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 Hawaiʻi (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. 499 | **U. S. Geological Survey** | **January—March, 1948**

PUBLISHED BY THE UNIVERSITY OF HAWAII

U. S. GEOLOGICAL SURVEY: R. H. Finch, Volcanologist

UNIVERSITY OF HAWAII: T. A. Jaggar, Geophysicist

THE ACTIVE PERIODS OF MAUNA LOA

By R. H. FINCH

Volcanologist, U. S. Geological Survey

This note is intended as a companion one to the discussion of the inactive periods of Kilauea in VOLCANO LETTER No. 497. A similar study of the activity of Mauna Loa, owing to the small percentage of the time it has been active in its recorded history, is simplified if the active periods are used.

Dr. T. A. Jaggar[1,2] and Stearns and Macdonald[3] have made rather comprehensive statistical studies of Mauna Loa outbreaks. There can be but minor differences in the estimates of the small percentage of the time that Mauna Loa has been active. Differences have arisen as to whether some eruptions are to be classed as summit or flank. For example, Jaggar and the writer class the 1832 outbreak as a summit eruption while Stearns and Macdonald class it as a flank eruption. The 1851 outbreak is classed as a flank eruption by Jaggar, though by most definitions it is best classed as summit activity.

A summit eruption is one that takes place in or near the caldera and does not produce a lava flow originating in a rift outside the caldera area. A flank eruption is one that occurs on a rift outside the caldera. The records indicate that all flank eruptions start with short-lived activity at or near the summit. The duration of this preliminary activity varies from a few hours to 2 or 3 days. Such activity at the summit indicates that the ascent of lava from the depths is confined to the feeding conduits under Mokuaweoweo, the caldera of Mauna Loa. The longest dimension of the general breakdown that constitutes the caldera is more than 5 miles northeast-southwest and is roughly parallel to the southwest portion of the main rift of Mauna Loa. The southwestern limits of the caldera are not well defined, as the area has been covered by numerous lava flows some of which continued down the mountain for several miles. It is not surprising, then, that an outbreak may be placed in the caldera by one observer and on the southwest rift by another.

[1] JAGGAR, T. A. HISTORY OF MAUNA LOA. Paradise of the Pacific, Vol. 46, No. 2, Honolulu, 1934.

[2] JAGGAR, T. A. THE COMING LAVA FLOW. Volcano Letter No. 440. Oct., 1936.

[3] STEARNS, H. T., and MACDONALD, G. A. GEOLOGY AND GROUND-WATER RESOURCES OF THE ISLAND OF HAWAII. Hawaii Div. of Hydrography Bul. 9. 1946. Pp. 86-92.

A list of the known eruptions of Mauna Loa and the probable duration of each is shown in Table 1.

The first eruption of Mauna Loa for which there is a definite date started on June 20, 1832. The table shows that during the 115 years and 9 months from this date to the present (March 31, 1948), Mauna Loa has been active 2,718 days, or 6.4 per cent of the time. It is interesting to note that the average duration of the 33 eruptions, starting with that of 1832, is 82 days. This large number is due mainly to four long-continuing eruptions, viz.: 1855-56, 480 days; 1859, 300 days; 1873-74, 560 days; and 1880-81, 275 days.

The first reported eruption of Mauna Loa, which is based on tradition, occurred about 1780. The exact date is not known but reports from different sources place the date definitely about 1780. The Turnbull report of activity in 1803 is quite definite and was probably a summit eruption[4]. The next reported eruption was in 1832. There may have been two or more eruptions between 1780 and 1832 instead of the one that was reported. A review of the records of the 1832 eruption rather definitely makes it a summit one, though there may have been one or more short lava flows from the caldera area. Stearns thought that a recent but un-

[4] HITCHCOCK, CHARLES H. HAWAII AND ITS VOLCANOES. Hawaiian Gazette Co., Ltd., Honolulu, 1911. P. 80.

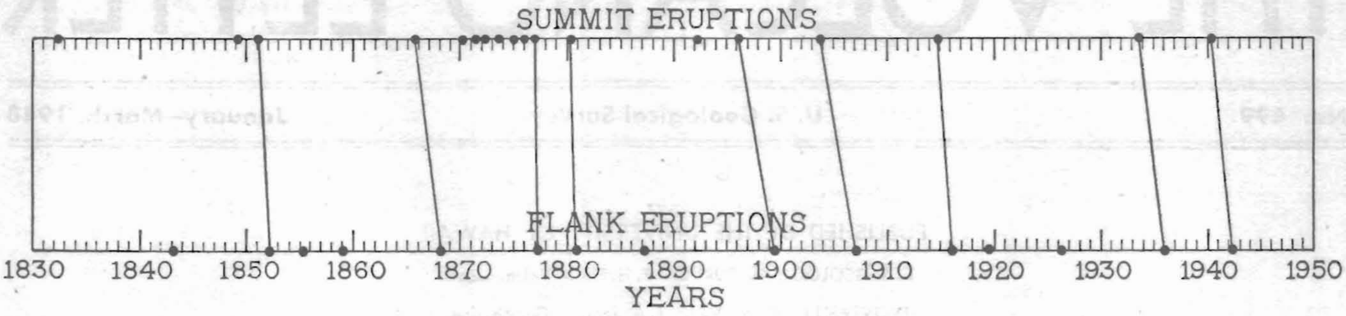

Figure 1.—Summit and flank eruptions of Mauna Loa plotted according to dates. The diagonal lines connect summit eruptions that were followed by flank eruptions without any intervening eruption.

dated lava flow from an elevation of about 8,000 feet on the southwest rift above Waiohinu occurred in 1832[5]. Aside from the freshness of the flow there is little to justify such a belief. An old map of the Hawaiian government survey shows a short flow from the east rim of Mokuaweoweo dated 1832. There is no such recent flow at the place indicated on the map. A mile or so to the north and to the southwest there are flows fresh enough to have occurred in 1832. The Goodrich[6] account of the 1832 outbreak states that it lasted from 2 or 3 weeks and that lava flowed from several vents about the summit. The records of later eruptions show that when a flank eruption starts, activity at the summit ceases. The belief that activity in 1832 was confined to the summit seems justified.

[5] STEARNS, H. T., and W. O. CLARK. GEOLOGY AND WATER RESOURCES OF THE KAU DISTRICT, HAWAII. U. S. Geological Survey, Water-Supply Paper 616, 1930. P. 71.

[6] GOODRICH, JOSEPH. VOLCANOES AND VOLCANIC PHENOMENA OF HAWAII. Amer. Jour. Sci. 1st Ser., Vol. 25, 1833. P. 199.

TABLE 1. YEAR, LOCATION, AND DURATION OF THE ACTIVE PERIODS OF MAUNA LOA.

PLACE AND YEAR OF ERUPTION		DURATION DAYS
SUMMIT	FLANK	
1780		?
1803		?
1832		21
	1843	120
1849		21
1851		12
	1852	20
	1855–56	480
	1859	300
1865		120
	1868	16
1870		14
1871		30
1872		145
1873–74		560
1875		60
1876		7
	1877	11
1880		6
	1880–81	275
	1887	15
1887–88		40
1892		3
1896		15
	1899	26
1903		61
	1907	15
1914–15		45
	1916	14
	1919	42
	1926	19
1933		17
	1935	42
1940		132
	1942	14

In studying the record books of the Volcano House, the hotel on the northeast rim of Kilauea, two different accounts of a summit eruption in 1871 were found. This eruption is not given in the list compiled by Hitchcock and subsequent writers. The first entry in the record book under the date of August 9, 1871, reads, "A great fire to be seen in the Mono Loa Crater." On August 28, the second entry reads, "Faint light at night from the outbreak on Mauna Loa." A search was then made to see if Macdonald[7] had found any reference to this outbreak. The Macdonald bibliography shows that Titus Coan had reported the outbreak in the *American Journal of Science* in 1871. Coan reported that Mauna Loa had been active for weeks prior to August 22, 1871. The record book of the Volcano House indicates that the eruption lasted about a month as there was no activity in Mokuaweoweo early in September, 1871. It seems safe to give a value of 30 days for the duration of activity in 1871.

