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. 395—Monthly | U. S. Geological Survey, Hawaii National Park | JANUARY 1933

KILAUEA REPORT FOR JANUARY 1933

Including weekly press reports 1094 to 1097, January 1 to January 29 midnight

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

Volcanology

There has been no activity on Kilauea or Mauna Loa. Small slides at Halemaumau were noted January 3, 4, and weakly at other times. Much steam developed on the pit floor due to heavy rains. Of twenty-five rim cracks measured each week about Halemaumau, slight widening was observed of only four January 7, nine January 14 about a sixteenth of an inch each, thirteen January 21, and, seven January 28. It will be observed below that the seismicity was lowest the week when the most cracks opened.

Wingate has started triangulation of the eastern rift belt of Kilauea near Kalapana, Jones made the circuit of the island Hawaii on visitation of seismographs, and Jaggar started a salinity survey of the sea-water at Keauhou Bay, Kona. Hydrometer tests showed freshness conspicuous along shore and in top water near shore, while bottom water out to nine fathoms was highly saline.

Earthquakes at Kilauea

Table (see Volcano Letter December, 1932; for for seismicity index (seis) see Volcano Letter 371)

Date	tr.	v. f.	f.	tel.	seis.
January 2 to 8	24	4	0	1	8.00
January 9 to 15	30	1	1	0	9.00
January 16 to 22	16	1	0	1	4.50
January 23 to 29	32	1	0	1	8.50

No shocks were felt at the observatory and none was reported from other parts of the island. The one feeble shock recorded at 0:45 p. m. January 11 evidently occurred at sea, about 20 to 30 statute miles northeast of Hilo. It was preceded during the noon hour by four foreshocks or tremors at unknown distance. Also a very-feeble shock, about 200 miles west to southwest of Hawaii, preceded it. This very-feeble shock was probably in the vicinity of a large submarine mountain. Following these two shocks were 11 tremors, the swarm ending at 1:54 p. m. January 12. Six of these tremors indicated distances of from 37 to 135 statute miles. A second swarm of 19 tremors was recorded January 28 and 29. It is not known whether or not these earthquakes occurred on one fault line.

The two earlier teleseisms were from New Guinea and the south Indian ocean, respectively: the last is as yet unknown.

A.E.J.

Tilting of the ground

The "Table of Tilt" shows the net tilt by weeks, as computed from seismograms at the Kilauea Observatory and from clinoscope readings at Halemaumau Southeast. The table represents the tipping of the ground, in seconds of arc, in the direction given. The total accumulated tilt at the Observatory since January 29, 1932 is 8.1″ South and 1.5″ East.

TABLE OF TILT

Date	Observatory	Halemaumau
Jan. 2 - Jan. 8	0.8″ SSW	13.6″ SW
Jan. 9 - Jan. 15	0.6″ SSE	21.3″ NNE
Jan. 16 - Jan. 22	0.9″ SE	20.1″ NE
Jan. 23 - Jan. 29	1.1″ SSW	4.6″ E

E.G.W.

Waikii Seismograph Station

The Waikii Station on Hawaii island (mentioned in Volcano Letter 388) is in charge of the Radio Engineer of the Mutual Telephone Company in the grounds of the radio telephone establishment on the western slope of Mauna Kea. It is financed by the Hawaiian Volcano Research Association like the stations at Hilo and Kealakekua. We are indebted to Mr. A. W. Carter of the Parker Ranch for permission to install on this land, and to Mr. J. A. Balch of the Telephone Company for cooperation in the work.

The elevation is 4700 feet, the location Lat. 19 degrees, 51 minutes, 57 seconds North, Long. 155 degrees, 39 minutes, 7 seconds West. The seismograph is a two-component Hawaiian type horizontal pendulum apparatus (Bull. Hawn. Volc. Obsy. XVI, No. 8, August 1928) and was set up by A. E. Jones during October 19 and 20, 1932. The observer is Ralph Buzzard. The time service is from a Howard master pendulum clock checked by radio time from U. S. Naval Station, Pearl Harbor, Honolulu.

The piers are still settling and very little performance of earthquake registration has yet been obtained from this station. The seismograms are on smoked paper and are studied and recorded at the Hawaiian Volcano Observatory at Kilauea Volcano, Hawaii National Park.

T.A.J.

LASSEN REPORT No. 32

A report of measurements at the Lassen Volcano Observatory in California during the Calendar year 1932 indicates no crateral activity. C. A. Huff made experiments to synchronize the time markings by wired wireless on three seismographs Mineral, Viola and Harkness, work still awaiting completion. Tilting of the ground appeared to be mostly seasonal and a function of temperature.

The seismographs at Mineral recorded 83 local earthquakes as follows:—

January	3	July	9
February	2	August	15
March	2	September	2
April	0	October	13
May	6	November	5
June	20	December	6

The number of local earthquakes here registered per year has been:—

1927	266
1928	37
1929	96
1930	74
1931	38
1932	83

The indicated distance to origin of most of the local earthquakes of which the seismograms permitted measurement ranged from 12 to 20 kilometers, for the 1932 records.

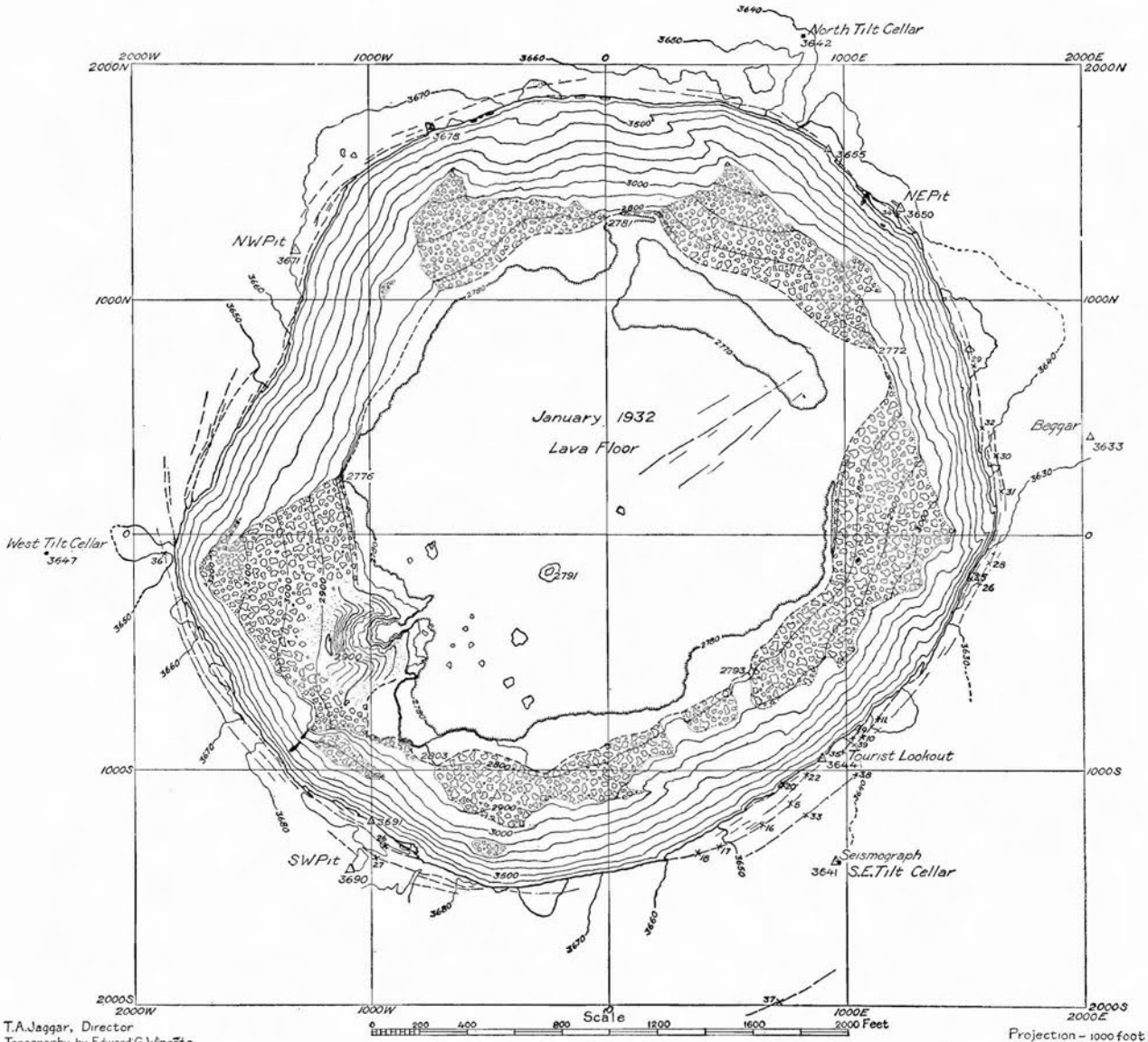
For the hot springs and steam vents, temperatures Fahrenheit measured mostly in August showed Supan's Big Steamer 192-194°, with vent enlarged toward the west, and mud ejected beyond the south rim. The New Vent of Diamond Peak gave 198°. The Lassen Crater vents 120, 142 and 146°. Bumpass Hell registered about 193°. Boiling Lake gave 124 to 148° in the water, 192 to 200° in the mud and steam vents. Terminal Geyser was 198°. Devil's Kitchen gave 196 to 200°, the big steam jet boiling with great vigor and slight overflow. Little Hot Springs Valley October 31 measured 198° imperfectly, the high velocity of escaping steam preventing proper use of thermometer. Morgan Springs gave from 148 to 202°. Supan's line of stakes showed slipping between No. 0 and No. 2 of 1.1 feet, a displacement which was distributed back to 0 between No. 2 and No. 5.

R. H. Finch

DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
HAWAIIAN VOLCANO OBSERVATORY

MAP OF HALEMAUMAU

ISLAND OF HAWAII
KAU DISTRICT
KILAUEA CRATER
HAWAII NATIONAL PARK



T.A. Jaggar, Director
Topography by Edward G. Wingate
Surveyed in September, 1932

Legend
Talus
Points where cracks are measured

Datum is Mean Sea Level

Contour Interval { Floor and Rim 10 Feet
Crater Walls 100 Feet

Projection – 1000 foot grid. Origin of coordinates at center of map is:-
Latitude 19° 24′ 34″ N
Longitude 155° 17′ 10″ W

The Volcano Letter

No. 396—Monthly U. S. Geological Survey, Hawaii National Park FEBRUARY 1933

KILAUEA REPORT FOR FEBRUARY 1933

Including weekly press reports 1098 to 1101, January 30 to February 26 midnight

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

Volcanology

There is little to report for the Hawaiian volcanoes which have been apparently entirely quiet during the month of February 1933. There has been much rain which produces visible vapor plumes on the bottom of Halemaumau pit of Kilauea volcano. Rock slides from the pit wall have been rare, and the clinoscopes around the pit have generally shown little tilt, though the southeast station recorded below always shows larger tilts than the Observatory on the northeast rim of the larger Kilauea crater. The record there of 50.2 seconds January 29—February 5 checked with excessive temporary pooling of rain-water close to the hut; the rainfall was 6.16 inches in two days January 30-31.

