BULLETIN 10

BIBLIOGRAPHY OF THE GEOLOGY AND WATER RESOURCES OF THE ISLAND OF HAWAII ANNOTATED AND INDEXED

BY

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BIBLIOGRAPHY OF THE
GEOLOGY AND WATER RESOURCES
OF THE ISLAND OF HAWAII

By GORDON A. MACDONALD

INTRODUCTION

This bibliography is an outgrowth of studies of the geology and
ground-water resources of the island of Hawaii by the U. S. Geological
Survey, in cooperation with the Division of Hydrography of
the Territory of Hawaii. All of the known papers dealing with the
geology, volcanoes, ground water, or surface water of the island,
are herein listed under the names of their authors, in alphabetical
order. Very nearly all of them have been read and annotated. The
author list is followed by a subject index. Titles or parts of titles
supplied by the bibliographer are enclosed in brackets.

Textbooks and general papers, dealing either directly with the
island of Hawaii or with the Hawaiian Islands as a whole have been
listed, as well as papers dealing with more specific subjects. The
great bulk of the early literature treats the active volcanoes Kilauea
and Mauna Loa. Previous to 1911, many newspaper and other pop-
ular accounts of the volcanic activity are listed, in order to fill in as
completely as possible the fragmentary record of volcanic activity.
Since the establishment of the Hawaiian Volcano Observatory, in
1911, a complete record of the activity has been kept by trained
observers, and with a few exceptions newspaper and other popular
accounts of activity have not been listed.

In preparing the list of titles, free use has been made of the
earlier bibliographies listed in the index. Especially helpful have
been the Bibliographies of North American Geology prepared by
J. M. Nickles and Emma M. Thom for the United States Geologi-
cal Survey. The writer wishes to thank Prof. H. S. Palmer of the
University of Hawaii for the use of his card catalogue on Hawaiian
geology; and Miss Janet Bell of the University of Hawaii Library,
Miss Margaret Titcomb, Librarian of the B. P. Bishop Museum,
and the librarians of the Library of Hawaii, especially Mrs. Arthur
Silverman, for aid in locating references.
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BIBLIOGRAPHY

Adams, O. B.
An account of activity in Mokuaweoweo in the early part of August, 1873. Lava fountains were playing 200 to 500 feet high. The eruption had been in progress 7 months, and is stated to have commenced on January 7, 1873.

Agar, W. M., Flint, R. F., and Longwell, C. R.
Contains a description of Kilauea Caldera in 1840, by J. D. Dana; and a description of the explosive eruptions of Kilauea in 1924, quoted from Jaggar and Finch (1924).

Alexander, J. M.
A description of Mokuaweoweo in September, 1885. A cone on the floor of Lua Poholo was still fuming. The greatest depth of the caldera was 800 feet. It is suggested that the lava rises higher in Mauna Loa than in Kilauea, without sympathetic overflow of the latter, because of the small diameter of the Mauna Loa conduit.

Mokuaweoweo is described, and its origin by coalescence of several smaller pits is recognized. Cinder cones in Mokuaweoweo and Lua Poholo were still fuming, but there was no other activity. The caldera consisted of a broad central pit, with lunate platforms at both ends, connected by gaps with the pits now called the North and South bays. A map is given.

Alexander, W. D.
A description of the flow and source area on February 9 and 10, 1859.

A description of Mokuaweoweo in October, 1885.
Contains brief accounts of the 1790 eruption of Kilauea; the 1801 eruption of Hualalai; the tsunamis of 1819, 1837, 1841, 1868, and 1877; and the eruptions of Kilauea in 1840, and of Mauna Loa in 1855, 1859, 1868, 1880, and 1887.

An account of E. D. Preston's geodetic work on Mauna Kea, and a description of the upper slopes of the mountain.

Two letters, posthumously published, describing the 1859 eruption of Mauna Loa, as seen during two visits in February and June, 1859.

Alexander, W. P.

A discussion of the application, duty, and conservation of water, prevention of seepage losses, conservation of soil moisture, and saline irrigation. A bibliography on irrigation of sugar cane in Hawaii contains a list of 73 titles.

Allen, E. T. (See also Day and Allen, 1925.)

A discussion of the volcanic gas problem in general, with several specific references to Kilauea and Mauna Loa. Evidence is advanced to prove that water must be present among the primary magmatic gases, and it is believed in general to be the most abundant of them. Heating of the magma by reactions between gases, and other constituents, at depth, and by surface oxidation of the combustible gases, undoubtedly occurs, but this heat is small compared to the original specific heat of the magma.

Gases collected at Sulphur Bank were chemically analyzed. The analytical procedure is described. Results showed: steam, 96.2%; fixed gases, 3.7%; SO₂, .006%; S, .004%; HCl, trace.
Anderson, Rufus
Contains a very brief account of a visit to Kilauea Caldera in
March, 1863. Halemaumau lava lake was active, its surface being
about 50 feet below that of the “black ledge.”

Anderson, Tempest, and Bonney, T. G.
1917. Volcanic studies in many lands: 2nd series, London,
p. 61–66.
Kilauea and Mauna Loa are very briefly described, and the former
is illustrated by six photographs. [Plate 56, said to represent a
cascade in the Mauna Loa lava flow of 1881, is actually a photo­
graph of a formerly well known small cascade on the floor of
Kilauea Caldera.]

Andrews, L.
1843. Volcano of Mauna Loa: Missionary Herald, vol. 39,
p. 381–382.
A description of the early phases of the 1843 eruption of Mauna
Loa. Smoke was first seen near the summit on January 9, and on
the following night a brilliant light was seen there. A flow poured
down the mountain. Before the close of the week that light
disappeared, and the lava broke out anew low on the slope toward
Mauna Kea. Kilauea presented no unusual appearance.

Anonymous
1842. Eruption of the volcano of Kilauea, in the island of Ha­
A description of Kilauea in 1840. During the eruption of that year,
the lava level in the caldera sank 300 feet. (Not seen.)

Quotes earlier descriptions (undated) of Kilauea Caldera.

1845. Account of a visit to the volcano of Kilauea, in Owhyhee,
Sandwich Islands, in September 1844: Blackwood's
Magazine (Edinburgh), American Edition, November;
reprinted in Honolulu Star-Bulletin, vol. 40, no. 12689,
3rd section, p. 1, 6, Oct. 8; no. 12690, p. 5, Oct. 10, 1932.
Kilauea Caldera is briefly described, and a rough sketch-map is
given. The main caldera wall was estimated to be about 1000
feet high, and the floor dotted with cones said to be 60 to 70 feet
high. Near the southwestern end a large lava lake [Halemaumau]
was active, and filled to about 20 feet below the rim. A large per­
sistent fountain was situated in the lake near its northeastern
edge. A large fissure, containing glowing lava in places and partly
filled by blocks collapsed from its walls, extended from near Hale­
maumau nearly around the west, north, and east sides within and
parallel to the main caldera walls. The floor within the fissure
was lower than that outside it.
A Hilo correspondent writes on August 12, 1851, “The great crater on Mauna Loa . . . is now in action.” For a few days smoke had been observed over the mountain, illuminated by glow at night. A subsequent communication reported the eruption to have continued twelve days.

An account of an early (undated) visit to Kilauea Caldera.

A description of Kilauea Caldera on September 9, 1855. The article is signed “Louis”.

An account of the great earthquakes of 1868 on Hawaii, and the activity of Mauna Loa and Kilauea, including a description of the effects of the accompanying tsunamis along the southern shore and at Hilo.

Letters describing the activity of Mauna Loa and Kilauea, and the great earthquakes of 1868.

A description of the Mauna Loa lava flow of 1868.

A general description of the Hawaiian volcanoes, an account of an overflow of the Halemaumau lava lake, and an account of the earthquakes and eruption of Mauna Loa in 1868.

Doubt is expressed as to the dimensions of Halemaumau lava lake, and the steepness of slope and height of its shield during August, 1871, as set forth by Coan (1871) in the American Journal of Science.

A brief account of the outbreak of the eruption of Mauna Loa on February 14, 1877.
Anonymous (continued)

A brief account of the summit eruption of Mauna Loa on February 14, 1877, and the submarine eruption in Kealakekua Bay on February 24, reprinted from the San Francisco Chronicle.

Brief accounts of the lava flow of Mauna Loa, near Hilo, during the early part of July, 1881.

An account of the 1881 lava flow of Mauna Loa, near Hilo.

An account of the lava flow of Mauna Loa, near Hilo, on July 25, 1881.

Brief descriptions of the lava flow near Hilo, on August 3 and 4, 1881, and of the volcanic cloud throughout the eruption.

A description of the lava flow near Hilo, on August 10, 1881.

A description of the lava flow, and particularly of the lava tubes, near Hilo on Aug. 18, 1881.

An account of the lava flow of 1881.

Brief notices of an earthquake which occurred at 4:52 a.m., September 30, 1881. At Waimea and Hamakua it was said to be more severe than the quakes of 1868.

1882. [On the vent of the 1880 eruption]: Hawaiian Annual for 1883, p. 35.
A brief statement that since the end of the 1881 eruption of Mauna Loa, the vent then formed had been continually steaming.
The tsunami (originating at Krakatoa Volcano, in the East Indies) was observed both on the western coast of Hawaii, and in Honolulu. At the latter place the water rose and fell twice, about one foot, starting about 6 a.m. on the 27th.

A correspondent residing in Kau records a submarine eruption on the morning of January 22, 1884, off the east cape of Hawaii. "A column of water, like a dome, shot several hundred feet up into the air, accompanied with clouds of smoke and steam. All Kilauea range... was enveloped in the dense clouds... and the ocean was also covered with clouds of steam as far as the eye could reach." No further activity was observed next day.

An account of the eruption of 1887, compiled from numerous sources.

The breakdown of March, 1891, in Halemaumau, was slightly larger than that in 1886. It also differed from the latter in that molten lava returned to the pit after an interval of only 3 weeks, whereas in 1886 it did not return for 3 months. The pit resulting from the breakdown was 3,000 feet long, 2,500 feet wide, and 500 feet deep.

A description of Mokuaweoweo on June 24, 1893. There was no activity at the time. Conditions at Kilauea also are described.

An account of the activity of Kilauea during the fall of 1893 and the first half of 1894. Late in 1893 the lava lake stood at a level several feet above the surrounding caldera floor, enclosed by a thin circular wall of its own building. Repeated overflows built a dome around the lake. An excellent description by L. A. Thurston of the great subsidence of the lava which began on July 11, accompanied by collapse of the walls of Halemaumau, is quoted.

1894a. The volcanoes of the Sandwich Islands: Chamber's Jour., vol. 11, p. 472-474, July 21. (Not seen.)

This tsunami (which devastated the Sanriku area in Japan) left a record of a rise and fall of about 0.3 foot at Honolulu, but had a magnitude of several feet on the Kona coast of Hawaii. At Honolulu the first manifestation was a rise in water level.
Anonymous (continued)

Brief accounts of the 1899 eruption of Mauna Loa, and descriptions of the source area, on July 8, 1899.


1901. [On the tsunami of August 9, 1901]: Honolulu Daily Advertiser, Aug. 10.
A wave about 4 feet high swept on shore at Kailua, Hawaii, at 11:30 a.m. At Keauhou Beach a house was swept away.

1906. More water development; the Kohala Ditch: Hawaiian Annual for 1907, p. 115–117.
A brief account of the construction of the Kohala Ditch.

At Hilo the water reached 12 feet above normal, reversing the flow of the Wailuku River, and covering the floor of the wharf at the foot of Waianuenue Street and the railroad tracks between there and Waiakea. Before the rise, the water receded well out from shore.

The tsunami which accompanied the great Valparaiso (Chile) earthquake caused a rise in water level of 5 feet at Hilo, and 12 feet on the southern shore of the island of Maui.

Excerpts from the writings of W. T. Brigham, W. L. Green, C. E. Dutton, J. D. Dana, and S. E. Bishop, containing descriptions and theories of origin of aa and pahoehoe.

A brief account of the 1907 eruption.

1907b. Table of volcanic eruptions, island of Hawaii, 1790 to 1907: Hawaiian Annual for 1908, p. 136–137.
A list of known eruptions, with their duration, the approximate altitude of the main vent, and the character of the eruption. The early part of the table is from W. L. Green’s “Vestiges of the molten globe.”

1907c. Hawaiian volcanoes: Pacific Rural Press, vol. 74, p. 172, Sept. 7. (Not seen.)

A brief account of the construction and opening of the Hamakua Ditch, leading water from the Kohala Mountain to the Hamakua district.
1912. The volcano of today and 20 years ago: Paradise of the Pacific, vol. 25, no. 8, p. 16–22, August.
A summary of the results of analyses of gases from Kilauea, collected in 1912.
Contains a brief popular description of Halemaumau lava lake during 1912.
An account of the temperature measurements on the molten lava of Halemaumau, by thermocouple, during 1911. (Not seen).
A very brief popular description of the recent lava flows which cross the highway between Waiohinu and the boundary of the Kona District.
The eruption commenced on April 10, 1926, on the southwest rift zone of Mauna Loa near the South Pit of Mokuaweoweo, this eruption lasting only a few hours. On April 14 lava broke out on the rift at about 8,000 feet, sending a flow toward Waiohinu and another into Kona. The latter lava entered the bay at Hoopuloa on April 18. Descriptions of the lava flow and source area are quoted from the Volcano Letter. Kilauea remained quiescent.
Contains brief popular descriptions of Kilauea and Mauna Loa.
1933. [On the tsunami of March 2, 1933]: Honolulu Daily Advertiser, Mar. 3.
At Kailua, Hawaii, a series of ten large waves started at 3 p.m. The last was the highest, reaching 9 feet above sea-level, and doing minor damage. The waves originated off the coast of the Sanriku district of Japan.
A brief account of a plan to market bottled water from springs in Puna. (Contains several misstatements.)
1940. The pulse of a volcano: Paradise of the Pacific, vol. 52, no. 10, p. 23–26, October.
An account of the 1940 eruption of Mauna Loa, abstracted from the records of the Hawaiian Volcano Observatory.
A list of publications on all subjects relating to the area of Hawaii National Park, either before or since the establishment of the Park, briefly annotated.

Andrews, S. L.
An account of the opening phases of the Mauna Loa eruption which commenced on January 9, 1843. Andrews notes that the crater of Kilauea presented at this time no unusual appearance, and concludes there is no connection between Kilauea and Mauna Loa, since, if there were, the force which raised the lava 6 or 8 thousand feet above Kilauea should have caused an outbreak there also.

Anrep-Elmpt, Reinhold
1885. Die Sandwich-Inseln oder das Inselreich von Hawaii, p. 68-72, Leipzig.
Contains a description of Kilauea Caldera on August 5, 1878. The general floor of the caldera was 174 meters lower than the Volcano House. Five small lava lakes and one large one (Halemaumau) were active. Halemaumau was 2,275 meters long and 1,700 meters wide, enclosed by a rampart 150 feet high, the fluid lava being not more than 25 feet below the rim.

Auchincloss, H. B.
A description of Kilauea in 1864.

Aurousseau, M., and Merwin, H. E.
Two new chemical analyses of olivines from the 1790 and 1840 lavas of Kilauea.

Ayres, A. S.
A discussion of the soils of the Hilo and Hamakua coasts, and the Waiakea and Olaa plantations. The following subjects are dealt with: methods of analysis, exchangeable and total calcium, exchangeable and total magnesium, exchangeable and total potassium, exchangeable and total manganese, base-exchange capacity, base saturation, soil acidity, organic matter, nitrogen, and carbon-nitrogen ratios.
Bade, W. F.
A brief description of Kilauea Caldera in August, 1921.

Baker, A. S.
A description of the north branch of the 1907 lava flow of Mauna Loa.
A description of the 1919 lava flow of Mauna Loa.

Baker, E. P.
A brief description of the source of the 1880 lava flow of Mauna Loa.
A general discussion of Hawaiian volcanoes. Mauna Loa and Kilauea are regarded as independent.
Brief notes on the source areas of the eruptions of 1852, 1880, and 1887. The latter was still fuming in July, 1888. Fissures trending southwestward at the southern end of Mokuaweoweo were probably produced at the beginning of the 1887 eruption, before the outflow of lavas at lower levels.
On March 6, 1891, a great subsidence occurred at Halemaumanu, the debris cone sinking out of sight, and leaving a pit 900 feet deep, with diameters at its top of three-fourths mile and one mile. Many earthquakes were felt at Hilo and Kapapala during the ensuing week. It is inferred that the lava drained away underground, toward the southwest. No surficial eruption occurred.

Baldwin, C. W.
Contains a description of the source area of the Mauna Loa lava flow of 1899.
Contains a brief general description of the physical features of the island of Hawaii, a description of Kilauea Caldera in 1878, and brief descriptions of the Mauna Loa eruptions of 1859, 1868, and 1881.

A general discussion of the physical features of Hawaii. The big valleys and high sea-cliff of northeastern Kohala are partly caused by erosion, but also perhaps partly by faulting. Lake Waiau is stated to be 40 feet deep.

A very brief popular description of Mauna Kea, Mauna Loa, and Hualalai. Lake Waiau is said to have been sounded a short time before, and to have measured only 40 feet deep at the maximum. Terraces near the boundary between South Kohala and North Kona, at 1,000 and 2,000 feet altitude, are believed to be of marine origin, indicating the land to have risen by that amount.

Baldwin, E. D.

1889. A trip to the summit of Mauna Kea: Hawaiian Annual for 1890, p. 54-58.
A description of the upper slopes of Mauna Kea. When visited in August, 1886, Lake Waian measured 200 feet long by 150 feet wide.

Bailey, C. T.


Bailey, C. T., and Stewart, J. E.


Baldwin, P. H. (See Waesche, 1939.)
Ballard, S. S. (See also Payne and Ballard, 1940.)

General features of the volcanic gas problem are briefly discussed; technique of collecting gases is described, including a new type vacuum collecting tube; method of analyzing gases collected at Sulfur Bank, Kilauea, is described. The latter consist largely of steam, the rest consisting, in one sample, of \( \text{SO}_2 \)-58.6\%, \( \text{CO}_2 \)-4.6\%, \( \text{O}_2 \)-7.0\%, residue-29.8\%, combustibles—none. The residue is largely nitrogen, proportion of N to O being about that of air, a little argon also being present. Allen’s (1922) “fixed gases” were probably air and \( \text{CO}_2 \).

Ballard, S. S., and Gow, P. L.

The new tube is of 800 cc capacity, with a stop-cock for closing it after the collection is complete, and a wire attached to the thin tip for breaking it off to permit entrance of the gas.

Ballard, S. S., and Payne, J. H.

A new collection procedure is present. Solfataric gases from Sulfur Bank consist of steam, \( \text{SO}_2 \), \( \text{CO}_2 \), and air. Collections were made monthly from September, 1937, to August, 1940, and a table shows the determined percentages of air, \( \text{SO}_2 \), and \( \text{CO}_2 \), in the dry fraction. \( \text{H}_2\text{S} \) appeared in March, 1940, and was present in April collections. Mauna Loa broke out on April 7. No \( \text{H}_2\text{S} \) was present in May and June.

Barth, T. F. W.

Normative nepheline is present in many lavas of Pacific islands, but is not recognized in the mode. It is concluded that some of the apparently normal plagioclase actually is anemousite, a feldspar containing the triclinic form of nepheline in solid solution. Rocks containing this are termed pacificite. A rock collected by Washington in Kaula Gulch, above Ookala, is described in detail.

A study of basalts from many localities, including several specimens from the island of Hawaii, leads to the conclusion that pigeonite is the most abundant pyroxene in such rocks. Pyroxenes crystallizing from basaltic magma show a regular sequence from diopsidic to hypersthenic (pigeonitic).

The rocks from several central Pacific regions, including the island of Hawaii, are described. The individual mineral phases are treated in detail. Both modal and normative compositions are given. The theory of crystal settling is considered adequate to explain the differentiation of Pacific lavas.


Study of basalts from many localities, including the island of Hawaii, shows that the essential mineral phases are plagioclase, forming a reaction series from calcic to sodic, and pyroxene, forming a reaction series from diopsidic to clinohypersthenic. Depending on initial composition either plagioclase or pyroxene may start to crystallize first, changing the composition until simultaneous crystallization occurs. Slight differences in composition of the parent magma may result in production of an end-magma either oversaturated or undersaturated in silica.

Barton, G. H.


Bartsch, Paul


The origin of the Hawaiian molluscan fauna is considered. Depths surrounding the islands are too great for migration of littoral forms along the bottom, and distances are too great for the forms to reach the islands during a free-swimming larval stage. It is suggested that the molluscs travel attached to or nestled among rocks enmeshed in the roots of floating trees.

Beach, A. R., and Eller, W. H.


Using a magnetometer, it was determined that a sample of Kilauean lava is definitely magnetic, has a definite polarization; that when heated to between 800° and 1100° F., lava can be magnetized; that most types of lava approach magnetic saturation when exposed to a field about 30 times as strong as that of the earth; that after lava has cooled there is no apparent change in its magnetic strength or polarization. It should be possible to date flows by comparing the polarization of the lava with known magnetic declinations of past years.
Becker, G. F.
On the basis of Coan's accounts, it is computed that the 1840 lava flow from Kilauea advanced at a rate of 22 feet a minute. Using a density for liquid lava of 2.5 times that of water, it is computed that the lava had a viscosity 60 times that of water.

Bennett, C. C.
1869. Honolulu directory, and historical sketch of the Hawaiian or Sandwich Islands, 88 pp., Honolulu.
Pages 45 to 51 contain a description of Kilauea Caldera in 1838, quoted from Strzelecki; the Mauna Loa eruptions of 1855 and 1859, quoted from Alexander; the eruptions, earthquakes, and mudflow of 1868; and the tsunamis of 1837, 1841, and 1868.

Berndt, E. A. (See Loomis, 1937.)
Berndt, L. P. (See Loomis, 1937.)

Betz, F., and Hess, H. H.
The Hawaiian Swell is a gentle rise, 600 miles wide and 1900 miles long, surmounted by abrupt volcanic peaks along two main trends: N 75° W and N 55° W. Shorter trends cross the main axis at N 80° E and N 30° E. Volcanic activity may be more intense at the intersections. The broad swell probably results from copious lava outpourings along a fissure zone, possibly a zone of transcurent (horizontal strike-slip) fault displacement.

Bingham, Hiram
Contains an account of an ascent of Mauna Kea and a visit to Kilauea Caldera, in 1830. The "black ledge" was about 600 feet below the caldera rim, and the active lava lake was in a depression about 400 feet deeper. The conception of a volcano as a "safety valve" is stated.

Birch, Francis, and Dane, E. B., Jr.
States viscosity of lava of 1920 flow from Mauna lki. Kilauea, as determined by Jean Verhoogen, as follows: at 1,074° C. = 4,950 poises; at 1,147° C. = 800 poises; at 1,248° C. = 150 poises; at 1,314° C. = 76 poises, all at 1 atmosphere pressure.
Bird, Isabella L.

Describes Kilauea Caldera and Halemaumau pit on January 31 and June 5, 1873, at which times there were two lakes in Halemaumau; and a summit eruption of Mauna Loa in June 1873, viewed in company with W. L. Green. Also gives brief accounts of visits to the summits of Mauna Kea and Hualalai.

Bishop, Artemus

A description of Kilauea Caldera in December 1826. Since the visit of Lord Byron, in June 1825, the caldera had apparently been filled to a depth of more than 400 feet with fresh lava. Natives informed Mr. Bishop that "after rising a little higher, the lava will discharge itself, as formerly, towards the sea, through some aperture under ground."

Bishop, Isabella B. (See Bird, Isabella L.)

Bishop, S. E.

A description of the 1855 lava flow of Mauna Loa, during January 1856, in the forest above Kaumana.

A description of the 1887 flow where it entered the sea, and of the source area.

A description of the Mauna Loa eruption of 1887. The eruption commenced on January 16, with a lava fountain in Mokuaweoweo. On January 18, lava broke out on the southwest rift, at an altitude above 5,700 feet, and reached the sea in 26 hours. Lava emission ceased on February 1. Rising air, heated by the flow, resulted in formation of a cumulus cloud above it. Fume clouds from this eruption were noted in Honolulu.

A description, with a map and cross-section, of Halemaumau on April 13, 1892. Halemaumau contained a flat lava floor 300 feet below the rim, in the center of which was an active lava lake 40 feet beneath its banks. The action of the lake is described.
The primary force impelling the rise of lava is believed to be the expansion of the magmatic gases. On release of pressure the magma expands into a foam and pushes upward. At Kilauea and other quiet volcanoes the rising magma meets no water to generate explosive steam. Halemaumau lava lake, during April 1892 and August 1894, and the great collapse of March 1894, are described. Fountains in the lake maintained the same position after the collapse as before.

1906. Active volcanoes of this Territory [Hawaii]: Pacific Commercial Advertiser, vol. 54, no. 7458, p. 77-78, July 2.
A brief general description of the island of Hawaii, and the activity of the volcanoes.

A brief account of the 1907 eruption at Mauna Loa. The Kahuku center (near Puu o Keokeo) is regarded as a separate volcano, the listed reasons including: Lack of eruption in Mokuaweoweo during the 1868, 1887, and 1907 eruptions at Kahuku; distance from Mokuaweoweo is about the same as from the latter to Hualalai or Kilauea; the Kahuku mountain appears distinct when viewed in profile.

Black, J. H.
A description of Mokuaweoweo during September, 1872. A black ledge occupied the floor of the caldera about 500 feet below the western rim and within it was another pit with dimensions about half those of the major caldera. A lava fountain was active in the central pit. A sketch map of the caldera is given.

Bloxam, Andrew
A brief account of a visit to Kilauea Caldera in June 1825, containing only very general descriptions.

Boles, Thomas
A popular description of the explosive eruption of Kilauea in May, 1924.
Bond, E.  
A brief description of the effects in Kohala of the earthquake of September 30, 1881, stated to have been more severe than those of 1868.

Bonesteel, C. H.  
A popular description of the advance of aa lava in the Kahuku branch of the Mauna Loa flow of 1916.

Bonney, T. G. (See also Anderson and Bonney, 1917.)  
Describes Kilauean activity in 1840, quoting Dana, Wilkes, and Coan; outlines Kilauean cycle of filling and collapse of the caldera, as stated by Dana; describes collapsed floor of Kilauea Caldera in 1823 and points out that this implies an underlying magma column at least as great in cross-section as the down-dropped block.

Boscowitz, Arnold  
Contains descriptions of Kilauea and Mauna Loa, quoted largely from Wilkes (1845).

Bowen, N. L.  
Pierite-basalts of Hawaii are attributed to accumulation without remelting of crystals of olivine and augite settling out of magma higher up in the reservoir (p. 104-106).  
Contains (p. 159-165) the same material as Bowen, 1927.

Branner, J. C.  
Contains a brief description of the large valleys of the Kohala Mountains. The valleys are believed larger, and the sea cliff higher, than in the areas farther north and south because of the greater age of the land surface in the intermediate area. The flat floors of some of the valleys are the result of submergence.

Brassey, Annie A.  
Contains a description of Kilauea Caldera in December 1876.

Brigham, W. T.  
Descriptions of Kilauea Caldera in 1864 and 1865.
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1868c. (compiler) Catalog of works published at or relating to the Hawaiian Islands: Hawaiian Club Papers, Boston, p. 63–115. A bibliography, partly annotated, of books and articles in periodicals on all subjects relating to the Hawaiian Islands, up to 1868. [It is sometimes referred to as “Hunnewell’s bibliography,” but is stated by N. D. Stearns (1935) to have been compiled by Brigham at James Hunnewell’s suggestion.]


1887. Kilauea in 1880: Am. Jour. Sci., 3rd ser., vol. 34, p. 19–27. A description of Kilauea Caldera on July 25, 1880. The central portion of the floor was a gentle broad dome 350 feet high, partly formed by lava overflow, but partly by uplift. surmounted by 4 lava lakes. Local elevation of the banks of the lava lakes to form high crags is described. Blue and green flames are recorded over the lakes and over blowing cones. The emanations were believed to contain very little steam.

1888. Notes on an ascent [of Mauna Loa] in 1880: Am. Jour. Sci., 3rd ser., vol. 36, p. 33–35. A description of Mokuaweoweo on July 28, 1880. The name “Pohaku Hanalei” is applied to South Bay. The lava fountains during the eruption of May 1, 1880, are stated (by the guide) to have been as high as the tops of the walls of South Bay.

1891. On the recent eruption of Kilauea: Am. Jour. Sci., 3rd ser., vol. 41, p. 507–510. An account of changes at Kilauea Caldera during February and March, 1891. In February several small lava lakes were present on the broad dome which occupied the caldera floor. The lakes were all at the same level, and believed to be interconnected. On March 6 an earthquake occurred, accompanied by subsidence in Halemaumau. On April 2, Halemaumau was an empty pit 500 feet deep.
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Brigham, W. T. (continued)

A 100-foot subsidence of the lava in Halemaumau, on September 4, 1908, is described.

An account of the history of Kilauea and Mauna Loa up to October 1909, based partly on long personal experience, but largely on a compilation of published and unpublished information from many sources. Each lava flow is described, and changes in the calderas are discussed with the aid of contemporary maps. Ascents of Hualalai and Mauna Loa in 1864 are described. The fume cloud from Kilauea is stated to be largely steam. Stalactites in lava tubes are believed to be of aqueous origin. Several of the older chemical analyses of lavas from Kilauea are tabulated.

A description of lava trees (on the 1840 lava flow) and of Makaopuhi Crater. Several dikes are recorded in the latter, at right angles to a line from Kilauea to Kapoho. Cones near Kapoho are described. Several warm springs are mentioned in this vicinity.

An account of an ascent of Hualalai in July 1864. The summit of the mountain is described. No fume or steam was observed. A "blow-hole" said to be 25 feet across and more than 1800 feet deep is described.

Brown, C. W.

On the evening of September 30, 1929, a ship 3 or 4 miles off shore from the Kauhola Point lighthouse, on the northeastern coast of Kohala, felt a series of sharp bumps believed to be caused by earthquakes.

Brown, E. W.

Observations at Halemaumau indicate that the lava lake probably exhibits a lunar tide of an amplitude of about 3 to 5 cm, and periods of one-half and one lunar month.

Measurements by vertical angles of the height of the solid crust and of the liquid lake lava in Halemaumau were made by Jaggar over 28 days in 1919, at 15 and 20 minute intervals. Analyses of these measurements show some evidence of tides with periods of the lunar day and lunar half day, with double amplitudes of about an inch. The evidence is believed sufficient to warrant further observations on the crust lava over a longer period but at less frequent intervals. Variations of the liquid lava are too irregular to show small tidal effects.

Brown, F. B. H.


The Hawaiian dicotyledonous plants are concluded to be of Isthmian American origin. Two dispersal periods are distinguishable, one during Jurassic-Cretaceous time and the other in Eocene-Oligocene time. The existence of a Hawaiian sub-flora originating in Central America in Jurassic-Cretaceous time indicates the Hawaiian Islands to be at least that old.

Brown, G. V.


A specimen of vesicular lava, collected at Kilauea by J. D. Dana in 1840, was impregnated with orange-red to sulfur-yellow selen-sulfur, composed of sulfur 94.82 percent, and selenium 5.18 percent. It is suggested that owing to the small proportion of selenium, the name “seleniferous sulfur” would be more appropriate.

Brun, Albert


Noted that the volcanic cloud given off by the lava lake of Kilauea does not evaporate in the air, and shows no optical phenomena, such as rainbow colors, in sunlight. No condensation of moisture was obtained in glass tubes in the fume cloud 100 meters from its point of emergence, and a dew-point hygrometer showed a smaller humidity than in clear air nearby. The conclusion is reached that the magmatic emanations at Kilauea are anhydrous. Gases extracted from two samples of solidified Kilauean lava are described. A partial analysis of the gases at Sulfur Bank revealed no SO₂.
1913. Note on the lava taken from the Halemaumau Pit by Mr. Frank A. Perret in July, 1911, with gas analyses and remarks: Am. Jour. Sci., 4th ser., vol. 36, p. 484-486. Gases liberated during refusion of the lava from “Old Faithful” fountain were analyzed, and found to be largely C, S, and H₂. The refused lava contains residual C, showing that the amount of H₂O in the Halemaumau lava is insufficient to convert all of the C to CO₂, and it is concluded that Kilauean magma is essentially anhydrous.

Bryan, E. H.

Bryan, L. W.

1939. Lake Waiau of Hawaii: Paradise of the Pacific, vol. 51, no. 2, p. 11, February. Lake Waiau is stated to be 8 to 10 feet deep, and to overflow during high water into Pohakuloa Gulch. Waihu Springs, at 11,000 feet altitude along Pohakuloa Gulch have never been known to go dry, and are believed to derive part of their water through underground channels from Lake Waiau.

1939a. Mauna Loa and bombing Pele’s lava: Paradise of the Pacific, vol. 51, no. 12, p. 79-80, December. A brief popular account of the bombing of the 1935 lava flow, expressing the belief that the bombing stopped the flow.

Bryan, W. A.
1915. Natural history of Hawaii, p. 147-188, Honolulu. Brief descriptions of the physiography of the island of Hawaii, the 1801 eruption of Hualalai, and of the historic eruptions of Manna Loa and Kilauea up to and including the year 1914. Also a summary of conditions in Kilauea Caldera from 1823 to 1910.

1916. [On the glaciation of Mauna Kea]: Pacific Commercial Advertiser, vol. 59, no. 10,592, p. 7, July 17; no. 10,630, p. 7, Aug. 30. An account of glacial features near the summit of Mauna Kea. The extent of the glacier is estimated as 50 square miles. Hualalai is believed to be older than Mauna Kea. On August 24, 1916, two cones on the floor of Moknaweoweo were fuming, but there was no other activity.

Bullard, F. M. (See Waesche, 1939.)

Burchard, E. D.

Burchard, E. D., and Carson, M. H.

Burri, R. C.
1926. Chemismus und provinziale Verhältnisse der jung-eruptiven Gesteine des pazifischen Ozeans und seiner Umrandung: Schweizerische Min. und Petr. Mitt., vol. 6, p. 172-178. The eruptive rock suites of the central Pacific are divided into a "Hawaiian type" and a "Tahitian type." The characteristics of each is discussed from the standpoint of Niggli's numbers. The Tahitian type differs from the Hawaiian in having lower \( f_m \) and \( c \), higher \( a_lk \) and \( a_l \).

Byron, George A. (Lord)
1826. Voyage of H.M.S. Blonde to the Sandwich Islands, in the years 1824-1825, p. 181-190, London. (Compiled by Mrs. Maria Graham Callcott from the notes and diaries of various members of the expedition.) A description of Kilauea Caldera in 1825, with a map of the caldera prepared by Lt. Malden. A narrow "black ledge" which surrounded the caldera was stated to be 932 feet below the rim, and the floor of the caldera, with many active vents, about 400 feet lower.

Callcott, Maria Graham (See Byron, 1826.)

Carson, M. H. (See also Burchard and Carson, 1929; Wentworth, Carson, and Finch, 1945.)
A brief general summary of the stage of development of water resources on the various islands of the Hawaiian group.

Discharge measurements for Honolii Stream and Wailuku River at Pukamau.

Discharge measurements for Honolii Stream and Wailuku River at Pukamau.

Discharge measurements for Honolii Stream and Wailuku River at Pukamau.

A brief general discussion of water supply in the Hawaiian Islands, with a short section specifically on the island of Hawaii. Difficulties of bringing water to the dry leeward side from the wet windward areas are discussed.

Discharge measurements for Wailuku River, Honolii Stream, Awini Ditch, Kohala Ditch; and miscellaneous measurements on Kokekekele, Kahoama, Kapehu, and Camp No. 4 streams, and Umauma flumes numbers 1 and 2.

Discharge measurements for Wailuku River, Honolii and Kapehu streams, Awini, Kohala, and Kehena ditches.

Discharge measurements for Wailuku River, Kapehu and Honolii streams, Awini, Kohala, and Kehena ditches; and miscellaneous measurements on Waiakea Stream near Middle Flume House, and Waiakea Springs 150 feet below the dam at Hilo. The record for Wailuku River at Pukamau is revised in Water-Supply Paper 770.
Discharge measurements for Wailuku River, Kapehu and Honolii streams, Awini, Kohala, and Kehena ditches; and miscellaneous measurements on Pae, Kaimu, Punalulu, Paopao, Kukui, and Waimaiile streams. The record for Wailuku River at Pukamaui is revised in Water-Supply Paper 770.

Discharge measurements for Waiakea Stream, Wailuku River, Kapehu and Honolii streams, Hilo Boarding School, Awini, Kohala, and Kehena ditches. The record for Waiakea Stream from July 1930 to June 1931 also is given. That for Wailuku River at Pukamaui is revised in Water-Supply Paper 770.


Discharge measurements for Waiakea Stream, Wailuku River, Kapehu Stream, Hilo Boarding School, Awini, Kohala, and Kehena ditches. The record for Wailuku River at Pukamaui, from July 1, 1929, to June 30, 1933, is revised.

Discharge measurements for Waiakea Stream, Wailuku River, Kapehu Stream, Hilo Boarding School, Awini, Kohala, and Kehena ditches. Contains also (pp. 11–12) a list of all gaging stations on the island of Hawaii, and the years or parts of years for which records are available.

Discharge measurements for Wailuku River, Waiakea and Kapehu streams, Hilo Boarding School, Awini, Kohala, and Kehena ditches.
Carson, M. H. (continued)

Discharge measurements for Wailuku River, Waiakea and Kapehu streams, Hilo Boarding School, Awinu, Kohala, and Kehena ditches.

1939a. Surface water resources: Hawaii Territorial Planning Board, First Progress Rept., p. 125-142.
Contains a list of stream gaging stations on the island of Hawaii, with a map showing their location; duration-discharge curves for the stations on Honolii, Kapehu, and Waiakea streams and the Wailuku River above the Hilo Boarding School ditch; and intensity-frequency curves for floods on Kapehu and Honolii streams and the Wailuku River at Pukamau.


A brief general discussion of the distribution of rainfall in the Territory of Hawaii, and its effect on the distribution, number, and size of surface streams. Specific references to the island of Hawaii are included.

Contains daily discharge measurements of Waiakea Stream; Wailuku River above Boarding School ditch intake; Waillikahi (formerly listed as Waimanu-liliili), Kaimu, Punalulu, Wai'alalea, Paopao, and Kukui streams, and Awini, Kohala, and Keheua ditches, in Kohala; also miscellaneous measurements of Lahomene and Kakaauki streams (tributaries of Waihilau Stream, formerly listed as third and second branches of Waimanu Stream).

Discharge measurements for Wailuku River; Waiakea, Waillikahi (formerly listed as Waimanu-liliili), Kaimu, Punalulu, Wai'alalea, Paopao, and Kukui streams; Awini, Kohala, Kapehu, and Keheua ditches; and miscellaneous measurements on Lahomene and Kakaauki streams. The two latter streams are tributaries to Waihilau Stream, formerly listed respectively as the third and second branches of Waimanu Stream.


Cartwright, Bruce

Observations at 10-minute intervals of the action of "Old Faithful" fountain in the Halemaumau lava lake on February 15 and 16, 1909.
Observations of Halemaumau lava lake in February, 1909, revealed the following features: (a) a point of greater activity, erupting at intervals (Old Faithful); (b) a line or lines along which fountains continually played; (c) a point where lava bubbled up like a spring; (d) a point or points where lava sank. Laboratory experiments to reproduce those features suggested that the rising liquid and gas were introduced from the side, probably that toward Mauna Loa.

Halemaumau and Mokuaweoweo: Paradise of the Pacific, vol. 26, no. 8, p. 10-11, August.
The surface action of Halemaumau lava lake suggests that the action is caused by hot gases entering from below, from the direction of Mokuaweoweo, melting the surrounding lava, which forms a lake through which the gas passes. Mauna Loa and Kilauea are interconnected, the apparent independence of action being the result of the longer conduit feeding Kilauea, containing a greater mass of lava, and having a longer lag. Kilauea acts as a regulator for Mauna Loa, and Mauna Loa is believed to have ceased building at the birth of Kilauea.

Castle, W. R.
A general description of the Hilo and "Laumaina" branches of the 1880-81 lava flow. The "Laumaina" or northern branch is stated for most of its course to adjoin or overlap on the southern side of the flow of 1855. Its lower end covered a great sweep to the south of the 1855 flow.

A description of Halemaumau in early July, 1893.

A description of the source area of the 1899 lava flow on July 16, 1899.

A general account of the physical features of the island of Hawaii, and brief popular descriptions of Kilauea and Mauna Loa, and volcanic activity at Kilauea. A description of Kaumana Cave is given.

Caton, J. D.
1880. Miscellanies, p. 27-241, Boston.
Contains a description of Kilauea Caldera on January 27, 1878.
Chamberlain, Levi
The circumference of Kilauea Caldera was found to be 7.5 miles at the rim, and its depth estimated as not less than 1,000 feet. At the black ledge, 500 or 600 feet below the rim, the circumference was at least 5.5 miles.