In accordance with the definition of activity given in the discussion of the inactive periods of Kilauea in VOLCANO LETTER No. 497, the summit eruption of 1887-88 has been included in the table though no molten lava was observed. The intermittent fuming and steaming spell of November, 1943 (VOLCANO LETTER No. 482) has not been included in the list because of the very short duration, the small volume of fume involved, and the fact that it was intermittent.

There is the possibility that occasionally a short-lived summit eruption has escaped notice owing to the remoteness of the summit of Mauna Loa and the fact that it is often obscured by clouds. In 1873, Green[8] noted no glow over the summit of Mauna Loa during three clear nights prior to his ascent of the mountain on June 6, but when the crater rim was reached, a light smoke could be seen drifting away and great fountains were playing. There was insufficient fume to reveal the activity at a distance either by day or night. A characteristic tremor that is recorded on the seismographs

[7] MACDONALD, G. A. BIBLIOGRAPHY OF THE GEOLOGY AND WATER RESOURCES OF THE ISLAND OF HAWAII. Hawaii Div. of Hydrography, Bul. 10. Honolulu, 1947.

[8] GREEN, W. L. VESTIGES OF THE MOLTEN GLOBE. Honolulu, 1887. P. 167.

during Mauna Loa eruptions indicates that an outbreak can now be detected whether the mountain is visible or not.

It has often been stated that a summit eruption is usually followed by a flank eruption in about two years. Computations made from the preceding graph (Fig. 1) indicate that this relationship holds for only about 56 per cent of the time. The 1832-43 relationship has not been used in these computations as the interval between the two outbreaks was 10½ years. Activity may have been more continuous in 1870-77 than indicated in Figure 1, where seven different summit eruptions are plotted. The 56 per cent was derived by calling this group four instead of seven. The last eight summit eruptions have been followed by flank eruptions 75 per cent of the time with an average interval of 18 months. A summit eruption is thus a factor that may be considered in forecasting flank eruptions.

Hawaiian Volcano Observatory Report for January—March, 1948

VOLCANOLOGY

January

The Mauna Loa seismograph recorded 29 earthquakes during January and 26 were recorded at the Kilauea seismograph. Of the five perceptible shakes felt during the month four originated under Mauna Loa and one under Kilauea.

Landslides from the walls of Halemaumau were especially frequent from January 15 to 18, inclusive.

February

Eight more earthquakes were recorded at Mauna Loa than at Kilauea, or 28 and 20, respectively. Three perceptible shakes originated under the southwest slope of Mauna Loa and one under Kilauea Crater.

The seasonal change in direction of tilt from northeast to southwest occurred about the middle of December. There was a normal accumulation of southerly tilt during February while westerly tilt was distinctly less than normal.

March

Forty earthquakes were recorded during the month. Thirteen more shakes were recorded at Mauna Loa than at Kilauea. The strongest earthquake of the month occurred at 16:18 March 19. It originated deep under Kilauea and was generally felt over the eastern part of the island of Hawaii.

There was a slight accumulation of easterly tilt since the middle of February. As westerly tilt is usual for this season of the year, the easterly tilt gives some indication of a pressure increase under Mauna Loa. The rapid southerly tilt that started at the beginning of the year continued throughout the month.

R. H. F.

SEISMOLOGY

Earthquake Data, January—March, 1948

Week Ended		Minutes of Tremor	Very Feeble	Feeble	Slight	Moderate	Local Seismicity*	Teleseisms
January	4	2	1	1	0	0	1.00	0
	11	7	1	0	1	0	4.25	0
	18	6	0	1	1	0	4.50	1
	25	1	1	0	0	0	0.75	1
February	1	1	2	1	1	0	4.25	1
	8	1	8	0	1	0	6.25	0
	15	1	1	1	0	0	2.25	0
	22	2	0	1	1	0	3.50	0
	29	1	2	0	0	0	1.25	1
March	7	1	3	0	0	0	1.75	0
	14	3	0	1	1	0	3.75	0
	21	3	2	0	0	1	4.75	0
	28	0	2	1	0	0	2.00	0

* For definition of local seismicity, see VOLCANO LETTER No. 371.

The data of the following local disturbances were determined from seismograph stations operated on the island of Hawaii by the Hawaiian Volcano Observatory of the U. S. Geological Survey. Time is Hawaiian Standard, 10 hours slower than Greenwich. The number preceding each earthquake is the serial number for the current year.

1. January 3, 06:04, feeble. Felt locally. Under Mokuaweoweo.
2. January 8, 16:15, slight. Felt locally. East slope Mauna Loa.
3. January 10, 17:11, slight. Felt locally. East slope Mauna Loa.
4. January 11, 1:50, very feeble.
5. January 15, 6:16, slight. Felt locally and at Hilo. NE slope Mauna Loa.
6. January 17, 9:50, feeble. Near Hilina Pali.
7. January 18, 12:10, very feeble.
8. January 23, 15:04, very feeble.
9. January 26, 23:02, slight. Felt from Naalehu to Hilo. NE rift Mauna Loa.
10. January 29, 8:55, very feeble.
11. January 31, 10:32, very feeble.
12. February 1, 11:58, feeble. Felt at Naalehu. SW slope Mauna Loa.
13. February 2, 1:12, very feeble.
14. February 2, 22:31, very feeble.
15. February 6, 13:44, very feeble.
16. February 6, 16:17, very feeble.
17. February 7, 8:59, very feeble.
18. February 7, 18:04, very feeble. SW slope Mauna Loa.
19. February 8, 3:56, slight. Kilauea.
20. February 8, 4:18, very feeble. Kilauea.
21. February 8, 7:07, very feeble. Kilauea.
22. February 10, 10:40, very feeble. Mauna Loa.
23. February 12, 4:14, slight. SW slope Mauna Loa.
24. February 20, 9:30, slight. Felt locally. Kilauea.
25. February 20, 9:37, feeble. Kilauea.
26. February 26, 0:52, very feeble. Mauna Loa.
27. February 27, 21:20, very feeble.
28. March 2, 10:05, very feeble. Mauna Loa.
29. March 2, 17:07, very feeble.
30. March 5, 2:43, very feeble. Mauna Loa.
31. March 9, 8:30, very feeble. Mauna Loa.
32. March 9, 15:46, slight. Felt from Hilo to Kona. Off coast north of Hualalai.
33. March 16, 3:43, very feeble.
34. March 19, 16:18, moderate. E-W dismantled. Felt from Hilo to Naalehu. Deep under Kilauea.
35. March 19, 23:09, very feeble. Felt at Naalehu.
36. March 26, 6:08, feeble. Mauna Loa.
37. March 27, 1:03, very feeble.
38. March 27, 11:44, very feeble.
39. March 30, 0:53, very feeble.
40. March 31, 8:41, very feeble. Mauna Loa.
41. March 31, 16:44, very feeble.

TELESEISMS

January 13, 16:55, slight. 1200 km. north of Easter Island.
January 24, 8:20, slight. Philippines.
January 27, 2:06, slight.
February 29, 15:30, slight. New Guinea.

MICROSEISMS

Microseisms were moderate to strong January 23–31 and February 8–10 and moderate March 26–31. They were present though slight on other days.

