PREFACE

The Volcano Letter was an informal publication issued at irregular intervals by the Hawaiian Volcano Observatory (HVO) during the years 1925 to 1955. Individual issues contain information on volcanic activity, volcano research, and volcano monitoring in Hawaii. Information on volcanic activity at other locations is also occasionally included.

To increase accessibility of this resource, previously only available in print format, this compilation was scanned from the highest quality Volcano Letter originals in the HVO archives. Optical Character Recognition (OCR) was run on the entire file. In addition, the file size was reduced by making it compatible with only Adobe Reader v. 8 and later. The scanning was done by Jim Kauahikaua and the quality control and posting was done by Katie Mulliken, both current staff at the Hawaiian Volcano Observatory.

Originals of the first three Volcano Letters could not be found so copies plus the Title Page and Index for 1925 have been extracted from an excellent scan of Volcano Letters for 1925 to 1929 available in Books.Google.com

The Volcano Letter was published by HVO through multiple changes in administration, including the Hawaiian Volcano Research Association (1925-1932), the U.S. Geological Survey (1932-1935), the Department of the Interior (1935-1938), and the University of Hawai‘i (1938-1955). Issues 1–262 were published weekly from January 1, 1925, to January 2, 1930, and consisted of a single page of text. Issues 263–384, also published weekly, from January 9, 1930–May 5, 1932, were generally longer—four-pages—and provided more detail on volcanic activity, including photographs, maps, and plots. Weekly issues 385–387, published May 12–26, 1932, were a single page of text due to budget reductions brought on by the Great Depression. Budget restrictions reduced the publishing frequency to monthly for issues 388–428, covering the period of June 1932 to October 1935; these issues were generally shorter, 1–2 pages, and sometimes featured figures. From November 1935 to July 1938, issues 429–461 remained monthly but increased in length (generally eight pages) and featured figures frequently. Issues 462–530, published over the period of August 1938–December 1955, varied in length from 2–15 pages, but were published quarterly, rather than monthly.

Six of the letters are misnumbered:
Jan. 21, 1926 number is 55 though it should 56
July 29, 1926 number is 82 though it should be 83
Feb. 16, 1928 number is 161 though it should be 164
May 31, 1928 number is 197 though it should be 179
Nov. 29, 1928 number is 204 though it should be 205

For background information on the Hawaiian Volcano Observatory: https://pubs.usgs.gov/gip/135/

The Volcano Letter publications are also available in print:

Fiske, R.S., Simkin, T., and Nielsen, E.A., eds.,1987, The Volcano Letter, No. 1-530. See https://www.si.edu/object/siris_sil_328087

April 2023

The Volcano Letter

No. 407—Monthly U. S. Geological Survey, Hawaii National Park JANUARY, 1934

KILAUEA REPORT FOR JANUARY, 1934

Including weekly press reports 1146 to 1149, December 31 to January 28, midnight.

Section of Volcanology, U. S. Geological Survey
T. A. Jaggar, Volcanologist in Charge

Volcanology:—Kilauea

The first week in January, 1934 Halemaumau remained quiet as before. The second week the pit showed the effects of heavy rainfall after drought. The rainfall readings for twenty-four hours preceding, at 8 a. m. were 1.37 inch January 10, 0.87 inch on January 11, 1.40 inch on January 12, and 0.29 inch on January 13, measured at Kilauea Observatory on the northeast rim of Kilauea crater. The heavy rains began the night before January 10. As seen from the west bluff of Kilauea, a dense vapor cloud appeared to be rolling out of Halemaumau pit. The actual fact was that the cloud was condensing on top in the air above the pit. The entire lava bottom was perfectly clear with no steam whatever except the usual slight vaporing from cracks under the south talus. The wind blew lightly from the northeast and the condensation of ordinary rain moisture began above the northeast edge of the pit. The big cumulus cloud above was probably assisted by nucleation from sulphur dioxide rising at the bottom solfataras. The heat from the pit made an updraft which drew in the wet air from the sides. The phenomenon showed how deceptive a so-called "steaming crater" might be anywhere on a wet day, where the observer was not in a position to look inside. This is the position of many sea-captains observing an island volcano "steaming". On a sunny day the crater in question would be clear, but the reports of two successive vessels would be for the volcano "active" and "inactive", when in fact there was no difference except the moisture in the air.

On January 11 there was the same cloud, the interior of the pit was clear, it was raining steadily. Now there were tails of steamy vapor in a horseshoe of cracks in the floor of Halemaumau SE, NE and NW where the prolonged rain had penetrated deeply to the hot region. There was clear air for eight hundred feet above the vapor jets, which had no evident relation to the cloud above the pit. The southwest inner cone, of December 1931, was not steaming. The next day January 12, with less rain, the vapor tails on the floor had stopped, and the cloud above the pit as a whole, was thin and stringy. There was drizzle, and a bright clearing sky.

On January 14 some stones were heard dribbling down the northwest inner slopes of Halemaumau. Fresh fallen rocks at the foot of the northeast talus were observed January 18. Small slides occurred later in the day, and fresh sliding occurred the morning of January 24, leaving a piece broken out of the northwestern end of the "Canoe" sill under the north corner of the pit. In the afternoon of the same day while the pit was vaporing from more heavy rains, rocks were heard falling at the north wall. Blue fume was apparent in the darkened corners of the pit in sun-shadow January 26. It is noteworthy at this time, however, that the yellow sulphur patches in Halemaumau do not show fume jets or hot air disturbance detectable with field glass, and they are not the places which steam at times of rainfall.

Weekly rim crack points, 37 in number, around the Halemaumau border, were measured for change in opening of cracks as follows:—

January 6, 1934. 7 points opened, 2 closed, summation 3 millimeters opening.

January 13, 12 points opened, 1 closed, summation 7 millimeters opening.

January 20, 3 points opened, 9 closed, summation 3 millimeters closing.

January 27, 5 points opened, 2 closed, summation 1.5 millimeters opening.

The summation of January 20 was unusual: opening by this amount is common.

Volcanology:—Mauna Loa

There were numerous thunder showers over Mauna Loa the third week in January, with calm weather preceding, and light snow fell on Mauna Loa and Mauna Kea. The recent lava eruptions in Mokuaweoweo crater, it will be remembered, were from December 2 to 17, 1933, followed by marked rain cumulus condensations due to convection on certain days. These upright clouds are still seen occasionally, especially when moisture from melting snow is present.

Ranger R. F. Lueck, National Park Service, and T. Generozza, U. S. Army, spent the night January 6 to 7 in Mokuaweoweo crater at the cone center of the December activity. Arriving at the North Bay 1:30 p. m. January 6, Lueck reports the fume had decreased in ten days 75 percent. They crossed the crater floor southward. Lueck kindly prepared the following report:—"We came to the new floor flow, which had turned west to follow the channel between the 1903 and 1914 cones. The new lava was smooth pahoehoe, broken up at the edges, where it was in contact with the old lava."

"We crossed it, the heat was quite noticeable, and this became more pronounced as we neared the base of the new cones. We finally reached them and there found a place on the fresh lava, where we thought we could spend the night in comfort and safety. Our ideas were suddenly changed, when, at 5:45 p. m. we felt a distinct shock, and at 5:48 another, of less intensity. As there was not much choice of a more suitable location, we stayed where we were."

"After we had crawled into our sleeping bags, we heard a series of rumbles, and occasional sharp cracks, which seemed to originate directly under us. The rumbling was not continuous, but came at intervals of three or four minutes. After about two hours of this, we began to think of a lot of places we would rather be than just here. At 8 p. m. we felt a shock more severe than any we had felt before, so we proceeded to leave that particular spot, as fast as our legs would carry us in the night, across the pumice beds and rough lava. We got to the edge of the new flow to the north of us, and decided to make the best of the situation, making our beds a second time, in a deposit of new warm pumice. During the night we noted several more light shocks, but none was severe enough to cause great alarm. At daylight we packed our belongings, and left for the return trip."

T.A.J.

Earthquakes

TABLE

Number of minutes of tremor; numbers of very feeble, feeble, and slight earthquakes; teleseisms or distant earthquakes; and local seismicity index as described in Volcano Letter 371.

Week ending 1934	tr.	v. f.	f.	sl.	tel.	seis.
January 7	26	4	0	0	0	8.50
January 14	52	1	0	2	1	17.50
January 21	31	0	1	0	0	8.75
January 28	24	5	0	0	0	8.50

The following earthquakes were located:

A very feeble shock was felt 11:22 p. m. January 2, 1934, at Honomu, Waikii, and Kilauea. It was located under the peak of Mauna Kea, 19° 50′ N, 155° 27.5′ W, at a shallow depth, probably being above sea level.

A very feeble shock at 8:06 p. m. January 6, approximate origin 21 miles away, was probably the sharp quake reported by Lueck at Mokuaweoweo.

January 7 two very feeble quakes were recorded 15 minutes apart. The first 3 miles deep under the pit seismograph station; the other was shallow about two miles SW of Kilauea Crater in the SW rift zone.

A slight earthquake was felt 1:59 a. m. January 9 at Hookena, Kapapala, Pahala, and Kilauea. It was located under the Mauna Loa SW rift 19° 12.5′ N, 155° 44.0′ W and shallow in depth.

A slight earthquake was felt generally in Hawaii at 1:35 p. m. January 13. It was located under the sea bottom 19° 11′ N, 155° 11′ W, possibly 10 miles deep.

A tremor originated at a shallow depth about a mile SW of Kilauea crater January 16. It was recorded on the Uwekahuna and Pit seismographs and was in almost the same place as the one located November 30, 1933.

Two shocks felt at Honomu January 17 and 21 were not recorded at Kilauea. The former recorded at the Hilo seismograph station with indicated distance to origin 10 miles.

A feeble shock, not reported felt, was recorded at 9:37 p. m. Jauuary 19. It was located on the Kilauea SW rift, under the 1823 lava flow 19° 14′ N, 155° 25.5′ W.

A very feeble shock was recorded January 25. The best location found for it was four miles deep under the Kamakaia Hills on the Kilauea SW rift, about 10 miles SW of the crater.

The teleseism was one of the destructive Indian earthquakes, near Patna in the Ganges basin. It began on the record 10:31:44 p. m. January 14. In all six groups of waves were recognized, the last group beginning at 11:02:33 p. m. The waves were not large in amplitude.

Microseisms: Subnormal January, 1, 2, 12, 16, 17, 18, 19, 21, 23, 24, 25, 26, 27; normal January 3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, 15, 20, 22, 28.

A.E.J.

Tilting of the ground

In the Table of Tilt below, the first column shows the net tilt by weeks as computed from seismograms at the Kilauea Observatory, which is on the northeast rim of Kilauea crater, 2.2 miles from Halemaumau.

The second column shows the algebraic sum of the readings at three clinoscope cellars around Halemaumau pit, reduced each to its radial direction, outward away from, and inward in the direction of, the center of Halemaumau.

The Table represents the tipping of the ground, in seconds of arc, in the direction given.

At the Observatory, a northeast reading is away from the crater, a southwest reading is in the direction of the crater.