Crack measurements around Halemaumau rim at 25 points showed five very slightly opened February 4th, eight February 11th, six opened and four closed February 18th, twelve opened and three closed February 25th. The aggregate opening for the twelve was only 1.36 millimeters.

A report of a tidal wave at Kaupoa on the west end of Molokai at night about February 14, with heavy surf flooding inland 100 to 200 feet horizontally, may indicate the aftermath of extraordinary westerly wind which produced unusual wave bombardment accompanied by very heavy microseisms at the seismographs the first part of the month. Thus it will be seen that meteorological conditions of rainfall and wind, as mentioned in this report, may produce seemingly seismic effects.

T.A.J.

Earthquakes at Kilauea

TABLE

(Numbers of tremors, very feeble and feeble local earthquakes: teleseisms or distant earthquakes: and local seismicity index described in Volcano Letter 371)

Week ending	tr.	v. f.	f.	tel.	seis.
February 5	22	1	1	0	6.75
February 12	29	2	0	0	8.25
February 19	22	4	0	0	7.25
February 26	32	2	0	1	9.00

The feeble shock at 6.17 a. m. February 4 was reported felt at Holualoa, Hakalau, Hilo and the Hawaii National Park. The location as found from three stations was about 50 statute miles due south of the observatory.

The following very-feeble shocks have been located.

9:12 p. m. January 31, was placed 15 to 20 miles east of East point. This location is given for the reason that it was not recorded at the Kona seismograph station.

11:56 a. m. February 10 was located 33 miles deep under a point half way between Kilauea and Mokuaweoweo craters.

8:24 p. m. February 13, distances from four stations, placed it in NW Kohala. The depth was possibly less than 5 miles.

Two earthquakes were felt in Honokaa. The first at 0:38 p. m. February 16 was located 23 miles deep under the peak of Mauna Kea. The second at 7:14 p. m. February 18 was located 7 miles deep under Ookala on the Hamakua coast. Both of these shocks were registered at four seismograph stations. The second was recorded as a tremor at the Hawaiian Volcano Observatory.

0:29 p. m. February 18, did not record at the Hilo station but with the aid of the Waikii record it was located 35 miles deep under a point 7 miles NE of Mokuaweoweo crater.

10:30 a. m. February 21 was located 20 miles deep under Mauna Loa.

8:00 a. m. February 22 was located about 12 miles at sea, 1 to 5 miles deep on the probable extension of the Kilauea SW rift.

Two others that could not be located were probably a short distance at sea.

Nine tremors showed some slight evidence of having originated some distance at sea. In one case as much as 500 kilometers or 300 miles away from the observatory.

A.E.J.

Microseisms

This motion of the ground appears to be prevalent throughout the world. Abnormal, large or strong microseisms have been correlated with large ocean waves or seas striking on the steeper coasts of the regions studied. In Europe the correlation has agreed with heavy surf on the coast of Norway. In North America they have been correlated with strong waves pounding the coast of Labrador. The change from light to moderate to strong and reverse is not abrupt. The transition between steps takes place slowly, often taking hours or a day to change from normal to abnormal. They have not been correlated definitely for the Island of Hawaii, but appear to vary with variations in the strength and direction of the sea waves. Ordinarily the time for a complete period, or motion of the ground to and fro, is 4 seconds, rarely it is 3 or 5 seconds.

The following inclusive dates under abnormal and subnormal give the intensity of the microseisms at this station since last published.

Abnormal	1932	Subnormal
Nov. 18, 24, 25.		May 23.
28, 29, 30.		May 28 to June 7.
Dec. 8, 10, 11.		June 11, 13, 14, 17, 18, 21.
22, 23, 24.		June 24 to July 1.
28, 29, 30		July 4 to 9.
		July 17, 18, 24.
		July 26 to 29, and 31.
		Aug 2 to 6, and 9 to 16.
		Aug. 25, 26
		Sept. 1, 2, 5, 6, 8, 15.
		Oct. 8, 9, 28, 29, 30, 31.
		Nov. 22.
		Dec. 3.

Abnormal	1933	Subnormal
Jan. 12.		Jan. 2 to 7
Feb. 4 to 7.		Jan. 19 to 30
Feb. 9 to 11		Feb. 18, 19

A.E.J.

Tilting of the ground

The "Table of Tilt" shows the net tilt by weeks, as computed from seismograms at the Kilauea Observatory and from clinoscope readings at Halemaumau Southeast. The table represents the tipping of the ground, in seconds of arc, in the direction given. The total accumulated tilt at the Observatory since February 26 1932 is 7.5″ South and 1.5″ East.

TABLE OF TILT

Date	Observatory	Halemaumau
Jan. 29 - Feb. 5	3.4″ SW	50.2″ SSW
Feb. 6 - Feb. 12	1.8″ S	9.0″ SSW
Feb. 13 - Feb. 19	1.1″ SSE	2.4″ ENE
Feb. 20 - Feb. 26	0.3″ SW	14.6″ NE

E.G.W.

The Volcano Letter

No. 397—Monthly U. S. Geological Survey, Hawaii National Park MARCH 1933

KILAUEA REPORT FOR MARCH 1933

Including weekly press reports 1102 to 1106, February 26 to April 2 midnight

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

Volcanology

March of 1933 was eventful in the seismic world by producing a terrific submarine earthquake east of Japan, and the so-called Long Beach earthquake disaster in the Los Angeles region of California. Hawaii suffered from the former with a tidal wave. But the volcanoes of Hawaii remained at peace.

The first week of the month was rainy, on March 5 in the forenoon rocks were heard falling frequently from the walls of Halemaumau pit at Kilauea after heavy rain March 4, there was moderate blue fume, and numerous small jets made plumes on the lava floor of the pit. Ponds of water had accumulated on the Kilauea crater floor. A small slide fell from the east end of the north buttress at 11 a. m. March 11; there were yellow scars on the east wall and fresh debris south. On March 18 a rim block southwest showed new cracks, a slide had fallen from a shell-shaped pocket in the northeast wall of the pit, and sulphur stain had incresased on top of the inner 1932 cone. During the forenoon March 25, slides occurred at the south 9:35 a. m., west of the north buttress at 10:16 a. m., then a third was heard, and the pit walls showed fresh scars. On April 1 the walls were quiet.

The weekly measurements of rim cracks at Halemaumau gave results as follows; March 4, 7 points opened out of 25, a few slightly closed, maximum motion at a single crack a widening of 1.5 mm., aggregate opening of all 3.5 mm. March 11,15 points out of 25 opened by slight amounts. March 18, 9 points out of 26 opened by slight amounts of 1.5 mm or less. March 25, 12 points out of 26 opened, maximum single opening 2.5 mm. both ends of a rim block southeast showed slight acceleration of opening at the back of the block, and a crack back of a block southwest opened 1.5 mm. April 1, 12 points out of 26 opened 1 mm or less mostly southeast and south.

Volcanologist Jaggar visited Waikii seismograph station March 14, and Honokaa shock-recorder station conducted by Mr. Pritchard March 15, and made tests at Keauhou Kona March 19 with hydrometers and bottom samplers furnished to the Observatory by the U. S. Coast Survey. Engineer Wingate prepared ground near Kapoho and Kalapana in Puna for triangulation towers to be built by the Hawaiian Volcano Research Association, capable of enduring for thirty years of repeated tests for ground movement. An experimental earthquake annunciator was set in operation at the Observatory, capable of releasing a four-point electric indicator in a room above, for grades one, two, three and four of an earthquake intensity scale. Seismologist Jones built a non-tilt attachment for improving the seismograph registration at Waikii, where the nature of the ground has given trouble with tilting effects and other movements which obscure the true seismic motion.

T.A.J.

Earthquakes Recorded.

TABLE

Number of tremors, very feeble, and feeble local earthquakes; teleseisms or distant earthquakes: and local seismicity index described in Volcano Letter 371.

Week ending	tr.	v. f.	f.	tel.	seis.
March. 5	17	2	0	1	5.25
March. 12	24	4	0	1	8.00
March. 19	20	2	0	0	6.00
March. 26	21	4	0	0	7.25
April. 2	31	4	0	0	9.75

An earthquake was felt at Honokaa February 27 at 8:46 p. m. H. S. T. It recorded on the observatory instruments as a tremor, and indicated a distance of 52 statute miles. This would place it under Waipio valley at the greatest possible horizontal distance.

A very feeble shock was recorded at 9:13 p. m. February 28. It has been located at lat. 19° 42.5′ N; long. 156° 05′W near Keahole Point.

A tremor recorded at 5:24 p. m. March 8 was located about 22 miles west of Keauhou Bay on the west side of Hawaii.

A very feeble shock recorded at 5:29 p. m. March 8, was located 7 miles deep under Hilina Pali (a fault scarp cliff). A second very feeble shock at 10:40 p. m. may have occurred on the same fault. It was not so well recorded at Hilo.

A very feeble shock at 10.02 a. m. March 9 was located approximately under Palima Point. It was reported felt in Pahala and in the vicinity of Kilauea crater.

A very feeble shock at 1:08 a. m. March 25 was located 13 miles deep under Napau Crater.

An earthquake felt at Kamuela at 1:55 a. m. March 28 was recorded at the observatory as a tremor. It was not recorded well enough on the other stations to be located. A second shock at 4:26 a. m. was felt as far south as Honomu. It was also reported from Honokaa, Kamuela and Waikii. Distances from two stations placed it 1 to 3 miles deep under central Kohala.

Two very feeble shocks and two tremors occurred less than 3 miles from the observatory, this would place them close to or in the Crater of Kilauea.

The teleseisms listed above were destructive near their epicenters. The location of the first near the coast of Japan was given by the U. S. C. & G. S. as at lat. 39° N long. 142° E. The arrival of the first preliminary was at 7:10:32 a. m. March 2 H. S. T. (10h 30m slower than Greenwich).

The location of the second, March 10 near the California coast was given by the Jesuit Seismological Association as lat. 32° N 118° W. Only the surface waves recorded at H. V. O. This was the Long Beach earthquake.

Microseisms were abnormal or strong March 4 & 5, they were subnormal or light March 12, and from March 21 to April 2.

A.E.J.

Tsunami or earthquake tidal wave March 2, 1933

The distant earthquake on the sea-floor about 7:10 a. m. Hawaiian time as registered at the Kilauea stations, occurred at the western edge of the Tuscarora Deep, 125 miles east of Matsushima, Japan, and near this place the ocean is more than 26,000 feet in depth. The elastic wave through the earth took 10 minutes to reach Hawaii. It registered on the seismograms at Kilauea, Kona and Hilo as a very big movement for several hours, too slow to be felt. The indicated distance was 3950 miles in the azimuth of Japan. The hour and date were 2:31 a. m. March 3 by Japan time.

