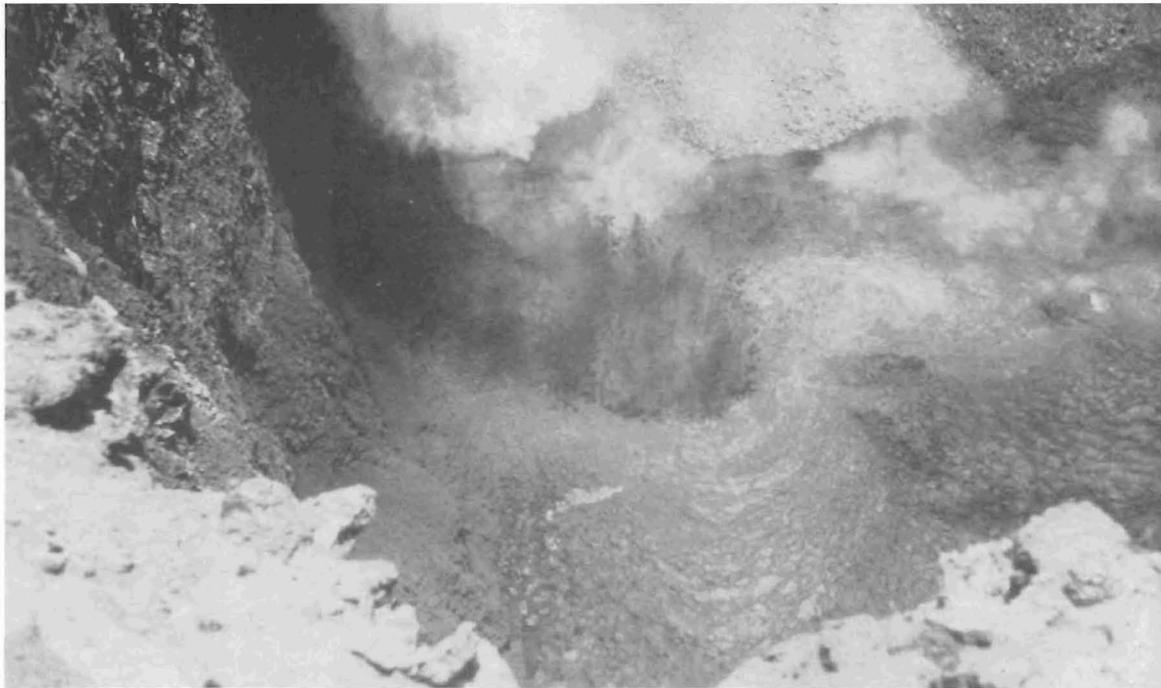


FIGURE 6. Lava fountains and cinder cone in Halemaumau on July 22. Rivers of lava are pouring out through gaps in the cone. The marginal bench along the western side of the crater floor is visible in the background. The highest cone segments are about 50 feet high.



FIGURE 7. Small spatter and cinder cones and lava lake in the crater of the large cinder cone, on September 9, looking westward from the southeast rim of Halemaumau. Comparison of the western wall of the crater with that shown in Figure 6 gives some indication of the amount of rise of the floor during the interval between the two photographs.



The end of October brought a brief revival of activity. On the night of October 31, the upper portion of the northern conelet collapsed, decreasing the height of the conelet from 65 to 35 feet, and big lava fountains veneered the outer slopes of the conelet with a thin layer of liquid spatter. On the next night, a further collapse of the conelet reduced its height to about 25 feet and broadened its wide-open crater to a diameter of about 90 feet. Lava overflowed the crater rim, completely covering the outer slopes of the conelet and extending thin flows to a point just beyond the northern edge of the cinder cone. On the south side of the conelet the flow spilled into the lava lake. With the reopening of the vent the gas cloud became thin and bluish again. As throughout much of the eruption, heat from the crater caused a convectional rise of the air above it, and condensation formed an often conspicuous cap of cumulus cloud two or three thousand feet above the crater rim.

Another overflow of the conelet, similar to that of November 1, occurred at about 10 P.M. on November 6. Within a few minutes a thin sheet of lava had covered the slopes of the conelet and the immediately adjacent region. The area of the overflow was estimated by C. K. Wentworth to be approximately 5 acres. Through early November, a small lava fountain was visible in the crater of the conelet. The fountain was generally only 15 or 20 feet in height, but it threw spasmodic bursts to heights as great as 150 feet.