CRACK MEASUREMENTS

Despite many slides from the walls of Halemaumau during the middle of January all cracks that were measured showed but little or no movement during the quarter.

TILTING OF THE GROUND

The southerly tilt that was continuous throughout the quarter was slightly greater than usual. There was about the usual accumulation of westerly tilt until February 20. From this date until March 31 there was an accumulation of one second of arc of easterly tilt. As there is normally a westerly tilt during this season of the year one second of easterly tilt may actually be greater than the figure indicates. Past records suggest that an easterly tilt is an indication of increase of pressure under Mauna Loa.

R. H. F.

Table of Tilt at Observatory on Northeast Rim of Kilauea

Week Ended		Amount	Direction
January	4	1.4″	S 49° W
	11	1.2″	S 36° W
	18	1.0″	S 35° W
	25	0.9″	S 56° E
February	1	1.5″	S 75° W
	8	0.4″	S 18° W
	15	1.5″	S 29° W
	22	1.2″	S 35° E
	29	1.5″	S 18° E
March	7	0.9″	S 50° W
	14	0.1″	E
	21	2.1″	S 30° E
	28	1.0″	S 60° W

HAWAIIAN VOLCANO RESEARCH ASSOCIATION

In cooperation with the UNIVERSITY OF HAWAII

The **Hawaiian Volcano Research Association** was founded in 1911 for the recording and study of volcanoes in the Hawaiian Islands and around the Pacific Ocean. Its equipment at Kilauea Volcano, Hawaii Island, has been transferred to the United States Geological Survey.

The **University of Hawaii** cooperates in maintaining a research laboratory at Kilauea. The Association and the University supplement the work of the government with research associates, instrumental equipment, and special investigations. Dr. T. A. Jaggar is their geophysicist resident at Kilauea.

The **Volcano Letter,** a quarterly record of Hawaiian volcano observations, is published by the University of Hawaii and supplied to members of the Research Association and to exchange lists of the above establishments.

THE VOLCANO LETTER

No. 500 | **U. S. Geological Survey** | **April-June, 1948**

PUBLISHED BY THE UNIVERSITY OF HAWAII

U. S. GEOLOGICAL SURVEY: R. H. Finch, Volcanologist

UNIVERSITY OF HAWAII: T. A. Jaggar, Geophysicist

THE TELESEISM ANNUNCIATOR AT THE HAWAIIAN VOLCANO OBSERVATORY

By BURTON J. LOUCKS

Instrument Maker, U. S. Geological Survey

The Hawaiian Volcano Observatory has issued warnings of the possibility of a tsunami or tidal wave on several occasions. The warnings were based on the seismograms of distant earthquakes and were made only when the fact that a strong shake had occurred was discovered during routine attention to the seismographs. The disastrous tidal wave of April 1, 1946,[1, 2] brought forcibly to mind the need for immediate discovery of the recording of potential tsunami-producing earthquakes regardless of the time of occurrence.

The April 1, 1946, earthquake started recording on the Observatory seismographs at 2:06 A.M. but it was not noted until the record was changed at 7:30 A.M., over half an hour after the waves reached Hilo. If the record had been seen earlier, a warning of the possibility of a tidal wave would have been issued. Experience had taught that the amplitude and distance to origin were such as to indicate the possibility of a tidal wave.[3]

In cooperation with the Hilo Chamber of Commerce, an earthquake annunciator was set up in the seismograph vault of the Hawaiian Volcano Observatory on December 16, 1946. The installation is intended to be only a stopgap to function until the U. S. Coast and Geodetic Survey station at Barbers Point, Oahu, is in operation.

[1] POWERS, H. A. THE TIDAL WAVE OF APRIL 1, 1946. Volcano Letter 491, 1946.

[2] MACDONALD, G. A., SHEPHERD, F. P., and COX, D. C. THE TSUNAMI OF APRIL 1, 1946, IN THE HAWAIIAN ISLANDS. Pacific Science, 1 (1): 21–37, 1947.

[3] FINCH, R. H. ON THE PREDICTION OF TIDAL WAVES. Proc. 2nd Pacific Science Congress, Australia, 1923. P. 1368.

The instrument consists of a horizontal seismograph pendulum with a boom and magnifying lever (Fig. 1). Whenever a quake of appreciable amplitude occurs, the long arm of the lever makes alternate contact with two pools of mercury (Fig. 2) and closes an electrical circuit. In this circuit (Fig. 3) is a buzzer that is audible in the Observatory building and a relay that closes another circuit with buzzers located in the residences of two members of the Observatory staff. One component of the Hawaiian-type seismograph is used. The heavy mass is a 3-foot section of 8-inch steel pipe filled with sand. The pipe is bolted into a framework of steel 2 by ½ inches with about 3 inches projecting out at the back, both top and bottom. These projections are slotted and 1½-inch pieces of No. 20 music wire with retainers on the ends are inserted in the slots and corresponding ones in the adjustable back plate to suspend the heavy mass as a horizontal pendulum. An aluminum boom is secured to the pipe framework and projects forward about 4 feet from the hinge line. The forward end of the boom is coupled to the magnifying lever by a thin piece of brass with cups that fit over phonograph needles in the end of the boom and of the short arm of the lever. A piece of steel wire which projects downward about ½ inch from the end of the long arm of the magnifying lever makes contact with the mercury when the pendulum oscillates or becomes displaced by tilt. Two brass rods project up from the lever support on either side of the end of the boom to act as buffers in case of strong local shakes. The buffers are wired into the electrical circuit. If a strong local earthquake dis-

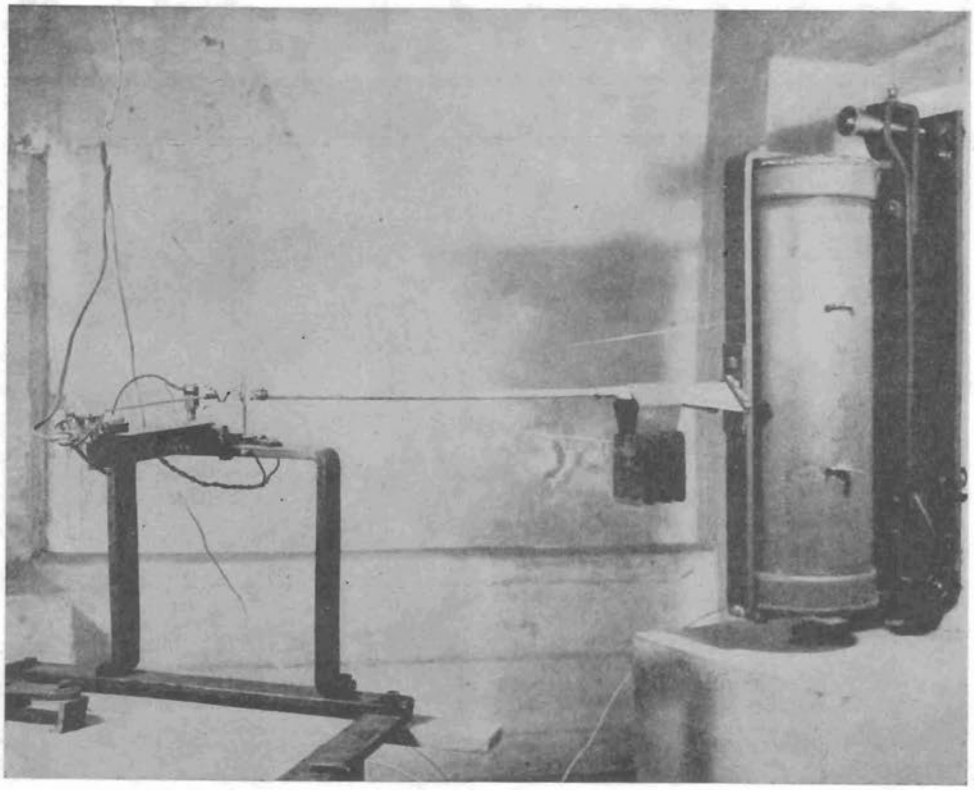

Figure 1. General view of the teleseism annunciator. The damping vanes on the boom near the heavy mass are not in use.

