

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 be 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

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THE VOLCANO LETTER

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THOMAS AUGUSTUS JAGGAR



THOMAS AUGUSTUS JAGGAR

Photo by R. H. Post, Honolulu

In Philadelphia, on January 24, 1871, Thomas Augustus Jaggar, Jr., was born to a long life of scientific adventure terminated only by his death in Honolulu on January 17, 1953. The son of a bishop of the Episcopal Church, he was educated in public and private schools in Cincinnati, Montreux, and Philadelphia. He entered Harvard University in 1889 and in 1893 graduated with the A.B. degree in geology. He received his Master of Arts degree from Harvard in 1894 and spent most of the next 2 years in Europe, studying mineralogy under Professor Paul Groth at Munich and petrography under Professor Harry Rosenbusch at Heidelberg. Returning to Harvard, he completed his work for the Doctorate of Philosophy under Professor John E. Wolff in 1897, with a dual thesis on the microscopic determination of the hardness of minerals and the geologic evidence derived from certain inclusions in dikes in the Boston area.

From 1895 to 1903, Jaggar held the position of Instructor in Geology at Harvard, and from 1903 to 1906 he was an Assistant Professor in the same department. During these years he was also a member of the United States Geological Survey, working under S. F. Emmons in the region of the Black Hills, South Dakota, and under Arnold Hague in the Yellowstone region. The work in South Dakota and adjacent parts of Wyoming led to the publication, in 1901, of his first big work, an important study of

the laccoliths of the Black Hills. A report on the petrography of the Absaroka Range was prepared for the never-published first volume of the Geological Survey's memoir on Yellowstone National Park. In 1900 and 1901, he was engaged with Charles Palache on a study of the Bradshaw Mountains in Arizona. In 1906, Jaggard was appointed Professor and Head of the Department of Geology in the Massachusetts Institute of Technology.

Dr. Jaggard's approach to geology was a dynamic one. Beginning in his student days, geological processes were his major interest. He was, of course, interested also in the results of the processes, but largely for what they could tell him of how they came about. Fired by Daubree's *Géologie expérimentale*, he set about applying the experimental methods of physics and chemistry to geology. The results of laboratory experiments on stream erosion and sedimentation appeared in print in 1908. However, he was much more interested in applying similar methods in the field, in an attempt to measure and analyze geologic processes actually in operation. The most dynamic aspects of dynamic geology are seismology and volcanology, and to Jaggard the attraction of earthquakes and volcanoes was irresistible.

In 1902, Dr. Jaggard was one of the geologists on the expedition of the S.S. "Dixie" to the Antilles to study the results of the catastrophic eruptions of Mont Pelée and La Soufrière. It was this expedition that decided him definitely on adopting the field study of geophysics as his life work. It is noteworthy that the catastrophe at St. Pierre was the factor that guided into volcanologic work the two greatest American volcanologists of the early twentieth century, Thomas Augustus Jaggard and Frank Alvord Perret.

In 1906, Dr. Jaggard visited Italy to study the eruption of Vesuvius and the damage caused by it. There he found Perret already working as a volunteer assistant to Professor Raffaele Matteucci, director of the Vesuvius Observatory. In 1907, Jaggard was the leader of the Technology Expedition to the Aleutian Islands, during which Makushin and Bogoslof volcanoes received special study. In 1909, Professor Jaggard and his colleague Professor R. A. Daly visited the Hawaiian volcanoes, and Dr. Jaggard went on to Japan to visit the laboratories and stations of the Imperial Earthquake Investigation Committee. At that time a long friendship and mutual admiration began between him and Professor F. Omori, the great leader of seismology in Japan. In 1910, Jaggard and Charles M. Spofford, Professor of Civil Engineering at M.I.T., visited Central America for the purpose of studying the volcanoes of Costa Rica and the results of the great Cartago earthquake of that year, and Jamaica to examine the work being done there in enforcing earthquake-proof construction.

These excursions served to convince Professor Jaggard of the inadequacy of the expeditionary method of studying volcanoes and earthquakes and of the necessity for permanent observatories to keep constant record, every day, year in and year out, of volcanic and seismic activity. He was impressed also by the small amount of knowledge possessed by men of science regarding the prediction or alleviation of natural disasters and by the small amount of effort being expended in the attempt to acquire that knowledge. On January 7, 1909, following the Messina earthquake disaster, he wrote in *The Nation*: "The highest development of geology is the un-

ravelling of the history of the past. We haven't time to go into prediction and humanistic geology." The blame did not lie, he added, with the geologist, but with the haphazard growth of the science and the very proximity of the earth which made terrestrial observation and measurement difficult. The time had come, however, when such studies could no longer be neglected. Instruments existed for the study of the earth processes, and others could be developed. The gravest difficulty lay in the fact that the new program would call for the establishment of permanent observatories in many lands. The goals of the program should be the prediction of volcanic eruptions and earthquakes and the development of engineering and types of construction to help alleviate the consequences of such cataclysms.

On July 1, 1909, the trustees of the estates of Edward and Caroline Whitney of Boston gave \$25,000 to the Massachusetts Institute of Technology to be used for research or teaching in geophysics, including seismology, with a view to the protection of human life and property. It was decided to use these funds for the establishment of a laboratory at Kilauea, Hawaii, for the study of the activity of that volcano and its earthquakes and of waves traveling through the earth from distant earthquakes. Thus did Dr. Jaggard enter upon his true life's work—the establishment and operation of the Hawaiian Volcano Observatory.

Actually, it did not fall to Dr. Jaggard's lot to perform the first work of the new program at Kilauea. During 1910 and 1911, none of the professors at M.I.T. could be spared to go to Hawaii. In the meantime, part of the Whitney Fund had been used for the construction, under the direction of Dr. A. L. Day and Dr. E. S. Shepherd of the Geophysical Laboratory of the Carnegie Institution of Washington, of special resistance thermometers for the measurement of the temperature of molten lava at Kilauea. A cableway had been designed at M.I.T. for spanning Halemaumau Crater in order to lower the thermometers into the lava lake. Dr. Shepherd's services had already been secured for the summer of 1911 to make the temperature measurements. Because Dr. Jaggard could not accompany Shepherd to Kilauea, arrangements were made with the Volcanic Research Society of Springfield, Massachusetts, for the loan of the services of Frank A. Perret, volcanologist of that society, who had been engaged in studies of the Italian volcanoes. Perret and Shepherd reached Kilauea on July 2, 1911, built an observation station at the rim of Halemaumau, and, after much difficulty, succeeded in obtaining a measurement of the temperature of the lava (1000°C.). Perret began the series of systematic records and reports on Kilauea activity that still continues. Dr. Jaggard was granted leave of absence from the Massachusetts Institute of Technology in December, 1911, and reached Kilauea on January 17, 1912.

Establishment of the Hawaiian Volcano Observatory would not have been possible without the enthusiastic aid of the people of Hawaii. The Whitney Fund provided only \$3,450 per year for 5 years. During his visit in 1909, Dr. Jaggard enlisted the support of the Honolulu Chamber of Commerce and some of Hawaii's leading citizens. On October 5, 1911, L. A. Thurston gave a luncheon at the University Club in Honolulu for the purpose of organizing a Hawaiian Volcano Research Association. This association subscribed an additional

\$5,000 a year, over and above the amount from the Whitney Fund, for the operation of the Volcano Observatory. The College of Hawaii, through its president, J. W. Gilmore, pledged its interest and support. Hilo people also were eager to help, and through the efforts of Demosthenes Lycurgus \$1,785 was quickly gathered for the construction of the Observatory building. On March 6, Dr. Jaggar was recalled to Boston, leaving the work at Kilauea temporarily in the hands of F. B. Dodge. But on June 13 he was back again, accompanied by Dr. Harry O. Wood, who became the first seismologist of the Volcano Observatory.

From that time on, the Hawaiian Volcano Observatory was the focal point of Dr. Jaggar's interest and efforts. Financially, things were seldom easy and often extremely difficult. There were times when Dr. Jaggar served wholly without any regular salary. There were still more times when Observatory funds were inadequate to buy even the most essential materials for the work, and he had to pay for them personally out of his own slim savings or appeal again for help from such loyal friends as Frank C. Atherton and Walter F. Dillingham. To such friends Dr. Jaggar was ever grateful, not only for their help to himself, but more particularly for their aid to the growth of the new science of volcanology. It is a fine tribute to Dr. Jaggar's determination and singleness of purpose that even in the hardest and most discouraging of times he did not falter, but somehow kept the program going. After responsibility for the operation of the Volcano Observatory was assumed by the United States Government in 1919, desperately lean periods were less frequent, and there were occasional times of relative opulence. Never, however, was Dr. Jaggar content with progress. Always, over the hills and valleys of varying prosperity, he was striving for greater things for the Observatory and for the science as a whole.

Work at Kilauea was diversified. To routine seismology and the continuous record of activity of Kilauea and Mauna Loa were added observations on the rise and fall of the level of molten lava in Halemaumau, measurements of the temperature of the melt, soundings of the depth of the lava lake, experiments on the viscosity of the lava, collections of volcanic gases for chemical analysis, borings to ascertain the nature of the crater floor and the distribution of temperature in the rocks underlying it, measurements of the shifting and tilting of the ground surface both laterally and vertically, study of the different types of lavas and how they form, and petrographic studies of the rocks. No phase or feature of the volcanoes remained uninvestigated if means could be found for Jaggar or his associates to attack it. In the field of distant earthquakes, a special study was made of tsunamis, the destructive ocean waves that sometimes accompany submarine earthquakes, and possible means of predicting them.

Hawaiian work did not preclude work elsewhere. Expeditions were made to Japan in 1914 and 1923 to study the eruption of Sakurajima and the great Yokohama-Tokyo earthquake. Seeking always to expand the continuous, observatory-type study of volcanoes, Jaggar visited New Zealand in 1920, at a time when the New Zealand Government was considering the establishment of a volcano observatory. In 1924 he visited Howland

and Baker Islands with the "Whippoorwill" Expedition, sponsored by the Bishop Museum and the U. S. Navy. In 1927 he was engaged in field work in the Aleutian Islands, and in 1928 he conducted the Pavlof Expedition of the National Geographic Society to the Alaska Peninsula. In 1930 he was a member of the U. S. Naval Observatory's Eclipse Expedition to Niuafo'ou Island.

In 1924 the operation of the Hawaiian Volcano Observatory passed from the U. S. Weather Bureau to the Geological Survey. In 1926 the Survey established a Section of Volcanology, with Jaggar as its Chief. Stations were established at Lassen Volcano in California and at Dutch Harbor, Alaska. Investigations of Aleutian volcanoes were begun by Jaggar in 1927 and continued by R. H. Finch, volcanologist in charge of the Lassen Observatory, in 1931 and 1932. These investigations were resumed by the Geological Survey during World War II and are now being pursued on a systematic basis under the direction of Howard A. Powers, formerly geologist for the Hawaiian Volcano Observatory.

Dr. Jaggar was one of the early advocates of a national park to include the crater areas of Kilauea and Mauna Loa, and in 1915 he made a trip to Washington for the prime purpose of pleading for its establishment. He felt that the wonders of the great Hawaiian volcanoes and the surrounding tropical beauty, which he himself loved so much, should be the property of all the American people. The vision was consummated in the establishment of Hawaii National Park the next year. In 1935 the Volcano Observatory was transferred to the National Park Service, and Jaggar became an official of the park he had helped to establish. He remained such until his retirement in 1940. After his retirement from government service, Dr. Jaggar became research associate in geophysics at the University of Hawaii and retained that position until his death.

For many years Dr. Jaggar was intensely interested in the sea bottom. This 72 per cent of the earth's surface, concealed from man's view by deep water, was a challenge to his imagination and curiosity. He advocated its exploration by any means available and was especially interested in the possibility of drilling into it from great, floating seadromes. He recognized the technical difficulties of such a procedure but was confident they could be overcome if the results would be worth it—and he was firmly convinced that they would be.

Even all this activity could not absorb all the energy of Jaggar's restless mind. He loved to work with his hands and spent much time in his machine shop. New types of seismographs and seismometers were usually under design and construction, as he carried on a constant search for instruments that could be built and installed cheaply and yet yield valuable results. Such instruments would make possible the great expansion of seismic studies that he envisioned. When Aleutian field work presented difficulties in transportation, he invented an amphibian automobile, used successfully during the Pavlof Expedition, for which he received the 1945 Franklin L. Burr Prize of the National Geographic Society. Interest in boats led to interest in navigation and the design of instruments for locating the geographical position of a ship or airplane through observation of stars at the zenith.

After his retirement he returned to one of his earliest interests, the precise measurement of hardness of minerals and other substances, and he designed and built a new instrument for hardness testing. He was interested in astronomy and spent many evenings at his telescope observing heavenly objects, especially the moon, in whose craters he saw an analogy to the great volcanic craters of the earth. He even entered the fields of philosophy and religion with essays on Jesus; the origin of the earth, life, and man; evolution; and trends of science. He was a staunch church member. While he was still at Harvard and M.I.T., he became deeply interested in the problems and methods of education. In his later life this interest was expressed through his service on the governing board of Iolani School in Honolulu.

It is difficult to evaluate properly the importance of Dr. Jaggar's work in volcanology. We are still too close to it. It is abundantly obvious, however, that its importance is very great. At the time Jaggar founded the Hawaiian Volcano Observatory, the science of volcanology was in its infancy. It has now entered a stage of adolescence where some concrete results are beginning to appear from the great amount of work put into it. Unreservedly, Jaggar may be said to have been one of the very few principal contributors to this progress.

Early results of the work at Kilauea related largely to the dual nature of the lava lake, the shallowness of the pool of pyromagma, the temperature distribution in the lake, and the composition of gases given off by it. These were important in building a picture of the physical nature of the magma column feeding the volcano. Later work added somewhat to that picture, demonstrated the swelling and shrinking of the entire volcanic edifice related apparently to changes of magmatic pressure beneath it, showed the occasional occurrence of great collapses and related thereto occasional violent steam explosions due to cracking of the surrounding rocks and entrance of ground water to the hot volcanic conduit, and built a partial picture of the earthquake activity associated with volcanic changes. Tentative cor-

relations of volcanic events with astrophysical forces and possible cycles in time have been made and are undergoing testing. The work is far from ended, but good progress has been made.

The work has not all been done by Jaggar, of course. Contributions have been made by a whole succession of capable scientific associates, among whom may be mentioned H. O. Wood, Arnold Romberg, E. G. Wingate, A. E. Jones, H. A. Powers, and Jaggar's long-time associate and successor as director of the Volcano Observatory, R. H. Finch. And certainly he would want included among his most valuable co-workers his wife, Isabel, who shared with him the disappointments, the joys of discovery, and much of the physical work. It has been Jaggar's vision and enthusiasm, however, that has guided the work and integrated it, and a very large proportion of it actually was done by him personally.

Possibly the greatest of all Dr. Jaggar's contributions are his ideas for the protection from lava flows of cities, harbors, or other important areas, through aerial bombardment or the construction of barriers to deflect the flows. Bombing has been tried, and the general method has proved feasible and effective. There is little question that the barriers also would do their job well. These things constitute a long step toward fulfillment of the motto adopted at the founding of the Hawaiian Volcano Research Association: "Ne plus haustae aut obrutae urbes"—no more shall the cities be destroyed!

Dr. Jaggar's dream was that some day the work on Hawaiian and other Pacific volcanoes might be combined with other types of geophysical studies in a great Institute of Terrestrial Research centered in Hawaii. It is a grand dream, which may, like so many of his dreams, someday materialize.

All of us who have been associated with Tom Jaggar mourn his passing. But at the same time we are grateful, as he would have us be, for his long and full life, profitably spent, and for memories of his superb intellect combined with a gentle and modest spirit whose greatest concern was with the well-being of the rest of mankind.

—G. A. MACDONALD.

HAWAIIAN VOLCANO OBSERVATORY REPORT FOR JANUARY-MARCH, 1953

By GORDON A. MACDONALD

VOLCANOLOGY

January

Hawaiian volcanoes remained fairly quiet through the month of January. Seismographs at Kilauea Crater recorded 41 earthquakes during the month, and the Mauna Loa seismograph recorded 33. This is about the usual number recorded during times of volcanic quiet. However, some of the quakes were larger than usual.

Several earthquakes were felt in Kona during the month. Most of them originated locally, on the Kealakekua fault or at sources between central Kona and the summit of Mauna Loa. A small earthquake felt at Naalehu and Kapapala at 9:08 A.M. on January 9 originated beneath the southeast slope of Mauna Loa about 8 miles northwest of Kapapala, and another at 9:10 P.M. on the same day had its epicenter about 1.5 miles closer to the summit of the mountain. The latter quake was felt quite strongly all over the southern part of the island and less strongly at least as far north as Kukuiahae.

At 2:04 A.M. on January 15 a strong earthquake originated beneath the southeast slope of Mauna Loa near the Kapapala Ranch headquarters. Objects were upset and knocked from shelves as far away as Hilo. Residents of the southern part of the island of Hawaii were generally awakened, and the quake was felt as far away as Oahu. In its epicentral area the inten-

sity of the quake is estimated to have been about 5 on the modified Mercalli scale.

Tilting of the ground at the Volcano House was in general slightly southward during the month, at a rate about normal for this season of the year. From January 1 to 15 there was an accumulation of a little more than 1 second of eastward tilting, suggesting a small increase of pressure beneath Mauna Loa associated with the Mauna Loa earthquake activity during the early part of the month. During late January, however, the eastward tilting and, presumably, the increase of pressure beneath Mauna Loa ceased. Late in January a slight northward tilting commenced.

February

Seismic activity on the island of Hawaii during the month of February was relatively slight. Seismographs at Kilauea Crater recorded only 18 earthquakes, the smallest number since January, 1951. The Mauna Loa seismograph recorded 25 quakes during the month. Some of these originated on the west slope of Mauna Loa and others on the northeast rift zone.

At 6:44 A.M. on February 12 an earthquake with an intensity of 4 on the modified Mercalli intensity scale was felt strongly at Kapapala. Its origin was close to Kapapala, probably on the Kaoiki fault, which parallels the highway between Kilauea Crater and Pahala.

The earthquake that occurred at 1:40 A.M. (Hawaiian time) on February 26 about 650 miles north of New Caledonia, near the Santa Cruz Islands, produced only a slight record on seismographs at Kilauea.

During the month there was a small accumulation of northward tilting of the ground at the seismograph station beneath the Volcano House. There was essentially no accumulation of tilt in the east-west direction. During this season of the year tilting at the Volcano House usually is south-southwest. Therefore, the slight northward tilting and absence of westward tilting indicate some increase of volcanic pressure beneath Kilauea Crater and, possibly, also under Mauna Loa.

Late in the afternoon of February 28, the seismographs recorded 18 minutes of continuous volcanic tremor, indicating movement of magma beneath the surface at Kilauea.