It was immediately apparent to A. E. Jones, seismologist at Kilauea, and to R. V. Woods, seismograph operator for the Hawaiian Volcano Research Association at Kona on the west side of Hawaii, that a tidal wave in the Pacific ocean might occur. The Radio News Broadcast announced the Japanese earthquake as a disaster about noon March 2 in Hawaii. Radio thus confirmed the notion that the water wave should come from the west, at a time before the water wave had arrived at Hawaii. Travelling 450 miles per hour, such a wave should reach Hawaii 8½ hours after the earthquake occurred.

Mr. Jones notified the Hilo Harbormaster about 10

a. m. to look for a wave about 3:30 p. m. The sampan fleet in the river was moved out to anchorages in the harbor, the waves came at 3:36 p. m., and the range of maximum motion in Hilo was from two to three feet, on the east side of Hawaii; time within six minutes of the expectancy indicated.

Captain Woods on the west side notified American Factors at Kailua and at Napoopoo, and the Captain Cook Coffee Co. that the wave might come about nine hours after 7 a.m. The waves came at the time appointed with great force on the western side of Hawaii, the side towards Japan. They came in a series of swings of the water for hours, beginning with recession. They began about 3:20 p. m. at about ten minute intervals, and the seventh wave was reported the greatest at Napoopoo. There the water receded below mean tide eight feet, rising above mean tide 9½ feet, total vertical range 17½ feet.

The sea-bottom was left bare over wide tracts of the bays at Napoopoo, Kailua, Keauhou and even at Kaalualu at the southeast end of Hawaii. Walls washed down, boats were unmoored and capsized, houses were flooded and moved, lumber was displaced, objects were washed out to sea, damage was done to interior furniture of houses, automobile lorries were flooded so that engines were damaged by sand, and goods were washed off wharves. At Napoopoo the events of 1896 and 1923 were remembered, and cargo was removed from the wharf in expectation of the wave.

At Honolulu the tide gauge made twenty fluctuations in 4 hours, making each complete wave average twelve minutes period. The waves were noted at Kauai, at west Oahu, at Lahaina, and were somewhat damaging at Kawaihae and vicinity on the northwest shore of Hawaii. The train of waves struck Midway Island between 11:05 a. m. and 1 p. m., Honolulu beginning 2:40 p. m., the west side of the island Hawaii 3:20. p. m., and Hilo 3:36 p. m. all progressively farther from the Japanese source.

In Japan there was a great disaster in Iwate province from both earthquake and tidal wave, with reported loss of 1535 lives, 2000 wounded, 7930 houses, 1570 boats, and millions of dollars of property damage at the ports of Kamaishi, Miyako, Yamoto and Omoto.

T.A.J.

Tilting of the ground

The Table of Tilt shows the net tilt by weeks, as computed from seismograms at the Kilauea Observatory, and from clinoscope readings at Halemaumau southeast. The table represents the tipping of the ground, in seconds of arc, in the direction given; the total accumulated tilt in a year since April 2, 1932 at the Observatory has been 2.2 seconds south, and 2.1 seconds west.

TABLE OF TILT

Date	Observatory	Halemaumau
Feb. 26 - Mar. 5	3.3″ SSW	21.4″ SSW
Mar. 6 - Mar. 12	0.9″ NE	7.5″ North
Mar. 13 - Mar. 19	2.2″ WSW	5.2″ East
Mar. 20 - Mar. 26	0.3″ NW	15.9″ NNE
Mar. 27 - Apr. 2	1.6″ SW	6.5″ NE

E.G.W.

The Volcano Letter

No. 398—Monthly U. S. Geological Survey, Hawaii National Park APRIL, 1933

KILAUEA REPORT FOR APRIL 1933

Including weekly press reports 1107 to 1110, April 2 to April 30, midnight.

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

Volcanology

The weather at the volcano Kilauea the first week in April was stormy, with thunder, lightning and southerly wind. No crateral changes of importance were observed in the quiet Halemaumau lava pit of Kilauea, nor on the summit of Mauna Loa. There was no sliding of rocks at the Halemaumau walls. A National Park party led by Ranger Fordyce, and accompanied by seismologist Jones, went to Mokuaweoweo, the summit crater of Mauna Loa April 10-12, encountered cold weather with snow, but discovered no new solfataric activity nor steaming.

At Halemaumau April 10 there were falls of rock from the northern walls, and a small avalanche fell from the notch at the east side of the north buttress at 9:35 a. m. During heavy rain there were numerous vapor jets at cracks in the lava floor, and this continued during cessations of the rain. A large pool of water near the southeast tilt cellar did not induce visible tilt at the clinoscope. On April 17 a dusty avalanche scar was discovered, 200 feet wide, extending from top to bottom of east wall of pit. The debris had landed on talus below. The east end of the canoe sill northeast had been breaking away, and rocks fell there from time to time. On April 19 there was similar falling of rocks, while small trickling slides and rock falls continued April 20. There were a few rocks falling April 26, but none during the forenoon of April 29.

Measurement of rim cracks about Halemaumau was recorded weekly as follows:—April 8, 8 points out of 26 opened 1 mm or less, 2 cracks slightly closed. April 16, 9 cracks out of 26 made aggregate opening of 6 mm. April 17 crack point No. 11 just above the new east avalanche scar had closed 2 mm, while four other nearby points had opened each a half millimeter. April 19 a newly moving crack showing broken ground on the southwest rim was found opening a quarter millimeter per day. April 22, 14 points out of 27 opened 2 mm or less, mostly at east side. April 29, 10 points out of 27 opened, 2 slightly closed, aggregate opening with these deducted making 6.5 mm.

T.A.J.

Earthquakes Recorded.

TABLE

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

Week ending	tr.	v. f.	f.	tel.	seis.
April 9	34	4	0	2	10.50
April 16	65	2	1	0	18.25
April 23	45	2	0	0	12.25
April 30	49	3	1	2	14.75

Hawaiian Standard Time is 10h. 30m. slower than Greenwich.

Spells of 5 and 16 minutes of tremor were recorded the first two weeks of the month. One tremor, recorded at the Kilauea station and at Hilo about 0.28 a. m. April 9, gave larger records as a local earthquake at the Kealakekua and Waikii stations. It was located seismometrically as at the northwestern shore of Hawaii, about 14 miles deep, under Kiholo Bay, Lat. 19° 15′ N.—Long. 155° 54′ W.

A feeble shock, felt in Hilo, at 4:10 a. m. April 16, was located as at sea a short distance WSW from Kalapana, 20 miles deep, Lat. 19° 13′ N, Long. 155° 03′ W.

A very feeble shock was well recorded at four stations at 0:11 a. m. April 30. It was located under a point a short distance out to sea, 12 miles deep, along the extension of the Kilauea SW rift zone, Lat. 19° 13′ N., Long. 155° 18′ W.

A feeble earthquake at 5:24 a m. April 30 was felt at Kilauea and located slightly south of Kilauea crater (3 miles) as 20 miles deep, Lat. 19° 22′ N., Long. 155° 17′ W.

A moderately large record of an Alaskan earthquake from Lat. 61° N, Long. 150° W. was registered on April 26. Only the surface waves of the three other teleseisms were recorded here.

Microseismic motion was abnormally large April 3 to 4; it was subnormally light on April 10, and from 12 to 30.

A.E.J.

Tilting of the ground

The Table of Tilt shows the net tilt by weeks, as computed from seismograms at the Kilauea Observatory, and from clinoscope readings at Halemaumau southeast. The table represents the tipping of the ground, in seconds of arc, in the direction given; the total accumulated tilt in a year since April 30, 1932 is 4.6 seconds south, and 3.7 seconds west.

TABLE OF TILT

Date	Observatory	Halemaumau
April 3 - 9	2.7″ SW	24.3″ SW
April 10 - 16	0.6″ SSE	5.7″ NNE
April 17 - 23	1.3″ ENE	10.5″ NE
April 24 - 30	1.0″ SW	4.2″ NE

E.G.W.

The Volcano Letter

No. 399—Monthly U. S. Geological Survey, Hawaii National Park MAY, 1933

KILAUEA REPORT FOR MAY, 1933

Including weekly press reports 1111 to 1115, April 30 to June 4, midnight.

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

Volcanology

No renewed lava outpouring has appeared in Hawaii. The last such activity was in Halemaumau pit in January 1932. At this pit within Kilauea crater at 8 a. m. May 6 there was trickling of rock fragments down the inner walls. On May 10 fresh scars from a slide were found on the east wall. The fall of rocks had occurred during the preceding night, and at the ends of old rim cracks on top, fresh hair cracks had developed in the soil. One rock was heard to fall in the morning. During the third week a slide fell from the west wall, where there had been little motion for several months past. Slight slides continued. June opened with only the promise based on statistics, that activities during this century have averaged once a year, and now a year and a half of quiet have gone by.

Weekly measurement of twenty-seven rim cracks around Halemaumau yielded the following results: May 6, 5 cracks opened slightly, 1 closed a half-millimeter, net aggregate opening 3 mm, mostly southeast; May 13, 10 opened and three closed, aggregate opening 4.5 mm; May 20, 15 opened and 4 closed, aggregate opening 12 mm; May 27, 8 opened and 2 closed, aggregate opening 4 mm; on May 30 a crack on the northeast rim had opened ½ mm in three days; June 3 the weekly measurement showed 15 opened and 3 closed, making net opening 9.5 mm. All this work is directed by Engineer Wingate.

T.A.J.

Earthquakes Recorded.

TABLE

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

Week ending	tr.	v. f.	f.	tel.	seis.
May 7	32	4	0	2	10.00
May 14	39	3	2	0	13.25
May 21	27	5	0	0	9.25
May 28	33	6	1	0	8.00

Hawaiian Standard Time is 10h. 30m. slower than Greenwich.

The following locations of earthquake origins were derived seismometrically from measured seismograms of the four principal stations on Hawaii, Kilauea, Kona, Waikii and Hilo; 3:50 p. m. May 2 under the divide between Mauna Loa and Hualalai; 7:30 p. m. May 9, felt moderately at Puu Ulaula rest house on northeast rift of Mauna Loa, 5 to 12 statute miles deep under that part of the mountain; 6:54 p. m. May 17 a shock felt at Hakalau, on the northeast coast of Hawaii, under a point about 1 mile out to sea from that village, and 15 miles deep. A very feeble shock May 20 was located under the northeast rift of Mauna Loa. A shock 0:21 a. m. May 24, felt at Honokaa, was located on the west shoulder of Mauna Kea, Lat. 19 degrees 49 minutes N., Long. 155 degrees 37 minutes W.

Other local earthquake centers were as follows: 7:31 a. m. May 24, felt at Honokaa, Lat 20 02 N. Long 155 31 W, 3 miles deep, halfway between Mauna Kea and the ocean to the north; 7:48 a. m. May 25, very feeble, Lat 19 55 N, Long 155 35 W, under the northwest shoulder of Mauna Kea, and not over 5 miles deep; 11:38 a. m. May 27, feeble and felt at Kilauea Observatory, Lat 19 27.5 N, Long 155 27.5 W, under a point half way between Kilauea Crater and the Mauna Loa crater, 7 miles deep; 1:47 a. m. May 28, felt at Holualoa in North Kona, approximately at sea off Keauhou Bay.

