10-23

DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HAWAII NATIONAL PARK

FILE No.

M O N T H L Y   R E P O R T S

FISCAL YEAR 1 9 2 9
" 1930
" 1931

10-23

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

HAWAII NATIONAL PARK

FILE NO.

MONTHLY REPORTS

FISCAL YEAR 1929

" 1930

" 1931

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HAWAII NATIONAL PARK

OFFICE OF THE SUPERINTENDENT [redacted], HAWAII

July 8, 1929

Director,
National Park Service,
Department of the Interior,
Washington, D. C.

Dear Mr. Director:-

Herewith is submitted the report of operations and activities during the month of June 1929 in Hawaii National Park.

000 GENERAL:

June has been an exceptionally dry month over a considerable area of the park. So far our own water supply, which is stored rainfall, shows no shortage but that at Kilauea Military Camp is already exhausted forcing them to haul water from Glenwood, ten miles away.

100 ADMINISTRATION:

120 Inspections by:

121 Superintendent:

The usual inspections of maintenance operations were made by the superintendent.

200 MAINTENANCE, IMPROVEMENTS, NEW CONSTRUCTION:

210 Maintenance:

No unusual maintenance problems have arisen during June although the dry, dusty weather has been hard on park roads.

220 Improvements:

A bad blind double curve on the Kilauea Crater road inside the crater has been eliminated by cutting road straight across it. The location is through a volcanic ash area and required no clearing. The constant danger of automobile collisions prompted this work.

230 New Construction:

Although our new buildings for 1930 have not yet been started the material for two ranger cottage has been contracted for and is being delivered.

300 ACTIVITIES OF OTHER AGENCIES IN THE PARK:

310 Public Service Contractors.

The Kilauea Summer Camp opened for this seasons business on June 20th.

400 FLORA, FAUNA AND NATURAL PHENOMENA:

410 Naturalist Service:

The lectures on volcanic history given at Uwekahuna Observatory continue to grow in popularity. Already the seating capacity of the observatory has proven too small. During June 19 lectures were given to 1,007 persons.

430 Natural Phenomena - (Volcano)

Indications now make it appear that the next flow of lava in this region may be from the southwest slope of Mauna Loa somewhere near the 1926 Hoopuloa flow. Recent earthquake which have all centered in that district indicate lava movement there now.

500 USE OF PARK FACILITIES BY THE PUBLIC:

510 Travel:

Travel is gradually creeping up to equal last year's total. June travel this year is far in excess of 1929 and has done much toward offsetting the 1930 visit of the sailors from the U. S. Fleet. Disregarding last years fleet attendance our figures would show a good increase in normal visitors. Territorial schools closed in late June and summer cottage residents in and near the park are expected early in July.

530 Weather.

June was an unusually dry month but wonderful otherwise.

Maximum temperature	———	17th	———	76
Minimum "	———	27th	———	51
Rainfall for month of June			———	3.70 inches
" " " " " at Hilo			———	3.01 "
" to date Volcano District			———	30.30 "
" " " at Hilo			———	59.47 "

540 Visitors:

Rear-Admiral Geo. Marvell the commanding officer of all U. S. Navy operations in Hawaii spent a three weeks vacation at Volcano House during June.

Six hundred persons arrived on the S. S. Malolo on a special post-convention tour of Shriners from Los Angeles.

600 PROTECTION:

Geo. D. Douglas former park ranger already charged with other offenses was indicted by the U. S. Grand Jury on June 21st and arrested under a charge of stealing official correspondence from the files of this office. Douglas is now held on $1000 bail pending trial. A full report has been made separately.

900 MISCELLANEOUS:

Notice has been received during June of the final dismissal from the Service under date of May 16 of Ranger Geo. D. Douglas.

The superintendent was in Honolulu on official business from June 20 to 30.

The superintendent, on June 5, addressed the Hilo Rotary Club on the history and present organization of the National Park Service.

A final search by 11 army planes was made, on June 25th to 27th, in the hope of finding the lost "Golden Eagle" plane of the Dole Pacific ocean non-stop flight. All rumors to the effect that the "Golden Eagle" carrying Denham Scott and John Frost had crashed against Mauna Loa were disproved by a concentrated flight of army aviators over the area in discussion. This final search was organized by Ezra R. Frost a brother of John Frost and himself an ex-army aviator. It is of interest to the park service that Ezra Frost spent the summer of 1923 as a ranger in Rocky Mountain National Park while I was Chief Ranger there.

Very respectfully yours,

Thos J. Allen Jr.,
Superintendent.

Copy to Yellowstone National Park.

" " Field Headquarters.

TJA/H:

10-157

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

TRAVEL REPORT

Hawaii National Park for the Month of June 1929

	This Month	This Travel Year To Date	This Month Last Year	Last Travel Year To Date	Increase for Travel Year Number	Increase for Travel Year Percent
PRIVATE TRANSPORTATION:						
Cars first entry,						
Cars reentry,						
Motorcycles,						
Total motor vehicles,						
Persons entering via motor vehicles,	7,710	45,348	5,229	45,556	- 208	.0045
Persons entering via other private transportation,	84	1,867	391	2,694	- 827	.307
Total persons entering via private transportation,	7,794	47,215	5,620	48,250	- 1,035	.0214
OTHER TRANSPORTATION:						
Persons entering via Hotel stages,	1,620	10,049	1,207	9,941	108	.0107
Persons entering via trains,						
Persons entering otherwise,						
Total other transportation,	1,620	10,049	1,207	9,941	108	.0107
GRAND TOTAL ALL VISITORS,	9,414	57,264	6,827	58,191	- 927	.0159

	This Year	Last Year	Increase Number	Increase Percent
Automobiles in public camps during month,	3	0	3	100
Campers in public camps during month,	7	0	7	100

10-159

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

STATUS OF PERSONNEL

Hawaii National Park for the Month of June 1929

	This Month	This Month Last Year
Number of employees beginning of month,	8	11
Number of additions, ...	5	4
Total, ...	13	15
Number of separations, ...	2	4
Number of employees close of month, . . .	11	11
Number of promotions during month	0	1
Aggregate amount of annual leave taken,	0	0
Aggregate amount of sick leave taken,	0	0
Aggregate amount of leave without pay,	0	10

10-160

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

REPORT OF PARK REVENUES

Hawaii National Park for the Month of June 1929

	This Year	Last Year
Park revenue on hand beginning of month,	0.00	0.00
Received,	25.00	25.00
Total,	25.00	25.00
Remitted,	25.00	25.00
On hand close of month,	0.00	0.00

Park revenues received this year to date,	$ 1,202.00
Park revenues received last year to date,	1,200.00
Increase,	2.00
Percent of increase,	1.7%

10-161

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

HAWAII NATIONAL PARK

REPORT OF SALES OF PUBLICATIONS

June 1929

	Number	Value
GOVERNMENT PUBLICATIONS:		
On hand beginning of month,	458	131.30
Received during month,	0	0.00
Total,	458	131.30
Sold during month,	14	9.50
On hand at close of month,	444	121.80
NON-GOVERNMENT PUBLICATIONS:		
On hand beginning of month,	0	0.00
Received during month,	10	25.00
Total,	10	25.00
Sold during month,	0	0.00
On hand at close of month,	10	25.00

Cash on hand beginning of month,	21.00
Sales during month,	9.50
Total,	30.50
Remitted during month,	0.00
Balance,	30.50

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Address: HAWAIIAN VOLCANO OBSERVATORY, HAWAII NATIONAL PARK, T. H.

THE VOLCANO LETTER

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No. 232 RELEASED WITHOUT COPYRIGHT RESTRICTION June 6, 1929

KILAUEA REPORT No. 906

WEEK ENDING JUNE 5, 1929

Section of Volcanology, U. S. Geological Survey

T. A. Jaggar, Volcanologist in Charge

Examination of Halemaumau pit at 5:50 p. m. May 30 showed that the whole northwest talus was covered with new gray debris, this overlapped the lava floor of 1929, and the wall showed fresh breaks above this talus clear to the top. Sliding at the north corner had been observed the previous day. On June 3 at 8:45 a. m. a large dun colored dust cloud from an avalanche was seen to rise over the northwestern half of the pit.

Eight very feeble earthquakes were registered for the week, one of these coincident with the above mentioned avalanche cloud. Tilt was moderate NNE., and microseismic motion was slight.

OCEAN SALTS FROM VOLCANOES

Visitors to the sulphur bank near the hotel at Kilauea have been impressed with the heavy layers and beautiful crystals of sulphur, with steam at 96° C. puffing up and smelling of sulphur dioxide. In the summer 1922 Dr. E. T. Allen determined that the vapor from the bore-holes has the following composition by volume:

Steam	96.2
Fixed gases (nitrogen etc.)	3.7
Sulphur dioxide	.096
Sulphur vapor	.004
Hydrochloric acid	trace
	100.00 percent

In one or two years the big iron pipes that encase the bore-holes become lined with an inch or so of compacted crystals of pure sulphur over a thin layer of sulphide of iron, a black coating that is next to the metal. All of this, and the heavy banks of sulphur that cover the old ash deposits, are laid down from .004 per cent sulphur vapor in the steam. (Bull. Haw'n Volc. Obsy. Vol. X, No. 8.)

Dr. E. G. Zies determined at the Valley of Ten Thousand Smokes near Katmai, Alaska, that the fumaroles gave off 26 million liters of steam per second containing about 0.2 per cent of hydrochloric acid, hydrofluoric acid, and hydrogen sulphide. Figuring the volumes given off per year and reducing to weights, this amounts to 1,250,000 tons annually of hydrochloric acid gas, 200,000 tons of hydrofluoric acid gas, and 300,000 tons of hydrogen sulphide gas.

The temperatures of these gases in 1919, seven years after the eruption, exceeded 500° C., the incrustations lining the cracks showed how powerful had been the solvent action of the gases, indicating the power of such an agency to concentrate valuable ore deposits.. At the Kilauea sulphur banks there is abundant pyrite, a product of the action of the fumarole gases on the lava.

The power and rapidity of this deposition, despite the tiny percentage of the ingredients in the steam, only appears when we consider the agregate quantity of even the least significant of the acid gases when continually discharged into the atmosphere at these rates. The average river contains insufficient chlorine to convert its sodium into salt; the ocean contains much more chlorine than sodium. One hundred million tons of hydrochloric acid is the annual requirement to account for the saltiness of the sea. In about 40 inches of world-wide rainfall this would amount to one-fifth of a millionth part of chlorine. Yet in ordinary chemical determinations one part in a million is considered insignificant. Hence we see what a large part can be played by volcanic steam which never ceases.

Of this 100 million tons of hydrochloric acid gas the Katmai area alone of the 450 active volcanoes of the world was contributing more than one per cent in 1919, and Kilauea, with its bare trace of chlorine, contributed about 30,000 tons. Many volcanic districts discharge acid gases. It appears that volcanoes, of which also there are many on the sea bottom mostly unknown, are quite competent to supply to the ocean the excess of chlorine needed for its salt.

The fluorine content of seawater is only one-twenty-fourth that of chlorine. The fluorine becomes locked up in the incrustations, and when it gets into the sea is absorbed into the bones and shells of marine animals, all of the phosphate beds of the vast ancient oceans showing a fluorine content of from 1.0 to 1.5 per cent. This element forms an insoluble compound with calcium, in contrast to chlorine which with sodium forms the highly soluble common salt. This disparity between the amounts of fluorine and chlorine in sea water, and the relatively large amounts of fluorine given off by volcanoes, disposes at once of the argument that volcanoes get their chlorine from the sea. Everything indicates that both these halogen gases are derived from the lava itself. (Annual Report Director Geophysical Laboratory, Year Book No. 27, 1928 Carnegie Institution, page 81.)

Sea water contains calcium carbonate as well as other salts. This is secreted from the water in the body of globigerina, a tiny organism ceaselessly dying and depositing billions of skeletons that make chalk on the ocean bottom. Locally the ocean floor is built up a foot per annum. Ten thousand years would shoal the ocean, but there have been millions of years, and the ocean is still deep.

The accumulation of heavy chalk or globigerina ooze is partly kept low by isostasy, the crust sinking and the continents rising. But this could not take care of millions of years of globigerina hailtsones. And what furnishes the lime to the salt water? Shifting shorelines and erosion of limestones on the land has furnished new lime to the rivers and the sea. But has the amount of rising limestone equalled the vast seabottom, which covers seven-tenths of the surface of the earth?

But though globigerina is everywhere in the upper waters, two-thirds of the seabottom has no chalk. What could account for chalk banks being absent? The chalky bottoms are where the ocean is not so deep. It was found that where the ocean is more than two and a half miles deep, where the pressure approaches three tons per square inch, sea water can readily dissolve the chalk skeletons. And so, with the circulation of the oceans the lime salts are brought back and secreted over again by the live organisms. (Liverpool Echo, January 26, 1929, citing J. Stanley Gardiner, professor of zoology, Cambridge.)

T.A.J.

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THE VOLCANO LETTER

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No. 233 RELEASED WITHOUT COPYRIGHT RESTRICTION June 13, 1929

KILAUEA REPORT No. 907
WEEK ENDING JUNE 12, 1929

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

Halemaumau remains practically unchanged, with occasional slides from the walls. Debris from recent slides was noticed on the northwest talus June 5, at 2 p. m., with larger bowlders on the lava floor. A small slide was observed on the south wall at 9:30 a. m. June 8. The pit otherwise was very quiet. On June 9 nothing new was seen. There was a small rockfall north about 10 a. m. today. Very thin dust from a slide rose north at 2:15 p. m.

Twice as many earthquakes were recorded this week as for the preceding week; namely, 16 of very feeble intensity. The accumulation of tilt was slight to the northwest Microseismic motion was normal.

WEATHERING OF HAWAIIAN LAVA

Many people who visit Hawaii ask the question "How long does it take for these fresh lava flows to make soil?" The first of a series of papers on the chemistry of decomposition of basaltic lavas in Hawaii (The Composition of Lavas and Soils from Kauai, by N. E. A. Hinds, Am. Jour. Sci. April, 1929) has been published by Professor Hinds, including reviews of many analyses made by Kelley, McGeorge, and Thompson, Bulletin 40, Hawaii Agricultural Experiment Station.

On all the islands there are astonishing differences of rainfall and of climate, wet on the side of the trade winds, dry on the opposite side. On the dry sides lava remains unaltered, on the wet sides it breaks down rapidly.

The predominant lavas of Kauai, the western of the larger islands, are olivine basalts, composing 85 per cent of the dome visible above sealevel; next come augite andesites and olivine augite andesites, while subordinate in amount are the basic lavas largely augite and olivine and some rare nephelite and melilite basalts.

Olivine is very conspicuous in most of the rocks as large and numerous visible crystals. Hinds found these in approximately 92 per cent of 400 specimens. Most of the lava is of the blocky or aa type, the ratio of aa to pahoehoe (smooth lava) being about 3 to 1. The chemical composition of the Kauai lavas when fresh, (and the smaller island Niihau to the west is very similar,) is as follows: Silica 40-49 per cent, alumina 8-14, iron 11-14, magnesia 7-16 lime 9-12, alkalies 2-5, water 0.30-1.00, and titanium oxide 2-3.

Rainfall on windward Kauai varies from 50 to 100 inches along the eastern and northern coasts, and from 10 to 30 inches on the western coast which is 12 to 15 miles from the summit of the single volcano dome that makes up the island. This summit, slightly over 5,000 feet in height, is possibly the rainiest locality in the world, where for a seven-year period the extraordinary average of 473 inches per annum of precipitation was measured. The main average temperature yearly for elevations varying from 14 to 300 feet ranges from 68° to 79° F.

Most of the weathering is chemical. There is a little frost on the uplands, and the detritus is moved by streams, landslides, and ocean waves, but the mineralogical and chemical changes in the soil vary mostly with the climate of different sections of the island. There are no analyses as yet from the swampy region of the summit plateau. The soils and subsoils are in the main from decomposition in place of lavas and agglomerates, the latter from local vents where this material has been dumped about subsidiary cones on the weathered lavas. There are some alluvial soils at the mouths of rivers, and some coral detritus near the shores.

Throughout the Hawaiian islands rock alteration varies with the climate and the age of the domes. Younger domes are Haleakala, Mauna Kea, Hualalai, Mauna Loa, and Kilauea; older ones are Kauai, east and west Oahu, east and west Molokai, west Maui. Kohala, Niihau, Lanai, and Kahoolawe. The last three have dry climates and are less dissected and better preserved than the wet islands. The stage of topographic evolution therefore is not a measure of age.

Some weathered lavas and their disintegrated products from Oahu yield the following:

	Lava (Per Cent)	Disintegrated Product
Silica	52	20
Alumina	11	38
Iron	10	18
Lime	10	0.33
Magnesia	6	0 20
Alkalies	3	0.50
Titanium ox.	4	4.7
Water	1	17

On Kauai bright brick-red soil is found in the dry regions, brown and dark-red soil in the wet, the powdered and clayey decomposition material passing downward into brown, yellow, gray, or green rotten rock in marked contrast to the soils and subsoils, for the latter retain none of the original texture. In the lower zone are great numbers of concentrically weathered bowlders (onion structure), having spherical or ellipsoidal masses of relatively fresh rock at the core. Going down farther we come to relatively unaltered rocks, the depth of the weathered zone depending on the amount of rainfall.

An average of eight soil analyses from Kauai gives percentage of insoluble residue, mostly silica 39, alumina 17. iron 14, magnesia 3, lime 0.89, alkalies 0.42, titanium oxide 2.3, water 12, averaged from a range of from 4 to 19.

The mechanical analyses of a typical soil gave in percentage volatile matter 19, fine gravel 0.02, coarse 1.57, fine sand 5.48, silt 6.449, fine silt 33.40, clay 33.50. The content of water in soils and subsoils is about the same, an average of 26 soils and subsoils together giving 8.6 per cent, of eight subsoils alone 8.14, and of 26 soils alone 9.16.

T.A.J.

NOTE: Address of Secretary, Hawaiian Volcano Research Association, is 300 James Campbell Building, Honolulu, T. H.

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No. 234 RELEASED WITHOUT COPYRIGHT RESTRICTION June 20, 1929

KILAUEA REPORT No. 908
WEEK ENDING JUNE 19, 1929

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

On June 13 at noon the north wall of Halemaumau was dusty with fresh red and gray scars and new material on the northwestern talus appearing fresh. There was other new red debris northeast, from the middle of the wall above. On June 18 the felt earthquake at 8:42 a. m. produced some sliding in the pit, but much stronger sliding was occasioned by the earthquake of 9:31 a. m. when much dust rose above the pit. Examination showed a gouge down the middle of the west wall where large fragments of rim rock had fallen so that broken debris lay on the lava floor below. At 11:40 a. m. rocks were heard and seen falling at the north, west, and south walls of the pit. On the west wall of Kilauea Crater north of Uwekahuna a fresh avalanche scar was produced by the large shock, with new talus below. A party near the Halfway House in the Kau Desert noted the earthquake of 9:31 as a shock accompanied by a rumble, and sufficiently strong to cause the trees to wave back and forth. At the Observatory the dominant effect was a slow east-west swaying with creaking of the building. The high magnification seismographs were dismantled.

It is worthy of note that this seismic disturbance occurs close to solstice, and that the press reports an eruption of Komagatake in the north island of Japan, and a disastrous earthquake in the southern district of New Zealand.

The seismographs registered for the week two distant earthquakes, two moderate local shocks, several very feeble local shocks, and one tremor lasting two minutes. The first of the two strongly felt Hawaiian shocks, at 8:42 a. m. June 18, indicated distance of origin 11 miles, and the second one, much stronger, at 9:31 a. m., 44 miles. The tremor following this lasted 10 minutes. The first distant earthquake was weakly recorded about 11:06 p. m. June 12. The second was more pronounced, beginning 12h. 28m. 46s. p. m. June 16. The indication of distance is 8,100 kilometers, and possibly this was the New Zealand shock.

Microseismic motion was light throughout the week. Tilt accumulated, moderate to the WSW.

ENGULFMENT AT KRAKATOA 1883

An important review of the history of the Krakatoa group of islands, bringing up to date the geology and the eruptive history, has just been published by the Volcanological Survey of the Netherlands East Indies as a special report for the Fourth Pacific Science Congress, Java, 1929 (The Geology and Volcanism of the Krakatau Group, by Dr. Ch. E. Stehn). The following is a summary of the constructive and destructive periods in the building of what is now a group of three islands at the corners of a triangle, with a new eruption in progress building a new islet in the sea between them (Volcano Letter No. 230).

I. Formation of a hypothetical ancient single volcano about 2,000 m. high of which the last lava streams and ejecta were hyperathene andesite with tridymite, and a microlithic devitrefied glass. The period involved the destruction of this volcano, leaving four remnant islands, with a sea basin in the center.

II Formation of an eccentric basaltic volcano covering the southern Rakata remnant, 800 meters high.

III. Submarine activity of two andesitic volcanoes, Danan and Perboewatan. Formation northward of an island, Krakatau proper, which joins up with the basaltic volcanic cone of Rakata. The same magma penetrates into the Rakata cone through a dyke fissure. Fresh activity in May, 1680.

IV. May 20, 1883, commencement of a new eruption which continued with short pauses, and became the gigantic famous eruption.

August 26-28, 1883, the greatest activity. Considerable increase in size of Rakata, Verlaten Eiland, and Lang Eiland from ejecta of andesitic magma, obsidian, pumice, and older rocks. Terminating with destruction of the volcanoes Perboewatan and Danan and half the basaltic cone of Rakata Peak. Formation of a basin 279 m. deep between the three islands left.

V. Severe abrasion by ocean waves especially on the west coasts, and extension of the low northern portion of Verlaten Eiland by the building of a spit.

VI. Submarine activity beginning June, 1927, and becoming an eruption December 29, 1927. Submarine cone of basaltic bombs, ashes, and old material appeared above the surface of the sea January 25, 1928, and later washed away. Submarine lava streams. The submarine crater rim appeared again January 28, 1929, forming new basaltic island "Anak Krakatau."

From May to August, 1883, smaller eruptions left their products close to the active craters and threw out much pumice. The paroxysm came on August 26 and thereafter. On August 27 Perboewatan subsided and a severe explosion followed, directing its discharge eastward. In no case were collapses preceded by explosions.

Fresh subsidences took place associated with tidal waves which formed bluffs. About six hours after the first subsidence August 27 came the gigantic collapse, followed by an explosion which piled unsorted pumice to thicknesses of 100 meters, strewed ash over 827,000 square kilometers, ejected ash clouds over 70 kilometers high, and made noises heard in Australia.

More subsidences and fractures occurred involving the basaltic Rakata Peak, and a second explosion that followed within an hour of the big one was believed to destroy Danan Volcano as shown by the sequence of the present strata. This disrupted the remainder of the big island and part of the sea bed, left a submarine ridge between the two explosion centers and deposited some shells and coral in the strata. More fractures followed and another engulfment of the northeastern part of Rakata and the south part of Lang Eiland, causing the last tidal wave.

Verbeek in 1885 prophesied "In any renewed activity of the volcano, islands will arise in the middle of the sea basin, just as formerly the craters Danan and Perboewatan formed in the sea within the old crater wall." This is just what is going on now.

In the light of what was observed showing engulfment the dominant process at Kilauea in 1924, Dr. Stehn's conclusion that collapse was the dominant process at Krakatoa in 1883 is of fundamental interest in volcanology.

T.A.J.

52,000 words of volcanic information if you save and bind the Volcano Letter
Hawaiian Time is 10h. 30m. slower than Greenwich

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No. 235 RELEASED WITHOUT COPYRIGHT RESTRICTION June 27, 1929

KILAUEA REPORT No. 909
WEEK ENDING JUNE 26, 1929

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

The week at Halemaumau has produced very few changes. On June 20 all was quiet One or two rocks fell south at 3:45 p. m. There was nothing new in the bottom or on the walls. On June 24 with a stiff NE. breeze, dust was disturbed on the northeast and south walls. Light rock falls were heard south and southwest. A dusty slide occurred northeast at 11:55 a. m. At 5 p. m. more dust was observed thinly spread over the pit. Today at 2:45 p. m. was seen the scar of slides from midway the north-northeast wall, and a pile of new gray debris at the foot. The ground back of the southeast rim shows very slight signs of caving at the cracks which opened in January, as though further movement had occurred there.

Earthquakes registered by the seismographs at the Observatory included seven very feeble local shocks, one two-minute tremor beginning 12:16 a. m. June 22, and one moderate earth shock also on June 22 at three minutes past noon. This earthquake, which was felt locally, had an indicated distance to origin of nine miles.

Tilt for the week accumulated moderately NNW. Microseismic motion was very slight.

NEW INVESTIGATIONS

Section of Volcanology.

Changes of personnel at the Hawaiian Volcano Observatory have recently occurred, and new investigations are now beginning. Mr. R. M. Wilson rejoined the Topographic Branch of the Survey in California in November, 1928, and Mr. Earl M. Buckingham was temporarily appointed in his place as topographic engineer at the Observatory. Mr. Buckingham made a new map of Halemaumau after changes in the walls had been made by the avalanches of January, 1929, and a new lava floor had been created by the eruption of February 20. He also continued investigations which had been started by Mr. Wilson dealing with mean sea level at Hilo, and with tilting of the ground at the Observatory as determined with level-bubble. Mr. Buckingham also joins the Topographic Branch of the Survey in California on July 1, 1929. Mr. Howard A. Powers, instructor in petrography at Harvard University, has been appointed Junior Geologist on the Survey as chief assistant at the Hawaiian Volcano Observatory, beginning July 1, 1929. Mr. Powers will specialize on the study of minerals in the rocks of the Hawaiian Islands along with mapping of the geologic formations on the basis of the excellent topographic maps of Hawaii made by the Topographic Branch in cooperation with the Territory under Captain A O. Burkland. These atlas sheets are now finished and in process of engraving for the whole of this island, and some geologic work has already been started by the Survey. This will now be carried forward, and the specimen collections of the Observatory will be subjected to microscopic and chemical examination. For the first time the Observatory will enter on the field of investigation of the older lavas of the island and their relation to the past history of the volcanoes.

For continuation of the seismologic work started in the Aleutian belt of Alaska, Mr. Austin E. Jones left Seattle on the Coast Guard cutter June 8, 1929, for Kodiak and Dutch Harbor, and in both those places he will establish seismograph recording. A new observer will be found for the seismograph at Kodiak, the service of which was discontinued in August, 1928, and the Hawaiian type seismograph now stored at Dutch Harbor will be set up in a cellar constructed for the purpose and operated in connection with the Naval Radio Station at that place. Mr. Jones is now at work building the cellar.

Hawaiian Volcano Research Association.

Professor Chester K. Wentworth of Washington University, St Louis, has been appointed Research Fellow of the Association for the summer months of 1929, and is now at work investigating the volcanic tuffs, soils, wind-blown deposits, and other related loose materials on the island of Hawaii. His special topic is the origin of the yellow tuff so well known in the Kau district from Pahala to South Points. These tuffs are important in that district as marking a dividing line between older and newer series of lavas Mr. Wentworth will subject the specimens to microscopic investigation and also make comparisons in the field of the relationships of these deposits to the surrounding rocks in the different districts of Hawaii where they are found. It is hoped in this way to determine the meaning of an important dividing line in the volcanic stratigraphy of Hawaii.

Dr. John B Stone now with the Cerro de Pazco Copper Corporation in Oroya, Peru, has been appointed Research Fellow of the Association to make an exploration and report in Chile during the winter months of 1929-30. The investigation has in view a study of the volcanoes on the west side of the central valley of Chile with especial reference to the beautiful cone of Osorno and the recently active volcano Calbuco on Lake Llanquihue. Dr. Stone will make a volcanological reconnaissance of the region with the special object of securing photographs and specimens and of bringing the Hawaiian Volcano Observatory in closer touch with the volcanologic work of Chile. This country is little known, but is important because of its many earthquakes and numerous volcanic vents.

Dr. Stone and Professor Wentworth have both done geological work in Hawaii in the past. Dr. Stone investigated the products and structure of Kilauea during the summer and autumn of 1925 under a Bishop Museum fellowship awarded by Yale University (Bulletin 33, Bernice P. Bishop Museum, 1926.) Mr. Wentworth was Bishop Museum Fellow 1923-24 investigating the sediments of the Pacific islands and published studies of the geology of Lanai and the pyroclastic geology of Oahu (Bulletins 24 and 30, Bernice P. Bishop Museum, 1925 and 1926.) T.A.J.

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HAWAII NATIONAL PARK

OFFICE OF THE SUPERINTENDENT [redacted], HAWAII

June 5, 1929

Director,
National Park Service,
Department of the Interior,
Washington, D. C.

Dear Mr. Director:-

The report of operations and activities for the month of May 1929 in Hawaii National Park is here submitted.

000 GENERAL:

May in Hawaii has been a beautiful Spring month. Flowering trees have bloomed at the low elevations and the tree ferns and semi-tropical growth in the park have taken on their fresh coloring. Two "Around the World" cruises stopped here in May. These were the S. S. Franconia and the S. S. Resolute.

100 ADMINISTRATION:

120 Inspections by:

121 Superintendent:

Frequent inspections of all operations was made by the superintendent.

A trip to the Haleakala section of this park on the island of Maui was made May 5th to 10th. This included an inspection of the park boundary locations, the condition of the rest house, the crater trails, the surveyed route of the proposed Haleakala road within the park and its connection with the territorial route on the outside.

200 MAINTENANCE, IMPROVEMENTS AND NEW CONSTRUCTION:

210 Maintenance:

The Halemau trail leading out of the Haleakala crater on Maui has been so badly washed out by heavy rains that it is beyond repair. The entire bottom of the gulch containing this trail is washed away and a new location is required. This location will be up through an adjoining gulch. Three miles of new trail will be built, the funds having been made available from "Road & Trail" moneys.

300 ACTIVITIES OF OTHER AGENCIES IN THE PARK:

310 Public Service Contractors:

316 Modification of existing contracts:

Approval has been given the Kilauea Summer Camp to change their operating dates from June 1 - September 30 to June 20th - September 15th.

340 Territorial Legislation:

The territorial legislature which adjourned in May passed bills including the following;

Authorization to issue territorial bonds in amount of $300,000 for construction of the Haleakala approach road on the island of Maui.

Authorization for the county of Hawaii to issue bonds in amount of $30,000 for construction in 1931 of a road between the Hawaii National Park - Chain of Craters road and Kalapana on the coast.

400 FLORA, FAUNA AND NATURAL PHENOMENA:

410 Naturalist Service:

May was an extremely busy month at Uwekahuna Observatory. 20 lectures were given to 1,754 persons. 1,783 persons took the trip through the lava tube and across Kilauea crater on the scheduled trips.

430 Natural Phenomena - (Volcano):

The fire pit of Kilauea volcano shows no indication of a lava return in the near future. There are however numerous avalanches in this pit which create some interest. Indications at present are that the next possible action will be an outbreak through the side of Mauna Loa. Early in May Dr. Jaggar of the Volcano Observatory made the prediction that a lava flow could be expected sometime within 18 months from either Kilauea or Mauna Loa.

500 USE OF PARK FACILITIES BY THE PUBLIC:

510 Travel:

The drop shown in travel figures this month as compared with the same period of 1928 is due to the visit of several thousand sailors to the park during May of last year.

540 Visitors:

Col. L. W. Oliver, U. S. A., Chief Staff of the Hawaiian Division spent two weeks at Kilauea Military Camp.

520 Weather Conditions:

Maximum temperature	14th, 18th	75
Minimum "	10th	48
Rainfall for month of May		2.92 inches
" " " " " at Hilo		2.28 "
" to date Volcano District		32.86 "
" " " at Hilo		55.86 "

600 PROTECTION:

010 Police Protection:

During the week of May 5th while he was absent from headquarters the residence of the superintendent was entered and nitric acid scattered on the entire contents including furniture, bedding, clothing, rugs, linens and other objects. Asst. District U. S. Attorney Moore, Chief of Hilo Detectives Geo. Richardson and Special Agent of the Dept., of Justice A. E. Farlane are working with the superintendent on the case but no arrest has been made as yet.

Suspended ranger Geo. D. Douglas was arrested May 30 on a complaint by Asst. U. S. Attorney Moore and held under a charge of attempted rape of an 11 year old daughter of a park laborer. Being unable to furnish the bail of $15,000 Douglas was held in jail until June 1st. On that day after submission of evidence U. S. Commissioner S. L. Desha, Jr., considered the evidence not sufficient to bind Douglas over to the grand jury and released him. Douglas is also under arrest on a territorial charge of unlawfully entering a Hilo residence at night. This case is set for June 5th.

900 MISCELLANEOUS:

Ranger Geo. D. Douglas was suspended May 17th on charges of inability to perform duties under his designation of ranger-naturalist and of neglect of duty as a Ranger. Final action on these charges has not been received.

During his inspection trip to the Maui section of the park the superintendent was guest of honor and principal speaker at a banquet given by Maui Chamber of Commerce at the Country Club.

Very respectfully yours,

Thos J. Allen Jr.,
Superintendent.

Copy to Yellowstone National Park.

" " Field Headquarters.

TJA/h:

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

T R A V E L   R E P O R T

Hawaii National Park for the Month of May 1929

	This Month	This Travel Year To Date	This Month Last Year	Last Travel Year To Date	Increase for Travel Year: Number	Increase for Travel Year: Percent
PRIVATE TRANSPORTATION:						
Cars first entry, ...						
Cars reentry, ...						
Motorcycles, ...						
Total motor vehicles, ...						
Persons entering via motor vehicles, ...	5,408	37,638	9,732	40,327	- 2,689	.067
Persons entering via other private transportation, ...	373	1,783	786	2,303	- 520	.226
Total persons entering via private transportation, . . .	5,781	39,421	10,518	42,630	- 3,209	.075
OTHER TRANSPORTATION:						
Persons entering via Hotel stages, .	1,728	8,435	1,550	8,734	- 299	.034
Persons entering via trains, .						
Persons entering otherwise, . .						
Total other transportation, .	1,728	8,435	1,550	8,734	- 299	.034
GRAND TOTAL ALL VISITORS, . .	7,509	47,856	12,068	51,364	- 3,508	.068

	This Year	Last Year	Increase: Number	Increase: Percent
Automobiles in public camps during month, ...	1	0	1	100
Campers in public camps during month, ...	3	0	3	100

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

STATUS OF PERSONNEL

Hawaii National Park for the Month of May 1929

	This Month	This Month Last Year
Number of employees beginning of month,	8	10
Number of additions,	1	12
Total,	9	22
Number of separations,	1	11
Number of employees close of month,	8	11

0

Number of promotions during month	0	1

Aggregate amount of annual leave taken,	0	0
Aggregate amount of sick leave taken,	0	0
Aggregate amount of leave without pay,	0	0

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

REPORT OF PARK REVENUES

HAWAII National Park for the Month of May 1939

	This Year	Last Year
Park revenue on hand beginning of month,	0.00	0.00
Received,	127.00	125.00
Total,	127.00	125.00
Remitted,	127.00	125.00
On hand close of month,	0.00	0.00

Park revenues received this year to date,	$ 1,177.00
Park revenues received last year to date,	$ 1,175.00
Increase,	2.00
Percent of increase,	1.7%

10-161

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

HAWAII NATIONAL PARK

REPORT OF SALES OF PUBLICATIONS

May 1939

	Number	Value
GOVERNMENT PUBLICATIONS:		
On hand beginning of month,	463	134.50
Received during month,	0	0.00
Total,	463	134.50
Sold during month,	5	3.20
On hand at close of month,	458	131.30
NON-GOVERNMENT PUBLICATIONS:		
On hand beginning of month,		
Received during month,		
Total,		
Sold during month,		
On hand at close of month,		

Cash on hand beginning of month,	$ 17.80
Sales during month,	3.20
Total,	$ 21.00
Remitted during month,	0.00
Balance,	$ 21.00

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No. 227 RELEASED WITHOUT COPYRIGHT RESTRICTION May 2, 1929

KILAUEA REPORT No. 901

WEEK ENDING MAY 1, 1929

Section of Volcanology, U. S. Geological Survey

T. A. Jaggar, Volcanologist in Charge

Halemaumau pit has been remarkably quiet during the past week with slight slides from the walls observed between 9 and 10 a. m. April 25 and about 11 a. m. May 1. These were quite possibly occasioned artificially.

Eight very feeble local earthquakes were registered at the Observatory. On the 24th of April there was very faint tremor at intervals.

Tilt for the week accumulated slightly WSW. Microseisms were normal.

GEOGRAPHICAL SHIFT OF EARTHQUAKES

Professors Terada and Miyabe (A Long Period Fluctuation in Latitude of the Seismic Activity on the Earth, Bull. Earthq. Res. Inst., Tokyo Imperial Univ., March, 1929, Vol. VI, pp. 333-343) have investigated how big earthquakes have shifted from south to north and back again in the course of five centuries on both sides of the equator.

The inquiry was suggested by successions of disasters in Japan lying on a line progressively farther north. Then it was found that in the 19th century maximum of average frequency of Eurasian earthquakes lay about latitude 35° N., whereas in the 20th century they cluster about latitude 40° N.

This led to platting mean frequency of severe world earthquakes by latitude belts. It was found that:

(1) A southing of latitude in the 16th century in Japan and Eurasia equalled a northing in the southern hemisphere for South America.

(2) A northing in Eurasia about 1600 equalled a southing in South America.

(3) A southing about 1700 in Eurasia equalled a northing in South America early in the 18th century.

(4) A northing about 1800 in Eurasia equalled a southing early in the 19th century in South America.

(5) Approaching 1900, Eurasian earthquakes moved south and South American earthquakes moved north, both starting to change direction in the 20th century.

The listing of Central American earthquakes showed some correspondence of latitude fluctuation with South America, and North American earthquakes exhibited a curve somewhat resembling the rest of the northern hemisphere. China and Japan were platted separately, and were found to have in common an east-west component of shift as well as a meridional one. In both, the successive displacements of earthquake activity are in the direction SW-NE. This corresponds in general with the axes of the great deep, the island arcs, the inner seas, and the continental structure of eastern China. For either hemisphere there is suspected from all the curves a period of about 200 years between like phases of the fluctuation. It should be remembered that these are curves of fluctuation of latitude for earthquakes where 1,000 or more casualties are reported. The curves have no bearing on general relative frequencies for latitude belts, where the epicenters are determined instrumentally (see Volcano Letter No. 198).

Seeking a cause for the northing and southing of earthquake frequency periods, the authors compare the deviation of the moon's longtitude from 1640 to 1925 with the earthquake curves (see Volcano Letter Nos. 94 and 129). De Sitter and Brown have suggested that the changes in the length of day are due to actual change in the earth's radius, and so to change of its moment of inertia. The maximum moment of inertia was near 1786 and the minimum 1897. The earthquake frequency reached higher latitudes about 1800, and moved toward the equator about 1900.

Terada and Miyabe find it easier to conceive increase and decrease in the equatorial protuberance and the polar flattening, than to assume expansion and shrinkage of the whole earth. The greatest shearing stress would be in the middle latitudes and so express itself in seismic activity. The simultaneous poleward and equatorward shifts of seismic frequency in the two hemispheres suggest that in some way the change in ellipticity of the globe shifts the earthquake latitudes.

There was an acute change in the length of day observed in 1918, believed by De Sitter as possibly explained by a general shrinkage of the earth's radius. Moreover, he considers the curve of the centuries as consisting of a succession of straight lines, changing suddenly. T.A.J.

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No. 228 RELEASED WITHOUT COPYRIGHT RESTRICTION May 9, 1929

KILAUEA REPORT No. 902

WEEK ENDING MAY 8, 1929

Section of Volcanology, U. S. Geological Survey

T. A. Jaggar, Volcanologist in Charge

Halemaumau has remained very quiet throughout the past week, with practically no changes. Only one slide was observed, occurring from the north wall at 9 a. m. today. The debris fell from near the top of the wall to its lowest point of contact with the north talus.

On May 6 fresh red scars were noticed north.

There has been a slight increase of white stain at the foot of the south talus, and some increase in the yellow stain at the west end of the spatter formed by the big fountains of February 20-21, 1929.

Four very feeble local earthquakes were registered at the Observatory. One of these was strong enough to rattle a window of one of the nearby cottages.

There was a slight accumulation of tilt to the southeast. Microseismic motion was slight.

MECHANISM OF TOKYO EARTHQUAKE

The disaster of 1923 contained as main facts:

(1) Great earthquake at Sagami Bay September 1, 1923.
(2) Coast uplifted 1 to 2 m., Oshima volcano island stood still.
(3) Bottom of bay subsided between 1912 and 1923 up to 210 m.
(4) An earthquake sea-wave flooded the coast.
(5) Region around Bay suffered clockwise horizontal displacement of vortical aspect between 1884 and 1924 as shown by triangulation.

The subordinate facts were:

(1) Land subsided and beaches retreated for 20 years before the earthquake; amount of subsidence 10 cm.
(2) The shoreline has been upheaved in ancient times.
(3) Westerly tilt was measured of 1.7 seconds July 30 to August 17, 1923.
(4) Four small faults and one big crack system were formed.
(5) The isoseismals were radial, irregular and extended to the NW.
(6) The direction of earthquake motion was somewhat vortical.
(7) Submarine cables were snapped.
(8) Deep sea fish floated dead.
(9) Landslips were common west and northwest.
(10) Mineral Springs, lakes, and wells changed.
(11) Aftershocks occurred in several zones.
(12) Decrement of aftershocks was irregular.
(13) Epicenter determinations of the great shock were conflicting, and indicated a "seismic domain."
(14) Distribution of the initial motion, somewhat doubtful, made the center probably on land due north of Sagami Bay.

The theories to account for the disturbance were as follows:

(1) Upthrust, suggested by T. Kato.
(2) Block movement, suggested by N. Yamasaki.
(3) Submarine fault, suggested by A. Imamura.
(4) Subterranean fault, suggested by S. Nakamura.
(5) T-shaped fissure, suggested by T. Shida.
(6) Plutonic intrusion, suggested by T. Ogawa.
(7) Linear rebound, suggested by M. Matsuyama.
(8) Horizontal folding, suggested by T. Terada.
(9) Vortical action, suggested by K. Suda and S. Fujihara.
(10) Magmatic action, suggested by H. Nagaoka.

S. Fujihara and T. Takayama now present somewhat fully in English the conception of a vortical shear. (On the Mechanism of the Great Sagami Bay Earthquake on September 1, 1923; Bull. Earthq. Res. Inst., Tokyo, March, 1929, Vol. VI, pp. 149-176). A vertical surface of discontinuity is believed to extend along the Japan coast with southwesterly motion on the Pacific side and northeasterly motion on the land side. A rotational motion of crustal blocks is believed to have taken place about Oshima as a center. The volcanoes have been notably rigid when other formations shifted. Oshima resisted the shear and a horseshoe distribution of stress has accumulated about Sagami Bay. This stress was last released in 1853-54. Discontinuous yielding occurred again September 1, 1923. There was a sudden warping of the horseshoe, which the authors illustrate by a model consisting of a circular rubber plate laid horizontally. An eccentric clamped vertical axis corresponds to Oshima. A tangential horizontal pull southward on the east side of the disc wrinkles it appropriately and rotates all points on the surface as the triangulation bench marks found to be moved.

The great subsidence of the bottom of the bay is believed to have been a warping for 11 years past, accelerated at the time of the earthquake. Rotation clockwise accompanied by convergence was computed for the bay, and a rotation in opposite sense for a region next to the northeast, accompanied by divergence. The primary epicenter lay in between. T.A.J.

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No. 229 RELEASED WITHOUT COPYRIGHT RESTRICTION May 16, 1929

KILAUEA REPORT No. 903
WEEK ENDING MAY 15, 1929

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

Halemaumau pit, the inner vent of Kilauea Crater, has remained quiet. Between 9:30 and 10 a. m. May 15 there was only one vigorous steaming area, namely at the top of the south talus. The north wall appears more freshly stripped than the others, but no slides have been observed during the week.

The upright cracks parallel to the eastern rim of the pit, and back from the edge, were measured May 15, and the 11 marked stations along the fissures showed very slight widening since March 29, 1929, the greatest movement amounting to 0.11 foot. This was at station No. 14, near where the opening crack extends tangentially into the pit wall.

Seven local earthquakes have been registered for the week, of which six were very feeble. One at 5:54 a. m. May 12 indicated an origin very close to the Observatory and was felt, the intensity being No. 3 Rossi-Forel. Microseisms for the week were slight, and tilt moderate to the northeast.

MECHANISM OF EARTHQUAKES

"A great earthquake is accompanied by topographic changes; such changes have been particularly remarkable in the three last great earthquakes that have happened in Japan. The study of these shakings has led to the conclusion that the change in the surface of the land is not such as would result in seismic rays radiating out in all directions."

"We may now consider proven the existence of blocks and block movements, using the evidence of measurements made by means of precise leveling. These measurements have demonstrated that the motions of these earth blocks are so independent that there exists little correlation between them, and there is deduced the existence of a malleable layer under the groups of blocks."

"The fact that the atmospheric pressure gradient plays an important part in the incidence of an earthquake, suggests the existence of a mobile stratum within which viscous matter is present, easily displaced under the action of differences of barometric pressure."

"Studies of the properties of magma, such as the phenomena of differentiation, the rapidity of magmatic intrusion, etc., permits us to consider the origin of seismic waves as result of shock provoked by sudden change in the kinetic moment of an intrusive."

"In the case of a feeble earthquake, there will be only the shock induced by the intrusion itself. But in the case of a big cataclysm there may be formed actual fractures in the terrestrial crust, resulting from the enormity of the disturbance."

"We have, in fact, many aftershocks following a great earthquake, which may be explained as injections of magma in the fissures formed by the first big disturbance. The topographic changes of level or of horizontal position are then accounted for as resulting from movements tending to readjust the isostatic equilibrium of the block."

"Seismic wave motion tends in fact to die out in passing a fault plane, whether that fault were the direct result of seismic happenings or other tectonic cause. The anomaly exists in the fact that seismic intensity diminishes when elastic waves pass athwart a fault plane standing perpendicular to the directions of propagation."

"In introducing magma as a cause, we can more easily explain other facts that accompany earthquake." (On the mechanism of production of seismic waves, by Mishio Ishimoto, in Japanese, abstract in French, Bulletin of the Earthquake Research Institute, Tokyo Imperial University, March, 1929, Vol. VI, pp. 127-147.)

The author discusses the relation of dykes, faults, and existing igneous outflows to earthquake rifts, presents maps and a diagram exhibiting the relations of dyke intrusion to time, specific heat, conductivity, density, thickness, distance, and temperature, and quotes Barrell (Professional Paper No. 57, U. S. Geol. Surv. 1907, pp. 157-159), to the effect that "the extension of dyke intrusions resembles volcanic eruptions in that both take place in an intermittent and paroxysmal manner."

It would appear from the facts of volcano research that lava outflow, magmatic intrusion, and swarming of earthquakes may all correlatively take place in an intermittent manner, which is cyclical and not at all paroxysmal. Paroxysm is nothing more than occasional acceleration.

T.A.J.

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No. 230 RELEASED WITHOUT COPYRIGHT RESTRICTION May 23, 1929

KILAUEA REPORT No. 904

WEEK ENDING MAY 22, 1929

Section of Volcanology, U. S. Geological Survey

T. A. Jaggar, Volcanologist in Charge

The past week at Kilauea and Mauna Loa has exhibited suggestion of movement on the flow rifts of the latter mountain. Kilauea has been notably quiet.

At Halemaumau, about sundown May 15 a ringing noise of snapping was heard in the new lava bottom like deep cracking due to cooling as the sun's rays left the surface. On *May 17 about 4 p. m. a slide* occurred at the east rim. On the 19th a little dust rose at the north corner of the pit about 9 a. m., and a very small fall of rock was heard during a visit at 2:30 p. m. May 20-21 it was noticed that the wall gulches above the north and northwest taluses are deepening toward each other, as though a slab of that wall might some day fall. Some stones now lie on the east side of the 1929 floor.

About 6 p. m. May 15 a smoky film of cloud was observed above the normal rain cloud that lay over Mauna Loa. At 8 p. m. May 17 Honomalino Ranch reported Mauna Loa to be smoky. The Puu o Keokeo district, about the 8,000-foot level of the southwest rift of Mauna Loa, was examined by ranchmen, and nothing new could be found on the mountain. The sulphur patch of 1926 was fuming slightly. Mauna Loa was absolutely clear in brilliant sunlight this morning, May 22.

Only three local earthquakes, all very feeble, have been registered, but two of these indicated a distance of origin appropriate to the south end of Mauna Loa; namely, 9 a. m. May 19, distance 34 miles, and 1:45 a. m. May 20, distance 28 miles. It may be added that two small earthquakes registered last week were: 6:16 a. m. May 14, felt at Honomalino, distance from Observatory 38 miles; and 12:05 a. m. May 15, distance 31 miles.

Tilt for the week was strong WSW., and microseismic motion was slight.

ACTIVITY OF KRAKATOA IN 1928-29

Krakatoa, in Sunda Strait between Java and Sumatra, was in new activity between December and April, 1927-28, as previously reported (Volcano Letter Nos. 167, March 8, and 196, September 27, 1928). The outbreak of 1928 was in the ocean between the three islands that had been left by the gigantic eruption of 1883, and a cone was built up on the sea bottom which was piled above sea level occasionally in 1928, and then washed by the waves. The third phase of activity was in April.

This third phase was characterized by a series of little eruptions lasting until May 15. From 6 a. m. May 14 till 8 a. m. May 15 a total of 7164 jets occurred, and 14 of these reached a height of 100-400 meters. Dr. Stehn reports that on May 1 after 7 p. m. strong glare was seen above the crater in the ocean accompanied by steam, which he attributed to the flowing of lava over the rim of the submarine crater. Flames were also seen above the vent of orange-yellow color, making the surface of the sea look as if it were ablaze. The flames rose about 10 meters and were suspected as being due to hydrogen.

The fourth phase of activity lasted from May 18 to May 27. An ash eruption rose 500 meters. Each period of activity was preceded by volcanic tremors registered on the island seismograph. The directions of motion of the seismic components suggested an inclined vent underground and some slow displacement of the position of maximum *action*.

June 1 and 2 there were slight eruptions. The submerged crater rim lay from 5 to 10 meters below sea level. The fifth phase of activity began July 6 and ended July 13, with small eruptions reaching a maximum height of 250 meters. Soundings indicated a lowering of the submerged cone. Explosions and tremors were renewed at the end of August and early in September. In October Krakatoa was quiet except for bubblings of gas and tremors recorded by the seismograph. Many audible explosion noises were heard in November, and seismic activity was renewed. The noises are described as peals, reports, and rumblings. The shaking was strong enough to cause noteworthy avalanches from the summit of Rakata Peak. Small eruptions occurred in December, one on the 20th throwing up ashes and bombs 80 meters with glow and rumblings.

Except for tremors, Krakatoa was quiet at the beginning of January, 1929. The seventh phase of activity began on January 12 with steaming above the eruption point and bombs of old pumice material floating about as long as they remained hot and charged with gas. Activity slightly increased, reaching a maximum January 20-21, when 8817 separate jets were counted within 24 hours, the maximum height being 1100 meters. On that day the crater rim was built up above the sea as a loose pile of bombs and blocks. Only a strong surf marked the spot the next day. Then the activity decreased somewhat, but after January 25 the eruptions increased and created a new island called "Anak Krakatau," meaning child of Krakatoa. Enormous masses of solid material were thrown out from two or three crater openings, eruption columns reached 1,200 meters in height with a width of 500 meters, and the photographs presented show a crescent-shaped island with magnificent explosive jets of dark material radiating upward surrounded by a wreath of white steam at sea level.

The greatest number of separate jets was counted February 3-4, amounting to 11,791 spurts within a period of 24 hours. On Febraury 9 the new island was 21 meters high, and on Febuary 18, 38 meters. Electric discharges were sometimes observed in the eruption columns. The building up of the island wall around the crater cut off the view of minor eruptions from the station on Lang Island, as did the dust cloud when the wind was unfavorable. Pauses in activity increased from February 4 to Febraury 18, when the seventh phase of explosion ended. The island was examined from an airplane, the horns of the crescent pointed WSW., and the length was about 250 meters. (Bulletin Netherlands East Indian Volcanologic Survey No. 17, March, 1929, and preceding numbers.)

T.A.J.

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No. 231 RELEASED WITHOUT COPYRIGHT RESTRICTION May 30, 1929

KILAUEA REPORT No. 905
WEEK ENDING MAY 29, 1929
Section of Volcanology, U. S. Geological Survey
T. A. Jaggar, Volcanologist in Charge

Halemaumau has remained quiet during the past week, and nothing more has been heard from Mauna Loa. The afternoon of May 24 showed a few rocks on the new floor at the southeast and some appearance of fresh debris of large size at the top of the north talus, with appropriate fresh red scars in the wall above. A small slide at 12:05 p. m. May 27 and another at 1:35 p. m. sent up dust at the north corner of the pit.

Seven very feeble local earthquakes were registered for the week, of which one at 4:07 a. m. May 28 was felt in Hilo and Papaikou, the seismogram at Kilauea indicating distance of origin 21 miles. A big distant earthquake beginning 12 h. 17 m. 34 s. p. m. Hawaiian Time May 26 gave evidence of origin about 6,800 kilometers from east Hawaii, or something over 4,200 English miles. As Honolulu recorded 6,500 kilometers, the possible location might have been anywhere in the belt extending north and south through Japan. Otherwise the distance would correspond to the ocean north of New Zealand or to Central America.

Tilt was moderate WNW., and microseismic motion slight for the week.

TEMPERATURES OF CRYSTALLIZING MINERALS

The older text books possessed little information about the temperatures of mineral formation, and so the loose generalizations of the 19th century imagined that basaltic lavas were cooler than deep-seated magma like granite, which was conceived to crystallize under enormous temperatures and pressures. The facts almost completely reverse this, and extensive laboratory work has thrown light on the temperature meaning of the mineral crystals found in the rocks. Besides the direct measurements of temperature of lava at craters, we now have many measurements of the melting temperatures of minerals, the inversion temperatures of minerals which change from one crystalline form to another, like quartz to tridymite, and to cristobalite, the melting temperatures of mineral mixtures, the temperature at which a mineral decomposes, and the effect on fusion or on chemical reaction of increased pressure in depth and of included gaseous mineralizers. (The Temperatures of Magmas, by E. S. Larsen, The American Mineralogist, Vol. XIV, pp. 81-94, 1929.)

Rocks crystallize from a liquid condition, or melt from a solid condition over a temperature interval which is greatly affected by the pressures involved and by the presence of steam or other gaseous ingredients which exist in the deep magma underground when the paste is congealing, but do not exist in the powdered rock of the open crucible heated in a furnace. Basalt melts through a temperature interval from 980° to 1,260° C., and granite 1,215° to 1,260°. Obsidian or rhyolite, the lava equivalent of granite, with much water in its composition melts easily until it loses its water, but thereafter it can be made liquid only at a much higher temperature. The two forms of quartz, the commonest mineral of granite, are stable up to 870°, above that to 1,470° silica becomes tridymite, and above that to 1,720° it becomes crystobalite. Quenched at any higher temperature silica takes the form of glass.

The apparent discrepancy between the higher melting range of the granitic magma as compared with basalt, and the much lower crystallizing range of temperatures which are evidenced by its minerals, can be explained as due to the gases in solution which are in the granitic magma, but are not in the rock when it is melted in a crucible. The slow cooling of a magma intermediate between rhyolite and basalt shows first the crystallization of lime-feldspar and dark minerals, leaving the remaining liquid richer in the material for quartz and orthoclase feldspar. There is finally left a liquid with a composition near that of pegmatitic granite. The original magma with the composition of basalt required a higher temperature to keep it liquid, and the granitic material was liquid at a lower temperature. The conclusion is that rhyolite or granite crystallize at the lowest temperature of the group. The magma in the throat of a volcano may be excessively hot owing to gas reactions and surface oxidation. When a mineral crystallizes from a solution, the temperature must be below the melting point of the mineral. But that does not tell how much below, as most of the rock minerals are in a condition of what is called "solid solution" and the crystallizing temperature differs with the composition. Most basaltic magmas remain almost completely liquid at a temperature below 870°.

The following is a summary of conclusions: (1) Rhyolitic magmas have lower temperatures than basaltic magmas. (2) Measurements of the basalt of Kilauea vary from 750° to over 1,200°, those at Vesuvius vary nearly as much. (3) The melting temperatures of minerals yield only maximum temperatures. Some biotite mica must form below 850°. (4) The inversion temperatures of silica show that some basalts and most rhyolites and quartz latites are nearly completely liquid at temperatures below 870° and probably all magmas crystallize above 570°. (5) Common hornblende inverts to basaltic hornblende at a rising temperature of 753°. Hence most hornblende rhyolites and quartz latites and many andesites containing common hornblende, crystallize below that temperature. (6) Since the inversion of quartz inclusions to tridymite or cristobalite is very rare, and this inversion takes place without a flux at an appreciable rate at 1,250°, very few magmas have so high a temperature. (7) The lack of fusion of most granitic and arkose inclusions indicates a temperature below 1,150° but mineralizers would permit fusion at much lower temperatures. (8) The results show that some basalts have temperatures below 870°, many are below 1,000°, very few are as high as 1,260°, and most are not far from 800° to 900°. (9) Rhyolite or granite magma has lower temperatures, in the range between 573° and 870°. Most of these rocks crystallize below 850°, the temperature of decomposition of biotite, and below 750°, the changing point of common hornblende, for they contain both these minerals. Hence most rhyolites or granites had temperatures between 600° and 700°.

T.A.J.

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HAWAII NATIONAL PARK

OFFICE OF THE SUPERINTENDENT [redacted], HAWAII

May 3, 1929

Director,
National Park Service,
Department of the Interior,
Washington, D. C.

Dear Mr. Director:-

Submitted herewith is the report of operations and activities in Hawaii National Park for the month of April 1929.

000 GENERAL:
April signified the end of the winter travel season to Hawaii. During this month although a steady number of visitors entered the park the big steamers arriving did not bring the capacity loads as during February and March.

100 ADMINISTRATIVE:
120 Inspection by:
121 Superintendent.
The superintendent made the usual routine inspections of all park operations and in addition made a trip in company with the local territorial forest supervisor Wm. Bryant to the summit of Mauna Kea 13,825'. While not in the park this mountain is adjoining it and gives a splendid view of the entire park area and its relation to other parts of this island. At the time of this trip there was plenty of snow on Mauna Kea which is the highest point in the Pacific.

125 Other governmental officers.
Mr. E. S. Wheeler in charge of the Bureau of Public Roads in the Territory of Hawaii spent several days in the park inspecting the conditions of the Chain of Craters and Around the Island roads. Mr. Wheeler was well pleased with the present condition of the oil-processed surface on the latter road.

200 MAINTENANCE, IMPROVEMENTS AND NEW CONSTRUCTION:

210 Maintenance:

Continued efforts were made to improve the condition of park roads. Major maintenance projects for the month were extensive patching of holes in the center and broken paving on the edges of the trunk road passing through the park and the elimination of a bad curve and general repairs to the Uwekahuna road.

300 ACTIVITIES OF OTHER AGENCIES IN THE PARK:

310 Public service contractors.

The operators of Volcano House have submitted sketches of proposed alterations for the purpose furnishing more rooms with private bath.

315 New Contract.

The superintendent has received and transmitted to Washington for approval and application from K. Maehara of Hilo to conduct a park photographer operation.

340 Territorial Legislation.

A bill introduced in the territorial legislature for the purpose of working convicts on the Kalapana road starting at the end of our Chain of Craters road and appropriating $25,000 for their quarters, has been tabled.

The general loan fund bill carrying among other items authority to issue bonds in amount of $300,000 for construction of the territory's approach road up Haleakala has been passed second reading by both houses. As the legislative session ends early in May, final action will probably before them.

400 FLORA, FAUNA & NATURAL PHENOMENA:

410 Ranger-naturalist service.

Lectures at Uwekahuna Observatory were given to 655 persons during April. Groups of teachers and pupils from island schools are often taking advantage of these lectures as part of their field work.

758 persons were guided on trips across the crater floor and through the lava tubes.

480 Natural phenomena.

Nothing of note has occurred in respect to volcanic action. The usual numerous slight earthquakes were registered on the seismographs and several small avalanches occurred in Halemaumau.

500 USE OF PARK FACILITIES BY THE PUBLIC:

510 Travel.

Despite the drop in attendance since March our travel continues to show a gain over previous years.

520 Weather Conditions.

Maximum temperature	17th	73
Minimum "	9, 13, 15, 17, & 27	50
Rainfall for month of April		5.20 inches
" " " " " at Hilo		11.53 "
" to date Volcano District		29.94 "
" " " at Hilo		53.58 "

600 PROTECTION:

640 Destruction of predatory animals.

Trapping operations against mongoose which preys on ground nesting birds was started during the later part of April. So far fifteen mongoose have been killed.

Very respectfully yours,

Thos J. Allen Jr.,
Superintendent.

Copy to Yellowstone National Park

" " Field Headquarters

TJA/h:

10-157

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

TRAVEL REPORT

Hawaii National Park for the Month of April 1923

	This Month	This Travel Year To Date	This Month Last Year	Last Travel Year To Date	Increase for Travel Year Number	Increase for Travel Year Percent
PRIVATE TRANSPORTATION:						
Cars first entry						
Cars reentry						
Motorcycles						
Total motor vehicles						
Persons entering via motor vehicles	3,780	32,230	3,635	30,595	1,635	.053
Persons entering via other private transportation	176	1,410	184	1,517	- 107	.070
Total persons entering via private transportation	3,956	33,640	3,819	32,112	1,528	.048
OTHER TRANSPORTATION:						
Persons entering via HOTEL stages	763	6,707	703	7,184	- 477	.066
Persons entering via trains						
Persons entering otherwise						
Total other transportation	763	6,707	703	7,184	- 477	.066
GRAND TOTAL ALL VISITORS	4,719	40,347	4,522	39,296	1,051	.027

	This Year	Last Year	Increase Number	Increase Percent
Automobiles in public camps during month	1	0	1	100
Campers in public camps during month	3	0	3	100

10-159

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

STATUS OF PERSONNEL

HAWAII National Park for the Month of April 1929

	This Month	This Month Last Year
Number of employees beginning of month,	8	10
Number of additions, ...	0	2
Total, ...	8	12
Number of separations, ...	0	2
Number of employees close of month, . . .	8	10
Number of promotions during month	0	0
Aggregate amount of annual leave taken,	0	0
Aggregate amount of sick leave taken,	0	0
Aggregate amount of leave without pay,	0	11

10-160

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

REPORT OF PARK REVENUES

Hawaii National Park for the Month of April 1929

	This Year	Last Year
Park revenue on hand beginning of month, ...	0.00	0.00
Received, ...	0.00	0.00
Total, ...	0.00	0.00
Remitted, ...	0.00	0.00
On hand close of month, ...	0.00	0.00

Park revenues received this year to date, ...	$ 1,050.00
Park revenues received last year to date, ...	$ 1,050.00
Increase, ...	None
Percent of increase, ...	None

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10-161

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HAWAII NATIONAL PARK

REPORT OF SALES OF PUBLICATIONS

APRIL 1929

	Number	Value
GOVERNMENT PUBLICATIONS:		
On hand beginning of month,	372	$ 37.20
Received during month,	100	100.00
Total,	472	137.20
Sold during month,	9	2.70
On hand at close of month,	463	134.50

	Number	Value
NON-GOVERNMENT PUBLICATIONS:		
On hand beginning of month,		
Received during month,		
Total,		
Sold during month,		
On hand at close of month,		

Cash on hand beginning of month,	$ 15.10
Sales during month,	2.70
Total,	17.80
Remitted during month,	0.00
Balance,	$ 17.80

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THE VOLCANO LETTER

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No. 223 RELEASED WITHOUT COPYRIGHT RESTRICTION April 4, 1929

KILAUEA REPORT No. 897

WEEK ENDING APRIL 3, 1929

Section of Volcanology, U. S. Geological Survey

T. A. Jaggar, Volcanologist in Charge

During a half hour at Halemaumau pit about 2:30 p. m. March 29 no slides were heard. Fresh debris was observed on the north and northeast talus slopes, and scars were visible half way up the wall above both places. A ranger *reported that the northeastern slide occurred about 2:30* p. m. March 27.

Measurement of cracks near the tourist outlook on the eastern rim of Halemaumau indicated that little or no change had occurred since January 18. At the former tourist outlook, farther south, where so much avalanching occurred in January, a rim crack was found to have widened 0.13 foot.

On March 30 at 8:30 a. m. a small slide removed rock from the eastern rim, and another was reported the next morning farther south. At 10 a. m. March 31 everything was quiet at the pit, and nothing new was observed. At 3:45 p. m. that day an avalanche sent up dust above the rim level.

Sixteen very feeble earthquakes were registered on the Kilauea seismographs, and irregular tremor occurred at intervals throughout the week, but very feebly. Tilt was moderate to the SSE., and microseismic motion was slight.

EARTHQUAKE INTENSITY SCALES

The attempt to define the size of an earthquake has led to making scales of earthquake severity. Where a large country is involved these scales have been based on popular reports. For scientific comparison with other places the size of the earthquake at any place ought to be expressed by a number. Just as four pounds of sugar ought to be four times as big as one pound, so a number four earthquake should be four times as big as number one. Herein lies the difficulty.

The Rossi-Forel intensity scale in common use is numbered 1 to 10, the numbers are defined by such expressions as "recorded only by seismographs," "cracking of plaster," "fall of chimneys," and by such adjectives as instrumental, moderate, and disastrous. The trouble with such a scale is that a nervous, sensitive person not used to earthquakes considers a feeble shock "stong." On the other hand, the average psychology of many people is a vaulabe criterion of intensity. The five grades (1) not felt, (2) felt by people at rest, (3) felt by everyone, (4) causing general fright, (5) causing consternation and panic, are definite.

The scientific basis of intensity, from a pendulum swinging in oil and scribing the length and time of its swings, or better, the length and time of the maximum swings of the earth while the pendulum stands relatively still, is called an "acceleration" or jerk. It is measured in rate of change of motion, millimeters per second change of motion per second (mm./sec.^{2}). The mathematical expression for this involves the square of the velocity of the earth particle divided by the amplitude of its motion. The changes of motion involve changes of direction as well as of speed. *But for measurement it suffices to consider* earthquake vibration a simple to and fro swinging. The seismograph pendulum assists this conception, for each instrument translates the earthquake motion into harmonic vibration in one direction only.

The Cancani intensity scale is based on a range of accelerations for each of 12 grades. The first 3 grades, from 1 to 10 mm., are instrumental only, and grade 12 would make a terrible catastrophe, reaching the acceleration due to gravity, 9,810 mm. per sec.^{2} Each grade doubles the value of the next preceding grade, expressed thus in millimeters (2½, 5, 10, etc.).

The Rossi-Forel scale, when reduced to accelerations, has values in terms of grade I as unity.

Grade	I, barely felt	equals	1
"	II, felt by few	"	2
"	III, felt by several	"	3
"	IV, feebly felt generally	"	4
"	V, felt by everyone	"	5.5
"	VI, alarm	"	7.5
"	VII, panic	"	15
"	VIII, damage	"	25
"	IX, destruction	"	60
"	X, catastrophe	"	125

It is thus arithmetically good from 1 to 4, and thereafter is an ascending curve. Grade I Rossi-Forel equals Grade IV Cancani.

The following are the grades of the Mercalli scale, abridged to show human effects:

I, INSTRUMENTAL, not felt.
II, VERY SLIGHT, felt by very few.
III, SLIGHT, felt by several.
IV, MODERATE, felt by many, no alarm.
V, RATHER STRONG, felt generally, some alarm.
VI, STRONG, felt by nearly everyone, many with fright.
VII, VERY STRONG, flight from houses, some damage.
VIII, RUINOUS, great terror, some wounded, much damage.
IX, DISASTROUS, a few lives lost, general ruin.
X, VERY DISASTROUS, great loss of life and utter ruin.

In the writer's tests, and Professor Mercalli among Italian peasants evidently had similar experience, ignorant persons in city or country can understand a human scale. They usually distort or exaggerate physical effects on masonry, water, trees, chimneys, etc., because they have no training in measured or judicial statement. T.A.J.

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No. 224 RELEASED WITHOUT COPYRIGHT RESTRICTION April 11, 1929

KILAUEA REPORT No. 898

WEEK ENDING APRIL 10, 1929

Section of Volcanology, U. S. Geological Survey

T. A. Jaggar, Volcanologist in Charge

Halemaumau, the inner pit of Kilauea Crater, has been almost motionless during the past week, and the new floor of black lava which was poured out February 20, 1929, appears almost as fresh as the day it solidified. In the forenoon of April 3 vapor rose over the whole pit after light rain. At 10:30 a. m. April 6 a small slide occurred at the north wall. At 8:05 a. m. April 9 light dust arose at the northeast side of the pit. On this day white salts were noticeable on the walls and talus blocks after two dry days following rain. The next morning, when there was a little drizzle wetting the stones, much of the whiteness disappeared.

The seismographs registered five very feeble local earthquakes during the week. One at 10:13 p. m. April 3 had indicated distance 11 miles from Observatory. The spasms of tremor were not observed after April 6. Tilt was slight to the south, and microseismic motion was normal.

THE ORIGIN OF LASSEN MUD FLOWS

By R. H. Finch

The cause of the mud flow from Lassen Peak on May 19, 1915, has been disputed. Drs. Day and Allen in their book, "The Volcanic Activity and Hot Springs of Lassen Peak," attribute the flow to melting of snow by a hot blast of gas, a deposit of hot volcanic ash, and hot rain. Loomis in his book, "A Pictorial History of Lassen Volcano," contends that hot water came out of Lassen Crater.

It is hard to believe that hot water came out of the crater, and Day has shown that the mud flow started some distance below the crater rim. The hot water theory may be dismissed. The writer agrees with Loomis that there is not sufficient evidence to indicate the occurrence of a hot blast or any considerable explosion just prior to the mud flow of May 19. There was only one flood on this date, excepting the possibility of a small one below the western flow, while the known explosions on May 22 produced several small mud flows. If there was no explosion and no hot blast, then there would not have been any hot ash deposit nor warm rain. Even if there had been an explosion, any rain accompanying it would probably have been but little warmer than any other rain—certainly not hot. It is also doubtful under the conditions existing on Lassen Peak at that time whether a rainstorm, unless of very unusual intensity, could cause a flood of the magnitude observed.

The flood originated in an embayment on the northeast slope of Lassen Peak that was uniformly covered by snow with a depth of several feet over most of the area. Now it is known that a few feet of snow of uniform covering can absorb several inches of rainfall so that the rain produces but little immediate run-off. If there had been bare spots in the snow field, then water could have run under the snow in considerable quantities and, in a place as steep as the Lassen slope, started avalanches. A hot blast, unless long continued, or a slight deposit of hot volcanic ash would produce much the same effects as a rain—a melting of superficial layers of snow and an absorption of the water by lower layers. A hot blast or a hot ash fall on a steep slope not uniformly covered with snow could, as in the case of rain, start streams under the snow and also cause avalanches.

It would seem, then, that the Day and Allen theory as to the cause of the Lassen mud flow on May 19 may also be questioned.

An examination of enlargements of the photographs taken by Mr. Loomis immediately after the mud flow on May 19, and of the material transported by the mud flow, indicates that a large volume of hot lava poured through the eastern notch of the crater. There is much new lava that was carried in fragments down the flood. This flow was not only much more voluminous than the one through the western notch, but as would be expected, it was probably, as a whole, more molten. The lava flow could easily have melted the snow down to the ground and sent a stream of warm water under the snow lower down the slope. An avalanche mixed with hot rock could easily have been started in this way and produced a flood of the magnitude observed.

Minor mud flows did accompany the explosions on May 22. There was a horizontal component of this explosion that was parallel with the course of the upper part of the mud flow on May 19. The area affected by this blast was much wider than the area devastated by the mud flow of May 19 and accordingly encountered snow banks with exposed edges. Considerable hot ash was also thrown out by this eruption. The largest mud flow that accompanied this explosion followed the course of the one on May 19. At places where there was still uniform snow covering, the mud flows occasioned by hot ash and perhaps mud rains of this explosion for the most part stayed on top of the snow.

TITLE PAGE AND INDEX

The Title Page and Index for 1928 is now published and has been mailed to the regular list. It will be sent to anyone desiring it.

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No. 225 RELEASED WITHOUT COPYRIGHT RESTRICTION April 18, 1929

KILAUEA REPORT No. 899

WEEK ENDING APRIL 17, 1929

Section of Volcanology, U. S. Geological Survey

T. A. Jaggar, Volcanologist in Charge

At Halemaumau on April 11 at 3 p. m. bluish vapor was noticed rising through the talus at the east edge of the new lava floor and staining the rocks yellow. At a sulphurous patch on the north edge of the new lava, yellow vapor was observed in a jet, by one of the park rangers. Fresh red debris was observed on the north talus slope. At 3:07 p. m. a small slide occurred at the south, and some very feeble sliding of sand occurred there almost continuously.

On April 13 at 10:15 a. m. a red scar was noticed above the east end of the big sill on the eastern wall, and fresh debris lay on the talus below. The pit was visited about 9 a. m. April 15, 16, and 17, but nothing new was observed and the walls were quiet.

At Kilauea Observatory nine very feeble local earthquakes were registered during the week. One at 4:48 p. m. April 13 was felt in Hilo and indicated a distance of 11 miles from the Observatory for its origin. Another at 12:17 p. m. April 14 was weaker, and indicated a distance of eight miles. Tilt was slight to the north, and microseismic motion was normal.

SECTION OF VOLCANOLOGY 1928

The Section of Volcanology of the United States Geological Survey makes headquarters at the Hawaiian Volcano Observatory on the northeast brink of Kilauea Crater. Its work in Hawaii is greatly assisted by the Hawaiian Volcano Research Association (see Volcano Letter No. 221). It maintains in addition the Lassen Volcano Observatory at Mineral, California, has placed a seismograph in the Loomis Museum at Viola, California, and another at Kodiak, Alaska. Service of the Kodiak instrument had to be discontinued temporarily after the closing, in August, 1928, of the Agricultural Experiment Station, where the seismograph was operated. Another seismograph with its time clock and other appurtenances has been deposited at Dutch Harbor in the Aleutian Islands. This station will be started and the Kodiak station revived in 1929.

The report of the Volcanologist for 1928 stated that "It is logical to expect activity from either Kilauea or Mauna Loa in 1929." This has been verified by the outbreak of Kilauea February 20, 1929. The new cycle of lava activity in Hawaii has proceeded with lava in Halemaumau pit in 1924, 1927, 1928, and 1929, and lava from Mauna Loa in 1926. The cycle should be half finished by January of 1930, and so approaching its maximum of lava gas pressure at that time, equivalent to that of 1919 for the last cycle.

The routine in Hawaii in 1928 consisted of mapping changes in Halemaumau, operating seismographs at the pit, Uwekahuna, the Observatory, Kona, and Hilo, measuring crater rim fissures and temperature of bore-holes keeping track of Mauna Loa, studying the seismograms and also those of Kodiak, publishing Volcano Letter and preparing Monthly Bulletin, experimental work with new seismographs and the oscillating table, building seismographs, keeping up the office work and records, operating tide gauge and maintaining time service by radio. The routine in Lassen National Park is similar in seismological work, but includes measurements of hot springs, of marked landslip areas, and of magnetism in lava flows, and geological mapping.

The personnel in Hawaii included T. A. Jaggar, volcanologist; R. M. Wilson and E. M. Buckingham, engineers; R. B. Hodges, clerk; F. Y. Boyrie and Tai On Au, machinists; and H. Yasunaka, janitor. The Kona station was operated by R. V. Woods, the Hilo station by J. B. Albert and the Kodiak station by Mrs. E. M. Floyd. The tide gauge was operated by M. F. Lacerdo. Additional employees were S. Oda, J. H. Tahara, and Aiu Ahoi. The Lassen station was in Charge of R. H. Finch, associate volcanologist; assisted by A. E. Jones and C. A. Anderson, who made special investigations. Mr. Howel Williams also worked on Lassen geology. Mr. B. F. Loomis built a very substantial concrete and stone seismograph exhibition building next the museum at Manzanita Lake, where was installed the Finch seismograph, that had been replaced at Mineral by the Hawaiian type of instruments.

The Pavlof Expedition of the National Geographic Society under T. A. Jaggar materially advanced the exploration of Aleutian volcanoes. This has been given further impetus by the Federal Relations Committee of the National Research Council, which has formed a group of federal representatives of government scientific bureaus interested in the Aleutian Islands, to formulate a project for collaborative study of that region.

The shop of the Hawaiian Volcano Observatory has now produced eight pairs of seismographs, the wheeled boat "Ohiki," the oscillating table, special drilling apparatus whereby 34 bore-holes are now available as temperature stations, and machines for various physical experiments.

T.A.J.

SAMPLE COPY

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No 226 RELEASED WITHOUT COPYRIGHT RESTRICTION April 25, 1929

KILAUEA REPORT No. 900

WEEK ENDING APRIL 24, 1929
Section of Volcanology, U. S. Geological Survey
T. A. Jaggar, Volcanologist in Charge

At Halemaumau at 2:40 p. m. April 17 thin clouds of avalanche dust were arising over the pit. A more concentrated cloud rose at the north side, and the field glass showed that men were standing at the NNE. rim, probably dropping rocks and so starting the slides. At 3:15 p. m. both the dust and the visitors were still present. On the 19th at 2:30 p. m. the cleft above the north talus was seen to be somewhat enlarged, and a fresh scar was identified west of it. Apparently a thin layer of surface debris from a comparatively large area of the wall had caused the slides of the 17th. On this day there were occasional falls of single rocks from the northern wall, and at 2:35 p. m. dust from a slide appeared in the cleft above the NNW. talus. At 10 a. m. April 22 the pit was quiet, dry, and sunny, and exhibited no change. At 9:30 a. m. April 24 artificial slides on the north side of the pit were occasioned by men dropping rocks. At 1:10 p. m. thick, reddish dust arose at the north.

The seismographs registered eight local earthquakes, or tremors, all excessively feeble except one on April 20 at 10:21 p. m., which was very feeble but indicated distance of origin about 16 miles from the Observatory.

Tilt was pronounced to the SSW. Microseismic motion was slight.

A NEEDED SHOCK RECORDER

Seismoscopes that show whether a local earthquake has occurred were invented centuries ago. Seismographs which write earthquake autographs with pencil, ink, a scraping pen on smoked paper, or a light beam on photographic paper are mostly the product of the last century.

It was an effort of the staff of the Kilauea Observatory from 1911 to make a simple local earthquake instrument. But it proved difficult. It is easy to place a marble on top of a pillar: an earthquake rolls it off. It is easy to set up a pencil on its end on a glass plate: an earthquake rocks it or topples it over. Both require watching or they tell little about the time duration, and size of the shock. And if they are found upset, a spider or a cockroach might have done it. If they require a strongly felt earthquake to upset them, what use are they? If they are too sensitive to tell how large a big earthquake is, again what use are they?

In short, the effort to record time, duration, and size appeared to require a masonry cellar at constant temperature, timekeeping like that of an astronomer, clockwork of the finest, observers directed by physicists, and five or six seismographs of different sensitiveness to be ready for big earthquakes, medium earthquakes, and little earthquakes. The Tokyo laboratory has 15 or 20 working instruments.

The object is to secure cheapness and attractiveness, in order to get records of local motion from many places and to interest many people. This is what, for meteorology, makes the thermometer and the rain gauge so useful. There is an enormous moral and ethical inertia, and even resistance, to be overcome, in order to make the discovery of the distribution of small local earth motions interesting to the man on the street. Recently the presidential addresses of the Seismological Society of America, the work of several associates of the Hawaiian Volcano Observatory, an appeal from the president of a leading insurance company, and a letter from the Scientific American, have set the writer to experimenting, and the Jaggar Shock Recorder is the result.

The problem boiled itself down to the question, "What have we really got from our outlying seismograph stations, after running them for 10 years." We have a list of earthquakes, identifying the same ones at four different places, showing others strangely limited to single places, showing how long the jarring lasted at each place, and how great was the amplitude or back-and-forth motion of the levers. The timekeeping was not accurate beyond that of central telephone stations appealed to by the seismograph operators. The amplitudes were comparable only to such extent as the pendulums were built alike, tuned alike, and set up in like directions. Artificial jarrings were possible, from locomotives and trucks and school children. Directions of maximum motion, where a pair of pendulums is used, are of doubtful value; the reason is that each instrument place is likely to have its own swaying habit in all earthquakes, strongest always either east-west or north-south; every hillside is a pendulum. And finally, the magnification is so great in these instruments that strong shocks merely dismantle them.

Determination of distance of origin by study of the preliminary tremor is the one thing for which distributed good seismographs are important. This, however, requires expensive instruments, wireless timekeeping at each place, paid observers, and continuous attention by a central observatory. And even then, many shocks occur without good preliminary tremors, and the distance determination of centers tells nothing of how deep underground were the bumping, or gaping, or scraping fault surfaces that made the shock.

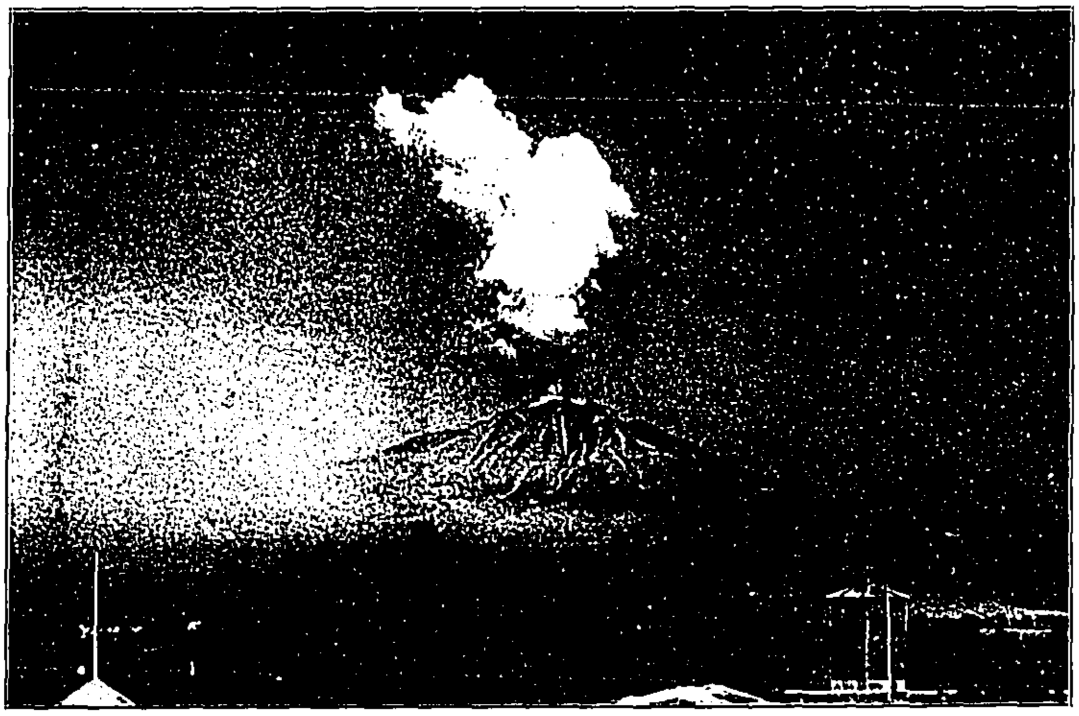
The seismologist says, "I wish I had sure knowledge of the measured size of that shock at plantations and ranches all around Mauna Loa." Then he could check up his theoretical place of origin by knowing where the shock was strongest. For this he needs a shock recorder, easy as a thermometer to read, working night and day, kept by the planter and the rancher. The need for this has grown, rather than lessened for we have recorded an astonishing number of little earthquakes felt all over the island of Hawaii.

The instrument that I have been working in the Kilauea station is made of a lead cylinder, hinged with two hacksaw blades, and writing on the face of an alarm clock. It produces an eight-inch paper disc with a line written round it like a gramophone record. The operation is no trouble at all. The paper is smoked, runs a week, and is then dipped in dilute shellac. Any quiet corner away from machinery receives the box, about three feet long, which is screwed down It is sensitive so as to show our feeblest instrumental Kilauea earthquakes. The time is recorded by a dial printed on the paper. The cost will be about $25. When interesting earthquakes occur, any number of copies of the disc seismogram may be printed on blue paper like any engineer's drawing. In this way, if purchasers of a shock recorder care to send us their record discs, we can send them blue prints to keep of any earthquakes that interest them.

We shall be glad to correspond with any prospective purchaser of one of these instruments. T.A.J.

The Volcano Letter

Two dollars per year | Ten cents per copy
No. 284—Weekly | Hawaiian Volcano Observatory, National Park, Hawaii | June 5, 1930



Eruption of Calbuco Volcano, Chile, January 6, 1929, photograph taken from Puerto Varas probably in early forenoon. Photo Karl. Steam apparently issuing with force. Pall of ash to the left.

EDITORIAL NOTE

As reported in Volcano Letter No. 235, Dr. John B. Stone during the winter 1929-30 completed on February 12, 1930, at Valparaiso an exploration of some volcanoes in south-central Chile occupying three months and six days. This was done under his appointment as Research Fellow of the Hawaiian Volcano Research Association. Starting from the scene of the recent disastrous earthquake at the city of Talca, Dr. Stone passed by the active volcano Quizapu near Cerro Azul, and then visited in turn the volcanoes Chillan, Antuco, Llaima, Villarica, Osorno, and Calbuco, climbing several of these. He observed from a little distance the volcanoes Troiguaca, Lonquimai, Quetrupillan, Shoshuenco, and Puyehue. All of these are potentially active and all lie between the latitudes 35° and 42° S. This region offers a great field of volcano research in the midst of a land of serious earthquakes, and it is to be hoped that Dr. Stone's investigations will stimulate public and private endeavor to create volcano observatories in Chile. The following is a first note on Chilean volcanoes.

TWO ACTIVE VOLCANOES OF CHILE

By JOHN B. STONE

The Chilean volcanoes east of the capital city, Santiago, lie near the crest of that portion of the Andes chain that includes the highest summits of the western hemisphere, but farther south the volcanoes are lower down on the west flank of the cordillera. In the region between the cities of Temuco and Puerto Montt, or roughly between the latitudes of 38° 30′ and 41° 30′ south, they lie along the line where the farms of the central longitudinal valley give way to the forests and mountains of the high Andes, and their summits reach only 6,000 to 10,000 feet above sea level. The two most active volcanoes of this region are Llaima and Calbuco. Both lie in a rainy belt and as a consequence their lower slopes are heavily wooded and their summits are capped by snow and glacial ice.

As seen from the southwest Llaima is an elongated cone with one principal summit and another slightly smaller and lower one off to the southeast. In December

Llaima Volcano, Chile, from the west. *Araucanian pines and old aa lava in foreground.* Photo Stone.

1929, the mountain was still covered far down its slopes by the snows of the preceding southern winter, and both the summit craters were emitting streamers of dense white fume.

The journey to Llaima is best begun from the provincial capital Temuco. A branch off the main north-and-south railroad extends for nearly 35 miles across partly cleared and cultivated lands and past several large, prosperous farms to the little village of Cherquenco. Beyond Cherquenco the forest is less broken by farms but is dotted with little sawmills producing rough lumber, which is hauled to the railroad on clumsy two-wheeled ox-carts. One of the sources of good lumber is the sharply defined belt of Araucanian pines that girdles the upper slopes of the volcano. The Araucanian pine or "monkey-puzzle" tree is similar to its close relative the Norfolk Island pine, familiar in the Hawaiian Islands (see Page Two). A sawmill high up in the pine forest on the northwest slope of Llaima was a convenient base of operations for the writer during the bad weather that prevailed at the time of his visit.

The double cone of Llaima stands on a broad base or platform built by earlier volcanic activity. Part of this platform and of the cone also are covered by basaltic aa flows, but the northwest summit cone and the southern slope of the mountain are largely concealed from observation by glaciers. Shiny black scoriae are common on the surface, and a layer two or three inches thick covers the glacial ice on the south side. Llaima was active from October 5 to 8 and again from November 27 to December 5, 1927, and at that time a "river of fire" is said to have been seen on the south slope. No recent flow could be distinguished by the writer beneath the winter snow, but a line of cones was seen far around to the southeast. These cones may mark the source of a flow as well as the site of the fountains which produced the fresh scoriae. Unfortunately it was impossible to reach them. Another possibility is that the scoriae were produced by fountaining in the summit craters and that the "river of fire" consisted only of the freshly fallen and still glowing cinders.

Calbuco is the farthest south of the volcanoes in the continuous mainland part of Chile, although others are known in the region of fiords and glaciers extending from Puerto Montt to the Straits of Magellan. Calbuco was observed in activity by Darwin in 1835, but had long been inactive before 1893 and had accumulated a thick cap of ice and snow. In the latter year the volcano returned to life. The heat of the eruption melted the ice and snow and caused floods that swept down the mountain leaving paths which can still be seen. Fortunately the country affected is very sparsely settled even now so that little damage was done, but the occurrence illustrates the most serious danger in this land of intermittent volcanic activity and heavy snowfall. An even greater flood occurred at Villarica volcano in 1910.

The last eruption of Calbuco was on January 6, 1929 (see Page One), and lasted only a few hours. Dull underground noises in the night of January 5 had warned the few people living on the north side of the volcano and they had fled from their little farms taking with them what livestock they could collect. At about 2 a. m. on the 6th a great flash shot from the top of the mountain and was followed by an enormous cloud of ash accompanied by much lightning. The ash eruption continued until the early hours of daylight. Only coarse sand reached the highest house on the mountain, but before the west wind the fine ash drifted far off to the east so that a layer a few millimeters thick was formed at Peulla 35 miles away, and light dust reached the end of the State Railway in Argentina more than 100 miles away. A terrific blast blew down the valleys on the north slope killing and leveling the brush and small trees growing there (see Page Three). Floods from the melted snow and ice rushed down the stream channels killing the trees along their margins and dumping volcanic sand on a few cultivated fields near the lake. For two weeks after the eruption no rain fell to wash the covering of ash from the grass and leaves so that cattle had to pick a meager nourishment from the tips of the highest bunch grass which had shed some of the dust.

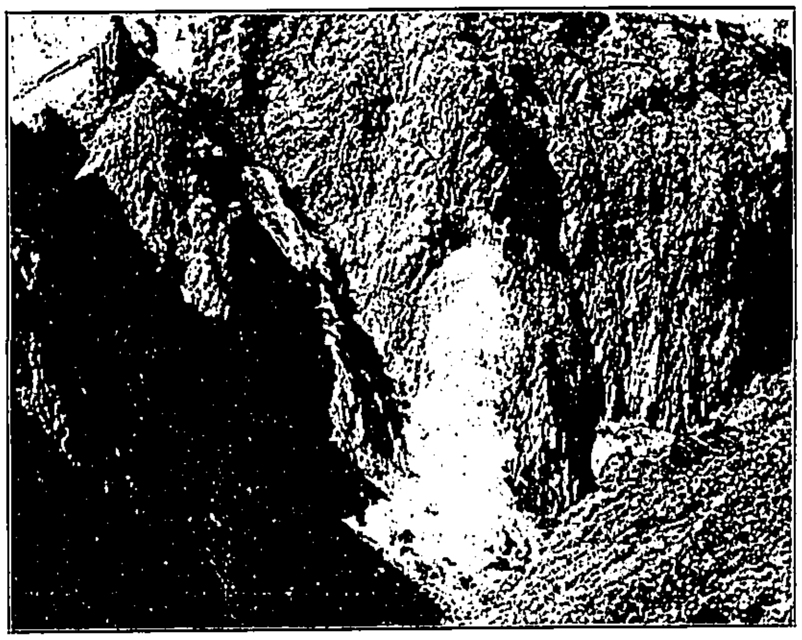
On January 19, 1930, the writer and a Chilean helper made the first ascent to the crater of Calbuco since the eruption of the previous year. The route from Ensenada on Lake Llanquihue leads up a valley swept by the floods of 1893 and 1929. Exposures in the steep walls of the stream channel show a history of past explosive eruptions. Lava flows reaching the lower slopes are rare and none is seen on the surface, but everywhere there is a deep cover of broken rock and sand like that thrown out by Kilauea in 1924. The new crater of Calbuco is a straight-sided hole perhaps 500 feet across (see Page Four). The rim, especially around the northeast edge is deeply covered by gravel and ejected blocks. Thick white fume escapes in several places from the talus slopes inside the pit. The crater plainly owes its present shape in part to collapse after the explosions.

KILAUEA REPORT No. 958
WEEK ENDING JUNE 1, 1930
Section of Volcanology, U. S. Geological Survey
T. A. Jaggar, Volcanologist in Charge

Kilauea Volcano continues to be quiet and without visible signs of magmatic change. Early in the week numerous small rock falls occurred from the north wall of Halemaumau, the slides at times accumulating sufficient material to make dust clouds. Much fine debris has piled up against the foot of the wall between the two large north talus heaps. The fire pit was without sounds and with very little steam at the end of the week.

The seismographs registered nine tremors, two of which lasted one minute each; one very feeble seism, with origin distance 28 miles; and one distant earthquake recording feebly at 12:08 a. m. May 31. Microseismic motion was slight throughout the week. Tilt accumulated very slight WSW.

Brush in valley of Rio Caliente killed and bent over by eruption of Calbuco Volcano in Chile in 1929. Photo Stone.



Looking into the new crater of Calbuco Volcano, Chile, from the north. Photo January 19, 1930, by Stone. Thick white fume issuing from talus.

THE VOLCANO LETTER

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No. 285—Weekly Hawaiian Volcano Observatory, National Park, Hawaii June 12, 1930

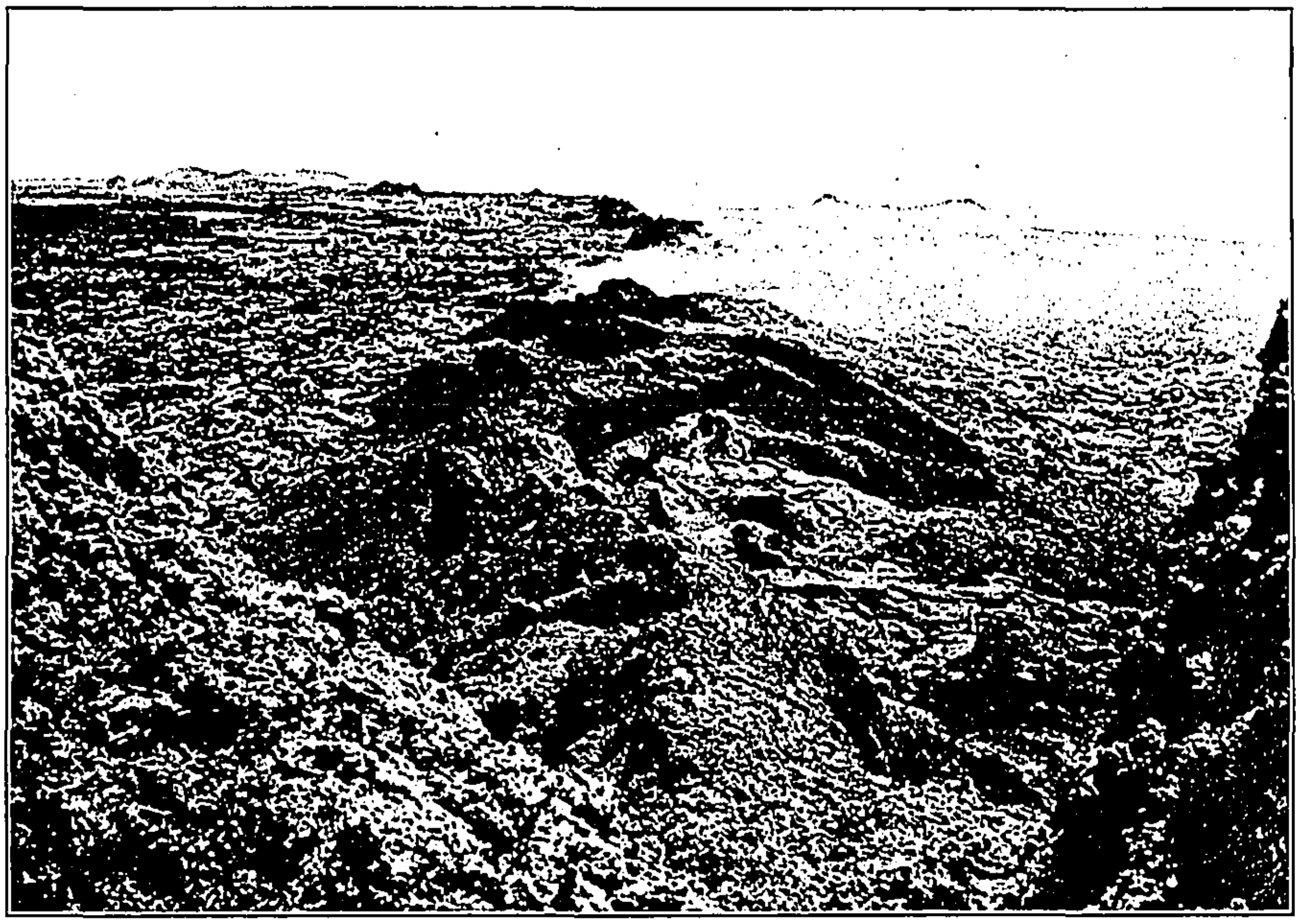
Mauna Loa rift source from the east, October 1, 1919, showing lava fountains, steam, and fume spouting up within ramparts of pumice. The new cones extend right and left outside the picture. Photo Jaggar.

SOURCE VENTS FOR MAUNA LOA FLOWS

There is apt to be much confusion in the mind of a visiting traveler when he hears talk of a lava flow. Careless writers are apt to speak of a lava flow in Halemaumau pit. An eruption of lava in the bottom of this great pit depressed below the southern floor of the larger crater of Kilauea is not a lava flow in the Hawaiian sense. A lava flow means to the residents of these islands an outbreak on one of the volcanic mountains which courses down the flank and is prone to enter the ocean if it lasts long enough. While it is possible for such a flow to arise by lava overwelling the brim of a summit crater, and although there have been short historical flows which originated in or near the summit craters of Kilauea, Mauna Loa, and Hualalai, none of these has ever traveled far. Usually such flows are confined within the compass of the large summit sink-craters by the overflow of the inner pit or the development up a crack of a new cone by rupture of the crater floor. The great lava flows of history, in the Hawaiian sense (see map last page), have emerged from the mountain flank along well known rifts that have been the sites of many outbreaks. The places of outflow have been from one to twenty miles away from the large summit craters, but there is generally a preliminary gush of some sort at the summit region.

Several pictures of Mauna Loa rift sources have recently been printed in the Volcano Letter (Nos. 270, 277). The well known rifts on Mauna Loa extend southwest and east-northeast from the summit. Indeed there is a strong suggestion that about the Rest House at the north at elevation 10,060 a new hump or dome is building up about the eastern rift, and that similarly a separate volcano is building about Puu o Keokeo as a center at elevation 6,870 to the south. An understanding of these rift belts as zones of potential weakness on volcanoes is essential to the understanding of lava flows. These radial fractures in a volcanic edifice may be curved or straight, several or few, but they stand for a deep-seated breakage in the dome, and along these broken belts there is underground connection along upright fractures with the central pipe, and this in turn is nothing more than the upright line of meeting of the rifts. Observation of the miniature slag lakes and overflow floors of the inner pit of Kilauea has shown how this fracturing of a dome happens. The overflow about a vent forms a slag heap. The slag heap becomes hard inside while remaining red hot. Renewed overflow at the central vent is accompanied by swelling gas pressures which rupture the heap. The lines of rupture are apt to be along the boundaries of three or more sectors. These sectoral cracks open widest along the contour of the heap which is lengthened the most by the swelling action. This is where the summit plateau changes its grade to a steeper marginal slope. There is probably a systematic geometry of building up domes and breaking them which has produced the strikingly uniform distances and triangular arrangement of crater summits on Hawaii.

The picture on Page One was made on October 1, 1919, when the writer was approaching the spouting source crack of the Alika flow from the east and looking from an old red cone at the new constructions of the active belt at a place about five miles north of Puu o Keokeo. After tethering the riding animals and walking across some ten alternations of rough aa and smooth pahoehoe, the aa making the most terrible footing on earth, there could be seen the line of rift cones, some 40 of them visible at one time, extending from near Puu o Keokeo northward. The source of the outbreak was revealed in panorama, consisting of a line of new gushing hillocks of slag, a true fissure eruption. Here great fountains were spouting continuously for a thousand feet like a wall of red flame, and in detail they were seen to be made of incandescent, light, crumbly material, yellow when it shot up, and red when it came down. Gas was rushing through a lava pool filling the rift, churning it to a foam with a noise like surf, and flinging up the foamy matter to solidify as it fell. Northward the smoking patches and driblet heaps became progressively smaller. This activity had all started by a simple splitting



Mauna Loa eruption of 1926, line of cones formed along rift, dying crater of main flow in foreground. Looking down mountain toward distant Puu o Keokeo on left. The flows poured off to the right. Taken May 4, 1926. Photo Jaggar.

open of the mountain flank along a new line within the belt of fracture generally known as the rift, and the splitting had progressed from the summit crater region downhill. The process had begun by strong earthquakes September 14 and 18, followed September 26 by a gush of smoky cauliflower clouds with chocolate-colored edges from the region immediately southwest of the summit crater of Mauna Loa. Two distinct columns of smoke developed side by side and a mile or so apart. The top of the jet reached 7,000 feet above its base, and with nightfall the cloud was illumined a bright orange-red. These gas jets waned so that by 10 p. m. only one fume jet could be seen, and by 3 a. m. the preliminary eruption was over.

The glow illumining the summit smoke in the first eruption was undoubtedly caused by a gush of frothy lava. There was then a lull from early morning of September 27 to 1:45 a. m. September 29, when moderate red glow and fume appeared over the southwest rift of Mauna Loa about the 8,000-foot level and both spread southward. This was the activity which quickly built up the line of pumice cones shown in the picture on Page One. There had evidently been a first release of gas from the expanding lava column up the central pipe, this in turn produced an expansive swelling that took two days to open the southwest rift, and thereafter the path of least resistance lay at the 8,000-foot locality and the outflow gathered volume there and maintained the release for several weeks. The eruption gradually dwindled in November. No sudden event was observed to mark its termination on Mauna Loa, but on Kilauea, where there had been continuous outflow in the big crater for many months, the lava suddenly subsided in Halemaumau on November 28.