March

Seismographs of the Hawaiian Volcano Observatory recorded a total of 75 earthquakes during March. Many of these were too small to be recorded at more than one station. For example, the seismograph at Konawaena School recorded four very feeble earthquakes of nearby origin that were too small to be recorded at Kilauea Crater. During the month the seismographs at Kilauea recorded 45 earthquakes, and the Mauna Loa seismograph recorded 51. The number of earthquakes at any single station was approximately normal. Although the total number of quakes was somewhat greater than normal, such a large proportion of the quakes were very small that the total seismic activity also was only about normal in amount.

On March 6, at 7:48 A.M., a slight earthquake was felt in central Kona. Its origin apparently was on the Kealakekua fault, probably near Kealia. At 2:26 P.M. on the same day an earthquake was felt throughout much of Kona and Kau. Its origin lay at a depth of about 30 miles beneath the summit area of Hualalai.

At 6:19 P.M. on March 25 a moderately strong earthquake occurred, with its epicenter on the south slope of Mauna Loa, 10 miles N 25° W of Naalehu. It was felt strongly at Naalehu, where it had an intensity of about 4 in the modified Mercalli scale. At Kapapala its intensity was 2 to 3. The quake was felt slightly over most of the island. At 1:40 A.M. on March 26 a smaller earthquake was felt quite strongly at Naalehu, where its intensity was estimated as about 2, and less strongly over much of the southwest portion of the island. Its epicenter also lay on the south slope of Mauna Loa, about 5 miles north of Naalehu.

During March, tilting of the ground surface at the Volcano House was southwestward, both the direction and the aggregate amount being approximately normal for that season of the year. Temperatures of steam at vents in the vicinity of Kilauea Crater remained unchanged. General conditions at Halemaumau also remained unaltered, with no visible activity other than steam vents and a weakly active vent liberating sulphurous fume on the floor of Halemaumau Crater northwest of the large cones of the recent eruption. During recent weeks there has been a marked increase in the volume of steam visible at the northeast wall of Puhimau Crater.

On March 14 continuous tremor was recorded on the seismographs for 16 minutes, apparently indicating movement of magma beneath Kilauea. Again on March 29 there were recorded 13 minutes of continuous tremor, possibly a succession of very small earthquakes, but appearing more probably to be volcanic tremor of the sort that accompanies magma movement. Thus far there has been no sign of abnormal tilting such as would indicate any marked decrease of pressure beneath either Mauna Loa or Kilauea. Although there has been no marked restlessness to indicate imminent eruption of either volcano, it is entirely possible that if magma stands high in the conduits, as is suggested by the evidence, eruption might occur with little or no warning.

SEISMOLOGY

Distant Earthquakes

Only one distant earthquake was recorded during the quarter. It was recorded on February 26, at 01:59 H.S.T., and produced only a slight record on the Bosch-Omori seismograph. The notice of Preliminary Determination of Epicenter issued by the U. S. Coast and Geodetic Survey places the origin of the quake in the region of the Santa Cruz Islands, at 11° S., 164.5° E., about 650 miles north of New Caledonia. Its origin time was 11:42:26 G.C.T.

Earthquake Data, January-March, 1953

(Based on Bosch-Omori seismograph on northeast rim of Kilauea Caldera)

Week Beginning	Minutes of Tremor	Very Feeble	Feeble	Slight	Moderate	Strong	Local Seismicity*	Teleseisms
Jan. 4	5	4	0	0	0	1	7.25	0
11	7	6	0	1	0	1	6.75	0
18	4	1	1	0	0	0	2.5	0
25	1	3	0	0	0	0	1.75	0
Feb. 1	0	0	0	0	0	0	0	0
8	2	5	0	0	0	0	3.0	0
15	4	2	0	0	0	0	2.0	0
22	3	1	0	1	0	0	3.75	1
Mar. 1	6	4	1	0	0	0	4.5	0
8	8	1	1	0	0	0	3.5	0
15	2	3	0	0	0	0	2.0	0
22	8	3	0	0	1	0	6.5	0
29	11	1	0	0	0	0	3.25	0

* For definition of local seismicity see Volcano Letter 371 or 512. Each local earthquake is assigned a seismicity value according to its strength, as follows: tremor, 0.25; very feeble, 0.5; feeble, 1.0; slight, 2.0; moderate, 3.0; strong, 4.0. These values are totaled to give the weekly local seismicity. Continuous volcanic tremor is ignored in the calculation. The strength assigned to an earthquake depends on the double amplitude of the maximum oscillation it causes on the Bosch-Omori seismograph, as follows: tremor, less than 0.5 mm.; very feeble, 0.5 to 4 mm.; feeble, 4 to 11 mm.; slight, 11 to 25 mm.; moderate, 25 to 60 mm.; strong, greater than 60 mm.

Table of Tilt at Seismograph Vaults on Rim of Kilauea Caldera

Week Beginning	Whitney Vault (Northeast rim)		Uwekahuna Vault (West rim)	
	Amount	Direction	Amount	Direction
January 4	0.2"	E	0.3"	N 45° W
11	1.0"	S 82° E	2.7"	N 21° E
18	0.1"	E	1.6"	S 11° W
25	0.4"	N 34° W	1.6"	N 11° E
February 1	1.2"	W	0.6"	E
8	1.0"	S 60° E	1.8"	S 9° W
15	0.6"	S 79° E	0.7"	S 27° W
22	0.8"	N 52° W	1.6"	S 11° W
March 1	0.7"	N 9° W	1.8"	S 9° W
8	0.6"	E	4.0"	S 19° W
15	0.8"	N 27° W	0.7"	N 27° W
22	1.4"	S 31° W	2.6"	S 14° E
29	1.2"	N 88° W	2.3"	S 16° E

Local Earthquakes

The data for the following local earthquakes were determined from seismographs operated on the island of Hawaii by the Hawaiian Volcano Observatory. Locations given are epicenters. The times given are arrival times at the Whitney Laboratory of Seismology, on the northeast rim of Kilauea Caldera. They are stated to the closest minute in Hawaiian Standard time, which is 10 hours slower than Greenwich Civil time. The number preceding each earthquake is the serial number for the current year. The intensity rating (Feeble, Moderate, etc.) given is that for the Whitney Laboratory. If the intensity was greater at one of the other stations, the name of that station and the intensity rating there are given in parentheses after the rating at the Whitney station.

- Jan. 2, 03:32, very feeble. Near summit of Mauna Loa (?).
- Jan. 2, 23:34, no record at Kilauea (Kona, very feeble).
- Jan. 3, 11:31, feeble (Kona, strong). Felt strongly in Kona. Central Kona, on Kealakekua fault near Keeli. 19° 28' N., 155° 52' W.
- Jan. 3, 11:34, very feeble (Kona, slight). Felt in Kona (Kona aftershock).
- Jan. 4, 23:07, very feeble. Kilauea.

6. Jan. 7, 15:58, tremor (Kona, very feeble). Felt in Kona.
 7. Jan. 7, 21:31, no record at Kilauea (Kona, very feeble). Central Kona.
 8. Jan. 9, 09:09, very feeble. Felt at Kapapala, Naalehu, Kona, SE slope of Mauna Loa at about 19° 22' N., 155° 31' W.
 9. Jan. 9, 09:22, very feeble.
 10. Jan. 9, 16:05, very feeble. Felt at Kapapala.
 11. Jan. 9, 16:42, no record at Kilauea (Kona, very feeble). Felt in Kona. Central Kona.
 12. Jan. 9, 21:10, strong. Felt strongly at Kahuku and Naalehu, moderately at Kapapala, Volcano district, Hilo, and Kona, slightly at Kukuihaele. SE slope of Mauna Loa about 4 miles SE of South Pit, at about 19° 24' N., 155° 33' W., about 14 miles deep.
 13. Jan. 10, 06:32, tremor (Kona, very feeble). Central Kona.
 14. Jan. 12, 03:27, tremor (Kona, very feeble). Central Kona.
 15. Jan. 13, 04:13, slight. Four miles S 45° E of Naalehu.
 16. Jan. 13, 07:29, very feeble. Felt quite strongly at Kapapala.
 17. Jan. 14, 05:38, very feeble. SW rift of Kilauea (?).
 18. Jan. 15, 02:05, strong. Felt strongly all over southern half of island from Hilo to Kona, and slightly as far away as Oahu. SE slope of Mauna Loa about 3 miles NNE of Kapapala Ranch headquarters, 19° 19' N., 155° 26' W., about 15 miles deep.
 19. Jan. 15, 07:30, tremor (Kona, slight). Felt in Kona. Central Kona.
 20. Jan. 16, 13:01, very feeble.
 21. Jan. 16, 21:54, very feeble.
 22. Jan. 17, 05:09, very feeble.
 23. Jan. 17, 17:40, very feeble.
 24. Jan. 18, 09:33, feeble. On SE slope of Mauna Loa near Ohaika.
 25. Jan. 21, 12:58, very feeble.
 26. Jan. 23, 14:18, no record at Kilauea (Kona, very feeble). Felt in Kona. Central Kona.
 27. Jan. 24, 11:14, no record at Kilauea (Kona, very feeble). Central Kona.
 28. Jan. 25, 03:17, very feeble.
 29. Jan. 27, 03:00, very feeble. Kilauea.
 30. Jan. 29, 00:17, tremor (Kona, very feeble).
 31. Jan. 30, 08:06, very feeble.
 32. Jan. 30, 10:53, tremor (Kona, very feeble).
 33. Feb. 3, 07:28, no record at Kilauea (Mauna Loa, tremor; Kona, feeble). Central Kona.
 34. Feb. 6, 20:21, no record at Kilauea (Kona, very feeble). Central Kona.
 35. Feb. 8, 18:48, tremor (Kona, very feeble).
 36. Feb. 9, 22:47, very feeble (Kona, feeble). Near summit of Mauna Loa.
 37. Feb. 11, 21:19, no record at Kilauea (Kona, very feeble). Central Kona.
 38. Feb. 12, 04:38, no record at Kilauea (Kona, very feeble).
 39. Feb. 12, 06:45, very feeble. Felt strongly at Kapapala, intensity about 4 (modified Mercalli). Kaoiki fault near Kapapala, at about 19° 17' N., 155° 27' W.; shallow focus.
 40. Feb. 12, 14:06, no record at Kilauea (Kona, very feeble).
 41. Feb. 13, 04:49, very feeble.
 42. Feb. 13, 04:51, very feeble.
 43. Feb. 13, 04:51, very feeble.
 44. Feb. 15, 22:10, very feeble.
 45. Feb. 16, 11:21, very feeble. Kaoiki fault, about 4.6 miles SW of Uwekahuna station, at about 19° 24' N., 155° 22' W.
 46. Feb. 16, 20:20, no record at Kilauea (Kona, very feeble). Central Kona.
 47. Feb. 18, 02:26, no record at Kilauea (Mauna Loa, tremor; Kona, very feeble). West flank of Mauna Loa.
 48. Feb. 18, 02:30, no record at Kilauea (Mauna Loa, tremor; Kona, very feeble). West flank of Mauna Loa.
 49. Feb. 20, 06:14, no record at Kilauea (Kona, very feeble). Central Kona.
 50. Feb. 20, 06:16, no record at Kilauea (Kona, very feeble). Central Kona.
 51. Feb. 21, 22:44, no record at Kilauea (Kona, very feeble). West slope of Mauna Loa.
 52. Feb. 22, 02:40, slight. Felt in Volcano district. Kaoiki fault between Bird Park and Ohaika.
 53. Feb. 25, 15:30, very feeble.
 54. Mar. 1, 22:42, very feeble. Off south shore at about 19° 00' N., 155° 24' W.
 55. Mar. 3, 19:32, no record at Kilauea (Kona, very feeble). Central Kona.
 56. Mar. 6, 04:39, feeble. Off south coast at about 19° 04' N., 155° 25' W.
 57. Mar. 6, 06:06, very feeble.
 58. Mar. 6, 07:48, very feeble (Kona, slight). Felt in central Kona. Kealakekua fault, near Kealia (?).
 59. Mar. 6, 14:26, very feeble (Kona, feeble). Felt in central Kona, Naalehu, and Kapapala. Beneath summit area of Hualalai Volcano, about 30 miles deep.
 60. Mar. 9, 19:27, feeble. Kilauea.
 61. Mar. 10, 06:31, very feeble. North slope of Mauna Loa about 3 miles NW of Kokoolau cone, at about 19° 39' N., 155° 37' W.
 62. Mar. 12, 18:58, tremor at Whitney Laboratory, very feeble at Uwekahuna. Kilauea.
 63. Mar. 17, 03:20, no record at Kilauea (Kona, very feeble). Central Kona.
 64. Mar. 18, 11:12, very feeble.
 65. Mar. 18, 23:40, very feeble. Moderate distance.
 66. Mar. 19, 06:45, no record at Kilauea (Kona, very feeble). Central Kona.
 67. Mar. 19, 20:01, very feeble.
 68. Mar. 23, 19:30, tremor (Mauna Loa and Kona, very feeble).
 69. Mar. 23, 21:19, very feeble. Felt in south Kona. West slope of Mauna Loa.
 70. Mar. 25, 10:50, very feeble (Mauna Loa, slight). Near summit of Mauna Loa, probably on NE rift zone.
 71. Mar. 25, 18:19, moderate. Felt strongly at Naalehu and Kapapala and slightly over most of the island. South slope of Mauna Loa, at about 19° 12' N., 155° 39' W.
 72. Mar. 26, 01:40, very feeble (Mauna Loa, feeble). Felt moderately at Naalehu and slightly as far as central Kona. South slope of Mauna Loa, at about 19° 08' N., 155° 35' W.
 73. Mar. 27, 22:30, no record at Kilauea (Kona, very feeble). Felt in Kona. Central Kona.
 74. Mar. 31, 03:54, very feeble.

VOLCANO NOTES AND NEWS

CONTINUED VOLCANIC ACTIVITY AT SAN BENEDICTO ISLAND,
MEXICO

By Adrian F. Richards

Initial activity of Boqueron Volcano on San Benedicto Island, Mexico, has been described by Howel Williams in Volcano Letter 517. (The name Boqueron, meaning "Big Mouth," was suggested by Dr. Williams.)

On November 15, 1952, J. M. Snodgrass, D. L. Inman, and the writer, all of the Scripps Institution of Oceanography, flew to Boqueron Volcano in a U. S. Navy PBM. The small conical mass of lava that had plugged the conduit of the 700-foot-deep crater was observed to have increased greatly in size so that the crater had become half filled with a biscuit-shaped mass of block lava. This extrusion of lava probably took place about November 12, at which time the master of the tuna clipper "Constitution" reported to the Scripps Institution that intermittent smoke with flames shooting above the crater had been visible during the night at a distance of 40 miles from the island. No incandescence was seen on November 15. On November 19, the master of the clipper "Paramount" reported to the writer that he had seen glowing boulders hurled 200 feet above the crater at night. Based on observations of December 10, additional block lava was probably added to the crater at that time. On December 8, according to M. Silva of the "Star of the Sea," lava escaped from the flank of Boqueron Volcano at the eastern base of the cone, 60 feet above sea level.

Lewis Walker and the writer reached San Benedicto Island on December 9 for a stay of 4 days. The fissure, through which the blocky lava welled, lengthened upslope to 192 feet altitude by December 11. The temperature at the throat of the fissure was estimated by the writer to be approximately 1300°C., based on the orange-white incandescence. This lava extrusion advanced out to sea 900 feet in 2 days, during which time it grew laterally to 1,200 feet in the shape of a lobate delta. When last observed, the lava was advancing seaward at the rate of 150 feet per day.

Based on identical readings of aircraft altimeters on flights over Boqueron on November 15 and December 11, the elevation of the top of the cone of Boqueron Volcano was determined to be 1,250 feet. This figure is 250 feet less than that reported by Dr. Williams on the September 20 flight. Comparisons of September, November, and December photographs show no apparent change in the height of the rim; consequently, the 1,250-foot value is probably more nearly correct. On December 9, at intervals of approximately 1 hour, dense cauliflower clouds of steam and ash were observed to rise to 3,000 feet. On December 10, the crater rim was observed to be half a mile wide. Red incandescence of the crater lava was occasionally seen in broad daylight. On the morning of December 12, the volcanic activity increased to a continuous eruption of steam and ash from the crater. This eruption continued through December 13, when the

island was seen by tuna fishermen. On January 5, Paul Lynn, master of the "Cape Beverly," reported rumbling sounds heard at a distance up to 1 mile from Boqueron, coincident with gas eruptions from the crater.

ERUPTION OF TRIDENT VOLCANO, ALASKA

Mount Trident, in Mount Katmai National Monument, erupted on February 15, 1953. Mount Trident is located near the base of the Alaska Peninsula, 110 miles northwest of Kodiak and 5 miles west-southwest of Katmai Volcano, which erupted violently in 1912. There is no previous record of activity of Trident Volcano during historic times.

On February 15 and 16, pilots of commercial and military planes reported a cloud of "smoke" rising about 30,000 feet into the air. Visibility was too poor, however, to permit precise determination of the type and place of activity. On February 18, the vent was finally located on the south slope of Trident Peak. Earlier reports that Katmai and Novarupta volcanoes were active proved false.

On February 21, seismologist Richard McDonald of the U. S. Geological Survey identified a lava flow issuing from a fissure about 1 mile southwest of the old crater of Trident Volcano. The flow was still active and was about 800 feet wide at its toe and 1,500 feet long. It had advanced about 1,000 feet since it was photographed on February 18. The eruption column rose to a height of about 11,000 feet, and a thin deposit of ash was observed over the surrounding area. The crater lake of Katmai Volcano was not frozen. Light steam rose from two craters on nearby Mageik Volcano, and steam was rising from a vent on the southeast flank of Mount Trident, about 1.5 miles east of the lava vent.

On March 11, geologist George Snyder of the U. S. Geological Survey reported Trident Volcano still active, with slow lava extrusion. Ash blanketed the area within a radius of 20 miles south and east of the volcano.

MYOJIN REEF, JAPAN

Dr. Helen Foster of the U. S. Geological Survey's office in Tokyo writes that Dr. H. Niino of the Tokyo College of Fisheries visited the area of Myojin Reef on February 1. He reported an island estimated to have a maximum diameter of 226 meters and a minimum diameter of 158 meters, in a northwest-southeast direction. The highest point was a black spine 94 meters high. There was also a grayish-white dome 54 meters high. Steam was being emitted from the spine, but there was no other sign of activity. The previous growth of the island was described in Volcano Letter 518.

The March 19 edition of the newspaper *Hawaii Hochi* reported three explosions at Myojin Reef on March 18. The eruption column was stated to reach a height of 1,000 feet.

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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.