The distant earthquakes, only partially recorded, beginning 8:37 a.m. May 1, and 6:00 p. m. May 4, were from unknown locations. Microseismic motion was mostly subnormally light for the month, becoming normal at the beginning of the second, and throughout the third week in May.

A.E.J.

Tilting of the ground

The Table of Tilt shows the net tilt by weeks, as computed from seismograms at the Kilauea Observatory, and from clinoscope readings at Halemaumau southeast. The table represents the tipping of the ground, in seconds of arc, in the direction given; the total accumulated tilt in the year since May 28, 1932 at the Observatory has been 7.8″ south, and 4.0″ west.

TABLE OF TILT

Date	Observatory	Halemaumau
May 1 - May 7	1.0″ WSW	1.3″ NNE
May 8 - May 14	0.3″ SW	0.9″ SSE
May 15 - May 21	1.8″ NE	4.9″ NW
May 22 - May 28	0.8″ WNW	0.0

Halemaumau readings for May show exceptional quiet as compared with other months; the following is a comparison of net tilt by months at Halemaumau southeast, and average rim crack openings by months for the whole 27 marked crack points. If these figures show anything, it is that the crack widening lags behind the tilts. The tilt movements notably alternate between northerly and southerly.

Average crack opening	Halemaumau Tilt by months	
Jan. 0.0160 Cm	8.3 seconds	NNE
Feb. 0.0170	23.2	SW
Mar. 0.0310	18.1	NE
Apr. 0.0260	6.0	SW
May 0.0235	5.0	SW

Spirit Level Changes at Halemaumau

Levelling executed June 12, 1933 for comparison with similar measurements December 31, 1932, giving differences of elevation of points near Halemaumau relative to the datum station Spit southeast of Kilauea Crater resulted as follows; elevation of Spit 3646.93 feet:—

BM Seis June 12	plus (up)	0.02 foot
BM No. 1, Tourist June 12	minus (down)	0.05 "
BM Beggar " "	"	0.03 "
BM NE Pit " "	"	0.08 "
Crack point No. 18 " "	"	0.33 "

The accumulated tilt at the clinoscope of Halemaumau SE (BM Seis above) between December 31 and May 31 was 4.2 seconds of arc SW.

Triangulation in Puna

Field observations over the Puna Triangulation net were completed May 28th. Favorable weather aided the work, and seventeen stations were occupied between May 16 and May 28. Unchecked notes indicate a triangle closure of about 2.1 seconds for 39 triangles. A complete report on the survey will be prepared for June Volcano Letter.

E.G.W.

The Volcano Letter

No. 400—Monthly | U. S. Geological Survey, Hawaii National Park | JUNE, 1933

KILAUEA REPORT FOR JUNE, 1933

Including weekly press reports 1116 to 1119, June 4 to July 2, midnight

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

Volcanology

Levels run about northeast rim of Halemaumau June 12 showed that the rim had generally lowered, less than one-tenth foot, since December 31, 1932. Weekly measurement of the 27 rim cracks at Halemaumau gave the following:—June 10, 7 points not more than ½ mm each. Two cracks forming a crescent block on the rim south and southwest, about 500 and 800 feet long, showed fresh hair fissures in the soil. June 12 similar cracks were found 100 to 150 feet back from the east and northeast rim. June 17 eleven points showed widening of 1½ mm or less, nine of these being at the east. Aggregate opening for all cracks was 7 mm. June 24 eight cracks had widened 1½ mm or less, mostly southeast, aggregate opening 5 mm. July 1 six points opened only a half millimeter each.

T.A.J.

Earthquakes

TABLE

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

Week ending,	tr.	v. f.	f	sl.	tel.	seis.
June 4	26	3	0	0	0	8.00
June 11	56	4	1	0	0	17.00
June 18	49	3	0	0	1	13.75
June 25	32	3	2	0	1	11.50
July 2	78	2	0	2	1	25.00

Hawaiian Standard Time is 10h. 30m. slower than Greenwich.

The teleseisms were only partly recorded.

Tilting of the ground

The Table of Tilt shows the net tilt by weeks, as computed from seismograms at the Kilauea Observatory, and from clinoscope readings at Halemaumau southeast. The table represents the tipping of the ground, in seconds of arc, in the direction given; the total accumulated tilt in the year since July 2, 1932 at the Observatory is 4.9″ south and 2.2″ west.

TABLE OF TILT

Date	Observatory	Halemaumau
May 29 - June 4	0.3″ NE	1.4″ N
June 5 - June 11	0.4″ NW	2.7″ S
June 12 - June 18	0.8″ NNE	11.0″ N
June 19 - June 25	1.0″ NNE	10.8″ NNE
June 26 - July 2	0.9″ N	6.4″ NNE

E.G.W.

PUNA TRIANGULATION

Prof. C. Tsuboi, writing in the 'Bulletin of the Earthquake Research Institute, Tokyo Imperial University, Vol. VI, March 1929 an 'Interpretion of the Results of Repeated Precise Levelings in the Tango District', remarks in the beginning, "In the country of Japan, from which a world-shaking earthquake originates not rarely, the scope of seismology naturally goes further beyond the study of propagation of purely elastic seismic waves and is extended to the investigation of those geophysical phenomena that are characteristic to the localities of the earthquake origin."

Similar studies were initiated by Dr. T. A. Jaggar in 1920, here in Hawaii, when he directed the work of Mr. R. M. Wilson in laying out and measuring the net of triangulation and levels about Kilauea Crater. This net was later re-surveyed by Mr. Wilson and the actual ground movements detected by this survey showed the value of applying engineering methods to the study of volcanic and seismic phenomena.

An expansion, by means of similar surveys, into known seismic belts on this island had been long contemplated, only a shortage of funds preventing an earlier beginning. The northeast rift of Kilauea, at its eastern end, was selected for the initial expansion. This section has had volcanic and seismic activity upon four occasons within the last hundred years. On the accompanying map the localities affected are shown by the date of occurrence.

The northeast rift of Kilauea is not a ridge but is a

The following locations are of local earthquakes well recorded at three or more seismograph stations on the Island or Hawaii.

Date	time	lat. N.	long. W.	depth	remarks
June 7	10;38 a.m.	19°;53′	155°;17′.5	10 mi.	not reported felt. S. of Ookala, W. of Hakalau.
June 9	4;55 p.m.	19°;26′.5	155°;42′.5	0 mi.	sharply felt. M. Loa, SW of summit, under 1851 lava flow.
June 15	6;26 p.m.	19°;36′	155°;16′	2 mi.	not reported felt. M. Loa NE rift.
June 19	7:33 p.m.	19°;12′.5	155°;25′	5 mi.	not reported felt. Kilauea SW rift.
June 20	0;32 p.m.	19°;26′	155°;16′.5	2 mi.	not reported felt. under Kilauea.
June 22	8;33 p.m.	20°;03′	155°;33′	7 mi.	felt by several. Mana, SW of Honokaa
June 25	1;15 a.m.	19°;24′	155°;15′	1 mi.	not reported felt. SE of Kilauea.
June 29	0;44 a.m.	19°;40′	155°;48′	0 mi.	moved furniture damaged stone wall. Hualalai shock.
July 2	7;47 a.m.	under Kilauea			not reported felt.

Depths are in statute miles below sea level. The microseismic motion was normal June 30 being subnormal or light during the remainder of the time covered by this report.

series of earthquake cracks, cinder cones, and pit craters, extending along the shoulder of a slope to the south and seaward, which begins at Kapoho and gradually becomes steeper to the west. Faulted cliffs appear to the westward of Kalapana. To inland, or north, there is but little slope away from the rift. The whole area is more or less densely covered with a low-level semitropical forest. At Pahoa, Kapoho, and Kaueleau are cane fields of the Olaa Sugar Co. The lava flow of 1840 followed a course eastward roughly paralleling the rift on the north. North from this flow the country rapidly changes to a grass-covered pahoehoe plain, with a thin growth of Ohia Lehua.

Reconnaissance was begun in January and together with the clearing of trails and lines of sight, the marking of stations, and the erecting of signals, consumed about four-fifths of the working time.

Existing triangulation, in this section of the Puna District, was fragmentary, being confined to four stations on the rift, with some six additional points along the shore, none of which had been determined through figures of any great strength.

The problem in laying out the new net was to get at least two stations, to the north of the rift and the last known cracks, so located as to serve, in a future re-survey, as a probably undisturbed base for computations. All of the stations along the rift, as well as those on the shore, are considered subject to change through volcanic and seismic causes. It was also desirable, with the instruments available, to hold the length of sights to a maximum of ten and a minimum of two miles. Two suitable points were finally found and are represented by the stations 'Makuu' and 'Kokoolau'.

Of the existing stations, listed in U. S. C. & G. S. Special Publication No. 156, only two were found unsuitable for use. The station 'Kamaili' was so located that no sight of sufficient length could be taken to the east, and 'Sand Hill', a cinder cone at the sea end of the 1840 lava flow, is gradually peeling off into the sea.

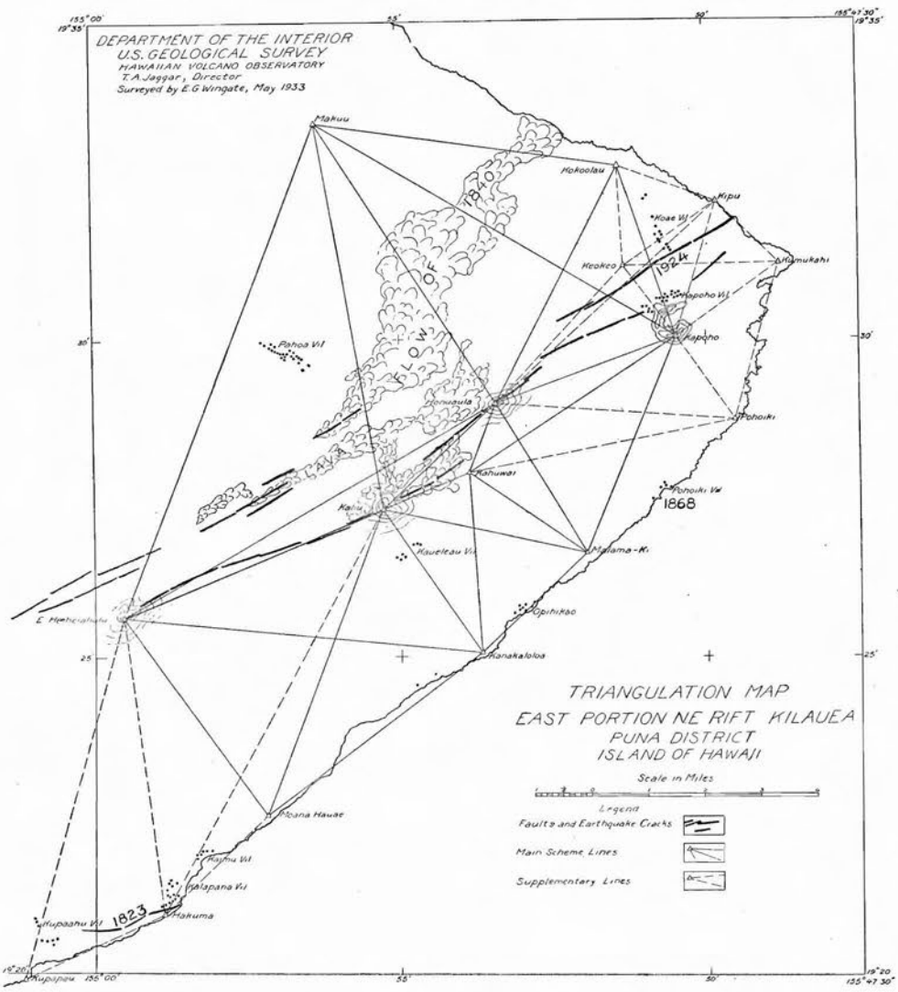
Two towers, of thirty and forty feet in height and of permanent construction, were erected under contract at stations 'Kanakaloloa' and 'Kokoolau' respectively. The observers' platform and scaffold were built around a separate, inner tripod to support the instrument.