Chamberlain, R. T.
Includes a determination of the gases enclosed in the 1808 lava of Kilauea.

Chandler, A. E.
Discusses the legal aspects of ownership, use, and conservation of water. Recommends no additional legislation regarding appropriation and use of surface waters, as court decisions have made legislation unnecessary. Considers legislation governing new appropriations of water, adjudication of water rights, and official appointment of water.

Chang, G. L.
Aa is due to crystallization while the flow is in motion. When it has crystallized to the extent that it ceases to flow readily, and the forces on it are sufficient, it crumbles into loose blocks, some of which subsequently stick together. If the flow is slower, allowing skins of chilled glass to form over the surface, and the force of the flowing lava is insufficient to break them, pahoehe is formed.

Chapman, R. W.
Three stages of congealation are recognized in blocks of glass-bearing basalt ejected from Halemaumau during the 1924 explosions. During stage 1 cooling was slow and microphenocrysts of olivine and augite formed. Stage 2 started with intrusion of the magma as a sill, and more rapid cooling precipitated crystals of labradorite and augite. In stage 3 fragments were hurled into the air, chilling the residual liquid to glass.
Cheever, H. T.
An account of a visit to Kilauea Caldera in January, 1850. Same as Cheever, 1851.

A description of Kilauea Caldera in January, 1850. Sulfur Bank and the southeastern solfatara are described, and the alteration of the rock by hot sulfurous vapors is recognized. The only active lava lake mentioned is Halemaumau, said to be a mile in greatest diameter, and 30 or 40 feet below its rim. Activity is said to have been much less than a year before, during a visit by Mr. Paris. Strzelecki's description of the caldera in 1838 is quoted in part, and other descriptions are summarized. The two views of Kilauea are of the year 1840, taken from the Narrative of the United States Exploring Expedition (Wilkes, 1845).

Cheney, May L.

Clark, W. O. (See Stearns and Clark, 1930.)

Clarke, F. L.
An account of Kilauea Caldera in June and July, 1886. Liquid lava appeared in Halemaumau on June 26, and on June 29 the lake had diameters of 225 and 435 feet. By July 4 the lake level had risen 75 feet higher than it was on June 29.

Clarke, F. W.
Contains chemical analyses of 18 Hawaiian lavas, most of them from the island of Hawaii, and of olivine from the 1852 lava of Mauna Loa.

Summarizes existing knowledge of the gases of Kilauea Volcano.

Clemens, S. L. (Mark Twain)
1872. Roughing it, p. 532–543, Hartford, Conn.
Contains a description of Kilauea Caldera in 1866.

A description of Kilauea Caldera in June, 1866; reprinted from the Sacramento Weekly Union, November 17, 1866.
Coan, Fidelia C.

On February 26, 1852, Mauna Loa continued in eruption. Activity on February 25 was more intense than it had been since February 17.

Coan, Lydia B.

A description of the lava flow of Mauna Loa near Hilo, on June 28, 1881.

Coan, Titus

A description, gathered from eye-witnesses, of the 1840 eruption of Kilauea, and of the condition of Kilauea Caldera directly preceding and following the eruption.

An account of the 1840 eruption of Kilauea.

An account of the early phases of the Mauna Loa eruption of 1843, which is stated to have commenced on the morning of January 10.

An account of a visit during the early part of March, 1843, to the Mauna Loa lava flow of that year.

In July, 1847, Kilauea Caldera was essentially the same as in 1846, except that the lava lake had overflowed a considerable surrounding area. About the beginning of 1848 the lake was observed to be crusted over with a thick stratum of lava, and that stratum was soon raised into a dome 200 or 300 feet high over the whole lake. Small lava streams escaping from fissures in its surface added to the bulk of the dome. In April and May, 1849, explosions occurred from an orifice at the apex of the dome. From then until the end of 1850 the caldera was mostly quiescent, the dome continuing in existence. An eruption occurred within Mokuaweoweo in May, 1849, some little time after the extraordinary activity at Kilauea, and continued for 2 or 3 weeks.
Mauna Loa erupted on August 8, 1851, on its western slope. The eruption lasted only 3 or 4 days. Floods of lava burst from an orifice supposed to be about 5 miles west of Mokuaweoweo, and formed a flow one to two miles wide and perhaps 10 miles long. In October, 1851, Kilauea continued much as in 1850.

A brief account of the outbreak of the Mauna Loa lava flow of 1852. Mauna Loa became active near the summit on February 17, pouring a lava flow down the mountain side. The activity lasted less than 24 hours. On February 20, lava broke out about half way down the mountain, toward Hilo.

A description of the 1852 eruption of Mauna Loa, from its outbreak on February 17, to March 6, when the lava flow was still advancing. Hydrostatic pressure of lava in the main conduit, reaching several thousand feet above the level of lateral outbreak, is believed to be the cause of the spouting lava fountains.

In July, 1852, the top of the dome in Kilauea Caldera had fallen in, the orifice being occupied by a lava lake. The upper part of the 1852 lava flow of Mauna Loa is described.

The aperture in the summit of the dome in Kilauea Caldera continued to enlarge during 1853. Streams of lava occasionally poured from fissures in the dome. A gradual rising of the whole caldera floor occurred by overflowing and by uplift from below. The entire central floor was an elevated plateau, rising as much as 200 feet above the former black ledge which surrounded it. The dome was at its southern edge. Mauna Loa was quiet in January, 1854.

The central plateau and dome still existed in Kilauea Caldera in July, 1855. Activity within the dome was increasing. The outer moat had been deeply flooded by ponded lava flows, and at the end of May there was a fiery girdle around the whole circumference of Kilauea Caldera.
A description of the lava flow and source area of the eruption of Mauna Loa on October 6, 1855. The highest source cone was estimated to be at 12,000 feet altitude. The eruption commenced on the evening of August 11, 1855. Kilauea Caldera in October, 1855, is described. The dome which had recently covered Halemaunau had collapsed, leaving a jagged rim 20 to 60 feet high, with active lava 100 feet below.

A description of the lava flow of Mauna Loa on the night of October 31, 1855. The development of tumuli on the top of the flow is mentioned.

A description of the 1856 lava flow of Mauna Loa, near Hilo. The term “tumuli” is applied to the domical elevations of the crust of a lava flow caused by pressure of the underlying lava.

Brief summary descriptions of the eruptions of 1840, 1843, 1852, and 1855. Descriptions of the lava flow of 1855 in October and November of that year, and of the source area of the flow in October are included.

During the year preceding October 22, 1856, activity at Kilauea had gradually decreased, until only a little sluggish lava was present in Halemaunau. The 1855 eruption of Mauna Loa is discussed. A fracture extended from the summit 5 miles north-eastward, lava rushed from it, forming a flow, and building elongate cones. The fissures feeding the flow are restricted to its source area, and do not underlie the whole length of the flow.

In November, 1859, the Halemaunau lava lake was slowly enlarging, and the area around it subsiding. General remarks on the lava flow of 1859 from Mauna Loa are included.

A description of Kilauea Caldera in 1862. The broad dome which in 1846 covered the site of Halemaunau had subsided, leaving a corresponding depression near the center of which was an active lava lake 600 feet across. The former black ledge had been repeatedly overflowed.
BIBLIOGRAPHY

Coan, Titus (continued)

A description of Kilauea Caldera in the summer of 1863. The lava lake had risen and overflowed, submerging the entire circumference of the caldera floor beneath new flows, building up the western floor about 100 feet since 1846. The black ledge of 1840 had been obliterated more than 10 years before.

A description of Kilauea Caldera in November 1864. Halemaumau lake was very active, and another lake was present a mile to the northwest.

Contains a brief general discussion of Mauna Loa and Kilauea, and descriptions of the eruptions of Kilauea in 1823, 1833, and 1840, and the eruptions of Mauna Loa in 1843, 1852, 1855, and 1859.

An eruption commenced in Mokuaweoweo on December 30, 1865, and was still continuing on February 27, 1866. Kilauea showed no signs of sympathetic action.

An eruption in Mokuaweoweo was first noticed from Hilo about the end of December, 1865, and continued four months. In May, June, and July, 1866, activity in Kilauea Caldera greatly increased. Halemaumau lake overflowed several times, and three to six other lakes were also present. The central elevated plateau remained undisturbed.

1868. The great volcanic eruption: Missionary Herald, vol. 64, no. 7, p. 219–221.
An account of the earthquakes of 1868 and a brief mention of the 1868 eruption of Mauna Loa.

An account of the catastrophic earthquakes from March 27 to April 2, 1868, in the southern part of Hawaii, and of the accompanying tsunamis and the eruptions of Mauna Loa and Kilauea. The lava level in Kilauea Caldera sank several hundred feet.

An account of the subsidence of the southern coast of Hawaii in April 1868, and of the condition of Kilauea in August 1868.
A description of the effects of the seismic disturbances and eruptions of 1868. Much of the southern shore was depressed 4 to 6 feet at Kalapana. A small lava flow on the southwest rift of Kilauea, the mud flow at Wood Valley, and the lava flow from Mauna Loa, are described. The sea waves accompanying the earthquakes were 20 feet high. Kilauea Caldera, in August 1868, is described. It contained a black ledge 100 to 600 feet wide, within which the previous central plateau had sagged gently down to a depth of 300 feet. Halemaumau was a pit 3,000 feet across and 500 feet deep, situated within the black ledge outside the central basin. No molten lava was visible.

A description of Kilauea Caldera in 1869 and the thirty-foot sea wave which struck Hilo on July 25 of that year. The central area of Kilauea caldera was an immense pit, below a black ledge. The crust subsided bodily 400 or 500 feet, leaving plants still growing upon it.

Much fume rose from Mokuaweoweo during the first two weeks of January 1870. The activity in Kilauea Caldera during the latter part of 1869 is described.

In July 1869, Kilauea Caldera was very quiet, and closely resembled conditions in July 1868. By August 1871, the south lake had been filled with molten lava, and from April to October, 1870, repeated overflows occurred. Halemaumau occupied the top of a broad domical shield. On August 22, Halemaumau was a pit 700 feet deep, with molten lava at the bottom. At the same time, Mauna Loa was active at a point said to be 4 miles southwest of Mokuaweoweo, and had been active for weeks.

Mauna Loa commenced to erupt on the night of August 10, 1872, in Mokuaweoweo. On August 17, the eruption was still continuing. Kilauea was very active.

A brief description of activity in Mokuaweoweo on January 27, 1873. Kilauea is reported to have been very active for several months.
Coan, Titus (continued)


Vivid demonstrations of activity in Mokuaweoweo were seen from Hilo on January 6 and 7, 1873, but it was not until April 20 that a continuous exhibition commenced. From then until January 6, 1874, the activity had been continuous. Activity at Kilauea varied in intensity, but the basin formed in 1868 was fast filling up.

On October 6, 1874, activity in Mokuaweoweo had been continuous for 18 months. Kilauea had been very active for the past year, the south lake (Halemaumau) full and overflowing much of the time, and the central basin formed in 1868 had been filled up to a depth of 200 feet.

On August 11, 1877, a brilliant eruption occurred in Mokuaweoweo, another on February 13, 1876, and still another on February 14, 1877. A brief account of the submarine eruption in Kealakekua Bay is included.

A subsidence of several hundred feet occurred in Halemaumau in April, 1879. The lava was drawn off subterraneously, possibly forming a lava flow beneath the sea. Mokuaweoweo was quiet.

An eruption of Mauna Loa commenced on May 1, 1880, at or near the summit. Since June 1879, Kilauea had resumed great activity. Halemaumau lake was active, and streams of lava broke through its walls and flowed into the central depression.

An eruption of Mauna Loa commenced on November 6, 1880, a flow moving toward Mauna Kea, and sending a branch toward Hilo.

A very brief description of the lava flow from Mauna Loa on June 28, 1881.
Describes the Kilauea lava flow of 1840 (pp. 69-78). Describes and correctly interprets origin of lava trees (pp. 78-79). Gives a general account of activity at Kilauea Caldera (pp. 262-269). Describes Mauna Loa eruptions of 1843, 1852, 1855, 1868, and 1880, and tidal wave of 1877 at Hilo (pp. 270-335). Asserts that lava flows maintain themselves wholly from the source, and are not fed from fissures beneath their course (pp. 310-311). Suggests name "pyroduct" for lava tubes (p. 333).

Coan, T. M.

Contains a general description of Kilauea and Mauna Loa, and brief descriptions of the eruptions of Mauna Loa in 1843, 1852, 1855, 1859, and 1868, quoted from the writings of others.

Contains a brief popular account of Mauna Loa and Kilauea.

An account of activity in Kilauea Caldera on July 3 and 4, 1855. Action was more violent than it had been for several years. The chief activity was at Halemaumau, where a lava lake occupied the summit area of a broad domical mound of congealed lava. At least one other smaller lake was present, farther north.

Cockburn, A. M.

Includes a brief account of temperature measurements and soundings of the Halemaumau lava lake made by Jaggar in 1917.

Cohen, E.

A preliminary note on the occurrence of basaltic glass on Hawaii. (Not seen.)

Specimens of glassy Hawaiian lavas collected by Hillebrand are described, and 8 chemical analyses are presented. Older analyses are summarized, and their general poorness is pointed out. In addition to the glassy rocks, several lithic specimens are described. These included basalts, andesites from Mauna Kea, and rocks transitional from basalt to andesite. The hypothesis of formation of lava stalactites by hydrous deposition is rejected in favor of formation by congealment of molten lava.
Coleman, S. N.
Pages 99 to 116 contain a brief popular description of Mauna Loa, partly quoted from Grosvenor (1924), the 1919 eruption of Mauna Loa quoted from Jaggar (1919), and of Kilauea. The book is beautifully illustrated.

Cooke, C. M.
In the evolution of land shells the factor of climate appears to be of little importance, that of age of the island of the greatest importance. The comparative age of the islands can be deduced from the number of endemic genera and species. The Hawaiian Islands seem to be the oldest, followed in order by Fiji, Rapa, northwestern Society Islands, Marquesas, southwestern Society Islands, higher Cook Islands, Samoa, Tonga, Austral Islands, and Mangala.

Cotton, C. A.
1944. Volcanoes as landscape forms, 416 pp., Wellington, New Zealand.
A general description of the mechanism of volcanism, and volcanic landscapes, both constructional and erosional. The activity of Kilauea Volcano, and Jaggar's theories of Hawaiian volcanism are described in considerable detail. Also discussed are the form of Hawaiian volcanic mountains; the supposed fault origin of certain large cliffs, such as those along the northern side of East Molokai and northeastern side of Kohala Mountain; the origin of Hawaiian calderas; and the erosion of Hawaiian volcanic mountains, the development of amphitheater-headed valleys, and the origin of the summit depression of Haleakala.

Coulter, J. W.
Contains a list of names of all topographic features and inhabited localities, with their locations, which appear on the quadrangle sheets of the United States Geological Survey.

Couthouy, J. P.
A brief description of Kilauea Caldera in 1840, shortly after the eruption of that year. The entire caldera floor was active.
Cowan, Frank  
1885. A visit in verse to Halemaumau, 21 pp., Honolulu. (Not seen.)

Cox, D. C. (See Macdonald, Shepard, and Cox, 1947.)

Cox, J. B.  
"In Hawaii, where conditions are especially favorable for a close relationship between insolation and rainfall, there is a periodic fluctuation of rainfall of great importance and considerable regularity. Periods of 1 year, 3.7 years, 11.1 years, and 33 years have been noted. Quite a close relationship can be found between this rainfall and the annual change in pyrheliometric measurements and sun-spot numbers. Forecasts obtained by the use of these data may be of importance in the operation of the sugar plantations." (Author's summary.)

Discusses the value of water in irrigating various types of crops, with especial reference to sugar cane. On the island of Hawaii, the area of irrigated sugar land is given as 10,653 acres, and of taro land 118 acres, with an average total consumption of 136 million gallons of water daily, and an investment in ditches, wells, pumps, and power of $1,333,885. An economic equation for an irrigated sugar plantation is given and applied to a typical plantation. A diagram illustrates the typical distribution of earnings, per ton of sugar, on such a plantation.

Crampton, H. E.  
Contains a very brief general description of Kilauea. In December 1909, Kilauea was unusually active after a period of relative quiet. Halemaumau pit was nearly circular, its walls falling in two terraces to a small pool of molten lava about 200 feet below the rim.

Cross, C. W.  
There has been a long series of eruptions of basaltic lavas from Hawaiian volcanoes from some time in the Tertiary to the present. That no others alternated with basalt and no apparent progressive change occurred, contrasts with the history of most volcanic centers. Eruptive activity of Kilauea, beginning in June, 1902, was confined to Halemaumau pit. An occurrence of trachyte on the island of Hawaii is mentioned.

The occurrence of trachyte at Puu Waawaa and Puu Anahulu is recognized for the first time. The rocks are described. A chemical analysis of the Puu Waawaa rock and a partial analysis of the Anahulu rock are given. Puu Waawaa is recognized as a cinder cone. The Anahulu terrace is believed to be an erosional form, and it is suggested that an ancient trachytic land mass may underlie Mauna Kea, Hualalai, and Mauna Loa. The relative age of the various Hawaiian Islands is discussed, and it is suggested that volcanic activity commenced at the western end of the chain and shifted gradually eastward.


A brief general discussion of Hawaiian lavas.


The Hawaiian Islands form a particularly well defined petrographic province; their lavas are clearly comagmatic. While basalt is the predominant rock, there is much greater variety than is commonly supposed. Many of the rocks are of alkaline types.


The rocks of all five major volcanoes of the island of Hawaii, as well as those of the other Hawaiian Islands, are described and classified. Several chemical analyses of lavas from Hawaii are presented. The distribution of the various rock types is discussed, and they are compared with analogous rocks from other volcanic districts. The parent magma of the Hawaiian province is believed to have about the composition of the average of the 43 analyses listed. Differentiation in the main reservoir beneath the entire area has been slight or absent. During the active growth of each volcano the lavas presented only a moderate variability. With decreasing eruptive activity, and possibly contraction of magma chambers, a high degree of differentiation produced more silicic and more femic lavas. Differentiation appears to have acted mainly on the liquid lava, but movement of crystals, under gravity, may have played a part. Daly's suggestion of the assimilation of limestone in the origin of the trachytes and nepheline basalts is discarded.
Cross, C. W., and others
A report by a committee of the National Academy of Science, to the Secretary of Agriculture, in regard to the conduct by the Weather Bureau, of the Volcano Observatory at Kilauea.

Curtis, G. C.
A brief account of the activity of Kilauea in the spring of 1913, and of the activities of the Volcano Observatory; with brief mention of the model of Kilauea being constructed for the Harvard Geological Museum.

On withdrawal of molten lava in Halemaumau pit, support to the adjacent walls is lost and blocks subside, roughly concentrically to the lava lake. Large down-faulted blocks lie along the extensive scarp of the caldera itself. Kilauea is perhaps the best example of a drop-fault volcanic crater.

Da Costa, E. G.
A general account of Kilauea and Mauna Loa.

Daingerfield, L. H.
A popular account of an ascent of Hualalai, Mauna Kea, and Mauna Loa.

Daly, R. A.
Contains a brief mention of Pleistocene glaciation on Mauna Kea. It is believed that the present Hawaiian coral reefs began their growth in post-Glacial time.

The trachyte of the island of Hawaii (Puu Waawaa), in common with other bodies of alkaline igneous rocks all over the world, is believed due to the concentration of alkalies by gases, possibly carbon dioxide resulting from the assimilation of limestone.

The vent at Kilauea is believed to be an opening in the roof of a laccolith. This offers a tentative explanation of the observed independence of activity of Halemaumau and Mokuaweoweo.


Kilauea is discussed in connection with the continuance of activity at central vents, which is believed to be partly due to exothermic reaction in the magma column, and partly to the continued convective rise of hot magma by two-phase convection. The latter means the rising of gas-charged vesiculating magma, and the sinking of heavier gas-free magma. Kilauea is believed to be fed by a laccolithic intrusive satellitic to Mauna Loa, and the Puna ridge is thought to be uparched by this laccolith. Mauna Kea is stated to consist of a base of basaltic pahoehoe, overlain by a zone of andesitic basalt aa, and capped by pyroclastic rocks associated with trachydolerites. Chemical analyses by Steiger of two Mauna Kea lavas are presented.


Describes gabbro of the Uwekahuna laccolith, olivine basalt of the 1852 flow from Mauna Loa, andesitic basalt and trachydolerite and herzolitic nodules from Mauna Kea, and projected blocks at Kilauea and Hualalai. Calculates average chemical composition of Hawaiian basalt.

Starting with average basalt, the author derives the ultrafemic types by admixture with sinking ferromagnesian constituents. Less femic types originate by passive concentration of salic and alkaline magma through removal of femic substances. The alkaline rocks require the actual addition of alkalis, perhaps partly through rising of light crystals or liquid phases, but largely by gaseous transfer. Assimilation of limestone supplies abundant CO₂ for this gaseous transport of alkalis.

1911b. Origin of the coral reefs; a suggestion bearing on the question of the former mobility of the earth's crust under the deep oceans: Science Conspectus, vol. 1, p. 120-123.

Contains a brief reference to the Pleistocene glaciation of Mauna Kea.
Contains many references to the volcanoes of Hawaii. The term "tumulus" is proposed for the small domical swellings on the backs of pahoehoe flows, and "lava ring" for the low wall built around a lava lake by repeated overflow, as at Halemaumau in 1893. The lava lake activity of Kiluaea is described. The maintenance of high surface temperature is ascribed to two-phase convection, and exothermic reactions. Kiluaea is considered to be the vent of a satellitic injection from the Mauna Loa magma chamber. The depressions formed by collapse at the summits of Mauna Loa and Kiluaea are termed "volcanic sinks," rather than calderas. It is pointed out that steam explosion is an adventitious feature of volcanism. The lava lake of Halemaumau is regarded as shallow, and underlain by a conduit of much smaller diameter. Mauna Kea is stated to be a basaltic lava-dome capped by andesite and trachydolerite.

The glaciation of Mauna Kea is briefly mentioned in connection with effects of glacial-controlled variation of sea-level during the Pleistocene epoch on the development of coral reefs.

Lists the rock types known to occur on Hawaii, including olivine basalts, olivine-free basalts, picrite-basalts, andesitic basalts, augite andesites, soda trachyte, dunite, wehrlite, and lherzolite. Advocates derivation of andesites and picrite-basalts from olivine basalt by gravitative differentiation. Indicates possibility of gaseous transfer in forming the alkaline rocks, but believes the principal factor to be assimilation of limestone.

Contains (pp. 165-166) a brief discussion of the continuance of activity at Kiluaea, and a brief reference to glaciation on Mauna Kea (p. 175).

A description of the large relief model of Kiluaea Caldera and environs, by George Carroll Curtis, donated by Robert Wilcox Sayles to the Harvard University Museum.

A brief summary of the activity of Kiluaea, which is regarded as a vent fed by a laccolithic off-shoot from the magma chamber of Mauna Loa.
Daly, R. A. (continued)

1933. Igneous rocks and the depths of the earth, 598 pp., New
York.
The sections on Hawaiian volcanoes are essentially the same as
that in the author's "Igneous rocks and their origin" (1914),
partly rewritten, and containing some new material. New physico-
chemical data is applied to the discussion of two-phase convec-
tion. Small differences in level of interconnected vents is at-
tributed to different degrees of vesiculation of the magmas oc-
cupying the respective vents.

1934. The sub-Pacific crust: 5th Pacific Science Congress, 1933,
Proc., p. 2503–2510.
A consideration of the available evidence as to the nature of the
earth's crust beneath the Pacific Basin (including the Hawaiian
Islands) leads to the conclusion that it is dominantly basaltic.
and about 71 km thick, resting on a substratum consisting in its
upper part of vitreous basalt.

1944. Volcanism and petrogenesis as illustrated in the Ha-
    waiian Islands: Geol. Soc. America Bull., vol. 55,
p. 1363–1400.
Chemical composition and density of Hawaiian lavas is briefly
reviewed. Former beliefs are reiterated, as to the importance of
exothermic gas reactions and two-phase convection in maintain-
ing volcanic heat, and as to the laccolithic nature of the
Kilauea magma chamber. The primary magma of Hawaii is be-
lieved to be olivine basalt, derived by abyssal injection from a
basaltic substratum. It is assumed to contain about 6 percent of
dissolved water. The trachytes are believed to result from
gravitative crystal differentiation of olivine basalt magma and
especially from selective remelting of low-melting constituents
of the wall-rocks. The picrite-basalts are believed to result from
the enrichment of olivine basalt magma in sunken crystals of
early-formed mafic constituents. To account for the andesites,
simple gravitative crystal fractionation is considered inadequate.
but a good solution is believed to be mixing of the products of
crystal differentiation and selective refusion by two-phase con-
vection in the olivine basalt abyssolith. The melilitne-nepheline
basalts (and phonolites of other island groups) are believed to
result from reaction of olivine basalt magma with a thick layer
of calcareous material accumulated on the ocean floor as Globi-
gerina ooze and red clay, and buried by the volcanics. Rising
resurgent CO₂, as well as primary gases, may have aided in the
enrichment of the top of the magma with alkalies.

Damon, S. C.

1855. Quick trip to Kilauea: The Friend, vol. 12, no. 9, p. 70,
    September.
A brief description of Kilauea Caldera on September 10, 1855.
BIBLIOGRAPHY

Dana, E. S.
Specimens of lavas of both Mauna Loa and Kilauea, including lava stalactites, are described. Lavas from Mokuaweoweo include clinkstone-like basalt, chrysollitic basalt, lavas with minute feldspar and augite crystals in their cavities, and others. Much elongated olivine crystals, and dendritic growths of augite are described. Glasses contain microlites and crystallites. The lavas of Mokuaweoweo and Kilauea are found to be strikingly similar. The lava stalactites are thought to have been formed by a process of “aqueo-fusion” by highly heated water vapor.

Essentially a reprinting of his earlier paper (1889).

Dana, J. D. (See also Hoffmeister, 1940.)
Describes aa and pahoehoe lava flows encountered on a journey from Kealakekua to Hilo, the condition of Kilauea Caldera during November, 1840, and the Kilauea lava flow of 1840. Recognized that many of the eruptions occurred along fissures on the flanks of the volcano. Described lava lake activity and the formation of driblet spires and Pele's Hair, and also eruptions from points on the walls of the caldera several hundred feet above the surface of the lava lakes. Summarizes changes in Kilauea Caldera from 1823 to 1840, and quotes Coan's description of the Mauna Loa lava flow of 1843. Describes the pit craters east of Kilauea, according to the accounts of Messrs. Wilkes, Drayton, and Pickering. Calls attention to the lack of explosive activity and the quietness of the eruptions and fluidity of the lavas. The conception of volcanoes as “safety valves” is rejected.

Contains brief general descriptions of Mauna Loa, Kilauea, and Hualalai, and a description of Kilauea Caldera in 1840. The lack of sympathy in action of Mauna Loa and Kilauea, and of individual lava lakes in Kilauea Caldera, is remarked upon. It is pointed out that the open vent of Kilauea in no way acts as a safety valve with respect to Mauna Loa, nor are volcanoes in any case safety valves, but rather indices of danger.
BIBLIOGRAPHY

An extract and condensation of the sections on history of Mauna Loa and Kilauea, from the author's report (vol. 10) of the United States Exploring Expedition (1849).

Remarks on the quietness of the outbreak in 1852, unaccompanied by earthquakes perceptible at the base of the mountain; on the great fluidity of Hawaiian lavas, and Coan's theory of hydrostatic pressure as the cause of the lava fountains, and the lack of sympathetic activity of Mauna Loa and Kilauea.

Remarks on the quietness of the 1855 eruption, the basaltic character of the lavas, the absence of lofty cinder ejections, and the fact that the eruptions took place from a fissure or fissures which opened down the side of the mountain. The forces operating on the magma are (1) hydrostatic pressure of the lava column in the mountain; (2) expansive force of vapors.

An account of the 1859 eruption of Mauna Loa, quoted from various sources, and a brief review of the history of Mauna Loa and Kilauea.

Two chemical analyses of Pele's Hair from Kilauea, by F. J. Allen and O. D. Allen, are presented, to supercede one by B. Silliman, Jr., published in the report of the U. S. Exploring Expedition (vol. 10, p. 200). Other analyses from the same source are no longer considered reliable.

An account of the great subsidence of the lava in Kilauea Caldera on the night of March 6, 1886, quoted from the Honolulu newspapers.

A discussion of volcanic action in general, with particular reference to Kilauea. The volcanic gases are believed to be largely water vapor. The water is believed to be partly juvenile and partly resurgent. The fundamental forces at work are: slow ascension of lava; surficial projectile effects; disruptive effects opening fissures; displacement or uplifts over large or small areas; thrusting of lava into open spaces, producing elevation of the lake bottom or sides, or into fissures rising far above the open lava lakes; underminings, leading to subsidences and engulfments. Vesiculation expands the lava and may raise the level of its surface.


Contains a drawing of the conical dome which occupied Halemaumau on October 14, 1886, from a photograph by W. D. Alexander.


An account of the early stages of the eruption of Mauna Loa in 1887, quoted from contemporary Honolulu newspapers.


The history of Mauna Loa and Kilauea, up until 1887, is compiled from numerous sources, including personal visits in 1840 and 1887. Errors in Wilkes' map of Kilauea for 1840 are pointed out. The cycle of Kilauea is summarized as: (1) a rise in level of the liquid lavas and the bottom of the crater; (2) a discharge of the accumulated lavas down to some level in the conduit determined by the outbreak; (3) a down-plunge of more or less of the floor of the region undermined by the discharge. Pumiceous material, termed "thread-lace scoria," is described. The general volcanic mechanism, and the influence of volatiles, is discussed. The higher lava fountains of Mauna Loa, as compared to normal Kilauean fountains, is attributed to greater gas content. Steam in the volcanic cloud is thought to be largely of meteoric origin. Reversing his earlier (1849) stand, Dana concludes Kilauea to be independent of Mauna Loa.


A map and profiles of Halemaumau, by F. S. Dodge in July, 1888, are given. These, together with other observations by Mr. Dodge, confirm Dana's conclusions from previous observations, that the debris cone had been floated upward on the column of lavas beneath the floor of the pit.
Dana, J. D. (continued)
Contains a history of Kilauea and Mauna Loa until 1888, compiled from many sources, and from two personal visits, with a discussion of the general features of volcanic activity. The material is essentially the same as that published in the author’s earlier series of papers on “History of the changes in the Mt. Loa craters.”

A brief account of the lava subsidence of March 6, 1891, at Halemaumau, quoted in part from the Pacific Commercial Advertiser for April 30, 1891. Molten lava returned to the pit after a lapse of 3 weeks.

Analyses of two olivines from “Sandwich Islands.”

Dane, E. B. (See Birch and Dane, 1942.)

Daubeny, Charles
Contains a description of Kilauea Caldera in 1823, quoted from Ellis.

Davis, J. B.
A brief description of the eruption of Mauna Loa in 1859, abstracted from newspaper accounts forwarded to England by W. L. Green.

Day, A. L.
A discussion of the gases collected at Kilauea in 1912. The gases found are listed, and it is pointed out that they cannot be in equilibrium at the temperature of the lava (1000° C.). Reactions between them are strongly exothermic, and thus a very large amount of heat is set free during the rise of the gases through the lava. Temperature of the lava was higher when the amount of gas liberated was large, lower when the amount of gas set free was small. Water gas is present.

A trip into Halemaumau was made to study physical and chemical processes in the volcano of Kilauea. Formation of a small dome over active lava provided a rare opportunity for collecting gases. The analysis of these confirms the presence of considerable quantities of water vapor.


During the summit eruption of Mauna Loa in December and January, 1914 and 1915, the volume of liberated gas was enormous, the temperature very high, and the lava of unusual texture. An outbreak of gas occurred at about 10,000 feet altitude in May 1916, with little or no lava ejection, the explosions being of great violence. Toward the close of May lava broke out at 7,000 feet altitude, this eruption being characterized by much lava, little gas, and low temperature.


Data are needed on the state of the material beneath the Halemaumau lava lake in the years preceding the 1924 explosions. During the explosions the size of the hole was increased about 10 times, but there is no vitreous material among the debris, and no trace of contact of the fragments with a liquid. The underlying material may have been relatively cold, the lake being fed through narrow tubes. Outbreaks of lava at points nearby, but at different levels, show that there could not have been hydrostatic equilibrium.

Day, A. L., and Shepherd, E. S.


Gases were collected from a domical spatter cone on the floor of Halemaumau. Abundant water condensed in the collecting tubes. The gases included abundant N and CO₂, some H₂ and CO, no rare gases, and no hydrocarbons. The visible cloud consists mainly of free sulfur. These gases cannot be in equilibrium at 1000° C., but must be actively reacting, supplying much heat to the lava lake. The emanations are definitely hydrous. Free S, SO₂, and SO₃ in the cloud explain the features observed by Brun (1911).


The conclusions of Green and Brun regarding the anhydrous nature of the eruption cloud from Kilauea are summarized. Investigations by the writers in 1912 demonstrate that this is not the case. Analyses of the gases collected are presented, and the method of collection is described.
The gases collected at Kilauea could not exist together in equilibrium at 1000° C. or above. They were in active reaction when collected, and when rising thru the lava, and some of the reactions are strongly exothermic, supplying much heat to the lava. The apparent anhydrous nature of the cloud is due to the dehydrating effect of SO₂ and SO₃. Chlorides form only a very small proportion of the gases. The absence of argon indicates that the gases are entirely magmatic, and contain no atmospheric gases.

Magmatic gases were collected from two small lava domes on the floor of Halemaumau. They were found to contain much water, in addition to N₂, CO₂, CO, SO₂, free H, and free S, with insignificant amounts of Cl, F, and perhaps NH₃. No hydro-carbons and no argon were found. The absence of argon is regarded as confirmation of the lack of contamination by atmospheric gases. The apparent anhydrous condition of the fume cloud, as reported by Brun, is attributed to the drying effect of CO₂ and SO₂. Exothermic reactions between the gases is regarded as an important source of volcanic heat at the surface.

Day, A. L., and Allen, E. T.
"There is evidence at Mauna Loa that the whole mountain becomes distended as the pressure develops prior to a catastrophic release; also that there is some segregation due to gravity in the great magma chamber, for outbursts at or near the summit release either gas alone or a light emulsion, while outbursts at lower levels are flows of heavy lava containing little gas."

Day, D. T.
Contains a brief summary of the geology and mineralogy of the island group as a whole. Geologic conditions are against the occurrence of deposits of ores of the precious and other heavy metals and coal, but various non-metallic substances are found. The following are briefly discussed: sulfur, gypsum, alum, iron sulfate, glauber salt, sal-ammoniac, ochers, building stones, kaolin, pumice, obsidian, and salt.

Includes a general account of the mineral resources of the Hawaiian Islands. (Not seen.)
de Montessus de Ballor, F.
1924. La geologie sismologique, p. 239-248, Paris.
Discusses the 1868 earthquake and eruptions on the south end
of the island of Hawaii. The mud flow is wrongly located at the
great coastal cliffs southeast of Kilauea Caldera, instead of in
Wood Valley. The cause of the earthquake is considered to be
only indirectly or accidentally volcanic, but also not truly tec-
tonic, being a collapse over voids presumably created by volcanic
extrusion. (Not seen.)

De Vis-Norton, L. W.
1918. Kilauea volcano during 1918: Hawaiian Annual for 1919,
p. 135-137.
The year 1918 witnessed the greatest overflows of Halemaumau
in 40 years. The first occurred on February 23, when lava cov-
ered the automobile road east of the pit. Again in November
overflow occurred, with lava breaking out of fissures on the
floor of the main caldera. Rises and falls of the lava level in
Halemaumau are summarized.

1919. Kilauea activities in 1919: Hawaiian Annual for 1920,
A summary of the rise and fall of the lava level in Halemaumau
during 1919. Many overflows occurred. Beginning on April 20,
a lava flow originating on the Postal Rift near Halemaumau
spread northward in the western part of the caldera. This flow
continued for months, reaching the north wall of the caldera in
July. An eruption of Mauna Loa on the southwest rift com-
menced on September 29, sending a lava flow into the sea in
South Kona.

1920. The Hawaiian volcanoes during 1920: Hawaiian Annual
for 1921, p. 142-146.
A summary of the rise and fall of the lava level in Halemaumau
during 1920. On December 21, 1919, a lava flow commenced on the
southwest rift of Kilauea, and continued active through
July 1920.

1921. Kilauea volcano during 1921: Hawaiian Annual for 1922,
A summary of activity at Kilauea during 1921. During the first
3 months Halemaumau was filled with lava, and activity was
strong. In the first part of January a lava flow commenced from
a rift southwest of Halemaumau, flooding the southern part of
the caldera. During March this flow spilled out through a gap
in the caldera wall, and is the only historic superfluent flow of
Kilauea.

35, no. 12, p. 75-79, December.
A brief popular account of the pit craters in western Puna, adja-
cent to Kilauea Caldera, now known as the "Chain of Craters."
A summary of the rise and fall of the lava level in Halemaumau during 1922. Between May 14 and 28 a spectacular collapse occurred, the lava level dropping from about 60 feet below the rim of the pit to more than 800 feet, accompanied by much avalanching. This was soon followed by outbreaks of lava at Makaopuhi and Napan craters.

A summary of the rise and fall of lava level in Halemaumau during 1923. Many earthquakes accompanied a drop in lava level from about 225 feet to 550 feet below the rim, between August 24 and 26. On August 26 lava broke out near Makaopuhi Crater.

A summary of conditions at Kilauea during 1924, with a brief description of the explosive eruptions during May and June. Those were preceded by great lava subsidence, and its ultimate disappearance. Molten lava returned to Halemaumau on July 19, but disappeared again on July 31.


An account of the 1935 eruption of Mauna Loa, and the bombing of the lava flow.

1937. La science sauve une ville: La Revue Columbienne, vol. 2, no. 9, p. 6–7, 15, May.  
An account of the 1935 eruption of Mauna Loa, and the bombing of the lava flow.

Dibble, Sheldon (See also Green and Dibble, 1833.)  
Contains an account (p. 65-67 of original edition, p. 51-53 of reprinted edition) of the destruction of Keoua's army by the explosive eruption of Kilauea about 1790. The account has been much quoted. Of the three sections into which the army had been divided, that closest to the caldera suffered least injury. The explosion hurled great volumes of sand and "cinders" into the air. In the section farthest from the caldera some persons were burned to death by hot sands and all experienced a suffocating sensation. All of the middle party were killed, the bodies although in no place being deeply burned, were thoroughly scorched.
Dodge, F. B. (See Jaggar, 1912c.)

Dodge, F. S.

A description of Kilauea Caldera in October, 1886. The cone of loose blocks observed in Halemaumau in July by Van Slyke was still present, and rising at a rate of about 1 foot a day. It had a deep pit in the center. The moat between this cone and the outer walls of Halemaumau pit was being gradually filled with flows of pahoehoe.

A description, with map and cross-sections, of Halemaumau in July 1888, and August 1892. Between July 1888 and March 1891, the broad dome in the caldera built up 60 feet by extensive overflows from Halemaumau. Halemaumau in August 1892 contained a nearly flat floor about 260 feet below its rim, with the lava lake elevated in a narrow wall about 40 feet above the surrounding floor.

An account of changes in Kilauea Caldera from 1885 to 1896.

A description of Mokuaweoweo on April 29, 1896. Active lava fountains and a lava lake were present near the southern end of the caldera, at the summit of a broad low lava shield.

1897. Physical characteristics [of the Hawaiian Islands]: Hawaiian Annual for 1898, p. 102–103.
A brief description of the main topographic features of the island of Hawaii.

Doerr, J. E., Jr.

A description of the descent and exploration of the small pit crater Devil’s Throat, by W. T. Sinclair, on June 25, 1923.

A popular description of tree molds.
A brief popular description of the common volcanic rocks found in the National Park.

Doorninck, N. H. van (See Van Doorninck, N. H.)

Dougherty, H. E.

An account of the 1868 earthquakes and eruption.

Douglas, David (See Hooker, 1836; Wilson, S. F., 1919.)

Contains descriptions of Mauna Kea, Kilauea, and Mauna Loa, in January, 1834. There is no mention of activity in Mokua-weoeo.

1837. Journal: Magazine of Zoology and Botany, vol. 1, p. 582 et seq. (Not seen. Republished in various later sources; see Douglas, 1914.)

The altitude of Mauna Loa is determined as 13,430 feet and that of Mauna Kea 13,746 feet. Mokuaweoweo was visited in January 1834, and was stated to have an outer circumference of about 24 miles. A black ledge lay 1270 feet below the highest point of the rim, and within this was another pit with a circumference of 6.25 miles. Mauna Loa was recognized to consist largely of lava flows, and soil beds between the flows near Kapapala were believed to represent breaks in the volcanic activity.