An earlier published airplane picture (Volcano Letter No. 270, Page Three) showed well the straight lines of cones built up from 50 to 100 feet on the southwest rift of Mauna Loa in April, 1926, when there was another lava flow of the same quality as the one just described for 1919. In fact the photograph in question shows the line of cups within cones that had been built in 1919 about a half mile to the west of the new fissure that was opened in 1926. The same picture also shows in the foreground a short line of still older cones with their interior cup-craters lying to the east of the 1926 crack. The characteristic initial structure is an elliptical cone at each of the many openings along the crack, with an egg-shaped cup inside, and in many cases as the eruption dwindles there will be two cups where a revival of activity has made an inner cone at some larger spindle-shaped crater whence the activity had shifted elsewhere and returned during the progress of the eruption from many vents.

The photographs on Pages Two and Three show the line of cones made at the source of the 1926 eruption looking towards Puu o Keokeo and the older cones of that district, and an excellent airplane picture of the western flank of Mauna Loa above the forest line and below the rift belt exhibits the torrent of molten lava in the midst of a band of solidified aa. The source vent picture was taken May 4, 1926, just as the eruption ceased and shows the place where the final source fountain had been in the foreground, still fumy with sulphurous acid, with very hot air rushing up the cracks, a depression 5 to 10 feet deep floored with a swirl of lava. The flow picture was taken on the same day (April 18) that saw the destruction of the fishing village of Hoopuloa by the front of the flow at the sea shore 10 miles farther down the mountain (Page Four Volcano Letter 270). The surface of the golden torrent shows a dark line of crusts and rafts down the middle and a tendency to form distributaries around islands, the rapid stream maintaining in general a middle position along the band of semicongealed black clinker produced by earlier overflows of its banks. At the top of the picture this band is seen to change to lighter colored lava under the fume and cloud of the source vent region, and this lightness is due to the presence of pahoehoe or smooth lava, with glistening surfaces on all the upper heaps within a half mile of the rift. This transition from pahoehoe to aa a short distance from the Mauna Loa source cracks is characteristic, and shows the results of stirring on a steeper slope as described in Volcano Letter No. 281.

We see then that the source vents for Mauna Loa flows create true fissure eruptions, with many cones and cups along miles of cracked mountain flank, and that a new eruption tends to start at the top of the rift belt and to split its way down the mountain to that place on the flank where the lava finds a path of least resistance for continuous flowing. Quite commonly the splitting of the crack extends below the place selected for final adjustment to outflow: this happened in 1919 and 1926 on Mauna Loa, and in 1920 on Kilauea. Thus the lowest opening on the crack is not the vent selected for most voluminous flowing, showing *that the outpouring* is not strictly hydrostatic, but is rather selective of that portion of the rift which may be opened widest by the swelling of the mountain.

T.A.J.

KILAUEA REPORT No. 959

WEEK ENDING JUNE 8, 1930

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

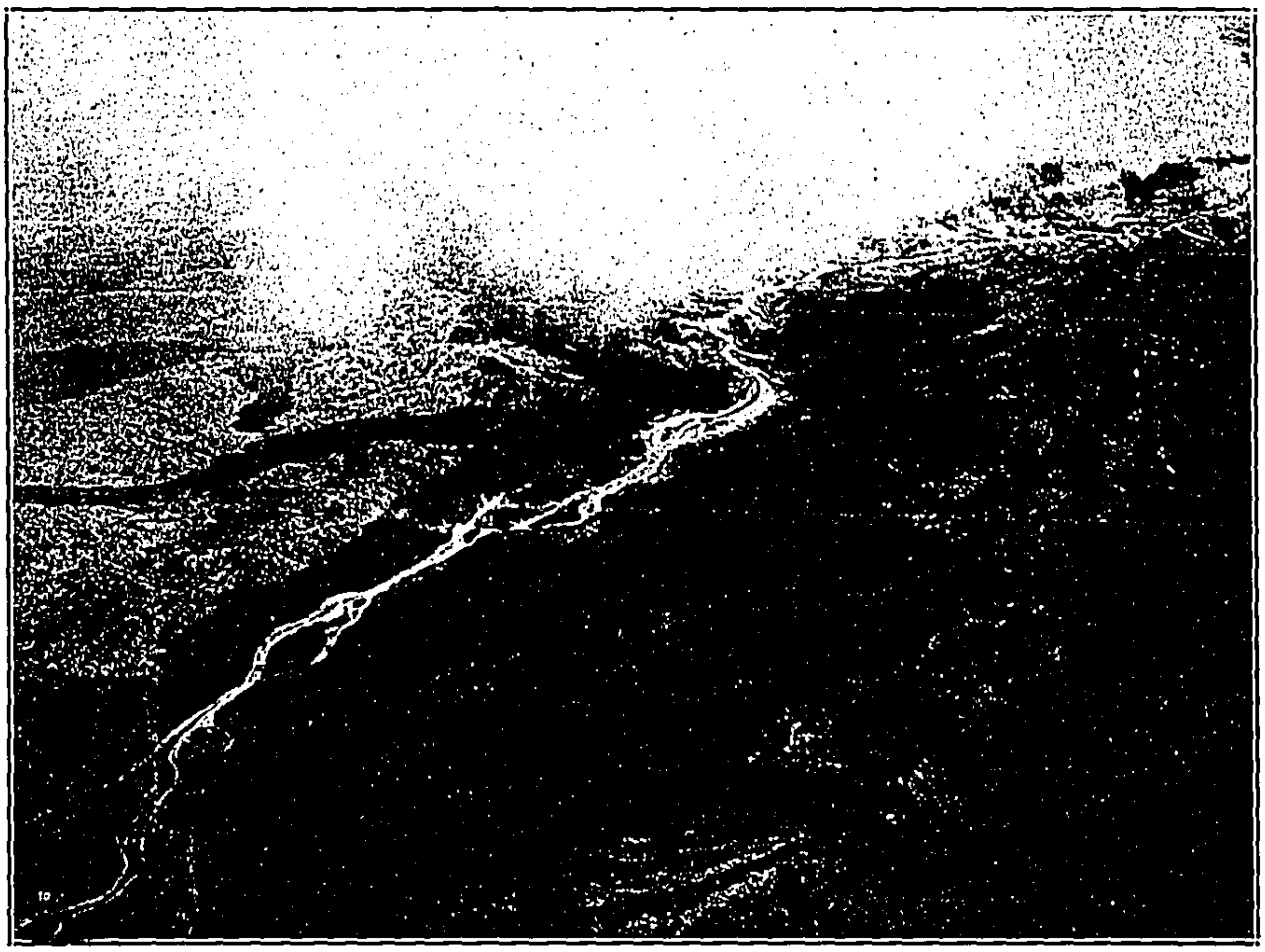
Halemaumau pit in Kilauea Crater remains quiet. At 11 a. m. June 5 no steam could be detected at any of the interior vents of the pit, though the vapor rising from cracks back of the west rim was as usual. On the morning of June 7 a little vapor could be detected at the south talus.

Ten local seismic disturbances were registered, of which six were short tremors lasting less than one minute, one was a very feeble seism, and three were feeble quakes. Two of these were felt on both east and west sides of the island, the times being 4:54 a. m. June 3, indicated distance from Kilauea 67 miles along with southeast tilt at the Observatory, and 6:32 p. m. June 4, probable distance 14 miles. The other was at 3:39 a. m. June 5, distance 28 miles. Tilt for the week was slight NE, and microseismic motion was slight.

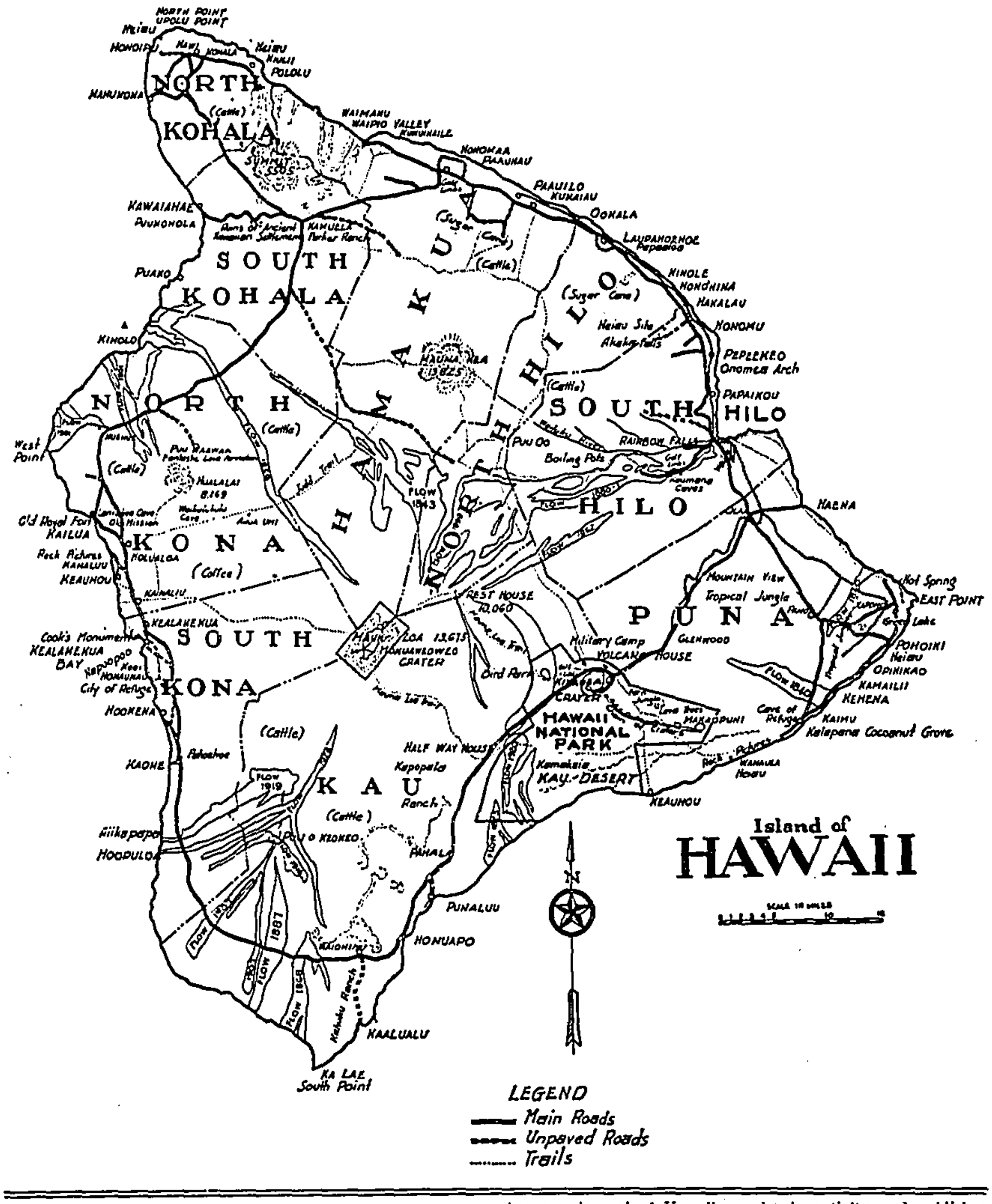
MAY TILTING OF THE GROUND

At the Hawaiian Volcano Observatory on the northeast rim of Kilauea Crater, the tilting or tipping of the ground in the seismograph cellar, expressed by overlapping seven-day means, in terms of angular change and direction of motion of the plumb line, was as follows:

April 28-May 4	1.03 seconds	WSW
May 5-11	1.33 seconds	WSW
May 12-18	0.48 second	ENE
May 19-25	0.85 second	WNW
May 26-June 1	0.85 second	WSW



Airplane view of Hoopuloa lava flow of April 18, 1926, showing incandescent stream within aa fields at about 5,000-foot contour of mountain. Mauna Loa eruption of 1926 from southwest rift pouring westward above Puu o Keokeo. Transition pahoehoe to aa upper right. Photo Eleventh Photo Section, U. S. Army Air Service.



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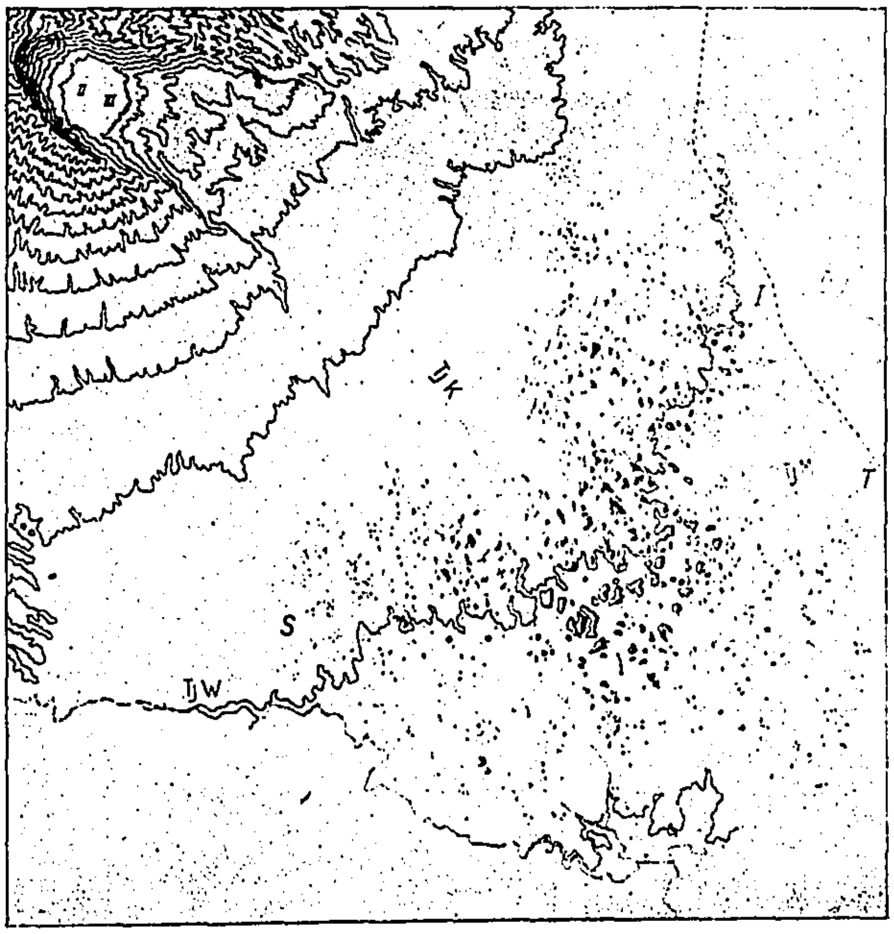
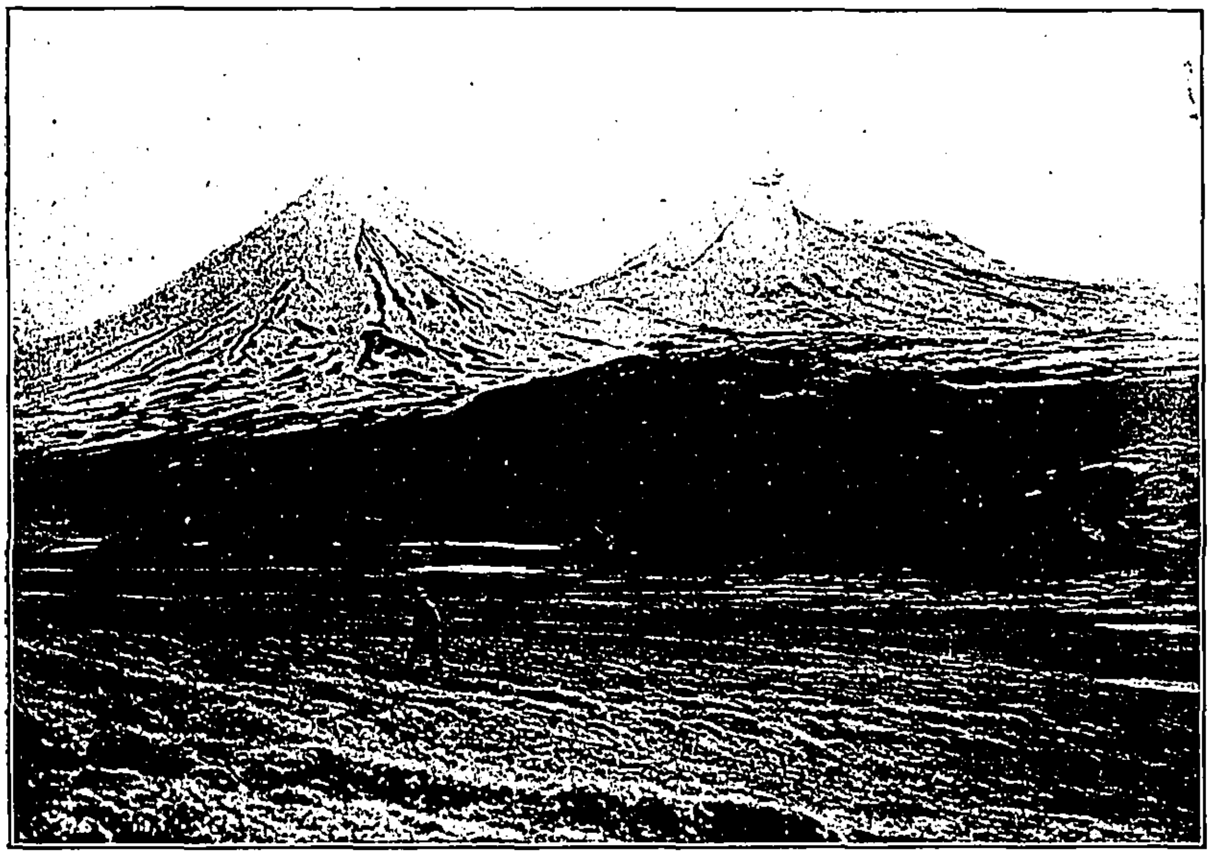


Map of southeast slope of Galounggoung Volcano in Java. The many hills indicated by mottling southeast. Crater valley at northwest is four miles long. Tj=streams, S=Singaparma, T=Tasik Malaja, I=Indihiang. May by Escher.

THE CRATER OF GALOUNGGOUNG

In west central Java the active volcano Galounggoung is a big cone 2,168 meters high with an amphitheater hollowed out of its eastern side, and from this amphitheater three streams drain off to the south in a flat country where many villages were devastated in a terrific eruption accompanied by mud floods in 1822. This flat country is covered by many hundreds of prehistoric small hills from 10 to 250 feet high. The map above shows the crater trenching the east-southeast flank of the cone, and the roman numerals I, II, and III at the head of the crater valley mark eruption centers. The principal historic eruptions were in 1822, 1894, and 1918, the last developing a lava dome below point III on the map. The first two eruptions were explosive and produced great floods in the rivers. In addition there was a landslip in 1868, just as there was in the same year on the southeastern flank of Mauna Loa in Hawaii. Indeed this amphitheater crater of Galounggoung is strongly suggestive of the gaps of Haleakala Crater, which open into valleys toward the sea, and of the Waipio, Mohakea, and Wood Valley embayments on the island of Hawaii. The hundreds of preristoric hillocks of Tasik Malaja bear some resemblance to some of the moraine-like hills on the north and west sides of Mauna Kea near the base of the mountain, these hills consisting of a jumble of mud and bowlders, possessing very irregular forms, and exhibiting no craters such as are characteristic of true cinder cones.

The places on the map of the Tasik Malaja hills marked Tj are streams, the hills are indicated by the mottling, and their disposition with the largest ones out in front of the crater valley certainly suggests a relationship between their origin and some ancient discharge from the valley. As Professor Palmer pointed out in his review of Escher's paper (Volcano Letter No. 253), 3,648 hills have been mapped, and the map here reproduced is taken from that paper, published by the Geological Society of Leiden in 1925.



Pavlof Volcano (right) and Pavlof Sister, volcanoes near the end of the Alaskan Peninsula. Pavlof shows summit crater and open valley with hillocks leading down from it. Photo National Geographic Society.

Each hill is composed of very fine material enclosing large blocks of andesite rock. The cubic content of all the hillocks taken together is about one twentieth of the material missing from the cone of Galounggoung at the great amphitheater. Underneath the hills, however, there is an underlying mixture of bowlders, gravel, and mud some 70 feet thick in the middle and thinning out toward the margin of the hilly area. If we add this under layer to the volume of the hills, we still fall far short of the volume lost from the big crater.

According to Escher the material of the hills had slid down from the crater in the condition of mud, probably from a crater lake. As a succession of eruptions had migrated from a summit crater to the southeast, it is probable that the crater lake broke through and caused a violent and watery landslide. "The hillocks represent the fixation of the last material of the slide, clots that remained standing higher, the principal mass having slowed down because of increasing bottom friction as it spread out fanwise and lowered, and as it lost part of its water." The finer mud and surface material flowed on down the slope, leaving the clots in relief where irregular clusters of bowlders clothed with mud made the remnant hills. The largest of these were in the middle of the landslide fan and opposite the middle of the crater valley. Taverne (Vulk. Med. No. 6, Mining Bureau of the Netherlands East Indies, Galounggoung and Telaga Bodas, Weltevreden 1924, page 29, and plate III) has reproduced an old map of Galounggoung after the eruption of October, 1822, and the area devastated and buried by this eruption corresponds closely with the area of the hills.

The following second review kindly sent us by Professor Palmer presents another explanation for the hills of Tasik Malaja. T.A.J.

THE BOWLDERY HILLS OF GALOUNGGOUNG

A paper by the eminent Dutch geologist, B. G. Escher, relating to the "Ten Thousand Hills of Tasik Malaja," was reviewed in the Volcano Letter for October 31, 1929 (No. 253). Escher considers these hillocks to be stranded masses of landslide material, the rest having swept on down the slope.

A short paper by Dr. F. X. Schaffer, head of the Division of Geology of the Naturhistorisches Museum in Vienna, has been received and suggests another origin for these hills ("Die Zehntausend Hugel von Tasikmalaja," Centralblatt f. Min. etc., 1926, pp. 207-209). Dr. Schaffer visited the region a year before read-

ing Escher's paper. At that time he was of the opinion, which he still holds, that the hillocks are man made. Most or many of the hillocks bear houses and friut trees. As dwelling sites they offer some protection from the numerous mosquitoes and rats which infest the rice fields at the bases of the hillocks. They offer some immunity from attack by hostile persons, and they insure dryness for the dwellings. They also offer places of refuge from the volcanic mud-flows that from time to time rush down the depressed sector of the volcano where they are to be found. The gently sloping, fan-shaped region built up by the mud-flows is very favorable for rice cultivation, which has undoubtedly been practiced from time immemorial. However, the preparation of the rice fields has involved the movement of great volumes of rock and earth in order to bring them to grade. In the process of clearing the land it would be probable that the people would make dumps of the bowlders and cobbles from the mud-flow material. Thus the dumps have become hillocks, and it was a simple matter to take advantage of the favorable characteristics of the hillocks that are favorable for house sites. The objection might be raised that the volume of man beings. This might be true of occidentals, but is not beyond the powers of the numerous and ant-like industrious Malays.
material moved is too great to be conceivable as the work of hu-

The reviewer has attempted to give Dr. Schaffer's views and nothing else on this occasion, which is what he attempted on the previous occasion for Professor Escher's paper. Schaffer concedes that the cores of the larger hillocks are not man-made. It is to be regretted that we have no information as to native legends of the origin of the hillocks. H.S.P.

SOME ANALOGOUS BOWLDER HILLOCKS

The foregoing discussions of bowldery hills in fan-like grouping in front of a crater valley in Java are too important to pass without some comment. This question of crater sinks merging into collapsed valleys has been splendidly reviewed and illustrated by Friedlaender, (Volcanological Review, Berlin, Vol. II, page 186, 1916, "On volcano fault-valleys," with maps of Bandaisan in Japan, of Hawaii, of Brava, San Thiago, and Fogo in the Cape Verdes, of Palma in the Canaries, of Stromboli in Italy, of Savaii and Tau in Samoa, and of Crater Lake in Oregon.) As mentioned in the last Volcano Letter, the Hawaiian volcanoes are breaking down by faulted sectors. When such downbreak is accompanied by explosion at the volcanic center, big downblasts, floods and landslips are common. The accompanying photograph of the north face of Pavlof (Page two) cones shows down-broken sectors, the right-hand peak, Pavlof proper, exhibiting an open A-shaped gash, clotted rocky hillocks of debris below it and under the crater, and a vast jumble of bowlders and wash spread out in a fan farther down the slope. This jumble contains hundreds of mounds like those described under Galounggoung. (See Nat. Geog. Mag. January 1929, pp. 130 and 134).

The most perfect parallel to the Galounggoung cluster of hills is to be found on the north slope of Bandaisan volcano in Japan, and these mounds were created by the explosion and landslip of the great eruption of July 15, 1888. They were described as follows (The Eruption of Bandai-san, by Sekiya and Kikuchi, Jour. Sci. Coll. Imp. Univ. Tokyo, Vol. III, Pt. 2, 1889, page 110, plates xv, xviii, xxi, xxii): Large and small conical mounds stand out from the surface of the debris in immense number. There are big bowlders, measuring from five to ten meters, carried along as part of the mud current, and thousands of mounds, large and small, have been formed on the vast sea of mud, standing out of the debris like so many miniature Fujiyamas. They consist of disintegrated crumbling rocks, and the refuse falling around their bases has assumed a conical shape by forming taluses around them.

The writer examined this field of landslip of Bandaisan in 1914, where a huge amphitheater was quarried out of the flank of the mountain by the eruption, making just such a map as that of Galounggoung on Page one. The hillocks are clustered fan-like amid the tumble of rubbish in front of the crater niche. There were scars on the sides of the valley devastated, 75 to 100 feet above the debris, showing how the mud and earth had sunk away from its highest level. This high level corresponded with the tops of the mounds. The mounds had mostly a hard bowldery core, and many of them stood as islands in the lake which the eruption had produced by damming. One hill sketched was a pyramid with four surfaces fallen away, its summit sharp, made of earth and stones. The explanation adopted by the writer was that the first rush of the landslide was a thick fan while *the huge rocks were grinding up*, then the vast amount of water acquired by the finer material made this finer stuff rush much farther as a mud flood, carrying smaller bowlders and bowlder clots, and spreading as a thinner layer. This outspreading of the lower fan drained down the deposit from the scar level to the final level, and the larger rock fragments in units and groups remained in relief, as mounds which resisted farther progress. This would leave the larger clots nearer the crater, the smaller ones farther away, and precisely that effect is shown by plate XV of Sekiya and Kikuchi, and by Escher's map on our Page one. There is every reason to suppose that Galounggoung has had the same type of eruptions as those of Bandai. In both cases the same expression is used by scientific observers, "thousands of conical mounds." Escher's explanation appears to the writer to be correct, and to account for the gradation in size, and the distribution relative to the crater, and the rocky cores, while Schaffer's observation concerns human selection after a cataclysm had created the hills.

T.A.J.

KILAUEA REPORT No. 960

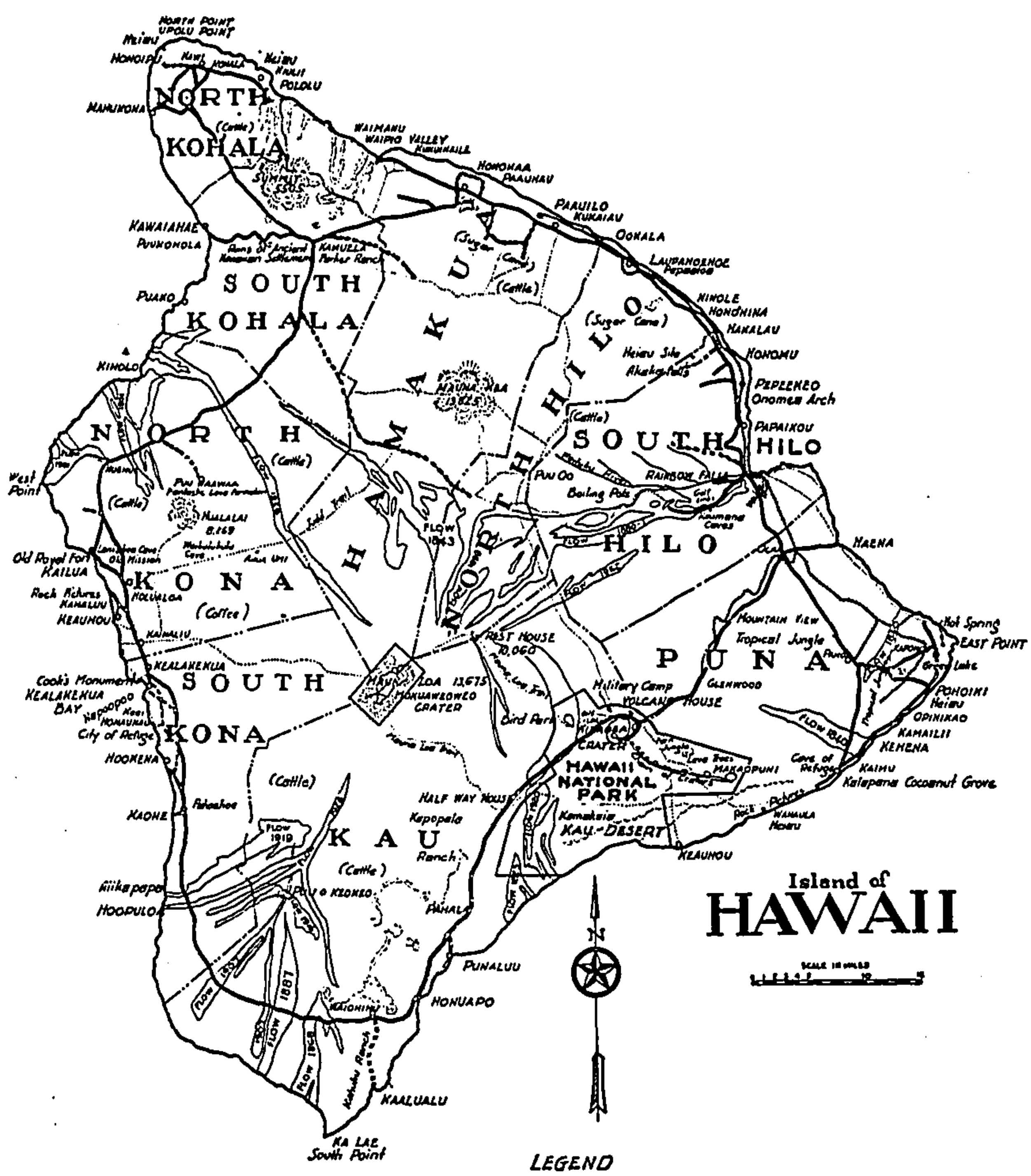
WEEK ENDING JUNE 15, 1930

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

There are no changes in the crater of Kilauea, and only once during the week was a little sliding observed at the pit walls.

The seismographs at the Observatory have registered one slight earthquake, three very feeble local seisms, two of them accompanied by easterly tilt, and four tremors lasting each from one-half minute to one and one-quarter minutes. The slight earthquake was generally felt on the east side of the island at 12:25 a. m. June 14, the seismogram indicating distance of origin about 12 miles from Kilauea Observatory. The felt movement was prolonged and moderate at Kilauea, shorter and ending in a sharp jerk at Hilo. The vertical component was very pronounced on the Kilauea seismogram.

Tilt for the week was stationary, and microseismic motion was very slight.



Note on this map the horseshoe valley west of Pahala and the depressions northeast of Kohala summit, as well as Kilauea Crater, all amphitheaters similar to Galounggoung Crater.

THE VOLCANO LETTER

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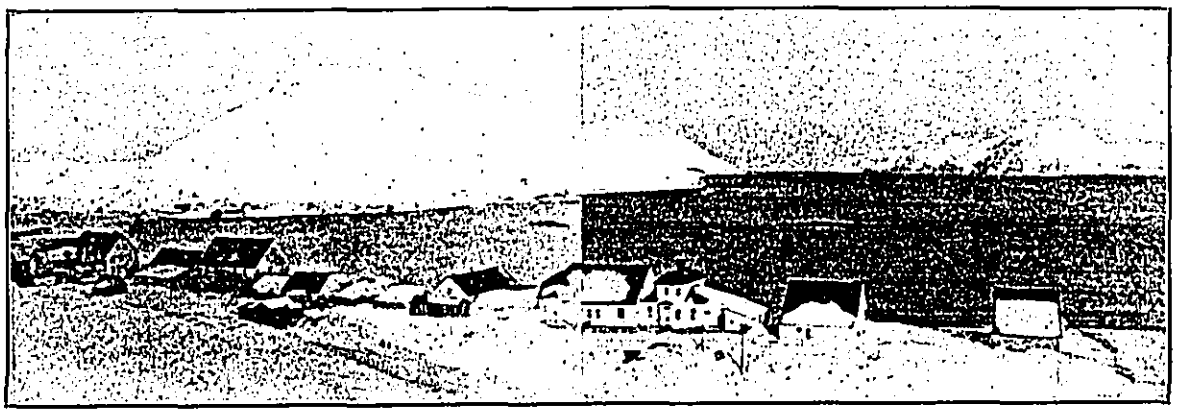
The Volcano Letter

Two dollars per year | Ten cents per copy
No. 287—Weekly | Hawaiian Volcano Observatory, National Park, Hawaii | June 26, 1930



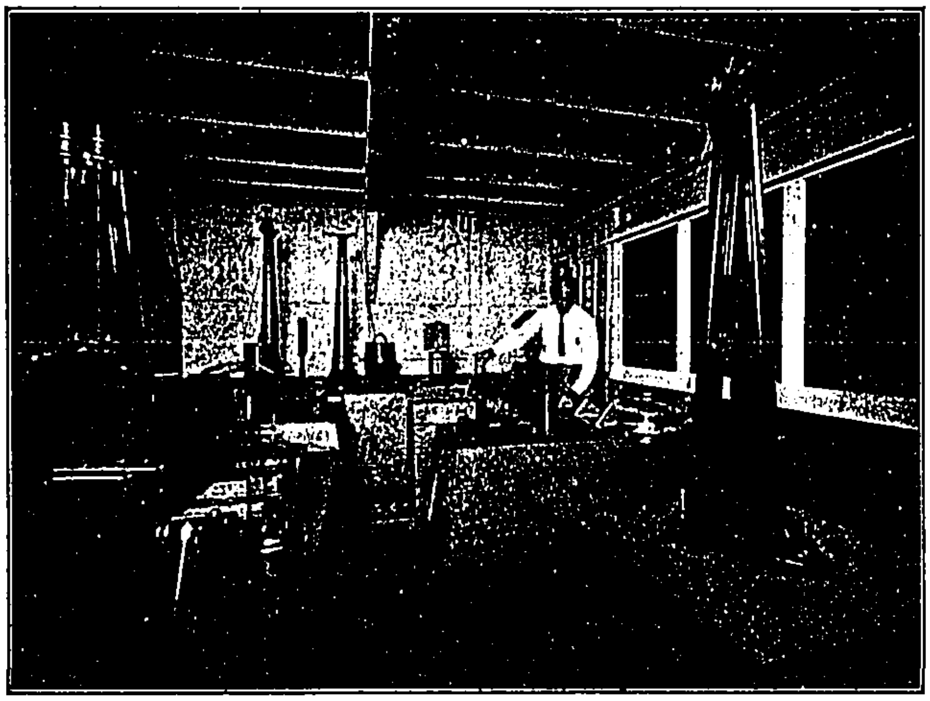
Unalaska harbor, in the Aleutian Islands, looking north in winter time, showing the village in foreground and on the left Amakmak Island, where are Dutch Harbor and the Naval Radio Station that houses the seismograph of the Volcanology Section, U. S. Geological Survey. Photograph by Yatchmeneff.

THE PULSE OF THE PACIFIC

How the seismograph works has been the subject of another number of the Volcano Letter (No. 268), and one of the first objects of investigation when the Hawaiian Volcano Observatory was started in 1912 was the pulse of the ground at an active volcano. For fifty years the Japanese have been taking the pulse beats of the earth crust in Japan, led first by John Milne, second by Professor Omori, and third by Dr. Imamura. All of these were stimulated by their researches to give attention to the active volcanoes of Japan, and recently the work has been narrowing down to what Imamura calls chronic earth tilting. The San Francisco earthquake of 1906 revealed a great rift extending for hundreds of miles, and the Coast Survey determined horizontal movement whereby the two sides of the rift shifted in opposite directions during the earthquake. Monuments have been set up to learn how much of such movement is chronic and continuous. The Carnegie Institution of Washington has set up sensitive instruments in southern California to learn how many small jarrings are associated with such faults. The Section of Volcanology of the Geological Survey has extended the Hawaiian work to Lassen Volcanic National Park in California and to Kodiak and Unalaska (see photographs Pages One and Three) in Alaska in order to take the pulse of new places. New Zealand and the Dutch East Indies are at work on the same problem.

All of this may be regarded as a big experiment requiring both time and space, the half century of time and for space the whole fiery circle of the Pacific, in order to find out, for local seismology, what movements of the ground are sufficiently continuous, chronic, or frequently repeated. One subject of local seismology at the volcano belts is to determine important cycles leading to recurrence of eruptions. For the geography or space side of the argument, the object is to determine what volcano or vent will erupt. For the places where volcanoes are not active, like Wellington or San Francisco, the object is to determine the earthquake danger, and what are the cycles in time for big earthquakes at the same place, and what are the places where the snapping of the earth's crust may progress through the ages from point to point, not accidentally, but because of some deep-seated law of which hitherto man was ignorant.

Thus in Hawaii the volcano observatory is seated on a comparatively simple structure, an island with three active volcanoes and two old ones. We have five active seismograph stations where pendulums register the tremblings, jolts, and tiltings of the ground and the lists exhibit thousands of earthquakes where in the year 1800 the only lists were in the memories of the natives or the log books of explorers. In 1800 there was an eruption with lava flows down the west side of Hualalai Volcano, and we know nothing of what spasms of earthquaking then preceded the bursting open of that dormant mountain. Ten years before Kilauea on the other side of the island had a bad explosive eruption with much shaking



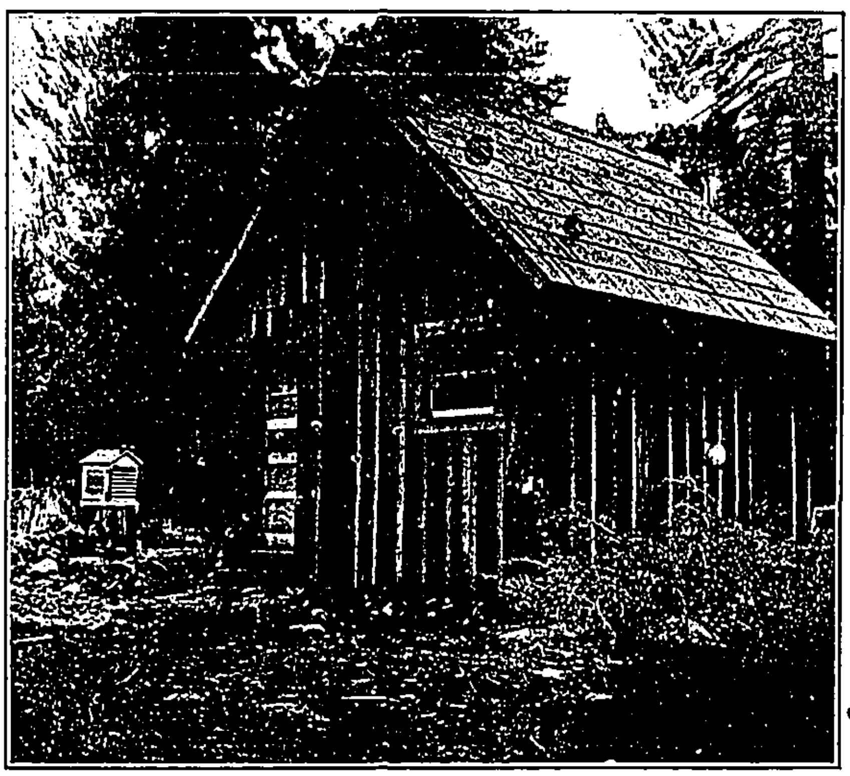
An early photograph of seismograph cellar, Hawaiian Volcano Observatory, which is dug down to bedrock. The concrete tables hold the rigid posts on which pendulums are swung equipped with chronographs that register movements on the rock on smoked paper. Station near Volcano House, Kilauea Crater.

and an enormous sinking of the bottom of its crater. Here were two events in a decade and two volcanoes somehow related. Compare with this the decade 1924-1934. Kilauea in 1924 had an explosive eruption with much shaking and sinking of its crater. Hualalai in 1929 had two months of shaking in excess of anything experienced there for a centry. Here were the same two volcanoes somehow related, but this time harnessed with seismographs. The transference within six years of the underground activity from Kilauea to Hualalai hints at a repetition of 1790-1800. The seismographs and tilt machines and leveling instruments, as well as continuous notes on Mauna Loa and Kilauea, had proved a rise and fall of the east side of the island, accompanied by rise and fall of lava in both Mauna Loa and Kilauea, for the eleven years preceding 1924. We see from all these facts that the observatory notes of only 20 years of work have enabled the scientists to sketch out an important eleven-year cycle, and the adjustment of this cycle to past history enables them to sketch out an important forecast relating to the geography of adjacent volcanic craters. Underlying these researches is the pulse of the crust of the earth measured by recording pendulums, and these have been writing the autograph of the bedrock since the summer of 1912.

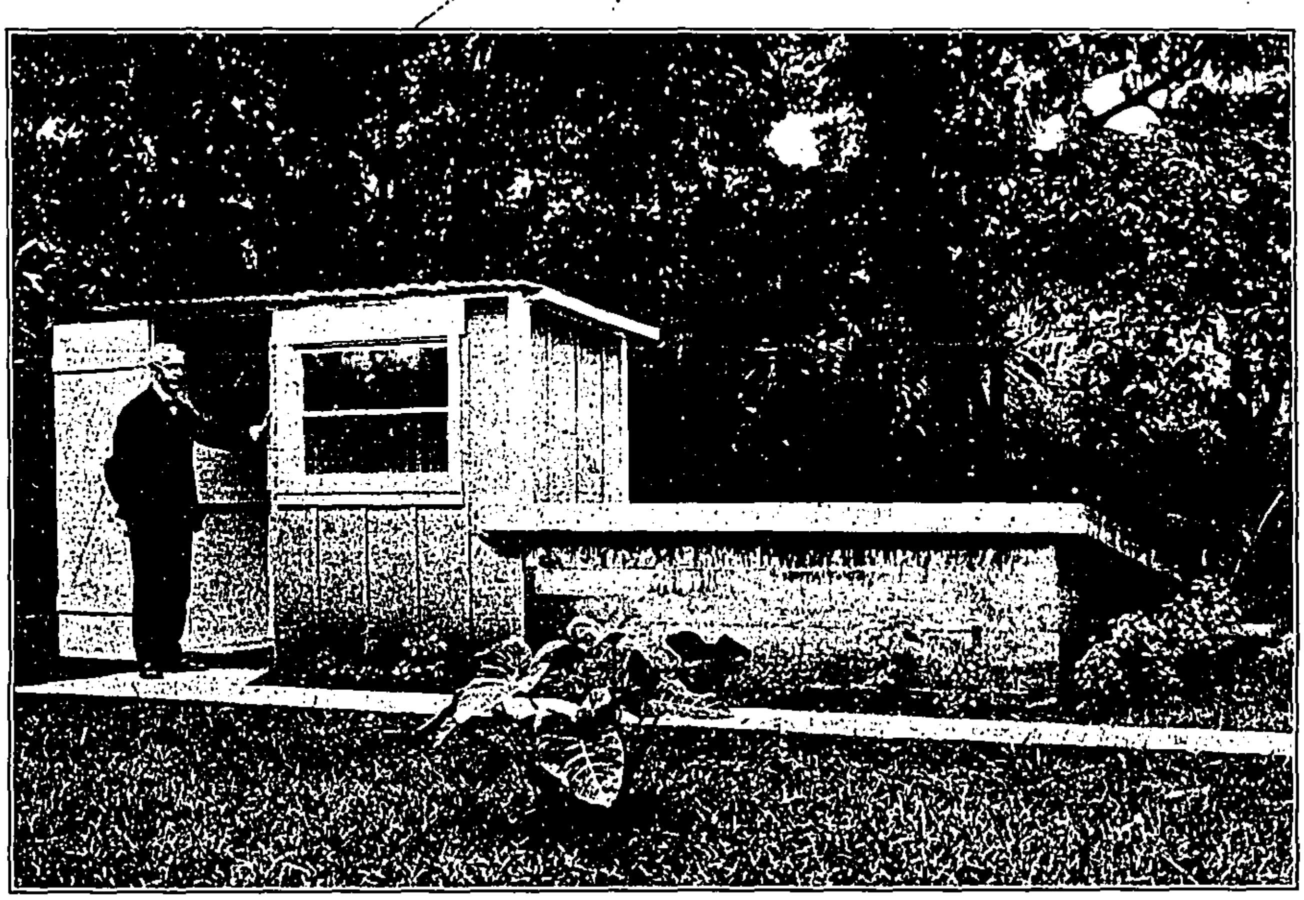
The cut on Page Two shows the seismograph cellar built on the bedrock under the Hawaiian Volcano Observatory back from the edge of Kilauea Crater on its northeast side. A number of iron posts are seen, bolted into the concrete. Heavy beams support the floor above, so that the building rests on the outer margins of the cellar, and the walking of people on the upper floor does not press down the floor of the cellar locally. This is important, for every time an observer enters the cellar to change the chronograph drums as shown in the picture, his weight in walking by a post is sufficient to swing the magnifying pens a half inch across the smoked paper. The instruments are very sensitive, and are designed to record on different chronographs strong motions and weak motions, up-and-down motions, east-west and north-south motions, and to distinguish between tiltings, tremblings, local earthquakes, and distant earthquakes. A local earthquake makes a quick motion, a distant earthquake makes a slow motion. With all of this goes continuous registration of time from a clock, and correction of the clock by wireless. With 15 or 20 local earthquakes a week, numerous distant earthquakes throughout the year, small wave movements in the ground due to lava in the pit, the action of a storm, the pounding of a distant surf, or the passage of a steam roller: with hundreds of earthquakes when an eruption begins: with tilting and certain kinds of tremor always in progress; it will be seen that it requires experience to decide what seismograms to study, and where to place seismographs in order to cover geographical questions. As a matter of fact, the published seismograph records from volcano stations are unsatisfactory, because the volcano seismologists have too much to study.

It is popularly supposed that we look at a seismogram and predict an eruption. But neither eruptions nor big earthquakes herald themselves in this manner. The science of local seismometry is steadily working to narrow down all these many movements so as to reject the unimportant ones, and then to measure intensively, with distributed instruments, those chronic movements that are directly related to the lava underground. Japan and Hawaii have both concluded that chronic tilting or tipping of the ground goes with chronic rise and fall of the land. In Volcano Letters 264 and 283 we have shown how gradually Kilauea swells and how gradually the rim cracks of the pit spread open. From week to week we publish changes of tilt at the seismograph cellar, because big changes accompanied big risings and fallings of the lava. Imamura has shown that in Japan both volcanic eruptions and earthquakes are preceded by years of important tilting. Large earthquakes near volcanoes are proving themselves to be in a different class, involving deeper movements, than the small surface jarrings of an active lava period. Here there is a gradation that can only be explained by placing many seismographs in geometric relation to a single volcanic mountain. There is undoubtedly some relationship between numbers and intensity of earthquakes on the one hand, and the magnitude and direction of tilting on the other, but to discover this relationship a limited piece of ground must be studied.

The Hawaiian station is now at work on its records of 18 years with a view to narrowing down the problem of earth motion in relation to underground lava as applied to Kilauea Crater alone. The most hopeful line of attack appears to be the measurement of tilt at a number of stations all equipped with the same instrument, and a determination of policy and of instrument construction that will permit the operation of the system so as to eliminate earthquakes, tremors, temperatures,



Lassen Volcano Observatory at Mineral, California. This simple house in the forest is over a concrete cellar containing the seismographs of the Section of Volcanology, U. S. Geological Survey. R. H. Finch is in charge of the station, designed to study the seismic movements of Lassen Volcano.



Special seismograph cellar at St. Mary's School, Hilo, Hawaii, operated by Brother J. B. Albert for the Hawaiian Volcano Research Association. This houses a pair of Hawaiian-type seismographs made in the shop of the Kilauea Volcano Observatory. The records are compared with those of the crater, 30 miles away.

storms, and artificial disturbances, and a routine sufficiently simplified as to make possible the measurement for a term of years at reasonable expense. T.A.J.

KILAUEA REPORT No. 961
WEEK ENDING JUNE 22, 1930
Section of Volcanology, U. S. Geological Survey
T. A. Jaggar, Volcanologist in Charge

The Hawaiian volcanoes continue without action, and nothing has been observed in motion at Halemaumau pit of Kilauea Volcano except the sliding of a few rocks at 2:20 p. m. June 18 and at 10:25 a. m. June 20.

The seismographs at Kilauea recorded six very feeble local seisms, two of these indicating distances of origin 18 and 23 miles. Seven tremors were registered lasting from one-quarter to three-quarters minute each, and easterly tilt accompanied one of these and one of the above mentioned local seisms.

General tilt for the week was slight NNE, and microseismic motion was slight.

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HAWAIIAN VOLCANO OBSERVATORY
Founded 1911

This laboratory at Kilauea Volcano belongs to the Hawaiian Volcano Research Association and is leased and operated by the United States Geological Survey.

It maintains seismographs at three places near Kilauea Volcano, also at Hilo, and at Kealakekua in Kona District. It keeps a journal of Hawaiian volcanic activity and publishes occasional Bulletins.

Membership in the Hawaiian Volcano Research Association is limited to patrons of Pacific science who desire personally to aid in supporting the work.

The work of volcano research so supported is in collaboration with the work of the United States Geological Survey, but supplements it with buildings, research fellows, instrumental plants, explorations and special investigations for which there is no governmental provision. The Geological Survey maintains volcano stations in Alaska, California and Hawaii.

The Board of Directors includes Lorrin A. Thurston, President; Frank C. Atherton and Walter F. Dillingham, Vice-Presidents; L. Tenney Peck, Treasurer; Wade Warren Thayer, Arthur L. Dean, and Richard A. Cooke.

Persons desiring application blanks for membership should address the Secretary, Hawaiian Volcano Research Association, 300 James Campbell Building, Honolulu, T. H.

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HAWAII NATIONAL PARK
HAWAII

OFFICE OF THE SUPERINTENDENT

June 9, 1930

Director,
National Park Service,
Department of the Interior,
Washington, D. C.

Dear Mr. Director:-

Submitted herewith is the report of operations and activities in Hawaii National Park for the month of May 1930.

000 GENERAL:

With the exception of the arrival of two large around-the-world liners during the month of May, it has been a period of ordinary procedure.

100 ADMINISTRATION:

121 Park inspections by the superintendent.

Regular and frequent inspections of all operations were made by the superintendent throughout May.

130 FINANCE & ACCOUNTS:

Approval of 1931 appropriation items was received during the month but no expenditures under these new accounts have been made as yet.

200 MAINTENANCE, IMPROVEMENTS & NEW CONSTRUCTION:

210 Maintenance.

Heavy trail maintenance has been required throughout the park in order to repair trails from winter rain damage and put them in order for vacation travel. The Byron Ledge trail has been entirely relocated for approximately three fourths of a mile where it drops from Waldron Ledge to Byron Ledge.

230 New Construction:

Construction of an entrance building at the main or Volcano Entrance to the park was started May 6th and 60% completed during May. The building is of a very attractive design and is being, built of lava rock masonry. It will be completed before the end of June.

300 ACTIVITIES OF OTHER AGENCIES IN THE PARK.

310 Public Service contractors.

315 New Contracts.

A contract for erection and operation of the "Volcano Photo Studio" has been issued to Mr. K. Maehara of Hilo, Hawaii and permits a general photographic business. Approval of contract occurred May 17th under a year to year permit and approval of building plans was made May 29. Mr. Maehara will begin construction of his studio in June.

400 FLORA, FAUNA AND NATURAL PHENOMENA:

420 Museum service.

All steamer passengers and other park visitors were given lectures at Uwekahuna Observatory and those desiring it were conducted on educational walks across the floor of Kilauea volcano. Four hundred and twenty-four persons attended lectures and 106 persons took the crater trip. A total of 1,174 persons visited Uwekahuna Observatory in May.

430 Volcanoes.

A severe earthquake shook the entire island of Hawaii the evening of May 26th but no damage occurred. This quake centered near to Halemaumau, the fire-pit in Kilauea Volcano, and was followed the next few days by avalanching. No lava is indicated as yet.

500 USE OF PARK FACILITIES BY THE PUBLIC:

510 Travel.

The S. S. Resolute arrived here May 4th and the S. S. Franconia followed on the 7th. These round-the-world liners each allowed their several hundred passengers a day in this park. Their departure marks the end of the 1929 - 1930 round-the-world cruising season as they are the last of such boats for this year.

520 General Weather.

Maximum temperature	——— 6th, & 29th ———	72 degree
Minimum "	——— 4th ———	49 "
Rainfall for month of May	———	8.38 inches
" " " " " at Hilo	———	11.49 "
" " to-date Volcano District	———	30.00 "
" " " at Hilo	———	57.92 "

540 Visitors.

Dr. N. H. Van Doorninck, a geologist of Holland, arrived here from the Dutch East Indies where he is a member of the Shell Oil Co., staff. Dr. Doorninck is now on a year's leave of absence and is representing Dutch East India conservationists in a study of U. S. National Parks for the purpose of attempting protection of fast disappearing big game life there. He left here enroute to mainland parks.

900 MISCELLANEOUS:

<u>Talks by Superintendent.</u>

Upon request of the organizations the superintendent addressed the Honolulu Ad Club on May 12th and the Honolulu Representatives Club on May 17th on the value of national parks to their surrounding communities.

<u>Burning of S. S. City of Honolulu.</u>

On May 25th the steamship City of Honolulu crack liner of the Los Angeles Steamship Co., burned at her pier in Honolulu and was partly submerged to prevent explosion. The loss which is published as being two million dollars is covered by insurance by the ship will be out of service during the next four or five months.

Very respectfully yours,

Thos. J. Allen, Jr.,
Superintendent.

Copy to "Field Headquarters" (2)
" " "Yellowstone National Park" (1)

10-157
UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

TRAVEL REPORT

Hawaii National Park for the Month of May 1930

	This Month	This Travel Year To Date	This Month Last Year	Last Travel Year To Date	Increase for Travel Year Number	Increase for Travel Year Per cent
PRIVATE TRANSPORTATION:						
Cars first entry.						
Cars reentry.						
Motorcycles.						
Total motor vehicles.						
Persons entering via motor vehicles.	4,625	(14,929 cars) 44,486	5,408	37,638	6,848	.154
Persons entering via other private transportation.	219	(189 cars) 1,889	373	1,783	106	.056
Total persons entering via private transportation. . . .	4,844	46,375	5,781	39,421	6,954	.176
OTHER TRANSPORTATION:						
Persons entering via ~~stages~~ Hotel. .	1,355	7,032	1,728	8,435	- 1,403	.167
Persons entering via trains . .						
Persons entering otherwise. . .						
Total other transportation. .	1,355	7,032	1,728	8,435	- 1,403	.167
GRAND TOTAL ALL VISITORS. . .	6,199	53,407	7,509	47,856	5,551	.104

	This Year	Last Year	Increase Number	Increase Per cent
Automobiles in public camps during month	1	1	0	000
Campers in public camps during month	4	5	1	.25

10-158

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

STATUS OF AUTHORIZED PROJECTS

Hawaii National Park for the Month of May 1930

Description of Projects	Percent Constructed To Date	Percent Constructed This Month	Percent Constructed Last Month	Probable Date of Completion
402 Ranger Station, Park Entrance	60%	60%	----	June 25, 1930

10-159
UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

STATUS OF PERSONNEL

Hawaii National Park for the Month of May 1930

	This Month	This Month Last Year
Number of employees beginning of month,	6	8
Number of additions, ...	8	1
Total, ...	14	9
Number of separations, ...	0	1
Number of employees close of month, . .	14	8
Number of promotions during month	0	0
Aggregate amount of annual leave taken,	0	0
Aggregate amount of sick leave taken,	1	0
Aggregate amount of leave without pay,	0	0

10-160

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

REPORT OF PARK REVENUES

Hawaii National Park for the Month of May 1930

	This Year	Last Year
Park revenue on hand beginning of month,	0.00	0.00
Received,	100.00	127.00
Total,	100.00	127.00
Remitted,	100.00	127.00
On hand close of month,	0.00	0.00

Park revenues received this year to date,	1,175.00
Park revenues received last year to date,	1,177.00
Increase, (Decrease)	- 2.00
Percent of increase, (Decrease)	- 1.7%

10-161

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

HAWAII NATIONAL PARK

REPORT OF SALES OF PUBLICATIONS

MAY 1930

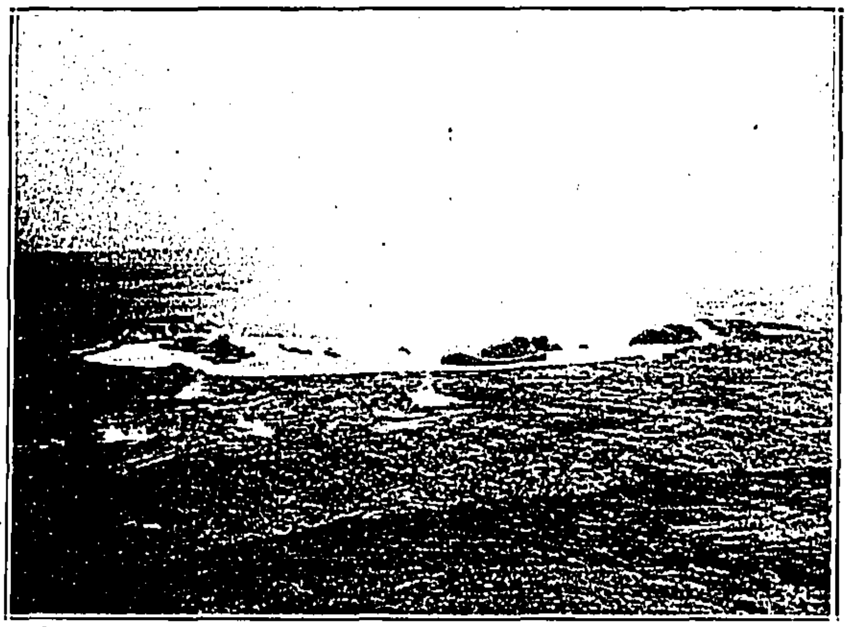
	Number	Value
GOVERNMENT PUBLICATIONS:		
On hand beginning of month, ...	256	37.30
Received during month, ...	250	115.00
Total, ...	506	152.30
Sold during month, ...	20	11.90
On hand at close of month, ...	486	140.40
NON-GOVERNMENT PUBLICATIONS:		
On hand beginning of month, ...		
Received during month, ...		
Total, ...		
Sold during month, ...		
On hand at close of month, ...		

Cash on hand beginning of month, ...	4.10
Sales during month, ...	11.90
Total, ...	16.00
Remitted during month, ...	0.00
Balance, ...	16.00

The Volcano Letter

Two dollars per year | Ten cents per copy

No. 280—Weekly | Hawaiian Volcano Observatory, National Park, Hawaii | May 8, 1930



Distant photograph of Halemaumau pit March 25, 1921, from the summit of Uwekahuna Bluff, near where the museum now stands. Shows the entire circle of the pit filled with overflowing liquid lava that was rushing around the islands to the south cauldron in the background.—Photo Jaggar.

WHEN KILAUEA FIRE-PIT OVERFLOWED

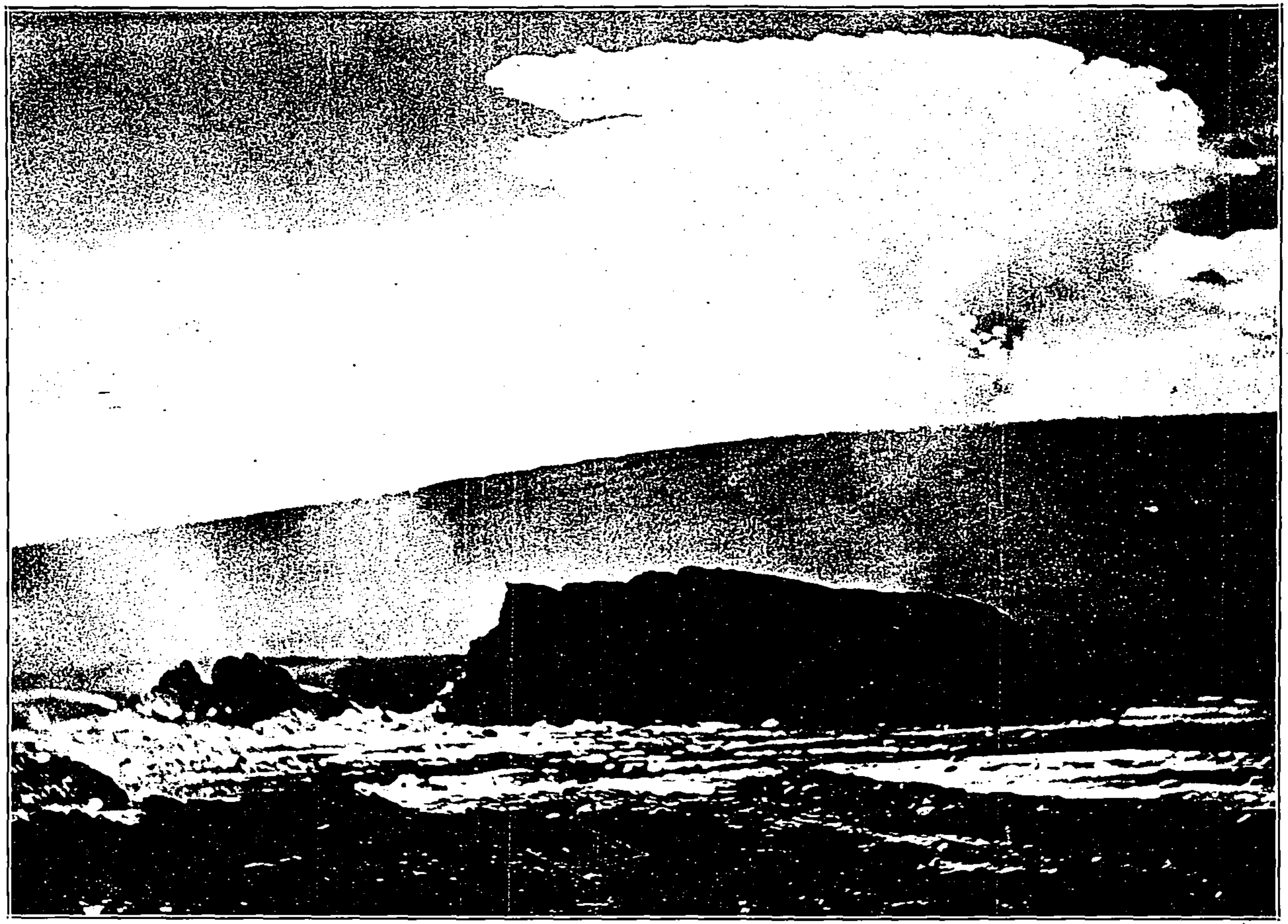
To the visiting traveler it seems quite incredible that the vast yawning cauldron of Halemaumau, the lava pit of the inner floor of Kilauea Crater, was overflowing its lips in five directions at the March equinox of 1921, only nine years ago. The following is condensed from the Journal of the first three weeks of March, 1921:

"At the beginning of March the continued subsidence of the lava in the pit made the scene surpassingly impressive owing to the great inner crags towering above the five lava lakes. The walls around the several lakes were sheer precipices, 70 feet high in places, and the rim of the pit stood 90 feet above the liquid lava. Some of the crags on March 6 were still subsiding steadily. The second week in March produced slow subsidence, both lakes and crags lowering a foot or two per day. The glow from the pit at night was dark red.

"The third week produced a spectacular rise, after beginning with dull, crusted, stationary lakes." March 15 inaugurated the rising by a swelling up of the lake bottom and heaving into the air the elephantine island exhibited in cut three of Volcano Letter No. 272. "Suddenly March 18 the crusts broke up, violent fountaining began, the lakes rose 40 feet in a few hours and united into one around the crags as islands, and the overflows escaped from the rim of the pit on three different sides. The overflow northeast swept down for a mile in the Volcano House direction, crossed the trail, and made aa lava at its front." This is what tourists see when they walk out to the pit from the Volcano House.

"The gas release which followed the overflowing produced three sinkhole cauldrons inside the pit which developed enormous clusters of roaring fountains, inrushing cascades (see Volcano Letter No. 278) and upthrown slaggy flings that formed ramparts. (Volcano Letter No. 277). Showers of grit and spun glass fell to leeward. The eruption continued steadfastly, with pit in adjustment to overflow, and the crag islands, which had risen less than the liquid, began to disappear. The longest flow was pouring all over the southern end of Kilauea Crater and out through a gap in the wall of Kilauea Crater, where it advanced a third of a mile into the desert and stopped."

"This activity was accompanied by whirlwinds generated by uprush of hot gas carrying shells and fragments of glowing basalt hundreds of feet into the air and lifting the fountains and burning gases into streamers of fire. These whirls made loud roaring noise, and the larger fragments fell several hundreds yards from the pit. At night the illumination was so great that print could be easily read at the Observatory two miles away.



Halemaumau pit brimming full, with its hot lake and crag in the foreground. In the background stands Mauna Loa with a remarkable convection cloud over it, probably due to a gas eruption at its summit crater. Photograph by Jaggar, March 19, 1921.

"The end of the month started a rapid sinking of the lava column, crags and lake lowered 10 feet or more per day, whirlpools and shifting sinkholes formed, the crags increasingly emerged from the liquid, fume became thicker the outflows of course ceased, and glowing wells were left over underground chambers at the source cones of the flows."

The first picture the visitor may compare with what he sees today when standing at the Uwekahuna Observatory, where the motion pictures are shown. This is a view taken March 25, 1921, looking down at what had been Halemaumau pit. Except that the pit at that time was somewhat smaller than at present, the effect is exactly as though one looked down at the present cauldron filled brimming full of liquid molten lava which was overflowing off to the right. At the far side of the white lake of *molten stuff is seen at the left the pressure ridge of the* southeast rim, which was near the road terminus. When the picture was taken, there was a great sinkhole cauldron at the pressure ridge, and most of the surface streaming of the lava through channels amid the crags was toward this sinkhole. The dark foreground is the terrace of Uwekahuna Bluff making this somewhat of a birdseye view, with the observer looking down at a landscape 500 feet below him.

A group of earthquakes immediately before and during the first days of this March rising of 1921 was felt in the southern and western parts of Hawaii, showing that the lava under Mauna Loa took part in the movement that was vented at Kilauea. There was almost certainly some gas effect of outrush at the summit crater of Mauna Loa, for at 3 p. m. March 19, 1921, a remarkable mushroom cumulus of what appeared to be a steam cloud with a stem, developed over the summit of Mauna Loa, its substance an ordinary cloud, but its persistency and situation suggesting a heating effect, in or near the summit crater of Mauna Loa. There was no activity of Mauna Loa otherwise reported. The large picture on Page Two shows this mushroom over Mauna Loa, taken from the east side of the boiling, rushing, lava lake of Halemaumau, and showing what was left of the great northwest crag of the fire-pit with the streaming and fountaining melt all around it. In the foreground is shown the glistening spatter lava and the general shimmer is due to the intensely hot gas rising from a million bubblings.

This overflowing of 1921 was the last of a series of such floods from Halemaumau which had been building up the Kilauea Crater floor at different times during the years 1918, 1919, 1920, and 1921. The last picture on Page Four shows the detail of a portion of the actual southwestern rim of Halemaumau in process of overflowing in 1919, and this was a third time within a twelvemonth that this had happened. The light-colored surface at the left in the photograph is the Kilauea Crater floor with the western bluff behind it and the northeastern slope of Mauna Loa still farther in the background. All the dark lava on the right is the Halemaumau interior brimming full of lava, and in the foreground streams of this lava are seen flooding over the broken rocks of the rim in pahoehoe festoons like treacle or candy. These flows are pouring away to the left. The white post on a small bluff near the middle of the picture was the southwestern trig station of the Halemaumau rim. Here again the observer of the present day sees what it would be like to have the lava of the floor of the pit up to his level and trickling over a low part of the present rim, while he stood beside it, and watched it flow. It is extremely difficult for most travelers to visualize this, or to imagine that that still black floor of the pit as he sees it today is capable of breaking out in a moment and making lava floods, tending in the course of years to fill up the cauldron. T.A.J.

KILAUEA REPORT No. 954

WEEK ENDING MAY 4, 1930

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

Halemaumau remains quiet, but a few rocks were heard falling from the north rim at 10 a. m. April 28. A white sulphurous spot was noted in the southwestern wall, and with very rainy weather steaming is seen at the south talus.

Eleven seismic disturbances of local origin were registered during the week, of which five were very feeble seisms. One of these indicated origin distance nine miles and was accompanied by tilt east, and another origin distance 16 miles and was accompanied by tilt south. There were six tremor spasms lasting each from one-quarter minute to one minute. Microseismic motion for the week was slight, and tilting of the ground was slight NW.

APRIL TILTING OF THE GROUND

At the Hawaiian Volcano Observatory the tilting or tipping of the ground in the seismograph cellar, expressed by overlapping seven-day means, in terms of angular change and direction of motion of the plumb line, was as follows:

March 31-April 6	1.11 seconds NE.
April 7-13	0.79 seconds SW.
April 14-20	1.03 seconds SW.
April 21-27	2.42 seconds NE.

Looking along the south margin of Halemaumau January 19, 1919, Uwekahuna Bluff in the background. In foreground lava of Halemaumau overflowing the rim in trickling streams.—Photo Jaggar.

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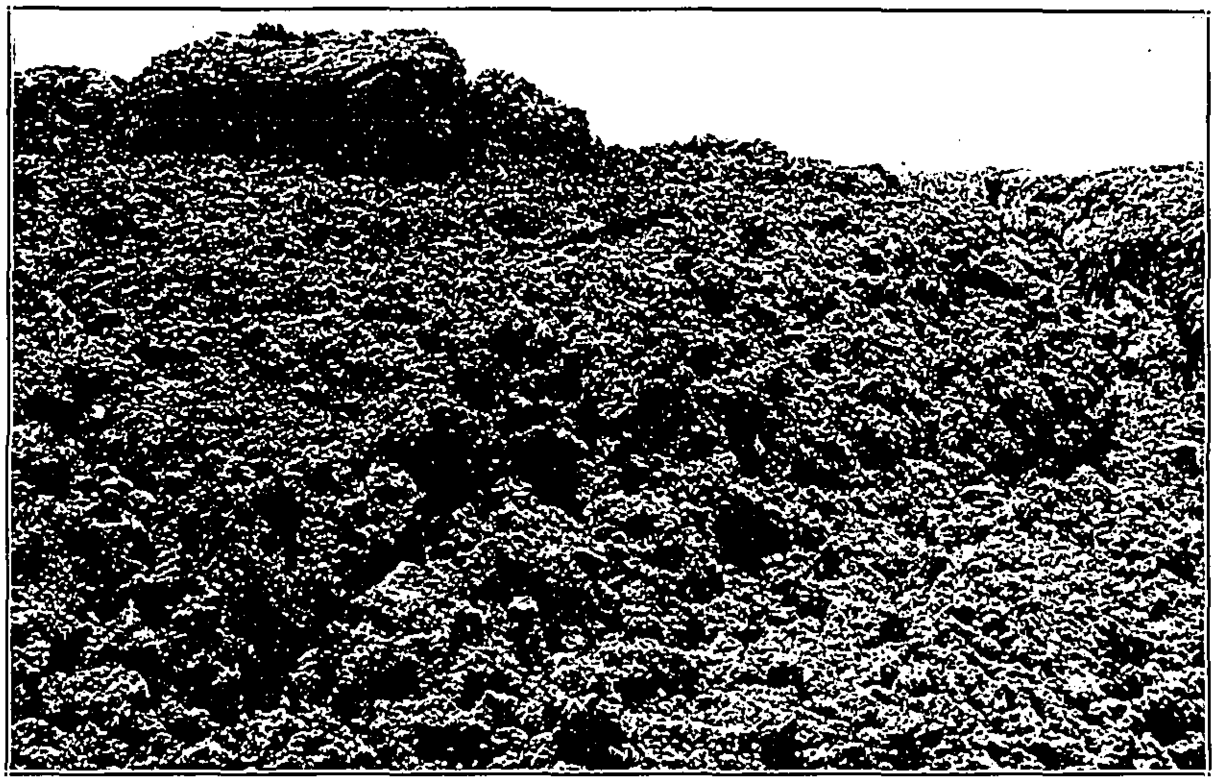
The Volcano Letter

Two dollars per year | Ten cents per copy

No. 281 Weekly | Hawaiian Volcano Observatory, National Park, Hawaii | May 15, 1930



Aa lava and channel of Alika flow in South Kona on the slope of Mauna Loa, 1919. This shows typical aa texture on the bank that congealed after the glowing stream ceased flowing. This stream, 40 feet wide, swept through the channel for days at eleven miles per hour.—Photo Kanemori.

DISTINCTION BETWEEN PAHOEHOE AND AA OR BLOCK LAVA

The picture shown above represents a characteristic surface of what the Hawaiians call aa lava (pronounced ah-ah), in contrast to the smooth candy-like surfaces (pahoehoe) of basalt shown on Page Two. In the experience of the Hawaiian Volcano Observatory four eruptions of Mauna Loa have been studied, many years of lava activity in Halemaumau pit at Kilauea have been occupied with photographing and note-taking amid spouting and streaming basaltic melt, and three times the flanks of Kilauea Mountain have given vent to flowing lava, with both the aa and pahoehoe types represented. It is generally agreed by investigators that there is no essential difference chemically between aa and pahoehoe, and it is well known on Mauna Loa and Kilauea that the fountaining pahoehoe at the source of a flow may turn into aa clinkers within a half mile of the vent, and remain aa for the rest of its course down the mountain into the sea. It must not be inferred from appearances that pahoehoe is more liquid and rapid flowing. Some aa flows have rushed down Mauna Loa very rapidly, the source region making a glassy and frothy pahoehoe which quickly transformed itself to clinker a short distance away from the source. Some pahoehoe flows at the end of an eruptive period have found their way down the mountain very slowly as the end-stage of the outflow, the progress being through tunnels and crusts of their own making. When an observer stands on the bank of a golden, liquid torrent of lava flowing so rapidly as to make no crusts or skins, he can not tell from the appearance of the liquid whether it will solidify as pahoehoe or aa.

It thus appears that both pahoehoe and aa may occur on the same flow, that they both have the same chemical composition, that they both flow rapidly at times and slowly at other times, that they both may be very sluggish and viscous or swift and liquid, and that in general pahoehoe is conspicuous around the summit craters and near the vents of outflow, and aa is characteristic of the long flows far down the mountain slopes. Two notable exceptions to this last generalization were the last stages of the eruptive period of the 1881 flow from Mauna Loa to Hilo, which was pahoehoe, and the last stages of the

Rift floods of pahoehoe in the timber of the Mauna Iki region, December 24, 1919, six miles southwest of Kilauea. These flows came up a crack in the mountain, drained down the level of Halemaumau, poured out for seven months, and built up a hill.—Photo Finch.

eruptive period of the 1920 flow from Mauna Iki on Kilauea, which also was pahoehoe. The former flowed 30 miles from the vent as smooth lava in tunnels, and the latter five miles from the vent. In both these eruptions the early stages of the eruptive period produced aa flows whenever the source heap (pahoehoe) gave vent to a long flood down the mountain slopes. There is a suggestion here that crystallization is stimulated by free flowing of highly liquid frothy melt, that more crystallization or "sugaring" due to stirring may be the characteristic of the clinkering that is distinctive of aa lava, and that such internal stirring is stimulated by the greater gas-bubble content of the lava at the beginning of an eruptive period.

The photograph on Page One shows on the right the channel which had been occupied by a torrent of brilliant yellow molten slag for many days in September-October, 1919, where the Alika flow in South Kona crossed the road about 1,400 feet above sea level. On either side for a width of 2,000 feet this torrent had created a clinker field by backing up and overflowing from time to time during the eruption. The progress downhill through the forest was first a tongue of aa lava that pushed over the brow of the mountain into the steeper country and marched forward like a caterpillar tractor dumping talus over its front and then overriding the fragments beneath. This advance was about one mile per hour. After it reached the sea the congealed sides of the flow became the clinker field, and the stream inside rapidly narrowed and started its pulsations of backing up and making lateral tongues of overflow, now here, now there. Wherever any of the lava congealed, except within a half-mile of the source crack at 8,000 feet elevation, it solidified as clinker or aa as shown on Page One. The narrowed torrent was very brilliant, flowing perhaps eleven miles per hour, bringing large rafts or blocks of material broken away from the banks, and occasionally dumping these on one side or the other during a spell of overflow. Such a raft is shown in the stranded lump on the left of the picture. The process of solidifying, when one watched a tongue of overflow cooling, proceeded without any skins forming, and with the development of small black dots on the surface of the incandescent liquid, these becoming centers of congelation accompanied by a sprouting or crumpling action which made the whole hardening area appear like a bed of coals, with cherry red glow in the cracks. Flames are often seen among the cracks, but they are deceptive in a flow of this kind, because it contains so much burning vegetable matter that it is impossible to distinguish true volcanic flames. The surface of a cooling aa flow is excessively hot, with intense radiation like a bed of coals. In contrast to this, the surface of a pahoehoe flow starts to skin over with a membrane of glass the moment it begins to cool, this membrane draws out millions of oval bubbles so that the appearance is like layers of netting one above the other, and the result is a thickening, glassy skin which wrinkles into ropes and folds the size of which is dependent on the thickness of the flexible crust available. This vesicular crust is an excellent heat insulator, so that one may approach close to the front of the bellying toes of a pahoehoe flow before he perceives that the sluggish monster is hot and creeping forward. There is no suggestion of cracks or flames, unless a heavy hardened crust breaks open and gives vent to a new tongue, which emerges as a rounded bulb encased in a newly formed skin.

It will be seen from this description that the surface of pahoehoe lava is characteristically glassy. The surface of the lumps and sprouts of aa lava is an endlessly broken jumble of partially crystalline rock, bounded by broken gas vesicles. After both kinds of flows are cold and solidified, the rock of the interior is a continuous sheet of largely crystalline basalt with many gas blebs or vesicles, and such interior rock is just the same for both kinds of flows. The broken bowldery appearance of the surface of an aa flow is largely an illusion, as many of the bowlders are not loose at all, but are sprouts and crags connected with the continuous ledge beneath. There are, however, many flows which break up these crags into bowlders which are rolled along on the surface of the paste and become plastered like snowballs into rounded spheres coated on the outside with lava layers.

Dr. O. H. Emerson made experiments in 1926 (American Journal of Science August, 1926, page 109) by melting Hawaiian lava in crucibles and stirring the melt. It was found that the tendency to crystallize was greatly enhanced by the stirring, the material along the walls of the crucible being glassy with some crystal nuclei, while the stirred parts consisted of a mass of small crystals with some glass in the interstices. Both aa and pahoehoe lava from Hawaiian flows were ground to powder and melted, and both when stirred produced typical aa clinker or arborescence. The mass was at a yellowish white heat and had the consistency of honey; it was allowed to cool in the dying fire, being at the same time constantly stirred with an iron rod. When the ball of slag was broken open the interior was aa and the outside was pahoehoe. It thus appears that higher crystallinity favors congealing as aa if the material is stirred in the open, and from this it might be argued that the more crystallized material under a pahoehoe skin should flow out as aa if it were allowed to escape. Exactly this has happened at Kilauea. Repeatedly lava domes of pahoehoe have formed, like the one at Mauna Iki which invaded the forest six miles southwest of Kilauea in December, 1919 (see photograph Page Two). When this dome reached a certain height, it burst open and gave vent to aa lava rivers repeatedly (see Page Three). On Page Four is shown the lower slope of aa beneath an island in Halemaumau which was suddenly lifted 40 feet in a night in 1917. This indicated that a sudden disturbance of the equilibrium of the pahoehoe crusts in the Kilauea fire-pit so as to cause a sudden congealing of the lava paste, may reveal crystallinity in that paste quite capable of making aa. By thrusting steel pipes into the lava lakes, the stirred melt which crystallized on the outside of the pipes in clots was drawn out as typical aa lumps, although the lakes themselves maintained an equilibrium which made only pahoehoe skins and crusts on their surfaces and at their shores. T.A.J.

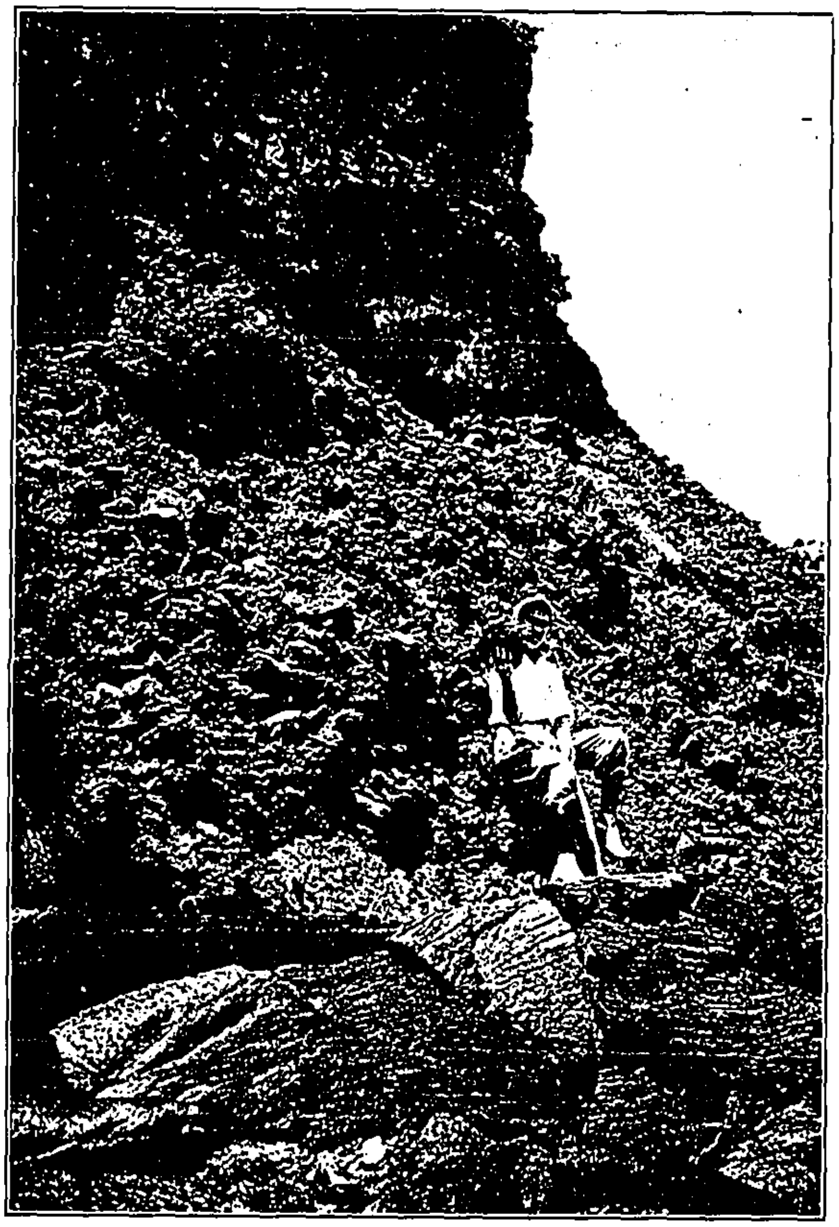
KILAUEA REPORT No. 955
WEEK ENDING MAY 11, 1930
Section of Volcanology, U. S. Geological Survey
T. A. Jaggar, Volcanologist in Charge

No changes have been observed at Halemaumau during the past week. Steaming is slight at all vents, and working of the walls has been negligible. Small slides on the north wall were noticed on May 10 and 11.

The Observatory instruments have recorded seismic disturbances as follows: 11 temors, the longest with duration 1.5 minutes; 3 very feeble seisms; 1 distant earthquake very feebly recorded on the north-south component at 3:54 a. m. May 9.

Microseismic motion was slight; tilt accumulated slight SSW.

An aa lava river which flowed five miles down the mountain from Mauna Iki, and was pahoehoe lava at the source. It turned into aa a few hundred yards away from the source and was first observed December 31, 1919. This shows the characteristic dark stream with clinkery surface, so different from the glistening folds and festoons of pahoehoe.—Photo Finch.



Aa pedestal of island in Halemaumau April 5, 1917. Two weeks earlier this island had been pushed up suddenly while an adjacent larger crag subsided and the underpinning of the island was revealed as a raw reddish wall of aa lava, in contrast to the slabs of pahoehoe in the foreground.—Photo Jaggar.

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The Volcano Letter

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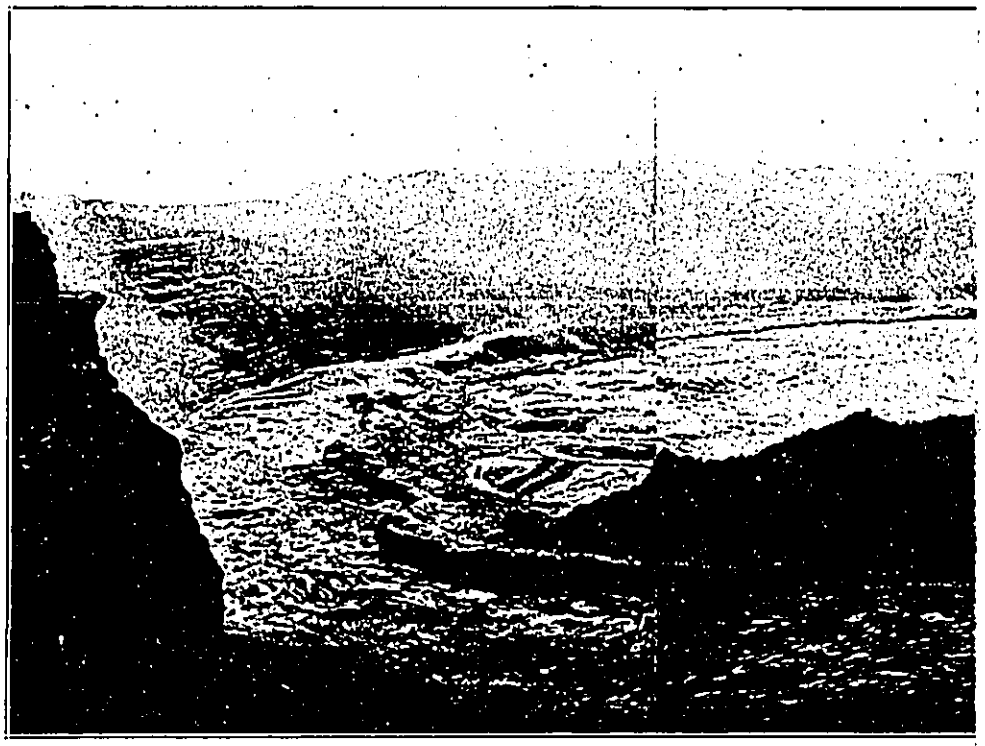
The steam belts border a flood of liquid lava, fed by about 50 fountains spurting from a radial crack, extending from Halemaumau to the southwest wall of Kilauea. December 16, 1919, 11:30 a. m.

The Kau Desert rift, opening and showing black pahoehoe lava rising up the crack, here about four feet wide. The western of two fissures about five miles southwest of Halemaumau, December 22, 1919.

WHEN KILAUEA MOUNTAIN BROKE OPEN 1920

Flank outbreaks down the sides of the mountain at Kilauea Volcano, by the splitting open of the ground and letting out the lava from Halemaumau through underground fractures extending all the way from the crater to the place of outbreak, are rare on Kilauea, though similar fissure eruptions have been common on Mauna Loa since the first white explorers came here. The map on the last page indicates the main Kilauea outflow fissures along the chain of craters to the east extending all the way to Ka-



Ring-island of bench magma in Halemaumau looking SSW with outer ring-pool fountaining lifted rapidly so as to part from its containing funnel and let the liquid fill the wall-crack

poho, and along a similar chain of craters to the southwest marked by the flows of 1920 and 1823. There is another small flow area of 1868 between the last two. These eastern and southern belts mark definite rift zones of very ancient origin extending from Kilauea Crater as vertical cracks, somewhat curved in plan, down the slopes below sea level. They mean that a slice of the mountain southeast of the crater is broken and tending to fall away toward the ocean, and the fault cliffs back of Keauhou are parallel slices already slipping into the sea.

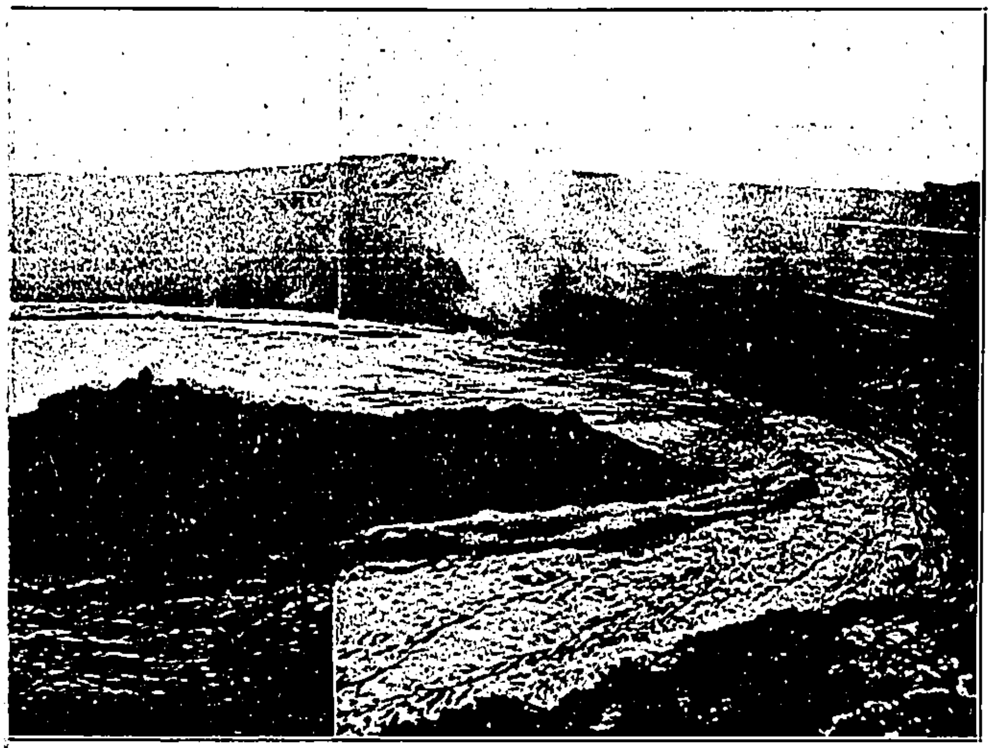
Some visitors to Hawaii National Park take the trail to Mauna Iki in the Kau Desert. Mauna Iki is a fresh lava hill so hot through cracks on its top that sticks burst into flame when thrust inside. Mauna Iki was completely built by lava welling up the southwest rift beginning December 15, 1919, and continuing action until the autumn of 1920. The breaking open of the mountain began by a radial split across the floor of Kilauea Crater southwest from Halemaumau December 15, 1919, at 11 a. m. whereby floods of lava formed steaming lakes along the foot of the southwestern walls of Kilauea. (See first photograph Page One.)

The next thing that happened was the rising of steam along the southwestern Kau Desert cracks outside of Kilauea Crater, and when these old cracks were examined, a freshly opened zone was found of many parallel cracks showing new breaks in the dirt, extending for a mile and a half away from the edge of Kilauea Crater. This zone was a quarter mile wide. The larger chasms had yawned open and engulfed their dirt fills. Creaking and tumbling could be heard within them. One of them, on this day of the outbreak across the Kilauea floor, was found in the afternoon to be 80 feet deep and five feet wide, away down to a narrower space that led below to black depths. Acid sulphurous steam arose with a temperature above 100° F., and along the line of the principal crack five steam columns had appeared, four of these being in a group near to Kilauea.

This gushing of the first day on the Kilauea floor pulled the level of the lava lake in Halemaumau down from 35 feet below the rim, to 148 feet on December 16, but the outflow in the south part of the greater crater stopped within an hour of its first eruption. In the afternoon of December 15 a swarm of earthquakes recorded on the instruments indicated that a sharp readjustment was going on along the rift belt, and doubtless lava was pouring from Halemaumau into underground cracks that were opening in that direction within the larger mountain edifice. When the first outflow on the Kilauea floor was seen, the cliff bounding the big crater, along the line of the gushing crack in the floor, was seen to make little avalanches, indicating that the crack in motion extended beyond the mere crater fill. After December 16 the lava in Halemaumau rose again until the liquid was even five feet higher in the pit (30 feet below rim) on December 22, than it had been on December 15. This created a new tension in the mountain and the flank rifts which had been opening in the Kau Desert started flowing so that the level of Halemaumau lowered again. Outflow on the southwestern Kilauea floor was resumed December 19 as soon as the liquid in the pit reached the level of the outflow vents.

The splitting open of the outside mountain was dramatic in its quietness. It seems quite incredible that a vast rocky dome made of heavy black basalt can split asunder along nine miles down its slope and give vent to increasing lava flows without any big earthquakes or explosions. But this is just what happened.

The writer followed these events day after day and watched the splitting of the ground farther and farther away from Kilauea Crater. December 21, starting at the southwest edge of Kilauea Crater, he found an open network of gaping fissures, and the five-foot crack of December 15 was now a chasm 15 feet wide, broken through rock below and volcanic ash above, the sand continuously slipping on the inner slopes and thereby giving evidence of motion in progress. Farther away down a crack four feet wide sluggish pahoehoe lava could be seen 50 feet below the surface, welling up in heavy snake-like folds, throwing out incandescent toes, and making a crackling noise by reason of the heating and snapping of the adjacent rock.



strongly, and inner lagoon quiet. The island is the top of a lily-shaped cake of lava paste
. Photos Jaggar.

No vapor arose here, the steam columns always coming from small cracks of presumably wet ground adjacent to the lava fillings.

Beyond Cone Peak, which lies on the rift zone a mile and three quarters from Halemaumau, the ground was freshly broken along an active zone a quarter mile wide with two main cracks, and these two cracks in the region west of Puu Kone showed live lava inside which reached the surface level of the mountain along a half mile of the surface about five miles from Halemaumau. As one walked down the mountain live lava was seen in the western crack at considerable depths, and a half mile farther this lava rose to the surface level, filling the crack with heavy black pahoehoe through which hissing gas vents were flaming and either building small spiracles or heaving the skin on roundish puddles. An occasional deep detonation suggested that the crack was being heaved open in the depths by the expanding lava. Ot one place the crack overflowed in two small pools 30 to 50 feet in diameter. The pools were crusted over and glowing toes oozed out from under their marginal skirts. A line of 15 spitting and spurting driblet cones followed the crack through the pools, and farther downhill this crack narrowed and was marked only by vapor jets. Thereafter the activity was transferred to the eastern crack which extended farther down the mountain and emitted bluish-brown fume and was full of hardened lava apparently stagnating level with the surface of the country. The gas hissed through spatter cones and the adjacent ground was splashed with spatter lumps from a previous spurting action which had ceased. The character of these cracks with their black fills is well shown by the second photograph, Page One.

After this about Christmas time of 1919 the fissures in the desert split their way day after day to a point nine miles from Halemaumau where the live crack opened beneath deep banks of dune sand, and the lava built up a hill 80 feet high in the forest. The outflowing pahoehoe made tree moulds, and when it penetrated old caverns in the forest the mixture of carbon gas and air made explosions that ruptured the cavern roofs and flung rock fragments away from the holes. Then the activity of outflow centered about floods of pahoehoe lava two miles long and three quarters of a mile wide with liquid lakes and pits on top. This was Mauna Iki, the new "baby Mauna Loa" in shape, and so named "little mountain."

The remarkable ring-shaped island in Halemaumau exhibited on Page Two-Three was the conspicuous feature of the interior of the pit at the time of these ups and downs that accompanied the Mauna Iki flowing. This ring-crag of bench magma was surrounded by an outer ring-pool fountaining violently, and contained an inner circular pond of quiet lava. The ring-island was the top of a lily-shaped column of the stiff lava paste moulded to the funnel shape of the containing pit, and lifted very rapidly so as to part from the walls between November 28 and December 15, 1919. Up the space between it and the walls boiled the foamy or liquid lava following as usual the wall-crack, or marginal fissure between wall and plug. This was the very peak or climax of the 1913-1924 cycle, when Mauna Loa had just been flowing, and Kilauea was about to flow.

T.A.J.

KILAUEA REPORT No. 956

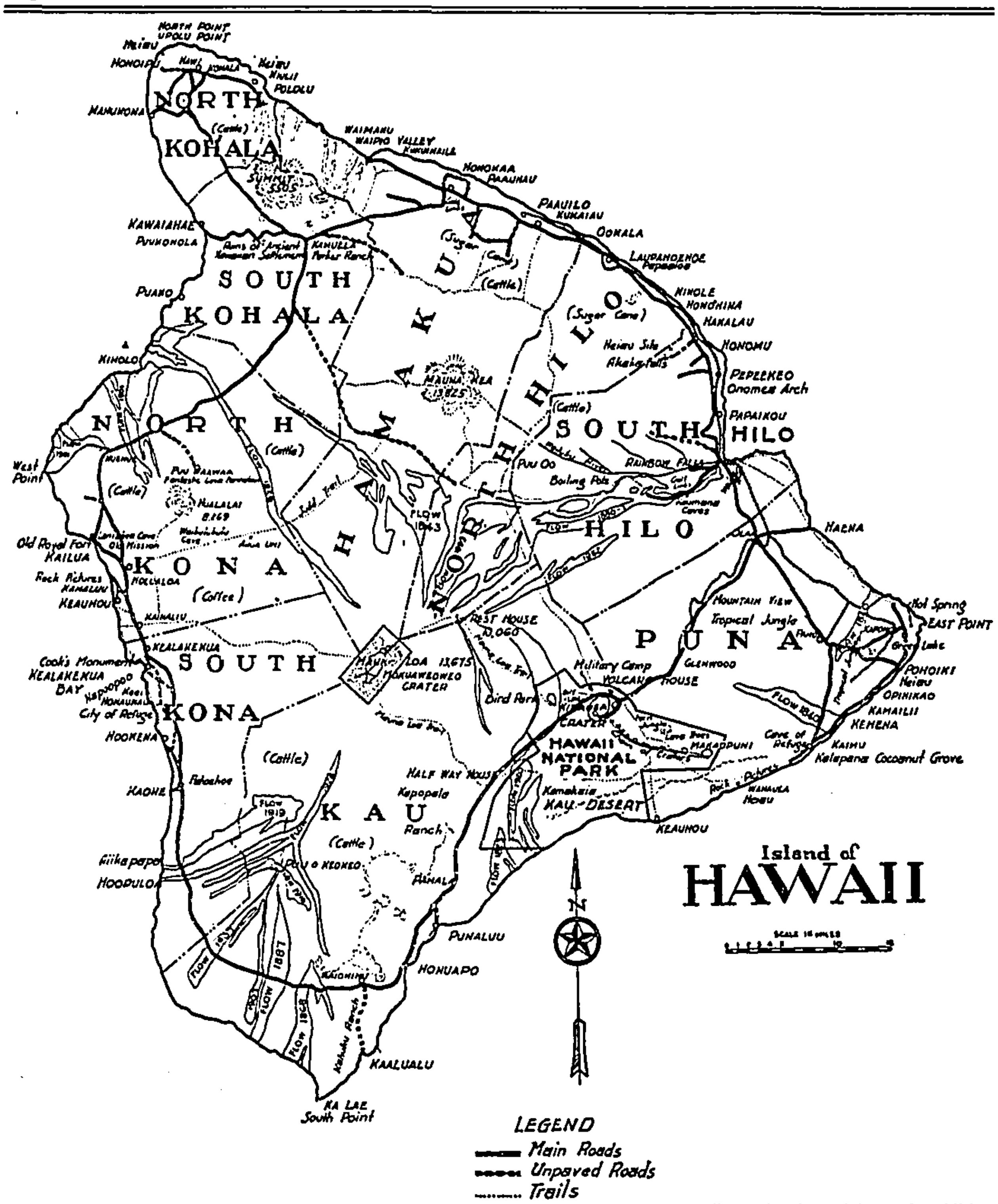
WEEK ENDING MAY 18, 1930

Section of Volcanology, U. S. Geological Survey

T. A. Jaggar, Volcanologist in Charge

At Halemaumau pit in Kilauea Volcano the steam on the south talus disappears entirely on dry days and rock slides are infrequent and very small. The pit is unusually quiet.

At the Kilauea Volcano Observatory eight very feeble local seisms have been registered during the week, three of them idicating respective distances of origin 15, 16, and 23 miles. Eleven spasms of tremor have been recorded, mostly from one-half to three minutes long, but two unusual periods of tremor lasted 10 and 12 minutes. Microseismic motion was normal, and tilting of the ground was slight SW.



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HAWAIIAN VOLCANO OBSERVATORY
Founded 1911

This laboratory at Kilauea Volcano belongs to the Hawaiian Volcano Research Association and is leased and operated by the United States Geological Survey.

It maintains seismographs at three places near Kilauea Volcano, also at Hilo, and at Kealakekua in Kona District. It keeps a journal of Hawaiian volcanic activity and publishes occasional Bulletins

Membership in the Hawaiian Volcano Research Association is limited to patrons of Pacific science who desire personally to aid in supporting the work.

The work of volcano research so supported is in collaboration with the work of the United States Geological Survey, but supplements it with buildings, research fellows, instrumental plants, explorations and special investigations for which there is no governmental provision. The Geological Survey maintains volcano stations in Alaska, California and Hawaii.