At the Observatory the total accumulated tilt in the year since January 1, 1933, is 1.9″ west and 1.1″ north, or 2.2″ NW by W.

TABLE OF TILT

Date	Observatory	Halemaumau
Jan. 1 – Jan. 7	1.82″ ESE	15.0″ inwards
Jan. 8 – Jan. 14	1.59″ S by E	11.0″ inwards
Jan. 15 – Jan. 21	0.12″ W	2.0″ outwards
Jan. 22 – Jan. 28	2.38″ SW	15.0″ outwards

A.E.J.

The Volcano Letter

No. 408—Monthly | U. S. Geological Survey, Hawaii National Park | FEBRUARY 1934

KILAUEA REPORT FOR FEBRUARY, 1934

Including weekly press reports 1150 to 1154, January 29 to March 4, midnight

Section of Volcanology, U. S. Geological Survey
T. A. Jaggar, Volcanologist in Charge

Volcanology

Kilauea and Mauna Loa continue without volcanic outflow of any kind: the last activity was lava gushing in the summit crater of Mauna Loa December 2 to December 18, 1933. The feeble sulphur fuming at yellow patches about the border of the lava floor of Halemaumau pit in Kilauea crater has almost ceased. Small slides in the pit were observed during the casual visits, at the west 2:30 p. m. February 4, at the southwest 10 a. m. February 5, east and northwest about 10 a. m. February 6, northeast the forenoon of February 12.

Thirty-two rim crack points around Halemaumau, showed weekly change in opening of cracks as follows:—
February 3. 11 opened, 1 closed, aggregate opening 6.5 mm.
February 10. 10 opened, 1 closed, aggregate opening 9.5 mm.
February 17. 3 opened, 7 closed, aggregate closing 3 mm.
February 24. 5 opened, 3 closed, aggregate opening 2 mm.
March 3. 7 opened, 5 closed, aggregate opening 1 mm.

T.A.J.

Earthquakes

TABLE

Number of minutes of tremor; numbers of very feeble, feeble, and slight earthquakes; teleseisms or distant earthquakes; and local seismicity index as described in Volcano Letter 371.

Week ending	tr.	v. f.	f.	sl.	tel.	seis.
February 4	100	4	1	0	1	28.00
February 11	106	2	0	1	0	29.50
February 18	41	2	1	0	1	12.75
February 25	36	3	1	1	1	13.50
March 4	74	3	0	1	0	22.00

The following earthquakes were located.

A feeble earthquake 3:14 a. m. January 30 was not reported felt. It originated 7 mi. SE of Mokuaweoweo, the summit crater of Mauna Loa, lat. 19° 24.5'N long. 155° 32' W. Two very feeble shocks 10:53 and 11:01 a. m. the same day, were close to or in Kilauea crater. A very feeble shock 2:29 p. m. February 1 originated 5 mi. west of Wood Valley, 19 ° 13'N, 155° 34.5'W. A very feeble shock 1:54 a. m. February 2 was in Kilauea crater. The Pit seismograph was disconnected for repairs during the month.

A slight earthquake was felt sharply at Kapapala ranch at 9:59 a. m. February 9. It was reported felt in Hookena, Hawaii National Park and Waikii. It was located 5 mi. SW of Wood Valley 19° 13'N, 155° 33'W. A feeble shock occurred 8:14 a. m. February 15 near or in Kilauea crater. A slight earthquake was felt sharply 3 mi. east of the observatory at 2:20 a. m. February 19. It was located a mile farther east, 19° 25'N, 155° 12.5'W. A feeble shock was felt at Kilauea crater, Hakalau and Honokaa at 5:31 p. m. February 24. The location was half way between Mauna Kea and Hualalai, 19° 46'N, 155° 42'W. and 11 mi. deep.

A very feeble shock occurred close to Kilauea crater 2:45 p. m. February 26. A slight shock was felt generally on the island of Hawaii at 10:22 p. m. March 1. It was reported from Kilauea Navy Camp, Kona, Pahala, Honomu, Hilo and Waikii. It was located 5 mi. north of Mokuaweoweo 19° 33'N, 155° 35'W.

Swarms of tremors, earthquakes barely enough to record, were noted on the following days. A swarm of 47 tremors was recorded between 8 and 11 a. m. Feb. 2. On the forenoons of Feb. 5, 6, 7 and 8 some were recorded together with suggestions of many other very faint tremors too small to be certain of. A swarm of 28 tremors was recorded during the middle of the day of Feb. 28.

A small teleseism began recording at 11:43:01 p. m. Jan. 30. The preliminary waves only were recorded. A small fragmentary record of a teleseism was obtained beginning at 5:41:51 p. m. Feb. 13. A fair record of a teleseism began recording at 8.03:30 p. m. Feb. 23, other waves began at 8:11:19 and 8:20:56. The maximum waves came at 8:22:19 p. m. It appeared to be 3,800 statute miles away.

The microseisms were normal Jan. 29, Feb. 1, 2, 3, 5, 9, 10, 18, 20, 21, 25. Mar. 1 & 4, they were strong or abnormal Feb. 11 and Mar. 2, they were subnormal during the rest of the period under consideration.

A.E.J.

Tilting of the ground

In the Table of Tilt below, the first column shows the net tilt by weeks, as computed from seismograms at the Kilauea Observatory, which is on the northeast rim of Kilauea crater 2.2 miles from Halemaumau.

The second column shows the algebraic sum of the readings at three clinoscope cellars around Halemaumau pit, reduced each to its radial direction, outward away from, and inward in the direction of, the center of Halemaumau.

The Table represents the tipping of the ground, in seconds of arc, in the direction given.

At the Observatory, a northeast reading is away from the crater, a southwest reading is in the direction of the crater.

At the Observatory the total accumulated tilt in the year since March 1, 1933 to March 1, 1934 is 2.7″ west and 3.8″ north.

TABLE OF TILT

Date	Observatory	Halemaumau
Jan. 29 – Feb. 4	1.2″ NE by E	17.0″ from.
Feb. 5 – Feb. 11	2.3″ SW by S	25.0″ from.
Feb. 12 – Feb. 18	2.1″ SW by W	10.0″ from.
Feb. 19 – Feb. 25	0.8″ SW by W	23.0″ towards.
Feb. 26 – Mar. 4	1.0″ S by W	00.0″

The pit tilt figures are somewhat unreliable, for during the period Feb. 2 to 25, a concrete ceiling was put in. The clinoscope was temporarily disconnected and though the connections were not changed, it is unlikely that it was replaced in the same position that it would have reached if undisturbed.

The temporary timbering in the clinoscope chamber must have had a large effect also. The figures are tentative. It is notable that the tilt away from the pit started January 19, 1934 with a net of 17″ at the end of January, so that the net tilt away from the pit of 29″ for the February interval may not be all artificial.

Correction. Tilt Jan. 1–7 should read 4″ inwards, not 15″ inwards.

A.E.J.

The Volcano Letter

No. 409—Monthly U. S. Geological Survey, Hawaii National Park MARCH, 1934

KILAUEA REPORT FOR MARCH, 1934

Including weekly press reports 1155 to 1158, March 4 to April 1, midnight.

Section of Volcanology, U. S. Geological Survey
T. A. Jaggar, Volcanologist in Charge

Volcanology

There has been no lava activity on the surface of the Mauna Loa—Kilauea volcanic system of the island Hawaii during the month of March. The summit crater of Mauna Loa, Mokuaweoweo, which was spouting basaltic lava December 2 to 18, 1933, has been under observation, as the National Park force are preparing a rest house or camp on the northern r'm of the crater. The rangers report that the blue sulphur fume, at the source cone of December inside the main Mokuaweoweo floor towards the south, has definitely increased, the last visit being noon March 23.

On the Ki'auea east rift, or Chain of Craters, there was a rumor of noises heard by workmen the afternoon of March 24 in the direction of Makaopuhi pit. There were a few tremors recorded on the seismograms of the Kilauea station at about the same time. The field was examined by A. E. Jones March 28. and inspection of the Chain of Craters revealed no sign of recent slides.

Small slides in Halemaumau pit of Kilauea Crater occurred as follows:— At 8:42 a. m March 13, at the northeast wall, started perhaps by strong and gusty northeast wind. At 1:25 p. m. March 19 making dust rise at the west. During the forenoon of March 24, at 10:56 a. m. at the north corner of the pit. On April 1 at 10:24 a. m. at the north corner, and fresh dust lay on the talus at the northeast corner.

The thirty-two rim crack points around the edges of Halemaumau for weekly measurement of opening or closing, yielded the following changes when measured on Saturday forenoons:—

March 10. 5 opened, 2 closed, aggregate opening 1.5 mm.
March 17. 6 opened, 6 closed, aggregate opening 2 mm.
March 24. 3 opened, 1 closed, aggregate opening 1.5 mm.
March 31. 7 opened, 0 closed, aggregate opening 3.5 mm.

T.A.J.

Earthquakes

TABLE

Number of minutes of tremor; and numbers of very feeble earthquakes; teleseisms or distant earthquakes; and local seismicity index as described in Volcano Letter 371.

Week ending	tr.	v. f.	tel.	seis.
March 11	48	2	1	13.00
March 18	35	2	2	9.75
March 25	33	2	1	9.25
April 1	19	5	0	7.25

The following very feeble shocks were located, none was reported felt.

One 0:34 a. m. March 10, 9 miles at sea off Cape Kumukahi. Lat 19° 37.5′ N. Long. 155° 43′ W.

One 1:56 a. m. March 10, under a fault scarp 2 miles SE of Ainahou. Lat 19° 19′ N. Long. 155° 11′ W.

One 5:09 p. m. March 11, 2 miles east of Kalalua crater on the Kilauea east rift. Lat. 19° 25′ N. Long. 155° 03′ W.

One 11:40 a. m March 13, under SE edge of Kilauea Iki crater. Lat. 19° 25′ N. Long. 155° 15′ W.

One 8:09 p. m. March 18 under SE edge of Kilauea crater. Lat. 19° 24.5′ N. Long. 155° 16′ W.

One 3:01 a. m. March 24, between Makaopuhi crater and the cl'ff to the south. Lat 19° 20′ N. Long. 155° 10′ W.

One 4:11 a. m. March 29, on the Mauna Loa SW rift, 10 miles at sea. Lat. 18° 58′ N. Long. 155° 55′ W.

One 1:46 p. m. March 30, north of Pauahi crater on the Kilauea east rift. Lat. 19° 23′N. Long. 155° 13′ W.

The records of the teleseisms were poor, usually preliminary waves followed by L waves.

One began at 1:27:07 a. m. March 5.

One began at 4:43:40 a. m. March 12, reported by press in Utah, Wyoming and Idaho.

One began at 2:51:14 a. m. March 13.

One began at 1:43:47 a. m. March 24 with secondary waves following at 1:51:11 a. m., estimated distance 3600 miles, located in Pacific Ocean near the Solomon Islands.

Microse'sms were subnormal March 5, 6, 7, 8, 10, 11, 13, 14, 17, 18, 19, 20, 21, 22 and April 1.