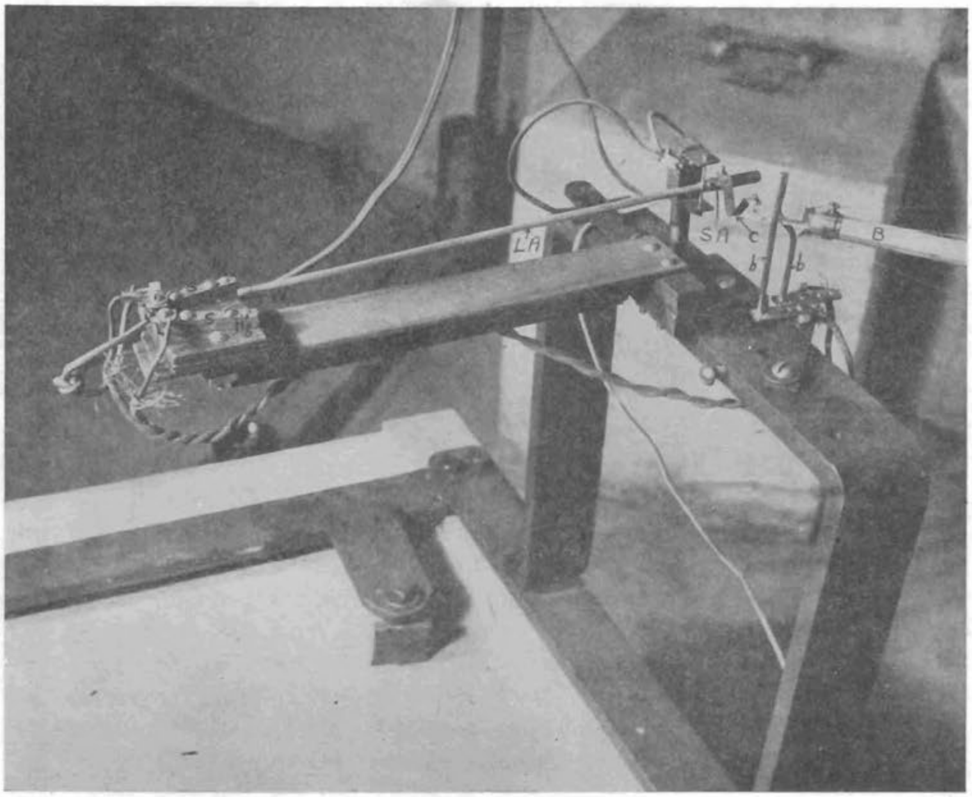

Figure 2. Details of magnifying lever and wiring. **B**, boom; **b**, **b**, buffers; **c** is the link that couples boom to magnifying lever; **SA** is short arm and **LA** long arm of magnifying lever; **W** is wire that contacts mercury pools; **Hg** is the mercury pool; and **s** is the steel bar that holds the mercury.

NATIONAL PARK SERVICE PHOTOGRAPHS BY DOUGLASS H. HUBBARD

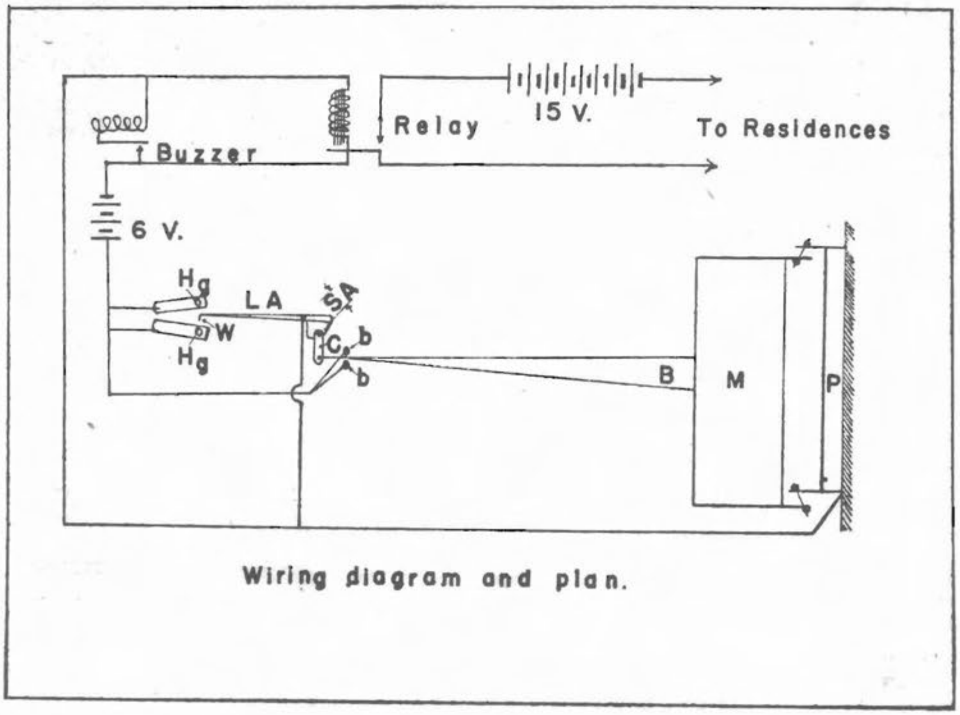

Figure 3. Wiring diagram and plan of the teleseism annunciator. Letters correspond to those in Figure 2.

mantles the instrument by throwing off the coupling mentioned above, it will still continue to function as an annunciator by means of the buffer contacts, though with diminished sensitivity.

The pools of mercury are in steel bars mounted on a piece of insulating material and are 1⅝ inches apart. When first set up they were only ¾ of an inch apart. Tilt due to daily temperature changes was so great that it was found necessary to increase the distance.

When the instrument was first installed, it was operated with a period of 12 seconds. To reduce the trouble due to tilt, the period was reduced to 7 seconds. The pendulum is undamped.

The instrument has been quite satisfactory and has announced several local earthquakes as well as a few teleseisms. It gave a good warning signal for the teleseism of May 14, 1948, which caused the tidal wave warning system in the Territory to be put into operation. This earthquake was the only one announced which was deemed to have sufficient amplitude and proper distance to justify a warning of the possibility of a tidal wave.

HAWAIIAN VOLCANO OBSERVATORY REPORT FOR APRIL-JUNE, 1948

VOLCANOLOGY

April

Forty-two earthquakes were recorded in April. Thirty-eight of the quakes were recorded on the Mauna Loa seismograph and 14 at Kilauea. The felt earthquakes which occurred at 00:25 April 26 originated near the north end of the Kilauea caldera. The facts that the shake was slight to moderate at the Observatory and was recorded as a tremor only on the Mauna Loa seismograph 10 miles away, indicate a very shallow focus.

The strong southerly tilt that set in about the first of the year continued until the last of April.

May

The earthquakes which occurred in May had widely scattered origins, as in the past several months. Twenty-eight quakes were recorded during the month, the majority of which originated under various portions of Mauna Loa. Twenty-five of the shakes were recorded on the Mauna Loa seismograph and 11 at Kilauea.