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The Volcano Letter

Two dollars per year | Ten cents per copy

No. 283—Weekly | Hawaiian Volcano Observatory, National Park, Hawaii | May 29, 1930

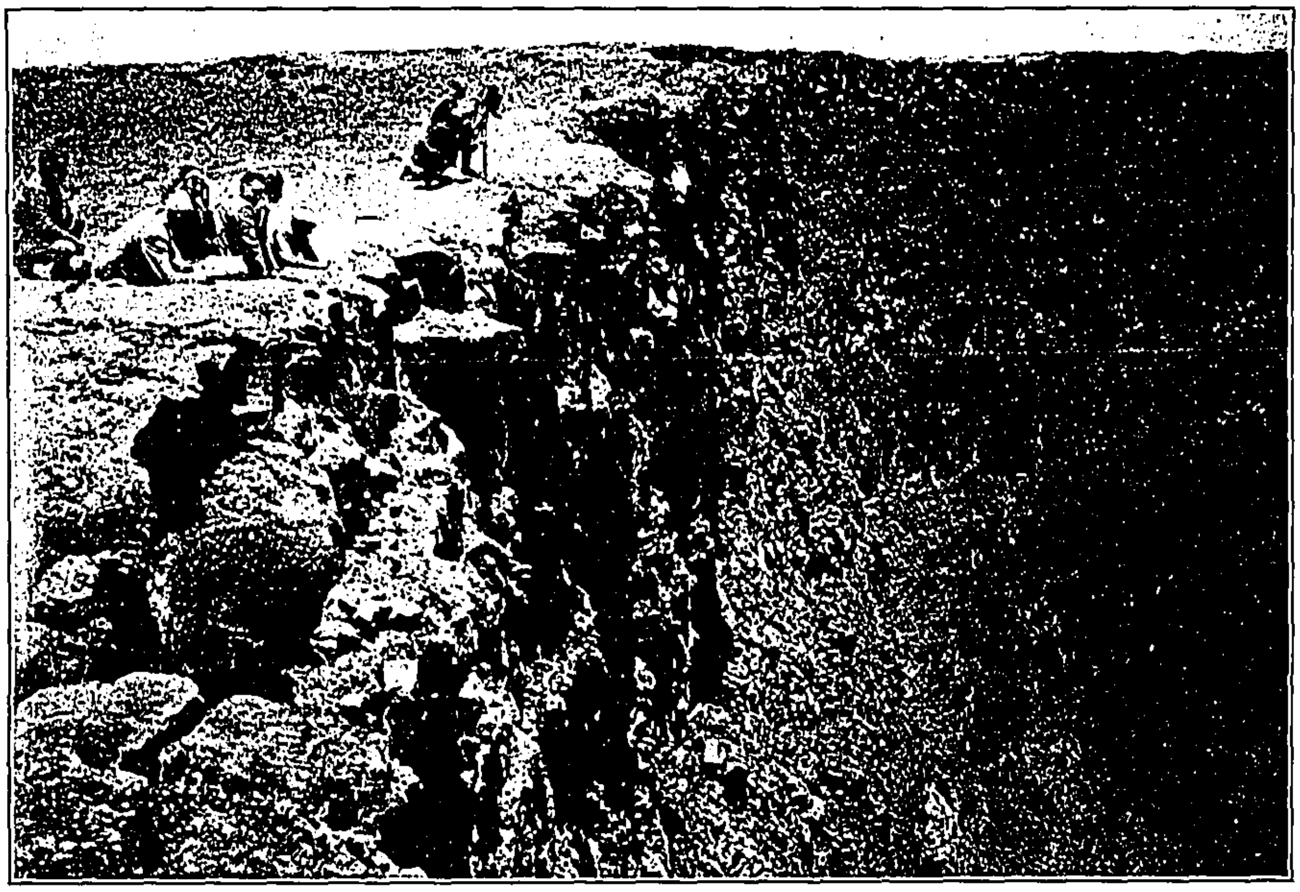
North rim of Halemaumau February 20, 1930, showing wall newly stripped off to build a new small talus between the two large taluses, thus coating the lava floor with dust. Avalanching has developed cracks into gulches up the wall right and left. Photo Jaggar.

RIM CRACKS AND CRATER SLIDES

The tourist visiting Halemaumau pit at Kilauea Volcano is now barred from the immediate edge of the pit by a rope fence which guides him to a station off to the east, which is safer than that part of the rim of the pit which is immediately opposite the automobile terminus. This breakage of the upper rim of Halemaumau so as to destroy the usefulness of the National Park station at the southeast, which had hitherto been considered very safe, occurred unexpectedly early in January, 1929, when big avalanches occurred at the south corner of the pit.

Referring to the map on Page Four, it will be seen that there are numerous cracks indicated as more or less parallel to the pit rim, but lying outside the edge of the pit and expressed as dotted lines. These indicate that the rock of the steep upper wall surrounding the pit is everywhere weak and tending to split off through the undermining action of the movement of the lava under the central part of the bottom of the pit. This was explained in Volcano Letter No. 269.

It is of interest to note that big spells of avalanching occurred in January, 1928, at the northwest; in January, 1929, at the south; and in February, 1930, at the north and northwest again. The photograph on Page One was taken on February 20, 1930, from the eastern rim of the pit, and shows the lava floor which had been left by the July eruption, 1929, completely coated with new pinkish dust from slides



Southeast rim of Halemaumau looking south during activity of July, 1927. There are other cracks back of the observers. Photo Tai Sing Loo.

which had been falling from the eastern, northern, and western walls throughout January and February, becoming strongest during the week ending February 23, 1930. These avalanches send a cloud of dust downward and forward when the falling rock matter strikes the floor, the dust cloud boils vertically, and as it loses velocity it dumps its dust on the ground beneath. In the picture it is evident that dust from the slides lay thickest on the west side of the floor, and the wall above was seen to be scarred and streaked from repeated falls. It will be seen that the north-northeast talus, on the right of the picture, and the northwest talus on the left, are both surmounted by gulches which extend up the wall above, and these gulches terminate at the upper rim in cracks which are shown at the top of the map. The rock wall between these gulches constitutes a buttress or slab backed by these cracks, the slides are eating away the cracks and weakening the buttress, and so the buttress is breaking up, making the small middle talus, and getting ready for a big slide from the top.

Now it is a remarkable thing that when these spells of general sliding occur, the rim cracks tend to widen, even on sides of the pit remote from the avalanches of that particular time. Thus we find the statement in the Kilauea Report for February 23, 1930, that crack No. 14 (easternmost of the cracks just below right side of the map) widened nearly two feet since December 4, 1929. These cracks along the southeastern side of the pit have been marked with paint at a number of points, and the places have been numbered.

This work was started by R. M. Wilson on July 6, 1927, after observation of the Halemaumau rim during the previous month had shown that cracks were widening and slides were occurring simultaneously, with increasing effect to the date mentioned. This action at that time was chiefly at the east. Mr. R. B. Hodges was detailed to conduct the measurements of the cracks from time to time and has done so since 1927. It happened that this month of working of the Halemaumau wall slabs immediately preceded the outbreak of July 7, 1927, and this made the measurement of the cracks doubly interesting. There was every suggestion that the widening of the cracks, the working of the walls, and the consequent avalanches accompanied tumescence or uplift of the rock structure surrounding the lava column just prior to its outbreak.

The procedure of crack measurement is very simple. The photograph on Page Two shows a characteristic small crack in the foreground at the left, this being that portion of the rim of Halemaumau looking south where excessive opening of cracks occurred in January, 1919, back of where the group of people is shown. This photograph shows the change of angle on the right from steep cliff above to funnel slope below. The photograph on Page Three shows the caliper used as adjusted to two paint marks on opposite sides of a crack at a numbered location. The caliper is adjusted to the crack, and the departure of its two points is measured with steel tape. Fifteen points along cracks were so marked and measured along the southeastern rim of the pit. These fifteen locations had dwindled to five remaining unbroken and accessible on April 14, 1930. The others had either caved in over the rim of the pit, or had become dangerously inaccessible as wide chasms, or had broken down at their marked points. The striking obvious feature of the motion of the cracks was that they had been opening and collapsing, and the pit rim had been enlarging, during these two and three-quarters years.

Measurement on six selected crack locations progressively northeastward back from the southeastern rim of the pit, the last No. 14 being in the vacinity of the fourteen-ton bowlder of 1924, is shown in the table for 15 of the 34 dates of measurement since 1927. This table shows the actual widths of cracks as they changed from date to date, reading downward. Reading from left to right for the same date cracks 10, 13 and 14 are on the same fissure growing wider as it approaches the place where it emerges on the edge of the pit. Cracks 3 and 4 are a little farther west. (These cracks extend from trig station 3641 to 3646 on the southeast side of the map Page Four.)

OPENING OF RIM CRACKS SOUTHEAST OF HALEMAUMAU

Caliper Measurements in Feet, of Distances Apart of Paint Marks on Opposite Sides of Each Crack, from 1927 to 1930

Date	Crack 3	Crack 4	Crack 5	Crack 10	Crack 13	Crack 14
July 6, 1927	2.14	1.17	0.42	0.77	1.54	1.63
July 24, 1927	2.17	1.25		0.77	1.61	1.65
Sept. 3, 1927	Gone in	1.65	0.44	0.79	1 61	
Oct. 1, 1927		1.83	0.45	0.80	1.67	1.82
Dec. 6, 1927		1.83	0 44	0 81	1.77	1 96
Feb. 13, 1928		1.83	0.50	0.84	2.35	2.75
April 21, 1928		1.83	0.51	0.87	2.41	2.90
June 18, 1928		1.83	0.57	0.84	2.46	3.00
Sept. 10, 1928		1.83	0.54	0.88	2.47	3.17
Dec. 4, 1928		1.83	0.56	0.89	2.50	3.24
Mar. 29, 1929		1.91	0.70	0.90	2 52	3.36
July 7, 1929		1.96	0.72	0.91	2.57	3.60
Dec. 4, 1929		2.20	0.73	0.95	Broken	3.96
Feb. 19, 1930		2.22	0.74	0.96		5.71
April 14, 1930		2 25	0.73	0.98		Inaccessible

Marked crack where it emerges southeast rim of Halemaumau, showing method of measurement with wooden calipers at painted spots.

The table shows that all the cracks have tended to open gradually, and that the same crack has widened the more the nearer it approached the pit rim as an open chasm. The cases of a crack becoming narrower are only three, and of a few hundredths of a foot. As the cracks fill below with fallen debris it is natural that they should fail to close. The two remarkable features of the table are the steadiness of the process of yawning open in all the cracks, and the greater opening the wider the crack. It is evident that this belt of cracks at the southeast has been steadily yawning open and that it was stimulated in its opening along with eastern avalanches of June, 1927, preceding the eruption of the following month, and that it was stimulated extensively along with southern avalanches of January, 1929, preceding the eruption of the following month. That eruption of February, 1929, produced five seconds of accumulated tilt away from the pit (see Volcano Letter No. 264). This confirms the notion that the yawning open of the cracks is an upward swelling of the inner dome of Kilauea. The first large change in the crack of Nos. 10 to 14 followed the eruption of January 11, 1928, and there were considerable changes after the eruption of July 25, 1929. The big avalanching spells circled the pit as follows: E, June, 1927; SSW, September, 1927; NW, January, 1928 S, January, 1929; NNW, February, 1920. The study of cracks coupled with study of tilt and avalanches is evidently a profitable activity for volcanology at craters.

T.A.J.

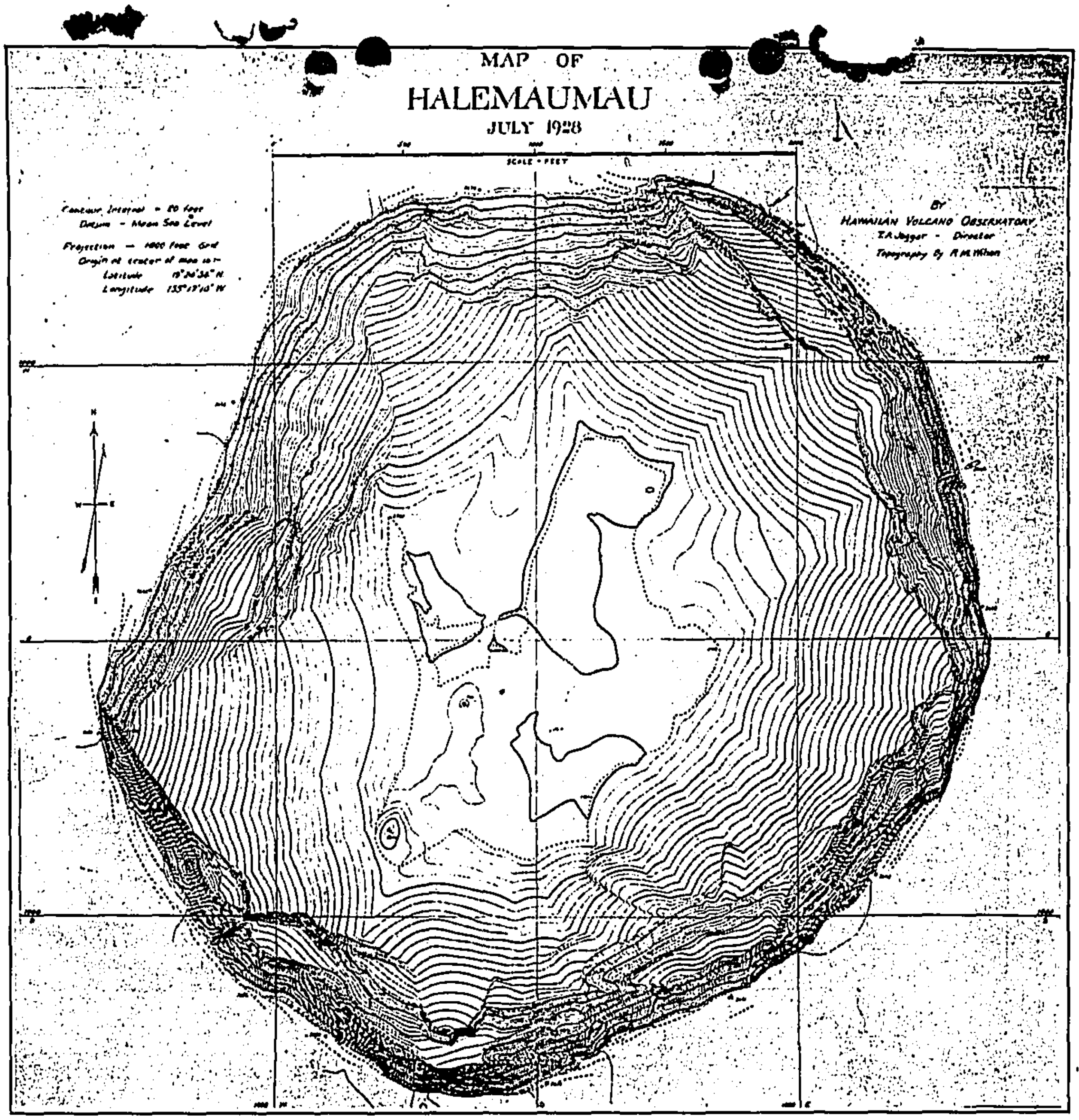
KILAUEA REPORT No. 957

WEEK ENDING MAY 25, 1930

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

The inner pit of Kilauea Crater has shown nothing of interest during the week. Some fresh debris lay on the east talus May 23 and a few rocks were heard falling on the north wall.

The seismographs at Kilauea Volcano, at Hilo, and at Kealakekua have registered some unusually intense local disturbances. The Kilauea instruments recorded 11 local



Map of Halemaumau pit, contour interval 20 feet, showing cracks by dotted lines at edge of pit. The long, straight sides of the pit are SE and WNW, and these are backed by curved cracks completing the northeastern circular curve of the pit. Pit axis follows rift NE-SW.

seisms, of which five were tremors, three very feeble, two feeble, and one a moderate earthquake. The tremors lasted from one-quarter to one minute, and one of these was accompanied by tilt to the east. One of the very feeble shocks indicated origin distance 16 miles, and another showed tilt to the east. The two feeble shocks indicated origin distances 106 and 61 miles, respectively, were felt locally, and the times of beginning were 2:47 a. m. and 6:52 p. m. May 20. The perceptible periods of vibration were rather slow on the east side of the island, and quicker in North Kona, suggesting an origin in the Hualalai direction. Like the Hualalai shocks of October, 1929, the perceptibility was more pronounced in North Hilo than at Kilauea.

The moderate shock occurred at 8:17 p. m. May 25, was strongly felt all over the island, no overturning of objects has been reported, and the accounts indicate stronger motion in Kau and Puna than in Kohala and Kona. At the Kilauea Obseravtory all the seismographs were dismantled, but the Uwekahuna instrument restored its pens and recorded the declining vibrations. The vertical component instrument showed a heavy downward fling as though the earthquake were epicentral at Kilauea. The first movement flung off all the pens instantly at Kilauea, but is reported to have written a short preliminary on the seismograph at Kealakekua in Kona. The first fling of the ground at Kilauea was downward to the south and east, and the restoration of the pens indicated tilt to the south and west. Keaau Bench in Puna, where the Hualalai shocks of 1929 were barely felt, perceived this shock strongly. At a Hilo theater the motion began with a swaying, followed by strong jerks that quickly ended, first to the northeast then to the southwest. The motion was not prolonged like the Hualalai shock of October 5, 1929. Puwaawaa reports a long vibration not particularly strong, Honokahau a moderate shock accompanied with thunderous noise, Kealakekua an alarmingly sudden quake, but without the overturning power of the Hualalai shocks. All of these facts suggest a deep movement somewhere under Kilauea and Mauna Loa.

Microseismic motion for the week was slight, and tilt at Kilauea was slight to the west.

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HAWAII NATIONAL PARK
HAWAII

OFFICE OF THE SUPERINTENDENT

May 6, 1930

Director,
National Park Service,
Department of the Interior,
Washington, D. C.

Dear Mr. Director:-

Herewith is submitted the report of activities and operations in Hawaii National Park for the month of April 1930.

000 GENERAL:

April has been an extremely quiet month with rain on every day and every night. The only event of interest was the arrival of the huge liner "Columbus" on its tour around the world.

Final passage and approval of a bill giving the U. S. exclusive jurisdiction over this park was made in Washington during April.

100 ADMINISTRATION:

121 Park inspections by the superintendent.

The usual inspections of work were made at intervals by the superintendent. Ranger Christ represented the superintendent on an inspection of trail damage repair at the Haleakala section of the park on Maui.

150 FINANCE AND ACCOUNTS:

The amount held as a budget reserve under 1930 appropriations has been released to us in order to repair rainfall damage to park trails.

200 MAINTENANCE, IMPROVEMENTS AND NEW CONSTRUCTION:

210 Maintenance.

Steady maintenance on roads has been needed to keep them in shape during the continual rains of March and April. The rains have also damaged our trails considerably and one relocation, that of the Byron Lodge trail, is now necessary.

230 New Construction.

Bid on materials and supplies for erection of an entrance building at our Volcano Entrance have been received but, due to rain no work has started.

The new Halemaumau trail which was badly washed shortly after completion has been repaired and made safe for travel again.

400 FLORA, FAUNA AND NATURAL PHENOMENA.

410 Ranger-naturalist service.

The rangers assigned to lecture and trail trips gave talks to 630 persons at 20 lectures and conducted 86 persons over the lava fields and through the lava tubes.

430 Volcano.

On April 4th the superintendent witnessed a huge avalanche not far from the location of the tourist station on the edge of Halemaumau fire-pit. Since then the entire pit edge near - 14 ton boulder which was thrown out in 1924 has cracked and settled and an area of about one acre on the surface is getting ready to cave in. The last days of April showed considerable upward tilting of the crater floor. This is an indication of lava pressure beneath.

500 USE OF PARK FACILITIES BY THE PUBLIC:

510 Travel.

April, while a quiet month, had the advantage of including Spring vacation time when numerous teachers and familys visited the park.

520 General Weather.

Continued rains have held forth in most districts of all the islands.

Maximum temperature	15th, 16th	69	degrees	69
Minimum "	25th	49	"	49
Rainfall for month of April		6.35	inches	6.35
" " " " " at Hilo		23.26	"	23.26
" " to-date Volcano District		27.70	"	27.70
" " " at Hilo		46.43	"	46.43

540 Visitors.

The Rotary Club of Honolulu engaged in an intercity meeting with Hilo spent one-night and half of one day in the park during April. The group included many prominent Honolulu men.

900 MISCELLANEOUS:

The Inter-Island steamer "Haleakala" which has made trips between Hilo and Honolulu twice weekly for several years has been laid up by the company and its scheduled assigned to steamers "Hualalai" and "Waialeale". Although a very finely fitted and comfortable ship otherwise, the "Haleakala" has long been disapproved among island people and travelers for having a disagreeable motion from a too heavy engine. Its removal from the run while undoubtedly a large financial loss to the owners may hold encourage inter-island travel on the smaller boats as the two new steamers are both modern and easy riding ships.

Very respectfully yours,

Thos. J. Allen, Jr.,
Superintendent.

Copy to "Field Headquarters" (2)
" " "Yellowstone National Park" (1)

10-157
UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

TRAVEL REPORT

Hawaii National Park for the Month of April

	This Month	This Travel Year To Date	This Month Last Year	Last Travel Year To Date	Increase for Travel Year Number	Increase for Travel Year Per cent
PRIVATE TRANSPORTATION:						
Cars first entry.						
Cars reentry.						
Motorcycles.						
Total motor vehicles.						
Persons entering via motor vehicles.	4,500	39,861	3,780	32,230	7,631	.192
Persons entering via other private transportation.	222	1,670	176	1,410	260	.155
Total persons entering via private transportation. . . .	4,722	41,531	3,956	33,640	7,891	.190
OTHER TRANSPORTATION:						
Persons entering via ~~stages~~ Hotel . .	1,063	5,677	763	6,707	- 1,030	.160
Persons entering via trains . .						
Persons entering otherwise. . .						
Total other transportation. .	1,063	5,677	763	6,707	- 1,030	.160
GRAND TOTAL ALL VISITORS. . .	5,785	47,158	4,719	40,347	6,861	.145

	This Year	Last Year	Increase Number	Increase Per cent
Automobiles in public camps during month	1	1	0	.000
Campers in public camps during month	3	3	0	.000

10-159

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

STATUS OF PERSONNEL

Hawaii National Park for the Month of April 1930

	This Month	This Month Last Year
Number of employees beginning of month,	9	8
Number of additions, ...	2	0
Total, ...	11	8
Number of separations, ...	5	0
Number of employees close of month, . .	6	8
Number of promotions during month	0	0
Aggregate amount of annual leave taken,	0	0
Aggregate amount of sick leave taken,	0	0
Aggregate amount of leave without pay,	0	0

10-160

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

REPORT OF PARK REVENUES

Hawaii National Park for the Month of April 1930

	This Year	Last Year
Park revenue on hand beginning of month,	0.00	0.00
Received,	25.00	0.00
Total,	25.00	0.00
Remitted,	25.00	0.00
On hand close of month,	0.00	0.00

Park revenues received this year to date,	1,075.00
Park revenues received last year to date,	1,050.00
Increase,	25.00
Percent of increase,	.024

10-161

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

13 Portfolios
243 maps
256 Total -

HAWAII NATIONAL PARK

REPORT OF SALES OF PUBLICATIONS

APRIL 1930

	Number	Value
GOVERNMENT PUBLICATIONS:		
On hand beginning of month, ...	286	43.90
Received during month, ...	0	0.00
Total, ...	286	43.90
CREDIT: (OFFICIAL USED)	25	2.50
Sold during month, ...	5	4.10
On hand at close of month, ...	256	37.30
NON-GOVERNMENT PUBLICATIONS:		
On hand beginning of month, ...		
Received during month, ...		
Total, ...		
Sold during month, ...		
On hand at close of month, ...		

Cash on hand beginning of month, ...	108.40
Sales during month, ...	4.10
Total, ...	112.50
Remitted during month, ...	108.40
Balance, ...	4.10

The Volcano Letter

Two dollars per year | Ten cents per copy

No. 275—Weekly | Hawaiian Volcano Observatory, National Park, Hawaii | April 3, 1930

Bogoslof Volcano in the Aleutian Islands, belonging to the United States. New lava heap in warm salt lagoon, surrounded by a ring of explosion debris, about June 28, 1928. The two older peaks are right and left outside the picture. Photo looking southwest, by Captain Roy A. Wheeler, Alaska Game Commission.

RECENT ACTIVITY OF BOGOSLOF VOLCANO

If the reader studies the map on the back hereof, he will find that nearly all of the steamship courses radiating from Honolulu either reach or pass by lands of active volcanoes. The northern course reaching Unalaska in a distance of 2,016 nautical miles, touches the middle of the Aleutian chain containing forty cones which have had historical eruptions. To the east this curve extends up the Alaskan Peninsula, to the west it goes through the Aleutian Islands to Attu, the whole length being some 1,500 statute miles. On the globe this is nearly a circular arc about the inner bight of the gulf of Anadyr as a center. None of these island volcanic arcs is truly circular; they are always somewhat straight at one end and hooked at the other. So in this case the curvature is greater at the western end. As in most of the island arcs, the active volcanoes tend to line the inner side of the curvature, toward the shallower ocean, in this case the Bering Sea .The same thing is true of the Caribbee Islands confining the eastern of the Caribbean Sea; and Martinique with its destructive volcano Pelee ,is the gem in the midddle of that volcanic necklace.

When the real meaning for this hook and curve alignment of volcanic islands has been discovered, we shall know much more about the globe than we know now. Underneath the volcanoes in the Aleutian Islands there are old granites and sedimentary rocks, exposed especially on the Pacific side, which protrude from the Alaskan continent, folded and pinched along axes parallel with the island line, and falling off to a profoundly deep trench to the south. This trench is also straight on the east and hooked northward at the west. This trench is over 20,000 feet deep. A basin more than 10,000 feet deep extends into the southwestern half of Bering Sea, but the rest of this inland sea is very shallow. The Aleutian Islands are really a submerged peninsula extending westward from Unalaska with the mountain peaks rising above the waves. Just in the eastern corner of the deeper basin of Bering Sea, and 40 miles north of Umnak, the large island next west of Unalaska, some rocky pinnacles stand in the ocean where on either side the water is 6,000 feet deep. These rocks are sometimes connected into a single island called Bogoslof, and at other times a channel between two of them has been washed clear by the sea. They are of enormous interest, for they consist of nothing other than the peak of a 6,000-foot volcano which during the last two centuries has been squeezing up stiff lava like paste from a paste tube, to add to the volume of its apex.

The rise of the first rocky spine above the water at Bogoslof was reported by early navigators about 1768 and was called Ship Rock. Another stiff aa crag of andesite, Castle Rock, rose to the southeast of Ship Rock with much explosion and oceanic disturbance in 1796, alarming the natives of Unalaska. According to Krusenstern, who made

Sea lion herd at east end of Bogoslof, June 1928. Photo Wheeler

a map in 1826, Castle Rock was then two nautical miles long, 4,000 feet wide, and 350 feet high, without summit crater, and with pinnacles on top. Castle Rock was extensively washed away and made smaller during the nineteenth century. In 1883 a new eruption began and a huge tabular crag of lava rose precipitously from the sea more than a mile to the northwest of Castle Rock and enclosed Ship Rock in its debris in the space between, the bombs and gravel and sand beaches joining the two peaks to form an elongate island. For more than a decade the boiling continued at Grewingk, as the table rock was called, but the erosion of the arctic storms, and explosive outbreaks, destroyed Ship Rock, and opened a channel between Castle Rock and Grewingk, which were apparently dead at the beginning of the twentieth century.

In 1906 new lava monsters began to rear their heads from the squirming lava tangle inside the undersea volcanic mountain, and these first appeared as a steaming new heap about midway between the two older islands, connected with the northwest table Grewingk by a low flat ridge of debris but separated from Castle Rock by a channel seven fathoms deep. The new mound was conical in appearance, with sulphurous eruptive rocks emitting large volumes of steam, and showing at the summit a broken horn bending to the northeast like the famous Pelee spine in Martinique, and consisting of a mass which had been forced up through an aperture while in a plastic condition, with smooth and scored sides. The new hill was named Metcalf Cone. The heat of the steam jets varied from 94° to 224° F., and cracks in the rock were hot enough to light paper. Metcalf Cone measured 2,000 feet across the base and 400 feet high. There were the usual alternations of explosive eruption with rising stiff lava, and at the beginning of 1907 Metcalf Cone was broken in two, while the channel between it and Castle Rock had filled itself with a new steaming heap of lava, McCulloch Peak.

At this time the writer visited Bogoslof, and on August 7, 1907, landed in a dory in the midst of a herd of roaring sea lions. The precipitous cliffs were covered with millions of murres and herring-gulls, and the air was darkened by myriads of them in rapid flight. Bogoslof was now a continuous island two miles long, the two active cones were 400 and 500 feet high, McCulloch Peak was three-quarters surrounded by steaming salt water at 90° F., and it looked like a huge lumpy potato with the bulbous lumps split apart, and the whole jagged mass encircled by debris slopes that led down into the orange-colored warm water of the lagoon. Immediately adjacent to it was the Metcalf half-dome, with the central spine wonderfully revealed in cross section. The spire appeared in the cliff like an inverted fish horn, its base 360 feet across and its top rounded both in plan and profile like a beak. There were regular markings on the rounded surface horizontally, as though the horn has been shoved up at intervals. It was like a great worm rising from its burrow with its head turned toward the east. It was 400 feet high and at the top it was broken away through lack of support into a rugged 40-foot precipice, overhanging the back slope.

Bogoslof in 1907 was at its maximum of volume above the waves, for the period since the big island of 1796 had been eroded away. It was now four rocky hills, Castle Rock at the southeast, then McCulloch Peak fuming and tumbling and encircled by sand bars and lagoons, then the half-dome of Metcalf Cone with its spine, bordered by a dry lagoon on the north, and at the northwest the tabular rock Grewingk with gravel banks piled against it. Our party discovered elevated rock platforms backed by sea caves which had been at sea level a year before, so that everything indicated that the huge pressure inside the submerged volcano, which was pushing up McCulloch Peak, was also lifting the volcano on its back and carrying the chain of islets with it. This heaving of the older land was particularly interesting, because the main island of Unalaska showed elevated sea benches, and now we know that at Kilauea, during the rising lava period of 1913-1922, the mountain top surrounding Kilauea Crater was lifted more than two feet, and carried the Volcano House up with it. In other words, the turtle-back of a volcano swells when the lava rises and flows out, and shrinks when the lava sinks back.

September 1, 1907, a dense black cloud rose from Bogoslof, ash and sand fell at Unalaska mantling everything with a snowstorm of rock powder a quarter inch deep, and there were rain and lightning and distant rumbling. McCulloch Peak had blown itself up. A steaming lagoon was left in its place, the rest of the island was piled high with fallen debris, and the backslope of Metcalf Cone had the smooth concave cone profile of a Vesuvius. There appeared to be a rythmic sequence to the events whereby Metcalf Cone built itself up 400 feet high and 2,000 feet across, lived 10 months and exploded, then McCulloch Cone was built up 450 feet high and 2,000 feet across, lived 10 months, and was destroyed. It is probable that this means a pulsation of rise and fall of lava, and when the lowering comes, the sea water penetrates the hot voids below, under great pressure and by many inlets, generates steam, and the path of least resistance for the exit of the steam is through the crannies of the wall crack, around the crater edges of the risen lava column.

In July, 1908, the remains of Metcalf Peak had subsided and there had probably been another explosion the previous winter. There was renewed activity in the bay surrounded by beaches that lay between Castle Rock and Grewingk, in September, 1909. A new lagoon was formed shut off from the sea, and two small lava islands arose which in June, 1910, had united and reached a height 178 feet above the water. A survey September 10, 1910, made the island one and a half statute miles long and three-quarters of a mile wide. The old rocks were becoming smaller. A new explosion September 18-19 1910, sent up immense clouds of vapor, smoke, and ashes, flames were reported, and a true crater was opened in the top of the central peak. This was the first time that a real crater within one of the lava domes was ever seen and photographed by the Coast Guard officers who have done so much valuable work in making these reports on Bogoslof. In July, 1913, this crater had steam and smoke slowly issuing from it, but the following year all smoking had ceased. During the next eight years Tahoma Peak, as the new hill of 1910 was called, was eroded away, and a channel was again opened between Castle Rock and Grewingk so that a boat could sail between the two older islands. Grewingk had greatly diminished in size, and Castle Rock was now two rocky horns with a big accumulation of sand and gravel heaps piled against them, especially on the northern and eastern sides, these trailing off into a long sand spit at the north, and the whole of this larger island was surrounded by sand beaches.

The writer visited Bogoslof for the second time July 6, 1927, and found a new period of moderate lava activity inaugurated, with a pile of steaming lava rising from a warm lagoon in the midst of sand banks, and again these banks joined all of Bogoslof into one island with a complete ring-shaped salt water lagoon, surrounded in turn by a complete ring of sand permitting no connection with the sea except by seepage. The lagoon was at 70° F., there were the usual herds of sea lions and myriads of birds, the bottom sand and pebbles of the lagoon were all coated with orange colored ochre, the lagoon was everywhere only two or three feet deep, there were numerous skeletons of dead birds on the beach, and in the sand were impact craters made by newly fallen bombs having rough aa surfaces. There were blocks of pumice one to two feet in diameter. The central lava heap (see Page One) was about 200 feet high and 1,000 feet wide. Its crest consisted of uniform aa clinker, steaming much more heavily than in this picture of a year later. It made no noise, and it is characteristic of Bogoslof that during most of the visits reported noise has been absent. In September of 1910, however, a week before the explosive eruption, roaring steam jets were found. In 1927 the annular ridge of gravel, sand, and explosion products stood about 10 feet above tide.

The new activity had started in July of 1926 when there was open water between the two older rocks. An explosive eruption was then seen by a whaler, and the natives reported explosions July 17 as seen from nearby islands. The water was greatly muddied and the whaler on August 12 saw black smoke with darkness accompanied by thunder and lightning, ending with a cloud of white steam and "fire" about 2 p. m. There was also an explosion in December, 1926, and it is probable that the lava dome of 1927 emerged thereafter. Probably the eruption began with a series of lava pulsations, alternating with explosion. In 1928 the activity was mild as shown in our pictures. A landing party on Bogoslof July 27, 1929 reported all quiet.

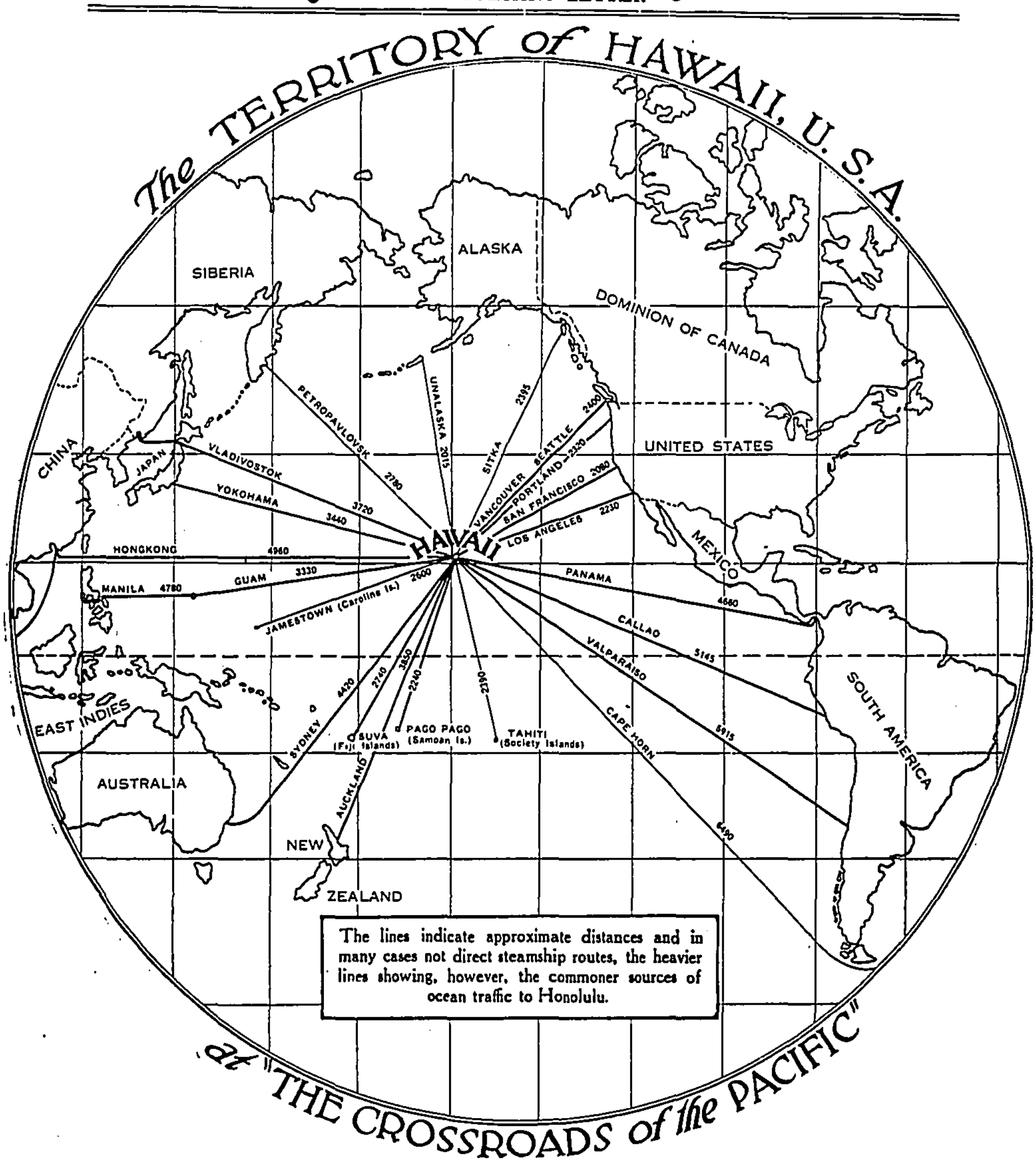
T. A. J.

KILAUEA REPORT No. 949
WEEK ENDING MARCH 30, 1930

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

Kilauea remains quiet. Halemaumau on March 26 exhibited a few fallen rocks at the north, and the pit seismograph showed some avalanche tremors. At 10:30 a. m. March 28 a little dust arose from the northeast wall, and such dust was seen occasionally March 30. At 3 p. m. March 30 there was fresh dust on the northwest wall and a triangle on the floor below was stained with dust. Otherwise the floor was mostly washed bare. A wide area of greenish-white solfataric stain has developed at the south edge of the floor. New bowlders extend out on the eastern floor. The talus NNW has increased in height, and a deep notch in the wall above the north talus has been extended upward.

Four very feeble local seisms have occurred during the week showing tendency to east tilt accompanying the shocks. Nine tremors are recorded each lasting less than a minute. Microseismic motion has been very slight, and tilt was moderate NNE.



Pacific Ocean, showing distances in nautical miles from Honolulu to the surrounding girdle of volcanic lands. Seismographs of the Section of Volcanology, U. S. Geological Survey are at Hawaii, California, Kodiak on W. side of Gulf of Alaska ,and Unalaska.

THE VOLCANO LETTER

The Volcano Letter combines, after January 1, 1930, the earlier weekly of that name, with the former monthly Bulletin of the Hawaiian Volcano Observatory. It is published weekly, on Thursdays, by the Hawaiian Volcano Research Association, on behalf of the section of Volcanology, U. S. Geological Survey. It promotes experimental recording or earth processes.

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The Volcano Letter

Two dollars per year | Ten cents per copy

No. 276—Weekly | Hawaiian Volcano Observatory, National Park, Hawaii | April 10, 1930

Tarumai Volcano in Hokkaido, North Japan, from an airplane looking northwest, photographed by the Otaru Shimbun 1:45 p. m. October 19, 1926. New activity of gas eruption through the summit lava dome of 1909, and through cracks south of the dome. Lake Shikots in the background. Photo from H. Tanakadate

ERUPTIONS OF TARUMAI VOLCANO

Tarumai is in the forested mountains of southern Hokkaido, the north island of Japan. It is one of several volcanoes in that vicinity which have had many eruptions, of steam, sulphurous gases, and stiff andesite lavas. Tarumai is a cone of ash and pumice 3,300 feet high which renewed its activity after a long repose in the spring of 1909. It had been quiet since 1894.

From January to April of 1909 there were numerous explosive "cauliflower clouds" that went up from the cup in the summit cone. April 19th revealed a new lava dome on top of the crater. A very stiff aa flow upward had taken place, lifting the crater floor, opening outward like a flower in its calyx, and finally filling the former crater and rising above it 440 feet. The dome was all covered with jagged lumps and had a diameter of 1,400 feet. The rock was hypersthene andesite. The mountain was now 130 feet higher than it had been by reason of this addition to its summit. (See photograph Page One).

The lava dome of Tarumai was much like the several domes of Bogoslof in the Aleutian Islands, and made of similar rock. On May 9, 1909, the writer visited Tarumai and with a thermo-element thrust into a crack a foot deep in the tumble of crags at the side of the lava heap determined a maximum temperature of 855° F. (457° C.). This was more than hot enough to burn wood. The dome was steaming, particularly around the edges. This new lump remained on top of the mountain.

In 1917 the gas activity through a fissure in the lava dome started new eruption sending up fire, sulphurous smoke and ash, with much trembling. Such activity continued in 1918, 1919, 1920, 1921, and 1923, forming craterlets in the dome precipitating ash and lapilli over the surrounding country. Small stones fell on a village Tomakomai in 1919, eleven miles to the southeast of the mountain. In 1923 ash fell on the city of Sapporo, the capital of Hokkaido, 25 miles to the north of Tarumai.

The photograph on Page One was kindly furnished by Professor H. Tanakadate and was taken from the airplane of the Otaru Shimbun at 1:45 p. m. October 19, 1926. At this time a new series of gas-made ruptures broke athwart the lava mound as well as across the mountain summit to the south of it. Stones fell about the mountain, the usual cauliflower clouds shot into the air, and ash fell 220 miles to the east. The picture was taken from the southeast, and shows both the lava heap of 1909 and the ground to the south of it smoking, while off to the north two and a half miles away stands Tarumai's twin volcano Fuupushinupuri, and behind it in the distance stands lake Shikots.

Halemaumau January 14, 1918, showing the hard top of the lava column swollen up lik ing from the outside edge inward. The steaming cliff on the left, and the distant whit lava lake is in the fume amid the central crags. Photo Jaggar.

Tanakadate has classified the volcanoes of Japan, (Proc. Fourth Pac. Sci. Cong., Java 1929 pp. 621-631) as ranging from abortive eruptions with no explosions or outflow, to liquid lava lakes in a crater. The abortive eruptions have many earthquakes localized about a dormant volcano. This is the same kind of activity as was localized in Hawaii in October, 1929, about the volcano Hualalai. Hakone is a district adjunct to Fujiyama which has frequently shown swarms of earthquakes, and in the Izu Peninsula south from there such earthquakes are producing damage and alarm at this moment.

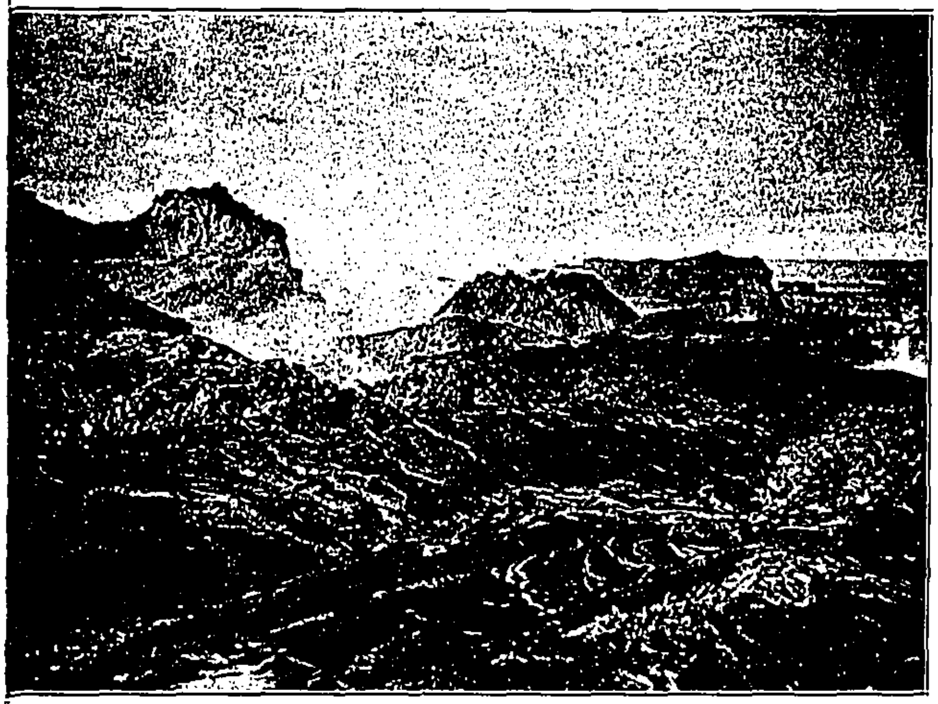
At Oshima Island out in Sagami Bay opposite the Izu Peninsula is a fuming volcano, seen by tourists arriving at Yokohama, which is characterized by liquid lava, of rather stiff aa type usually, that rises and falls in its crater. This is Mihara Volcano, and comes nearer to the Kilauea type than anything else in Japan. Sakurajima produced a stiff lava flow, Tarumai dome was still stiffer. Usu, a few miles to the south of Tarumai, produced earthquakes and a lifted block of the mountain flank in 1910, with no lava except what was thrown up as bombs. Bandaisan in 1888, in central Japan, disrupted a mountainside with steam explosion, and other volcanoes throw out crater lakes and make mud floods, with no apparent lava. Many of these produce elevation of the country.

GROUND MOVEMENT IN A VOLCANO

The Volcano Letter has called attention (No. 264) to the swelling of volcanoes and in describing Bogoslof last week we pointed out that the eruptions of 1907 indicated uplift of sea shore in a year. A publication entitled "Topographical Changes accompanying Earthquakes or Volcanic Eruptions," by A. Imamura (Publ. Earthq. Invest. Comm. Japan No. 25, 1930), makes the following statement: "The character of the acute earth tiltings which accompany an earthquake is inferable from the chronic tiltings that precede the earthquake, and vice versa. And topographical changes which take place prior to volcanic eruptions have characteristics in common with those that take place prior to earthquakes."

These statements may be paraphrased by saying that either a great earthquake or a volcanic eruption indicate that acute earth tilting or tipping of the surrounding country is taking place. This tilting may accompany either a lift of the country or a dropping of the country. Experience shows that the center of the rising or the lowering of the country during the crisis may involve a mosaic of crustal blocks in case of an earthquake, but is apt to involve the crater itself in case of an eruption. And finally this accute uplift or lowering of country indicates that chronic tiltings of the region may be inferred as preceding the crisis, and these chronic tiltings are now being measured. This measurement is of the utmost importance for the future of seismology and volcanology. The reason for this importance is that probably prediction of cycles and crises may be based on knowledge of chronic movements. Chronic tippings have been measured for years in Hawaii and Japan, and their relations to small local earthquakes are like the relations of strain in a timber to its creakings. It seems probable that there is here open to view a new vista in volcano-earthquake science.

The review of Tarumai eruptions in the preceding article exhibits a pair of volcanic mountains close by a de-



the crust on a pudding as an incipient dome with stages of higher and higher swell-
n cliff with stone shelter on top at the extreme right, are the edges of the pit. The

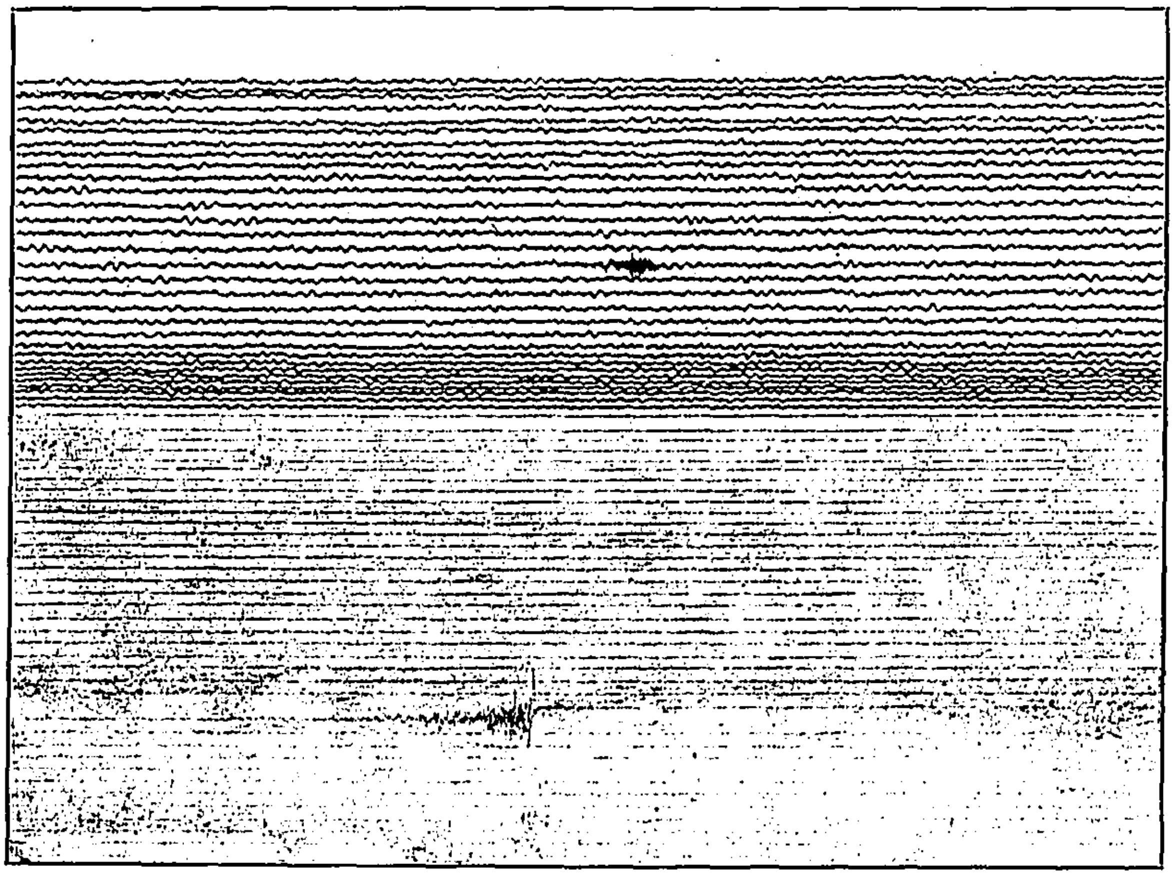
pressed lake basin. This relationship in Japanese volcanoes is very common. It appears to mean fault blocks which are tipped or warped down in the mosaic of the earth's crust under the lake basin, and swollen up under the volcano. The pairing of the two follows some definite and important law in the mechanism of the earth's crust. The lake basin lowers through the ages and the volcano dome swells up.

The picture (Pages Two-Three) of the inner floor of Haleamumau pit at the active center of Kilauea Volcano in a time of great activity of rising lava, and just before the first overflows within Kilauea Crater during the last eleven-year cycle, as shown above, is comparable to Tarumai. If the reader will examine carefully the left-hand side of this picture, he will see that within the low cliff the curve of a swollen dome, like the crust of a pudding, circles into the foreground of the picture and passes on around to the right of the big cluster of crags in the middle. If he will look still farther inside the curve, he will see a swollen inner dome in a half circle between him and the central crag. And beyond this is the group of central crags pushed up still higher as irregular blocks, and amid these blocks lay the liquid lava lakes fountaining and streaming among the wells that led up from the lava column below to the apertures amid the crags. This is all just as true a lava dome as the one on Tarumai.

Now this deep lava in its rising at Kilauea was lifting the surrounding outer country. This was proved by leveling in 1912 and again in 1922. The edge of the pit was lifted from five to fifteen feet, and the edge of the outer crater was lifted over two feet. The seismographs there showed a strong and progressive tilting away of the ground.

The illustration on Page Four is a part of the wonderful seismogram described in Volcano Letter No. 264 as the autograph written by a pendulum hung like a door parallel to the edge of Halemaumau with a pen attached to it that wrote the lines round and round a drum turned by clockwork. The drum moved on a screw during the day toward the pit so that the pen would normally have written lines one-twentieth of an inch apart. This normal writing is shown by the light lines in the lower half of the picture. The autograph of the earth here shown is a record of the activity of big fountains of lava in Halemaumau pit half a mile away. The top line was the beginning of the autograph of the ground the morning of February 21, and this was the day when the fountaining stopped. Each successive line from the top downward is part of a half hour following the preceding line. The dark lines of the upper half of the seismogram are full of tremor from the lava fountaining. They open apart at first because the gas pressure was high, the crater was lifting, the seismograph cellar floor was tilting away from the center of the pit, and the writing pen moved away from the lines it had previously written. In the midst of this came a little earthquake showing black on the diagram.

Then at noon the gas pressure gave out, the lava began to go down, the ground tilted back toward the pit, and the lines became crowded, though the fountaining and the tremor still continued. Just before the fountaining stopped between 1 and 2 p. m., the record of tremor also stopped, everything became stationary, the tipping of the ground toward the pit ceased, and the lines on the seismogram recorded the event perfectly by no longer exhibiting tremor and by becoming normally spaced without any crowd-



Seismogram of February 21, 1929, written at the edge of Halemaumau pit in a closed hut by a horiontal pendulum with the writing boom hung tangential to the curvature of the pit. Tremor due to lava activity at the top, inward tilting due to sinking lava shown by crowded lines in the middle, cessation of activity and a local earthquake shown by normal lines at the bottom.

ing. About midnight February 21-22, as shown in the lower part of the seismogram, a normal local earthquake was felt and this as shown was accompanied by a widening apart of the line as though upward pressure were restored and the earthquake were a creaking of a block tending to tilt suddenly. This is what is meant by tilt accompanying local earthquakes. It is hard to imagine a more fascinating earth autograph than this one showing the tremor and centrifugal tilt above, the centripetal tilt in the crowded middle lines, and the sudden resumption of normal conditions at the bottom, all corresponding to observed volcanic activity.

T. A. J.

KILAUEA REPORT No. 950

WEEK ENDING APRIL 6, 1930
Section of Volcanology, U. S. Geological Survey
T. A. Jaggar, Volcanologist in Charge

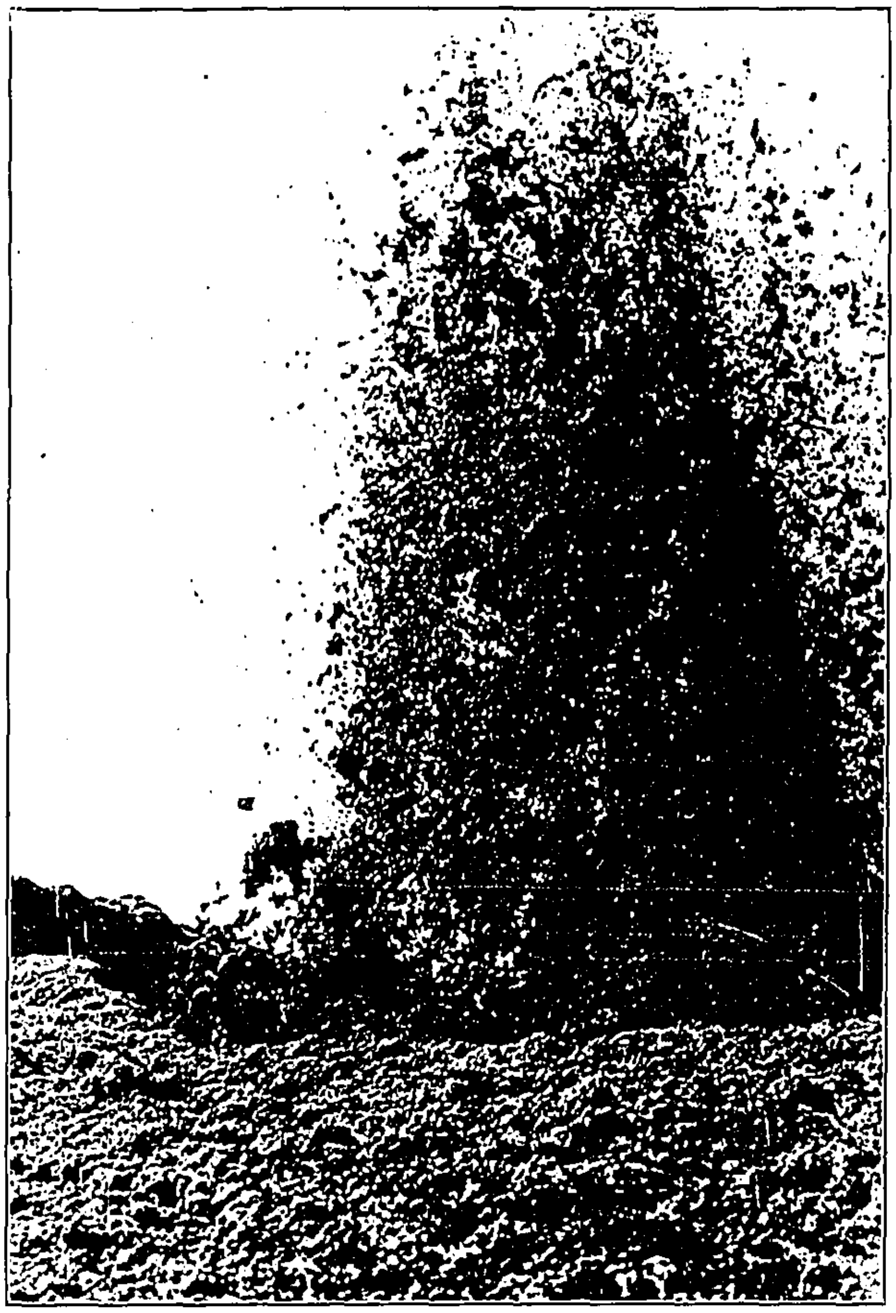
Dust from slides has been seen at Halemaumau at 2:35 p. m., 3 p. m., and 4:15 p. m. March 31, and at 4 p. m. April 2. These slides produced much fresh material on the eastern talus heaps. On April 3 steaming on the south talus was very slight. A big slide occurred NE at 2:45 p. m. April 4 producing important changes in the region of the 14-ton bowlder northeast of the tourist station. The next day a number of large stones lay on the lava floor at the east side and steam was noticeably absent. At 10:25 a. m. dust again rose at the NE.

The Observatory seismographs have recorded 5 very feeble local seisms and 12 tremors during the week. Microseismic motion has been slight, and tilting of the ground slight NE.

The Volcano Letter

Two dollars per year | Ten cents per copy

No. 277—Weekly | Hawaiian Volcano Observatory, National Park, Hawaii | April 17, 1930



Gigantic incandescent lava froth fountain at north crater of Alika flow source, eruption of Mauna Loa October 25, 1919. Fountaining 50 feet away and 200 feet high, looking west from edge of new cone 200 feet above surrounding country. Southwest rift of Mauna Loa 7,834 feet above sea level. Photo Jaggar.

THE BUBBLING AND GUSHING OF LAVA

If a volcano enthusiast among Hawaii residents had written the title of this article, he would have called it "lava fountains."

Such is the common term used in Hawaii for the uprush of liquid lava at one place. This upward rushing of slag makes in the liquid lava lakes of Halemaumau the clustered burst of big bubbles through the slaggy skin in the middle, called "central fountains." The agent that lifts the central fountains is gas, but W. L. Green in the nineteenth century thought it was air. When these bursting bubbles recur about once a minute at Kilauea, they have often been called "Old Faithful," and for many months about 1910-12 Old Faithful stayed in nearly the same place. In 1913 there came a time when there were two pools, and the new pool had a "New Faithful." Then in 1916 and

Border fountain of heavy lava spinning Pele's hair at east cove of main lake May 23, 1917, interior of Halemaumau pit. Lava spurt is 15 feet high. Exposure 1/100 second. Photo Jaggar.

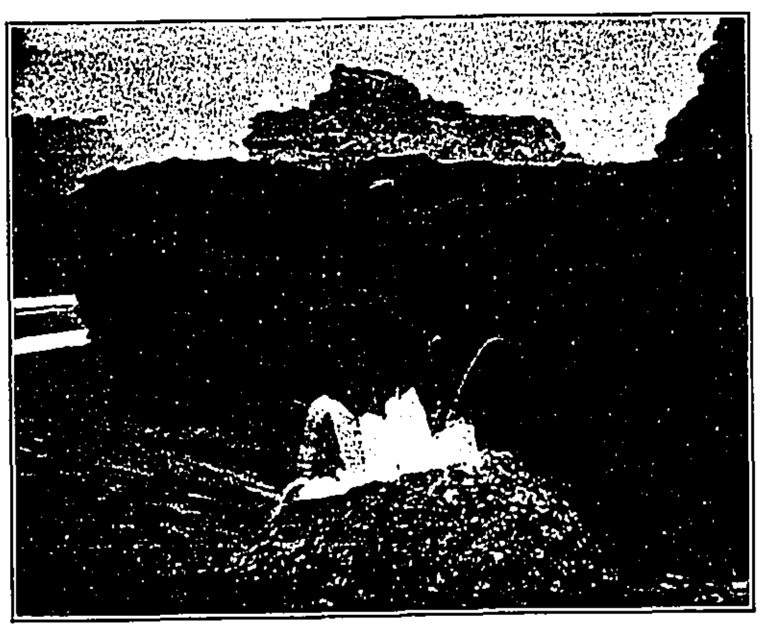
thereafter when experiments were conducted at the edge of the lava lakes, many fountains were studied which had a tendency to migrate along the surfaces of the streaming pools with repeated bursts of gas, the gas sometimes flaming, at other times making puffs of unburned, brown, sulphur fume. These migrations commonly ended at a "border grotto," a place of continuous marginal fountaining or bubble bursting, where the black vitreous melt was flung over the bank and built up an oven. The continuity of the effervescence here indicated some localized disturbance such as a subsurface streaming against the bank to determine a continued release of gas bubbles. And sometimes these continuous fountains formed in the middle of the lake indicating a subsurface pouring of lava down a well, and thereby a stirring out of the bubbles, which rose and burst eternally.

When a pot of porridge boils, it is not customary to call the bubbling places "fountains." "Fountain" is a misnomer for the golden slaggy dome bursts of incandescence in a liquid lava pond. The layman conjures up a picture of a spouting jet over an artesian well or an oil gusher when he hears the word "fountain." Just such fountains occur in lava. The picture on Page One, a very lucky snap shot, shows a true lava fountain 200 feet high. This was made at the time when in 1919 Mauna Loa had opened a crack in its flank releasing gas-charged lava from the depths to spout up like an oil gusher. After a month this had built up a cone 200 feet high with a marvelous cauldron of violently seething golden glassy froth boiling inside, and from the tube below a jet of this molten basaltic pumice was shooting into the air through the pool without interruption. Sometimes it would go higher, sometimes lower. For weeks it was going continuously. The material separated into lumps and shreds as millions of bubbles expanded in the pool, some of it was drawn out into hairs and membranes, and the larger hardening skeins and slops of this molten rock matter were four to five feet long.

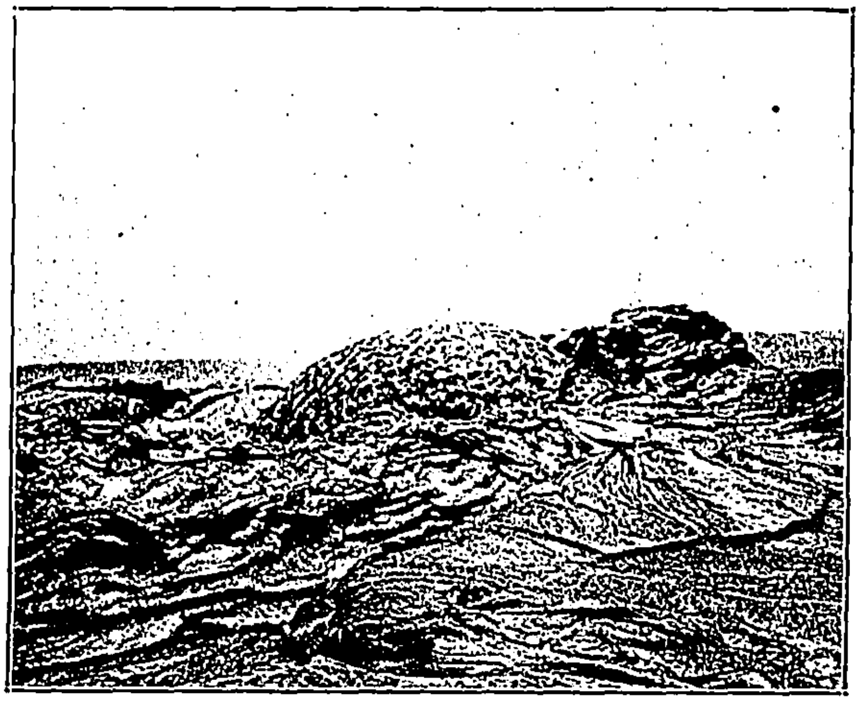
In order to take the photograph, it was necessary to clamber up through hot pumice of buff color on the outside of the cone to windward, where over the summit edge lay the fountaining basin with its gigantic waves surging forward to a cascading outlet at the right. From under the back wall of this cup rose a geyser of fiery fragments, the pieces bright red-hot and very porous, and at the edge there were occasional fragments still glowing, showing that from moment to moment the jet was turned, like a lawn sprinkler, first in one direction and then in another. This made it necessary to take some chances in running in to within 50 feet of the nearest falling jets, on the summit edge, point and snap the camera, and get away without being bombarded. The sensation of looking up at that towering curve of rising and falling bombs, the highest pieces shooting from 200 to 300 feet above the summit, and the lighter ones seeming to float like burning paper, all with intolerable heat and a complex of rumbling, whirring, and pounding noises as the larger lumps flopped down on the ground close at hand and stuck there, viscid and glistening, was an adventure to be remembered. More than a second or two of that heat would have ruined the camera. The crater was like a titanic open chalice of fiery liquor foaming in scarlet surges, these being impelled continuously forward by the geyser jets behind, the flood lifted by the jets losing its liquid aspect almost instantly, and the expanding gas within giving it the appearance of very loosely knitted worsted. The beaten foam quickly quieted down to form black curds where the pond cascaded through the sluiceway leading to outflow. The color of the molten stuff is bright yellow at night, but in daylight is a reddish transparent tone with a luster like jelly, brightly glistening in the sunlight, and with purplish shadows, the jet distinctly changing color with the cooling from orange on the rising side to wine color on the falling slope of the arch.

Such is the most magnificent of the true lava fountains and it may well be compared to the prominences on the sun, but the latter are wholly of gas. Probably in both cases hydrogen is the dominant gas. A tremendous banner of burning gas stands above the Mauna Loa fountain at night, salmon and rose with bands of green. The motive power is gas expansion, just as it is in the bubble bursts of Kilauea. In the picture on Page Two the camera is 25 feet from a border fountain in Halemaumau, the lava lake being beyond and to the left, and the foreground is the lake margin. This shows the process of spinning Pele's hair. Gas is rushing up through a stiff, viscous lava, and carrying the lava with it, drawing it out into shreds, and the bank reflects it back into the lake like a surf repelled from a rocky shore. The tangle of fine glassy cobwebs, puffed and blistered by the endlessly bursting glass blisters on the melt, is caught up by rising heat currents of air and carried away by the wind.

This same corner two months before was building a border cone through the closing in of a marginal grotto so that the oven became entirely enclosed except for a crater through the top (see Page Three). Here we have a beehive cone with a lava fountain inside, connected by a tunnel with the lake, only a few feet away. Such cones are generally formed by a crack opening in one bank of the lava lake, and allowing the lava to penetrate it and start convectional streaming with release of gas. This makes a spurting fountain in the crack which opens a circular crater and roofs over its cupola and its tunnel. It is only one step further to the place where such gushing of gas-charged molten glass, escaping from Halemaumau through a large radial crack at a place 500 feet from the pit (Page Four) wells up in a dome through a shell or half-cone of its own spatter and marginal congealing and keeps on welling up like an artesian gusher with its surface eternally coated with a net of bubble membranes, as shown in the picture, and so forming a "standing fountain," the source of a flow which was pouring off to the south on the Kilauea floor during the great crisis of overflow at Halemaumau in March, 1921. Thus we see that there is a transition from the central to the border fountains, and from the border fountains to outflow fountains. The explanation of the rhythmic fountains such as Old Faithful appears to be that they are always over a small well under the shallow lake, where the convectional circulation is draining the gas-charged liquid downward, and stirring out an accumulation of bubbles which cluster together and escape at regular intervals through the viscous lava of the lake surface. Whether there shall be rhythmic release or continuous escape probably depends on the depth and viscosity. T.A.J.



Same east cove of Halemaumau as Page Two, on March 30, 1917, in the evening. Flaming and spurting cone, exposed for 30 seconds, and exhibiting a succession of jets. Photo Jaggar.



Smooth dome fountain at source of flow outside of Halemaumau 500 feet to the southwest, March 20, 1921. The liquid part stood nine feet high, of orange incandescence, rising from under the knob on the right and pouring away into the background. Photo Jaggar.

KILAUEA REPORT No. 951
WEEK ENDING APRIL 13, 1930

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

On April 9 a big scar on the east wall under the 14-ton bowlder showed as the location origin of the avalanche of April 4, which threw immense rocks far out on the lava floor of Halemaumau. The 14-ton bowlder is doomed to fall into the pit with the ledge which helps to support it on the east rim. This was the largest rock blown out during the explosive eruption of May, 1924.

The sulphur stain on the south bottom of the pit has become whitish in color. Steaming is as usual, and no other changes are to be reported.

The seismographs at the Volcano Observatory registered 12 tremors, the longest having a duration of three-quarters minute; and one very feeble seism. The net accumulation of tilt for the week was slight south. Microseismic motion was normal.

MARCH TILTING OF THE GROUND

At the Hawaiian Volcano Observatory the tilting or tipping of the ground in the seismograph cellar, expressed as angular change and direction of motion of the plumb line, was as follows:

March 3—9	1.03 seconds	NNE
March 10—16	2.32 seconds	WSW
March 17—23	1.06 seconds	SSW
March 24—30	2.05 seconds	NNE

This computation is by overlapping seven-day means. January and February were by direct reading (Volcano Letter No. 267 and No. 271).

THE VOLCANO LETTER

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HAWAIIAN VOLCANO OBSERVATORY
Founded 1911

This laboratory at Kilauea Volcano belongs to the Hawaiian Volcano Research Association and is leased and operated by the United States Geological Survey.

It maintains seismographs at three places near Kilauea Volcano, also at Hilo, and at Kealakekua in Kona District. It keeps a journal of Hawaiian volcanic activity and publishes occasional Bulletins

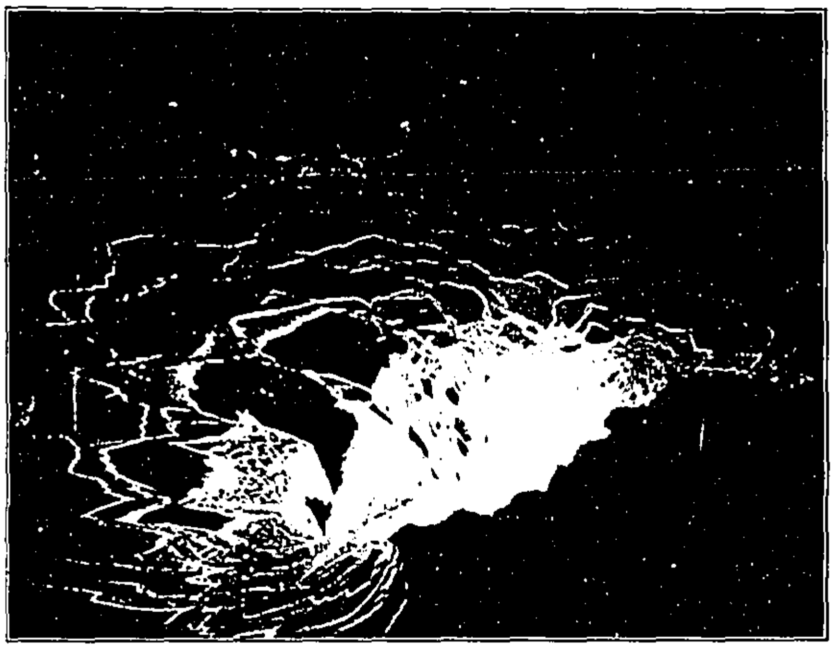
Membership in the Hawaiian Volcano Research Association is limited to patrons of Pacific science who desire personally to aid in supporting the work.

The work of volcano research so supported is in collaboration with the work of the United States Geological Survey, but supplements it with buildings, research fellows, instrumental plants, explorations and special investigations for which there is no governmental provision. The Geological Survey maintains volcano stations in Alaska, California and Hawaii.

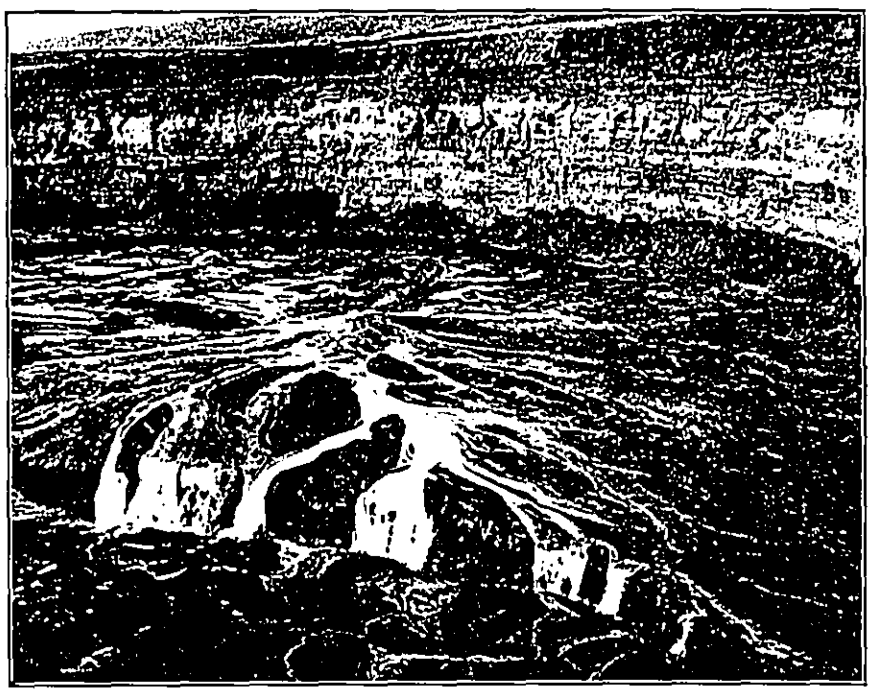
Persons desiring application blanks for membership should address the Secretary, Hawaiian Volcano Research Association, 300 James Campbell Building, Honolulu, T. H.

The Volcano Letter

Two dollars per year | Ten cents per copy
No. 278—Weekly | Hawaiian Volcano Observatory, National Park, Hawaii | April 24, 1930



Lava cascade into North Pool of Halemaumau, 7 p. m. December 21, 1923, showing the concentric breaking of crusts as the incandescent fluid was sucked down a well which had temporarily become a sinkhole. Photo Finch.



Overflow flood of lava from North Pool of Halemaumau January 8, 1924, the North Pool lying in the middle of the radial flows. These cascade into the main lake in eight fiery ribbons shown in the foreground. Photo Emerson.

LAVA CASCADES IN HALEMAUMAU

To understand the distinction between lava paste and lava froth in Halemaumau pit of Kilauea Volcano, the observer should compare the happenings of different periods, when in the one case the froth (liquid lava) fountains up in artesian fashion through one of the wells or shafts that leads down through the paste (bench lava); and in

Cascade from remnant lake after a subsidence, into a sinkhole in what had been lake bottom in January, 1917. Photograph was taken February 14, 1917, revealing the former bottom of the lake as a shallow affair about 40 feet below the former lake level. This bottom is the lava paste or bench lava. Photo Jaggar.

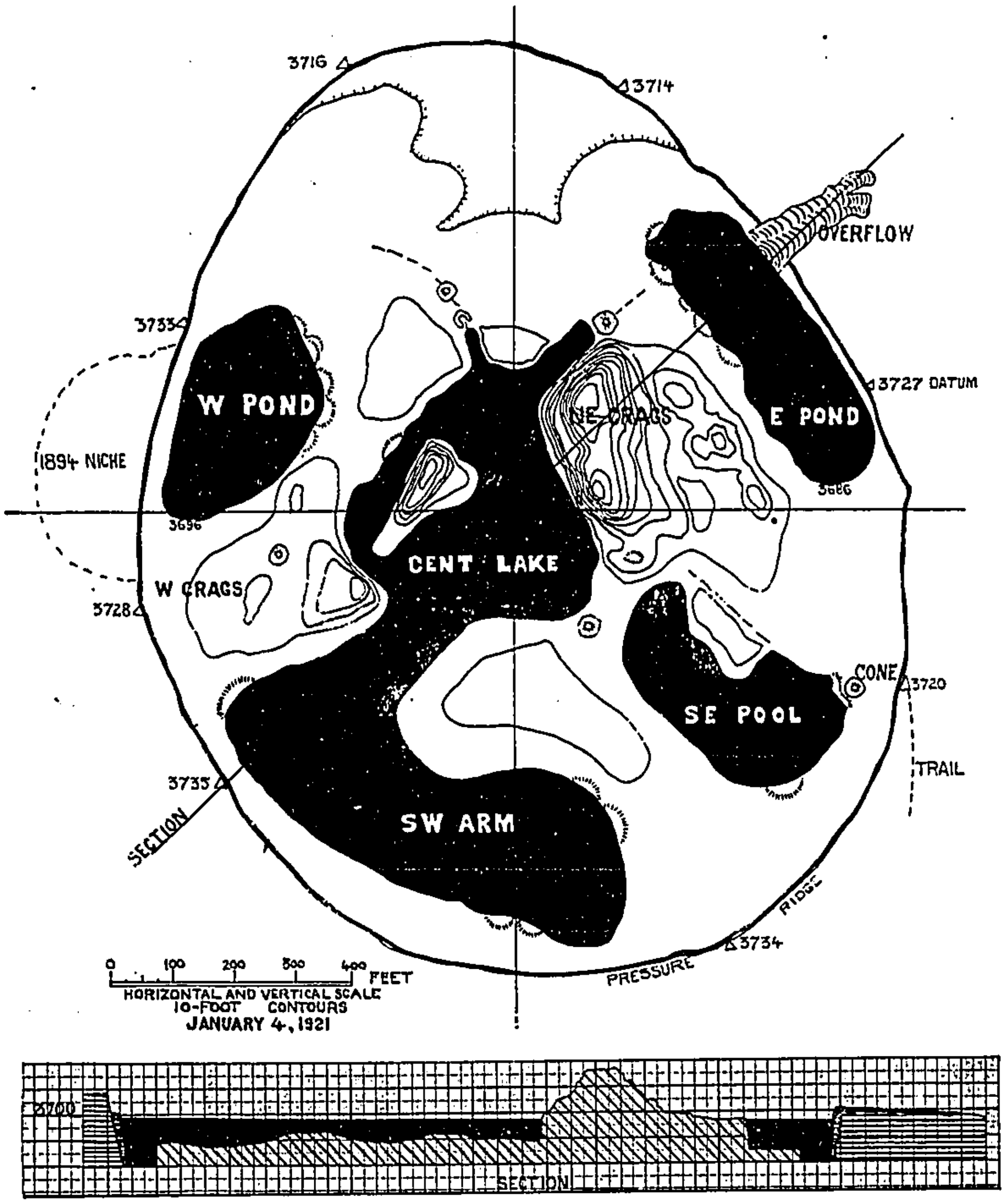
the other case the froth lowers in its well so that the remaining liquid lava rising through other wells streams across the lake area and cascades down into the evacuated shaft. Lava pulsations up and down for periods of a week or more are characteristic of a time of high activity, and the feeding well, which this week is overflowing on one side of the pit, may next week be receiving a cataract of golden incandescent fluid from its neighbors.

The general arrangement at a time of high rising, when the lava was actually level with the rim of Halemaumau, and had just been overflowing on the northeast, is shown in the map on the last page. This was in January, 1921, when there had been a big December rise, and the lava paste, shown by the shaded block in the cross-section, had been lifted bodily within the funnel, so that wells for the liquid lava were developed at the two wall cracks right and left (shown in black). The section goes from southwest to northeast, and the northeast margin of the pit is shown freshly overflowed in plan and section. This of course was a cascade into the open country. Now if we suppose the well, shown at the left in the section, to lose its supply of feeding lava in the depths and reverse its flow from up to down, while the right-hand well, connected by tunnels with all the lakes, keeps on bubbling up strongly, there will be developed a cascade into the left-hand well. Whatever may be the cause, it is a fact that the wells maintain different levels in the circulation, from time to time. (See Volcano Letter No. 272.)

The most intense fluctuation between different wells in the paste, with domings up and outflow over one well one week, and siskings down with inward cascades in the same well the next week, occurred during the last great rise of Halemaumau lava that preceded the explosive eruption of 1924. There had been a big subsidence in the pit of 400 feet in August, 1923, accompanied by the outflow in the forest near Makaopuhi on the Chain of Craters road. There was immediate rapid recovery in Halemaumau throughout the autumn of 1923, developing an enormous lava fill, from wall to wall, only 114 feet down January 21, 1924. At times this was a sea of liquid lava when all the bench lava was flooded, at other times it was a large shallow heart-shaped pool surrounded by a flat platform, with four low islands, and at the north an isolated pond of liquid lava in the platform between the two lobes of the heart. This was called the North Pool.

It is of interest to note that the lava paste, represented by the islands and platforms, was doing some horizontal moving which the islands exhibited. Thus in November, when at the beginning of the month the lava was 320 feet down and by fairly uniform rising stood only 260 feet below the rim November 30th, an island in the main pool, which had been there for several weeks, moved nearly to the southeast bank during November 24-25. A second island had appeared in the main pool November 10, disappeared on the 12th, reappeared on the 13th, and soon thereafter became joined to the larger island. In December the lava showed numerous oscillations in level, making a net gain of 39 feet.

These oscillations of December, 1923, are what produced the spectacular cascades. The dominant rising was at the south, and on December 7 there was a very strong spurt with downrushing cascade into the North Pool. These performances were repeated about once a week so that on the 14th and 21st December (see first photograph) similar torrential cataracts into this pool reached still greater size. On the 27th the influx was repeated



Map of Halemaumau and profile section January 4, 1921. Elevations above sea level in feet. Liquid lava black, diagonal shading bench lava, broken lines are cracks. This situation followed a marked rise in December when the liquid lava had gained at the expense of the crags and islands, and had overflowed the rim of the pit from the East Pond.

companying subsidence of the lava column and disturbance of the bench lava, but all a part of normal circulation phenomena, and not an outflow, for the level of the lake remained relatively constant for 11 days while the cascade persistently poured into the gulf. The lava lake even rose at times, relative to its own banks, while this was going on. T.A.J.

KILAUEA REPORT No. 952
WEEK ENDING APRIL 20, 1930
Section of Volcanology, U. S. Geological Survey
T. A. Jaggar, Volcanologist in Charge

No changes in Halemaumau have been noted except additional rocks on the bottom below the 14-ton bowlder. The bowlder has not changed its position. Crack measurements show no changes near the tourist observation station.

Dense steam was rising from Halemaumau on the afternoon of April 18 and the morning of the 19th due to light rains.

Ten seismic disturbances were registered by the instruments at the Observatory during the week, classified as follows: Six tremors, the longest with three-fourths minute duration; three very feeble seisms, one showing an origin 18 miles away; one distant earthquake, the long wave recording feebly at 9:09 p. m. April 15.

Tilt accumulated moderately SW. Microseismic motion was slight.

with very rapid fluctuations, so that during a half hour more than ten million cubic feet of lava was poured out, and over 40 acres were covered with the molten flood that drowned all islands and individual lakes. Then tumultuous fountains would break out at various places, some of the source wells would become sinkholes, and in all five wells were located.

In January, 1924, the weekly periodic flooding continued, but the North Pool sometimes became a source, and on January 8 (see second photograph) this pool was sending out extremely liquid radial torrents which cascaded into the main lake, as shown in the picture. The heat was almost unbearable at many places on the rim of the pit. A cone at one side discharged gas through a crack near its base. Several islands were drowned. On January 18 the liquid rose 65 feet in less than 16 hours so that on January 21 the lake was 45 acres in extent with no islands or separate pools visible, and the tumultuous fountains often hurled up spray 100 feet into the air. These violent fluctuations continued in February, but after February 12 the whole lava column including the paste lowered gradually until by February 21 the floor was 380 feet below the rim, the cascades into the North Pool being repeated February 15, 17 and 18, sometimes with a drop of 40 feet, while the main source was a south feeding well from which bright lines radiated. The topography of the paste lava reappeared and then collapsed around the northern pool *along with the development of fume. Glow was last seen* at the southeast, where there had been a conelet. In April came the subsidence and earthquakes in Puna, and in May the gigantic collapse at Halemaumau, accompanied by steam-blast eruption.

What process causes a well to be a feeder one day and a sinkhole the next is a matter of speculation, but there are many measurements on hand at the Hawaiian Volcano Observatory, the study of which may help to solve this problem. If the map and cross-section on Page Four are compared with those of Page Four of Volcano Letter No. 272, it will be seen that January 4 differs from March 14 of 1921 in that the paste lava block had been lifted clear of the two walls so that there were cracks filled with liquid lava on each side, whereas in March the level was lower and the cake of paste, which must be shaped like an inverted cone to fit the funnel of the pit, was settled differently within the tapering shaft. The lift of the paste as a whole is somehow connected with the gas expansion of the deep magma, from solution in which the gases escape and unite with increased heat and consequent liquefaction of the melt in which they formed bubbles, and it is highly probable that the few wells of the upper part of the combined lava column fork out into a network of wells down below. This network expands and lifts the whole sponge. If this is what happens, probably the upper harder part of the paste, with its crags and floors and overflows, is always breaking into blocks with doming and splitting of the crust, and this motion changes the relation of the different wells to each other. There is a circulation of the liquid froth with a maximum of rising where it is lightest and hottest, and of sinking where it has lost its gas and become heaviest. It is also eternally solidifying here and liquifying there, the partial solidification adding to the material of the paste. Thus the source wells and sinkholes shift in accordance with the equilibria of all these processes.

The photograph on Page Two shows the southern part of *what had been the lava lake of Halemaumau a few days* before, in February, 1917, when a sinking spell had revealed a well under the lake where the fountains had been. Into this well now there was a mighty cataract of molten lava with hot flame of pale bluish aspect rising from the sinkhole, and fume condensing above and to the left. This was the first great topographic demonstration of the shallowness of the lava lakes. The picture on Page Three, shows a marginal cataract of 1919 of the same character, with the whole lake pouring continuously into a void, tearing great skins on its surface, all of this ac-

Main lake in Halemaumau cascading into a well at the Northeast cove June 9, 1919, a process that kept on for 11days without altering the relative level of the lake, though the entire lava column was sinking at this time.

Photo Jaggar.

April 2, 1929

Director,
National Park Service,
Department of the Interior,
Washington, D. C.

Dear Mr. Director:-

The March report of activities in Hawaii National Park is submitted herewith.

000 GENERAL:

March saw the continuation of good winter travel season to the Hawaiian Islands. The end of the month brought into effect our new post-office title of "Hawaii National Park, Hawaii" instead of "Volcano House, Hawaii".

100 ADMINISTRATIVE:

120 Park Inspection By:

121 Superintendent.

The superintendent made frequent inspections of all work during the month. He also spent considerable time in learning areas of the park which he had not heretofore visited.

123 Other governmental officers.

U. S. Attorney S. B. D. Wood spent a week in the park on unofficial status.

200 MAINTENANCE, IMPROVEMENTS AND NEW CONSTRUCTION:

210 Maintenance.

Extensive repairs to park roads were continued during March. A three mile section of the Kilauea Crater road which was in extremely poor condition due to a multitude of deep chuck holes in a heavy oil crust has by concentrated effort been put in a fairly acceptable shape. This road has been the subject of past newspaper editorials and a special effort is being made to maintain it until funds are available for rebuilding. The present repairs will be nullified by both rain and travel but it is the intention to repeat them as long as we have maintenance money to do so.

220 Improvements.

Park trails in the vicinity of headquarters and the hotel have been made much safer by the addition of railings at locations where the trails cross earthquake cracks or pass deep holes hidden by foliage.

300 ACTIVITIES OF OTHER AGENCIES IN THE PARK.

310 Public Service Contractors.

313 Rates.

A request was received from the Volcano House company to advertise a $6.00 summer rate for periods of not less than seven days. The request was granted without reference to the Department as this same rate had already been approved before.

340 Territorial Legislation.

No action has yet been taken on territorial bills for the expenditure of funds on the Haleakala approach road or the extension of the Chain of Craters road to Kalapana.

400 FLORA, FAUNA AND NATURAL PHENOMENA.

410 Ranger-naturalist service.

Lectures were given on steamer days to 1,017 persons and 156 person were guided over the trail to Halemaumau and thru the Thurston Lava Tube.

460 Birds.

The recent beautiful Spring days of late March have well proven the protection given to birds by the Hawaii National Park. Altho other parts of the Islands are bemoaning the scarcity of birds they still thrive in great numbers throughout the Park. The majority of our extinct craters are heavily forested and on sunny days even the casual listener is convinced that the bird population of these craters is plentiful.

480 Natural Phenomena.

No visible volcanic action has occurred during March but steady volcanic tremor indicated on the seismograph has kept up expectation of possible lava flows in the near future. Dr. Jaggar however, has made no predictions.

On March 6th a heavy earthquake was recorded as being some 2,000 miles away and tidal wave warnings were issued by the local observatory to all island shipping authorities. The quake occurred near the Aleutian Islands and the tidal wave reached the Island of Hawaii some five hours later with a rise of only one foot on the tide gauges. The possibilities of damage were very great and the warning sent out was justified.

500 USE OF PARK FACILITIES BY THE PUBLIC.

510 Travel

Park travel continued to show increase during March.

520 Weather Conditions.

Maximum temperature	— 19th, 27th, & 29th —	75
Minimum "	——— 7th ———	46
Rainfall for month of March	———	7.79 inches
" " " " " at Hilo	———	17.44 "
" to date Volcano District	———	24.74 "
" " " at Hilo	———	42.05 "

600 PROTECTION:

630 Accidents.

On March the 18th Mr. Malcolm McKee Rice of Los Angeles, California left Volcano House on foot at 6:00 o'clock in the evening to see the lava fields. At 10:00 P.M. he had not returned and rangers crossed the lava fields on Kilauea Crater searching him with lanterns. He was not found that night but returned at 6:00 A.M. unharmed. Mr. Rice stated he had seen the lanterns but could not attract attention. Wild stories which he recounted and which were obviously untrue led to the believe that Mr. Rice was a trifle weak minded and he was closely watched until he left the Park.

Very respectfully yours,

Thos J. Allen Jr.,
Superintendent.

Copy to Yellowstone National Park,

" " Mr. F. A. Kittredge, Chief Engineer, N.P.S.

TJA/JKH:

10-157

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

TRAVEL REPORT

Hawaii National Park for the Month of March 1929

	This Month	This Travel Year To Date	This Month Last Year	Last Travel Year To Date	Increase for Travel Year: Number	Increase for Travel Year: Percent
PRIVATE TRANSPORTATION:						
Cars first entry, ...						
Cars reentry, ...						
Motorcycles, ...						
Total motor vehicles, ...						
Persons entering via motor vehicles, ...	3,895	28,450	3,250	26,960	1,490	.058
Persons entering via other private transportation, ...	210	1,234	348	1,333	99 dec	.074
Total persons entering via private transportation, . . .	4,105	29,684	3,598	28,293	1,391	.047
OTHER TRANSPORTATION:						
Persons entering Hotel via stages, .	1,569	5,944	1,495	6,481	537 dec	.083
Persons entering via trains, .						
Persons entering otherwise, . .						
Total other transportation, .	1,569	5,944	1,495	6,481	537 dec	.083
GRAND TOTAL ALL VISITORS, . .	5,674	35,628	5,093	34,774	854	.024

	This Year	Last Year	Increase: Number	Increase: Percent
Automobiles in public camps during month, ...	0	0	0	0
Campers in public camps during month, ...	0	0	0	0

10-155

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

STATUS OF PERSONNEL

Hawaii National Park for the Month of March 1929

	This Month	This Month Last Year
Number of employees beginning of month,	7	9
Number of additions, ...	3	1
Total, ...	10	10
Number of separations, ...	2	0
Number of employees close of month, . . .	8	10
Number of promotions during month.	0	0
Aggregate amount of annual leave taken,	0	0
Aggregate amount of sick leave taken,	2	0
Aggregate amount of leave without pay,	0	3

10-160

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

REPORT OF PARK REVENUES

..........Hawaii............ National Park for the Month of ......March 1929..............................

	This Year	Last Year
Park revenue on hand beginning of month, ...	0.00	0.00
Received, ...	25.00	25.00
Total, ...	25.00	25.00
Remitted, ...	25.00	25.00
On hand close of month, ...	0.00	0.00

Park revenues received this year to date, ...	$ 1,050.00
Park revenues received last year to date, ...	$ 1,050.00
Increase, ...	None
Percent of increase, ...	None

10-161

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HAWAII NATIONAL PARK

REPORT OF SALES OF PUBLICATIONS

MARCH 1929

	Number	Value
GOVERNMENT PUBLICATIONS:		
On hand beginning of month,	426	$ 42.60
Received during month,	0	0.00
Total,	426	$ 42.60
Sold during month,	54	5.40
On hand at close of month,	372	$ 37.20
NON-GOVERNMENT PUBLICATIONS:		
On hand beginning of month,		
Received during month,		
Total,		
Sold during month,		
On hand at close of month,		

Cash on hand beginning of month,	$ 9.70
Sales during month,	5.40
Total,	$ 15.10
Remitted during month,	0.00
Balance,	$ 15.10

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No. 219 RELEASED WITHOUT COPYRIGHT RESTRICTION March 7, 1929

KILAUEA REPORT No. 893

WEEK ENDING MARCH 6, 1929

Section of Volcanology, U. S. Geological Survey

T. A. Jaggar, Volcanologist in Charge

The lava activity that was observed in Halemaumau pit Februrary 20 has entirely ceased, and there remains the frozen lava lake with virtually no motion of any kind. The incandescent pasty lava undoubtedly exists under the crust, but the shell on the lake has become too thick to show any further glow or gas action. On March 1 at 11 a. m. fresh debris lay on the eastern taluses, and there was also slight change in the northern and southern slopes. A slide was heard at the southwest. Sulphur stain was increasing near the north spatter cone, and a new patch had appeared at the south edge of the lava floor, which was steaming. At the west a crack in the floor was seen, and the south side of the lava area appeared to be settling more than elsewhere. White stain suggests fumarole action on a large red rock in the gravel near the bottom at the east. White stains are increasing on the lava crust. Columnar fluting is conspicuous at the southern end of the east sill, where also there is steam from the wall.

On March 2 the strong earthquake at 10:24 a. m. dislodged a small slide at the east wall of the pit. At 11 a. m. March 3 a little sliding was heard, there was a line of steaming up and down the top of the south talus, and fresh avalanche debris had increased at the east.

In the forenoon March 4 slides were common N. and NE., and about noon visitors throwing rocks at the edge NNE. started a slide that made a red scar in the wall, put numerous white rocks on the talus below, and made a cloud of dust. March 5 there were small rock falls N. and SE.

The seismographs registered only 6 local earthquakes for the week, 4 very feeble, 1 feeble at 10:19 a. m. March 2, and 1 slight and locally felt 10:24 a. m. March 2 of intensity III R. F. The last two indicated a distance from the Observatory of 17 miles, probably in the Kapapala direction, making the center somewhere between Kilauea and Mauna Loa. Tilt for the week was moderate to the north, and microseisms were normal.

MOUNT SHASTA MUD FLOWS

During the summers of 1924 and 1926 there were floods from Mud Creek, which drains the Konwakiton Glacier on the south slope of Mount Shasta. Owing to the depth of the mud deposited by the floods, trees were killed over hundreds of acres, roads buried, and railway traffic interrupted, while the drainage system into which Mud Creek flows was contaminated by mud for over 75 miles.

The floods were due to the rapid melting of the Konwakiton Glacier. The glacier rests on a thick deposit of unconsolidated volcanic ash. Mud Creek always carries a great amount of this ash. Light snowfalls of the winters preceding the mud flows allowed the summer sun to cause more rapid melting of the glacier than is common. The floods in Mud Creek were the result.

Some press reports, written by correspondents a considerable distance from Mount Shasta, attribute the rapid melting of the glacier to an increase in the volcanic heat of the mountain. Nothing has been found to support such a contention. The hot springs on the summit of Mount Shasta are steaming much the same as they have been for years. The highest temperature found at these springs on June 18, 1928, was 180° F., or a little below the boiling point for an elevation of 14,000 feet. R.H.F.

EARTHQUAKES ON ISLAND OF HAWAII 1928

The total number of seismic disturbances registered by the seismographs of the Hawaiian Volcano Observatory during the year 1928 is 1,053. Of these 1,034 were local earthquakes and tremor swarms.

Of the local earthquakes, the grouping by intensity is as follows: 1,004 were very feeble and so registered only by instruments; 25 were feeble, making a clean-cut earthquake seismogram, and felt by some persons; 3 were slight, making strong seismograms, and generally felt, except by persons in motion; 2 were moderate and strongly perceptible. The latter were January 4 and February 26.

The total of local shocks compares as follows with the three previous years: 1925, 922; 1926, 1,778; 1927, 1,149; 1928, 1,034. The average then is about a thousand per year at present, as 1926 was the exceptional year of the Mauna Loa outbreak, when there were 761 shocks in April alone.

The number of teleseisms for 1928 is 20, of which 4 are near the March equinox, 8 before and near the June solstice, and 8 near the September equinox.

An interesting feature was the notable increase of tremor swarms, lasting each from 2 to 34 minutes. They were conspicuous in January, March, June, and December, and were identified with pit avalanches in the late summer and autumn. T.A.J.

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No. 220 RELEASED WITHOUT COPYRIGHT RESTRICTION March 14, 1929

KILAUEA REPORT No. 894

WEEK ENDING MARCH 13, 1929

Section of Volcanology, U. S. Geological Survey

T. A. Jaggar, Volcanologist in Charge

Halemaumau continues quiet. On March 8 there was some sliding of rock from the north wall and also March 12. but in less amount. On March 13 at 11 a. m. fresh red debris was observed on the east talus from a newly stripped portion of the wall two-thirds of the way down, above the big sill. A few stones were heard slipping twice during a visit of a half hour. Some stones from slides had rolled out over the new lava southeast.

The weather being sunny, no vapor was detectable rising anywhere from the new lava floor, not even from the stained area at the south edge. From the slide rocks outside the southeast edge of the floor, and from a wet spot at the top of the south talus, vapor was rising. There was also steam and moist ground at the lower ledges southeast, whereas most of the talus slopes appeared dry. Hot vapor rose from fissures inside the south wall of the pit, near the top.

Four very feeble local earthquakes were registered at the Observatory during the week. A large distant earthquake began about 3h. 11m. 22s. p. m. March 6, and the long waves threw the writing pens off the drum. The indicated distance was 3,650 km., corresponding to the north side of the Aleutian Deep south of Amukta Pass. This origin was confirmed by radio report from Alaska. Small seismic sea waves were registered as following this earthquake in Hilo Harbor at the tide gauge between 7:45 and 10 p. m. March 6.

Tilt for the week was slight SSW and microseismic motion was very slight.

SEISMIC SEA WAVE MARCH 6

The large, distant earthquake registered at the Hawaiian Volcano Observatory as beginning 3 h 11 m. 22 s. p. m. March 6, Hawaiian Standard Time (G.M.T. 1 h. 41 m. 22 s. March 7) exhibited on the seismogram very clear preliminary tremors lasting 5 minutes and 26 seconds and a well marked beginning of secondary waves, which merged without distinction into such large long waves that the writing pens of the seismographs at Kilauea and at Hilo swung off the smoked paper. These seismograms indicated an earthquake of great magnitude at a distance approximately 3,650 kilometers, or 2,270 statute miles from the Observatory. The seismogram showed signs of the return wave that had passed around the crust of the earth on the side of the globe remote from Hawaii about four hours after the start of the record. Calculation showed that the time of the actual shock at the epicenter was 6 m. 52 s. before the registration began; that is, the seismic waves through the rock under the bottom of the sea took a little less han 7 minutes to travel 2,270 miles.

This distance is slightly less than that of California from Hawaii, and the indication from the direction of first disturbance and from the excess of long wave motion in the north-south direction implied an earthquake origin lying probably either NNW or SSE from Hawaii. Toward the south this would be near the Marquesas Islands, and toward the north it would mean the well known earthquake region of the extremely deep trough (over 4,000 fathoms) that lies about 125 miles south of the Aleutian Islands. Everything indicated that one of the big Aleutian earthquakes was in progress.

In accordance with previous experience at this station (Volcano Letter No. 57, January 28, 1926) the big submarine earthquakes from Alaskan waters and also those still farther away from the sea bottom off Chile are liable to create flood waves in the ocean that may do some damage on the eastern side of the large Hawaiian Islands. The experience of February 3, 1923, had shown that a large earthquake south of the Alaskan Peninsula could make a disastrous tidal wave which arrived at Hilo about seven hours after the shock was registered at the Kilauea seismographs. Accordingly, in the present instance a tidal wave warning was sent to the harbor masters at Hilo on Hawaii, and Kahului on Maui, and through the Naval Radio to the Commandant at Pearl Harbor in Honolulu. It seemed probable that the water wave would reach Hawaii about 10 p. m., by analogy with the transit time of the sea wave of 1923.

The speed of travel of such waves is comparable to that of the wave represented by the normal daily tide, and this speed has nothing to do with the violence of the resulting shore waves, which are compounded with the natural period of the local harbor or basin, and usually keep swinging back and forth for hours at intervals of 15 or 20 minutes. The speed of the free wave in the open ocean is for the Atlantic tides about 500 miles per hour, and for an earthquake wave in the Pacific 300 miles per hour, more or less.

On March 6 the event proved that a great earthquake had occurred at the north edge of the Aleutian Deep approximately 100 miles south of Amukta Island, as reported by Japanese steamers in that vicinity, which felt the sharp bump of the quake. Also Dutch Harbor reported severe shaking. The surging waters began to swing in and out of Hilo Bay about 7:45 p. m., as recorded on the tide gauge at Pier 1 back of the breakwater, with a range of motion of something over a foot and an interval of about 15 minutes between crests. In the Wailoa River at the head of Hilo Bay the harbor master reported 16 inches between high and low level swings. I watched these swings as follows:

8:20 p. m.,	current inward
8:27 p. m.,	" outward
8:31 p. m.,	" inward
8:34 p. m.,	" outward
8:38 p. m.,	" inward

With higher tide the surges were watched between 9 and 11 p. m., and the intervals grew longer. The S. S. Haleakala at Pier 2 broke stern lines as result of the surging motion. The maximum was between 8 and 9 p. m., and about 10 p. m. the surges dwindled. It was evident that the speed of propagation of the water movement must have been over 400 miles per hour.

The correspondence of location of earthquake, and of sea wave as registered on the tide gauge, with published expectation in accordance with seismogram data, was completely satisfactory. The time of transit of sea wave appears to be less than that of 1923 Its resultant surges in Hilo Harbor were much lower than in 1923, when disastrous wave action reached heights about 15 feet above normal. As the earthquake of 1929 appears to have been equally intense, and the position only a few hundred miles farther west, it seems likely that local surging must depend on wave resonance with the stage of the tide, and the effects of winds and waves over the ocean intervening between the earthquake origin and the port. T.A.J.