Microseisms were abnormal March 25, 26, 27, 28, 29, and 30. They were normal or moderate during the rest of the period under consideration.

A.E.J.

Tilting of the Ground.

In the Table of Tilt below, the second column shows the net tilt by weeks, as computed from the seismograms at the Kilauea Observatory, which is on the northeast rim of Kilauea crater 2.2 miles from Halemaumau.

The third column shows the algebraic sum of the readings at three clinoscope cellars around Halemaumau pit, reduced each to its radial direction, outward away from, and inward in the direction of, the center of Halemaumau.

The Table represents the tipping of the ground, in seconds of arc, in the direction given.

At the Observatory, a northeast reading is away from the crater, a southwest reading is in the direction of the crater.

At the Observatory the total accumulated tilt in the year April 1, 1933 to April 1, 1934, is 1.8″ east and 4.0″ north.

TABLE OF TILT

Date	Observatory	Halemaumau
Mar. 5 to Mar 11	0.7″ SSW	3″ towards
Mar. 12 to Mar. 18	0.7″ NE	14″ towards
Mar. 19 to Mar 25	2 1″ SW by S	4″ from
Mar. 26 to Apr. 1	1.2″ NE by E	16″ towards

A.E.J.

The Volcano Letter

No. 410—Monthly | U. S. Geological Survey, Hawaii National Park | APRIL 1934

KILAUEA REPORT FOR APRIL 1934

Including weekly press reports 1159 to 1162, April 1 to April 29, midnight.

Section of Volcanology, U. S. Geological Survey
T. A. Jaggar, Volcanologist in Charge

Volcanology

No significant changes have been observed, in the craters of Kilauea and Mauna Loa during April, which suggest any immediate activity of lava. In Halemaumau pit of Kilauea volcano, a small fall of rocks at the northwest wall occurred 8:40 a. m. April 11, another at northeast wall 8:30 a. m. April 12, trickle slides moved down the northwest buttress inside the pit at 9:18 a. m. April 21, again at 10:15 a. m. northeast, and at 10:38 a. m. stronger at the top of the northwest buttress; dust arose again at 1:15 p. m. April 25 a northwestern slide again occurred, at 10:12 a. m.

The thirty-two rim crack points marked, around the edges of Halemaumau, for weekly measurement with steel tape, showed the following weekly changes as measured Saturday forenoons:—

April 8. 7 opened, 7 closed, aggregate result zero.
April 15. 5 opened, 6 closed, aggregate closing 1.0 mm.
April 22. 12 opened, 1 closed, aggregate opening 7.5 mm.
April 29. 12 opened, 4 closed, aggregate opening 5.5 mm.

For Mauna Loa, Ranger R. F. Lueck was in Mokuaweoweo crater April 29 for six hours. He visited the cones at the center of eruption of December last. He is familiar with this center from previous visits (Volcano Letter, January, 1934). Where at this center during his January visit he could smell sulphur strongly, there was now in April no more blue fume nor odor at the December vents. The 1914 cone, however, west of the rifts of 1933 in the bottom of the greater crater, was making blue and yellow fumes, as before. Lueck reported that a cone six miles down from the summit along the northeast rift belt of the volcano was steaming from its crater. This cone lies east of the National Park trail below the usual steaming places, and no steam had been noticed there on previous trips.

T.A.J.

Earthquakes

TABLE

Number of minutes of tremor; numbers of very feeble, feeble, and slight earthquakes; teleseisms or distant earthquakes; and local seismicity index as described in Volcano Letter 371.

Week ending	tr.	v. f.	f.	sl.	tel.	seis.
April 8	15	4	0	0	0	5.75
April 15	25	5	2	1	1	12.75
April 22	18	1	0	0	0	5.00
April 29	18	2	0	0	0	5.50

The following local earthquakes were located.

A very feeble shock at sea on the Kilauea east rift, at 5:46 p. m. April 3. Lat. 19° 40′N. Long. 154° 37′W.

A very feeble shock a short distance north of Kilauea crater at 7:34 p. m. April 6. Lat 19° 28′N. Long. 155° 14′W.

At 2:06 a. m. April 9, a moderate earthquake felt in Kohala, felt lightly in Hilo and in Maui. It recorded as very feeble at the observatory and was located at the north end of the island Lat. 20° 09′N. Long. 155° 53′W.

At 8:21 a. m. April 9, a second shock in central Kohala. It was less widely felt, but recorded as feeble at the observatory; Lat. 20° 06′N. Long. 155° 43′W.

A very feeble shock at 2:38 a. m. April 11, 12 mi. at sea, S by E of Cape Kumukahi, Lat. 19° 16′N. Long. 154° 40′W.

A very feeble shock at 0:01 a. m. April 12 was located in Kilauea crater Lat. 19° 24.8′N. Long. 155° 16.5′W.

A feeble shock at 9:14 a. m. April 14 was located 10 miles north of Mokuaweoweo, Lat. 19° 37.5′N. Long. 155° 37′W.

A slight earthquake at 7:51 p. m. April 14, was felt in Olaa and Hilo. It was located 10 miles at sea on the east rift, Lat. 19° 37.5′N. Long. 154° 43′W.

A very feeble shock was felt in Hawaii National Park at 10:25 p. m. April 15. It was located 3 miles SE of the Volcano House, Lat. 19° 24.5′N. Long. 155° 14′W.

A very feeble shock at 1:06 a. m. April 24 was located near Waiohinu near the south end of the island, Lat. 19° 02′N. Long. 155° 38′W.

The teleseism was partly recorded, the records showing first or P wave only, beginning at 11:57:10 a. m. April 15.

Microseismic ground motion was normal April 4, 9, 11, 12, 13, 14, 15, 18, 20, 21, 26, 27, and 28, and subnormal the remainder of the month.

A.E.J.

Tilting of the Ground.

In the Table of Tilt below, the second column shows the net tilt by weeks, as computed from the seismograms at the Kilauea Observatory, which is on the northeast rim of Kilauea crater 2.2 miles from Halemaumau.

The third column shows the algebraic sum of the readings at three clinoscope cellars around Halemaumau pit, reduced each to its radial direction, outward away from, and inward in the direction of, the center of Halemaumau.

The Table represents the tipping of the ground, in seconds of arc, in the direction given.

At the Observatory, a northeast reading is away from the crater, a southwest reading is in the direction of the crater.

At the Observatory the total accumulated tilt in the year April 29, 1933 to April 29, 1934 is 5.3″ N. and 2.1″ E.

TABLE OF TILT

Date	Observatory	Halemaumau
Apr. 2 to Apr. 8	0.8″ SW by S	3″ towards
Apr. 9 to Apr. 15	0.6″ SW by S	2″ from
Apr. 16 to Apr. 22	0.3″ E by S	8″ from
Apr. 23 to Apr. 29	0.3″ West	1″ towards

A.E.J.

The Volcano Letter

No. 411—Monthly | U. S. Geological Survey, Hawaii National Park | MAY, 1934

KILAUEA REPORT FOR MAY 1934

Including weekly press reports 1163 to 1167 April 29 to June 3, midnight.

Section of Volcanology, U. S. Geological Survey
T. A. Jaggar, Volcanologist in Charge

Volcanology

Slides in Halemaumau pit of Kilauea crater occurred as follows:—a thin dust cloud rose high and straight at northeast side 3:20 p. m. May 3; trickle slides at northeast wall 9:20 a. m. May 8, and thereafter during the day; the strongish earthquake of 10:09 a. m. May 10 left fresh red fragments on lower northwest talus, and there was a break in the wall just above. On May 11 fragments trickled down the northwestern wall as shown by the noise in that region at 9:05 and 9:12 a. m. The earthquakes of 3:23 and 3:25 p. m. May 13 were followed by a slide at Halemaumau at 3:38 p. m. leaving scars at top of west and north wall.

On May 14 at 8:20 a. m. with notably still air and rainy weather, Halemaumau showed vapor rising from the southeast and west walls, from the southwest talus, in voluminous jets up the south talus, at the wall about the southwest rift tunnels, and all along the upper rim cracks, east and west, outside of the pit.

In contrast to this. vapor was notably absent up and down the walls and taluses north and northeast, and no vapor jets whatever rose from the lava floor of the pit, nor from the 1932 cone at the southwest margin of the floor. The walls of the pit were dark red with moisture. This vapor distribution seems to indicate that the release of atmospheric moisture from underground is entirely outside the lava plug.

On May 20 it was noticed, that the tension cracks in the 1932 floor of Halemaumau all radiate from the region of the southwest cone. These include the border cracks, which are notably absent around the northern sides of the floor. The effect is as though strain of uplift were in progress under the 1932 cone. Yet for the last ten months 59% of the tilting at the three tilt cellars around Halemaumau has been inward, measured in seconds, reduced to radii from the center of the pit. The tension cracks are rather a relic of 1932, than anything related to present stress.

Weekly measurement of opening and closing of thirty-two rim crack points around the edges of Halemaumau, showed the following changes Saturday forenoons:—

May 5. 10 opened, 4 closed, aggregate opening 3.5 mm.
May 12. 8 opened, 3 closed, aggregate opening 4.5 mm.
May 19. 5 opened, 13 closed, aggregate closing 4.5 mm.
May 26. 4 opened, 7 closed, aggregate closing 3.0 mm.
June 2, 14 opened, 3 closed, aggregate opening 7.0 mm.

T.A.J.

Earthquakes

TABLE

Number of minutes of tremor; numbers of very feeble, feeble, slight, and moderate earthquakes; teleseisms or distant earthquakes: and local seismicity index as described in Volcano Letter 371.

Week ending	tr.	v. f.	f.	sl.	mod.	tel.	seis
May 6	21	4	0	0	0	1	7.75
May 13	21	3	2	1	1	0	14.75
May 20	11	1	0	0	0	1	3.25
May 27	5	1	0	0	0	0	1.75
June 3	18	1	0	0	0	0	5.00

A tremor at 1:07 p. m. April 30, recorded at both Hilo and Observatory stations, was located about 55 statute miles east of Cape Kumukahi (east point of Hawaii) Lat. 19° 32'N. Long. 153° 59'W.

A very feeble shock at 8 p. m. May 9, was 10 miles deep under Mauna Loa, Lat. 19° 30'N. Long. 155° 30'W.

A moderate to strong quake began at 10:09:05 a. m. May 10 on the Observatory seismograms and was followed by aftershocks at 10:39 a. m. and at 0:34 p. m. The main shock was described at Hakalau as being very strong leading to flight from houses. Honomu and North Kohala reported it as very sharp, and sharp. Hookena and Kapapala reported it moderate, Holualoa and Puuwaawaa as small. Honokaa thought it rather strong. Hilo had objects fall and old paint crack off ceilings, there was some alarm. It was reported felt on the island of Maui. It dismantled some seismographs on Hawaii. The location found was 17 miles deep under the NE section of Mauna Loa. Lat. 19° 38'N. Long. 155° 23'W.

The first aftershock at 10:39 a. m. was felt in Hakalau, it was located 27 miles deep under the SE section of Mauna Loa. Lat. 19° 27"N. Long. 155° 26'W. It registered as very feeble at the Observatory.