The accumulation of seasonal westerly tilt during the first 5 months of the year was the smallest for several years, and the records indicate that this may be taken as a suggestion of a slight pressure build up under Mauna Loa. The unusually sharp southerly tilt which began the first of the year ceased early in May.

A conspicuous steam cloud was observed over Mokuaweoweo at sunset on May 16 and on several other days during the month. Such observations are rather common at this season of the year.

June

Thirty local earthquakes were recorded in June. Of this number 28 were recorded on the Mauna Loa seismograph and 18 at Kilauea.

There was no accumulation of tilt during the month. The lack of westerly tilt rather than a positive easterly tilt is the only indication of a pressure build up under Mauna Loa.

R.H.F.

SEISMOLOGY

Earthquake Data, April-June 1948

Week Ended	Minutes of Tremor	Very Feeble	Feeble	Slight	Moderate	Local Seismicity*	Teleseisms
April 4	0	4	0	0	0	2.00	0
11	0	3	0	1	0	3.50	0
18	0	2	0	0	0	1.00	0
25	2	1	0	1	0	1.00	0
May 2	1	2	0	0	0	1.25	0
9	0	0	0	0	0	0	0
16	2	0	0	0	0	0.50	1
23	2	1	0	1	0	3.00	1
30	1	2	1	1	0	3.75	0
June 6	1	3	2	0	0	3.75	0
13	2	0	0	0	0	0.50	0
20	2	1	0	1	0	3.00	1
27	0	3	0	0	0	1.50	0

* For definition of local seismicity, see Volcano Letter No. 371.

The data of the following local disturbances were determined from seismograph stations operated on the island of Hawaii by the Hawaiian Volcano Observatory of the U. S. Geological Survey. Time is Hawaiian Standard, 10 hours slower than Greenwich. The number preceding each earthquake is the serial number for the current year.

42. April 5, 11:23, very feeble.
43. April 6, 0:25, slight. Felt locally. Shallow under northern end of Kilauea caldera.
44. April 6, 19:53, very feeble.
45. April 6, 22:12, very feeble.
46. April 14, 9:01, very feeble.
47. April 15, 3:37, very feeble. Kilauea.
48. April 24, 10:05, slight. Felt locally and at Hilo. East slope of Mauna Loa.
49. April 24, 23:59, feeble. Felt locally. Mauna Loa.
50. April 28, 20:53, very feeble.
51. April 30, 0:51, very feeble. Mauna Loa.
52. May 20, 20:04, very feeble. Under Mokuaweoweo.
53. May 22, 11:34, slight. Deep under Hualalai.
54. May 24, 23:16, slight. Felt locally. N.E. rift of Mauna Loa.
55. May 26, 0:39, feeble.
56. May 29, 16:29, very feeble. Under Mokuaweoweo.
57. May 29, 18:45, very feeble.
58. June 1, 7:34, feeble. Felt at Ainahou.
59. June 2, 21:13, very feeble.
60. June 3, 8:58, very feeble.
61. June 5, 12:08, very feeble.
62. June 6, 10:17, feeble. Kilauea.
63. June 18, 6:05, very feeble.
64. June 19, 17:06, slight, Felt locally, East slope of Mauna Loa.
65. June 24, 17:49, feeble.
66. June 25, 10:18, feeble. Kilauea.
67. June 25, 13:05, feeble. Felt locally. Mauna Loa.
68. June 26, 1:42, slight. Under Oahu; felt at Hilo.
69. June 28, 10:51, very feeble.

TELESEISMS

May 14, 12:40, moderate. Aleutians.
May 17, 7:57, slight. South of Alaska peninsula.
June 17, 3:04, slight.
June 29, 0:36, slight.

MICROSEISMS

Microseisms were moderate on April 9, 10, 24, and 25 and slight on other days.

CRACK MEASUREMENTS

A few of the cracks that were measured in the vicinity of Halemaumau rim showed slight openings.

TILTING OF THE GROUND

Seasonal southerly tilt, which was stronger than usual during the first 4 months of the year, continued until May 4, when a slight northerly tilt began. The seasonal change from westerly to easterly tilt occurred on June 9.

R.H.F.

Table of Tilt at Observatory on Northeast Rim of Kilauea

Week Ended	Amount	Direction
April 4	1.2″	S 11° E
11	2.4″	S
18	1.0″	N 82° W
25	1.2″	S
May 2	0.4″	S 19° W
9	0.8″	N 61° W
16	0.2″	N 45° E
23	0.8″	S 56° E
30	1.2″	N 11° W
June 6	0.2″	S 45° E
13	1.0″	S 55° W
20	0.4″	N 72° E
27	0.9″	N 9° W

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THE VOLCANO LETTER

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U. S. GEOLOGICAL SURVEY: R. H. Finch, Volcanologist

UNIVERSITY OF HAWAII: T. A. Jaggar, Geophysicist

THE NEW LOCATION OF THE HAWAIIAN VOLCANO OBSERVATORY

By RUY H. FINCH
Volcanologist, U. S. Geological Survey

One of the results of the transfer of the Hawaiian Volcano Observatory from the National Park Service to the U. S. Geological Survey is the establishing of the Observatory in a new location. It is being moved to the old National Park Museum and Lecture Hall buildings at Uwekahuna Bluff on the western rim of Kilauea Caldera (see figure). The buildings have been remodeled to include offices, shops, and laboratories.

The Observatory was located on the northeast rim of the Caldera from the time it was established in 1912 until 1941, when it was moved 600 feet back from the rim into the newly constructed Observatory and Naturalist Building. The vertical seismograph and a tilt meter were placed in a cellar under this building. The Bosch-Omori seismograph, the principal instrument of the Whitney Laboratory of Seismology, was left in its old location[1] under a concrete slab and 18 inches of soil.

Both the first and second locations of the Observatory were on badly fissured basalt with numerous steam cracks. Because the concrete floor was built over steam cracks, the temperature of the cellar at the original location is about 95° F. the year around. For similar reasons the cellar of the second location has a constant temperature of about 85° F. The mean annual air temperature of the area is about 61° F. A commercial highway passes about 200 feet from each cellar, and the records are marred by the frequent passing of heavy trucks.