Contains an account of an ascent of Mauna Kea, and descriptions of Kilauea Caldera and Mokuaweoweo, in January, 1834.

Douglas, E. M.

Gives the following data for the island of Hawaii: greatest length 81 miles, greatest width 73 miles, area 4,016 square miles.
Duerksen, J. A.

A study of gravity and latitude determinations on Hawaii and Oahu shows that Hawaii is entirely uncompensated isostatically, and that Oahu is only partly compensated.

Duncan, George

A description of various types of air-lift pump installations, and the use of air-lift pumps in drilled wells at Olaa. The wells are 12 inches in diameter and 450 feet deep. Ground level is 220 feet. Static water level is 16.5 feet above sea level. Salt content is 0.4 grain per gallon. Draw-down is 0, with production of 500,000 gallons a day from each well. The two wells are only about 50 feet apart.

A description of the Maui-type well of the Olaa Sugar Company. The water level is generally close to 17 feet above sea-level. Water level shows a rise about 3 days after heavy rains. Two phenomenally large rises of water level are described. No water moves laterally into the shaft above water table. Contains a description of the rocks penetrated.

Duthie, D. W. (See Sheepshanks, 1909.)

Dutton, C. E.

Contains a description of Kilauea Caldera in 1882. The inner pit had been completely filled up. Two lava lakes were active. Kilauea is regarded as completely independent from Mauna Loa. The volcanic action of Mauna Loa is discussed. The quietness of the eruptions is remarked upon, and it is stated that Mauna Loa is nearly devoid of cinder cones. There was no activity in Moknaweo-weo. Mauna Kea is described, and attention called to the greater explosiveness of its eruptions. Hualalai and Kohala are briefly described, and Hualalai is reported to have erupted in 1801, 1805, and 1811.
1884. Hawaiian volcanoes: U. S. Geol. Survey, 4th Ann. Rept., p. 75–219. A beautifully written description of Kilauea, Mauna Loa, Mauna Kea, Kohala, and Hualalai, with an account of journeys about the island of Hawaii in 1882, and a partial summary of the history of volcanic eruptions on Hawaii, including a good description of the 1868 eruption of Mauna Loa. The Pahala ash in the Kau District is believed to be an elevated marine deposit. The formation of littoral cones is described, and the Kahuku cliff is recognized as a fault scarp. The term “caldera” is first applied to the great summit depressions of Kilauea and Mauna Loa. Convection currents and the rise of very hot gas bubbles are suggested as agents maintaining the liquidity of the Kilauea lava lake. Kilauea is regarded as a distinct volcano, independent of Mauna Loa. The calderas are believed to result from collapse, caused by melting of the underlying rocks in the vicinity of the lava column and consequent removal of support. Caldera formation is regarded as an episode of the middle and later stages of growth of the volcano. It is pointed out that flank activity of Mauna Loa is preceded by summit activity. It would seem that there is a continuous accumulation of eruptive energy and materials within the mountain, which at first seek escape through the summit orifice, but as accumulation goes on the mountain is ruptured, lavas are discharged lower down on the flanks, and the volcanic energy is temporarily depleted. The eruption of lavas from a fissure several hundred feet above open vents on the caldera floor is suggested to be due to gas inflation of the liquid. The hypothesis that volcanic activity results from the absorption of vadose water vapor into underlying magmas is examined and rejected. The spasmodic character of volcanic eruptions is recognized, and believed due to the activation of successive portions of the reservoir by acquisition of elastic expansive force. Conditions at Kilauea in 1882 and Mokuaweoweo in 1878 and 1882, and the source fissure of the Mauna Loa eruption of 1880 are described. The first flow of 1880 is stated to have spread out in the Humuula Saddle, and its source to have been about a mile upslope from that of the slightly later Kau flow. The source of the flow of 1855 is stated to be a short distance downslope to the northwest of that of the first 1880 flow.


A brief summary of the author’s conclusions regarding Mauna Loa and Kiluea, published in detail in his longer paper (Dutton, 1884).

Edwards, Ira
A popular account of Kilauea Caldera and its environs.

Egler, F. E.
A general discussion of soil erosion in the arid parts of several islands of the Hawaiian group. The effect of soil erosion on relative amounts of rainfall which run off as streams or sink into the rocks to join the ground water body is discussed. The retention of the high rainfall for production of forage and of usable water is seen to depend on maintenance and preservation of the soil mantle.

Eller, W. H. (See also Beach and Eller, 1939.)
A brief popular account of tilting of the ground surface at Kilauea, in response to movements of subterranean magma.

Ellis, William
A description of a trip through the island of Hawaii in 1823, and of many of the physical features encountered. An eruption of Hualalai is said to have occurred about 23 years before, and a small crater on Hualalai to be still fuming. The lava of 1823 at Kilauea is described as it appeared on July 31, and the eruption stated to have occurred about 3 weeks before. Kilauea Caldera is described. The “black ledge” was about 400 feet below the rim, and an active lava lake 300 or 400 feet lower still. Native accounts of the past activity of Kilauea are recorded. An eruption in Puna about 30 years previous is mentioned.

1826. Narrative of a tour through Hawaii, or Owhyee . . . , 442 pp., London; reprinted Honolulu, 1917.
Contains the same material on the island of Hawaii as the author’s “Journal of a tour around Hawaii.”

1826a. On the burning chasms of Ponohohoa, in Hawaii . . . :
A description of Ponohohoa chasms and the Kilauean lava flow of 1823, in July, 1823. (Not seen.)
A description of Kilauea Caldera during August, 1823. (Not seen.)

Contains the same material as the author's "A journal of a tour around Hawaii."

**Emerson, J. S.**

A description of Kilauea Caldera between March 24 and April 14, 1886, accompanied by a map (pl. 1). No molten lava was present in Halemaumau, which was a great empty pit, with a smaller pit in its center.

A general description of the Kau District, and of the yellow dust (Pahala ash) which covers much of the surface. Dutton's idea of marine origin of the yellow dust is abandoned, and it is recognized as volcanic ash. The source of the ash is believed to have been a large crater marked by the valleys near the hills Puu Iki, Puu Enuhe, Makanao, and Kaumalkeohu ("Mohokea caldera" of C. H. Hitchcock, 1903).

**Emerson, O. H.** (See also Finch and Emerson, 1925; Jaggar, Finch, and Emerson, 1923.)

Samples of both aa and pahoehoe were powdered and fused in a crucible, the melt being stirred as it cooled. The cavity left by stirring was in each case found to be lined with aa. On this basis, it is concluded that the formation of aa is due to mechanical stirring of the lava while the flow is in motion.

**Fagerlund, G. O.**

A popular eye-witness account of the eruption of Mauna Loa, which commenced on April 28, 1942, at a source at 9,200 feet altitude on the northeast rift. The intense local earthquakes with nearly vertical acceleration which occur near the source are described. Contains excellent photographs of the rarely-witnessed early “curtain of fire” phase of Mauna Loa eruptions which precedes the generally observed cone-building stage of restricted lava fountains.
BIBLIOGRAPHY

There is evidence that the volume of steam from vents at the northern edge of Kilauea Caldera has decreased in the last 100 years. Fluctuation of steam discharge accompanied the activity of 1886, but normally there is little or no change in temperature and volume correlative with Halemaumau activity. A photographic method of recording future changes is outlined.

On April 8, 1945, a chasm 325 feet long, 40 feet wide, and 20 to 40 feet deep was formed in 30 to 50 feet of Pahala ash resting on basalt, along a concealed fault 18 miles southwest of Kilauea Caldera. The ash disappeared into the underlying fissure. South of the chasm a block 18 feet wide and 150 feet long dropped as much as 2 feet. No earthquake occurred at the time of collapse, though former quakes may have weakened the structure. The immediate cause of the collapse was seepage through the ash occasioned by flooding during exceptionally heavy rains on April 7 and 8. Seepage undermined the ash causing collapse, and water flowing into the fissure carried the ash downward.

Faris, R. L.
Magnetic declinations, dips, and horizontal intensities for 37 stations on the island of Hawaii during 1913, by J. W. Green.

Fennell, W. P.
An account of the opening phases of the eruption of Mauna Loa, which commenced about 3:15 a.m., July 4, 1899.

Fenner, C. N.
A general discussion of the crystallization process of basaltic lavas, applicable to the lavas of Hawaii. Specifically, there are considered the results of the crystallization of augite and olivine from a picrite-basalt of East Maui.

Contains a further general consideration of the course of crystallization of basaltic lavas, and of the composition of the liquids residual from such crystallization, applicable to the lavas of Hawaii.
Ferguson, J. B.
Chemical analyses are given of the Puu Waawaa trachyte, basalt from the floor of Kilauea Caldera, and basalt dipped as a liquid from the Halemaumau lava lake. All three contain a little molybdenum. Petrographic descriptions of the Kilauea specimens by Whitman Cross are given.

An account of the effects on Kilauean lavas by the action of steam in the laboratory. Powdered lava was heated to 1000° or 1100° C. in a platinum boat, in a porcelain tube through which steam was passed. The steam appears to have acted as an inert gas, although there is a small decrease in amount of ferrous iron present. The experiments leave no doubt that considerable ferrous iron, when in silicate combinations, can exist in the presence of water vapor at high temperatures.

Finch, R. H. (See also Jaggar, Finch, and Emerson, 1923; Jaggar and Finch, 1924, 1928, 1928a, 1929; Wentworth, Carson, and Finch, 1945; Wingate and Finch, 1942.)

A description of the earthquake phenomena which accompanied and preceded the 1924 eruption of Kilauea.

The seismic sea wave accompanying the earthquake of February 3, 1923, off Kamchatka, was predicted four hours in advance by the Hawaiian Volcano Observatory. The velocity of the waves from the origin to Hilo was about 7.5 miles a minute. It is pointed out that the transit time of the P waves of the earthquake through the earth, in minutes and seconds, is nearly equal to the transit time of the sea waves in hours and minutes. The seismic sea waves of September 7, 1918, April 9, 1919, November 11, 1922, and April 13, 1923, in Hawaii, are briefly described.

A description of the mild but numerous quakes in eastern Puna which preceded the explosive Kilauean eruption of 1924, and the faulting which accompanied the quakes, deepening the shallow graben north of Kapoho about 8 feet.

On April 8, 1924, it was predicted that one or more perceptible earthquakes would occur within a few days. Strong shocks occurred on April 10 and 11. The prediction was based on reversal to southerly tilt at the Observatory after a period of northerly tilt, and the accumulation of 6 seconds of southerly tilt in 6 days, although lava was absent from Halemaumau pit.


A description of the southwestern slope of Mauna Loa in the vicinity of the rift zone, between 9,900 and 12,000 feet altitude. The area of sulfur deposits between 11,000 and 12,000 feet was steaming during December 1925, but no odor of SO₂ was detected.


Flames and small explosions at and near the margins of the 1926 lava flow from Mauna Loa, and other flows, are the result of distillation of inundated vegetable matter, producing inflammable hydrocarbon gases.


Reviews the paper on the same subject by Emerson, and points out that the latter's experiments were suggested by Finch.


A discussion of the rainfalls which sometimes accompany volcanic explosions, with special regard to the explosions of Kilauea in 1924. It is concluded that such rainfalls, while sometimes warm, are never hot; and that most of the precipitated water is from the atmosphere, not from volcanic steam.


These forms are caused by the chilling of lava around inundated tree trunks. The casts are the result of later lowering of the flow surface by draining away of the lower, still liquid portion.


A brief discussion of the mode of formation of slump scarps along the margins of lava flows, with special reference to those of the 1921 lava at Kilauea.
Finch, R. H. (continued)

Periods of collapse at Kilauea which generally occur at the time of a Kilauea lava flow at lower altitude or immediately following cessation of a Mauna Loa eruption are considered, and the volumes of the engulfed material are calculated. The latter range from 18,640,000,000 cubic feet in 1832 to 260,000,000 cubic feet in 1916. That of the 1924 collapse was 7,120,000,000 cubic feet. Finch (1941) states that 10 percent should be added to the figures for the 1823 and 1832 collapses.

The net result of the first century of recorded history at Kilauea has been a gradual filling of the crater. The net fill between 1823 and 1941 is 63,960,000,000 cubic feet. A gradual diminution in size of the volcanic conduit is shown by a restriction of the area involved in tumescence. The “canals” between the interior platform and the pit walls in 1846 and 1919 resulted from the bodily elevation of a funnel-shaped crater fill.

An eruption of Mauna Loa commenced on April 26, 1942, in Mokuaweo and along the upper northeast rift. On April 28 activity shifted to the rift between 9,500 and 9,100 feet altitude. A lower source was located 2½ miles below that. The flow from these sources threatened Hilo, and Army planes bombed it in an effort to divert it. A map shows the approximate position of the flows. The seismic prelude, on which unpublished predictions of the eruption were based, is briefly discussed. The diversion of lava flows by bombing the walls of the source cones is suggested.

The geologically recent history of Kilauea has contained 8, and perhaps 9, explosive periods. The ash deposits are described. The earlier explosive episodes were of lava fountain type, producing glassy ash and pumice. Suggesttions of unconformities within the coarse gravelly material, generally considered the product of the 1790 explosions, may indicate that some of it was ejected prior to 1790.

1 The mapping of the upper parts of the flow in and near Mokuaweo, shown here, was done by G. A. Macdonald for the U. S. Geological Survey, and released for use by the National Park Service in the Volcano Letter. Through an error it was not credited.
BIBLIOGRAPHY


Surging of the lava in the conduit would repeatedly allow ground water to enter the hot chamber thus vacated. Rapid steam generation, as in a “flash boiler” would cause an explosion without the necessity of a gas-tight confining cover. Repeated lowering of the magma would cause repeated explosions. The interval between major explosions is in accord with that of the surging in Halemaumau preceding collapse.


Estimates of depth of the main lava rivers are much smaller than the observed depths of the channel after flowing has ceased. This appears to result from the existence of a slower-moving, more viscous material beneath the rapidly flowing fluid surficial stream.


The viscosity of a flow varies greatly in different parts. The figure determined by Palmer (1927) represents the order of magnitude for the main river near the source. That by Nichols (1939) is erroneous for the main river, because of assumption of too great depth for the channel of the Alika flow and of unit movement for the 1887 flow, but may be applicable to the marginal parts of flows. The viscosity determined by Nichols exceeds that of dry melts.


Previous indications of the flank eruption of Mauna Loa which began on April 26, 1942 were: (1) the summit activity of 1940; (2) progression of epicenters along the northeast rift of Mauna Loa, starting near Hilo on February 8, 1942; (3) a swarm of earthquakes on the northeast rift on February 21, with epicenter at 9,000 feet altitude; (4) the large number of Mauna Loa shakes in February and March, greatly exceeding those of Kilauean origin; (5) easterly tilt in February and March indicating impending Mauna Loa activity, and large fluctuations in March of the east-west tilt indicating that molten lava was approaching the surface. Brief reference also is made to earthquakes in 1935 and 1941.
Finch, R. H. (continued)

Conspicuous fume clouds over Mokuaweoweo and spells of continuous tremor on the seismographs indicate slight activity at Mauna Loa in November 1943. Both fuming and tremor were intermittent. Fume was first observed on October 10, again on November 11. Tremor became conspicuous on November 21, reached a maximum on the 22nd, and practically disappeared on the 23rd.

A brief general discussion of harmonic tremor recorded on seismographs of the Hawaiian Volcano Observatory. It is ascribed to underground surging of magma in conduits below Halemaumau. Absence of harmonic tremor at the time of the "False eruption" on January 11, 1928, confirms the belief that the small amount of lava erupted then was squeezed from a crusted pool of 1927 lava by a heavy landslide.

Kilauea showed signs of uneasiness, starting with an earthquake 8 or 10 miles below the southwest rim of Halemaumau on Nov. 12. Another on Nov. 15 was much shallower, and from then until Dec. 6 scattered Kilauea shakes showed progressively shallower foci. Beginning Nov. 12, a strong outward tilt occurred at Halemaumau, but tilt was normal at the Observatory, indicating a doming of the caldera floor. Tilt suddenly reversed on Dec. 6 and 7, indicating a sinking back of the floor.

For 1½ years seismographs indicated the pressure under the Kilauea-Mauna Loa system to be high. In November 1943 and August 1944 fume was liberated by Mauna Loa. On November 12, 1944, Kilauea showed uneasiness in an earthquake below Halemaumau 8 miles deep. On November 15 occurred another 5 miles deep, and from then to November 30 occurred 12 more, with gradually shallower foci, the last only 1 or 2 miles deep. Tumescence accompanied the quakes. On December 6 and 7, 29 quakes and reverse tilting probably accompanied a subsidence of the magma column. A strong earthquake centering under Mauna Loa on December 27, 1944, at 4:41 a.m., was felt as far away as Oahu. Others occurred on December 27, 30, and 31, all but the last originating 18 to 19 miles below the eastern edge of Mokuaweoweo.
Hawaiian earthquakes originate in 3 principal types of fault systems: the fundamental rifts, comparatively superficial faults within the volcanic structures, and volcanic conduits. In the first, minimum depths are about 3 miles below sea-level. In the second, foci range from nearly 14,000 feet above sea-level to about 15,000 feet below it. In the third, foci vary from the surface to depths as great as those of group 1. Hualalai, Mauna Loa, and Kilauea are believed probably to lie on the same fundamental rift. Kohala and Mauna Kea on another. The earthquakes of 1868, December 27, 1944, and May 19, 1945, are believed to have originated on the fundamental rift under the eastern slope of Mauna Loa.

The eastern or Puna rift of Kilauea: Volcano Letter, no. 493, p. 1–3, July-September.

The eastern or Puna rift of Kilauea is described. The post-Pahala lavas of Kilauea are believed to be thin in eastern Puna. Pit craters are believed to form by engulfment into rift tubes, through which magma moves laterally along the rifts. The concentration of pit craters along the upper part of the Puna rift results from intersection of the rift with a series of northeast-trending fissures paralleling the faults of the Hilina system.

Finch, R. H., and Emerson, O. H.


The Postal Rift tube on the floor of Kilauea Caldera, in 1919, contained considerable quantities of sulfates as coatings and stalactites. A tube in the 1920 flow in the Kau Desert contained kieserite, and a prehistoric tube contained gypsum. The sulfates are shown to be formed by the action of steam bearing SO₂ and SO₃ on the rock lining the tube and in the roof of the tube. They are later leached out and carried onto the tube lining by descending rain water.

Flint, R. F. (See Agar, Flint, and Longwell, 1929.)

Forbes, E. H. (See Penfield and Forbes, 1896.)

Forbes, Kate M.


A popular description of Kilauea Caldera, during a period when the Halemaumau lava lake was active.

Fornander, Abraham


Contains a general discussion of the geology of the Hawaiian Islands, and specific discussions of various features of the geology of Oahu.
Foster, Z. C. (See also Hough, Gile, and Foster, 1941.)
Contains a discussion of the various soil associations of the island of Hawaii, graphs showing land use and changes in land use, and maps showing land utilization in 1900, 1920, and 1937.

Fourmarier, P.
Contains a general account of Kilauea, including a cross-section of Makaopuhi Crater.

Freeman, O. W.
The general geology, soils, climate, water resources, and mineral resources of the Hawaiian Islands are briefly discussed.

Friedlaender, Benedict
The condition of Mauna Loa and Kilauea in 1893 is described.
No activity was present in Mokuaweoweo. Mauna Loa and Kilauea are regarded as independent volcanoes. Their independence of action is attributed to the lower specific gravity of the lavas of Mauna Loa, owing to the greater abundance of gas in them.

A description of the activity in Mokuaweoweo on April 26, 1896, and of Kilauea. (Not seen.)

An account of an ascent of Mauna Loa from the Kona side, and a description of the activity in Mokuaweoweo on April 26, 1896, during the summit eruption of that year. It is stated that from the molten lava of Kilauea there arises only a thin "smoke"; a volcano cloud exists only under favorable circumstances, when the superheated steam condenses to a cloud without any appreciable connection with the lava lake. Mauna Loa, however, as long as it was active nearly always had a cloud, and the cloud always had a trunk connecting it with the lava fountains. Believes that Mauna Loa lavas are hotter and richer in gas than those of Kilauea, and that this may account for the different heights of the two volcanoes.
Friedlaender, Immanuel

Contains brief references to water vapor in the volcanic cloud at Halemaumau, to Pele's hair at Kilauea, to the types of lava flows at Kilauea and Mauna Loa, and to pisolitic ash at Kilauea.

A description of activity in the summit caldera of Mauna Loa on November 25, 1914, the data taken from the Bulletin of the Hawaiian Volcano Observatory, vol. 2, no. 31.

A discussion of the spacing of major vents in volcanic regions, including the Hawaiian islands. W. L. Green's (1887) suggestion that the spacing of the major fissures is approximately the same as the thickness of the earth's crust overlying the main magma zone or reservoir, is accepted, although it is pointed out that Green's arguments are not conclusive.

Photographs of the explosive eruption of Kilauea in 1924.

A brief account of the 1926 eruption of Mauna Loa.

Contains a brief account of the activity of Kilauea and Mauna Loa.

Frisen, R. M.

A popular account of the bombing of the 1935 lava flow of Mauna Loa.

Fuchs, Karl

Contains brief descriptions of Mauna Loa and Kilauea, and of the eruption of 1855 (misdated 1866).
Fuller, J.
A description of the source area of the 1852 lava flow of Mauna Loa. On March 3, 1852, the cone was 1000 feet across and 100 to 150 feet high. The lava fountains were 200 to 500 feet high, the highest jets reaching possibly as high as 700 feet.

Geikie, Archibald
The section on volcanoes and volcanic action contains brief descriptions of Kilauea and Mauna Loa, the characteristics of their lavas and the eruptive forms resulting, as described by earlier writers. It is pointed out (p. 282) that 20 or 21 of the 27 eruptions of Mauna Loa and Kilauea between 1832 and 1887 occurred during the wet winter season.

Gile, P. L. (See Hough, Gile, and Foster, 1941.)

Girardin, M. J.
A brief early description of the volcanoes of Hawaii, compiled from the works of others.

Goldsmith, E.
Contains a description of lava stalactites from Kilauea, the formation of which is attributed to the drip of very fluid lava.

Goodrich, Joseph
An ascent of Mauna Kea in 1824 is described, and "granite" fragments are mentioned among the ejecta of the cones, which are formed of material "from huge rocks to volcanic sand," Kilauea Caldera, in 1824, is described. A black ledge lay about 500 feet below the rim, and an inner pit was 500 feet deeper. Lava broke out in the inner pit on December 22, 1824, forming a lava fountain 40 or 50 feet high, and a lava lake.

A letter dated October 25, 1828, states that since 1825 Kilauea Caldera had been filling up, the inner pit being 300 or 400 feet shallower. The depth of the black ledge below the rim is revised from his previous estimate of 500 feet, to 900 feet on the basis of measurements by Lord Byron's party. Mauna Loa is described as a huge pile of lava.

An ascent of Mauna Kea in December 1831 (?) is described. Lake Waiau was about 25 rods across, and half frozen over. In January 1832, Kilauea Caldera became violently active, accompanied by strong earthquakes. On June 20, 1832, Mauna Loa became active at or near the summit, and continued so for 2 or 3 weeks, lava running down the mountain sides in different places, visible as far away at Lahaina. A visit to Kilauea in July 1832, showed the caldera to have been filled up to about 50 feet above the level of the black ledge. The walls of the caldera had been split from top to bottom in January, 1832, and the surrounding region deluged with lava. A lava lake was active.

Goranson, R. W.

The computation of the theoretical value of gravity, and of isostatic compensation, are discussed. A variation of Airy’s hypothesis is adopted. Based on gravity measurements by the U. S. Coast and Geodetic Survey, the upper part of Mauna Kea has a density of 2.12, and Mauna Loa 2.52. The island of Hawaii is believed to be isostatically uncompensated, constituting a load upon the suboceanic crust. If the latter had zero strength, the island should sink 3,100 meters, but as the crust must have some rigidity, the actual sinking would be less than that.

Gordon-Cumming, C. F.

A description of Kilauea Caldera in October 1879, and a brief summary of events during the earlier part of the year. A great subsidence of the lava in Halemauman commenced on October 28.


Vol. 1 contains a description of Kilauea Caldera on October 29 to November 2, 1879 (p. 155-197), a brief description of changes at Kilauea from 1789 to 1878 (p. 209-223) and descriptions of the Mauna Loa eruptions of 1843, 1851, 1852, 1855, 1859, 1868, and 1877 (p. 223-244). Vol. 2 contains an account of the Mauna Loa eruption of 1880-81 (p. 255-279).

Goto, Y. B. (See Powers, Ripperton, and Goto, 1932.)

Gow, P. L. (See Ballard and Gow, 1931.)
Graton, L. C.

A detailed evaluation of the importance of heat and volatiles in volcanic activity. Heat is supreme, furnishing the energy which is the essence of volcanism. Volatiles are a useful and important agent but have been accorded an exaggerated role. Exorbitant proportions of gas to melt, eruption without participation of molten lava, and gas fluxing are found unacceptable. The heat is derived from internal sources; radioactivity and exothermic reactions are inadequate. An attempt is made to visualize the behavior of granite magma containing 9.4 percent water at a depth of 40 km. and 1200° C., as it rises to the surface. Exsolution and expansion of gas and kinetic losses, may cause cooling of 350° to 500° exclusive of radiation and conduction. Gas is a refrigerant, not a heating agent. Volcanic explosions appear to have shallow origins. The fact that gases at Kilauea are not in equilibrium does not indicate that they should or have reacted together, exothermally or otherwise. The upward increase of temperature in the Halemaumau lava lake may have been a result of convection. The 1924 explosions of Kilauea are regarded as magmatic, not phreatic.

Green, I. S., and Dibble, S.

A description of Kilauea Caldera in January, 1832. The plain between the main caldera and Kilauea Iki had been fissured during a strong earthquake about 11 a.m. on January 10, and lava flowed from the fissure into both Kilauea and Kilauea Iki.

Green, J. W. (See Faris, 1914.)

Green, W. L.

An account of the 1859 eruption of Mauna Loa.

1877. The Hawaiian Islands on the reseau triangulaire, 7 pp., Boston.
The principal volcanic centers of the Hawaiian Islands are believed to lie at intersections of two sets of major fissures, one trending north-south and the other N. 60° E., spaced about 20 miles apart.
1884. The volcanic problem from the point of view of Hawaiian volcanoes: Honolulu Almanac and Directory, 1885, p. 81-95.

Essentially a review and discussion of C. E. Dutton's "Hawaiian Volcanoes," but contains also original observations by the writer.


Argues for the absence of magmatic water at Hawaiian eruptions; considers vapor given off by lava streams and fountains to be anhydrous, and the total amount of liberated vapors very small. Believes in gravitational settling of olivines, but considers the action of water in altering certain minerals, such as olivine and augite, to be the prime cause of the differences between basaltic and more feldspathic rocks. The cause of the rise of magma at vents is believed to be the weight of the surrounding crust on an underlying fluid basalt layer. Hawaiian volcanoes, which lie along a N. 60° W. trending belt, are said to be located at intersections of 2 sets of fissures trending N-S and N. 60° E., about 20 miles apart. Attributes tuff cones of Oahu and cones on Mauna Kea to accidental contact of molten lava with water. Agrees with Dutton in considering Kilauea Volcano independent from Mauna Loa. Describes from personal observations the Mauna Loa lava flow of 1859, lava fountain activity in Mokuaweoweo in 1873, and activity at Kilauea in 1860, 1867, and 1873. Presents a tabular summary of eruptions from 1823 to 1887, and compiled notes on many of the eruptions.


A rebuttal of certain criticisms by Dana of theories advanced in volume 2 of Green's "Vestiges of the molten globe" (1887), among them the ideas that the Kilauean lava fountains are caused at least partly by air carried down in the whirlpools in the lava lake, and that the Mauna Loa lava fountains are due largely to the hydrostatic pressure on the lava and not primarily to gas expansion. The theory of the settling of olivine crystals in the magma of the Hawaiian magma column is reiterated.

Gregory, H. E.


A brief note of the former glaciation of the summit region of Mauna Kea.


Contains brief general remarks regarding the Hawaiian Islands. It is stated that there is no physiographic evidence that the major islands have ever been connected above sea level.
Gregory, H. E., and Wentworth, C. K.

The physical features of the mountain are described. During the Pleistocene the mountain top was covered with a glacier cap which extended down to altitudes between 10,550 and 12,500 feet. Terminal, lateral and ground moraines, and outwash gravels, were formed. Volcanism was largely extinct before glaciation, but a few small eruptions occurred during glacial times.

Griffin, A. P. C.

A list of books and articles in various periodicals, relating to Hawaii, contained in the Library of Congress. It is very incomplete.

Grosser, Paul

A very brief account of the activity of Kilauea between 1894 and 1897, and of Mauna Loa in 1892 and 1896. It is noted that on the return of lava to Halemaumau after a period of quiescence, the lava flowed into the pit from a fissure 70 meters above the floor.

Grosvenor, Gilbert

Contains a popular account of Kilauea Volcano, and a series of excellent photographs, some in color, of lava features, Kilauea Caldera, and the lava lake of Halemaumau.

Gulick, O. H.

A description of Kilauea Caldera in the summer of 1863. The lava lake of Halemaumau was about 450 feet across and 20 feet below its banks, and very active. In 1846 or 1847 the lake was elevated above the general floor, and enclosed by a wall.
Guppy, H. B.

1906. Observations on the Mokuaweoweo Crater: Pacific Commercial Advertiser, vol. 44, no. 7513, p. 7, Sept. 6; no. 7514, p. 7, Sept. 7. A description of Mokuaweoweo between August 8 and 13, 1897. The origin of the caldera is discussed, and it is concluded that it formed by coalescence of several pit craters, followed by lateral enlargement by collapse of the sides. Dana's conclusion that Lua Poholo was formed between 1874 and 1885 is questioned, on the ground that the pit craters are often not visible from a short distance, and the pit may have been overlooked in the earlier mapping.

1906a. Observations on the temperature of the underground waters on the southeast coast of Hawaii: Pacific Commercial Advertiser, vol. 44, no. 7515, p. 6, Sept. 8. Between October 1896 and September 1897 frequent temperature readings showed the springs at Punalu'u and Ninole to range between 63.7° and 64.4° F. Springs on the west side of Keaauhou Bay measured 80.5° and 88.8°, and a well at the Keaauhou house 74°. At Apua and Kupaau the temperature was 78°, said to be 3° or 4° above mean air temperature. Half a mile to a mile inland at Kalapana temperatures of 80.5° and 81° were obtained. Springs at Opihikao measured 90°, and a pool near Kapoho 88°. The high temperatures are attributed to the admixture of thermal waters.

Gutenberg, B., and Richter, C. F.

1941. Seismicity of the earth: Geol. Soc. America, Spec. Paper 34, p. 84–85. Although many of the earthquakes on the island of Hawaii are direct results of volcanic processes, other larger shocks are tectonic in origin. That of April 2, 1888, and the Hualalai earthquake swarm of September 1929 are so considered. The big shock of September 26, 1929, was recorded in western Europe. The quakes produced seismograms of the usual character for shallow earthquakes. Strong shocks occurred on January 23, 1938 at 21° N. 150° W.; and on June 17, 1940, at 20.5° N. 155.25° W. Honolulu was shaken by quakes in 1871 and 1881, which were less strong in other parts of the islands.

1945. Seismicity of the earth (supplementary paper): Geol. Soc. America Bull., vol. 56, p. 603–668. Contains a brief discussion of earthquakes in the Hawaiian region (p. 644-646). The epicenters of 6 quakes, large enough to permit the use of data from distant stations, are located. They occurred on Jan. 23, 1938; Sept. 2, June 17, and July 16, 1940; Oct. 6, 1929; and Sept. 25, 1941. Three of these had instrumental magnitudes between 6.0 and 6.9; the other three between 5.3 and 5.9. These shocks are presumed to be tectonic, in distinction to the numerous small shocks directly associated with the volcanoes.
Haas, Hippolyt

Brief descriptions of Mauna Loa, Mauna Kea, and Kilauea, compiled from the works of others.

Hague, Arnold

1865. [Chemical analyses of two rocks from Kilauea]: Neues Jahrb., p. 308.
Analyses are given of two specimens of basalt collected at Kilauea by J. D. Hague in 1861. The analyses were made by Arnold Hague in the laboratory of Bunsen.

Hall, W. W.

An account of the Mauna Loa lava flow, near Hilo, on July 16, 1881, and a description of Kilauea Caldera in the middle part of July.

Haskell, R. C.

An account of the source area of the Mauna Loa lava flow of 1859 on February 9 and 10, and a description of the movement of pahoehoe and aa along the lower course of the flow.

A crack, 2 inches to 2 feet wide, extends for 4 miles above the cones of the 1859 eruption, described in the writer's earlier account (Haskell, 1859). Little lava issued above the cones, however. There was no visible activity in Mokuaweoweo in June, 1859.

In November, 1859, lava was still flowing into the sea in North Kona, at a light red heat after flowing 25 miles. In June, 1859, Kilauea was very quiet. The caldera had been filled up even with the black ledge of 1840.

Hawaii National Park
Circulars of general information.
Contain information and photographs of Kilauea and Mauna Loa, and outline maps of the National Park.
Hawaiian Volcano Observatory

Contains an account of Kilauea's activity from July 1909, to April 1912, an account of the condition of Mauna Loa on Feb. 17, 1912, and a prediction of the next eruption of Mauna Loa. Contains also an account of the founding of the Hawaiian Volcano Observatory.

Contains a complete journal of activity, both volcanic and seismic, at Kilauea Caldeira, accounts of the eruptions of Kilauea and Mauna Loa during the years 1914 to 1929 inclusive, and special articles on various volcanic phenomena.


Volcano Letter. See Volcano Letter.

Seismometric Bulletin, vol. 1, nos. 1 to 4 only, 1915.
(See Wood, H. O., 1915.)

Heim, Arnold

A group of 8 photographs of volcanic features at Kilauea, with titles in German, French, and English, and a brief explanatory text in German.

Hess, H. H. (See also Betz and Hess, 1942.)

Objection is taken to the classification of a microphenocryst of pyroxene with an optic angle of 45°, in the 1840 lava of Kilauea, as pigeonite by Macdonald (1944). The term augite is preferred, pigeonite being restricted to material with an optic angle of 0-30°. It is stated that the commonest pyroxene of basalts normally has an optic angle of about 45°. (See Macdonald, 1944c.)

Hill, S. S.

Contains an account of Kilauea Caldeira and the active lava lake in 1848.
Hillebrand, William
A letter describing the effects of the eruptions of Kilauea and Mauna Loa, and the great earthquakes of 1868. The condition of Kilauea Caldera on April 18 is described.

Hinds, N. E. A.
On Mauna Loa and Kilauea faulting has produced gaping fissures, low scarps, and summit sinks. The high dissected cliffs of Kohala have been ascribed to faulting, but further investigation is necessary to determine whether they were originally developed by faulting or are merely the result of long-continued wave attack.

The relative ages of the various major volcanic structures in the entire Hawaiian chain is considered. The geomorphology of the various islands is discussed, and the general morphologic features of Kilauea, Mauna Loa, Hualalai, Mauna Kea, and Kohala are briefly outlined. The rates of marine and fluvial erosion in Hawaii are considered. Contains many excellent photographs.

This general textbook on the evolution of land forms contains a simple brief account of Kilauea and Mauna Loa, as typical examples of shield volcanoes, and a brief account of activity of Kilauea leading up to the explosive eruption of 1924.

Hitchcock, C. H.
At the beginning of March, 1886, the lava lake of Halemaumau occupied the top of a broad dome, 160 feet above the level of the floor at the northern edge of the caldera. On March 6 the lava level in Halemaumau suddenly dropped, leaving a floor of talus 570 feet below the rim. Lava returned to the pit early in June, and by the end of June the pit was entirely filled and a roughly conical mound was rising above its rim. It was still rising in October, 1886. Maps by Emerson and Dodge show Halemaumau in April and October.

The yellow dust of the Kau area is of eolian origin, derived from deposits of volcanic ash, and not an elevated marine sediment as believed by Dutton.
Contains an account of the 1899 eruption of Mauna Loa, assembled from the accounts of others. The lava river near the cone was estimated by C. H. Kluegel to be 10 feet deep, 60 feet wide, and flowing 40 feet per second on a slope of 80 feet in 400. A photograph shows Mokuaweoweo in July 13, 1899. Lateral outflows of Mauna Loa are preceded by summit activity. The extensive ash deposits of Hawaii are recognized, and ascribed to explosive eruptions.

Moho'okea Caldera is a large depression on the southern slope of Mauna Loa, 7 miles long and 5 miles wide, containing several high "islands," among them Kaibolena and Puu Emuhe. The existence of the caldera is based on the configuration shown on the map of Hawaii by W. D. Alexander (1901).

Kilauea Caldera had been inactive, but during the last week of February, 1905, lava broke out in Halemaumau pit, and on February 27 had formed a lake 250 feet long and 100 feet wide.

Mentions fresh-water springs in the ocean off Kawaihae and Punalu'u.

An area on the southeastern slope of Mauna Loa, between Kaumaikeohu on the north and Kaulakiki on the south, is believed to be an area of collapse, and is named the Moho'okea Caldera. Puu Emuhe, Puu Makanao, and other hills are regarded as upfaulted blocks.

A description of lava lake activity at Kilauea during May 1908, quoted from an account by L. A. Thurston in the Honolulu Daily Advertiser for May 29, 1908.

All known eruptions of Kilauea to date are listed, including prehistoric ones recounted in Hawaiian legend. The activity of Kilauea from November 1907 to April 1909 is briefly described. The existence of a moving column of more or less solid rock, shifting up and down like a piston in the cylinder of Halemaumau, is recognized.
Hitchcock, C. H. (continued)

Contains a brief description of the physical features of the island of Hawaii, and a history of the activity of Kilauea and Mauna Loa up until February 1909, partly from personal observations, and largely from numerous other sources, published and unpublished. Generalities of the volcanic action are discussed. Mauna Loa and Kilauea are regarded as independent volcanoes, but showing a sympathy of action. It is recognized that the Keamoku flow, near Kilauea Caldera, is not the lava flow of 1823, but much older. Several chemical analyses of Hawaiian rocks are tabulated.

The opinion is expressed that earthquakes accompany every important volcanic outbreak. It is recognized that lava outflow is in part independent of hydrostatic pressure, the liquid occasionally escaping from vents high above other open vents. The eruptions of Kilauea and Mauna Loa, and the violent earthquakes of 1868, are described. The flow now recognized as of 1823 was mistakenly believed to be that of 1868 from Kilauea, and the Kamooalii flow was mistakenly assigned to 1823.

Hitchcock, D. H.

A description of the north branch of the Mauna Loa lava flow on November 9, 1880.

Accounts of the early stages of the Mauna Loa lava flow, as seen on November 30, 1880.

A description of the Hilo branch of the lava flow of Mauna Loa on June 11, 1881.

A description of the lava flow from Mauna Loa on June 27, 1881. The flow had then reached the flats back of Halai Hills, very close to Hilo.

An account of the 1887 eruption of Mauna Loa, and the earthquakes which preceded it.
Hobbs, W. H.


The great subsidences of the lava level which occur at Kilauea and Mauna Loa are thought to be the result of drainage through buried lava tubes, in older (pahoehoe) flows.

Hodgkins, Blanche


A brief description of the Mauna Loa lava flow of 1935. On November 29 an was advancing at 7000 feet altitude, at a rate of 100 to 120 feet an hour. The upper portion was cooled to blackness, but the lower was still red-hot and fluid. On December 22 pahoehoe was advancing near Humuula, at a rate up to 800 feet an hour. The advance was alternately fast and slow. The flow would crust over, then hot lava would melt its way through the nose and flow out. Gas and steam formed as the lava progressed over vegetation, forming bubbles on the surface which burst emitting blue flames. Gases traveled underground for as much as 100 feet from the nearest hot lava, then exploded.

Hoffmeister, J. E.


A brief survey of Dana’s work on volcanoes, particularly on Kilauea and Mauna Loa. His volcanic cycle for the Hawaiian volcanoes is quoted. Dana combated von Buch’s theory of craters of elevation, assigned a major role to the expansion of water vapor in propelling magma to the surface, and was the first to recognize phreatic explosions (called by him semi-volcanic).

Hooker, W. J.


Contains a description of Mauna Kea and Mokuaweoewoe in January, 1834. A liquid lava lake was stated to be very active in Mokuaweoewoe. (See Douglas, D., 1834; Jarvis, 1844.)
Hough, G. J., Gile, P. L., and Foster, Z. C.
A discussion of the origin, development, and general features of Hawaiian soils. Contains analyses of 3 exceedingly young soils and 6 young soils from localities on the island of Hawaii.

Howard, A. D.