The second aftershock at 0:34 p. m. recorded as feeble, was from the shore line of Hawaii to the south of Kilauea, Lat 19° 15'N. Long. 155° 18'W., and probably 4 miles deep. It was reported felt very slightly at Kilauea and Hilo.

Two small quakes were well recorded on the Kona seismograph at 7 p. m. on May 10 and at 11:20 p. m. May 11, but were not well recorded elsewhere.

A slight quake was felt at Kilauea, Hilo and Honokaa at 3:23 p. m. May 13. It was located 14 miles deep on the rift dividing Mauna Loa and Kilauea at Lat. 19° 22.5'N. Long. 155° 22.5'W. It was followed by an aftershock, felt in Kilauea and Hilo, at 3:25 p. m. It was about 2 miles deep under the SW section of Mauna Loa, Lat. 19° 13'N Long. 155° 39'W.

A very feeble shock at 6:30 p. m. May 15 may have occurred under the Mauna Loa SW rift.

Ten very small shocks (tremors and very feeble) occurred under the Kilauea crater during the five weeks covered here.

A small record of a teleseism began at 6:13:56 p. m. May 3, a second began at 11:50:25 a. m. May 14. Both were located by the U. S. Coast and Geodetic Survey. The first Lat. 61°N. Long. 148°W. near Prince William Sound, Alaska; the second Lat. 59°N. 150°W. near Kenai Peninsula, Alaska.

Microseismic motion of the ground was subnormal most of the five weeks, normal intensity was reached only on May 10 and 12.

A.E.J.

Tilting of the Ground.

In the Table of Tilt below, the second column shows the net tilt by weeks, as computed from the seismograms at the Kilauea Observatory, which is on the northeast rim of Kilauea crater 2.2 miles from Halemaumau.

The third column shows the algebraic sum of the readings at three clinoscope cellars around Halemaumau pit, reduced each to its radial direction, outward away from, and inward in the direction of, the center of Halemaumau.

The Table represents the tipping of the ground, in seconds of arc, in the direction given.

At the Observatory, a northeast reading is away from the crater, a southwest reading is in the direction of the crater.

At the Observatory the total accumulated tilt in the year June 3, 1933 to June 3, 1934 is 1.8" E and 4.5" N.

TABLE OF TILT

Date	Observatory	Halemaumau
Apr. 30 to May 6	1.3" NE by N	2" towards
May 7 to May 13	0.4" NW by W	4" towards
May 14 to May 20	1.5" SW	1" towards
May 21 to May 27	0.1" S	4" from
May 28 to June 3	0.5" SE by S	2" towards

A.E.J.

The Volcano Letter

No. 412—Monthly U. S. Geological Survey, Hawaii National Park JUNE, 1934

KILAUEA REPORT FOR JUNE, 1934

Including weekly press reports 1168 to 1171
June 3 to July 1, midnight.

Section of Volcanology, U. S. Geological Survey
T. A. Jaggar, Volcanologist in Charge

VOLCANOLOGY

At Halemaumau pit of Kilauea Volcano there was no new motion nor sign of lava activity. It is of interest to note how the pressure ridges around the edges of what was the lava lake of 1932 (January), now the floor of the pit, show three stages of shrinkage of the lake. There is the ridge around the edge of the floor, outlining the large lake of December 1931. Then there is a narrow ridge across the floor from the northwest to southeast, marking the first stage of diminution. Lastly there is an innermost rampart with hummocks inside, just in front of the big southwest cone, which contained the last fountaining source of the lava. What liquid lava receded must have finally sucked down the vent under the cone, and so made the slumping of crusts which are now seen in tumbled condition on the floor and at the cone.

Measurements of vapor temperatures by Jaggar, at cracks near Halemaumau, June 1, 2, 3, and 5 gave the following figures in degrees Centigrade (35° C. equals 95° F., and 88° C. equals 190° F.):—

Southwest, over Kau Desert rift line, 54, 57 and 64 degrees C.

West, near big steam crack, 58 and 67 degrees C.

East, north of tourist outlook, 50 and 55 degrees C.

One hundred feet back of this from the pit, 70 to 75 degrees C.

Near road terminus houses, southeast, 35 to 48 degrees C.

Near flag northwest of pit, 51, 53, 56, 58 and 64 degrees C.

Whitened 1919 lava half-mile north of pit, 74, 83, and 88 degrees C.

Whitened 1894 lava southeast of Halemaumau, 82 to 88 degrees C.

These figures show temperatures lower than January 1925 for cracks near the pit (See Volcano Letter 301). The high temperatures in cracks more remote are as usual. The implication is that deeper cracks are found, tapping deeper and hotter vapor, towards the border of the greater Kilauea crater. Probably at the border of the inner fill of Halemaumau, now inaccessible, there are very hot places. These would correspond with the old "postal card crack," which was at the border of a Halemaumau fill of 1894, a "wall-crack," destroyed by overflow in 1919 and by collapse in May, 1922.

Slides in Halemaumau during June were:—

5:30 p. m. June 8, from the notch to the east of the north buttress.

June 14-15, large fresh fall of rocks found, making a broad gray streak on the east talus.

9:42 a. m. June 23, small and continuous slide on north side of lower buttress at the southeast wall, lasting some minutes.

10:57 and 11:21 a. m. June 30 over the middle of the north sill.

Weekly measurement of opening and closing of thirty-two marked rim-crack points, around the edges of Halemaumau, showed the following changes Saturday forenoons:—

June 9. 7 opened, 3 closed, aggregate opening 3.0 mm.
June 16. 6 opened, 5 closed, aggregate opening 0.5 mm.
June 23. 8 opened, 5 closed, aggregate opening 3 mm.
June 30. 9 opened, 7 closed, aggregate opening 1.5 mm.

T.A.J.

EARTHQUAKES

TABLE

Number of minutes of tremor; numbers of very feeble, and moderate local earthquakes as registered at Kilauea; teleseisms or distant large earthquakes; and local seismicity index (see Volcano Letter 371)

Week ending	tr.	v. f.	mod.	tel.	seis.
June 10	15	1	0	0	4.25
June 17	102	3	0	0	27.00
June 24	51	2	0	0	13.75
July 1	32	6	1	1	14.00

The following successive local disturbances began at the times indicated, and the epicenters as shown were located from seismograms; when possible, the depth of the source is indicated. The location of epicenters is based on four main seismograph stations, Kilauea, Hilo, Kona, and Waikii. The intensity is that recorded at Kilauea instruments.

May 16 at 6:29 p. m. very feeble, Lat. 19° 01'N, Long. 155° 38'W.

May 20 at 6:14 p. m. tremor, Lat. 19° 49'N, Long. 156° 13'W on the extension of the Hualalai rift.

June 5 at 8:59 a. m. very feeble on the NE Mauna Loa rift, nearer Hilo than Kilauea.

June 15 at 10:50 p. m. very feeble, Lat. 19° 42'N, Long. 155° 22'W, 6 miles deep under SE slope of Mauna Kea.

June 25 at 2:30 p. m. very feeble, Lat 19° 36'N, Long. 155° 20'W on the northeast Mauna Loa rift.

June 26 at 7:07 p. m. moderate, Lat. 19° 12'N, Long. 155° 05'W, a few miles at sea south from the Puna coast, felt at Honokaa, Hilo, and Kilauea.

June 27 at 7:01 a. m. very feeble, Lat. 20° 02.5'N, Long. 155° 18'W, under Hamakua coast, felt in Honokaa.

Other very feeble local earthquakes at Kilauea crater were two in number June 12, and one each June 19, 23, 26, and 28.

The distant large earthquake was incompletely recorded beginning June 28 at 10h:06m:43s; p. m.

Microseismic motion was subnormal, becoming normal June 4, 19, 24, and 25.

TILTING OF THE GROUND

The table shows tilt by weeks from seismograms at Kilauea Observatory, northeast rim of Kilauea crater; and at Halemaumau the algebraic sum of radial tilts for the three clinoscope cellars, towards or from the center of the pit.

At the Observatory the total accumulated tilt in the year ending July 1, 1934 was 3.3" N and 1.6" E of the position July 1, 1933.

TABLE OF TILT

Date 1934	Observatory	Halemaumau
June 4 to June 10	0	3.3" towards
June 11 to June 17	0.9" NE by E	2.0" towards
June 18 to June 24	0.9" NNE	0.6" towards
June 25 to July 1	0.9" W by N	72.8" towards (Earthquake 26th)

A.E.J.

The Volcano Letter

No. 413—Monthly U. S. Geological Survey, Hawaii National Park JULY, 1934

KILAUEA REPORT FOR JULY, 1934

Including weekly press reports 1172 to 1175
July 1 to July 29, midnight

Section of Volcanology, U. S. Geological Survey
T. A. Jaggar, Volcanologist in Charge

VOLCANOLOGY

Slides in Halemaumau during July were:—

At 1:15 p. m. July 5, north side, making dust cloud, leaving fresh break in wall over west end of Canoe Sill, and leaving fresh debris on the talus.

10:20 a. m. July 7, small slide north.

9:33 a. m. July 19, small slide north.

2:36 p. m. July 20, slides from east and north walls started by an earthquake. The shock was felt by an observer standing on the southwest rim, a swaying motion. This was Mr. Twigg Smith, who immediately saw a considerable slide at the east corner of the pit, and a smaller one at the north buttress. Dust rose above the pit. Rocks were still falling at the east at 3:05 p. m. The earthquake origin was probably under the southeast part of Kilauea crater. The pit instruments were partly dismantled, and the cracks used for measurements were somewhat changed.

10:15 a. m. July 21, slide at northwest talus.

Afternoon, July 21, slide made a dust cloud.

8:40 a. m. July 22, a few rocks sliding north.

1:45 p. m. July 24, a few rocks heard sliding.

National Park workers at the summit crater of Mauna Loa reported disagreeable fumes in the west part of the crater, and on July 22 two noises like blasts about twenty seconds apart, to the eastward.

Weekly measurement of opening and closing of thirty-two marked rim-crack points, around the edges of Halemaumau, showed the following changes Saturday forenoons:—

July 7. 8 opened, 3 closed, aggregate opening 5.0 mm.

July 14. 4 opened, 4 closed, aggregate opening 1.5 mm.

July 21. 11 opened, 4 closed, aggregate opening 4.5 mm.

July 28. 6 opened, 8 closed, aggregate closing 1.0 mm.

Crack point No. 37, about 800 feet back from the southeast rim of Halemaumau, and extending northeast along the wall-crack of Kilauea crater against the "Sand Spit" where the Volcano House road emerges on the lava floor, has been opening extensively. It has made marked cracks in the paving of the road, and in the mortared stone coping. This was observed by A. E. Jones June 25. The total opening is 15 mm. (0.6 inch) April 14 to August 4, 1934. This crack had opened slowly during the previous half-year, but it suddenly began rapid weekly movement after April. (For position see map Volcano Letter 395).

T.A.J.