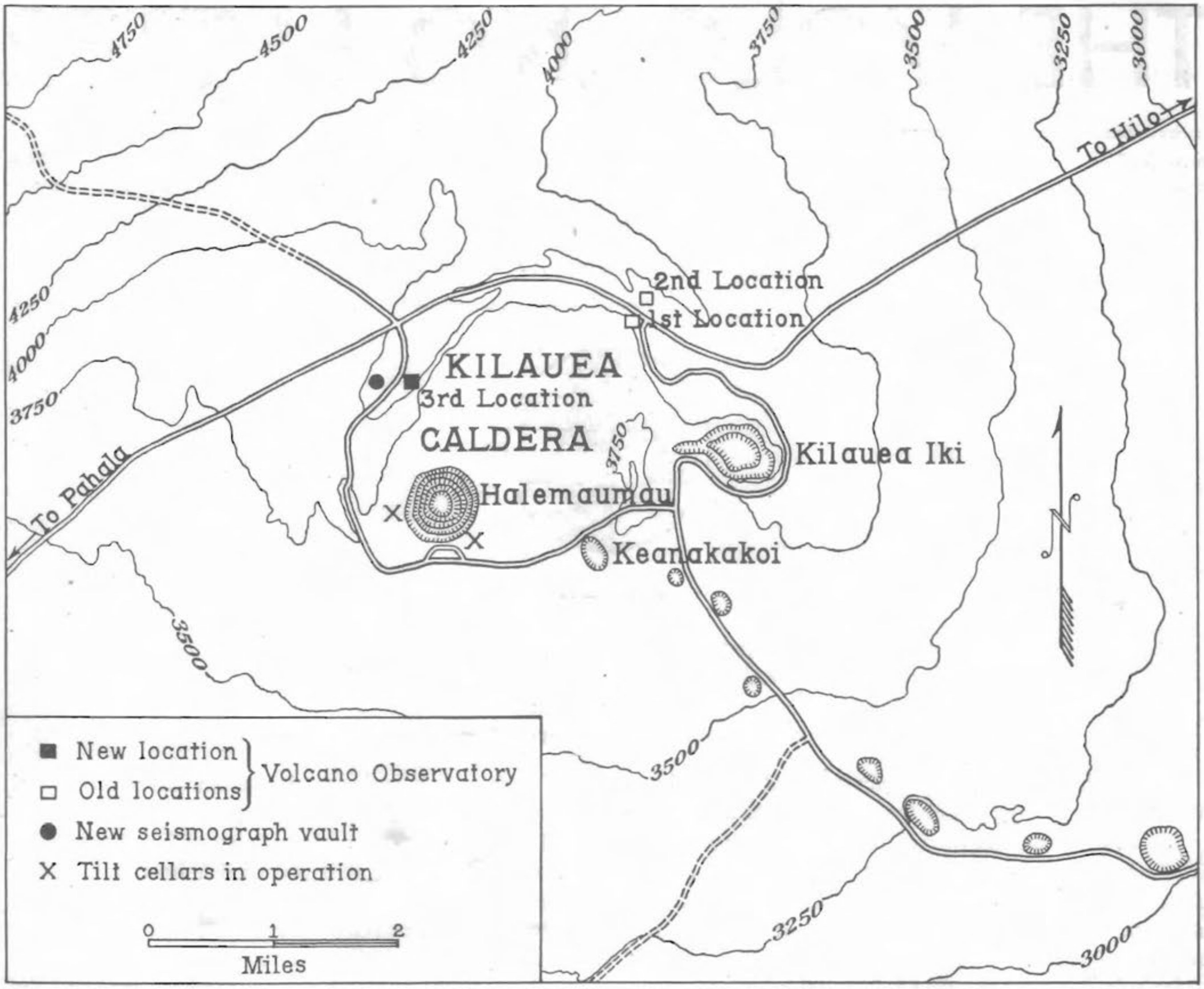
[1] Volcano Letter 475, 1942.

Tilt records have been taken from the Bosch-Omori seismograph since 1913. The instrument has been operated since 1919 with a period of about 7.7 and a magnification of about 115. It is proposed to operate this seismograph in its present location for another year before removal to the new cellar near Uwekahuna (see figure). This will afford an opportunity to correlate tilt records of the two locations, one on the northeast rim and the other on the northwest.

The Bosch-Omori seismograph tilt records do not correlate well with those obtained from a special tilt pendulum under the Observatory-Naturalist Building. When the numerous fissures of the area are considered, this is not surprising. Despite the nearly constant temperature of the second cellar, the tilt records obtained here were marred by the large tilt produced by diurnal temperature changes in the superstructure. The tilt data measured at the original location of the Observatory are real as they have been checked by leveling.[2]

The new location of the Observatory is at an elevation of 4,075 feet a short distance southerly from the highest point on Kilauea Mountain. It is 1 mile northwest from the center of Halemaumau just off the Crater Rim Road. The site affords a good view of Kilauea Caldera, the southwest rift, and part of the Puna rift as well as

[2] JAGGAR, T. A., and FINCH, R. H. TILT RECORDS FOR THIRTEEN YEARS AT THE HAWAIIAN VOLCANO OBSERVATORY. Bull. Seis. Soc. Amer. Vol. 19, No. 1, 1929. See also leveling data in T. A. Jaggar, Memoir 21, Geol. Soc. Amer., pp. 208–214, 1947.



Map showing the positions of the successive locations of the Hawaiian Volcano Observatory, the new seismograph vault, and the tilt cellars now in operation.

Mauna Loa. This was the first site selected by Dr. T. A. Jaggar for the Observatory in 1912 but was given up on account of the scarcity of water and its relative inaccessibility at that time.

A new seismograph cellar has been constructed 1,250 feet nearly due west of the Uwekahuna Bench Mark. The new cellar is 1⅛ miles from the center of Halemaumau, about 1 mile closer than the old cellar. It is 450 feet from the Crater Rim Road and about 2,000 feet from the around-the-island highway. The cellar is 12 x 20 feet with an entrance way 5 x 8 feet to serve as an air lock and processing room. The roof is a reinforced concrete slab covered with about 18 inches of volcanic ash. The foundation of the cellar is within massive basalt which lies under 20 inches of ash. There is only one visible fissure between the cellar and the Caldera rim. During the week ended September 16 a thermograph trace made in the cellar showed a drop of less than 1½° F. This record, which was obtained during a dry spell, showed a diurnal variation of about ½° F. The maximum was reached about 6:00 p.m.

The first instrument installed was a portable tilt meter oriented to measure east–west tilt. For the first 2 weeks values obtained seemed to be due largely to cellar floor and instrumental adjustments.

Two tilt meters and the vertical seismograph will shortly be installed in the new cellar. In about a year the Bosch-Omori seismograph will be moved over, and later on it is planned to install a higher-magnification instrument.

HAWAIIAN VOLCANO OBSERVATORY REPORT FOR JULY–SEPTEMBER, 1948

VOLCANOLOGY

July

Forty-one earthquakes were recorded during July. Thirty-seven of the shakes were recorded at Mauna Loa and 19 at Kilauea. Six of the seven earthquakes recorded on July 30 were perceptible. They originated at a depth of about 6 miles to the east of Kilauea Caldera. These quakes furnish the most conspicuous signs of uneasiness under Kilauea that have been noted during the last 3 years.

Seasonal northerly tilt during July was slightly greater than usual.

August

Only 27 earthquakes were recorded during August. Eleven of the shakes were recorded at Kilauea and 23 at Mauna Loa. The uneasiness at Kilauea which was quite distinct on July 30 did not continue. The only perceptible quake recorded during August (at 03:04, August 3) had a shallow origin under the northeast rift of Mauna Loa.

There was no accumulation of tilt in the east–west direction during the month. The north–south tilt curve shows an accumulation of northerly tilt greater than in 1946 or 1947. This may be taken as an indication of a slight pressure build up under Kilauea.

September

The majority of the 30 earthquakes recorded during September originated under Mauna Loa. Twenty-one of the shakes were recorded at Kilauea and 26 at Mauna Loa. The strongest of these shakes occurred at 8:20 a.m., September 13. It originated at a depth of 20–25 miles below the surface between Hilo and Mauna Kea.

The north–northeast tilt during the month of September was about normal for this season of the year.

SEISMOLOGY

Earthquake Data, July–September 1948

Week Ended	Minutes of Tremor	Very Feeble	Feeble	Slight	Moderate	Local Seismicity*	Teleseisms
July 4	4	2	0	1	0	4.00	0
11	0	0	0	0	0	0	0
18	2	2	0	0	0	1.00	3
25	0	1	1	0	0	1.50	2
August							
1	3	1	1	3	2	13.25	0
8	1	3	0	0	1	4.75	0
15	1	0	0	0	0	0.25	0
22	0	0	0	0	0	0	0
29	2	2	0	0	0	1.50	0
September							
5	1	3	1	0	0	2.75	0
12	3	0	1	0	0	1.75	2
19	0	2	0	1	1	6.00	0
26	4	0	1	0	0	2.00	0

* For definition of local seismicity, see Volcano Letter No. 371.