The signals at E. Heiheiahulu, Kaliu, and Kapoho were of the new type adopted by the Hawaiian Territorial Survey and are described in 'Special Pub. No. 156' above. All other signals were 2x2 inch poles surmounted by cross targets of light weight galvanized iron, two feet square, painted in two colors, yellow and red. The signals were carefully centered by plumb line and all were erected within five days of the first observations.

The area surveyed was approximately ninety-five sq. miles and due to very favorable weather conditions all observations were completed in eleven days. A 'Berger' direction-transit graduated to 20 seconds, was used and the angles were read by repetition, six repetitions with the telescope direct, and six reversed. The horizon angle was similarly observed.

Twenty triangles in the main scheme had an average closure of 01.8 seconds, plus or minus and eighteen supplementary triangles closed with an error of 02.3 seconds, plus or minus.

The line, of existing triangulation, E. Heiheiahulu-Kaliu was adopted as a base for the present work as it appeared to be the line least subject to disturbance since last measured in 1914.



Computation of the length through the main scheme by two separate chains of triangles adjusted only within themselves gives a closure in in the order of one part in 40,000. Every line, however, in the present survey is subject to the same errors inherent in the line of older triangulation chosen as a base, which was probably of third order accuracy.

Limited funds prohibited the measurement of a base and for the same reason the existing figures about Hakuma and Kupapau were not strengthened. The total field work cost an average of $73.00 a station.

The work was greatly facilitated by the courteous cooperation of officials of The First Trust Co. of Hilo and the Bernice P. Bishop Estate of Honolulu in permitting the erection of permanent towers on their property, and of Mr. Richard Lyman of the Olaa Sugar Co., in allowing the clearing of trees from certain lines of sight. Funds for the erection of the two towers were voted by the Board of Directors, Hawaiian Volcano Research Association, without which the survey as completed would have been impossible.

Complete records of the field observations have been furnished the Hawaiian Territorial Survey and the engineer of the Bernice P. Bishop Estate.

E.G.W.

The Volcano Letter

No. 401—Monthly U. S. Geological Survey, Hawaii National Park JULY, 1933

KILAUEA REPORT FOR JULY, 1933

Including weekly press reports 1120 to 1123, July 2 to July 30, midnight.

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

Volcanology

The data about the crater of Kilauea, in the absence of lava activity at the inner pit Halemaumau, concern observation of slides from the inner pit wall, other changes if any at the pit, measurement of rim cracks about the upper rim of the pit, measurement of horizontal angle right to left across the pit for pit rim monuments, and tilt of the ground at the pit edge in the clinoscope cellars platted with reference to one component only, the line of direction connecting the center of the pit with each cellar; this is to find out whether the ring of ground around the pit is tilting inward or outward. These measurements are under the direction of topographic engineer E. G. Wingate.

On the outer Kilauea Crater wall (Uwekahuna) about three fourths of a mile south from the summit trig station west of the crater, a small slide left a scar which was detected July 15. There were recent slides on the west wall of the summit crater of Mauna Loa discovered at about the same time. In the early part of the month gales of wind from the northeast blew clouds of dust about the lee side of Kilauea crater into the southwestern country. The age-long persistence of the trade wind is a geologic force to be reckoned with in the transport of loose ash on the island of Hawaii.

In Halemaumau July 9 a few rocks had fallen from the south wall of the pit leaving a small dusty track, and a dark red patch on the northeast wall had appeared. On July 26 there were wall slides at 11:50 a. m., and at 0:50 p. m. The pit seismograph had shown four small quakes July 24, one of them accompanied with NNE tilt, but the walls showed no new scars from avalanches.

Measurement of rim cracks gave the following:— Out of 27 points, 8 showed no movement, 6 opened slightly, and 2 closed a half millimeter each, the area of movement being the rim southeast and south, the date July 8 for the previous week. The following week, date July 15, 12 points out of 27 had widened, 2 of them one half millimeter each, one 1 mm. Five cracks showed slight opening July 22, and 2 points on one crack showed slight closing. On July 29, six crack points showed very slight widening, two showed slight closing, the aggregate opening being 3 mm. One of the opened cracks is far back from the rim, half way between the sand spit south and Halemaumau.

The horizontal angle representing the SE-NW diameter of Halemaumau, as measured from the Observatory on the northeast edge of Kilauea crater, showed on July 28 a closing of 1.2 second since the last measurement on June 20, 1933, a period of 38 days. T.A.J.

LASSEN REPORT NO. 33.

During the first five days of July 1933, 53 earthquakes were recorded on the seismographs at Mineral. The distribution of the earthquakes by days was as follows:

July 1	3	shakes
2	5	"
3	4	"
4	39	"
5	2	"

Things had quieted down by July 8th. Several of the shakes were of sufficient intensity to be perceptible at Mineral, though more were felt in the eastern part of Lassen Park. The indicated distance from Mineral was about 10 miles.

R.H.F.

Earthquakes

TABLE

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

Week ending	tr.	v. f.	f	sl.	tel.	seis.
July 9	54	8	0	0	1	17.50
July 16	82	9	1	0	0	26.00
July 23	74	13	2	1	1	29.00
July 30	51	9	0	0	0	17.25

A feeble earthquake was felt at the Volcano House at 0:45 a. m. July 14. It was about one statute mile from the observatory.

A feeble earthquake was felt in Hilo at 3:17 p. m. July 19; as located from the records of three stations it was 25 miles deep under the Kilauea southwest rift zone, near 19° 20'N; 155° 20'W.

A slight earthquake was felt by several near Kilauea crater at 0:39 p. m. July 20. It was less than four miles from the observatory and probably under the crater.

A feeble earthquake was recorded—not reported felt—at 5:59 p. m. July 22. It was about two miles away and under the crater of Kilauea.

During the period covered by this report 25 very feeble shocks and ten tremors have been located at shallow depths, under Kilauea crater. The greater number occurred during the third week when the seismicity figure was the greatest.

The first teleseism was poorly recorded, the second was fair showing several wave arrivals.

The microseisms or ground motion was moderate or normal July 6, 10, 11, 26, 27, 28, and 29, on the other days of the month it was light or subnormal. A.E.J.

Tilting of the ground

The Table of Tilt shows the net tilt by weeks, as computed from seismograms at the Kilauea Observatory, and from clinoscope readings at Halemaumau southeast. The table represents the tipping of the ground, in seconds of arc, in the direction given; the total accumulated tilt in the year since July 30, 1932 at the Observatory is 2.9" south and 2.1" west.

TABLE OF TILT

Date	Observatory	Halemaumau
July 3 - July 9	1.9" N	2.9" NW
July 10 - July 16	0.8" NNW	9.2" N
July 17 - July 23	0.1" WSW	2.9" WNW
July 24 - July 30	0.7" NNW	3.2" N

E.G.W.

Mauna Loa

For Mauna Loa on July 18 Messrs. Doerr and Wingate report steam seen chiefly in afternoon hours on the northeast rift 3 to 7 miles below Mokuaweoweo; no steam noticed in the north embayment of crater. A moderate amount of fume and steam came from sulphur cracks NNW of the cones of 1903. The 1914 cone was steaming strongly at the top, moderate fume issued from its vicinity, and sulphur patches were visible on the northern slopes of the cone. No fume or steam was observed at the south lunate platform. The west and northwest wall of the crater showed scars of recent rock slides, and at 12:55 p. m. a considerable slide occurred making streams of dust, with the wind blowing lightly from SW. Under clear weather conditions in still air Mr. Doerr notes that such dust might be seen from Kilauea, and it happens that on that same evening at Volcano House the volcanologist saw what looked like a faint fume cloud start above Mokuaweoweo and move slowly north, while the wind below at Volcano House was strong NE. Wingate reports that sulphur stain was seen from the east points of view at the base of, and on, the north wall of Mokuaweoweo about one half mile east of the summit trig station. The water holes examined had much less ice than during 1925-26. There was a small tremor on the Observatory seismogram about the time of the 12:55 avalanche in Mokuaweoweo.

The Volcano Letter

No. 402—Monthly | U. S. Geological Survey, Hawaii National Park | AUGUST, 1933

KILAUEA REPORT FOR AUGUST, 1933

Including weekly press reports 1124 to 1127, July 30 midnight to August 27 midnight.

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

Volcanology

Two slides at Halemaumau were noticed during the first week of the month, and on one occasion some trickling of pebbles. On August 7 a small slide had left a dusty track at the top of the west wall at the big steam crack. One or two rocks were heard falling about 10 a. m. Cracks at the east platform, recently filled in, had shown dribbling in of the sand for some weeks. At 10:24 a. m. August 10 a few rocks fell from the wall at the south corner of the pit, and raised a small cloud of dust. On August 26 a somewhat fresh crack in the ash NE and N of the pit was discovered about 400 feet back from the rim.

Cracks measured at the edge of Halemaumau weekly, showed on August 5 very slight opening at 8 points out of 27, confined to the south and southeast rim area: on August 12 only 3 points had opened and 4 had closed, making the aggregate movement zero, the quietest week by measurement and observation since July, 1931: on August 19 seven rim cracks scattered along the southeast, south and southwest rims of the caldron had widened slightly, the largest amount being 1.5 mm. Two points indicated a very slight closing.

E. G. Wingate, topographic engineer, reports the horizontal angle representing the SE-NW diameter of Halemaumau, July 28—August 21, to have closed 1.7 seconds in 24 days; the angle opened 2.5 seconds August 21—August 29, in 8 days. This angle, measured from the Observatory on the northeast edge of Kilauea crater, is between Stations "NW Pit" and "Seis."

The horizontal angle representing the SSE—NNW diameter of Kilauea crater, measured from "Obsy," between "Uwekahuna" and "Spit," closed 2.5 seconds July 28—August 21, 24 days: and opened in 8 days August 21—29 by 0.3 second.

The combined tilt at Halemaumau, computed for the three clinoscope cellars, and resolved for each cellar into one component to or away from the center of the pit, shows inward tilting of 22.2 seconds July 31—August 27, a period of 27 days. This combined tilt has been computed for each day since October 11, 1932 and on August 27 showed an accumulation of inward tilt amounting to 53 seconds, for this interval 320 days.