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NOTES ON THE 1880-81 LAVA FLOW FROM MAUNA LOA

By E. D. BALDWIN¹

At Honolulu in November, 1880, we were under a strict smallpox quarantine, no one being allowed to leave the Island of Oahu for fear of carrying the disease to the other islands. It was then that we received word that at 9 P.M. on November 5 a great lava flow had broken out on the top of the Mauna Loa divide about a mile above Puu Ulaula. One branch of the lava flow was heading northward toward Mauna Kea. The main branch was advancing rapidly down the mountainside south of the 1855 lava flow. It had often been remarked at Hilo that, if a great lava stream should flow down on the Puna (south) side of the 1855 lava flow, Hilo would be doomed. Here was a massive aa lava stream that in a few days had flowed with great speed down the steep part of the Mauna Loa slopes and then made a turn toward Hilo, on the Puna side of the 1855 lava flow.

A third flow started southward into Kau at 8 P.M. on November 9.

The great lava flows of Mauna Loa commonly are aa at first, changing to pahoehoe after a period of 2 or 3

¹ Mr. E. D. Baldwin, for 28 years surveyor and civil engineer in the Hawaiian Government Survey, under the Kingdom, the Republic, and the Territory, had a life-long interest in Hawaiian volcanoes. The present article was written in 1933, after his retirement and shortly before his death. His daughter, Mrs. Jessie Baldwin Hardy, referred it to K. P. Emory of Bernice P. Bishop Museum who in turn referred it to T. A. Jaggar and G. A. Macdonald. The map accompanying the article was prepared by Macdonald.

The article contains much of interest that does not appear to have been published previously. The accounts of the two barriers to protect Hilo from the 1881 lava flow are of special interest in connection with recently proposed barriers. As Mr. Baldwin points out, the wall built to protect the Waiakea mill certainly would not have been effective, as the lava soon would have overtopped the wall and continued on its course. The great earthen embankment along the edge of the Alenaio Gulch, proposed but not constructed, might well have saved the center of Hilo if the flow had continued. It would not, however, have saved the harbor, and it would not be adequate to protect the much expanded Hilo of today.—G. A. M.

weeks if the flow continues that long.² This fact was well known to all our old Hilo settlers. With the rapid advance of this great aa flow and the knowledge that at any moment the more rapid pahoehoe flow might start, one can easily imagine the nervous excitement of the Hilo residents. They appealed to the authorities at Honolulu for advice and suggested that Professor W. D. Alexander, Surveyor General of the Kingdom of Hawaii, be sent to Hilo to report on the lava flow. The Government acted immediately and passed Professor Alexander through the quarantine and on to the Island of Hawaii.

The writer was then a young man, living in Professor Alexander's home and just beginning his apprenticeship in the Government Survey. Consequently, after Professor Alexander's return from Hilo, the writer had the pleasure of listening to his brilliant account of the lava flow.

One of Hilo's greatest mountaineers, Judge D. H. Hitchcock, was assigned to guide Professor Alexander to the flow. The party started on horseback at daybreak on November 29, spent the night at Hitchcock's Kipuka Ahina camp, then continued to the lava flow on foot the next day. They first visited the western branch of the flow, which Professor Alexander stated was a red-hot stream of aa, then turned back downslope and visited the Hilo branch of the flow. The latter, he stated, was running liquid aa, with its front near the Mawae corner of the Piionua land division.

Professor Alexander described the lava flow as appearing very liquid at its front, but so viscous that they were unable to drive a stick into it or get any of the molten lava on a stick to shape it into souvenirs, as they

² It should be noted that this succession of pahoehoe following aa as the eruption progresses is the result of a change in condition of the lava being poured out at the vent, resulting in a new pahoehoe flow flooding over and beyond an earlier aa flow, and not an example of change of aa to pahoehoe in a single flow as it progresses down slope.—G. A. M.

ing pan floated down with the lava.

At several places there were openings in the top of the flow that exposed the tunnel of red-hot, flowing lava beneath. At one of these, on the steep slope near Kaumana, we threw stones on the flowing lava and timed their passage; we found that the stream of lava was traveling at an average rate of 40 miles an hour in its confining tunnel. This seemed astounding at first, but when one considers that the flow was then more than $\frac{1}{2}$ mile wide at its advancing front, the lava would have to be traveling very fast in its narrow channels higher up to supply the broad spread of lava at the front of the flow.

The central supply tunnel was probably 20 to 50 feet wide, with numerous smaller branch tunnels extending from the main tunnel. Often these supply tunnels became blocked; then there would be a sudden outburst of lava, throwing great blocks of the cooled lava, with the molten lava, into the air.

After camping near the Natural Bridge for about a week, we went down to the front of the flow again and found it very active. On the side toward Hilo a great, red, molten stream was flowing down Alenaio Gulch. Another very active branch of the flow was pushing off toward Waiakea. We rounded the Alenaio flow and went over to the Waiakea branch. On returning, we found that the Alenaio flow had advanced so rapidly that we were cut off from our former trail. Our alternative was to break through a dense grove of hau trees or run across a tongue of lava about 30 feet wide and 1.5 feet thick that had flowed out only a few minutes before. The tongue was red hot, just beginning to turn black on top. After testing the tongue of new lava by throwing heavy stones on it and observing that the stones rolled over it as if it were solid, we sprang over it with as few steps as possible, only slightly scorching our shoes.

A pahoehoe lava flow in full motion is a very interesting sight. At the advancing front the lava seems to come out of its tunnel and flow in an open red river of fire as much as several hundred feet long. This then appears to clog up and cool on top, and the lava pushes out in great and small lobes, piling one over the other and eventually forming a new tunnel underneath for the molten lava. The latter will then again break out

and go through the same process as before.

After 2 weeks we reluctantly packed up our camp and started on our return trip to Honolulu. As we passed down toward Hilo we could see the lava flow making a rapid advance toward the town and the Waiakea sugar mill. On passing upper Halai Hill we noticed Princess Ruth Keelikolani sitting on the brow of the hill with her retainers, all decked out in red bandanas. The report is that she broke a bottle of champagne and made other sacrifices to Pele. The natives give Princess Ruth credit for stopping the flow.

When we left Hilo, about July 29, the lava was approximately 1.5 miles from the main part of the town. Again the Hilo people appealed to the authorities at Honolulu for help. At that time Professor Alexander had in his employ Mr. W. R. Lawrence, a former military engineer and practical civil engineer. He sent Mr. Lawrence to Hilo to survey the front of the lava flow and suggest any method that might be used to prevent the flow from entering the main portion of the town.

It was evident that the main flow of molten lava, like water, was seeking the lowest level and following the bed of Alenaio Stream. Mr. Lawrence recommended building a massive embankment along the town side of Alenaio Gulch. At Honolulu, the writer had been loaned to the Interior Department to assist in reading proof of the 12 volumes of a new copy of the Land Commission Awards and was working in the telephone room of the Interior Office. There he had the pleasure of hearing Mr. H. A. P. Carter, Minister of Foreign Affairs, telephoning to a Honolulu business firm to order a thousand picks, shovels, hoes, wheelbarrows, etc. The Government was arranging to set 1,000 men to work building the embankment to protect Hilo. But the work was never actually started, as the next steamer brought word that the lava had stopped flowing on August 9.

The people of Waiakea Plantation had built an ordinary stone wall across the front of the Waiakea branch of the flow in an effort to protect the Waiakea mill and claimed that the Waiakea flow was stopped by that wall. The writer later visited the wall and found that a small tongue of lava had piled up a few feet along it. Fortunately the eruption ended just at that time, as in the opinion of the writer the stone wall could not have stopped the flow.

HAWAIIAN VOLCANO OBSERVATORY REPORT FOR APRIL-JUNE, 1953

By GORDON A. MACDONALD

VOLCANOLOGY

April

Hawaiian volcanoes were quiet throughout the month of April, and seismic activity was approximately normal in amount. Seismographs at the rim of Kilauea Caldera recorded 50 earthquakes during the month, and the Mauna Loa seismograph recorded 33. Thus, Kilauea showed somewhat more activity than Mauna Loa. The Kona seismograph recorded 19 small earthquakes not recorded at any other station. These originated in central Kona close to the station. Probably some or all of them resulted from small movements on the Kealakekua fault, which runs out to sea along the northern edge of Kealakekua Bay.

A feeble earthquake felt in the Volcano area at 11:09 A.M. on April 10 had its origin beneath the east slope of Mauna Loa. A quake at 2:20 A.M. on April 14 recorded as very feeble on the seismograph but was felt by several persons in central Kona. Another feeble quake originated beneath the southwest slope of

Mauna Loa at 1:42 A.M. on April 24 and was felt in Kona and in the Volcano district. Moderate earthquakes at 8:50 and 11:03 A.M. on April 29 probably had their origin on the Kaoiki fault, which separates Kilauea and Mauna Loa west of Kilauea Crater.

Tilting of the ground surface at the northeast rim of Kilauea Caldera normally is toward the southwest throughout the month of April. This year, the southward component of tilting was approximately normal in amount, suggesting essentially no change in volcanic pressure beneath Kilauea. Westward tilting, however, was at a rate somewhat greater than normal, suggesting the possibility of some reduction of pressure beneath Mauna Loa.

May

During early May, Hawaiian volcanoes were fairly quiet. From May 1 to 17 ground tilting at the northeast rim of Kilauea Caldera was approximately normal, both in direction and

amount, for that season of the year. The number of earthquakes recorded was nearly twice the normal number, but most of them were very small.

On May 17 the ground surface at the northeast rim of the caldera began tilting rapidly northward, and northward tilting continued at a rate notably greater than normal throughout the rest of May. On May 20 the number of earthquakes recorded at Kilauea Crater increased greatly and through the rest of the month averaged about 20 per day, bringing the total number recorded during May to 259. Of these, about 90 percent had their origin beneath or near Kilauea Crater.

Several small earthquakes were felt in Kona during the month. All these except one originated in the Kona area, some of them probably on the Kealakekua fault. At 4:59 A.M. on May 29 a strong quake originated on the Kealakekua fault. This earthquake dismantled one component of the seismograph at Konawaena School. It was felt strongly in central Kona and weakly over much of the rest of the island.

At 2:44 A.M. on May 24 a moderate earthquake originating beneath the east flank of Mauna Loa was felt over much of the island. A sharp earthquake felt at Kapapala at 7:33 P.M. on May 27 probably had its origin on the Kaouiki fault.

June

Kilauea Volcano remained notably restless throughout the month of June. Of the 184 earthquakes recorded by seismographs at Kilauea Crater during the month, the great majority originated in Kilauea Volcano. The total number of earthquakes was more than four times the usual number recorded during times of volcanic quiet. Northward tilting of the ground surface at the northeast rim of Kilauea Crater during June amounted to 4 seconds of arc. This rate of tilting is about five times as rapid as the average for this season and demonstrates a distinct increase of volcanic pressure beneath Kilauea.

Several earthquakes originating beneath the slopes of Mauna Loa and along its northeast rift zone indicate some uneasiness of that volcano also. However, ground tilting in the east-west azimuth at the northeast rim of Kilauea Crater was slightly westward at a rate approximately normal for this season of the year. This suggests a lack of any marked change of volcanic pressure beneath Mauna Loa.

A feeble earthquake felt in Hilo and the Volcano district at 8:38 P.M. on June 15 appears to have had its origin beneath the east flank of Mauna Loa, about 3 miles north-northeast of the Whitney Laboratory of Seismology. Another, felt in the same areas at 10:47 A.M. on June 27, originated beneath the east slope of Mauna Loa about 3 miles S60°E of Puu Kulu. A slight earthquake at 12:49 A.M. on June 9, felt in Hilo but not reported felt in the Volcano area, apparently had its origin beneath the crater region of Kilauea Volcano.

The seismograph at Konawaena School recorded 17 earthquakes during June. Most of them originated in central Kona close to the seismograph, probably on the Kealakekua fault.

LANDSLIDE ON THE HAMAKUA COAST

A small landslide took place on the sea cliff near the mouth of Manowaiopae Stream, just south of Laupahoehoe (Hamakua Coast), early on the morning of May 28. According to Joe Jose, who lives near the site of the slide, a small slip occurred at 3:00 A.M., followed by a larger one at 5:00 A.M. Seismographs on the Island of Hawaii recorded no earthquakes at those times, so the slides apparently were not set off by earthquakes. At the foot of the sea cliff the slides built a small peninsula; this was immediately attacked by waves which rapidly removed a large portion of it.

Such landslides are not uncommon along the sea cliffs of Hawaii, especially along the windward coast of Kohala. According to William Ellis (*Journal of a Tour around Hawaii*, Boston, 1825), similar landslides occurred late in 1822 or early in 1823 between Pololu and Honokane valleys and at a locality known as Laupahoehoe, about 1½ miles northwest of Waimanu Valley. Another landslide may have occurred at the latter locality during the violent earthquake of April 2, 1868. A large slide occurred on the sea cliff just east of the mouth of Honopue Valley during heavy rains in January, 1941 (Stearns and Macdonald, *Geology and Ground Water Resources of the Island of Hawaii*, 1946, p. 51). All these slides built debris fans at the base of the cliff, but only the Laupahoehoe fan was large enough to survive for long the attack of waves.

SEISMOLOGY

Local Earthquakes

The data for the following local earthquakes were determined from seismographs on the Island of Hawaii operated by the Hawaiian Volcano Observatory. Locations given are epicenters. The times given are arrival times at the Whitney Laboratory of Seismology, on the northeast rim of Kilauea Caldera. They are stated to the closest minute in Hawaiian Standard time, which is 10 hours slower than Greenwich Civil time. The number preceding each earthquake is the serial number for the current year. The intensity rating (Feeble, Moderate, etc.) given is that for the Whitney Laboratory. If the intensity was greater at one of the other stations, the name of that station and the intensity rating there are given in parentheses after the rating at the Whitney station.

75. Apr. 2, 02:59, no record at Kilauea (Kona, very feeble). Central Kona.
76. Apr. 7, 23:37, tremor (Kona, very feeble).
77. Apr. 10, 11:09, feeble (Mauna Loa, slight). Felt in Volcano district. Northeast slope of Mauna Loa.
78. Apr. 13, 18:00, no record at Kilauea (Kona, very feeble).
79. Apr. 14, 02:20, tremor (Kona, very feeble). Felt in Kona. Central Kona.
80. Apr. 16, 14:36, no record at Kilauea (Kona, very feeble).
81. Apr. 17, 09:35, very feeble. Kilauea.
82. Apr. 22, 15:28, very feeble.
83. Apr. 24, 01:42, feeble. Felt in Volcano district, south Kona, and Kohala. Southwest slope of Mauna Loa, near 19°20'N., 155°47'W.
84. Apr. 24, 05:44, very feeble.
85. Apr. 29, 08:50, moderate. Southwest rift of Kilauea (?).
86. Apr. 29, 11:03, moderate. Kilauea.
87. Apr. 29, 13:00, slight. Southwest rift of Kilauea (?).
88. May 3, 23:50, no record at Kilauea (Kona, very feeble).
89. May 6, 17:59, tremor (Kona, very feeble).
90. May 7, 14:43, no record at Kilauea (Kona, very feeble).
91. May 8, 01:18, no record at Kilauea (Kona, very feeble).
92. May 8, 16:19, tremor (Kona, very feeble).
93. May 8, 17:53, tremor (Kona, very feeble).
94. May 11, 08:48, slight. Kilauea (east rift zone ?).
95. May 13, 08:25, very feeble.
96. May 13, 12:10, very feeble.
97. May 15, 13:31, very feeble.
98. May 16, 10:31, very feeble.
99. May 17, 09:30, no record at Kilauea (Kona, very feeble).
100. May 17, 13:48, very feeble.
101. May 18, 03:05, very feeble.
102. May 19, 18:02, tremor (Kona, very feeble). Felt in south Kona.
103. May 20, 13:05, very feeble.
104. May 21, 14:12, very feeble.
105. May 22, 23:22, very feeble (Kona, feeble). Felt in central Kona. Kealakekua fault (?).
106. May 24, 02:05, slight. Felt in Volcano district. Kilauea.
107. May 24, 02:12, very feeble. Kilauea.
108. May 24, 02:44, moderate. Felt over much of Hawaii Island as far north as Kukuihaele. East slope of Mauna Loa near 19°26'N., 155°27'W.
109. May 24, 13:15, tremor (Uwekahuna, very feeble).
110. May 25, 10:17, tremor (Kona, very feeble). Felt in south Kona.
111. May 26, 06:26, feeble. Felt at Naalehu.
112. May 27, 19:33, tremor. Felt at Kapapala.
113. May 29, 04:59, slight (Kona, strong). Felt in central and south Kona, Naalehu, and Volcano district. Kealakekua fault at north side of Kealakekua Bay, near 19°29'N., 155°56'W.
114. May 29, 05:08, tremor (Kona, very feeble). Central Kona.
115. May 29, 07:47, no record at Kilauea (Kona, very feeble). Central Kona.
116. May 29, 10:21, no record at Kilauea (Kona, very feeble). Central Kona.
117. May 30, 05:16, very feeble.
118. May 31, 04:13, very feeble.
119. June 4, 01:14, very feeble.
120. June 4, 17:01, very feeble.
121. June 4, 18:48, very feeble. Felt fairly strongly at Kapapala. Southeast slope of Mauna Loa near Kapapala.

122. June 5, 11:23, very feeble.
 123. June 6, 04:48, very feeble. Kilauea.
 124. June 8, 16:58, very feeble.
 125. June 9, 00:44, very feeble.
 126. June 9, 00:49, slight. Felt in Hilo. Kilauea (?).
 127. June 10, 00:40, very feeble. Kilauea.
 128. June 11, 21:27, no record at Kilauea (Kona, very feeble). Central Kona.
 129. June 15, 03:24, no record at Kilauea (Kona, feeble). Central Kona.
 130. June 15, 20:34, feeble. Felt in Hilo and Volcano district. Northeast slope of Mauna Loa about 3 miles N 30° E of Volcano House, near 19°29'N., 155°14'W.
 131. June 16, 11:10, no record at Kilauea (Kona, very feeble). Central Kona.
 132. June 17, 02:27, no record at Kilauea (Kona, very feeble). West slope of Mauna Loa.
 133. June 18, 03:05, very feeble.
 134. June 20, 20:55, tremor (Kona, very feeble).
 135. June 21, 07:20, no record at Kilauea (Kona, very feeble).
 136. June 23, 17:50, very feeble (Kona, slight). Central Kona.
 137. June 23, 17:53, no record at Kilauea (Kona, very feeble).
 138. June 26, 17:53, no record at Kilauea (Kona, very feeble).
 139. June 26, 20:24, very feeble (Kona, feeble). Central Kona.
 140. June 26, 20:54, tremor (Kona, very feeble).
 141. June 27, 10:47, moderate. Felt in Volcano district. East slope of Mauna Loa about 3 miles S 60° E of Puu Kulua, near 19°31'N., 155°23'W.
 142. June 27, 23:12, tremor (Kona, very feeble).
 143. June 28, 20:20, very feeble.
 144. June 30, 00:45, tremor (Kona, very feeble). Central Kona.
 145. June 30, 06:37, tremor (Kona, very feeble). Central Kona.