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No. 221 RELEASED WITHOUT COPYRIGHT RESTRICTION March 21, 1929

KILAUEA REPORT No. 895

WEEK ENDING MARCH 20, 1929

Section of Volcanology, U. S. Geological Survey

T. A. Jaggar, Volcanologist in Charge

No volcanic changes have been observed at Kilauea or Mauna Loa indicating anything unusual. Some rapid tilting, accompanied by tremor, at three seismograph stations in and around Kilauea Crater has interested the observers because of its resemblance to similar movements incident to the eruption of February 20. This interest is reinforced by prolonged tremor spasms at the Observatory March 15, 17, 18, 19, and 20, two of these accompanied by east tilt.

On March 15 at Halemaũmau a small slide was heard about 9 a. m. toward the north, and the falls of rock during the forenoon were very slight. The next morning, March 16, there was very little steam in the pit, and only a few slides. March 18 at 9 a. m. there was a very little sliding at the northwest. Yellow sulphur has appeared in cracks at the stained whitish spots along the north and south edges of the new lava. The downfaulted bench around the edge of the subsided lava lake is in steps. A little steam shows sometimes quite suddenly at the north sulphur spot as though nucleated by invisible gas blown over the place from a nearby orifice. There is vapor high on the west and south taluses, on the lower east talus, and at the top of the talus NNE. On March 19 just before 6 p. m. red and gray dust rose from avalanches in Halemaumau.

Seventeen very feeble earthquakes were registered at the Observatory, of which one at 9:05 a. m. March 13 indicated origin distance two miles away, and another, 11:14 a. m. March 19, origin distance 11 miles. The tremor spasms above mentioned are not included with these earthquakes. Tilt for the week was strongish WSW., several of the shocks of March 17 until 4:14 p. m. exhibiting westerly tilt simultaneous with the tremor. Microseismic motion was normal.

HAWAIIAN VOLCANO RESEARCH ASSOCIATION 1928

The work of the Association is divided between general furtherance of the progress of the Hawaiian Volcano Observatory and the specific tasks of maintaining seismograph stations and issuing publications. The Board of Directors are L. A. Thurston, W. F. Dillingham, F. C. Atherton, L. T. Peck, W. W. Thayer, W. R. Castle, A. L. Dean. The Honolulu office is 1031 Fort street, L. W. de Vis-Norton, secretary. The Association is incorporated, and has about 180 patrons and members, and a mailing list of about 600 institutions, libraries, and individuals.

The division of work between the United States Geological Survey and the Association at the Kilauea observatory is broadly on the line between salaries and equipment: the permanent salaries are Governmental. Outside of the observatory, the Research Association employs the seismograph observers in Hawaii, and occasionally other persons on Research Fellowships.

The Observatory was founded by the Research Association in 1912, and has gradually acquired increasing Government aid. The collaboration may be compared with the demands of manufacturing associations on the Bureau of Standards. The Association has supplied shops, instruments, laboratories, expeditions, researches, books, specialists, vehicles, and machines, that have made possible path-breaking investigations which could not have been attacked under Government alone, owing to the restrictions that control Government funds.

The work of the Association in 1927-28 in seismology illustrates perfectly its influence and results. The Association built the Uwekahuna Observatory, for use as a trailside museum by the National Park Service; equipped it with a seismograph for both exhibition and research, and placed the best collections on exhibition. This accomplished three distinct advances: it provided a new seismograph and observation station in a new place; it gave the public a museum and relieved the Observatory of exposition duties; it provided the National Park with motion picture hall and apparatus for exhibiting to travelers volcano activities of other times. Government staffs immediately assumed operation expense.

The Association at the same time equipped and manned a machine shop for making seismographs. Seven instruments have now been built in that shop, new ones are installed in Kona and Hilo, many other tools and machines have been built, and the machinist is now a Government employee. The old seismograph released from Kona was rebuilt and installed in a small roofed cellar near the Kilauea pit: this instrument showed remarkably instructive tilt and tremor in the Halemaumau eruption of February 20, 1929.

In the summer of 1928 the seismologist built an oscillating table for mounting and testing seismographs by imparting to them artificial earthquakes. The "Ohiki," wheeled boat built by the Research Association and tested in a longshore trip on Hawaii, was the experimental basis of a successful season with an amphibian in Alaska.

The published work of the Association in 1928 concerns volcano notes from many lands, the weekly reports from Kilauea, Lassen Observatory notes from California, reviews of volcanologic books, popular statements of the technical work in progress on local shocks, tilt, microseismic motion, distant earthquakes, tidal waves, temperatures of borings, work of the several seismograph stations, notes on explorations, new methods and cooperative work of other bureaus, some National Park enterprises, addresses, and articles on borings, Coast Survey work, gravity measurements, and on tide gauge measurements and station installation.

The improved registration of earthquakes by the Association seismographs was never better demonstrated than during the last three months, when the local earthquakes that preceded and followed the February eruption were well recorded at five stations, and all five also made record exhibiting data that bear on distance of origin, direction, and intensity, for the great Aleutian earthquake of March 6, 1929. To the radio equipment installed at Kilauea and in Kona the Observatory owes increasingly accurate time service, the time signals being sent out from Washington, D. C., and from naval stations in California and Hawaii.

T.A.J.

SAMPLE COPY

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Address: HAWAIIAN VOLCANO OBSERVATORY, VOLCANO HOUSE, P. O., HAWAII

THE VOLCANO LETTER

A Weekly news leaflet of the Hawaiian Volcano Research Association

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No. 222 RELEASED WITHOUT COPYRIGHT RESTRICTION March 28, 1929

KILAUEA REPORT No. 896

WEEK ENDING MARCH 27, 1929

Section of Volcanology, U. S. Geological Survey

T. A. Jaggar, Volcanologist in Charge

Avalanche dust rose from the northeast side of Halemaumau at 3:10 p. m. March 20. In the forenoon of March 23 what appeared to be a fresh scar on the north wall of the pit was observed, and a very few small slides occurred. About midday March 25 the pit was quiet, except that a slide occurred at the north end of the large northeastern sill about 1 p. m.

At 8:40 a. m. March 27 the pit was very quiet, no stones fell, there was steam back of the upper edge E., N., NW., and W. outside of the pit, but the floor was not steaming. There was the usual vapor from the taluses. About 11 a. m. some dust rose from the pit.

At the Observatory 20 very feeble earthquakes occurred, and tremor in irregular recurring spasms, also very feeble, as follows: March 28, 8 to 10 a. m., 8:50 to 10:45 p. m.; March 21, 6:30 to 8 a. m., and irregularly in the afternoon; March 23, irregularly 10:12 a. m. and 3:25 p. m.; March 24, irregularly 6 to 7 a. m.; March 25, 9:34 to 9:37 p. m.; March 26, 8 of the earthquakes above mentioned, between 3:19 p. m. and 4:50 p. m., may be expansions of tremor too feeble to register continuously.

Microseisms were normal, diminishing during the week. Tilting of the ground was slight to the south.

VOLCANOES IN CHILE

The following notes from a letter received from Mr. John B. Stone are of great interest as they are written by a geologist who worked five months on the geology of Kilauea Volcano in 1925 (Bulletin 33, B. P. Bishop Museum, Honolulu, 1926).

"I have recently returned from a vacation trip to Chile" (Mr. Stone is engaged in mining geology in Peru) "during which I went as far south as the island of Chiloé. One of the objects of my trip was to get some information on the volcanoes in that region.

"In Santiago the director of the seismological service stated that the volcanoes in north Chile are not active, but that those in the region between Santiago and Chiloé are active intermittently. There are others farther to the south, but the country is almost uninhabited and little is known about them. Among the volcanoes are Llaima, near the town of Temuco; Villarica and Pueyhue, near Osorno; and Osorno Volcano, Calbuco, and Tronador, near Puerto Varas on Lake Llanquihue. These volcanoes are on the west side of the central valley of Chile (which is beautiful farming country), and are easily accessible from the excellent railway running south from Santiago to Puerto Montt."

A short time before the first of December, 1927, there were earthquakes along the coast of Chile, and at the same time several volcanoes of the southern Andes were active.

The volcano Llaima began erupting violently about November 29, 1927. Enormous flashes and a great quantity of smoke, lava, and cinders came out of the crater. Llaima is some 65 kilometers from Temuco, and it is not more than 3,000 meters high. It has two craters, and is covered with snow all the year round. It lies in latitude 38 degrees 44 minutes. The volcano had a violent eruption in 1864, and flashes of fire have frequently been seen in its craters. There are said to be 34 volcanoes between the latitudes of 24 degrees and 42 degrees.

"I went south from Valparaiso by sea, and on arriving in Puerto Montt on January 6, 1929, found that the volcano Calbuco was in eruption. The air was full of light ash, but only steam was issuing from the volcano at noon of that day. I went in an automobile to Puerto Váras, but was unable to get closer to the volcano than six or eight miles. According to the people there the eruption began about 1 a. m. January 6, 1929, and the outbreak was accompanied by a slight earthquake. The volcano then threw out ash until about 6 a. m., and there was another smaller earthquake about 4 a. m. For the rest of the day there was a fine steam plume from the peak, and once or twice I thought I saw small, dark puffs that could have been ash. Faint steam or smoke was rising over a large area of the woods at the foot of the volcano. I thought it might be caused by the fall of hot ash. but there were reports of a lava flow. On January 7, 1929, I saw the volcano from a different angle, and there appeared to be two steam jets. The only press report of the eruption that I saw was much exaggerated.

"It would be possible for an observer with headquarters at Puerto Varas, or possibly at Osorno town, to keep half a dozen volcanoes under fairly close observation. The eruption that I saw is probably typical, consisting of a short ash ejection, possibly accompanied by lava flows. The country is far more accessible than Alaska, and except for the heavy winter rains is a most agreeable place to live in. Puerto Varas, I judge, is only about 200 feet above sea level, and Calbuco volcano would appear about 5 000 feet high" (1,738 meters or 5,700 feet, according to Sapper). "I think that an expedition less expensive than those to Alaska could get important results in two or three months. December-January is the best season.

"At the Braden Copper Mine at Sewell, I found that the Talca earthquake of about December, 1928, had lasted one minute and a half and had destroyed the tailings dam at the mill, thereby causing a rush of mud that killed 43 people. A new Chilean law has established a Department of Public Works, which has as one of its chief duties the supervision of buildings to make them more nearly earthquake-proof." T.A.J.

March 7, 1929

Director,
National Park Service,
Department of the Interior,
Washington, D. C.

Dear Mr. Director:-

The report of park activities for the month of February 1929 in Hawaii National Park is submitted herewith.

000 GENERAL:

The past month has seen the start of the heaviest winter tourist season ever enjoyed in the Hawaiian Islands. All hotels in Honolulu are filled with guests and this park as well as section of the other islands are receiving a natural proportion of the visitors.

100 ADMINISTRATIVE:

A complete revision of our filing system is held up pending receipt of necessary materials.

120 PARK INSPECTION BY:

121 Superintendent:

All work in progress was inspected by the superintendent at various intervals during the month.

200 MAINTENANCE, IMPROVEMENTS AND NEW CONSTRUCTION:

210 Maintenance:

Following receipt late in January of an additional allotment for road maintenance extensive repairs have been started on all park roads. In this work the big tractor grader purchased last Fall but used little until now is proving of great value.

Heavy rains during February have created a problem in regard to maintenance on the new oiled section of the "Around the Island" or Kau road. The materials of the road body and shoulders are of volcanic rock and soil with no clay or other binder. The surfacing is oil-processed gravel. The rains have run off the tight oiled road top as they would from pavement but in so doing they carry away all the top soil of the shoulders and undermine the oiled edges. A special report with pictures is being prepared in this matter.

230 IMPROVEMENTS:

A new 3000 gallon water tank was erected at one of the employees cottages to replace an old one which was beyond repair. For the information of other park superintendents who will read this report, all water supply in Hawaii National Park is from rainfall collected at the roofs of buildings and stored in redwood tanks.

A needed parking area at the fire pit Halemaumau has been cleared to accommodate 250 cars. Work consisted of removing boulders of 1924 eruption scattered on crater floor and a small amount of leveling.

300 ACTIVITIES OF OTHER AGENCIES IN THE PARK:

310 Public Service Contractors:

314 Complaints:

Several oral complaints have been received on the lack of rooms with bath and lack of hot water & heat in rooms at the Volcano House. The hotel manager is aware of these complaints but can do nothing. The remedy is probably either a new hotel or extensive alterations to the present buildings.

340 Territorial legislation affecting the Park:

The territorial legislature now in session has been requested by the governor to include in moneys appropriated an item of $300,000 for construction of their section of the Haleakala road on the island of Maui. This expenditure would reach the park boundary and make possible the construction of the park service road to the Haleakala crater.

Also included as part of a bill permitting the island of Hawaii to issues bonds for road construction is an item of $50,000 to be used to connect our Chain of Craters road with the sea coast road at Kalapana. This is for 1931 construction.

400 FLORA, FAUNA & NATURAL PHENOMENA:

410 Ranger-naturalist Service:

Uwekahuna Observatory lectures were attended by 1070 persons during February. Lectures were discontinued during the period of volcanic action.

460 Birds:

Hundreds of chinese thrush and pekin nightingale have already been liberated as part of the "Buy a Bird" campaign of restocking the island of Hawaii by private subscription. This was referred to in our January report.

480 Natural Phenomena:

At one A. M. in the morning of February 20 Halemaumau the fire pit of Kilauea volcano broke into a very complete and spectacular eruption which continued for 36 hours and suddenly ceased when expectations were being held for a prolonged stay of lava flow. Special report of this flow has already been made and is added to by the Volcano Observatory bulletins attched hereto.

500 USE OF PARK FACILITIES BY THE PUBLIC:

510 Increase in travel.

The eruption of February 20 - 21 and the resultant ten days heavy travel increased our travel firgures with a jump. All available park forces were taxed to the limit day and night to handle traffic and guard crowds at the fire-pit rim.

521 Weather Conditions:

February was a month of very rainy days altho as a rule the mornings were fair. The constant rains at this altitude were accompanied by snows on the mountains Mauna Loa and Mauna Kea. Snow line on February 21st was at 8500 feet, the lowest it has been in a number of years.

Maximum temperature	17th	82	
Minimum "	21st	46	
Rainfall for month of February		11.32	inches
" " " " at Hilo		16.17	"
" to date Volcano District		16.95	"
" " " at Hilo		24.01	"

540 Visitors:

Former Secretary of War, Newton D. Baker & Mrs. Baker visited the park February 22 and 23 staying at Kilauea Military Camp while here.

600 PROTECTION:

640 Predatory Animals:

On February 20th a cooperative goat drive was staged by the territorial forestry department. Part of this drive covered the sea coast area of Hawaii Park. Although only a single days drive was had 1100 wild goats were caught. This drive was participated in by 40 mounted men who rode in a vast semicircle gradually closing into to a small point on the sea coast where the imprisoned animals were turned over to Hawaiians to be sold as meat. Goats are distinctly a predatory animal here and altho there are still thousands of them on the Island they become harder to drive each year. Mr. Chas Judd the territorial forester was a member of this drive.

900 MISCELLANEOUS:

Upon recommendation of the National Park Service and the Interior Department the Post-Office Department has changed our post-office address from Volcano House, Hawaii to Hawaii National Park, Hawaii. This change is effective on April first.

Very respectfully yours,

Thos J. Allen Jr.,
Superintendent

cc to Asst. Director (Field)
Yellowstone Nat'l Park, Wyoming
cc to Mr. F. A. Kittredge, Chief Engineer, N.P.S.,

TJA/H:

10-157

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

T R A V E L   R E P O R T

..........Hawaii.......... National Park for the Month of ..February....1929..........

	This Month	This Travel Year To Date	This Month Last Year	Last Travel Year To Date	Increase for Travel Year: Number	Increase for Travel Year: Percent
PRIVATE TRANSPORTATION:						
Cars first entry, ...						
Cars reentry, ...						
Motorcycles, ...						
Total motor vehicles, ...						
Persons entering via motor vehicles, ...	13,485	24,555	3,755	23,710	845	.0356
Persons entering via other private transportation, ...	251	1,024	240	985	39	.0396
Total persons entering via private transportation, . . .	13,736	25,579	3,995	24,695	884	.0358
OTHER TRANSPORTATION:						
Persons entering via Hotel stages, .	1,552	4,375	1,751	4,986	611	dec. .1225
Persons entering via trains, .						
Persons entering otherwise, . .						
Total other transportation, .	1,552	4,375	1,751	4,986	611	dec. .1225
GRAND TOTAL ALL VISITORS, . .	15,288	29,954	5,746	29,681	273	.0092

	This Year	Last Year	Increase: Number	Increase: Percent
Automobiles in public camps during month, ...	1	0	1	100
Campers in public camps during month, ...	3	0	3	100

10-159

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

STATUS OF PERSONNEL

Hawaii National Park for the Month of February 1929

	This Month	This Month Last Year
Number of employees beginning of month,	7	9
Number of additions,	0	0
Total,	7	9
Number of separations,	0	0
Number of employees close of month,	7	9
Number of promotions during month	0	0
Aggregate amount of annual leave taken,	0	0
Aggregate amount of sick leave taken,	4	0
Aggregate amount of leave without pay,	0	0

10-160

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

REPORT OF PARK REVENUES

Hawaii National Park for the Month of February 1929

	This Year	Last Year
Park revenue on hand beginning of month, ...	0.00	0.00
Received, ...	0.00	0.00
Total, ...	0.00	0.00
Remitted, ...	0.00	0.00
On hand close of month, ...	0.00	0.00

Park revenues received this year to date, ...	$ 1,025.00
Park revenues received last year to date, ...	$ 1,025.00
Increase, ...	none
Percent of increase, ...	none

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10-161

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HAWAII NATIONAL PARK

REPORT OF SALES OF PUBLICATIONS

FEBRUARY 1929:

	Number	Value
GOVERNMENT PUBLICATIONS:		
On hand beginning of month, ...	437	$ 43.70
Received during month, ...	0	0.00
Total, ...	437	$ 43.70
Sold during month, ...	11	1.10
On hand at close of month, ...	426	$ 42.60
NON-GOVERNMENT PUBLICATIONS:		
On hand beginning of month, ...		
Received during month, ...		
Total, ...		
Sold during month, ...		
On hand at close of month, ...		

Cash on hand beginning of month, ...	$ 8.60
Sales during month, ...	1.10
Total, ...	9.70
Remitted during month, ...	0.00
Balance, ...	$ 9.70

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No. 217 RELEASED WITHOUT COPYRIGHT RESTRICTION February 21, 1929

KILAUEA REPORT No. 891

WEEK ENDING FEBRUARY 20, 1929

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

Until midnight of Tuesday, February 19, nothing whatever was noticed in Halemaumau pit at Kilauea Volcano to make certain the immediate approach of a new lava eruption. There was merely the expectation as reported in Volcano Letter No. 209 of December 26, 1928. The past week has been quiet at the pit, a survey party noted that the steam rising from the northwestern floor was a little bluish the forenoon of February 19, and a few rocks fell from the northern walls.

About 12:30 a. m. February 20 frothy fountaining lava gushed up a new crack athwart the 1927-28 lava bottom of Halemaumau, at the base of the northwest talus.

The seismographs exhibited 17 very feeble earthquakes for the week at the Observatory. One at 10:08 p. m. February 13 gave distance to origin 24 miles. Fourteen of the shocks were just before the lava outbreak between 10:47 p. m. February 19 and 12:28 a. m. February 20. Continuous volcanic tremor began 12:46 a. m. on the 20th. Microseisms for the week were slight. Tilt for the week was moderately strong to the NNE. The pit seismograph showed a first tremor at 10:27 p. m. the 19th, accompanied by tilt away from the pit (SE.); other tremors followed each with a tilt, and continuous tremor began at 12:44 a. m.

HALEMAUMAU OUTBREAK FEBRUARY 20

In view of the forecast of December 26 (Volcano Letter No. 209) it was satisfactory to find molten lava gushing up the peripheral wall-crack of the bottom of Halemaumau northwest just after the midnight preceding February 20. This inaugurated a new eruptive spell quite like those of July 19, 1924 at 1 p m., July 7, 1927, at 1 a. m., and 12:26 a. m. January 11, 1928: but the new eruption appears more vigorous and voluminous than any of those. All four followed either midnight or midday, as though a solar influence might be present. In none of the four was a witness actually present at the first gush of gas. The 1924 eruption lasted 12 days; 1927, 13 days; 1928, 1 day.

The watchman at Volcano House and some others saw glow over Halemaumau about 12:30 a. m. The volcanic tremor on the seismograms became continuous, after some scattered trembling spells before and after midnight, at about 12:45. Strong tilt away from the pit in trembling spasms was registered at the pit seismograph 1,900 feet southeast from the center of Halemaumau. These spasms finally became continuous trembling of the ground.

A rift broke open through the lava floor and base of the talus slides, 1,370 feet long, trending N. 63° E., about 270 feet out from the northwestern edge of the floor proper. By analogy with 1927 what happened was the rush of blue sulphurous gas, carrying with it increasingly incandescent basaltic foam, until spray fountains of melt were jetting up from 100 to 300 feet all along the crack. The eruption was of Mauna Loa type. Only thin fume arose. In the first hour and a half a lava lake was formed covering all the floor except the central cone summit to a depth near 30 feet. The average rise of the lake for 11 hours was more than 5 feet per hour.

At 2 a. m. there was a group of big fountains at the north with one great jet like an upturned hose shooting 225 feet into the air; this was reduced to 100 feet by 12 noon. Next southwest came a smaller fountain building a cone. Next was a long nearly straight line of violently boiling fountains across the west side of the lake roaring like a surf for a length of 1,000 feet. The great north fountain, just under where the avalanches have been numerous for years, and about where the old Postal Card fissure was 10 years ago, is the source of a wide lava stream out into the lake.

Around the line of perpetual fountains, which played up 50 to 100 feet, at the west, the lake quickly filled in to submerge their vent fissure. These fountains were thus out in the lake with the lake surging about them making a concentric elliptical pattern in the crusts. These crusts streamed in toward the fountain line and foundered. The rest of the lake cracked in radial bright lines toward the east. Glowing lava toes pushed from under the skirt of skin around the lake edges, and the talus shores steamed a little.

The lake at noon February 20 was 1 500 feet long and 1,000 feet wide, and shaped like a properly oriented map of Australia. The old central cone at first made a crescent island with horns turned south, but was submerged by 10 a. m. By 4:30 a. m. the lake touched the rock wall northwest. The high south-southwest cone of 1927 stood 53 feet above the lake at noon February 20.

There was a little avalanching at the east in the early morning, but this was exceptional. The tremor, and the reverberation of the rumbling fountains increased as the day wore on, and as the heavy viscous lake tended to restrain the gas of the rising foam. By evening the line of fountains made thudding detonations and reddish yellow flames rose as the huge gas bubbles burst in quick succession through the boiling western part of the lake.

By 5 a. m. the northern fountains were building cones and ovens, with glowing grottoes inside, and cascades of glowing slag poured down from the higher ones. Thin blue fume, brown in transmitted light, rose from the big pit, and reflected the light of the slag pool below so as to rival the moonlight. The steady roar could be heard at Volcano House. Gray or salmon colored moisture clouds billowed up rapidly hundreds of feet above the fume veil: these were made of atmospheric humidity drawn in by convection.

Needles of lava glass and wisps of Pele's hair, along with pellets of pumice, fell to leeward and in the Kau desert. Rampart shores of the lake were forming southwest and southeast during the day. Small fountains in the lake itself became more numerous as the vent fountains diminished. At first the spray banks to leeward of the north fountains were of greenish brown pumice, later of black glass. In daylight the lava lake surface acquired a leaden color with a blocky pattern. T.A.J.

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No. 218 · RELEASED WITHOUT COPYRIGHT RESTRICTION · February 28, 1929

KILAUEA REPORT No. 892

WEEK ENDING FEBRUARY 27, 1929

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

In Halemaumau pit of Kilauea Volcano a new eruption of gas charged lava, which began near 12:45 a. m. February 20, and continued its fountaining throughout that day and the first half of the next, went out of action about 1:15 p. m. February 21 so far as fountains are concerned. Since that time a heavily crusted lake, with glow cracks seen at night, has remained in the bottom of the pit, and all around it stands a rampart approximately 8 feet high above the lake sufrace This implies that the lava lake subsided by shrinkage and loss of gas about 8 feet below its highest stand, and this subsidence was mostly accomplished during the 24 hours following noon of February 21. The average diameter of the new lava fill is approximately 1,600 feet, and its average depth about 64 feet. These figures give 128,680,000 cubit feet (3,640,000 cubic meters) of new lava.

The report of the watchman who saw the first evidences of the eruption from the northeast rim of Kilauea Crater, 2 miles away, was to the effect that a dark cloud arose, then a white steamy cloud, and then the glow of spouting lava. The fountaining rift in the bottom of the pit for the first 12 hours was described in Volcano Letter No. 217. The heat of the big lake on February 20 made whirlwinds at the south edge of the pit which carried needles of lava glass and small lapilli. A long rampart was building at the lake edge toward the west, and a smaller one appeared at the southeast. During the next day this rampart formed all around the lake.

At 7 p. m. February 20 the big north fountain had built a high spatter wall and oven, the lake was in contact with the northwest wall of Halemaumau, and a line of grottoes had appeared under the west rampart.

The rumbling thud of the long line of fountains west and the big geyser of slag at the north had become deep and heavy, with occasional detonations. Along with this all the seismographs showed stronger volcanic tremor, which had increased since the morning. The pattern of bright lines was concentrically elliptical around the belt of western fountains, and zigzag radial lines extended E., SE., and S. The spray from the north fountain was sometimes 100 feet high.

On February 21 after an earthquake felt about 3:33 a. m., the lava was sinking, and avalanches were sliding at the north about 10 a. m.; the west fountains, beginning at 10:30 a. m., dwindled to small spurting at the east end of their crack, and the big north jet lessened. This last had built an "armchair" grotto. At 11:30 a. m. the west fountains went out of action, seismometric tremor decreased, and about this time the lake was receding. At noon there was no trace of the line of western fountains, and it was evident that the active north fountain had built its niche by lowering and causing its cone to cave in. The second northwest conelet of the 20th was gone. The coarse blocky crust pattern showed no trace of the radial lines. In a few places the crust cracked, and glowing melt welled up. The border rampart was complete, 7 feet above the lake, with an overflow margin outside. At 1:10 p. m. the north fountain stopped, and at 1:13 p. m. a slide occurred NE.

At 8:30 p. m. a long oval glow area was defined at the west, and a glowing cove at the east, with sluggish lava welling up along the outlines. The rest of the lake had a dull cherry red pattern like a bed of coals. There was the grinding noise of foundering crusts. A northwestern slide occurred at 8:50 p. m. During the night the dark red glow on the clouds decreased. Another earthquake was felt at 12 midnight.

The forenoon of the 22nd showed brown fume hanging under the rain clouds far to the SW., but the pit appeared clear. After this the lake changed little, avalanche debris rested on the new pumice bank at the north and on the eastern talus, and glow cracks were still visible at night. On the evening of the 23rd the hot air rising above the new lava made a rain cumulus with long tails leading down to the pit. On the 24th fifteen spots were counted on the lake crust where the last lava trickles had welled up. After rain, steam had increased at the top and bottom of the south talus and at the N. edge of the new lava. Small slides at the north were heard the forenoon of the 25th, and yellow stains at the north fountain locality were seen on the 26th.

The seismographs at the Observatory registered 5 very feeble and 3 slight local earthquakes for the week, and one weak teleseism at 10:50 p. m. February 25. The felt earthquakes of February 21 at 3:33 a. m. and 2:00 p. m. indicated origins 13 miles away, and the earthquake felt at 4:51 p. m. February 24 showed distance 14 miles. Both the last named were felt at Pahala, and the first two were felt in Hilo. Volcanic tremor began 12:46 a. m. February 20 and ended 11:30 a. m. February 21. At the pit seismograph it continued until about 1:00 p. m. Tilt at the Observatory was strong SSW. Microseismic motion increased at the end of the week.

The Halemaumau seismograph, recording only NW.-SE. tilt (to and away from rim), registered 11 seconds angle of tilt to the SE. between 9:15 a. m. February 19 and 12:45 a. m. (time of outbreak) February 20. Five seconds of this accompanied small earthquakes between 10:06 p. m. the 19th and 12:35 a. m. the 20th. The rim region then tilted back to the NW. 6 seconds between 12:35 a. m. the 20th and 2:23 p. m. the 22nd;tipping was strongest between 8 a. m. and 1 p. m. the 21st. At that time there was thus a net gain of 5 seconds(11 minus 6) tilt away from the pit.

February 4, 1929

Director,
National Park Service,
Department of the Interior,
Washington, D. C.

Dear Mr. Director:-

Submitted herewith is the report of park activities for Hawaii National Park during January 1929.

000 GENERAL:

Following the Christmas season steamer travel to the Hawaiian Islands tended to increase. The first world tour boat for the 1929 season arrived during January.

100 ADMINISTRATIVE:

110 Status of Work:

In the December report park road maintenance was mentioned as being in arrears. Since that time heavy rains increased the work to be done but receipt of an additional allotment for this account late in January will enable work to be proceeded with and it is expected that during February all roads can be improved considerably.

120 PARK INSPECTIONS BY:

121 Superintendent:

Routine inspections of work in progress were made at various intervals.

200 MAINTENANCE, IMPROVEMENTS AND NEW CONSTRUCTION:

210 Maintenance:

An allotment of $1500 has been made this park for force account maintenance on recently completed new roads.

220 Improvements:

Minor improvements are being made to all park buildings as far as allotments will permit.

300 ACTIVITIES OF OTHER AGENCIES IN THE PARK:

310 Public Service Contractors:

313 Schedule of Rates:

Department approval has been secured allowing the Volcano House to make of charge of fifty cents each for natural sulphur steam baths instead of twenty-five cents as formerly.

400 FLORA, FAUNA & NATURAL PHENOMENA:

410 Ranger-naturalist service:

Lectures at Uwekahuna Observatory were attended by 477 persons during January. Lectures were also given in the evening at Volcano House and steamer parties guided across the trail from the hotel to the fire pit.

460 Birds:

Bird lovers of the island of Hawaii are organized in a movement to replentish the bird life of this island. Subscrip-tions are being taken from interested organizations and indivi-duals for the purchase of pairs of cardinals, chinese thrush, meadow lark and pekin nightingale. Five dollars will purchase a pair of birds to be liberated in any part of the island. As many persons owning summer houses in and adjacent to Hawaii National Park are subscribing the park will be directly benefited by the movement. A clipping in regard to the movement is attached.

480 Natural phenomena:

During the first ten days of January a considerable area of the south east wall of Halemaumau was broken by huge cracks. A large section of this area measuring approximately 30 feet wide, 100 feet long and 200 feet deep avalanched into the pit on January 10th at the time when the visitors from the world tour ship Belgenland were viewing the volcano. As the area breaking up includes the site used in late years as a view point for visitors the action has created considerable interest. The fallen section included the 19th hole tee of the Worlds Greatest Hole in One Club. Since then a new tee has been built upon a safer site along the pit edge.

490 Park Seacoast Forestation:

A recent trip to the section of the park along the sea-coast showed that planting of cocoanut trees there has been successful. Only 6 out of 72 trees have died in a year and the balance are throving wonderfully. Some of these are already 4 feet in height.

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500 USE OF PARK FACILITIES BY THE PUBLIC:

On January the ninth the Steamship Belgenland enroute around the world stopped at Hilo and 450 passengers spent the day in the park.

521 Weather Conditions:

The high peaks of both Mauna Loa and Mauna Kea were snow capped at the end of January.

Maximum Temperature	----	17th	------	82	
Minimum "	----	10th	------	43	
Rainfall for month of January			----------	5.63	inches
" " " " " at Hilo			-----	8.44	"
" to date Volcano District			--------	5.63	"
" " " at Hilo			---------------	8.44	"

900 MISCELLANEOUS:

The superintendent addressed a meeting of the Hilo Federal Business Association on the "History of National Parks".

Very respectfully yours,

Thos J. Allen Jr.,
Superintendent.

cc to Mr. F. A. Kittredge, Chief Engineer,
National Park Service.

TJA/JKH:

10-157

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

TRAVEL REPORT

Hawaii National Park for the Month of January 1929

	This Month	This Travel Year To Date	This Month Last Year	Last Travel Year To Date	Increase for Travel Year Number	Increase for Travel Year Percent
PRIVATE TRANSPORTATION:						
Cars first entry, ...						
Cars reentry, ...						
Motorcycles, ...						
Total motor vehicles, ...						
Persons entering via motor vehicles, ...	3,210	11,070	4,703	19,955	8,885 dec.	.445
Persons entering via other private transportation, ...	164	773	163	745	28	.037
Total persons entering via private transportation, . . .	3,374	11,843	4,866	20,700	8,857 dec.	.427
OTHER TRANSPORTATION:						
Persons entering via stages, .	1,104	2,823	1,119	3,235	412 dec.	.127
Persons entering via trains, .						
Persons entering otherwise, . .						
Total other transportation, .	1,104	2,823	1,119	3,235	412 dec.	.127
GRAND TOTAL ALL VISITORS, . .	4,478	14,666	5,985	23,935	9,269 dec.	.387

	This Year	Last Year	Increase Number	Increase Percent
Automobiles in public camps during month, ...	0	0	0	0
Campers in public camps during month, ...	0	0	0	0

10-15

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

STATUS OF PERSONNEL

Hawaii National Park for the Month of January 1929

	This Month	This Month Last Year
Number of employees beginning of month,	8	9
Number of additions, ...	1	1
Total, ...	9	10
Number of separations, ...	2	1
Number of employees close of month, . . .	7	9

Number of promotions during month	0	0

Aggregate amount of annual leave taken,	0	0
Aggregate amount of sick leave taken,	0	0
Aggregate amount of leave without pay,	0	0

10-160

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

REPORT OF PARK REVENUES

Hawaii National Park for the Month of January 1929

	This Year	Last Year
Park revenue on hand beginning of month,	$ 0.00	$ 0.00
Received,	1,025.00	1,025.00
Total,	1,025.00	1,025.00
Remitted,	1,025.00	1,025.00
On hand close of month,	0.00	0.00

Park revenues received this year to date, ... $ 1,025.00

Park revenues received last year to date, ... $ 1,025.00

Increase, ... none

Percent of increase, ... none

10-161

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

REPORT OF SALES OF PUBLICATIONS

JANUARY 1929:

	Number	Value
GOVERNMENT PUBLICATIONS:		
On hand beginning of month,	447	$ 44.70
Received during month,	0	0.00
Total,	447	$ 44.70
Sold during month,	10	1.00
On hand at close of month,	437	$ 43.70
NON-GOVERNMENT PUBLICATIONS:		
On hand beginning of month,		
Received during month,		
Total,		
Sold during month,		
On hand at close of month,		

Cash on hand beginning of month,	$ 7.60
Sales during month,	1.00
Total,	$ 8.60
Remitted during month,	0.00
Balance,	$ 8.60

BUY A BIRD

AN APPEAL TO THE BIRD LOVERS IN HAWAII

With a view to re-habiliating the Island of Hawaii With song birds, the "Buy A Bird" committee of the Chamber of Commerce of Hilo will start a fund collecting campaign Wednesday, January 2nd, ending January 31st, to bring in as many pairs of the following listed birds as possible.

Each family in Hilo and on the island, is asked to subscribe five dollars for a pair of birds. If it is not possible to subscribe that much, give us as much as you can and the rest will be made up by others. The committee did not want to bring in too many varieties to start with and after careful study of bird habits, the following four birds will be purchased.

Cardinal

The Cardinal or Redbird is a very handsome chap, of dark red plumage with tufted crown, a very hardy bird. It stays in one locality and seldom, if ever, migrates. They make their homes about towns and villages and take readily to back door offerings, often making their homes in trees surrounding such generosity.

The mates have, during breeding time, a dozen distinct notes, and they may be heard whistling 12 months in the year, as one bird lover put it: "The notes of the Cardinals are clear and tender, far sweeter than the notes of fife or clarinet."

One particularly enjoyable feature of [illegible]

America. In the estimation of many bird lovers it ranks first as a songster. The clear, liquid metallic notes may be heard early in the morning and after sunset coming from densely wooded sections or from the shaded lawns of city homes. This particular thrush whistles rather than sings and its musical range is really marvelous.

They live upon worms and winged insects, feeding usually on the ground where the rich soil offers little resistance to their short slender bills. Formerly they populated low damp woods, heavily timbered roadsides and underbrush along streams, but these haunts seem to be changing [illegible]

torians have this to say about the Chinese Thrush: "There are many birds with brighter plumage, more striking voices and more interesting habits but there are none whose bearing is more distinguished nor whose songs are more spiritual."

Meadow-Lark

No bird becomes more attached to a given locality than this bird and seemingly can live out a winter in the northlands of America with very little to eat. In a country like Hawaii it is felt that they will become thoroughly at home and increase in large numbers.

So closely do these birds guard the contents of their nests that one can pass within two feet of the parent and brood and be unaware of their presence.

The Meadowlark is a varied colored bird, brown, gray and yellow, spotted somewhat after the fashion of the grouse or quail, and is almost the same size as the mynah bird.

Pekin Nightingale

To a certain extent the description accorded the Chinese Thrush would apply to the Nightingale, which is, however, a slightly smaller bird. Unlike the English Nightingale the Pekin Nightingale is said [illegible] back door offerings, often making their homes in trees surrounding such generosity.

The mates have, during breeding time, a dozen distinct notes, and they may be heard whistling 12 months in the year, as one bird lover put it: "The notes of the Cardinals are clear and tender, far sweeter than the notes of fife or clarinet."

One particularly enjoyable feature of the Cardinal is that they raise two broods in a season, the male caring for the first brood while the female tends to the hatching of the second.

Chinese Thrush

This bird comes from a family which is unquestionably the sweetest-voiced in marvelous.

They live upon worms and winged insects, feeding usually on the ground where the rich soil offers little resistance to their short slender bills. Formerly they populated low damp woods, heavily timbered roadsides and underbrush along streams, but these haunts seem to be changing from dense woods to towns and plantations as the trees grow up about them.

Hilo and all plantation centers having so many heavily wooded sections spread throughout the city, will be a popular resort for these birds.

In color the Chinese Thrush is a gray or grayish brown and in size slightly smaller than the mynah bird. The his-

No bird becomes more attached to a given locality than this bird and seemingly can live out a winter in the northlands of America with very little to eat. In a country like Hawaii it is felt that they will become thoroughly at home and increase in large numbers.

The Skylark is already here and although introduced in very small numbers several years ago has, in spite of the ravages of the mongoose, become quite abundant.

Their food is almost entirely made up of insects and decayed vegetable matter and they too are a ground feeding bird.

Pekin Nightingale

To a certain extent the description accorded the Chinese Thrush would apply to the Nightingale, which is, however, a slightly smaller bird. Unlike the English Nightingale the Pekin Nightingale is said to thrive in captivity and having been successfully introduced into Honolulu your Committee felt that even though it made its haunts in the deep woods surrounding towns and villages, its song would be welcome addition to the other birds enumerated here.

We already have some of these cheerful songsters here.

EACH SUBSCRIBER HAS A CHOICE OF THE ABOVE BIRDS AND IS ASKED TO NAME THE LOCALITY IN WHICH THE BIRDS ARE TO BE RELEASED

SUB COMMITTEE CHAIRMEN

HAMAKUA

Alex Fraser .... Wainaku
John T. Moir .... Papaikou
James Webster .... Pepeekeo
William Pullar .... Honomu
August S. Costa .... Wailea
John M. Ross .... Hakalau
R. A. Hutchison .... Papaaloa
Frank Anderson .... Paauhau
Frank Fraser .... Honokaa
W. P. Naquin .... Kukuihaele
James Johnston .... Ookala
Robt. M. Lindsay .... Paauilo

WAIMEA

A. W. Carter .... Kamuela

KOHALA

George C. Watt .... Kohala
J. Henry Hind .... Hawi
Alex Black .... Halawa
John Madden .... Mahukona
Ronald von Holt .... Kahua
Mrs. M. H. Lucas .... Puuwaawaa
Herbert Shipman .... Puu Oo

THE CENTRAL COMMITTEE

Alexander J. Porter, Chairman; John T. Moir, Dr. V. D. Shuttee, Gilbert K. Patten, Herbert Shipman.

DON'T

A few don'ts to help protect what bird life we have and what we bring in.

DON'T kill birds of any kind, they are all helpful.

DON'T throw stones at birds.

DON'T disturb nests or eggs. Bird will leave a nest of eggs if molested.

DON'T shoot at birds with sling shots, air rifles or guns.

DON'T forget that the bird at which you are throwing things may be the bird that you helped pay for.

DON'T allow your playmates or neighbors to disturb or injure birds or nests.

DON'T fail to appreciate the fact that the little fellows are giving you all they have when they sing to you.

DON'T forget that they have feelings too.

DON'T let up on your campaign to kill off all the rats and mongoose in your neighborhood.

DON'T let anything interfere with the good they are doing.

FUNDS

Money can be deposited with the Central Committee, the Chamber of Commerce of Hilo, The Chinese Chamber of Commerce, The Japanese Chamber of Commerce, The Bank of Hawaii, The Bank of Bishop or any of the Sub-Committee chairmen.

SUB COMMITTEE CHAIRMEN

KONA

Arthur Stillman .... Huehue
L. A. Aungst .... Holualoa
Kona Civic Club .... Kealakekua
L. C. Child .... Kailua
Robinson McWayne .... Hookena

KAU

Judge W. Hayselden .... Waiohinu
William Campsie .... Naalehu
James Campsie .... Pahala
B. M. Sumner .... Kapapala Ranch

VOLCANO

A. M. Brown, Jr. .... Keauhou Ranch
James Gandy .... Volcano House

OLAA-PUNA

A. J. Watt .... Olaa
Richard Lyman .... Pahoa

This space donated toward the above movement by

The

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This space donated toward th above movement by

The Hilo Tribune-Herald

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HAWAII NATIONAL PARK

OFFICE OF THE SUPERINTENDENT VOLCANO HOUSE, HAWAII

January 3, 1929

Director,
National Park Service,
Department of the Interior,
Washington, D. C.

Dear Mr. Director:-

Herewith is submitted the report of operations and activities of Hawaii National Park for the month of December 1928.

000 GENERAL:

A new superintendent took over the active administration of this park on the first day of the month and has spent the time since then in making a general survey of conditions.

December was very quiet in all respects.

100 ADMINISTRATIVE:

110 Status of Work:

Maintenance of park roads is not up to date due to lack of funds. This work cannot be proceeded with until additional funds are provided.

Park buildings are all in need of much repair work. This will be proceeded with during January as far as present allotments will permit.

120 PARK INSPECTIONS BY:

121 Superintendent:

The superintendent spent most of December making his original visit to park roads, trails, buildings etc. He inspected all work in progress. As yet no inspection has been made of the Haleakala section.

130 FINANCE & ACCOUNTS:

Designation as Special Disbursing Agent has been made to Thos J. Allen Jr., succeeding Richard T. Evans.

200 MAINTENANCE, IMPROVEMENTS AND NEW CONSTRUCTION:

210 Maintenance:

The allotment made this park for road maintenance was entirely inadequate and was overexpended under former Supt. Evans. Roads are becoming more and more in need of repair which cannot be had without funds. A small amount of work is being carried on to prevent destruction.

220

Painting and minor improvements were made to the park office and superintendent's residence.

400 FLORA, FAUNA, AND NATURAL PHENOMENA:

410 Ranger-naturalist service:

Lectures on geology and volcanic action to-gether with an exhibition of films and lantern slides were made at Uwekahuna Observatory and at the hotel on each steamer day and holiday. These were attended by 377 persons.

460 Birds:

An effort is being made by the Territorial Forestry department and interested organizations to re stock the island of Hawaii with song birds. To this end several groups of thrushes were liberated at different locations during December.

480 Natural Phenomena:

The volcanic activity of this region was without unusual occurences during the past month. Dr. Jaggar in the last Volcano Bulletin of the calendar year stated that deductions based on previous cycles of volcanic activity pointed to some action from either Mauna Loa or Kilauea during 1929.

500 USE OF PARK FACILITIES BY THE PUBLIC:

510

December was extremely quiet as to travel and showed a slight decrease over the same period during 1927.

521 Weather Conditions:

Maximum temperature	— 25th —	79
Minimum "	— 27th —	47
Rainfall for month of December	———	9.98 inches
" " " " " at Hilo	———	23.90 "
" to date Volcano District	———	72.57 "
" " " at Hilo	———	158.65 "

540 Visitors:

Visitors to the park this month included the entire board of supervisors of the Island of Hawaii who were on their semi-annual inspection trip of the whole county; Senator R. W. Shingle who is president of the Hawaiian Senate and is interested in having the county of Hawaii continue the Chain of Craters road to Kalapana. He is also a trustee for the James Campbell Estate and conferred with the superintendent regarding the land exchanges at the Thurston Lava Tube.

Mr. & Mrs. J. Almada visited the park for two days on their honeymoon trip. Mrs Almada is the daughter of the President of Mexico.

Very respectfully yours,

Thos J. Allen Jr.,
Superintendent.

cc to Mr. H. M. Albright, Asst Director (Field)
National Park Service.

TJA/JKH:

10-157

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

TRAVEL REPORT

HAWAII National Park for the Month of December 1928

	This Month	This Travel Year To Date	This Month Last Year	Last Travel Year To Date	Increase for Travel Year Number	Increase for Travel Year Percent
PRIVATE TRANSPORTATION:						
Cars first entry						
Cars reentry						
Motorcycles						
Total motor vehicles						
Persons entering via motor vehicles	2,560	7,860	4,208	15,252	7,392 dec.	.484
Persons entering via other private transportation	247	609	282	582	27	.046
Total persons entering via private transportation	2,807	8,469	4,490	15,834	7,365 dec.	.465
OTHER TRANSPORTATION:						
Persons entering via stages	508	1,719	592	2,116	397 dec.	.188
Persons entering via trains						
Persons entering otherwise						
Total other transportation	508	1,719	592	2,116	397 dec.	.188
GRAND TOTAL ALL VISITORS	3,315	10,188	5,082	17,950	7,762 dec.	.432

	This Year	Last Year	Increase Number	Increase Percent
Automobiles in public camps during month	0			
Campers in public camps during month	0			

10-

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

STATUS OF PERSONNEL

Hawaii National Park for the Month of December 1938

	This Month	This Month Last Year
Number of employees beginning of month,	8	9
Number of additions,	5	3
Total,	13	12
Number of separations,	5	3
Number of employees close of month,	8	9
Number of promotions during month	0	0
Aggregate amount of annual leave taken,	0	0
Aggregate amount of sick leave taken,	0	0
Aggregate amount of leave without pay,	0	0

10-160

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

REPORT OF PARK REVENUES

.......Hawaii.............. National Park for the Month of ....December 1928..............

	This Year	Last Year
Park revenue on hand beginning of month, ...	$ 25.00	$ 0.00
Received, ...	25.00	25.00
Total, ...	$ 50.00	$ 25.00
Remitted, ...	50.00	25.00
On hand close of month, ...	0.00	0.00

Park revenues received this year to date, ... $ 1,450.00

Park revenues received last year to date, ... $ 1,450.00

Increase, ... ~~[illegible]~~

Percent of increase, ... none

---

Please send publications and news notes about volcanic matters
Address: HAWAIIAN VOLCANO OBSERVATORY, VOLCANO HOUSE, P. O., HAWAII

THE VOLCANO LETTER

A Weekly news leaflet of the Hawaiian Volcano Research Association

Sent free to libraries and to members. Dues of Association $5 per annum. Members receive in addition the illustrated Monthly Bulletin of the Hawaiian Volcano Observatory. Anyone may join the Association and thereby support Pacific volcano research. The Society has also patrons—individuals, firms and institutions.

No. 209 RELEASED WITHOUT COPYRIGHT RESTRICTION December 26, 1928

KILAUEA REPORT No. 883

WEEK ENDING DECEMBER 26, 1928

Section of Volcanology, U. S. Geological Survey

E. M. Buckingham, Temoprarily in Charge

There has been a slight increase in the working of the Halemaumau walls. It is believed that this is due to possible fluctuations of the Kilauea floor as indicated by tilt measurements.

On December 20 considerable steam was escaping from the south cone and a vent on the SSE. talus. On December 23 an avalanche from the NNE. wall was observed at 3 p. m. On December 26 there was evidence of avalanching from the north and east walls, and dust from two slides was seen. Several falls of rocks were heard.

There were six very feeble local earthquakes registered during the week. In addition were two perceptible shocks having epicenters from 10 to 12 miles southeast of the Obseravtory. The first, at 8:43 p. m. December 24, was accompanied by a tilt at the Observatory of seven seconds to the north. The second shock occurred at 10:13 p. m. December 25. Tilt for the week accumulated slightly northeast.

Measurements made at the Halemaumau seismograph station on December 19 and 26 indicate a tilt of 10 seconds away from the pit during this interval. Tilt has been slowly accumulating in this direction since the early part of November.

EXPECTED HAWAIIAN ERUPTION

In 1912 the writer wrote that Mauna Loa should become active before 1915; it broke out in 1914. In 1917 he wrote that a great crisis in Hawaiian volcanism should come around 1920; both Mauna Loa and Kilauea had flank outflows within the twelve month preceding July 1, 1920, and a great explosive crisis came in 1924. In 1923 he wrote that the nine year cycle following 1913 would probably be unusually long and representative of one of the long term intervals such as 1868 and 1790 had illustrated; the 1924 engulfment accompanied by shore collapse at Kapoho was a close parallel to 1868. All of these tests of reasoning with reference to forecast are merely based on observation and experience, coupled with a logical deduction from the records of the nineteenth century.

Experience has shown that in Japan, Italy, Hawaii and the Caribbee Islands, one hundred and thirty years or some such figure is a common interval between either big eruptions or big earthquakes near eruptive centers, or both. On the other hand Vesuvius and Kilauea both exhibit a minor interval of from nine to ten years, and the larger volcanoes Etna and Mauna Loa tend to average their outbreaks at intervals of one half this period, or about four and one half years. Mere charting of the facts for the last thirty years has shown a distinct tendency in the pit-lava of Kilauea to rise when Mauna Loa breaks out, and to sink when Mauna Loa stops action. These things are not invariably observed, for the simple reason that the Kilauea lava column is not always visible.

It is not permissible to say that Kilauea and Vesuvius shall break out every nine years, or Mauna Loa and Etna every four and a half years. A volcano is not a clock. The interval theory is based on averages, and the averages are based on certain laws of nature such as those that determine the space intervals of ripple marks in the sands of the sea or the time intervals of waves when they break rythmically on the beach. The lava under a volcano has been pressing upward for ages through a crack of a certain size. It has blocked or impeded that crack with its own heap of lava and so has forced itself to adopt a rhythm or interval like the puffs from a steam engine. If it has several vents, these divide responsibility for the interval, and if one vent is low and close to the water table, while the other is high and far above the ground water of the island, the probability of explosion is greater for the lower vent. This is because a sudden drop in the lower vent may place the lava column below the water table and so develop a steam chamber. This is the situation of Kilauea as compared with Mauna Loa.

The whole great edifice or volcanic system is itself involved in responsibilities to large masses of lava underground which it perhaps shares with other active or half extinct volcanic systems along the same rift or crack, and these responses may demand certain major eruptions or major dormancies at very long intervals of time, when the whole crust of the earth for that part of the world is disturbed to an unusual extent. It is like the intake and outgo of a large corporation, itself made up of the accounts of smaller stores. One must know all the books or the accounts will not balance. So when we argue about the expectancy of eruption at Kilauea, we must take account not only of average small intervals and average great intervals but also of the volume of output of lava in relation to the intervals as compared with the volume expected by analogy with average eruptions in the past.

As compared with the outpourings of 1852, 1855, 1859, and 1868 the lava output of the island of Hawaii in the last eighteen years has been very small, unless there has been an enormous unseen lava flow under the ocean. Yet there are many features of the flows of 1914, 1916, 1919 and 1926 from Mauna Loa, and the intervening effusions about the crater of Kilauea, that closely resemble the double cycle that followed 1850. We have platted a curve of the combined activities of Mauna Loa and Kilauea, which shows a pronounced low level about December of 1913 and December of 1924, and a remarkable high level about December 1919. The lava of Kilauea rose rapidly after 1913 with arresting depressions after each Mauna Loa flow. After 1924 the lava has risen slightly in the bottom of Halemaumau pit and Mauna Loa flowed vigorously in 1926. If the curve of rising now continues comparably to what happened after 1913, it is logical to expect activity from either Kilauea or Mauna Loa in 1929. T.A.J.

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HAWAII NATIONAL PARK
VOLCANO HOUSE, HAWAII

OFFICE OF THE SUPERINTENDENT

December 4, 1928

Mr. Stephen T. Mather, Director,
National Park Service,
Department of the Interior,
Washington, D. C.

Dear Sir:-

The following report on the operation and activities of the Hawaii National Park during the month of November 1928, is submitted for your information and approval:

000 GENERAL:

The weather for the month was average with exceptionally good weather during the last week. Travel showed a very slight increase. A very quiet month.

121 SUPERINTENDENTS:

Superintendent R. T. Evans left Hawaii National Park on November 4th to accept a new assignment on the mainland. Ranger Douglas was left in charge of the Park as Acting Superintendent until the arrival of the new Superintendent. The Superintendency was accepted by Mr. Thomas J. Allen Jr., formerly Assistant Superintendent of Rocky Mountain National Park who arrived with Mrs. Allen on November 30, 1928.

220 IMPROVEMENTS:

The month was devoted mostly to renovateing park buildings, repairing of roads and general conditioning of the Park for the arrival of the new Superintendent. Two of the labor gang had been laid off for one week and remained off for two. This with the absence of Superintendent Evans left the force cut down considerably. The most useful improvement was on the Around-the-Island Road, which was packing only in the center. Signs had been erected but proved ineffective, a line a large stones down the center of the road solved the problem.

330 FEDERAL BUSINESS ASSOCIATION:

Members of the Federal Business Association visited the Park on November 24th for an afternoon of entertainment. After spending some time with Dr. T. A. Jaggar they drove about the Park arriving at Uwekahuna where they viewed the collection and illustrated lecture. After the lecture the party took dinner with Lt. K. W. Thom, Commandant of Kilauea Military Camp.

420 MUSEUM SERVICE:

Uwekahuna Museum experienced a lull in attendance. Only 469 people attended the fourteen lectures presented. Of the total attendance 210 were from the Steamship Malolo, for which two special lectures were held on the morning of November 18, 1928.

During the month the specimen cases were simonized throughout and painted, also some minor alterations.

510 TRAVEL:

Tourist travel was light throughout the month, except for the Goodwill tour of the Matsonship "S S Malolo" which brought many prominent people from the Pacific Northwest and San Francisco.

Hotel guests from 11 states & 5 foreign countries	648
Arrival at Kilauea Military Camp	148
Visitors, in Park, estimated	2,720
To Haleakala Section, estimated	40
Arrivals at Naval Camp	15
	3,571

520 WEATHER CONDITIONS:

The month of November proved more favorable as to weather conditions than the preceeding month.

Maximum temperature	30th	87
Minimum "	24th	50
Number of days without precipitation		8
Rainiest Day	11th	1.08 inches
Rainfall for month of November		7.30 "
" " " " " at Hilo		21.63 "
" to date Volcano District 68.59; at Hilo		136.68 "

650 ACCIDENT:

During the night of November 10th a collision of two cars occured within the Park, near the West Entrance. One man, J. Enos, of Kurtistown was slightly cut about the face, he was driving his Ford Touring Car #25,208. The other car a Chevrolet Sedan, owner S. Asalla of Naalehu, was driven by Albro Andres, of Naalehu also.

900 ARMISTICE DAY PROGRAM:

Trying to stimulate local travel to the Park area, a special program was planned for Armistice Day and announced in the local newspapers. A general hike to Mauna Iki, one of the show places of the Park, under the guidance of Ranger Hyles, two Special lectures at Uwekahuna, and a guide at the Lava Tube where features that the local population does not usually have a chance to receive the advantage of, as most of the tourists visit the Park on week days. Appreciation was shown by many requests, from people who wanted to be notified of another Special Program.

Mr. Thomas J. Allen Jr., now Superintendent, has kindly suggested that I prepare and sign the above report.

Very respectfully yours,

George D. Douglas

George D. Douglas,
Acting Superintendent.
(Nov. 5 to 30th.)

cc to Mr. H. M. Albright, Asst. Director (Field)
National Park Service.

cc to Mr. F. A. Kittredge, Chief Engineer,
National Park Service.

GDD/JKH:

U. S. Department of the Interior
National Park Service
Hawaii National Park

No. 14
MEMORANDUM FOR THE PRESS
IMMEDIATE RELEASE

NOVEMBER TRAVEL:

A month otherwise devoid of special interest in travel, was made important by the arrival of the "S S Malolo" on her second visit to Hilo with several hundred passengers for Hawaii National Park. Visitors to the Park numbered 3,571. Eleven states and five foreign countries were represented.

ARMISTICE DAY PROGRAM:

On November 11th a special feature program was outlined which proved popular with visitors to Hawaii National Park. In the morning a guide was stationed at the Thurston Lava Tube conducting parties thru with a Hawaiian Torch. From the Tube they journeyed to the Half-Way House ten miles from Park Headquarters where a hiking party under guidance of a Park Ranger, started for Mauna Iki, a mountain built up by an underground lava flow from the Volcano Kilauea, where they enjoyed the novelty of cooking a meal over a hot crack. Enroute they viewed the evidence of a tragedy which occurred in 1790. The footprints in volcanic ash remain to tell the story of the death of the Hawaiian Army with women and children, wiped out in the 1790 explosive eruption of Kilauea. Along the trail they also saw the great sheets of pisolites which fell during that year. The hikers returned in time to attend one of the two illustrated lectures which were presented at Uwekahuna Observatory, where the Collection of volcanic specimens of Dr. T. A. Jaggar are on display.

GOODWILL TOUR OF THE "MALOLO":

This feature inaugurated by the Matson Navigation Co., on the Pacific Coast, brought several hundred people from the Pacific Northwest, to visit Hawaii Nei. Among the visitors were: R. G. Callvert, Managing Editor of the Portland Oregonian; Fred Lockley of the Oregon Journal; Mayor G. L. Baker of Portland and F. Shull, President of the Portland Chamber of Commerce, also M. G. Tennent, Mayor of Tacoma.

Volcano House, Hawaii,
December 4, 1928

George D. Douglas,
Acting Superintendent.

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HAWAII NATIONAL PARK

OFFICE OF THE SUPERINTENDENT . VOLCANO HOUSE, HAWAII

November 3, 1928

Mr. Stephen T. Mather, Director,
National Park Service,
Department of the Interior,
Washington, D. C.

Dear Sir:-

The following report on the operation and activities of the Hawaii National Park during the month of October 1928, is submitted for your information and approval:

000 GENERAL:

The slight increase in rainfall was not responsible for the reduced travel to the park but rather the light tourist travel generally and the local interest in the political campaign.

220 IMPROVEMENTS:

The 93 man-days of labor were spent onthe maintenance of roads. The first downpour in months occurred on the 1st when an inch of rain fell in an hour, damaging sections of all the roads. The new Chain-of-Craters and Around-the-Island Roads were kept in excellent shape by weekly dragging and shoulders, ditches and berms were cleared of weeds and grass.

320 SERVICES OF ARMY DOCTOR:

A scroll was executed by Ranger Douglas expressing appreciation of the public health services of Doctor Lucius K. Patterson, army surgeon, who since his assignment to the Kilauea Military Camp in December 1927 has attended nearly all of the park personnel for sickness and injuries, many times getting up in the night to respond to a call. His four years tour of duty in the islands will terminate early in November.

321 FEDERAL BUSINESS ASSOCIATION:

At a meeting in Hilo on the 9th, called by H. C. Hill, collector of Internal Revenue for the territory, a Federal Business Association was organized. Bert D. Chilson, postmaster of Hilo, was elected president and a luncheon at the Hilo Yacht Club the first Friday of each month was determined upon as the monthly meeting.

323 LANDING FIELD:

At the request of Secretary of War Dwight F. Davis instructions were issued by Secretary of the Interior Roy West that the old landing field near the firepit be cleared of bowlders and rendered safe for emergency landing. Captain K. W. Thom and soldiers from the Kilauea Military Camp did the work which was completed by the 10th. The field is 1200 feet long and 200 wide.

350 HUI O PELE HAWAII:

New members numbered 182, representing 31 states and 2 foreign countries - Panama and Greece. California led the states with 37, Hawaii was second with 17 and New York third with 15.

420 MUSEUM SERVICE:

Illustrated lectures were given at Uwekahuna Observatory to 497 people, including 165 Japanese officers and sailors for whom special exhibitions were shown in the forenoons of the 29th and 30th. The light generating plant is indicating need of considerable repair and replacement.

510 TRAVEL:

General travel did not show signs of revival until near the end of the month. The S S City of Honolulu which holds the best records for crowds brought only 38 on the 2nd and 34 on the 30th. The Japanese navy tanker Shiretoko contributed 165 officers and sailors on the 29th and 30th. The Sierra Club, 84 strong led by Mr. and Mrs. Clayton L. Drew, paid its second annual visit on the 6th and 7th.

Hotel guests from 18 states and 7 foreign countries —	473
Arrivals at Kilauea Military Camp ——	199
Autoists, estimated, part of day ——	2,580
To Haleakala Section (estimated) ——	50
	3,302

530 WEATHER CONDITIONS:

October opened with the first downpour in months, more than an inch falling in less than an hour on the afternoon of the 1st. The nights of the 15th and 16th were cool enough to suggest frost.

Maximum temperature ——	on 1st ——	89
Minimum " ——	on 16th, 18th and 23rd ——	52
Number of days without precipitation ——		3
Rainiest day ——	1st ——	2.50 inches
Rainfall for month of October ——		8.03 "
" " " " "	at Hilo ——	17.72 "
" to date Volcano District 53.29;	at Hilo	115.02 "

540 VISITORS:

Col. J. M. Pruyn, Provost Marshall Hawaiian Dept., U.S.A., on 10th.
Chas. H. Will, who constructed the Chain-of-Craters and Around-the-Island Roads and has been spending four months in the orient, on the 31st.
Victor K. Houston, Territorial Delegate, on
S. C. Kennedy and A. G. Budge, Inter-Island Steam Nav., Co., officials, inspecting the Volcano House and new hotel at Kailua, on 5th.

Very respectfully yours,

R. T. Evans

R. T. Evans,
Superintendent.

cc to Mr. H. M. Albright, Asst. Director (Field)
cc to Mr. F. A. Kittredge, Chief Engineer, N.P.S.

U. S. Department of the Interior
National Park Service
Hawaii National Park.

No. 13
MEMORANDUM FOR THE PRESS
IMMEDIATE RELEASE

- -

OCTOBER TRAVEL:

Winter travel generally did not get started till near the end of the month. Visitors to the park numbered 3302. Eighteen states and seven foreign countries were represented in registrations at the Volcano House. On the 29th and 30th about 130 officers and sailors came to the park from the Japanese naval tanker Shiretoko anchored at Hilo, where they had participated in the dedication of a new Shinto temple.

SIERRA CLUB:

Twenty-four members of the California Sierra Club again in charge of Mr. and Mrs. Clayton L. Drew, visited the park on October 6th and 7th. They were able to add only one feature to the itinerary followed by all tourists - a hike of three miles through the Fern Forest where darkness nearly overtook them. In 1927 most of their time was consumed on Oahu and Maui, in 1928 on Oahu and Kauai; but they are already planning to next year spend a week on Hawaii, most of it in the park where hiking trips will be made over the less frequented trails on the slopes of Mauna Loa, into the fern and ohia forests that flank the Chain-of-Craters Road, across the Kau Desert and through the kipukas above the pali that stands 2000 feet above the south coast line.

SEASON FOR BIRDS:

Birds have been much in evidence during October, especially the beautiful native apapane (Himatione sanguinea), red with black bill, tail and legs. A special lookout was kept for the iiwi (Vestiaria coccinea) which is often confused with the apapane. In order to corroborate a report that iiwis were seen in Bird Park, Ranger Hyles made an investigation, taking a pair of small binoculars as an aid. He identified one in the top of a tall ohia. When seen clearly it should not be confused with the apapane for it is larger and its longer curved bill, feet and legs are vermilion. It is a brilliant object. Its chosen diet is the nectar of blossoms, especially the lehua. It furnished the red feathers for feather cloaks in the olden days - which may account for its small numbers.

Pheasants, both Japanese and Mongolian, may be seen or heard most anywhere along the roads and trails, which is very gratifying to observers.

Volcano House, Hawaii
November 2, 1928

R. T. Evans,
Superintendent.

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5893

Please send publications and news notes about volcanic matters
Address: HAWAIIAN VOLCANO OBSERVATORY, VOLCANO HOUSE, P. O., HAWAII

THE VOLCANO LETTER

A Weekly news leaflet of the Hawaiian Volcano Research Association

Sent free to libraries and to members. Dues of Association $5 per annum. Members receive in addition the Illustrated Monthly Bulletin of the Hawaiian Volcano Observatory. Anyone may join the Association and thereby support Pacific volcano research. The Society has also patrons—individuals, firms and institutions.

No. 197 RELEASED WITHOUT COPYRIGHT RESTRICTION October 4, 1928

KILAUEA REPORT No. 871
WEEK ENDING OCTOBER 3, 1928

T. A. Jaggar, Volcanologist in Charge

Halemaumau has been particularly quiet throughout the week. During the first part of the week the pit was dusty from previous avalanching, and steam vents were only slightly active; but with the southerly rainstorm of October 1 the pit walls and floor were washed clean of the dust coatings, and steaming was very noticeably increased, particularly at the fountain vents of July, 1927. Ocassional small rock falls are difficult to locate because of the lack of dust to mark them.

The Observatory seismographs have recorded 18 very feeble local earthquakes during the week. Microseismic motion was normal at the beginning and end of the week, but was more feeble than normal on September 29 and 30. Tilt accumulated very slightly towards the east.

THE HALEMAUMAU SEISMOGRAPH

The seismograph installed at Uwekahuna, the west wall summit of Kilauea Crater, in December, 1927, has in general recorded the same earthquakes shown on the records of the instruments at the Volcano Observatory. As would be expected from its magnification, most of the Uwekahuna earthquake traces are smaller in amplitude. But a few which apparently originate at the pit of Halemaumau are shown larger on that instrument, perhaps due to the fact it is nearer to the pit than are the Observatory instruments. To carry the idea thus suggested still farther, a seismograph has recently been installed close to the edge of the pit. It is expected that this will record tremors due to avalanches that are too feeble to be recorded on the more distant seismographs at Uwekahuna and at the Volcano Observatory. By comparison it should then be possible to discover definitely which of the tremors recorded at the Observatory are caused by avalanches.

Spirit leveling near the pit has made it apparent that the tilting motions there are large. It is perhaps these tilting movements and the corresponding change in inclination of the pit walls that are the cause of periodic spells of avalanching that have been evident during the past years. This tilting measured close to the vent of the volcano may prove to be a more sensitive key to the movements of the lava column, just as the tilts at the Volcano Observatory are known to be correlated when the lava level is visible within the pit and the tiltings are correspondingly stronger. This new seismograph is in a position to pick up the first feeble indications of returning activity.

The installation is distant 1,900 feet radially from the center of Halemaumau in direction S. 34° 05′ E., and is back 450 feet from the edge of the pit along the same radius extended. This places it a little north of the trail from the automobile parking place to "Halemaumau sign," and it is about 300 feet from the shelter hut. The elevation is approximately 3,635 feet above mean sea level. A shallow depression was dug in soft pahoehoe lava till a more stable layer was reached, upon which was founded a pier for the recording drum and a column for the support of the pendulum. The pendulum axis is approximately parellel to the pit edge to make it sensitive to shocks and tilt from the direction of the pit. The shelter hut is 4 by 5½ feet, inside dimensions, and is about 4½ feet from floor to roof in the highest part. Its walls are of one-inch boards, with tar paper both inside and out, and with rocks and gravel piled against the outside up to the eaves. The roof is double, with a four-inch space packed with sawdust. It is further protected from rain and sunshine by a corrugated iron roof with a ventilated air space beneath it. The floor is of gravel and asphaltum so sealed as to prevent steam from rising inside the chamber from the floor, as this area of the crater is porous with small steam ducts rising through it almost everywhere. The building was constructed during the first two weeks of September, and the instrument was first set up on September 12. Operation was experimental for several days, the useful run beginning on the 18th.

The seismograph used is the one removed from the Kona station when the larger Hawaiian type seismograph was installed there this summer. This instrument has been overhauled and somewhat revised. It is a single component horizontal pendulum, with suspension similar to the Bosch-Omori. The boom axis hangs from the column to the drum in a direction S. 78° 45′ W. The inertia mass is 30 kg., and static magnification is 70. It is at present adjusted to a period of nearly seven seconds, and the damping ratio is 2.6. Sensitivity to tilt is 2.5 seconds of arc for one centimeter displacement of the null point of the writing pen. Recording is on smoked paper, which moves about 23.5 mm. per minute. The instrument will run nearly 60 hours without attention. Before it was installed at the pit its constants of magnification and sensitiveness were tested on the oscillating table at the Hawaiian Volcano Observatory.

The records so far accumulated do not cover a long enough period of time so that deductions may be made from them. The useful run of the instrument began on the 18th, but was interrupted during the first few days by lack of proper adjustments. From that date up to and including October 1, there were 13 very feeble tremors recorded. It seems so far that this new instrument is recording an entirely different group of very feeble tremors than those recorded at the Hawaiian Volcano Observatory. None of the 13 recorded is identified as recorded at the Obeservatory. There has not yet occurred a heavy enough shock to be recorded on both instruments.

Large tilting movements close to the pit are to be expected, and the seismograph is apparently to bear out that expectation. From September 28 to October 2 there was recorded no less than 10 seconds of arc tilt away from the pit. This is perhaps not due entirely to volcanic causes, however, as the instrument may not yet be fully settled on its foundation. On October 1, beginning at 3:54 p. m. and ending at 6:45 p. m., there was an apparent surge of tilt which accounted for more than half the amount above noted; but this interval of time represents very closely the time and duration of a very heavy shower of rain. In this instance the pen movement was probably caused by wind, temperature, or other effects of the shower, rather than by actual ground tilting, though there was evident no tendency for the pen to return to its former position after the effects of the shower had ceased.

R.M.W.

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HAWAII NATIONAL PARK
OFFICE OF THE SUPERINTENDENT VOLCANO HOUSE, HAWAII

October 4, 1928

Mr. Stephen T. Mather, Director,
National Park Service,
Department of the Interior,
Washington, D. C.

Dear Sir:-

The following report on the operation and activities of the Hawaii National Park during the month of September 1928, is submitted for your information and approval:

000 GENERAL:

The opening of schools and the termination of vacations generally were responsible for a diminution in travel to the Hawaii National Park notwithstanding the delightful brand of weather that September offered.

150 NEW EQUIPMENT:

On the 4th the superintendent acquired a new 6-cylinder, 5-passenger Studebaker "Dictator" sedan, serial No. 1,440,375; engine No. GE 31,569; 65 horse-power; color gray; weight 3400 pounds; turning in as part payment the 1924 Dodge touring car engine No. 156-813. License plate No. 180 was transferred to the new car. The Studebaker enjoys a fine reputation for sturdiness and the sedan is the most suitable type in the frequent heavy rains of Hawaii. Cash $1,185.

Driven in September 690 miles.

On the 7th there was purchased for road patrolling a "New Model A Ford Pickup" light truck; engine No. A258,984; weight 2100 pounds; to carry plate #1121. Cash $655.

Driven in September on the 25 miles of park roads 779 miles.

220 IMPROVEMENTS:

Most of the 111½ man days of labor were spent on the maintenance of the two new roads - Chain of Craters 7 miles and Around the Island 4.24 miles. The B.P.R. engineers declare that as soon as the contractor finishes the construction of a road the maintenance begins. Added to the 7 miles of old Crater Road which needs constant repairing the new roads create a burden upon the Allotment for Roads for the one-man grader-maintainer is expensive to operate.

317 CHAIN OF CRATERS ROAD:

The formal dedication of this road set for October 7th was again indefinitely postponed when it was learned that the Packard Caravan from San Francisco would not materialize.

320 AROUND THE ISLAND ROAD:

The process oiling of this unit was completed on the 8th. No heavy rains interfered with the work and the job promises to be a success. The second voucher was FINAL.

Project #3-B-1, by Chas. H. Will, date of contract July 21, 1928.

#68 Asphaltic oil applied 44,714 gals. at .09	---	4,024.26
#69 Processing ---------- 3.56 miles at 936.50	---	3,332.07
Reworking, per 1/16 mile sections 1.06 at 75.00		79.50
10% retained from August work		224.16
FINAL transmitted to Washington - - - - - - - - - -	$	7,659.99

Mr. E. J. McCracken, Bureau of Public Roads engineer, who has been in the park for three years, making surveys and superintending the construction of three projects under contracts, left with his wife on the 30th for San Francisco.

321 KILAUEA MILITARY CAMP:

Warrant officer William Liske, Chief marine gunner, succeeded Lieut. D. G. Willis as commandant of the Naval Section of the 1st.

Maj. Gen. Fox Conner, commanding the Hawaiian Department, with his family was a guest at the camp from the 1st to 16th. Maj. Gen. George C. Barnhardt and family arrived on the 26th for a two weeks visit. Col. John O. Steger, Col. Granville Sevier, Col. W. R. Bettison and Col. Lewis Turtle were also guests for two week periods.

420 MUSEUM SERVICE:

Fourteen lectures were given at Uwekahuna Observatory to 398 people in September. Ranger Douglas was granted 8 days annual leave beginning on the 25th. The lecture on the 25th was given by R. B. Hodges of the U. S. Geological Survey, and the one on the 29th by the superintendent.

During the 1928 travel year there were presented at Uwekahuna 228 lectures to 10,621 people, including all distant tourists.

510 TRAVEL:

Visitors numbered 4,927 against 2,220 for the same month last year. Of the 515 tourists who registered at the Volcano House the largest single contingent came on the 4th on the S.S. City of Honolulu, mostly members and families of the B.P.O.E. No. 99 of Los Angeles conducted by past exalted ruler C. G. Pyle and his special guest Carl Albert, the boy orator of Oklahoma. Brother Elks of Hilo entertained them at the Volcano House in the evening with Hawaiian songs and hulas and a dance.

510 TRAVEL: (Continued)

Hotel guests from 21 states and 6 foreign countries	---	515
Guests at Kilauea Summer Camp	---	18
Arrivals at Kilauea Military Camp	---	199
Autoists, estimated, part of day	---	4,145
To Haleakala Section (estimated)	---	50
		4,927
Total travel for 12 months of 1928 travel year	----	78,414
" " " same period preceding year	----	37,551
Increase ------ 108%		

520 WEATHER CONDITIONS:

September added another month of delightful weather to the spell that began on January 1st. The first snow of the season appeared on Mauna Loa and Mauna Kea as far down as 11,000 elevation on the 7th.

Maximum temperature	------- 10th and 23rd	--------	88
Minimum "	------- 23rd	--------	52
Number of days without precipitation		--------	7
Rainiest day	------- 10th	--------	.72 inches
Rainfall for month of September		--------	5.14 "
" " " " " at Hilo		--------	13.94 "
" to date Volcano District 47.21; at Hilo		----	97.30 "

540 VISITORS:

Supreme Court Judge J. J. Banks, of Honolulu on 15th-30th
A. H. Armitage, manager Inter-Island S S Co., 1st - 5th
Mrs. B. Powers, of Honolulu, who is to manage the new hotel in Kona, on 1st - 5th.
Milton Sills, Dorothy Mackaill and party on 5th
They will film a picture on the Puna coast.
Dr. T. A. Jaggar, returning after 5 months absence on the mainland and in Alaska, on the 19th.

610 FELONIOUS ASSAULT:

It seemed to the superintendent that nothing might be accomplished by not following the parting advice of U. S. District Attorney S. B. D. Wood when he left for Honolulu on the 2nd "to keep quiet and let the affair die." Deputy Sheriff Martin of Hilo proceeded quietly with his investigation which during September took him to Honolulu twice and brought him to the park once. Baldwin, resigned as summer ranger and in Hilo teaching school, broke out a few times in vehement protest against the injustice of himself being charged with the crime by insinuation and inplication on the part of the Hilo Detective Department.

He is still mad enough to attempt to clean up that department. It is held by many that illegal liquor operators in Hawaii County pay $10,000 monthly for police protection. One of the first and most persistent theories of the assault upon Mrs. Baldwin was that a bootlegger or a bootlegger's agent perpertrated it as a warning to Baldwin and the Park to offer them no interference.

650 ACCIDENTS:

On the 1st about 5:30 P.M., M. J. Scully, deputy collector of customs, with two friends, Mr. and Mrs. Temple Burke, lost control of the Willis-Knight roadster in which they were riding on the Pali Road. The car plunged over the pali but fortunately landed on a narrow shelf only 12 feet down bottomside up. The occupants of the car, miraculously unhurt, were able to crawl to safety.

On the 12th little Thompson Kamhi, young son of one of the park employees, while en route to school east of the park fell from the auto which was full of children and fractured his scull on the concrete highway. He was hurried to the Kilauea Military Camp where Surgeon - Captain Lucius K. Patterson rendered expert treatment. Though unconscious for the better part of several days he improved steadily and was able to return home in about ten days.

Very respectfully yours,

R. T. Evans

R. T. Evans,
Superintendent.

cc to Mr. H. M. Albright, Asst. Director (Field)
National Park Service

cc to Mr. F. A. Kittredge, Chief Engineer,
National Park Service.

RTE/JEH:

Please send publications and news notes about volcanic matters
Address: HAWAIIAN VOLCANO OBSERVATORY, VOLCANO HOUSE, P. O., HAWAII

THE VOLCANO LETTER

A Weekly news leaflet of the Hawaiian Volcano Research Association

Sent free to libraries and to members. Dues of Association $5 per annum. Members receive in addition the Illustrated Monthly Bulletin of the Hawaiian Volcano Observatory. Anyone may join the Association and thereby support Pacific volcano research. The Society has also patrons—individuals, firms and institutions.

No. 195 RELEASED WITHOUT COPYRIGHT RESTRICTION September 20, 1928

KILAUEA REPORT No. 869

WEEK ENDING SEPTEMBER 19, 1928

Section of Volcanology, U. S. Geological Survey

T. A. Jaggar, Volcanologist in Charge

Heavy coatings of white salts formed on the fresh surfaces of the north wall during the week. Today, however, they have disappeared after a night of rain. The thick layer of dust on the Halemaumau floor is finally being washed away, and yellow-stained areas are again showing. Steam vents are all mildly active.

There were 20 very feeble local earthquakes recorded at the Observatory during the week. Microseismic motion was normal, and tilt accumulated slightly towards the N.

PROJECT FOR ALEUTIAN GEOGRAPHIC OBSERVATORY

By T. A. Jaggar

The writer on September 7, 1928, addressed the Seattle Chamber of Commerce on a proposed Aleutian Geographic Observatory to be established at Dutch Harbor, Alaska. This project is formulated in extension of a report on a possible Alaskan volcano observatory, revising somewhat and broadening the project. (Volcano Letter Nos. 116, 128, 134 and 147.)

Experience shows that mapping should be the main aim, and that all sciences should be represented. The founding of the Hawaii observatory by the sugar and other industries through the Volcano Research Association, with government collaboration, suggests that the fish, fur, and shipping industries might do something effective for southwest Alaska.

Modern exploration and discovery is extended by each new invention. Montana and Arizona have been "discovered" to be garden spots through irrigation and agricultural machines. The "Carnegie" is mapping all the oceans with echo sounding and new electrical instruments (Volcano Letter No. 175, May 3, 1928).

The advent of the salmon canneries, of Diesel engines in 60-foot boats of 2,000 miles fuel radius, of radio communication, and of some new maps, have greatly improved the Alaskan field for the explorer.

It is proposed that the observatory be at Dutch Harbor as a fixed home for land and sea mapping and for measuring geophysical, biological, and chemical processes along the arc of the Alaskan peninsula and the Aleutian Islands. The station will work in concert with eight scientific bureaus of the government, seven civil offices, and two outside institutions. It is called geographic, because it will study that part of the earth in relation to man.

It will measure and secure data all the year around concerning the weather, tides, currents, magnetism, earthquakes, volcanic activity, crust upheaval, animals, plants, fish, natives, and commercial needs.

For the summer half of the year, the observatory will maintain expeditions to collect land and marine organisms, minerals, rocks, and human antiquities; to map the lands, the geology, the depths of the sea, the air currents, temperatures and pressures, and such earth activities as magnetism, tremor, tilting, and changes of mean sea level. The snowy craters of the big volcanoes will be explored and photographed with the aid of alpinists and aviators.

It is a land of ancient inhabitants who linked America with Asia; it contains the greatest craters on earth; it exhibits volcanic activities that should throw light on the origin of the earth and the origin of ores; on the mainland there are known occurrences of gold, silver, lead, copper, zinc, sulphur, petroleum, and coal, and the numerous big western islands have not even been prospected.

It is a grassy country without trees. Sheep, reindeer, and cattle are grown there, but ranching is a new industry. There is much fur produced, largely foxes, mink, and land otter. The Aleutian land is one of the great breeding grounds for the study of migratory birds.

There has come recently a demand for scientific study of the Aleutian lands from numerous scientific institutions and conventions, so that the matter is being pressed by the National Research Council of the United States. The writer has reconnoitered the field by three expeditions devoted primarily to volcanology.

The proposal is to place four workers at the main station winter and summer, equipped with a powerful Diesel yacht and small boats, also laboratories, shop, quarters, dock, and photographic dark room. The station will keep in radio communication with its yacht and with existing stations. It will provide a base and a boat for the Coast Survey and the Geological Survey in mapping the coasts and interiors. It will publish weekly and quarterly reports.

The substations will work from April to September, and each summer will produce a new substation, for intensive geophysical measurements, photographing, and collections, on a volcano for instance, setting up a seismograph and weather instruments, and keeping a journal. The summer staff will be eight persons, and the substation will report to the main station. The substation camp will be left for future use. Specialists in all sciences will be imported from outside institutions for work at the substations.

The observatory vessel will carry the observers, the pack horses, and the camp equipment to the substation site, and the base camp may be moved by boat as often as necessary, when the substation work is in the nature of an exploring expedition. It will probably be advantageous for the first established substations to work in conjunction with map-making expeditions.

It is useless to establish such an institution without adequate funds. The following is the estimated cost of equipment and operation:

EQUIPMENT		ANNUAL UPKEEP	
Boats	$25,000	Salaries	$22,200
Houses	12 000	Station Upkeep	6,000
Horses	400	Boat Upkeep	4,200
Apparatus	1,000	Food Supplies	3,500
Contingent	8,600	Travel & Freight	3,000
		Contingent	11,100
		(Incl. publications)	
	$50,000		$50,000

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HAWAII NATIONAL PARK
OFFICE OF THE SUPERINTENDENT VOLCANO HOUSE, HAWAII

September 7, 1928

Mr. Stephen T. Mather, Director,
National Park Service,
Department of the Interior,
Washington, D. C.

Dear Sir:-

The following report on the operation and activities of the Hawaii National Park during the month of August 1928, is submitted for your information and approval:

000 GENERAL:

Delightful weather in the Kilauea section greeted the tourist who came in a steady stream and attracted more than usually the island residents from the hot sea coasts.

125 INSPECTION:

On the 11th the park disbursing accounts were inspected by the following committee of Accounting Office Investigators : F. F. Conway, F. H. Acuff, S. A. Conley and M. H. Knee, who complimented the neat and accurate condition of the books.

Senator Carl Hayden of Phoenix, Arizona, and Mrs. Hayden visited the principal features of the park on the 1st and 2nd, remarking especially that the park should have an imposing gateway. On the 3rd and 4th they made the trip around the island accompanied by the superintendent and Mrs. Evans.

320 AROUND THE ISLAND ROAD:

The only bid received for the oiling of this 4.25 mile project was from Chas. H. Will of Hilo who made the road a short time ago. Amount $9,963.38. Awarded the bid he began operations on July 28th and started spreading the oil on August 13th.

Unusual equipment is being used on this work which is new in the islands. A 1,000 gallon oil truck, complete with spreader, pumps, nozzles, heater, thermometer, and pressure gauge spreads the oil after a proper amount of asphalt has been added. A Yuba tractor follows with discs and spring-tooth harrows to mix the oil with the road metal. A one-man caterpillar grader further mixes the material and distributes it evenly.

Estimate for August, Project #3-B-1, Contract dated July 21, 1928:

#68 Asphaltic oil	18,112 gals at .09	$ 1,630.08
#69 Processing	.65 miles at $936.50	611.53
		2,241.61
	10% retained	224.16
Voucher #16; Check #181,441		$ 2,017.45

350 HUI O PELE HAWAII:

New members numbered 253 from 33 states and 7 foreign countries. After California with 86 and Hawaii with 41 came Illinois with 14 and New York with 13.

410 RANGER SERVICE:

On the 4th Mr. Jack St. C. Myles of Honolulu came via the Civil Service route to be a ranger. His duties will be patrolling, police, and guiding mostly.

Robert I. Baldwin, temporary summer ranger, resigned on the 31st.

420 MUSEUM SERVICE:

Ranger Douglas lectured to 1,007 people on 17 occasions during August, and by request R. B. Hodges, U. S. Geological Survey, lectured to 75 members of the Young Mens Buddist Association of the islands on the 20th. Conveniences in the engine house were augmented by the installation of a wash-bowl, a faucet in the tank and a drinking faucet outside the building.

510 TRAVEL:

The S S City of Honolulu on the 4th brought the largest crowd—224 of whom 110 were members of the 11th Excursion to Hawaii of the Los Angeles Chamber of Commerce under the leadership of field conductor Charles Bayer and president George L. Eastman.

A pageant at 9 P.M. of the 18th at the rim of Halemaumau concluded the program on the island of the Captain Cook Sesqui-centennial. More than 1,500 people in 250 cars were present including many notables. The performance was given on a raised platform under bamboo torches and was impressive and colorful. The thunderous roar of almost continuous avalanching in the nearby pit made the ceremony doubly impressive.

Hotel guests from 35 states and 7 foreign countries	1,291
Guests at Kilauea Summer Camp	47
Arrivals at Kilauea Military Camp	296
Autoists, estimated, part of day	6,325
To Haleakala Section (estimated)	50
	8,009
Total travel for 11 months of 1928 travel year	73,487
Same period preceding year	35,323

520 WEATHER CONDITIONS:

The climate for August was ideal for out of doors activities. Rains were light and infrequent.

Maximum temperature	25th	87
Minimum "	15th and 31st	58
Number of days without precipitation		3
Rainiest day	16th	0.75 inches.
Rainfall for month of August		3.52 "
" " " " " at Hilo		8.25 "
" " 1926 —— 58.93 inches; for 1927		128.62 "

540 VISITORS:

Senator Carl Hayden and wife of Phonix, Arizona, 1st to 4th.
H. K. Spafford, national commander American Legion on 4th.
Deputy Attorney-Gen. E. R. McGhee, of Honolulu, on 15th
Mrs. Grace Thompson-Seton on
Dwight F. Davis, Secretary of War, of Washington, D. C., on 18th
Governor W. R. Farrington of Honolulu, on 5th and 18th.
Major-Gen. Fox Connor, Com. Hawaiian Department, on 18th.
Admiral Marvell, U.S.N., of Pearl Harbor on 18th.
Hon. Victor Houston, Territorial Delegate, on 18th.
H. S. Wheeler, B.P.R. engineer of Honolulu, 22nd to 26th.

610 FELONIOUS ASSAULT:

August was spent by the superintendent in efforts to shake off the suspicion of guilt that had been shifted to ranger Baldwin as the assailant of his wife. The Hilo Detective Department continued, to foster this theory and to participate in a wide whispering propaganda and finally announced that they had dropped the case.

The idea that Baldwin was the assailant was so repulsive to the superintendent that he radioed to the Director, the U. S. District Attorney and Governor Farrington for help and legal advice. The Governor sent the 3rd Deputy Attorney General Earl R. McGhee who arrived on the 15th. He succeeded in inducing Sheriff Pua to undertake a new investigation, this time by Deputy Sheriff Martin, for the purpose of catching the real culprit.

On September 1st District Attorney Sanford B. D. Wood and U. S. Marshall Cox came from Honolulu. Mr. Wood came in an unfriendly spirit, probably intending to arrest Baldwin. As his assistant Mr. Moore had closely attached himself to the army crowd five weeks before Mr. Wood chose to line up with Captain Richardson of the Hilo detectives. He subjected both Mr. and Mrs. Baldwin to humiliating interrogation, finally declaring that he believed Mrs. Baldwin's story but avoiding our efforts to have him clear the husband. His counsel to us was to keep quiet and let the affair die. As with Mr. Moore so with Mr. Wood when he departed the newspapers published an interview to the effort that the Federal Department of Justice had again closed the case.

Though willing to be rid of the case this manner of disposing of it is unsatisfactory and terribly unjust to Baldwin. However, it seems hopeless to obtain for him a greater measure of justice here, unless Deputy Sheriff Martin actually finds the guilty man. We are obliged to await the outcome of his investigation.

630 ACCIDENT:

Andrew Akina Jr., 26 years old, hunting wild pigs with three companions south east of Thurston Lava Tube on Sunday the 5th, got lost in the fern jungles and was not found despite the best efforts of friends and park employees until the afternoon of the 7th.

Very respectfully yours,

R.T. Evans,
R. T. Evans,
Superintendent.

CC to Mr. H. M. Albright, Asst. Director (Field),
National Park Service.

CC to Mr. F. A. Kittredge, Chief Engineer,
National Park Service.

RTE/H:

SAMPLE COPY

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Address: HAWAIIAN VOLCANO OBSERVATORY, VOLCANO HOUSE, P. O., HAWAII

THE VOLCANO LETTER

A Weekly news leaflet of the Hawaiian Volcano Research Association

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No. 191 RELEASED WITHOUT COPYRIGHT RESTRICTION August 23, 1928

KILAUEA REPORT No. 865

WEEK ENDING AUGUST 22, 1928

Hawaiian Volcano Observatory, U. S. Geological Survey

R. M. Wilson, Temporarily in Charge

At 9:50 a. m. August 18 the north wall of Halemaumau was working very slightly. Two falls of rocks were heard in 10 minutes from that side, and another from the northeast corner. The north wall and talus gave the appearance of having had numerous small slides. During the "Pageant to Pele," presented to a large audience at the side of the pit from 9 to 11 p. m., there was nearly constant avalanching, filling the air with dust, and at times drowning the exercises. By daylight August 19 could be seen heavy coatings of red dust on the floor and walls of Halemaumau and on the south Kilauea floor. The avalanching continued at irregular intervals, coming from blocks tumbling from the north rim, and gathering debris along their course. Examinations show that widely cracked areas formerly back of the north rim have gone in, and that there are numerous fresh cracks of varying sizes. Many of the new cracks are emitting steam, and several of those that are dry are allowing the escape of heat. At the present time there is still some sliding from the north rim.

The Observatory seismographs have recorded nine local tremors during the week ending August 22. These were all very feeble with the exception of one which occurred at 10:47 p. m. August 18. This one is classed as feeble, and was apparently caused by an unusually large avalanche in the pit of Halemaumau. Tremors of this magnitude can very seldom be ascribed to avalanches, yet the evidence points to the fact that this one is the result, and not the cause of an avalanche. The amplitude increases gradually to the maximum, and fades out again gradually; there are no phases to be recognized, as would be the case in a true earthquake. The record of the same disturbance from the Uwekahuna seismograph is 25% greater in amplitude, in spite of the fact that the magnification of that instrument is less than the corresponding factor for the instruments at the Volcano Observatory. This is easily explained in the case of an avalanche tremor by the fact that the Uwekahuna instruments are but 0.7 mile from the pit, while those at the Volcano Observatory are 2.6 miles away. This tremor was the climax of a series of five avalanche tremors, of which the first was at 9:41 p. m. Thus the Observatory seismographs bear witness to exceptionally heavy avalanching during the evening of the 18th, when there were present at the edge of the pit well over a thousand spectators who had come there to see the entertainment furnished by the program of the Cook Sesquicentennial.

Microseisms throughout the week have been normal. Slight tilt has accumulated toward the northeast.

THE PAVLOF VOLCANO EXPEDITION

A letter from Dr. Jaggar dated July 11 gives us additional notes of the progress being made by the National Geographic Pavlof Volcano Expedition, of which he is the Director. The letter was written in camp at the north end of Pavlof Bay, just east of Pavlof Volcano. The party had just completed a trip into the interior of the Peninsla; where two comps were made on the northeast base of the volcano. From these camps a nine-day side trip was made to the region north of the mountain, where an interesting bit of volcanic topography was found similar in nature to the Chaos Jungle at Viola on Mount Lassen, California. A view into the crater of Pavlof was had, and two inner cones were seen. In the crater there was also visible an old lava flow and considerable steam from a number of solfataras. No hot springs were found, but mineral springs were discovered on two occasions.

The topographic section of the expedition had mapped 2,000 square miles of country. The expedition had taken 225 photographs and a considerable number of color plates. Wild flowers are there in abundance, and specimens of the different kinds have been collected and pressed. Dr. Jaggar says that fossils have been found and that the geology of the region is very interesting. The geologic details, however, must wait for a more thorough investigation by some geologist in the future who will be able to base his work upon the present reconnaissance and the topographic maps being made by the party.

The weather has been bad, especially from the point of view of the topographic party, who need clear weather for long distance photography and plane table operations. There have been hundreds of caribou seen, and 25 to 30 bears. The expedition has had no difficulty in keeping its larder stocked with meat, fish, and clams at all times. Salmon have been caught with a small seine operated by the "Honukai."

The "Honukai" is still holding its place as one of the most useful units in the expedition's transportation. It traverses the beaches with ease, and can go over the greater part of the dry tundra country. Swampy tundra and "niggerheads" have at times caused it to turn back, however. The use of the steel mats in soft places, as suggested by the experience with the "Ohiki" in Hawaii, has proved valuable in the extreme.

At the time of writing, the expedition was planning to go westward to Volcano Bay as the last lap of the season's explorations.

A radio message has just been received from Dr. Jaggar stating that the work was completed and the expedition was starting back home from Alaska on August 16.

R.M.W.

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HAWAII NATIONAL PARK
VOLCANO HOUSE, HAWAII

OFFICE OF THE SUPERINTENDENT

August 8, 1928

Mr. Stephen T. Mather, Director,
National Park Service,
Department of the Interior,
Washington, D. C.

Dear Sir:-

The following report on the operation and activities of the Hawaii National Park during the month of July 1928, is submitted for your information and approval:

000 GENERAL:

The slightly more rainfall during July than in June did not bother travel to the park as the vacation urge was irresistible.

100 ADMINISTRATIVE:

The superintendent left Volcano House at 3:30 P.M. July 4th for trip to Honolulu, returning to Volcano House at 6:00 P.M. July 11th. In Honolulu he opened bids with Senior Engineer B.P.R. for oiling the Around-the-Island Road - Project 3; interviewed eligibles on the ranger list of the Civil Service Commission; conferred with territorial officials; inspected movie reels and lantern slides of lava scenes.

150 NEW EQUIPMENT:

The Spearwell one-man road-maintainer purchased in San Francisco by Chief Engineer F. A. Kittredge for use in the process-oiling of the Around-the-Island road arrived in Hilo on July 7th and in Hawaii National Park on August 2nd.

220 IMPROVEMENTS:

The road to Bird Park was the largest single object of the 173½ man-days of labor, much filling in of pukas being done so that the summer visitors might drive large as well as small cars over it.

350 HUI O PELE HAWAII:

At the request of the superintendent this organization donated $300.00 for (1) the erection of 4 roofed lava masonry benches along the trails; (2) the purchase of a movie reel of lava activity to take the place of one that is wearing out from almost daily showing in the lectures at Uwekahuna; (3) the purchase of lantern slides for distribution upon request to superintendents of mainland parks.

350 Hui O Pele Hawaii (Continued):

New members to Hui O Pele numbered 283 in July - only three less than for the month of June - and they came from 34 states and 9 foreign countries. California was represented by 87 and Massachusetts by 29. All visitors to the Kilauea Crater are eligible for membership and the fee is $1.00 for which the new member receives a certificate and brooch.

420 MUSEUM SERVICE:

Ranger Douglas during July held 16 lectures at Uwekahuna Observatory to an aggregate audience of 1,065 persons.

510 TRAVEL:

Though guests at the Volcano House during July were slightly more in number than during June it was felt that travel was much improved. On six days arrivals by steamship numbered more than 100. A dance at the hotel on the 3rd brought 200 people from nearby island points and quite a number of other island people stayed for periods of two to four weeks at the hotel or in the summer homes just east of the park.

Hotel guests from 33 states and 8 foreign countries - - -	1,163
Guests at Kilauea Summer Camp - - - - - - - - - - - - -	49
Arrivals at Kilauea Military Camp - - - - - - - - - - -	455
Autoists, estimated, part of day - - - - - - - - - - - -	5,570
To Haleakala Section (estimated) , - - - - - - - - - - -	50
	7,287
Total travel 10 months of 1928 travel year - - - - - - -	65,478
Same period preceding year - - - - - - - - - - - - - - -	50,340

520 WEATHER CONDITIONS:

July was generally fine for the light rainfall was distributed through afternoons mostly.

Maximum temperature	on 21st	86
Minimum "	on 7th and 16th	52
Number of days without precipitation		4
Rainiest day	14th	2.25 inches
Rainfall for month of July		7.51 "
" " " " " at Hilo		13.17 "
" " 1926 - 58.93 inches; for 1927		128.62 "

540 VISITORS:

Assistant District Attorney Willson C. Moore, of Honolulu, on 24th.

Lt. Col. J. M. Pruyn, Provost Marshall, of Fort Shafter, on 24th.

Capt. K. W. Thom and wife on 25th.

Capt. Thom came to relieve Capt. Elmer R. Block as commandant of the Kilauea Military camp, the transfer of command becoming effective on the 30th. Capt. Block, whose four year tour of duty in the Hawaiian Islands is drawing to a close, has been commandant of the local camp for two years and has maintained the best of relations with the park superintendent.

610 FELONIOUS ASSAULT:

At or about 8:30 in the evening of July 21st the wife of ranger Robert I. Baldwin was criminally assaulted in front of her cottage in the park. Fearful of the man's threat to kill if she made an outcry and afraid to leave three small children to seek help she was forced to await her husband's return from Hilo about 15 minutes after midnight before giving the alarm.

All park employees were immediately aroused, the surgeon at Kilauea Military Camp was summoned to attend the injuries and a hunt for the criminal was begun. The army surgeon, Capt. Lucius K. Patterson, upon his return to the Camp went through the barracks and examined the clothing of some 320 soldiers. Three detectives from the Hilo Police Department soon arrived and were put in charge of the case.

The departure of 175 soldiers from the Military Camp the following afternoon was prevented by the exchange of the following radiograms:

To General Fox Conner. To Col. L. W. Oliver, Chief of Staff.
Fort Shafter. Fort Shafter.
Wife of Park Ranger assaulted and raped last night Stop. In order to thoroughly investigate and apprehend guilty party I request that Kilauea Camp Commander be directed to hold detachment returning to-day until Thursdays boat. Please expedite reply.
R. T. Evans Park Supt.

AND

Superintendent Evans, Hawaii National Park, Volcano House
Message received. Commanding Officer Kilauea Military Camp ordered to get in touch with you and use his judgement.
Connor:

These soldiers were held until the next boat on Thursday in order to thoroughly examine them for cuts and bruises and to check their whereabouts on the night of the 21st. The remaining soldiers, sailors and marines in the Military Camp, employees of the national park, the hotel and neighboring ranches were all similarly examined. Lt. Col. J. M. Pruyn, 35th Infantry, Provost Marshall, and Assistant District Attorney Willson C. Moore arrived from Honolulu on Tuesday's boat and conducted the examinations. Capt. Patterson, army surgeon, Captain of Detective George J. Richardson, Lieut Willis, U.S.M.C. in command of the Navy Recreation Camp, Mr. R. M. Wilson of the Volcano Observatory and the national park superintendent assisted in the examinations.

Residents within the park and in ranches and summer homes just outside were in a state of fear, requiring continuous police protection. Efforts at apprehending the criminal were fruitless, though the Hilo detectives have not given up the case.

Due to the fact that some fifty soldiers in twoes and threes and singly were on the park roads in the vicinity of the ranger's cottage that evening the conviction was strong that it was a soldier. Later, the theory grew that some native committed the act in revenge for ranger Baldwin's interference with the liquor traffic across the park. Also, it was bruited about by persons with habits of drink that Baldwin had done it himself and raised the outcry for the sake of publicity and notoriety. It has pleased many persons to accept the last theory. It leaves the case a national park affair and excuses the Hilo police department for not catching the culprit.

610 Felonious Assault: (Continued):

A reward has been posted for the arrest of the assailant, in the sum of $632.50, contributed as follows:

United States Army - - - - -	$ 125.00
Hilo Police Officials - - -	75.00
R. M. Wilson - - - - - - - - -	50.00
R. T. Evans - - - - - - - - -	50.00
Residents of Volcano District	332.50
	$ 632.50

Mr. R. M. Wilson, U. S. Geological Survey, in charge of the Volcano Observatory, personally interviewed the residents of the Volcano district and secured pledges for the $332.50. He, also, at the very beginning put the entire observatory personnel at the disposition of the park superintendent.

Very respectfully yours,

R.T. Evans

R. T. Evans, Superintendent.

CC to Mr. H. M. Albright, Asst. Director (Field),
National Park Service.
" " Mr. F. A. Kittredge, Chief Engineer,
National Park Service.

RTE/H:

10-23
(May, 1929)

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
Hawaii NATIONAL PARK

FILE NO.

M?O N T H L Y   R E P O R T S

FISCAL YEAR 1 9 3 0

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HAWAII NATIONAL PARK
HAWAII

OFFICE OF THE SUPERINTENDENT

July 10, 1930

Director,
National Park Service,
Department of the Interior,
Washington, D. C.

Dear Mr. Director:-

The report of operations and activities in Hawaii National Park for the month of June 1930 is here submitted.

000 GENERAL:

June brought the end of the local school term and the beginning of our summer travel season both by traveling visitors and island vacationists. Continued rainy season has held back travel to a great extent.

100 ADMINISTRATION:

110 Status of Work.

The engineering work park road reconstruction surveys is about two months behind our original schedule for starting. One month of this is unavoidably due to delay in the Congressional action on the appropriations and the second month is caused by Civil Service delays in furnishing engineers.