Hunnewell, James (See Brigham, 1868c.)

Hutchins, W. A.
A comprehensive study of laws and institutions governing the development and use of surface and ground water in the Hawaiian Islands. Includes a section on land titles, and a brief summary of the occurrence of ground water.

Iddings, J. P.
1913. Igneous rocks, vol. 2, p. 193, 198, 651, 654–655, New York. The name "kohalaite" is proposed for oligoclase andesites, characteristically developed on the flanks of the ancient Kohala Volcano; the name "hawaiite" for rocks containing normative andesine, but in which the mafic minerals are so abundant as to give the rock a basaltic aspect. The lavas of Hawaii are very briefly discussed, and a list of chemical analyses is given.

1914. The problem of volcanism, p. 18–21, New Haven.
A brief account of the general features of the action of the Kilauea lava lake and of some historic lava flows from Mauna Loa.

Ingalls, A. B.
An account of a trip to the 1899 eruption of Mauna Loa, from Kona by way of Mokuaweoweo. The lava fountains are briefly described, and the difficulties of the party in passing through the fume cloud.

Jackson, C. T.
A chemical analysis of Pele's hair from Kilauea is given. The analysis has been quoted by Brigham (1868).
Jaggar, T. A. (See also Hawaiian Volcano Observatory Bulletin; Volcano Letter.)

An account of steps preliminary to establishment of the Hawaiian Volcano Observatory, and of work at Kilauea by Perret and Shepherd during July and August, 1911.

Kilauea is stated to be older than Mauna Loa. It is predicted that the next eruption of Mauna Loa will be before February 1915, in Mokuaweoweo. Within five years after that there should be a flank lava flow, probably on the north flank.

An account of the establishment of the Volcano Observatory.

A compilation, from the register of the Volcano House and other sources, of the activity at Kilauea during the time between the last entry in Brigham’s Volcanoes of Mauna Loa and Kilauea, and the commencement of systematic observations at the Observatory.

A week by week account of the activity at Halemaumau during that period. The reports for the period March 7 to April 3 were prepared by F. B. Dodge, assistant at the Observatory.

It was predicted that Mauna Loa would resume summit activity between September 1912 and February 1915, and that a flank eruption would occur on the northeast rift at an altitude above the 1899 vent within 5 years after the start of the summit activity.

The plan of the island of Hawaii shows a symmetry in accordance with the structure of the several volcanoes, and the activity of two of them, which leads to the conclusion that there is a record of succession shown. Kilauea is not the youngest vent.
Jaggar, T. A. (continued)

A brief account of the foremost early observers of Kilauea, Titus Coan, W. L. Green, and J. D. Dana, a list of some others who contributed early observations, an account of the establishment of the Hawaiian Volcano Research Association, of the investigations of Brun, Perret, Shepherd, Day, and others. Plans for the future activity of the Volcano Observatory are set forth.

A brief account of the Hawaiian Volcano Observatory and its work.

The summit eruption of Mauna Loa in December 1914 was merely the beginning of an eruptive period. Other such summit eruptions were followed about 3 years later by flank eruptions. Daily, bi-monthly, and semi-annual lava tides in Halemaumau, and the sympathy of action of Mauna Loa and Kilauea, are discussed. The incomplete records of the nineteenth century suggest an eruption of Mauna Loa about every 10 years, and Kilauea activity during the repose periods of Mauna Loa. These periods are probably controlled by lava accumulation, but when exceptional tidal stress occurs near the end of a repose period it may act as a trigger to initiate eruption. The sequence of a typical eruption proceeds as follows: (1) Unusual earthquake strain, for days or months, with abnormally many small quakes; (2) cracking open allows a foaming uprush of lava; (3) the adjustment of gas pressure, through escape of much gas; (4) escape of liquid lava; (5) cooling and congealing to a small depth; (6) a term of repose, and accumulation in depth. The 1914 eruption of Mauna Loa represented stages 1, 2, and 3. A lava flow may be expected probably within three years, probably on the north side of the mountain.

Shortly before 4 p.m., on November 25, 1914, a column of white vapor suddenly rose at the summit of Mauna Loa. A definite seismic prelude to the eruption is recognized, in the registration of 55 local earthquakes in the preceding 21 days. On November 27, eight main lava fountains were playing in Mokuaweoweo, on December 3, four fountains were active. A sketch map of Mokuaweoweo on November 27, by L. C. Palmer, is reproduced.
Mauna Loa commenced activity in the summit caldera on November 25, 1914, at 12:25 p.m., following a repose period of 93 months, the longest on record. The main eruption expended itself during the first 12 hours, in a line of tremendous lava fountains. Activity on December 11 and 15 is described. The fountaining lava was much richer in gas than the usual fountains of the Halemaumau lava lake. The eruption continued until January 11, 1915.

Contains discussions of rock and lava tides at Kilauea, possible sympathetic action of Kilauea and Mauna Loa, and the effect of astronomical forces in setting off eruptions. The typical volcanic cycle consists of six stages; (1) a period of unusual earthquake strain; (2) gas-foam explosion; (3) a period of gas release; (4) a period of release of liquid lava; (5) cooling and congealing to a small depth below the crater, initiating a period of repose; (6) a term of accumulation of new lava and gas pressure.

An eruption of Mauna Loa commenced on May 19, 1916, with a vapor cloud rising 20,000 feet in the air above a point at 11,000 feet altitude on the southwest rift. On May 21 lava broke out at 7,000 feet, sending flows into South Kona and toward Kahuku. The eruption ended about May 31. On June 5 came a collapse of 400 feet in Halemaumau, followed by recovery of 150 feet in June. This great collapse following so closely after cessation of the Mauna Loa eruption suggests a subterranean connection between the two volcanoes.

A short explosive outbreak high on the southwest rift on May 19, was followed by lava fountaining and extrusion on May 21 between 6,500 and 7,500 feet. The first flow moved southeast, but on the 22nd a second flow moved southwestward. The eruption was accompanied by many earthquakes, and by a climax in the lava level in Halemaumau, and followed shortly by a great subsidence in Halemaumau. The eruption fissures opened progressively up hill. A short period of exceptionally numerous earthquakes in September 1915 is regarded as due to magma rising in Mauna Loa fissures, splitting its way upward, and attaining release of gas pressure in some unobserved eruption, subterranean or submarine. The sympathetic activity of Mauna Loa and Kilauea leaves little doubt that they are connected, as correlated gas vents and not as hydrostatic siphon tubes.
Jaggar, T. A. (continued)

The lava column at Halemaumau consists of a main semisolid incandescent body (bench magma), perforated by small shafts leading to a saucer on its summit which contains a shallow lake of liquid lava about 50 feet deep. The bench magma grades by increasing viscosity upward into the lava lake and downward into a more fluid part of the magma column. Its top is constantly being added to by overflows from the lava lake and accumulation of founder ed crusts. Loading of part of its surface by overflow results in isostatic sinking of that part, and a compensating rise of some other part, the latter often producing islands of bench magma in the lava lake. During subsidence the lake magma sinks more rapidly than the bench magma. Definite flames of burning gases are present. The combustible gases, in order of abundance, are sulfur, carbon monoxide, and hydrogen. The latter is largely oxidized below the surface by air carried down in founder ed crusts and sucked down at fountains, forming water vapor. This subsurface oxidation supplies much heat to the lava lake. The lake surface above inlet conduits is relatively cool, but over sinkholes the temperature is high. It is there that fountains occur. The founding of a crust block is followed immediately, or accompanied by, the bursting of a dome-shaped mass of bubbles, forming a fountain. The fountains in the lava lake are caused by violent reaction between the magmatic gases and the air carried down in founder ed crusts. Subsidence of the magma in the sinkholes is maintained by the explosive loss of gas, resulting in a heavier liquid which sinks, forming a two-phase convection. Temperature tests with Seger cones and pyrometers show the ordinary lake magma just below the surface to be at 750° to 850° C., that in the fountaining grottoes at 1100° to 1200° C., and the oxidizing gases in the blowing cones at 1250° to 1350° C.

Live aa is identified within Halemaumau, forming a part of the "bench magma,"—the semisolid incandescent mobile material which surrounds and underlies the lava lake.

The terms aphroolith and dermolith are proposed to replace aa and pahoehoe, respectively. The characteristics of the two types of lava are described.

Soundings on January 23, 1917, showed the liquid lava lake to be 14 meters deep, with a seemingly pasty bottom. Temperatures measured with Seger cones in steel pipes thrust into the lava show temperatures of \(1250^\circ\) to \(1350^\circ\) C. in the flame blasts and cupolas of the zone of free atmospheric oxidation; \(1100^\circ\) to \(1200^\circ\) in the fountains and grottoes; a zone of surface heating due to surface oxidation, the temperature decreasing from about \(1000^\circ\) at the surface to about \(860^\circ\) at a depth of 1 meter; and below that gradually increasing again at approximately the rate to be expected due to surface cooling by radiation. At a depth of 13 meters the temperature was \(1170^\circ\) C. This is believed to be higher than the temperature of the magma rising through the conduits, owing to heating effects through oxidation of the magmatic gases at the lake bottom by air escaping from sunken crusts.


A brief summary of some of the discoveries of the Volcano Observatory, and its aims, and an appeal for continued support by the people of Hawaii. The discoveries include: The shallowness of the liquid lava lake, resting on the semi-solid bench magma, parts of which form the projecting islands, which are not floating; the existence of not one but several conduits under the lake; the occurrence of tides in the lake; the variations of temperature in the lake.


A summary of findings at Hawaiian volcanoes as to: (1) the nature of the gases and flames, (2) the nature of the lava column, (3) the thermal gradient of the lava lake, (4) aphrolith and dermolith, (5) cyclical and sympathetic lava movements, (6) seismic indication of volcanic activity.


The types of volcanic episode which might do damage to the country surrounding Kilauea and Mauna Loa, and possible means of predicting the time and place of the occurrence, are discussed.


An excellent description of the source area and lava flow of the 1919 eruption of Mauna Loa. The source vents opened about midnight September 28, and the flow reached the sea, 14 miles away, at 4:30 am. September 30, continuing for 10 days. Entrance of the lava into the sea, and behavior of the lava river, are described.
Jaggar, T. A. (continued)

The Kilauean magma column consists of the hypomagma beneath, in which gases are still in solution; grading upward into pyromagma, making up the lava lakes, in which gases are separating causing vesiculation; and epimagma, the "bench magma" surrounding and underlying the lakes, in which gases are no longer expanding and which is incandescent but semisolid. Two convections exist, one caused by vesiculation in the pyromagma, the other by sinking of masses of epimagma. Tumefaction in hypomagma is propagated in directions of least loading wherever bubble pressure gains headway and releases new gas in bubble form. Linear expansion of the perlith, the solid rock surrounding the magma column, by gas heating, may contribute to tumescence. Tumescence results in tilt of the surface away from the volcanic center, and also in tremor, during several weeks preceding eruption. Lowering of the magma surface is accompanied by a reverse tilt. Lowering of the Kilauean magma often is preceded by earthquakes from the Mauna Loa rifts. Tilting is partly due to diurnal heating; but longer-term tiltings are quasi-rhythmic quarterly and monthly series, suggesting solar and lunar causation. Lava movements show similar rhythms, culminations of lava rise lagging a little after equinox, and lava troughs appear to be reactions following the equinox effect and occurring somewhat after solstice. All the major Hawaiian mountains are described. The Kohala cliff is due to faulting, and the whole block back to the head of Waipio Valley has moved downward. Kilauea and Hualalai are regarded as older than Mauna Loa. Local earthquakes and tremors, and measurement of tilt at Kilauea are discussed.

A brief popular account of the work of the Hawaiian Volcano Observatory, and the activity of Kilauea and Mauna Loa. Contains many excellent photographs of active volcanism.

1921a. When Kilauea was dangerous: Paradise of the Pacific, vol. 34, no. 12, p. 77-79, December.
A brief popular description of the explosive eruption of Kilauea in 1790, and of the footprints in the 1790 ash in the Kau Desert, believed to have been made by the army of Keoua which was partly destroyed by the eruption. The footprints are overlain by part of the ash, showing that they were made during the eruption.
BIBLIOGRAPHY

A discussion of the aims of volcano observatories in general and of the Hawaiian Volcano Observatory in particular, and of the results obtained at the Hawaiian Observatory. Methods include the measuring and analysing of the physical and chemical properties of magma and gases, seismometric and geodetic records and measurements, continuous systematic mapping and photography of the volcano. The term clastolith is applied to aa lava.

A popular account of the aims of volcanology. Contains a partial summary of activity at Kilauea and Mauna Loa from 1914 to 1922. Directly following the Mauna Loa eruptions of 1914 and 1916, the lava in Halemaumau exhibited a sympathetic reaction by sinking rapidly several hundred feet at the time of cessation of Mauna Loa activity.

A brief description of the seismic sea wave of February 3, 1923. The waves reached northwestern Oahu at 12:02 p.m., and Hilo about 12:30 p.m. First noticed was a recession of the water, followed by a series of waves for several hours. At Hilo the third wave observed was the largest, the water rising more than 20 feet in places. Much damage resulted at Hilo, and also at Kahului on Maui.

During 1922 and 1923 six holes were bored to depths of 15 to 79 feet, with churn and shot drills. One on the 1894 lava on the floor of the caldera revealed little of interest except a bed of sand or gravel at 70 feet (the 1790 ash?). Holes at Sulfur Banks yielded largely steam at boiling temperature (204° F.), and showed the sulfur deposit to be superficial. Iron and copper sulfides were present beneath the upper oxidized zone.

Hawaiian volcanoes are generally placid, but on May 18, 1924, Kilauea erupted explosively. A similar blast had occurred 134 years before. Japanese statistics show 130 years to be a critical interval at many volcanoes, and in 1918 it was predicted that about 1920 might be a dangerous time. Subsidence of the lava, beginning in 1920, led in 1924 to collapse at Halemaumau and ensuing explosions. There is evidence that the lava sank so low as to let ground water close over the crack containing the glowing magma, resulting in generation of enormous steam pressures. Explosion is a secondary phenomenon occasioned by plugging of the vent and generation of steam from ground water.
Jaggar, T. A. (continued)

Contains brief references to seismologic work at Kilauea.

The outstanding features of the upper slopes of Mauna Kea, as compared with Kilauea, Mauna Loa, and Hualalai, are the greater weathering, trenching, and signs of age, the large size of the cinder cones, the appearance of greater viscosity of the lava, and the glaciated area. The cones were built by fling from lava fountains. Evidence of the former glacier are roches moutonnées, polished and grooved rock surfaces, erratic boulders, and moraines. Below the edge of the former glacier extend stream gorges, and below these is a plain of alluvium extending 10 miles west-northwest from the sheep station.

Contains a popular account of volcanologic work at Kilauea.

A short popular account of lava streaming in the Halemaumau lava lake.

The engulfment of oxidized surficial lavas furnishes oxygen to the magma beneath. This accounts for the generally oxidized nature of the gaseous volcanic emanations, and supplies much heat to the magma.

The evidence of glaciation at the summit of Mauna Kea, previously described by Daly, is briefly redescribed. In addition, there are recognized on the lower southern slopes, large areas of glacial outwash gravels.

At Kilauea, when there is a rapid rise of lava it is generally around the edge of the crater as if the central part had been plugged by solidifying lava. Hourly observation of the liquid lava reveals fluctuation of level, presumably tidal. There is a fluctuation of 2 to 7 feet twice a day, a daily variation of 3 to 5 feet, and a monthly shifting of the times of maximum and minimum level. The hard lava floor also shows a daily change of level of about 1 foot, but the times of maximum and minimum were nearly opposite to those for the liquid lava.
BIBLIOGRAPHY

The collapse and engulfment which occurs at Kilauea at the end of short lava flow periods, and which followed the steam explosions of 1924, are termed “minus volcanicity.” In contrast, “plus volcanicity” is characterized by rising lava, expulsion of magmatic gases, centrifugal tilting, doming, and overflows. A normal cycle begins with plus movements, followed by minus movements. Minus volcanicity is dominant in all post-Tertiary volcanism, with down-faulted craters, much explosion, and decadence of external lava activity.

An excellent description of the source vents and lava flow of the 1926 eruption of Mauna Loa. The formation of “concretionary” lava balls is described.

Holes three meters deep and 300 meters apart, at the corners of equilateral triangles on the floor of Kilauea, were drilled with a compressed air drill, for the purpose of repeated temperature surveys, and establishment of isothermal lines. Some temperature measurements are given, and causes of temperature differences are discussed. Temperatures in the drill-holes are apparently affected by atmospheric temperatures.

During the explosive eruptions of Kilauea in 1924, engulfment equalled more than 7 billion cubic feet, 253 times the volume ejected explosively. The sequence of phenomena from 1914 to 1924 agrees with the hypothesis that magmatic tension opened fault rifts, lava in the pit lowered hydrostatically, the unsupported pit walls collapsed, ground water entered the shaft between hot lava below and a plugged vent above, and a geyser mechanism resulted. Thereafter the lava regained its gas tension, rose in the conduit, and shut off the ground water, and in July reappeared in the pit.

The normal sequence in active volcanism, as exemplified at Kilauea, is: (1) accumulation of magma with rising ground, intrusion and overflow; (2) loss of magmatic gas, withdrawal of magma, engulfment, graben faulting, subsidence, and steam eruption; (3) recovery of magma, filling of voids with magma, cessation of steam eruption, slightly rising or stationary ground, and some overflow or lava-dome formation.
Jaggar, T. A. (continued)


1929. Graded swelling and shrinking of volcanoes: (abst.) Hawaiian Acad. Sci. Proc. for 1929, B. P. Bishop Mus., Spec. Pub. 15, p. 10-11. The outbreak of lava in Halemaumau, February 20, 1929, was accompanied by: small earthquakes with centrifugal tilt before the outburst, cessation of tilt and continuous tremor during lava fountaining, centripetal tilt and excessive tremor as the end of action approached, and cessation of both when the lava stopped flowing. Leveling, and other data, indicate swelling of the mountains of Kilauea and Mauna Loa during rising lava, and shrinking and collapse during sinking lava. From 1790 to 1924 there was a major cycle of 134 years, and minor cycles averaging 11.1 years, which is the same length as the sun-spot cycle. Lava minima corresponded somewhat to the sun-spot minima.

1930. Breathing cones: Volcano Letter, no. 263, Jan. 9. Small cones upon the floor of Halemaumau in 1919 and 1921 are described. Stalactites resembling bunches of grapes, and long worm-like stalactites, within these cones, were formed by remelting of the roof of the cavern by hot gases. A blast of air through such a cavern may cause the whole inside to glow, owing to rapid further oxidation of the iron oxides lining it.

1930a. The swelling of volcanoes: Volcano Letter, no. 264, Jan. 16. A brief description of the swelling of Kilauea, indicated by visible tilting, by horizontal pendulums, and by level lines, which accompanies the rise of magma in the vent; and the reverse movements which accompany lowering of the magma.

1930b. Kilauea eruption in July, 1929: Volcano Letter, no. 271, Mar. 6. A brief description of the eruption which began on July 25, 1929, and ended on July 28, in Halemaumau pit. The floor of the pit was built up 55 feet. The volume of new lava was 127 million cubic feet, shrinking to 98 million cubic feet.
The floor of Halemaumau pit, at Kilauea, in 1921 was occupied by pasty "bench magma," and very fluid "lake magma." The bench magma formed the floor and walls of the lake and the islands in the lake. The lake magma rose through tunnels and wells penetrating the bench magma, partly flooding its upper surface. The bench magma also was mobile, but its movements were slower than those of the lake magma, and it generally lagged behind in rising or sinking.

Footprints in pisolitic ash near the head of the 1920 lava flow of Kilauea are overlain by a thin bed of sand and cinder, and this by another layer of ash also containing footprints. The prints were probably made by Keoua's army during the eruption of 1790. The lower layer of prints, all made by persons hurrying away from the volcano, were probably made during the midst of the eruption. The upper prints are more leisurely, and point in various directions.

1930e. The bubbling and gushing of lava: Volcano Letter, no. 277, April 17.
The bursting gas-bubbles at the surface of the Halemaumau lava lake, commonly called "fountains," are differentiated from the true fountains or jets of lava such as typify the sources of Mauna Loa lava flows.

Lava cascades into wells penetrating the bench magma in Halemaumau pit, Kilauea, result partly from lowering of the level of the lake magma relative to the bench magma, but also from a considerable difference in level of the lake magma in different wells.

1930g. Distinction between pahoeheo and aa or block lava: Volcano Letter, no. 281, May 15.
Pahoeheo and aa are essentially alike in chemical composition, both may flow rapidly or slowly, both may be sluggish and viscous, or liquid and fluid. Generally pahoeheo forms near the vent, and the long streams are aa, but long streams are occasionally pahoeheo. Stirring stimulates the formation of aa. The more crystallized material within a pahoeheo skin, if allowed to flow out quickly, forms aa.

Avalanches from the walls of Halemaumau pit, and marked widening of the cracks about the rim of the pit, appear to accompany tumbescence or uplift of the rock structure surrounding the lava column just prior to its outbreak.
Jaggar, T. A. (continued)

Contains a brief summary of events typical of the development of a fissure vent at a flank eruption of Mauna Loa, and of the rapid building of a spit and bay-mouth bar at Hoopuloa Cove.

Both Kilauea Caldera and Halemaumau pit are five-sided. The northwestern and southeastern walls are diverging prolongations of the southwest rift, and the northeastern and southwestern walls are diverging prolongations of the Chain of Craters rift. The northern walls are structurally less fundamental.

Contains a brief popular account of volcanism at Kilauea, and the work of the Hawaiian Volcano Observatory.

Beginning suddenly on September 19 and continuing for a month, there occurred a tremendous swarm of earthquakes centering about Hualalai. Seismological data are given. During the 26 days following Sept. 21, instruments registered 6,211 shocks. Large quakes on Sept. 25 and Oct. 5 showed no preliminary tremor at Hilo, Kealakekua, or Kilauea. It is suggested that this is due to a single magma body underlying the whole island, transmitting the shock to all parts of the island simultaneously.

A detailed account of the activity at Kilauea from November 19, to December 3, 1930. The eruption ceased on December 7.

A brief popular account of the eruption on the southwest rift of Kilauea which started on December 15, 1919, and continued into 1920.

A brief account of tsunamis. Tide-gage records of the tsunami of March 6, 1920, at Honolulu and Hilo, are given, and the effects of that tsunami and the one of February 3, 1923, are briefly discussed.

An exposition of a general theory of volcanism, containing many references to Kilauea and Mauna Loa as examples of various processes.

1931b. When the pit lava sinks: Volcano Letter, no. 324, March 12.
Rising of the magma at Halemaumau is dependent on expansion and combustion of gases, this foaming up being caused by release of pressure. Sinking of the magma may be caused by (1) loss of gas, causing the glassy slag to shrink, or subsurface crystallization causing shrinkage, either being slow; or (2) opening of a subsurface crevasse, draining the liquid away, which is rapid. Great subsidence of the Kilauea magma column directly following the cessation of Mauna Loa eruptions proves the deep connection between Kilauea and Mauna Loa.

Short cycles involving both Kilauea and Mauna Loa of about 11 years duration are combined into super-cycles of about 132 years. Each short cycle, beginning with 1781, is briefly discussed.

The 11-year cycle at Kilauea corresponds closely with the average 11.1-year interval between sunspot maxima. Greatest lava activity occurs at time of maximum sunspots, and minimum of sunspots accompanies lava quiescence.

In an address before the Hilo Chamber of Commerce, the danger to Hilo from future lava flows of Mauna Loa is emphasized. The possibility of deflecting the flow at high altitude, by blasting open the pahoehoe tube, which was advocated by L. A. Thurston, appears good.

"Schollen-domes" are caused by inflationary pressure of liquid lava beneath. Worm stalactites and associated stalagmites are formed by gas-fluxing of the roof of a lava tube. While incandescent, these stalactites are flexible.

A list of local earthquakes recorded at Kilauea during 1929 and 1930; and a summary of the total number of earthquakes per year for the period 1925-1930.
Jaggar, T. A. (continued)

1931h. The crater of Mauna Loa: Volcano Letter, no. 360, November 19.
An outline of the changes which have occurred in Mokuaweoweo Caldera in historic times, based on maps by Wilkes in 1841, Lydgate in 1874, J. M. Alexander in 1885, B. Friedlaender in 1896, and Wingate in 1929, all of which are reproduced. The most striking changes were the gradual collapse of the north and south lunate platforms, and building up of the floor of the main pit after 1868.

A brief outline of the changes in Halemaumau, based on a photograph of Curtis' model of Kilauea Caldera in 1913, and excellent aerial photographs of Halemaumau in 1923 and 1930.

1931j. Journal of Halemaumau eruption December 23-27, 1931:
A day-by-day account of the activity in Halemaumau, which commenced at 2:36 p.m. on December 23. The actual opening of the fissure across the pit floor was witnessed by Wingate. The bottom crust appeared rather to be pulled apart than heaved up and broken. Tumescence undoubtedly occurred. The first cracking was followed immediately by liberation of large volumes of fume.

Kilauea and Mauna Loa appear to exhibit short cycles of activity of approximately 11 years, combined with longer cycles of approximately 33, 66, and 132 years. These correspond more or less closely to sunspot cycles of about 11.1 years. Greatest volcanic activity appears to coincide with times of greatest frequency of sunspots.

Recorded tsunamis in Hawaii are listed and their effects briefly described. They occurred in 1819, 1837 (severe), 1841, 1868 (severe), 1872, 1877 (severe), 1919, 1923.

A day-by-day account of the eruption in Halemaumau.

A day-by-day account of activity in Halemaumau. The eruption which began on Dec. 23, 1931, ended on Jan. 5, 1932, after producing a fill 115 feet deep on the floor of the pit.
A brief comparison of the Hālēmaʻumaʻu eruptions of July 1924, 1927, 1928, February 1929, July 1929, 1930, and 1931, and the Mauna Loa eruption of 1926. Typically, they were each preceded by strong earthquakes a week or two before, or by unusual seismic frequency; by widening of rim cracks; by centrifugal tilt. There were temporary inward tilting and continuous tremor while the lava fountaining was going on.

1932c. Twenty years of volcano study in Hawaiʻi: Volcano Letter, no. 381, April 14; no. 382, April 21; no. 383, April 28; no. 384, May 5.
An account of the history of the Volcano Observatory at Kīlauea from its founding in 1911, to 1931; and of the volcanological investigations in Hawaiʻi and elsewhere by the Observatory staff and associated workers. Includes a list of publications of the Observatory, and papers by Observatory personnel in outside publications.

Contains a brief summary of the features of the eruption of Kīlauea from December 23, 1931, to January 6, 1932, and of earthquakes and tilt during 1931 and the early part of 1932.

A detailed account of a strong eruption within Hālēmaʻumaʻu, which partook in several ways of the characters habitually shown by Mauna Loa eruptions but not typical of Kīlauea activity. The actual opening of the eruptive fissure was witnessed,—a rare circumstance.

Triangulation and leveling at Kīlauea during 1926-27, compared to the results of 1921-22, show a lowering of the mountain top of 13 feet and horizontal inward surface shift of 2 to 4 feet. Level changes between 1912 and 1921 showed a bulging up of the mountain top of 1.58 feet in 4 miles in the summit region. Tilts registered by the seismographs were of the order of 60 seconds outward in 1918-1920, and 70 seconds inward during the 1924 collapse.

A description of the summit eruption of Mauna Loa which began on December 2, and ended December 17, 1933.
Jaggar, T. A. (continued)

A tabular summary of the dates and durations of historic eruptions of Mauna Loa, with the location of each, is presented. The interval between summit eruptions and succeeding flank eruptions averages 2 years and 5 months. The summit activity from 1870 to 1877 is briefly discussed, and it is suggested that ground water coming in contact with hot magma may have been responsible for the unusually high eruption column of 1877. The 1933 eruption is briefly described.

An account of the eruption in Halemaumau which began on September 6 and ended on October 8, 1934.

The eruptive history of Mauna Loa is reviewed. Activity at the summit occurs on an average of every 3½ years, and flank lava flows every 6 years. It is predicted that a lava flow will occur, probably on the northeast rift, within two years.

A description of the eruption of Kilauea in 1790, and of footprints in ash in the Kau Desert believed to have been made during that eruption. A translation by Thrum of an account of the eruption is quoted and discussed.

1934d. Kilauea’s lost lava flow: Paradise of the Pacific, vol. 46, no. 6, p. 5–9, June.
Lava flows on the flanks of Kilauea are accompanied by lowering of the lava level in Halemaumau. In 1924, lowering of lava left a huge void at Halemaumau, but no visible lava flow occurred, although much cracking resulted along the east rift. A submarine lava flow must have occurred on the east rift. Overlying water would prevent explosions.

A popular discussion of temperature measurements in cracks and boreholes at Kilauea. Temperatures at successive depths in a hole 72 feet deep are recorded. The heat in surficial lavas within Kilauea Caldera appears to be caused by rising hot vapors, and not by conduction from depth.

A popular account of methods of predicting eruptions of Mauna Loa and Kilauea.
A description of occurrences in Halemaumau during April, 1935. The volcano was inactive, changes consisting largely of avalancheing from the walls of the pit.

An account of the opening stages of the eruption on the northeast rift of Mauna Loa, which commenced on November 21, 1935.

A day-by-day account of the eruption of Mauna Loa from December 1 to December 23, 1935. Contains a discussion of the modes of formation of aa and pahoehoe. It is suggested that the lava in a pahoehoe tube is in hydrostatic equilibrium with that rising in the conduit, and that breaking the tube near the conduit would drain the conduit below that level, permitting the flow to solidify and block the upper segment of the tube, shutting off the supply of lava to the flow.

A brief account of the operations of bombing the 1935 lava flow from Mauna Loa.

1936a. Summit outbreak of Mauna Loa December, 1933; Volcano Letter, no. 439, September.
A discussion of the volcanic cycle of Mauna Loa and Kilauea; and a description of the summit eruption of Mauna Loa which began on December 2 and ended on December 18, 1933. Includes a map of Mokuaweoweo by A. E. Jones, showing the extent of the flows.

A transcription of radio broadcasts from the edge of Halemaumau describing the activity therein on September 10 and 11, 1934.

Eruption began in Halemaumau on September 6, and ended on October 8, 1934. The eruption showed four phases: (1) on Sept. 6 a large pool of liquid lava covered the whole pit floor 60 feet deep; (2) Sept. 7 to 20, the lake contracted, and fountains became more explosive as the vents clogged, and a small heap was built up by overflows around the lake; (3) on Sept. 20, extrusion along the boundary of the new lava fill with the marginal talus banks; (4) Sept. 22 to Oct. 8, periodic draining through the eastern source well, with explosive bursts of gas and flame, and stiff lava.
Jaggar, T. A. (continued)

A pahoehoe flow which issued at a vent near 9,000 feet altitude ponded in the saddle between Mauna Loa and Mauna Kea, then turned toward Hilo. Twenty 600-pound bombs were dropped by U. S. Army planes, 5 striking directly on the targets, which were the flowing stream at 8,500 feet altitude and the tube a mile down slope. The tunnel roof was demolished and the tunnel blocked with debris, permitting escape of a new liquid stream at the target. It is also supposed that release of gas affected the equilibrium causing congealation back into the vent. The flow immediately slowed, and ceased completely 6 days later.

Proposes the erection of three barriers to deflect future flows of Mauna Loa from Hilo. One barrier would run 5 miles N. 20° W. from Puu Uulaula, another half a mile north and a half a mile south of Puu Huluhulu, and the third would lie as an arc around Hilo on the south and southwest.

1938. Our Hawaiian volcanoes, Castle and Cooke Ltd., 12 pp., Honolulu.
A brief popular account of Hawaiian volcanoes in general.

The eruptive histories of Kilauea and Mauna Loa are briefly reviewed. At Kilauea there are successive 11-year cycles of slow building up of lava level terminated by collapse. There are also longer cycles of about 134 years beginning and ending with major breakdowns accompanied by steam explosions. Times of collapse coincide roughly with times of sunspot minima, and sunspot maxima occur in times of rising lava. The world over, post-Tertiary time has been characterized by the decline of volcanism and by the breakdown of most of the big volcanoes to form calderas. Von Buch's theory of "craters of elevation" has been to some extent justified by the demonstration at Kilauea and elsewhere that volcanoes swell and shrink from within.

A brief description of the effects of bombs dropped on the 1935 lava flow. Bombardment of the pahoehoe tunnel is said to have "cooled, dammed, solidified, and freed from gas an enormous volume of slag, which froze where it lay," solidifying the tunnel lava and stopping the flow. The flow just west of the lower vent of the 1935 flow is believed to be the western branch of the flow of 1880.
1939a. Exploration of NE rift of Mauna Loa: Volcano Letter. no. 466, p. 3-4, October-December.

A description of volcanic features in the vicinity of Pun Ulaula. Cones northeast of Puka Uahi are said to be the source of the 1855 flow. Cones about Puka Uahi were sources of flows in 1855, 1880, 1881, and 1899.


The dominant gases of primary volcanism are carbon dioxide and hydrogen. Sulfur is a crateral concentrate. In the best gas collections the amounts of water-vapor, chlorine, and sulfur trioxide become vanishingly small.


Analyses of gaseous constituents of Hawaiian liquid lavas are arranged in order of abundance of each gas. Progressing from poor to good collections, it is found that $H_2O$, $SO_3$ and $Cl_2$ decrease, while $CO_2$, $CO$, $SO_2$, $S_2$, $H_2$, $N_2$, and $A$ increase. It is believed that in a perfect collection uncontaminated by atmospheric gases, the first three would be absent. Study of gases liberated by reheating rocks in vacuum suggests that $N_2$ and sulfur are minor constituents at depth. The water present in collections is believed due largely to the reaction $H_2 + CO_2 = CO + H_2O + 10,000$ calories. To account for the large amount of $H_2O$ present by this reaction, implies the much greater abundance of $H_2$ in depth, which is consistent with the larger amounts of $H_2$ yielded by reheating solidified rocks. The magmatic gases at depth are believed to be largely $H_2$ and $CO_2$, in approximately equal amounts, with less $N_2$, and the other gases in small volume.


Thirty years at Kilauea leads to the following conclusions: A lava column is made up of (1) deep magma from the centro-sphere, unique and homogeneous; (2) gas foam, fluent and vesicular; (3) gases; (4) glowing residue, semisolidified. Lava lowering is as common as rising, and explosive eruptions are complications of such lowerings with ground water. There is no distinction between magmatic and tectonic earthquakes at depths of 400 miles.

1945a. Volcanoes declare war, 166 pp., Honolulu.

A popular book dealing with the entire circum-Pacific belt of volcanoes. It contains descriptions of the Kilauea eruptions in 1924 and 1934, and the Mauna Loa eruption of 1935. Aerial bombing of the latter flow is believed to have stopped the eruption.
The city and harbor of Hilo are in danger of destruction by lava flows from the northeast rift of Mauna Loa. A plan to construct a diversion channel and earthworks has been evolved by the author and the U. S. Engineer Dept. The proposed earthworks, and stream and road crossings, are described. Three barriers were originally proposed, but only one near Hilo is under consideration by the Engineers. It would extend from the Wailuku River near Pukani Falls diagonally across drainage lines south of Hilo to a point 1.25 miles south of Keokea Point, deflecting any lava flow to a point 1.5 miles east of Hilo Bay. Length would be 8.85 miles, height from 20 to 58 feet. The mean of three separate estimates of cost is $1,379,967, for a construction time of 32 months.

A summary and discussion of activity at Kilauea and Mauna Loa from 1911 to 1941. (Not seen.)

Jaggar, T. A., and Finch, R. H.

Numerous earthquakes along the east rift of Kilauea were accompanied by cracking and faulting in eastern Puna and great subsidence of the lava in Halemaumau. Violent explosions commenced on May 11, and continued until May 24. Large volumes of fragments ranging from blocks weighing several tons to fine dust were ejected. Some were incandescent, but all were of old rock. No new magmatic material was ejected. Gradually the dust clouds of the explosions were replaced by clouds of pure white steam.

Seasonal tilts, eastward in summer and westward in winter are demonstrated, tilt being greatest when lava levels are high. There is no correlation between tilt and rainfall. Northeast tilt occurs when the lava level is rising and southwest tilt when it is falling, the central lowering which accompanied the 1924 collapse being 4 meters, possibly due to evacuation of a centrally swollen underlying sill. Correlation between lava movements of Kilauea and Mauna Loa are perfect, when the Kilauea vent is open.

An account of temperature measurements in shallow borings, 5 to 20 meters deep, at Kilauea Caldera, in 1922. Gradients were erratic. A bore-hole on the caldera floor gave measurements, at 3-meter intervals, of $35^\circ$, $45^\circ$, $54^\circ$, $58^\circ$, $65^\circ$, $64^\circ$, and $69^\circ$. 
Tilt is measured constantly by noting the wandering from the median line of the two-component Bosch-Omori seismograph, and has been checked by level lines. At the observatory seasonal tilts of 20 seconds or more in $\frac{1}{2}$ year are found, the tilt being easterly, or centrifugal, in winter and westerly in summer. No correlation is found with rainfall. Northerly tilting accompanies the rise of lava levels in Halemaumau, and easterly tilting precedes eruptions of Mauna Loa, each indicating a tumsence of the mountains during periods of rising magma. There is perfect correlation between lava movement at Kilauea and Mauna Loa when Kilauea is not sealed. Highest lava levels at Halemaumau coincide with seasonal easterly and northerly tilt during the winter. This may be the result of (1) summer solar heating checking volcanic radiation; or (2) winter solstice tidal effect exerting a southward pull on the Hawaiian ridge, producing trigger stress for winter effervescence and tumescence.

Jaggar, T. A., Finch, R. H., and Emerson, O. H.
A systematic tide lifts both liquid lava and semi-solid floor in Halemaumau, the floor lagging behind the liquid by approximately half a day. Seasonal tilt affects both Mauna Loa and Kilauea, the former producing an easterly tilt at the Observatory during winter, and a westerly tilt during summer. The nine-year cycle of volcanic activity suggested by W. L. Green has been satisfactory in Hawaii for the last 30 years, cycles since 1808 averaging 8.5 years.

Janssen, J.
Contains a very brief account of a visit to Kilauea Caldera in 1883, probably in June. A lava lake was active. Spectrum analyses of flames from the lavas demonstrated the presence of sodium, hydrogen, and carbon compounds.

Jarvis, J. J.
1843. History of the Hawaiian or Sandwich Islands, p. 18-23, 145-146, Boston.
The earthquakes of November 1838 and April 1841 at Hilo, and the tsunamis of November 1837 and May 1841 are described. The destruction of part of Keoua’s army by the explosive eruption of Kilauea in 1790(?) is briefly recounted.
BIBLIOGRAPHY

An account of an ascent of Mauna Kea, and a visit to Kilauea Caldera in July, 1840. The caldera is described. The black ledge was about 500 feet below the rim, and an inner pit about 250 feet lower. A lava lake at the southwestern extremity of the inner pit was active. No fume could be seen at a distance rising from Mokuaweoweo, which was therefore presumed to be inactive. Inaccuracies of Douglas' description (Hooker, 1836) of Mokuaweoweo are pointed out, the guide who accompanied Douglas stating that at the time of their visit the only activity in Mokuaweoweo was a little fume rising from fissures.

Joly, J.
1909. On the radioactivity of certain lavas: Philosophical Mag., vol. 18, p. 577. (Not seen.)

Jones, A. B. (See also Jaggar, 1936a.)
A tsunami accompanying an earthquake in the Solomon Islands reached Hawaii a little more than 8 hours later than the earth waves. Oscillations occurred every 15 minutes for 48 hours, and averaged about 6 inches in height.

A graph showing seismicity at Kilauea from August 1928 to January 1932. The seismicity value for each week is the summation of arbitrary values assigned to each progressively stronger grade of quake.

Earthquakes during the year 1933 are listed and their epicenters plotted on a map. A swarm of quakes in October preceded the eruption by 6 weeks. 13 quakes accompanied the outbreak. A slight tendency for the quakes to get progressively shallower up to the time of the eruption was noted.

1934a. Earthquakes of Hawaii: (abst.) Hawaiian Acad. Sci.,
About 40 percent of the earthquakes recorded at Kilauea in 1933 have been located. 14 percent occurring on the undersea slopes of the island. Two-thirds were on Kilauea and Mauna Loa. Many were on the known rifts, and there was a slight concentration near the volcanic craters and centers. The eruption of December 2, 1933, started with 12 recorded shocks, 6 being well located. The first was slightly deeper than the following shocks, which were near or above sea-level.

A seismicity curve is drawn for a year preceding and following the eruption. High areas on the curve correspond with periods of eruption. Epicenters of the quakes are plotted on maps. The earthquake foci are located by use of newly developed travel-time and S-P curves for Hawaii. Most Kilauea earthquakes fall on the circumferential fault planes which enclose Kilauea Caldera.