The data of the following local disturbances were determined from seismograph stations operated on the island of Hawaii by the Hawaiian Volcano Observatory of the U. S. Geological Survey. Time is Hawaiian Standard, 10 hours slower than Greenwich. The number preceding each earthquake is the serial number for the current year.

70. July 3, 18:14, very feeble, Mauna Loa.
71. July 12, 0:29, very feeble. Felt at Naalehu.
72. July 17, 6:11, very feeble. Felt at Naalehu.
73. July 19, 10:08, very feeble. Kilauea.
74. July 24, 13:19, feeble. Felt locally and at Hilo. Mauna Loa.
75. July 30, 2:28, moderate. Awakened some people. East of Kilauea Caldera.
76. July 30, 2:31, moderate. Same location as No. 75.
77. July 30, 2:44, slight. Same location as No. 75.
78. July 30, 12:28, feeble. Same location as No. 75.
79. July 30, 16:46, slight. Same location as No. 75.
80. July 30, 16:56, slight. Same location as No. 75.
81. August 1, 8:59, very feeble.
82. August 3, 3:04, moderate. Felt locally and at Hilo. NE rift of Mauna Loa.
83. August 4, 15:59, very feeble. Kilauea.
84. August 6, 14:23, very feeble. NE rift of Mauna Loa.
85. August 8, 5:14, very feeble. Felt locally. Mauna Loa.
86. August 10, 6:38, very feeble. Mauna Loa.
87. August 29, 17:48, very feeble. Mauna Loa.
88. August 29, 17:49, very feeble.
89. September 3, 20:31, very feeble.
90. September 4, 7:36, very feeble. Near Mokuaweoweo.
91. September 5, 8:01, feeble. Felt locally and at Hilo. NE rift of Mauna Loa.
92. September 5, 8:52, very feeble. Mauna Loa.
93. September 7, 11:05, feeble. Felt locally. Mauna Loa.
94. September 13, 8:20, moderate. Generally felt on east half of island. 20–25 miles deep, SE of Mauna Kea.
95. September 15, 9:45, slight. Near Mokuaweoweo.
96. September 18, 22:23, very feeble. Mauna Loa.
97. September 19, 14:51, very feeble. Mauna Loa.
98. September 21, 18:44, feeble. Mauna Loa.
99. September 28, 3:53, very feeble. Mauna Loa.

TELESEISMS

July 14, 12:48, slight. Near New Guinea.
July 15, 1:12, slight. Off coast of Mexico.
July 15, 20:30, slight.
July 22, 10:22, slight. Off west coast of Vancouver Island.
July 22, 11:10, slight.
September 8, 5:17, slight. Near Tonga.

MICROSEISMS

Microseisms were moderate during the latter half of September and slight on other days.

CRACK MEASUREMENTS

The cracks measured in the vicinity of Halemaumau rim were either stationary or opened only slightly.

TILTING OF THE GROUND

Easterly tilt was unusually slight but nearly continuous throughout the quarter. Northerly tilt was continuous and a little greater than in the past two years.

Table of Tilt at Observatory on Northeast Rim of Kilauea

Week Ended		Amount	Direction
July	4	0.2″	S 45° E
	11	1.2″	N 30° E
	18	0.4″	W
	25	1.0″	N 7° W
August	1	1.2″	N 53° E
	8	0.3″	N 26° E
	15	1.0″	N 30° W
	22	0.6″	N 12° E
	29	0.7″	N 45° E
September	5	1.3″	N 57° W
	12	0.6″	N 37° E
	19	0.5″	N 14° E
	26	1.4″	N 48° E

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U. S. GEOLOGICAL SURVEY: R. H. Finch, Volcanologist

UNIVERSITY OF HAWAII: T. A. Jaggar, Geophysicist

FLOW-PUMICE ON HAWAIIAN BASALTS

By R. H. FINCH, HOWARD A. POWERS, and GORDON A. MACDONALD

U. S. Geological Survey

Mauna Loa is a large, elongate shield volcano, built of lava flows of primitive olivine basalt to an altitude exceeding 13,600 feet above sea level and 30,000 feet above the ocean floor. Most eruptions take place from fissures in two rift zones which meet in a summit caldera. All known eruptions have started in the summit region. In some, activity is confined to the summit; in others, after brief summit action, the main eruption breaks through fissures in the flank of the mountain. In historic time, Mauna Loa has not established and maintained a lake of fluid lava comparable to the lake which has been typical of much of the historic activity of Kilauea.

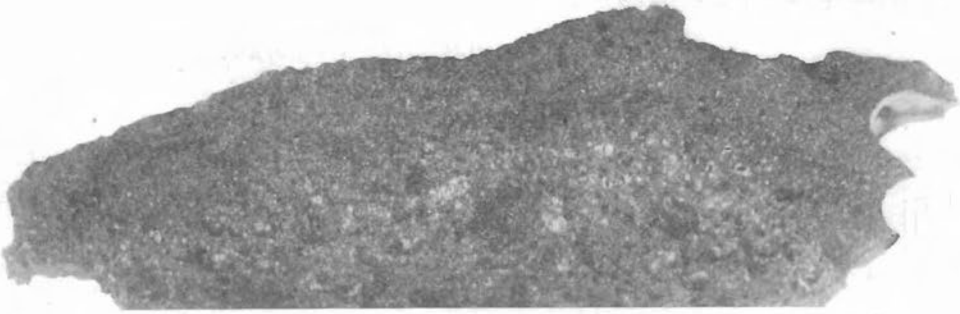
Cones of pyroclastic material have been built around Mauna Loa vents where lava fountaining has persisted for more than a few hours. Most cones contain much pumice. In addition, a skin of pumice is found on thin, short flows adjacent to eruptive fissures both in the summit area and along the rift zones. The material has previously been observed[1] and studied[2] but without regard to the process of formation.

The flow pumice, as much as an inch in thickness, is composed of basaltic glass, drawn out into thin vesicle walls, which are brown in color. Most of the vesicles are small, and only slightly elongated in the direction of flow of the lava. A few much larger elongated cavities are scattered through the pumice skin. A cube of the flow-pumice chosen to contain the least possible number of larger gas cavities has a gross density of about 0.6; the density of the glass is about 2.7. Thus, the porosity of the pumice due to gas inflation is about 75 percent. The pumice grades abruptly into a layer of vesicular black glass in which the vesicle walls are thicker and the vesicles are larger and less numerous. The layer of black glass grades into the grossly vesicular, partly crystallized rock which forms the bulk of each flow layer of lava. In this inner part, the gas cavities are so large that gross density determination is impractical; but by inspection, the gross porosity of the interior is of the same order of magnitude as that of the surface pumice.

Several details of the field occurrence of the pumice aid in interpreting the process of its formation. At the margin of many of the pumice-covered flows, the last ooze of liquid which formed the toe of the flow was quenched at its exposed surface into vesicular black glass rather than into true brown pumice. Elsewhere, the pumice-covered crust had cracked in places, allowing interior fluid to ooze upward through the cracks. Surface quenching of this residual liquid also produced the vesicular black glass rather than brown pumice. It is apparent in the field that the emplacement of these pumice-covered flows was completed in but a few minutes. During this short time, the liquid of the interior

[1] GREEN, W. L. VESTIGES OF THE MOLTEN GLOBE. Part 2, 281–282. Honolulu, 1887.

[2] MACDONALD, G. A. PETROGRAPHY OF THE ISLAND OF HAWAII. U. S. Geol. Sur. Professional Paper 214-D. In press.