120 Inspections by Superintendent.

The usual regular inspections of operations were made by the superintendent frequently. An additional inspection was made of fire hazard on all buildings in park and a great deal of the month was spent on new trail and building planning.

125 Other governmental officers.

Mr. E. S. Wheeler, district B.P.R. engineer for Hawaii was here June 4th and 5th making general program plans for survey and reconstruction work on roads during the 1931 year.

130 Equipment and supplies.

We received delivery of a 1½ ton dual rear wheel Ford truck, equipped with a special hoist and stake type body, on June 13th. On June 26th we received two Indian Chief "74" motorcycles for patrol duty. All of this equipment was purchased thru Field Headquarters.

180 Circulars etc.

A mimeographed list of questions, a sample of which is attached to this report, is being handed to each departing hotel visitor in order that we may learn their reaction to the service which is being given them by all sources within the park and have on a more definite basis expressions which have heretofore been oral.

200 MAINTENANCE, IMPROVEMENTS AND NEW CONSTRUCTION:

220 Improvements.

The trail from the foot of Waldron Ledge leading past Kilauea Iki crater and as far as the edge of Kilauea crater on Byron Ledge has been widened and rebuilt on better standards.

230 New Construction.

The Volcano Entrance was completed at the end of June. This is a lava masonry building fronted by lava flag stone terrace and its construction has received many compliments.

A new 8000 gallon water tank was erected for additional storage purposes. The tank is located to secure a better pressure to certain buildings.

240 Improvement of approaches to the park.

County Belt Road.

A three mile surfacing contract which has just been completed on the county road around the island has just been completed and extends by that distance the paved mileage between the park and the Kona district. An additional 15 mile of reconstruction work is now ready for advertisement under Federal aid funds.

Haleakala Road.

The territorial road project approaching the park boundary at our Haleakala area on Maui is progressing satisfactorily. The contractor is now doing approximately $20,000 of work per month.

300 ACTIVITIES OF OTHER AGENCIES IN THIS PARK.

310 Public Service Contractors.

311 Character of service rendered to the public.

The camp type of accomodations were opened for the season on June 16 when Kilauea Summer Camp resumed operations for this year. Early business indicated an increase in patronage over previous years.

314 Complaints.

The new list of questions has already made definite the administrative opinion that hot water and heat, both of which are missing from rooms of the Volcano House, are the basis of a great many complaints by visitors. These complaints will be tabulated and submitted separately in the near future.

317 Status of authorized projects of contractors.
The foundations for the photo studio of K. Maeharu have been laid.

330 Donations.
The Hui O Pele committee of the Honolulu Ad Club has begun construction of an overnight shelter on Hilina Pali overlooking the park sea coast area. This is to be a masonry structure of aa lava. It is being built on approved plans and the site was chosen over the ground by Chief Landscape Architect Vint. When completed the building will be donated to the National Park Service.

400 FLORA, FAUNA AND NATURAL PHENOMENA:
410 Ranger-naturalist service.
The ranger-naturalist, service at Uwekahuna Observatory lectures and guided crater trail trips continued to prove popular. Seventeen lectures were given five hundred fifteen people and one hundred two persons attended trail trips. An additional five hundred thirty persons visited the observatory at Uwekahuna but were not lectured to.

500 USE OF PARK FACILITIES BY THE PUBLIC:
510 Travel.
Continued rains have retarded local travel and to some extent have discouraged early tour travel between Honolulu and the park.

520 General Weather.

Maximum temperature	——— 14th, 10th ———	71 degree
Minimum "	——— 8th, 10th ———	52 degree
Rainfall for month of June	———	6.88 inches
" " " " " at Hilo	———	16.54 inches
" " to-date Volcano District	———	48.90 inches
" " " at Hilo	———	70.54 inches

540 Visitors.
The Hawaiian Evangelical Association which held its annual conference in Hilo during five days of June devoted one day for a tour of Hawaii National Park by their member. Four hundred ninety-eight persons mostly Hawaiian enjoyed a full day here at that time.

600 PROTECTION:
630 Accidents.
On the morning of June 29th Hideichi Yasunaka who is employed at the Volcano Observatory of the U. S. G. S. drove with his three small children to change the seismograph sheet at Uwekahuna and while there parked his car facing the cliff edge. While he was inside the museum one of the children released the

car controls and the machine ran over a 60 foot cliff, turned over, and stopped on a shelf below. Miraculously the three children received but minor injuries. The car, which was personal property and insured, was a total wreck. The parking area at this point is protected by large boulders but one of these has been rolled away from its proper location and left a gap.

Very respectfully yours,

Thos. J. Allen, Jr.,
Superintendent.

Copy to "Field Headquarters" (2)
" " "Yellowstone National Park" (1)

10-157
UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

TRAVEL REPORT

Hawaii National Park for the Month of June 1930

	This Month	This Travel Year To Date	This Month Last Year	Last Travel Year To Date	Increase for Travel Year Number	Increase for Travel Year Per cent
PRIVATE TRANSPORTATION:						
Cars first entry.						
Cars reentry.						
Motorcycles.						
Total motor vehicles.						
Persons entering via motor vehicles.	6,857	51,343	7,710	45,348	5,995	13.2
Persons entering via other private transportation.	269	2,158	84	1,867	291	15.6
Total persons entering via private transportation. . . .	7,126	53,501	7,794	47,215	6,286	13.3
OTHER TRANSPORTATION:						
Persons entering via ~~stages~~ Hotel . .	692	7,724	1,620	10,049	-2,325	23.1
Persons entering via trains . .						
Persons entering otherwise. . .						
Total other transportation. .	692	7,724	1,620	10,049	-2,325	23.1
GRAND TOTAL ALL VISITORS. . .	7,818	61,225	9,414	57,264	3,961	6.9

	This Year	Last Year	Increase Number	Increase Per cent
Automobiles in public camps during month	2	3	- 1	33.3
Campers in public camps during month	4	7	- 3	42.9

10-158

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

STATUS OF AUTHORIZED PROJECTS

Hawaii National Park for the Month of June 1930

Description of Projects	Percent Constructed To Date	Percent Constructed This Month	Percent Constructed Last Month	Probable Date of Completion
402 Ranger Station, Park Entrance	100	40	60	
405 Ware House	2	2	—	Aug. 10, 1930

10-159

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

STATUS OF PERSONNEL

Hawaii National Park for the Month of June 1930

	This Month	This Month Last Year
Number of employees beginning of month,	14	8
Number of additions, ...	0	5
Total, ...	14	13
Number of separations, ...	2	2
Number of employees close of month, . .	12	11
Number of promotions during month	0	0
Aggregate amount of annual leave taken,	3 hrs.	0
Aggregate amount of sick leave taken,	0	0
Aggregate amount of leave without pay,	8	0

10-160

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

REPORT OF PARK REVENUES

Hawaii National Park for the Month of June 1930

	This Year	Last Year
Park revenue on hand beginning of month,	0.00	0.00
Received,	50.00	25.00
Total,	50.00	25.00
Remitted,	50.00	25.00
On hand close of month,	0.00	0.00

Park revenues received this year to date,	1,225.00
Park revenues received last year to date,	1,202.00
Increase,	23.00
Percent of increase,	.019

10-161

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HAWAII NATIONAL PARK

REPORT OF SALES OF PUBLICATIONS

June 1930

	Number	Value
GOVERNMENT PUBLICATIONS:		
On hand beginning of month, ...	486	140.40
Received during month, ...	0	0.00
Total, ...	486	140.40
Sold during month, ...	10	7.30
On hand at close of month, ...	476	133.10

	Number	Value
NON-GOVERNMENT PUBLICATIONS:		
On hand beginning of month, ...		
Received during month, ...		
Total, ...		
Sold during month, ...		
On hand at close of month, ...		

Cash on hand beginning of month, ...	16.00
Sales during month, ...	7.30
Total, ...	23.30
Remitted during month, ...	0.00
Balance, ...	23.30

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HAWAII NATIONAL PARK
VOLCANO HOUSE, HAWAII

OFFICE OF THE SUPERINTENDENT

In an endeavor to learn the visitors opinion as to what they receive, both in service and in interest, from their visit to Hawaii National Park the United States National Park Service asks that you reply to the following questions. If you care to write more fully you may do so either on the reverse of this sheet or by separate letter.

1. Were the government rangers courteous, helpful, and well informed ? If not please state the incident of their failure to be so.

2. Were the lectures interesting or lacking in something ?

3. Were the lectures long enough or too long ?

4. Was your car driver satisfactory and courteous ?

5. Under normal conditions would you prefer an open or closed car for this trip ?

6. Did your driver furnish you with evidently reliable information ?

7. Did your driver hurry you or give you the proper time to see points of interest ?

8. Were the employees of the hotel courteous and helpful ?

9. Was the food satisfactory or otherwise ?

10. Was the service in dining room or elsewhere satisfactory ?

11. Was your room comfortable ?

12. Did your trip to Hawaii National Park exceed your expectations or were you disappointed in any feature in addition to the absence of lava which disappoints all of us ?

These may be mailed free in the accompanying envelope or left in the transportation office at Hilo or at the hotel desk in the park.

________________ Name

________________ Address

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HAWAII NATIONAL PARK
HAWAII

OFFICE OF THE SUPERINTENDENT

June 16, 1930

In the interest of safety and prevention of accident the following instruction has become necessary:

Hereafter parents or guardians of children residing or visiting in Hawaii National Park are requested to forbid them playing anywhere on the roads leading to the volcano or the main road passing through the park. This includes all public roads. Park rangers are instructed to enforce this and to see that children using the roads as thorofares do not subject themselves or motor traffic to possible accident by unnecessary loitering.

To park employees this is an order; to others it is a request for cooperation.

Thos. J. Allen, Jr.

Thos. J. ~~Allen~~, Jr.,
Superintendent.

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HAWAII NATIONAL PARK
HAWAII

OFFICE OF THE SUPERINTENDENT

April 7, 1930

Director,
National Park Service,
Department of the Interior,
Washington, D. C.

Dear Mr. Director:-

The report of operations and activities for Hawaii National Park during the month of March 1930 is submitted herewith.

000 GENERAL:
March has been a rather dismal month with practically continuous rain and several periods of big wind.

100 ADMINISTRATION:
120 Park Inspections.
121 Superintendent.
Regular inspections of all work was made at frequent intervals by the superintendent.

123 National Park Service officers.
Chief Auditor Chas Gable and Chief Landscape Architect T. C. Vint remained in the park during the early part of March and left Honolulu on March 14th.

160 Status of alienated lands.
Information from the Territorial Land Commissioner informs us that the lands now inside the 1927 boundary which are occupied by the Thurston Lava Tube are still in private ownership due to failure of the owners to agree to accept the lands which the territory offers in exchange.

200 MAINTENANCE, IMPROVEMENTS AND NEW CONSTRUCTION:
210 Maintenance.
Steady rains have forced continual road maintenance on all park roads in order to prevent formation of excessive chuck holes and floating away of the light ashlike surface material.

230 New Construction.
The Bird Park auto-trail has been completed and has already resulted in increased travel to that area.

200 Landscape Work.

In accordance with recommendations of Chief Landscape Architect Vint, the Volcano House company have torn down numerous old fences facing the main road including a large high tennis court enclosure. Also three long cement steps extending into the hotel driveway have been cut off even with the drive edge in order to give more room and a parking place is now being constructed at the south end of the drive in an area formerly occupied by a culivated flower garden. Also the company have agreed to experiment with native plants toward a gradual elimination of the cultivated flower garden now in front of the hotel. Mr. Vint will undoubtedly submit his own report on the entire landscape situation here.

At a conference between Mr. Vint, Mr. Gable, Governor Lawrence Judd, the territorial land commissioner, and the park superintendent the governor agreed to proceed with any plan the Park Service would present toward retaining the present natural beauty all both present and future territorial and county roads leading to Hawaii National Park.

300 ACTIVITIES OF OTHER AGENCIES IN THE PARK:

310 Public Service contractors.

311 Character of service rendered to the public.

As a result of Mr. Gable's inspection it has been recommended that the service and facilities as now furnished at Volcano House are not satisfactory as to completeness and that heat, hot water, baths and better lightning should be installed. This agrees with former reports of the superintendent as to service.

The Inter-Island Airways also a subsidiary of the Inter-Island Steamship Company has purchased two La Salle sedans and is now operating their own transportation, to and through the park, for visitors arriving at Hilo by plane. In view of the good service already available by the Hawaii Transportation Company this operation appears unnecessary.

312 Cooperation and lack of cooperation with superintendent.

The Volcano House company have shown immediate cooperation in regard to landscape improvements of a minor nature as requested this month and as listed under paragraph 260. They have also cooperated in releasing part of their area for use by a photographers operation.

The company has refused to consider installation of heat, baths etc at this time and a separate report has been filed in this respect.

In regard to improving management conditions at Volcano House an agreement was reached some months ago whereby the superintendent would withhold requesting removal of the hotel manager providing the manager's wife lived elsewhere than on this island. The compromise was the suggestion of the company officials. Now after a three months trip the manager's wife has returned and is living in a rented cottage within a mile of the park. As this arrangement has been made with full knowledge of the company it indicates decided lack of cooperation and direct violation of agreement which they themselves suggested.

315 New Contracts.

A contract for the establishment of a photographers operation by K. Maehara of Hilo, Hawaii has been forwarded for approval. The site for the studio has been chosen by Mr. Vint.

Recommendation for a contract which will place the present operating system of the Hawaii Transportation Company under government control has been forwarded for approval.

316 Modification of existing contracts.

An area indicated as Plat A on the plats of the Volcano House company has been released by them and withdrawn from their use. Likewise an area 60' x 80' located on what is indicated as a tennis court on Plat B of their lands has been allowed for use as a site for a photo studio providing the studio agree to a six months removal notice in case the area is needed for hotel improvements.

400 FLORA, FAUNA, AND NATURAL PHENOMENA:

410 Ranger-Naturalist service.

Lectures were given to 776 persons at Uwekahuna Observatory. 135 persons were taken of the Worlds Wierdist Walk and an additional 340 persons were explained the exhibits in Uwekahuna Observatory.

480 Volcanoes.

Still no lava returns to our volcanoes but continual avalanching in the pit shows lava movement nearby.

500 USE OF PARK FACILITIES BY THE PUBLIC:

510 Increase and decrease in travel.

Although the total park attendance figures show an increase of fourteen percent over the same period last year the real tourist travel to Hawaii is in reality showing a large decrease. Our attendance is being maintained by a greater local interest and by an arrangement which keep the Kilauea Military Camp army section filled with enlisted men at all times. The figure for hotel travel which shows a loss of over twenty-two percent is a good indication of the actual tourist travel conditions here this year. The decline is directly traceable to the stock market actions of last Fall.

530 Weather.

Maximum temperature ——— 18th ———	79	degree
Minimum " ——— 30th, 31st ———	46	"
Rainfall for month of March ———	11.72	inches
" " " " " at Hilo ———	11.86	"
" " to-date Volcano District ———	21.36	"
" " " at Hilo ———	23.17	"

600 PROTECTION:

640 Destruction of predatory animals.

Since January first a total of 1,151 wild goats and 18 wild pigs have been exterminated. A drive on wild goats will be held as soon as a date agreeable for territorial forestry department cooperation can be set.

Very respectfully yours,

Thos. J. Allen, Jr.,
Superintendent.

Copy to "Field Headquarters" (2)
" " "Yellowstone National Park" (1)

10-157

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

TRAVEL REPORT

Hawaii National Park for the Month of March 1930

	This Month	This Travel Year To Date	This Month Last Year	Last Travel Year To Date	Increase for Travel Year Number	Increase for Travel Year Per cent
PRIVATE TRANSPORTATION:						
Cars first entry.						
Cars reentry.						
Motorcycles.						
Total motor vehicles.						
Persons entering via motor vehicles.	4,855	35,361	3,895	28,450	6,911	.195
Persons entering via other private transportation.	166	1,448	210	1,234	214	.148
Total persons entering via private transportation. . . .	5,021	36,809	4,105	29,684	7,125	.194
OTHER TRANSPORTATION:						
Persons entering via ~~stages~~ Hotel. .	1,058	4,614	1,569	5,944	- 1,330	-.224
Persons entering via trains . .						
Persons entering otherwise. . .						
Total other transportation. .	1,058	4,614	1,569	5,944	- 1,330	-.224
GRAND TOTAL ALL VISITORS. . .	6,079	41,423	5,674	35,628	5,795	+.140

	This Year	Last Year	Increase Number	Increase Per cent
Automobiles in public camps during month	2	0	2	100
Campers in public camps during month	3	0	3	100

10-158

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

STATUS OF AUTHORIZED PROJECTS

Hawaii National Park for the Month of March 1930

Description of Projects	Percent Constructed To Date	Percent Constructed This Month	Percent Constructed Last Month	Probable Date of Completion
502.4 Bird Park, Auto Trail	100	5	95	----------

10-159

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

S T A T U S   O F   P E R S O N N E L

Hawaii National Park for the Month of March 1930

	This Month	This Month Last Year
Number of employees beginning of month,	9	7
Number of additions, ...	0	3
Total, ...	9	10
Number of separations, ...	0	2
Number of employees close of month, . .	9	8
Number of promotions during month	0	0
Aggregate amount of annual leave taken,	0	0
Aggregate amount of sick leave taken,	0	2
Aggregate amount of leave without pay,	0	0

10-160

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

REPORT OF PARK REVENUES

Hawaii National Park for the Month of March 1930

	This Year	Last Year
Park revenue on hand beginning of month,	0.00	0.00
Received,	25.00	25.00
Total,	25.00	25.00
Remitted,	25.00	25.00
On hand close of month,	0.00	0.00

Park revenues received this year to date,	1,050.00
Park revenues received last year to date,	1,050.00
Increase,	0.00
Percent of increase,	000

10-161

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HAWAII NATIONAL PARK

REPORT OF SALES OF PUBLICATIONS

MARCH 1930

	Number	Value
GOVERNMENT PUBLICATIONS:		
On hand beginning of month, ...	286	43.90
Received during month, ...	0	0.00
Total, ...	286	43.90
Sold during month, ...	0	00.00
On hand at close of month, ...	286	43.90
NON-GOVERNMENT PUBLICATIONS:		
On hand beginning of month, ...	5	12.50
Received during month, ...	0	0.00
Total, ...	5	12.50
Sold during month, ...	0	0.00
On hand at close of month, ...	5	12.50

Cash on hand beginning of month, ...	120.90
Sales during month, ...	0.00
Total, ...	120.90
Remitted during month, ...	0.00
Balance, ...	120.90

The Volcano Letter

Two dollars per year | Ten cents per copy

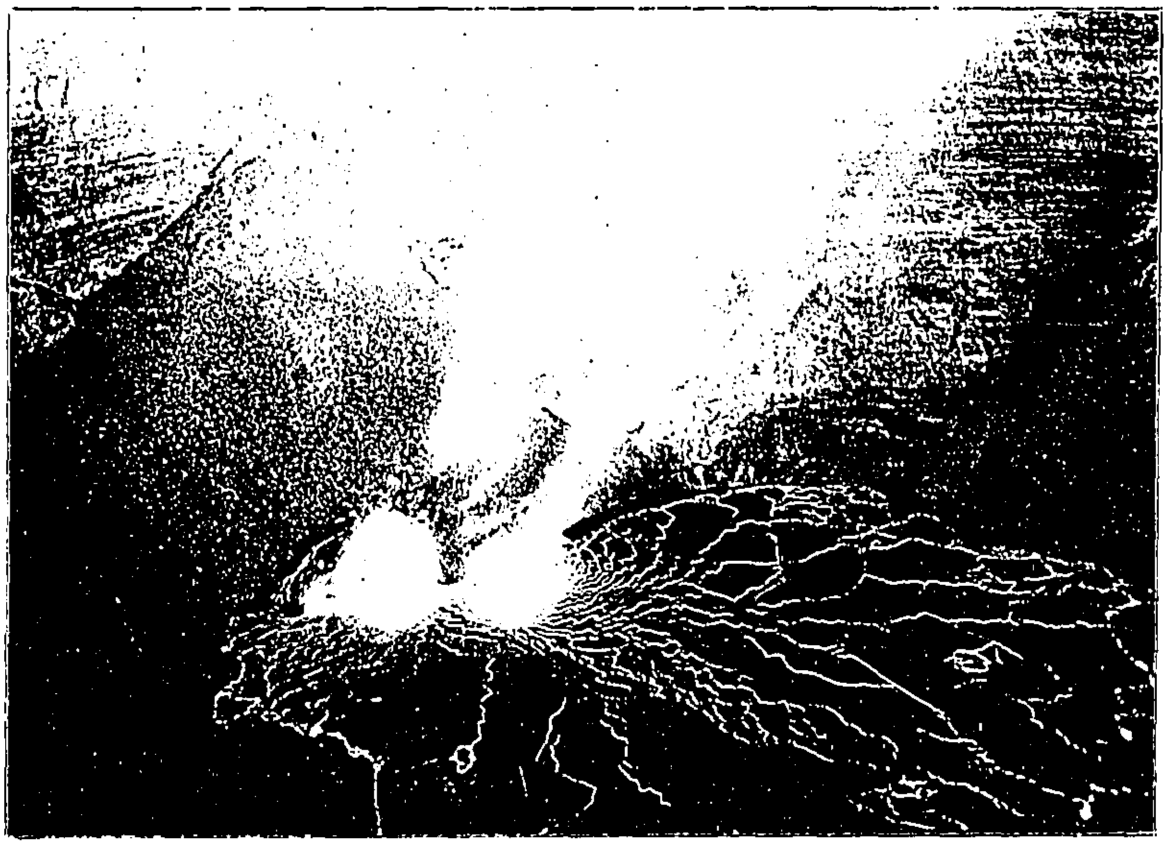
No. 271—Weekly | Hawaiian Volcano Observatory, National Park, Hawaii | March 6, 1930

Interior of Halemaumou pit July 28, 1929, showing west wall, the great west talus slope, the triple fountain niche with condensing fume, and the built up rampart around the borders of the new lake. Photo M. Furuya. Copyright.

KILAUEA ERUPTION IN JULY, 1929

The fiery activity of the bottom of Halemaumau pit, the inner cup of Kilauea Crater, which was described in Volcano Letter No. 267 as being so brilliant in February of 1929, now seems to visitors to be a myth, particularly as recent avalanches coated the black lava floor with pinkish dust. But the inrush of lava in spectacular fountains was not limited to February of last year. The process was repeated during the last week of July, with a performance of magnificent fireworks that lasted four days, when thousands of automobiles brought a vast flock of visitors from near and far to stand spellbound night and day on the edge of the fire pit, like a congregation of worshippers. At such times the psychological effect on the community is one of the wonders. The Observatory workers surveying at the far edge of the cauldron, looking across at the tourist station, see a stationary line of human beings four deep in coats of many colors, fringing the top edge of the abyss. Behind them is a steady stream of newcomers, and still farther back the endless snaky line of motor cars winding up the cliff, like ants at the approaches to an ant-hill. And at night the ants are all aglow in their progress, and those clustered on the rim twinkle like fireflies with their flashlights, while the volcanic fires illumine the line of white faces stationed motionless above the cliff. And the cliff is flooded with glaring rosy light.

This July outbreak developed its maximum inflow of



Halemaumau at dawn July 28, 1929, showing the active grottoes and bright line pattern of new lava lake with the west and northwest taluses in the background. The active belt of February had been along the base of the right-hand talus shown (see photograph Page Three). The new active crack was along the base of the left-hand talus. Photo Hilo Photo Works.

lava at the western edge of the floor of February, and on a line of cracking intermediate between the February fissure and the crack straight across the middle of the pit which had been the source of the 1927 inflow. This can be understood by an examination of the picture on Page Two, where the line of the new July fountains is parallel to the base of the big left-hand talus cone. Comparing the picture on Page Three it will be seen that the February fountains extended from the extreme right, which is the north corner of the floor, to the big belt of boiling lava that lay under the wall between the two taluses. This last photograph shows the shape of the lava pool of February and the floor left behind when it cooled off. The new crack of July followed the upper left-hand shore line of the pool shown on Page Three, that is, the lava cracked its way up one margin of the February fill, doubtless lifting that fill as a wedge-shaped cork and tipping it a little away from the western talus slope. It may have been the same mass of lava, still liquid below, recharging itself with gas until it could lift the plug.

What happened in July to inaugurate the new eruption was, firstly, a series of very small earthquakes a few minutes apart about 4:35 a. m. July 25, 1929, registered on the seismographs but not felt at the Observatory on the edge of the greater crater next to the Volcano House. These little jarrings were each accompanied by a tilting of the ground to the east. Then spasmodic tremors developed in the lines written on the smoked paper of the instrument by the tiny steel pens, and after 6:30 a. m. this became a strong continuous tremor well known to the seismologist as the volcanic vibration which is a sure sign of lava fountains in Halemaumau pit, two miles away. At 6:10 a. m. a cloud of bluish smoke was rising from the pit.

The observers at once drove to Halemaumau and found inside the pit two fountains of lava spurting high from above the lower edge of the large western talus cone. The blue smoke that rose from them smelled strongly of sulphurous acid gas, and sometimes there were puffs of brown sulphur fume. Then the new heat made a billow of moisture cloud shape itself high above the pit. The fountains gained strength, always sending a cascade down to flood the February floor of the pit, and began to fling blobs of pumice-like lava 200 feet into the air, along with strings and shreds of brown spun glass. This material falling back built up a greenish brown mossy bank against the slide-rock slope. New lava vents opened between the two groups of fountains and the glowing melt oozed up through the crevices of the slide rock, trickled down to the floor below, crusted over, and left a glowing hole at the top and a bright cavern at the base. From this cavern a steady stream of golden fluid poured. Within an hour two-thirds of the February floor was covered.

The next event was a tunneling, under this floor, of the new lava, which ridged up the old slabs like a mole hill and sent a blast of gas out through a small orifice with a roar. Then sputtering lava fountains broke through the cracks along with flames and hot brown fume, and the roaring became spasmodic. By 8:30 a. m. the fragments of slag from the big fountains were falling forward on the new pool, the jets rising with a slow, majestic, steeply curved trajectory, of bright blood-red color, and made up of light weight material which fell lazily. By noon there were whirlwinds at the edge of the pit created by the tremendous updraft over the hot lake, and one could collect pellets of brown pumice, some of them two inches long, which were falling outside of the pit. There were also many glassy needles sometimes clustered together in straight sticks resembling golden straws. Tangles of Pele's hair were falling. This is made by the sputter and bluster of the gas rushing through the puddles of glass of which the fountains are composed, and so spinning siliceous cobwebs.

Quickly the older floor became covered ,and it was possible to estimate how deep was the new fill from the peak of the cone of 1927 which stands 2,643 feet above sea level near the south edge of the February floor, and from the February grotto of the north fountain which had built up a high bank 2,635 feet above sea level. There was a terrace 30 feet high left by slumping in February, and this new fill of July had 30 feet of central saucer to fill up before it could surmount the terrace. On the second day, July 26, the new lake surrounded the remnant peak of the 1927 cone and about 10 a. m. it half encircled the north grotto heap of February, 1929. During the first 24 hours the lava rose 44 feet, at the end of 48 hours the depth had increased to 77 feet, and on the morning of the fourth day, July 28, the pit had been filled 88 feet. After 85 hours of inpouring, the afternoon of July 28, and just before the eruption stopped, the maximum elevation of the new lake surface was 2,640 feet above sea level, or 94 feet above the floor it had flooded. This entirely drowned the grotto heap of February, and left the 1927 cone protruding only three feet above the new fill. Then there was a sinking back, leaving a border terrace as before and lowering the central floor about 40 feet.

The eruption remained very brilliant at night during the three evenings of activity. Glowing cascades poured over ramparts along the edges of the new fill. The source fountains built up grotto niches like armchairs as shown on Page One. The surface crusts of the lake cracked up and foundered, and as in the February eruption there was a streaming-out of the surface skin on the slag pool making radial bright lines incessantly in motion away from the source region of the fountaining jets. The built-up spatter walls at these fountains would cave in and leave red-hot walls. A tropic bird flying around the interior of the pit was overcome by the gases, fell into the lava lake, and it was a pitiful sight to see it burst into flame. Broad spatter banks were built back of the large fountain group. Once or twice a fall of rocks occurred at the north wall of the pit. The source fountains finally developed three niches as shown in the pictures. The lava would slop down, making a glistening bank in daylight against the talus slope. This bank was eternally breaking down in red-hot landslides. Finally irregular clotted crust islands were left over the surface of the floor. The bottom had increased in length from 1,500 feet to 2,100 feet, and in width from 1,000 feet to 1,700 feet. Its area is about 50 acres, the volume of frothy lava that poured in, in three and a half days, was 127 million cubic feet, and the new rock that remained after shrinkage was 98 million cubic feet, equalling about 8 million tons of new matter. The pit before had been 1,105 feet deep, afterwards it was 1,050 feet deep.

T.A.J.

KILAUEA REPORT No. 945

WEEK ENDING MARCH 2, 1930

Section of Volcanology, U. S. Geological Survey

T. A. Jaggar, Volcanologist in Charge

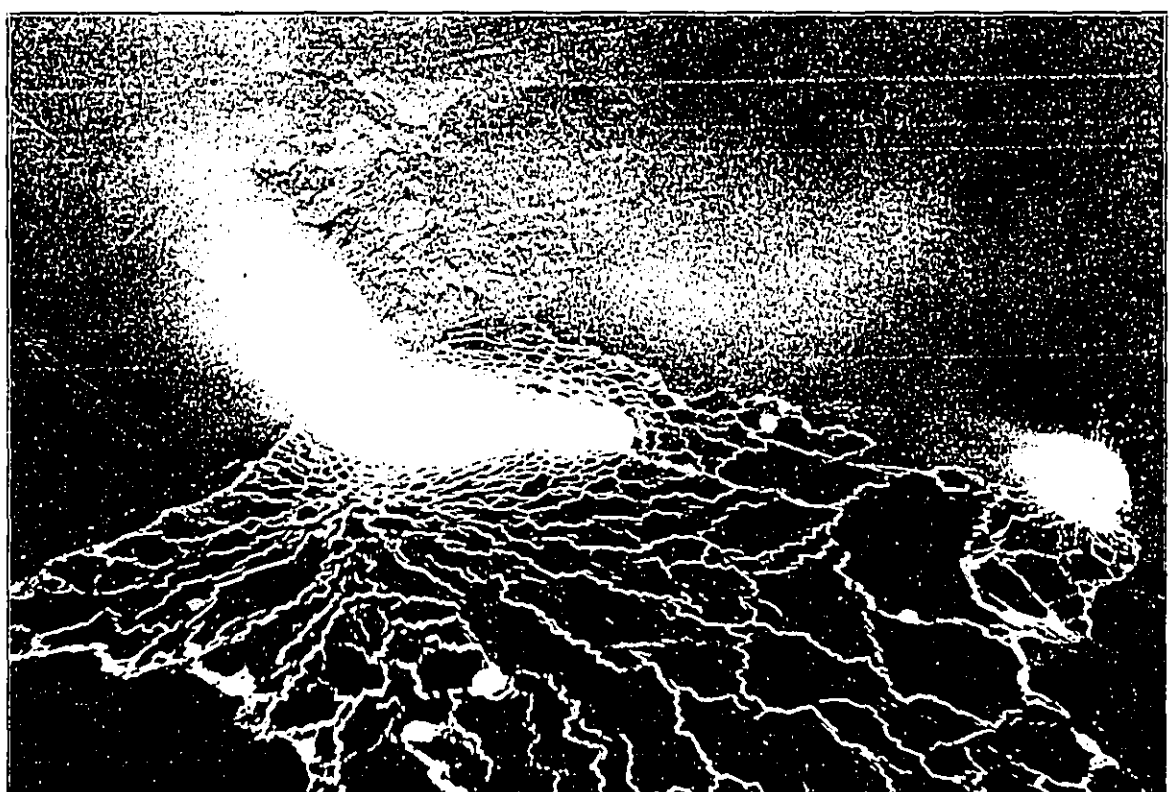
Little of importance has happened at Halemaumau pit during the past week. On February 25 the dust on the crater floor had been washed away by heavy rains. Dust from slides was seen occasionally during the week, notably at 12:30 p. m. and 1:08 p. m. February 26. Vapor was notably absent from the usual places March 1.

The seismographs registered three very feeble local seisms indicating distances of origin 34, 44, and 51 miles; and 8 spells of tremor. Microseismic motion increased February 27-28 along with strong northeast wind, and has otherwise been moderate. Tilting of the ground was strong NE.

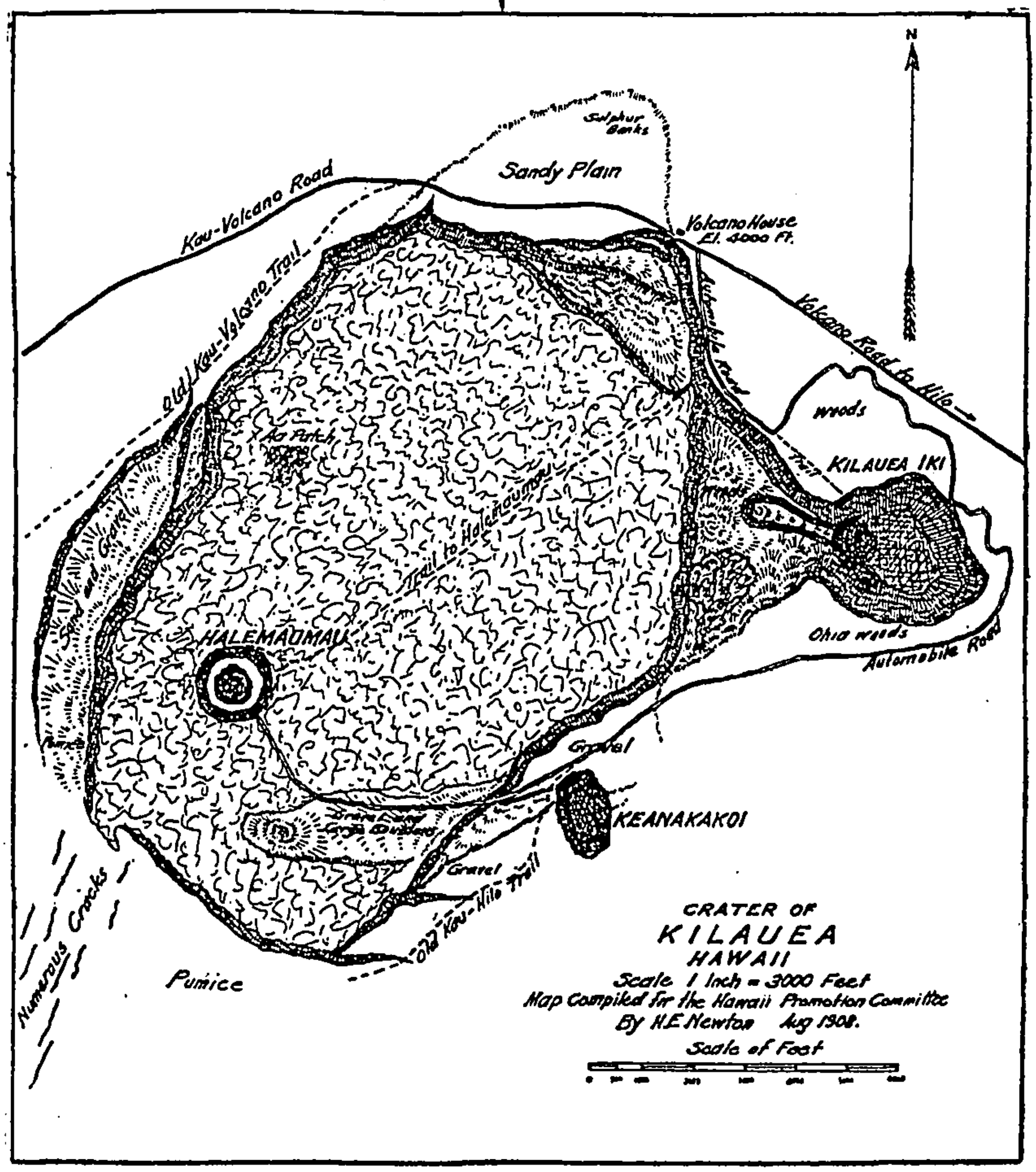
FEBRUARY TILTING OF THE GROUND

At the Hawaiian *Volcano Observatory, on the northeast* edge of Kilauea Crater, just opposite the Volcano House, the tilting or tipping of the ground as measured with seismographs in a concrete basement was as follows, expressed as angular change and direction of motion of the plumb line:

January 27—February 2	5.38 seconds SW
February 3—9	3.03 seconds NE
February 10—16	2.66 seconds SW
February 17—23	1.39 seconds SSE
February 24—March 2	5.26 seconds NE



The eruption of February 20, 1929, for comparison, showing approximate outline of the floor over which the new eruption poured its lava. The new eruption source was at the extreme left, and all the area here shown had become cold and solid when the July flood began. Photo Maehara. Copyright.



Old map of Kilauea, showing general relation of Halemaumau to Kilauea Crater. Present inner pit is much larger, and the new Chain of Craters Road now extends off to the southeast.

THE VOLCANO LETTER

The Volcano Letter combines, after January 1, 1930, the earlier weekly of that name, with the former monthly Bulletin of the Hawaiian Volcano Observatory. It is published weekly, on Thursdays, by the Hawaiian Volcano Research Association, on behalf of the section of Volcanology, U. S. Geological Survey. It promotes experimental recording of earth processes.

Readers are requested to send articles, photographs, publications and clippings about volcano and earthquake events, instruments and investigations, especially around the Pacific.

Subscription for non-members two dollars per year of 52 numbers. Address the Observatory.

HAWAIIAN VOLCANO OBSERVATORY
Founded 1911

This laboratory at Kilauea Volcano belongs to the Hawaiian Volcano Research Association and is leased and operated by the United States Geological Survey.

It maintains seismographs at three places near Kilauea Volcano, also at Hilo, and at Kealakekua in Kona District. It keeps a journal of Hawaiian volcanic activity and publishes occasional Bulletins.

Membership in the Hawaiian Volcano Research Association is limited to patrons of Pacific science who desire personally to aid in supporting the work.

The work of volcano research so supported is in collaboration with the work of the United States Geological Survey, but supplements it with buildings, research fellows, instrumental plants, explorations and special investigations for which there is no governmental provision. The Geological Survey maintains volcano stations in Alaska, California and Hawaii.

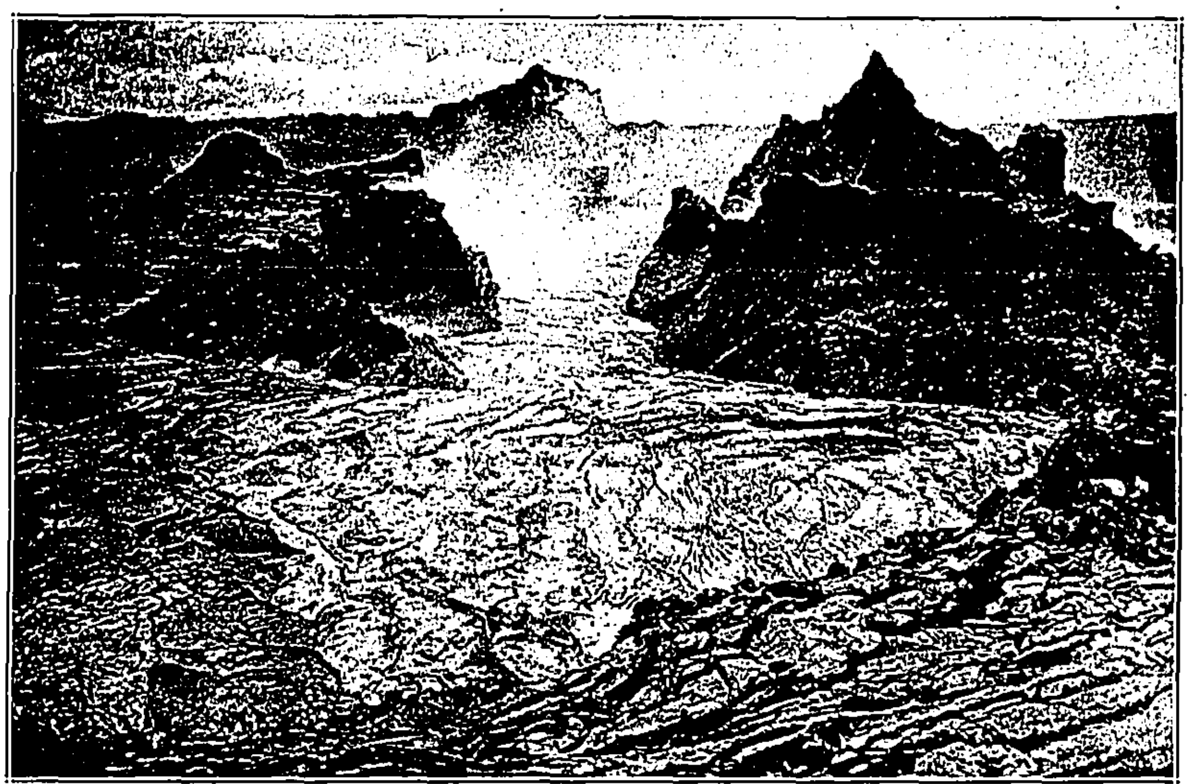
The Board of Directors includes Lorrin A. Thurston, President; Frank C. Atherton and Walter F. Dillingham, Vice-Presidents; L. Tenney Peck, Treasurer; Wade Warren Thayer, Arthur L. Dean, and Richard A. Cooke.

Persons desiring application blanks for membership should address the Secretary, Hawaiian Volcano Research Association, 300 James Campbell Building, Honolulu, T. H.

The Volcano Letter

Two dollars per year — Ten cents per copy

No. 272—Weekly — Hawaiian Volcano Observatory, National Park, Hawaii — March 13, 1930



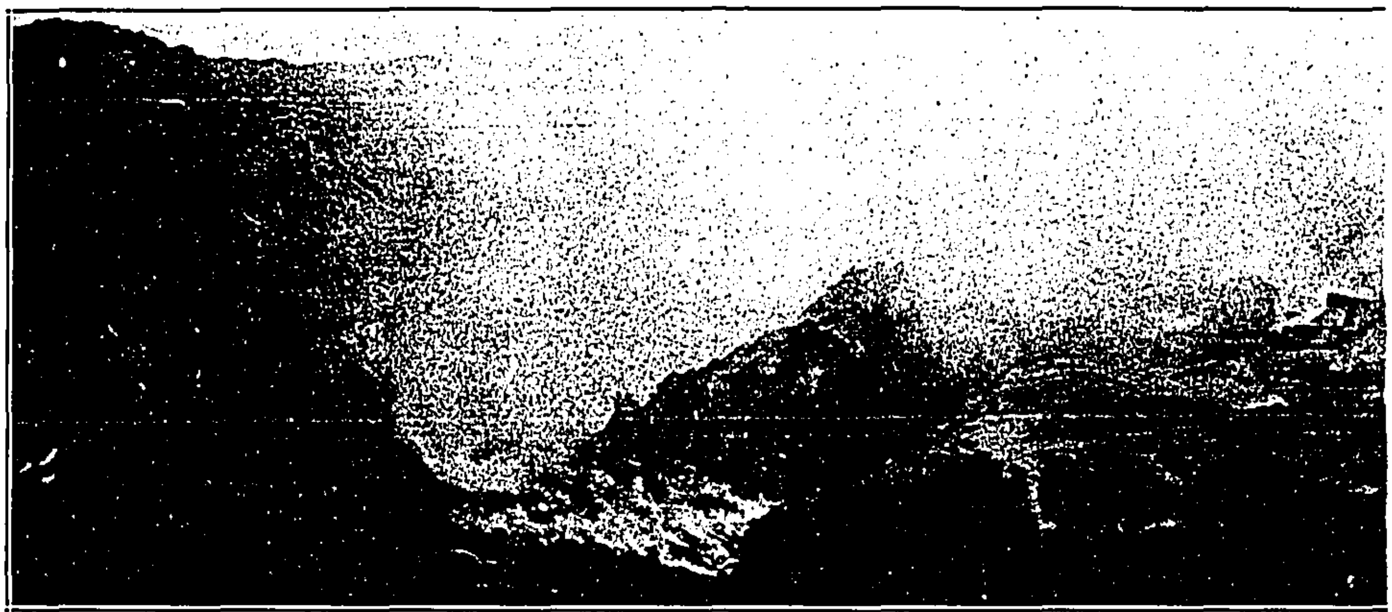
Interior of Halemaumau pit September 20, 1921. Crust of the north pool of the main lake in the foreground is being overflowed with liquid lava by the cracking up and sinking of the surface blocks. The crags are old overflow platforms, inside the pit, swollen up and tilted. Photo Jaggar.

LAVA FROTH AND LAVA PASTE

One of the most far-reaching discoveries made by continuous observation of the liquid lavas in the fire pit at Kilauea is that the lava in motion divides itself into two substances. This fact has been misapprehended in the past, owing to the supposition that the one substance is the liquid or molten material, and the other substance is the portion which has solidified. What are here referred to are two substances, both of which are liquid. Generally their viscosity differs, so that the one substance is highly fluid, and the other substance, forming the bottoms of the lava lakes, the side walls of the lava lakes, and forming the beds and marginal fields of the lava rivers, is semi-solid or pasty but mobile and red-hot. And this mobility shows itself in that the bottoms and side walls of the lava lakes, and the overflow fields of the lava flows all move with the liquid torrents, but with a more uniform pasty flow.

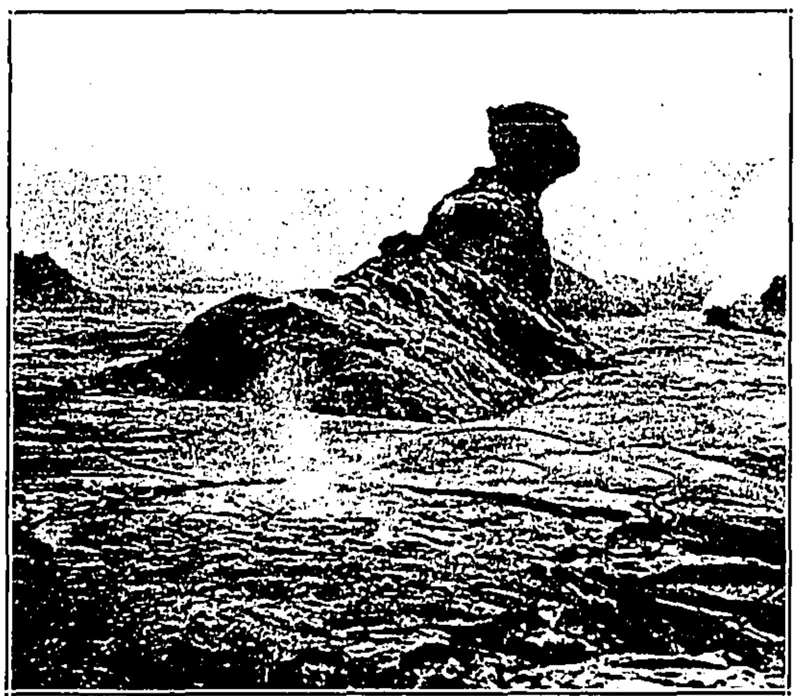
In the photograph on Page One the observer is looking toward the middle of Halemaumau pit from the north rim in September, 1921, when the lava column as a whole was rising. The black cliff in the background is the rim of the pit. There had been a strong lowering of the entire circle of crags and lava lakes during the preceding six months, and now the lava was rising again. The lowering in question had followed the tremendous overflowing of the pit rim in March, 1921. So the two equinoxes had produced risings. When the picture was taken, the very day of the equinox, there was a flood of glowing liquid lava welling over the border of the liquid lake and up through the crusts of the north pool in the foreground. A lake of liquid lava is often crusted over like a frozen pond in winter. The crusts burst apart if the pond below rises, and as the hardened crusts are heavier than the gassy froth beneath, they tip up and sink. That is what is happening in this picture and the jumble of peaks is a part of the paste on top of which the liquid lake maintained an irregular shallow saucer of its own. The platform in the foreground was a part of the rim of this saucer. The flat crusts being flooded on the left were the frozen surface of the main lake. The high peak on the right stood 105 feet above the lake which was boiling and liquid in the central region among the crags. The lake surface stood 75 feet below the pit rim.

The reader may well ask, "How can a jumble of peaks be a paste? Surely these are floating islands in the lava?" This conception of floating islands is a time-honored fallacy. Solidified basalt has a higher specific gravity, therefore is heavier, than liquid basaltic melt. Much more is it heavier than gas-foamed liquid basaltic melt of the fountaining and flaming lava lakes. Therefore solidified crusts sink, and solid crags and peaks certainly do not float on liquid lava. These solid crags grade downward into a red-hot, dense, heavy substance which from time to time has revealed itself as continuous with the rock of the crags, extending under the liquid lakes as submerged



Halemaumau from the north September 14, 1920, after many months of low and smoky lava. The small island in lava lake is the same as the one suddenly uplifted in the picture below. Photo Hilo Photo Works.

incandescent cliff or bank or shoal. The nature of the revelation has been by sudden uplift, forty feet in a few hours, of the shoreline of a lava lake, or by sudden downward drainage of the lake itself. These processes have revealed smooth glazed surfaces under the lake, and comparatively small wells or tunnels feeding the liquid slag into the shallow lake basin. The half-hardened paste of the inner crag matter is the substance from which these basins are sculptured. All the lake basins are shallow, because the lakes are puddles of rapidly cooling melt maintained liquid by the hot gases which are rapidly escaping. The lakes cool and partially solidify on the bottom and



Island in the central lava lake of Halemaumau which was lifted suddenly March 15-16, 1921, by the swelling up of the lake bottom, revealing a mushroom stem and a broad base. This heaving of the lava paste preceded the gushing of the liquid lava March 18. Photo Jaggar

at the sides. The side solidification forms a rampart over which the rising lake floods in short-lived fills which stratify. The feeding well, up which the hot lava froth rises through a deep accumulation of this lava paste, has its walls continually congealing inward in proportion to the volume and heat of the oncoming new lava from the depths.

The two pictures on Page Two exhibit a small flat lava islet which lifted itself suddenly just before the intense overflowing of March, 1921. This performance was one of the revelations above referred to. The first picture, in September, 1920, was taken when the lava lake had reached a low position of 280 feet below the rim of Halemaumau, and the jumble of crags and lakes was very smoky. The whole lava column had been lowering during 1920. About the September equinox of that year it started to rise just after this picture was taken. The flat triangular islet represented the top of a shoal in the lake, and appeared or disappeared according as the lake lowered or rose more than the pasty lava column of the crags. The islet was a part of this stiff lava column through which a honeycomb of wells fed the lake. When measurements were made with transit from the edge of the pit during the next six months, both the crags and the liquid rose together, the liquid greatly gaining on the crags and partially drowning them about January 1, 1921. Then there was a temporary lowering when the crags emerged again, but the crags also lowered more slowly than the lake. This kind of alternation is the rule in measurements of the rise and fall of the lava column, and these measurements are part of the proof that we have to deal with two substances in the pit, a slow and steady larger mass of paste, and a more tumultuous and erratic smaller body of froth.

The lower picture, and the map on Page Four show what happened just before the intense effervescence and overflow of Halemaumau of March 18, 1921. The islet had reappeared and is shown on the map just under the words "Cent Lake". This central lake was 110 feet below the rim March 14. Then crags and lakes began to rise. This inconspicuous little island, a few feet across, between March 15 and 16 suddenly lifted from beneath the lake, and became a huge ungainly gray monster with rounded back, flat topped head, and slender neck. This great bulk of lake bottom substance, which was pushed up faster than the liquid in the center of the pit, demonstrated a swelling in the under paste that was exceptional.

During the next 24 hours the crags rose 10 feet, and then came the intense fountaining up of the liquid in artesian fashion so as to fill the whole vast cylinder of Halemaumau to overflowing in six hours. Approximately 283,000 cubic feet of liquid entered the pit in that time, allowing 50 per cent of the space to the hard paste. This would imply an inflow of more than 47,000 cubic feet per hour.

The lifted islet in the third picture stood like a thin-stemmed wine glass on top of the newly uplifted hill of lava dross. The summit stood 40 feet above the lake like a tilted toadstool threatening to fall at any moment. A portion of it broke away the next day. The lower hill was a rounded black elephant's back with a smooth surface and some shore marks steeply upturned. Evidently the stem of the islet had narrowed just below lake level in the days before the uplift and during the uplift the whole mass was toppled over towards the west.

In the *cross-section under the* map (Page Four), a feeding well is indicated at the southeast, and one of the connecting tunnels following the wall crack, or edge region, of the fill, at the northwest. These tunnels have the same kind of history as the wells. They represent a solidifying inward of the walls of a surface stream of slag, until the stream is flowing in a sewer pipe of its own making. The cross-section shows how much bulkier is the paste or craggy matter, as compared with the liquid. There is good reason, based on experiment, for thinking that the rising liquid gets hotter upward, being heated by reactions between the gases that are escaping from solution to the bubble form, and are increasingly mixing with oxygen. Technically we speak of the paste as the "bench magma," the word "magma" meaning dough, and the liquid lakes or flows as "lake magma." This dual quality of basaltic lava we shall have to consider further in treating of smooth-lava and clinker-lava flows. T.A.J.

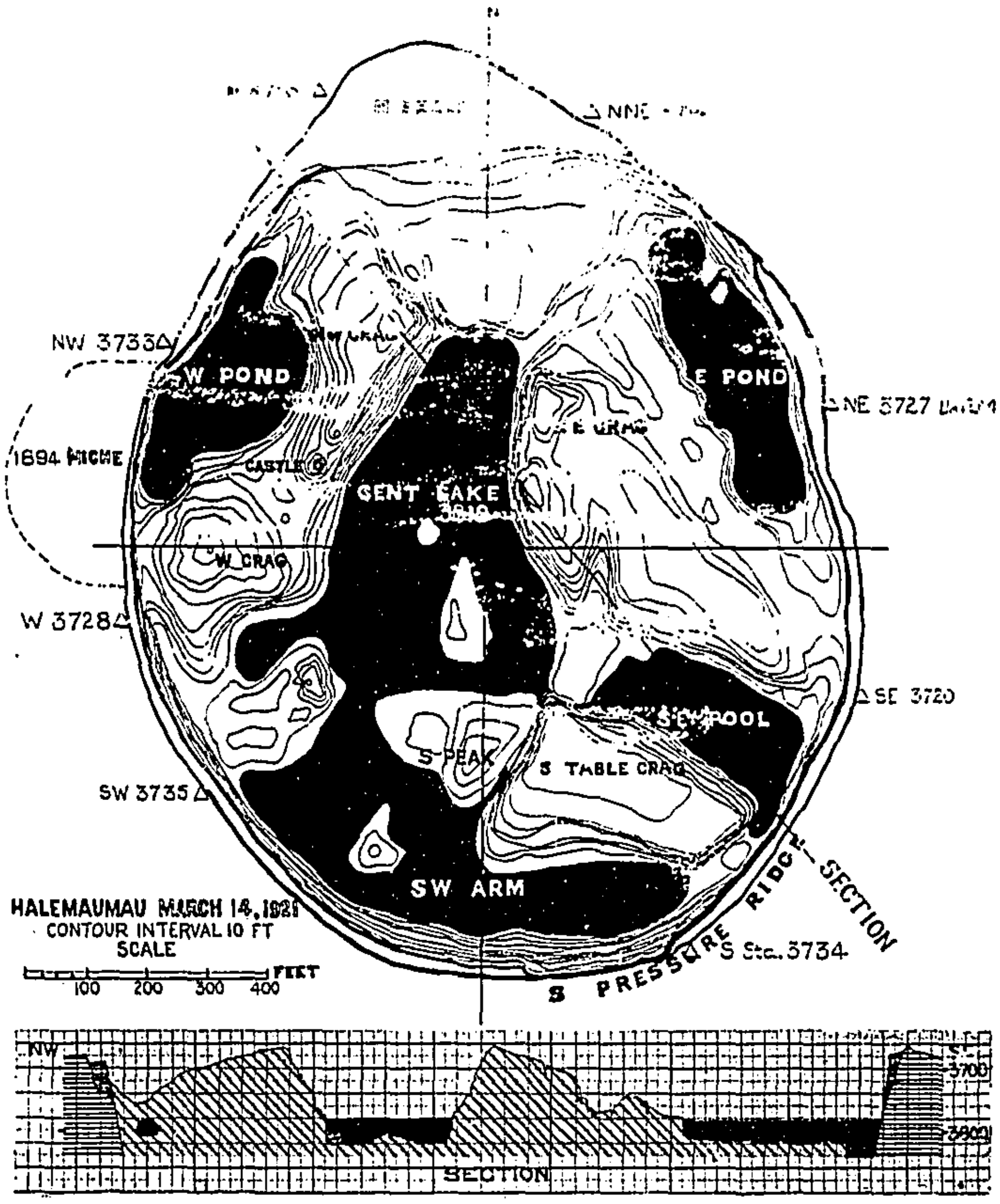
KILAUEA REPORT No. 946

WEEK ENDING MARCH 9, 1930

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

On March 5 it was evident at the north wall of Halemaumau that sliding had been resumed leaving fresh breaks in the wall. About six slides were noted by workmen during the day. The roar of a slide was heard at 2:34 p. m., and another was seen a few minutes later, both causing dust to rise. The pit seismograph indicated 12 avalanche tremors during the preceding day. At 3:15 p. m. there was another dust cloud. Two dust clouds at 11:15 a. m. and 11:40 a. m. March 6 indicated fairly large avalanches. On March 8 there were slides at the north and northwest walls, and on March 9 slides were numerous during the forenoon, one making a large dust cloud at 10:50 a. m. About 4 p. m. a very large cauliflower cloud rose over the whole pit from an unusual avalanche.

The seismographs at Kilauea registered during the week 5 tremors, 7 very feeble local seisms, and one rcorded as feeble indicating origin distance 9 miles 10:56 p. m. March 8, and reported as felt in Hilo. Three other distances indicated for very feeble shocks were 31, 38, and 46 miles. Kapapala reports numerous recent shocks. The tremors lasted from one-quarter to three-quarters minute. Microseismic motion was slight, and tilting of the ground was slight to the north.



Map and profile section of Halemaumau, surveyed March 14, 1921. Shows the very small central islet before its upheaval March 16. Elevations in feet, bench lava in 10-foot contours referred to lake level, liquid lava black. Surveying stations indicated by triangles. Survey by Jaggar.

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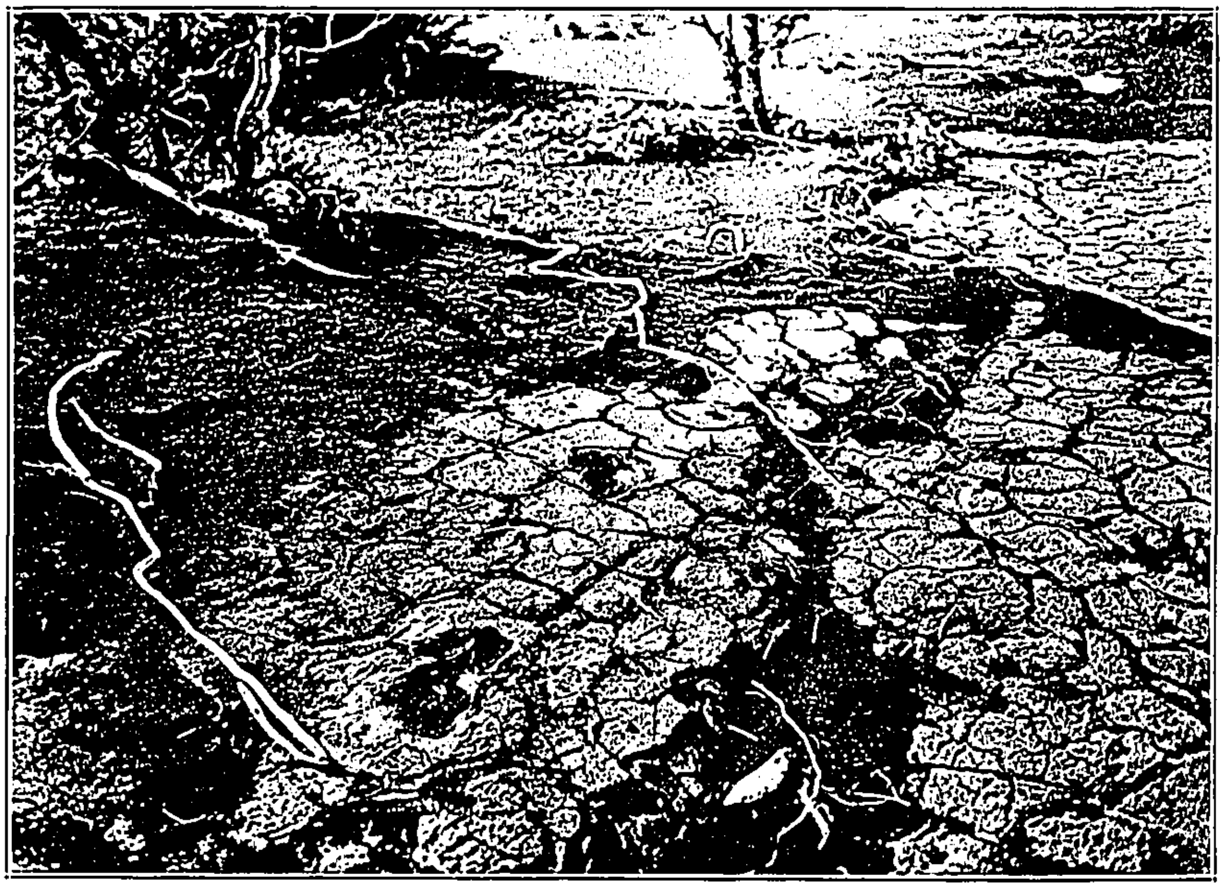


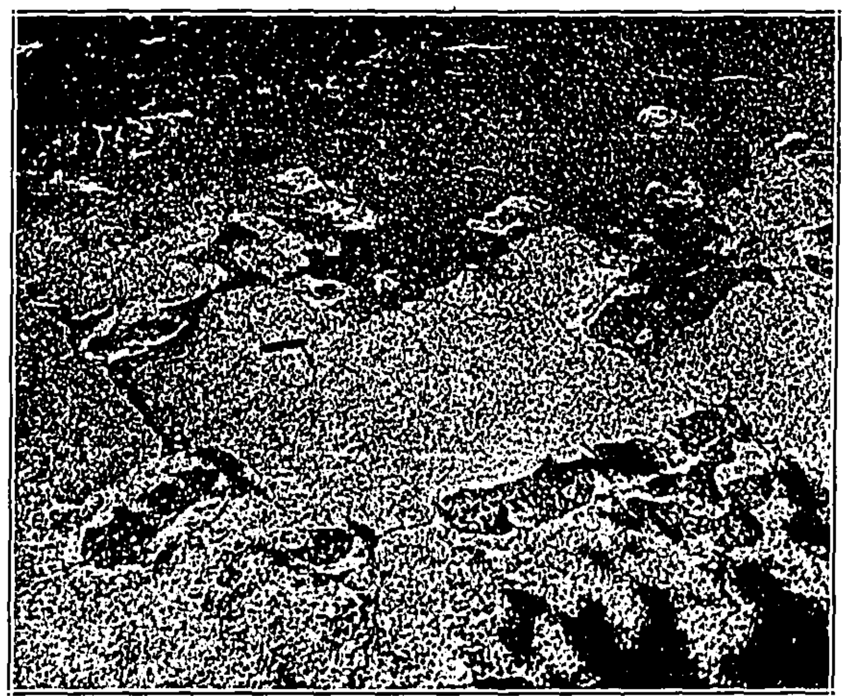
Photograph of fossil human footprints in the lower of two layers of Kilauea ash mud of 1790. The upper layer is here eroded away. There was black sand and cinder between the two layers. The ash is a hardened natural cement. As these footprints are in the ash of the first ash eruption, and are elsewhere buried under the second ash layer, they must date from the eruptive period. Photo Jaggar.

THE HUMAN FOOTPRINTS IN KILAUEA'S ASH BED

Two archeological discoveries of interest as bearing upon the human side of the ancient eruptions of Kilauea were made in 1919 and 1920 as incidents of the work of the Hawaiian Volcano Observatory. One of these was the finding by R. H. Finch of well preserved hardened footprints in what had been the ash-mud of heavy rainfalls in the Kau Desert southwest of Kilauea Crater, dating from the explosive eruption of that crater about 1790. The other was the unearthing of a skeleton on the second shelf of Uwekahuna bluff by the late Joseph Hedemann. This discovery was made February 21, 1919, among the big bowlders a little way below the Uwekahuna Museum, and the remains appeared to represent a very ancient burial of a woman in reclining posture, half covered with ash and washed soil, and walled in between two large rocks. The evidence indicated a time of burial not far removed from 1790. The locations of these two finds may be identified on the accompanying map of Hawaii as just to the west of the head of the flow of 1920 at the edge of the National Park, for the footprints, and the west cliff of Kilauea Crater, for the skeleton.

The photograph shown on Page One exhibits a surface of ancient, sun-cracked mud which consists of what geologists call pisolitic ash. Pisolites are little pea-shaped balls occurring all through a layer of the ancient rock dust that fell over the country during an explosive eruption. This dust was hurled upward in the midst of clouds of steam, and fell round about like snow. It is characteristic of such times that the atmospheric moisture condenses as heavy rainfall ,usually with thunder and lightning. When the dust is caught in the raindrops, the rain falls as mud. If such mud drops fall along with dry ash, or into beds of dry ash, they will form a layer of pellets. These pellet layers were common in the explosive eruption of Kilauea in 1924, and at Vesuvius in 1906. If the rain is abundant the ground may be muddy while still preserving the identity of the pellets. If this muddy ground is afterwards heated by the sun, it will shrink and crack in irregular blocks as shown in the picture. The volcanic dust had been greatly roasted by the combined fire and steam activities of the eruption of 1790, and this made it into a weak Portland cement. On drying it would harden and resist erosion for many years.

Between the two white sticks in the foreground of the picture may be seen two footprints which are the impressions in this muddy cement of large, naked, human feet advancing toward the observer, the left foot at the back with its ball joint and big toe clearly seen on the left-hand side of the impression, and the right foot in front showing complete heel and toes, the print being filled with drifted black sand. The stride was long and in a direction down the mountain with the ball of the foot digging in as though the man were hurrying. It will be observed that the drifted dune sand and cinder lie over



Footprints of adult, probably the mother, in hardened ash of foreground, and of child in background. They show the impress of separate toes. These were progressing to the right, or down the mountain. Penknife shows scale. This is the upper ash layer, without sun cracks, and the little white pellets are fossil mud raindrops. Photos Jaggar

this layer of sun-cracked mud. This fact is of importance, for in the second photograph on Page Two, footprints are shown in another and higher layer of the same kind of ash filled with fossil raindrop pellets, having the dark cinder underneath the ash layer. This upper layer is also cemented, but it is everywhere lacking in the sun cracks, which are characteristic of the lower layer. The upper layer has pebbles which fell during the eruption, the lower layer has none. Everywhere the two layers may be found in this same relation, with the dark sand and cinder in between, and the whole thickness from two to six feet of beds in different places. What they mean is that there was a first eruption that deposited the lower ash and pellet layer without any pebbles; then there was a more violent eruption which buried this layer under sand and cinder; finally came more fine ash, mud pellets, and a little cinder to pepper this last layer with pebbles. These several eruptions may have been hours or days apart.

Now we have shown in photograph No. 1 that after the first layer was formed and before the sun had come out and dried it, a big native strode down the mountain and left his footprints, before the violent flurry of ash and cinders buried them up. The surface that we see in this photograph has been washed clean by more recent rains, for nine-tenths of the ash of this period has been eroded away. It is only in a few fortunate hollows that this footprint record is preserved. A few other footprints have been discovered in the lower sun-cracked layer, and they usually show that the makers were running and going down hill. On the other hand, the footprints in the upper layer are more leisurely, are crowded in large numbers and represent men, women, and children, and are progressing both up and down the mountain. In other words, the persons present at the time of the lower layer were there in the midst of the dangerous period, with more eruptions yet to come. This succession proves conclusively that the footprint-making was contemporaneous with those explosive eruptions.

Who made the footprints? Why were natives in considerable numbers crossing the mountain just at the time of this dangerous eruption? The missionary Ellis tells us (Narrative of Tour Through Hawaii, by William Ellis, Hawaiian Gazette Company Ltd., Honolulu, 1917) that Keoua considered himself the legitimate heir to the throne of the island of Hawaii and in the year 1789 marched from Hilo with all his forces to attack the warriors of Kamehameha in Kau and Kona. He crossed Kilauea Volcano, and "an eruption took place that very night, and destroyed the warriors of two small villages, in all about 80 men." The Hawaiians told Ellis that Pele favored Kamehameha, and aided his cause by destroying Keoua's soldiers. Keoua had broken the tabu of Kilauea, Pele was exceedingly angry "and soon after sunset repeatedly shook the earth with the most violent heaving motion, sent up a column of dense black smoke, followed by the most brilliant flames."

"A violent percussion was afterwards felt, streams of bright red lava were spouted up, and immense rocks in a state of ignition were thrown to a great height in the air. A volley of smaller stones, thrown with much greater velocity and force, instantly followed the larger ones, and striking them caused the larger stones to burst frequently with a report like thunder, accompanied by the most vivid flashes of lightning."

"Many of Keoua's people were killed by the falling fragments of rocks, and many were actually buried beneath the overwhelming mass of ashes and lava." Not intimidated by this event, Keoua continued his march, and the volcano continued its action, confining its operation within the boundaries of Kilauea. Ellis states that he heard this account several times from natives with some little variation as to the numbers killed, and a variant of the story said that Pele appeared to Keoua, in the column of smoke as it rose from the crater. The main facts about the natural history of the eruption he believed to be true.

Other accounts of this eruption indicated that Keoua camped three nights at the volcano while eruptions were in progress, especially at night. On the fourth day he divided his people into three companies, with the chief's division in front, and they had not proceeded far before the ground shook violently, and then an immense black cloud rose out of the crater and produced darkness. Black sand, stones, and dust came down in a destructive shower, some of the first party were killed, and all of the second division were asphyxiated with the hot dust and their corpses were discovered by the third division, some lying down, others sitting up and clasped in farewell embrace. The warriors had their families and livestock with them, and the only living being discovered was a solitary hog.

It is probable that the fossil footprints were made by Keoua's people. The second picture shows the footprints of an adult in front and a child in the background headed down the mountain at the locality west of Mauna Iki where probably the natives were beyond immediate danger, trudging through rain-soaked puddles of muddy ash. This material now is hard enough for a man to walk over it with heavy boots without breaking the shell. Some broken crusts may be seen in the foreground on Page One. This trail of fossil footprints has been followed uphill from the southwest for seven miles in the direction of the west side of Kilauea Crater to a point a mile and three quarters southwest of Uwekahuna bluff. Here the material of the upper layers is coarse and pebbly, but a lower layer of fine ash, corresponding to the mud-cracked stratum of Photograph One, reveals footprints at the margins of erosion patches where the bottom layers protrude. The track of a barefoot adult was found headed south, with stride 24 inches long and foot 10½ inches long, and some of the ash surfaces showed raindrop imprints as well as the pellets. Other tracks were headed north, made by a smaller person, with long strides as though running. There are several places along the trail where the walkers converged to narrow passes so that the ash was beaten down by many feet. (For discussion see Bull. Hawn. Volc. Obsy., July and October, 1921.)

The burial represented by the skeleton (now in the Bishop Museum) lay just on the line of this trail where it would have passed Kilauea. The ash there is too pebbly to preserve any footprints. The skeleton may have been one of the priestesses of Pele. There was formerly a heiau or Hawaiian temple to Pele somewhere in this vicinity. It is also possible that this was one of the victims of the eruption among Keoua's people. T.A.J.

KILAUEA REPORT No. 947

WEEK ENDING MARCH 16, 1930

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

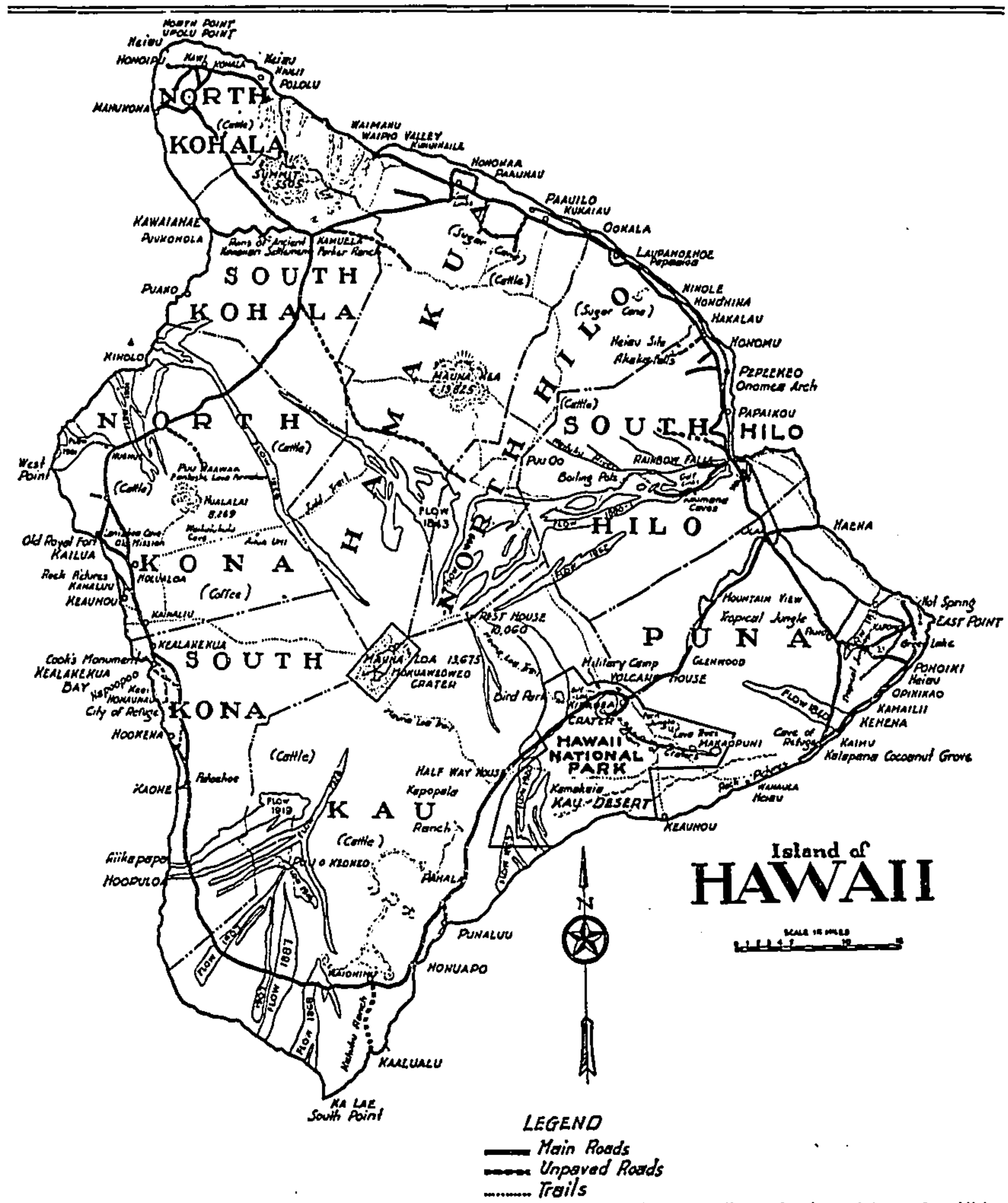
Numerous slides occurred at Halemaumau March 10 to 14. These were mostly from the north rim and wall, as during previous weeks. The seismograph near Halemaumau recorded many avalanche tremors not strong enough to be registered on the Observatory instruments farther away. Probably the largest slide during the week was at 8:35 p. m. March 12. Sliding was nearly continuous between 6:30 and 7 a. m. March 14, and a few light falls of rocks were heard later in the day.

Heavy rains fell, causing much steam at times. Steam was as usual on the south talus and wall.

A total of 15 seismic disturbances were recorded by the instruments at Kilauea, divided as follows: nine tremors, five very feeble seisms, and one feeble seism felt locally and in Kau at 6:01 a. m. March 13. Its indicated distance to origin was 10 miles.

Tilt at the Observatory was moderate to the southwest. Microseismic motion was slightly stronger than normal.

Skeleton burial found lying in niche between bowlders on high east face of Uwekahuna bluff, the west cliff of Kilauea Crater. The skeleton was in a half-seated position, facing toward Halemaumau, walled in in front. Length from skull to end of spine 27.5 inches. Photographed February 25, 1919.



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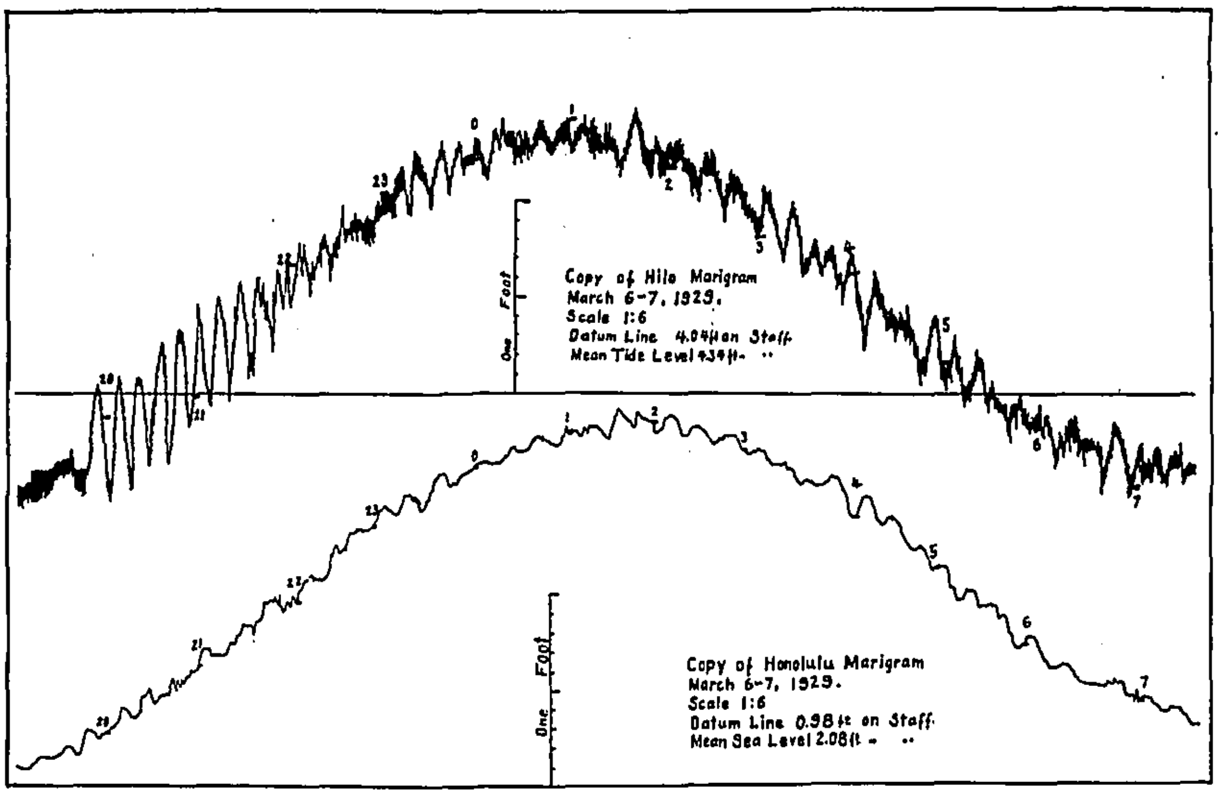


Tide gauge writings at Hilo and Honolulu showing on the left of the Hilo marigram the pronounced waves of the ocean from a distant submarine earthquake off the Aleutian Islands March 6, 1929. The Honolulu record shows only a faint trace. The datum line for each marigram is at the base of the one-foot scale.

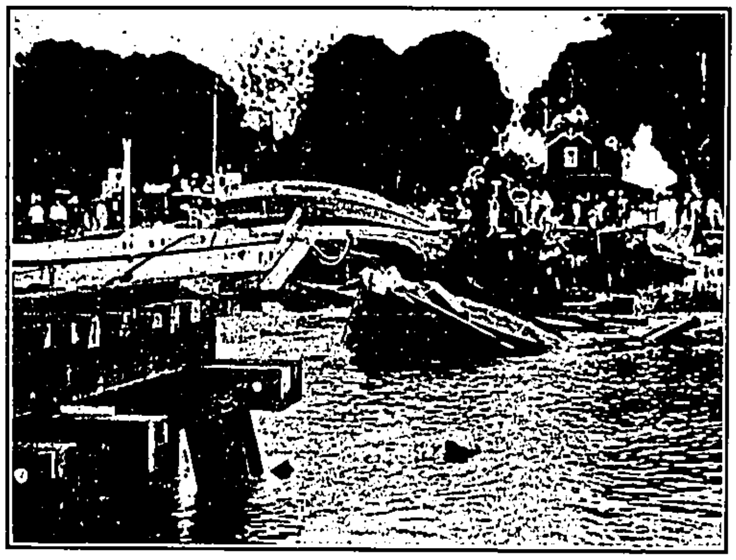
OCEAN WAVES FROM SUBMARINE EARTHQUAKES

In the Volcano Letter of February 13, 1930, a seismogram is shown, the autograph written by a pendulum at Kilauea Volcano recording slow waves through the mountain from a gigantic earthquake in southeastern Alaska. The earthquake originated in the mountains 2,700 miles away, and a few minutes later the magnifying apparatus attached to the pendulum in Hawaii indicated swayings with a period of 10 seconds, elastic wave movements swinging the rock of the Hawaiian ridge back and forth about one thirtieth of an inch. At the source the jolts may have shaken the mountains back and forth several inches in a period of a second or so. The waves slow down and widen out as they progress rapidly through the substance of the globe.

This earthquake was in the mountains and so did not affect the sea bottom. But there are many such earthquakes off the coast of Alaska and the Aleutian Islands which jolt the deep valleys under the sea, and probably drop the bottoms of those valleys, sometimes by several feet. On the coast there was a measured lift of over 40 feet during an earthquake spasm in 1899 at Yakutat Bay. These lifts of the continent are believed compensated by drops of the sea bottom. Such movements may be more than 100 miles long, and a large block of water of the ocean is instantly and violently disturbed. This water is thrown into what is called a tidal wave, or tsunami, having its own period and rate of propagation across the ocean dependent on reflection from the shores, on resonance with or opposition to the normal tide waves of that ocean, on the depth of the ocean both at the place of disturbance and along the route of travel, and finally, for any place where the tidal wave is received, on the shelving quality of the shore and the local complication with waves due to the wind.

There is popular misunderstanding about what a tidal wave can do when it arrives. Hundreds of sea waves due to earthquakes arrive at San Francisco, Los Angeles, Callao, Queensland, Japan and Hawaii which are recorded only by the tide gauges. The public does not know of their existence. When a very exceptional one piles up the waters in a confined bay back of a shelving bottom there may be a disaster, but these are rare. Much the same kind of a disastrous shore flood may be produced by persistent hurricane winds as in the Galveston, Mobile and Florida disasters. In all cases the piling of the waters goes into unfortunate rythmic harmony with the local waves and tides, for every bay has its own normal swing of several minutes duration, like a big pendulum.

The two tracings of tide gauge curves on Page One represent the swing of the same tide for 12 hours beginning at 7 p. m. (19 o'clock) March 6, 1929, the range be-



Wreckage in Wailoa River February 3, 1923, at Hilo, Hawaii, due to the piling up of the waters from a distant Aleutian earthquake under the Gulf of Alaska seven hours earlier. Sampans were thrown over the railway bridge which was destroyed, at Waiakea station. Photo Morihiro.

ing about two feet up to 2 a. m. March 7, and back again by the same amount around 8 a. m. of that date. The upper curve was written by a float under the wharf at the head of Hilo Harbor back of the breakwater, and the lower curve was similarly written for Honolulu Harbor. It will be observed that both curves in the right-hand halves exhibit three or four swings to the hour each 20 or 15 minutes long. These are the normal seiches or water basin swayings dependent on the sizes and shapes of the Hilo and Honolulu basins respectively. When the earthquake wave comes in, as strongly shown in the 15-minute pulsations at 20 o'clock on the left-hand side of the Hilo marigram, and hardly shown at all on the Honolulu marigram, this normal pulse of the bay is exaggerated into a pronounced oscillation which dwindles and dies in three hours.

This tidal wave movement of Hilo Bay was forecast on the seismographs in Hilo, at Kilauea, at Kona, and in Honolulu about 3:11 p. m. by the outbreak, so to speak, on the writing pens, of the record of a tremendous submarine Aleutian earthquake. The imperceptible underground waves caused the wirting pens on the Hilo seismograph to swing back and forth 10 inches and to write for more than three hours; and even to write the record of the earth wave that went around the other side of the globe remote from us so as to arrive here at the end of about four hours. This means a very big earthquake; the origin was indicated by the seismogram to be 2,200 statute miles away and that distance could not mean a mainland earthquake, therefore a submarine disturbance was a certainty. The evidence favored an origin either north-northwest or south-southeast of Hilo, which would be either near the Aleutian Islands, or else near the Marquesas Islands. If it were north, the expectable ocean wave would reach the north side of Oahu and the east shores of Maui and Hawaii; if it were south, the stronger movement of the waters might have been recorded at Honolulu, but past experience did not make a southern origin probable.

The nature of the seismogram resembled that of an Alaskan earthquake of February 3, 1923, which had made a destructive tidal wave at Kahului in Maui and at Hilo in Hawaii about seven hours after the earthquake happened in the north Pacific. The record had come to our seismographs about seven minutes after the jolt at the origin. There was thus plenty of time to notify Hilo of the possibilities in the case, and this notification was given, but was not on that occasion taken seriously. The indicated distance to origin in 1923 was 2,500 statute miles, and the origin proved to be under the ocean about 250 miles ESE of Unimak Pass in the Gulf of Alaska. There was probably a sudden inrush of ocean waters over a lowered sea bottom, and then a wave spread out across the Pacific with a speed proportionate to its size. It is this great speed which makes these waves comparable to tides, and the free wave of the daily tide lifted by sun and moon in the north Atlantic Ocean, a basin 3,000 miles wide, travels some 500 miles an hour. Either a tide or an earthquake wave may become dangerous if forced on a shelving shore. The Galveston flood was a wind-forced tide. The wave of 1923 at Hilo began about 12:30 p. m. and smashed sampans over the Hilo railroad bridge across the Wailoa River (see photographs Pages Two and Three). This wave reached Haleiwa in northern Oahu at 12:02 p. m., and it traveled thence to Hilo at about 5.18 statute miles per minute. At Waikiki in Honolulu the first movement was a long recession of the waters revealing new reefs during about 20 minutes. Then there were in-and-out surges at intervals of 15 to 20 minutes. This earthquake was strongly felt in Alaska, was registered on seismographs all over the world, and the sea wave was registered on tide gauges in San Francisco, South America, and at Adelaide, Australia.

Returning to the seismogram of March 6, 1929, although the origin was even nearer than the center of February 3, 1923, and the amplitude of the motion in Hawaii was greater, and although Unalaska reported a severe shock on land and telegrams from steamers confirmed the location as south of the middle Aleutian Islands, where the crews on the vessels felt the bump; yet the amplitude of the sea wave, as shown on Page One, was only about seven inches at Hilo and two inches in Honolulu, and the surge in the sampan basin of the Wailoa River, lasting from 7:45 p. m. until 10 p. m. at intervals of 15 minutes, was something over a foot. Even this movement at its maximum between 8 and 9 p. m. was sufficient to break the stern lines of a steamer at one of the wharves back of the Hilo breakwater. The sampan fleet anchored out in the bay until the disturbance was over. The harbor authorities are always notified of the facts by the Hawaiian Volcano Obesrvatory and take proper precautions, just as any sailor would do at the possible approach of a storm. There is usually much less danger than in the case of a storm, but it would be folly to be unprepared.

Of 11 sea waves due to earthquakes on the sea floor which have been discussed at the Hawaiian station, the rate of propagation has varied from 284 to 481 statute miles per hour. An earthquake 3,915 statute miles from Kilauea in the Acapulco deep, jolted coast towns of Mexico at 4:49 p. m. June 16, 1928, and the sea wave arrived at Hilo 1:18 a. m. June 17, traveling 7.7 miles per minute. The waters at Hilo rose and fell 1.32 feet, the periodic oscillations were 15 to 22 minutes, and the water disturbance was indicated for more than 24 hours. The record was very feeble on the Honolulu tide gauge. On the other hand, an earthquake near Kamchatka December 28, 1927, 3,310 miles away made a tide record as well marked in Honolulu as in Hilo, the sea wave traveling 7.3 miles per minute. (See Page Four.) T. A. J.

KILAUEA REPORT No. 948

WEEK ENDING MARCH 23, 1930

Section of Volcanology, U. S. Geological Survey

T. A. Jaggar, Volcanologist in Charge

There were fewer slides at Halemaumau than during the previous week, though avalanche dust was observed on the 17th, 18th, and 19th. On March 22 a big scar was noticed above the northwest talus. There was little change in steaming.

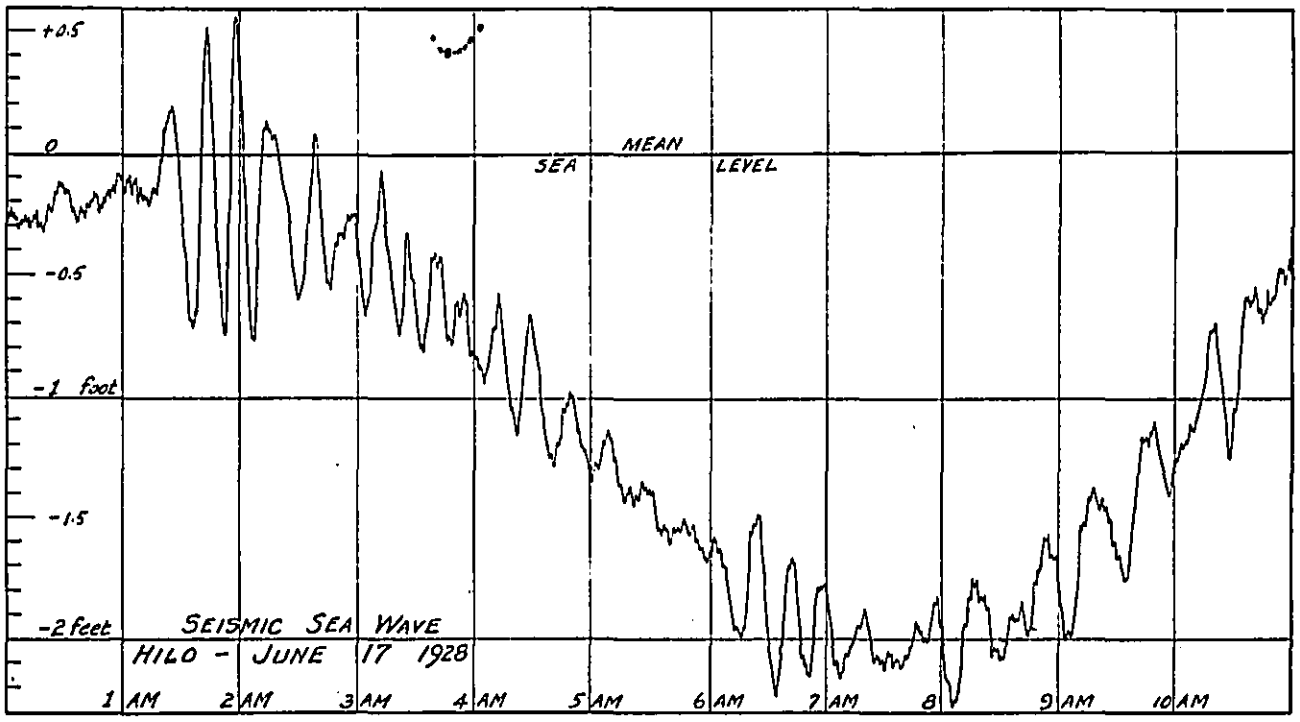
Seven seisms, the smallest number since early September, 1929, were recorded by the Kilauea instruments. Two were tremors and five were very feeble seisms.

Tilting of the ground was slight southwest. Microseismic motion was normal.

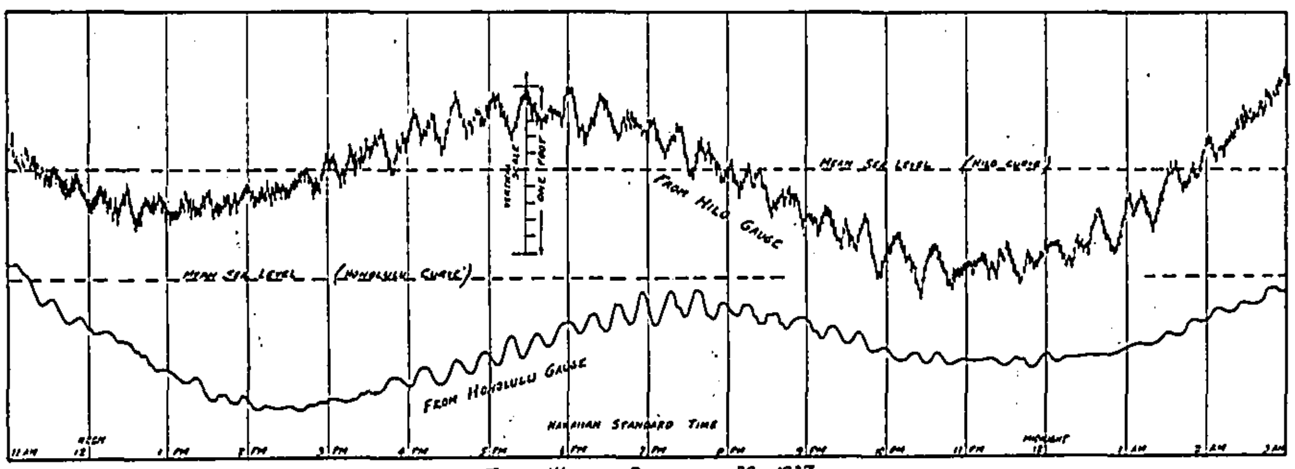
NOTICE

Copies of the Title Page and Index for 1929 have recently been mailed to all persons on the Volcano Letter mailing list during that year. A copy will be sent to any person sending application to the Hawaiian Volcano Observatory, National Park, Hawaii.

Railroad embankment washed down by tidal wave between Hilo and Kuhio Wharf February 3, 1923. The major wave at Hilo was the third noticed visually, and the waters rose over 20 feet in places damaging wooden houses and wharves. Damage was done also at Kahului in Maui. Photo Morihiro.



Tide gauge record of seismic sea wave, Hilo, Hawaii, June 17, 1928 This was made by an earthquake off Mexico.



TIDAL WAVE, DECEMBER 28 1927

Tide gauge records for Hilo and Honolulu compared. These were written December 28, 1927, by a seismic sea wave from an earthquake off Kamtchatka in a direction N 22 W. from Hawaii, and so registering more strongly in Honolulu than in the figure on Page One.

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Founded 1911

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UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HAWAII NATIONAL PARK
HAWAII

OFFICE OF THE SUPERINTENDENT

March 7, 1930

Director,
National Park Service,
Department of the Interior,
Washington, D. C.

Dear Mr. Director:

The report of Hawaii National Park operations and activities during February 1930 is submitted herewith.

000 GENERAL:
Expected volcanic action from either Kilauea or Mauna Loa craters has so far failed to materialize altho the expectation is still retained. This has resulted in our years travel to date showing a poor comparison which however may be compensated later.

100 ADMINISTRATION:
121 Inspections by the superintendent.
In addition to routine work inspections the superintendent made a special trip to the Haleakala section inspecting trail conditions.

125 National Park Service Officers.
Chief Auditor Chas. L. Gable and Chief Landscape Architect Thos. C. Vint, arrived in Honolulu on March 13 where they were met by the superintendent and taken to the Haleakala and Kilauea sections of this park. Mr. Gable has been auditing the books of Kilauea Volcano House Company and aiding the superintendent in administrative matters. Mr. Vint has been working on park planning for areas on both islands.

200 MAINTENANCE, IMPROVEMENTS AND NEW CONSTRUCTION:
210 Maintenance.
The trip to Haleakala revealed the fact that the occurrence of a years rainfall within two months has ruined all trails leading out of the crater and will necessity their repair for immediate travel and their relocation as soon as possible. At present they are so unsafe that funds will be requested separately for this work to be accomplished at once.

250 New Construction.
The Bird Park auto-trail was 93% completed at the end of February.

300 ACTIVITIES OF OTHER AGENCIES IN THE PARK:

311 Character of service rendered public.

Mr. Gable has been making a complete study of service rendered the public by the operators here. It is expected he will make a separate report before leaving the Islands.

400 FLORA, FAUNA AND NATURAL PHENOMENA:

410 Ranger-naturalist service.

Lectures at Uwekahuna Observatory and guided trips of Kilauea crater floor were continued by park rangers. Lack of a suitable naturalist still prevents evening lectures at Volcano House.

430 Volcanoes.

Earthquakes during February were not unusual but a great amount of avalanching occurred in Halemaumau fire-pit. This was caused by continual tilting from underground lava rising and falling.

500 USE OF PARK FACILITIES BY THE PUBLIC:

510 Travel.

1930 travel now shows a decrease of 1929 as February 1929 had a volcanic eruption which attracted many visitors.

520 Weather.

February weather was not unusual for this period of the year.

Maximum temperature	17th	79	degree
Minimum "	20th	47	"
Rainfall for month of February		3.71	inches
" " " " " at Hilo		5.25	"
" " to-date Volcano District		9.63	"
" " " at Hilo		11.52	"

600 PROTECTION:

Private Overman from Kilauea Military Camp became separated from a party of soldiers returning from hike up Mauna Loa and was the cause of a five day search by rangers and soldiers until tracks heading away from this side of the mountain were followed to the main road and Overman was declared not lost but a deserter.

Very respectfully yours,

Thos J. Allen Jr.

Thos J. Allen Jr.,
Superintendent.

Copy to "Field Headquarters" (2)
" " "Yellowstone National Park" (1)

10-157

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

TRAVEL REPORT

HAWAII NATIONAL PARK National Park for the Month of February 1930

	This Month	This Travel Year To Date	This Month Last Year	Last Travel Year To Date	Increase for Travel Year Number	Increase for Travel Year Per cent
PRIVATE TRANSPORTATION:						
Cars first entry.						
Cars reentry.						
Motorcycles.						
Total motor vehicles.						
Persons entering via motor vehicles.	4,741	30,506	13,485	24,555	5,951	.195
Persons entering via other private transportation.	265	1,282	251	1,024	258	.201
Total persons entering via private transportation. . . .	5,006	31,788	13,736	25,579	6,209	.195
OTHER TRANSPORTATION:						
Persons entering via ~~stages~~ Hotel . .	926	3,556	1,552	4,375	- 819	.189
Persons entering via trains . .						
Persons entering otherwise. . .						
Total other transportation. .	926	3,556	1,552	4,375	- 819	.189
GRAND TOTAL ALL VISITORS. . .	5,932	35,344	15,288	29,954	5,390	.152

	This Year	Last Year	Increase Number	Increase Per cent
Automobiles in public camps during month	0	1	- 1	100
Campers in public camps during month	0	3	- 3	100

10-158

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

STATUS OF AUTHORIZED PROJECTS

Hawaii National Park for the Month of February 1930

Description of Projects	Percent Constructed To Date	Percent Constructed This Month	Percent Constructed Last Month	Probable Date of Completion
502.4 Bird Park, Auto Trail	95	55	40	March 3,,1930

10-159
UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

STATUS OF PERSONNEL

HAWAII NATIONAL PARK National Park for the Month of February 1930

	This Month	This Month Last Year
Number of employees beginning of month,	12	7
Number of additions, ...	0	0
Total, ...	12	7
Number of separations, ...	3	0
Number of employees close of month,. .	9	7
Number of promotions during month	0	0
Aggregate amount of annual leave taken,	0	0
Aggregate amount of sick leave taken,	0	4
Aggregate amount of leave without pay,	0	0

10-160

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

REPORT OF PARK REVENUES

HAWAII NATIONAL PARK National Park for the Month of February 1930

	This Year	Last Year
Park revenue on hand beginning of month,	0.00	0.00
Received,	0.00	0.00
Total,	0.00	0.00
Remitted,	0.00	0.00
On hand close of month,	0.00	0.00

Park revenues received this year to date,	1,025.00
Park revenues received last year to date,	1,025.00
Increase,	0.00
Percent of increase,	000

10-161

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HAWAII NATIONAL PARK

REPORT OF SALES OF PUBLICATIONS

FEBRUARY 1930

	Number	Value
GOVERNMENT PUBLICATIONS:		
On hand beginning of month,	287	44.90
Received during month,	0	0000
Total,	287	44.90
Sold during month,	1	1.00
On hand at close of month,	286	43.90
NON-GOVERNMENT PUBLICATIONS:		
On hand beginning of month,	5	12.50
Received during month,	0	0.00
Total,	5	12.50
Sold during month,	0	0.00
On hand at close of month,	5	12.50

Cash on hand beginning of month,	119.90
Sales during month,	1.00
Total,	120.90
Remitted during month,	0.00
Balance,	120.90

The Volcano Letter

No. 267—Weekly | Hawaiian Volcano Observatory, National Park, Hawaii | February 6, 1930

New lava filling bottom of Halemaumau as seen from east side of pit, 5:30 p. m., July 9, 1927. Torrent pouring in from high cone on talus at the left. Three inflows have occurred, burying this floor, since 1927. Photo Tai Sing Loo, copyright.

KILAUEA'S LIGHTED FURNACE

Travelers do not realize, when they visit the silent, sleeping fire pit, that the live smelting furnace of Kilauea is ready for action at any moment. It is hard for them to imagine that it is possible for the liquid lava to spurt up through the rocks at the side of the black lava floor while they are watching, and without doing them any harm. The liquid lava of the inner pit never does anyone any harm. Pele comes back with the silent gleam of a beacon light at night, with only a wisp of vapor, and then the slag fountains wax in vigor and majesty. All of this happened twice, with magnificent fireworks, during the past year.

These demonstrations that the pilot light is always burning have occurred seven times since the summer of 1924. That summer the lava began to flow into the bottom of Halemaumau, two years later gigantic floods of lava streamed to the sea from Mauna Loa, and in midsummer of 1927 four beautiful fountains of fiery melt appeared in the bottom of the Kilauea fire pit. They came quietly in the midnight hours of July 6-7, sending up fume which reflected the glowing jets beneath. They covered up the earlier lava floor, and the liquid basalt spread out into a molten lake so as to drown the vents of two of the fountains. The vents lay in a line tending to be parallel to the great west cliff of Kilauea Crater. And this bluff in turn is parallel to the cracks that lead out into the southwestern desert. These facts mean that under the round craters there are straight fissures going down deep, and it is up these fissures the lava comes.