Recorded earthquakes from January 2 to November 12, 1934, are listed and their epicenters plotted on a map. Eruptions typically are preceded by a premonitory swarm of quakes one or two months before the outbreak, and followed by a subsequent swarm of quakes one or two months after cessation of activity. The latter are believed due to subsidence of the mountain caused by withdrawal of the lava within. Throughout the duration of the eruption, one month, the seismograph recorded harmonic tremor.


Through a study of seismogram phases, using quakes with origin very close to one of the Hawaiian seismographs, the difference in speed of the P and S waves reaching the other seismographs is determined. Wave velocity between Hawaii and Oahu is determined, and checks with other determinations of speed in the sub-Pacific crust. Other waves are believed to indicate a complex structure, with four to seven discontinuities in the Hawaiian Ridge. A travel time-distance graph for Hawaii is included.


Methods of measuring ground-surface displacements include leveling, horizontal angles, width of cracks and tilt. Each method is described, and the results for the first half of 1935 are listed. Earthquakes during the same period are listed and their epicenters plotted. The maximum of earthquake frequency occurred between 21 and 22 o'clock, Hawaiian time, with a smaller maximum between 0 and 2 o'clock, confirming the results of Rodes that the maximum of earthquake frequency occurs when the sun is over the eastern Pacific.
Jones, A. (continued)


Brief discussions of the forms and development of aa and pahoehoe lava flows, including a description of the development of flow units in pahoehoe. Attention is called to the “flash discharge” of lava and large amounts of gas during the first few hours of an eruption, action later slowing down.


A study of earthquake records at Kilanea. The various types of seismic disturbance are described, and theoretical typical examples of the traces produced by each on the seismograph are shown. The following features are discussed: period of waves, variation of period with depth of focus, variation of amplitude with period, period change with distance, amplitude ratios, depth of focus, geographic vs. depth distribution, intensity distribution. A classification of local quakes based on the number of P and S waves is outlined.


Relative roughness is considered as a criterion for classification of lava flows. A classification is proposed, in which the divisions are: massive pahoehoe; scaly pahoehoe, composed of thin overlapping flow units; shelly pahoehoe; slab lava, formed by disruption of shelly pahoehoe; ropy lava, grading into furrowed aa; aa lava in place; aa rubble, grading into coarser aa clinker; and block lava. A gradation from aa to pahoehoe is recognized.

Jones, George


During the opening hours of the 1887 eruption earthquakes were very numerous at Kahuku Ranch. Starting at 2:12 a.m., January 17, by 4 a.m. on January 18 the number of shocks strong enough to rattle doors was 314, and by 12 midnight the number was 381.


Contains a summary of ideas regarding the formation of amphitheater valley-heads, marine benches, and other geomorphic features.
Judd, J. W.
Contains a number of general references to Hawaiian volcanoes. Kilauea and Mauna Loa are believed to be supplied from separate reservoirs and to be independent in action (p. 138, 326). Kilauea Caldera is thought to have formed by enlargement of a fissure through liquid lava encroaching upon and eating away its sides (p. 181).

Keep, Josiah
1893. Recent observations at Kilauea: Science, vol. 21, p. 76.
A description of Kilauea Caldera in July, 1892. Halemaumau pit was about 250 feet deep. The lava lake on its floor was enclosed in a wall, or curb, locally as much as 30 feet high.

Kelley, E. G.
A description of Kilauea Caldera on May 8, 1838, as described by Captains Chase and Parker, of the whaler ships Charles Carroll and Ocean. On the caldera floor there were counted 26 small cones, and 6 active lava lakes, the southwesternmost of which was the largest. The frontispiece to the volume is a view of the caldera, from sketches by Parker and Chase. No black ledge is shown, or mentioned in the description.

Kelley, W. P., McGeorge, W., and Thompson, A. R.
A general discussion of Hawaiian soils, their composition, properties, and development. Contains chemical analyses of 48 soils of the island of Hawaii, including specimens from Kohala, Hamakua, Hilo, Olaa, Kau, and Kona.

Kent, T. B.
1880. Visit to the crater of Kilauea: Hawaiian Annual for 1881, p. 41–44.
A description of Kilauea Caldera and the lava lakes in the summer of 1880.

Kimble, Howard
A discussion of the water resources of Kona. The development of natural reservoir sites is considered impractical. Four tanks, at altitudes of 2100, 2250, 2530, and 2800 feet on Kilaeu Stream are recommended. The construction of artificial rain-sheds is discussed.
King, Clarence
Records settling of crystals of feldspar and augite (olivine?) in lava flows of Kilauea. The glass at the surface of the flows was mistakenly believed to be acidic. The lava lake was overflowing onto the caldera floor (in March 1872).

Kinney, H.
A description of the source area of the 1852 lava flow. The lava fountains are stated to have reached heights as great as 800 feet.

Kinsley, Jean
Estimates of viscosity of flowing lavas of Kilauea and Mauna Loa by Becker (1897) and Palmer (1927) are briefly discussed. The former concluded the viscosity to be about 60 times, and the latter about 15 times, that of water. Experiments by Jaggar in 1921, at the lava lake in Halemaumau, are described.

Kirchoff, Theodor
Contains a description of Kilauea Caldera in December, 1887.

Kneeland, Samuel
Pages 17–44 contain a brief popular account of the volcanoes Kilauea and Mauna Loa. A description of activity in Mokuaweoweo on August 9, 1872, is given on p. 39.

Krukenberg, C. F. W.
A description of specimens collected at Kilauea by W. Hillebrand, including compact and porous basaltic glasses, Pele's hair, spherulitic glass, and palagonite tuff. Partial chemical analyses are given. Contains many illustrations showing the structure of Pele's hair, reticulite (thread-lace scoria), and other glassy rocks.

Ladd, H. S. (See Wentworth and Ladd, 1931.)

Landgrebe, Georg
Brief descriptions of Mauna Kea, Mauna Loa, and Hualalai, and a more extended description of Kilauea Caldera and the volcanic activity therein.
Lansdale, E. V.

1870. Six hours in a volcano: Hours at Home (mag.), vol. 11, no. 4, p. 337–343.
Contains an undated description of Kilauea Caldera, probably in the early part of 1870.

Larrison, G. K. (See also Pierce and Larrison, 1914.)

Discharge measurements for the Wailuku and Honolii rivers, several stations at the 2,700-foot level west of Hilo, Upper and Lower Hamakua, Kohala, and Kehena ditches; miscellaneous measurements on Pukihae, Pohakumanaka, Hanawai, Aleamai, Maili, Waipahoehoe, Kapae, Makoevali, Honoomu, Kapaahehe, Kawaiulul, and Waipio streams, and springs at Pihonua.

Contains a list of stream, ditch, and rainfall gaging stations on the island of Hawaii.

Discharge measurements for the Upper and Lower Hamakua ditches; and miscellaneous measurements on Waikoloa, Kipahu, Wailuku, and Waiau streams, and Akona, Lyons, Kohala, and Pelekuiaoa ditches.

Discharge measurements for the Upper and Lower Hamakua and Kohala ditches.

Libbey, William

Spectroscopic observations (Sept. 14th to 25th, 1893), show the probable presence in the gases of lava fountains in Halemaumau, of hydrogen, carbonic acid, and hydrocarbons.

A description of Kilauea Caldera, and of the Halemaumau lava lake in 1893.
Like, A. N.
Quotes analyses of gases collected by Shepherd in 1912 and 1917, and by Jaggar in 1919, and summarizes conclusions to be drawn from a study of the analyses.

Lockyer, N. (See Zurcher and Margollé, 1869.)

Logan, Daniel
1903. Hawaiian volcanoes, 24 pp., Honolulu.
A brief popular account of the activity of Mauna Loa and Kilauea from 1887 to 1902.

Longwell, C. R. (See Agar, Flint, and Longwell, 1929.)

Loomis, Elisha
Contains a description (p. 10–11) of Kilauea Caldera on June 16, 1825. Activity consisted of a largely crusted-over lake at the bottom of a central pit 200 or 300 feet deep. Around this pit there was a broad flat lava floor. This in turn was almost completely surrounded by a ledge 250 feet wide, about 250 or 300 feet higher, which in turn was 250 or 300 feet below the caldera rim.

Lyman, C. S.
Kilauea Iki Crater is described. Tree casts containing charcoal were found on its floor (in the lava of 1832).

A description of Kilauea Caldera in July and August, 1846. The inner pit which was present in 1840 was largely obliterated. The height of the northwestern wall above the caldera floor was 680 feet, agreeing with measurements in 1840. A ridge of loose blocks 50 to 100 feet high paralleled the edge of the former black ledge, and generally left a “canal” between it and the ledge. It apparently was formed by the uplift of the talus which had previously lain at the foot of the cliff of the inner pit, the floor of which had been bodily elevated. A large lava lake was active.

A list of earthquakes felt at Hilo, from June, 1833, to July 5, 1858.
1924. Around the Horn to the Sandwich Islands and California, p. 89–92, New Haven.
A description of Kilauea Caldera in July 1846. The floor was nearly level with the "black ledge". Just inside the black ledge was a ridge of angular blocks, in some places 150 feet or more high, leaving a "canal" 10 to 50 yards wide between it and the black ledge, into which recent lava streams had flowed.

Lyman, F. S.
An account of the earthquakes and mud-flow of April 2, 1868, at Wood's Valley.

An account of the catastrophic earthquakes, the lava flow of Mauna Loa, and the mud flow at Wood's Valley, in March and April, 1868.

A description of Kilauea Caldera in late August, 1873.

Lyman, H. M.
A brief account of the early stages of the 1859 eruption.

Brief remarks regarding the 1859 eruption of Mauna Loa. Activity is believed to have moved progressively down the fissure, forming the series of spatter cones.

Lyons, A. B.
Descriptions of Halemaumau during July 1889 and 1892, showing the changes resulting from the great collapse of March 7, 1891.

A brief introductory section deals with the geology of the island group as a whole. The remainder of the paper is devoted to Oahu.

A discussion of the chemical changes involved in the formation of Hawaiian soils. Contains chemical analyses of Pele's hair from Kilauea, lavas from Kohala, and soils from Hilo and Ookala.


Contains a brief description of the principal mountain masses of the island of Hawaii, as part of a discussion of the archipelago as a whole. The Hawaiian ridge is regarded as a submarine fold, broken to permit escape of lava. The great sea-cliff of Kohala and Waipio Valley are both regarded as formed by faulting, and it is implied that much of the sea-cliff along the Hamakua and Hilo coasts may be also.

Lyons, C. J.


The years of minimum sun spots and years of important eruptions of Mauna Loa and Kilauea, from 1790 to 1900, are tabulated, the results suggesting some connection between the two.

Lyons, L.


A brief account of the Mauna Loa lava flow of 1859, and its destruction of the village of Wainanali'i.

Maby, J. H.


A brief notice of the commencement of the 1887 eruption of Mauna Loa, on January 16. Smoke was observed on the mountain at 4:40 p.m., and "fire" broke out at 8:20.


An account of the lava subsidence in Halemaumau in March 1891. Up to March 5, Halemaumau was very active. At 9 p.m., March 5, there was a slight earthquake and the Halemaumau crags sank 100 feet. At 9:10 p.m., March 6, there was another earthquake, and the crags sank still more, and finally sank out of sight on the night of March 7. Many quakes occurred at Kapapala.
MacCaughey, Vaughan

Contains a brief general discussion of volcanic features, including cinder cones, pit craters, kipukas, and ash terranes; the two principal types of lava flow, aa and pahoehoe; and tree casts and molds.

A brief popular account of some lava flows along the southwest rift of Kilauea. The flows of 1823 and 1868 are interchanged.

A description, quoted from a letter by L. W. DeVis-Norton, and discussion of activity at Kilauea Caldera in January, 1919. The rise of lava level is attributed to “the usual equinoctial rise . . . due partly to the abnormal squeezing of the Hawaiian fissure system.”

Macdonald, G. A. (See also Stearns and Macdonald, 1946.)

Brief account of traditional and historic lava flows in eastern Puna, including the lava flows of 1793(?) and 1840, and the traditional eruption of Kaholua o Kahawai cinder cone.

Ground and surface water conditions near Hilo are briefly discussed. It is shown that the normal use of water in the city is greater than the lowest recorded discharges of the Wailuku River, from which its supply is derived. Construction of wells drawing from the basal zone of saturation is recommended, and four possible well sites are indicated.

A brief description of the rocks penetrated in excavating the shaft of the Mault-type well at Olaa.

Interstitial feldspar with refractive indices of oligoclase or andesine, but a small positive optic axial angle, is concluded to be soda-lime plagioclase containing a small amount of potash.

On April 26 eruption occurred in and near the caldera, and on April 28 at 9,200 feet altitude on the northeast rift. For a few hours lava gushed forth in a nearly continuous curtain of fountains a mile long, followed by restriction of the fountains and building of a cone. Another outburst, at 7,800 feet, was probably fed by an old lava tube. Bombing of the flow apparently had no effect on the continuation of the eruption. The effectiveness of bombing in diverting lava flows is discussed. Extrusion of lava ended on May 10.


During the 1840 eruption of Kilauea, olivine basalt nearly devoid of olivine phenocrysts was erupted from vents near Aia and Makaopuhi craters, followed shortly by eruption of picrite-basalt with abundant olivine phenocrysts from lower vents in eastern Puna. The difference in composition is the result of the phenocrysts in the lavas from the lower vents. Gravitative differentiation in the magma column appears to have resulted in removal of olivine phenocrysts from the upper part, which fed the upper vents, and their accumulation at a lower level, which fed the lower vents.


Picrite-basalts in proximity to the feeding conduit of Kilauea appear to have suffered recrystallization in the solid state, as a result of remaining for a long period at high temperature, during which original pigeonite broke down and recrystallized to hypersthene and augite. The groundmass texture resembles that of contact metamorphosed hornfelses.


Solfataric alteration of basaltic lava and vitric-crystal ash at Sulfur Bank and other localities at Kilauea Caldera has produced a rock composed largely of opal, with a little kaolin and relict ilmenite and magnetite. The replacement has approximately the same volume as the original rock. Original structures and textures are excellently preserved. The alteration resembles that in areas of acid emanations in other volcanic regions. A less abundant type of alteration yields a mixture of limonite and goethite, with a little kaolin.

The classification of pyroxenes by Hess (1944) is discussed. It is believed that the gap in optic angle of monoclinic pyroxenes will eventually be found nonexistent. Hess' statement that the commonest pyroxene of basalts has a $2V$ of about $45^\circ$ is not borne out in Hawaiian lavas, in which pigeonite with small $2V$ is commonest. A $2V$ of $32^\circ$ is accepted as the boundary between augite and pigeonite. The pyroxene microphenocryst in the 1840 lava of Kilauea (Macdonald, 1944; Hess, 1944) is termed pigeonitic augite.


The geology of Mauna Kea is briefly discussed. The rocks consist of the older Hamakua volcanic series, with a lower member composed largely of primitive basalts and an upper member containing more highly differentiated types, and the younger Laupahoehoe volcanic series composed largely of andesites, with which are interbedded glacial deposits. Besides the radial rift zones, Mauna Kea also shows concentric arcuate alignments of vents, indicating arcuate fractures occupied at depth by ring dikes or cone sheets. The arcuate alignment of vents appears to result from the intersection of shallow-seated radial fissures with the deeper arcuate intrusions.


Of hundreds of aa lava flows examined in Hawaii, practically all have a massive phase, generally thicker than the clinker phase. In measured sections, the proportion of clinker to total aa ranges from 15 to 66 percent. Only very rarely is a flow even locally clinker throughout.


Maps of the northeast rift zone and summit regions of Mauna Loa show the exposed areas of historic lava flows through 1942. The sources of the flows of 1855, 1880, 1899, 1935, and 1942 are briefly discussed. During the 1942 eruption lava issued from concentric fissures, as well as the normal radial fissures.
Macdonald, G. A. (continued)


The lavas of Mauna Loa and Kilauea volcanoes consist predominantly of olivine basalt, with smaller proportions of basalt and picrite-basalt. Andesites are unknown. Hypersthene-bearing lavas are moderately abundant on Mauna Loa, but rare on Kilauea. The lavas of Mauna Loa show considerably greater variation than those of Kilauea. Hualalai Volcano is built largely of olivine basalt, with associated smaller amounts of basalt and rocks transitional between olivine basalt and picrite-basalt, and rare andesite. The lava flow of 1801 consists of olivine basalt. Xenoliths of gabbro, dunitie, and augite peridotite are present in the lavas. Soda trachyte forms a cinder cone and thick flow on the northern flank of the mountain. Only the earliest stages of magmatic differentiation are indicated, thus strengthening the conclusion reached at other Hawaiian volcanoes, that appreciable differentiation commences near the end of the caldera-filling stage.

The lavas of Mauna Kea Volcano are divided into the older Hamakua volcanic series and the younger Laupahoehoe volcanic series. The Hamakua volcanic series consists of two members. The lavas of the lower member are very largely olivine basalt, with less numerous flows of basalt, and primitive picrite-basalt containing abundant phenocrysts of olivine. The lavas of the upper member include olivine basalt, basalt, andesine andesite, and augite-rich picrite-basalt. The Laupahoehoe volcanic series consists preponderantly of andesine andesite, with a smaller proportion of olivine basalt. Coarse-grained inclusions and ejecta comprise gabbro, dunitie, and augite peridotite. The lavas of Kohala Volcano are divided into the earlier or Pololu volcanic series, and the later or Hawi volcanic series. The Pololu lavas consist largely of olivine basalt, and to a minor extent of basalt and picrite-basalt. The Hawi lavas are predominantly oligoclase andesite, with less abundant trachyte. Coarse-grained inclusions of gabbro, dunitie, and augite-hypersthene peridotite are present.

Differentiation was largely or entirely by crystal settling. The parent magma was olivine basalt. Sinking of intratelluric olivine crystals during early magmatic phases produced olivine-rich picrite basalt and a reciprocal phase of basalt poor in olivine. Later, the removal of crystals of calcic plagioclase, hypersthene, and augite yielded rest-magmas equivalent to andesine andesite, oligoclase andesite, and trachyte, and the accumulation of sunken crystals produced augite-rich picrite-basalt.
Macdonald, G. A., Shepard, F. P., and Cox, D. C.  
1947. The tsunami of April 1, 1946, in the Hawaiian Islands:  
The effects of the tsunami, which originated near the Aleutian  
Islands, are described. Maps show heights reached by the water  
around all the major islands. The factors influencing variations  
in height are discussed. A list of past tsunamis in Hawaii is given.  
Types of damage are described, and means of lessening damage and  
loss of life in future waves are outlined.

Macdonald, J. M.  
1889. The great volcano of Kilauea, Hawaiian Islands, 32 pp.,  
Wilder’s Steamship Co., Honolulu.  
Contains a brief description of Kilauea Caldera in April, 1889.

Macrae, James (See Wilson, 1922.)

Maehara, K.  
1926. [Photograph of explosive eruption of Kilauea]: Sunset,  
vol. 56, p. 7.  
A full-page colored photograph of the eruption cloud at Kilauea  
in May 1924.

Mann, Horace  
1866. [Notes on the volcano Kilauea, Hawaii]: Boston Soc.  
In August, 1864, action at Kilauea Caldera was sluggish, the lava  
lake being 300 feet across and 30 or 40 feet below its rim. Moku-  
weoweo was inactive. A “blow hole” on the summit of Hualalai  
was said to be 25 feet in diameter and more than 1000 feet deep.

1866a. [On denudation observed in the rocks of the Hawaiian  
232–234.  
Brief general remarks upon the climate and drainage of the is-  
land of Hawaii. The western and southern slopes, with very rare  
flowing streams and little dissection, are contrasted with the area  
of numerous streams and deep stream valleys north of Hilo on the  
northeastern slope.

Marcuse, Adolf  
1892. Die Erdmessungs-expedition nach den Hawaiischen In-  
seln: Gesell. Erdkunde Berlin Verhandlungen, Heft  
9 und 10, p. 14–16.  
A description of Kilauea Caldera in December 1892. Halemaumau  
pit was ellipsoidal, and about 3,000 feet long, with an active lava  
lake 280 feet below the rim. The rim of the pit was 280 feet below  
the benchmark at the caldera rim, and appeared to have been built  
up 70 feet during the previous 5 years. It is noteworthy that the  
altitude at Little Beggar also measured 28 feet higher than 5 years  
before.
Hualalai, Mauna Kea, Mauna Loa, and Kilauea, and the principal eruptions from 1790 to 1887 are briefly described. The raising of the floor of Kilauea through lava overflows is tabulated as follows: 1823—20 m.; 1832—22 m.; 1840—22 m.; 1849—3 m.; 1868—9 m.; 1886—4 m.

Margollé, Elie (See Zurcher and Margollé, 1869.)

Mark Twain (See Clemens.)

Marshall, Patrick
1912. Oceania: in Handbuch der regionalen Geologie, 36 pp., Heidelberg.
Contains (p. 7) a very brief summary of the salient features of the island of Hawaii, especially Kilauea and Mauna Loa.

Martin, J. H. S.
An account of the early stages of the eruption of 1887. The first outbreak is said to have been near Pohaku o Hanalei. About 7 p.m., January 18, the lava broke out at Keau Hill, on the Kahuku lands, and one stream reached the sea at Hopeloa on January 20.

Martin, W. F., and Pierce, C. H.
A description of stream gaging stations, and discharge records available to the end of 1911, for the island of Hawaii. Includes a general description of the physical features of the island. Springs along the southern coast are mentioned, and the Punaluu springs are said to discharge 30 or 40 second feet. Springs near Kapoho are said to be warm. Pages 509–536 contain a gazetteer of Hawaiian place names.

Mason, S. L. (See Mather and Mason, 1939.)

Mather, K. F., and Mason, S. L.
Contains a summary of the eruptive action of Kilauea, and generalities of the volcanic origin of the mid-Pacific islands, quoted from J. D. Dana (1849).

Mather, S. T.
A brief general account of Mauna Loa and Kilanaea.
Maxwell, Walter

The general nature of Hawaiian lavas and the effects on them of weathering are briefly discussed. Several partial chemical analyses of alteration products also are given, but with only very vague locations. The decomposition of lava by acid steam at Kilauea Caldera is described, and partial analyses of the lava and decomposition products are presented. The steam at Sulfur Bank was found in 1896 to contain 5% sulfuric acid. The origin of the red lateritic soils of the Hawaiian Islands is discussed. The bulk of the book is devoted to a description and classification of Hawaiian soils.

Contains data on evaporation from free water surfaces and soils, transpiration of moisture by vegetation, powers of soils to absorb and retain moisture, salts in soils and waters, duty of water, irrigation practice at the Hawaiian Experiment Station, distribution of water and results of over-irrigation.

McCandless, J. S.
1936. A brief history of the McCandless Brothers and their part in the development of artesian well water in the Hawaiian Islands 1880-1936, p. 15-17, 66-68, [Honolulu].
Gives some data regarding the drilling of wells at Mahukona, Paunilo, Kohala, and Olaa, on the island of Hawaii.

McGeorge, W. T. (See also Kelley, McGeorge, and Thompson, 1915.)
A discussion of the chemical changes involved in the development of Hawaiian soils from their parent rocks. Several chemical analyses of soils from Hawaii are included. Six chemical analyses of lavas from the island of Hawaii also are given, including specimens from the lava flows of 1823 (Keamoku flow?), 1868, 1883, 1907, the small overflow of Kilauea in 1910, and Pele's hair.

McKay, W. A.
An account of the source area of the lava flow of 1887, on January 29.
Meinzer, O. E.

Menzies, A.

Mercalli, G.
1907. I vulcani attivi della terra, 421 pp., Milan. Contains brief descriptions of the calderas of Mauna Loa and Kilauea (p. 63), and of the lava fountains (p. 128), a general outline of the typical eruptive sequence at Mauna Loa (p. 159), brief descriptions of the historic activity of Mauna Loa and Kilauea (p. 329–334), and a discussion of the relationship of Mauna Loa and Kilauea.

Merrill, G. P.
1894. [On the rocks of Mauna Kea]: U. S. Coast and Geodetic Survey, Annual Rep., 1893, pt. 2, appendix 12, p. 630–632. A description of 15 rock specimens from Mauna Kea. All are said to be basaltic. A partial chemical analysis of one, and specific gravity determinations for 18 specimens are given. The localities are shown on a map facing page 596.
Merritt, W. C.
A description of Mokuaweoweo on July 19, 1888. A cone in the southwest corner was fuming, and many small fumaroles were observed, but there was no other activity. The eastern wall was roughly 350 feet high. E. G. Hitchcock and H. R. Hitchcock report that in October, 1873, a lava fountain 600 feet high was playing in the southwestern part of the caldera. Kilauea Caldera, on July 14, 1888, is briefly described.

Merwin, H. E. (See Washington and Merwin, 1921, 1922; Aurorosseau and Merwin, 1928.)

Miller, J. M.
Contains a brief, very general description of Kilauea and Mauna Loa, and a brief reference to the outbreak of the Mauna Loa lava flow on July 4, 1899.

Miller, W.
A brief account of the early stages of the 1855 eruption of Mauna Loa.
On July 30, 1856, Mauna Loa was reported to be still in activity.

Mist, H. W.
1877. The recent volcanic irruption at the Sandwich Islands: Geographical Mag., p. 133.
A brief account of the Mauna Loa eruption of 1877, seen from the sea, and the submarine eruption in Kealakekua Bay.

Moffett, Cleveland
A popular account of the collection of volcanic gases in Halemaumau by Day and Shepherd in 1912.

Monnier, Marcel
Contains a brief description of Kilauea Caldera in 1884.

Moore, E. S.
Pele's tears from Kilauea are described, and a partial chemical analysis is given. Their forms are very similar to those of australites, which are therefore believed to be of volcanic origin.
Moseley, H. N.
A description of Kilauea Caldera in August, 1875.

Murray, John (See Thompson and Murray, 1885.)

Nakuina, Emma M.
1893. Ancient Hawaiian water rights: Hawaiian Annual for 1894, p. 79-84.
A brief account of riparian rights and some of the customs pertaining to them in ancient Hawaii.

Newell, F. H.
Contains a brief general discussion of water supply and irrigation in the Territory of Hawaii, and the Island of Hawaii, and brief descriptions of the Kohala, Upper Hamakua, and Lower Hamakua ditches. A brief discussion of water rights is included.

Nichols, J. W.
Contains a description of Kilauea Caldera in December, 1874.
(Not seen.)

Nichols, R. L.
The viscosities of lava flows calculated by Becker (1897) and Palmer (1927) both assumed turbulent flow, and are therefore in error. Assuming laminar motion, viscosity of the 1919 lava of Mauna Loa is shown to have been 4.3 x 104 poises, very much higher than previous estimates. Calculated viscosity of the 1887 flow is 4.77 x 104 poises. Experiments by Jaggar on lava in the Halemaumau lake also indicate high viscosity.

Nickles, J. M.
Contains references to many papers on geology and water resources of the Hawaiian Islands.

Contains references to many papers on geology and water resources of the Hawaiian Islands.

Nordhoff, Charles
A description of Kilauea Caldera on March 3, 1873.
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Description of Kilauea Caldera and the lava lakes on March 3, 1873.

Ohrt, Frederick
A Maui-type well is recommended to supply water to the lower part of the city, as an auxiliary source in addition to surface water from the Wailuku River and water from Kaumana Springs. The site recommended is on the west extension of Lanikaula Street, at an altitude of about 100 feet.

Oleson, W. B. (See also Stevens, and Oleson, 1894.)
A description of the Mauna Loa lava flow on November 17 and 18, 1880.

Omer, G. C., Jr.
Preliminary magnetic studies on the island of Hawaii are described. Magnetic permeability is found to decrease from the shoreline to the summit of the volcanoes, presumably because of the heated condition of the rock under the summit areas. Plotting of magnetic departures at Honolulu against monthly seismicity at Kilauea for the period 1933–1936 shows a peak in the north-south departures several months before the eruptions of 1933, 1934, and 1935, which on seismic evidence appears to correlate with the beginning of rise of magma in the upper part of the volcanic conduit. Between about February 1 and March 20, 1945, magnetic variation at 7 stations ranged from 0.05° to 0.35°, the vectors radiating from a point at about 8,000 feet altitude on the northeast rift zone of Mauna Loa.

O’Shaughnessy, M. M.
A brief general discussion of irrigation practise in Hawaii, including a paragraph on ancient water rights, and brief sections on gravity supplies, pump installation, and ground water.

Contains a brief general discussion of irrigation, ancient water rights, and water supplies in the Hawaiian Islands. The construction of the Kohala Ditch is described.
Palmer, H. S. (See also Wentworth and Palmer, 1925.)

Although in general the more northwesterly of the Hawaiian Islands are the older, the order of eruption of the major volcanoes is not strictly that of their geographic succession toward the southeast. For instance, Kohala, on Hawaii, is older than the more northerly Haleakala, on Maui.

On the basis of Jaggar's observation of velocities of 11 miles per hour in the 1919 lava flow from Mauna Loa, it is calculated that this lava had a viscosity between 11 and 20, and probably about 15 times that of water.

A small scale fluting of rock surfaces, and a large scale fluting of cliffs, usually at valley heads, are both attributed to solution by water. The specific examples described are on Oahu, but the generalities apply to Hawaii as well.

The same as the author's "Lapies in Hawaiian basalts."

Iron occurs in Hawaiian rocks and soils, but not in commercial quantities or form. No commercially workable bodies of metal-bearing rock occur in Hawaii.

Describes physical and chemical changes involved in development of soils from their parent rocks, referring specifically to rocks near Wahiawa, Oahu, but applicable in principle to the island of Hawaii.

A discussion of the chemical and mineralogical changes involved in the development of soils from their parent rocks in Hawaii. Although the discussion relates directly to changes observed on Oahu, the generalities are equally applicable to regions of similar climate on Hawaii.

The area east of the fault cliff at Ka Lae is covered with fine-grained yellow-brown to red-brown wind-deposited loess, in places containing lenses of carbonaceous plant debris, and elsewhere with intercalated lava flows. The loess has been in part deposited since the occupation of the Hawaiian Islands by human beings.


A brief popular discussion of the processes of volcanism, erosion, and reef-building, as affecting the Hawaiian Islands, including the island of Hawaii.


A tabular comparison of the Hawaiian Islands with the forty-eight states, as to maximum and minimum elevation, range in elevation, ratio of range in elevation to area, and ratio of range in elevation to side of a square of equal area. Only four states have greater elevations than the island of Hawaii, and only two have greater range of elevation.


A general elementary description of Hawaiian lavas, the processes operating upon them in the production of soils, and the changes involved in forming a red lateritic soil. The specific examples refer to the Wahiawa area on Oahu, but the generalities apply to Hawaii as well.


A brief general discussion of the hydrologic properties of the rocks, and the Ghyben-Herzberg lens of fresh water floating on salt water, high-level perched ground water, and ground water held at high levels between confining dikes, in the Hawaiian Islands.

Palmer, H. S., and Powers, H. A.


Pits, 1 to 2 inches across and 1 to 1.5 inches deep, in pahoehoe flows along the shore of Hawaii, are the result of enlargement of gas bubble holes, by etching and perhaps by abrasion. The large gas bubbles were trapped just beneath the surface of the pahoehoe, near the crest of wrinkles in the flow-top.
Paris, J. D.
A description of the effects in South Kona of the violent earthquake of September 30, 1881, said to be more violent than the quakes of 1868.

A brief account of the opening phase of the Mauna Loa eruption of 1887, as witnessed in Kona. A continuous series of earthquakes is said to have occupied the first 36 hours of the eruption.

Payne, J. H., and Ballard, S. S. (See also Ballard and Payne, 1940.)
Gases from Sulfur Bank, at Kilauea, over a two-year period, were found to consist of predominant steam, and the remainder of 85 to 98 per cent CO₂, 1 to 15 percent SO₂, and approximately 1 percent air. H₂S appeared first on March 14, 1940. Mauna Loa became active on April 7, 1940. H₂S was still present on April 11 and 21, but was absent in collections on May 10 and June 18, although Mauna Loa was still erupting. The appearance of H₂S may be a premonitory sign of impending volcanic activity.

Payne, J. H., and Mau, K. T.
At steam vents where SO₂ is absent silica and soluble bases are leached away, leaving hydrated oxides of aluminum and iron. Where SO₂ is present aluminum, iron, alkalis, and alkaline earths are leached out leaving a siliceous residue. Chemical analyses of fresh and altered rocks are given. (Doubt has been thrown on the accuracy of some of these. See Macdonald, 1946.) The field indications have been confirmed by laboratory studies.

Penck, Albrecht
Contains estimates of volume for several historic lava flows of Mauna Loa, as follows: 1852 lava 0.51 cubic kilometers, 1855 lava 4.86 cu. km., 1859 lava 2.73 cu. km., 1868 lava 1.67 cu. km., 1880-81 lava 2.01 cu. km. It is suggested that the 1789 eruption marked the inception of Kilauea Caldera, since the bedded tuff derived from it is thought to form the outer frame work of the dome, and has never been overflowed by lava. (Not seen; quoted by Tyrrell, 1931, p. 109; Sapper, 1927.)

Penck, Walther
Stated by Daly (1933, p. 389) to have adopted the laccolithic hypothesis for Kilauea advanced by Daly. (Not seen.)
Penfield, S. L., and Forbes, E. H.

Perkins, E. T.
1854. Na motu: or reef-rovings in the South Seas, p. 209-216, New York. Contains a brief description of Kilauea Caldera in 1853. Halemaumau lava lake occupied the summit of a slight eminence, was about a quarter mile in circumference, and the molten lava was about 50 feet below the rim.

Perret, F. A.
1911. [Observations at Kilauea]: Pacific Commercial Advertiser, vol. 53, Aug. 17, Aug. 24, Aug. 31, Sept. 7, Sept. 14, Sept. 21; reprinted without illustrations in Hawaiian Annual for 1912, p. 164-175, 1911; and in Hawaiian Volcano Observatory, 1st Rep., p. 35-46, 1912. A record of the activity and changes at Kilauea from July 2 to September 17, 1911, and an account of the temperature measurements at Halemaumau. This is the first continuous record of Kilauean activity kept over a considerable period by a single observer.

1913. The floating islands of Halemaumau: Am. Jour. Sci., 4th ser., vol. 35, p. 273-282. Most of the “floating islands” are fragments of the surrounding wall fallen into the lake. Others are thickened portions of crust or small cinder and spatter cones. The flotation is attributed to the surface tension of the lava, buoyancy of a rising column of lava and gas beneath, evolution of gas from the island itself owing to chemical reaction. It is noted that rise and fall of the liquid lava may not raise or lower the island. The behavior of one particular island, during August 1911, is described.

1913a. The circulatory system in the Halemaumau lake during the summer of 1911: Am. Jour. Sci., 4th ser., vol. 35, p. 337-349. The circulation is primarily due to loss of gas and cooling in the surface layers, which are thus heavier than the lava beneath and tend to sink. The lava of fountains is cooled and degassed, and on falling back sinks into the lake forming local low areas toward which the heavy surface layers flow and sink. Most of the fountains are over the conduit, due to the upward escape of gas bubbles, hence it is there the surface layers sink, the lava rising at the end of the lake farthest from the conduit.
A description of the subsidence of the lava lake in Halemaumau between July 18 and September 30, 1911, and the accompanying collapse of the walls of the pit. Variations in lunisolar gravitational attraction are believed to play an important part in determining the level of the lava in the pit.

Describes products of explosive eruption at Kilauea, including ash, pisolites, bombs, blocks, and Pele's hair. Some of the bombs are clearly magmatic. Proposes the name “Pele's tears” for the small drop-shaped ejecta.

Normal fountains of the Kilauea lava lake show three successive phases in each outburst: (1) the spatter phase, (2) the dome phase, and (3) the subsidence phase. The fountains are caused by the rise and expansion of large bubbles of gas, which burns on release into the atmosphere. Gas flames are observed also over breaks in the lake crust and at blowing cones.

Descriptions of pahoehoe and aa, lava tubes, driblet spires, tumuli (Schollendome), and lava trees and tree-molds, with brief remarks on the mode of formation of some of the features.

An account of experiments performed by E. S. Shepherd and the writer in determining the temperature of the lava lake, and obtaining a sample of liquid lava from “Old Faithful” fountain. Contains a report by A. Brun on the gases in this lava sample.

Perry, Antonio
A brief popular account of the history and development of riparian rights in Hawaii.

Petersen, Sophie
A geographical description of the Hawaiian Islands, with special emphasis on the volcanic features.
BIBLIOGRAPHY

Pfaff, Friedrich

A brief description of Kilauea Caldera in 1823, as seen by Ellis, requoted from Brigham (1868).

Phillips, A. H.

Chemical analyses of Pele's hair from Kilauea, collected by W. Libby, Jr., and of a lava stalagmite, are presented. The theory of formation of lava stalactites by deposition from hydrous solution is abandoned on the grounds that if they were formed in that way the iron should be totally oxidized. Textures of the stalactites are like those of ordinary lava, and chemical composition is like that of Pele's hair. They are probably formed from fused lava.

Phillips, Coleman

Contains brief references to the Hawaiian Islands, and in an appendix (p. 205–210) a brief description of the active volcanoes, from Ellis (1826) and Bird (1875).

Pickering, Charles

The opinion is expressed that the emanations from new Hawaiian lava flows do not contain water vapor. Brigham agreed that the emanations from Kilauea are dry. Water is not necessary to a volcanic eruption.

Pickering, W. H.

Brief descriptions of craters and other volcanic features of Hawaii, especially of Kilauea and Hualalai, and comparison of them with features on the surface of the moon. The history of Kilauea from 1868 to 1905 is very briefly sketched.
BIBLIOGRAPHY

Pierce, C. H. (See also Martin and Pierce, 1913.)

Pierce, C. H., and Larrison, G. K.

Discharge measurements for Wailuku, Honolulu, and Kawanui Rivers, near Hilo, 4 stations at Pihiouma, 87 stations at the 2,700-foot level in the forest west of Hilo on the Wailuku, Honolulu, and Kawanui rivers; Kawanui and Waipio rivers, and the Hamakua and Kohala ditches in the Kohala area. Miscellaneous measurements are included for Pohakunanaka, Pukihae, Maile, Kikola, Kumunuiakea, Kapue, Kaliulie, Alanai, Kalaoa, a tributary of Hanawa, Kapeha, Makea, Makoewai, Kapahuche, Hanawa, Onomea, Honoum, Waiauna, Pepeke, and Waimanu streams, and Liniol Springs near Ponolu. Rainfall figures also are included.

Pigott, C. S.

Thirteen samples of Hawaiian lavas, including six from Kilauea, the 1919 lava of Mauna Loa, the Puu Anahulu trachyite, and a lava from Mauna Kea, all show approximately the same radium content (average 0.96 x 10^{-12} gram per gram of sample). This is about the same as found for granites.

Powers, H. A. (See also Palmer and Powers, 1935; Wingate and Powers, 1931.)

A brief account of the eruption of 1927 and the two eruptions of 1929 in Halemaumau. Estimates of volume of extruded lava are given.

During heavy rains accumulation of a puddle of water about 20 feet in diameter and 1 foot deep, weighing about 4000 pounds, 30 feet south of the Halemaumau seismograph station, is believed to result in abnormal southerly tilt at that station, ranging from 0.3 to 3.0 seconds of arc.

Lava broke out in Halemaumau pit on November 19. An account of activity until November 23 is given.
A brief summary of the general characteristics of the eruptions in Halemaumau between May 1924 and December 1930, their dates, and changes brought about by them. Depth of the lava fill increased 200 feet, representing 463,000,000 cubic feet of lava.

Hualalai volcano opened its activity with floods of aa and pahoehoe from a rift zone aligned in a northwest-southeast direction, producing a mountain similar to Mauna Loa today. Gradually eruptions changed from quiet outpourings to more violently explosive ones which built large cinder cones. Then later, activity again changed back to the more quiet type, and accompanying this change activity largely shifted outward along the rift lines in both directions from the center. The last eruption was in 1801.

A brief popular discussion of the composition and properties of the basaltic magma typical of Hawaiian volcanoes, and of some of its congealed products.

Contains several previously unpublished analyses of lavas of Kilauea and Mauna Loa, and an average of 18 analyses of Kilauea lavas.