Distant Earthquakes

The following earthquakes of distant origin were recorded on the seismographs of the Hawaiian Volcano Observatory. Locations of the epicenters are from the notices of Preliminary Determinations of Epicenters published by the U. S. Coast and Geodetic Survey. The time given is that of the first detectable emergence of the quake on the Bosch-Omori horizontal or Sprengnether vertical seismograms, in Hawaiian Standard time.

- April 5, 14:48, slight. Banda Sea, at 7°S., 132°E.
 April 18, 13:48, slight. Off south coast of Mexico, at 10°N., 102°W.
 April 23, 06:34, slight. New Britain region, at 4°S., 154°E.
 June 15, 08:05, slight. Near south coast of Kodiak Island, Alaska, at 56½°N., 154°W.

Earthquake Data, April-June, 1953

(Based on Bosch-Omori seismograph on northeast rim of Kilauea Caldera)

Week Beginning	Minutes of Tremor	Very Feeble	Feeble	Slight	Moderate	Strong	Local Seismicity*	Tele-seisms
April 5	6	0	1	0	0	0	2.5	1
12	5	1	0	0	0	0	1.75	1
19	12	0	1	0	0	0	4.0	1
26	17	0	0	1	2	0	9.25	0
May 3	11	0	0	0	0	0	2.75	0
10	15	2	0	1	0	0	6.75	0
17	73	0	0	0	0	0	18.25	0
24	149	3	0	2	1	0	45.75	0
31	38	6	0	0	0	0	12.5	0
June 7	30	3	0	1	0	0	11.0	0
14	48	1	1	0	0	0	13.5	1
21	58	2	0	0	1	0	18.5	0
28	15	2	0	0	0	0	4.75	0

* For definition of local seismicity see Volcano Letter 371 or 512. Each local earthquake is assigned a seismicity value according to its strength, as follows: tremor, 0.25; very feeble, 0.5; feeble, 1.0; slight, 2.0; moderate, 3.0; strong, 4.0. These values are totaled to give the weekly local seismicity. Continuous volcanic tremor is ignored in the calculation. The strength assigned to the earthquake depends on the double amplitude of the maximum oscillation it causes on the Bosch-Omori seismograph, as follows: tremor, less than 0.5 mm.; very feeble, 0.5 to 4 mm.; feeble, 4 to 11 mm.; slight, 11 to 25 mm.; moderate, 25 to 60 mm.; strong, greater than 60 mm.

Table of Tilt at Seismograph Stations on Rim of Kilauea Caldera

Week Beginning	Whitney Station (Northeast rim)		Uwekahuna Station (West rim)	
	Amount	Direction	Amount	Direction
April 5	1.4"	S 38° W	0.6"	N
12	0.9"	N 56° E	1.3"	S 37° E
19	1.3"	S 63° W	0.4"	N 45° E
26	1.3"	S 80° W	0.7"	N 27° W
May 3	0.6"	N 79° E	1.6"	N 12° W
10	0.4"	S 72° E	2.6"	S 14° E
17	1.5"	N 14° W	2.2"	S
24	1.3"	N 34° E	2.4"	N 23° W
31	1.2"	N 17° W	1.3"	S 14° W
June 7	1.0"	N 7° E	0	0
14	0.1"	W	0.7"	N 26° E
21	0.7"	N 9° E	1.4"	S 27° E
28	1.8"	N 20° W	0.4"	N 45° E

VOLCANO NOTES AND NEWS

VOLCANOLOGICAL SURVEY OF INDONESIA

The Volcanological Survey of Indonesia (Dinas Gunung Berapi Indonesia) is carrying on the work started by the Netherlands East Indies Volcanological Survey. Directly after the war the work was handicapped by a lack of funds and adequate personnel. Since 1950, however, rapid advances have been made in reconnaissance and mapping of volcanic districts, some of them previously unknown. Much of this has been made possible through the co-operation of the Air Force of the Republic of Indonesia. A summary account of the progress up to the end of 1952 is contained in *Berita Gunung Berapi (Communications of the Volcanological Survey of Indonesia)* 1 (1-2), Sept.-Dec., 1952.

Following the transfer of Sovereignty, Dr. G. A. deNeve became director of the Volcanological Survey, succeeding W. A. Petroshevsky in September, 1950. It was decided that aerial reconnaissance offered the most expeditious way of obtaining a general view of the volcanic activity of the whole of Indonesia and determining which volcanoes are most urgently in need of more detailed examination. This reconnaissance was largely accomplished by mid-1951, and ground examinations and mapping had been carried on in some areas. As a result of this work 15 new active volcanic centers have been found on Sumatra,

northern Celebes, and Flores, bringing the total number of active volcanoes and solfatara and fumarole fields in Indonesia to 167, in place of the 152 listed by C. H. Stehn in 1940.

Additional work was done during 1952 by teams of investigators transported to and from their respective areas of study in Catalina amphibian planes. Special studies have been carried out on Semeru to delineate the areas in danger from cold lahars (mud flows) and at Kelud for the restoration of the tunnels constructed to drain the crater lake.

This energetic resumption of work on Indonesian volcanoes is deserving of great praise, and it is to be hoped that the work can be continued in a similar manner and its scope increased still further.

ACTIVITY OF TRIDENT VOLCANO

Trident Volcano, in Alaska, continues in mild activity. The lava flow issuing about a mile southwest of the old crater of Trident continued to grow slowly until June 2. George Snyder, geologist of the U. S. Geological Survey, reports that between June 2 and June 17 the rate of growth of the flow increased markedly. He estimated the thickness of the flow in the vicinity of the vent to be about 1,000 feet on June 17. The rate of gas emission is much decreased over that during March. Snyder

reports there were two large explosions and constant gas liberation during an hour's observation on June 17. Steam is issuing from the crater of nearby Mageik Volcano. Robert R. Coats reports (U. S. Geological Survey Bulletin 974-B) that Mageik Volcano and the neighboring volcanoes Katmai, Martin, and Novarupta have been steaming almost constantly since 1912. A small cinder cone is reported to have been built on the southwest flank of Novarupta, in the Valley of Ten Thousand Smokes, in July, 1950 (Lowell Sumner, Sierra Club Bul. 37 (10):45, Dec., 1952). George Snyder states (Preliminary Report of Mt. Trident Eruption) that according to the *Kodiak Mirror* for Feb. 21, 1953, Mageik Volcano last erupted in 1951.

The accompanying photograph shows the lava flow on the southwest flank of Trident Volcano on February 21 and the cloud of ash and fume rising at the vent from which the flow is issuing.

Snyder estimates that from the beginning of the eruption until March 11 the volume of lava and ash liberated by Trident Volcano was between 2.2 and 4.5 billion cubic feet (0.015 to 0.03 cubic mile) and that between March 11 and June 17 from 1 to 2.5 billion cubic feet of additional lava was extruded. Compared with this, the volume of ash and other fragmental material produced by the great eruption of Katmai Volcano in 1912 has been estimated at 6 to 7 cubic miles.

R. E. Wilcox writes that the last significant ash eruption of Trident Volcano was on June 30.

ACTIVITY OF GREAT SITKIN VOLCANO

Richard McDonald, seismologist of the U. S. Geological Survey, reports that on May 11, 1953, the Coast and Geodetic Survey ship *Pioneer* observed a spectacular column of steam rising an estimated 5,000 feet above Great Sitkin Volcano, in the Aleutian Islands. The steam column lasted about an hour. An earthquake felt at Adak on May 12, with an intensity of 5 on the modified Mercalli scale, had its epicenter on a line passing through Great Sitkin. On the afternoon of May 14 a steam cloud was seen to rise about 4,000 feet above the crater rim of Great Sitkin, and during the evening another earthquake occurred, slightly less severe than that of May 12, with its epicenter on the same line. Both quakes apparently were more severe on Great Sitkin than on Adak. When next observed, on May 19, the steaming of Great Sitkin Volcano was much diminished but still greater than normal. Subsequent observations on May 23, June 5, and June 7 showed only weak emission of steam. No ash eruption was observed during the period from May 11 to June 7, nor did the form of the basalt dome in the crater of Great Sitkin change appreciably.



FIGURE 2. Trident Volcano, Mount Katmai National Monument, in eruption on February 21, 1953. The cloud of ash and fume is rising from a vent on the southwest slope of Trident, and a small lava flow also is issuing from the same vent. Knife Peak Volcano appears on the left of the view, and Katmai Volcano, with its summit caldera formed during the great eruption of 1912, is on the right. Official U. S. Navy photograph.

ACTIVITY IN THE MARIANA AND VOLCANO ISLANDS

Charles G. Johnson, of the U. S. Geological Survey's Military Geology Branch, has forwarded a report from the 54th Strategic Reconnaissance Squadron, USAF, on aerial reconnaissance of activity on Farallon de Pajaros, in the Mariana Islands, and submarine volcanic activity near Minami Iwo Jima, in the Volcano Islands.

During late March the Farallon de Pajaros volcano was in mild explosive activity. On March 25, Major J. F. Fagan reported small puffs of smoke from the crater at intervals of 2 to 3 minutes. On March 26, Lt. J. D. Long counted eight explosions in 11 minutes, during which rocks estimated to be as much as 3 feet in diameter were thrown an estimated 30 feet above the crater rim. On March 27, Capt. C. G. Cook observed only two belches of smoke containing only small fragments in a period of 20 minutes. On March 28, Capt. K. S. Durham observed puffs of smoke rising about 300 feet above the crater every 65 to 70 seconds. Similar activity was reported on March 30 and 31.

About 1.5 miles north-northeast of Minami Iwo Jima subma-

rine volcanic activity produced a small area of very light green water.

ACTIVITY ON SAN BENEDICTO ISLAND

Adrian F. Richards, of the Scripps Institution of Oceanography, again visited the Revilla Gigedo Islands in March, 1953. At that time Boqueron Crater on San Benedicto Island was quiet. The lava in the crater was cool at the surface but gave vent to numerous active fumaroles. The delta of blocky lava at the eastern base of the cone was about three times as large as it had been during December, 1952, extending seaward about 2,100 feet beyond the old shoreline and providing a good small-boat harbor on its south side. Information from fishermen leads Richards to believe that the flow probably ceased its forward growth during January.

Richards also reports an area of active fumaroles covering nearly 2 acres near the peak on the north and northeast sides of Mount Evermann, on Socorro Island. Many small, boiling mud pots were observed.

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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.

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.

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CONDITION OF ACTIVE VOLCANOES OF ITALY IN 1952

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Although there are many volcanoes in Italy which have been active in very recent geologic time, the number which have been active in historic time is quite limited, even considering the fact that recorded history in this region goes back to around 800 B.C., when the first Greek colonies were established in the region. Today active vents are located in only three areas: (1) the Naples area, including Vesuvius and the Solfatara of Pozzouli, (2) the Eolian Islands, represented by Stromboli and Vulcano, and (3) Mt. Etna in Sicily.

The writer was privileged to spend most of 1952 in a study of the active and recently extinct volcanoes of Italy. The purpose of this brief paper is to set forth the state of activity during 1952 of the so-called active vents.

VESUVIUS

It should be kept in mind that Vesuvius is but one of a number of volcanoes in the Naples area which have been active in recent geologic time. Probably the oldest of these is Epomeo on the island of Ischia which last erupted in 1302. A very severe earthquake in 1883 at Casamiccola (Ischia) indicates that the volcanic energy is not entirely dead. In the Phlegrean Fields, on the shore of the Bay of Naples, there are no less than 19 separate craters, the last activity being the birth of the new crater, Monte Nuovo, in 1538. The Solfatara, one of the craters in the Phlegrean Fields, just west of Naples (Fig. 1), maintains a constant emission of hot gases from which the name "Solfatara" is derived. The activity of the Solfatara, with the exception of an eruption in 1198 in which lava poured, has been in about its present state since the earliest records.

The great eruption of Vesuvius in 79 A.D., in which Pompeii and Herculaneum were destroyed, blew away a large part of the old cone, and a new cone, the present Vesuvius, was built, its center being somewhat removed from the center of the old cone. The remnants of the old cone, which still partly encircle Vesuvius, are known as Monte Somma (Fig. 2).

Following the eruption of 79 A.D., the activity of Vesuvius appears to have been very irregular, with long

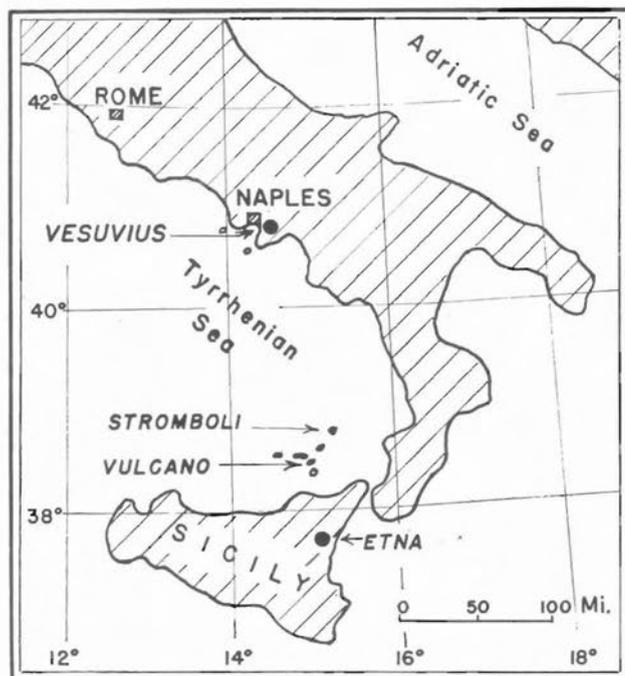


FIGURE 1. Map of southern Italy, showing the location of the principal volcanoes mentioned in the text.

intervals between eruptions, until the grand eruption of 1631. This eruption, one of the greatest in the entire history of Vesuvius, marks a new era in the activity of the volcano. Since 1631 Vesuvius has been in an almost constant state of activity. This activity, which may be described as cyclic, is marked by eruptive periods in which moderate activity is climaxed by a grand eruption which ends a cycle, the new cycle beginning with a repose period. Mercalli has published a list of 12 eruptive periods since 1700, each culminating with a paroxysm followed by a distinct interval of complete inactivity (repose period), the duration of which varied from 2 to 7 years. The repose period is marked by simple emanations of gaseous material. It is the period during



FIGURE 2. Vesuvius during 1952, with the Bay of Naples in the foreground. The present cone of Vesuvius is on the right. The peak at the left is a high portion of the encircling remnant of Monte Somma. Photo by author.

which the magma acquires a gas-saturated condition required for the next eruption.

The great eruption of 1906 closed a cycle, and the repose period which marked the beginning of the new cycle lasted until 1913 (some slight activity in 1911 is interpreted by some writers as marking the end of the repose phase), a period of 7 years. In the following years Vesuvius was in an almost continuous state of moderate activity until the grand eruption of 1944 which marked the end of the cycle. The 1944 eruption began on March 18 and lasted 11 days. Extensive lava flows covered the towns of Massa and San Sebastiano, as well as destroying a portion of the Vesuvius railway line. The new cycle was initiated by a repose phase which has continued to the present time. As the repose phase of Vesuvius has rarely exceeded 7 years, and it is now in its ninth year, it is obvious that a renewal of activity may be expected at any time.

At the end of the 1944 eruption the crater was an elliptical-shaped basin with a maximum depth of about 900 feet below the west rim. Since the 1944 eruption, the crater has been gradually filling by avalanches from the sides. Its depth in July, 1952, was estimated to be about 700 feet. As the sides avalanche, they not only fill up the bottom of the crater but also enlarge the upper rim. As some of the large avalanches crash into the crater, a great cloud of dust, resembling a cauliflower in appearance, boils out of the crater. Frequently, such clouds are reported in the press as eruptions.

The greatest thermal activity at present is on the eastern side, 200 to 300 feet below the rim on the outer slope. For the past year or so this has been a "hot" spot, and recent press reports list temperatures in excess of 650°C. Whether this indicates that the next outbreak will occur at this point cannot, of course, be determined, but it is at least suggestive. Numerous steam fumaroles rise from points on the interior walls of the crater. There is a considerable accumulation of sulphur around fuma-

roles on the inner slope of the northeast rim, which is the highest point on the crater.

If the renewal of activity at Vesuvius follows the pattern of the previous eruptive cycles, the first activity will begin with the opening of a *bocca* in the bottom of the crater and the development of a small cinder cone. Later, lava will appear as intercrater flows, perhaps filling the crater and overflowing the rim or issuing from cracks near the top as slow outpourings of lava.

STROMBOLI

The Eolian Islands (Lipari Islands), in the Mediterranean sea off the southern coast of Italy and directly north of Sicily, consist of a number of volcanoes, two of which (Stromboli and Vulcano) are considered active. Stromboli is a large volcano, rising from the floor of the Mediterranean Sea in water between 6,000 and 7,000 feet deep and reaching a height of approximately 3,000 feet above sea level. Its total height from its submarine base is 3,200 meters; by comparison, Mt. Etna reaches a height of only 2,900 meters. Thus Professor G. Ponte was not entirely incorrect when, in a recent paper, he described Stromboli as the highest active volcano in Europe.

Normally, the lava column stands very high in the conduit, and frequent gas explosions hurl quantities of red-hot scoria several hundred feet into the air. The explosions occur at intervals of 15 to 30 minutes, and at each outburst a red glow is reflected on the rising gas column, gradually dying out as the lava crusts over. This red glow, coming and going at more or less regular intervals, has given to this volcano the name, "Lighthouse of the Mediterranean." So characteristic of Stromboli is the throwing out of incandescent scoria that it has been selected as one of the types of volcanoes. Although the so-called Strombolian type of activity is characteristic of Stromboli, the volcano also exhibits rare but violent explosive eruptions accompanied by large *pino* (pine-tree shaped) clouds, which spread ash

FIGURE 3. Stromboli, from the north. The eccentric crater is about 600 feet below the summit. The talus-like slope extending from the crater to the sea is the Sciarra del Fuoco. Photo by the author.



and cinders widely. Effusive lava flows are also much more common than has been generally accredited, and because of this fact it must be recognized that Stromboli, like most volcanoes, exhibits various eruptive phases and is not limited to the so-called Strombolian type.