It was shown in Volcano Letter 399 that Sta. Seis, the SE clinoscope cellar at Halemaumau had risen by spirit levelling relative to Sta. Spit outside of the Kilauea floor south by 0.02 foot on June 12,1933 relative to December 31, 1932. Levels run August 14, 1933 show that Sta. Tourist east of Halemaumau had lowered 0.13 foot relative to Sta. Seis since September 27, 1932. The distance between these bench marks is 440 feet. "Tourist" is on the rim of the pit, and "Seis" is about 400 feet back. "Tourist" is not greatly off from the line of the computed clinoscope tilt at "Seis" (to and from the center of Halemaumau). An angular depression of 53 seconds as above would at this distance give a change in elevation of minus 0.11 foot. This indicates a close agreement between measured and computed changes in elevation. In approximately this same period the horizontal angle across Halemaumau has closed 3.44 seconds.

The indication from all results is that the pit as a whole is lowering slightly at the present time. This is in agreement with the tilting of the ground for a year past, as recorded in Engineer Wingate's monthly report for the cellar of the Hawaiian Volcano Observatory on the northeast edge of Kilauea crater, the record for the preceding year each month, showing an accumulation of tilt to the southward, or in the general direction of the crater.

Measurement of vapor temperatures at eight vents of the Sulphur Bank near Volcano House with mercurial maximum thermometer, made by Wingate and Jones, on August 16, gave degrees Centigrade as follows:— 85.5, 80.0. 79.0. 77.0, 89.0, 94.5, 94.7, 94.6. These vents were not at the borings, where the maximum temperatures as measured several years ago were rather constant at 96.0 degrees Centigrade, or 204 degrees Fahrenheit. This temperature happens to be the boiling point of water for this elevation.

T.A.J.

Earthquakes

TABLE

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

Week ending	tr.	v. f.	f	sl.	tel.	seis.
August 6	45	5	0	1	0	14.50
August 13	28	4	0	0	0	10.00
August 20	22	2	0	0	0	06.50
August 27	37	3	0	0	1	10.75

A slight earthquake was felt by Pritchard in Honokaa, by Sumner in Kapapala, Pahala, by Hutchinson Sugar Co. in Naalehu, by L. P. Lincoln in Hookena, by Fabius Paauilo, and by Hodges and others in Hawaii National Park at 11:56 a. m. July 31. It was located 19° 20′ N 155° 30′ W and 10 miles deep; nearly under Kapapala Ranch where it was felt sharply.

A small shock was felt by Mr. Sumner and others at Ohaikea, August 4.

A shock was felt at Naalehu at 4:08 a. m. Aug. 7. It recorded as very feeble on the Observatory seismographs. It was located from the records of two stations as being 2 miles northwest of Naalehu, 19° 05′ N 155° 39′ W and close to the surface.

The teleseism began recording at 9:33:25 p. m. H.S.T. Aug. 24. The secondary waves arrived at 9:44:07 p. m. The direction was Northwest and the distance 5,965 statute miles. According to press dispatches it was destructive in central China.

Microseismic motion of the ground was moderate or normal on July 31 and August 2, 3, 4, 8, 12, 14, 15, 16; it was light or subnormal on the other days of the month.

A.E.J.

Tilting of the ground

The Table of Tilt shows the net tilt by weeks, as computed from seismograms at the Kilauea Observatory, and from clinoscope readings at Halemaumau southeast. The table represents the tipping of the ground, in seconds of arc, in the direction given; the total accumulated tilt in the year since August 27, 1932 at the Observatory is 1.5″ south and 1.3″ west.

TABLE OF TILT

Date	Observatory	Halemaumau
July 31 - Aug. 6	1.3″ N	6.5″ NNW
Aug. 7 - Aug. 13	0.4″ NNW	2.6″ NW
Aug. 14 - Aug. 20	1.2″ NNW	1.9″ N
Aug. 21 - Aug. 27	0.7″ NE	6.6″ NW

E.G.W.

The Volcano Letter

No. 403—Monthly U. S. Geological Survey, Hawaii National Park SEPTEMBER, 1933

KILAUEA REPORT FOR SEPTEMBER, 1933

Including weekly press reports 1128 to 1132, August 27 to October 1, midnight.

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

Volcanology

In Halemaumau September 1 there had been a slide from the east corner. At 10:59 a. m. September 23, rocks fell from the north wall, and the dusty track of a moderate slide southsouthwest was seen. The northeast wall of the greater crater Kilauea showed a yellowish-orange scar from a slide, about a half mile west of the Hawaiian Volcano Observatory. On September 26 all-day inspection of the pit recorded sliding at 10:09 a. m. from the south-southwest wall, making a voluminous dust cloud and much noise. On September 30, sliding was reported as beginning in the pit between 6 and 7 a. m. Dust from slides rising from the pit was noted at the Observatory at 8:12 a. m. and 8:30 a. m. and between 8:37 and 8:45 a. m. the pit as seen from Uwekahuna was full of dusty air.

Weekly rim crack measurements around the Halemaumau border by E. G. Wingate gave:—

September 2. Six crack points out of 29 showed slight widening, two were very slightly closed.

September 9. Six points out of 29 very slightly opened, two points very slightly closed.

September 16. Twelve points widened, out of 29, one point closed. Widening not confined to any one sector.

September 23. Six scattered points widened out of 29, one point closed very slightly.

September 30. Marking nails for crack measurement had been set at three new points on September 26, on the east and northeast rim of Halemaumau.
Measurement for the week showed very slight opening of six scattered points out of 32, and very slight closing occurred at 4 points.

Mr. Wingate reports transit measurement of the horizontal angle from the Hawaiian Volcano Observatory triangulation station, to the two stations representing the southeast-northwest diameter of Halemaumau, as follows, the figures being the change of angle since the last date. Minus is a closing of the angle, or an approaching of the two walls of the pit. Plus is an opening of the angle, or a widening of the pit.

August 29 to September 5, 7 days, 0.6 second minus
September 5 to September 18, 13 days, 1.5 seconds plus
September 18 to September 27, 9 days, 0.4 second minus

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.
September 3	42	3	1	0	1	13.00
September 10	49	1	0	1	2	14.75
September 17	19	6	0	0	0	7.75
September 24	58	5	0	1	1	19.00
October 1	44	3	2	0	1	14.50

Periods of continuous tremor occurred during four weeks out of the five. This vibration has a frequency of about 100 times a minute and is indistinguishable from the tremor found on the seismograph records during the times of lava fountaining in the pit of Halemaumau.

A very feeble shock, on August 31, occurred about 10 statute miles northwest of Hilo. Lat 19 48'N, Long. 155 12'W 24 miles deep.

A feeble shock, September 2, occurred 5 miles under Pali O Mamalu. Lat. 19 2'N, Long. 155 40'W, it was not reported felt.

A slight earthquake, Sepember 7, occurred about 27 miles deep, under Wood Valley. Lat 19 18'N, Long. 155 27'W it was reported felt at Uwekahuna by Doerr, and in Hilo by M. Campbell.

A tremor, 6:13 a. m. September 11, occurred at sea a short distance off of the west coast of Hawaii, and close to the possible extension of the Mauna Loa southwest rift line. Lat. 19 02'N, Long. 155 58'W.

A very feeble shock, 7 a m. September 11, was reported felt by Mair in Pahala. It occurred 7 miles north-northeast of Wood Valley, and about 7 miles deep. Lat 19 23'N, Long. 155 28'W.

A very feeble shock Sept. 14 probably occurred under the sea a short distance of the Puna coast and south west of Kalapana.

A very feeble shock registered September 16, originated 10 miles west of Humuula.

A very feeble shock September 20, originated on the Mauna Loa northeast rift. It may have been one of many reported felt at Kapapala.

A slight earthquake September 21 apparently originated a short distance away from the Observatory, probably under the Kilauea southeast rift. It was not reported felt.

A feeble earthquake was recorded September 26, the location found was 8 miles east of Humuula, Lat. 19 42'N, Long. 155 23'W and 7 miles deep. It was felt in Papaikou, Honomu, Hakalau, Hilo, Olaa and Pahala according to reports sent in by H. Milne; J. B. Oliver; Hakalau Plantation; M. Campbell; and W. Mair.

A feeble shock was reported felt in Pahala by W. Mair September 28. It was located 7 mi. northeast of Kapapala. Lat. 19 22'N, Long. 155 27'W and about 9 miles deep.

A very feeble shock on September 30 was approximately located under the saddle between Mauna Loa and Mauna Kea.

A fair record of a teleseism began at 11:46:11 a. m September 6, and continued for 20 minutes. It was 2,934 statute miles away from he Observatory. The other teleseisms were partial, showing only the maximum or long waves.

The microseisms were moderate September 5, 9, 16, 18, 21 22, 23, 24, and October 1; they were light or subnormal during the remaining days of the month.

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, outwards from and inwards toward the center of Halemaumau.

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

At the Observatory, a NE reading is outward, a SW reading is inward.

The total accumulated tilt in the year since October 1, 1932 at the Observatory is 1.5" north and 0.7" west.

TABLE OF TILT

Date	Observatory	Halemaumau
Aug. 28 - Sept. 3	0.9" NE	1.3" outward
Sept. 4 - Sept. 10	0.7" NE	2.6" inward
Sept. 11 - Sept. 17	1.3" NNE	0.4" inward
Sept. 18 - Sept. 24	1.1" NNE	2.6" inward
Sept. 25 - Oct. 1	1.0" NNE	0.1" inward

E.G.W.

The Volcano Letter

No. 404—Monthly | U. S. Geological Survey, Hawaii National Park | OCTOBER, 1933

KILAUEA REPORT FOR OCTOBER, 1933

Including weekly press reports 1133 to 1136, October 1 midnight to October 29 midnight.

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

Volcanology

Slides from the walls of Halemaumau pit have occurred as follows for the short periods under observation daily in the forenoons, and occasional observation at other times. Slide during day preceding 10 a. m. October 6 left a scar near top of east wall, and fresh dust and small rocks scattered over the east bay of the lava floor. The southeast pit seismograph had registered the vibrations. October 6 at 9:50 a. m. a few rocks were heard falling. October 7 at 8:58 a. m. and 10:07 a. m. small slides at east corner of pit. October 9 forenoon, rocks fell infrequently. October 13 at 3:38 p. m. dust arose at east corner. October 14 new dusty appearances were seen at east talus and south wall. October 24 and 25 in the forenoons, a few rocks were heard falling. October 26 at 10:15 a. m. a small slide fell from the south wall, and one caused dust at 10:35 a. m.

Slides occurred on the west wall of Kilauea crater, about three quarters of a mile south of the museum at 4:38 p. m. October 2, and on October 8 at 10:50 a. m. and at 10:58 a. m. October 23 numerous showers caused vapor to rise from Halemaumau, mixed with some blue fume, and October 26 strong northeast wind raised clouds of dust in Kau desert. A very fresh avalanche scar was located by Wingate October 24 at the north end of the west platform inside of Alealea crater along the Chain of Craters road, with another scar nearby. This was believed related to a shock at 10:32 a. m. October 20, accompanied by a booming noise and a low rumble, felt by a construction crew near Puu Hulahula, and by others heard at 28-miles and at Halemaumau.