The general characteristics of the lavas of Kilauea and Mauna Loa are described. The deeply dissected volcanoes of the Hawaiian Islands consist of a foundation of olivine basalts like those of Kilauea, overlain more or less completely by flows of very variable composition, including trachyte and nepheline basalt. Basalt is the primary magma. The undifferentiated lavas contain no true phenocrysts of pyroxene, and the groundmass pyroxene is pigeonite. Differentiated lavas contain many pyroxene phenocrysts, which are characteristically diopside, and groundmass pyroxene is more commonly diopside than pigeonite. In the differentiated lavas there is a more or less continuous precipitation of diopside-hedenbergite pyroxenes, passing from diopside toward hedenbergite. Separation of the phenocrysts known to form in Hawaiian lavas cannot change the primitive basalts to differentiated types undersaturated in silica, hence fractional crystallization alone is inadequate to explain the differentiation.
Powers, H. A. (continued)


On April 1, 1946, at 2 a.m. Hawaiian time, earth movements near the Aleutian Islands, about 2300 miles north of Hawaii, set in motion long ocean waves which reached Honolulu 4.5 hours later and Hilo 5 hours later. Speed of the waves was about 460 miles per hour in the open ocean, slowing to 300 miles an hour in shallow water near the islands. Great damage was done, especially in Hilo. Seismic sea-waves reach Hawaii as often as once a year, but most are small. Seven have caused damage. Severe waves originating near South America reached Hawaii on November 7, 1837; August 13, 1868; and May 10, 1877. A severe wave of local origin struck the south coast of Hawaii Island on April 2, 1868. Strong waves reached Hawaii from Kamchatka on February 3, 1923; and from near Japan on March 2, 1933. A tidal-wave warning system, based on both seismographic records of submarine earthquakes and actual wave observation, is suggested.

1946a. Reanalyzing tilt records at the Hawaiian Volcano Observatory: Volcano Letter, no. 492, p. 1–6, April-June. A graph shows the average monthly tilting of the ground at the northeastern rim of Kilauea Caldera during the years 1940 to 1945 inclusive. Tilt from 1914 to 1940 is reanalyzed. A graph shows the average annual tilt computed as three-year overlapping means. This shows the tilt resulting from uplift and subsidence at Kilauea to have an azimuth of N 20° E. Average annual tilt is plotted on this coordinate, and one at right angles to it. The lowest point in southerly tilt appears to have been reached in 1939. Since then, to the end of 1945, there had been an accumulation of about 13 seconds of northerly tilt.

1946b. The Aleutian tsunami at Hilo, Hawaii, April 1, 1946: Seismol. Soc. Am. Bull., vol. 36, p. 355–356. The tsunami traveled to Hilo at an average speed of about 7.9 miles a minute. Three waves were observed at Hilo, the third being the largest. The highest level reached by the water was 55 feet at Pololu Valley; the lowest was 2 feet at Milolii. At Keokeo Point, east of Hilo, the height was 32 feet.


A general appraisal of Stearns and Macdonald (1946), dealing especially with the sections on Mauna Loa, Kilauea, and volcanology. Errors, largely typographic, are listed, and possible differences of interpretation are pointed out.

An analysis of seasonal variations of tilt of the ground surface at the northern rim of Kiluea Caldera, in an attempt to weigh the quantitative effect of factors other than volcanic.

Powers, H. A., Ripperton, J. C., and Goto, Y. B.

1932. Survey of the physical features that affect the agriculture of the Kona District of Hawaii: Hawaii Agricultural Experiment Station Bull. 66, 29 pp.

A description of the general geology, soils, and agriculture in part of the Kona district. The region is said to comprise the southwestern slope of Hualalai, the western slope of Mauna Loa, and between them the western slope of an older volcano nearly buried by the lavas of Hualalai and Mauna Loa. The cliff running inland at Napoopoo is described as a fault cliff mantled with later lavas.

Powers, Sidney


A summary of activity at Kiluea from January 1913 to November 1914, and a more detailed account of activity from December 1914 to March 1915. A brief account of the 1914 eruption of Mauna Loa.


A brief general account of the activity of Kiluea and Mauna Loa, and a description of the Hawaiian Volcano Observatory and its work.


An excellent brief semipopular account of the volcanic activity of Kiluea and Mauna Loa.


Several times there have been uplifts of the portions of the floor of Kiluea Caldera surrounding Halemaumau or of debris within the crater. In 1848 the crust was elevated by liquid lava beneath to form a dome 300 feet high and 2000 feet across. In July 1886, there was upheaved a steep cone of talus blocks over the place where the inner pit of Halemaumau had been. In 1894 and 1914 portions of the bank and floor of Halemaumau were tilted and lifted bodily upward.

The surface ash deposits of Kilauea are described, and separated into an older series, overlain by deposits of the 1790 explosive eruption. A layer of ash 17+ feet thick is described at the foot of the cliff at the southwest side of Uwekahuna Bluff, and a thinner layer overlying an unconformity at the northeast side of Uwekahuna Bluff. The older surface ash may be older than the caldera.

Intrusive bodies at Kilauea: Zeits. für Vulkanologie, Bd. 3, p. 28–33.

Concludes that the intrusive body in Uwekahuna Bluff, called a laccolith by Daly, is a filled lava tube.


Hawaiian volcanoes developed at regular intervals along two parallel major fracture systems, roughly in order from west to east. No connection exists between the lines of fracture now apparent and the major fracture lines. Kilauea is regarded as older than Mauna Loa. Puu Kapukapu is probably a small horst. The cliff north of Kealakekua is believed to be a fault scarp. The conception of the Mohokea Caldera is accepted, and Puu Enuhe, Makanao, and other hills are regarded as horsts within it.


Descriptions of the Thurston lava tube near Kilauea Caldera, and of the Kaumana tubes in the 1881 lava flow near Hilo. The “blow-piping” effects of gas on the roof of the tubes is described.


The general features of the geology of Hawaii are briefly outlined. The lava flow forming Laupahoehoe peninsula is said to have issued from fissures near the mouth of Laupahoehoe Valley. Two major and three minor flows are recognized in the lava of 1801 on Hualalai. Puu o Keokeo, on Mauna Loa, is not an independent volcanic center. Pillow lavas are absent, unless in a flow between Waipio and Waimanu valleys. Cinder cones along the southwest coast were formed by lava entering the sea. The trachyte of Puu Anahulu is a flow more than 100 feet thick. No trachyte was found in the Kohala Mountains. Origin of the trachyte by assimilation of limestone in basalt is improbable, owing to the lack of available limestone. The Uwekahuna intrusive at Kilauea is believed to be a filled lava tube. The life history of Hawaiian volcanoes is outlined.
Bibliography

Powers, W. E. (See Wentworth and Powers, 1941, 1943.)

Preston, E. D.
The density of the lower half of Mauna Kea is found to be 3.7, and that of the upper half 2.1, the mean density of the whole mountain being 2.9.

Includes observations on latitude, force of gravity, and terrestrial magnetism at stations along a traverse across the slopes of Mauna Kea from Kawaihæ to Hilo, and at Napoopoo.

Pukaua, Keoki
A brief popular description of certain features of the Mauna Loa lava flow of 1919.

Reeds, C. A.
Contains a very brief popular summary of the action of Kilauea.

Rees, ———
1841(?) A late visit to the volcano of Kilauea, in Hawaii, one of the Sandwich Islands: Littell’s Museum of Foreign Literature, vol. 43, p. 236-239; reprinted from United Service Journal.
A description of Kilauea Caldera in September 1839. Many small cones, up to 50 feet high, and small lava flows were active over the caldera floor. Several small lava lakes were present, and one large lake a mile long and three quarters of a mile wide, with precipitous walls 350 feet high. There is no mention of any black ledge. The description is similar to that of Captain Shepherd (1840) who was at the caldera at the same time.

Remy, Jules
Descriptions of Kilauea Caldera on June 22, and Mokuaweoweo on June 17, 1853. No activity is mentioned in Mokuaweoweo.
Richardson, D. S.
A popular description of the lava lake in Halemaumau, and Kilauea Caldera, during 1908. (Not seen.)

Richter, C. F. (See Gutenberg and Richter, 1941, 1945.)
Ripperton, J. C. (See Powers, Ripperton, and Goto, 1932.)
Rittman, A.
Contains a brief description of lava lake activity at Kilauea (p. 16-17), and other scattered references to Hawaiian volcanoes. The book is largely devoted to a general treatment of volcanism from the physico-chemical standpoint.

Rock, J. F.
A very brief description of an ascent of Mauna Loa from South Kona.

Rodgers, C. T.
1921. The Hawaiian Sisters, Mauna Loa and Mauna Kea: Mid-Pacific Mag., vol. 21, p. 571-574.

Russell, I. C.
Pages 29 to 36 contain a brief general description of Mauna Loa and Kilauea, and their activity.

Sapper, Karl
A list of the historic eruptions of Mauna Loa and Kilauea, with a brief description of each, and a comparison of the activity of the two volcanoes.

Contains many references to Mauna Loa and Kilauea. The historic eruptions of Hawaiian volcanoes are listed (p. 311), and the Mauna Loa eruptions of 1852, 1855, 1859, and 1868 are briefly described (p. 127-129); Penck's (1894) estimates of volumes of flows are quoted. Lava lake activity at Kilauea is described (p. 140-149), and the temperature measurements and gas collections at Kilauea and Mauna Loa are reviewed (p. 40-45, 56-57). The cyclical periodicity of Kilauea is discussed (p. 271-274).
A brief classification of volcanoes and volcanic phenomena, and a review of volcanic theory. Contains a few brief references to Mauna Loa and Kilauea (see especially p. 22–23).

Sawkins, J. G.  
Contains a general account of the physiography of Hawaii, and descriptions of Kilauea Caldera and Mokuaweoweo in 1851. The latter was inactive. The South Pit is termed “Pohakuhanalie.” Another pit crater south of the latter contained very hot lava, and it was believed that it may have been the seat of the eruption of 1851.

Sayles, R. W.  
A description and photographs of a remarkably accurate model of Kilauea Caldera in the Harvard University Museum in 1913, made by G. C. Curtis. Also a brief account of how it was made.

Schneider, Karl  
Contains brief descriptions of Mauna Kea, Mauna Loa, Kilauea, and Hualalai, and lists of the historic eruptions of the last three volcanoes.

Schulz, P. E.  
1941. Tilt recordings at the Hawaiian Volcano Observatory and their conversion to seconds of arc: Volcano Letter, no. 473, July-September.  
A discussion of the relationship of the undamped period of the Bosch-Omori seismograph to the conversion factor for stylus displacement to seconds of ground tilt, and the order of magnitude of error which results from tilting of the instrument itself.

The new locations of the seismographs and tilt meter, as a result of moving the observatory to a new building, are described.

The 1940 eruption of Mauna Loa started on April 7 and ended August 18. After the first few hours it was confined to Mokuaweoweo Caldera. Rapid outpouring on the first day formed a lava lake 50 feet deep over much of the caldera. Later the surface settled as much as 9 feet, producing slump scarps with pulled stalactites. The settling was only partly caused by contraction on cooling. Intrusion of new lava under the initial flow raised pressure ridges and broad pressure plateaus.

Science Service


Borings 10 feet deep and 1000 feet apart are to be made in the floor of Kilauea Caldera, for the purpose of ascertaining the relation of increase in temperature with depth, whether there is any difference between the temperatures in different holes at the same depth, and to see to what extent heat is produced by slow oxidation of the lava.

Scrope, G. Pouletete


Includes a general description of Kilauea and Mauna Loa and their calderas, and brief accounts of the Mauna Loa eruptions of 1843, 1855, and 1859, and the Kilauea eruption of 1840. Agrees with Dana's view of the lack of any subterranean connection between Mauna Loa and Kilauea. Contains some inaccuracies.

Sedgwick, T. F.


The occurrence of ground water in Kona is briefly discussed. It is believed possible that perched ground water may exist, and an exploratory tunnel or drill hole along Kiilae Stream is recommended.

Sheepshanks, John


A description, by the Bishop of Norwich, of Kilauea Caldera in 1859.
Shepard, F. P. (See Macdonald, Shepard, and Cox, 1947.)
Shepherd, E. S. (See also Day and Shepherd, 1913-1913c.)

Attempts to determine the temperature of the lava lake were made with two resistance thermometers. Both were unsuccessful, the thermometers being lost. A thermo-element lowered into the lava was also lost, but yielded one brief reading. This indicated a temperature of 1,000° C for the lava two feet below the surface.

Analyses of 10 gas samples collected in 1917, and one by Jaggar in 1919, show H₂O generally to be the most abundant, averaging 65.9 percent. CO₂ is next most abundant. The gases are completely oxidized. The presence of considerable nitrogen in most samples indicates admixture of air, carried down by sinking crusts, sucked down by fountaining, or diffused into the lava from the conduit walls.

Two tubes of gas collected by Jaggar from a hot crack in the 1919 flow are analyzed. The gases show a high degree of oxidation, consisting predominantly of steam, with abundant nitrogen, CO₂, and SO₃, a little SO₂, a very little CO, no sulfur, and no chlorine. The amount of nitrogen is insufficient to account for the water present as formed by reaction with air.

Analyses of 14 gas samples from Kilauea, collected by Jaggar in 1919, are given. The gases are almost completely oxidized. Water is the major constituent (about 70%), and is present in much too great amount to be accounted for by direct oxidation of hydrogen by air. The second most abundant is CO₂, with SO₂ the third most abundant. SO₃ and sulfur are variable. Some hydrogen and chlorine are present. The gases are distinctly inhomogeneous.

Volcanic gases are discussed in general, and methods of collecting and analysis described. Sources of error are pointed out. The writer believes that volatiles obtained from a systematically collected series of lavas, by heating in vacuum, will throw as much light on the nature of the crater reactions as gases collected at the crater during eruption.
1925a. Note on the chemical significance of engulfment at Kilauea: Washington Acad. Sci. Jour., vol. 15, p. 418-420. The lava lake at Kilauea has a temperature only 100° above the crystallizing temperature of the lava. The gases reaching the surface are almost completely oxidized. A source of some heat is seen in reaction between magmatic gases and oxygen carried down by sinking crusts. Another source of oxygen is suggested to be the ferric oxide in breccias precipitated into the volcanic conduit by collapse and engulfment such as followed the 1924 explosions, the ferric oxide reacting with and being partially dissolved by the ascending lava.

1927. The present status of the volcano gas problem: National Research Council, Bull. 61, p. 259-263. The investigations of gases from Kilauea and elsewhere are briefly discussed. The equation between ferrous oxide and water is not important in the generation of volcanic heat, as we are dealing with silicates, not oxides, where the sign of the heat change is opposite. Jaggar’s surface oxidation hypothesis is not accepted. Reaction between gases which are not in equilibrium is a possible source of heat, but appears unnecessary, as the rise of a few cubic meters of lava a second could supply the heat lost at Kilauea. The gas-heating and gas-fluxing hypotheses were invented to account for the lava lake on the assumption that it was an undrained, closed system. If the lake is a lava spring with not one but many submarine outlets, those hypotheses are less necessary.

1938. The gases in rocks and some related problems: Am. Jour. Sci., 5th ser., vol. 35-A, p. 311-351. Reviews methods of study and difficulties. Concludes that the distribution of volatiles in rocks is largely fortuitous; that due to contamination of gases on their way to the surface, neither the composition nor quantity of primitive magmatic volatiles can be deduced. How this contamination occurs is shown for Kilauea. Approximate figures for minimum volatile content of unaltered rocks show 80 percent or more water, nearly complete oxidation of the gases, and absence of notable amounts of hydrocarbons and rare gases. The suggestion that volcanic heat may arise partly from reaction of ferrous oxides with water, giving ferric oxides and hydrogen, is inconsequential; we are dealing rather with ferrous silicates, in which case the sign of the heat change is reversed. Contains several new chemical analyses of lavas of Kilauea and Mauna Loa.

Shepherd, John
Sherzer, W. H.


Five periods of explosive activity of Kilauea are recognized. The first (earliest) formed a bed exposed at the base of the northwest wall of the caldera (Uwekahuna ash). The last occurred during Lord Byron's visit (1825) when "red hot stones, cinders, and ash were also propelled to a great height." The fourth is the eruption of 1789–90. The second and third formed deposits which underlie unconformably the 1790 ash. The first began with ejection of dust and sand, followed by lapilli, some bombs, and blocks. The second started with a little fine ash, then quantities of pumice, and closed with ejection of many blocks. The deposits of the third eruption are mostly fine. It began with ejection of black sand, followed by fine dust. The explosions of 1790 appear to have come not from Halemaumau, but from nearer the center of the caldera.

Silliman, Benjamin


Specimens from Kilauea and Mauna Kea, collected by Goodrich, include: sulfur, siliceous sinter, trap, basalt, greenstone, obsidian, olivine, augite, scoria, spun volcanic glass (Pele's hair), lava stalactites, and "fragments resembling rocks" composed of quartz, glassy feldspar, augite, hornblende, mica, and olivine.


Specimens collected at Kilauea in July, 1829, by Goodrich, are described. A letter from Goodrich states that the caldera was much filled up since his last previous visit, in 1828.

Silvestri, O.


Specimens of lava from Kilauea, collected by P. Tacchini, are described. They are divided into three groups: very recent lavas collected in the central part of the caldera near a cone formed in 1883; modern lavas collected about the edge of the caldera; and ancient (prehistoric) lavas from the cliffs surrounding the caldera. The ancient lavas include basalts, basaltoids, and augitic andesites. The latter have a trachytic aspect, but grade into the basalts. Fourteen chemical analyses are given, one of them being of the lava erupted in 1883.
Sinclair, W. T. (See Doerr, 1932.)

Skottsberg, Carl
Contains a discussion of the theories of land bridges and continental drift, from the viewpoint of the geographic distribution of the plants of the two island groups.
A study of plant invasion on lava flows. (Not seen.)

Sleeper, J. H.
An account of the lava flow on March 18, 1859.

Slyke, L. L. van (See Van Slyke, L. L.)

Sosman, R. B.
Ferrous oxide is probably unstable, decomposing at temperatures of 500° to 600° to Fe₃O₄ and Fe. Similar relations may hold for silicate melts containing iron oxides. Oxygen released would rise toward the surface producing oxidation reactions at higher levels. Thus is furnished a possible source of oxygen beneath the floor of Kilauea Caldera.

Spencer, C. N.
At Hilea, not less than 618 earthquakes were felt between 2 a.m. on January 16, and 7 p.m. on January 18. At the latter time lava broke out on the Kahuku land, about 1 mile northeast of the crater of Halepooahanah and about 1 mile south of Umi's heiau. A flow reached the sea near Puhue at 11:40 a.m. January 19. A series of strong earthquakes occurred on January 24. The source area of the flow is described.

Spicer, H. C.
Gives temperatures of Kilauea lava, as observed by Jaggar (1200° C.), and by Day and Shepherd (1185° C.).
BIBLIOGRAPHY

Staley, Thomas


Contains a very brief description of the earthquakes and eruption of Mauna Loa in 1868. In regard to Kilauea it is stated that on March 27 the lava lake had overflowed its usual limits. Following the earthquakes, the lava level had sunk several hundred feet.

Stearns, H. T.


A brief popular account of the phreatic explosions of Kilauea in 1924.


The geologic history of the island of Hawaii is briefly stated. The first mountain to appear was an ancestral Mauna Loa, situated under the present southwest rift of Mauna Loa. The life of Kohala Volcano commenced at about the same time. Later eruptions commenced at the intersection of the Loa and Kohala (Kea) rifts, building Mauna Kea, the closing eruptions of which were explosive. Next came the formation of Hualalai and Kilauea, and finally the establishment of the present vent of Mauna Loa. Kilauea was formed at the intersection of the Kea rift with seaward slip faults on the flank of the ancestral Mauna Loa.


Molten lava disappeared from Halemaumau on February 21, 1924. A marked subsidence occurred on April 29. Strong seismic activity indicated a subsidence of the lava in the northeast rift. A small explosion occurred at Halemaumau during the night of May 10, and explosions continued with increasing violence to a maximum on May 18, then with decreasing violence until May 27. Ejecta hurled out by the explosions consisted entirely of old rock torn from the throat of Halemaumau. No magmatic material was included. The explosions were phreatic. The lava column subsided below ground water level, permitting ground water to enter the hot conduit. Steam accumulated under the plug of talus until explosive pressures were attained.
The oldest historic lava flow of Kilauea is that of 1823. It welled out of a crack 6 miles long, in the southwest rift zone, spreading out in a flow which in places is only a few inches thick. The absence of cinder or dribble cones indicates that lava fountains were not present. Lava balls along the walls of the crack were formed by accretion around clots of cooled lava which fell back into the vent. Two phreatic explosions occurred just after the eruption.

The rocks of the Kau District are separated into the Ninole basalt (Tertiary?), Pahala basalt (Pleistocene?), and Kamehame basalt (late Pleistocene? and Recent). During Tertiary (?) time the Mauna Loa ridge was built above sea level, then volcanism ceased, erosion cut deep canyons, and faulting began on the southeast side. During Pleistocene(?) time Kilauea Volcano was born at the intersection of those faults with the Kea rift, volcanism was renewed on the Loa ridge and the Mokuaweoweo vent originated, Kilauea reached maturity, and faulting occurred on its southern slope. During late Pleistocene(?) and Recent time, Mokuaweoweo passed from youth to maturity, and activity increased on the northeast (Puna) rift of Kilauea. In historic time Mauna Kea is dormant, Kilauea in old age, and Mokuaweoweo approaching old age with beginning of a caldera.

A brief description of the phreatic explosions.


A description of the Maui-type well at Olaa, and water levels in that well during 1936.

A description of the Maui-type well at Ookala, and water levels in the Maui-type well at Olaa during 1937.

Brief account of the opening stages of the 1935 eruption of Mauna Loa.


Water levels in the Maui-type wells at Olaa and Ookala, during 1938. There is listed the ground water draft for wells at the Kawai Sugar Co., Kohala Plantation Co., and Olaa Sugar Co. for the years 1920 and 1937; and the discharge of perched ground water from tunnels of the Hawaiian Agricultural Co., Hutchinson Sugar Plantation Co., Kohala Plantation Co., and Olaa Sugar Co., for the year 1937.


The general features of ground water occurrence in Hawaii are outlined. Maps show the status of geologic and ground-water surveys, the areas of irrigation on sugar-cane plantations, the areas underlain by different types of ground water, and the location of wells at which ground water is being pumped. The ground water draft from wells during the years 1920 and 1937, and from tunnels during 1937, is shown in tables.


Waipio, Waimanu, Honokane, and Pololu valleys are 4 great amphitheater-headed valleys 3000 feet deep. Their slopes are in basalts of Kilauean type. The rest of the mountain is mantled with massive andesites. A trachyandesite flow several hundred feet thick partly fills Pololu Valley, and tunnels reveal smaller canyons under the andesites elsewhere. Canyons more than 4000 feet deep were cut between the basaltic and andesitic eruptions. A high caldera rim probably protected the NE. slope from the andesite flows which mantled the rest of the mountain.


Water levels in the Maui-type wells at Olaa and Ookala, during 1939.
Stearns, H. T. (continued)


The general features of ground water occurrence are briefly reviewed. Six types of structures perch water above the basal water table: (1) sills, (2) ash or tuff beds, (3) soil, (4) alluvium, (5) ice, (6) dense flow rock.


Hawaiian volcanism exhibits (1) a youthful phase, with rapid outpouring of highly fluid olivine basalts; (2) a mature phase, with formation of summit caldera; (3) an old age phase, during which the caldera is partly or wholly filled, and differentiation yields andesites and trachytes; and (4) a rejuvenated phase, with the extrusion of basalts and ultrabasic lavas following a long cycle of erosion.


Water levels for the Maui-type wells at Olaa and Ookala, and ground water draft at wells of the Kawaiiki Sugar Co., Kohala Sugar Co., and Olaa Sugar Co., during 1940. The chloride content given for the water of the Ookala well is wrong, and is corrected to read 12.5 to 16.6 parts per million in Stearns, H. T. (1942).


Three bench levels are recognized, one being formed by the present sea, one when the sea stood about 5 feet higher, and one when the sea stood 25 feet higher. The present bench is described. Specific references are to Guam, Midway, and Oahu, but the principles refer equally to Hawaii, where the benches are developed along the Kohala, Hamakua, and Hilo coasts.


Water levels for the Maui-type wells at Olaa and Ookala, and ground water draft from the wells of the Kawaiiki Sugar Co., Kohala Sugar Co., and Olaa Sugar Co., for 1941. Chloride content of the water of the Ookala well is given.


A general discussion of the occurrence of ground water in volcanic rocks. The hydrology of volcanic islands is treated with special reference to the Hawaiian Islands. Basal water, perch water, water confined in dike complexes, and water under artesian pressure are discussed briefly. The general features of surface water in volcanic terranes also are summarized.
Water levels in the Maui-type wells at Olaa and Ookala, and ground-water draft from the wells of the Kaiwiki Sugar Co., Kohala Sugar Co., and Olaa Sugar Co., during 1942.

Of the four stages of glaciation on Mauna Kea described by Wentworth and Powers (1941), the deposits of only the last (Makana) stage are definitely glacial. Those of the first two stages are paroxysmal explosion debris. Those of the third stage are fanglomerate, possibly laid down in early Wisconsin time by floods resulting from hot lava melting the ice cap.

A brief outline of the Cenozoic history of the Pacific basin, applying to the island of Hawaii as well as all other Pacific islands. During the later half of the Tertiary period intense volcanism built thousands of basaltic volcanoes, at some of which there later appeared differentiated rocks such as andesite and trachyte. This load on the crust caused general subsidence probably of several thousand feet. In early Pleistocene the islands emerged about 1000 feet. After this, several smaller submergences and emergences occurred, accompanying glaciation and deglaciation. In later Quaternary time renewed volcanism occurred, but on a scale much smaller than that of the earlier volcanism.

Water levels in the Maui-type wells at Olaa and Ookala, and ground-water draft from the wells of the Kaiwiki Sugar Co., Kohala Sugar Co., and Olaa Sugar Co., during 1943.

A brief review, designed principally for the lay reader, of the geology of the entire island group. Contains on pages 25–47 a brief summary of part of the material in Stearns and Macdonald (1946).

Stearns, H. T., and Clark, W. O.

A detailed description of the geology and ground-water resources of the western part of Kiluea and the southern part of Mauna Loa, with colored geologic maps. An account of the products and processes of Hawaiian volcanism, including types of lava flows, types of ejecta, phreatic and magmatic explosions. A description of the historic eruptions within the Kau district; and of the struc-
natural features, including fault cliffs, calderas, and pit craters. The stratigraphy is divided into: Ninole formation, separated by profound erosional unconformity from the overlying Pahala formation. The latter has a thick persistent ash member at the top, which separates it from the overlying Kamehame formation, including the historic lavas. A description of ground water perched by ash beds, and tunnels to recover it.

Stearns, H. T., and Macdonald, G. A. 1946. Geology and ground-water resources of the island of Hawaii: Hawaii Div. of Hydrography, Bull. 9, 363 pp. Hawaii was built by five major volcanoes. The geology of each is described, and the activity of the active volcanoes Mauna Loa and Kilauea is discussed. Kohala, the oldest of the five volcanoes, is built largely of basaltic flows of the Pololu volcanic series, overlain by andesites and trachytes of the Hawi volcanic series, Mauna Kea consists largely of the Hamakua volcanic series, mostly basaltic but with andesites in its upper part. The later Laupahoehoe volcanic series contains both basalts and andesites, some flows being of very late Pleistocene or Recent age. A glacier occupied the summit of Mauna Kea during the Pleistocene epoch. Most of Hualalal Volcano is built of basaltic rocks of the Hualalai volcanic series, but the Waawan volcanics on its northern flank are trachyte. Hualalai erupted last in 1801. Mauna Loa and Kilauea are entirely basaltic. The Ninole volcanic series on Mauna Loa underwent deep erosion before eruption of the Kahuku volcanic series. The latter, and the equivalent Hilina volcanic series on Kilauea, and Hamakua volcanic series on Mauna Kea are capped by the Pahala ash. The post-Pahala lavas on Mauna Loa and Kilauea are named respectively the Kau and Puna volcanic series. Their eruption has continued through Recent time. All of the major volcanoes are broad shield volcanoes (lava domes). The eruptions were fed through innumerable fissures, concentrated in radial rift zones, in which lava has congealed to form dikes. The lower flanks of Kilauea and Mauna Loa are sliding seaward on normal faults. Kilauea and Mauna Loa are independent volcanoes. Kilauea originated on the southern slope of Mauna Loa, where faults intersect the easternmost of the two fundamental fissures along which the volcanoes are built.

The geologic history of the island is discussed; and the geology and hydrology are shown on a colored geologic map. The petrography of the island is summarized. The stratigraphy of the island is summarized in the following table:

The occurrence of ground water in the several volcanoes is described. Basal water lies near sea level in all the mountains, but along the leeward coasts it is brackish. Relatively small amounts of water are perched at high levels on ash and soil beds in the Kau area, along the eastern slopes of Mauna Loa and Mauna Kea, and in Kohala Mountain. Water is confined between dikes in Kohala Mountain, and probably also in the other volcanoes. Existing wells, tunnels and springs are described and their location is shown on the geologic map. The total available amount of ground water is estimated, and compared with that now produced.
Stratigraphic rock units in the island of Hawaii (Stearns and Macdonald, 1946)
(The volcanic rocks of Mauna Loa, Mauna Kea, and Hualalai, those of Mauna Kea and Kohala, and those of Mauna Loa and Kilauea interringer)

<table>
<thead>
<tr>
<th>Age</th>
<th>Hualalai</th>
<th>Kohala Mountain</th>
<th>Mauna Loa</th>
<th>Kilauea</th>
<th>Mauna Kea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Historic</td>
<td>Historic member of Hualalai volcanic series (volcanics of 1801)</td>
<td>Unconsolidated alluvium, dunes and landslides</td>
<td>Historic member of Kau volcanic series (volcanics of 1892-1942)</td>
<td>Historic rocks of Puna volcanic series (volcanics of 1790-1934)</td>
<td>Ribbons of gravel and small alluvial fans</td>
</tr>
<tr>
<td>Recently</td>
<td>Exposed part of prehistoric member of the Hualalai volcanic series</td>
<td>Fluvial conglomerates</td>
<td>Prehistoric member of Kau volcanic series</td>
<td>Prehistoric member of Puna volcanic series</td>
<td>Upper member of Laupahoehoe volcanic series</td>
</tr>
<tr>
<td>Late Pleistocene</td>
<td>Pahala ash (exposed on Waawaa volcanics only)</td>
<td>Pahala ash (not differentiated)</td>
<td>Pahala ash</td>
<td>Pahala ash</td>
<td>Glacial debris and fluvial conglomerates</td>
</tr>
<tr>
<td>Early and middle Pleistocene</td>
<td>Waawaa volcanics and lower unexposed part of Hualalalai volcanic series</td>
<td>Fluvial conglomerates</td>
<td>Kahuku volcanic series</td>
<td>Hilina volcanic series</td>
<td>Lower member of Laupahoehoe volcanic series</td>
</tr>
<tr>
<td>Pliocene</td>
<td>Great erosional unconformity</td>
<td>Pololu volcanic series</td>
<td>Ninole volcanic series</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Stearns, Norah D.
Although dealing specifically with Oahu, contains many references of general applicability to all the Hawaiian Islands.

Stevens, J. L., and Oleson, W. B.
Contains brief descriptions of the flows of 1855, 1859, and 1880, from Mauna Loa, quoted from other sources; a description of Kauauma Cave, a lava tube in the 1880 lava near Hilo; and an undated description and photographs of Kilauea Caldera.

Stewart, C. S.
A description of Kilauea Caldera in June, 1825, during a visit with Lord Byron.

A description of Kilauea Caldera in July, 1825. (Not seen.)

Contains a description of Kilauea Caldera during July, 1825. The volcano was visited in company with Lord George Byron, of H.M.S. Blonde. The cliff at Byron’s Ledge was about 400 feet high, above the “black ledge.” Measurements made by Lt. Malden, of the “Blonde,” are quoted.

1828a. Private journal of a voyage to the Pacific Ocean, and residence at the Sandwich Islands, in the years 1822, 1823, 1824, and 1825, p. 372–389, New York.
The text is identical to that of the author’s “Residence in the Sandwich Islands” (London, 1828). Contains a description of Kilauea Caldera in July, 1825.

A description of Kilauea Caldera in October, 1829. The “black ledge” was 900 feet below the rim. The inner pit had been filled in at least 200 feet since 1825. Small cones were active within the inner pit.

Contains a description of Kilauea Caldera during October, 1829. The height of the cliff above the “black ledge” on the western side is given as 900 feet. The pit below the “black ledge” had filled about 200 feet since 1825, and its floor was about 200 feet below the ledge.
Stewart, G. W.  

Stewart, J. E. (See also Bailey and Stewart, 1923.)  

Stone, E. K.  

Stone, J. B.  
1926. The Keaiwa flow of 1823, Hawaii: Am. Jour. Sci., 5th ser., vol. 11, p. 434-440. The lava flow of 1823 from Kilauea issued from a fissure, known as the Great Crack, in the southwest rift zone. It was a very thin, very fluid pahoehoe flow, which issued continuously from the lower portion of the fissure over a length of 6 miles, with only a little weak fountaining. Ball lava along the fissure resulted from talus fragments in the fissure being wrapped in a chilled skin of the ascending lava. Small phreatic explosions occurred near the sea.  
1926a. The products and structure of Kilauea: B. P. Bishop Mus., Bull. 33, 59 pp., 2 pl., 7 fig. Contains a detailed description of the lava flows and ash deposits in the vicinity of Kilauea Caldera, and of the fault scarps along the south coast, and a discussion of the origin of the rifts, the caldera, and the pit craters. Kilauea Caldera is compared with Mull and Glencoe, in Scotland. The Pahala ash is concluded to have originated from Kilauea. Kilauea is believed to have originated at the head of a southwesterly-trending graben on the southeast slope of Mauna Loa, and thus to be younger than Mauna Loa. Kilauea Caldera originated by gradual collapse, possibly within the last few hundred years. Daly’s (1911) theory of the laccolithic origin of Kilauea is rejected. The Kilauea dome is independent of that of Mauna Loa, and built of lavas from the Kilauea vent. Late lavas of the two volcanoes interfinger.
Strzelecki, P. E. (count de) (See also Cheever, 1851.)


Account of a visit to Kilauea Caldera during the summer of 1838. Contains the first printed use of the name Halemaumau. The floor of the Caldera was 900 feet below the rim. Six lava lakes were active, one of which was Halemaumau. The latter was surrounded by a rampart rising 150 feet above the general level of the caldera floor.


Contains a description of Kilauea Caldera in the summer of 1838, differing somewhat from his note in the Hawaiian Spectator (1838).


A description of Kilauea Caldera in 1838.

Stubbs, W. C.


Contains a very brief summary of the geology, climate, and soils of the island group as a whole.

Suess, Eduard


Vol. 1, p. 230-231, contains brief remarks on characteristics of eruptions of Mauna Loa. The force of eruption is believed attributable to water vapor. Vol. 3, pt. 3, p. 1056-1060, contains a brief description of the Hawaiian Islands. Dana’s ideas of two parallel rows of volcanoes, and progressive extinction from northwest to southeast, are accepted, as also is Dana’s and Lindgren’s belief in the fault origin of the north coast of East Molokai. Vol. 4, pt. 4, p. 1471: the source of heat in volcanism is believed to be the rise of hot juvenile gases from very great depths in the earth. The great depth from which they come explains the difference in level of the lava columns of Kilauea and Mauna Loa, since the difference in height is insignificant in comparison to the great depth of origin. A certain amount of independence of the two conduits is proven, however. On p. 1552-1566, Hawaiian volcanoes are compared to lunar craters.
BIBLIOGRAPHY

Swartz, J. H.
A discussion of the results of electrical resistivity methods in locating the boundary between fresh and salt water in the Ghyben-Herzberg lens. The paper refers specifically to parts of the island of Maui, but the general principals are applicable also to Hawaii.

Tallman, C. F.
A very brief general account of Kilauea.

Territorial Planning Board
1939. Summary of records of surface water resources of the Territory of Hawaii, 1901-1938, p. 351-411, Honolulu. Stream and ditch flow records are summarized in tables through 1938. All records but two on the island of Hawaii are in the Hilo or Kohala areas. The other two are near Waiohinu.

Thom, Emma M.
Contains references to several papers on geology and water resources of the Hawaiian Islands.
Contains references to many papers on geology and water resources of the Hawaiian Islands.

Thompson, A. R. (See Kelley, McGeorge, and Thompson, 1915.)
Thompson, C. W., and Murray, John
Contains a description of Kilauea Caldera in August, 1875. A cloud over Mokuaweoweo was reported to be illuminated by molten lava beneath.

Thrum, T. G. (See also Jaggar, 1934c.)
Contains descriptions of the lava subsidence at Halemaumau, on March 6 and 7, 1886, and of the condition of Halemaumau on March 24 and 25. Halemaumau lava lake and the New Lake had been unusually full, but accompanying a series of earthquakes on the night of March 6 the lake disappeared, leaving empty pits about 570 feet deep at Halemaumau and 135 feet deep at New Lake.
1903. Kilauea resumes volcanic activity: Hawaiian Annual for 1903, p. 68–72. After a period of inactivity, Kilauea resumed eruption on August 25, 1902. In November it was more active than for 20 years previous.


1904. Table showing quantity of water developed for cane irrigation, T. H., and expenditure for same, so far as obtained from the various plantations to November 25, 1904: Hawaiian Annual for 1905, p. 164. The yield of tunnels owned by the Kohala Sugar Co., constructed in 1903, is reported as 7 million gallons daily.


1907. Table of volcanic eruptions, island of Hawaii, 1790 to 1907: Hawaiian Annual for 1908, p. 136–137. A list of historic eruptions, with date of outbreak, period of activity, approximate height of main vent, and general character and location of activity.

Thurston, Lorrin A.


1915. On the “bottomless pit” of Hualalai: Hawaiian Annual for 1916, p. 139. Reports the “bottomless pit” to be 194 feet deep.

It is suggested that in the case of lava flows descending relatively gentle slopes, high explosive be dropped through windows in the feeding tube near the flow source, shattering the tube, forcing the lava to spread out again near the source, and removing the supply of lava from the lower end of the flow.

Contains a brief description of Kilaea in 1879, a description of the lava subsidence at Halemaumau in 1894, a description of the explosive eruptions of Kilaea in 1924, an account of a visit to Mokuaweoweo in 1890, a suggestion as to the use of high explosive to divert lava flows, and an account of the bombing of the 1935 lava flow of Mauna Loa.

Thurston, Lucy G.
1882. Life and times of Lucy G. Thurston, p. 82, Ann Arbor, Mich. Third ed., p. 82, Honolulu, 1934.
Contains brief remarks on the eruption of Huulalai (in 1800-1801), based on memories of aged native inhabitants of Kona.

Thurston, Lucy G., Jr.
1842. The missionary’s daughter, p. 113–116, New York.
A description of Kilaea Caldera in August 1839. The depression is stated to have been about 1,500 feet deep. A lava lake near the center of the caldera floor was about a third of a mile in diameter. The great lake in the southwestern part of the caldera was very active. Pages 212-219 contain an account of the 1840 eruption of Kilaea, by Titus Coan.

Thwing, E. W.
Contains a description of Halemaumau in January, 1907.

Tilley, C. E.
1922. Density, refractivity, and composition relations of some natural glasses: Mineralogical Mag., vol. 19, p. 279. Gives indices of basaltic glass from Halemaumau (1.605), and Mauna Iki (1.603), Kilauea.

Turnbull, John
Contains the following ambiguous statement which has been interpreted by some to indicate that Mauna Loa was active, but which is as likely to refer to a fume column from Kilauea Caldera. “In the evening of the 21st of January, 1803, we weighed [at Kealakekua Bay] and stood away along the shore to the eastward. In this course we had a very full view of some eruptions from the volcanoes in the center of the island of Owhyhee.”
Turner, W. S.
1858. The volcanoes of Hawaii: National Mag., p. 120-127, February.
Descriptions of the 1855 lava flow of Mauna Loa, near Hilo, and of Kilauea Caldera, in June 1857. It is stated that a few ferns were growing on the lava of 1855. The black ledge was said to be 800 or 900 feet below the rim. Halemaumau lake was 15 rods wide and 20 long, about 40 feet below its rim. The action of the lake is described.

Tyrrell, G. W.
Contains (p. 102-124) a brief general account of the activity of Kilauea and Mauna Loa, and a review of the problems of the structure of the Kilauean vent and the supply of lava and heat to the lava lake.

United States Geological Survey
Topographic maps.
Topographic maps have been published for the whole island of Hawaii, by quadrangles, on a scale of 1:62,500. A single map of the entire island has been published (1943) by the Division of Hydrography, Territory of Hawaii, in cooperation with the Geological Survey.

Water Supply Papers.

Vancouver, George (Captain)
Fume rising from Kilauea on January 11, 1794, indicates that the volcano was then active. Vancouver writes: "As we passed the district of Opoona, on the morning of the 11th... we had a most excellent view of Mowna Roa's snowy summit, and the range of hills that extend towards the east end of Owhyhee (Hawaii). From the tops of these, about the middle of the descending ridge, several columns of smoke were seen to ascend, which Tamaahmaah (Kamehameha), and the rest of his friends said, were occasioned by the violent subterranean fires that frequently broke out in violent eruptions."