The first picture is looking toward the west from the eastern rim of Halemaumau near where tourists stand at present. It shows on the left the two new source cones of 1927, and the top of the higher one stood 122 feet above the level of the liquid lake below. This vent had broken out through the slide-rock slope far above the bottom of the pit. The picture was taken two days after the beginning of the eruption when 30 acres of new lava had spread over the bottom. The jets on the first day had begun with blue flames and rushes of gas, followed by light basaltic pumice with the gas jets, and this in turn became more viscous although all such lava is more or less a froth. At the fountain jet it is bright yellow, but the blobs of freezing froth which drop back on the cones change color to orange, scarlet, crimson, maroon, purple and black. By "freezing" is meant consolidating from a molten condition. The material is a true glass containing

Halemaumau bottom from the east, 8:15 a. m., January 11, 1928, when the two black flows had squeezed up cracks in front of landslip shown in background. Foreground is floor of July, 1927. Photo Wilson.

much iron oxide which gives the thin edges a greenish brown translucent color. The ingredients are silica, alumina, iron, lime and the alkalies as in the slags of commerce. The temperature is around 2,000 degrees Fahrenheit. The gases which maintain this temperature and are actually burning in their upward rush are hydrogen, sulphur and the oxides of carbon.

After the first day only the large southernmost vent (the left-hand cone of the picture) was visibly working, and after 13 days the eruption of 1927 ceased. It will be noticed from the picture how strikingly the process inside Halemaumau resembles a river and its delta. The molten streams meander and distribute on their flood plain and build lobes penetrating the hollows between the different talus slopes. Then the lower portion actually becomes a liquid lake, within ramparts of its own solidification, and when the eruption ends the slag pool loses gas and shrinks, leaving the ramparts standing up as a border, which shows in the picture. There is just such a border in the bottom of the present pit at the beginning of 1930, and this is remnant from the solidified pool of July, 1929. To return to 1927, the molten lake filled to a depth of about 80 feet, most of this pouring in during the first day, and the diameters were 1,760 by 1,420 feet.

The psychological effects on the community are characterized by intense enthusiasm, and a rush to see the fireworks, which is like the opening of a world's fair. In the early morning of the first outbreak in 1927 there were 50 spectators at Halemaumau, during the first day there were 1,800 visitors, and on succeeding days the numbers diminished to just such extent as the spectacular quality of the performance decreased.

When the lava sinks away after such a release of gas pressure, and the eruption comes to an end, there is a tendency to collapse of the mountain blocks which were held apart before. The walls of the pit lean inward and large rock slides occur from time to time; the eruption of July, 1927, came to an end on the 20th of that month and on July 21 slides were incessant and the air above the pit was heavy with dust. Also the mountain blocks grate against each other and this makes perceptible earthquakes. These local seismic movements do no damage and are mostly known only by the records of the delicate instruments at the Observatory. There are tremors all the time everywhere in the world. The volcano observatory is feeling the pulse of the ground, and the lists in the weekly Kilauea Report are merely adding statistics, that point the way to the meaning of the next outbreak of fireworks. There are quick-period tremors and tippings of the ground, suddenly increasing at time of outbreak. Otherwise the tippings are seasonal as recorded for January, 1930, in this number of the Volcano Letter. (last page)

January of 1928 produced an upwelling of new lava shown by the small black flows that came up cracks in the lava floor left by the July eruption of 1927 (see second picture). The photograph is from about the same point of view as before. It will be observed that the July floor was squeezed down by an immense avalanche in the background, which had fallen from the wall at midnight January 10-11, 1928. Red glow immediately appeared, the outflow was sluggish with only a slight blue flame, and the measurable flowing lasted only an hour or two. The effect was as though liquid lava were present as a remnant from July under the crust, but peculiar seismic disturbances in December, 1927, the month before the outbreak, makes it more probable that it was a half-hearted eruption brought into being by the shock of the avalanche.

The year 1929 was ushered in, by such a disturbance underneath the pit, that an immense avalanche carried away the tourist station in January, and this was followed February 20, 1929, by a new eruption of lava, in the bottom of Halemaumau, of short life and great intensity. The Volcano House watchman saw a black dust cloud rise from the pit, followed by white steam in the moonlight, at the usual hour near 1 o'clock at night. He notified the community by a bugle call. A bright glare developed over the pit. At 2 a. m., a line of fountains lay across the bottom of the pit in a northeast-southwest direction as before but close under the west wall of the pit, and this time the biggest fountain was at the north end of the crack. It shot out its jets diagonally eastward to a height of 225 feet and built up a big pumice cone. The line of fountains was about 1,000 feet long, spraying upward in a cluster of jets that soon became engulfed in the new lake under the west wall of Halemaumau but made a magnificent display, doming up the golden fluid with a boiling 50 feet high, and making concentric and radial cracks of incandescence in the dark crust of the pool, the blocks of which eternally streamed into the center of activity and sank. Meantime there developed an even pattern of bright lines streaming outward like a fan from the huge northern fountain. The rumbling thud of the fountains became deep and heavy with occasional detonations. The cone at the north changed to an armchair in shape, and on the second day the southern group of fountains (left-hand in third and fourth illustrations) went out of action in the forenoon, the lake subsided and left a border rampart, and at 1:10 p. m., February 21, 1929, the eruption came to an end. The two pictures show the new flood on the bottom of the pit from the same point of view as the earlier photographs, the first exhibiting the high activity at the beginning and at night, the second the dwindling activity of the second day after a lava shore line had solidified. The other activities of 1929 will be described in a later issue.

T. A. J.

KILAUEA REPORT No. 941

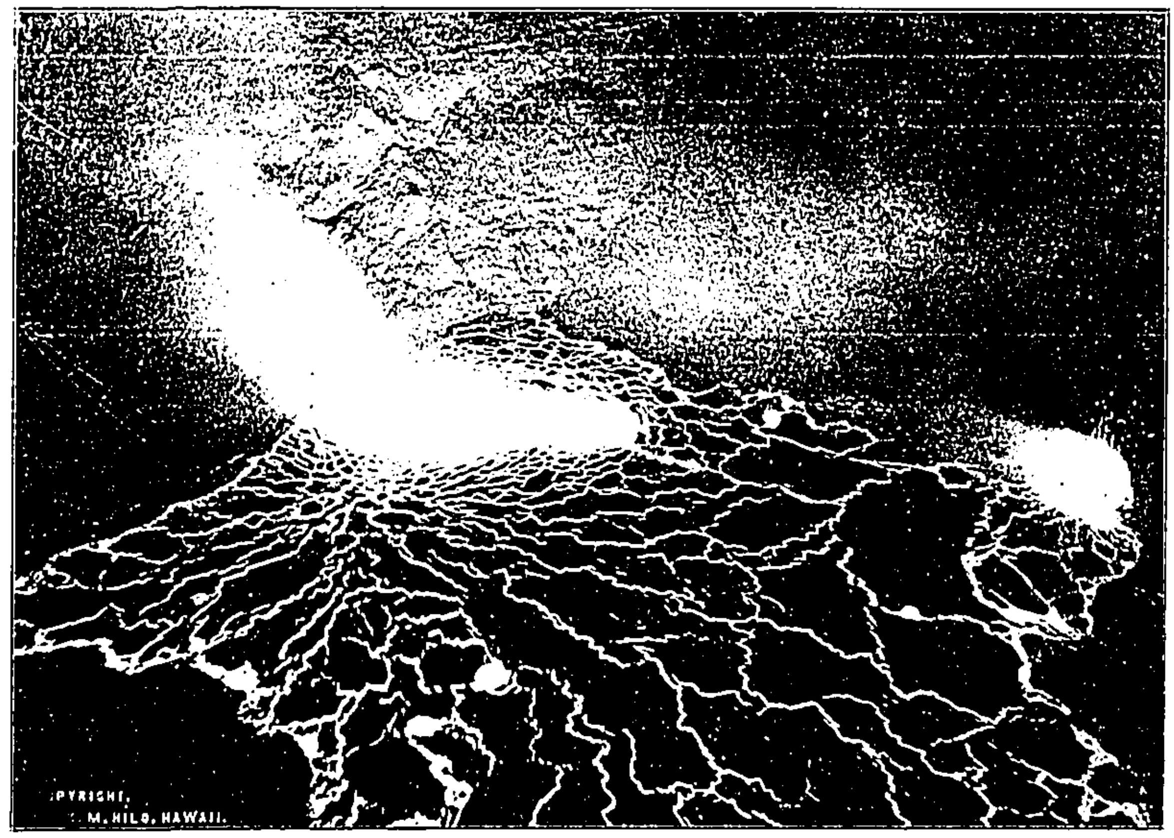
WEEK ENDING FEBRUARY 2, 1930

Section of Volcanology, U. S. Geological Survey

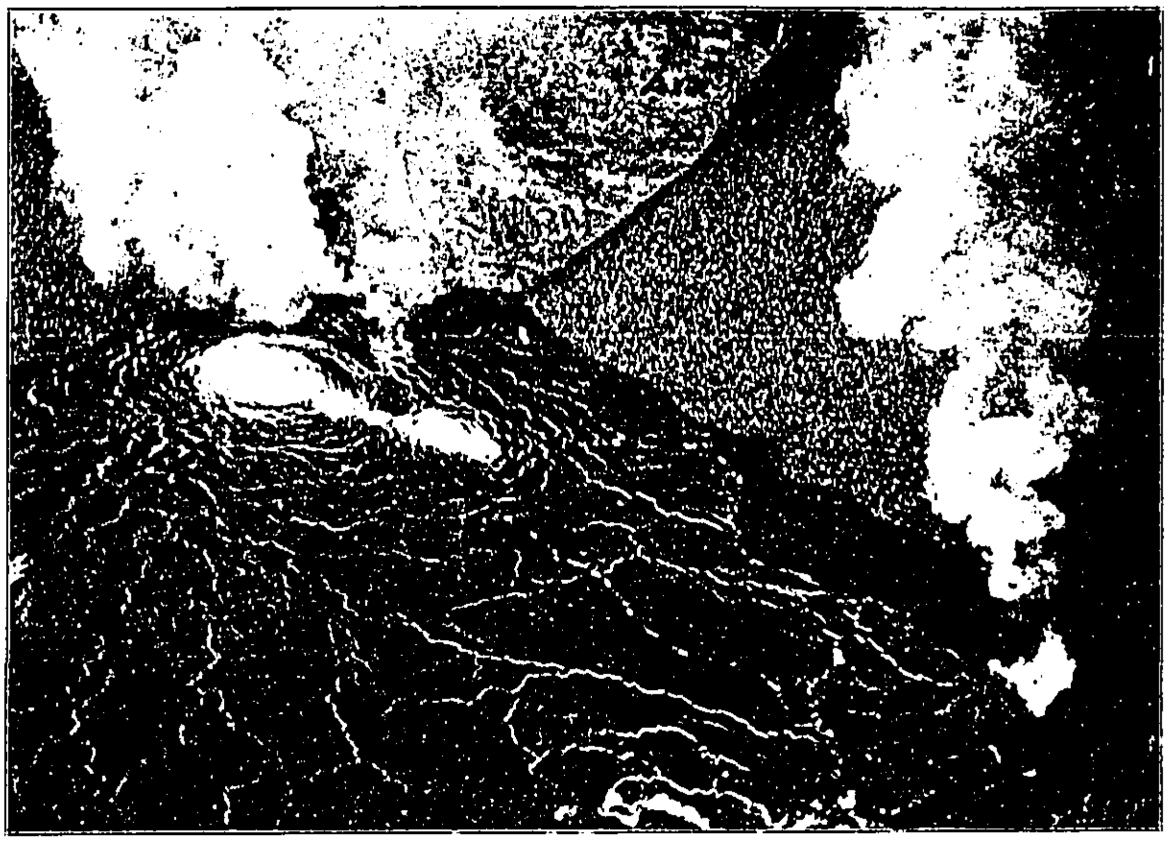
T. A. Jaggar, Volcanologist in Charge

On January 27 at 2 p. m., dust rose from a slide at the northern wall of Halemaumau, and at 3:30 p. m. more thin dust was seen over the pit. On January 29 at 1:30 p. m., the wind was blowing a heavy gale from the south, and the Halemaumau orifice was nearly hidden from view of the observatory by the dust. Great clouds of dust were blowing in the Kau Desert. The wind increased during the day so that wind tremor was strong on the seismograms. On January 31, after a rainstorm, the walls were dark red with wetting, there was the usual steam, and some fresh debris was observed on the northeast talus.

Fifteen seismic disturbances were registered at Kilauea. Seven were tremors and six were very feeble local seisms, three of which indicated average distance to origin 41 miles corresponding to the North Kona center. One very feeble seism indicated origin 18 miles away, possibly corresponding in origin to another feeble shock, origin distance 23 miles, at 2:38 a. m., January 29. A slight shock



Glowing and fountaining liquid lava pool at dawn, February 20, 1929. Interior of Halemaumau from the east, big north fountain on right. This buried the floor of July, 1927, to a depth of 64 feet. Photo Maehara, copyright.



This photograph is a daylight view, same scene as the last, at 6:30 a. m. of the second and last day of the eruption, February 21, 1929, when the fountains had dwindled. In the background is the northwest talus. Condensation of fume over the fountains and deep rumble had increased. Solidified rampart shore of lake is shown. On the right is the grotto which had been built high by the large fountain. The source crack lay along the line connecting this grotto with the line of fountains at the left, all of which at first had been a fissure following the edge of the plug left by the July eruption of 1927. The former plug lifts like a cork in a funnel, and the slag froth escapes between the cork and the wall. Photo Maehara.

was more strongly felt at 6:42 p. m., January 29, origin distance 48 miles, probably felt generally on the island of Hawaii. Very feeble, feeble and slight are technical terms of increasing intensities.

Microseismic motion for the week was moderate both E-W and S-W, and tilting of the ground was very strong SW.

JANUARY TILTING OF THE GROUND

At the Hawaiian Volcano Observatory, on the northeast edge of Kilauea Crater, just opposite the Volcano House, the tilting or tipping of the ground as measured with seismographs in a concrete basement was as follows for the five weeks following December 29, 1929. This is expressed as angular change and direction of motion of the plumb line.

December 30-January 5	3.21 seconds SW
January 6-12	1.33 seconds SSE
January 13-19	3.75 seconds NNE
January 20-26	2.06 seconds NNE
January 27-February 2	5.38 seconds SW

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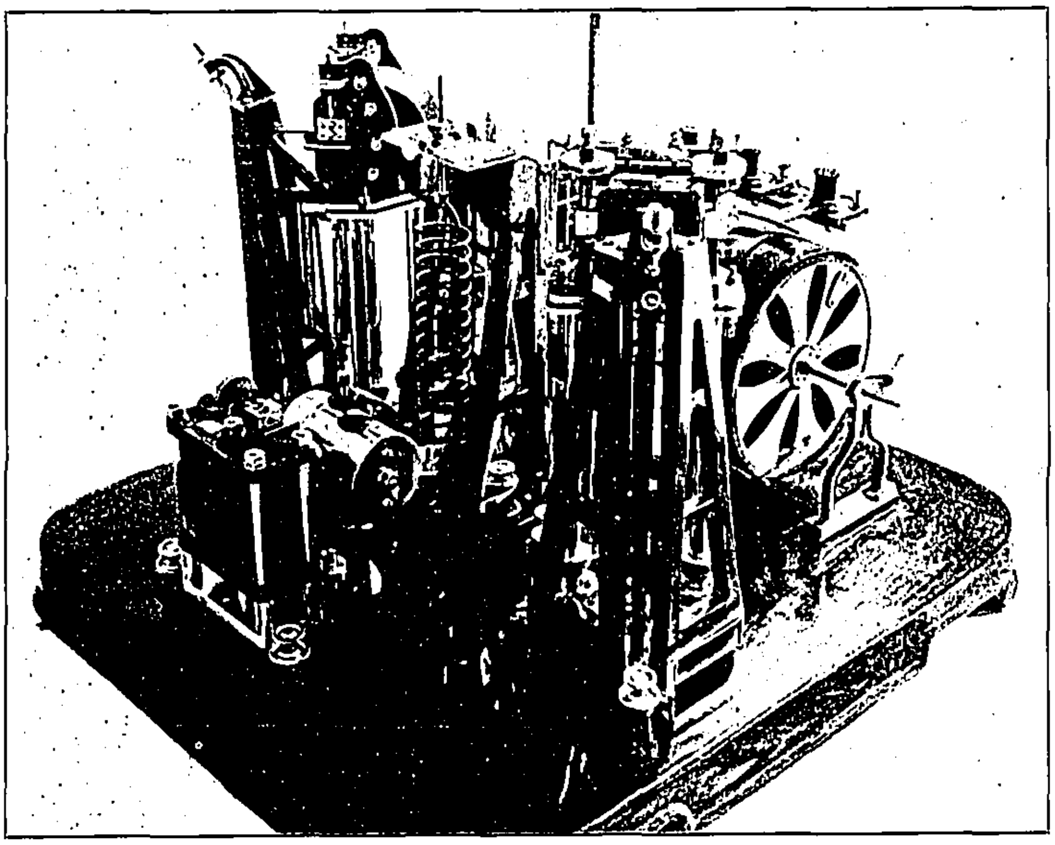
The Volcano Letter

Two dollars per year | Ten cents per copy
No. 268—Weekly | Hawaiian Volcano Observatory, National Park, Hawaii | February 13, 1930



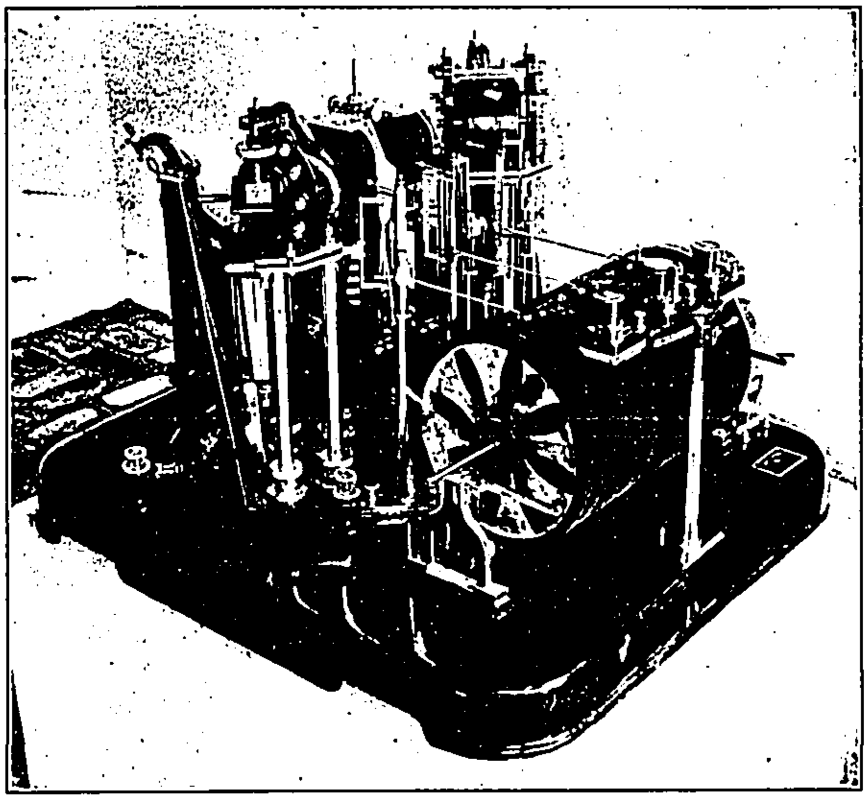
Back of Imamura seismograph as installed at Uwekahuna Observatory, Kilauea Crater. Vertical component pendulum on the left, recording drum on the right. Large gleaming cylinder in background is one of the horizontal pendulums under its damping magnet.

HOW THE SEISMOGRAPH WORKS

There is much misunderstanding about seismographs and earthquakes. One woman visited the seismograph cellar at the Hawaiian Volcano Observatory, and was observed to be looking around in all the corners of the room, seeking for something. When asked what she was looking for, she remarked that she was searching for the main wire. It later appeared that she thought the seismograph was connected in some mysterious electrical fashion with the inside of the volcano. Probably most travelers who see for the first time the excellent little seismograph, made in Japan, exhibited in the alcove of the Uwekahuna Observatory and Museum at Kilauea, as shown in the above picture, imagine it is far too complicated for them to understand. As a matter of fact the principles involved are extremely simple.

The reason the picture looks so jumbled is that this instrument attempts to combine six different things. These are respectively three different pendulums, a damping or clogging apparatus to keep the pendulums from swinging too much on their own account, a recording machine to compel all three pendulums to write their autographs on smoked paper all the time with high magnification of their relative movement, and a time-keeping device which also is compelled to mark the minutes on the paper. Each of these things by itself is very simple, but to make all work in harmony on one piece of paper is like asking a wrist watch to make a record of everything the wearer does.

There are three japanned openwork iron frames in a line across the baseplate, each holding a 13-pound cylindrical weight lightly hung on pivots. These are the pendulums and these are at the heart of the apparatus. Two of them are hung like doors at right angles to each other; their free motion is much like that of the needle holder of a gramophone. If with the sound box turned back, you hit with your fist the side of the gramophone cabinet, the sound box will jump towards your fist. If you hit the other side it will jump the other way. If you let the sound box hang down without any record under it, and imagine it immersed in a tumbler of oil, it will move through the oil by the amount that you have displaced the cabinet, but it will not waggle back and forth afterwards. That is what is meant by damping. It is an oil damper. The machine in the picture uses magnetism for damping, the rounded objects at the top and at the left being horseshoe magnets with a plate between the poles which is attached in each case to the cylindrical weight. The magnetic forces restrain the weight from waggling. The left-hand weight is hung on a spiral spring as shown, and differs from the other two in that its motion is up and down like the child's wooden ball hanging from an elastic band.



Imamura Seismograph, Uwekahuna Observatory, showing the pendulums at the back, the three slender pens, the clock-driven drum covered with smoked paper, and the three electro-magnets (spools) at the right. These lift the pen points once a minute.

This is called the vertical pendulum and registers up-down motion of the ground. The other two are horizontal pendulums and register east-west and north-south motion of the ground.

Now let us look at picture No. 2. This is the same instrument seen from the front. The heavy baseplate is set on concrete, this is on bedrock, and the alcove is protected from wind currents. Three very dainty slender levers protrude from a magnifying connection with the three pendulums. They are the three straight lines that look like strings protruding horizontally from the group of pendulums, and at their right-hand outer ends they hold tiny pivoted steel pens which rest on the smoked paper that covers the surface of the big cylindrical drum. If there is a north-south movement of the ground, the farther pen will move back and forth on the smoked paper 50 times farther than the ground itself moves; the middle pen similarly magnifies 50 times the up-and-down motion of the ground, and the near pen the east-west motion. Accordingly the single sheet of smoked paper will receive a back-and-forth white line for all three motions of the same earthquake, and we may compare side by side at that place on the paper, how much the motion was north-south, up-down, and east-west.

A digression is necessary here, because the reader thinks that the pendulum moves. It is perfectly true that if I move the pendulum with my finger, the pen will move 50 times as much. The seismograph, however, is not designed to ask the earthquake to move the pendulum. It rather asks the pendulum to stand still while the earth oscillates under it. This is what you ask the gramophone arm to do when you move the cabinet sidewise. If the iron door of a basement furnace is hanging open, and an earthquake moves the cellar sidewise, the door at first swings (apparently) in the opposite direction from the cellar. What it really does is to stand still by its inertia, while the furnace does the moving. So it is with the seismograph pendulums.

The time when the earthquake began at the instrument, the time when its vibrations changed from very short tremors to longer movements, the time occupied by each independent back-and-forth movement (known as the "period" of the earth wave), the time when the long movements slowed down to short movements again, and the time when the last trace of quaking stopped, are all important features of a seismogram. The seismogram is the paper record, the seismograph is the instrument itself. It will be seen above that if the paper stood still and an earthquake happened, we would get three short lines scratched on the smoke of the smudged white paper surface. This smoking, by the way, is obtained by merely twirling the paper-covered drum over a smoking kerosene lamp. The three short lines on stationary paper would tell us that there had been an earthquake, and how long its biggest oscillations were, respectively north-south, up-down, and east-west. But it would not tell us how long it lasted, nor at what o'clock it occurred. Here is where the drum comes in.

The surface of the drum is turning around all the time on a screw spindle that passes through the center of the drum, turned by a clockwork at the end of the drum. A fresh paper is wrapped around the drum and started every morning when the clockwork is wound. The three pens are thus writing lines round and round the drum, and the screw spindle pushes the drum along lengthwise, so that when a complete revolution is made each pen is offset a little from its previous position. Thus each pen writes a band of lines, each line corresponding to an hour, say, and the band of 24 lines corresponding to the pen's work for the 24 hours of the day. If the ground does not move, the lines are straight and smooth and owe their existence solely to the rotation of the drum. If, however, an earthquake occurs each pen departs from its straight line and writes a zigzag, lasting as long as the earthquake lasts, its back-and-forth scrapings being close together if the earthquake is of quick period, and being far apart if the earthquake motion is slow. This is best understood by reference to the print of an actual seismogram on Page Four. There is an upper and lower band of lines, the upper south-north, the lower east-west. Near the bottom of each band there are big back-and-forth scrapings of very slow earthquake waves that came from a center in southeastern Alaska October 24, 1927. Right in the middle of this there are quick back-and-forth scrapings, the record of a local earthquake here at Kilauea Volcano at 6:20 a. m., feebly felt, on the same day. Possibly the slow wave motion of the big distant earthquake, 2,700 miles away, released the accumulated friction of the local mountain block in Hawaii, which slipped and jarred the island.

In the middle of the close-set lines of the local earthquake *will be seen a gap in the record. There are in fact* gaps of this kind a little less than an inch and a half apart on all the lines, marking the minutes. These are marked in on the seismogram by the three electromagnets, which look like spools at the right of the drum in the pictures.

The electromagnets are connected by wires through a battery with a big pendulum clock that hangs on the wall of the seismograph alcove. This clock closes a contact once a minute with its second hand, and once an hour with its minute hand, and the electric impulse lifts the three little pen points off the drum for about a second, and thereby creates a minute mark in the form of a gap in the line. A longer gap is made on the hour. The operator, when he puts on the drum in the morning, writes on the smoke the time of starting, and the rest is easy. With these time marks we may measure all the facts of time and duration of the earthquakes, and their several phases.

The picture on the third page shows a simplified single-pendulum seismograph set on a concrete shaking table, which is attached to a lathe chuck, through which in the shop of the Observatory artificial earthquakes may be made. This is a horizontal pendulum, and the big black cylinder is its swinging weight. At the right-hand end, also on the concrete table, are the drum and driving clock with a single writing pen and electromagnet. The lever from the lathe has its motion reduced at the steel rollers underneath the concrete table, so that the very small motions of the ground, which are characteristic of a local earthquake, may be imitated. T. A. J.

KILAUEA REPORT No. 942
WEEK ENDING FEBRUARY 9, 1930

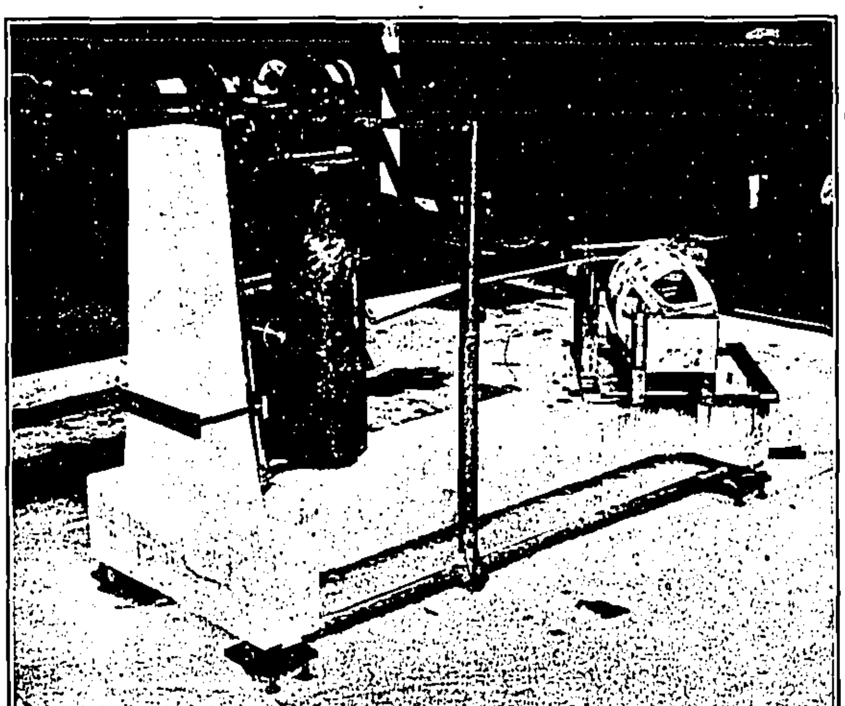
Section of Volcanology, U. S. Geological Survey
T. A. Jaggar, Volcanologist in Charge

Halemaumau pit continues quiet On February 5 a few big bowlders from a recent avalanche lay on the southeast talus. A fresh streak of debris was also on the same talus heap. Steam was absent on the crater's floor. On February 8 no changes were observed, and there was very little steam.

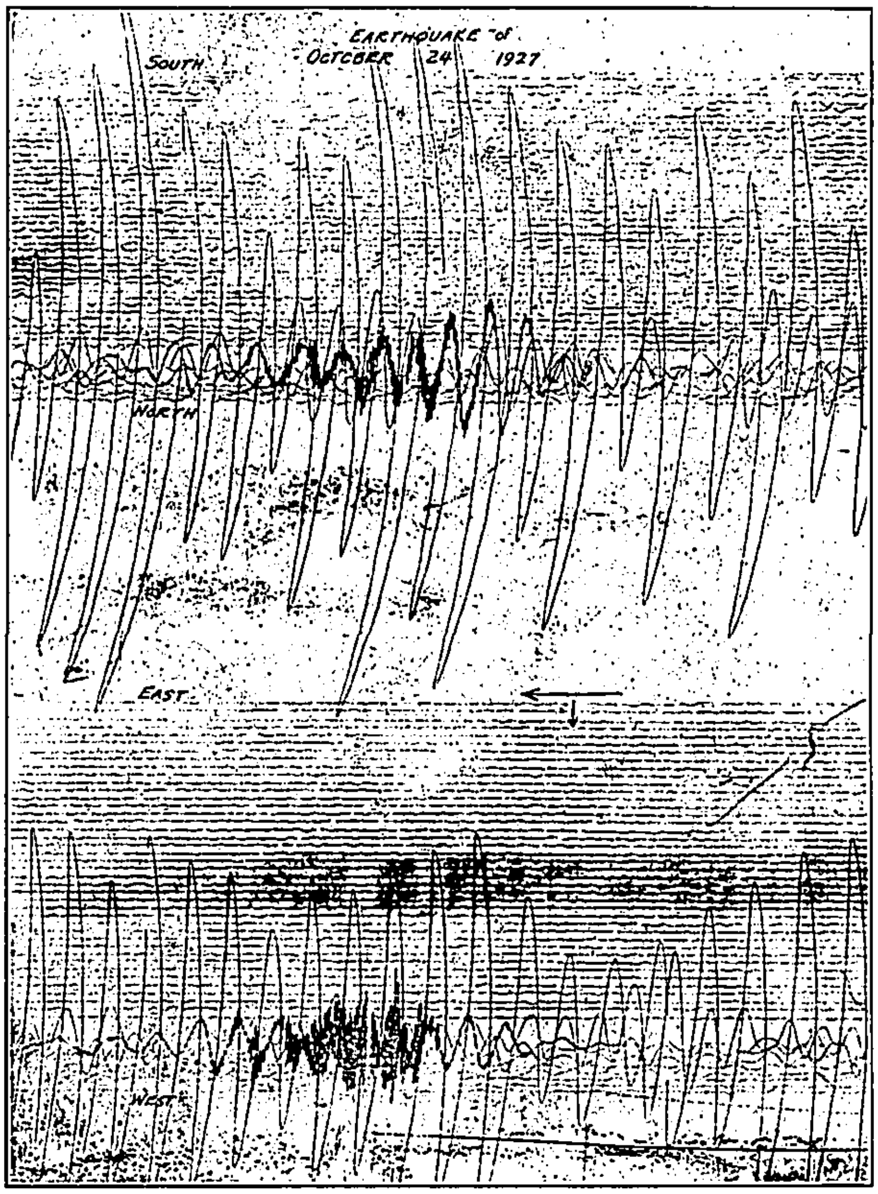
The seismographs at the Observatory recorded eight tremors, two very feeble and four feeble seisms. The feeble shocks were felt in some places on the island, and occurred as follows:

February 2, 6:02 p.m., indicated distance 32 miles
February 8, 8:06 p.m., indicated distance 32 miles
February 8, 8:13 p.m., indicated distance 23 miles
February 9, 9:43 a.m., indicated distance 40 miles

Microseismic motion was slightly stronger than normal early in the week, decreasing to normal on the 6th. Tilt accumulated moderately strong to the northeast, directly reverse to the direction of tilt during the previous week.



Concrete oscillating table operated by a lathe chuck. The complete single Hawaiian type pendulum is hung on the table, along with its recording drum, and subjected to artificial earthquakes. In Hawaiian Volcano Observatory shop.



Seismograms of the two earthquakes October 24, 1927. The upper and lower bands of lines register a night's work of the seismograph. The upper is north-south motion. The lower is east-west motion. The big oscillations shown are the faint slow waves of an Alaskan giant earthquake as registered in Hawaii. The close-set zigzags, like shading in the middle of the large motions, are made by a local Hawaiian earthquake, which possibly was "touched off" by the big earth waves. Lines read from right to left, and begin at the top. The breaks in the lines are minute marks, or time signals.

THE VOLCANO LETTER

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HAWAIIAN VOLCANO OBSERVATORY
Founded 1911

This laboratory at Kilauea Volcano belongs to the Hawaiian Volcano Research Association and is leased and operated by the United States Geological Survey.

It maintains seismographs at three places near Kilauea Volcano, also at Hilo, and at Kealakekua in Kona District. It keeps a journal of Hawaiian volcanic activity and publishes occasional Bulletins

Membership in the Hawaiian Volcano Research Association is limited to patrons of Pacific science who desire personally to aid in supporting the work.

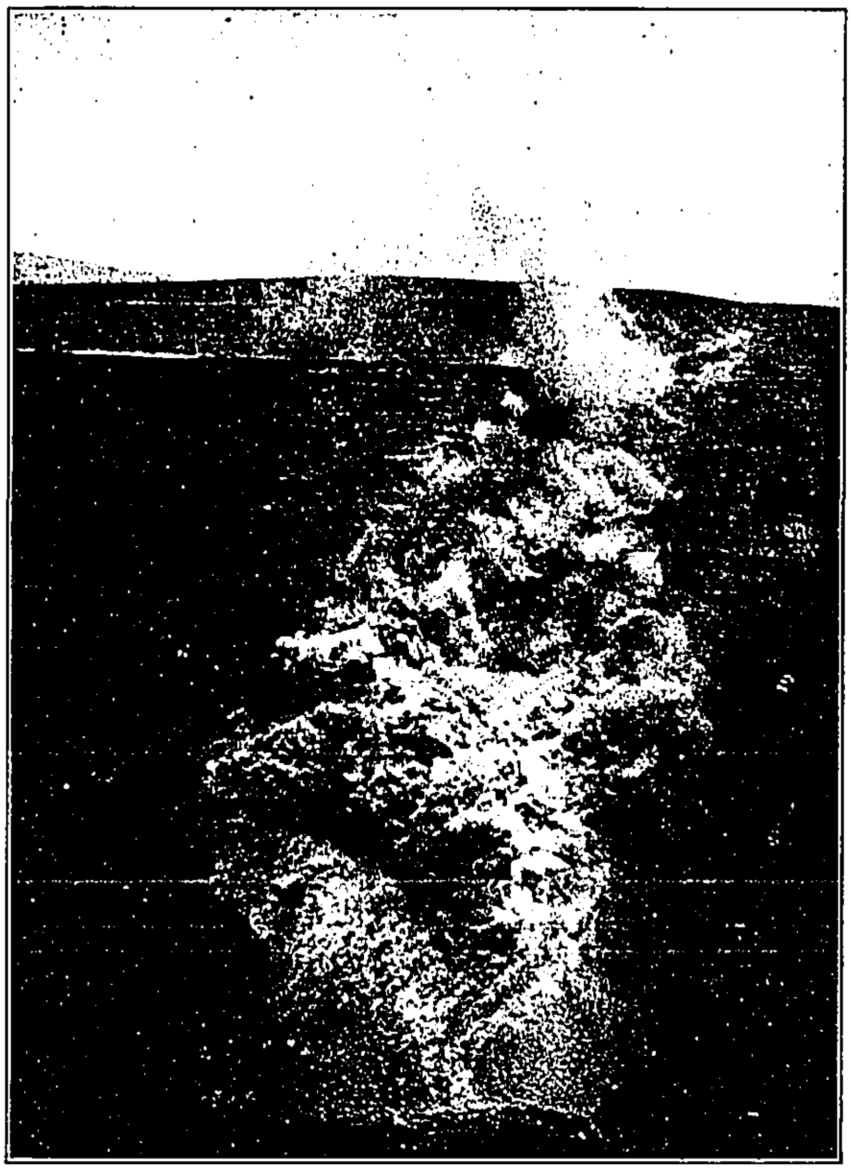
The work of volcano research so supported is in collaboration with the work of the United States Geological Survey, but supplements it with buildings, research fellows, instrumental plants, explorations and special investigations for which there is no governmental provision. The Geological Survey maintains volcano stations in Alaska, California and Hawaii.

Persons desiring application blanks for membership should address the Secretary, Hawaiian Volcano Research Association, 300 James Campbell Building, Honolulu, T. H.

The Volcano Letter

Two dollars per year — Ten cents per copy

No. 269—Weekly — Hawaiian Volcano Observatory, National Park, Hawaii — February 20, 1930

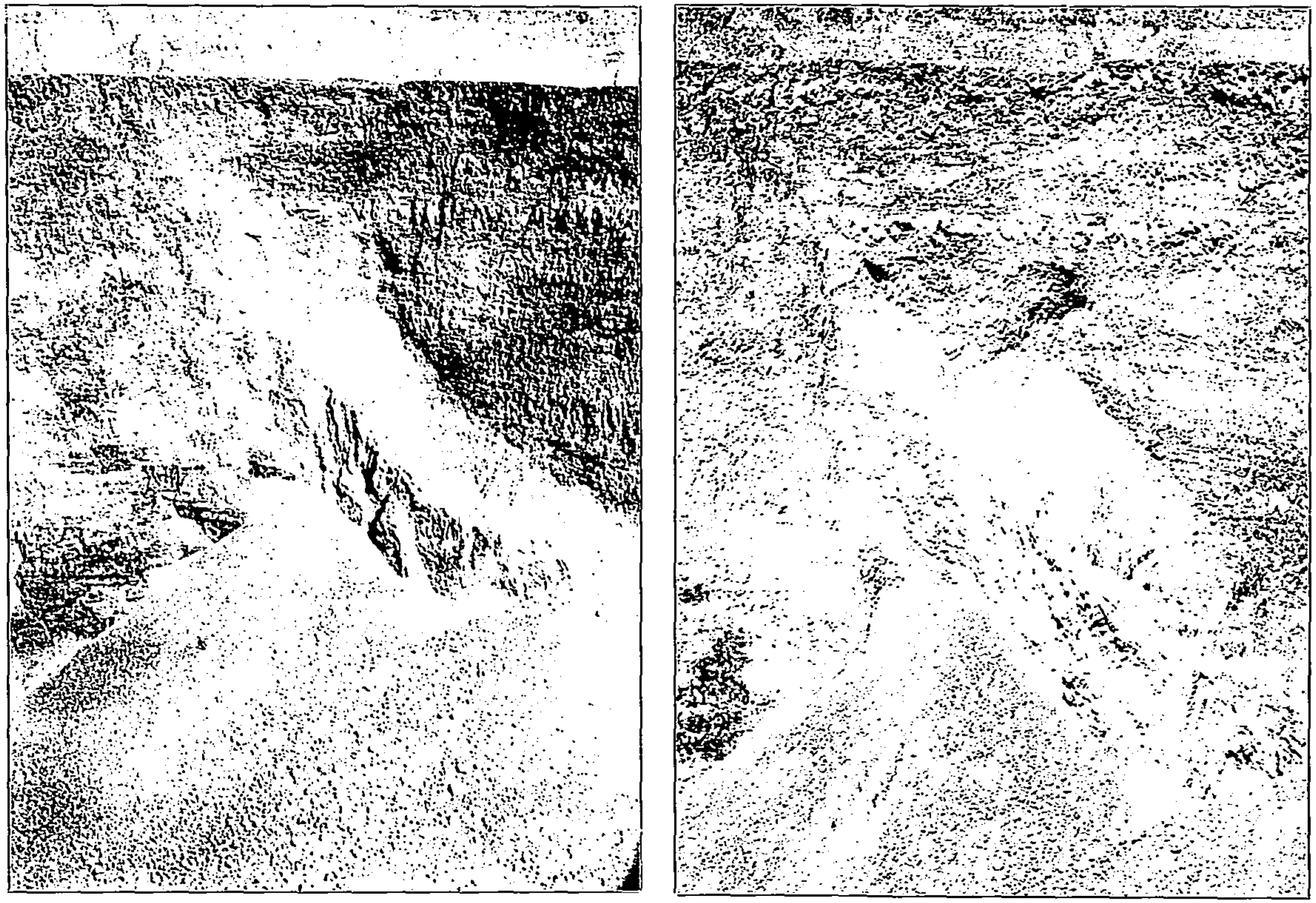


Avalanche falling on northwest talus of Halemaumau 10:27 a. m. October 5, 1927. This picture shows how cauliflower clouds of dust are easily generated by the grinding of falling rock. An exaggeration of this with all the walls falling at once, and steam rushing up, is what happens in an explosive volcanic eruption. Photo Evans.

MEANING OF CRATER AVALANCHES

Many visitors to the fire pit of Kilauea happen upon the adventure of seeing and hearing large or small slides of broken rock that fall from the walls of the pit. A splendid motion picture of such a slide is exhibited to tourists at the Uwekahuna Observatory. The lower portion of the rock wall begins to "work", and black cascades of gravel and dust are seen streaming down the notches to the talus. Then pieces of the wall flake off higher up. Finally a very large piece shows itself to be in process of separating from the face of the wall, with black cascades on each side, the moving portion being a flat cake of wide area often extending to the very top edge. All the rock matter breaks up on its impact below, and during the crushing and grinding of its separation from the wall, hundreds of tons being involved. The talus or slide rock slope below receives the impact, is built up at the top, and tends to become steeper than the angle of rest. This starts a sliding in the debris slope, and great clouds in "cauliflower" form carry the dust boiling above the edge of the pit. These slides have been renewed from time to time during the past six years, becoming very vigorous from no apparent cause.

The photograph on the first page and the map on Page Four show one of these avalanches and the contour plan of its results. The place where this avalanche occurred in 1927 is the wall in the upper left-hand rectangle of the map. The evenly spaced contour lines of the lighter portion of the map of the pit are mostly slide-rock slopes of about 30 degrees inclination. The flat of the bottom lava is out-



Two photographs of the north corner of Halemaumau pit showing the detail of the wall before and after avalanches of February 18 and 20, 1928. The first January 2, 1928, shows two talus cones, the prow of the big sill next above, and a light band above that which is a cross section of an old debris slope with lava flows on the right lapping against it. The second February 26, 1928, shows the same scene after the avalanches had scoured the talus cone and the wall above had flaked off all the way to the top. Photo Wilson.

lined in dots. The rock wall shows close-set and irregular contour lines. This wall exhibits a flat bench of light shading in the upper right-hand rectangles. This bench is the top of a thick sill or sheet of intrusive lava which was red hot but hard at the end of the explosive eruption of 1924, when that wall of the pit broke and started red hot avalanches from this sill. The sill is well shown in the first of the two pictures on Page Two as a rock ledge shaped like the prow of a boat next above the talus slopes and to the right of the sharp pointed talus cone.

When this map was made in July of 1928 the surveys showed that there had been four cavings-in from the rim during the preceding 12 months. Over this northwest talus a strip 700 feet long and containing nearly an acre of rock was missing. The picture on Page One shows how it happened, but a still bigger avalanche here January 11, 1928, had caused the debris slope below to break away as a landslip and flow out over the floor. Other portions of the rock wall, totally changed since the surveys of a year before, were at the southwest, at the north-northeast, and a long, narrow strip three-quarters of an acre in extent at the east-northeast. When we add to this the tremendous southeastern caving in of the rim of the pit which occurred in January of 1929, making it necessary to change the inspection station at the road terminus, it will be seen that two years of wall-breaking had pretty well encircled the pit.

This gradual encircling of the pit by slides was noticed during the early years of the work of the Observatory, when lava was almost continuously present, rising and falling in the pit. The times of maximum avalanching were also times of maximum subsidence of the lava, of maximum local earthquake frequency, and of maximum inward tipping of the ground toward the center of subsidence. The jarring of earthquakes doubtless loosens the wall material, but no conspicuous causal relation whereby earthquakes make avalanches has appeared. In some definite cases, on the other hand, avalanches conspicuously make earthquakes. The greatest of these was the grand avalanching that enlarged the pit during the explosive eruption of 1924. Since then there has been instituted measurement of the width of cracks close to the edge of Halemaumau. In January, 1928, when the big avalanching at the northwest was starting, crack measurement showed an opening of five inches in 11 days, and leveling revealed a lowering in eight months of nearly half a foot for the ground at the edge of the pit. The ground was tipping in toward the crater center during these weeks. During a time of similar opening of cracks in August, 1928, an avalanche of large size occurred which produced a tremor record much larger on a seismograph nearer to the pit than on the Observatory seismographs, and showing other evidence that the slide was the cause of the tremor.

Now if we examine the map on the last page, we shall see these border cracks as dotted lines just back from the edge of the pit, and parallel to the edge in many places. It also appears that the pit is a pentagon rather than a circle, the five angles being at the tops of the taluses southwest, northwest, north-northeast, east and south. Each of these angles has a reason for its existence, and the reasons are evident. The straight sides of the pit southeast and northwest roughly conform to the rift system that extends far out into the desert. The steep southwest wall is a cross fracture between these two more gently sloping rift walls. The northeast side is very steep and clearly determined by the two ends of the big sill which have been places of motion and weakness since 1924. The short north wall is a cross facture between the sill wall and the rift wall, a remnant, so to speak, adjusting the big hole, during its engulfment, to the controlling deep joints. This formation of a pentagon has repeatedly been observed in photographs of the craters on the moon, which are also engulfment pits. The fundamental cause, then, of straight sides to an otherwise circular pit, is a guidance by deep straight fissures or lines of weakness in a process of breaking which is controlled by a small center of engulfment.

The meaning of crater avalanches reverts to a center of engulfment. Why should there be a center of falling in? This takes us back to how a volcano begins. It begins by lava welling up a crack. If it kept on welling up the whole length of the crack it would make an even ridge. It does not do this. Cracks are not regular and the narrower places become clogged. Then the wider places become centers rather than linear fissures. They become centers because the upflow is through the soft material of their own overflow. The crack is buried far below and an oval or circular heap of new lava becomes the dominant structure up which the eruptions are building. If the eruptions were perfectly continuous, without alternations of gas and liquid, and without alternations of rising and falling, there would be no craters. There would be a lava lake eternally overflowing. There is no visible pit when Halemaumau fills to the brim. The pit is the product of a sinking back of the lava whereby the hardened walls fall in, and reveal something of the shape of the well. The volcanologist as a detective has to learn from what happens by cracking, shaking, steaming, and tipping of the outside ground, what is the probable shape of the bottom of the well when the lava retreats.

This is no simple matter, and the accumulated learning of the world from the mapping of cross sections of old volcanoes, from the study of volcanic earthquakes, from the reports of explosive eruptions, and from studies of physical geography of craters, needs study in order to make an accurate guess as to what the lava column would look like if we could cut a slice through the volcano straight down for seven miles. For there is seven miles of lava building if the Hawaiian ridge started in a deep part of the Pacific. Computations suggested that the lava column sank about a mile under Kilauea in 1924, and that previously it may have wedged out right and left several miles in some kind of underground reservoir. The pit was left a rather flat funnel, but some of the flatness is due to the debris plugging the bottom. Our work with instruments is like that of the surgeon with the X-ray and the stethoscope. We must learn the internal organs of a volcano, the chemistry of its digestion and excretion, the cycle of its breathing, and the shape of its alimentary canal.

The avalaches grow more or less frequent as the walls of the pit are more or less undermined. Under the debris is a rock wall of flat slope. Is this a wall, or is it a congestion of gigantic wall slabs? Have these slaps slipped down? And are they jammed about the center? Such a notion of the structure agrees with the fact that eruptions start through crevices high up around the border of the inner pit bottom. Are these slabs the top of a column of debris which fell in, in 1924? And is this whole column being infiltrated with lava? If so, does the column lower when the stiff lava lowers, and so start earth tremors and avalanches? And does it rise when the lava expands, and so stop all undermining?

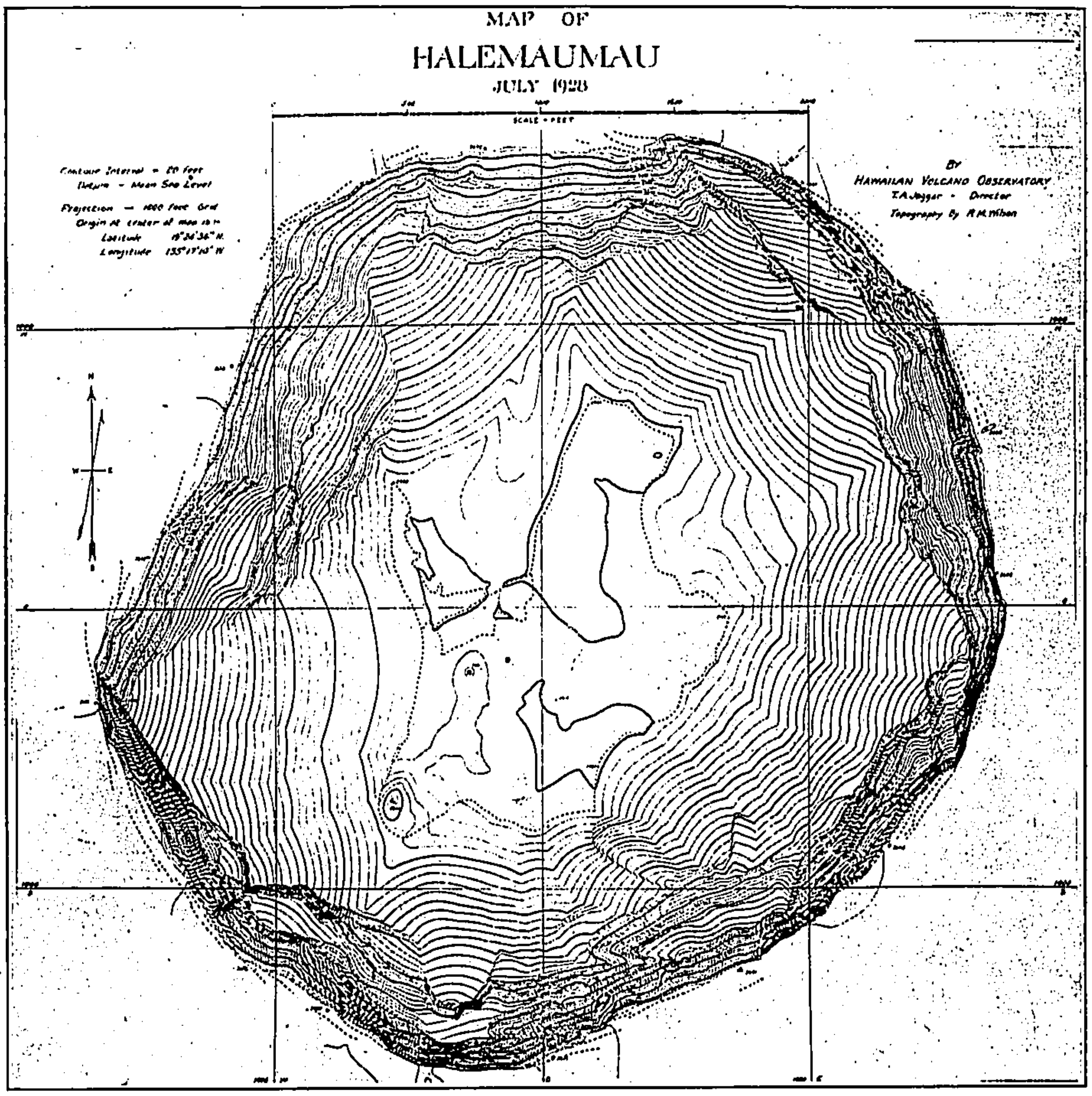
This would cause the outside country to tip away. Such is the fact when lava rises. And also the avalanches cease when lava rises. Thus it appears that the rock slides are not only what creates these pits and keeps them circular. The slides are also indicative of what is going on far below. T.A.J.

KILAUEA REPORT No. 943
WEEK ENDING FEBRUARY 16, 1930
Section of Volcanology, U. S. Geological Survey
T. A. Jaggar, Volcanologist in Charge

On February 11 at 1:30 p. m., gray dust rose from an avalanche within Halemaumau pit apparently from the west side. This lasted for several minutes. Another was reported at the north wall of the pit at 4:10 p. m. Inspection on February 12 indicated that the slides had been voluminous, leaving much dust. At 8 a. m. February 14 a convection cloud hung over the pit, and a similar condition at 9 a. m today, February 17, appeared as a high column of vapor from the northeast wall of the pit, occasioned by unusually calm conditions which had covered the whole floor of Kilauea Crater with a steam fog.

The seismographs at the Observatory registered 16 tremors and 7 very feeble local seisms during the week ended at midnight February 16, two of the shocks indicating origin distance 23 miles and one a distance of 43 miles. These distances correspond closely to Mauna Loa and Hualalai. The tremors did not exceed one minute in duration.

Microseismic motion for the week has been slight, and tilt accumulated strong SW, again reversing the direction of the previous week. Such strong pulsations of tilting sometimes indicate underground lava movement.



Map of Halemaumau Pit, contour interval 20 feet, surveyed July, 1928 by R. M. Wilson. Dotted outline is lava bottom of July 1927. Dotted lines at edge of pit are cracks. Talus slopes make the open contours of the lower area. The rectangular net marks 1000-foot intervals. Bottom is 2482 and top 3692 feet above sea-level. The rock wall extends clear to the bottom in funnel shape northwest and southeast, between the northwest and west taluses, and between the southeast and south taluses. The two black spots in the southwest wall are caverns on the Kau Rift, and the line of four cones across the bottom follows this fissure, which determines the longer axis of the pit.

ILLUSTRATED LECTURES IN HONOLULU

A course of five illustrated lectures by T. A. Jaggar on "How the Volcano works" is in progress in Honolulu, and the dates have been changed. The place is the ballroom of the Royal Hawaiian Hotel, the hour nine in the evenings of February 11 and 24, March 14 and 24, and April 14. These are open meetings of the Hawaiian Volcano Research Association during the tourist season.

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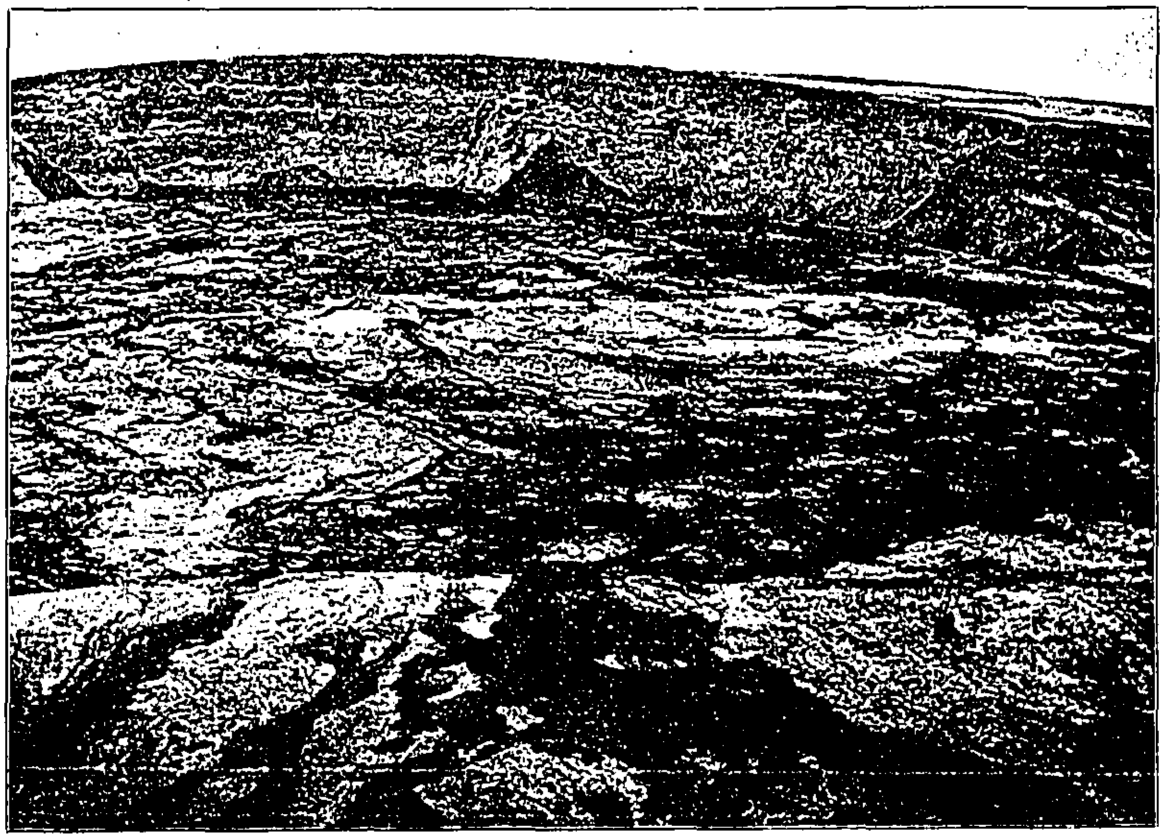


Mokuaweoweo, the summit crater of Mauna Loa, at 9:45 a. m. October 9, 1929, photographed from the east from an airplane at elevation 15,200 feet. This shows part of the northern half of the crater mantled with a light snowfall, the high western wall, and the cone of 1896 in the bottom, with the eruption crack of 1914 athwart it showing a line of spatter heaps of lava. In the foreground are clinker flows of the east edge of the cauldron. Photo Bureau of Aeronautics, U. S. Navy, by permission of Rear Admiral George F. Marvell, Commandant Pearl Harbor, Hawaii.

AIRPLANES FOR VOLCANOLOGY

The volcano Pelee in Martinique developed gas and ash eruption in the autumn of 1929 which was renewed in December (Volcano Letter No. 262, January 2, 1930). The following is a picturesque statement of our modern birds-eye viewpoint: "A student of the Imperial College of Tropical Agriculture, who returned to Trinidad January 12, 1930, from leave in the United States, in an airplane of the West Indies Airways, says that Martinique was hidden in a volcanic cloud through which could be caught glimpses of silent villages and deserted cocoa estates. The northern part of the island has been evacuated and public gatherings are prohibited." (London Times January 14, 1930.)

Thanks to the U. S. Army and Navy air services, planes and air photographers have been placed at the service of the U. S. Geological Survey so that mapping of the culture and the drainage of southeastern Alaska, the Mississippi Valley and the island of Oahu in Hawaii, as well as many other places, is more perfect and less expensive than ever before. Repeatedly airplanes with photographers have been supplied to the Hawaiian Volcano Observatory, in times of stress, on the island of Hawaii, and the results have revealed the meaning of lava outbreak on these vast flat volcanoes, in a way that could never be approached by land expeditions. Over Vesuvius both motion and still pictures have been taken of the crater activity. One of the most remarkable monographs on craters ever published is entitled, "Volcano Studies in Java," by N. J. M. Taverne of the Netherlands East Indies Volcano Service, issued in 1926, containing superb photogravures of 24 craters pictured from the air over a wild mountainous country of savage jungles. The pictures reveal the cones in profile, the gullys on their flanks, extraordinary lava plugs standing in relief, the distribution of hot springs and solfataras in the jungle, double craters and inner benches, details of relief in adjacent peaks which it would take years to map, inner lava floors and domes, crater lakes, flank craters and sharp peaks with lava plugs, and all the manifold complexities of unsuspected pits in the jungle and erosion of ash covered surfaces that might be missed entirely by a land expendition.

During the recent seismic activity in September-October, 1929, on the western side of Hawaii, the writer was privileged to inspect the whole eastern, southern, and western flanks of the island mass in a Naval plane at elevations from 10,000 to 12,000 feet, traveling about 160 miles from Hilo over Kilauea Volcano, across the great rifts that extend down the southwestern flank of Mauna Loa, and then northward over Kona across the divide between Mauna Loa and Hualalai. The relief of the great Hawaiian turtle-back mountains, with the straight fault cliffs and sink craters, the lines of circular pits on Kilauea, and the lines of pumice cones on Mauna Loa, all revealing meandering black aa flows like giant serpents leading to the

Mokuaweoweo from the southeast, photographed from an airplane, June 25, 1929, showing on the crater floor the cone of 1914 on the left and the cones of 1896 on the right, both amid patches of solfataric whitish stain. Phcto by permission 11th Photo Section Air Corps, U. S. Army.

sea, is in marked contrast to the steep cones of Java. The visibility was excellent on this flight and no trace of new outbreak correlated with the earthquake spasm was found. It would have taken weeks to explore the same territory with pack train, and even then a small outbreak might have escaped notice.

Thanks to the courtesy of Rear Admiral George F. Marvell, Commandant of the Pearl Harbor Naval Station, U. S. Navy, we are permitted to exhibit on Page One a photograph of Mokuaweoweo, the summit crater of Mauna Loa, made by J. A. Pringle with a hand-held 4 by 5-inch camera and 10-inch lens at 8:45 a. m. October 9, 1929, from the east at elevation 15,200 feet. This was photographed from a small scout plane capable of flying at these high altitudes. The far rim of this sink crater is at elevation 13,653 feet above sea level, and the area is coated with a light fall of recent snow. This serves to exhibit on the floor of the crater the old cone of 1896, cut across from left to right with the gash and line of driblet cones that were formed in 1914. In the foreground is the east edge of the crater with aa flows, and the dark objects under the distant cliffs are talus slopes. If there had been new activity it would have appeared as spurting lava sending up clouds of blue sulphurous gas.

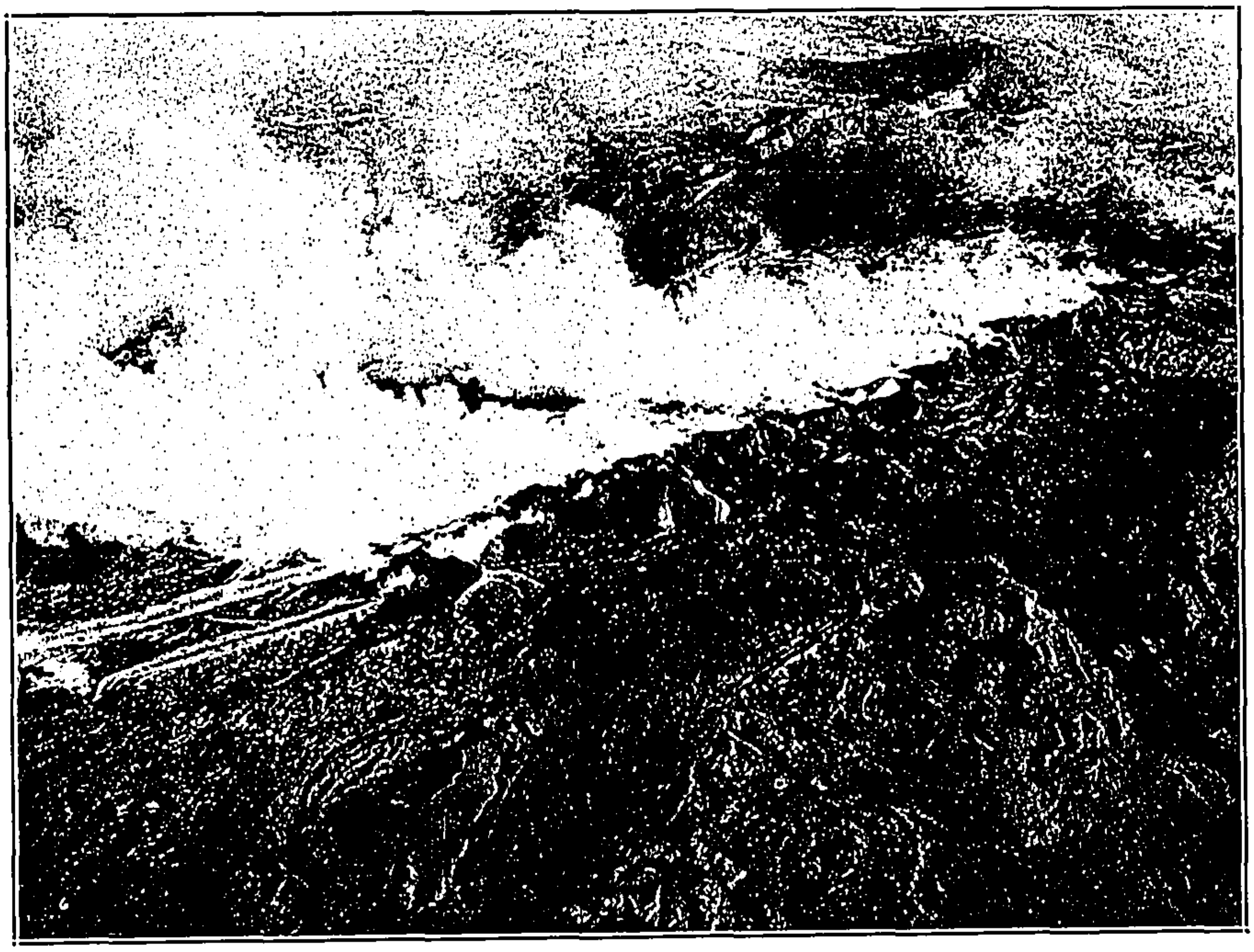
It is of interest to compare this same scene, photographed without snow from a greater distance by the Eleventh Photo Section of the Air Corps, U. S. Army, June 25, 1929 (Page Two). Here there is sulphurous stain on the black lava floor of the crater, and as this picture is taken from the southeast the 1896 cones appear on the right and the cone built by the large fountain of 1914 is shown at the left. The angle in the high cliffs at the back where the white expanse changes to shadowed bluff, is the angle in plan between the southwestern and northeastern rifts of the Mauna Loa dome. Extended down the mountain the northeastern rift is the seat of a line of cinder cones that poured flows toward Hilo in the nineteenth century. On the other side of the mountain the Kahuku rift gave vent to an increasing succession of flows from 1868 to 1926, the later ones devastating portions of South Kona.

The photograph on Page Three follows the eruption of April, 1926, down the southwestern ridge of Mauna Loa and presents a most comprehensive picture from the air revealing how the mountain ruptures along a belt of parallel cracks. This place is the source, about 7,600 feet above sea level, of the actual flood of slag which swept down on the village of Hoopuloa at the sea shore, and destroyed it. The aviators were flying along the southeastern side of the rift belt and the wind was blowing from the eastward so that the fumes sweep off to the west in the picture. In the foreground is shown an old cone containing a large crater and two smaller ones over a crack in general parallel to the active fissure, and in the background the line of dead cup craters, also parallel to the 1926 rift, is the scene of the tremendous eruption of the Alika flow of 1919. Here then are several active cracks parallel to each other, all constituting a rift belt, or fractured zone of the mountain, several miles wide. The active crack of 1926 is very straight and had built up a dozen cones each 50 to 75 feet high along about two miles of length shown in the picture. The right-hand end is up the mountain and the left-hand end shows two white streams of lava flowing in very straight courses down the mountain. The nearer one is flowing along the fissure and has found an open vent on the fissure into which it cascades. There are other live streams behind the smoke, vented by the middle and lower cones shown. The upper cones on the right have gone out of action, and one of their dead river beds is shown in the lower right-hand part of the picture. All of the live streams were distributing over the flat upland, but they united in a single torrent when they passed over the shoulder of the mountain and went down the steep slope through the forest into South Kona. A characteristic detail of the actual lava river is the dark line of rafts and partly congealed crusts carried down the middle of the stream, while the border portion remains bright and glowing with escaping gases along the belt of friction on the banks.

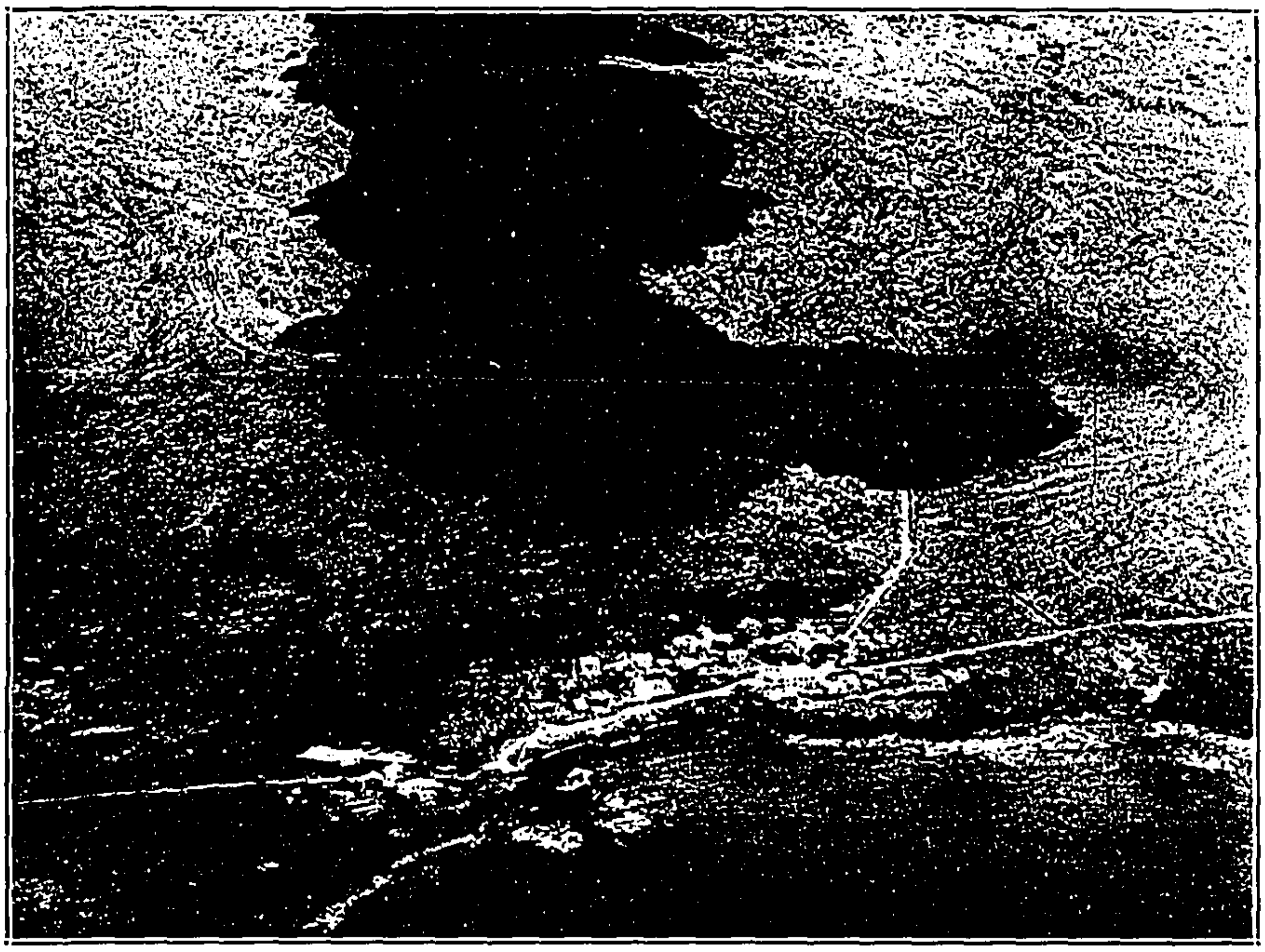
These pictures illustrate the alignment stage of volcanic outpouring, before the accumulations have built high enough to obscure the fissure and to produce a dome rather than a ridge. There are many heaps and pittings along fracture belts on the moon which are strikingly similar to the detail of this Mauna Loa fissure eruption. It is the occurrence of pits in direct relation to fracture lines around the edges of the big craters, and to straight fault fissures, on the moon, that effectively denies the validity of the impact theory of lunar craters. This theory imagines pits to have been made by the impact of meteorites. When the pits are definitely grouped along fractures, and smaller ones are structurally related to the lines of breakage around the edges of the bigger craters, it is incredible that meteorites should have sought out lines of cracking for their impacts. There is every reason for believing that the lunar craters resemble the Hawaiian pits in a sequence beginning with rampart rings of large diameter, and ending with small pits along curved fractures, the curves being guided by the older and larger domes and rings, which broke down when they became decadent.

The last air picture of the Army aviators gives a wonderful map of the western shore of Hawaii at Hoopuloa April 17, 1926, at 4 p. m., about 12 hours before the front of aa lava entered and burned the town, obliterated the harbor and the road, and crushed and buried the wharf. Here the winding stream through the flow is only faintly seen, and the main character of the advancing fronts, 20 to 40 feet high, is that of a caterpillar tractor. An upper layer of bowlders and gravel is rolled forward on a viscous red-hot paste inside, tumbles down at the front in a debris slope, and this is eternally overridden by the advancing mass for which it lays the track. The flow consists of four different mechanisms. There is the main river, the overflow fields of clinkery bowlders, the main front, and the subordinate fronts at the sides of the flow which build lobes and widen the slag flood as a whole at the expense of its height. It is interesting to observe in this picture the two ancient lava rivers right and left of the 1926 stream. It is the notch between their two deltas that had created Hoopuloa Harbor. It was the valley between their two heaps that guided the Hoopuloa flow straight down on the village which had unwittingly assembled its houses in this fatal lowland. Exactly the same lesson has been taught again and again by Vesuvius, and never has been learned. The lowlands and bays are attractive to the vine growers and the fishermen, but if they sought safety in a volcanic land they would be compelled to rebuild on the ridges and the points of land.

T. A. J.



Southwest slope of Mauna Loa giving vent to fissure eruption of lava April 18, 1926. This is the rift source of the lava flow that destroyed Hoopuloa fishing village. The line of cones is at elevation 7,600 feet, photographed from an airplane looking north showing lava source of 1919 in background, ancient cone in foreground, live lava streams on left, and dead flows of the new eruption on the right. Photo 11th Photo Section Air Corps U. S. Army.



Airplane photograph of Hoopuloa at 4 p. m. April 17, 1926, 12 hours before the village was buried. Aa lava flow with front 1,100 feet wide, 30 feet high, advancing 3 feet per minute. The tongues would push forward now here, now there. The two old lava stream beds on each side show how the new flow crept down the valley in between. Photo 11th Photo Section, U. S. Army Air Corps.

KILAUEA REPORT No. 944

WEEK ENDING FEBRUARY 23, 1930

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

Many avalanches have occurred during the week at Halemaumau. The whole north wall has been working between the niches extending upward from the tops of the north and northwest taluses, rocks trickling almost continuously. Dust from the slides lay thickest on the west side of the floor. Avalanches were sometimes heard at the Uwekahuna Observatory, the rumbling of the sliding masses of debris preceding by several seconds the appearance of the dust clouds above the rim of the pit.

Cracks along the east rim show a slight widening, and one of the measured points, No. 14, widened nearly two feet since December 4, 1929. Here the ground shows much cracking and settling, as though this end of the big sill were working in sympathy with the north end. Few slides have been noted here, however.

There was increase of copper salt southeast noticed February 17. With dry weather steaming has been very slight at Halemaumau.

There were 13 tremors, nine very feeble seisms, and one slight seism recorded by the seismographs. The slight shock occurred on February 19 at 5:42 p. m., with indicated distance to origin 27 miles, and was felt strongest in Kau District.

Microseismic motion was slight. Tilt accumulated moderately SSE.

THE VOLCANO LETTER

The Volcano Letter combines, after January 1, 1930, the earlier weekly of that name, with the former monthly Bulletin of the Hawaiian Volcano Observatory. It is published weekly, on Thursdays, by the Hawaiian Volcano Research Association, on behalf of the section of Volcanology, U. S. Geological Survey. It promotes experimental recording of earth processes.

Readers are requested to send articles, photographs, publications and clippings about volcano and earthquake events, instruments and investigations, especially around the Pacific.

Subscription for non-members two dollars per year of 52 numbers. Address the Observatory.

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HAWAII NATIONAL PARK
HAWAII

OFFICE OF THE SUPERINTENDENT

February 4, 1930

Director,
National Park Service,
Department of the Interior,
Washington, D. C.

Dear Mr. Director:-

The report of operations and activities in Hawaii National Park during January 1930 is submitted herewith.

000 GENERAL:

January saw the start of the winter travel season to Hawaii. All steamer lines carried heavy passenger lists from the coast. The Los Angeles Steamship Company has inaugurated a new schedule whereby their boats will make more frequent trips to the Hawaii National Park during 1930. The new schedule calls for a ship to reach here at least once every week.

100 ADMINISTRATION:

121 Inspections by superintendent.

Various routine inspections of work in progress were made by the superintendent.

200 MAINTENANCE, IMPROVEMENTS and NEW CONSTRUCTION:

210 Maintenance.

Park roads are now completely repaired from damage of early winter storms.

250 New Construction.

Work has been started on improvement of the secondary type road to Bird Park. This project is under Roads and Trails program. It was approximately 40% completed during January.

300 ACTIVITIES OF OTHER AGENCIES IN THE PARK:

390 Kilauea Military Camp.

For several years it has been a custom for soldiers from Kilauea Military Camp to form their initials or company insignia on the smooth floors of extinct craters by the use of large loose rocks. This had so disfigured some of the craters as viewed from their rims that orders were issued by this office stopping the practice. In order to eliminate formations already in place the officers of the military camp furnished us fifty men who thoroughly cleaned up everything.

400 FLORA, FAUNA, and NATURAL PHENOMENA:

410 Ranger naturalist service.

Uwekahuna Observatory lectures by rangers, guided trips across the floor of Kilauea crater and through the Lava Tube were continued as popular features. Our efforts to secure a competent naturalist have once more been discouraged - this time due to our prospect being unable to produce a college degree as required by Civil Service regulations.

430 Volcanoes.

No volcanic actions have occurred in the past month by registered earth movements and tilting still indicate possibility.

500 USE OF PARK FACILITIES BY THE PUBLIC:

510 Travel.

Hotel and Military Camp travel is lower than the corresponding month for 1939 due to a series of military inspections in the Hawaiian department and to a continual rainy and windy weather all through Hawaii.

520 Weather.

January was marked by several days of high wind and two days of extremely high wind. In the Kona district of this island a heavy thunder and lightning storm brought a deluge that washed away many buildings, caused thousands of dollars damage, and drowned three persons. Snow now tops both Mauna Loa and Mauna Kea and has dropped nighttime temperatures in the park as low as 40 degrees.

Maximum temperature	5th	72 degrees
Minimum "	14th	43 "
Rainfall for month of January		5.92 inches
" " " " " at Hilo		6.09 "
" " to-date Volcano District		5.92 "
" " " at Hilo		6.09 "

540 Visitors.

General Sir C. H. Powell of England spent two days at Volcano House.

600 PROTECTION:

610 Police protection.

Two soldiers from Kilauea Military Camp were arrested by Ranger Brumaghim for rolling rocks over the Uwekahuna cliffs and they were turned over to military authorities for discipline.

Discovery was made on January 6 of three small trees and a park sign deliberately shot into pieces. Search of the area revealed a quantity of army regulation rifle shells. Three different partys of soldiers had been given leave by officers to hunt outside the park boundaries that day and the usual permission of the superintendent had been granted to carry their rifles through the park. All men involved denied the shooting of trees and the offense could be proven on no particular person. In order to prevent further offenses the commander of the camp issued an order entirely removing the hunting privaleges of the entire camp. A copy of the order was furnished this office.

The trial of George D. Douglas under indictment for malicious damage at the superintendent's residence occurred of January 16th at Kailua. A verdict of not guilty was ordered by the presiding judge J. Wesley Thompson. Failure to prove this case is attributed to the lapse of eight months before trial and the consequent confusion of witnesses.

Very respectfully yours,

Thos J. Allen Jr.
Thos J. Allen Jr.,
Superintendent.

Copy to " Field Headquarters " (8)
" " " Yellowstone National Park " (1)

TJA/ht

10-157

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

TRAVEL REPORT

Hawaii National Park for the Month of January 1930

	This Month	This Travel Year To Date	This Month Last Year	Last Travel Year To Date	Increase for Travel Year Number	Increase for Travel Year Per cent
PRIVATE TRANSPORTATION:						
Cars first entry.						
Cars reentry.						
Motorcycles.						
Total motor vehicles.						
Persons entering via motor vehicles.	5,895	25,765	3,210	11,070	14,695	.570
Persons entering via other private transportation.	260	1,017	164	773	244	.240
Total persons entering via private transportation. . . .	6,155	26,782	3,374	11,843	14,939	.554
OTHER TRANSPORTATION:						
Persons entering via ~~stages~~ Hotel . .	876	2,630	1,104	2,823	- 193	.068
Persons entering via trains . .						
Persons entering otherwise. . .						
Total other transportation. .	876	2,630	1,104	2,823	- 193	.068
GRAND TOTAL ALL VISITORS. . .	7,031	29,412	4,478	14,666	14,746	.501

	This Year	Last Year	Increase Number	Increase Per cent
Automobiles in public camps during month	0	0	0	0
Campers in public camps during month	0	0	0	0

10-158

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

STATUS OF AUTHORIZED PROJECTS

Hawaii National Park for the Month of January 1930

Description of Projects	Percent Constructed To Date	Percent Constructed This Month	Percent Constructed Last Month	Probable Date of Completion
502.4 Bird Park, Auto Trail	40	40	----	Feb. 28, 1930

10-159

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

STATUS OF PERSONNEL

........Hawaii.............. National Park for the Month of ....January 1930........................

	This Month	This Month Last Year
Number of employees beginning of month,	13	8
Number of additions, ...	1	1
Total, ...	14	9
Number of separations, ...	2	2
Number of employees close of month, . .	12	7
Number of promotions during month	0	0
Aggregate amount of annual leave taken,	0	0
Aggregate amount of sick leave taken,	0	0
Aggregate amount of leave without pay,	0	0

10-160

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

REPORT OF PARK REVENUES

Hawaii National Park for the Month of January 1930

	This Year	Last Year
Park revenue on hand beginning of month,	0.00	0.00
Received,	1,025.00	1,025.00
Total,	1,025.00	1,025.00
Remitted,	1,025.00	1,025.00
On hand close of month,	0.00	0.00

Park revenues received this year to date,	1,025.00
Park revenues received last year to date,	1,025.00
Increase,	0.00
Percent of increase,	0.00

10-161

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

HAWAII NATIONAL PARK

REPORT OF SALES OF PUBLICATIONS

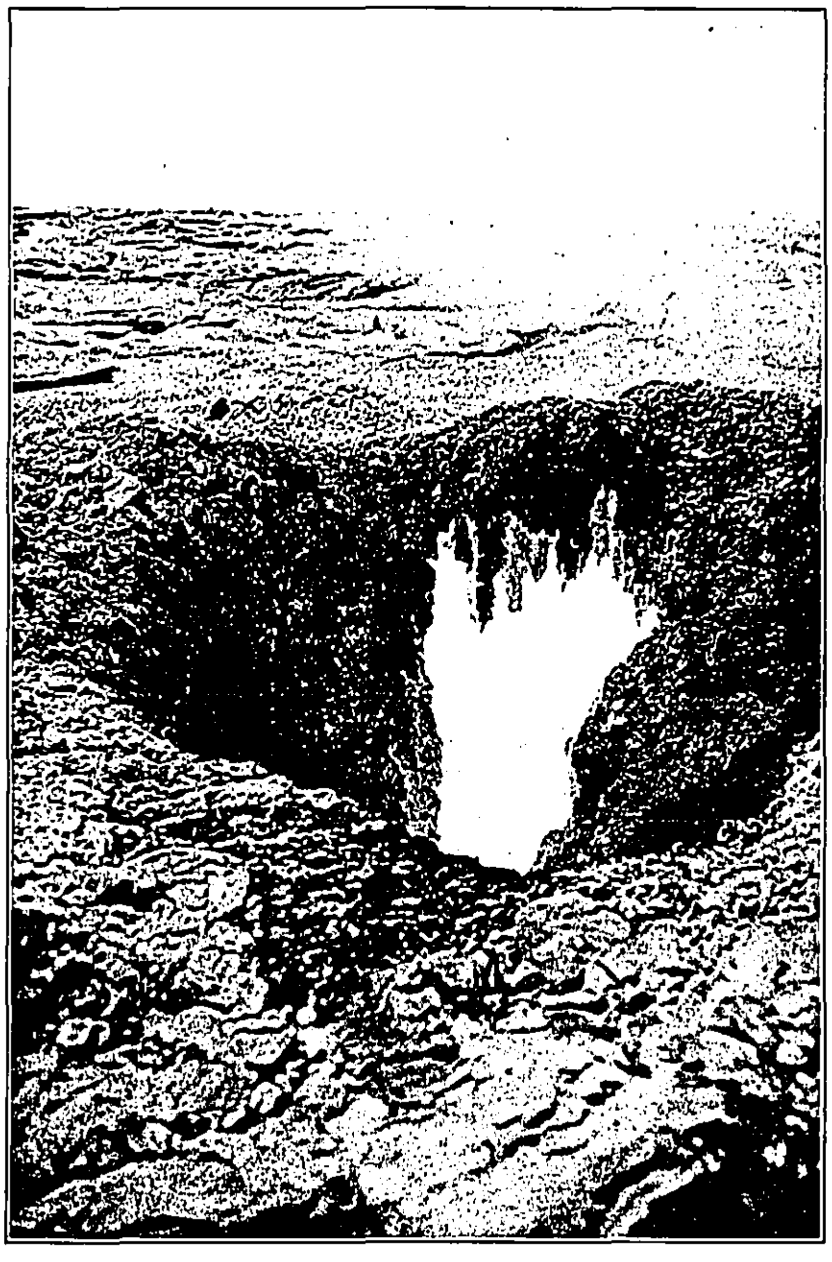
JANUARY 1930

	Number	Value
GOVERNMENT PUBLICATIONS:		
On hand beginning of month,	295	51.10
Received during month,	0	0.00
Total,	295	51.10
Sold during month,	8	6.20
On hand at close of month,	287	44.90
NON-GOVERNMENT PUBLICATIONS:		
On hand beginning of month,	5	12.50
Received during month,	0	0.00
Total,	5	12.50
Sold during month,	0	0.00
On hand at close of month,	5	12.50

Cash on hand beginning of month,	113.70
Sales during month,	6.20
Total,	119.90
Remitted during month,	0.00
Balance,	119.90

The Volcano Letter

No. 263—Weekly | Hawaiian Volcano Observatory, National Park, Hawaii | January 9, 1930



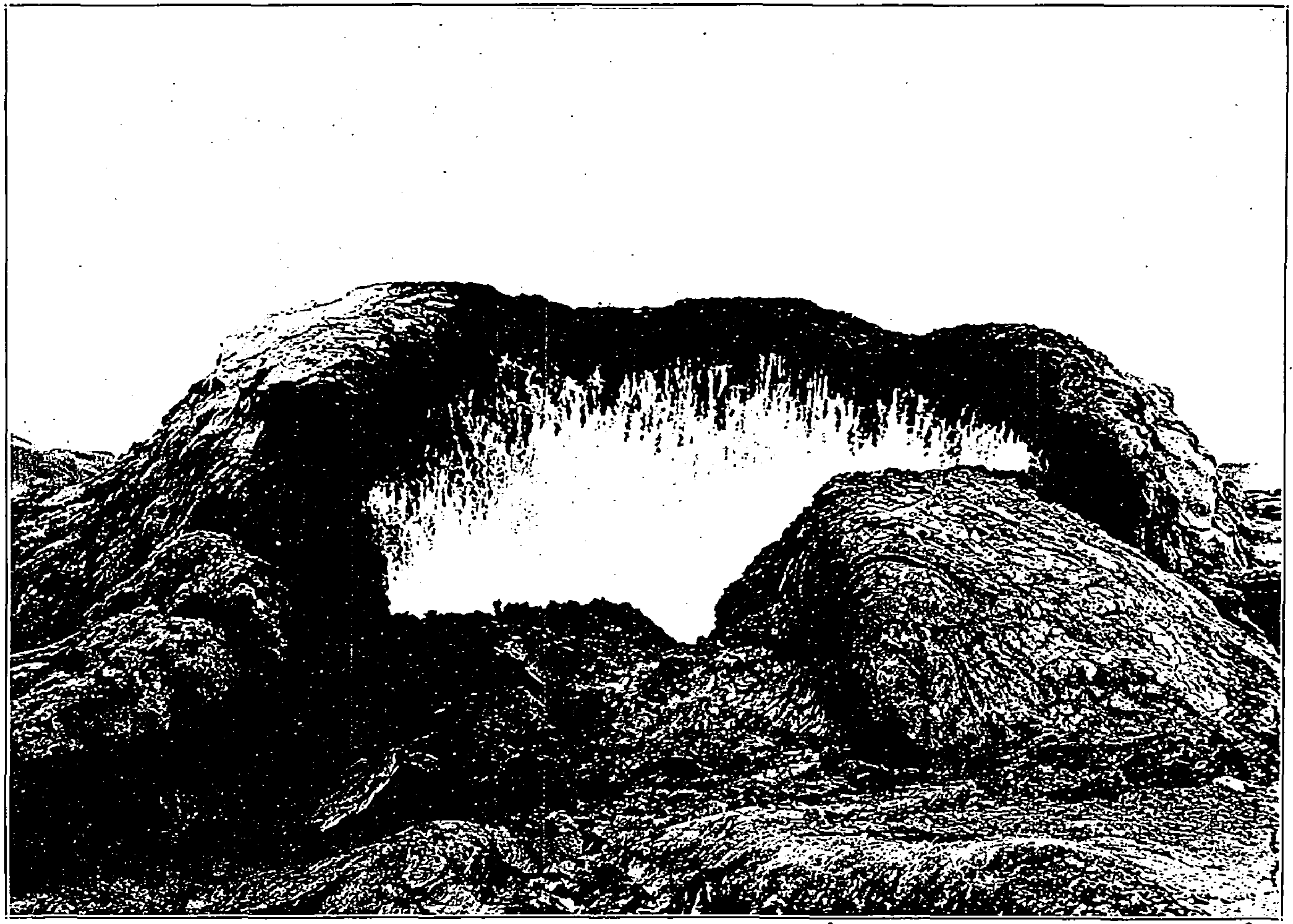
Looking into red hot tunnel hung with stalactites at orifice of eastern breathing cone, February 13, 1919, 11 a. m. This is inside Halemaumau pit on the inner floor when the lava lakes were level with rim of pit. The glowing tunnel connects through to the largest lake, and lava was splashing inside the tunnel. —Photo Jaggar.

BREATHING CONES

The extraordinary lava activity of the year 1919 at Halemaumau, the fire pit of Kilauea, marked the peak of the eleven-year cycle. To a tourist who sees the vast cauldron of today, a thousand feet deep and three thousand feet across, it is hard to realize that glowing molten slag was overflowing the edge of the pit a decade ago. The pit had its definite margin of cold rock, but within that margin and overlapping it there were lava lakes, pots, driblet spires, flow heaps, tunnels, stalactite grottoes, smoke holes, and breathing cones.

The East Cone of the spring of 1919 was a low hillock built up around a lava pot on the inner floor of Halemaumau. Visitors habitually walked over this floor, which extended from the lakes inside the pit area to merge with the overflows outside. This pot was supplied with glowing, gassy melt through a tunnel leading from the main lake. With the rise and fall of the liquid lava a cone was built around the pot, and the interior ceiling of the tunnel became hung with huge gas-glazed stalactites three or four feet long.

One could stand on the rim of this conelet, and gaze into the open pot where lava of bright yellow glow was splashing 15 feet below. Under the lip of the orifice the interior chamber was bright orange with incandescence, hung with the delicately sculptured fiery stalactites



Rift Oven of the Red Solfatara. This photograph was taken by evening light April 4. 1921, with panchromatic plate and deep red filter. The glowing oven, 9 feet high and 20 feet across, stood over the rift about 500 feet outside Halemaumau and remained like this throughout the spring. Photo Jaggar shaped like long bunches of grapes. By night a banner was visible of blue-green flame fluttering above the orifice sending off pale blue transparent fumes acrid with sulphur.

As a whole during this period the lakes were rising, the inner floor was being overflowed in spasms, and the heaps, cones, and spiracles were building up. The East Cone hissed and breathed and roared at different times. Sometimes it would vomit up its molten stuff like an artesian well, and give vent to a glowing flow. At such times the pot and tunnel were obliterated, only to reappear with the stalactites reforming when the outflow ceased.

The grape-like droplets, and the gray, yellow, red, or brown glazes on the surface of these stalactites are not the result of direct spatter. There are other stalactites in curtains and frozen drip points which are formed by direct splash. The grape bunches, however, and the long worm-like stalactites are formed by the remelting of the roof of the cavern by slow action of the intensely hot burning gases. This burning is converted into a blow-torch effect when air has access to the tunnel so as to convert the combustible gases from the boiling lava into oxidation flames. When air reaches the volcanic gas pipe suddenly, the change in the iron oxides of the glaze may be equally sudden, and a whole cavern may be caused to glow by the access of air alone.

The illustration on the first page shows the East Cone here described at a time when the liquid lava was about 15 feet down. The second illustration shows a similar cone that developed over a crack about 500 feet away from Halemaumau in the direction of the desert to the southwest in the spring of 1921. This cone it was that displayed several times an extraordinary revival of glowing through access of air below while its walls were still hot.

This second cone was called the Rift Oven of the Red Solfatara. It was over the great deep crack that leads from Halemaumau radially down the mountain to the southwest. The two long, black gashes standing vertical in the present wall of Halemaumau as seen by tourists to the left of the visitors' station are where this rift emerges into the pit. It can be readily understood that if lava now rose into those tunnels by the filling up of the pit, and a vertical shaft outside of the pit led from the uppermost tunnel to a cone on the surface, that the gases from the boiling lava in the shaft would heat the cone. This was exactly the situation of 1921. The cone breathed and puffed, lava was visible far down the shaft, pale flame played around the orifice, and sulphurous gas was given off.

There was direct connection between the lava in this well and the lava lakes in the pit, but often the lava in the well by reason of gas frothing would stand much higher than the same liquid in the open pit. The gases kept the well at bright orange glow and maintained the stalactites, even when the heat from the open lakes and the glow above the pit decreased strongly. With the liquid lava 200 feet down the well in April, 1921, the glow was maintained up to the top, in a shaft 10 to 15 feet in diameter, by the action of burning gases. Finally there came a time, however, when the interior of the oven became dark red and even black and the stalactites were seen to be a silvery gray with the black oxide of iron. The hot gases continued to rise.

Now came the extraordinary and dramatic demonstration of what air could do in heating up a volcanic furnace. All this time the lava lakes in Halemaumau had been above the level of the wall tunnel. In July the lava lakes lowered below the tunnel so that a black cavern or arcade could be seen, just as at present, leading into the wall at the southwest. Immediately an air blast, smelling strongly of sulphuric acid came rushing with a roar up the outside well, where quiet gas had been rising before. The shaft, oven, stalactites, and the entire lining of an adjoining tunnel all began to glow again, the tunnel walls becoming red hot away out to its remoter entrance 150 feet away from the rift. Incandescent sparks were visible after nightfall in the blast. Then the furnace cooled off again and within four days the wells and the tunnel were dark, but the steel-gray glaze of magnetic needles of iron oxide, the common lining of such caves, had changed to brick red.

T. A. J.

KILAUEA REPORT No. 937

WEEK ENDING JANUARY 5, 1930

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

The current report on volcanic conditions in Hawaii overlaps the preceding one by two days, as it introduces a new series of weekly reports ending at midnight Sundays. This is for convenience in the new series of the Volcano Letter, beginning 1930, prepared at the station on Mondays instead of Wednesdays.

For the week ending January 5, 1930, there is little change in Halemaumau pit. On December 30 part of the July fountain heap had slightly fallen in the middle. There is remarkably little steam emerging from the floor and talus slopes, in spite of recent rains. This is in contrast to the rim cracks outside of the pit, which on January 1 at 2 p. m. sent up much vapor. Much fine material was observed lying thickly on the talus at the north. January 3 much steam arose from the pit, in general blending with the clouds above, and from the cracks of the Kilauea floor. At 9:30 a. m. January 4 there was more vapor at the Halemaumau vents, particularly on the south wall.

Eight very feeble local earthquakes were recorded by the Observatory seismagraphs, and five of these indicated average distance of 44 miles, corresponding as heretofore since September to the distance of Hualalai from the station. One very feeble shock indicated distance of origin 19 miles.

Microseismic motion for the week was slight, and tilt accumulated strongly to the southwest. This tilt is characteristic of the seasonal curves for January.

HAWAIIAN VOLCANOES IN 1929

The end of 1929 finds the Hawaiian volcanoes quiet, but the year has produced three notable activities, two of them volcanic eruptions and one a seismic spasm of extraordinary quality. The first was the influx of new lava in the bottom of Halemaumau in February, following upon similar fillings of the bottom in July 1924 and 1927, and in January 1928. The second 1929 event was a similar influx in July and each of these eruptions of lava leaves a new floor higher than before so that the pit has decreased some 300 feet in depth since June of 1924.

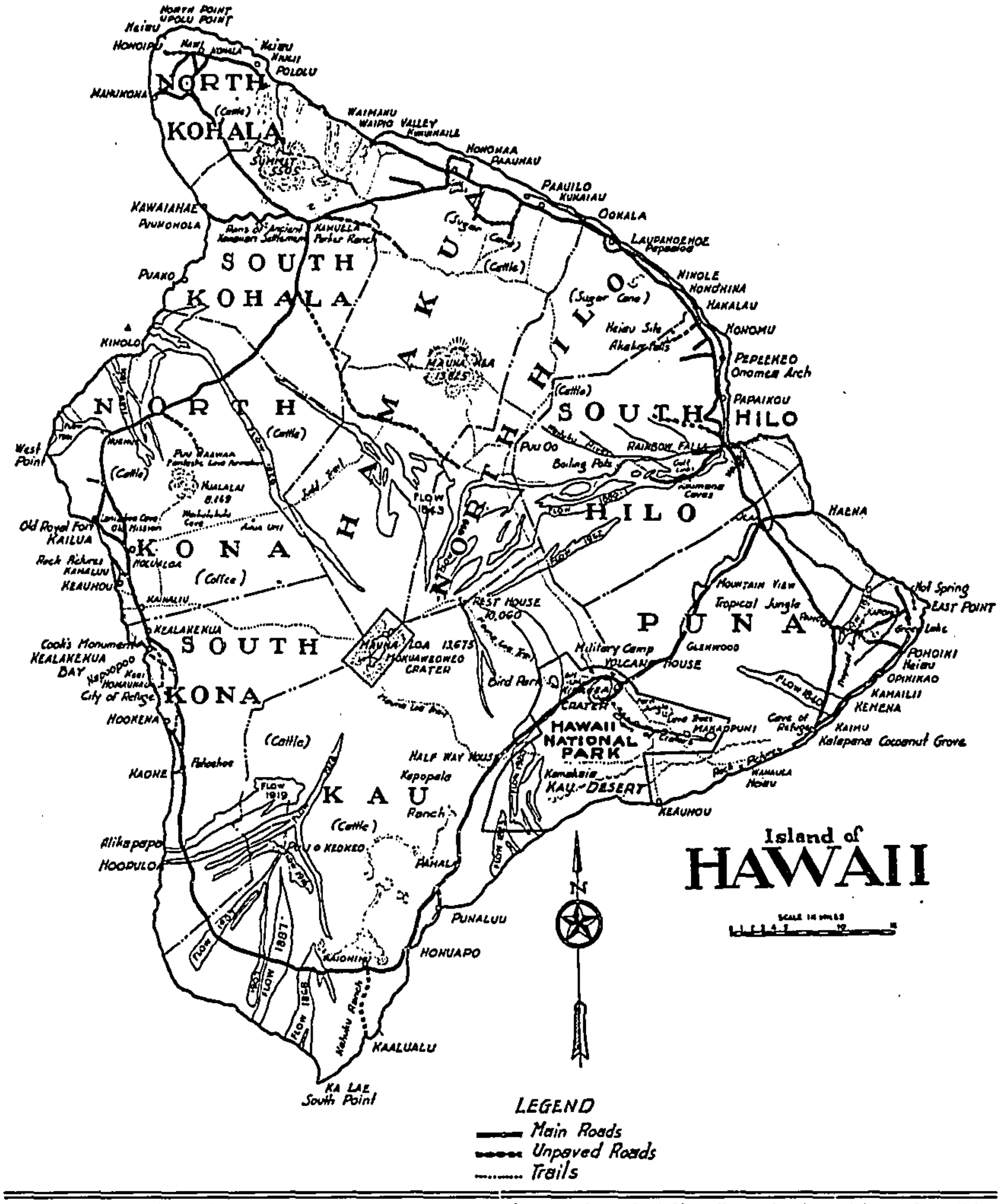
A curve platted to follow the progress of these fillings of Halemaumau in relation to the lapse of time indicates decrease of interval between eruptions, so that the expectation was recorded that lava activity might return in the autumn of 1929 unless the magma were to rise in one of the other volcanoes. There are three of these which are potentially active, Mauna Loa, Hualalai, and Haleakala.

The seismic spasm which began in September and has continued, dwindling, ever since, appeared to confirm this expectation. The evidence of locality points to Hualalai. The shaking was violent in North Kona, reached its maximum October 5, and now has become very slight, but still shows signs of life. The indication is that the underground lava column at the Mauna Loa center, which for many years has vented itself to the southwest, is now pressing up along rifts extending toward the northwest and may eventually find release there.