The writer made three visits to Stromboli in 1952: in June, again on December 1-3, and during the week of December 12-19. As one approaches Stromboli by ship (it is an overnight trip from Naples) in the early morning, the symmetrically shaped cone with a white vapor column rising from the crater can be seen for some time before the ship is close enough to enable one to distinguish the big scar on the side of the cone, known as the Sciarra del Fuoco (Fig. 3). On the first trip to Stromboli in June, 1952, numerous columns of white vapor were observed rising from the crater, and at infrequent intervals a dense, yellowish-brown gas issued. There was no noise, and no red glow was observed. The cone was climbed on June 21 and the activity observed from the top of the north peak, from which vantage point one is able to look down into the crater some 600 feet below. The first view into the crater is a thrilling sight.

The crater is a large, oval-shaped basin, about 500 feet in its longest dimension, about 600 feet below the summit of the mountain. It is separated into two sections by a low ridge of debris. Extending from the northwest edge of the crater to the sea is the Sciarra del Fuoco. In June, 1952, there were within the crater two active vents and possibly a third. The vent nearest the edge of the Sciarra del Fuoco was an oval-shaped crater, possibly 30 to 40 feet in diameter, from which issued a grayish gas and, at intervals, a dense white cauliflower cloud of steam. There was no noise associated with this vent.

At the opposite end of the oval-shaped crater was the most active vent. From it a grayish-white vapor issued which frequently filled the entire crater, obscuring everything. There was a continuous roar, more of

a chugging or "slushing" noise, comparable to that made by a locomotive when the engineer slides the wheels in starting, or to the unrhythmical exhaust of a pump station in an oil field. At intervals of 15 to 30 minutes this exhaust was interrupted by more violent outbursts (not an explosion but a tremendous outrush of gas) which hurled rocks (scoria) from 600 to 1,000 feet above the crater floor. They were not incandescent, and most of them fell back into the crater, the noise continuing until another outburst took place. There appeared to be a third vent, approximately midway between the two described. This vent could not be seen clearly from the vantage point, but a gas column was observed rising from this point from time to time. Active avalanching was taking place on the opposite wall of the crater. At irregular intervals avalanches slid from the wall, giving rise to dense, yellowish-brown cauliflower clouds which filled the crater and spread a rain of fine ash over the upper part of the cone.

Lava flow of June 6, 1952. This flow apparently began without any preliminary explosions or *pino* clouds which normally accompany an outflow, as the inhabitants of San Vincenzo were not aware of the flow until a tourist, arriving by ship, commented on the lava flowing down the Sciarra del Fuoco. The flow appears to have started on June 6 and to have continued for several days. The lava reached the sea at the base of the Sciarra del Fuoco, building out two small projections into the sea which were still steaming when visited by the writer on June 22.

The cone was not ascended on the December 1-3 visit to Stromboli because of bad weather conditions. However, from the deck of the ship, as the writer was leaving Stromboli for Naples late in the evening of December 3, a red glow was noted which faded and reappeared. Suddenly, with a brilliant glare, a tremendous explosion hurled fragments into the air which could be clearly distinguished even at a distance of a number of miles. The glare which illuminated the lower part of the cone was a whitish red, the upper part a



FIGURE 4. Vulcano, from Quattr'ochi, Lipari. The low rim encircling the highest cone is the remnant of an earlier cone. Photo by the author.

bright red. Two such explosions occurred during the hour the "Lighthouse of the Mediterranean" was watched from the deck of the ship before it disappeared over the horizon.

Two visits to the crater were made on the third trip to Stromboli in mid-December. On the first ascent (December 14) the conditions were generally the same as in June, except that the steam column was much denser (probably due to colder air temperature) and the visibility, as a result, much poorer. The west vent, as usual, was the most active and was accompanied by the chugging or exhaust noise as in June. When a second ascent was made on December 18, the conditions were somewhat different. From the west vent, at intervals of 20 to 30 minutes, showers of red-hot scoria were thrown to a height of around 600 feet. The outbursts, although definite explosions, were more like an exhaust with a hissing noise, or like the outrush of gas under high pressure. The scoria fragments were mostly flat and appeared to represent the thin crust from a bubble, which on bursting showered fragments into the air. All the scoria fell back into the cavity, none reaching the Sciarra del Fuoco. The chugging, so prominent on previous visits, was entirely absent, and between outbursts there was a silent emission of steam. The eastern vent (adjacent to Sciarra del Fuoco) continued to send up large quantities of steam, and at irregular intervals, probably 30 to 40 minutes, it exploded with a shrill, whistling noise. There was no apparent relationship between the activity of the two vents.

VULCANO

Vulcano is one of the Eolian Islands, immediately adjacent to Lipari, famous in classic mythology as the site of Vulcan's forge (Fig. 4). It was quite active in the early centuries of the Christian era but has been less active in recent times. The last eruption was in 1888-90. Since that time it has been in a solfataric state of activity. When the writer visited Vulcano in late November, 1952, it appeared to be in about the same

state of activity as described in the literature of the past 10 to 20 years. Abundant fumaroles were active on the upper half of the inner slope of the west wall of the crater. Deposits of sulphur were abundant around all the openings. Strangely enough, no fumaroles occur on the floor of the crater, and there is no evidence in deposits to indicate that any ever were present.

Another active fumarole area is at the west base of the main cone, known as Faraglioni di Levante, or Porto di Levante. The mining of sulphur was carried on here for years, but no work is now being done. The sulphur occurs as impregnations in the porous tuffs. Active fumaroles occur along the beach and in the shallow water near shore, as well as on the land a few yards back of the beach. There are several active, boiling mud pits similar to those at the Solfatarata of Pozzouli. Drilling is under way in this area in an effort to obtain natural steam for the generation of electricity.

MT. ETNA

Located on the east coast of Sicily, Mt. Etna is the greatest volcanic mass in Europe and one of the large volcanoes of the world. It has the shape of an enormous cone truncated at a height of 9,190 feet by a plateau on which stands the summit cone, which reaches a height of 10,742 feet. The regularity of the slope is marred by about 200 parasitic cones which mark the site of previous eruptions. On the east slope of the cone is the tremendous depression or valley known as the Valle del Bove.

Mt. Etna has been known as an active volcano from the earliest times. One of the greatest eruptions of Mt. Etna was in 1669, when the city of Catania was destroyed by a lava flow. From 1669 to 1951 there have been 35 eruptions, separated by an average interval of 8 years. The most recent eruptions were in 1923, 1928, 1942, and 1950-51.

The summit crater is a circular depression, some 2,000 feet in diameter. Numerous steam columns rise from

the floor and sides of the crater, but sublimate deposits are insignificant. Prior to 1942 the crater was a cone-shaped depression nearly 1,000 feet deep, with many steam vents and small cones on the floor. In 1942 there was an eruption within the crater, and it filled to its present level, which is about 300 feet below the rim. A low cinder cone, from which abundant steam issues, occupies a portion of the crater floor. On the northeast edge of the crater floor there is a circular depression (small-scale replica of Halemaumau on the floor of Kilauea) which was formed by subsidence of the crater floor in 1945. On the northeast edge of the summit crater and outside the rim is the Northeast Bocca (also known as the northeast subterminal crater). It is a cone formed during the eruption of 1911, partly merged with the present summit crater but some 200 feet below and on the outer slope. From this opening great volumes of steam and occasionally other gases issue. This is the vent which supplies the vapor column rising constantly from Mt. Etna. The vent can be well observed from a vantage point on the main crater rim. Large clouds of white steam boil out with a hissing noise, accompanied by a roar which resembles the continuous roll of thunder. The guide reported that the thunder-like noise is present only when the vapor is white (i.e., steam). If it is dark (ash-filled) there is no noise. A similar relationship between the composition of the eruption cloud and noise was noted at Parícutin Volcano, Mexico.

The last eruption of Mt. Etna began on November 25, 1950, preceded by intense activity at the northeast subterminal crater. Large quantities of fluid lava issued from the east base of the summit cone near the 9,000-foot level and flowed into Valle del Bove. This great expanse of fresh, black lava forms a striking floor in the Valle del Bove today.

A very sharp earthquake damaged a number of towns on the eastern slope of Mt. Etna on March 22, 1952. The greatest damage centered around San Venerina, where 400 families were left homeless. Whether this is to be the point of a future outbreak is, of course, not known, but it is interesting to point out the possibility of such being the case.

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HAWAIIAN VOLCANO OBSERVATORY REPORT FOR JULY-SEPTEMBER, 1953

By GORDON A. MACDONALD

VOLCANOLOGY

July

Seismographs of the Hawaiian Volcano Observatory recorded 82 earthquakes during July. Of these, 44 were recorded at Kilauea caldera and 58 at the Mauna Loa station. Many, of course, were recorded at both stations, but an unusually large proportion were too small to be recorded at any but the closest. The number of earthquakes was somewhat greater than usual, but only two were large enough to be felt. On July 26 at 1:52 P.M., a moderate quake was felt from central Kona to Hawi. It appears to have originated in the vicinity of Hualalai. At 10:24 P.M. on July 28, a quake felt lightly in central Kona probably was of nearby origin.

During the month, tilting of the ground at the northeast rim of Kilauea caldera was northward at a rate slightly greater than normal. There appears to have been little change of volcanic pressure at Kilauea. From July 22 to 31 there was a marked westward tilting. This, together with northwestward tilting at the Mauna Loa station, suggests a decrease of pressure beneath Mauna Loa, accompanied by some subsidence of the mountain.

August

Hawaiian volcanoes continued moderately uneasy throughout August. Observatory seismographs recorded 79 earthquakes during the month. Of these, 47 were recorded at the stations on the rim of Kilauea caldera, and 58 at the Mauna Loa station. Most of the quakes came from shallow foci on the northeast rift zone of Mauna Loa or in the vicinity of Kilauea Crater.

Earthquakes felt strongly at Kapapala and slightly from Naa-lehu to the Volcano district, at 6:48 A.M. on August 1, 5:20 P.M. on August 4, and 12:46 A.M. on August 6, originated on the southwest rift zone of Kilauea a short distance southwest of Mauna Iki. A quake felt strongly in central Kona at 3:00 A.M. on August 8 originated nearby, probably on the Kealakekua fault.

An earthquake felt all over the island of Hawaii and by many persons on Maui and Oahu, at 7:46 P.M. on August 21, appears to have originated beneath the north slope of Hualalai volcano in the vicinity of Puu Waawaa. This is the area from which came more than 6,000 earthquakes during September and October, 1929. Another earthquake, felt strongly in Kona and lightly over most of the rest of the island at 12:53 A.M. on August 23, originated beneath the southwest slope of Hualalai, east of Holu-aloa.

Through August the ground surface at the northeast rim of Kilauea Crater tilted northward at a rate somewhat greater than normal and westward in place of the eastward tilting normal during that season of the year. Some of this abnormal tilting may have been caused by the load imposed on the ground by the weight of the new addition to the Volcano House, then under construction. It appears probable, however, that much of it was of volcanic origin, resulting from a decrease of volcanic pressure beneath Mauna Loa and an increase beneath Kilauea.

September

Hawaiian volcanoes continued to be seismically restless during the month of September. A large number of very small earthquakes was recorded. Many of them apparently originated on or near the zone just south of the island from which came the great number of quakes during March and April, 1952, preceding the eruption of Kilauea. (See Volcano Letter 515.) Several other quakes had their origins along the Kaoiki fault zone near Ainapo and in central Kona. Two of the latter, at 3:00 P.M. on September 23 and 1:20 P.M. on September 27, were felt in Kona.

The ground surface at the northeast rim of Kilauea caldera tilted northward throughout the month at a rate slightly greater than normal for this season of the year. Eastward tilting was at approximately the normal seasonal rate. The possible small increase of volcanic pressure under Kilauea, suggested by the northward tilting, tends to be confirmed by the slight opening of cracks on the crater floor.

SEISMOLOGY

Local Earthquakes

The data for the following local earthquakes were determined from seismographs on the island of Hawaii operated by the Hawaiian Volcano Observatory. Locations given are epicenters. The times given are arrival times at the Whitney Laboratory of Seismology on the northeast rim of Kilauea caldera. They are stated to the closest minute in Hawaiian Standard time, which is 10 hours slower than Greenwich Civil time. The number preceding each earthquake is the serial number for the current year. The intensity rating (Feeble, Moderate, etc.) given is that for the Whitney Laboratory. If the intensity was greater at one of the other stations, the name of that station and the intensity rating there are given in parentheses after the rating at the Whitney station.

146. July 1, 15:14, tremor (Mauna Loa, very feeble). Northeast rift of Mauna Loa.
147. July 2, 00:12, very feeble.
148. July 2, 05:34, no record at Kilauea (Mauna Loa, very feeble). Northeast rift of Mauna Loa.
149. July 2, 07:09, tremor (Mauna Loa, very feeble). Northeast rift of Mauna Loa.
150. July 2, 11:58, no record at Kilauea (Mauna Loa, very feeble).
151. July 6, 02:51, very feeble, west slope of Mauna Loa.
152. July 6, 07:19, very feeble, northeast rift of Mauna Loa.
153. July 6, 15:07, tremor (Mauna Loa, very feeble).
154. July 6, 20:26, slight. Beneath southwest edge of Kilauea caldera.
155. July 6, 23:55, very feeble.
156. July 7, 15:59, tremor (Uwekahuna, very feeble).
157. July 7, 17:55, very feeble.
158. July 9, 09:21, tremor (Uwekahuna, very feeble).
159. July 10, 10:07, tremor (Mauna Loa, very feeble).
160. July 13, 15:56, very feeble.
161. July 14, 12:37, tremor (Mauna Loa, very feeble).
162. July 15, 04:59, very feeble. Felt at Kapapala.
163. July 19, 13:24, tremor (Mauna Loa, very feeble).
164. July 20, 18:07, very feeble (Mauna Loa, feeble). East slope of Mauna Loa.
165. July 21, 17:30, tremor (Mauna Loa, very feeble).
166. July 24, 02:29, tremor (Uwekahuna, very feeble).
167. July 26, 10:18, no record at Kilauea (Kona, very feeble). Felt in central Kona.
168. July 26, 13:52, tremor (Kona, very feeble). Felt in central Kona and at Hawi.
169. July 26, 21:47, tremor (Mauna Loa, very feeble).
170. July 26, 22:44, very feeble.
171. July 28, 22:24, tremor (Kona, feeble). Felt in central Kona. Central Kona.
172. July 30, 14:30, tremor (Mauna Loa, very feeble). Probably Kaoiki fault.
173. July 31, 13:07, very feeble.
174. July 31, 23:44, very feeble.
175. Aug. 1, 06:48, very feeble (Mauna Loa, feeble). Felt at Pahala. Southwest rift of Kilauea near 19°20'N., 155°21'W.
176. Aug. 1, 08:13, 20'N., 155°21'W.
177. Aug. 1, 23:39, tremor (Mauna Loa, very feeble).
178. Aug. 2, 02:31, very feeble.
179. Aug. 4, 11:10, very feeble.
180. Aug. 4, 17:20, very feeble (Mauna Loa, feeble). Felt: Kapapala, strong; Volcano, Naalehu, slight. Southwest rift of Kilauea near 19°20'N., 155°23'W.
181. Aug. 5, 02:46, tremor (Mauna Loa, very feeble). Mauna Loa, northeast rift.
182. Aug. 6, 00:47, very feeble (Mauna Loa, slight). Felt at Kapapala. Southwest rift of Kilauea near 19°22'N., 155°21'W.
183. Aug. 6, 14:39, very feeble.
184. Aug. 6, 18:47, very feeble.
185. Aug. 6, 21:08, tremor (Mauna Loa, very feeble).
186. Aug. 7, 02:17, very feeble.
187. Aug. 7, 05:53, very feeble.
188. Aug. 8, 00:37, tremor (Mauna Loa, very feeble).
189. Aug. 8, 03:00, very feeble. Felt strongly in central Kona.
190. Aug. 11, 07:12, very feeble.
191. Aug. 11, 09:16, very feeble. Kilauea.
192. Aug. 11, 12:39, very feeble. Kilauea.
193. Aug. 12, 08:38, very feeble.
194. Aug. 13, 05:55, very feeble (Uwekahuna, feeble).
195. Aug. 14, 18:20, tremor (Mauna Loa, very feeble).
196. Aug. 14, 22:14, very feeble.
197. Aug. 15, 10:33, tremor (Mauna Loa, very feeble).
198. Aug. 15, 12:04, tremor (Mauna Loa, very feeble).
199. Aug. 15, 16:27, no record at Kilauea (Kona, very feeble). Kona.
200. Aug. 16, 20:53, no record at Kilauea (Kona, very feeble). Central Kona.
201. Aug. 18, 17:47, no record at Kilauea (Mauna Loa, very feeble).
202. Aug. 20, 12:56, tremor (Mauna Loa, very feeble).
203. Aug. 21, 19:47, slight (Mauna Loa, Kona, and Hilo, strong). Felt all over island of Hawaii and as far away as Honolulu. Felt on Maui, generally weakly, but strong in Haleakala Crater. North slope of Hualalai near Puu Waawaa.
204. Aug. 21, 21:07, very feeble. Felt in Kona.
205. Aug. 23, 00:53, strong. Felt: Kona strong; Naalehu and Kapapala, moderate; Volcano, slight. Beneath southwest slope of Hualalai about 3 miles east of Holualoa.
206. Aug. 24, 23:05, no record at Kilauea (Kona, very feeble). Felt slightly in central Kona. Central Kona.
207. Aug. 25, 14:54, tremor (Mauna Loa, very feeble).
208. Aug. 27, 09:44, tremor (Mauna Loa, very feeble).
209. Aug. 27, 10:49, tremor (Mauna Loa, very feeble).
210. Aug. 29, 06:16, tremor (Mauna Loa, very feeble).
211. Sept. 1, 04:07, very feeble.
212. Sept. 1, 15:31, very feeble (Mauna Loa, feeble).
213. Sept. 1, 15:36, tremor (Mauna Loa, very feeble).
214. Sept. 2, 06:24, tremor (Mauna Loa, very feeble).
215. Sept. 3, 04:42, very feeble. Felt at Hawaii National Park. Kilauea.
216. Sept. 4, 05:58, no record at Kilauea (Kona, very feeble).
217. Sept. 4, 15:40, no record at Kilauea (Mauna Loa, very feeble).
218. Sept. 10, 07:00, tremor (Mauna Loa, very feeble).
219. Sept. 10, 20:02, no record at Kilauea (Mauna Loa, very feeble).
220. Sept. 12, 01:58, very feeble.
221. Sept. 12, 06:57, very feeble.
222. Sept. 13, 07:16, very feeble.
223. Sept. 13, 16:35, tremor (Mauna Loa, very feeble).
224. Sept. 14, 14:03, tremor (Mauna Loa, very feeble).
225. Sept. 15, 02:37, no record at Kilauea (Kona, very feeble). Kona.
226. Sept. 15, 10:57, tremor (Mauna Loa, very feeble).
227. Sept. 16, 04:22, tremor (Mauna Loa, very feeble).
228. Sept. 17, 19:34, very feeble.
229. Sept. 23, 07:50, tremor (Mauna Loa, very feeble).
230. Sept. 23, 14:50, very feeble (Kona, slight). Felt in central Kona. Central Kona.
231. Sept. 24, 02:09, no record at Kilauea (Mauna Loa, very feeble).
232. Sept. 25, 09:40, tremor (Mauna Loa, very feeble).
233. Sept. 25, 11:46, tremor (Mauna Loa, very feeble).
234. Sept. 25, 12:00, tremor (Mauna Loa, very feeble).
235. Sept. 25, 12:19, tremor (Mauna Loa, very feeble).
236. Sept. 25, 13:10, tremor (Mauna Loa, very feeble).
237. Sept. 25, 16:33, tremor (Mauna Loa, very feeble).
238. Sept. 25, 17:13, tremor (Mauna Loa, very feeble).
239. Sept. 26, 11:04, no record at Kilauea (Mauna Loa, very feeble).
240. Sept. 26, 12:16, no record at Kilauea (Mauna Loa, very feeble).
241. Sept. 26, 12:57, no record at Kilauea (Mauna Loa, very feeble).
242. Sept. 26, 13:02, no record at Kilauea (Mauna Loa, very feeble).
243. Sept. 26, 13:43, tremor (Mauna Loa, very feeble).
244. Sept. 26, 17:25, no record at Kilauea (Mauna Loa, very feeble).
245. Sept. 26, 20:11, no record at Kilauea (Mauna Loa, very feeble).
246. Sept. 27, 06:08, very feeble. Probably Kaoiki fault.
247. Sept. 27, 13:20, no record at Kilauea (Kona, feeble). Felt in central Kona.