Van Doorninck, N. H.
1933. Het vulcanisme van de Hawaii-Eilanden: Geologie & Mijnbouw, 12 Jaarg., Nr. 6, p. 283–284, September 1; Nr. 8, p. 285, November 1. (Not seen.)

Van Slyke, L. L.
A description of changes in Kilauea Caldera in the period following the description by J. S. Emerson (1887) in April. Where there had formerly been a deep conical central pit in Halemaumau, the bottom had become bodily elevated to form a large cone-like heap of loose lava blocks. Molten lava was visible in small wells and a small lake within Halemaumau pit.

Vening Meinesz, F. A.
The author assumes the islands to have an average density 10 to 15 percent greater than the surrounding rocks, and that they are regionally compensated, the depth of compensation being 30 km. Using a density of 3.07 for the island mass, the average anomaly is a minimum when the radius of the region of compensation is 174.3 km; using a density of 2.937, it is a minimum when the radius is 232.4 km. On these assumptions the average anomaly without regard to sign for the five areas considered are respectively 15 and 11 milligals. For local compensation and 30 km depth of compensation, in contrast, they are respectively 88 and 81 milligals. If the assumption is made that the island of Hawaii, for example, is essentially uncompensated, it should be sinking at a rate calculated as about one meter per century, but there is no evidence of such subsidence. The troughs northeast and southwest of the Hawaiian Islands are explained by down bending during regional isostatic sinking.

Verhoogen, Jean (See Birch and Dane, 1942.)

Volcano House register
Throughout the period of its existence, since 1865, contains many notations and accounts by guests of activity at Kilauea. Many of these have been quoted by Brigham, Dana, and Hitchcock. See Hitchcock (1909), p. 205.

Volcano Letter
Nos. 1-494, Jan. 1, 1925 to October-December 1946. Published weekly, Jan. 1, 1925-May 26, 1932; monthly, June 1932-July 1938; quarterly, August 1938-present. Contains summaries of volcanic and seismic activity at Kilauea and accounts of eruptions of Kilauea and Mauna Loa from January, 1925, to December 1946, as well as special articles on various volcanic phenomena. Publication is continuing.
von Wolff, F.

Contains general descriptions of the shield volcanoes of Kilauea and Mauna Loa, a brief discussion of the origin of their calderas, a list of the historic eruptions of Mauna Loa until 1887, a brief description of the eruptive history of Kilauea, and a description of the Hawaiian type of volcanic activity exhibited by Kilauea and Mauna Loa.

1929. Der Vulkanismus, Bd. 2, Spez. Teil, Teil 1, 2te Hälfte, p. 728–760.
Contains a general description of the Hawaiian Islands and of the volcanoes of the island of Hawaii, with a summary of the geology of the latter, and collections of the chemical analyses of lavas expressed in molecular proportions and classified according to the system of Osann. Pages 748 to 760 contain summaries of the historic activity of Mauna Loa and Kilauea and of volcanological investigations at Kilauea, including temperature measurements and gas analyses.

Waeschke, H. H.

1937. Crack measurement and tilt at the Hawaiian Volcano Observatory: Volcano Letter, no. 446, April.
A brief popular account of rim cracking and avalanches at Halemaumau, and of tilting of the ground surface in relation to Kilauea and Mauna Loa.

1937a. Triangulation and level changes at Kilauea: Volcano Letter, no. 452, October.
A brief popular account of vertical and horizontal movements of the ground at Kilauea, caused by magmatic movements beneath the surface, as detected by precise surveying methods.

A very brief account of the effects of the 1935 eruption at the summit of Mauna Loa. A map of the flow within the caldera, by F. M. Bullard and P. H. Baldwin, is given on page 1.

A discussion of ground tilting at the north rim of Kilauea Caldera, and its relation to magma movements under Mauna Loa and Kilauea. Several graphs illustrating tilt are reproduced. Tilt normally describes an annual loop of 5 to 20 seconds of rotational arc, the loop elongated NNE-SSW. On this are superimposed variations due to changes in magmatic pressure.
Tilt at the northeast rim of Kilauea Caldera, considered as the path of the top of a vertical rod, describes an annual loop of 5 to 20 seconds of rotational arc with the loop elongated in a NNE-SSW direction. Northeast tilt occurs in colder weather, and southwest tilt in warmer weather. There is also direct relationship between lava movement and amount and direction of tilt.

1940b. Mauna Loa summit crater eruption 1940: Volcano Letter, no. 468, April-June.
An account of the 1940 eruption of Mauna Loa, from its beginning on April 7, through the month of June. (The eruption ended in August.) This was the longest summit activity since 1873-74. The eruptive history of Mauna Loa from 1899 to 1940 is summarized. Seismic events from 1935 to 1940 are briefly reviewed.

Ground tilt, measured daily for 27 years on the Bosch-Omori seismograph at the Volcano Observatory, has been plotted graphically. Tilting movement, considered as the path of the top of a vertical rod, describes an annual loop of 5 to 20 seconds of clockwise rotational arc with the loop elongated north-northeast and south-southwest. Tilt is generally northeasterly during the summer and fall, and southwesterly during the winter and spring. Besides seasonal relationships, tilt is directly related to lava movements. Local loading appears to have no effect. As indicating the presence or absence of accumulating volcanic pressures, tilt is an important aid in prediction of volcanic activity.

Walker, R.
1912. A visit to the volcano twenty-four years ago: Paradise of the Pacific, vol. 25, no. 8, p. 19-22, August.
A brief popular description of Kilauea Caldera in 1888. A copy of a painting by Hitchcock, labeled "Kilauea in action," is actually of the 1899 eruption of Mauna Loa.

Washington, H. S.

A compilation, including many chemical analyses of rocks from the island of Hawaii, most of them from Kilauea.

The constancy of position of Halemaumau, and of the "Old Faithful" fountain during periods of lava lake activity, are pointed out (p. 269-270). A similar conclusion of the permanency of position of the principal vents is reached for Stromboli.


Contains a brief general statement of the number and quality of chemical analyses of Hawaiian lavas.


A brief general discussion of volcanoes, containing remarks regarding the influence of investigations at Kilauea on the volcanic gas problem.


The Kohala Mountains are the ruins of the oldest volcano on Hawaii. The lavas are mostly andesine basalt or oligoclase andesite. The lavas of Mauna Kea are mostly similar to those of Kohala. They do not support Daly's suggestion of gravitative control. A recent lava at sea level has a composition almost identical with one collected from the summit.


The lavas of the Hawaiian Islands are dominantly basaltic, and to a less extent andesitic, with sporadic trachytic rocks. There appears to be a variation of chemical composition with time, earlier flows being more saline and alkaline, later flows more femic and calcic. It is suggested that beneath the recent flows of basalt at Mauna Loa and Kilauea are cores of more alkaline lavas, possibly trachytic or phonolitic, representing the earliest phase of volcanicity.

1921d. The lavas of the Hawaiian volcanoes: Hawaiian Annual for 1922, p. 39-49.

A popular discussion of Hawaiian lavas, and their relations to lavas in other parts of the world.


The lavas of Kohala include oligoclase andesites, olivine-oligoclase andesites, feldspar phryic basalts, and aphyric basalts. Those of Mauna Kea include andesine andesites, andesine basalts, aphyric labradorite basalts, feldspar phryic basalts, chrysophyric basalts, and picrite-basalts. There are presented 9 new chemical analyses of Kohala lavas, and 10 of Mauna Kea lavas.
The lavas of Hualalai are generally olivine basalts, although that of Puu Waawaa and Puu Anahulu is trachyte. New chemical analyses are presented of 3 olivine basalts, one aphyric basalt, one feldspar phric basalt, one gabbro, and the Puu Anahulu trachyte. The recent lavas of Mauna Loa include aphyric andesine basalt, chrysophyric oligoclase basalt, and picroite-basalt. The ancient lavas include aphyric labradorite basalt, ophitic olivine basalt, feldspar phric basalt, and picroite-basalt. The recognition by Clark and Noble of older (Pahala and pre-Pahala) rocks on Mauna Loa is quoted. There are presented 6 new chemical analyses of recent Mauna Loa lavas by the author, and 4 analyses of ancient lavas by R. K. Bailey, of the United States Geological Survey.

Eight new chemical analyses of Kilauean lavas are given, and the rocks described. The ancient lavas of Kilauea include olivine-free basalt, olivine basalt, and picroite-basalt. The recent lavas are olivine-free basalt and rare picroite-basalt, olivine basalts being very rare. The general character of the lavas of Hawaii is summarized.

It is shown that the difference in state of oxidation of the iron, and other chemical differences between an and pahoehe, are insignificant. Pahoehe is believed to be generally less crystalline, and to be poorer in gas than aa. Aa is thought to remain more fluid than pahoehe, losing its gas more slowly, both temperature and gas content being partially maintained by crystallization. Aa cools more slowly than pahoehe, and therefore crystallizes more completely.

New values are given for the specific gravity of the andesite at Lampahoehe and an olivine basalt from Kaula Gulch. The average specific gravity of the samples of Mauna Kea lavas is 2.969. This is much higher than the value used by E. D. Preston (1894).

Contains a very brief summary of activity at Mauna Loa and Kilauea during 1926 and 1927.
Washington, H. S., and Merwin, H. E.
Salts collected on the walls of a hot crack in the lava flow of 1920, near Mauna Iki, include aphthitalite, and at cooler places, thenardite. The aphthitalite is a non-hydrated sulfate of potassium and sodium, and contains a little (0.05%) of CaSO₄ and 0.94 percent CuSO₄. Optical properties are: α and β = 1.487. γ = 1.492. The alkalies and copper probably were volatilized as sulfides, and oxidized to sulfates on contact with air.

Contains a chemical analysis and determinations of the optical properties of augite crystals similar to those which occur in many picrite-basalts of Mauna Kea.

Watkins, C. S.
Several years previous to 1854, on repeated occasions vessels reported violent agitation of the water during calm weather, suggested as due to submarine eruptions, about 500 miles south-east of Hawaii.

Weld, F. A.
A brief description of the 1855 lava flow of Mauna Loa, on November 16, 1855, and of Kilauea Caldera on November 14.

Wells, R. C.
Contains chemical analyses of 4 lavas from the Kau District, collected by W. O. Clark; 8 lavas of Kilauea and Mauna Loa, collected by H. A. Powers; and 7 specimens of tuff collected by C. K. Wentworth. All have been published elsewhere.

Contains determinations of the nickel content of 9 Hawaiian basaltic lavas, 5 of them from Kilauea, 3 from Mauna Loa, and one from Kauai.

Wentworth, C. K. (See also Gregory and Wentworth, 1937.)
A brief outline of the origin and evolution of the major physiographic features of Hawaii. (Not seen.)
A general discussion of erosion in the Hawaiian Islands.

The relative efficacy of fluvial and marine erosion is considered for the Hawaiian Islands in general. Marine erosion may exceed fluvial erosion only on a very young land mass, such as parts of Hawaii, or on an island less than 10 miles in diameter. The first appearance of Hawaiian volcanoes above sea-level is believed to have been no earlier than late Tertiary.

The amphitheater-headed valleys and great cliffs of parts of the Hawaiian Islands are believed to be the product of normal erosion. Principal factors affecting the erosional process are: high porosity of the rocks and their susceptibility to chemical weathering, high mean temperature, rarity of great changes in temperature, absence of frost, and local high rainfall. Chemical weathering at elevations near the low water table dominates the development of the deeper valleys and is a controlling feature in determining their configuration.

The best sugar lands of the island of Hawaii are underlain by deposits of volcanic ash and tuff.

Numerous explosive eruptions have occurred on the island of Hawaii, yielding products ranging from huge bombs and blocks to impalpable ash, from thin widely distributed layers of ash to steep cinder cones, and from fresh basic glass to much-altered ash-derived soil.

Contains brief references to the extent of glaciation on Mauna Kea, and states that there were probably several periods of glaciation.

The island is divided into 30 geomorphic divisions, each of which is briefly described. The five major volcanic structures also are briefly described, and their length, width, area, and summit altitude given. The sequence of development of the volcanoes is summarized.
Wentworth, C. K. (continued)

The major physiographic features of Hawaii are discussed. The general features of pyroclastic rocks are outlined. The distribution, structure, and petrography of pyroclastic formations on Hawaii are discussed at length, and the pyroclastic history and origin of the various formations are stated. Late pyroclastics of Mauna Kea are termed the Waiau formation, and surficial ash deposits at and near Kilauea Caldera are termed the Keanakakoi formation. The nature and origin of palagonite are discussed. The shapes of typical bombs are shown to result not from rotation, but largely from fluid drag during flight. The Pahala and Waiau formations are believed to be largely contemporaneous, and to have originated from the cones on the upper flanks of Mauna Kea.

Includes much physical data, such as land areas, lengths of shoreline, indices of irregularity, heights of sea cliffs, altitudes of principal summits and saddles, and a map showing the geomorphic provinces of the principal Hawaiian Islands. The general geology is very briefly discussed, as also are the subjects of building stone; lime, cement, and clay; and materials for concrete.

Refers specifically to Honolulu, but the generalities of the Ghyben-Herzberg relationship apply equally to Hawaii.

Wentworth, C. K., and Palmer, H. S.

A marine bench 4 to 12 feet above sea-level is recognized on a large number of islands in the North Pacific. On Hawaii it is seen along the coast north of Hilo. It is believed to represent a downward shift of sea-level of 12 to 15 feet.

Wentworth, C. K., and Ladd, H. S.

Contains no specific mention of the island of Hawaii, but many generalities which apply to Hawaii as well as to other of the Hawaiian Islands.
BIBLIOGRAPHY

Wentworth, C. K., and Williams, Howel

Propose the term “reticulite” for the very attenuate pumiceous material with equant cells, called by J. D. Dana “thread-lace scoria.”

Wentworth, C. K., and Powers, W. E.

The upper part of Mauna Kea was glaciated four times, presumably contemporaneously with the Pleistocene glacial advances elsewhere. The four stages on Mauna Kea are named, youngest to oldest, the Makanaka, Waihu, Pohakuloa, and pre-Pohakuloa stages. The three earlier ones lie under succeeding series of later lava flows. Terminal moraines, ground moraine, and outwash gravels are recognized. A few small lava flows occurred since the last glaciation.

Springs on the upper slopes of Mauna Kea are fed by bodies of ground water perched on or in beds of glacial drift. The largest occur in the Waihu branch of Pohakuloa Gulch, the total discharge of the springs in Waihu Gulch probably exceeding 100 gallons a minute. The chief spring horizon is the top of the Waihu (next to youngest) drift.

Wentworth, C. K., Carson, M. H., and Finch, R. H.

Laminar and turbulent flow are discussed. Nichols’ (1939) conclusion that the flow was laminar is reasonable, and it appears that the viscosity values deduced by Becker (1897) and Palmer (1927) are too low. The viscosity may range between $10^4$ and $10^7$ times that of water, or the order of $10^2$ to $10^5$ poises, but data is not sufficiently accurate to permit the statement in the form of a coefficient of viscosity.

Wesley, W. H.

1889. The volcanoes of the Sandwich Islands: Knowledge, new series, vol. 12, p. 97-100.
The volcanic activity of Kilauea is compared with that of Vesuvius. (Not seen.)
Westervelt, W. D. (See also Loomis, 1937.)

A brief account of the early phases of the Mauna Loa eruption of 1907, and the legendary account of the formation of Na puu o Pele, two small cones in southwestern Kau.

1907a. Lava tree molds and lava stumps: Hawaiian Annual for 1908, p. 113–122.
A description of tree molds and lava trees in the vicinity of Kilauea Caldera and in eastern Puna, and a discussion of their formation. Tree molds are correctly interpreted as formed by engulfment of trees, which chilled the lava to form a congealed shell around themselves. Lava trees, however, are (mistakenly) believed to result from the lava being ejected around the edges of a partly buried tree, building up heaps of spatter after the manner of driblet cones.

A translation from the Hawaiian of a brief account, written in 1859, of the eruption of Kilauea in 1840, and those of Mauna Loa in 1843, 1852, 1855, and 1859. Former fresh-water springs at the village of Wainanali, at the coast, are said to have been destroyed by the lava of 1859. The eruption of 1868 is described, from a letter by F. S. Lyman in the Pacific Commercial Advertiser for April 15, 1868.

A discussion of the changes which have occurred in Kilauea Caldera. Legends may be interpreted as meaning a period of overflow from a summit crater, then the confinement of lava within a small area (the caldera), and third changes within the caldera itself.

A brief popular account of the changes in the floor of Kilauea Caldera during historic time. The principal changes are disappearance of a platform called the “black ledge” which formerly extended entirely around the caldera about half way down its sides, and the shrinking of the lava lake into the confines of Halemaumau. A large sulfur bank which formerly occupied part of the southeastern wall of the caldera has been largely buried by lava flows.

1916a. Hawaiian legends of volcanoes, 205 pp., Honolulu. Pages 177-193 contain notes on some of the eruptions of Mauna Loa and Kilauea, and the tsunami of 1877. Of special interest are a quotation from Mrs. Sarah J. Lyman recording summit activity of Mauna Loa on January 30, 1875; and a statement that in 1877, following the summit activity of February 14 and preceding the submarine eruption at Kealakekua Bay on February 24, “there was an underground eruption to the sea marked by a fissure down the mountain side through which clouds of steam and smoke were forced.” Mrs. Lyman is quoted as stating that during the tsunami of May 10, 1877, the wave was 13.5 feet above high tide at Waiakea and swept inland 660 feet, killing 5 persons and destroying 46 houses.

Whitney, H. M.


1877. A new and remarkable volcanic outbreak in Kealakekua Bay: Hawaiian Gazette, vol. 13, no. 9, p. 3, February 28. The summit eruption of Mauna Loa on February 14, 1877, is stated to have lasted only 6 hours. On February 24 a submarine eruption occurred in Kealakekua Bay, along a fissure trending west-northwest. Steam and lava rose along this line as far out to sea as a mile from Keel (Palemano) Point. Lava fragments reaching the surface were red hot, emitting steam and sulfurous gas, and sank as soon as they had cooled. Another rupture, said to be doubtless a continuation of the submarine fracture, was traced inland nearly 3 miles. A severe earthquake preceded the eruption.

A brief account of the early stages of the eruption of Mauna Loa, which commenced on November 5, 1880.


A brief account of the progress of the Kau branch of the lava flow from Mauna Loa, during the week preceding November 18, 1880. Kilauea was said to be very active.

1895. The tourists' guide through the Hawaiian Islands, 2nd ed., p. 71-73, 77-80, Honolulu.

Contains descriptions of Kilauea Caldera in 1891, and of Mokuaweoweo in 1872.

Wild, J. J.

1878. At anchor; a narrative of experiences afloat and ashore during the voyage of the Challenger, from 1872 to 1876, p. 171, London.

Contains a general description of the island of Hawaii, and descriptions of the tsunamis of 1837 and 1877 at Hilo. The latter wave is said to have been 36 feet high, from trough to crest, at Hilo, and 30 feet high at Kealakekua. A glare from activity in the summit caldera of Mauna Loa was observed on August 13, 1875.

Wilkes, Charles


Contains descriptions of Kilauea Caldera during December, 1840, and January, 1841, of the 1840 lava flow from Kilauea, and brief descriptions of Mokuaweoweo and South Pit (termed Pohakuhanela), as well as a brief account of an ascent of Mauna Kea by Messrs. Pickering and Brackenridge. The term "pit crater" is used for the first time, and defined as: "that description of crater of which there is no appearance whatever until one is close upon it, and which never throws out lava." They were believed to be formed by collapse of lava tubes. Wilkes considers the craters of Kilauea and Mauna Loa to be not connected. The lava lakes within Kilauea Caldera were also said to rise and fall independently. Activity was reported in Mokuaweoweo not long after Cook's visit (1778), and 5 years before Wilkes' visit.
Williams, Howel (See also Wentworth and Williams, 1932.)


A brief discussion of the surface ash deposits of Kilauea. Ash of the 1790 eruption along the southwest rift is vitric. The late products of the 1790 explosions, lithic and crystal tuffs, alternate. The 1924 ejecta are almost wholly lithic.


Mokuawoweo and Kilauea calderas are classified as calderas of the "Kilauea type," resulting from collapse, owing to rapid effusion of lava from flank fissures or intrusion as dikes or sills draining the central conduit. Descriptions of the two by previous writers are reviewed.

Williams, J. N. S.


What was probably the first tunnel in Hawaii to convey water from streams for agricultural purposes is found in the North Kohala district, near Niulii. It was probably constructed between 1823 and 1849, by Hawaiian labor for J. Parker, an American farmer. The tunnel is 200 feet long, and leads water from Nene Stream to taro patches. The method of construction was unique, consisting of 19 shafts, 20 feet deep, the bottoms of which were inter-connected to form the tunnel.

Williamson, C. G.


A list of the earthquakes felt in South Kona from April 1 to April 21, 1868. (Republished in Brigham, 1869.)


Volcanism on the island of Hawaii appears to have shifted gradually southward, Kohala being the oldest of the major volcanoes. The history of Mauna Loa and Kilauea is briefly summarized. A table of earthquakes during 1868 is included. The Wood Valley mud-flow and the eruptions of 1868 are briefly described.
Wilson, R. M.


The eruption commenced just before 1 a.m., July 7. It was unheralded except by widening of cracks near the rim of Halemaumau. Harmonic tremor was absent until just before the appearance of the lava, except for a very feeble trace from 10:55 to 11:12 p.m. on July 6. No other seismic prelude occurred. A journal of the eruption is given. Three large fountains, 125 feet high, broke out along a north-northeast trending fracture on the floor of Halemaumau. Half of the lava outflow occurred during the first day. Weak lava effusion continued until July 19, but harmonic tremor lasted only a little more than 24 hours.


A description of methods and results of triangulation at Kilauea in 1922 and 1926, and of leveling in 1912, 1921, and 1927. Triangulation shows a movement of points about the caldera concentrically toward Halemaumau between 1922 and 1926. Leveling shows an apparent rise in the Volcano House benchmark of 3 feet between 1912 and 1921, but this is probably due to lack of correction for rod length in the earlier survey. Between 1921 and 1926 the Volcano House benchmark dropped 3.5 feet. Between 1912 and 1921 the entire area about the caldera showed a dome-like bulging centering a mile south of Cone Peak, with a maximum displacement upward of 1.6 feet relative to the Volcano House benchmark. Between 1921 and 1926 the area subsided concentrically around Halemaumau, the maximum displacement downward being 13 feet relative to the Volcano House datum.

Wilson, W. F.


A compilation of Douglas' journal, and letters written by him, and by others regarding him. Contains a description of his ascent of Mauna Kea in January, 1834, a description of Kilauea Caldera on January 24, 1834, and an account of his ascent of Mauna Loa on January 29, 1834. Two lava lakes were active at Kilauea. Mokuaweoweo Caldera measured 1,270 feet deep on the east side. Mauna Loa was observed to contain less explosive material than Mauna Kea. Two letters describe Mauna Loa as highly active, but no mention of activity appears in the journal.
1922. With Lord Byron at the Sandwich Islands in 1825, being extracts from the diary of James Macrae, 75 pp., Honolulu.

Contains an account of an ascent of Mauna Kea in June, 1825, and a brief description of Kilauea Caldera on June 27, 1825. The volcanic nature of Mauna Kea is recognized, and cinder cones and their ejecta briefly described. Kilauea Caldera is said to have been 1,000 to 1,200 feet deep, with a ledge extending entirely around it about half way down. On the floor there were more than 12 small smoking cones.

Winchell, Horace


Describes augite crystals from Puu Pa, on the lower western slope of Mauna Kea, and shows them to be nearly pure diopside.

Wingate, E. G.


At Kilauea, tilting of the ground away from Halemaumau accompanies a rising of the lava column, and tilting toward Halemaumau accompanies a sinking lava column. This can be measured by tiltmeters and on the seismographs, but also by means of precise leveling and triangulation. Survey nets for this purpose are described. It is hoped that eruptions of both Kilauea and Mauna Loa may be predicted by such methods.


The 1924 earthquakes and faulting at Kapoho, in eastern Puna, were accompanied by subsidence of the shoreline as far south as Pohoiki.


A description of a triangulation net established in 1933 in eastern Puna, to detect future ground movements in that area.


Contains brief general remarks regarding the history of Kilauea.
Wingate, E. G., and Powers, H. A.
A brief description of conditions in Mokuaweoweo Caldera on December 1, 1931, and of an earlier lava flow on the east rim, during which lava erupted simultaneously from fissures on the rim and on the floor of the caldera 200 feet below.

Wingate, E. G., and Finch, R. H.
A summary account of the 1942 eruption of Mauna Loa.

Winters, N. E.
A very brief general discussion of soil erosion in the Territory of Hawaii.

Wolff, F. von (See von Wolff, F.)

Wood, Edgar
A description of the source area of the lava flow of 1899. Sketch maps show the location of the vents.

A brief account of the eruption of Mauna Loa in 1903. What appears to have been a submarine eruption to the west of Hawaii is mentioned.


Wood, H. O.
A description of the Hawaiian Volcano Observatory, its activity, and its purpose. Special attention is given to the seismological equipment in the Whitney Laboratory. The nearly constant micro-tremor which accompanies lava movement in the vent is briefly described, and the term volcanic vibrations is proposed for it.

Reviews all contemporary accounts of the 1868 quakes which were so destructive in Kau, and indicates approximate positions of isoseismal lines. Discusses the tsunami which accompanied the big quake of April 2. Concludes that the quakes were probably tectonic in origin.


A list of earthquakes recorded at Kilauea from January 1 to August 31, 1915, showing the character of the shake, nature of the motion, and time of arrival of the various waves.


The eruption was preceded by many light local earthquakes, 72 being recorded in the 25 days preceding the outbreak on November 25. At Kapapala 29 quakes were felt during a 2-day period about September 28; and two shocks were detected instrumentally at the Volcano Observatory on September 27, but not felt. In general perceptible quakes have not preceded Mauna Loa outbreaks, but it is probable that seismographs would in each case have detected a seismic prelude. Strong northeast tilt was recorded by the seismographs preceding the eruption.


The study of 441 shocks of which the distance, but generally not the direction, of origin was known, indicates a clustering at distances of 20 to 25 and 30 to 35 km from the observatory. Few originated at or near Halemaumau. Most are believed to have originated on the major rift zones of Kilauea and Mauna Loa, and to have been caused by fault displacements, and belong to the tectonic category. Tremor is of truly volcanic origin, correlated with surface turbulence in Halemaumau.


A description of the southwest rift of Mauna Loa near Puu o Keokeo, and of the source area of the 1916 lava flow, and of the condition and activity of the vents on May 30.
Wood, H. O. (continued)


The 1914 eruption is shown probably to have had two parts. Activity began on November 25, and decreased in early December; activity became strong again on December 11. The floor of Mokuaweoweo was considerably built up, in places at least 75 feet.


A description of the eruption and lava flows of 1916. It is suggested that the eruption may have been the result of tectonic action opening rifts in the mountain. The advance of an aa front is described, and the formation of aa is discussed (p. 333-335).


During the period 1907-1915, when the molten lava stood high in Halemaumau pit but did not overflow, times of high level occurred approximately at summer and winter solstice. Shorter cycles appear to follow the lunar cycle. There is probably also a small rising and falling of the lava level not corresponding with the diurnal rock and water tide. The dominant effect is of the sun, and it is the declination of the sun (and presumably also of the moon), not its distance from the earth, which is the control. The nutation caused by the declination of the moon is less than 8 percent of that caused by the sun's declination, and the strains set up in the earth are considered to be proportionate, those caused by the sun being less than 8 percent as great as those caused by the sun. This corresponds with the greater semi-annual effects observed at Kilauea as compared with the semi-monthly effects. A curve is constructed showing the variation in both lunar and solar nutational strain. The Chandler or free nutation is probably also effective. It has a cycle of change in greatness of effect of nearly 7 years. The maximum of effect due to the free nutation will coincide with the maximum of effect due to the forced nutations (caused by the sun and moon) approximately every 130 years. This 130-year period is remarkably like the period of 126 years found by Omori in the cycles of eruption of Asama. The period from the great explosive eruption of Kilauea in 1790 to the time of great lava activity in the Kilauea Caldera in 1855 is 65 years, or just half of the possible 130-year cycle.

With particular reference to the 1868 eruption, it is suggested that many eruptions are tectonic in origin, resulting from the opening of fissures by crustal movements rather than from gas tension or tumescence. Sudden magma subsidences at Kilauea are accompanied by swarms of earthquakes, and are believed to be due to opening of fissures and subsurface intrusion.


The causes of volcanic earthquakes are discussed. The great Hawaiian earthquake of 1868 is described, and concluded to have been of tectonic origin. The tsunami is attributed to dropping of the ocean floor south of the island. During the 1914 eruption of Mauna Loa noteworthy fuming occurred only during the first 24 hours, but lava output continued for weeks and was much greater after the 21st day than before it. This continued outpouring long after by far the greater portion of the gas had been released and any eruptive potential due to gas tension had been much reduced, suggests that lava extrusion may result from tectonic pressure on the walls of the reservoir. Swarms of quakes accompanying lava subsidence at Halemaumau may result from tectonic opening of fissures at depth into which intrusion occurs. It is suggested that the Hualalai earthquakes of 1929 may have been of tectonic origin. Many other Hawaiian earthquakes also may be tectonic.

Woodworth, J. B.


The double line of volcanoes of the Hawaiian chain does not necessarily imply two parallel fissures, but may result from the fringe of border fractures along a single great torsion crack (p. 182).

Wriston, R. C.


Contains an aerial photograph of Halemaumau on November 9, 1923, one of the first such photographs ever taken.
Zies, E. G.
1929. The Valley of Ten Thousand Smokes; I. The fumarolic incrustations and their bearing on ore deposition; II. The acid gases contributed to the sea during volcanic activity: National Geographic Society, Contributed Technical Papers, Katmai Series, vol. 1, no. 4, 79 pp.
It is stated (p. 64) that a calculation by E. S. Shepherd shows that Kilauea (during its phase of lava lake activity) gave off into the atmosphere about 30,000 tons of hydrochloric acid per year.

Zschokke, T. C.
A popular discussion of soil erosion and methods for its prevention.

Zurcher, Frederic, and Margollé, Elie
Contains a general account, quoted from various sources, of Mauna Loa and Kilauea.
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gar, 1917c, 1918, 1920g; Jones, A. E.

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Baldwin, P. H., map of 1935 lava in Mo-

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Bench magma: Jaggar, 1917a, 1917b,

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ter, no. 456, February 1938; Melzner,

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1911, 1911a, 1914, 1933; Dana, J. D.,

1849, 1879; Ferguson, 1914; Hague,

1865; Hitchcock, C. H., 1909, 1909a;

Hough, Gile, and Foster, 1941; Iddings,

1913; Jackson, 1846; Lyons, A. B.,

1896; Macdonald, 1946; in prep.; Max-

well, 1898; McGeorge, 1917; Payne

and Mau, 1946; Phillips, A. H., 1894;

Pig-

got, 1931; Powers, H. A., 1931e; Shep-

herd, 1938; Silvestri, 1888; Stearns

and Clark, 1930; Stearns and Macdonald,

1946; von Wolff, 1929; Washington,

1903, 1917, 1921, 1923, 1923a, 1923b;

Wells, 1937, 1943.
Chloride content, of ground water: see also Wells, water levels and chloride content. Stearns and Macdonald, 1946.

Circulation in lava lake: Perret, 1913a.

Clastolith: Jaggar, 1921b.

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Coan, Titus, work of, on Hawaiian volcanoes: Jaggar, 1913.

Concentric fissures, eruption from: Finch, 1942a; Macdonald, G. A., 1945b; Stearns and Clark, 1930.

Concrete, aggregate materials: Wentworth, 1939.


Constancy of position of vents at Kilauea: Washington, 1917.

Cracks, at Kilauea: Jaggar, 1930h; Volcano Letter (systematic crack measurements published in each issue); Waesche, 1937.

Craters of elevation theory, opposed: Dana, J. D., 1849, 1888, 1890; Hoffmeister, 1940.

Cristobalite: Dunham, 1933.

Cycle, volcanic: Dana, J. D., 1885, 1890; Green, W. L., 1887; Hoffmeister, 1940; Jaggar, 1915a, 1915d, 1918, 1925a, 1925f, 1936a, 1938a; Jaggar, Finch, and Emerson, 1923; Sapper, 1927; Stearns, H. T., 1940c; Stearns and Macdonald, 1946; Wood, H. O., 1917a.

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Dana, J. D., Characteristics of volcanoes, review: Green, W. L., 1890.

Dana, J. D., work of, on Hawaiian volcanoes: Hoffmeister, 1940; Jaggar, 1913.

Debris cone, Halemaumau: Dana, J. D., 1889; Dodge, 1887; Powers, S., 1916b.

Density of Mauna Kea and Haleakala: Washington, 1925d.

Dermolith: Jaggar, 1917e, 1918.

Devil's Throat, exploration: Doerr, 1932; Stone, J. B., 1926a.

Differentiation, magmatic: see Magmatic differentiation.

Douglas, David, work in Hawai'i: Wilson, W. F., 1919.

Driblet spires: Perret, 1913e.

Dutton, C. E., Hawaiian volcanoes, review: Green, W. L., 1884.

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Earthquake waves, travel times of: Jones, A. E., 1895b.

Earthquakes, during:

1833: Lyman, C. S., 1859.
1838: Jarvis, 1843.
1841: Jarvis, 1843.
1858: Lyman, C. S., 1859.
1868: Anonymous, 1868, 1868a, 1868c; Brigham, 1868b, 1869; Coan, T., 1868, 1868a, 1869; de Montes-sus de Ballore, 1924; Dougherty, 1941; Finch, 1945; Gutenberg and Richter, 1941; Hillebrand, 1868; Hitchcock, C. H., 1912; Lyman, F. S., 1868, 1868a; Staley, 1868; Williamson, 1868, 1869; Wood, H. O., 1914, 1933.

1871: Gutenberg and Richter, 1941.
1877: Whitney, 1877.
1881: Anonymous, 1881g; Bond, 1881; Gutenberg and Richter, 1941; Paris, 1881.
1887: Jones, G., 1887; Paris, 1887; Spencer, 1887.
1891: Baker, E. P., 1891.
1912: Jaggar, 1920.
1913: Jaggar, 1920.
1930: Volcano Letter, nos. 262-313; Jaggar, 1931g; Jones, A. E., 1932.
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1935: Volcano Letter, nos. 419-439; Finch, 1943c; Jones, A. E., 1937; Waesche, 1940b.
1936: Volcano Letter, nos. 431-442; Waesche, 1940b.
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1940: Volcano Letter, nos. 467-470; Gutenberg and Richter, 1941, 1945; Waesche, 1940b.
1943: Volcano Letter, nos. 479-482.
1944: Volcano Letter, nos. 483-486; Finch, 1944a, 1945, 1945a.

Earthquakes, general: Bryan, E. H., 1933; de Montessus de Ballore, 1924; Fagerlund, 1942; Finch, 1945a; Gutenberg and Richter, 1941, 1945; Jaggar, 1931g, 1945; Jones, A. E., 1922, 1935a, 1935b, 1938; Lyman, C. S., 1859; Wood, H. O., 1913, 1915b, 1933.
Ejected blocks, Halemaumau: Chapman, 1946; Macdonald, G. A., 1944a; Stone, 1926a; Washington, 1925b.
Equinox, effect on height of lava column: see Astronomical influences on height of lava column.
Erosion, general: Cotton, 1944; Palmer, 1927a, 1927b, 1933; Stearns and Macdonald, 1946; Wentworth, 1926a, 1927, 1928.
Erosion, of Hoopu loa flow: Jaggar, 1930i.
Erosion, rates of: Hinds, 1931; Wentworth, 1927.
Explosions, volcanic: Dana, J. D., 1849, 1888, 1890; Finch, 1945; Graton, 1945; Green, W. L., 1887; Hodgkins, 1936; Hoffmeister, 1940; Jaggar, 1924a, 1927a, 1945; Jaggar and Finch, 1924; Scherzer, 1923; Stearns, H. T., 1925, 1925b, 1926, 1926b; Stearns and Clark, 1930; Stone, J. B., 1926.

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Flames, volcanic: Finch, 1926; Hodgkins, 1936; Jaggar, 1917a, 1918; Janssen, 1883; Perret, 1913d.
"Floating islands" at Halemaumau: Jaggar, 1917e; Perret, 1913.
Flood-developed chasm: Fagerlund, 1945.
Flora, origin: Brown, F. B. H., 1921; Skottsberg, 1925.

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Gas fluxing, in blowing cones: Jaggar, 1930.
Gases, volcanic, collection of: Ballard and Gow, 1931.
Gases, volcanic, nature of: see Magma, gases, Solfataric gases.
Gazetteer: Coulter, 1935; Martin and Pierce, 1913.
Geologic history: Jaggar, 1920; Stearns, H. T., 1925a, 1926a, 1945a, 1945b; Stearns and Clark, 1930; Stearns and Macdonald, 1946; Stone, 1926a.
Glass, volcanic: Tilley, 1922.
Gravity anomalies: Duerksen, 1943; Grondin, 1928; Jaggar, 1928a; Preston, 1896, 1894; Venien Meinesz, 1941; Washington, 1925d.
Green, W. L. work of, on Hawaiian volcanoes: Jaggar, 1913.
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Ground water, general: Meinzer, 1921, 1930; O'Shaughnessy, 1904; Palmer, 1942; Stearns, H. T., 1930a, 1940a, 1942a; Stearns and Clark, 1930; Stearns and MacDonald, 1946; Swartz, 1937.

Ground water, Kau District: Meinzer, 1930; Stearns and Clark, 1930; Stearns and MacDonald, 1946.

Ground water, pumpage of: See Wells, pumpage.

Halemaumau, changes in: Jaggar, 1931i, 1932b.

Hamakua District, geology and ground water of: Stearns and MacDonald, 1946.


Hawaiian Volcano Observatory: Cross and others, 1920; Curtis, 1913; Hawaiian Volcano Observatory, 1914; Jaggar, 1911, 1912a, 1913, 1913i, 1914, 1915, 1917, 1917i, 1921b, 1924b, 1925a, 1928a, 1930k, 1932c; Powers, S., 1915a; Schulz, 1942; Thurston, 1921; Wood, E. O., 1913.


Hawaiian Archipelago, general: Betz and Hess, 1942; Cook, 1929; Fornander, 1856; Freeman, 1927; Friedlaender, 1918; Gregory, 1928; Hinds, 1931; Lyons, A. E., 1894, 1896a; Palmer, 1921; Powers, S., 1917; Skottsberg, 1925; Stearns, H. T., 1945b; Stubbs, 1901; Suess, 1913; Wentworth, 1926, 1930; von Wolf, 1929.

Hawaiian Volcano Research Association: Thurston, 1921.

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Heat, origin of, at Kilauea: see Volcanic heat, source of.

Hilo, water supply for: MacDonald, G. A., 1942; Ohrt, 1944; Stearns and MacDonald, 1946.

Hilo District, geology and ground water of: Stearns and MacDonald, 1946.


Huialalai, earthquakes in 1929; Volcano Letter, no. 248-251, 1929; Jaggar, 1930i.

Huialalai, eruption of 1901: Alexander, W. D., 1891; Brigham, 1909; Bryan, W. A., 1915; Dutton, 1883, 1884; Ellis, 1825, 1826, 1831; Powers, S., 1920a; Thurston, L. G., 1882.

Hualalai, eruptions in 1805 and 1811: Dutton, 1883, 1884.

Hualalai, general: Bird, 1875; Brigham, 1868a, 1909, 1918; Daingerfield, 1922; Dana, J. D., 1850; Dutton, 1883, 1884; Hinds, 1931; Jaggar, 1920, 1930, 1931a; Mann, 1866; Marcuse, 1894; Menzies, 1909; Pickering, W. H., 1906; Powers, H. A., 1931a; Powers, Ripperton, and Goto, 1932; Schneider, 1911; Stearns, H. T., 1946; Stearns and MacDonald, 1946; Washington, 1923a.

Hydrogen sulfide, incidence at Kilauea: Payne and Ballard, 1940.


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Irrigation, general: Alexander, W. P., 1923; Chandler, 1917; Cox, 1942; Maxwell, 1900; Newell, 1909; O'Shaughnessy, 1904, 1909.

Isostasy: Duerksen, 1943; Goranson, 1928; Preston, 1893, 1894; Stearns, H. T., 1945a; Vening Meinesz, 1941.

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Kau District, geology of: Stearns, H. T., 1926a, 1931; Stearns and Clark, 1930; Stearns and MacDonald, 1946.

Kau District, ground water in: Stearns and Clark, 1930; Stearns and MacDonald, 1946.

Kau, lava flows in: MacCaughhey, 1918.

Kaumana Cave, near Hilo: Castle, 1920; Powers, S., 1920; Stevens and Oleson, 1894.