Meanwhile nothing new has happened in the craters of Kilauea and Mauna Loa. The July lava in Halemaumau pit at Kilauea Volcano solidified with some shrinkage, leaving the scar of its big southwestern fountains in a built-up heap surrounded by pumice and shaped like an armchair, and leaving what was the lake area a lumpy floor surrounded by a rampart. The only changes have been falls of rock from the walls of the pit slightly overlapping the new lava floor with their debris.

Seismic phenomena local to Kilauea have not been remarkable during the last part of the year, and there is nothing in tilt, tremor, or earthquakes indicative of a change of magmatic action under Kilauea Volcano. The avalanching at Halemaumau in December has been remarkably slight.

T. A. J.



THE VOLCANO LETTER

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HAWAIIAN VOLCANO OBSERVATORY
Founded 1911

This laboratory at Kilauea Volcano belongs to the Hawaiian Volcano Research Association and is leased and operated by the United States Geological Survey.

It maintains seismographs at three places near Kilauea Volcano, also at Hilo, and at Kealakekua in Kona District. It keeps a journal of Hawaiian volcanic activity and publishes occasional Bulletins.

Membership in the Hawaiian Volcano Research Association is limited to patrons of Pacific science who desire personally to aid in supporting the work.

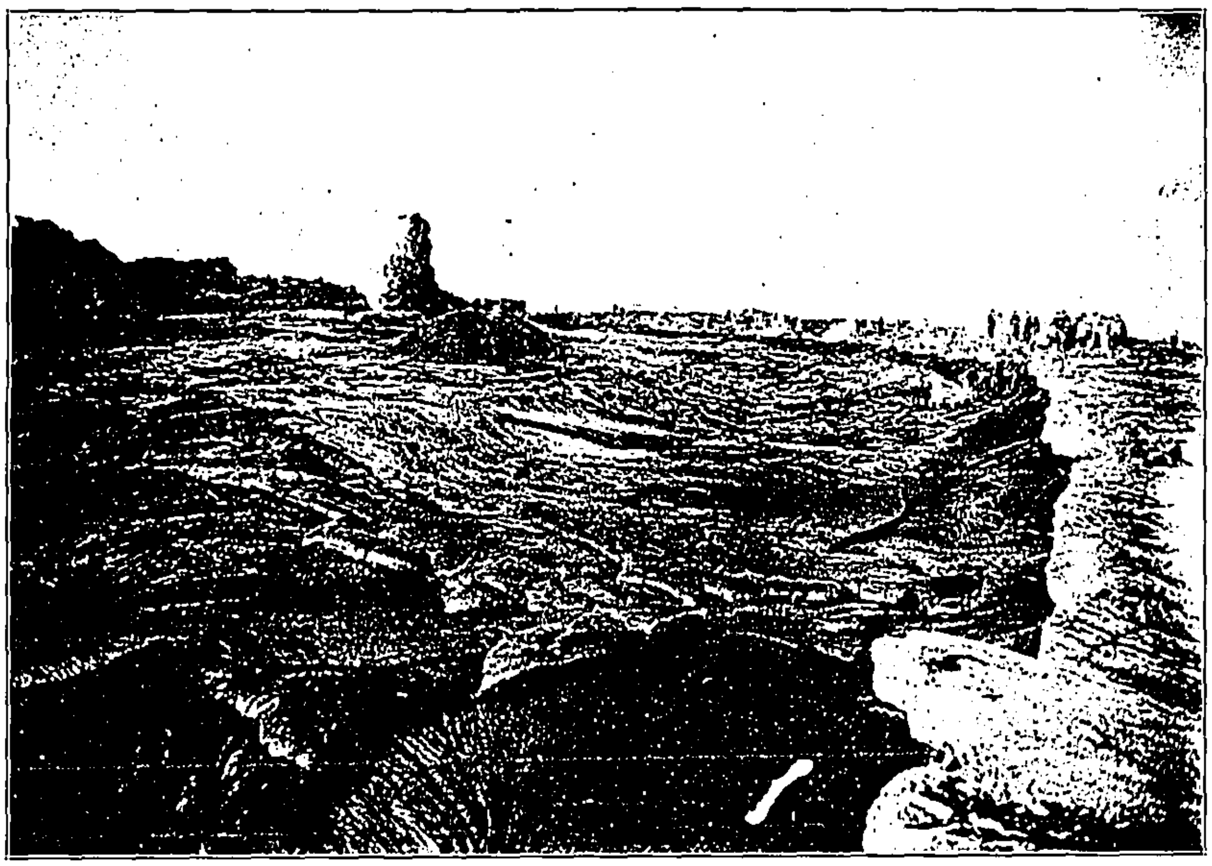
The work of volcano research so supported is in collaboration with the work of the United States Geological Survey, but supplements it with buildings, research fellows, instrumental plants, explorations and special investigations for which there is no governmental provision. The Geological Survey maintains volcano stations in Alaska, California and Hawaii.

The Board of Directors includes Lorrin A. Thurston, President; Walter F. Dillingham, Vice-President; L. Tenney Peck, Treasurer; Frank C. Atherton, Wade Warren Thayer, Arthur L. Dean, and Richard A. Cooke.

Persons desiring application blanks for membership should address the Secretary, Hawaiian Volcano Research Association, 300 James Campbell Building, Honolulu, T. H.

The Volcano Letter

No. 264—Weekly | Hawaiian Volcano Observatory, National Park, Hawaii | January 16, 1930



The southeastern rim of Halemaumau on February 22, 1918, the day before the pit overflowed the road terminus. The light ground at the right is the rim, the dark foreground is the ovellow lava of the fcuntaining lakes, which are among the crags at the left. The rim rock shows no swelling.

THE SWELLING OF VOLCANOES

The edge of Kilauea Crater is a live place, no matter what the eruptions are doing. The ground under the Observatory and the hotel is always tipping away from the center of the crater, or else tipping back again. The ground at the edge of the firepit, always visited by the tourists, tips back and forth still more strongly than the rim of the greater crater. The ground between Volcano House and Hilo actually rose by amounts measurable in feet between 1912 and 1922 and sank by similar amounts at the time of the great engulfment eruption of 1924. This engulfment enlarged Halemaumau pit, by caving-in of the rim, some 700 feet outward on all sides. There is thus a cycle of swelling and shrinking in a volcano, and this note is to call attention to the gradations of swelling which have been studied by the Observatory.

Measured Tipping of the Ground.

Tipping of the ground is one of the subjects studied with pendulums at the Hawaiian Volcano Observatory. This means that the flat floor of the seismograph cellar tips a little each day back and forth. Accumulated tilting in a week becomes a real change in the plumb line. At the edge of a sink crater in the top of a lava dome over red-hot lava a little way down—such is the situation of the Observatory—it may be readily understood that when molten lava pours forth from the pit inside of the crater, an increased heat and pressure inside the mountain is developed. The effect of this should be a small swelling up of the mountain, measurable as tilt away from the center. Just such tilt was measured on the seismographs during the years leading to the great overflows which built up the Kilauea floor between 1918 and 1921. And the reverse of this, a strong, sudden and large inward tip toward the center happened in 1924 when the lava sank away. This was accompanied by collapse of the pit and the famous steam-blast eruption.

Visible Swelling at the Pit.

But this swelling of the volcano at the edge of the pit itself was so tremendous that it actually became visible. We are now speaking of Halemaumau, the inner pit of the Kilauea sink, more than two miles from the Observatory, and itself the crater of the domed-up inner floor of the large sink. The first illustration shows the southeastern rim of Halemaumau on February 22, 1918. The crowd of people is clustered on the rim, and a few of them have stepped down and are walking on the shells of new hardened lava which by rising has just reached the rim level.

At this time, December 28, 1920, great outflows poured from Halemaumau through the breathing rift cones just outside. This picture shows the Red Solfatara, with bright orange and yellow sulphur and selenium, in foreground, and flows around the cones.

It is as though the present floor which tourists see one thousand feet down were up to the level of the rim station.

This picture was taken the day before the inner lava overflowed the rim. The black crags on the left are adjacent to the lava lake, and represent blocks of the overflow benches of the lake which had been uplifted. There is a rectangular stone shelter on the rim of the pit in the background, and this was the principal tourist station of that time. The lake of slag was boiling and fountaining as a large puddle of molten stuff, generally in clover-leaf shape, off to the left of the picture, with risings and fallings from hour to hour which made the black fill in the foreground.

At this time the light-colored rim of the pit on the right was rising. The rise only showed as a faint tip away from the center. Then came the overflow which sent a torrent of candy-like lava a half mile away over the automobile road, and the inner floor of the pit swelled up into more crags. Within six days the old rock of the southwest rim of the pit had been pushed up nine feet in a ridge showing the profile of a half arch on the outer side, while the wall inside remained upright. This old, hard rock moved like broken wax. A year later came another spasm of swelling extending the pressure ridge for several hundred feet around to the tourist station. A six-foot leveled platform of concrete used as a surveying station was tipped back 45 degrees until it fell to pieces. By August of 1919 a similar leveled concrete platform 100 yards back from the rim of the pit on the north side was tilted away from the center 10 degrees or more. Meantime there had been numerous overflows, and gushings of lava up cracks back from the rim of the pit. It was clear that in fissures of unknown form the underpinning of the floor of the greater crater was surcharged with lava that caused it to swell.

This whole period of 1919-20 was a time of repeated risings and outflows about Kilauea Crater as a center. The pressure ridge around the south rim of Halemaumau became a great feature 15 or 20 feet high, and persisted until a deep collapse occurred in April, 1921. Our second picture shows the same rift cone that contained the glowing stalactites in the second illustration of Volcano Letter No. 263, but at this earlier time the cone vent was vomiting out lava flows and burying brilliant colored deposits of alum, epsom salts, selenium and sulphur. This cone was over the deep crack leading from Halemaumau to the southwest, and about 500 feet from the edge of the firepit.

The illustration on the last page is a photograph of the first concrete monument above referred to. It shows the round surveying station on the old rim of the pit actually heaved up into the air and tipped back, so that all the ridge which extends across the picture had been the flat edge of the pit only two weeks before. The observer is looking toward the pit.

A Pendulum Set up at Halemaumau.

All this evidence of visible swelling when the lava was high made it interesting to place at the rim of the pit a machine to microscope such movements. A seismograph pendulum was set up in a stone hut a few hundred feet back from the tourist station at the southeast rim of the present big cauldron. A horizontal pendulum is somewhat like a barnyard gate. *The boy sitting on the gate* corresponds to the lead weight. If the gate post is tipped away from the pasture, and the gate is unlatched, the boy swings out toward the road. Just so it is with the pendulum at the crater, with a hinge at one side, attached to a concrete post, and the gate-like pendulum hung parallel to the edge of the pit. If lava comes into the bottom of the big pit so as to swell up the whole dome floor of the larger Kilauea Crater, the pendulum should swing away from the center of the pit. If the bottom of the pit collapses, the pendulum should swing toward it.

The pendulum at Halemaumau writes all day long on a sheet of paper which is pulled under its pen by a clockwork. If the pendulum swings away from the pit the written line shows it, and the amount of the swing may be measured for any hour of the day, and for any day of the year, by the position of the line on the paper. To revert to the boy on the gate, if an automobile were dragging a sheet of white canvas along the road, and the boy on the open gate dug his muddy heel into the canvas, the mark would show how much the gate was open. So it is with a seismogram.

The outbreak of lava far down in Halemaumau February 20, 1929, wrote a complete autograph on this instrument, 1,100 feet above it and at least half a mile from the center of fountaining. First there were little earthquakes written on the instrument and then a tipping of the ground away from the pit. The moment the lava fountaining began, the seismograph pen started writing a strong back-and-forth line like a tremulous invalid, and the tipping stopped. This tremor continued and became excessively strong toward the end of the two days' activity, and then the tipping began to go in the opposite direction, namely, toward the pit. This tipping and tremor continued up to the moment when the fountaining stopped, when the line became smooth and straight. These sheets of paper taking the pulse of an active crater for the three days, February 19, 20 and 21, 1929, are epoch-making in the history of science. They prove that a microscopic record of a lava outbreak may tell the story with perfect fidelity.

Swelling and Shrinking on a Large Scale.

We have seen that the visible gushing lava swells and shrinks its containing vessel, that the mountain top swelled and contracted during the cycle of activity from 1913 to 1924, and that these things were measured by instruments designed to show the trembling and tipping of the ground, and measured also by the careful methods of the surveyor. These last made use of the telescope, the level bubble, and the exact determination of mean sea level at Hilo with the aid of the tide gauge.

When the traveler gazes at the pure curve of the dome of Mauna Loa, he may well make inquiry, "How much of that is swelling?" This leads to the question, "How large a part do swelling and shrinking play in the mechanism of building active volcanoes?" And going still farther to such a region as eastern Japan or western California, where volcanic heat is still rampant and where great earthquakes occur, he may well ask, "Does not this mechanism of volcano swelling, deep under the earth's crust, play an important part in the uplift of the shore lines in both these uplifed lands?"

In Hawaii itself the question of large scale uplift and breakdown of the islands is of intense interest both geo*graphically and with* respect to the passage of time. The geographic evidence is the astonishingly regular gradation of height or uplift of the islands as we go from east to west; Hawaii is the highest and contains the active volcanoes; Midway Island, far away at the west, is a tiny coral reef. In between there are intermediate islands containing old volcanic rock. The time evidence shows that Kilauea at the east, among the active volcanoes, almost continuously ejects liquid lava, but is breaking down along its shore line. Mauna Loa, next to the west, is less continuously active, and Hualalai, farther west, has still greater intervals. Haleakala, the last of the four volcanoes with an active record, was probably last flowing very long ago, about 1750, and its crater is a more broken structure. In time and space the Hawaiian Islands are swelling and swollen at the east, and shrinking or shrunken at the west. T. A. J.

KILAUEA REPORT NO. 938

WEEK ENDING JANUARY 12, 1930

Section of Volcanology, U. S. Geological Survey

T. A. Jaggar, Volcanologist in Charge

The Hawaiian volcanoes remained quiet, fresh snow was observed on Mauna Kea and Mauna Loa when the mountains cleared January 8, and on Hualalai an odor of spicy sulphur was noticed by the foresters near the western summit January 7. A similar odor had been perceived there by the forest ranger December 31.

At Halemaumau dust from a slide at the north side of the pit was observed during the forenoon January 8, and the wall there was afterwards seen to be grooved from the loss of fresh debris, which lay on the talus below.

The seismographs at Kilauea Observatory registered 19 local disturbances for the week, of which 12 were tremors, lasting each from 15 to 45 seconds, and seven were very feeble earthquakes. One such earthquake indicated origin distance 52 miles, time 6:08 p. m., January 8. This probably centered in North Kona. Microseismic motion for the week was slight, and tilt was slight to the southeast.

The rim of Halemaumau, looking straight toward the pit. This photograph, March 6, 1919, shows southeast surveying station tipped up away from the pit on a pressure ridge 15 feet high. The swelling had begun suddenly February 25. Photos Jaggar.

THE VOLCANO LETTER

The Volcano Letter combines, after January 1, 1930, the earlier weekly of that name, with the former monthly Bulletin of the Hawaiian Volcano Observatory. It is published weekly, on Thursdays, by the Hawaiian Volcano Research Association, on behalf of the section of Volcanology, U. S. Geological Survey. It promotes experimental recording of earth processes.

Readers are requested to send articles, photographs, publications and clippings about volcano and earthquake events, instruments and investigations, especially around the Pacific.

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HAWAIIAN VOLCANO OBSERVATORY

Founded 1911

This laboratory at Kilauea Volcano belongs to the Hawaiian Volcano Research Association and is leased and operated by the United States Geological Survey.

It maintains seismographs at three places near Kilauea Volcano, also at Hilo, and at Kealakekua in Kona District. It keeps a journal of Hawaiian volcanic activity and publishes occasional Bulletins.

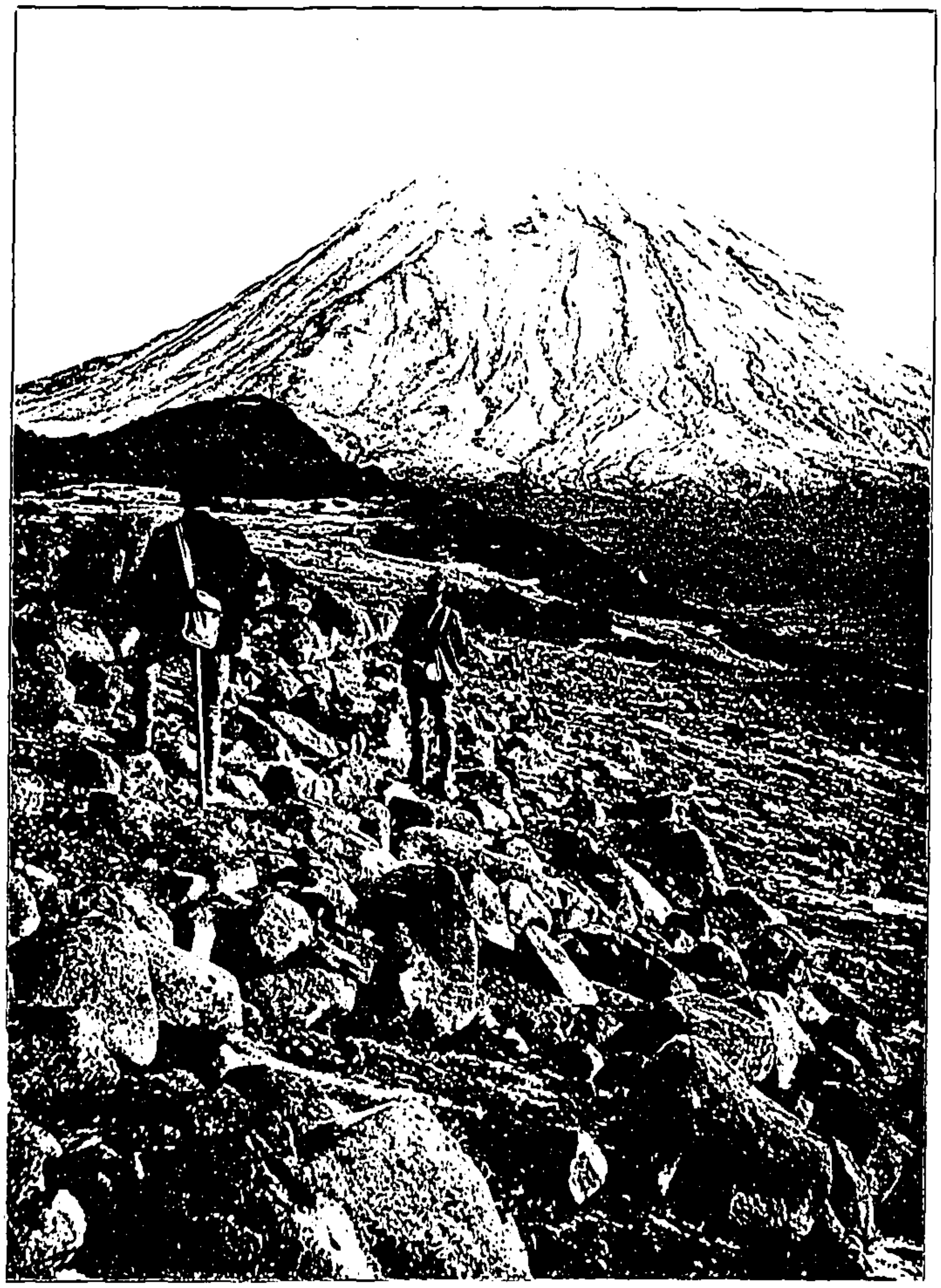
Membership in the Hawaiian Volcano Research Association is limited to patrons of Pacific science who desire personally to aid in supporting the work.

The work of volcano research so supported is in collaboration with the work of the United States Geological Survey, but supplements it with buildings, research fellows, instrumental plants, explorations and special investigations for which there is no governmental provision. The Geological Survey maintains volcano stations in Alaska, California and Hawaii.

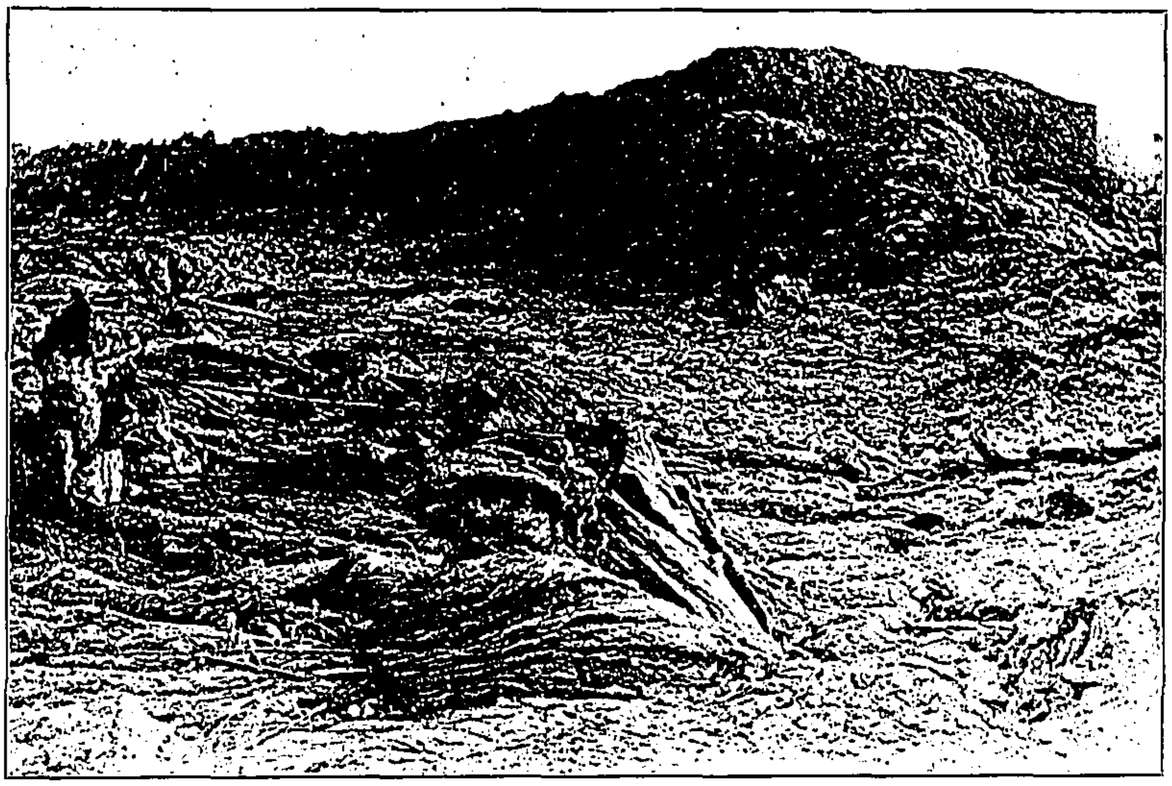
Persons desiring application blanks for membership should address the Secretary, Hawaiian Volcano Research Association, 300 James Campbell Building, Honolulu, T. H.

The Volcano Letter

No. 265—Weekly | Hawaiian Volcano Observatory, National Park, Hawaii | January 23, 1930



Ngauruhoe Volcano, New Zealand National Park, as seen in winter from the Eastern side. This is the most active of the splendid volcanic cones of New Zealand, and was throwing out rocks and had glowing lava within its crater in March, 1928. —Photo Malcolm Ross.



Fresh Pahoehoe Lava on Niuafou, 1913. There has bee n much controversy about whether historic lava flows have occurred in the Tonga Islands. This photograph, with fresh source cones and ropy basalt of 1912, when there was an eruption near Futu, settles the question in the affirmative. Photo from Captain Crawford, Canadian Australasian Steamship Company.

VOLCANOES OF NEW ZEALAND-TONGA BELT

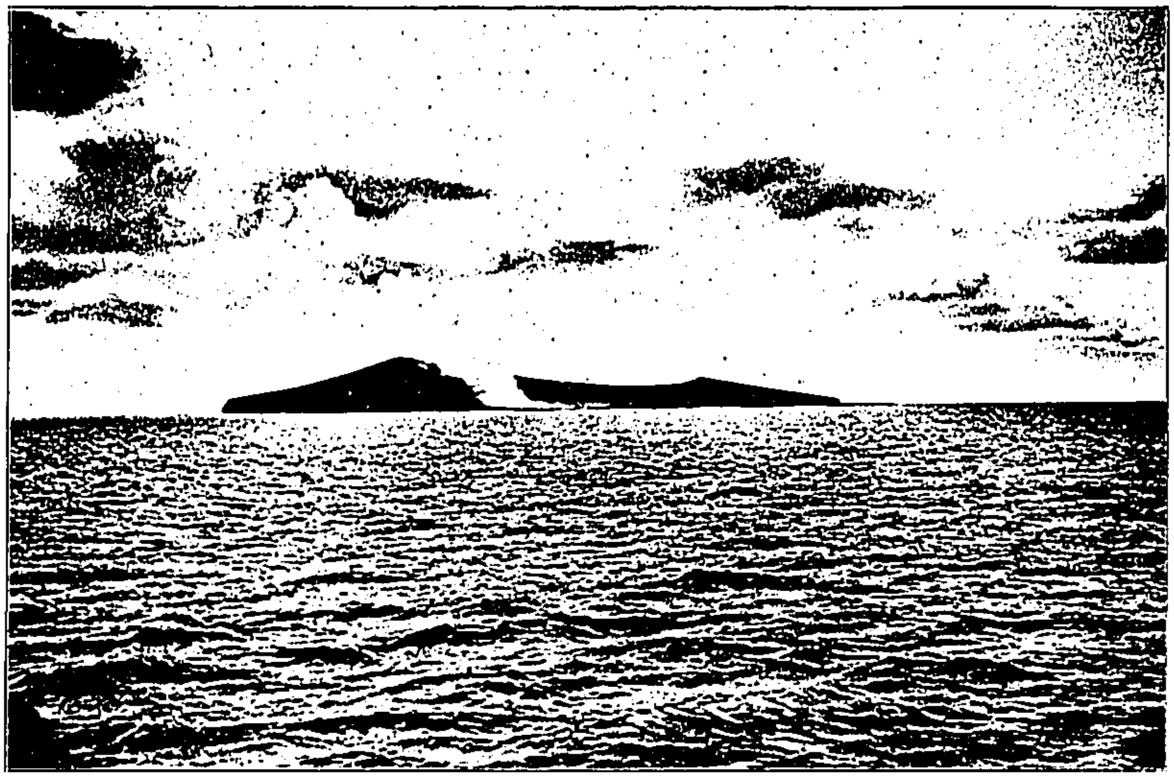
The recent disastrous earthquake in the mountains near Murchison, at the northern part of the South Island of New Zealand, makes the study of rift lines or faults carried out by the New Zealand Geological Survey of great importance in connection with the meaning of volcanoes. Mr. L. I. Grange, of that Survey, has been making a detailed geological survey of the active volcanic zone of the North Island, and believes that the area of greatest interest for earthquakes and volcanoes is the 72 miles in a generally NNE direction between Lake Rotorua and Lake Taupo. An active fault, the Paeroa Rift, has been located through the volcanic district trending northeast in the direction of White Island from Lake Taupo, and if this fault were projected southward 200 miles it would go through well known earthquake centers in the western part of Cook Strait, and then pass through Nelson. If projected it would pass close to Murchison. The big displacement which has been studied at White Creek is eight miles farther west. The New Zealand geologists do not connect the fault movements of the South Island with anything but mountain-building forces. There are no volcanoes in the South Island. But large, active faults of both islands trend NE-SW, and the possibility should not be overlooked that deep volcanic faults with intrusive magma extend under the southern mountains.

This relationship makes the volcanoes of the New Zealand belt worthy of review. Along this great crack south of Lake Taupo lie the three big volcanoes Tongariro, Ngauruhoe, and Ruapehu, the last farthest south. These are in the National Park. Ngauruhoe is 7,515 feet high and has had eruptions 11 times since 1839. Its eruption of March, 1928, was reviewed in the Volcano Letter (No. 216, February 14, 1929).

The crater of Ngauruhoe has recently been described by F. W. G. White, and the inner crater has been continually changing. The walls of the outer crater are very precipitous, and in 1896 there was a hole on the southwest side of the level floor of the main crater. Earlier there had been an inner crater toward the northwest, and this all suggests what is so common in Hawaii, that the central level floor is the top of a lava plug, and that the gases of explosive eruptions churn out their vents around the wall crack at the borders of this plug. The southwest hole has become enlarged to be the principal center of activity.

In January, 1929, the activity was so slight that White went to the bottom of the innermost pit. The old northwest pit had become a rounded depression covered with ice. The walls of the southwest active pit were partly precipitous. In a conical hollow on the northeast side, Grange had seen lava in this pit in 1928. Its slopes were now steaming and there were two holes in the bottom from which hot air was issuing, each a foot and a half in diameter. The remainder of the bottom was covered with sandy material washed in among bowlders, and there was very little sulphur in the crater. The only other solfataric place that was steaming was well up on the edge at a rock projection east of the northern lip of the outer crater. The crater contained more ice and showed less activity than usual, at the time of White's visit (N. Z. Jour. Sci. and Tech. June, 1929, p. 48).

As has been pointed out in the review of J. Allan Thomson's admirable summary of the New Zealand volcanic belt (Volcano Letter No. 158), the question of lava flows from Ngauruhoe in 1869 and 1881 has been disputed. An aa flow now at the foot of the mountain is attributed to the 1869 eruption, and inside the conelet of March, 1928, wholly within the crater, Grange saw red-hot lava that appeared viscous, with blue smoke escaping through it with a tremendous roar, which flung up red-hot fragments 50 feet. The presence of lava in the center is thus unquestionable. The great explosive disaster at Tarawera Volcano in 1886, in the North Island, about midway between the active volcano White Island in the Bay of Plenty and the National Park group of volcanoes, has given New Zealand the reputation, like Java and Japan, of producing chiefly ash explosions. In all three of these lands we are learning more and more that andesitic and



Falcon Island, reported to have disappeared in 1913, reappeared with a violent series of explosions October 4, 1927, building up basaltic ash, scoria, pumice and lava blocks to make a cone and crater in the Tonga Islands. Photo from Andrew Thomson, Apia Observatory.

basaltic magma, or underground lava, which occasionally comes to the surface, is the prime mover of volcanism, but does not flow out so freely as in Samoa and Hawaii.

It seems likely that if we could know of all the submarine lava flows which come out through cracks in the bottom of the sea, between New Zealand and Samoa, we might discover that lava outflow is not so rare as has been imagined. The photograph reproduced on the second page is quite like the lava flows of western Samoa, and this unquestionably was pouring over the surface of the island Niuafou in 1912. The description of the 1929 eruption of Niuafou, which follows this article, leaves no doubt that lava flow is characteristic of this island, and Niuafou is not more than 250 miles from Savaii where the great lava floods of western Samoa occurred in 1906-11.

The recent eruption of Falcon Island (Volcano Letter Nos. 151 and 210) has been newly reviewed by the investigators who studied it for the Bishop Museum (Amer. Journ. Sci. Dec. 1929, Falcon Island, by Hoffmeister, Ladd, and Alling. See photograph this page) to the effect that the great volcanic crack in the earth's crust which has piled up the line of Tonga-New Zealand volcanoes, starts at Savaii and extends across Cook Strait into the South Island of New Zealand. The formations along the line are said by Park to be "broken, sharply folded, faulted, sheared and up-tilted" Niuafou lies off the line to the west 150 miles, but it is doubtless part of the same system. These explorers of Falcon Island reach the conclusion that many of the atolls, or horseshoe-shaped coral reefs of the southwest Pacific, may have been started by corals and other organisms building on a circular bank built up by a temporary volcano such as Falcon and later cut down by the waves. It may be added that while such volcanoes exhibit chiefly fragmental material, it must be remembered that a pile of solid lava in the form of a dome probably exists beneath. How an outflow of liquid lava like one of the Mauna Loa flows, would behave under deep, cold water is a matter of theory, not of observation.

ERUPTION ON NIUAFOU, TONGA ISLANDS

Niuafou is a roughly circular wooded island about 20 miles in circumference in the middle of the triangle of ocean between Fiji, Tonga, and Samoa. It is about 600 feet high. There are many craters, including a large main lagoon near the center of the island, where there are hot springs. The shoreline is worn into lava cliffs.

There is difference of opinion as to whether lava flows have occurred; Sapper cites destruction of villages by lateral lava flow in 1853 and 1867 (Vulkankunde, p. 336). Thomson allows only explosive eruptions (N. Z. Jour. Sci. Tech. 1926, p. 369) as the 1886 outbreak destroyed the coconuts and covered the surface with 2 to 20 feet of ash.

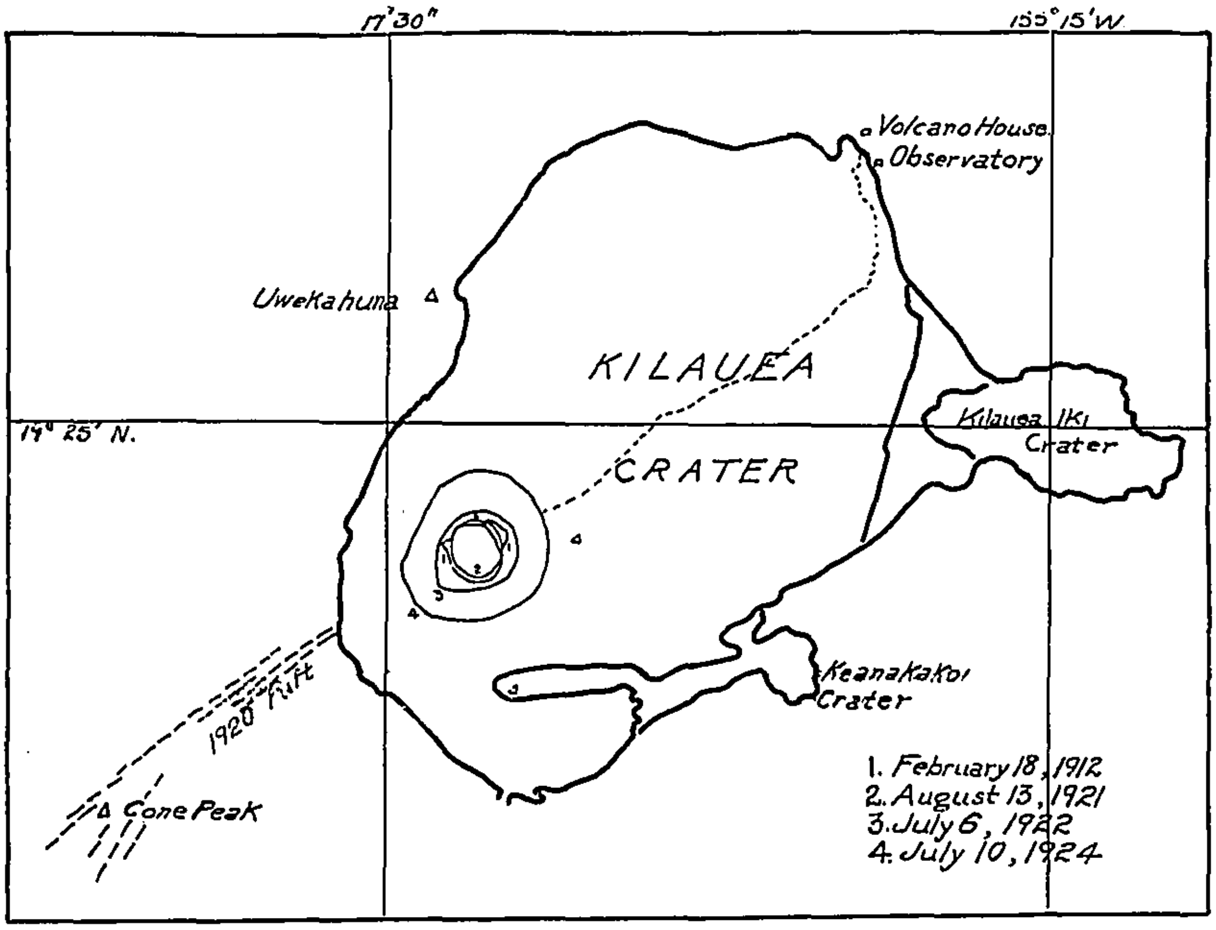
In spite of 5 eruptions in 115 years, Niuafou has nine seaboard villages with a population near 1,000, and belongs to the Tongan monarchy under British protectorate.

The last eruption was in 1912, when 30 craters were in action between the lagoon and the strandline near the village Futu, on the west side of the island. Pahoehoe lava flowed into the sea. Of this we possess a photograph taken in 1913, (see second page).

The new eruption July 25, 1929, was similar and wrecked Futu. It began at 4 a. m., overrunning a long strip of coast a mile wide. Copra crops, houses, horses and pigs were burned and buried.

Three craters burst open without warning to the south of Futu. The populace hurried to Agaha, the larger village at the northwest, and took refuge on the high ground back of it. Their discomfort was increased by rain and wind.

The correspondent (Auckland Star, Aug. 6, 1929) climbed on horseback to Hala-gutu, the high lip of the interior crater lake, and saw that a chain of craters was forming along the low coast land. Each vent belched out molten rock and deep red flames. "Among the clouds and swirls of smoke and fumes were to be seen streams of lava thrusting their way in tortuous twists and turns through the rich vegetation, scorching it to brown and black cinder."



The recent enlargement of Halemaumau Pit, the inner lava cauldron of Kilauea is here shown. The lava rose and overflowed, and the pit grew smaller, for outlines 1 and 2. The pit enlarged by collapse for 3 and 4.

The smoke cleared July 26. At the extremity of the flow 40 acres of new ground had formed, altering the contour of the coast line. Halfway between there and Futu, goats were marooned on a new islet. Sulphurous fumes were bad, but the explorer with his two native companions finally reached the ruins of Futu by boat. The village site was a field of smoking lava, only a third of the habitations escaping destruction. Native houses were found battered to the ground by the hot wind blasts. Numbers of animals, including horses which had broken tether, were found alive in the village remnant. The stone Roman Catholic church was burnt out, and the lava had flowed round a cemetery, leaving the stone cross intact in its center. The Wesleyan mission church escaped. No lives were lost.

The foregoing account is sufficiently definite and circumstantial to indicate that this eruption was a lava flow. There is no mention of darkness or ash fall. It seems likely that Niuafou is the crest of a volcano recently built above sea level, liable to both outflow and steam blast.

Niuafou is reported to have many earthquake shocks, "almost of daily occurrence" (Sydney Morning Herald, Aug. 2, 1929). These are attributed by the natives to their god Maui, rocking the island by his troubled subterranean sleep. It is hard to imagine a better place for the study of tilt and volcanic earthquakes, and this island is strategically placed for very interesting geophysical and oceanographic observations. There ought to be a seismograph station there with a permanent staff in close touch with the Observatory at Apia. T. A. J.

KILAUEA REPORT No. 939

WEEK ENDING JANUARY 19, 1930

Section of Volcanology, U. S. Geological Survey

T. A. Jaggar, Volcanologist in Charge

The week has produced no change in the Hawaiian volcanoes, new snow has fallen on the mountains, and in Halemaumau pit of Kilauea Crater all that is noticed is the presence of a few new scars due to slides along the north and northwest walls. On January 15 in the afternoon of a dry day there was almost no steam in the bottom of the pit, but in the forenoon of January 18, after heavy rain, much visible vapor rose from cracks. This is characteristic also of the outer floor of the greater crater.

The seismographs for the week ending midnight January 19 registered 10 local disturbances, of which five were tremors less than one minute long and five were very feeble local earthquakes, one of which indicated distance from Observatory 48 miles. A weakly recorded distant earthquake began 6:50 a. m., January 17 and registered for 4 m. 47 s. Microseismic motion was moderate for the week, and tilting of the ground was strong SW.

THE VOLCANO LETTER

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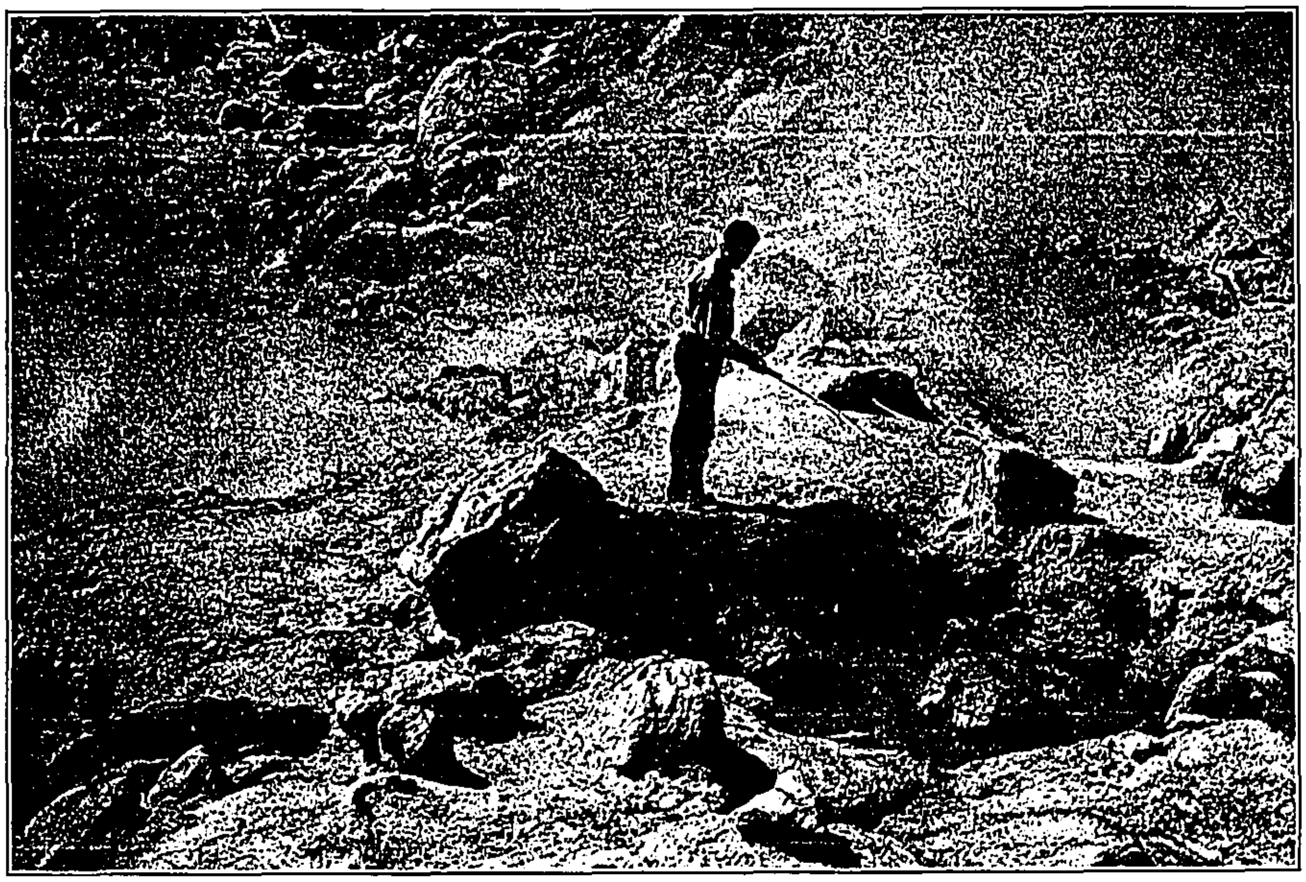
The Volcano Letter

NO. 266—Weekly Hawaiian Volcano Observatory, National Park, Hawaii Jan. 30, 1930



Bumpass Hell, one of the solfataras with boiling waters far up the slopes of Lassen Volcano in California. The pool is black because of a scum which overs it consisting of minute particles of sulphide of iron, or pyrite. The observer from Lassen Volcano Observatory is at work immersing a thermometer in the scalding waters. Photo R. H. Finch, August 26, 1927.

MUD FLOW ERUPTION OF LASSEN VOLCANO

On May 30, 1914, the old crater depression on top of Lassen Peak, a volcano in northern California, ejected dust and steam, the crater hole enlarged, explosions increased in number during the year, occurring every few days and rarely lasting more than 20 minutes. A big eruption occurred May 19, 1915, which devastated the creeks northeast of the volcano with a mud flood. Three days later, May 22, a much bigger explosion occurred, producing a down-rushing steam blast which overturned trees and cut a swath through the forest in the same direction as the preceding flood for at least four miles. The explanation of the mud flood has been problematical, as Lassen had no crater lake, as in the case of Mount Pelee in Martinique. Lassen was, however, covered with snow. The resident photographer and creator of the Lassen Museum, B. F. Loomis, believed that both Lassen eruptions gave vent to liquid water from within the mountain, a region of many hot springs, and that the water was followed by steam. (A Pictorial History of Lassen Volcano, Anderson, California, 1926.)

Dispute centers about this water question. Day and Allen (Volcanic Activity in Hot Springs of Lassen Peak, Carnegie Institution) attribute the flow to the melting of snow by the several agencies hot rain, hot volcanic ash, and a hot blast of gas. Day has shown that the mud flow started some distance below the crater rim. The flood originated in an embayment on the northeast slope of Lassen Peak that was uniformly covered by snow with a depth of several feet over most of the area. (See third picture on page 3).

It is hard to believe that hot water came out of the mountain in such volumes, but the writer agrees with Loomis that the evidence does not indicate the occurrence of a hot blast or any considerable explosion just prior to the mud flow of May 19, 1915 Except for a small flood below the western flow of aa lava that came out of a notch in the crater, the notheast flood was the only important one of this date. Even if there had been an explosion, any rain accompanying it would probably have been but little warmer than any other rain—certainly not hot. It is also doubtful under the conditions existing on Lassen Peak at

Lassen Volcano in eruption, photographed from the northeast by B. F. Loomis at 2:30 p. m., May 22, 1915, a few hours before the biggest eruption. Flood wash of May 19 in the foreground. Note the crateral gash, the cut in the snow, and the ash stain on the snow at the left. This is the critical picture. No sign of horizontal blast.

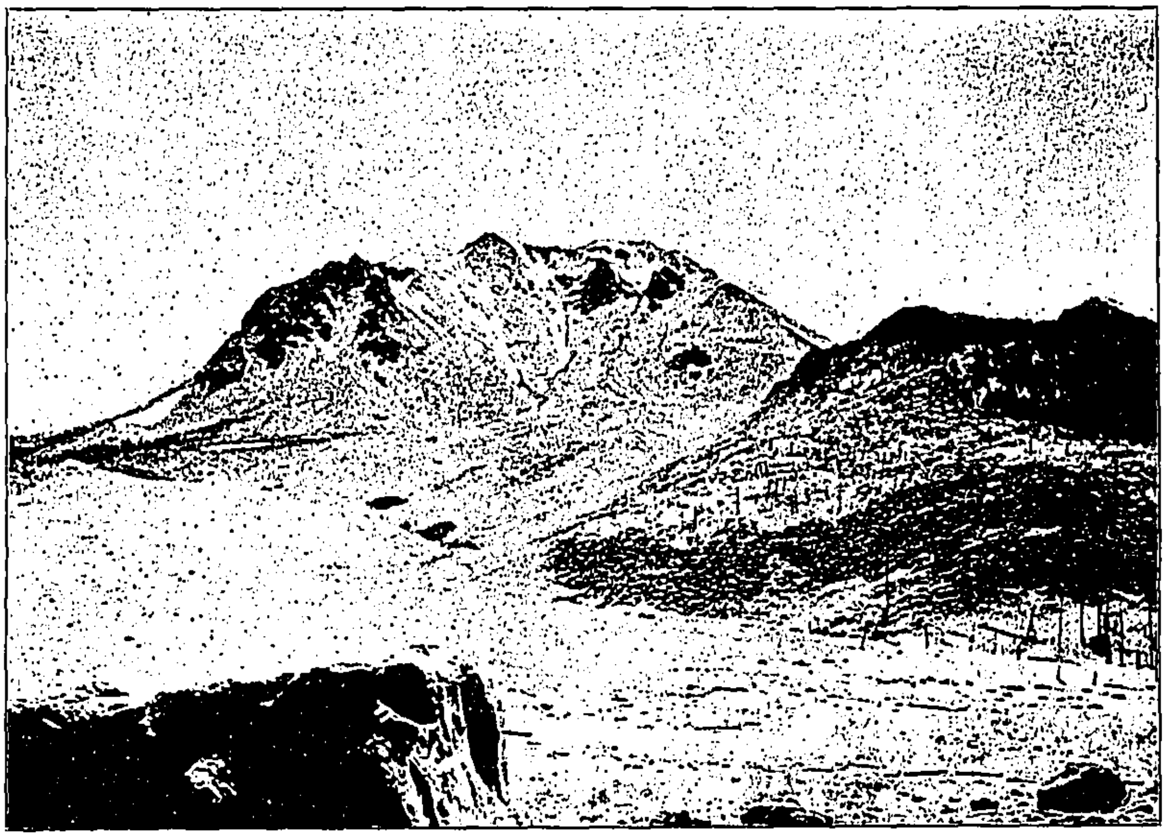
that time, whether a rainstorm unless of very unusual intensity, could cause a flood of the magnitude observed. If there were no explosion and no hot blast, then there would not have been any hot ash deposit nor warm rain.

It is true that the known explosions of May 22, 1915, three days later, produced several small mud flows. The behavior of rain on snow is worthy of some discussion. A few feet of snow of uniform covering can absorb several inches of rainfall so that the rain produces but little immediate run-off. If there had been bare spots in the snow field, water could have accumulated so as to run under the snow in considerable quantities in caverns and, in a place as steep as the Lassen slope, might have undermined so as to start avalanches. A hot blast, unless long continued, or a slight deposit of volcanic ash would produce much the same effect as a rain—a melting of superficial layers of snow and an absorption of the water by lower layers. A hot blast or a hot ashfall on a steep slope not uniformly covered with snow, could start streams under the snow as in the case of rain, and might thereby cause avalanches. It would seem that the Day and Allen theory of rain and ash may be questioned as a sufficient cause for the tremendous Lassen mud flow of May 19, 1915.

An examination of enlargement of the photograph (see illustration top of page) taken by Mr. Loomis immediately after the mud flow of May 19, 1915, and just before the maximum explosive eruption which occurred on the evening of May 22 (this photograph was taken at 2:30 p. m. that same day, May 22, and the great explosion occurred while the party was returning home), and of other photographs, and of the material transported by the mud flow, all indicates that a large volume of hot lava poured through this eastern notch of the crater where the V-shaped column of steam extends down the mountainside.

There is much new lava that was carried in fragments down the flood. The source of this at the flow in the notch was not only much more voluminous than the one through the western notch of the crater, but as would be expected it was probably as a whole more molten and less viscous. The lava flow could easily have melted the snow down to the ground and have sent a stream of warm water under the snow lower down the slope. An avalanche mixed with hot rock could have been started in this way and might have produced a flood of the magnitude observed, if great snowdrifts were present.

Minor mud flows did accompany the explosions on May 22, 1915. There was a horizontal component of this explosion that was parallel to the course of the upper part of the mud flow on May 19, 1915. The area affected by this blast was much wider than the area devastated by the mud flow of May 19, so that the blast encountered snow banks with exposed edges. The largest mud flow that accompanied this explosion followed the course



Lassen Volcano after it had quieted down, summer of 1924, showing linear remnant snowdrifts in summit gulches only. All the rest is the debris of May 22, 1915, and later, showing removal of the forest by the blast. Photo Loomis.

of the one on May 19th. Much hot ash was thrown out by this eruption, and at places where there was still a uniform snow covering, the mud flows occasioned by hot ash and possibly by mud rain at this time for the most part remained on top of the snow. R. H. F.

THE LASSEN MYTH

In 1915 the Lassen eruption awakened the public to the knowledge that this volcano is active. It was immediately dubbed "the only active volcano on the mainland of the United States". Nothing could be more erroneous.

Geologists have long known that the volcanoes of the northwest are potentially active. Tradition has it that Mount Saint Helen's and Mount Baker have both had eruptions in historic time. The Cinder Cone east of Lassen was well known to the Indians and to geologists as the maker of a modern lava flow within a century. Eighteen volcanoes lie along the Cascade fault in Oregon, and many more extend north through Washington into British Columbia. At Geyserville just north of San Francisco there is rushing volcanic steam under high pressure. This was in the epicentral belt of the San Francisco earthquake.

Mount Shasta or any of the volcanoes exhibiting fresh lava flows in the northwestern United States might erupt at any time. Intervals between outbreaks are long in continental volcanoes of this class, and the white man's history is short. T. A. J.

KILAUEA REPORT NO. 946

WEEK ENDING JANUARY 26, 1930

Section of Volcanology, U. S. Geological Survey

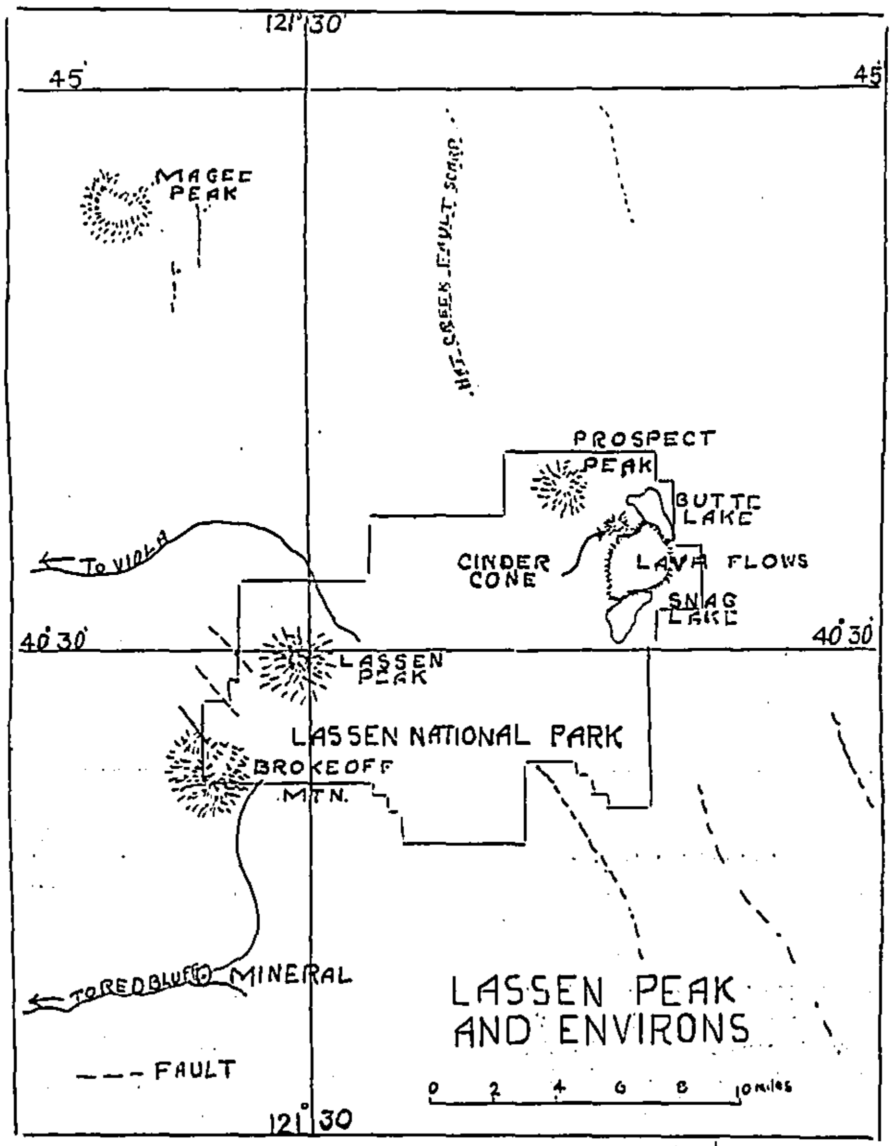
T. A. Jaggar, Volcanologist in Charge

There are still no changes in the appearance of the Kilauea fire pit to be construed as indicating lava activity. The volcano remains quiet.

On January 20 there was very little steaming. A new scar was seen on the northeast wall, caused by a slide. Early on the 22d considerable steam rose from the various Kilauea floor vapor vents and two large columns rose from the Halemaumau rims south and southwest. A new scar from a slide showed on the north wall. At 11:45 a. m., January 23, thin gray dust from an avalanche rose over the northeast corner of the pit. At 4 p. m. dust rose on the north side. On the 24th, at 6:15 and 7:30 a. m. more dust from slides was seen.

The instruments at the Observatory recorded six tremors and three very feeble earthquakes. One of the latter, occurring at 2:09 a. m., January 23, indicated 34 miles as the distance to origin.

Tilting of the ground at the Observatory accumulated moderately to the NNE. Microseismic motion was slight.



Sketch map of Lassen National Park showing position of Lassen Peak. Observatory is at Mineral, R. H. Finch in charge. The eruption flood devastated a sector due northeast from the summit in the direction of the Hat Creek fault scarp, making flood damage down Lost Creek due north of the mountain.

THE VOLCANO LETTER

The Volcano Letter combines, after January 1, 1930, the earlier weekly of that name, with the former monthly Bulletin of the Hawaiian Volcano Observatory. It is published weekly, on Thursdays, by the Hawaiian Volcano Research Association, on behalf of the section of Volcanology, U. S. Geological Survey. It promotes experimental recording of earth processes.

Readers are requested to send articles, photographs, publications and clippings about volcano and earthquake events, instruments and investigations, especially around the Pacific.

Subscription for non-members two dollars per year of 52 numbers. Address the Observatory.

HAWAIIAN VOLCANO OBSERVATORY
Founded 1911

This laboratory at Kilauea Volcano belongs to the Hawaiian Volcano Research Association and is leased and operated by the United States Geological Survey

It maintains seismographs at three places near Kilauea Volcano, also at Hilo, and at Kealakekua in Kona District. It keeps a journal of Hawaiian volcanic activity and publishes occasional Bulletins

Membership in the Hawaiian Volcano Research Association is limited to patrons of Pacific science who desire personally to aid in supporting the work.

The work of volcano research so supported is in collaboration with the work of the United States Geological Survey, but supplements it with buildings, research fellows, instrumental plants, explorations and special investigations for which there is no governmental provision. The Geological Survey maintains volcano stations in Alaska, California and Hawaii.

Persons desiring application blanks for membership should address the Secretary, Hawaiian Volcano Research Association, 300 James Campbell Building, Honolulu, T. H.

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HAWAII NATIONAL PARK
HAWAII

OFFICE OF THE SUPERINTENDENT

January 10, 1930

Director,
National Park Service,
Department of the Interior,
Washington, D. C.

Dear Mr. Director;

I herewith submit the report of activities and operations in Hawaii National Park during the month of December 1929.

000 GENERAL:

Travel to this park at this season of the year is very light due to weather conditions and the holiday season.

100 ADMINISTRATION:

120 Park Inspections by:

121 Superintendent.

The usual inspection routine of all work in progress was made by the Superintendent.

124 Other Interior Department Officer.

On December seventh Director George Otis Smith of the Geological Survey made a trip over all park roads in company with the superintendent, Dr. T. A. Jaggar of the Volcano Observatory and A. O. Burkland topographic engineer of the Geological Survey. Following the trip through the park the superintendent accompanied Director Smith on a two day trip around the island of Hawaii. Miss Helen Smith and Miss Eunice Pepper were also in Mr. Smith's party.

200 MAINTENANCE, IMPROVEMENTS AND NEW CONSTRUCTION:

210 Maintenance.

The heavy rains of November and early December have forced us to unusual amounts of work for repairs and have exhausted our years maintenance funds on roads. Failure of surfacing sections on the new Around the Island road are still unrepaired due to lack of funds which have been requested during December but not as yet approved.

220 Improvements.

Two residence buildings have been lined throughout by plaster wall-board in order to make them more comfortable and dryer during the winter season. Stoves for heating have been ordered but not as yet received.

Kerosene hot water heaters and tanks have been installed in the same two buildings.

The superintendent's residence and two laborers cottages have been given exterior painting.

300 ACTIVITIES OF OTHER AGENCIES:

310 Public Service Contractors.

Upon request of the superintendent the Volcano House management has complied with regulations, equipped their employees with numbered badges, and furnished a list of names and numbers to this office. By this means it is hoped to more definitely locate the sources of poor or indifferent service.

313 Schedule of Rates.

The department has approved the same rates for 1930 as were in effect at Volcano House during 1929.

340 County Legislation Affecting Park.

At a meeting of the county supervisors and Hilo Chamber of Commerce definite expression of opinion was made endorsing the expenditure of authorized bond issue moneys for improvement of the island belt road. The Chamber of Commerce, also recommended that the supervisors add $85000 of their regular annual funds to the $30000 bond funds to be used in 1931 for construction of the National Park - Kalapana road.

400 Flora, fauna and natural phenomena.

410 Ranger-naturalist service.

Lectures at Uwekahuna Observatory and hiking trips across Kilauea Crater and through the Thurston Lava Tube were conducted as usual several times each week. Otto Degener, last summer's naturalist, is at present compiling a book on the flora of this park. This book should be a very complete and valuable source of information.

470 Animals.

Cold weather at the high altitudes of Mauna Loa has driven some wild goats to the Bird Park area. Should this invasion continue it will be necessary to conduct a campaign to eliminate them.

480 Volcanoes.

As yet no volcanic eruptions have occurred since July although some action is expected momentarily. Earthquakes continue to register at various points and the Kilauea region shows a decided ground tilting from underground lava pressure. Volcano bulletins are attached to this report.

500 USE OF PARK FACILITIES BY THE PUBLIC:

510 Increase in Travel.

Travel to this park continued to show increase over the same periods of previous years. Two Japanese naval oil tankers visited here furing December and hotel travel also showed a gain over 1938. At present our total is 54 per cent ahead of last year.

520 General Weather Conditions.

Maximum temperature	31st	78	degree
Minimum "	1st	43	"
Rainfall for month of December		7.03	inches
" " " " "	at Hilo	16.63	"
" to date Volcano District		81.05	"
" " " at Hilo		123.81	"

540 Visitors.

Mr. & Mrs. Harvey Lyon of Oakland, California; Mr. Lyon is District Governor of Rotary International.

Harry N. Burhans formerly executive secretary of Denver Tourist Bureau and now San Francisco Chamber of Commerce representative at Honolulu.

Mrs. G. T. Lommes, secretary U. S. Civil Service Commission for Hawaii.

Director of the Geological Survey George Otis Smith, his daughter Miss Helen Smith, and his niece Miss Eunice Pepper.

The Pacific Tour party of the San Francisco Chamber of Commerce.

600 PROTECTION:

630 Signs.

A continual program of improvement in signs is carried on by the ranger force.

900 MISCELLANEOUS:

Mr. Harry Burhans

Mr. Harry Burhans who was formerly the executive secretary for the Denver Tourist Bureau in Colorado is now the special representative of the San Francisco Chamber of Commerce at Honolulu. Mr. Burhans has always been a national park enthusiast and showed it here recently. At a meeting of the Hilo Chamber of Commerce, which was attended by men from various parts of this island and by the county supervisors, Mr. Burhans gave a speech on the tourist industry which was in reality an excellent talk on the advantages and priveleges of national parks and which contained many fine references to the administration of the National Park Service. It was an entirely different talk than had ever been heard here and made quite an impression. The Service is fortunate in having Mr. Burhans interest and confidence in general and I am personally very glad he is now in Hawaii.

Change in Prohibition Agent.

Mr. Fred Woods who has held the local position as U. S. prohibition agent at Hilo has recently been discharged for cause. At present his place is being filled by Mr. Leo Pearson from the Honolulu office.

Very respectfully yours,

Thos J. Allen Jr.,
Superintendent.

Copy to "Field Headquarters" (2)
" " "Yellowstone National Park" (1)

TJA/h:

10-157

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

TRAVEL REPORT

Hawaii National Park for the Month of December 1929

	This Month	This Travel Year To Date	This Month Last Year	Last Travel Year To Date	Increase for Travel Year Number	Increase for Travel Year Per cent
PRIVATE TRANSPORTATION:						
Cars first entry.						
Cars reentry.						
Motorcycles.						
Total motor vehicles.						
Persons entering via motor vehicles.	5,280	19,870	2,560	7,860	12,010	.619
Persons entering via other private transportation.	185	757	247	609	148	.196
Total persons entering via private transportation. . . .	5,465	20,627	2,807	8,469	12,158	.585
OTHER TRANSPORTATION:						
Persons entering via ~~stages~~ Hotel . .	710	1,754	508	1,719	35	.020
Persons entering via trains . .						
Persons entering otherwise. . .						
Total other transportation. .	710	1,754	508	1,719	35	.020
GRAND TOTAL ALL VISITORS. . .	6,175	22,381	3,315	10,188	12,193	.545

	This Year	Last Year	Increase Number	Increase Per cent
Automobiles in public camps during month	0	0	0	0
Campers in public camps during month	0	0	0	0

10-159

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

S T A T U S   O F   P E R S O N N E L

Hawaii National Park for the Month of December 1929

	This Month	This Month Last Year
Number of employees beginning of month,	12	9
Number of additions, ...	2	4
Total, ...	14	13
Number of separations, ...	1	5
Number of employees close of month, . .	13	8

Number of promotions during month	0	0

Aggregate amount of annual leave taken,	0	0
Aggregate amount of sick leave taken,	0	0
Aggregate amount of leave without pay,	0	0

10-160

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

REPORT OF PARK REVENUES

..........Hawaii........ National Park for the Month of ....December 1929..........

	This Year	Last Year
Park revenue on hand beginning of month, ...	0.00	25.00
Received, ...	25.00	25.00
Total, ...	25.00	50.00
Remitted, ...	25.00	50.00
On hand close of month, ...	0.00	0.00

Park revenues received this year to date, ...	1,477.00
Park revenues received last year to date, ...	1,475.00
Increase, ...	2.00
Percent of increase, ...	.0014

10-161

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HAWAII NATIONAL PARK

REPORT OF SALES OF PUBLICATIONS

December 1929

	Number	Value
GOVERNMENT PUBLICATIONS:		
On hand beginning of month, ...	311	60.80
Received during month, ...	0	0.00
Total, ...	311	60.80
Sold during month, ...	16	9.70
On hand at close of month, ...	295	51.10
NON-GOVERNMENT PUBLICATIONS:		
On hand beginning of month, ...	6	15.00
Received during month, ...	0	00.00
Total, ...	6	15.00
Sold during month, ...	1	2.50
On hand at close of month, ...	5	12.50

Cash on hand beginning of month, ...	101.50
Sales during month, ...	12.20
Total, ...	113.70
Remitted during month, ...	0.00
Balance, ...	113.70

SAMPLE COPY

Please . .d publications and news notes about volcan. matters

Address: HAWAIIAN VOLCANO OBSERVATORY, HAWAII NATIONAL PARK, T. H.

THE VOLCANO LETTER

A Weekly news leaflet of the Hawaiian Volcano Research Association

Sent free to libraries and to members. Dues of Association $5 per annum. Members receive in addition the illustrated Monthly Bulletin of the Hawaiian Volcano Observatory. Anyone may join the Association and thereby support Pacific volcano research. The Society has also patrons—individuals, firms and institutions.

No. 258 RELEASED WITHOUT COPYRIGHT RESTRICTION December 5, 1929

KILAUEA REPORT NO. 932

WEEK ENDING DECEMBER 4, 1929

Section of Volcanology, U. S. Geological Survey

H. A. Powers, Temporarily in Charge

Seismic conditions on the Island of Hawaii remain unchanged. Fewer earthquakes were recorded this week, but distances indicate sources in the North Kona District of west Hawaii.

Kilauea Volcano has had some increase of steam activity at the various vents in and about the outer crater and in Halemaumau pit, due to southerly rainstorms. Small rock falls from the walls occurred from time to time, but no large avalanches have been noted or reported. At 3:10 p. m., November 27, after heavy rain, there was only one spot with vigorous steam, the sulphur stain on the southeast floor of the pit. A fresh scar was noticed on the east wall, and a slide was heard in that region. On November 30 at 9:30 a. m. much steam was coming from cracks on the floor, thickest at the southwest stained area. On December 2, about 9:30 a. m., there was a small avalanche over the north talus, and steam was still noticeable at the southwest sulphur stain. At 11 a. m., December 4, more slides were heard from the north wall, one from the rim sliding down the niche at the north end of the big sill. This part of the pit shows by scars that it has more slides than other sections have. Little steam was to be seen. Cracks of the lava floor are stained brown, giving them clear outline.

Twenty-five seismic disturbances were counted on the seismograms of the Bosch-Omori instruments, classified as follows: 10 tremors, 13 very feeble earthquakes, and 2 feeble earthquakes. One of the feeble earthquakes, at 2:06 p. m., December 1, was reported felt in Kona; it had indicated distance to origin 42 miles. Seven earthquakes showing distance phases give an average distance of 46 miles from the Observatory, corresponding very closely to average distances of previous weeks.

Tilt for the week accumulated slightly to the southwest. Microseismic motion was slight.

THE MURCHISON EARTHQUAKE, NEW ZEALAND

On the 17th of June, 1929, the South Island, New Zealand, was shaken by an earthquake which had its center in the northern part of the island near Murchison. The intensity of the shock is reported as VIII on the Rossi-Forel scale, as chimneys were shaken down and masonry walls cracked through an area over a hundred miles in diameter (Geological Reconnaissance in the Murchison Earthquake Area, by H. T. Ferrar and L. I. Grange, New Zealand Journal of Science and Technology, Vol. XI, No. 3, 1929, pp. 185-191). After the initial shock which did the damage the "northwest corner of the South Island continued to creak like the deck of a ship for weeks" due to the gradual release of earth-stresses.

The authors review the New Zealand earthquakes of the past and point out that, in most cases, they were associated with movements on fault-planes which were known to geologists to be active faults. A reconnaissance of the area disturbed by the quake of June 17, however, showed that earth movement had occurred only along the White Creek and Kongahu fault-zones, both classed by geologists as dormant faults. Further, most New Zealand faults are concave toward the upthrow block, whereas the White Creek fault is convex toward its upthrow side.

Marked differences in the extent of damage in different localities within the disturbed area are cited and explained in general by the effect of geologic structure on the transmission of the earthquake waves. For instance, Blenheim seems to have been protected considerably by the Wairau fault-plane which passes between that town and the quake center on the White Creek fault.

The disturbance on the Kongahu fault upraised a considerable area of sea-floor in the vicinity of Whitecliffs. This area is to be studied in detail next summer. The movement on the White Creek fault has been studied by H. E. Fyfe and is reported in the same issue of the Journal (Movement on the White Creek Fault, New Zealand, pp. 192-197).

The White Creek fault is the eastern one of two almost parallel faults which bound a strip of Tertiary rocks, inset by the faults in granite country rock. The dip of the plane is nearly 90 degrees, and its trace is slightly concave to the west trending slightly east of north. It has been known as a dormant fault for several decades. The fault is located about seven and a half miles west of Murchison.

At its intersection with the fault-plane, the Murchison-West Coast road was offset vertically 14 feet 9 inches, the east side of the fault having risen relatively to the west side. There was no detectable horizontal movement. The trace of the fault was clearly marked by shattered ground and disturbed vegetation for a distance of at least three miles.

Data obtained by releveling part of the Nelson-West Coast railway show that the level of the country east of the fault-line has been changed for a distance of about nine miles from the fault. At the fault, the eastern block was found to have risen 14 feet 9 inches, the total throw of the fault. The maximum measured increase in elevation of the eastern surface was 16.08 feet, about 25 chains east of the fault.

A graph showing the nature of displacement along the White Creek fault is compared with the graph by Reid illustrating the displacement of the surface along the San Andreas fault after the 1906 earthquake. In the California quake, the movement was horizontal and the total displacement was divided between the two blocks so that each block moved relative to a fixed point in the fault-plane. The movement along the White Creek fault-plane was vertical and, according to the data at hand, the entire displacement is accounted for by the upthrow of the eastern block. The author postpones his discussion of the application of Reid's elastic-rebound theory until the whole White Creek area has been releveled and the absolute movement of both blocks determined. H. A. P.

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No. 259 RELEASED WITHOUT COPYRIGHT RESTRICTION December 12, 1929

KILAUEA REPORT No. 933

WEEK ENDING DECEMBER 11, 1929

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

Everything remains quiet at the Hawaiian volcanoes. At Halemaumau pit a slide on the north side at 11:05 a. m., December 10 made a roaring noise and produced a small dust cloud. A bigger avalanche occurred at noon, December 11, making a loud roar and sending up dust which remained visible for 15 minutes.

Seventeen local earthquake disturbances were registered at the Observatory. Nine of these were *tremors*, 8 were very feeble earthquakes, and 5 of these indicated distances averaging 47 miles from Kilauea. The duration of the most prolonged of the tremor spasms was 2 minutes. Tilting of the ground accumulated moderately to the west, and microseismic motion was slight.

LASSEN REPORT No. 22

Lassen Volcano Observatory, Mineral, California
R. H. Finch, Associate Volcanologist

During the afternoon and evening of November 17, 1929, eleven earthquakes were registered on the seismographs at Mineral. Another shake occurred during the early morning of November 18. Two of the earthquakes were plainly perceptible. The one that occurred at 7 p. m., November 17 gave buildings a sharp jolt. The disturbances can undoubtedly be classed as Lassen shocks as the indicated distance to origin, 12 miles, is equal to the distance to Lassen Peak from Mineral.

NOTICE

Recipients of the Volcano Letter are requested to examine the address on the envelopes and to notify the Hawaiian Volcano Observatory of any changes desired.

MAYON VOLCANO

On July 1, 1928, Mayon, the "Fujiyama" of the Philippines, was in mild eruption, sending blocky incandescent lava flows from notches in the rim of the summit crater, and emitting dust-laden steam. Chlorine and sulphuric acid were found in the dust. The climax was reached about July 20, and in August the volcano reurned to its normal state, emitting steam vapors (Mayon Volcano and its Eruptions, by Leopoldo A. Faustino,, Phil. Jour. Sci. Vol. 40, No. 1, Sept. 1929, pp. 47, 24 illustrations). The lavas are andesitic basalts, with plagioclase, augite, hypersthene, magnetite, and hematite.

Mayon is in southeastern Luzon, 23 hours by rail from Manila. It is 2,421 meters high, and has had 28 eruptions in 114 years since a destructive eruption in 1814. There were two long quiet periods, 1814-27 and 1900-28. The normal condition is continuous mild activity. The most violent eruptions are followed by the longest periods of rest. The beautiful cone has never been destroyed, and the conduit has always been in the center. The losses of life have been by asphyxiation, dust blasts, overpowering incandescent slides, flood, and earthquake. The last two are secondary. The incandescent slides appear to be thrusts clear to the sea of unbalanced slopes attacked by radial aa flows above and bombardment of falling material. The lava flows follow the steep gulches and rise above them, forming ridges where trenches were before.

There were disastrous outbreaks in 1814 and 1897. The *greater damage was the overwhelming* of shore villages by a torrent of "fire, lava, and large hot stones." Two great disasters by flood and typhoon, in 1766 and 1875, were occasioned by heavy rainfall causing the unstable volcanic slopes to wash down to the sea as mud flow, with high mobility and great rapidity. Thousands perished and much property was destroyed. The path of the waters was an expanse of bowlders and sand, with pieces of wood, to mark the place where was once a thriving community.

The events in 1928, after 28 years of quiet, began with rumblings in January. June 16 the steam jets increased in volume and crater glow was seen. Dust "cauliflowers" began June 24. Incandescent flows overlipped the crater June 27. Army fliers June 29 circled the crater at 2,600 meters, and photographed the cauldron at 200 meters distance. They felt the heat strongly, inhaled sulphur, and estimated the crater diameter at 500 meters. It was circular, with vertical inner walls, a deposit of cindery material on the sides, and a pool of bubbling hot lava in the center. The rim is notched with a main chute or horseshoe opening on the eastern side. Aluminum sulphate and sulphur are common in the crater during quiet times.

Fragments were shot into the air, reports were heard, lava poured out through the notches in the crater wall and followed the gullies, forming snakelike trickles radiating from the summit. The molten material crusted over and cracked, and the impact of falling glow-stones made fireworks.

At the end of June the lava streams lengthened, resembling red hot glaciers covered with moraines. Black clouds of dust-laden steam swept down the mountain. The explosions waxed and waned until July 20. Hollows filled with the molten material and the junction of two valleys assumed the appearance of a subordinate crater. July 16 volcanic materials were descending the northern slopes. There was periodicity of three to five hours in the spells of roaring, hissing, cracking, and tumbling noise. At the climax there was a spectacular evening display of bombs describing parabolic curves of fiery rocketing at the summit. A column of heavy dark clouds rose 3,000 meters above the summit, the top of the mountain was rose red, brilliant lightning flashed from dustcloud to dustcloud, and streams of lava flowed in all directions. Sometimes the column moved spirally. When the wind arose, "the volcano appeared like a gigantic locomotive puffing on a heavy grade." T. A. J.

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No. 260 RELEASED WITHOUT COPYRIGHT RESTRICTION December 19, 1929

KILAUEA REPORT NO. 934

WEEK ENDING DECEMBER 18, 1929

Section of Volcanology, U. S. Geological Survey

T. A. Jaggar, Volcanologist in Charge

No lava activity has occurred, but stormy weather has produced much steam in Kilauea Crater. On December 12, at 1:19 p. m., a steady roar from Halemaumau pit was heard at the Observatory caused by an avalanche, lasting several seconds, which finally sent up dust above the east rim which drifted toward the north. A prolonged very feeble earthquake movement registered on the seismographs coincided with the slide.

A southwest rainstorm December 16 flooded the country and condensed much vapor over Kilauea and Halemaumau. Violent wind wrecked the Observatory weather-vane at 10:05 a. m. At noon, December 18, the pit was quiet and in spite of rainy weather there was hardly any steam on the south talus. Fresh debris lay on the north and east talus cones.

The Observatory seismograph registered 13 local disturbances during the week, of which nine were very feeble earthquakes and four were tremors. Seismometric evidence for five shocks indicated an average distance of 48 miles for the location of the origin. This corresponds to North Kona as in other recent weeks, and earthquakes are still felt in that district.

Tilting of the ground at the Observatory was moderate SSW. Microseismic motion increased December 16, accompanied with wind tremor. With the change of wind to northeast December 17, the microseisms remained large and rythmical.

A large distant earthquake was registered December 17, beginning 12:37 a. m., the preliminary phase indicating distance of origin 4,300 km. (2,600 miles). This distance corresponds to the north end of the Tonga Deep, the west end of the Aleutian Deep, the cordilleran belt of the west coast of North America, or the west end of the Alaskan Peninsula. The Kodiak station reports fire and smoke from three volcanoes between Kodiak and Unalaska.

THE CENTER OF THE TOKYO EARTHQUAKE

Professor Imamura, Director of the Seismological Institute of Tokyo Imperial University, has just published a brief summary concerning the most recent information about the location of several centers for the great Kwanto earthquake of September 1, 1923 (On the multiple source of origin of the Great Kwanto Earthquake of 1923 and its relation to the fault system connected with the Earthquake, by A. Imamura, Proc. Imp. Acad., Oct. 1929, Vol. V, No. 8, p. 330).

It was found that the Tango earthquake of 1927 had a double source of origin. It may be that the Tokyo earthquake had a multiple series of epicenters. The seismic waves that caused such widespread destruction emerged from at least three different places, along a line NE-SW, beginning at the middle of Sagami Bay. Two of these points were in the bay and one in the mountains north of Fujiyama. The first break was from the middle of the bay, the second from the mountains three seconds later, and the third, 7.5 seconds still later, came from the head of the bay west of Kamakura. Everything that succeeded these early phases of the earth motion, if the process repeated itself, was masked by the exceptionally large earth movements that lasted for more than a minute.

The Seismological Institute at Tokyo stood broadside to the big NW-SE. trending faults, and so with several pairs of seismographs could interpret the direction of motion of the earliest phases.

Imamura has continued the work of the late Professor Yamasaki in mapping the fault systems surrounding the epicenters. These have been interpreted in connection with precise leveling and triangulation. There emerges from this mapping a series of east-west faults across the Bosyu Peninsula and the eastern part of Sagami Bay; a series of very big faults along the volcanic axis NW.-SE. extending from the bay to the mainland along the Oshima-Fujiyama belt; and a series of N.-S. faults tending to curve westward in the entrance to Tokyo Bay and in the region west of Yokohama. Fifteen faults and flexures have been worked out with lengths varying from 1 to 22 km. and vertical displacements varying from 0.3 meter to 2.0 meters. Some of these topographical changes accompanied the first earthquake and others were probably adjusted along with the big after-shocks.

The details of these movements are worked out in accordance with the strength of effects and sensations in different places, and with seismogram records in different places. A map is presented exhibiting the directions of initial motion as recorded on seismographs all over central Japan, and the facts seem accordant with two main epicenters, one in the bay and one on the mainland. The time-distance curves of the preliminary tremors also accord with the double origin.

Imamura concludes that shearing stresses tore asunder the bottom of the bay on a weak zone and then leapt to the Tanzawa Mountain to release a second violent rending of the earth's crust. This was succeeded by a still bigger collapse in the bottom of the bay, when the whole countryside was thrown into agitation. It will be seen that this analysis is totally different from Imamura's earlier theories which attributed the earthquake to tectonic movements under the Pacific off to the east. T. A. J.

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No. 261 RELEASED WITHOUT COPYRIGHT RESTRICTION December 26, 1929

KILAUEA REPORT NO. 935

WEEK ENDING DECEMBER 25, 1929

Section of Volcanology, U. S. Geological Survey

T. A. Jaggar, Volcanologist in Charge

Kilauea remains quiet. There are no avalanches. A white stain has appeared in a niche of the wall at the top of the northwest talus. On wet days fog has condensed over the pit and in it, but the steam on the talus slopes has diminished.

The Kilauea seismographs have registered 10 tremors and 3 local earthquakes, making 13 disturbances. Two of the local shocks indicate distances of 34 and 51 miles. These were felt in North Kona. Microseisms were slight, and tilting of the ground was stationary.

The distant large earthquake of December 17 is located by "Science Service" at the west end of the Aleutian Deep, near Attu.

A BIG ATLANTIC EARTHQUAKE

A powerful movement of the earth crust under the Atlantic Ocean along the steamer track between New York and Liverpool is unusual. Such an earthquake recalls the Charleston disaster of 1886. This is not a place of deep holes under the ocean like the earthquake centers off Japan and Chile.

The shock occurred about 3:40 p. m., eastern standard time, November 18, 1929, 180 miles south of the Newfoundland coast, off the edge of the continental shelf, and probably moved a large area of sea bottom. The bottom is fairly steep, and possibly submarine landslip accounted for the breaking of Atlantic cables in several places. The location of center was about lat. 44° N., long. 58° W.

The first reports told of very heavy shocks in Nova Scotia lasting for many minutes. Halifax was severely shaken. In Windsor chimneys were knocked down and dishes were broken. In St. John's, Newfoundland, the shock was only "half a minute" long, and not so strong, but the Burin Peninsula in south Newfoundland received a violent shaking. From Boston to Maine in the United States the phenomenon was described as "sharp earthquake shocks."

The big steamship "Olympic" was 300 miles from the center, and the captain felt the vessel suddenly quiver, as though she had lost a propeller blade, and this was followed by vibrations for two minutes. The ship was found to be uninjured.

Sea waves piled into the Newfoundland inlets along the west shore of Placentia Bay two and a half hours after the earthquakes. Burin and La Maline bays were most damaged. At Burin whole families were trapped at their dinner tables as a wall of water 15 feet high swept inland. Boats and schooners were lifted from their moorings and dashed against the waterfront buildings and wharves. A mother, who was with her two children alone in her home, rushed to the door to learn the cause of the roar of waters. When she ran back to rescue the children, the wave broke over the house, drowned them all, and washed the wreckage out to sea.

Women and children were the greatest sufferers, as the men were away with the fishing fleets. Nine lives were lost at Burin, and 17 others at Lord's Cove and La Maline. In Long Harbor, at the head of a narrowing inlet, fishing booms and weirs were damaged and 75 yards of roadway were destroyed.

Twelve out of 22 telegraph cables in the epicentral earthquake area were fractured, and 10 of these cross the ocean. Two Western Union cables were severed at 90 fathoms depth off Nova Scotia, and a third at a depth of 900 fathoms. Thus the dislocation of the sea bottom was distributed. Davison reports (Nature, Nov. 30, 1929, p. 859) that such an earthquake occurred in 1884, breaking three cables along a straight line on the southeastern slope of the Newfoundland Bank, and that probably the present earthquake had a multiple origin.

Boston was 700 miles from the supposed center, and the U. S. Coast Survey (Science News, Science, Nov. 29, 1929, page X) estimates perceptible shaking over a million and a half square miles, and strong shaking over 200,000 square miles. This is a very large disturbed area, and yet not the slightest trace of this earthquake appeared on the Bosch-Omori seismograph of magnification x120 at Kilauea Volcano in Hawaii This distance is only 5,800 miles, and yet the Porto Rico earthquake at similar distance recorded clearly on these instruments.

It is 43 years since the last great earthquake (1886) on the Atlantic seaboard of the United States. That one, the Charleston cataclysm, was preceded a year and a half before (1884) by a disturbance breaking cables along a straight line off the Newfoundland Bank. In 1929 there is a new disturbance breaking 12 cables off the Newfoundland Bank.

We do not know what cycle controls the marginal movement of the North Atlantic basin around Bermuda as a center, but these west Atlantic earthquakes are so rare that seismological measurement should be made practical in the eastern United States during the next few years, with special attention to local frequency of small movements.

T. A. J.

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No. 262 RELEASED WITHOUT COPYRIGHT RESTRICTION January 2, 1930

KILAUEA REPORT No. 936

WEEK ENDING JANUARY 1, 1930

Section of Volcanology, U. S. Geological Survey

T. A. Jaggar, Volcanologist in Charge

There has been no visible change in volcanic conditions at Kilauea during the past week. Halemaumau pit remains quiet. No new scars are to be seen on the walls and no new slides have been reported.

On December 30 an observer noted that a section of the center of the July grotto had fallen. Steam was noticeably absent at the vents within the pit on this day and on January 1, although rainy weather has been prevalent during the week.

Nine seismic disturbances were recorded by the seismographs. Of these five shocks, of very feeble intensity, gave an average distance to origin of 44 miles. One feeble earthquake, at 11:52 p. m. December 29, indicated an origin 9 miles from the observatory.

Microseimic motion was slight. Tilt accumulated moderately strong ENE.

ACTIVITY OF PELEE, MARTINIQUE

Little has been heard from Martinique since the terrible destruction of St. Pierre in 1902 by volcanic blast from Pelée. This volcano is in the middle of the Caribbee Islands, which extend in a curve from Porto Rico to Trinidad.

September 16, 1929, ash eruptions began again from the crater of Mount Pelée. At 8:45 p. m. September 26 an earthquake lasted a minute and a half at Fort de France. October 14 Pelée burst into eruption more strongly than in September. This calmed down on the 18th, but October 19 the director of the volcano observatory reported for the early morning of that day an outbreak stronger than the two preceding. Gas and ashes were thrown up, and the flashes of light lasted for 10 minutes. Intermittent rumblings and bursts of white steam accompanied the eruption, the dust column rose nearly 4,000 feet, and cinders were showered over the country. The activity occurred at the head of the valley of the Riviere Blanche, just as in 1902, beside the ruins of the famous lava spine which rose in that year.

The complete evacuation of Prêcheur, Saint-Pierre, and Morne-Rouge has been ordered by the authorities. It appears that Saint-Pierre had risen from its ashes by 1923, and possessed 1,000 inhabitants, more than 100 houses, a club, shops, a restaurant, a market, and a custom house. There is a daily steamer from Fort de France, and the town has running water, a sewage system, and is presided over by a mayor. The 1929 activity appeared to have been kindled at about the September equinox, just as was the seismic shaking in Hawaii, but like the latter, it dwindled. New activity is reported in December. (Seismological Despatches, Georgetown University; London Times, Oct. 21; New York Times, Sept. 21 and Oct. 20, Nov. 4.)

T. A. J.

REVIVAL OF SANTA-MARIA, GUATEMALA

It will be remembered that the Pelée eruptions of May, 1902, were followed in October of that year by disastrous ash falls and floods from Santa-Maria volcano in Guatemala. In like manner the Pelée outbreak in September, 1929, is followed by a disastrous explosive eruption at Santa-Maria. This volcano is 12,361 feet high.

The volcano dominates the coffee lands of western Guatemala. Between 1922 and 1925 (Volcano Letter No. 87, Aug. 26, 1926) new stiff lava rose in the vast crater which the 1902 eruption had left in the flank of the mountain. The new plug replaced the crater with a lava hill 1,600 feet high and 4,000 feet across. Its top was a cluster of smoking turrets.

We now have despatches of November 5 and 8 which are difficult to interpret because of the newspaper habit of calling everything "lava" that pours from a volcano (Chicago Tribune, Paris, Nov. 5, and New York Times, Nov. 8). The "lava" is presumably glowing ash and mud floods.

On November 4, 1929, after three days of increasing rumblings, hot ash was vomited up about the new plug, probably cauliflower clouds of ash and steam shot thousands of feet into the air, incandescent blasts of falling material were impelled downward, and torrents of rainfall mixed with the hot ash to swell all the streams. Probably there was engulfment of the lava plug and widening of the crater. Heavy showers of ash were still falling November 7. There were destroyed villages, coffee plantations, and farms. El Palmar suffered the most, 21 bodies being recovered there. El Palmar is six miles south of the crater.

In the zone between Mazatenango, 15 miles to the south, and the crater cavity half-way up the mountain, the country is completely covered with ashes, and the air smells of sulphur. The buildings of El Palmar and the farmhouses thereabout still stand. On November 7 there were people still to be seen in the streets. Forty-five deaths are reported as the total, and loss of farm property in the coffee district to the value of one million dollars. Eight coffee plantations were destroyed, and the losses of life appear to be due to suffocation with hot ash, to burns, and to bombardment from falling stones, just as in 1902. Some bodies were found of persons who had climbed trees. The green foliage was burned to a dirty brown.

T. A. J.

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HAWAII NATIONAL PARK
HAWAII

OFFICE OF THE SUPERINTENDENT

December 11, 1929

Director,
National Park Service,
Department of the Interior,
Washington, D. C.

Dear Mr. Director:-

Submitted herewith is the report of operations and activities for the month of November 1929 in Hawaii National Park.

000 GENERAL:

Steamship travel to this park has been exceptionally light during November. The period between summer and winter tourist seasons usually shows a slacking of travel but heavy storms at sea and on the islands further decreased it this year. However a visit of Japanese training ships keep our total travel ahead.

100 ADMINISTRATION:

110 Status of Work.

Due to heavy rains no trail construction was performed during November. It was not considered advisable to do such work in constant bad weather and all men were used on repair of road damage.

120 Park inspections.

The superintendent made that usual inspection of all work.

150 Equipment and supplies.

The park office has been furnished with a new desk, new table, map filing section, form filing section, safe, and a lobby settee. All of this equipment except the settee is of steel construction suitable for our damp climate.

180 Circulars, etc.

The annual suggestions for changes in our Rules and Regulations pamphlets have been forwarded to Washington.

200 MAINTENANCE, IMPROVEMENTS AND NEW CONSTRUCTION:

210 Maintenance.

Continual rains during the greater part of November required an exceptional amount of road maintenance work. A heavy storm on November 25th during which seven inches of rain fell in eight hours time did considerable damage all of which had not been repaired at the end of November. A total of twenty inches rain in the month was more or less disastrous to our roads.

220 Improvements.

Early in November the emergency parking area in Kilauea volcano crater was improved by leveling, grading and marked by loose rock walls. This work was done in anticipation of a return of molten lava at any time and will enable our small force to handle heavy traffic with much greater dispatch. The parking area will hold almost 500 cars at present which should be enough to keep traffic moving in and out without obstruction.

300 ACTIVITIES OF OTHER AGENCIES IN THE PARK:

310 Public Service Contractors.

Action towards betterment of management conditions at Volcano House was taken on November 24th. Special reports and details of this have been submitted separately.

400 FLORA, FAUNA AND NATURAL PHENOMENA:

410 Ranger, naturalist and guide service.

Pending appointment of a ranger-naturalist all lectures given are confined to volcanic history of this region and trips across the crater floor and through Thurston Lava Tube.

460 Birds.

In order to protect rare native birds from being driven out of Bird Park and other areas by the savage attacks of Mynah birds an attempt is being made to reduce the latter by the use of air rifles. Poisoning would kill ground nesting birds and shot guns would frighten away the native birds. The air rifle may be the proper method of attack.

470 Animals.

Wild pigs are becoming so bold that they now frequent areas traversed by park roads. A constant effort is being made by all park employees to exterminate these. Many times park laborers bring in a dead pig after their work day is over.

Wild goats are also gathering in such large numbers that another drive on them will soon be staged.

500 USE OF PARK FACILITIES BY THE PUBLIC:

510 Increase in travel.

The increase shown on our travel figures is due to the visit here of officers, cadets and crew of two Japanese naval training vessels.

530 General Weather Conditions.

Over twenty inches of rain fell at park headquarters during November with much greater fall at other areas not recording. Compared with the year total of seventy-four inches this months rainfall is enormous.

Maximum temperature	15th	78	
Minimum "	2nd	52	
Rainfall for month of November		20.61	inches
" " " " " at Hilo		17.72	"
" to date Volcano District		74.02	"
" " " at Hilo		107.18	"

540 Visitors.

Vice Admiral K. Nomura and officers and cadets of training ships Iwate and Asama of the Imperial Japanese Navy.

Miss Eileen Tressiter, Miss L. Foster and Mr. Paul Shoe of Yosemite Park & Curry Company.

900 MISCELLANEOUS:

Air passenger service between all islands of Hawaii started on November 11, 1929 by the Inter-Island Airways Co., This organization a subsidiary of the Inter-Island Steamship Co., is running three trips weekly between Honolulu and Hilo by Sikorsky amphibion planes. It is now possible to leave Honolulu at 8:00 A.M., visit this island and return by 5:00 P.M. the same day.

Very respectfully yours,

Thos J. Allen Jr.,
Superintendent.

Copy to "Field Headquarters" (2)
" " "Yellowstone Nat'l Park" (1)

TJA/hs

10-157

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

TRAVEL REPORT

Hawaii National Park for the Month of November 1929

	This Month	This Travel Year To Date	This Month Last Year	Last Travel Year To Date	Increase for Travel Year: Number	Increase for Travel Year: Per cent
PRIVATE TRANSPORTATION:						
Cars first entry.						
Cars reentry.						
Motorcycles.						
Total motor vehicles.						
Persons entering via motor vehicles.	9,340	14,590	2,720	5,300	9,290	.637
Persons entering via other private transportation.	214	572	163	368	210	.367
Total persons entering via private transportation. . . .	9,554	15,162	2,883	5,662	9,500	.627
OTHER TRANSPORTATION:						
Persons entering via Hotel ~~stages~~ . .	469	1,044	688	1,211	- 167	.138
Persons entering via trains . .						
Persons entering otherwise. . .						
Total other transportation. .	469	1,044	688	1,211	- 167	.139
GRAND TOTAL ALL VISITORS. . .	10,023	16,206	3,571	6,873	9,333	.576

	This Year	Last Year	Increase: Number	Increase: Per cent
Automobiles in public camps during month	1	0	1	100
Campers in public camps during month	2	0	2	100

10-159

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

STATUS OF PERSONNEL

Hawaii National Park for the Month of November 1929

	This Month	This Month Last Year
Number of employees beginning of month,	7	8
Number of additions, ...	5	3
Total, ...	12	11
Number of separations, ...	0	2
Number of employees close of month, . .	12	9
Number of promotions during month	0	0
Aggregate amount of annual leave taken,	2	0
Aggregate amount of sick leave taken,	0	0
Aggregate amount of leave without pay,	0	0

10-

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

REPORT OF PARK REVENUES

Hawaii National Park for the Month of November 1929

	This Year	Last Year
Park revenue on hand beginning of month,	0.00	0.00
Received,	125.00	125.00
Total,	125.00	125.00
Remitted,	125.00	100.00
On hand close of month,	0.00	25.00

Park revenues received this year to date,	$ 1,452.00
Park revenues received last year to date,	1,450.00
Increase,	2.00
Percent of increase,	.0014

10-161

101.

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

HAWAII NATIONAL PARK

REPORT OF SALES OF PUBLICATIONS

NOVEMBER 1929

	Number	Value
GOVERNMENT PUBLICATIONS:		324 13 309
On hand beginning of month,	324	73.80
Received during month,	0	0.00
Total,	324	73.80
Sold during month,	13	13.00
On hand at close of month,	311	60.80
NON-GOVERNMENT PUBLICATIONS:		
On hand beginning of month,	6	15.00
Received during month,	0	0.00
Total,	6	15.00
Sold during month,	0	0.00
On hand at close of month,	6	15.00

Cash on hand beginning of month,	88.50
Sales during month,	13.00
Total,	101.50
Remitted during month,	0.00
Balance,	101.50

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No. 254 RELEASED WITHOUT COPYRIGHT RESTRICTION November 7, 1929

KILAUEA REPORT NO. 928

WEEK ENDING NOVEMBER 6, 1929

Section of Volcanology, U. S. Geological Survey

T. A. Jaggar, Volcanologist in Charge

All has remained quiet in the volcanic districts of Hawaii during the past week. Small earthquakes have continued in the North Kona District with some slight revival about November 4, the shocks as usual being feebly felt in Hilo.

On Thursday, October 31, about 1:30 p. m., a considerable avalanche fell from above the northeast talus in Halemaumau crater. The wall continued to work during the afternoon and two more slides were reported about 3 p. m. These breaks in the wall left a scar noticed on November 2, and there was new dust on the northeast edge of the July lava floor. This was whitish pink and similar fresh material was seen on the east talus slope. A lump had been left in relief protruding from the red boss in the middle of the eastern wall.

On the morning of November 4, at 9:30 a. m., there had been more than two inches of rain and all walls of the pit were dark red with moisture while many small steam jets arose from cracks of the crater floor. The steam was specially conspicuous at the several sulphurous spots of the floor. A few rocks were heard falling on the north talus. At 10:15 a. m., November 6, dust rose from a slight slide at the north side of the pit.

The seismographs at Kilauea registered 57 local disturbances, of which 35 were tremors and 21 very feeble earthquakes. One earthquake slightly more intense ranked as feeble at 3:03 a. m. November 5. This and a preceding shock 12 minutes earlier indicated distances from Kilauea seismometrically of only 18 and 12 miles. They were felt in Hilo, and suggest jarrings local to the east side of the island. The distances for nine other shocks registered indicate origins 50 to 60 miles away, corresponding as heretofore in the recent seismic crisis, with the western or northern parts of Hualalai. Microseismic motion was slight, and tilt was slight to the south.

The Kealakekua observer reports many slight tremors and only three earthquakes in the preceptible class. Hilo reports four felt shocks for the week.

LASSEN REPORT NO. 21

TEST FOR ARSENIC AT MORGAN SPRINGS

There are rather persistent rumors that one or more of the individual vents at Morgan Hot Springs, about six miles south of Lassen Peak, are poisonous, because of the fact that cattle have died in this vicinity. The deposits at Morgan Springs contain silica and various sulphates as well as common salt. Because of the latter, they are commonly frequented by live stock. To keep stock away from the heavier deposits of salts, most of the larger springs have been fenced in.

During the latter part of the summer of 1929, the flow from many of the smaller springs was very low and some had ceased entirely. The quantity and temperature of the discharge from the larger springs were about normal. The incrustation of common salt, alum, and other material around the springs was heavier than usual, as might be expected during an unusually dry season.

The presence of arsenic in the springs has been offered as a possible explanation of the death of cattle in this vicinity. The Marsh test for arsenic of a number of samples of suspiciously colored water and incrustations from the springs failed to show any trace of arsenic.

Near the springs there is at least one poisonous plant which might account for the known death of cattle. An overdose of alum, epsom salts, and other material mixed with the deposits of common salt might result in the death of stock that used the springs for their source of salt.

CHAS. A. HUFF.

VOLCANOES OF FLORES

An admirable monograph on this subject has been published by Kemmerling accompanied by excellent photographs and maps (Vulk. en Seismol. Meded. No. 10, Vulkanen von Flores, by G. L. L. Kemmerling, Bandoeng, 1929, pp. 138, photos 54, plates 10). There are from 100 to 200 eruption points on the island, the young volcanic mountains making about one half its surface. The cones are arranged in rows either parallel or at right angles to the fold structure of the Tertiary rocks. Volcanism is older at the west. In the east, lines of young volcanic cones trend either E-W or N-S.

There are 14 active volcanoes, the records are scanty, and it appears that lava effusion is still important in the Indian Archipelago. Lava streams and lava plugs are common. Table mountains of loose ejecta have sometimes funnel-shaped explosion craters, which change to kettles with wide bottoms ascribed to a hardening of the central region, and cylindrical pits are rare. Lava slag heaps are very rare.

The volcano regions are comparatively uninhabited. There is indirect danger, however, of collapse near the sea causing huge tidal waves. The lavas are basaltic andesites with feldspars high in anorthite. The recent ejecta are basaltic and underlying gabbro or granodiorite is indicated by fragments.

T. A. G.

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No. 255 RELEASED WITHOUT COPYRIGHT RESTRICTION November 14, 1929

KILAUEA REPORT No. 929

WEEK ENDING NOVEMBER 13, 1929

Section of Volcanology, U. S. Geological Survey

T. A. Jaggar, Volcanologist in Charge

Volcanic quiet continues in Hawaii. Seismic activity, however, is still going on in the region of Hualalai Volcano. The frequency of local earthquakes there has averaged about the same as the previous week.

At 9:15 a. m. November 9 a few new rocks lay on the northwest edge of the floor of Halemaumau, and a pink streak up the wall above, as well as fresh purple dust below, indicated a recent slide. The dust on the northeast floor had washed away. A circuit of the pit November 10 at 3:30 p. m. showed that much steam rises from the middle and the top of the large west talus cone as well as up the middle of the south talus. This last line of steam jets curves eastward into the wall above. About 4 p. m. there were two small falls of rock at the west and northwest walls.

The seismographs at Kilauea registered 62 local disturbances for the week. Of these 32 were tremors, 28 were very feeble earthquakes, and there were two feeble shocks.

These last were felt generally in Hawaii; one was at 8:19 p. m. November 10, indicating a distance of 34 miles, the other at 8:17 p. m. November 11, distance 30 miles from the Observatory. Fourteen records gave an average distance of 44 miles from the Observatory as measured seismometrically, and this corresponds with the location of Haulalai summit.

Tilt for the week was moderate NNE., and microseismic motion was slight.

A VERTICAL MOTION SEISMOGRAPH

For some weeks we have been experimenting in the shop of the Volcano Observatory on a companion instrument for the horizontal pendulums, to register vertical motion of local earthquakes. For seventeen years, with the aid of two Japanese instruments, and with experimental machines optical and mechanical, this problem of measuring vertical motion has been studied here, but without any success in solving it. It is a very old problem in seismology. The vertical motion of an earthquake is smaller than the horizontal motion. To measure it we must secure a mass acting as an up-and-down pendulum, with exactly the same properties as the horizontal pendulums otherwise, in weight, damping, magnification and friction. Then if they register E-W and N-S motion, the new pendulum will register up-down motion, and we can calculate something of the vertical angle by which the earthquake waves emerge from the ground. This in turn furnishes data as to the depth of the local bumping or grating that is the cause of the quake.