Weekly rim crack measurements around the Halemaumau border are reported by E. G. Wingate as follows:—

October 7. Seven crack points out of 32 opened very slightly, two closed very slightly.

October 14. Eleven points out of 32 opened, two points closed, very slightly.

October 21. Three points opened out of 32, one closed, very slightly.

October 28. Out of 32 points, four opened one-half millimeter each. Seven closed one-half millimeter each. One crack northeast showed one-half millimeter lateral movement. The closing cracks were south and southeast, the opening ones were east and northeast. The west rim showed no movement.

T.A.J.

Earthquakes

TABLE

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

Week ending	tr.	v. f.	sl.	mod.	tel.	seis.
October 8	24	3	0	0	1	10.00
October 15	29	1	0	1	1	11.75
October 22	46	8	1	2	0	25.50
October 29	42	8	0	0	0	15.00

The indicated origin of the moderate earthquake at 3:01 a. m. October 13 was at sea, about 30 statute miles southeast of Cape Kumukahi, in Lat. 19° 15′N; Long. 154° 23′W. It was lightly felt.

The slight earthquake of October 19 at 5:37 a. m. could not be well located. It probably occurred a few miles north of the Mauna Loa northeast rift. It was felt in Hilo and Honomu.

The two earthquakes at 9:10 and 9:11 a. m. October 21 occurred at places about eight miles apart, under the southeast flank of Mauna Loa. The first at Lat. 19° 21′.5N; Long. 155° 31′.5W; and about two miles deep. The second at Lat. 19° 25′N, Long. 155° 30′W and about nine miles deep. The second could not be as accurately located as the first, owing to confusion of its waves with the waves of the first earthquake. Both were reported felt generally on Hawaii.

Six small earthquakes were felt at Kapapala ranch during the month, the observatory records were too small to indicate a distance for any of them. The same was true for an earthquake felt at Pahala and one felt at Kapulani.

The record of the teleseism beginning at 5:11:16 a. m. October 5 was fair, showing a few phases. Only the long waves of the teleseism of October 14 were recorded.

The microseisms were light on October 10, 12, 15, 16, 17, 18, 19, 20, & 29. The microseisms were moderate or normal October 2, 3, 5, 6, 7, 8, 9, 11, 13, 14, & 21. The microseisms were strong or abnormal October 4, 22, 23, 24, 25, 26, 27,& 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, outwards from and inwards toward the center of Halemaumau.

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

At the Observatory, a NE reading is outward, a SW reading is inward.

The total accumulated tilt in the year since October 29, 1932 at the Observatory is 1.1″ south and 0.8″ west.

TABLE OF TILT

Date	Observatory	Halemaumau
Oct. 2 - Oct. 8	0.7″ E	2.8″ inward
Oct. 9 - Oct. 15	0.3″ NE	11.0″ inward
Oct. 16 - Oct. 22	0.3″ SW	1.3″ outward
Oct. 23 - Oct. 29	2.0″ NE	10.6″ inward

E.G.W.

The Volcano Letter

No. 405—Monthly U. S. Geological Survey, Hawaii National Park NOVEMBER, 1933

KILAUEA REPORT FOR NOVEMBER, 1933

Including weekly press reports 1137 to 1140 October 29 midnight to November 26 midnight

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

Volcanology:—Kilauea

Halemaumau pit of Kilauea volcano produced a rock slide at the west end of the north sill 9:35 a. m. November 4, and another small one was heard at 10:43 a. m. Fragments of rock dribbled down the south wall 10:44 a. m. November 6. There were very heavy rains November 8-9 amounting to 6.75 inches. Pools of water remained all over the Kilauea crater floor, being lakes at the southwest valley and at the upper bench southwest. November 9 a slide occurred at noon on the south side of the pit. November 11 several hundred tons of rock had fallen from above the lowest part of the canoe sill northeast. The pieces had rolled 150 feet down the talus; at 10:07 a. m. Nov. 11 rocks fell at the northeast. About 10 a. m. Nov. 13 rocks were heard falling from the north, west and south walls; at the same hour November 16 a small slide was heard at the east, and there was fresh debris on the talus. The week ending November 26 was notably quiet.

Weekly rim-crack measurements around the Halemaumau border were as follows:—

November 4. Out of 32 points, 7 opened 1 mm. or less, 4 closed very slightly, 1 northeast crack moved laterally 1 mm.

November 11 Out of 32 points, 10 opened slightly, 4 closed slightly, aggregate result for all, an opening of 3 mm.

November 18. Out of 32 points, 9 opened, 3 closed, aggregate movement an opening of 4 mm.

November 25. Out of 32 points, 11 opened and 3 closed, aggregate opening 5.5 mm.
It will be seen that the aggregate opening gradually increased during the month.

Volcanology:—Mauna Loa

The cluster of earthquakes of October about Mauna Loa, felt especially at Kapapala ranch on the east side of that volcano, led E. G. Wingate and A. E. Jones to visit the summit crater, camping there the night of November 1-2. At Puu Ulaula resthouse the night October 31 the outdoor temperature was 31 degrees Fahrenheit. The northeast end of Mokuaweoweo was reached at 1:30 p. m. November 1.

The main crater showed puffing vapor from the 1914 cone, fume was dense at times from the solfataras of the sunken area adjacent to the 1914 cone, and the central cones of 1903 were about as usual. The summit camp was in a cavern, and ice from cracks was melted for drinking water. The east rim was explored the forenoon of Nov. 2 as far as the Wilkes Camp. The northwest and southwest walls of the crater were dusty showing some fresh scars. There was little blue fume at the central region, and possibly slightly more at the 1914 cone than in July. The Resthouse thermometer recorded 28 degrees F. at 6:10 a. m. Nov. 3. Later events proved that the dense fume and puffing vapor near 1914 cone heralded coming eruption of December 2.

T.A.J.

Earthquakes

TABLE

Number of minutes of tremor; 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.
November 5	18	2	00	5.50
November 12	35	5	00	11.25
November 19	30	0	00	7.50
November 26	56	3	1	15.50

This is the only month of the year 1933 to date registering at the Observatory no felt earthquakes of the inntensities "feeble," "slight" or "moderate" for the Kilauea locality.

During the four weeks local shocks that were well recorded on more than one instrument (for location of origin) were rare.

An earthquake reported by Lincoln and Hale in Hookena district, South Kona, was felt at 7:44 p. m. November 10. It was very feeble on the seismograms, and from them appeared to be on the southwest rift of Mauna Loa in Latitude 19 degrees, 16 minutes North; Longitude 155 degrees, 43 minutes West.

A shock reported by Buzzard and registered on his seismogram at Waikii on the west slope of Mauna Kea 9:49 a. m. November 13, appeared to originate deep under that district.

A seismic movement recorded at the Kilauea observatory as a tremor, at 0:52 a. m. November 25, was reported by Archdeacon Walker as felt sharply in Kohala. The distance from the Observatory record would place it in North Kohala.

A very feeble shock registered at 5:15 p. m. November 25 was located under a point northeast of Wood Valley on the east slope of Mauna Loa, about five miles deep. Latitude 19° 22′ North, Longitude 155° 26′ West.

A very feeble shock registered 9:10 a. m. November 26, was located as near the surface of Mauna Loa about five miles north of the 1868 lava source on the southwest rift, Lat. 19° 12′ North, Longitude 155° 41′ West.

Microseisms of the month were light or subnormal October 31 and November, 16 and 21: they were strong or abnormal November 3, 25, 26. The remainder of the month they were normal.

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 November 26, 1932 is 2.2″ West and 2.9″ South, or 3.6″ SW by S.

TABLE OF TILT

Date	Observatory	Halemaumau
Oct. 30 - Nov. 5	0.9″ S by E	4.5″ from
Nov. 6 - Nov. 12	1.3″ S by W	2.5″ from
Nov. 13 - Nov. 19	0.6″ E by S	9.0″ towards
Nov. 20 - Nov. 26	1.9″ NE by E	7.0″ towards

E.G.W. and A.E.J.

The Volcano Letter

No. 406—Monthly U. S. Geological Survey. Hawaii National Park DECEMBER, 1933

KILAUEA REPORT FOR DECEMBER 1933

Including weekly press reports 1141 to 1145, November 26 to December 31, midnight.

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

Volcanology:—Kilauea

As Mauna Loa broke out with lava eruption at the summit crater the early morning of December 2, Halemaumau pit in Kilauea crater was watched with special intentness throughout the month. Its bottom being sealed, with the lava plug of December—January 1931-32, this pit showed no sympathy with the Mauna Loa outbreak nor with the Mauna Loa cessation December 18.

In Halemaumau fresh debris lay on NE talus Nov. 27. The color of blue sulphur fume can be seen in sun-shadows. Two large newly fallen rocks were seen at the bottom under E wall December 16.

Weekly rim-crack measurements around the Halemaumau border were as follows:—

Dec. 2, 1933. Out of 32 points measured, 9 opened, 5 closed, aggregate opening 2.5 mm.
Dec. 9, 1933. Seven points opened, 5 closed, aggregate opening 1.5 m.
Dec. 16, 1933. Two points opened, 4 closed, aggregate a closing 1 mm.
Dec. 23, 1933. Eight points opened, 2 closed, aggregate opening 3.5 mm.
Dec. 30, 1933. Seven points opened, 8 closed aggregate opening ½ mm.

During the week ended December 17 levellings repeated on the old line on Kilauea floor near Halemaumau, and the horizontal angle from Observatory, measured twice across the pit, by Jones, revealed no unusual movement of the crater floor.

The minute motion of the ground measured instrumentally around Halemaumau and at the Observatory, by weeks, as shown in Earthquake and Tilt reports herewith, was as follows:—

		Obsy. Tr.	Seis.	Obsy. tilt	Hal. tilt
Week ending Nov. 26		56	15.50	1.9″ ENE	7.0″ inward
Week ending Dec. 3	(Mauna Loa eruption)	1393	360.00	1.5″ NW	15.8″ outward
Week ending Dec. 10	(Mauna Loa eruption)	345	86.00	0.3″ WSW	5.9″ inward
Week ending Dec. 17	(Mauna Loa eruption)	580	170.00	0.7″ SSW	0.0 zero
Week ending Dec. 24		20	6.50	1.1″ WNW	7.9″ inward
Week ending Dec. 31		34	12.50	1.2″ NNE	19.2″ inward

The number of minutes of tremor and accompanying local seismicity rose and fell with the Mauna Loa eruption 22 miles away. The Observatory tilt was strong and northerly or easterly (away from Kilauea crater), before and after the eruption, weaker and westerly during the eruption. The total tilt of the three clinoscope cellars around Halemaumau pit, outward away from the pit, or inward towards the pit, measured on the radial lines from the center of the pit, and disregarding other directions of tilting, yielded very interesting results. The aggregate tilting at the pit had been notably inward for many months. The week of the outbreak it was strongly outward as though the Kilauea floor swelled upward; after the outbreak it was more strongly inward, as though the sinking of the Kilauea floor followed the sinking back of the lava under Mauna Loa. This sequence is just what happened at Kilauea when the live lava in Halemaumau was visible during the Mauna Loa eruptions of 1914, 1916 and 1919.