Kea Lava flow: Stearns, H. T., 1926;

Stone, J. B., 1926.

Kealakekua Bay, eruption in; Anonymous, 1877a; Coan, T., 1877; Mist, 1877; Whitney, 1877.

Kealakekua Bay, faulting at: Dana, S. D., 1890; Powers, Ripperton, and Goto, 1932; Powers, S., 1917; Stearns and MacDonald, 1946.

Kilauea, activity during*:

1790: Alexander, W. D., 1891; Dibble, 1843; Ellis, 1825, 1826, 1851; Jaggar, 1921a, 1930d, 1934c; Jarvis, 1843; MacDonald, G. A., 1941; Westervelt, 1916.

*For a general history of activity of Kilauea see Kilauea, history of activity. The following contains accounts of activity during some years not listed above (quoted from other sources, particularly the Volcano House register), as well as for the years listed; Brigham, 1909; Dana, J. D., 1888, 1890; Hitchcock, C. H., 1909; Jaggar, 1947.
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1803: Turnbull, 1805.

1823: Coan, T., 1866; Daubeny, 1826; Ellis, 1823, 1826, 1826a, 1827, 1831; Pfafl, 1871; Stearns, H. T., 1926; Stone, J. B., 1926.

1824: Goodrich, 1826.

1825: Buxam, 1925; Byron, 1826; Loosli, 1927; Stewart, C. S., 1826, 1827, 1828, 1828a; Wilson, W. F., 1922.

1826: Bishop, A., 1827; Chamberlain, 1826.

1828: Goodrich, 1829.

1829: Stillman, 1831; Stewart, C. S., 1831, 1833.

1830: Bingham, 1847.

1832: Goodrich, 1833; Green and Dibble, 1833.

1833: Coan, T., 1866.


1838: Bennett, 1869; Kelley, E. G., 1841; Strzelecki, 1838, 1845, 1846.

1839: Rees, 1841 (?); Shepherd, J., 1840.

1840: Agar, Flint, and Longwell, 1929; Alexander, W. D., 1891; Anonymous, 1842; Coan, T., 1841, 1842, 1856d, 1866, 1882; Conaway, 1841; Dana, J. D., 1849, 1850, 1850a; Jarves, 1844; Macdonald, G. A., 1941, 1944; Westerveldt, 1908; Wilkes, 1845.

1841: Wilkes, 1845.

1842: Dana, J. D., 1849.

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1844: Anonymous, 1845; Dana, J. D., 1849.

1846: Coan, T., 1863; Gulick, 1865; Lyman, C. S., 1851, 1924.

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1849: Coan, T., 1851.

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1851: Coan, T., 1852; Sawkins, 1855.

1852: Coan, T., 1853.

1853: Coan, T., 1854; Perkins, 1854; Remy, 1892.

1855: Anonymous, 1855; Coan, T., 1856, 1856a; Coan, T. M., 1910; Damon, 1855; Weld, 1856.

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1857: Turner, 1868.

1859: Coan, T., 1860; Haskell, 1860; Sheepehans, 1899.

1860: Green, W. L., 1887.

1862: Coan, T., 1863.

1863: Anderson, R., 1865; Coan, T., 1864; Gulick, 1864.

1864: Auchincloss, 1864; Brigham, 1865, 1868a; Coan, T., 1864a; Mann, 1866.

1865: Brigham, 1868.

1866: Brigham, 1868; Clemens, 1872, 1938; Coan, T., 1866a, 1867.

1867: Green, W. L., 1887.

1868: Anonymous, 1868, 1868a; Brigham, 1869; Coan, T., 1868a, 1868b, 1869; Hildebrand, 1868; Hitchcock, C. H., 1912; Staley, 1868; Williamson, 1869.

1869: Coan, T., 1870, 1870a, 1871.

1870: Coan, T., 1871; Lansdale, 1870.

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1874: Coan, T., 1874a; Nichols, J. W., 1876.

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1876: Brassey, 1879.

1878: Anrep-Ellmpt, 1885; Baldwin, C. W., 1901; Caton, 1880.

1879: Coan, T., 1879, 1880; Gordon-Cumming, 1881, 1883; Thurston, 1936.

1880: Brigham, 1887; Coan, T., 1880; Kent, 1880; Whitney, 1880a.

1881: Hall, 1881.

1882: Dutton, 1883, 1884.


1884: Anonymous, 1884; Green, W. L., 1887; Monnier, 1888.

1886: Clarke, F. L., 1886; Dana, J. D., 1886, 1887a; Dodge, 1887; Emerson, J. S., 1887; Hitchcock, C. H., 1887; Thrum, 1886; Van Slyke, 1887; Walker, 1912.

1887: Dana, J. D., 1888, 1890; Kirchoff, 1890.

1888: Dana, J. D., 1889; Dodge, 1893; Merritt, 1889.

1889: Lyons, A. B., 1892.

1891: Anonymous, 1891; Baker, E. P., 1891; Brigham, 1891; Dana, J. D., 1891; Maby, 1891; Whitney, 1895.

1892: Bishop, S. E., 1892, 1902; Dodge, 1893; Keep, 1893; Lyons, A. B., 1892; Marcuse, 1892.

1893: Anonymous, 1893, 1894; Castle, 1893; Friedlaender, B., 1895; Libbey, 1897.

1894: Anonymous, 1894; Bishop, S. E., 1892; Grosser, 1899; Thurston, 1894, 1936.

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1897: Grosser, 1899.
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1903: Thrum, 1903a.
1908: Brigham, 1908; Hitchcock, C. H., 1908, 1909; Richardson, 1908.
1910: Jaggar, 1912b.
1911:Anonymous, 1914; Jaggar, 1912b; Perrett, 1911.
1912: Anonymous, 1912; Hawaiian Volcano Observatory, Weekly Reports; Jaggar, 1912c.
1913: Curtis, 1913; Hawaiian Volcanic Obs., Weekly Reports; Powers, S., 1915.
1934: Jaggar, 1934a, 1934b, 1934c, 1945a; Jones, A. E., 1934, 1934a; Volcano Letter, nos. 407-418.
1936: Volcano Letter, nos. 431-442.
1938: Volcano Letter, nos. 455-462.
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Kilauea, ash deposits at: Finch, 1942a; Perret, 1943c; Powers, S., 1916a; Sherzer, 1923; Stearns and Clark, 1930; Stearns and Macdonald, 1946; Stone, J. B., 1926a; Wentworth, 1938; Williams, H., 1927.
Kilauea, engulfment at: Finch, 1940; Hobbs, 1914; Jaggar, 1925f, 1927a, 1931b; Perret, 1913b; Wood, H. O., 1921.
Kilauea, faulting at: Hinds, 1926; Powers, S., 1917; Stearns and Clark, 1930; Stone, J. B., 1926a.
Kilauea, filling of caldera: Finch, 1941; Marcuse, 1894.
Kilauea, gases liberated at: see Magmatic gases, Solfataric gases.
Kilauea, general: Anderson and Bonney, 1917; Anonymous, 1907, 1932; Baker, E. P., 1885; Bonney, 1899; Boscowitz, 1884; Brigham, 1909; Bryan, E. H., 1933; Cartwright, 1913; Castle, 1920; Cheney, 1892; Coan, T., 1882; Coan, T. M., 1871, 1889; Coleman, 1946; Cotton, 1944; Curtis, 1915; Da Costa, 1925; Daly, 1914, 1916a, 1918, 1926, 1933; Dana, J. D., 1914, 1916a, 1918, 1926, 1933; Dana, 1887, 1888, 1890; Dutton, 1883, 1884; Edwards, 1928; Finch, 1940, 1941; Forbes, 1915; Fourmarier, 1938; Friedlander, 1931; Geikie, 1903; Grosvenor, 1924; Hawaii National Park, circulars of information; Heim, 1913; Hind, 1931, 1943; Hitchcock, C. H., 1909; Hitchcock, C. H., 1909a; Iddings, 1914; Jaggar, 1921, 1922, 1925, 1925b; Kneeland, 1888; Landgrebe, 1855; Macdonald, G. A., 1941; Marcuse, 1894; Marshall, 1912; Mather and Mason, 1939; Mather, S. T., 1927; Mercalli, 1907; Pickering, W. R., 1906; Powers, S., 1915a, 1916, 1916b; Rodgers, 1921; Scrope, 1862; Stearns, 1946; Stearns and Clark, 1930; Stearns and Macdonald, 1946; Stone, J. B., 1926a; Suess, 1918; von Wolff, 1929; Wilkes, 1845.
Kilauea, model of: Curtis, 1915; Daly, 1918; Sayles, 1918.
Kilauea, Punai rift of: Finch, 1946.
Kilauea, relationship to Mauna Loa: Alexander, J. M., 1886; Andrews, 1843; Baker, E. F., 1885; Cartwright, 1913; Daly, 1910b, 1911, 1914, 1926, 1933; Dana, J. D., 1849, 1850, 1852, 1888, 1890; Dutton, 1883, 1884; Friedländer, B., 1895, 1896a; Green, W. L., 1887; Hitchcock, C. H., 1909a; Jaggar, 1915a, 1915d, 1916, 1917, 1922, 1931b; Judd, 1881; Mercalli, 1907; Scrope, 1862; Stearns, H. T., 1925a, 1926a; Stearns and Macdonald, 1946; Stone, J. B., 1926a; Suess, 1918; von Wolff, 1929; Wilkes, 1845.
Kilauea, size of magma column: Bonney, 1899; Day, A. L., 1925.
Kilauea, structure of: Jaggar, 1930f; Stearns and Clark, 1930; Stearns and Macdonald, 1946; Stone, J. B., 1926a.
Kilauea, temperature measurements: Anonymous, 1914; Cockburn, 1927; Daly, 1914, 1933; Graton, 1945; Jaggar, 1917a, 1917d, 1917e, 1918, 1927, 1934; Jaggar and Finch, 1928a; Perret, 1911, 1913f; Sapper, 1927; Shepherd, E. S., 1914; Spicer, 1942; von Wolff, 1929.
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Kohala District, ground water in: Stearns and Macdonald, 1946.
Kohala, fault origin of northeast coast: Cotton, 1944; Jaggar, 1920; Stearns and Macdonald, 1946.
Kohala Mountains, geology of: Branner, 1903; Hinds, 1926, 1931; Lyons, A. B., 1896a; Jaggar, 1917a, 1917d, 1917e, 1918, 1927, 1934; Jaggar and Finch, 1928a; Perret, 1911, 1913f; Sapper, 1927; Shepherd, E. S., 1914; Spicer, 1942; von Wolff, 1929.
Kohalaite: Iddings, 1913.
Kona District, ground water in: Sedgwick, 1915; Stearns and Macdonald, 1946.
Kona District, water development in: Kimble, 1915; Stearns and Macdonald, 1946.
Lake Wai'au, Hawaii: Baldwin, C. W., 1908, 1914; Baldwin, E. D., 1889; Bryan, L. W., 1938, 1939; Goodrich, 1883; Stearns and Macdonald, 1946.

Lapiés: Palmer, 1927a, 1927b.

Laupahoeoe Peninsula, origin of: Powers, S., 1920a; Stearns and Macdonald, 1946.

Lava balls, formation of: Jaggar, 1926; Stearns, H. T., 1926; Stearns and Clark, 1930; Stearns and Macdonald, 1946; Stone, J. B., 1926.

Lava flows, deflection of: Jaggar, 1931e, 1945b; Macdonald, G. A., 1943; Thurston, 1929, 1936.

Lava flows, volumes of: Dana, J. D., 1888, 1890; Hitchcock, C. H., 1909; Penck, 1894; Sapper, 1927; Powers, H. A., 1929; Stearns and Macdonald, 1946.

Lava fountains: Cartwright, 1909; Coan, T., 1902b; Dana, J. D., 1852, 1888; Green, W. L., 1887, 1890; Jaggar, 1917a, 1920e; Perret, 1913d; Washington, 1917.

Lava lake at Halemaumau: see Kilauea, lava lake.

Lava rings, formation of: Daly, 1914, 1933.

Lava rivers: Finch, 1943a; Hitchcock, C. H., 1900; Jaggar, 1925b.

Lava stalactites, origin: Brigham, 1909; Cohen, 1880; Dana, E. S., 1889, 1890; Goldsmith, 1904; Jaggar, 1930, 1951f; Phillips, A. H., 1894; Schulz, 1943.

Lava trees: see Tree molds.

Lava tubes: Castle, 1920; Coan, T., 1920; Perret, 1913e; Powers, S., 1920.

Laws governing use of water: Chandler, 1917; Hutchins, 1946; Nakuiama, 1893; Newell, 1909; O'Shaughnessy, 1904, 1909; Perry, 1912.

Limestone, assimilation of, in producing alkaline rocks: Daly, 1910a, 1911a, 1916, 1944.

Littoral cones: Macdonald, G. A., 1944; Powers, S., 1920a; Stearns and Clark, 1930; Stearns and Macdonald, 1946; Wentworth, 1938.

Loess: Palmer, 1931a.

Lua Poholu, time of formation: Dana, J. D., 1888, 1890; Guppy, 1906; Stearns and Macdonald, 1946.

Macrae, James, work in Hawaii: Wilson, W. F., 1922.

Magma, cause of rise: Bishop, S. E., 1902; Daly, 1914, 1933; Graton, 1945; MacCaughhey, 1919; Wood, H. O., 1933.


Magnetic differentiation: Cross, 1915; Daly, 1911a, 1914, 1916, 1933, 1944; Green, W. L., 1887, 1890; Macdonald, G. A., 1944; Powers, H. A., 1935.

Magnetic gases: Allen, 1922, 1922a; Anonymous, 1913; Brigham, 1887; Brun, 1911, 1913; Chamberlin, 1908; Clarke, F. W., 1924; Dana, J. D., 1887, 1888, 1890; Day, A. L., 1914, 1915, 1916, 1917; Day and Shepherd, 1913, 1913a, 1913b, 1913e; Friedlaender, L., 1941; Graton, 1945; Green, W. L., 1887; Jaggar, 1917a, 1917e, 1918, 1920, 1940, 1940a; Janssen, 1888; Libhey, 1894; Like, 1930; Moffett, 1915; Perret, 1913f; Pickering, C., 1871; Sapper, 1927; Shepherd, E. S., 1919, 1920, 1921, 1925, 1927, 1938; von Wolff, 1929; Washington, 1921a; Zies, 1920.

Magnetic observations: Faris, 1914; Omer, 1945; Preston, 1894.

Magnetic properties of rocks: Beach and Eller, 1932; Orner, 1945.

Marine terraces, Hawaii: Baldwin, C. W., 1892.

Mauna Kea, general: Alexander, W. D., 1892; Baldwin, E. D., 1889; Bingham, 1847; Bird, 1875; Bryan, W. A., 1916, 1918; Daingerfield, 1922; Daly, 1911, 1914; Douglas, D., 1834, 1837, 1914; Dutton, 1885, 1888; Goodrich, 1825, 1833; Gregory and Wentworth, 1937; Hanks, 1909; Hinds, 1931; Jaggar, 1920, 1925; Jarves, 1844; Macdonald, G. A., 1945; Marcuse, 1894; Merrill, 1894; Rodgers, 1921; Stearns, H. T., 1946; Stearns and Macdonald, 1946; Washington, 1921b, 1923; Wilkes, 1845; Wilson, W. F., 1919, 1922.


* For a general history of activity of Mauna Loa see Mauna Loa, history of activity. The following contain accounts of activity during a few years not listed above (quoted from other sources), as well as for the years listed: Brigham, 1909; Dana, J. D., 1888, 1890; Hitchcock, C. H., 1909; Jaggar, 1947.
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1840: Jarnes, 1844; Wilkes, 1845.
1843: Andrews, 1843; Coan, T., 1843, 1844, 1856d, 1866, 1882; Westervelt, 1908; Whitney, 1859a.
1849: Coan, T., 1851.
1851: Anonymous, 1851; Bryan, W. A., 1915; Coan, T., 1852; Sawkins, 1855.
1852: Baker, E. P., 1889; Coan, T., 1852a, 1852b, 1853, 1856d, 1866, 1882; Fuller, 1852; Kinney, 1852; Westervelt, 1908; Whitney, 1859a.
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1854: Coan, T., 1854.
1855: Alexander, W. D., 1891; Coan, T., 1856a, 1856b, 1856d, 1857, 1866, 1882; Dana, J. D., 1856; Fuchs, 1875; Jaggar, 1930a; Macdonald, G. A., 1945c; Miller, W., 1856; Turner, 1858; Weld, 1856; Westervelt, 1908; Whitney, 1859a.
1856: Bishop, S. E., 1856; Coan, T., 1856c; Miller, W., 1866a.
1859: Alexander, W. D., 1859, 1891, 1933; Coan, T., 1860, 1866; Dana, J. D., 1859; Davis, 1859; Green, W. L., 1859, 1887; Haskell, 1859, 1890a; Lyman, H. M., 1859, 1890a; Lyons, J., 1859; Sleeper, 1859; Westervelt, 1908; Whitney, 1859, 1859a, 1859b.
1864: Brigham, 1868a; Mann, 1866.
1865: Coan, T., 1866a, 1867.
1866: Coan, T., 1866a, 1867.
1868: Alexander, W. D., 1881; Anonymous, 1888, 1890a, 1890b, 1886c; Brigham, 1883b, 1889; Coan, T., 1888, 1889a, 1888; Dougherty, 1941; Dutton, 1884; Heilbrond, 1886; Hitchcock, C. H., 1912; Lyman, F. S., 1868a; Staley, 1885; Westervelt, 1908; Whitney, 1868; Williamson, 1869.
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1871: Coan, T., 1871.
1872: Black, 1872; Coan, T., 1872; Kneeland, 1888; Whitney, 1895.
1873: Adams, 1873; Bird, 1873; Coan, T., 1873, 1874; Green, W. L., 1887; Merritt, 1880.
1874: Coan, T., 1874, 1874a.
1875: Coan, T., 1877; Green, W. L., 1887; Thompson and Murray, 1885; Westervelt, 1916a; Wild, 1878.
1876: Coan, T., 1877.
1877: Anonymous, 1877, 1877a; Coan, T., 1877; Mist, 1877; Westervelt, 1916a; Whitney, 1877.
1878: Dutton, 1884.
1879: Coan, T., 1879.
1880: Alexander, W. J., 1891; Baker, E. P., 1881, 1889; Barton, 1884; Brigham, 1888; Castle, 1881; Coan, T., 1880, 1881, 1882; Dutton, 1884; Gordon-Cumming, 1883; Hitchcock, D. H., 1880, 1880a; Jaggar, 1939a; Macdonald, G. A., 1945c; Oleson, 1880; Whitney, 1880, 1880a.
1881: Anonymous, 1881 to 1881f; Castle, 1881; Coan, L. B., 1881; Coan, T., 1881a; Hall, 1881; Hitchcock, D. H., 1881, 1881a; Stewart, G. W., 1881.
1882: Anonymous, 1882; Dutton, 1883, 1884.
1887: Alexander, W. D., 1891; Anonymous, 1887; Baker, E. P., 1889; Bishop, S. E., 1887, 1887a; Dana, J. D., 1887b; Hitchcock, D. H., 1887; Jones, G., 1887; Maby, 1887; Martin, J. H. S., 1887; McKay, 1887; Paris, 1887; Spencer, 1887.
1888: Baker, E. P., 1889; Merritt, 1889.
1890: Thurston, 1896.
1892: Grosser, 1899.
1893: Anonymous, 1893; Friedlaender, B., 1895.
1896: Dodge, 1896a; Friedlaender, B., 1896, 1896a; Grosser, 1899.
1897: Guppy, 1906.
1899: Anonymous, 1899; Baldwin, C. W., 1900; Castle, 1899; Fennell, 1899; Hitchcock, C. H., 1900; Ingalls, 1900; Jaggar, 1939a; Macdonald, G. A., 1945a; Miller, J. M., 1900; Wood, E., 1899.
1903: Anonymous, 1903a; Wood, E., 1904.
1907: Anonymous, 1907a; Baker, A. S., 1907; Bishop, S. E., 1907; Westervelt, 1907.
1920: Meinzer, 1921a.
1933: Jaggar, 1933a, 1934, 1936a.
1940: Anonymous, 1940; Schulz, 1945; Waesche, 1940b.
1943: Finch, 1943d, 1945; Volcano Letter 480, 482.
1944: Finch, 1945; Volcano Letter 483, 484, 485.
1946: Volcano Letter 492.
Mauna Loa, buried older volcano under: Powers, Ripperton, and Goto, 1932; Stearns and Clark, 1930; Stearns and Macdonald, 1946.
Mauna Loa, faulting at: Hinds, 1926; Stearns and Clark, 1930; Stearns and Macdonald, 1946.
Mauna Loa, general: Anderson and Bonney, 1917; Anonymous, 1907, 1919, 1932; Baker, E. F., 1885; Bonney, 1899; Boscowitz, 1884; Brigham, 1909; Bryan, E. H., 1953; Castle, 1920; Cheney, 1892; Coan, T. M., 1871; Coleman, 1946; Da Costa, 1925; Daingerfield, 1922; Daly, 1914, 1933; Dana, J. D., 1888, 1899; Dutton, 1883, 1884; Finch, 1925b; Friedlaender, L., 1931; Geikie, 1903; Haas, 1909; Hawaii National Park, circulars of information; Hinds, 1931, 1943; Hitchcock, C. H., 1909a; Iddings, 1914; Jaggar, 1921, 1921a, 1921b, 1934, 1939b; Kneeland, 1888; MacCaughy, 1918; Marceuse, 1894; Marshall, 1912; Mather, S. T., 1927; Menzies, 1907; Mercalli, 1907; Powers, S., 1915a, 1916; Rodgers, 1921; Scrope, 1862; Stearns, 1946; Stearns and Clark, 1930; Stearns and Macdonald, 1946; Stone, E. K., 1910; Suess, 1897; Tyrrell, 1931; van Doorinck, 1933; von Wolff, 1914; Washington, 1923a; Zurcher and Margolés, 1869.
Mauna Loa, history of activity: Anonymous, 1907b; Brigham, 1909; Bryan, W. A., 1915; Coan, T. M., 1871, 1889; Dana, J. D., 1888, 1890; Dutton, 1884; Gordon-Cumming, 1883; Green, W. L., 1887; Hawaiian Vol. Obs. Bull., Weekly Reports, Volcano Letter; Hitchcock, C. H., 1909a; Jaggar, 1922, 1931a, 1934, 1934b, 1938a; Macausce, 1894; Mercalli, 1907; Sapper, 1917, 1927; Schneider, 1911; Scrope, 1862; Stearns and Macdonald, 1946; Stewart, G. W., 1882; Thrum, 1907; von Wolff, 1914, 1929; Waesche, 1940b; Williamson, 1869.
Mauna Loa, northeastern rift: Jaggar, 1939a; Macdonald, G. A., 1945b.
Mineral resources: Day, D. T., 1898, 1899; Freeman, 1927; Palmer, 1928.
Mineralogy, Hawaii: Aurousseau and Merwin, 1928; Brown, G. V., 1916; Daly, 1911a; Dana, J. D., 1892; Dunham, 1933; Finch and Emerson, 1925; Penfield and Forbes, 1896; Washington and Merwin, 1921, 1922; Winchell, 1940.
Mokuaueuwo, history of: Jaggar, 1931b; Stearns and Clark, 1930; Stearns and Macdonald, 1946.
Molluscan fauna, origin: Bartsch, 1936.
Molybdenum, in Hawaiian rocks: Ferguson, 1914.
Mudflow of 1868, Hawaii: Coan, T., 1869; Lyman, F. S., 1868, 1868a; Williamson, 1869.

N
Nickel, in Hawaiian lavas: Wells, 1943.

O
Olivine: Aurousseau and Merwin, 1928; Daly, 1911a; Dana, J. D., 1892; Penfield and Forbes, 1896.
Oxidation of lava by steam: Ferguson, 1919.

P
Pahala ash, Hawaii, origin: Dutton, 1884; Emerson, J. S., 1902; Hitchcock, C. H., 1888, 1900; Palmer, 1931a; Stearns and Clark, 1930; Stearns and Macdonald, 1946; Stone, J. B., 1926a; Wentworth, 1938.
Pahoehoe, characteristics of: Hodgkins, 1936; Jaggar, 1917c, 1918, 1930g; Jones, A. E., 1937a, 1943; MacCaughey, 1917; Perr et, 1913e; Stearns and Clark, 1930; Washington, 1923c.

Pahoehoe, formation of: Chang, 1930; Emerson, J. S., 1926; Finch, 1926a; Jaggar, 1935b; Jones, A. E., 1937a; Washington, 1923c.

Pele, Hills of: Westerveldt, 1907.

Pele's bail': Dana, J. D., 1879; Friedlaender, I., 1914; Jackson, 1846; Jaggar, 1935b; Jones, A. E., 1937a; Washington, 1923c.

Peta's tears: Moor, 1916; Perr et, 1913c.

Petrology, Hawaii: Aroussseau and Merwin, 1928; Barth, 1930, 1931, 1931a, 1944; Beach and Eller, 1939; Bower, 1927, 1928; Burri, 1926; Cohen, 1876; Cross, 1903, 1904, 1911, 1913, 1915; Daly, 1910a, 1911a, 1914, 1916, 1933, 1944; Dana, E. S., 1889, 1890; Dana, J. D., 1849, 1879; Doerr, 1933a; Fenner, 1929, 1931; Iddings, 1913; King, 1878; Krukenberg, 1877; Lyons, 1896; Macdonald, G. A., 1942b, 1944, 1944a, 1944b, 1946, in prep.; Merrill, 1894; Moore, 1916; Powers, H. A., 1931b, 1935; Powers, S., 1920a; Stillman, 1829, 1831; Silvestri, 1888; Stearns and Clark, 1930; Stearns and Macdonald, 1946; Stone, J. B., 1926a; Tilley, 1922; Washington, 1921b, 1921c, 1921d, 1923, 1923a, 1923b, 1925c.

Phreatic explosions: see Explosions, volcanic.

Physiography, of Hawaii: Baldwin, C. W., 1901, 1905, 1914; Bishop, S. E., 1906; Bryan, W. A., 1915; Castle, 1920; Dodge, 1897; Douglas, E. M., 1923; Hinds, 1931; Hitchcock, C. H., 1909a; MacCaughhey, 1917; Mann, 1866a; Martin and Pierce, 1913; Palmer, 1935; Petersen, 1927; Stearns and Macdonald, 1946; Wentworth, 1936.


Pit-craters: Brigham, 1868, 1915; Dana, J. D., 1849; De Vis-Norton, 1922; Doerr, 1932; Finch, 1946; Stone, 1926a; Wilkes, 1845.


Plant invasion on lava flows: Skottsberg, 1942.


Prediction of volcanic eruptions: Jaggar, 1912, 1912d, 1915a, 1915a, 1934b, 1934f; Finch, 1942.

Pressure plateaus: Schulz, 1943.

Pressure ridges: see Tumuli.

Pumpage of ground water: see Wells, pumpage.

Puna, faulting in 1924: Finch, 1925; Jaggar and Finch, 1924; Wingate, 1931a.

Puna district, geology and ground water of: Stearns and Macdonald, 1940.


Puna, pit craters in: Brigham, 1915; De Vis-Norton, 1922; Stearns and Macdonald, 1946.

Puu O Keokeo, independent volcanic center: Bishop, S. E., 1907; Powers, S., 1920a.


Pyroclastic deposits: see Eruptions, volcanic.


Radioactivity, of lavas: Joly, 1909; Piggot, 1931.

Radium, in Hawaiian lavas: Piggot, 1931.

Rain, volcanic: Finch, 1930.

Rainfall cycles: Cox, 1924.

Regional structure: Betz and Hess, 1942; Daly, 1934; Dana, J. D., 1888, 1890; Friedlaender, I., 1918; Green, W. L., 1877, 1887; Woodworth, 1896.

Resistivity (electrical) studies: Swartz, 1937.

Reticulite: see Thread-lace scoria.


Road metal: Stearns and Macdonald, 1946.

Rocks: see Petrology.

Safety valves, volcanoes as: Dana, J. D., 1849, 1850.

Salt content, of ground water: see Chloride content.

Sea water, specific gravity of: Wentworth, 1939a.

Seasons, effect of, on volcanic eruption: Geikie, 1903.

Sediments, of Pacific islands: Wentworth and Ladd, 1931.

Seismic prelude to eruptions: Finch, 1943c; Wood, H. O., 1915a.

Seismic sea waves: see Tsunamis.


Shift, horizontal, at Kilauea: Jaggar, 1933; Waesche, 1937a; Wilson, K. M., 1935.
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Shore benches: Howard, 1938; Stearns, H. T., 1941a, 1945a; Stearns and MacDonald, 1946; Wentworth, 1938a; Wentworth and Palmer, 1925.

Sinks, volcanic: Daly, 1914; Hinds, 1926.

Slump scarps, in lava flows: Finch, 1933; Schulz, 1948.

Soils: Ayres, 1943; Foster, 1939; Freeman, 1927; Hough, Gile, and Foster, 1941; Kelley, McGeorge, and Thompson, 1915; Lyons, A. B., 1896; Maxwell, 1808; McGeorge, 1917; Palmer, 1930, 1931, 1935a; Powers, Ripperton, and Goto, 1932; Stubbs, 1901.

Soil erosion: Egler, 1941; Winters, 1939; Zehokeke, 1931.

Solfataric alteration of rocks: MacDonald, G. A., 1944b, 1946; Payne and Mau, 1946; Maxwell, 1898.

Solfataric gases: Ballard, 1938; Ballard and Payne, 1940; Brun, 1911; Clarke, F. W., 1924; MacDonald, G. A., 1944b; Maxwell, 1808; Payne and Ballard, 1940.

Solstice, effect on height of lava column: see Astronomical influences on height of lava column.

Source fissures of lava flows: Coan, T., 1857, 1882; Dana, J. D., 1849, 1856; Haskell, 1859a; Jaggar, 1930.


Springs, general: Stearns and MacDonald, 1946.


Springs, Kau District: Guppy, 1906a; Hitchcock, C. H., 1905a; Martin and Pierce, 1913; Stearns and Clark, 1930; Stearns and MacDonald, 1946.


Springs, Puna District: Anonymous, 1935; Brigham, 1909, 1915; Guppy, 1906a; Martin and Pierce, 1913; Stearns and MacDonald, 1946.

Springs, temperature of: Guppy, 1906a; Martin and Pierce, 1913.

Stalactites, lava: see Lava stalactites.

Steam, oxidation of lavas by: Ferguson, 1919.

Steam vents, Kilauea: Fagerlund, 1944.

Stratigraphy of Island of Hawaii: Stearns, H. T., 1926a, 1945b; Stearns and Clark, 1930; Stearns and MacDonald, 1946; Stone, J. B., 1926a.

Stream gaging records: (continued)

Aealaul Stream: Martin and Pierce, 1913; Pierce and Larrison, 1914; Larrison, 1915.


Hakalau Stream: Martin and Pierce, 1913.

Hamakua Ditch, lower: Martin and Pierce, 1913; Pierce and Larrison, 1914; Larrison, 1915, 1917, 1918; Bailey, 1919; Bailey and Stewart, 1923; Stewart, J. E., 1924.

Hamakua Ditch, upper: Larrison, 1915, 1917, 1918; Bailey, 1919; Bailey and Stewart, 1923; Stewart, 1924.

Hamakua Ditch, new: Pierce and Larrison, 1914.

Hanawai Stream: Martin and Pierce, 1913; Pierce and Larrison, 1914; Larrison, 1915.

Hanaupuego Stream: Martin and Pierce, 1913.


Hokunamoe Stream: Martin and Pierce, 1913.

Holualoa Stream, in Kona: Stewart, J. E., 1924.

Honokea Stream: Martin and Pierce, 1913.

Honolili Ditch: Martin and Pierce, 1913.

Honolii Stream, near Hilo: Burchard and Carson, 1929; Carson, 1930, 1930a, 1930b, 1932, 1932a, 1933, 1933a, 1934.

Honolii Stream, stations at 2.700 feet altitude: Martin and Pierce, 1913; Pierce and Larrison, 1914; Larrison, 1915.

Honolii Stream, at Kawai: Martin and Pierce, 1913; Pierce and Larrison, 1914; Larrison, 1915.

Honomua Stream: Martin and Pierce, 1913; Pierce and Larrison, 1914; Larrison, 1915.

Huihili Stream: Martin and Pierce, 1913.

Kaahakini Stream: Martin and Pierce, 1913.

Kahina Pukil Stream: Martin and Pierce, 1913.

Kamehame Stream: Martin and Pierce, 1913; Pierce and Larrison, 1914.

Kalaoa Stream: Martin and Pierce, 1913; Pierce and Larrison, 1914.
Kaleikil Stream: Martin and Pierce, 1913.
Koheleki Stream: Martin and Pierce, 1913.
Kapahehe Stream: Martin and Pierce, 1913; Pierce and Larrison, 1914; Larrison, 1915.
Kapeha Stream: Martin and Pierce, 1913; Pierce and Larrison, 1914.
Kapena Stream: Martin and Pierce, 1913.
Kapue Stream: Martin and Pierce, 1913; Pierce and Larrison, 1914; Larrison, 1915.
Kaumana Springs, at Hilo: Stearns and MacDonald, 1946.
Kawainui River, near Pepeekoe: Martin and Pierce, 1913; Pierce and Larrison, 1914.
Kawainui River, stations at 2,700 feet altitude: Martin and Pierce, 1913; Pierce and Larrison, 1914; Larrison, 1915.
Kawainui Branch of Waipio River: Martin and Pierce, 1913; Pierce and Larrison, 1914.
Kekalani Stream: Martin and Pierce, 1913.
Kehena Ditch, at Honokane mauka: Larrison, 1915.
Kehena Ditch, summary of yearly discharge: Carson, 1941.
Kikalani Stream: Martin and Pierce, 1913.
Kikola Stream: Martin and Pierce, 1913; Pierce and Larrison, 1914.
Kiilau Stream: Martin and Pierce, 1913.
Kipahulu Stream: Larrison, 1917.
Kohala Ditch, summary of yearly discharge: Carson, 1941.
Koheska Stream: Martin and Pierce, 1913.
Kolawe Stream, near Waipio: Martin and Pierce, 1913.
Kolekole Stream: Martin and Pierce, 1913.
Kumunuakea Stream: Martin and Pierce, 1913; Pierce and Larrison, 1914.
Laupahoehoe Stream: Martin and Pierce, 1913.
Linoli Springs: Pierce and Larrison, 1914.
Lyons Ditch: Larrison, 1917.
Maile Stream: Martin and Pierce, 1913; Pierce and Larrison, 1914; Larrison, 1915.
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Makowai Stream: Martin and Pierce, 1913; Pierce and Larrison, 1914; Larrison, 1915.
Manoloa Stream: Martin and Pierce, 1913.
Manowalapao Stream: Martin and Pierce, 1913.
Maulua Stream: Martin and Pierce, 1913.
Moanalulu Stream: Martin and Pierce, 1913.
Nanui Stream: Martin and Pierce, 1913.
Nihole Stream: Martin and Pierce, 1913.
Okole Stream: Martin and Pierce, 1913.
Olaa flume at Kaumana: Bailey and Stewart, 1923; Stewart, J. E., 1924. Olaa flume near Mountain View: Carson, 1940.
Onomea Stream: Martin and Pierce, 1913; Pierce and Larrison, 1914.
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Papa Stream: Martin and Pierce, 1913.
Papaalona Stream: Martin and Pierce, 1913.
Peleau Stream: Martin and Pierce, 1913.
Pelekualao Ditch: Larrison, 1917.
Pepeekoe Stream: Martin and Pierce, 1913; Pierce and Larrison, 1914.
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Pohakupuka Stream: Martin and Pierce, 1913.

Poopoo Stream: Martin and Pierce, 1913.

Pukihae Stream: Martin and Pierce, 1913; Pierce and Larrison, 1914; Larrison, 1915.


Pun Alaell Stream: Martin and Pierce, 1913.

Puuohua Stream: Martin and Pierce, 1913.

Pun Olii Stream: Martin and Pierce, 1913.

Wniaama Stream: Martin and Pierce, 1913; Pierce and Larrison, 1914.

Waiakea Estuary: Stearns and Macdonald, 1946.


Waiakea Stream: Martin and Pierce, 1913; Pierce and Larrison, 1914.

Waiakamalo Stream: Martin and Pierce, 1913.

Waikoloa Stream: Martin and Pierce, 1913.

Wailuku River, stations at 2,700 feet altitude: Martin and Pierce, 1913; Pierce and Larrison, 1914; Larrison, 1915.


Waima Stream, near Waipio: Martin and Pierce, 1913.

Waimale Stream: Carson, 1933a, 1942.

Waimalino Stream: Martin and Pierce, 1913.


Walohulu Springs: Bailey, 1919.

Walpahoe Stream: Martin and Pierce, 1913; Pierce and Larrison, 1914.

Walpahoehoe Stream: Martin and Pierce, 1913.

Punio River, at 360 feet altitude: Martin and Pierce, 1913.

Waihue Stream: Martin and Pierce, 1913.


Wiska Stream: Martin and Pierce, 1913.


Winehun Springs: Bailey, 1919.

Waihee Stream: Martin and Pierce, 1913.

Waikoloa Stream: Larrison, 1917.

Wailuku River, near Hilo: Martin and Pierce, 1913; Pierce and Larrison, 1914; Larrison, 1915, 1917; Bailey, 1919; Bailey and Stewart, 1923; Stewart, J. E., 1924.


Waiapu River. stations at Piihonua: Pierce and Larrison, 1914.

Waiakumalo Stream: Martin and Pierce, 1913.

Wailuku River, stations at 2,700 feet altitude: Martin and Pierce, 1913; Pierce and Larrison, 1914; Larrison, 1915.

Waihe Stream: Martin and Pierce, 1913.

Wahilau Stream: Larrison, 1917.

Waihi Stream: Martin and Pierce, 1913.

Waiakamalo Stream: Martin and Pierce, 1913.

Waima Stream, near Waipio: Martin and Pierce, 1913.

Sub-Pacific crust: Daly, 1934.

Subsidence of coastlines, Hawaii: Coan, T., 1808b, 1869; Wingate, 1931a.

Sulfate deposits: Finch and Emerson, 1925.

Sunspots, relation to volcanism: Jaggar, 1931d, 1931k, 1938a; Lyons, C. J., 1899; Stearns and Macdonald, 1946.

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Tectonic forces, as cause of volcanic eruption: Wood, H. O., 1914, 1917, 1921.

Temperature, of lava lake: see Kilauea, temperature measurements.

Thread-lace scoria: Dana, J. D., 1888, 1890; Krukenberg, 1877; Stearns and Clark, 1930; Wentworth and Williams, 1932.

Thurston lava tube, Kilauea: Powers, S., 1920; Stearns and Clark, 1930.

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Tilt, of ground surface: see also Tumescence. Eller, 1937; Jaggar, 1920, 1932d, 1933; Jaggar, Finch, and Emerson, 1923; Wood, H. O., 1917a.

Trachyte of Puu Waawa, Hawaii: Cross, 1903, 1904; Daly, 1910a; Ferguson, 1914; Powers, S., 1920a; Washington, 1923a.

Tree molds and casts: Brigham, 1915; Coan, T., 1882; Doerr, 1933; Finch, 1931; Hitchcock, C. H., 1909; Perret, 1913e; Westervelt, 1907a.

Triangulation, at Kilauea: Waesch, 1937a; Wilson, R. M., 1935; Wingate, 1931, 1933.


Tsunamis: Alexander, W. D., 1891; Anonymous, 1883, 1896, 1901, 1906a, 1906b, 1933; Bennett, 1869; Brigham, 1858, 1859; Coan, T., 1858a, 1858b, 1870, 1882; Dana, J. D., 1850, 1859; Finch, 1924; Hitchock, C. H., 1909a; Jaggar, 1923, 1930p, 1931; Jarves, 1843; Jones, 1931; Macdonald, Shepard, and Cox, 1947; Powers, H. A., 1946, 1946b; Stearns and Macdonald, 1946; Thrum, 1906; Westervelt, 1916a; Wood, H. O., 1914, 1933.

Tumescence, of volcanoes: see also Tilt. Day and Allen, 1925; Jaggar, 1920, 1929, 1930a, 1930h, 1933, 1939a; Jaggar, Finch, and Emerson, 1923; Jaggar and Finch, 1928; Powers, S., 1916b; Waesch, 1937, 1937a; Wilson, R. M., 1933.

Tumuli, formation of: Coan, T., 1856b, 1856c; Daly, 1914; Jaggar, 1931f; Perret, 1913e; Schulz, 1943.

Tunnels, ancient, in Kohala District: Williams, J. N. S., 1918.


Two-phase convection, at Kilauea: Daly, 1911, 1911a, 1914, 1933, 1944; Graton, 1945; Jaggar, 1917a, 1920.

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