EARTHQUAKES

TABLE

Week ending.	Minutes of tremor.	very feeble earthquakes	Slight earthquakes	Distant earthquakes	Local * Seismicity.
July 8	24	8	0	1	10.00
July 15	12	2	0	0	4.00
July 22	25	1	1	5	9.25
July 29	14	2	0	1	4.50

* For local seismicity see Volcano Letter 371.

The following successive local disturbances began at the times indicated, the epicenters as shown were located from seismograms; when possible, the depth of the source is indicated. The location of epicenters is based on four main seismograph stations, Kilauea, Hilo, Kona, and Waikii. The intensity is that recorded on the Kilauea instruments.

July 5 2 20 a. m. very feeble, Lat. 19° 17'N. Long. 155° 35'W, 22 miles deep under the SE flank of Mauna Loa.

July 5. 3:15 p. m. very feeble, Lat. 19° 33'N, Long. 155° 23'W, 3 miles deep under the Mauna Loa NE rift.

July 20, 2:36 p. m. Slight, felt strongly by visitors near the Pit of Halemaumau, felt slightly at the NE end of Kilauea, occurred under the SE rim of the crater. Dismantled the Pit seismograph, only recorded as a small tremor on both the Hilo and Kona seismographs.

July 20, 1:30 a. m. Felt at Kapapala Ranch. Lat. 19° 24.5'N, Long. 155° 27'W, 4 miles deep.

The teleseisms were recorded as follows;

July 6, 0h:27m:02s. p. m. the secondary waves began at 0:32:45 p. m. It's origin was 41.5° N 124.9° W (Jesuit Seis. Ass.) off the coast of Northern California.

July 17, 3:17:50 p m. secondary waves at 3:27:15 p. m. Its origin was 16° N., 84° W, (USC&GS) in northern Panama.

July 18, 9:19:31 a. m. secondary waves at 9:26:14 a. m. Origin 14° S, 168° E, (USC&GS) near the New Hebrides.

July 18, a fragment of a distant earthquake began recording at 9:30 p. m.

July 20. 7:57:17 p. m. secondary waves at 8:04:48 p. m. Origin 3,700 miles away.

July 21, 0:20:29 a. m. secondary waves at 0:29:52 a. m. 4,900 mi. to origin.

July 27, 11:14:08 a. m. secondary waves at 11:23:36 a. m. 4,985 mi. to origin.

Microseismic ground motion was normal July 6, 18, 19, 21 and 27 and was subnormal the other days of the month.

A.E.J.

TILTING OF THE GROUND

The table shows tilt by weeks from seismograms at Kilauea Observatory, northeast rim of Kilauea crater; and at Halemaumau the algebraic sum of radial tilts for the three clinoscope cellars, towards or from the center of the pit.

At the Observatory the total accumulated tilt in the year ending July 29 is 3.8″ N and 1.8″ E.

TABLE OF TILT

Date 1934	Observatory	Halemaumau
July 2 to July 8	....0.5″ North	..... 3.0″ from
July 9 to July 15	....0.8″ N by W	.... 5.4″ towards
July 16 to July 22	....1.4″ N by W	....64.3″ from * (quake)
July 23 to July 29	....1.2″ ENE	..... 4.0″ from

* Local earthquakes have caused the SE clinoscope to change 73″ towards the pit June 26 and 64″ from the pit July 20. What portion of these changes represent actual tilt is uncertain.

A.E.J.

The Volcano Letter

No. 414—Monthly U. S. Geological Survey, Hawaii National Park AUGUST, 1934

KILAUEA REPORT FOR AUGUST, 1934

Including weekly press reports 1176 to 1180

July 29 to September 2, midnight

Section of Volcanology, U. S. Geological Survey

T. A. Jaggar, Volcanologist in Charge

VOLCANOLOGY

Slides in Halemaumau during August were:—

At 9:10 a. m. August 4, south wall, a small slide.

9:12 a. m. August 4, north wall.

On the previous day August 3 a small slide was reported northwest about 10 a. m.

About 11 a. m. August 12, small slide at the north.

At 9:25 a. m. August 19, an avalanche at the north.

At 1:15 p. m. August 19, another similar slide.

At 10:30 a. m. August 25, slide at the north.

Weekly measurement of opening and closing of thirty-two marked rim-crack points, around the edges of Halemaumau, showed the following changes Saturday forenoons:—

August 4. 6 opened, 4 closed, aggregate opening 2 mm.

August 11. 7 opened, 11 closed, aggregate closing 2.0 mm.

August 18. 9 opened, 7 closed, aggregate opening 2.0 mm.

August 25. 7 opened, 6 closed, aggregate opening 1.0 mm.

September 1. 7 opened, 1 closed, aggregate opening 3.0 mm.

No excessive movement occurred at Crack No. 37, described in July Volcano Letter.

August 30 temperature readings were made on the Kilauea floor north of Halemaumau. A new trail for the purpose has been built by the Hawaii National Park. Heat is at vapor vents. These vents are persistent deep crackings, which assert themselves up through surface flows. Similar temperatures are found over definite areas. Presumably deep cracking has let down rain water and brought up vapor. The mapping of these areas is important, and their changes of temperature may possibly bear on forecast. Hitherto the data of forecast for eruption are elusive, except where based on statistics, or phenomena only a few hours before the event.

In a whitened area north of Halemaumau, in 1919 lava, maximum temperature was 86° Cent; heavy grass and moss grew in the wet vapor. The 1924 ash has assisted vegetation everywhere. Farther north opposite Uwekahuna trail, the temperature was 45° C., also 1919 lava with less vegetation. In 1894 lava near the big lava dome northeast of Halemaumau, a whitened area showing lichens and grass gave 79° C. The whitening is due to insoluble sulphates. On the Volcano House trail farther east, whitened cracks cutting both 1894 and 1921 lava gave 85° C. A big steam hole farther northeast on the line between Halemaumau and the north side of Kilauea Iki gave 89° C (the boiling point of water for this elevation is about 97° C.) This was 1894 lava, the cracks showed blue-green algae in the openings, the rock was rusty and covered with salts, and a reddish belt of these cracks extended east-northeast away toward the outer walls of Kilauea crater, in a sharply marked zone radial to the Halemaumau center. The larger steam-holes that show vapor on a sunny day are very hot. Along the telephone line east of Halemaumau in 1894 lava, the maximum temperature was 63° C., the ground showing some whitened cracks and grass. The temperature of the air was 26°C.

A. E Jones was in charge of a party under Hawaii National Park July 30 to August 3, to map the lava floor of the summit crater of Mauna Loa, as left by the eruption of December 1933. The floor was flagged and a revised topographic map made with plane-table. The helpers were John Mahaiula, Fred Pestana, Louis Braz and Torao Nishimoto. The new summit rest-house was occupied and was found a protection against cold. The four days on the summit were generally clear and comfortable. The temperature was 32° F. at sunset and 20° F. at daylight. The crater was quiet, sounds of falling rocks were heard occasionally, and the 1933 lava was shell pahoehoe. Near the eruption vents the rock was hot enough to be uncomfortable, the shell lava broke easily and in places was dangerous, and sulphurous fume was locally strong. The results of mapping show the new lava field in the eastern half of the main Mokuaweoweo bowl to be two miles long by three-fourths mile wide and 100 feet thick; the source cones at the southwest are 100 feet high. The depression contour basins of the crater are now at the north and southeast. The new lava heap is thus an elongate dome highest at the southwest athwart the crater sink, with its axis northeast-southwest.

T.A.J.

EARTHQUAKES

TABLE

Week ending.	Minutes of tremor.	Very feeble earthquakes	Slight earthquakes	Distant earthquakes	Local * Seismicity.
August 5	11	4	0	0	4.75
August 12	14	3	0	1	5.00
August 19	12	1	1	0	5.50
August 26	18	2	0	0	5.50
September 2	11	4	0	0	4.75

* For local seismicity see Volcano Letter 371.

The following successive local disturbances began at the times indicated, the epicenters as shown were located from seismograms; when possible the depth of the source is indicated. The location of epicenters is based on four main seismograph stations, Kilauea, Hilo, and Kona. Waikii did not return any records for days when earthquakes ocurred. The intensity is that recorded on the Kilauea instruments.

July 30. 0:23 a. m. very feeble, Lat. 19° 40′ N. Long. 155° 45′ W; under Hualalai.

July 30. 4:18 a. m. very feeble, Lat. 19° 20′ N. Long. 155° 14′ W; under Ainahou Ranch.

July 30. 3:28 p. m. very feeble, Lat, 19° 22.5′ N. Long. 155° 17′ W; under the south slope of Kilauea 1 mile from crater.

July 31. 0:06 a. m. very feeble, Lat. 19° 22.5′ N. Long. 155° 13′ W; 1 mile deep under Heake crater, one of the chain of craters.

August 7. 10:19 a. m. very feeble, Lat. 19° 32′ N; Long. 155° 32′ W; 5 miles deep under Mauna Loa NE rift, near summit. Felt in Hilo.

August 11. 2:38 p. m. very feeble, Lat. 19° 18′ N. Long. 155° 28′ W; 1 mile deep under SE flank of Mauna Loa, near Wood valley.

August 16. 2:08 a. m. slight, Lat. 19° 38′ N. Long. 155° 15′ W; 5 miles deep uder Mauna Loa NE rift. It was felt in Hilo and Honomu.

August 25. 2:08 p. m. very feeble, Lat. 19° 25.3′ N. Long. 155° 16 5′ W; 1 mile deep under Kilauea crater.

August 28. 5:51 p. m. very feeble, Felt by several on Kilauea crater rim, probably centered under crater.

The long waves of a teleseism began recording at 5h:30m:40s. p. m. August 6.

USC&GS reports it as occurring near the New Hebrides, Lat. 14° S. Long. 168° E.

Microseismic ground motion was normal (20 to 30 microns) July 30 and 31, and was subnormal (8 to 20 microns) August 1 to September 2.

A.E.J.

TILTING OF THE GROUND

The table shows tilt by weeks from seismograms at Kilauea Observatory, northeast rim of Kilauea crater; and at Halemaumau the algebraic sum of radial tilts for the three clinoscope cellars, towards or from the center of the pit.

At the Observatory the total accumulated tilt in the year ending September 2, 1934 is 1.9″ N and 2.7″ E.

TABLE OF TILT

Date 1934	Observatory	Halemaumau
July 30 to Aug. 5	0.7″ NNW	0″
Aug. 6 to Aug. 12	0.4″ WNW	1.0″ from
Aug. 13 to Aug. 19	0.8″ ENE	6.9″ towards
Aug. 20 to Aug. 26	1.2″ ENE	5.6″ towards
Aug. 27 to Sept. 2	0.5″ N by E	1.2″ towards

A.E.J.

The Volcano Letter

No. 415—Monthly U. S. Geological Survey, Hawaii National Park SEPTEMBER, 1934

KILAUEA REPORT FOR SEPTEMBER, 1934

Including weekly press reports 1181 to 1184
September 2 to September 30, midnight
Section of Volcanology, U. S. Geological Survey
T. A. Jaggar, Volcanologist in Charge

VOLCANOLOGY

Halemaumau pit of Kilauea Volcano broke into lava eruption in its bottom about 2:44 a. m. September 6. On the preceding day there were slides before and after noon, and the seismograph SE of Halemaumau registered southwesterly tilt the afternoon of the 5th. This was the first real premonitory symptom.