Earthquake Data, July-September, 1953

(Based on Bosch-Omori seismograph on northeast rim of Kilauea caldera)

Week Beginning	Minutes of Tremor	Very Feeble	Feeble	Slight	Moderate	Strong	Local Seismicity*	Tele-seisms
July 5	10	4	0	1	0	0	4.5	0
12	7	2	0	0	0	0	2.75	0
19	6	1	0	0	0	0	2.0	0
26	6	5	0	0	0	0	4.0	0
Aug. 2	8	9	0	0	0	0	6.5	0
9	5	6	0	0	0	0	4.25	0
16	3	1	0	1	0	0	3.25	0
23	6	0	0	0	0	1	5.5	0
30	5	3	0	0	0	0	2.75	0
Sept. 6	2	3	0	0	0	0	2.0	0
13	3	2	0	0	0	0	1.75	1
20	33	2	0	0	0	0	9.25	0
27	8	2	0	0	0	0	3.0	2

* For definition of local seismicity see Volcano Letter 371 or 512. Each local earthquake is assigned a seismicity value according to its strength, as follows: tremor, 0.25; very feeble, 0.5; feeble, 1.0; slight, 2.0; moderate, 3.0; strong, 4.0. These values are totaled to give the weekly local seismicity. Continuous volcanic tremor is ignored in the calculation. The strength assigned to the earthquake depends on the double amplitude of the maximum oscillation it causes on the Bosch-Omori seismograph, as follows: tremor, less than 0.5 mm.; very feeble, 0.5 to 4 mm.; feeble, 4 to 11 mm.; slight, 11 to 25 mm.; moderate, 25 to 60 mm.; strong, greater than 60 mm.

Table of Tilt at Seismograph Stations on Rim of Kilauea Caldera

Week Beginning	Whitney Station (Northeast rim)		Uwekahuna Station (West rim)	
	Amount	Direction	Amount	Direction
July 5	1.4"	N 42° W	4.8"	S 8° E
12	0.3"	S 45° W	1.6"	N 12° E
19	1.6"	N 9° W	0.4"	S 45° W
26	2.7"	N 69° W	1.6"	N 12° W
August 2	1.8"	W	2.9"	N 27° W
9	1.1"	N 64° W	1.1"	S 34° E
16	1.8"	N 4° W	3.4"	S 12° E
23	0.9"	N 16° E	3.4"	S 12° E
30	1.0"	S 61° E	1.0"	N 72° E
September 6	1.0"	N 70° E	0.3"	N
13	1.2"	N 5° E	2.6"	N 7° W
20	1.8"	N 4° E	1.4"	S 27° E
27	1.4"	S 85° E	3.5"	N 22° W

New Seismographs

On June 26, 1953, the old Hawaiian-type seismograph at the Mauna Loa station was replaced by a new Loucks-Omori seismograph. The station had been out of operation for about 3 weeks during renovation of the vault and installation of the new instrument. The Loucks-Omori seismograph is an Omori-type seismograph developed at the Hawaiian Volcano Observatory as a result of gradual and long-continued modification of the Bosch-Omori instrument. Built by Burton J. Loucks and John C. Forbes in the Observatory's instrument shop, it consists of two heavy horizontal pendulums hung respectively north-south and east-west, operating at an undamped period of 3 seconds, with a static magnification of 200.

The seismograph station on Haleakala, island of Maui, had been out of operation since the early part of World War II. On August 20, 1953, a new Loucks-Omori seismograph was installed in the Haleakala station. Like the Mauna Loa instrument, it has a static magnification of 200 and is being operated at a period of 3 seconds. The station is situated in the headquarters area of the Haleakala Section of Hawaii National Park, at 20°45'57"N. and 156°14'58"W. It is operated by the National Park staff under the direction of Mr. Eugene Barton, Assistant Superintendent. Records are sent to the Hawaiian Volcano Observatory for interpretation.

New buildings for seismograph stations were completed during July on the grounds of the Waimea School at Kamuela, the Naalehu School at Naalehu, and the Pahoia School at Pahoia, island of Hawaii. These new stations will be operated in co-operation with the Territory of Hawaii Department of Public Instruction. It is expected that seismographs will be installed in them within the next few months.

Distant Earthquakes

The following earthquakes of distant origin were recorded on the seismographs of the Hawaiian Volcano Observatory. Locations of the epicenters are from the notices of Preliminary Determinations of Epicenters published by the U. S. Coast and Geodetic Survey. The time given is that of the first detectable emergence of the quake on the Bosch-Omori horizontal or Sprengnether vertical seismographs, in Hawaiian Standard time.

July 1, 21: 05,	slight. New Hebrides Islands, 18½° S., 169° E.
Sept. 13, 14: 46,	slight. Fiji Islands, 18½° S., 178½° E. Accompanied by a tsunami. Several persons killed, and extensive property damage.
Sept. 28, 15: 46,	slight. Origin probably within a few hundred miles.
Sept. 30, 13: 23,	moderate.

VOLCANO NOTES AND NEWS

ACTIVITY AT NGAURUHOE, NEW ZEALAND
NOVEMBER, 1952, TO JULY, 1953

By J. Healy

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On November 29, 1952, Ngauruhoe volcano erupted clouds of ash 6,000 feet into the air in what the manager of the Chateau, Mr. L. S. Dennis, described as the most intense activity for many months. The mountain had erupted at intervals of several months during the previous 2 years, but now activity mounted, and for a period of nearly 3 months it continued in violent eruption for most of the time. Unfortunately, the weather was not good and only spasmodic observations were possible.

The eruption of ash in billowing, cauliflower-shaped clouds characterized the eruptive activity, and was accompanied by thunderous explosions, frequently heard at the Chateau at a distance of 8 miles. Toward the end of January the climax was reached, and for several days windows and doors at the Chateau were rattled by the closely spaced detonations. Guests on the evening of January 23 watched white-hot blocks being thrown from the crater, fall beyond its rim, and roll down the mountain slopes, while the entire crest was illuminated by a bright red glow that dilated at short intervals as big "shots" went up. Considerable noise like thunder and drums was heard during this period. At this distance the visibility of discrete blocks being erupted through the air testified to their large size. The periodicity of large explosions at this stage was about 8 to 10 minutes,

whereas earlier it had been up to a half hour. Later the periodicity again increased as the eruptive activity waned.

Strong activity continued until the middle of February, after which active periods became shorter and more widely spaced. On March 27 a single eruption of a black ash cloud to an estimated height of 20,000 feet was reported, but since that date eruptions have been few. One was reported on July 28.

The writer inspected the crater from the air on February 4, 1953, but clouds kept the plane at about the level of the west rim. Steam was on that occasion issuing from vents near that rim, but from a vent farther east a straight plume of light-brown ash was rising. A climber had previously reported on January 30 the emission of "brown, semi-transparent substance several hundred feet into the air" and had stated that this was falling back to build up the cone around the vent. He also reported the discharge of masses of molten, orange-colored lava, so it appears most likely that this light-brown emission consisted of red-hot ash and scoria.

Ngauruhoe is an andesite volcano with perfect conical symmetry, and the summit, which is a little over a quarter mile in diameter, was divided prior to 1949 into three units. The main crater floor occupied the eastern half, with the precipitous east rim rising above it. On the western side were two contiguous subcraters—a smaller one on the north, and a larger active one on the south. The crater at that time and the eruptive activity of 1948 have been described by Allen (1). In the eruption of 1949, which has been described by Battey (2) and Cloud (3),

the active subcrater was filled with lava in the early stages but finally became a shallow pit floored with loose pyroclastic material. Its earlier rim, which separated it from the main crater floor on the east, was obliterated, and the foot of the east wall was buried.

The latest activity was similar to that described by Allen in the account of the 1948 eruption, and the crater now shows a return to the earlier conditions. The active subcrater on the southwest has again been deepened, and a rim of pyroclastic material has again been built up between it and the wide floor of the main eastern half of the summit. A difference has remained, however. The 1949 eruption apparently weakened the northwest rim and permitted small fumaroles to emerge on the outer slopes. During the winters since then a large patch outside the northwest rim has been observed to remain free of snow, due to the presence of warm ground.

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ERUPTION OF MOUNT SPURR, ALASKA

By Ray E. Wilcox

Mount Spurr is the northeasternmost of a chain of many active volcanoes comprising the Aleutian volcanic arc. The explosive outbreak of Mount Spurr which took place early on July 9, 1953, was its first strong activity during the 200 years of recorded history of that area.

The eruption took place from an old ice-filled vent at an altitude of about 7,000 feet on the south shoulder of Mount Spurr. Reports of concurrent eruptions from other points on Mount Spurr and Mount Torbert appear to have been erroneous, as also do reports of eruption in the Lake Beluga-Mount Susitna area, 30 miles east of Mount Spurr, on July 10. The eruption was observed by Werner Juhle and Henry Coulter, of the U. S. Geological Survey, from July 11 to 14, and by the writer from July 12 to 27.

The earliest observations of the eruption were made by airplane pilots at 5:05 A.M., July 9, apparently only minutes after the initial outbreak. From a distance of 60 miles they noted the eruptive cloud rising through the overcast to a height of about 15,000 feet and a width of about $\frac{1}{8}$ mile, growing rapidly. By 5:25 A.M. the cloud had risen to the 30,000-foot level and had begun to mushroom. At 5:40 A.M. the mushrooming portion extended from an altitude of 32,000 feet to 60,000 or 70,000 feet, with an estimated diameter of 30 miles. Its stalk was estimated to have a diameter of about a mile. Electrical discharges were seen at intervals of about 3 seconds throughout the mushroomed portion. By 6:00 A.M. falling ash obscured the area below the expanded portion of the cloud, and the stalk was lost from sight.

A report by a pilot at 9:00 A.M. indicated that the ash still was erupting in large quantities and that the radius of the mushroom cloud had increased to 40 to 60 miles at 27,000 feet altitude. At noon the activity was greatly diminished, but by 3:30 P.M. a moderately strong eruption had resumed and, apparently, continued through the afternoon and evening. On the morning of July 10 the vent was steaming only, but at 3:30 P.M. an especially strong surge of ash-laden steam rose to 20,000 feet. From July 11 to 14 the activity consisted of the liberation of moder-

ately large quantities of steam, with little or no ash. The intensity of the steam eruption in general diminished from day to day, with the exception of one stronger surge of steam and minor ash at 2:00 P.M. on July 13. This trend of gradually diminishing intensity continued through the rest of July.

No lava flows were produced during the eruption. Immense floods and mud flows did occur on July 9 or 10, however, the water for which no doubt stemmed from the melting of the ice in the crater and, possibly, from local torrential rains associated with the strong ash eruption. Thousands of cubic yards of debris of all sizes up to several yards in diameter were carried down the south flank of the mountain to pile up in the Chakachatna River and form a dam, behind which the water backed up for a distance of about 5 miles, nearly to Chakachamna Lake.

The huge ash cloud from the first surges of the eruption moved slowly eastward, and by 11:00 A.M. its leading edge had spread over Anchorage, 80 miles east of the volcano. Street lights in Anchorage came on automatically at 11:00 A.M., due to the increasing darkness, and by noon ash was falling abundantly, accompanied by a perceptible odor of gas. Complete darkness lasted from 1:00 to 3:00 P.M. Ash continued to fall through the remainder of the afternoon and evening, but by early morning on July 10 only a haze of dust hung over the area. No significant amount of new ash appears to have reached the Anchorage area after that. At Anchorage the measured thickness of ash ranged from $\frac{1}{8}$ to $\frac{1}{4}$ inch. In the Beluga Lake area the ash deposit may have ranged from 1 inch to several inches in thickness, judging from the large number of trees and bushes bent down by the load. On the southeast slope of Mount Spurr, Juhle found only a couple of inches of coarse debris. Westward the ash deposit thinned rapidly, and little or no ash could be seen on the snow a mile or two west of the active vent.

[Sometime in the last week of August, Dr. R. Werner Juhle, who made some of the observations of activity of Mount Spurr presented above, lost his life in Knife Creek in (the Valley of Ten Thousand Smokes) Katmai National Monument, Alaska. He had gone out alone from the base camp on a traverse planned to take several days. When he failed to return at the appointed time, an exhaustive search by planes and by men on foot aided by bloodhounds (flown up from San Francisco for the search) discovered his footprints leading up to and disappearing on the bank of a narrow, deep rapids of Knife Creek. His pack and exposure meter were found on the opposite bank of the rapids but prolonged search failed to find any further trace. Dr. Juhle, one of the outstanding recent graduates in geology from Johns Hopkins University, had done his Doctor's thesis on Iliamna Volcano, Alaska, and was engaged during the 1953 field season in the study of Katmai Volcano and the Valley of Ten Thousand Smokes as part of the co-operative investigation of Katmai National Monument by the National Park Service, Geological Survey, and other organizations.—H. A. Powers.]

J. P. EATON JOINS HVO STAFF

On September 15, Dr. Jerry P. Eaton joined the staff of the Hawaiian Volcano Observatory as Seismologist. Dr. Eaton has just completed his work for the degree of Doctor of Philosophy at the University of California, with a thesis on "The Theory of the Electromagnetic Seismograph." The thesis deals in large part with the response characteristics of Sprengnether seismographs, one of which is being operated at the Observatory's Uwekahuna station. Dr. Eaton is assuming charge of the seismological work, and most other geophysical work, of the Volcano Observatory.

STAFF OF HAWAIIAN VOLCANO OBSERVATORY

Gordon A. Macdonald, Volcanologist, Director
 Jerry P. Eaton, Seismologist
 Chester K. Wentworth, Geologist, part-time
 Burton J. Loucks, Instrument Maker
 John C. Forbes, Assistant Instrument Maker
 Elizabeth G. Eklund, Secretary, part-time

Seismograph Station Operators

Hilo Station:

Sister M. Thecla, St. Joseph's School

Kona Station:

Howard M. Tatsuno, Konawaena School

Haleakala Station:

Hawaii National Park Staff

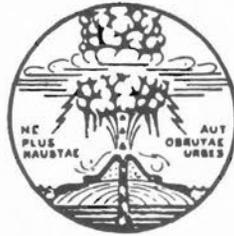
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A SUGGESTED EXPLANATION OF THE ALTERNATION OF ACTIVITY BETWEEN TWO VENTS AT KILAUEA VOLCANO

By CHESTER K. WENTWORTH

After the first month of the eruption of Kilauea in 1952 and for several weeks thereafter, visible outflow of lava took place from one or both of two vents somewhat southwest of the center of the Halemaumau pit. At first both vents were active centers of fountaining, with one or the other more active, but in late August and early September one or the other would remain crusted over and almost dead while the other would be quite vigorous and even spectacular in its action for several hours to a day or more. Then the inactive one would come to life and rival its twin while the latter in turn became quiet. Such alternations took place a number of times, were observed by many persons who were able to visit the eruption repeatedly, and came to be predicted confidently by various observers.

Such behavior, among the many other points of interest, aroused speculation as to its cause, and the following note offers a tentative explanation, after a brief additional description. The two vents, during the early part of the period under discussion, were the sources of fountains which bubbled through a common liquid pool of lava. With some variation, the centers were about 150 to 175 feet apart, and in the later stages there had been built two merged ring cones that generally were maintained some 50 or 60 feet above the central lake, and which together had roughly the shape of a figure eight. At various times this bilobate lake had as many as six outlet lava rivers which streamed through breaks in the ring cones and formed ever-changing and often merging fans on the low dome of the rising floor of Halemaumau. In later stages the outlet rivers were only three, two, or one in number. In the last case the lava output from both fountains, if any, passed out by the one outlet. With only slight differences, the liquid level was commonly about the same throughout the lake. Most of the features of the filling crater and the character of the fountains have been described elsewhere.¹ It is only necessary here to mention certain conditions which may bear on the alternation of activity.

First, we must keep in mind that the two vents maintained their approximate positions during the last 100 feet or more of rise of the lava fill and were, as far as we can see, the same as two of the most prominent of the vents along the initial rift in the floor which survived after the sheet fountaining of the first few hours. Second, it is to be presumed from the evident circulation of liquid in the pool, the peripheral breaking and exposure of bright lava, and the rise of the chilled floor without change of pattern that the larger part of the lava fill had remained very hot but was far from a homogeneous liquid. It seems quite certain that the two vents were branches from the same source at no very great depth.

Essential to the postulated mechanism is recognition of two sorts of physical condition in and around a vent conduit. We assume that, when lava outflow from a given vent is continuous and active, there must be a heating of the surrounding solid rock and an injection of all openings near the conduit so that the whole column represents an active, live, bulb-like pressure and heat system which would quickly make a liquid response and invade any adjacent opening. The pressure of the liquid must be at least slightly in excess of that required by the level of the vent pool through which it issues.

If such a conduit becomes inactive, cooling will result, the liquid parts will become less mobile, and the whole will presently lose its capacity for a quick hydraulic response to an opening. On the other hand, cooling will result eventually in shrinking, possibly in the production of actual openings, and moreover, if stresses are transmitted, the response of the mass is likely to be by rupture rather than by flow. It is not a contradiction to suggest the possible growth of linear stresses while at the same time postulating shrinkage, because we have to consider the possibility of juxtaposition of two interconnected conduits in alternating phase.