Specimen of pumice-surfaced lava collected from the 1942 summit flow of Mauna Loa. The pumice is brown, nearly ½ inch in thickness, and grades abruptly into black vesicular glass. Photo by V. R. Bender, National Park Service.

part of the flow, insulated by the skin of pumice, lost enough of its dissolved volatile component but retained enough heat so that oozes of it which reached the air were quenched as black glass. In many other places, only small patches of the pumice-surfaced flows remain exposed because they have been buried by gushes of less gas-rich lava extruded later in the same eruption. These later gushes have congealed with the more common skin of black glass.

Pumice-covered pahoehoe from the 1942 summit activity is exposed throughout an area of about a quarter of a square mile; in an equally large area it is now buried. Lava flows extruded from nearly 4 miles of open fissure during less than 10 hours of eruption cover a total area of 3⅓ square miles. Flows distant from the fissure have an aa surface; the flows near the fissure have a pahoehoe surface. The pumice-surfaced pahoehoe is restricted to gushes of lava which traveled less than a quarter of a mile from their vents. The main flow of 1942 issued from a fissure in the northeast rift zone at an altitude below 9,400 feet, and began about 24 hours after the summit activity had ceased. There is very little pumice-surfaced pahoehoe at this lower fissure, though pumice is plentiful in the pyroclastic cone which was built around the persistent lava fountains. Abundant pumice-surfaced lava is associated with some of the older flank fissure vents, but the pumice was clearly formed only on the earliest gushes of lava.

These occurrences of pumice contribute some data on the time and manner of escape of volatiles from basaltic magma in the Hawaiian volcanoes. Separation of some volatiles from the liquid must have taken place during its rise in the feeding dikes, because fountaining at the vents indicates bursting of gas bubbles, and many larger gas bubbles have left cavities in the pumice formed both at the fountains and on the pahoehoe flows. However, the formation of pumice among the pyroclastic products and as a skin on lava flows indicates that the liquid reached the surface with sufficient volatiles in solution to inflate it to four times in subsurface volume. The fact that pumice does not form on lava surfaces more than a few hundred yards in distance and a few minutes in time away from the point of emission suggests that the release of volatiles involved is nearly explosive in its rapidity and occurs as soon as the magma appears at the surface. Inherently, the great bulk of the congealed products of eruption can give evidence only of the fact that volatile constituents were present and did escape; evidence of the time and manner of this escape is found only in the small amount of material which was quenched as fountain product and as the surface phase of short flows very near the vents.

HAWAIIAN VOLCANO OBSERVATORY REPORT FOR OCTOBER–DECEMBER, 1948

VOLCANOLOGY

October

Forty-nine seismic disturbances were recorded at Mauna Loa and 44 at Kilauea. Nearly all of the 76 individual earthquakes were very weak. The majority originated either under Kilauea Caldera or along the northeast rift of Mauna Loa.

North–northeast tilting of the ground on the northeast rim of Kilauea continued at a rate normal for this season of the year.

Moderate amounts of sulphurous fume were observed in the summit crater of Mauna Loa on October 5 and 6.

November

Fifty-two seismic disturbances were recorded during the month. Though the numbers recorded at Kilauea and Mauna Loa were 44 and 38 respectively, the majority of the more distinct shakes originated under Mauna Loa.

The rapid easterly tilt that marked the first half of the month ceased on November 14, and there was no accumulation of tilt in the east–west direction during the last half. There was no accumulation of north–south tilt in November.

December

There was no visible activity at any Hawaiian volcano during 1948. Tilt and earthquake data indicate that there was also a lack of any appreciable subterranean activity.

Seventy-five local earthquakes were recorded during December. Seventy-two of these were recorded at Mauna Loa and 61 at Kilauea. A majority of the earthquakes were weak and originated on the northeast rift of Mauna Loa.

The seasonal change from easterly to westerly tilt occurred on December 2, and there was a slight accumulation of westerly tilt during the month. Seasonal northerly tilt continued until December 27, when normal southerly tilt set in. There was a slight accumulation of easterly tilt during 1948.

R.H.F.

SEISMOLOGY

Earthquake Data, October–December 1948

Week Ended		Tremor	Very Feeble	Feeble	Slight	Local Seis-micity*	Tele-seisms
October	3	3	1	0	0	1.25	0
	10	4	4	0	0	3.00	1
	17	14	0	0	0	3.50	0
	24	10	2	0	0	3.50	0
	31	8	1	0	0	2.50	0
November	7	5	0	0	0	1.25	0
	14	10	0	1	0	3.50	0
	21	11	1	0	0	3.25	0
	28	10	4	0	0	4.50	0
December	5	10	0	0	0	2.50	2
	12	14	2	1	0	5.50	0
	19	13	1	0	1	5.75	0
	26	10	3	0	0	4.00	0

* For definition of local seismicity, see Volcano Letter No. 371.

The data of the following local disturbances were determined from seismograph stations operated on the island of Hawaii by the Hawaiian Volcano Observatory of the U. S. Geological Survey. Time is Hawaiian Standard, 10 hours slower than Greenwich. The number preceding each earthquake is the serial number for the current year.

100. October 7, 18:12, very feeble. Hualalai.
101. October 9, 00:53, very feeble. Mauna Loa.
102. October 9, 18:06, very feeble.
103. October 10, 12:06, very feeble. Mauna Loa.
104. October 18, 10:51, very feeble. NE rift Mauna Loa.
105. October 18, 17:30, very feeble. NE rift Mauna Loa.
106. October 27, 16:13, very feeble. Kilauea.
107. November 14, 03:28, feeble. NE rift Mauna Loa.
108. November 21, 09:33, very feeble.
109. November 23, 13:22, very feeble. Mauna Loa.
110. November 25, 09:55, very feeble.
111. November 28, 09:45, very feeble. Mauna Loa.
112. December 7, 20:22, very feeble. NE slope Mauna Loa.
113. December 9, 06:44, very feeble. Mauna Loa.
114. December 9, 15:05, feeble. Felt locally.
115. December 13, 07:35, slight. Mauna Loa. Record being changed.
116. December 18, 14:57, very feeble. NE rift Mauna Loa.
117. December 20, 09:01, very feeble. Mauna Loa.
118. December 23, 21:02, very feeble. Mauna Loa.
119. December 26, 03:30, very feeble.
120. December 28, 11:08, very feeble. East slope Mauna Loa.
121. December 28, 14:08, very feeble.
122. December 29, 19:58, very feeble.

TELESEISMS

October 5, 11:15, slight. Near northern Iran.
December 3, 14:32, slight. Off west coast of Mexico.
December 4, 14:01, slight. Southern California.
December 30, 14:00, slight.

MICROSEISMS

Microseisms were strong October 18–25 and November 1–12 and moderate during the rest of the quarter.

CRACK MEASUREMENTS

A few of the cracks near the Halemaumau rim showed a slight opening, though a majority of the cracks that were measured showed no appreciable movement.

TILTING OF THE GROUND

There was a rapid accumulation of easterly tilt from October 27 to November 14. The seasonal change to westerly tilt occurred on December 2. During the year of 1948 there was an accumulation of easterly tilt. Normal northerly tilt continued to December 27, when seasonal southerly tilt set in. Northerly and southerly tilt were about equal in 1948.

Table of Tilt at Observatory on Northeast Rim of Kilauea

Week Ended		Amount	Direction
October	3	0.3″	S 27° W
	10	0.4″	N 20° E
	17	0.8″	N 19° E
	24	0.9″	N 34° W
	31	1.2″	N 50° E
November	7	0.6″	N 78° E
	14	4.5″	S 11° E
	21	0.4″	N 27° W
	28	0.7″	N 9° E
December	5	0.7″	N 59° E
	12	0.5″	N 63° W
	19	0.5″	S 78° W
	26	0.6″	N

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