Sept. 6 tremor spasms began 1:07 a. m. a few minutes apart, and shocks close to the pit accompanied the outbreak, the feeble shock at 2:44 a. m. being followed by the continuous tremor of fountaining, and by the bright glow of inpouring lava and clouds of fume. The fountaining places began at the edge of the 1932 floor north, northwest and west. The first two were at the base of taluses, the third a crack back of the west buttress. Here the lava squirted up in 25 jets along a horizontal line halfway up the wall of the pit. These jets cascaded down the wall in ribbon cataracts. They poured over the large west talus and went out of action by 6 a. m. The northwest fountains were several hundred feet high like jets from hose nozzles, covering up the northwest talus with pumiceous lava. The northern line of fountains trending E-W about 600 feet was quickly submerged under the spreading lake, and became a lake center destined to survive. Between 3 and 4 p. m the northwest fountains went out of action, making a great diminution in fume volume. and the eruption adopted stability of action at the northern fountains, followed by gradual dwindling for thirty days.

Sulphurous fume of absinthe red color in transmitted light boiled up several thousand feet the first twelve hours. With it went fragments of basaltic pumice, but nothing resembling ash. The reflected fountain light was yellow-green to orange. The noise was a rumbling. and a rushing of gas. Hundreds of whirlwinds swept up clouds of dust west and southwest of Halemaumau, the trade wind being from the northeast. Pumice fragments up to 30 cm. fell on the ground outside of the pit.

At 4 a. m. Sept. 6 there were 30 jet fountains. At 8 a. m. the new bottom pool covered the entire 1932 floor 60 feet deep. Its area was 90 acres and its volume 9 million cubic yards. Only the top of the 1932 border cone was still emergent. Ten main vents persisted until 6 a. m. along the cascade crack, the cascades being 300 to 400 feet high. and there were two or three subordinate cascades, on an extension of the crack which opened on the north side of the west boss.

Northeast and southwest of the pit, the broken ground exhibited new breaks in the ash soil. At noon Sept. 6 the north fountains had dwindled and the northwestern ones were very violent. The lake was covered with a bright-line pattern and black silky skins. There were straight lines of bubble fountains along the meeting belt of surface currents. A bench and rampart of crusts developed around the lake, wider at the taluses. where the submerged slope was flatter. The tremor diminished when the violent northwest fountaining stopped rather suddenly, between 3 and 4 p. m., and only thin blue fume was left arising from the northern interior fountains.

Sept. 7 there were 8 fountains. the larger one making blast-like detonations, flinging up lava 300 feet, and emitting brown puffs. Tremor increase rang the annunciator bell at the Observatory two miles away. The lake diminished to a northern circle around the fountains 1200 feet in diameter. Sept. 9 the floor had shrunk and lowered 10 to 20 feet, and the inner lake was smaller, at the NNE side of the floor. There was a slump scarp all around. A few slides occurred. The lake Sept. 10 measured about 1000 feet east-west by 400 feet north-south, and was defined by a border rampart over which went overflows. The lake became an oval plateau on top of a terraced heap. Spatter banks formed behind the two bigger fountains east and west showing that the lake was shallow as usual Only the fountains were over wells. September 11 overflows poured out of the lake heap on all sides. Sept. 12 islands of crust and spatter began to form near the eastern fountains. Detonations came from the wells from time to time as the vents clogged. Five sulphur patches appeared on the taluses. Sept. 15 there were five principal fountains and a line of islands from NW to SE across the lake. Sept. 16 the western fountain was dominant, with a cone and crater about it. There were ten fountains, six islands and a peninsula.

Sept. 20 the floor measured 2700 by 2200 feet. The lake pool measured 744 by 390 feet. This pool stood 38 feet above the floor, and the highest grotto heap of its banks stood 136 feet above the pre-eruption floor of 1932 immediately under it. The average 1932 floor level was 2796 feet above sea-level, while the average 1934 new floor level is 2874 feet. This makes the average thickness of the new layer 78 feet.

Overflows built up the new lake heap against the north wall of the pit. Ten cracks gradually developed in the outer floor radial to the lake. The overflows appeared to be a stiff viscous pahoehoe Always the streaming was outward from the west fountains as source well, and sometimes the east fountains exhibited a well of inward cascading downward. Evidently a convectional circulation was being established. and the sinkhole well tended to explode with detonations. The lake remained brimming full and the fume remained thin.

Sept. 20 a new feature back of the border slump scarp at the edge of the greater floor of Halemaumau was the welling up of trickle flows glowing red, evidently following the "wall-crack" between the talus and the new cake of 1934 fill. This was the first time after the early days that any glowing lava had appeared from a source away from the lake. These trickle flows at 11 a. m. rose along the base of the east talus, and at 2:30 p. m. they rose along the base of the south taluses. The next day September 21 the west talus developed the same kind of trickle flows along its base. These risings at the floor edge were favored by freedom of percolation of the lava among talus bowlders, but the trickle flows extended to places under the rock walls of the pit. In no case did they cascade over the slump scarp inward, but rose as a dike between the floor cake and the outer funnel. In each case their appearance was marked by extra pressure at the lake, accompanied by overflows. The band of border extrusion was 20 feet wide in places. Sept. 22 during a big overflow from the lake southwest, wall-crack trickle appeared along the small talus heaps west-northwest.

Sept. 22 detonation spells from both east and west wells of the lake recurred from time to time, usually when the east fountain had been transformed into a sinkhole grotto Big bursts of gas and flame came up. The phenomenon of downpouring would last from 10 to 20 minutes. Then the pot would resume ordinary fountaining with outward streaming. Harmonic tremor greatly increased during detonation spells. September 23 the west fountain had become a pool in a raised craterlet, from which a cascade poured southward into the lake.

This craterlet made noisy high explosions emitting brown fume bursts. Four avalanches were observed at the north wall of the pit. About 2 p. m. the lake drained out almost completely through the eastern sinkhole, leaving an empty saucer 20 or more feet deep, with the western source quiet. and explosions at the sinkhole Then the liquid poured in again. The duration of these drainages was from a half-hour to two hours, increasing until October 1 in duration and violence at intervals of about six hours. Eventually the detonations were heard three miles away.

The elevation above sea-level of the lake Sept. 20-21 was 2882 feet. of the floor, 2844 feet, of the floor edge 2860 feet. The spatter heaps stood 26 to 28 feet above the lake. The depth of the pit from the Tourist Stand southeast (B. M. 3644 feet) to the lake plateau was 762 feet. and to the mean level of the bottom 770 feet. The highest spatter heap at the lake stood 71 feet above the lowest part of the floor.

The last week of the month was characterized by the six-hour intervals between explosive drainages of the lake, and by swelling up of the edges of the floor. Probably the whole floor was swelling by intrusion. This accounts for the drainages, and agrees with the earlier wall-crack trickle flows. Apparently the pulsations of lowering the lake basin—all overflows had now ceased—were occasioned by inflow of the liquid under the shell of crust forming the floor of Sept. 7-8. The floor was lifted and the lake went down. The lake heap was thereby abolished. The explosions

were due to clogging of the gases in the increasingly viscous lava of the wells, unable to fountain freely with artesian well action, when by reason of recession the effervescent fluid was trying to fountain at the bottom of a shaft. Failing to overflow, the wells became gun barrels. With each detonation an umbrella-shaped fling of stiff lava would shoot up 400 feet, the roofs of the grottoes would be blown to pieces, and fragments would clatter down all over the surrounding surfaces. Finally the explosive spells would be followed by complete quiet for a half-hour. Then the liquid would quietly recover in the wells, and restore the lake to a period of four or five hours of quiet streaming.

The drainages tended to come after noon and after midnight, and usually once in between. Sept. 25 a band of red glow showed around the floor edge of Halemaumau, indicating that wall-dike intrusion was still in progress. Sept. 26 this disappeared, but a week later it reappeared. The detail of a sinking spell of the lake was as follows. At 9 a. m. the west fountain cone was cascading over its flank; at 11 a. m. the lava had lowered 25 feet from the lake, both east and west fountain wells were cannonading vertically, long squirts of viscous melt were sent up 200 feet, the intervals between detonations or hisses were from five to ten seconds, then the lava pooled in the wells and came back with quiet fountaining at 12:15 p. m. The explosions gradually lessened, a fan-shaped flood from the west fountain met an expanding puddle from the east fountain in mid-lake, the new liquid overriding the foundered crust that formed the floor of the lake.

September 28 there were still some overflows from the lake. An elephant-back ridge 25 feet high was revealed swollen and crevassed in the edge of the new floor at the foot of the east talus. Instead of welling up the wall-crack, the under-lava was now blocked in that direction, and so was lifting the floor instead. The floor which had been 15 feet below the slump-scarp, was now 25 feet above it.

Another survey by T. A. Jaggar September 29 showed the average floor border at elevation 2860 feet as before; the inner floor 2881 feet instead of the former 2844 feet. The lake had lowered slightly from 2882 to 2879 feet elevation. The summits of the lake heap now averaged 2903 feet, where on September 21 they stood at 2909 feet. The length of the lake, now narrower and irregular, had increased from 744 to 812 feet. Its width decreased from 390 to 360 feet. The relative height of the lake heap above the floor remained about 75 feet for its maximum relief above a valley in the floor southeast of the lake basin. The east cone was its highest point, elevation 2910 feet. The relief of the floor is much greater than is apparent as seen from above. The cones about the fountains were 20 to 30 feet above the full lake.

Sept. 29 the lake made small overflows, overhanging grottoes surmounted the two fountains, gradual drainage until noon was followed by intense explosions at both wells, lasting until 1:30 p. m. The explosions demolished the arched grottoes. There was repose until 2:00 p. m. Then the wells quietly filled from below with red puddles covered with gray skin. The lake basin was refilled from both wells by torrents cascading downward over the slag-heaps of the ridge. The lake area was being converted into several ponds. Sept. 30 there was a forenoon drainage; at 8 p. m. the west fountain started lowering and exploding, while the eastern one was giving vent to a voluminous river of lava, which stopped flowing at 8:30 p. m. Then its source the east well gave vent to explosions 400 feet high, the smaller shots coming 20 to the minute. The west pot exploded sending fiery spray 600 feet high, the maximum to date; the detonations were heard 2.2 miles away and rattled iron roofs. The well seemed empty, but the gushes occasionally brought up great sheets of lava; splashes stuck on the pit wall a third of the way to the top. The greater explosions came about every 8 minutes. Cessation followed as usual. By night five glow spots showed along the edge of the floor east.

Weekly measurements of rim cracks around Halemaumau, 32 in number, gave:

Sept. 8. 14 opened, 12 closed, aggregate opening 24 mm.
Sept 15. 11 opened, 6 closed, aggregate opening 6 mm.
Sept. 22. 10 opened, 2 closed, aggregate opening 5.5 mm.
Sept. 29. 8 opened, 6 closed, aggregate opening 2.5 mm.