Assume, for instance, that arm A of such a dual system for some reason commences to chill and becomes less fluid. It will gradually lose its capacity for liquid

¹ G. A. MACDONALD, THE 1952 ERUPTION OF KILAUEA, *Volcano Letter* 518: 1-10. 1952.

pressure behavior and approach and enter the rupture stage. If arm B continues active, building slightly higher pressures as the pool rises and maintaining or raising the surrounding throat temperature and liquidity, it can be able at some common point to apply stress in the form of liquid pressure to a part of arm A which may be in the rupture state. The result could be a breaking through of liquid, rise of the column, and renewal of activity in vent A. If such breaking through into vent A saps the hydraulic and thermal activity of vent B sufficiently, it is plausible that conduit B might then, in time, cool toward the rupture state. If this takes place while vent A goes through its phase of fully injecting the rupture system adjacent to its main conduit, the time may come after some hours when the hot, swelling, hydraulic phase of conduit A will develop sufficient boundary stress to invade the rupturing realm of conduit B and bring that vent to a renewed phase of liquid activity, thus completing a cycle. The period of such a cycle would depend essentially on volumes and cooling rates.

It is not possible or necessary to define or describe what degree of solidity is reached in the rupture stage if it is once accepted that there can be a relative contrast between the mobile, liquid pressure of the hydraulic

phase and the firm, or pasty but crackable, condition of the rupture phase. The contrast is one of response to stresses that operate over a few minutes or hours; it is one of rigidity rather than strength. The contrast is related to but not of the same dimensions as the well-known contrast between zones of flow and of rupture in the parlance of structural geologists.

It appears that the alternation is related to a rate of outflow of lava and heat which can maintain one active vent but probably not two and thus leads to waning of one when the other waxes. It seems also that the postulated tendency can operate in varying degrees from sharp, accurately timed alternation (though this would hardly be the normal) to a more irregular, somewhat diffuse, and not always completed alternation, perhaps with a considerable amount of overlapping. It should also be recognized that the pressure built in the liquid phase need not be strictly hydrostatic or uniform, merely that it be effectively continuous throughout the volume involved. Neither must it be measured exactly by the fluid level of the pool; it will obviously be higher in the active conduit than in the connected but recently inactivated conduit which was formerly feeding the same pool at a slightly lower level.

THE PHILIPPINE COMMISSION ON VOLCANOLOGY

During 1952, the Congress of the Republic of the Philippines established by legislative act a five-man Commission on Volcanology. The Commission is composed of Dr. Jose M. Feliciano, Head of the Department of Geology and Geography of the University of the Philippines, Chairman; Dr. Casimiro del Rosario, Director of the Weather Bureau; Mr. Benjamin Gozon, Director of the Bureau of Mines; Professor Ramon Abarquez, Chairman of the Section on Geology, Seismology, and Volcanology of the National Research Council; and Mr. Jose C. Quema, representative of the Philippine Geological Society. The purposes of the Commission are:

1. To conduct studies of all active Philippine volcanoes.
2. To establish necessary facilities in order to predict volcanic eruption if possible.
3. To formulate in advance and in detail specific plans of action and of relief in the event of eruption.
4. To recommend to the President of the Philippines such measures as may be necessary to protect life and property in areas which may be affected by volcanic eruptions, including the declaration of certain areas as closed to human habitation or subject to regulation.
5. To study the economic importance of Philippine volcanism.

A working staff has been established by the Commission, with its headquarters at the University of the Philippines in Quezon City, near Manila. The staff consists of Mr. Arturo Alcaraz, Geologist-in-Charge; Mr. Gregorio A. Andal, Assistant Geologist; Mr. Be-

nigno Yambao, Junior Geologist; Mr. Eugenio Omahoy, Volcanological Observer on Camiguin Island; and Miss Annie C. Atterado, Secretary. A seismograph station is being operated at the town of Mambajao on Camiguin Island, close to the base of the volcano; field studies are in progress at both Hibok-Hibok and Taal volcanoes. Daily reports are received on volcanic conditions at Taal and Hibok-Hibok. A seismograph station at Taal volcano is being operated by the Weather Bureau, in close co-operation with the Commission on Volcanology. A bibliography on Philippine volcanoes and solfataric areas has been compiled and was presented to the Eighth Pacific Science Congress in November, 1953.

Detailed topographic and geologic mapping of all active Philippine volcanoes is planned, and it is hoped to establish additional seismograph and tilt-measuring stations in the near future. At present, a Loucks-Omori two-component horizontal seismograph, with static magnification of 200, is being operated at Hibok-Hibok volcano. The seismograph at Taal is a Wiechert inverted pendulum, also with a magnification of 200. Dr. Gordon A. Macdonald of the United States Geological Survey, Director of the Hawaiian Volcano Observatory, is spending approximately three months in the Philippine Islands, aiding in the work of the Commission on Volcanology. During the Eighth Pacific Science Congress very helpful advice was received by the Commission from Dr. G. A. de Nevé, Director of the Volcanological Survey of Indonesia; Mr. James Healy, Chief of volcanological investigations for the New Zealand Geological Survey; and Professor Howel Williams of the University of California.—G. A. MACDONALD.

HAWAIIAN VOLCANO OBSERVATORY REPORT FOR OCTOBER-DECEMBER, 1953

By JERRY P. EATON

VOLCANOLOGY

October

Seismic unrest at Mauna Loa and Kilauea continued through October. A series of sharp earthquakes on October 26, 27, and 28 caused some excitement at the Observatory. Four of these quakes, which originated under the east rift of Kilauea, were felt in the Volcano area at 1:07 A.M., 3:36 A.M., and 4:30 A.M. on the twenty-seventh, and at 10:58 P.M. on the twenty-eighth. A continuous watch was maintained at Halemaumau crater from 4:30 A.M. on October 27 until late in the afternoon of the same day, when it appeared that the seismic crisis had passed.

Of about 20 small to moderate earthquakes originating along the southwest rift of Kilauea and the Kaoiki fault, one was felt at Pahala on October 9 at 6:15 A.M., one was felt at Naalehu on October 27 at 8:02 A.M., and three were felt at the Kapapala Ranch on October 28 at 3:50 P.M., 5:03 P.M., and 9:15 P.M.

Thirteen earthquakes were centered in Kona. Of these, five were felt: October 2 at 10:06 P.M., October 8 at 9:22 A.M., October 15 at 5:10 P.M., October 19 at 2:33 A.M., and October 31 at 6:15 A.M. In addition, earthquakes felt at Pepeekeo on October 23 at 2:02 P.M. and at Kukuihaele, in Kohala, on October 9 at 6:15 A.M. were recorded by the Observatory's seismographs.

Although the number of earthquakes recorded during October was not unusually large, a surprising number of these were felt.

Northward tilting of the earth's surface at the Volcano House on the northeast rim of Kilauea Crater continued at a rate slightly greater than normal for this season of the year. Eastward tilting was at the normal seasonal rate. An increase of pressure under Kilauea indicated by this excessive northward tilting was not confirmed by the further opening of cracks in the floor of the crater.

November

Seismic activity centered at Kilauea during the month of November. Of the 44 earthquakes rated as very feeble or larger which were recorded during November, 21 originated on Kilauea, 8 originated on Mauna Loa, and 15 recorded too weakly to be located.

Twelve of the Kilauea earthquakes centered very near the Observatory, four being felt weakly in the Volcano area at 9:32 P.M. on November 22, at 3:38 P.M. on November 28, at 7:44 P.M. on November 29, and at 1:04 P.M. on November 30. The largest earthquake of the month was felt quite generally in the Puna and Hilo districts and weakly as far as Kealakekua, Kona, and Kukuihaele, North Hamakua. It occurred on November 29 at 8:43 P.M. and originated on the east rift of Kilauea 10 miles from the Observatory at a depth of about 10 miles.

A feeble earthquake recorded at 8:37 P.M. on November 8 was felt at Naalehu and probably centered along the coast south of Kilauea. Slight earthquakes were felt in Kealakekua at 8:35 P.M. on November 4 and in Kamuela at 9:45 A.M. on November 16, but neither was recorded at the Observatory.

Northward tilting of the ground at the Volcano House on the north rim of Kilauea Crater continued at a rate slightly greater than normal for this season of the year, indicating continuing high pressure under Kilauea.

December

Many small earthquakes originating under Kilauea and Mauna Loa during December indicated that the Hawaiian volcanoes remained in a state of unrest. Of 51 quakes rated as very feeble or larger recorded by the Observatory's seismographs during the month, 17 originated at Kilauea, 8 at Mauna Loa, 1 at Kohala, and 25 were recorded too feebly to be located.

Between November 30 and December 6 a large number of tremors was recorded by the Mauna Loa seismograph. One of the larger earthquakes accompanying this swarm of tremors was felt in Hilo at 1:56 A.M. on December 1. It is probable that the tremors stemmed from foci near the focus of this larger earthquake, deep under the northeast rift of Mauna Loa.

Two quakes originated on the southeast flank of Mauna Loa between its summit and the Kaoiki fault. Two of the five quakes occurring on the Kona side of Mauna Loa were felt, one in Kalihiki at 4:16 P.M. on December 14, the other in Captain Cook at 1:00 P.M. on December 16.

Seismic activity at Kilauea continued to center around the caldera. Twelve of the 17 quakes occurring on Kilauea originated within a few miles of the Observatory. In addition, two quakes proceeded from epicenters on the southwest rift of Kilauea, two others from epicenters along the coast south of Kilauea.

Earthquakes were felt in the Kohala district at 7:42 P.M. on December 11, 2:53 A.M. on December 12, and 7:11 P.M. on December 17. The second of these was not recorded on any of the Observatory's seismographs.

The rate of northward tilting of the earth's surface at the Volcano House on the northeast rim of Kilauea caldera decreased, as is usual at this time of the year. Eastward tilting, however, proceeded at the same moderate rate which had prevailed since mid-August. The failure of eastward tilting to slacken and reverse during December suggested an increase in pressure under Mauna Loa. No other evidence was available, however, to check this conclusion.

SEISMOLOGY

Local Earthquakes

The data for the following local earthquakes were determined from seismographs on the islands of Hawaii and Maui operated by the Hawaiian Volcano Observatory. Locations given are epicenters. The times given are arrival times at the Whitney Laboratory of Seismology, on the northeast rim of Kilauea caldera. They are stated to the closest minute in Hawaiian Standard time, which is 10 hours slower than Greenwich Civil time. The number preceding each earthquake is the serial number for the current year. The intensity rating (Feeble, Moderate, etc.) given is that for the Whitney Laboratory. If the intensity was greater at one of the other stations, the name of that station and the intensity rating there are given in parentheses after the rating at the Whitney station.

- | | | |
|---------------|--------|---|
| 248. Oct. 1, | 09:23, | tremor (Mauna Loa, slight). Kaoiki fault. |
| 249. Oct. 1, | 22:02, | very feeble. |
| 250. Oct. 2, | 20:18, | tremor (Mauna Loa, very feeble). Southwest rift of Kilauea 2 miles east of Kapapala Ranch. |
| 251. Oct. 2, | 20:36, | tremor (Mauna Loa, very feeble). Kaoiki fault. |
| 252. Oct. 2, | 22:06, | no record at Kilauea (Kona, very feeble). Felt in Capt. Cook, Central Kona. |
| 253. Oct. 4, | 22:27, | tremor (Mauna Loa, very feeble). |
| 254. Oct. 5, | 01:20, | very feeble. |
| 255. Oct. 5, | 11:21, | very feeble. Kilauea. |
| 256. Oct. 8, | 09:22, | feeble (Mauna Loa, moderate). Felt in central Kona. Nine miles east of Hainoa Crater on Hualalai. |
| 257. Oct. 9, | 06:16, | very feeble. Felt at Kukuihaele. Kohala. |
| 258. Oct. 9, | 16:26, | no record at Whitney Laboratory (Mauna Loa, very feeble). |
| 259. Oct. 9, | 16:28, | no record at Whitney Laboratory (Mauna Loa, very feeble). |
| 260. Oct. 9, | 19:03, | no record at Whitney Laboratory (Kona, very feeble). Central Kona. |
| 261. Oct. 9, | 21:11, | tremor (Mauna Loa, very feeble). |
| 262. Oct. 9, | 21:53, | tremor (Mauna Loa, very feeble). Felt at Pahala. Mauna Loa. |
| 263. Oct. 10, | 02:04, | tremor (Mauna Loa, very feeble). |
| 264. Oct. 10, | 02:51, | very feeble. East rift of Kilauea at Alae Crater. |
| 265. Oct. 14, | 17:23, | tremor (Mauna Loa, very feeble). Kaoiki fault. |
| 266. Oct. 14, | 18:28, | tremor (Mauna Loa, very feeble). Five miles east of Hainoa Crater on Hualalai. |
| 267. Oct. 15, | 07:11, | very feeble. Kilauea. |

268. Oct. 15, 17:10, very feeble (Kona, feeble). Felt in Capt. Cook. Central Kona.
269. Oct. 16, 00:33, very feeble. South flank of Mauna Loa near Anipeahi.
270. Oct. 17, 18:09, very feeble. South flank of Mauna Loa.
271. Oct. 18, 00:57, very feeble. Kilauea.
272. Oct. 18, 15:16, very feeble. East rift of Kilauea.
273. Oct. 19, 02:33, no record at Kilauea (Mauna Loa, very feeble). Central Kona.
274. Oct. 20, 06:15, tremor (Mauna Loa, very feeble). Kaoiki fault.
275. Oct. 22, 14:00, no record at Kilauea (Kona, very feeble).
276. Oct. 22, 14:02, very feeble (Mauna Loa, feeble). Felt at Pepeekeo. East flank of Mauna Kea.
277. Oct. 23, 14:49, no record at Whitney Laboratory (Mauna Loa, very feeble).
278. Oct. 25, 00:53, no record at Kilauea (Mauna Loa, very feeble).
279. Oct. 25, 01:23, very feeble.
280. Oct. 25, 04:17, very feeble. Makaopuhi Crater.
281. Oct. 25, 10:42, tremor (Uwekahuna, very feeble). East rift of Kilauea near Napau Crater.
282. Oct. 26, 14:13, very feeble. East rift of Kilauea near Napau Crater.
283. Oct. 26, 17:46, slight. East rift of Kilauea south of Alae Crater.
284. Oct. 26, 17:50, slight. East rift of Kilauea south of Alae Crater.
285. Oct. 26, 17:51, slight. East rift of Kilauea.
286. Oct. 26, 17:53, very feeble.
287. Oct. 27, 00:22, feeble.
288. Oct. 27, 01:07, strong. Felt at Volcano. East rift of Kilauea south of Aloi Crater near Ainahou.
289. Oct. 27, 01:10, very feeble.
290. Oct. 27, 01:38, slight.
291. Oct. 27, 03:37, strong. Felt at Volcano. East rift of Kilauea south of Makaopuhi Crater.
292. Oct. 27, 04:30, strong. Felt at Volcano. East rift of Kilauea near Alae Crater.
293. Oct. 27, 06:20, strong. East rift of Kilauea south of Napau Crater.
294. Oct. 27, 08:02, very feeble. Felt at Naalehu. Southwest rift of Mauna Loa near Alike Cone.
295. Oct. 27, 23:56, tremor (Uwekahuna, very feeble).
296. Oct. 28, 06:44, tremor (Uwekahuna, very feeble). Kaoiki fault near Halfway House.
297. Oct. 28, 07:21, very feeble. Kaoiki fault near Halfway House.
298. Oct. 28, 15:50, very feeble. Felt at Kapapala. Hilina Pali.
299. Oct. 28, 17:03, very feeble. Felt at Kapapala. Southwest rift of Kilauea near Ponoehoa Chasms.
300. Oct. 28, 21:15, very feeble. Felt at Kapapala. South flank of Mauna Loa.
301. Oct. 28, 22:58, very feeble. Felt at Volcano. East rift of Kilauea near Aloi Crater.
302. Oct. 29, 04:47, very feeble. Southwest flank of Kilauea.
303. Oct. 29, 05:40, very feeble.
304. Oct. 30, 08:16, tremor (Uwekahuna, very feeble). Kilauea caldera.
305. Oct. 31, 06:08, tremor (Kona, feeble). Felt in North Kona and North Kohala. North flank of Hualalai.
306. Oct. 31, 12:26, very feeble. Southwest flank of Kilauea.
307. Oct. 31, 13:22, very feeble. Southwest flank of Kilauea.
308. Nov. 1, 03:22, no record at Whitney Laboratory (Uwekahuna, very feeble).
309. Nov. 1, 14:42, very feeble. Southwest flank of Kilauea near Maunaiki.
310. Nov. 3, 10:14, tremor (Uwekahuna, very feeble). Southwest rift of Kilauea.
311. Nov. 5, 00:16, tremor (Mauna Loa, very feeble).
312. Nov. 5, 07:55, tremor (Mauna Loa, very feeble). Mauna Loa.
313. Nov. 5, 23:47, very feeble. Southwest rift of Mauna Loa.
314. Nov. 6, 02:30, feeble (Mauna Loa, slight). Mauna Loa, 3 miles south of the Mauna Loa seismograph.
315. Nov. 6, 11:24, tremor (Mauna Loa, very feeble).
316. Nov. 8, 18:14, very feeble.
317. Nov. 8, 20:37, very feeble. Coast south of Kilauea.
318. Nov. 10, 13:48, tremor (Uwekahuna, very feeble).
319. Nov. 12, 09:37, tremor (Mauna Loa, very feeble).
320. Nov. 14, 04:55, very feeble. Coast south of Kilauea.
321. Nov. 14, 05:12, very feeble. Coast south of Kilauea.
322. Nov. 19, 03:20, no record at Kilauea (Mauna Loa, very feeble).
323. Nov. 19, 05:36, tremor (Uwekahuna, very feeble).
324. Nov. 20, 05:10, tremor (Uwekahuna, very feeble).
325. Nov. 21, 11:26, very feeble (Mauna Loa, feeble). Red Hill.
326. Nov. 21, 15:23, very feeble (Uwekahuna, feeble). Kilauea.
327. Nov. 21, 16:11, very feeble. Mauna Loa.
328. Nov. 22, 21:32, moderate. Felt in Hawaii National Park and at Volcano. Kilauea caldera.
329. Nov. 23, 17:26, very feeble. Near Kilauea caldera.
330. Nov. 25, 07:07, no record at Whitney Laboratory (Uwekahuna, very feeble).
331. Nov. 25, 12:42, tremor (Uwekahuna, very feeble).
332. Nov. 26, 02:09, no record at Kilauea (Mauna Loa, very feeble).
333. Nov. 26, 03:09, very feeble.
334. Nov. 26, 05:52, very feeble (Mauna Loa, feeble). Red Hill.
335. Nov. 26, 13:54, very feeble (Uwekahuna, feeble). Near Kilauea caldera.
336. Nov. 26, 13:55, very feeble (Uwekahuna, feeble). Near Kilauea caldera.
337. Nov. 26, 16:58, very feeble. Near Kilauea caldera.
338. Nov. 27, 19:25, very feeble. Kilauea.
339. Nov. 28, 08:11, very feeble. Kilauea.
340. Nov. 28, 15:38, moderate. Felt in Hawaii National Park. Near Kilauea caldera.
341. Nov. 28, 20:46, no record at Kilauea (Mauna Loa, very feeble).
342. Nov. 29, 03:05, very feeble. Near Kilauea caldera.
343. Nov. 29, 03:49, no record at Kilauea (Kona, very feeble). Kona.
344. Nov. 29, 07:36, tremor (Uwekahuna, very feeble). Near Kilauea caldera.
345. Nov. 29, 19:44, moderate. Felt in Hawaii National Park. Near Kilauea caldera.
346. Nov. 29, 20:43, strong. Felt from Hawaii National Park to Hilo. East rift of Kilauea near Napau Crater.
347. Nov. 29, 21:18, very feeble.
348. Nov. 29, 23:18, no record at Whitney Laboratory (Uwekahuna, very feeble).
349. Nov. 30, 13:02, tremor (Uwekahuna, very feeble).
350. Nov. 30, 13:04, slight. Felt in Hawaii National Park. Near Kilauea caldera.
351. Nov. 30, 13:30, no record at Whitney Laboratory (Uwekahuna, very feeble).
352. Dec. 1, 01:56, tremor (Mauna Loa, very feeble). Felt in Hilo. Northeast rift of Mauna Loa.
353. Dec. 1, 02:01, no record at Kilauea (Mauna Loa, very feeble).
354. Dec. 1, 03:20, no record at Kilauea (Mauna Loa, very feeble).
355. Dec. 1, 03:21, no record at Kilauea (Mauna Loa, very feeble).
356. Dec. 1, 04:17, no record at Kilauea (Mauna Loa, very feeble).
357. Dec. 1, 04:20, tremor (Mauna Loa, very feeble).
358. Dec. 1, 04:24, tremor (Mauna Loa, very feeble).
359. Dec. 1, 08:46, no record at Kilauea (Mauna Loa, very feeble).
360. Dec. 1, 09:09, tremor (Mauna Loa, very feeble).
361. Dec. 1, 10:54, tremor (Mauna Loa, very feeble).
362. Dec. 1, 12:34, no record at Kilauea (Mauna Loa, very feeble).
363. Dec. 1, 12:43, tremor (Mauna Loa, very feeble).
364. Dec. 1, 12:45, tremor (Mauna Loa, very feeble).
365. Dec. 1, 13:13, tremor (Mauna Loa, very feeble).
366. Dec. 1, 13:20, no record at Kilauea (Mauna Loa, very feeble).
367. Dec. 1, 14:12, tremor (Uwekahuna, very feeble).
368. Dec. 1, 16:27, tremor (Mauna Loa, very feeble).
369. Dec. 1, 21:23, no record at Kilauea (Mauna Loa, very feeble).