The last activity of the lava lake was observed on November 9, and the last fountain activity on the morning of November 10.

Considering the eruption to have ended on November 10, its duration was 136 days. Glowing spots continued to be visible in the lava lake and north conelet until November 11, and at the south conelet and at solfataras on the crater floor northwest and south of the big cinder cone until November 18. At the end of 1952, moderate amounts of pale bluish-gray fume were still issuing at these solfataras.

THE LAVA

The total volume of the new lava fill in Halemaumau is approximately 64,000,000 cubic yards, and its average thickness is approximately 310 feet. The average depth to the crater floor from the visitors' observation area at the southeast rim of the crater is 460 feet. Figure 8 shows progressive stages in the filling of Halemaumau.

The only specimens of the erupted lava recovered are pumice. The latter has not yet been analyzed chemically,

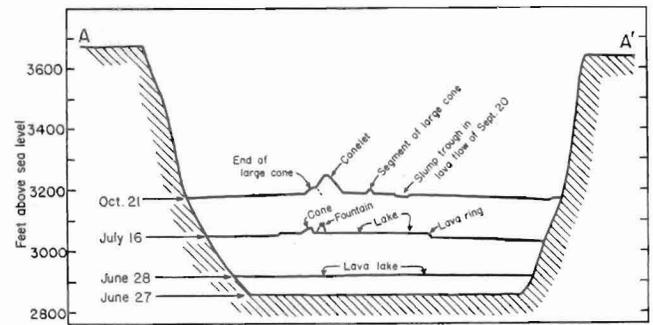


FIGURE 8. Profile across Halemaumau along line A-A' in figure 1-A, showing successive levels of the crater floor just preceding and during the 1952 eruption. The vertical scale is twice the horizontal.

but it is basaltic in character, the refractive index of the glass being $1.598 (\pm .003)$.

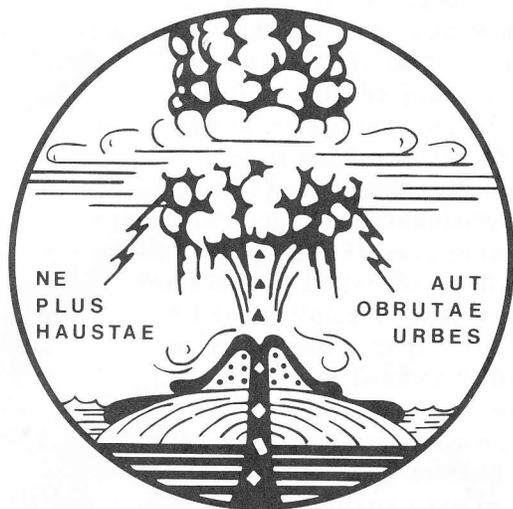
The temperature of the lava fountains was measured repeatedly with an optical pyrometer of the disappearing dot type. The reading on the hot core of the big fountains during the first month of the eruption ranged from 1030° to 1055° C., depending at least partly on the distance of the observer from the fountain. To these readings should be added a correction of about 20° for light absorption by the lava and, probably, a correction of 10° to 30° because of the fairly large distance from which readings were obtained. The actual temperature of the fountains appears, therefore, to have been in the vicinity of 1080° C. Early in August, the temperature of the fountains started to decrease. By mid-August, the corrected temperature had dropped to about 1050° C. and, by late August, to 1040° . Corrected temperature readings on active lava flows ranged from about 1030° to 920° .

The radioactivity of the erupted lava appears to have been low. Two samples of pumice ejected respectively during the first night of the eruption and at 6 A.M. on July 3, analyzed by the U. S. Geological Survey in Washington, D. C., each contained less than 5 parts per million of uranium equivalent.

ACKNOWLEDGMENTS

Many persons have contributed information on the eruption. It is impossible to mention all by name, but to all we extend our sincere thanks. Without their help it would not have been possible for the small staff of the Volcano Observatory to obtain so complete a record of the eruption. The staff of Hawaii National Park was especially helpful.

The Volcano Letter



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