By measuring the cracks the forenoon of the eruption Sept. 6, a movement of opening of 20 mm. had already taken place, involving 12 opened and 11 closed; 12 mm. of the opening was at Crack No. 37, a deep border fissure of the Kilauea crater floor southeast, which had cracked the road paving. The differential movement was down to the northwest, and up to the southeast. This movement had been in progress for some months (See July Volcano Letter).

The tilt movements at the three clinoscope cellars around Halemaumau accompanying the eruption, were inward towards the pit at the north and southeast cellars, and away from the pit at the west cellar. This amounted to more than 100 seconds at the west and southeast cellars, but the instruments were dismantled, so that the values are indefinite. The north cellar registered 22.5 seconds south since the previous day, (Sept. 5-6).

The tilt at these cellars after the eruption proceeded was recovery at the southeast and west cellars, and continuance in the same direction at the north cellar. The west cellar recovered 21 seconds to the ENE; the southeast cellar 7 seconds to the SE; and the north cellar continued 5 seconds to the SW, between Sept. 6 and Sept. 10. The tilting movements were more normal after September 10. This was the first demonstration of the effect of eruption on these tilt cellars. The instrument pivots are not yet proof against earthquakes. T. A. J.

EARTHQUAKES.

TABLE

Week ending.	Minutes of tremor.	Very feeble earthquakes	Feeble earthquakes	Slight earthquakes	Local * Seismicity.
Sept. 9	4,878	9	1	1	1,725.
Sept. 16	10,080	1	0	0	2,565.
Sept. 23	10,075	3	2	0	2,808.
Sept. 30	9,885	0	0	0	2,763.

* For local seismicity index see Volcano Letter 371.
Note, Some of the tremor was very feeble in amplitude and was weighted accordingly.

The following successive local disturbances began at the times indicated; the epicenters as shown were located from seismograms; when possible the depth of the source is indicated. The location of epicenters is based on three main seismograph stations, Kilauea, Hilo, and Kona. No earthquakes were recorded at Waikii. The intensity is that recorded on the Kilauea instruments.

September 6, 1:07 to 2:44 a. m. several very feeble shocks and tremors occurred that were near or in the crater; they preceded the eruption in Halemaumau. At 2:21 a. m. a slight earthquake (2 Rossi-Forel) was felt by several persons living on the rim of the crater. It was located in the creater near Halemaumau. lat. 19° 25′ N long. 155° 17′ W and very near the surface of the crater floor. At 2:44 a. m. a feeble earthquake (1 Rossi-Forel) occurred. It was located near the south rim of Kilauea near the surface, in lat. 19° 23.5′ N long. 155° 16.7′ W. All of the above shocks immediately preceded the out-flow of lava in Halemaumau, and were supposedly caused by the breaking of the crust under the strain of trapped volcanic gas and magma.

September 17. 11:56 a. m. a feeble shock was felt at the Observatory and at Honomu. It was located at 19° 02′ N, 155° 13′ W. 11 miles deep.

Sept. 22. 9:44 a. m. a feeble shock was felt at the Observatory and at Kapapala ranch. It was located 11 miles deep under Hilina Pali, at 19° 15′ N. 155° 20′ W.

September 23. 1:49 a. m. a very feeble shock occurred probably one of seven felt at Kapapala ranch. It was located 9 miles deep under Pa'ima Point on the Kilauea SW rift. 19° 11.5′ N. 155° 27′ W.

No teleseisms were noticed on the seismograph records. Any small records would have been obscured by the large continuous "Harmonic Tremor" generated by flowing lava in Halemaumau.

This tremor had a period of 0.6 seconds and represented a ground movement of from 6 to 48 microns during the early hours of the eruption. Towards the end of the month the fluctuations in amplitude became more marked, dropping at times to less than one micron, at other times becoming as large as 15 microns, all with the same period. These spells were coincident with spells of explosion that recurred at 6 to 7 hour intervals during the last week of the month. (Sept. 24 to 30).

Microseismic motion of the ground was normal on the following days of the month, September 6, 7, 8, 12, 14, 19, 21, 24, 26, and 30, and subnormal the rest of the month. A. E. J.

TILTING OF THE GROUND

The table shows tilt by weeks from seismograms at Kilauea Observatory, northeast rim of Kilauea crater; and at Halemaumau the algebraic sum of radial tilts for the three clinoscope cellars, towards or from the center of the Pit.

At the Observatory the total accumulated tilt in the year ending September 30, 1934 is 0.4″ S and 1.4″ E.

TABLE OF TILT

Date 1934	Observatory		Halemaumau	
Sept. 3 to Sept. 9	2.0″	SW	120.″ ?	towards
Sept. 10 to Sept. 16	1.4″	ENE	0.4″	towards
Sept. 11 to Sept. 23	1.0″	NNE	2.6″	from
Sept. 24 to Sept. 30	1.2″	NNE	6.0″	from

A. E. J.

The Volcano Letter

No. 416—Monthly | U. S. Geological Survey, Hawaii National Park | OCTOBER, 1934

KILAUEA REPORT FOR OCTOBER, 1934

Including weekly press reports 1185 to 1188
September 30 to October 28 midnight
Section of Volcanology, U. S. Geological Survey
T. A. Jaggar, Volcanologist in Charge

VOLCANOLOGY

Oct. 1 at 9 a. m. the west fountain pot started exploding and the lake drained. At 10:46 a. m. the liquid returned by overflow of the east fountain well. Another spell in the evening sent the glowing spray almost up to the pit rim 770 feet high. The noises were heard 3.5 miles away. This ended the detonating phase of activity. Oct. 2 the west fountain was overflowing its cone with seven streams, then the east fountain sent out a torrent 100 feet wide, then a middle fountain sent a stream northward to a new pool, which there overflowed the lake basin and reached the base of the north wall of the pit. After noon the wells lowered to weak bubbling fifty feet down. At seven in the evening heavy fume was rising from the wells.

Oct. 3 three quarters of the lake basin had become a slag-heap, with the north pool a depression in its flank 300 feet long. The middle fountain and the north pool were actively liquid. There were nine smoke holes. At night three pools were outlined by glow. Streaming showed there were tunnels to outlets east and west from the west pot. At the outer edges of the floor there was glow in cracks east, south and southwest. Intrusive lava was welling up along the edges of the floor cake. October 4 the middle fountain noisily jetted up diagonally like a hose, supplied the north pool, and kept the pit luminous at night, but this was the end of illumination. The east pot was a smoke hole, the east pool was dark at night, only a trickle remained at the west pool, and the floor margin glow was less. October 5 the lake area had collapsed, there was fume, streaming continued in the north pool, and blowing noise was audible. Around the edges of the floor there was conspicuous swelling from intrusion, especially northeast. Oct. 6 and 7 the central cone became a whitened fuming heap, the north pool was liquid underneath and showed crusts cracking and foundering in the melt, and the west cone had ceased fuming. Thuddung noise was heard in the western part of the swelling floor, prolonged wall-slides began at the north, and the steaming lessened at the taluses.

The last moving lava in Halemaumau was seen Oct. 7, and the last day of eruption was October 8. On Oct. 8 at 10 a. m. hisses were heard from the middle fume cone. At 11:25 there was prolonged wall-sliding north, and dust arose through a rim crack NNE. About 1 p. m. there were two north slides. Sliding all day occurred at west end of Canoe Sill. At 11:30 a. m. there was a slide east of Southwest Tunnel. At 11:43 a. m. there was a slide at top of West Talus. At 8 p. m. there were 11 glow spots along the east and south wall crack of the floor, and 12 about the lake area.

Oct. 9 at 7:17 a. m. a big avalanche took away the upper edge wall slab NNE of Halemaumau. The lake basin and the northern and eastern taluses were fuming. Out to the edge of the floor from the lake area there are left ten radiating tension cracks. There was a slide N. at 9:06 a. m., a big fall of fresh rock from the lower wall lay on the floor SE, and a few fresh bowlders lay on the floor NE. During the next week the taluses showed dry hot places at the bottom, 11 places on the northeastern half of the floor showed blue fume, and border swellings had cracked into chasms at the edge of the floor east, west and south. The solfatara at the base of the east talus increased its fuming. At the end of the month there was no visible shrinking down of the floor, there was wall-crack heat everywhere, slides were few, snapping was heard, spots of white and yellow staining appeared, especially at the base of the WNW wall cascade and on the NW pumice bank left against the talus by the big fountains of Sept. 6. A curved line of stain on the floor in front of this outlined and buried front of the talus cone.

Weekly measurements of rim cracks around Halemaumau, 32 in number, gave:—

Oct. 6, 11 opened, 3 closed, aggregate opening 5.5 mm
Oct. 13, 7 opened, 4 closed, aggregate opening 3.0 mm
Oct. 20, 9 opened, 5 closed, aggregate opening 3 mm
Oct. 27, 10 opened, 5 closed, aggregate opening 2.5 mm

A levelling circuit from South Sandspit as base by Jones Oct. 17-25, showing changes since July 2, 1934, in elevation of rim of Halemaumau, relative to the south rim of Kilauea Crater, revealed the following facts, presumably correlated with the outbreak of September that was concentrated at the north side of the Halemaumau bottom:—

Elevation to maximum of 1.28 feet within a stretch of the north rim 1800 feet long.

Depression to a maximum of 0.5 foot northwest and northeast of the pit, along a thousand feet of the rim on each side of the elevated tract.

The rest of the rim shows diminishing depression southward to a line of no change 400 feet SSE of the pit.

The north tilt cellar was involved in the elevated area to an elevation of 0.69 foot; its disturbance at the time of the outbreak was much less than that of the other two cellars in the slightly depressed areas. T. A. J.

EARTHQUAKES

TABLE

Week ending	minutes of tremor	very feeble earthquakes	feeble earthquakes	moderate earthquakes	distant earthquakes	local * seismicity
Oct. 7	5,091	5	0	0	0	1,252.
Oct. 14	64	2	0	1	1	20.00
Oct. 21	23	4	1	0	0	8.75
Oct. 28	63	2	1	0	0	17.75

* For local seismicity index see Volcano Letter 371.

The following successive local disturbances began at the times indicated; the epicenters as shown were located from seismograms; when possible the depth of the source is indicated. The location of epicenters is based on three main seismograph stations, Kilauea, Hilo, and Kona. The intensity is that recorded on the Kilauea instruments.

October 3. 1:50 p. m. very feeble, lat. 19° 18′ N. long. 155° 26′.5 W. 21 miles deep under Kaoiki fault.

October 8 to 9 numerous tremors and very feeble shocks correspond with avalanching of Pit walls.

October 12. 5:45 p. m. a shock was felt at Honokaa, not recorded at Kilauea.

October 13. 7:14 p. m. moderate. Felt generally over the island of Hawaii. 19° 28′ N 155° 30′ W. 44 miles deep under the central part of Mauna Loa.

October 18. 0:20 a. m. feeble, felt generally on Hawaii. 19° 30′ N. 155° 40′ W. 39 miles deep, under central part of Mauna Loa. Followed at 1:41 a. m. by a very feeble shock from near the same place. 19° 30′ N. 155° 42′ W.