370. Dec. 2, 23:19, tremor (Mauna Loa, very feeble).
 371. Dec. 3, 01:54, no record at Whitney Laboratory (Mauna Loa, very feeble).
 372. Dec. 3, 01:59, tremor (Mauna Loa, very feeble).
 373. Dec. 6, 21:02, feeble. Near Halfway House on the south flank of Mauna Loa.
 374. Dec. 8, 03:29, no record at Whitney Laboratory (Uwekahuna, very feeble). Near Kilauea caldera.
 375. Dec. 8, 14:00, very feeble. Kilauea caldera.
 376. Dec. 8, 23:59, very feeble. Kilauea caldera.
 377. Dec. 9, 01:13, slight. Felt in Hawaii National Park. Kilauea caldera.
 378. Dec. 9, 01:18, slight. Kilauea caldera.
 379. Dec. 9, 01:56, slight. Kilauea caldera.
 380. Dec. 9, 10:03, very feeble. Kilauea caldera.
 381. Dec. 9, 10:43, very feeble. Kilauea caldera.
 382. Dec. 11, 12:27, no record at Kilauea (Kona, very feeble).
 383. Dec. 12, 08:56, very feeble. Southwest rift of Kilauea near the Ponoehoa Chasms.
 384. Dec. 12, 15:15, tremor (Uwekahuna, very feeble). Near the coast south of Kilauea.
 385. Dec. 13, 02:53, very feeble.
 386. Dec. 14, 04:08, very feeble.
 387. Dec. 14, 08:15, very feeble.
 388. Dec. 14, 12:39, very feeble. Kilauea caldera.
 389. Dec. 14, 14:54, very feeble.
 390. Dec. 15, 21:08, no record at Kilauea (Kona, very feeble).
 391. Dec. 16, 13:00, no record at Kilauea (Kona very feeble). Felt in Capt. Cook. Kona.
 392. Dec. 16, 17:01, very feeble.
 393. Dec. 17, 19:11, very feeble. Kohala.
 394. Dec. 20, 04:11, very feeble (Uwekahuna, feeble). Southeast flank of Kilauea near Kalapana.
 395. Dec. 21, 12:24, tremor (Mauna Loa, very feeble). East rift of Kilauea.
 396. Dec. 21, 12:40, tremor (Uwekahuna, very feeble). Kilauea caldera.
 397. Dec. 28, 22:24, no record at Whitney Laboratory (Uwekahuna, very feeble). Kilauea caldera.
 398. Dec. 29, 06:01, tremor (Uwekahuna, very feeble). Kilauea caldera.
 399. Dec. 30, 08:05, tremor (Uwekahuna, very feeble).
 400. Dec. 31, 16:53, very feeble. Kilauea caldera.
 401. Dec. 31, 19:54, very feeble.
 402. Dec. 31, 20:50, no record at Kilauea (Kona, very feeble). Kona.
 403. Dec. 31, 22:55, very feeble.

Distant Earthquakes

The following earthquakes of distant origin were recorded on the seismographs of the Hawaiian Volcano Observatory. Locations of the epicenters are from the notices of Preliminary Determinations of Epicenters published by the U. S. Coast and Geodetic Survey. The time given is that of the first detectable emergence of the quake on the Bosch-Omori horizontal or Sprengnether vertical seismograms, in Hawaiian Standard time.

- Nov. 3, 17:59, slight. New Hebrides Islands, $12\frac{1}{2}^{\circ}$ S., $166\frac{1}{2}^{\circ}$ E.
 Nov. 17, 03:55, slight. Near coast of Guatemala, 14° N., 92° W.

- Nov. 25, 07:59, moderate. Near south coast of Honshu, Japan, 34° N., 141° E. Felt Honshu and Hokkaido. Seismic sea wave.
 Dec. 4, 05:11, strong. Off coast of Vancouver Island, $49\frac{1}{2}^{\circ}$ N., 129° W.
 Dec. 12, 07:53, feeble. Near coast of Peru, $3\frac{1}{2}^{\circ}$ S., 81° W. Several killed and heavy property damage in Tumbes and Corrales.

Earthquake Data, October-December, 1953

(Based on Bosch-Omori seismograph on northeast rim of Kilauea caldera)

Week Beginning	Minutes of Tremor	Very Feeble	Feeble	Slight	Moderate	Strong	Local Seismicity*	Teleseisms
Oct.	4	11	0	0	1	0	11.0	0
	11	21	5	1	0	0	8.75	0
	18	16	6	1	0	0	8.0	0
	25	40	19	3	4	0	46.5	0
Nov.	1	8	7	0	1	0	7.5	1
	8	17	6	0	0	0	7.25	0
	15	30	4	2	0	0	11.5	1
	22	39	9	3	0	2	23.25	1
Dec.	29	732	28	0	1	1	211.0	1
	6	22	8	1	3	0	16.5	1
	13	42	9	0	0	0	15.0	0
	20	6	2	1	0	0	3.5	0
	27	9	7	0	0	0	5.75	0

* For definition of local seismicity see Volcano Letter 371 or 512. Each local earthquake is assigned a seismicity value according to its strength, as follows: tremor, 0.25; very feeble, 0.5; feeble, 1.0; slight, 2.0; moderate, 3.0; strong, 4.0. These values are totaled to give the weekly local seismicity. Continuous volcanic tremor is ignored in the calculation. The strength assigned to the earthquake depends on the double amplitude of the maximum oscillation it causes on the Bosch-Omori seismograph, as follows: tremor, less than 0.5 mm.; very feeble, 0.5 to 4 mm.; feeble, 4 to 11 mm.; slight, 11 to 25 mm.; moderate, 25 to 60 mm.; strong, greater than 60 mm.

Table of Tilt at Seismograph Stations on Rim of Kilauea Caldera

Week Beginning	Whitney Station (Northeast rim)		Uwekahuna Station (West rim)		
	Amount	Direction	Amount	Direction	
October	4	1.3"	N 41° W	4.8"	S 20° E
	11	1.1"	N 72° W	1.0"	N 72° E
	18	1.0"	S 54° E	1.3"	N 14° W
	25	2.9"	N 7° W	3.0"	S 18° E
November	1	0.6"	S 67° E	2.2"	N
	8	1.2"	N 84° E	2.4"	S 23° E
	15	1.0"	N 21° E	3.9"	N 24° W
	22	0.5"	N 45° E	1.8"	N 45° W
December	29	0.7"	N 9° W	2.6"	N 14° W
	6	0.8"	S 72° E	0.3"	S
	13	1.2"	S 45° E	1.0"	S 18° E
	20	0.3"	N 63° W	0.3"	E
27	1.5"	N 72° E	4.2"	N 23° W	

VOLCANO NOTES AND NEWS

ERUPTIONS OF MIHARA-YAMA, O-SHIMA,
AND ASAMA-YAMA, JAPAN

By Helen L. Foster

(From data supplied by Central Meteorological Observatory, Tokyo, Japan)

Mihara-yama, O-shima: October 5, 1953 to January 6, 1954. Mihara-yama, O-shima, erupted from July 16, 1950, to September 24, 1950. It was then quiescent until February 4, 1951, when eruption recommenced and lasted until June 28, although the activity in April, May, and June was intermittent. The volcano was again quiescent until October 5, 1953, when activity commenced again, heralded by minor earth tremors and rumbling sounds. The first explosion was heard at 8:32 A.M. on October 5. A new vent about 1.5 meters in diameter opened on the inner south wall of the larger cinder cone formed in the 1951 eruption. Lava fragments as large as 1 foot in diameter were hurled to a height of 50 or 60 meters above the vent. Explosions continued intermittently until October 13, when activity subsided after 7:30 P.M. Although emission of gas clouds occurred at intervals, no further explosions were recorded until November 10. On November 11 lava flows and fragments were emitted from two new vents in the crater of the 1951 cinder cone. Only steam and gases were emitted from the vent, which had been active in October. By November 14 a small cone about 3 meters high had formed around the active vents. The volcano was quiescent again during most of the remainder of November, although steam and other gas fumes were emitted.

On December 1 eruptions began again and continued intermittently until December 18, 1953. Gas, ash, and ejecta were emitted from the November vents and from a new vent which opened between those formed in October and November.

Observations on December 24 determined that in the vicinity of the vents which were active in October there was a crater 40 meters long, 20 meters wide, and 8 meters deep which had two vents. In the area of the vents active in November there was a crater 70 meters long and 40 meters wide, with two vents.

Eruption recommenced on December 29 at 3:27 A.M. Activity continued through December 31, 1953. Slight activity was again recorded on January 4, 5, and 6, 1954, when explosions hurled bombs 200 meters high and horizontal distances of 400 meters. Minor topographic changes were taking place in and around the old 1951 cinder cone as the result of collapse and the accumulation of new ejecta.

All the new activity of Mihara-yama in 1953 and 1954 has been on a small scale as compared with the eruptions of 1950 and 1951. Only small quantities of lava and ejecta have been emitted, all of which have been within the crater of the 1951 cinder cone, with the exception of a few pieces of ejecta which have been thrown beyond the 1951 cinder cone crater.

Asama-yama: December 27, 1953 to January 7, 1954. A series of small explosions of Asama-yama began on December 27, 1953. The volcano had been quiescent since June, 1952.

Explosions occurred on December 27 at 1:41 P.M. and 4:45 P.M. and on December 29 at 8:40 A.M. and 10:23 A.M., and on December 30 small ash falls from minor explosions occurred, beginning at 8:00 P.M.

Another explosion occurred on January 3, 1954, and a cloud, probably ash-laden, rose to a height of 600 meters.

On January 7 explosions occurred at 3:30 P.M. and 3:34 P.M., and an ash cloud rose to a height of 700 meters. These explosions were the largest of the series of about 10 which have occurred since December 27, 1953.

CURRENT ACTIVITY OF ALEUTIAN VOLCANOES

By H. A. Powers

There has been but slight activity at most Aleutian volcanoes during the fall of 1953. Observations are being made by members of the Armed Forces and by Austin Jones, Seismologist of the Geophysics Branch, U. S. Geological Survey.

Trident. During July and August a tongue of lava flowed as much as 3 miles, starting from the northwest side of the original vent and following the west margin of the June flows. It terminated in two broad lobes, one crossing the south-flowing stream from Katmai Pass where it dammed a small lake at

about 2,000 feet altitude, the other extending a half mile farther south into the Pass drainage at a lower altitude. The new lava flow did not increase visibly in area during the fall months, but was still steaming in December. The vent is sporadically erupting small bursts of ash, and constantly fuming and steaming.

Spurr volcano has been steaming but has had no renewal of ash eruption since the July explosions.

Shishaldin erupted hot ash during the first week of October.

Pavlov was seen "glowing" on November 25 by the personnel of the *Penguin*, sailing from the Pribilof Islands.

Steam plumes but no new ash on the recent snows are reported at various December dates from Gareloi, Kanaga, Great Sitkin, Cleveland, and Makushin.

SECTION OF VOLCANOLOGY
EIGHTH PACIFIC SCIENCE CONGRESS

A highly successful meeting of the section of volcanology of the Eighth Pacific Science Congress was held on November 17, 1953, at the University of the Philippines. The meeting opened with the presentation of the report of the Standing Committee on Volcanology of the Pacific Area, by J. Healy, Chairman of the Committee. The report was presented only in brief at the meeting, but the full report was distributed to those present, and copies were sent to contributors who were not present. The 33-page mimeographed report contains accounts of volcanic and thermal activity and investigations in Canada, Hawaii, Alaska, continental United States, Mexico, Guatemala, San Salvador, Nicaragua, South America, New Zealand, Australian territories, Philippines, Japan, Fiji, Solomon Islands, and Indonesia. A 22-page appendix contains a list of volcanological and allied research workers in all these countries. Mr. Healy deserves, and received, the sincere thanks of his fellow workers for his excellent report and organization of the meeting itself.

Following presentation of the Chairman's report, a symposium on Volcanology of the Pacific was convened by Mr. Healy. Chairmanship of the morning session, which was devoted to *nuées ardentes* and related phenomena, was turned over to Mr. Arturo Alcaraz of the Philippine Commission on Volcanology, with Mr. Jose C. Quema of the Philippine Bureau of Mines as secretary. Papers presented during the morning session were: *Glowing Avalanche Deposits of Central America*, by Howel Williams; *Mount Katmai and the Valley of Ten Thousand Smokes, Alaska* (a new interpretation of the great eruptions of 1912), by Howel Williams, Garniss Curtis, and Werner Juhle; *An Outline of Mount Lamington Phenomena*, by G. A. Taylor (presented by J. Thompson); *Volcanic Activity of Catarman and Hibok-Hibok*, by V. R. Pelaez; *Recent Volcanicity at Taupo, New Zealand*, by I. L. Baumgart and J. Healy; *Some Problems of Welded-Lava and Welded-Tuff Related with the Sunken Calderas in Japan*, by T. Matumoto, T. Isikawa, and M. Minato (presented by Howel Williams).

The afternoon session was devoted to descriptive volcanology, petrology of volcanic rocks, and geophysics, under the chairmanship of G. A. Macdonald of the U. S. Geological Survey. Fourteen papers were presented, as follows: *The Dedicus Submarine Volcano*, by A. Alcaraz, L. F. Abad, and M. H. Tupas; *Eruption on San Benedicto Island, Mexico, 1952*, by R. S. Dietz and A. F. Richards; *Combined Air- and Terrain-Reconnaissances Carried out by the Volcanological Survey in the Indonesian Archipelago, and Its Program for Future Research*, by G. A. de Nevé; *Seventy Years Krakatoa and Twenty-Five Years Anak Krakatoa, with a Communication Concerning the Latest Investigation in October, 1953*, by G. A. de Nevé; *Volcanic Activity in New Guinea*, by J. G. Best (presented by J. Thompson); *A Cluster of Little-Known Philippine Volcanoes*, by A. Alvir; *The Significance of Pillow Lavas in Pacific Islands*, by H. T. Stearns (read by title only); *The Difference of Chemical Composition between Japanese and Manchurian Volcanic Rocks*, by I. Iwasaki and T. Katsura (presented by Y. Miyake); *Preliminary Account of the Hydrothermal Condition at Wairakei, New Zealand*, by J. Healy; *Geochemical Investigation of Geysers in Japan*, by K. Noguchi (presented by Y. Miyake); *Volcanic Activities in Japan During 1949-1953*, by T. Minakami and R. Morimoto (presented by G. A. Macdonald); *Transpacific Detection by Underwater Sound of Myojin*

Volcanic Explosions, by R. S. Dietz and M. J. Sheehy; The New Seismological Equipment for the Permanent Conservation-Posts of the Volcanological Survey of Indonesia, by G. A. de Nevé; Rehabilitation of the Guarding-System of the Volcanological Survey, by G. A. de Nevé.

A public lecture on Hawaiian volcanoes, illustrated with color movies of the 1949 and 1950 eruptions of Mauna Loa and 1952 eruption of Kilauea, was given by G. A. Macdonald on the evening of November 18, in the auditorium of the Philippine General Hospital.

On November 15, the delegates to the Division of Geology and Geophysics took part in a field trip to Taal volcano. Vol-

cano Island, in the midst of Taal Lake, and the crater from which occurred the disastrous explosions of 1911 were visited. Further glimpses of Taal volcano and the structure of the surrounding region were obtained on a field trip to Tagaytay Ridge on November 19, under the auspices of the Philippine Geological Society and the Philippine Association of Mining, Metallurgical, and Geological Engineers. Following the meetings of the Congress, a group of 15 persons from the Division of Geology and Geophysics participated in a field trip to the southern part of the Philippines, during which both Hibok-Hibok and Mayon volcanoes were visited. Both volcanoes were fuming, but no other activity was visible.

STAFF OF HAWAIIAN VOLCANO OBSERVATORY

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