Volcanology:—Mauna Loa

The summit crater Mokuaweoweo was split along the upper end of the southwest rift and vomited up lava at 5:43 a. m. December 2, 1933. The rift opened along a belt 1.5 miles long in the southwest part of the crater, the gash trending S. 27 W. from the inner basin across the south lunate platform, up the cliff to the outside country next the lava of 1851, on to the south for a half-mile about 500 feet west of the lip of the South Pit No. 1, then for a half-mile more offset 500 feet to the east, emerging from the west corner of this pit and continuing across the upland southwest to pour cascades of lava into both Pit No. 1 and the 2nd. Pit. (Lua Hohonu). The main activity of the eruption was inside the main Mokuaweoweo basin about 500 feet east of the cone of 1914.

The time of outbreak estimated is that shown by the beginning of continuous volcanic tremor at Kilauea seismographs. At 7 a. m. December 2 there were two dense white columns of vapor as seen from Kilauea Observatory about 2 miles apart, the northern one the denser and by angular measure inside Mokuaweoweo. At 9 a. m. there were 3 principal fume jets, the northern the greatest and highest, the two southern ones each double. At 7:30 p. m. the glowing columns were in number, the northern triple and most brilliant, the middle one bright, the southern one faint. The division in three corresponded to the southern-pits gash, the south lunate gash, and the inner basin gash. The southern pits went out of action the first day. After the first two hours the fume column became blue and sulphurous (absinthe red in transmitted light). Pele's hair fell in small amounts at Hookena to leeward. At 11 a. m. December 2 there were lines of moderate fountains, 200 or more feet high, along each gash at its widest part, namely; the upland SW of South Pit No. 1: the lunate at the foot of the cliff NW of this pit, just inside Mokuaweoweo; and the inner basin east of 1924 cone. There were about 35 fountains in the basin and 20 each at the two other localities. The basin fountains concentrated to a smaller number about built-up cones. These basin vents poured lava both east and west. The eastern flows became the great feature, filling the northeastern and lowest part of Mokuaweoweo basin. The western ones obliterated the pit of 1914 which had been adjacent to the cone, and filled against the western cliff of the south lunate platform. The South Pit filled about 70 feet at the base of the new cascade which poured into it from the lunate platform. The main flow area covered about a square mile the second day, and the southern pits had received a square quarter-mile additional. The southernmost rift made big upland fountains the first day, the lava cascading strongly into the south side of South Pit No. 1, and weakly into Lua Hohonu. There was liquid flooding of silvery sheets of lava the first day, but the second day there were crusted floor flows, and flocculent skins on the scarlet torrents from the main line of about 17 conelets. On this day Dec. 3 the big fountain within a horse-shoe cone at the southwest cliff sent a festooned stream in a channel down to the South Pit over the ancient black lava cascade so well known here, and also over fresh streams of the previous day. This fountain was literally in the wall-crack of Mokuaweoweo, on the west side of the South Gap.

December 3 the main fountaining was at two cone centers in Mokuaweoweo basin, and at the southwest wall; the outside southwest cracks were steaming only. The flow lava was pahoehoe of which coin specimens were made. The cones were heaped with basaltic pumice, and Pele's hair lay to leeward. Milky blue fume cirrus lay in belts across the sky, sometimes southeast, sometimes north of Mauna Loa during the next few days. There was glow over the crater at night and fume by day. December 4 the southwest wall fountain stopped. December 5 the two central fountain groups were within throne-like cone heapings 100 to 200 feet high. The steam

at the pit gashes to the southwest of Mokuaweoweo had ceased. The flows within Mokuaweoweo continued to spread north and east, against the east wall, and as far as the north lunate, and one flow had pushed west between the 1903 and 1914 cones. The eastern part of the cliff beneath the north side of the south lunate had been further obliterated by filling. A fan-like rush lava poured east from the throne-cones. This was the scene observed from air-planes day after day, the fountains of the northern cone dwindling to two small ones December 12. December 13 there was only one fountain, with occasional jets from other vents. With change of wind some Pele's hair fell along the northwest trail. The fume and glow as seen from Kilauea continued until December 17, becoming faint. Midnight December 17-18 the fountain was in action. It died down at 2 a. m. December 18, revived slightly after daylight, and thereafter went out of action. The area remained very hot and fuming with jarrings and rumbles.

The first echelon ruptures were at the top of the southwest rift of Mauna Loa, extending the action of that rift as observed in 1926, farther west and farther up, until this year's action centered in the crater itself. The eruption lasted 16 days, with no flank outbreak. Inquiry around the south end of the island December 6 revealed that the early morning earthquakes of the outbreak on December 2, felt in Hilo and Kona, were not felt at the south. The seismographic measurements show that most of the earthquakes originated to the north and east of Mauna Loa during the eruption, becoming deeper and mostly toward Kilauea at the end of the period.

If the splitting of the mountain crosses the crater and opens a flank rupture about 1936 or before, emitting lava flow, it may be along the Hilo rift, or the northwestern 1859 rift, or along the Hualalai rift. It happens that the earthquakes of December 2 this year 1933 were not felt at Puu Waawaa, where the 1929 quakes were strongest.

Toward the end of December, after summit snows about Christmas, there were hot convection puffs of rain cloud over the new lavas of the summit crater. These rose very rapidly and might easily have been mistaken for new eruption. The flows on the Mokuaweoweo floor were about ten feet high near their borders, with some breaking up of the pahoehoe surfaces, where they were pulled after congealing.

T.A.J.

Earthquakes

TABLE

Number of minutes of tremor; numbers of very feeble; feeble (I, R. F.); & slight (II, R. F.) earthquakes & local seismicity index as described in Volcano Letter 371.

Week ending	tr.	v. f.	f.	sl.	seis.
December 3	1,393	11	3	3	360.00
December 10	345	0	0	0	86.00
December 17	580	4	0	0	170.00
December 24	20	1	1	0	6.50
December 31	34	8	0	0	12.50

The approximate origins of the earthquakes that were well recorded at more than one seismograph station, follows—

Earthquakes Preceding Mauna Loa Eruption.

November 28, a very feeble shock, located under Kilauea crater.

November 30, a very feeble shock, located a mile SW of Kilauea crater.

December 1, a very feeble shock, located on the NE rift, near Mokuaweoweo, the summit crater of Mauna Loa.

Earthquakes correlated with the Mauna Loa outbreak, on December 2.

5:55 a. m. a slight shock, about II on the Rossi-Forel scale of intensity, felt with alarm at the rest house on Mauna Loa, located at the NE end of Mokuaweoweo crater, nine miles deep. The remainder of the group appear to be less deep.

5:56 a. m. a feeble shock, about I on the Rossi-Forel scale, located about seven statute miles NW of Mokuaweoweo crater.

5:58 a. m. a feeble shock, located about one mile NE of the N end of Mokuaweoweo crater.

6:01 a. m. a slight shock, felt with alarm at the rest house, located near west rim of Mokuaweoweo crater.

6:06 a. m. a slight shock, felt with alarm at the rest house, & felt lightly in Hilo by M. E. Campbell, located three miles NE of the N end of Mokuaweoweo crater.

6:08 a. m. a feeble shock, located near the west rim of Mokuaweoweo crater.

Immediately after the first unlocated shock at 5:42 a. m. Dec. 2 harmonic or continuous volcanic tremor began. In the past, eruptions have been accompanied by this type of ground movement. The period of 0.6 seconds (100 vibrations per minute) is fairly constant, while the amplitude is variable with the size of the eruption. The spells of tremor were noted approximately as follows;

date		time	duration minutes
Dec. 2	Beginning	5:43 a. m.	244
" 2	"	9:46 a. m.	590
" 2	"	6:40 p. m.	320
" 3	"	9:00 a. m.	209
" 8	"	8:30 p. m.	80
" 10	"	8 p. m.	240
" 11	"	0 a. m.	300
" 11	"	8 p. m.	100
" 12	"	0 a. m.	150
" 12	"	7 p. m.	90

The amplitude of the waves varied from 0.8 to 0.4 microns, smaller amplitudes become unnoticeable on the records. (1 micron=0.001 m. m.)

Earthquakes During the Eruption.

Dec. 2, 7:28 p. m. a very feeble shock, located under the slope of Mauna Loa about half way between the craters of Kilauea and Mokuaweoweo.

Dec. 3, a very feeble unlocated shock was felt by M. E. Campbell in Hilo. It appeared to be about five miles from the Hilo station.

Dec. 7, a tremor, reported felt in Naalehu by the Hutchinson Sugar Plantation, was located on the Mauna Loa SW rift near the source of the 1887 flow, seven miles up the mountain from the highway.

Dec. 12, a very feeble shock, located three miles west of Kilauea crater, four miles deep under Pali O Kaoiki, a fault between Mauna Loa and Kilauea.

Dec. 14, a very feeble shock, felt in the vicinity of Kilauea crater, located near the Mauna Loa rest house and 17 miles deep.

Earthquakes Following the Eruption.

Dec. 20, a very feeble shock, located half way up the east slope of Mauna Kea from Hakalau.

Dec. 20, a tremor; Dec. 27, 3:44 a. m. a very feeble shock felt lightly at Honomu: 3:56 a. m. a very feeble shock, felt sharply at Honomu, and 4:44 a. m. a very feeble shock felt lightly at Honomu. These four were located in a group under the SE slope of Mauna Kea, half way between Hilo & the summit.

Dec. 27, a very feeble shock, felt near Kilauea, located on the Mauna Loa NE rift half way between Hilo and the summit.

Dec. 30, a very feeble shock felt in Hilo by M. E. Campbell, located six miles SE of Mokuaweoweo and ten miles deep.

Dec. 31, a very feeble shock, located five miles at sea, south of Kilauea crater.

Microseisms. Light or subnormal; Dec. 1, 3, 18, 19, 31.
Moderate or normal; Nov. 27 to 30; Dec. 2, 4, to 13, 17, 20, 21, 27 to 30.
Strong or abnormal; Dec. 13 to 16; 22 to 26.

A.E.J.

Tilting of the ground

The Observatory column shows the net tilt in seconds of arc in the direction given, computed from seismograms. The second column shows the algebraic sum of clinoscope readings for the three cellars around Halemaumau. Each reading is reduced to its radial direction from or towards the pit. As the Observatory is on the northeast rim of the larger Kilauea crater, a southwest reading is towards the crater.

The total accumulated tilt at the Observatory in the year since December 31, 1932 is 1.1" North, and 2.9" West.

TABLE OF TILT

Date	Observatory	Halemaumau
Nov. 27 - Dec. 3	1.5" NW	15.8" from
Dec. 4 - Dec. 10	0.3" W. by S.	5.9" towards
Dec. 11 - Dec. 17	0.7" SSW	0.0
Dec. 18 - Dec. 24	1.1" WNW	7.9" towards
Dec. 25 - Dec. 31	1.2" NE by N	19.2" from

A.E.J.