October 27. 7:47 a. m. feeble, felt near Kilauea crater. 19° 56′ N. 155° 38′.5 W. 23 miles deep.

The preliminary waves of a teleseism began recording at 5:20:09 a. m. October 10, the secondary waves began at 5:26:34 a. m.

Microseismic motion of the ground was normal October 9, 10, 11, 12, 16, 17, 18, 21, 22, 23, 24, 25, 27, 28, and was abnormal October 15: Other days subnormal.

The 5,091 minutes of tremor in the table represents the closing week of the lava inflow, and has about half the value of other weeks. (See Volcano Letter 415.) The explosive sequence that began in Halemaumau 9:15 a. m. October 1 made at first a record similar to a small earthquake record, later records were obscured by tremor. The last detonation at 9:57 a. m. was felt at Hawaiian Volcano Observatory 2 miles away. The harmonic tremor almost disappeared after October 1, its amplitude always stronger at the stations nearer the pit, and showing direct relation to the visible lava fountaining. A. E. J.

TILTING OF THE GROUND

The table shows tilt by weeks from seismograms at Kilauea Observatory, northeast rim of Kilauea crater; and at Halemaumau the algebraic sum of radial tilts for the three clinoscope cellars, towards or from the center of the pit.

At the Observatory the total accumulated tilt in the year ending October 28, 1934 is 1.0″ N and 1.7″ E.

TABLE OF TILT

Date 1934	Observatory		Halemaumau	
Sept. 30 to Oct. 7	1.2″ NE		9.1″	from
Oct. 8 to Oct. 14	0 6″ N by W		23.3″	toward*
Oct. 15 to Oct. 21	1.4″ ENE		21.3″	from
Oct. 22 to Oct. 28	0.6″ NE by N		2.2″	toward

* Disturbance following quake of October 13.

A. E. J.

The Volcano Letter

No. 417—Monthly U. S. Geological Survey, Hawaii National Park NOVEMBER, 1934

KILAUEA REPORT FOR NOVEMBER, 1934

Including weekly press reports 1189 to 1193
October 28 to December 2, midnight

Section of Volcanology, U. S. Geological Survey
T. A. Jaggar, Volcanologist in Charge

VOLCANOLOGY

Slides in Halemaumau during the month had the following characters:

At 9:50 a. m. October 29 a block fell noisily southeast.
Pebbles fell at the new lava cascades November 1.
Between 8:30 and 10 a. m. November 3, intermittent sliding north.

November 4 this continued.

Week ending November 11, sliding at the west end of the Canoe sill north, notching the wall and making a sandy talus below; the buttress east of the SW tunnels caved away. This made pink dust on the floor.

11 a. m. November 13, a slide northeast sent up dust.
November 20 the sandy top of the north talus, after many slides recently, had changed its shape.

Fume in the pit was noted as follows:—

October 30, 9 fume places and 3 sulphur spots.

November 4, fume from pit as whole rose in thin bluish clouds.

November 11 fume had increased north.
November 12 solfatara at East Talus had lengthened southward. Ten places were fuming.

November 20, a dry day, the central fume patches of the 1934 lava lake area could not be seen; only 7 places counted.

November 22, after more than 1 inch of rainfall, 20 places showed vapor, but none at the lava lake site. On the Kilauea floor southwest over the rift belt, noisy purring at the vapor vents.

December 2, after 3.66 inches rain at Halemaumau gauge, pit was full of vapor, hundreds of steam plumes on the bottom, clockwise whirls indicated small tornadoes.

November 3 fresh hair cracks in soil appeared at pit rim NNE. Cracks of the intrusion ridges around edge of 1934 floor had widened November 11. Stain at the southeast ridge was increasing. Hot dry belts marked the bases of the talus cones, and bright yellow sulphurous stain was increasing at base of WNW wall. The stained area of pumice on top of northwest talus changed from yellow to white under rain washing; it was probably alum. The talus ESE and SSW steams after rainfall.

It is remarkable on the Kilauea floor southwest and northwest of Halemaumau how by condensation the puffing vapor vents have made areas green with tufty grass in the 1924 sand and gravel.

Weekly measurement of opening and closing of 32 marked rim crack points, around the edges of Halemaumau, showed the following changes Saturday forenoons:—

Nov. 3, 9 opened, 3 closed, aggregate opening 4 mm
Nov. 10, 7 opened, 7 closed, aggregate opening 0.5 mm
Nov. 17, 12 opened. 3 closed, aggregate opening 5 mm
Nov. 24, 7 opened, 3 closed, aggregate opening 3 mm
Dec. 1, 5 opened, 4 closed, aggregate opening 0.5 mm

T. A. J.

EARTHQUAKES

TABLE

Week ending	Minutes of tremor	Very feeble earthquakes	Distant earthquakes	Local * Seismicity
Nov. 4	9	1	0	2.75
Nov. 11	11	0	0	2.75
Nov. 18	29	1	0	7.75
Nov. 25	15	2	0	4.75
Dec. 2	11	2	1	3.75

* For local seismicity index see Volcano Letter 371.

During the five weeks period, only one shock has been approximately located. The Hilo and Kona records of the other shocks were too small to be of value in making a location. The very feeble shock at 5:53 a. m. November 12 was on the Kilauea SW rift. 19° 13′ N. 155° 24′ W.

The preliminary waves of a teleseism began to record about 3:43:54 p. m.; what may have been either secondary or long waves began to record at 3:54:47 p. m. The maximum waves at 3:58 p. m. were very large.

Microseismic motion of the ground was normal November 1, 2, 4, 11, 13, 14, 22, 25, 27, 28, and abnormal October 29, 30, 31, November 3, 5, 6, 12, 21, 23, 29 30, December 1, 2, and subnormal the other days of the month.

A. E. J.

TILTING OF THE GROUND

The table shows tilt by weeks from seismograms at Kilauea Observatory, northeast rim of Kilauea crater; and at Halemaumau the algebraic sum of radial tilts for the three clinoscope cellars, towards or from the center of the pit.

At the Observatory the total accumulated tilt in the year ending December 2, 1934 is 1.9″ N and 1.1″ E.

TABLE OF TILT

Date 1934	Observatory	Halemaumau
Oct. 28 to Nov. 4	0.5″ N by W	10.9″ toward.
Nov. 5 to Nov. 11	0.4″ N	2.5″ from
Nov. 12 to Nov. 18	0.7″ E	2.0″ from
Nov. 19 to Nov. 25	0.5″ ENE	4.9″ from
Nov. 26 to Dec. 2	0.5″ WSW	18.7″ from.

A. E. J.

The Volcano Letter

No. 418—Monthly U. S. Geological Survey, Hawaii National Park DECEMBER, 1934

KILAUEA REPORT FOR DECEMBER, 1934

Including weekly press reports 1194 to 1197
December 2 to December 30, midnight

Section of Volcanology, U. S. Geological Survey
T. A. Jaggar, Volcanologist in Charge

VOLCANOLOGY

Slides in Halemaumau were as follows:—

December 16, 9:25 a. m., a fall of rocks at west lava cascade

December 30 about 10 a. m., rocks fell occasionally northeast

Fume in the pit was noted as follows:—

December 10, 9 a. m., 7 places fuming around northern edges of floor. The place of densest fuming was at base of east talus.

December 16, dry sunny day, about 9:30 a. m., vapor visible only at east talus.

Week ending December 23. Fume continues moderately dense at east talus.

Week ending December 30, blue fume from the four northern and eastern talus slopes, where they make contact with the new lava floor. The solfatara making densest steam and fume was at the base of the east talus. where there was in September the largest swelling in the floor due to intrusion. The fume separates itself from the steam and rises to fill the air in the upper part of the pit, while the water vapor dissipates. This fume shows best when the sunlight is behind it; it is thin. December 17 strong northeast wind was blowing clouds of dust over the Kau desert, and making whirls counterclockwise on the western edge of the pit. Thirteen places around the floor showed vapor after rain, but the bases of the taluses showed dryness due to excessive heat below. Vapor rose from high cracks in the western wall.

December 30 six fuming places were counted as visible.

December 10 stain had begun to appear at the wall-crack extrusion against the talus SSE, and the slope showed wet streaks steaming. A snapping noise was heard from the floor. December 16 the base of the WNW cascade had been growing increasingly bright yellow, probably with sulphur stained sulphates, and had extended its stain out on the floor. December 22 new rocks had fallen on the floor east. December 30 during the visit one snap in the floor like a detonation was heard about 9:50 a. m.

Weekly measurements of 32 rim cracks about Halemaumau, for changes of opening and closing as exhibited Saturday forenoons, resulted as follows:—

Dec. 8, 8 opened, 5 closed, aggregate opening 2.5 mm
Dec. 15, 9 opened, 6 closed, aggregate opening 2.5 mm
Dec. 22, 16 opened, none closed, aggregate opening 11.0 mm
Dec. 29, 3 opened, 3 closed, aggregate opening 0.5 mm

The general situation in the Halemaumau bottom is a pause in hot lava deeply crusted since the eruption of September, which had filled in over the 1931-32 floor by something over 90 feet for an average. The yellow sulphates and hot fume around the border, the swollen and cracked floor, the hot dry bases of the talus slopes, and the cracking noises, all indicate that the mobile paste is still there.

T. A. J.

EARTHQUAKES

TABLE

Week ending	Minutes of tremor	Very feeble earthquakes	Feeble earthquakes	Distant earthquakes	Local * Seismicity
Dec. 9	8	2	0	0	4.50
Dec. 16	19	7	0	0	8.25
Dec. 23	12	6	1	0	8.00
Dec. 30	15	2	0	1	4.75

* For local seismicity index see Volcano Letter 371.

The following successive local disturbances began at the times indicated; no epicenters could be found. The intensity is that recorded on the Kilauea instruments.

December 22. 1:55 a. m. very feeble, was felt lightly near Kilauea crater.

December 22. 0:46 p. m. feeble, was felt lightly near Kilauea crater. It was reported as stronger at Kapapala Ranch.

December 24. 9:27 a. m. very feeble, was felt at Hakalau.

The long waves of a teleseism began recording at 3:39 a. m. Dec. 30.

Microseisms were subnormal December 14, 29, and 30; they were normal December 13, 15, 22, 24, 25, and 26; and they were abnormal the rest of the period.

TILTING OF THE GROUND

The table shows tilt by weeks from seismograms at Kilauea Observatory, northeast rim of Kilauea crater; and at Halemaumau the algebraic sum of radial tilts for the three clinoscope cellars, towards or from the center of the pit.

At the Observatory the total accumulated tilt in the year ending December 30, 1934 is 1.3″ N and 2.8″ E.

TABLE OF TILT

Date 1934	Observatory	Halemaumau
Dec. 3 to Dec. 9	0.7″ NE by N	8.2″ toward
Dec. 10 to Dec. 16	0.6″ NE by E	0.2″ from
Dec. 17 to Dec. 23	1.4″ E	10.1″ from
Dec. 24 to Dec. 30	1.0″ E	6.3″ toward

A. E. J.