The angle of emergence is a very important element of earth motion. Mallet at the Neapolitan earthquake measured it by the vertical angles of cracks across the corners of broken buildings. Dutton at the Charleston earthquake found buildings at the seismic center with the second storey fireplaces telescoped into the first storey chimney-piece. The thrust there was upward. By Mallet's theory the buildings more distant from the seismic center would be more vertically cracked, those nearer to the center would show cracks more nearly horizontal. Angle of emergence was of great practical importance in the earth waves that destroyed stone fences to the value of many tens of thousands of dollars in Kona recently. The walls were flung over in the direction away from the mountain in many cases, which was also the direction away from the seismic center. There is needed an instrument less crude than the breaking of masonry, for measuring this angle, and for measuring it during all the different phases of the progress of the earthquake.

The obvious answer of all machinists has been a spiral or flat spring with a weight on the end. Many vertical motion seismographs have been made this way. But unfortunately springs are also thermometers, so much so that in the Wiechert vertical instrument a temperature change of one tenth degree moves the writing pen three centimeters. This is compensated by a lever holding the spring supported by iron and zinc rods which expand on warming. To get a slow natural period in a helical spring seismograph, where the spring is counteracting gravitation, the usual method is to attach a horizontal rod to the support at a hinge-line, weight the end of the rod remote from the hinge, attach a spiral spring vertically to a support above the rod, and then attach the lower end of the spring to the rod so that the angle ULH (upper support, lower attachment and hinge) is so much less than 45 degrees that instability begins to set in. The weighted rod sways up and down on the spring, and at the lower part of its journey it tends to flop. When this is the adjustment, the natural period may be slowed to six or seven seconds. Meanwhile the stiffness of the spring, the weight to be carried, the size of the spring, and the frictionless quality of the hinge all play their parts.

What we need in Hawaii is a vertical moving pendulum with a mass equivalent to 225 pounds, eight inches from the hinge line, a natural period of six seconds, a magnification at the pen of 120 times, complete correction against temperature change, against horizontal motion, and against tilt of the ground, and with recording mechanism, damping and friction identical with the Hawaiian type horizontal instruments. The experiments have been made with a small model, and then with a full size model wherein a variety of spring arrangements have been installed having in view temperature correction. Further progress will be reported from time to time. T.A.J.

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No. 256 RELEASED WITHOUT COPYRIGHT RESTRICTION November 21, 1929

KILAUEA REPORT NO. 930

WEEK ENDING NOVEMBER 20, 1929

Section of Volcanology, U. S. Geological Survey

T. A. Jaggar, Volcanologist in Charge

There are no changes in the dormancy of Hawaiian volcanoes. Kona continues to feel about one earthquake a day, but the seismic activity has greatly declined.

Halemaumau has shown no changes except increase of steam due to heavy rain. Mauna Loa at 7 a. m. November 20 showed two remarkable convection clouds, each with pine-tree shape, a narrow stem with widened tabular top. One of these was over the summit crater, and the other over the steam-jet region of the northeast rift. Both were mere rain clouds induced by peculiar still atmospheric conditions, and both disappeared in the course of 20 minutes.

The seismograph at the Observatory registered 28 local disturbances and one distant earthquake. There were 16 very feeble shocks of which 5 indicated origin distance averaging 46 miles from the Observatory. The other local movements were tremors. The distant earthquake began at 7:39 a. m., November 15, recorded about 36 minutes, and showed imperfect phases. Microseismic motion was slight, increasing to strong at the time of the easterly wind storm November 17-18, and diminishing thereafter. Tilt for the week was slight SE.

EARTHQUAKES DUE TO MINE COLLAPSE

Earthquakes became numerous on the Witwatersrand mining district after 1907. (The Rand's earthquakes, by A. G. Boyden, South African Mining Review, December, 1928, p. 328.) Loss of life underground is occasioned by these disturbances, falls of rock trapping and crushing the miners, the collapse being the effect of the earth movement. The Rand syncline is unstable owing to many dykes and dislocations, the mine excavations constitute a belt of weakness many miles long and nearly a mile deep, and earthquakes have increased as this belt settled.

On the surface the major tremors have been alarming, but damage to property above ground has been slight. The following is the record of underground accidents:

Year	Local Tremors	Accidents	Killed	Wounded
1923		71	44	83
1924		79	45	76
1925	484	168	28	160
1926	528	137	34	143
1927	666	143	32	161
1928 (10 months)	558	130	22	168

The quakes are believed due partly to slipping on faults and dykes making frictional vibration, and partly to the reaction of a hammer-like blow of a large mass of falling *rock for which this slipping is responsible. The collapse is* taking effect in many ancient workings, and the jarring results in "rock-bursts" at the live workings, the yielding of pillars of ore left to support stopes. There are also "rock punches," when hard columns break through softer rock below them.

Committees appointed at three different times have grappled with the situation. Seismographs have been set up. The ore pillars have been replaced by timber and stone packs, designed to let the stopes close gradually. Another device was to fill the worked-out cavities with sand sent down fluid through pipes or bore-holes. This must be done on a large scale to lessen the big falls of "hanging wall." It seems the best procedure for preventing loss of life. An instrument is needed, delicate enough to detect increasing strain in the rock. The miners themselves hear and feel dangerous ground. T. A. J.

EARTH TILTING IN TOKYO

An Omori tiltometer compared with the registration of an Ishimoto clinograph (On the Tilting of the Earth Observed at Tokyo, by S. Haeno, Proc. Imp. Acad. IV, 1928, No. 4, p. 151) gave a daily and annual variation in approximate agreement with the corresponding variations of the earth's temperature at a depth of 10 cm. No agreement was found between tilting and precipitation nor between tilting and barometric pressure.

The daily variation exhibits a plumb-line swing counterclockwise ESE in the morning, WNW. in the forenoon and afternoon, and ESE again from about 4 p. m. to midnight. The plumb-line swings in a flattened elliptic curve with major axis 0.57 second N. 80°W.

The annual variation of tilt causes the plumb line to describe a clockwise swing N. 50° E. from July to February of 10 seconds, and SW. from February to July, with marked departures from regularity. The minor axis of the ellipse described (annual NW.-SE. variation) is 3 seconds. The abnormal movements may be connected with seismic phenomena. Agreement is close in direction and amount of annual tilting between Tokyo and Kilauea (Bull. Haw'n. Volc. Obs. Dec. 1927, fig. 48). T. A. J.

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THE VOLCANO LETTER

A Weekly news leaflet of the Hawaiian Volcano Research Association

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No. 257 RELEASED WITHOUT COPYRIGHT RESTRICTION November 28, 1929

KILAUEA REPORT NO. 931

WEEK ENDING NOVEMBER 27, 1929

Section of Volcanology, U. S. Geological Survey

T. A. Jaggar, Volcanologist in Charge

The week has been uneventful at the Hawaiian volcanoes and the seismic activity in North Kona has continued to decline, though the registered earthquakes continue to indicate a source near Hualalai Volcano.

Halemaumau showed no changes November 20 and the next day appeared unaffected by a small earthquake which occurred that evening. Rock falls were heard at the pit at 12:08 p. m. November 24 and 7:45 a. m. November 26. They were heard at the Observatory because of the southerly wind. A very heavy rainstorm from the southwest with repeated wind thunder, and lightning crises between November 23 and November 26 flooded the country and coated Mauna Loa and Mauna Kea with snow. Consequently much steam rose from Halemaumau November 25, and after more than seven inches of rain for the 24 hours preceding the forenoon of November 26, the road near Keanakakoi was washed out. The July floor of Halemaumau showed about 25 new vapor jets clustered in front of the cone made by the lava fountain at the west, there were many scattered steaming places on the floor, and the stained areas at the floor edge south and northwest were steaming conspicuously. The walls of the pit were also steaming. The rock falls made a fresh scar at the west.

The Observatory seismographs at Kilauea registered 32 local disturbances, of which two were feeble, 12 very feeble, and 18 tremors. The two feeble shocks were in the perceptible class, and one of these at 8:29 p. m. November 20 was strongly felt in Hilo and feebly felt near Kilauea. Its indicated distance to origin was 12 miles. The other shock at 6:59 a. m. November 24 was felt strongly in Kona and had indicated origin distance 40 miles. The average origin distance of five such Kona earthquakes for the week was 48 miles, corresponding as recently during other weeks, to Hualalai Volcano.

Tilt for the week was moderate ESE., and microseismic motion became strong November 22-25, declining thereafter.

THE TENGGER CALDERA

Many craters in different parts of the world have the character of a large cauldron miles across surrounded by cliff walls, floored with the products of several inner vents, and broken at one side by a radial valley leading down the mountain. The radical valley is not an essential. but is common. In Java and Bali there are four notable calderas of different sizes, Idjen of diameter 16 km., Batoer 14 km. (Volcano Letter No. 215), Tengger 8 km., and Roeang 2 km. Escher defines caldera as "A very large steep depression with a flat floor in the top of a volcano, the diameter of the upper rim being much larger than that of necks." by "necks" are meant the inner conduits up which lava rises, these being smaller units than the whole caldera.

The caldera conception may be very well illustrated by Mokuaweoweo and Kilauea in Hawaii, each over 5 km. across and containing inner pits or cones that lie over necks. The Kau Desert is somewhat like a radial valley leading from Kilauea Crater.

Calderas have been subjects of controversy in geology. The disputes concern the question whether the large orifice overlies a magma column of that large size, whether the large cauldron was produced gradually or by a single titanic eruption, whether it was made by the up-welling and sinking back of lava, whether it was made by a gigantic explosion, whether it could have been made by gradual down-faulting and this be related to a down-faulted sector that made the radial valley, or finally whether it was produced by a plexus of causes not always the same in different cases. The last seems most reasonable, and is the moderate viewpoint of Dr. Escher in discussing Tengger (Vesuvius, the Tengger Mountains, and the problem of Calderas, by B. G. Escher, Leidsche Geol. Meded. Deel. II, pp. 51-114, 1927, Royal Geological Museum of Leiden)..

The Tengger is a large crater ring in eastern Java near the resort Tosari, and famous for the activity of the crater Bromo and the wonderful photographic views which have been made of the sand-sea, the great smoking volcano Smeroe, and the marvelous landscape of the huge caldera which surrounds Bromo.

Bromo is in the Tengger caldera along with four other smaller craters. Off to the northeast extends the Sapikerep Valley leading away from the caldera. The older explanation was that there was first a big double volcano which had an enormous eruption accompanied by engulfment and such lava flows out through the valley as to break down that side of the mountain. Then came deposits of loose materials and finally younger lava filling through small new vents inside the caldera.

Escher was greatly impressed by the scouring effect of the gas phase in the eruption of Vesuvius in 1906 which he calls an eruption of the Perret type. He draws analogy for explaining Tengger from the sequence of events in Vesuvius between 1906 and 1926. This sequence in Vesuvius was (1) a small high crater, (2) the big eruption and the large deep crater, (3) crumbling walls, (4) building up the inner floor, and (5) high crater floor, one principal inner cone, some smaller cones and some lava domes.

The history of Tengger was probably as follows: (1) a twin volcano 4,000 meters high with one strongly developed erosion valley, (2) a gas phase in the eastern of two craters scoured out a deep funnel, (3) a gas phase and collapse funnel in the western crater, (4) lava overflowed this western crater into the eastern one and later into the radial valley, (5) a repose period, valley erosion, and subsidence of the eastern crater lava, (6) minor activity in the five inner craters of which Bromo is the survivor.

Assisted by Kuenen the author carries out experiments in gas erosion of upright funnels through sand with a compressed-air blast to make cylindrical and other chimneys by gas erosion. The paper contains striking maps, photographs, and block diagrams showing stages in the crateral evolution T.A.J.

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HAWAII NATIONAL PARK

OFFICE OF THE SUPERINTENDENT [redacted], HAWAII

November 8, 1929

Director,
National Park Service,
Department of the Interior,
Washington, D. C.

Dear Mr. Director:-

The report of activities and operations for the month of October 1929 in Hawaii National Park is submitted herewith:

000 GENERAL:

October, the first month of our new travel year started this park off with a favorable increase in travel. Exceptionally fine weather for visitors prevailed all during the month with so little rainfall that our water supply was threatened but not dangerously.

100 ADMINISTRATION:

120 Park inspections.

The superintendent being absent until October 23rd all inspections of work in progress were made by Acting Superintendent Christ at various times.

200 MAINTENANCE, IMPROVEMENTS AND NEW CONSTRUCTION:

210 Maintenance.

The rapid growth of weeds and plants on the shoulders of the new Chain of Craters road is requiring unusually detailed maintenance work. It is not possible to remove these without slow hand labor. This same problem is present on our new trails.

230 New Construction.

The two new cottages for employees have been completed except as to painting. This was postponed pending return of the superintendent.

Kipuka Keana Bihopa (Bishop's Cave Kipuka) trail was completed.

300 ACTIVITIES OF OTHER AGENCIES IN THE PARK:

310 Public Service Contractors.

A growing number of complaints are being received as to the rates, accomodations, and service being given at the Volcano House. This matter was discussed with the Director at the Yellowstone conference and is now being discussed further in a detailed separate report.

400 FLORA, FAUNA, AND NATURAL PHENOMENA:

420 Ranger-Naturalist.

Although routine lectures on volcanic history are being given to all park visitors the educational work of this park is being retarded by our failure to secure a good ranger-naturalist. This problem which was thought to be solved at the end of October has again resolved itself into a vacancy with no capable applicants.

460 Birds.

It is interesting to note that a great many of the birds which island residents introduced during the past year have found their way to this park and apparently intend to remain here.

490 Volcanic Action.

Late September and October saw the occurrence of approximately 3000 earthquake shocks at all points on this island as well as one or two which were felt at all of the other islands. A large number of these shocks were very severe altho no immense damage was done. The majority of the quakes centered on the north half of the island of Hawaii near the old crater Hualalai which has been quiet since 1801. Much unwarranted and unfavorable newspaper publicity was given the Islands during these disturbances. The earthquakes indicate a return of great lava pressure which is expected to result in active flow sometime before the end of 1929.

500 USE OF PARK FACILITIES BY THE PUBLIC.

510 Increase in travel.

October had a forty six per cent increase in travel with which to start the new travel year. The coming winter season is expected to break all records for Hawaii Travel.

520 General Weather Conditions.

Maximum Temperature	9th	85	
Minimum "	5th	52	
Rainfall for month of October		2.87	inches
" " " " " at Hilo		4.19	"
" to date Volcano District		53.41	"
" " " at Hilo		89.46	"

540 Visitors.

Rear Admiral & Mrs. Marvell, commandant of U. S. Naval forces in Hawaii spent ten days in the park during October.

900 MISCELLANEOUS:

Superintendent Allen returned to the park on October 23rd after attending the superintendents conference at Yellowstone Park and receiving accounting work instruction at Yosemite Park.

Very respectfully yours,

Thos J. Allen

Thos J. Allen Jr.,
Superintendent.

Copy to "Field Headquarters"

" " "Yellowstone National Park"

TJA/hs

10-157

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

TRAVEL REPORT

Hawaii National Park for the Month of October 1939

	This Month	This Travel Year To Date	This Month Last Year	Last Travel Year To Date	Increase for Travel Year Number	Increase for Travel Year Per cent
PRIVATE TRANSPORTATION:						
Cars first entry.						
Cars reentry.						
Motorcycles.						
Total motor vehicles.						
Persons entering via motor vehicles.	5,250	5,250	2,580	2,580	2,670	.508
Persons entering via other private transportation.	358	358	199	199	159	.444
Total persons entering via private transportation. . . .	5,608	5,608	2,779	2,779	2,829	.504
OTHER TRANSPORTATION:						
Persons entering via Hotel ~~stages~~ . .	575	575	523	523	52	.090
Persons entering via trains . .						
Persons entering otherwise. . .						
Total other transportation. .	575	575	523	523	52	.090
GRAND TOTAL ALL VISITORS. . .	6,183	6,183	3,302	3,302	2,881	.466

	This Year	Last Year	Increase Number	Increase Per cent
Automobiles in public camps during month	1	0	1	100
Campers in public camps during month	2	0	2	100

10-158

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

S T A T U S O F A U T H O R I Z E D P R O J E C T S

Hawaii National Park for the Month of October 1929

Description of Projects	Percent Constructed To Date	Percent Constructed This Month	Percent Constructed Last Month	Probable Date of Completion
502/6 Kipuka Keana Bihopa Trail.	100	20	80	

10-15.

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

STATUS OF PERSONNEL

Hawaii National Park for the Month of October 1929

	This Month	This Month Last Year
Number of employees beginning of month,	7	9
Number of additions,	1	2
Total,	8	11
Number of separations,	1	3
Number of employees close of month,	7	8
Number of promotions during month	0	0
Aggregate amount of annual leave taken,	0	5
Aggregate amount of sick leave taken,	0	0
Aggregate amount of leave without pay,	0	0

10-160

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

REPORT OF PARK REVENUES

Hawaii National Park for the Month of October 1929

	This Year	Last Year
Park revenue on hand beginning of month,	25.00	0.00
Received,	0.00	0.00
Total,	25.00	0.00
Remitted,	25.00	0.00
On hand close of month,	0.00	0.00

Park revenues received this year to date,	$ 1,327.00
Park revenues received last year to date,	1,325.00
Increase,	2.00
Percent of increase,	.0015

10-161

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
Hawaii National Park

REPORT OF SALES OF PUBLICATIONS

OCTOBER 1929

	Number	Value
GOVERNMENT PUBLICATIONS:		
On hand beginning of month, ...	369	90.00
Received during month, ...	0	0.00
Total, ...	369	90.00
Sold during month, ...	45	16.20
On hand at close of month, ...	324	73.80
NON-GOVERNMENT PUBLICATIONS:		
On hand beginning of month, ...	6	15.00
Received during month, ...	0	0.00
Total, ...	6	15.00
Sold during month, ...	0	[illegible]
On hand at close of month, ...	6	15.00

Cash on hand beginning of month, ...	72.30
Sales during month, ...	16.20
Total, ...	88.50
Remitted during month, ...	0.00
Balance, ...	88.50

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No. 250 RELEASED WITHOUT COPYRIGHT RESTRICTION October 10, 1929

KILAUEA REPORT No. 924

WEEK ENDING OCTOBER 9, 1929

Section of Volcanology, U. S. Geological Survey

T. A. Jaggar, Volcanologist in Charge

No lava has appeared on the island of Hawaii. Halemaumau showed thin dust clouds from slides the forenoons of October 3 and October 5, and there were big slides in the pit and from the walls of Kilauea Crater at the time of the strong earthquake 9:22 p. m. October 5. There were more slides at the pit the forenoon of October 6 and examination of Halemaumau October 7 and 8 showed that falls from the rim had left streaks, the new lava floor is staned with dust from a big slide at the northwest, and a long strip of rim has fallen at the southeast. At that rim also cracks had widened. Small new talus cones were piled at the base of the western wall.

The Observatory seismographs registered 129 earthquakes for the week, and in addition there were spells of spasmodic tremor October 2, 4, 5, 8, and 9. The numbers of earthquakes for complete days midnight to midnight beginning October 3 and ending October 8 were 15, 18, 30, 19, 10, and 16. This shows a distinct frequency maximum on October 5, the day of the very strong earthquake, and does not support the notion that a decrease of frequency precedes violent shocks. This big earthquake began at 9:22 p. m. October 5. No preliminary waves were present to indicate distance of origin. The long slow waves moved the pendulums for an hour.

Seismometric evidence of distance of origin indicated two principal groups of centers, one from 24 to 28 miles from the Observatory, the other from 34 to 37 miles away. There were eight shocks for the shorter distance and seven for the longer. Other shocks indicated distances varying from 18 to 40 miles.

Microseismic motion was slight and tilt for the week was strong WNW. It is of interest to note that for the three weeks of the seismic crisis the tilts at the Observatory have all been northerly with increase of strength first easterly and now westerly. This suggests a swelling pressure under Kilauea.

THREE WEEKS OF HAWAIIAN EARTHQUAKES

The earthquakes that began in West Hawaii September 19 reached maximum of frequency the last week of September and have declined irregularly since that time both in frequency and in intensity.

The outstanding event of the first week of October was a very strong earthquake at 9:22 p. m. October 5, 1929, which was more disastrous than the one of September 25. There is good reason for believing also that it was more intense, as its effects in cracking roadfills and overthrowing embankments at the road spurs in North Kona introduced new phenomena. For the rest, the effects on buildings extended the damage for masonry and water tanks to Waiki and Waimea, while in Kona the long siege of shaking had weakened foundation posts, walls, and tanks with some 200 shocks recorded as sharp prior to October 5. Many of these had been very hard jolts, usually with maximum fling down the mountain slopes as shown by the collapse of hundreds of stone walls in a seaward direction.

Thanks to the Naval Air Service the writer inspected the districts of South Hilo, Puna, Kau, Kona, and South Kohala from an airplane at elevation 10,000 to 12,000 feet in the early morning hours of October 3, traveling approximately 160 miles from Hilo over Kilauea, across the south flank of Mauna Loa, and across the divide between Mauna Loa and Hualalai. The visibility was good, and all the upland of the three active volcanoes was revealed as showing not a trace of new outbreak. Other flights have since been made by the airmen, and the mountains have been clearly seen repeatedly including this date, October 9. Moreover the seismographs show no trace of continuous harmonic tremor, which is characteristic of fountaining lava.

The big shock of October 5 was reported by an observer in Hilo as no more severe than one of an earlier date. It seemed to last fully a minute, nothing in that house was overturned, no water was spilled from a glass three-quarters filled, and the cement basement was not cracked. Cement is reported cracked in the Federal Building.

In the concrete basement of the Observatory the writer perceived a long, gentle, swaying motion which dismantled the seismographs and subjected them to much strain: there was no jerking. Rocks were heard falling from the Kilauea cliffs and several fresh scars were seen on the high northwestern walls and elsewhere. One or two small cracks in the soil were reported.

In Kealakekua the motion was a heavy jerk, somewhat prolonged, and applied very suddenly. Vertical retaining walls broke on the downhill side of roads and of filled land, stone houses were cracked, tanks burst or were thrown off their foundations, and some weak structures collapsed. Furniture was moved and loose objects were thrown about.

Puuwaawaa Ranch received the brunt of the disturbance as usual, unbraced foundation posts went over, the masonry of the basement of the main house was partly thrown down, new avalanches fell in the gulches of Puuwaawaa Hill, bowlder fences were generally prostrated, and a chimney stump was broken for the second time. The effects suggest Grade IX Rossi-Forel for a radius of nine miles around Puuwaawaa Hill, and Grade VIII for a radius of 20 miles around a point northeast of that hill. Grade VII appears to include the Kohala sugar district and the region of Kealakekua Bay.

The count of felt earthquakes from October 1 to October 6 was 5 to 14 shocks per day at Kealakekua, 17 to 83 shocks per day at Holualoa, and 89 to 241 shocks per day as registered on the shock-recorder at Puuwaawaa. In each case there was decline in numbers during the week, with some revival for the day of the big shock October 5. Prior to the big shock there was a marked lull in frequency during the daylight hours. The seismographic registration gives the following numbers of shocks October 1 to 4 for different places: Hilo 38, 26, 13, 74; Kealakekua 155, 110, 96, 138; Puuwaawaa 241, 117, 97, 114. Each of these thus shows a revival before the big shock of October 5. The intensity relations, obtained by counting the numbers of strongish shocks, indicate a general correspondence between the curve of intensity and the curve of frequency; that is, there were maxima in numbers of strong shocks about September 24-25 and about October 5.

T.A.J.

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No. 251 RELEASED WITHOUT COPYRIGHT RESTRICTION October 17, 1929

KILAUEA REPORT NO. 925

WEEK ENDING OCTOBER 16, 1929

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

Halemaumau the inner pit of Kilauea remains quiet and as yet no lava activity has appeared elsewhere, although the felt earthquakes in West Hawaii continue. October 9 the four jets of steam on the northeast rift of Mauna Loa at about 12,000 feet elevation were conspicuous owing to still air, but they have been there for many years without change.

Halemaumau has developed nothing new. The morning of October 10 there were many vapor jets owing to a night of rain. An avalanche fell at the north wall 1.23 p. m. October 11. This left a fresh scar above the northwest talus.

In general Halemaumau shows wet patches on the west talus and the three lava niches of the July fountains at the edge of the black lava floor at the foot of this talus. The south talus has a line of wet fissures with steam up and down its upper portion. The floor extends over the whole bottom area with only a few stones from slides overlapping it. It has a large area of white and yellow stain at its south edge and many cracks. The recent dust stain over the northwest side of the floor has been washed away.

The seismographs at Kilauea registered 97 shocks and tremor spasms, a decrease of 32 from the previous week. The average indicated distance of 39 shocks by Omori's formula is 44.3 miles. This is exactly the distance from the Observatory to Hualalai summit. The number per day October 9-15 was 15, 14, 10, 9, 9, 14, 23, thus showing marked revival October 15.

Microseismic motion for the week was strong. Tilt was slight NNW. The intensity of the earthquakes increased October 14-15 as well as the frequency.

THE EARTHQUAKE CRISIS

Hawaii has now had four weeks of unusual earthquakes centering about Hualalai volcano. There is no question about this epicenter. The local damage shows it, the perceptibility records show it, the instrumental frequency registration shows it, and the instrumental measures of distance show it at three stations Hilo, Kilauea and Kealakekua.

The seismograms of 39 local earthquakes during the past week at Kilauea Observatory, critically measured, indicated 20-30 miles for three shocks, 30-40 miles for 11 shocks, 40-50 miles for 13 shocks, and 50-60 miles for 13 others. The average distance measured is 44.3 miles, exactly the distance of the center of Hualalai mountain. The shocks fall into three principal groups, of distances 34-37 miles, 42-46 miles, and 51-60 miles respectively. These distances correspond to the east, middle and west parts of Hualalai ridge.

The history of the week ending midnight October 15 reports earthquakes in the Kona district diminishing in frequency and strength from October 9 to October 13, and increasing strongly October 14-15. There was a strong shock in Kona 11:35 p. m. October 14, and four strongish ones occurred on October 15 at 9:59 a. m., 1:04 p. m., 5:41 p. m., and 10:05 p. m. At the same time small shakings increased greatly.

At Kilauea the strong shock of 11:35 p. m. was registered as moderate and barely felt, dismantling one seismograph pen. The others registered with 3 to 4 centimeters of amplitude on the seismograms of about 120 times magnification. They would rank as slight earthquakes.

Hilo reported two shocks felt October 8 and 9 each, one each day October 10 and 11, and none October 12 to 14. The Kealakekua observer in Kona reported five October 7, three October 8, two October 9, eight October 10, six October 11, three October 12, and two October 13.

The Kealakekua seismograph showed

59	shocks and tremors	October	7-8
94	" " "	"	8-9
61	" " "	"	9-10
42	" " "	"	10-11
41	" " "	"	11-12
43	weaker ones	"	12-13
25	very weak	"	13-14

It is of interest to review the whole crisis from September 19 to the present time. The Kilauea Observatory seismographs jumped in their registration from only 9 shocks the week ending September 18, to 221, 244, 129, and 97 the four following weeks. The climax in frequency of local earthquakes was thus the week ending October 2, and the strongest shock of the series came at 9:22 p. m. October 5.

The number of shocks registered at Kilauea, and those of intensity corresponding to Kona earthquakes moderate, strong and very strong, were for the week ending

Sept.	18	Total	9	All Small					
"	25	"	221	12	Moderate	2	Strong		
Oct.	2	"	244	18	"	12	"	1	Very Strong
"	9	"	129	9	"	3	"	1	" "
"	16	"	97	6	"	1	"		

The agreement between frequency and intensity of shakings is good, and the decline in both frequency and intensity during the last fortnight is so pronounced as shown by these figures, that the prospect is reassuring. However there is always a possibility of a very big earthquake when the lava breaks forth in a new place.

The concentration of seismicity at the north side of Hualalai volcano; the waxing of earthquakes in both size and number to a maximum about October fifth; and the persistency of seismic action still, although it seems to be lessening, all imply preparation for a volcanic outbreak as result of the intrusion of basaltic magma underground near the surface. The splitting jerks are now less, perhaps because the mountain fissures are more open, and the earth crust is in tension. Lava outbreak is expectable.

—T.A.J.

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No. 252 RELEASED WITHOUT COPYRIGHT RESTRICTION October 24, 1929

KILAUEA REPORT NO. 926

WEEK ENDING OCTOBER 23, 1929

Section of Volcanology, U. S. Geological Survey

T. A. Jaggar, Volcanologist in charge

There has been no lava activity on Hawaii. Halemaumau pit remains quiet. Wet streaks have been noticed on the wall above the south talus, and higher there is steam at ancient cracks. Small avalanches tumble occasionally.

The seismographs at Kilauea registered 3 feeble earthquakes of the faintly perceptible class, 9 very feeble ones, and 41 prolonged tremors, very feeble, which were small earthquakes at their origin in Kona; total number 53 seismic disturbances as compared with 97 for the previous week. Microseisms were strong and tilt was very slight WNW.

The average distance of nine shocks computed seismometrically was 41 miles, corresponding to Hualalai. An earthquake was strongly felt in Kona about noon October 21. The observer there October 16-19 counted small shakes per day three, four, four, one, as felt. The Hualalai seismic crisis has declined.

VOLCANIC TUFF AND SUGAR CANE ON HAWAII

Studies of volcanic ash and tuff on the Island of Hawaii during the past summer show that the sugar industry is dependent partly on products of explosive vulcanism for its annual $1,250,000 crop. These materials, together with the slightly coarser agglomerate, either aa lava or of explosive origin, form the surface mantle where sugar is grown, and their weathering has apparently been essential to the production of a sufficiently deep and fertile soil on this Island.

On other islands of the Hawaiian group sugar cane grows on soils derived by the weathering of lava rocks, old enough so that a deep soil cover has been developed in those areas which have a moderate to heavy rainfall. The island of Hawaii, is mostly of such recent origin that in few of the areas where aa or pahoehoe lava forms the surface has a soil cover of value for sugar cane culture been produced. In the Kohala district, the sugar growing areas are underlain by agglomerate, made up of small fragments, and much more readily weathered than pahoehoe flow lava. Here the presence of detrital volcanic materials produced by explosive eruptions may be partly responsible for the soil in which cane is grown.

Very little is known as to the actual rates at which either lava or ash might weather under the varied conditions found in Hawaii. The rate of decay on the moist windward slopes, possibly may be ten or twenty times that on drier, leeward slopes. A considerable growth of trees and ferns may develop on lava flows in so short a time as 20 or 30 years under favorable moisture conditions. But the soil condition which will support such vegetation is still far short of that required for the growth and especially for the proper tillage of sugar cane. It may be doubted whether a soil sufficiently deep for commercial sugar production would develop from lava in a period shorter than a thousand years under the most favorable conditions found anywhere in the group.

On the other hand, the fine grained, powdery ash which has been produced at many different times by explosive eruptions on Hawaii, Oahu and other islands of the group has formed a mantle several feet thick over large areas in which weathering must have proceeded much more rapidly. Such material has from the beginning a constitution permitting plowing and cultivating and it seems likely that the finer grained phases of it may become sufficiently leached and modified to permit the growth of sugar cane in a few decades.

The soils of the Hamakua coast and Hilo districts as well as those of the Pahala district have been developed in this way, and the sharp southward limit to sugar growth which follows closely the course of the Wailuku River is the line along which the comparatively young Mauna Loa flows have covered the older ash from the Mauna Kea summit cones. The soils of the Olaa district are mainly derived from agglomerate, partly decomposed aa lava, similar to that of the Kohala region.

It thus appears that if a volcano must erupt and by spreading its product over the land, temporarily interrupt the growth of crops and other human activities, an explosive eruption is much to be preferred to lava. This is apparent if we attempt to compare the value of an acre of land freshly ash-covered with the value of an acre freshly lava-covered. If we take $200 as an average value for good sugar land and from the discussion above assume that perhaps 100 years may elapse before ash-covered land can attain this value through weathering we can easily compute the initial value of the ash-covered land. If the rate of appreciation is fixed at 6% per annum the initial value at the beginning of the hundred year holding would be $0.632 per acre.

Similarly if we assume that lava under favorable rainfall might attain an equally fertile and arable soil in 1000 years its initial value would be a very small fraction of one cent, and even at the end of the first 500 years an area of the size of the state of Texas would be worth only a cent from the sugar viewpoint.

All this is equivalent to saying that, whereas a fresh lava flow is about as worthless agriculturally as any terrane could be, a fresh ash-fall, even of great thickness, has a moderate but tangible worth. The good fortune of the Island of Hawaii is that its legacy was left largely in the form of volcanic tuff which in the twentieth century has attained its financial maturity in a crop worth a million and a quarter dollars. —C. K. Wentworth.

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NO. 253 RELEASED WITHOUT COPYRIGHT RESTRICTION October 31, 1929

KILAUEA REPORT NO. 927
WEEK ENDING OCTOBER 30, 1929

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

The week has produced no lava activity and the Kona earthquake crisis has continued. Halemaumau pit at Kilauea showed a few new slide rocks on the crater floor west the morning of October 26, but there has been no evident motion there except what the usual small earthquakes will account for.

Seismographs at Kilauea have registered 86 local disturbances divided among 56 tremors, 39 very feeble quakes, and one feeble earthquake at 4:04 p. m., October 29. The average distance for thirteen of the shocks measures 51 miles from the observatory seismometrically, corresponding to the west end of Hualalai volcano. The frequency is higher than the previous week.

Holualoa in North Kona reports numbers of felt shocks for the days beginning October 20 as follows: 6, 69, 5, 2, 8, 2, 1. The seismograph at Kealakekua gave a similar record with about 30 per cent more shocks shown instrumentally. Evidently the volcanic agency that started this seismic crisis is still at work, with marked revivals on such days as October 21 and 23. On these two days there were 41 and 31 disturbances respectively at the Kilauea instruments.

Microseismic motion at Kilauea declined during the week to normal, and tilt was slight NNE. Hilo reports two tremors felt October 18 and three October 21.

VOLCANIC MUD-FLOW IN JAVA

Professor B. G. Escher (L'Eboulement Préhistorique de Tasikmalaja et le Volcan Galounggoung, Leidsche Geologische Mededeelingen, Deel I, Aflevering 1, XI 1925, Blz. 8—21) reports on a quantitative study of the missing sector of the cone of Galounggoung volcano in Java, and its relation to the "Ten Thousand Hills of Tasikmalaja" nearby. There have been mapped a total of 3,648 of these hills or hillocks. Escher groups these into categories according to heights (0 to 10, 10 to 20, 20 to 30, 30 to 40, 40 to 50, 50 to 60, and 60 to 70 meters) and computes their total aggregate volume as 142,000,000 cubic meters.

The hillocks are composed of very fine material enclosing large blocks. Various exposures were studied where recent cuts had been made to get out the andesitic blocks for road materials.

The cone of Galounggoung is young and still smooth and nearly perfect except for a wedge-shaped valley sector on the southeast slope. A first glance at the topographic map suggests that this trench is a radial down-sunken block, narrow above and widening down the slope. Escher restored the original contours across the trench and by comparison with the actual contours prepared a map which shows by 100 meter layers the thickness which has been removed. Multiplying by the areas, he gets the total volume of the missing part of the cone as about 2,860,000,000 cubic meters, or about 20 times the 140,000,000 cubic meters of the hillocks.

The aggregate volume of hillocks is far too small to correspond directly to the missing part of the cone. One agency, though a minor one, is erosion that has carried part of the hillocks into the ocean.

A second probability is that the hillocks are only projections from a broad layer of similar rock and mud material. The underlying mixture forms a layer which is at least 20 meters thick at the center though it thins toward the margins of the area it covers. Escher holds that the underlying material and that of the hillocks are due to a single tremendous landslide or mud flow. Where the hillocks are highest is where the moving mass had its greatest energy. Within historic times mudflows caused by rains have produced similar deposits at the other volcanoes in Java. The thickness is difficult to compute. It could only be done where a capping of lava had protected and preserved the whole thickness, and such a capping is unfortunately lacking. It is clear that the volume of the hillocks is not the total volume of the landslide material for the underlying part must be added.

A third point to be considered in connection with the origin of the debris is the nature of the fluid which on its release caused the landslide. The two hypotheses which suggest themselves are that the liquid was lava and that it was water. Escher excludes lava for no lava is found in any of the cuts. It must have been water, which implies that the crater must have had an impervious lining capable of making a crater lake. The barrier must have consisted of alternating beds of lava and explosion material which were held in place by their great weight. Some very unusual condition must have arisen to allow it to be broken. Taverne has shown that the first eruptions of Galounggoung were from a central crater, and that later a new vent opened a little to the southeast which gnawed into the southeast wall of the first crater. A third vent was a little farther southeast and gnawed still more into the southeast wall of the original crater and finally thinned it to the breaking point.

When the crater wall had thinned sufficiently the crater lake broke through and caused an extremely violent and watery landslide. The hillocks represent the fixation of the last materials of the slide, clots that remained standing higher, the principal mass having slowed down because of increasing bottom friction as it spread out fanwise and lowered, and as it lost part of its water. The surficial parts continued their movement for the friction against the air was small.

The air pressure of the resulting landslide wind must have been tremendous and would undoubtedly have annihilated such a town as Tasikmalaja had there been one there at the time. Therefore, one can confidently speak of the landslide as prehistoric for such an event would surely have been recorded had there been any written records.

It is not specifically so stated by the author, but the reviewer concludes that the volume of the hillocks plus the volume of the underlying layer of similar material may well be equal to the volume of the missing sector of the cone.

HAROLD S. PALMER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HAWAII NATIONAL PARK

OFFICE OF THE SUPERINTENDENT [redacted], HAWAII

October 5, 1929

Director,
National Park Service,
Department of the Interior,
Washington, D. C.

Dear Mr. Director:-

Submitted herewith is a report of activities and operations in Hawaii National Park during the month of September 1929.

000 GENERAL:

Although we had extremely warm weather with very little rain-fall in the early part of the month. September was a beautiful month. On the 19th of September, snow was seen on the summit of Mauna Loa and Mauna Kea; altho it is rather early for snow to be seen on Hawaii.

100 ADMINISTRATIVE:

110 Status of Work.

All operations, both construction and maintenance are running according to schedule.

120 Park inspections by.

121 Superintendents.

Superintendent Thos J. Allen Jr., left Hawaii National Park on September 5th to attend the National Park Superintendents' Conference at Yellowstone National Park from 13th to 24th of this month. Ranger Joseph H. Christ was left in charge of the Park as Acting Superintendent until his return from the conference.

Regular inspections of all operations was made by the Acting Superintendent.

A trip to the Haleakala Section of this park on the island of Maui was made September 15th to 18th. This included an inspection of the Halemau Trail before its completion, also surveyed route from the rest-house to the summit of Halemau Trail.

150 Equipment and Supplies.

The Hawaii National Park has purchased two horses for trail construction work and patrolling. A corral was built at a Kipuka near Kilauea Iki; an area of 16 1/4 acres.

200 MAINTENANCE, IMPROVEMENTS, and NEW CONSTRUCTION:

210 Maintenance.

The month of September was devoted by road crews to making new trails to Mauna Iki and Kipuka Keana Bihopa.

Other usual maintenance was performed on the park road and trail system as well as on structures.

220 Improvements.

The new trail to Mauna Iki, a distance of 2.2 miles is entirely completed this month. This trail saves a distance of 1 1/2 miles. The constant danger of hikers loosing trail prompted this work.

230 New Construction.

The erection of the two new residence cottages progressed at a satisfactory rate during this month.

The Kipuka Keana Bihopa trail a distance of 8 1/2 miles is 80% completed.

300 ACTIVITIES OF OTHER AGENCIES IN THE PARK:

310 Public service contractors.

The Volcano House and Summer Camp have enjoyed a fair month. The Kilauea Summer Camp close season's business on the 15th of September.

400 FLORA, FAUNA, and NATURAL PHENOMENA:

410 Naturalist Service.

The afternoon lectures on volcanology and natural history subjects were continued all during the month and with increased popularity of local people. 14 lectures were given to 792 persons in September.

420 Natural Phenomena.

All the seismographs, which Volcano Observatory put up at different points on the island of Hawaii, records many earthquake activity in the island of Hawaii every day of the last ten days of September. Dr. Thomas A. Jaggar Jr., volcanologist centered the next eruption will either come from Hualalai or Mauna Loa mountains within this year.

500 USE OF PARK FACILITIES BY THE PUBLIC.

510 Increase in Travel.

Hawaii National Park continued to show an increase in this year's travel over previous years. The amount of this increase is shown in the inclosed tables.

520 General Weather Conditions.

Maximum temperature	22nd	84
Minimum "	15th	53
Rainfall for month of September		3.16 inches
" to date Volcano District		50.54 "

600 PROTECTION:

630 Accidents.

On the afternoon of September 22, 1929, 2:30 P.M. Mr & Mrs. C. W. Atkinson of Honolulu, T. H. were visiting the Thurston Lava Tube in the Hawaii National Park. When coming to the lower end of the tube, Mrs. Atkinson came out of the tube and walked down the trail to the autos, but instead of following the signs which is posted on the gate, she left the trail and followed the fence and got lost in rear of the tube. A searching party was organized and she was found by 4:45 P.M.

Very respectfully yours,

Joseph H. Christ

Joseph H. Christ,
Acting Superintendent.

Copy to Field Headquarters
" " Yellowstone Nat'l Park.

JHC/ht

10-157

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

TRAVEL REPORT

Hawaii National Park for the Month of September 1929

	This Month	This Travel Year To Date	This Month Last Year	Last Travel Year To Date	Increase for Travel Year: Number	Increase for Travel Year: Per cent
PRIVATE TRANSPORTATION:						
Cars first entry						
Cars reentry						
Motorcycles						
Total motor vehicles						
Persons entering via motor vehicles	5,820	92,483	4,145	61,596	30,887	.334
Persons entering via other private transportation	381	3,072	199	3,644	- 572	.157
Total persons entering via private transportation	6,201	95,555	4,544	65,240	30,315	.317
OTHER TRANSPORTATION:						
Persons entering via Hotel stages	682	14,302	583	13,174	1,128	.079
Persons entering via trains						
Persons entering otherwise						
Total other transportation	682	14,302	583	13,174	1,128	.079
GRAND TOTAL ALL VISITORS	6,883	109,857	4,927	78,414	31,443	.285

	This Year	Last Year	Increase: Number	Increase: Per cent
Automobiles in public camps during month	0	0	0	0
Campers in public camps during month	0	0	0	0

10-158

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

STATUS OF AUTHORIZED PROJECTS

Hawaii National Park for the Month of September 1929

Description of Projects	Percent Constructed To Date	Percent Constructed This Month	Percent Constructed Last Month	Probable Date of Completion
401 Ranger Cottage	100	25	75	
502 Halemau Trail	100	89	11	
507 Kipuka Keana Bihopa Trail	80	80	--	Oct.,10, 1929

10-159

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

STATUS OF PERSONNEL

.......Hawaii............... National Park for the Month of ....September...1929.................

	This Month	This Month Last Year
Number of employees beginning of month,	15	9
Number of additions, ...	2	3
Total, ...	17	12
Number of separations, ...	10	3
Number of employees close of month, . . .	7	9
Number of promotions during month	0	0
Aggregate amount of annual leave taken,	0	5
Aggregate amount of sick leave taken,	0	0
Aggregate amount of leave without pay,	0	0

10-160

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

REPORT OF PARK REVENUES

Hawaii National Park for the Month of September 1920

	This Year	Last Year
Park revenue on hand beginning of month,	0.00	0.00
Received,	25.00	75.00
Total,	25.00	75.00
Remitted,	0.00	75.00
On hand close of month,	25.00	0.00

Park revenues received this year to date,	$ 1,327.00
Park revenues received last year to date,	1,325.00
Increase,	2.00
Percent of increase,	.0015

10-161

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

HAWAII NATIONAL PARK

REPORT OF SALES OF PUBLICATIONS

SEPTEMBER 1939

	Number	Value
GOVERNMENT PUBLICATIONS:		
On hand beginning of month, ...	395	98.90
Received during month, ...	0	0.00
Total, ...	395	98.90
Sold during month, ...	26	8.90
On hand at close of month, ...	369	90.00
NON-GOVERNMENT PUBLICATIONS:		
On hand beginning of month, ...	8	20.00
Received during month, ...	0	0.00
Total, ...	8	20.00
Sold during month, ...	2	5.00
On hand at close of month, ...	6	15.00

Cash on hand beginning of month, ...	58.40
Sales during month, ...	13.90
Total, ...	72.30
Remitted during month, ...	0.00
Balance, ...	72.30

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No. 245 RELEASED WITHOUT COPYRIGHT RESTRICTION September 5, 1929

KILAUEA REPORT No. 919

WEEK ENDING SEPTEMBER 4, 1929
Section of Volcanology, U. S. Geological Survey
T. A. Jaggar, Volcanologist in Charge

On August 29 dust rose from Halemaumau pit at 1:30 p. m. in two small clouds separated by an interval of about one minute. At 12:05 p. m. August 30 a large dust cloud rose from the east side of the interior of the pit with protuberances projecting upward, an indication that a strong avalanche had occurred. The pinkish dust hung visibly over the pit for many minutes. The effects of this were seen at 10 a. m. August 31 in that the north side of the new lava floor was dusted by the outward projections from a big avalanche that had fallen from the north wall, and that corner of the pit was still sliding. There were some large stones on the north side of the floor. Much fresh rock was in evidence on the northeast talus. Above the northern niche at the edge of the floor west, blue smoke appeared as though puffing. Small patches of milky stain lay on the edge of the floor south and north-northwest.

Fifteen very feeble earthquakes were registered. The day records of August 30 and September 3 were interrupted by repairs. Microseismic motion was slight.

MURCHISON EARTHQUAKE, NEW ZEALAND

At 10:17 a. m. June 17, 1929 New Zealand time (11h. 30m. faster than Greenwich) a disastrous earthquake struck middle New Zealand with maximum damage in the Buller Gorge of the mountainous district of the north end of the South Island.

The shock was severe in Wellington, dismantling the Milne-Shaw seismographs. Aftershocks on these instruments indicated epicenters in the northern part of South Island. Murchison suffered the most damage. Landslips in precipitous country destroyed four homesteads and killed fourteen people. Numerous chimneys and two clock-towers were broken, many walls cracked, one badly built two-story house partially collapsed after the second severe quake; on these data the preliminary statement of the Geological Survey Office makes the intensity at Murchison R. F. VIII.

There was a severe aftershock June 23. This and the main earthquake appeared to center on the White Creek fault-plane that crosses the Buller River 7 miles west of Murchison. It was possibly a twin-earthquake with second centrum on the Kongahu fault-plane off NW coast of South Island. Many aftershocks occurred, some perhaps on other fault-planes. Differential movement of about 14 feet displacement was found at the White Creek fault. In 1928 this fault had been mapped for seven miles, but it is not known whether the displacement since was sudden or gradual, nor whether movement has yet ceased.

At Whitecliffs on the west coast a strip of sea-bottom was uplifted 100 feet, forming a ridge 180 feet wide by 4000 feet long, apparently the west side of a small fault-block tilted. Tilting of the land at Kelburn is suspected.

Dr. E. Marsden, Minister for Scientific and Industrial Research, called a conference of scientists June 26 on earthquake investigation, seismograms are being registered at Wellington and Christchurch, a seismograph and sound-ranging instruments were set up at Murchison, having in view study of focal depth of aftershocks, and the Milne seismograph was set up at Westport to locate aftershocks, and check time-curves of the permanent instruments. Questionnaires were broadcasted and geological investigations are in progress. The air Defense Service will photograph the faults from airplanes. Soundings were made off the west coast, and repeat observations in levelling and triangulation are in progress. Bench marks have been placed and occupied on each side of the active White Creek fault, which appears to have allowed movements of earth blocks to take place since the earthquake.

On request of Dr. Marsden drawings and specifications of the Jaggar shock-recorder were sent to Wellington from the Hawaiian Volcano Observatory June 29 and he writes that two of these have been constructed. It is planned to have some of these shock-recorders distributed about the country, and to have an additional major station with three-component seismograph in the middle of the North Island. A full report of the earthquake will be published later. (Circular of N. Z. Geol. Surv. "Murchison Earthquake Investigations" by H. T. Ferrar, Acting Director, 31 July, 1929 (mimeographed.)

New Zealand has an exceptionally good field for path-breaking in the study of the relation of local earthquakes to instrusive magma. There are cold springs, warm springs, hot springs and boiling springs; active volcanoes, inactive volcanoes and ancient volcanoes, mountain folds, live faults, dykes and batholiths. There is much Tertiary and Recent mountain uplift. There is an axis of gradation of these things from Samoa to the South Island, from Hawaiian type volcanism to Norwegian type fjords.

No one knows what causes an earthquake. No one ever will know until local observers with local instruments and controlled experiments investigate local earthquakes in a strategic field. The doctrines of emergence angle, epicenters, distance, depth, nature of source, as nowadays applied to distant earthquakes, (and that means big earthquakes,) are not doing clinical work on local patients. The earthquake problem needs a Pasteur. Omori and the Italians were the pioneers. T.A.J.

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No. 246 RELEASED WITHOUT COPYRIGHT RESTRICTION September 12, 1929

KILAUEA REPORT No. 920

WEEK ENDING SEPTEMBER 11, 1929
Section of Volcanology, U. S. Geological Survey
T. A. Jaggar, Volcanologist in Charge

The week at Halemaumau lava pit has produced nothing new. Occasional dust is seen from small slides, but these are often caused by visitors rolling stones. Two notches up the wall north and northwest are deepening by avalanche erosion, and the buttress between them is likely to fall in the future.

Near the 1919 desert chasm, a quarter mile southwest of the Kilauea rim, there are patches one or two feet long of Pele's hair and pumice droplets scattered about in the holes of the sand. These have accumulated to leeward from the February and July lava fountains of Halemaumau.

Only four very feeble local earthquakes are registered for the week at Kilauea. The day records of September 5 and September 10 were omitted, owing to repairs. Microseismic motion increased slightly September 6 to Septem- 9. Apparent tilt, imperfectly recorded, was moderate NE.

ALEUTIAN NOTES

Alaskan Volcanoes 1929.

Mr. Austin E. Jones, seismologist for the Section of Volcanology, has spent the summer at Dutch Harbor and Kodiak establishing seismograph stations. He reports that a party landed on Bogoslof Volcano July 27, 1929, and found it very quiet. This is in line with its behavior in 1928, when the heap of steaming lava, in the midst of the circular lagoon, which had been so active in 1926-27, was much cooler and showed less steam than in the previous year.

Akutan Volcano had been reported in strong activity in 1928, and this year on June 18 the lower slopes were lightly covered with ash. It was reported fuming again during July, 1929.

Mount Cleveland and a volcano to the west of it, in the region of the Islands of the Four Mountains, were smoking heavily in July. A mountain west of Kanatak on the Peninsula was reported fuming in March. In the Katmai group Mount Martin and Mageik have been seen steaming throughout the year. Shishaldin, the great volcano on Unimak Island, was "flaming high" on May 28, 1929, and glowing matter was overwelling the edge of the crater and rolling down the slopes. On June 17 Shishaldin was quiet though steam was visible when the crater was inspected with field glasses. It was fiery again June 23 and appeared to have opened three new craters low on the north side. On August 4 the summit steam was barely visible to the naked eye. In 1928 Shishaldin was smoking heavily in August.

The above note on the fuming of Mount Cleveland recalls the heavy earthquake just south of those islands at the edge of the Aleutian deep reported in the Volcano Letter No. 220. This occurred March 6, 1929.

Aleutian Seismograph Stations.

Mr. Jones started work in the middle of June, 1929, at Dutch Harbor digging a cellar and building a hut over it to house the seismograph in the reservation of the U. S. Naval Radio Station at Dutch Harbor, Unalaska Bay, on Amaknak Island, a mile to the north of Unalaska village. The instrument was making a test run on July 16 and thereafter. It is a pair of Hawaiian type horizontal pendulum recording E-W and N-S components on smoked paper. The magnification is X135 and the damping by vanes immersed in oil. The time control is a Howard master clock, and an electric connection makes it possible for the operator from the radio station to impress directly on the seismogram the time signal received daily from Mare Island, California. The location of the hut is lat. 53° 53' 08" N. and long. 166° 32' 07" W. The distance is about 400 feet SSE. from the radio station on the line of the hand railway leading to the station jetty. The excavation was carried to a depth of five and a half feet where rock was reached. The hut is a 10 by 10 foot shed projecting one and one-half-feet above ground at the back, with double sheathing and a double window, roofed with tar paper, and banked up with earth and sod.

The instrument pier is Y-shape so that the stem holds the drum and the two arms carry uprights at their ends, all of concrete, which support the pendulums. The concrete is reinforced with steel.

The station is operated by Mrs. McDonald, wife of the Chief Radioman, using 120th meridian time (Pacific Coast). Microseisms were very faint in July, and the instruments registered two small local shocks and an earthquake indicating epicenter about 90 miles distant, not felt.

Work was started on reestablishment of the Kodiak seismograph station, by Mr. Jones, early in August. The 1927-28 station has been in the basement of the dwelling house of the Agricultural Experiment Station on the hill back of Kodiak, now turned over to the Bureau of Fisheries. On August 10 the concrete dairy house of the station was turned over to the Geological Survey for use as a seismograph laboratory. This is sturdily built of concrete with walls in places 30 inches thick. The Bureau of Fisheries occupies the establishment only during the summer season, but a local operator has been secured for year-around recording with the two-component Hawaiian seismograph, identical in model with those at Dutch Harbor, Lassen Volcano Observatory, Kealakekua, and Hilo.

Mr. Jones is to be congratulated on his successful season in constructing these stations, much of which he did with his own hands, and the Section of Volcanology is grateful for the cordial assistance given by the officers and men of the Bering Sea Patrol, U. S. Coast Guard, and the Naval Radio Service, and by the officers of the Bureau of Fisheries at Kodiak. T.A.J.

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No. 247 RELEASED WITHOUT COPYRIGHT RESTRICTION September 19, 1929

KILAUEA REPORT NO. 921

WEEK ENDING SEPTEMBER 18, 1929

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

The inner pit at Kilauea remains quiet. There is a little steam on the southern talus slopes. Dust from avalanches was seen at 3:10 p. m. September 11 and 2:55 p. m. and 3 p. m. September 12. The slides of September 12 made a dense gray dust cloud of moderate size which hung over the northeast rim for a few minutes, and after the second slide the air within the pit was full of dust for many minutes. At 9 a. m. September 14 there was fresh debris on the north talus; and September 16 there was no change.

The seismographs have registered one feeble earthquake at 7:31 p. m. September 16, indicating origin distance five miles from the Observatory, and eight other very feeble disturbances. A teleseism of moderate amplitude was registered for about 50 minutes beginning 9:04 a. m. September 17. The long waves developed soon after the start and no preliminary waves were detected. Microseismic motion was slight, and tilt was imperfectly recorded with moderate WSW. trend.

ROCK BENEATH THE DEEP SEA

What is called the deep ocean includes depths of two or more miles. Professor Twenhofel, a leader in sedimentation studies, has made an important contribution in answer to the question, "How thick are the deposits under the deep sea?" (Magnitude of the Sediments under the Deep Sea, by W. H. Twenhofel, Bull. Geol. Soc. Amer. Vol. XL, pp. 385-402, June 30, 1929.)

The text books have asserted that the deposits in the very deep oceans are trivial, and recent theories, such as that of July, would lead one to expect basalt only a short distance below the red clay at depths of 18,000 feet of water. "The rates of deposition in the deep sea are unknown, and no methods seem to have been devised by which they may be measured." Sediments from rivers have been thought to remain near the lands where they originate, and it was always believed impossible to transport considerable thicknesses of land sediments out to the deep oceans.

Twenhofel corrects all this, with evidence to indicate the deep sea sediments may even exceed those of the shallow water, that the quantity of lime in the earlier deep sea sediments was small in comparison with the lime in those of later geologic ages. On the basis of the deposition of 20 tons of mineral matter per annum over each square mile of an ocean basin averaging, since the beginning of Devonian time, an area of 115,000,000 square miles, and according to current estimates of geologic time, he finds there has been deposited in the deep sea approximately 80,000,000 cubic miles of inorganic sediments.

During the same time there was deposited an unknown volume of lime carbonate, silica, and other substances, the precipitating agencies being surface organisms which have increased in effectiveness in later geologic ages.

Underneath these deep sea sediments there is buried an unknown and possibly large volume of shallow water and continental slope sediments, the total thickness of which is dependent on what length of time in the pre-Paleozoic represented shallow water conditions, for the areas that subsided in the Devonian and later, on the basis of Walther's conclusions.

It is suggested that the deep sea sediments of the early ages contain more insoluble and undecomposed materials, in contrast to the ages since the late Mesozoic, during which the organisms of the surface waters have deposited much lime over the lesser depths, and this lime is permanently removed from the continental masses.

The major factors in the problem are the length of geologic time, the dimensions of the deep ocean basins, and the fact that few deep sea sediments have ever really been destroyed, whereas the shallow water sediments have been repeatedly uplifted and partially destroyed, and with each uplift have contributed their constituents to the deep abysses of the sea.

Calcareous organisms are deposited all over the sea bottom, but the shells pass into solution at depths beyond 16,000 feet. The siliceous shells go into solution around 18,000 feet. Over the entire area of the deep sea there is a shower of inorganic material such as clay, silica, iron oxide, small particles of resistant minerals, manganese oxides, phosphatic matter, minerals of igneous rocks whose direct origin is uncertain, matter which clearly is of volcanic origin, and rare particles believed to come from meteorites. There is also some lime of inorganic precipitation.

The atmosphere transports fine materials for long distances, as shown by the vast loess deposits of the continents. Europe has received 266 tons per square mile per annum during 3,000 years; 850,000,000 tons of dust are carried 1,440 miles in the air of the Mississippi Valley each year. This material falls over the sea as over the land.

Flocculated particles are carried by the currents of the sea, and the muds of the Amazon are visible 300 miles from its mouth. No one knows how much volcanic matter comes up through the sea bottom or falls from the air.

Sea water contains 1,500 tons of solid matter per cubic mile. This is precipitated more rapidly in warm tropical waters. As the waters of the deep sea cover 115,000,000 square miles with average depth of two miles, they contain 234,000,000,000 tons of sediment in suspension, or more than 21 times the amount carried to the sea by streams.

The length of geologic time since the beginning of the Paleozoic may be estimated to be at least 567,000,000 years, and since the beginning of large deep oceans 300,000,000 years. At the rate of only one foot of sediment in 87,100 years there would be deposited since the Devonian about 4,000 feet, or 0.7 mile, of mineral matter from all sources over the present deep sea bottom.

Twenhofel concludes that the sediments on the continent above sea level are little more than half the calculated volume of the inorganic sediments in the deep sea deposits, and only about 28 per cent of the total volume of all deep sea sediments including limestones. These astonishing conclusions add new zest to the project of boring beneath the mud of the deep sea bottom, the last stronghold of nature unexplored by man, and constituting more than 70 per cent of the earth's surface.—T.A.J.

SAMPLE COPY

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THE VOLCANO LETTER

A Weekly news leaflet of the Hawaiian Volcano Research Association

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No. 248 RELEASED WITHOUT COPYRIGHT RESTRICTION September 26, 1929

KILAUEA REPORT No. 922
WEEK ENDING SEPTEMBER 25, 1929

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

The week at Kilauea has been entirely lacking in visible volcanic activity. The lava pit Halemaumau has been quiet, and no changes have been noted. From time to time dust from avalanches has been observed, sometimes caused by earthquakes originating at distant points.

On September 19 at 11:50 a. m. a small cloud of dust rose NE. On September 21 at 2:30 p. m. a few stones were heard falling NE., and very slight smoke was noted at the north July grotto at intervals. On September 22 a new line of sulphur at the floor edge north of the grottoes was observed. Steam was slight on the west talus and normal on the south talus. At 6 p. m. dust from a slide was seen from the Volcano House.

On September 24 at 9 a. m. there was no change. New debris lay on the north talus. At 3 p. m. an avalanche occurred, sending up dust. At 4:15 p. m. and thereabouts there were other clouds from larger slides, the buff-colored dust probably originating on the red north wall of the pit. Today two new bright scars can be seen on the south wall from the Observatory.

An extraordinarily large number of seismic disturbances have occurred during the week, the total count being 221. This is an especially surprising number when contrasted with the total of nine shocks for the week preceding. The earthquakes appear to originate in North Kona District, on the west side of the island of Hawaii, but are felt all over the island, intensity decreasing with distance. Due to crowded and overlapping lines on the seismograms some shocks could not be counted.

The earthquakes appear to portend lava activity, but at the present time nothing has been observed to indicate flow. It may be significant that the shocks fall on the equinoxial period. Many of them are of the very feeble, or imperceptible, class; others are classed as feeble, slight, and moderate, and can usually be felt. Moderate shocks are generally strong enough to dismantle the seismograph pens.

The earthquake distances vary from 14 to 37 miles from the Observatory. Plotting these distances on a map of the island, in conjunction with distances shown by records of two other seismograph stations at Hilo and Kealakekua, the epicenters of the shocks appear to fall on points along lines extending both northwest and northeast of the summit of Mauna Loa. The apparent locations of a large number of the shocks are in the region lying between Mokuaweoweo and Hualalai.

Some of the shocks showed distances in miles as follows: 2, 14; 3, 17; 5, 18; 2, 20; 7, 23; 4, 25; 1, 26; 1, 28; 1, 30; 1, 32; 2, 37.

Frequently the distance phase of earthquakes is obliterated by long tremors obscuring the preliminary wave of the shocks. In such cases it is impossible to compute distance.

A few of the earthquakes of this series are tremors varying from two to 17 minutes in length, which occasionally wax in aplitude sufficient to become perceptible. Tilt for the week accumulated slight NNE.

SEISMIC CRISIS ON HAWAII

Numerous tremors beginning soon after noon September, 19, 1929, at Puu Waawaa Ranch, seven miles north of the summit of Hualalai Volcano, a mountain 8,269 feet high on the west side of the island of Hawaii, inaugurated a seismic crisis. This has gone on increasing to September 25, and implies new movement of the Hawaiian Lava column.

At Puu Waawaa there were more tremors September 20, becoming shock groups in continuing series on September 21. The spasms were at first separated by several hours, later they were lenghtened so that the intervals of quiet were only for an hour or two. Also the motion spread to the entire Kona District and perceptible earthquakes became numerous at equal distances from Hualalai to the north and northeast. The belt shaken most is about 35 miles from Hualalai as a center, and the region of the Kau, Puna and South Hilo districts has received the least shaking. The seismograps at Kilauea Volcano have shown increased disturbance both in intensity and frequency.

At Puu Waawaa on September 21 there were 13 shocks in 10 hours, on September 22 there were 79 seismic spells in 22 hours, and on September 23-24 there were 86 spells in 26 hours. This makes the number of disturbances per hour 1.3 for September 21, 3.6 for September 22, and 3.3 for September 23-24.

Huehue Ranch, eight miles northwest of the Hualalai summit, recorded 73 felt shocks in 34 hours, averaging 2.2 per hour. At the F. R. Greenwell residence, Honokahau, six miles WSW. from Hualalai summit, 444 shocks were felt in 73.5 hours, averaging 6.0 shocks per hour. Slight rumble through the ground seeming to come from the mountain was observed with some of the quakes at Huehue and and Honokahau. This was not heard at Puu Waawaa.

For intensity Honokahau registered 71 that were sharp, and Puu Waawaa about the same number, the intensity increasing between September 19 and September 25. As the number of sharp shocks increased, the perception of them over the island at great distances also increased. For frequency the Kealakekua seismograph gave a consistent record for five days beginning September 19-20 of 13, 21, 60, 92, and 280 disturbances per day. For distance of origin from the three seismograph stations Kilauea, Hilo, and Kealakekua, the records suggest the saddle between Hualalai and Mauna Loa volcanoes as an important epicenter, and other seismographs imply motion both northwest and northeast from the central crater of Mauna Loa. The local felt earthquakes all indicate motion on the northwest flank of Hualalai.

The writer examined the summit region of Hualalai September 22, found no fresh cracks, no signs of heat, and felt no earthquakes. The Hualalai and Mauna Loa profiles have been clear, and as yet have shown no fume.

Summarizing, the situation shows increasing tremor earthquakes of volcanic quality centering about the northwest region of Hualalai, accompanied by deeper earthquakes centering about the northern slopes of Mauna Loa and extending their perceptibility to the whole north half of Hawaii Island. Everything suggests that the Mauna Loa lava column, which has sent out its flows from the southwest rift of that mountain during the last 25 years, is now transferring its upward wedging in the direction of Hualalai. This is just what happened in 1801, ten years after the explosive eruption of Kilauea. The present time is five and a third years after the explosive eruption of 1924.

T.A.J.

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No. 249 RELEASED WITHOUT COPYRIGHT RESTRICTION October 3, 1929

KILAUEA REPORT No. 938

WEEK ENDING OCTOBER 2, 1929

Section of Volcanology, U. S. Geological Survey

T. A. Jaggar, Volcanologist in Charge

Halemaumau continues to be very quiet and without lava activity. Numerous earthquakes during the week have probably been the cause of several slides.

A total of 244 shocks were counted on the seismograms. In addition to these were several spells of spasmodic tremor. Some of the tremor occasionally waxes into wide amplitude and earthquakes. Earthquakes registered were as folows by days: September 25, 63; 26, 61; 27, 27; 28, 27; 29, 29; 30, 15; October 1, 19, October 2, 3. September 25 and October 2 are incomplete days coming at the beginning and at the end of the period covered by this report. It should be stated that many more shocks are felt in West Hawaii, the apparent center of the present seismic disturbance, than are recorded at Kilauea.

Thirteen shocks give distance 23 miles, 10 distance 28 miles, 6 distance 30 miles, 7 distance 32 miles; others distances varying from 14 to 46 miles from the Observatory.

Microseismic motion was slight throughout the week. Tilt was strong ENE.

CONTINUED HAWAIIAN SEISMIC CRISIS

The development of swarms of earthquakes, as reported last week, on the west side of the island of Hawaii, has continued throughout a second week without the appearance of lava activity to date (noon October 1). The concentration of local shaking in frequency and intensity has remained about Hualalai volcano. In general until September 26 the frequency mounted to a maximum, and thereafter it systematically declined. The intensity of individual shocks has occasionally been extremely strong between September 25 and September 30, but no shock has exceeded grade IX R. F.

The strongest shock of the series to date appears to have been at 6:20 p. m. September 25, felt generally throughout the inhabited Hawaiian Islands. This inaugurated groups of heavy shocks which have occurred in west Hawaii 6:20 to 11:00 p. m. September 25, 10:00 to 12:00 p. m. September 27, 3:18 to 5:18 September 28, 5:00 to 6:00 a. m. and 10:00 to 11:00 p. m. September 29. Extremely severe shocks have occurred (other than 6:20 p. m. September 25) at 10:50 a. m. September 27, 7:08 a. m. and 3:18 p. m. September 28, and 11:55 a. m. September 30. All of these have added greatly to damage of tanks, masonry, stone fences, chimneys, roadways and weak buildings on slopes. There have been numerous other wrenching shocks in the North Kona district which would rank as very strong.

The Count of Earthquakes

As before, the two places which have received larger numbers of groups of felt shocks were Honokahau and Puuwaawaa. Thus for the twenty-four hours midnight to midnight September 24, Puuwaawaa counted 144 earthquakes, Kealakekua only 40. For September 25 Puuwaawaa 171, Kealakekua 30. Kealakekua is twenty miles south of Puuwaawaa. These were felt spasms or groups of shocks. For a twenty four hour period, September 24-25, about 210 shocks were registered at Kealakekua by an 80-times magnifying seismograph.

A shock recorder of magnifying power 25 was set up on a verandah at Puuwaawaa Ranch and for each twenty-four period beginning midnight September 26 registered individual quakes, small and great, in the following numbers:

September	26	599 shocks	
"	27	541 "	
"	28	400 "	(about)
"	29	334 "	
"	30	221 "	

The Kealakekua seismograph was injured by the earthquake of 6:20 p. m. September 25, but thanks to the prompt action of Captain R. V. Woods, was re established September 26. It showed some decline in frequency and amplitude of earthqaukes September 25 to 27, the decline in frequency becoming pronounced on September 27, but with it there came seven shocks of much larger amplitude September 27 to 28. The seimogram of September 30 to October 1 shows an increase of frequency to about 100 shocks.

Comparison With 1868 Crisis

The summary of the situation on October 1, 1929, is that a period of tremor began at Hualalai volcano in west Hawaii at noon September 19, produced a damaging shock of grade IX, six and one half days later, then produced decline in frequency and some increase in intensity of shock groups for five days more. The populace nearest to the mountain is sleeping in the open air, stone walls have been thrown down with notable fracturing away from the mountain, and the stronger shocks have been of the quality to displace furniture, throw down and overturn loose objects, move buildings, crack masonry and produce slides on steep slopes.

In the quality of growing gradually to a maximum from tremor to bumping shocks, and from bumping shocks to oscillations of longer period, this seismic crisis in Hawaii is quite unlike such earthquakes as those of San Francisco and Tokyo. These latter are called tectonic, and begin with a terrific earthquake, thereafter declining with aftershocks. Therefore it seems probable that the present Hawaiian series is volcanic, and marks the shift of magma underground from the Mauna Loa center toward the Hualalai center. We have a close parallel to this in the shift of magma from the northeast rift of Mauna Loa, to a new series of eruptions in the southwest rift, in the year 1868. There were no southwestern Mauna Loa eruptions recorded prior to 1868. In that year on March 9 came a hard earthquake in Kona, on March 27 the beginning of continuous quaking at the south end of Hawaii, on March 28 a very severe damaging shock of the same quality as the one of September 25, 1929, and thereafter an increase of very hard shocks along with many small ones, so that just as in the present year the earthquakes were felt farther and father away. On April 2 came a terrific shock of grade X producing a landslide near Pahala, destroying wooden houses as well as masonry ones, and leading four days later to a rapid outflow of lava, from the south end of Mauna Loa, that endured less than a week. Earthquakes gradually ceased, though there were still two or three a day, five months later.

In 1868 the shift of lava was from northeast to southwest. Now apparently the shift of lava is from southwest to northwest, if rising lava is making the earthquakes. That it should do so a few years after the explosive eruption of Kilauea of 1924, agrees perfectly with 1801, when Hualalai erupted after the 1790 explosions of Kilauea.

T.A.J.

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HAWAII NATIONAL PARK

OFFICE OF THE SUPERINTENDENT [redacted], HAWAII

September 4, 1929

Director,
National Park Service,
Department of the Interior,
Washington, D. C.

Dear Mr. Director:

Submitted herewith is a report of activities and operations in Hawaii National Park during the month of August 1929.

000 GENERAL:

August was as fine a month as could be hoped for anywhere in the entire world. Although extremely hot weather occurred along the seacoast areas of the Hawaiian islands temperatures in the National Park were very comfortable. A heavy attendance of summer cottage visitors was enjoyed during August.

100 ADMINISTRATIVE:

110 Status of work.

All operations, both construction and maintenance are running according to schedule at this time.

120 PARK INSPECTIONS BY:

121 Superintendent.

The Superintendent made regular inspections of construction and maintenance operations in the Kilauea section and Ranger Christ was sent to Haleakala to inspect and begin construction on the trail work in that area.

125 Other governmental officers.

Delegate to Congress Victor K. Houston spent two weeks on a combination vacation and business trip on this island. During that time he found opportunity to visit various portions of the National Park and to talk over with the Superintendent the various needs here.

200 MAINTENANCE, IMPROVEMENTS AND NEW CONSTRUCTION:

210 Maintenance.

The first week of August was devoted by road crews to making a thorough overhaul of the Kilauea crater road. The extreme use to which this road was put by heavy traffic during the eruption in late July practically ruined the natural dirt surface and forced upon us very heavy maintenance work. The road is now in very good shape.

Other usual maintenance was performed on the balance of the park road and trail system as well as on structures.

One section of the new portion of the "Around-the-Island" road is developing a great number of pot-holes in its oil surfacing which must soon be repaired. This work is being postponed pending a conference with the Chief Engineer in Yellowstone in September.

230 New construction.

Erection of the two new residence cottages progressed at a satisfactory rate during August.

The trail to Napau crater, a distance of 2.6 miles was entirely completed this month.

300 ACTIVITIES OF OTHER AGENCIES:

310 Public service contractors.

Both the Volcano House and the Kilauea summer camp have enjoyed a very busy month. Each of these places has been practically full all during August.

400 FLORA, FAUNA AND NATURAL PHENOMENA:

410 Naturalist service.

Both the afternoon and evening lectures on volcanology and natural history subjects were continued all during the past month and with increased popularity. One lecture on volcanology was given by Dr. Jaggar to a visiting group of surgeons visiting the Pan-Pacific Surgical Conference held in Honolulu. 35 lectures to 2,600 persons were given during August.

5

500 USE OF PARK FACILITIES BY THE PUBLIC:

510 Increase in travel.

Hawaii National Park continued to show an increase in this years travel over previous years. The amount of this increase is shown in the inclosed tables. It is expected that we will have far exceeded 100,000 visitors by the end of the travel year.

520 General weather conditions.

Maximum temperature - - - 23rd and 24th, 79°
Minimum temperature - - - 5th, 14th - , 54°
Rainfall for month of August - - - - - - 3.71 inches
Rainfall for month of August in Hilo - - 8.35 "
Rainfall to date Volcano district - - - 47.38 "
Rainfall to date in Hilo - - - - - - - - 80.51 "

540 Visitors.

Governor Lawrence Judd spent one night in the park during his first official tour of the islands. Other visitors included Delegate Victor K. Houston, Mr. Chandler, president of the Los Angeles Steamship Company and a group from the Los Angeles Chamber of Commerce on their fifteenth good will tour to Hawaii.

Mr. and Mrs. H. S. Bissell of California, together with their family, spent two days in the park toward the end of the month. The Bissells were then on their way home after a two years cruise of the Pacific ocean in their small sailing yacht, the Wanderlust. They were accompanied by captain Lee Brisson of Papeete, Tahiti, who was in charge of their boat and crew.

600 PROTECTION:

625 Protection.

A small fire caused by a discarded cigarette occurred in Bird Park the last day of August. This fire smoldered all night long in two logs and was found early the next morning by Ranger Christ and extinguished within 45 minutes with the help of five men on the road crew. The heavy rain the evening before prevented this fire from gaining headway. No material damage resulted.

900 MISCELLANEOUS:

On August 8 the Superintendent had occasion to visit Honolulu on official business and was given the privilege of making the trip as a passenger on board the Army Fokker plane, Bird of Paradise. Other persons making the trip at the same time were the members of the Territorial Aeronautical Commission.

Very respectfully yours,

Thos. J. Allen Jr.,
Superintendent.

10-157

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

T R A V E L   R E P O R T

.... Hawaii .... National Park for the Month of ..... August 1929 ....

	This Month	This Travel Year To Date	This Month Last Year	Last Travel Year To Date	Increase for Travel Year: Number	Increase for Travel Year: Percent
PRIVATE TRANSPORTATION:						
Cars first entry,.						
Cars reentry,.						
Motorcycles, ...						
Total motor vehicles,.						
Persons entering via motor vehicles,.	8,715	86,663	6,325	57,451	29,212	.337
Persons entering via other private transportation,. . . .	374	2,691	296	3,445	- 754	.219
Total persons entering via private transportation,. . .	9,089	89,354	6,621	60,896	28,458	.318
OTHER TRANSPORTATION:						
Persons entering via Stages, . .	1,451	13,620	1,388	12,591	1,029	.075
Persons entering via trains, .						
Persons entering otherwise,. .						
Total other transportation,.	1,451	13,620	1,388	12,591	1,029	.075
GRAND TOTAL ALL VISITORS,. .	10,540	102,974	8,009	73,487	29,487	.286

	This Year	Last Year	Increase: Number	Increase: Percent
Automobiles in public camps during month, ...	3	0	3	100%
Campers in public camps during month, ...	6	0	6	100%

10-158

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

STATUS OF AUTHORIZED PROJECTS

Hawaii National Park for the Month of August 1929

Description of Projects	Percent Constructed To Date	Percent Constructed This Month	Percent Constructed Last Month	Probable Date of Completion
403 Ranger Cottage	100	25	75	
503 Napau Trail	100	95	5	
502 Halemau Trail	11	10	1	October 1, 1929
401 Ranger Cottage	175	75		September 15, 1929

10-1

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

STATUS OF PERSONNEL

Hawaii National Park for the Month of August 1929

	This Month	This Month Last Year
Number of employees beginning of month,	16	11
Number of additions, ...	5	5
Total, ...	21	16
Number of separations, ...	6	7
Number of employees close of month, . . .	15	9
Number of promotions during month	1	0
Aggregate amount of annual leave taken,	0	0
Aggregate amount of sick leave taken,	0	0
Aggregate amount of leave without pay,	0	0

10-160

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

REPORT OF PARK REVENUES

Hawaii National Park for the Month of August 1929

	This Year	Last Year
Park revenue on hand beginning of month,	0.00	0.00
Received,	50.00	0.00
Total,	50.00	0.00
Remitted,	50.00	0.00
On hand close of month,	0.00	0.00

Park revenues received this year to date,	$ 1,302.00
Park revenues received last year to date,	1,250.00
Increase,	52.00
Percent of increase,	4%

10-161

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

HAWAII NATIONAL PARK

REPORT OF SALES OF PUBLICATIONS

AUGUST 1929

	Number	Value
GOVERNMENT PUBLICATIONS:		
On hand beginning of month,	425	114.50
Received during month,	0	0.00
Total,	425	114.50
Sold during month,	30	15.60
On hand at close of month,	395	98.90
NON-GOVERNMENT PUBLICATIONS:		
On hand beginning of month,	9	22.50
Received during month,	0	0.00
Total,	9	22.50
Sold during month,	1	2.50
On hand at close of month,	8	20.00

Cash on hand beginning of month,	40.30
Sales during month,	18.10
Total,	58.40
Remitted during month,	0.00
Balance,	58.40

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No. 241 | RELEASED WITHOUT COPYRIGHT RESTRICTION | August 8, 1929

KILAUEA REPORT No. 915

WEEK ENDING AUGUST 7, 1929

Section of Volcanology, U. S. Geological Survey

H. A. Powers, Temporarily in Charge

There has been no renewal of volcanic activity at Kilauea. Appearances at the fire pit indicate that there will be several weeks of quietude before another flow of lava occurs. A few slides have fallen north and east, but otherwise Halemaumau remains unchanged.

Recent measurements of the east rim cracks show no significant changes over the measurements of May 15, the largest amount of movement being 0.135 foot.

A substantial increase in the number of earthquakes during the past week may mean slight subsidence of the invisible lava column. Twenty-seven very feeble local shocks were registered at the Observatory. In addition there was a two-minute period of microtremor 5:14-5:15 a. m. August 7; also two felt earthquakes, one at 10:43 p. m. August 6 and the other at 2:42 a. m. August 7. The distance to origin of the former can not be determined because the preliminary phase was destroyed by the minute mark; the latter shock originated about nine miles from the Observatory.

Microseismic motion was slight throughout the week except for a temporary feeble increase early August 2. The accumulation of tilt was slight to the NNE.

FOURTH PACIFIC SCIENCE CONGRESS

Mr. R. H. Finch, Associate Volcanologist in charge of Lassen Volcano Observatory in California, was delegated by the United States Geological Survey to attend the Fourth Pacific Science Congress as representing the Section of Volcanology of the Survey. In this journey he received assistance also from the Hawaiian Volcano Research Association as their delegate.

Mr. Finch reports that Dr. Maclawin of New Zealand represented the New Zealand Government so as to be able to give advice on extending the observations on New Zealand volcanoes. At a Japanese dinner in Singapore Mr. Finch met Dr. H. Tanakadate, volcanologist of Sendai University. The return trip from Java May 31 was on a Japanese freighter passing by Borneo and Celebes, and through the Sulu Archipelago and Sulu Sea. Most of the large islands of the Philippines was seen, as well as the southeast side of Luzon. A small fume cloud was observed over Mayon. Dr. Kozu from Sendai, and S. Kunitomi, seismologist of the Central Meteorological Observatory of Tokyo, were passengers. The program of papers at the Congress was serious and of sustained high quality. Mr. Finch feels that he benefitted much by his contacts at the Congress. He reports:

"The opening meeting of the Fourth Pacific Science Congress was held in Batavia, Java, on May 16, 1929. The Congress then moved to Bandoeng, Java, where in the delightful climate appropriate to an elevation of 2,000 feet the scientific sessions of the Congress were held from May 18 to May 24.

"The Congress was organized under the supervision of the General President, Dr. O. De Vries and Dr. H. J. Lam, General Secretary. About 250 foreign delegates were present, as well as a strong delegation from the Dutch East Indies. The delegates came from 24 different countries, with South American countries and Mexico not represented.

"One of the most interesting excursions prior to the opening of the Congress was to the volcano Krakatau. With the steamer 'Rumphius' provided by the Royal Packet Navigation Company (K.P.M.), excellent views were obtained of the three older islands of the Krakatau group. Landings were made on these islands, as well as on Anak Krakatau (Baby Krakatau), the island that was formed by explosions early in 1929. Exhibitions of native dances and native industries of the principal tribal groups of the Dutch East Indies were other outstanding features of the entertainment provided before the Congress opened. Both foot and airplane trips were made during the session of the Congress to Tangkoeban Prahoe volcano. After the Congress adjourned on May 25, there were excursions until June 4, many of which were to active volcanoes.

"For the most part papers were not presented before the Congress by the authors themselves. Papers on closely related topics were grouped and reviewed by one person. The time saved by this method was devoted to open discussion. Printed abstracts of most of the papers were available before they came up for review and discussion. The papers will be printed in full in the proceedings of the Congress.

"There were four sectional meetings under the head of volcanology. Many questions of interest to volcanologists were discussed in the sections of seismology and petrology. Of especial interest under seismology was the evidence offered on the occurrence of earthquakes with a focal depth of from 180-240 miles. The papers of Dr. Kozu on the influence of temperature upon the volume of granite and some lavas given under petrology proved of great interest to volcanologists.

"The invitation of Canada to hold the next Congress in Vancouver, B. C., in 1932, was accepted." R.H.F.

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No. 242 RELEASED WITHOUT COPYRIGHT RESTRICTION August 15, 1929

KILAUEA REPORT No. 916

WEEK ENDING AUGUST 14, 1929

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

Dust from slides in Halemaumau was seen at various times during the forenoon of August 8, possibly caused by persons dropping rocks.

On August 11 it was noted that slumping since the July eruption leaves a terraced fault bank high along the west side where the deeper conduit was. The deeper withdrawal occurred there, and the deepest part of the slump appears to be at the northwest in the floor surface. There is little change of the east side of the bottom. Twenty or more hummocks are at the west. One of these is open and round like a tree mold, and stands up like a huge pipe 20 feet across. There are avalanche rocks on the steep down-faulted terrace at the edge of the floor under the northwest talus.

Blue smoke continues to come from the east rampart, and there is the usual steam from vents in the west and south taluses.

Earthquakes for the week number 28. None was felt, all being of very feeble intensity. Two of the shocks were of the continuous tremor type, one occurring 12:45 - 12:47 p. m. August 7 and the other 10:43 - 10:53 p. m. August 10.

Tilt accumulated slight to the NW. Microseismic motion was slight, with a little strengthening on August 10.

VOLCANIC LIGHT, HEAT AND POWER

In view of the possibility of warming the rooms of the hotel at Kilauea Volcano by natural steam with the aid of a hot water radiator system, it is of interest to learn what has been done in other places. At Kilauea the four bore-holes at Sulphur Bank close to the hotel yield constantly great quantities of steam at 96° C. If this were passed through a tubular boiler containing the water circulation for the hotel radiators, with the pipe properly insulated, every room might contain an adjustable heater filled with pure water from the tanks. There would thus be no waste of water. The slight corrosive effect of the acid steam would be met by building the boiler of a suitable resistant metal. The hot water system would be a great comfort to many guests in cold, rainy weather and by drying the building would act as a preservative against mildew.

Even in ancient times it was the dream of mankind to utilize volcanic heat. This does not mean harnessing the eruptions of volcanoes, but rather making use of the fumaroles and boiling springs generally found in volcanic districts. For many years the steam of fumaroles has been used in Iceland for the heating of schools and other public buildings. In Japan there is a village heated in winter with the aid of volcanic steam led into the buildings. Most of this is the steam of ground water brought to the boiling point through the agency of underground magma or of volcanic gases. The latter are dominantly hydrogen, carbon, chlorine, and sulphur, and their compounds through union with oxygen of the air.

Even farmers have made use of volcanic energy to assist them in agriculture. On the island Ischia, near Naples, the peasants make use of numerous fumaroles to warm their tomato plants and so make them sprout sooner. On the bottom of the extinct Agnano Crater a gardener found the volcanic heat useful in order to keep his vegetable crop producing all the year around by distributing his sowing and his harvesting in accordance with an irrigation system dependent on hot springs. Recently a company has been formed that makes use of volcanic steam for the warming of hot houses where useful plants are produced.

It is well known that in many places in Iceland, North America, the tropics, and New Zealand hot springs are used as laundries, and of course they have been used from time immemorial as baths beneficial in certain diseases.

Near Lardarello in Tuscany boric acid has been produced from scalding natural steam for more than a century. Prince Ginori Conti began there in 1904 to operate a small steam engine by curbing a natural steam vent. Further development of the steam power was hampered by the low pressure and temperature of the surface steam and the rapid eating away of the metal by the acid vapor.

In order to obtain higher pressures and temperatures, bore-holes were drilled which yielded a rush of steam at 190° C. and 14 atmospheres of pressure. There was finally obtained at Lardarello from several bore-holes 250,000 kgs. of steam per hour averaging two atmospheres of pressure and a temperature from 120° to 190° C.

In order to avoid the corrosion of expensive machinery, the high-pressure natural vapors were condensed under pressure, the fixed gases were assembled and conserved as by-products, and pure water was heated above the boiling point in a low pressure boiler so as to make steam, utilized by expanding it in low pressure turbines.

At Castel Nuovo a well 130 meters deep operates three turbo-generators of 2,000 kilowatts capacity. At present the plant yields some 12,000 kilowatts and no exhaustion of the resources of the ground has yet appeared.

In Java experiments at Kawah Kamodjang Crater with a bore-hole 128 meters deep yields a volume of steam at six atmospheres pressure estimated capable of producing 900 kw. At the Geysers in the St. Helena Range in California a great store of hot steam has been revealed by drilling, and this increases with depth. Borings for power have been made here discovering temperatures from 99° to 173° C. and pressures from 60 to 169 pounds. The wells vary in depth from 154 to 636 feet. Both temperature and pressure increases with depth. These wells also have been harnessed for power. The geological conditions indicate that the region overlies intrusive volcanic magma. (Volcanoes which heat Towns, by Dr. L. Steinberg, Weser Zeitung April 26, 1929, Bremen. Steam Wells at the Geysers, California, by E. T. Allen and A. L. Day, Carnegie Institution Publication No. 378, 1927.) T.A.J.

SAMPLE COPY

Please send publications and news notes about volcanic matters
Address: HAWAIIAN VOLCANO OBSERVATORY, HAWAII NATIONAL PARK, T. H.

THE VOLCANO LETTER

A Weekly news leaflet of the Hawaiian Volcano Research Association

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No. 243 RELEASED WITHOUT COPYRIGHT RESTRICTION August 22, 1929

KILAUEA REPORT No. 917

WEEK ENDING AUGUST 21, 1929

Section of Volcanology, U. S. Geological Survey

T. A. Jaggar, Volcanologist in Charge

A slide was reported at the north wall of Halemaumau about 3 p. m. August 16, and the next morning a fresh scar was observed there. Notably little visible steam appears about the new lava floor. A small crack at the east edge of the floor yields blue fume, and on August 17, at 9:45 a. m. the upper edge of the northern grotto niche at the west side of the floor began to yield blue smoke. This was very slight and diminished on succeeding days. The talus slopes make a little vapor visible on cool, moist days.

Nineteen very feeble earthquakes were registered at Kilauea and one feebly perceptible shock at 12:38 p. m. August 14. This had indicated distance to origin of 30 miles. Microseismic motion increased slightly during the nights of August 15-16 and August 19-20.

Tilt accumulated moderately NNE.

THE RISING LAVA IN HALEMAUMAU

The three short-lived eruptions which have occurred in the inner pit Halemaumau since 1925 have brought into the bottom of the pit a total of 8,692,000 cubic yards of solidified lava and have filled the bottom to a depth of 210 feet. Expressed in terms of the old Halemaumau which was overflowing in 1921, and was a much smaller shaft, this volume of lava would have meant in the old pit a rise of level of 350 feet.

Because of the fact that the dimensions of the pit have been increasing owing to the breakdown of the walls, and also because the bottom has been changing, it has been necessary from time to time to revise the topographic map of the actual pit crater. By keeping this map up to date it has been possible to compute with fair accuracy the actual amount of lava added during each eruptive period.

Before the outbreak of July 7, 1927, the bottom of Halemaumau stood at an elevation of 2,390 feet above sea level. It was 1,260 feet below the observation station on the southeast rim. During the 1927 eruption the level of the lava rose to an average elevation of 2,500 feet above sea level, and the total area of the new surface was 30 acres. After making proper allowance for the slope of the containing walls, the volume of new lava was computed to be 85,430,000 cubic feet.

Heavy avalanching during the months following, and other avalanches at the time when an internal landslip in the pit in January, 1928, was accompanied by an upward squeezing of red hot lava, produced burial of much of the 1927 lava floor beneath debris from the walls.

A new eruption of lava came February 20, 1929, pouring its floods over 19 acres of the 1927 lava that still remained unburied by debris. During the 36 hours of activity, a lava lake was formed which had an average depth when frozen of 45 feet, a surface area of 40.5 acres, and a total volume of 51,900,000 cubic feet. The new floor thus formed had an elevation of 2,546 feet above sea level and was 1,104 feet below the rim at the observation station.

The last eruption which began on July 25, 1929, and continued for 85 hours built up the floor of Halemaumau to a point 1,050 feet below the observation station. The total volume of this lava of July, 1929, in the new floor is 97,350,000 cubic feet and the surface area is 54 acres.

The figures given for the volume of each flow represent only the actual amount of lava which remained in the pit after activity had ceased. In each case a great deal of the frothy liquid material extruded during the eruption was either withdrawn from the lake when the lava column sank into the earth at the end of the active period, or else contracted by loss of gas. During the eruption of July, 1929, the inflated lava lake at the time of maximum activity before any recession contained a total volume of 126,850,000 cubic feet of molten lava.

A tabulation of these data facilitates comparison:

	Depth	Area	Volume
July, 1927	110 ft.	30 acres	85,430,000 cu. ft.
Feb., 1929	45 "	40.5 "	51,900,000 " "
July, 1929	55 "	54 "	97,350,000 " "

H.A.P.

THE NEW CYCLE IN HALEMAUMAU

The above figures computed by Dr. Powers exhibit the facts of a true rising of the lava column of Kilauea since the explosive eruption of 1924. After that engulfment the funnelling talus had its lowest point 1,330 feet below the observation station. The depression of the bottom was diminished by 70 feet with the lava filling of July, 1924, by 110 feet with that of 1927, by 45 feet with that of February, 1929, and by 55 feet with the eruption of July, 1929. As the talus of the bottom opens out funnelwise at an angle of 30 degrees, the areas have increased and in general the volumes have increased. The duration of eruption in the two outbreaks of 1929 was less than in the outbreaks of 1924 and 1927, while the volume of inpouring per day was much greater. The 1924 eruption lasted 10 days and the 1927 eruption 13 days, while the two outbreaks of 1929 each stopped suddenly at the end of a day and a half and three days and a half, respectively.

The fountaining at the beginning of all these eruptions was of the Mauna Loa type, throwing up basaltic pumice. The fountains of 1924 were estimated to be 150 feet high, those of 1927 125 feet high, those of February, 1929, 200 feet high, and those of the last day of the July eruption, 1929, reached maxima of 300 feet at times. The 1927 eruption was estimated to pour out 50 per cent of its volume during the first hour, and something similar was true in 1924. Both these eruptions built up cones at single vents, whereas the two 1929 eruptions opened fissures at the floor margins, and the largest fountains left only niches. This history seems to indicate that the intensity of gas action and the freedom of flowing has increased in 1929, and at the same time the interval between outbreaks has decreased.

A platted curve of the rate of rising now in progress, with an average fill of about 70 feet for each eruption, and a diminishing interval between eruptions, should make the next inflow of lava take place some time between now and November, 1929. This expectancy might be interfered with if Mauna Loa should erupt, but that would be an equally satisfactory demonstration that the Hawaiian lava column is alive.

T.A.J.

SAMPLE COPY

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THE VOLCANO LETTER

A Weekly news leaflet of the Hawaiian Volcano Research Association

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No. 244 RELEASED WITHOUT COPYRIGHT RESTRICTION August 29, 1929

KILAUEA REPORT No. 918
WEEK ENDING AUGUST 28, 1929

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

The pit Halemaumau at Kilauea Volcano has shown no movements of interest during the past week. A round convection cloud hung over the pit during the night August 23-24, gradually vanishing with forming and reforming as the sun's heat dried the air about 8 a. m. On August 25 at 2 p. m. the weather was rainy and this developed steam at hot places in the wall of the pit above the northeast and southwest taluses and on the talus slopes. Blue vapor rose from the crack at the niche at the western edge of the floor where the northernmost source fountain had been in July, 1929.

Sixteen very feeble earthquakes were registered at Kilauea, including several spells of spasmodic tremor August 21, mostly during the noon hour and possibly occasioned artificially. One slight perceptible shock occurred at 1:45 a. m. August 28 with origin not more than four miles from the station according to the seismographic evidence.

Microseismic motion was slight, with some increase August 21-22. Tilt to August 24 accumulated moderately SSW. Tilt measurement was temporarily interrupted thereafter by repairs to the seismograph basement.

MEASURED DEFORMATION FROM TOKYO EARTHQUAKE

Tanakadate calls attention to the fact that regional deformation by uplift, sinking, or sidewise motion of the land has only been measured in relation to earthquakes within the last 40 years. (Geomorphology of the Kwanto Earthquake in Japan—in Italian—by H. Simotonai Tanakadate, R. Accad. delle Sci. Fis. e Mat. Napoli, December 3, 1927.) This has been done for the San Francisco earthquake 1906 and, for the Japanese Empire, in the cases of the earthquake of Nobi 1891, of Omati 1918, Kagi in Formosa 1906, and the recent Tango earthquake.

After the great Kwanto earthquake of September 1, 1923, the Naval Institute of Hydrography measured the bottom of Sagami Bay in comparison with soundings of 12 years before, and found enormous changes. A belt extending SSE. from the central part of the bay had lowered from 110 to 210 meters, and a horseshoe of the bottom enclosing this on the northwest had been lifted or shallowed to a maximum of 250 meters. The maximum subsidences were, in a pocket near the head of the bay of 300 meters, and in the channel leading to Tokyo Bay of 400 meters. The biggest belt of sea bottom elevation trends northwest along the northeastern half of the bay, and the biggest belt of sea bottom depression trends out to sea from the southern half of the bay, interrupted by a belt of 100 meters of elevation, between the active volcano island Oshima and the mainland northwest of it.

In other words the belts of elevation and depression are along northwest-southeast axes alternating, with the southern elevation axis lying along the active volcano line Oshima-Fuji. Although the entire northeastern belt of elevation exhibits such positive uplifts as 100, 180, 230, and 250 meters, which cannot possibly be accounted for by the filling of bottom depressions by submarine landslip, the immediately adjacent shorelines rose only one or two meters. The same may be said of the Idu Peninsula on the opposite side of the bay, immediately adjacent to the undersea ridge raised 100 meters and undersea depression from 100 to 300 meters; this shoreline moved hardly at all. The bottom of the bay appears to be sharply differentiated mechanically from the solid rocks of the shore.

The area of the sea bottom region lowered was 700 square kilometers and the bulk displaced 50 cubic kilometers. The area of the sea bottom region elevated was 240 square kilometers and the bulk displaced 20 cubic kilometers.

Coming now to the shoreline, it was mostly elevated somewhat, at the instant of the earthquake, from the head of Tokyo Bay to the mouth of Sagami Bay. A region back in the interior, extending northeastward from Fuji Volcano, was slightly depressed. The axis bounding these two belts is northeast and southwest, or about at right angles to the Sagami Bay axis. Precise levels run by the Military Institute of Geography immediately after the earthquake discovered elevations of one or two meters or less at the southern end of the Boso Peninsula east of Sagami Bay, and at the extreme head of the bay near Kodu. The maximum uplift was at Hemuro Mountain 21 kilometers north of Kodu amounting to 2.65 meters. This maximum land uplift was a localized hump clear inside the Fuji belt of depression. The subsidences in this last belt were small, of the order of tens of centimeters.

The relative horizontal movements of bench marks relocated by precise triangulation in 1924-25, compared with the geodetic net of 1884-89 from base lines measured in 1882 and in 1924, reached a maximum on the volcano Oshima, of 3.78 meter, in a direction N. 8° E. In general the displacement is at a maximum around Sagami Bay of the order of one or two meters, and is north on the west side of the bay, eastward to the north of the bay, and southeastward to the northeast of the bay. This encircling movement diminishes in the interior country. The displacement at Oshima island is toward the bay.

The country has been shown to be broken up into small fault blocks and the two peninsulas where the maximum shore movements occurred consist of lithified tuffs of Tertiary age excessively dislocated from that time to the present, and much of this dislocation extends into broken shore-terraces directly related to Quaternary and recent earthquakes. Tanakadate shows that by investigation of the tide gauge at the Miura Peninsula, nearest to the earthquake center, the shore had been gradually sinking about 10 centimeters in the last 23 years. Before that, on the authority of researches by scientists, and of a careful investigation of 150 fishing villages, the evidence shows that prior to the earthquake of 1923 there had been gradual lowering of the shore, and encroachment of the sea, of the order of three feet in 65 years. This applies especially to the two peninsulas. The evidence goes to show that in just such measure as the subsidence prior to the earthquake had been greater, so much the higher was the elevation or springing up of the ground at the moment of the earthquake.

A great earthquake in the same region in 1703 produced elevation of the Boso Peninsula and lifted dry land areas unknown before, said to have been from one to four kilometers wide, at different places along the shore. Accordingly it seems likely that from Tertiary time to the present this has been a region of "hereditary earthquakes," like southern Italy, where magmatic invasion brings about elevation, eruptions, and earthquakes. T.A.J.

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HAWAII NATIONAL PARK

OFFICE OF THE SUPERINTENDENT [redacted], HAWAII

September 4, 1929

Director,
National Park Service,
Department of the Interior,
Washington, D. C.

Dear Mr. Director:

Submitted herewith is a report of activities and operations in Hawaii National Park during the month of August 1929.

000 GENERAL:

August was as fine a month as could be hoped for anywhere in the entire world. Although extremely hot weather occurred along the seacoast areas of the Hawaiian islands temperatures in the National Park were very comfortable. A heavy attendance of summer cottage visitors was enjoyed during August.

100 ADMINISTRATIVE:

110 Status of work.

All operations, both construction and maintenance are running according to schedule at this time.

120 PARK INSPECTIONS BY:

121 Superintendent.

The Superintendent made regular inspections of construction and maintenance operations in the Kilauea section and Ranger Christ was sent to Haleakala to inspect and begin construction on the trail work in that area.

125 Other governmental officers.

Delegate to Congress Victor K. Houston spent two weeks on a combination vacation and business trip on this island. During that time he found opportunity to visit various portions of the National Park and to talk over with the Superintendent the various needs here.

200 MAINTENANCE, IMPROVEMENTS AND NEW CONSTRUCTION:

210 Maintenance.

The first week of August was devoted by road crews to making a thorough overhaul of the Kilauea crater road. The extreme use to which this road was put by heavy traffic during the eruption in late July practically ruined the natural dirt surface and forced upon us very heavy maintenance work. The road is now in very good shape.

Other usual maintenance was performed on the balance of the park road and trail system as well as on structures.

One section of the new portion of the "Around-the-Island" road is developing a great number of pot-holes in its oil surfacing which must soon be repaired. This work is being postponed pending a conference with the Chief Engineer in Yellowstone in September.

230 New construction.

Erection of the two new residence cottages progressed at a satisfactory rate during August.

The trail to Napau crater, a distance of 2.6 miles was entirely completed this month.

300 ACTIVITIES OF OTHER AGENCIES:

310 Public service contractors.

Both the Volcano House and the Kilauea summer camp have enjoyed a very busy month. Each of these places has been practically full all during August.

400 FLORA, FAUNA AND NATURAL PHENOMENA:

410 Naturalist service.

Both the afternoon and evening lectures on volcanology and natural history subjects were continued all during the past month and with increased popularity. One lecture on volcanology was given by Dr. Jaggar to a visiting group of surgeons visiting the Pan-Pacific Surgical Conference held in Honolulu. 35 lectures to 2,600 persons were given during August.

5

500 USE OF PARK FACILITIES BY THE PUBLIC:

510 Increase in travel.

Hawaii National Park continued to show an increase in this years travel over previous years. The amount of this increase is shown in the inclosed tables. It is expected that we will have far exceeded 100,000 visitors by the end of the travel year.

520 General weather conditions.

Maximum temperature - - -	23rd and 24th, 79°	
Minimum temperature - - -	5th, 14th - , 54°	
Rainfall for month of August - - - - - -	3.71	inches
Rainfall for month of August in Hilo - -	8.35	"
Rainfall to date Volcano district - - -	47.38	"
Rainfall to date in Hilo - - - - - - - - -	80.51	"

540 Visitors.

Governor Lawrence Judd spent one night in the park during his first official tour of the islands. Other visitors included Delegate Victor K. Houston, Mr. Chandler, president of the Los Angeles Steamship Company and a group from the Los Angeles Chamber of Commerce on their fifteenth good will tour to Hawaii.

Mr. and Mrs. H. W. Bissell of California, together with their family, spent two days in the park toward the end of the month. The Bissells were then on their way home after a two years cruise of the Pacific ocean in their small sailing yacht, the Wanderlust. They were accompanied by captain Lee Brisson of Papeete, Tahiti, who was in charge of their boat and crew.

600 PROTECTION:

625 Protection.

A small fire caused by a discarded cigarette occurred in Bird Park the last day of August. This fire smoldered all night long in two logs and was found early the next morning by Ranger Christ and extinguished within 45 minutes with the help of five men on the road crew. The heavy rain the evening before prevented this fire from gaining headway. No material damage resulted.

900 MISCELLANEOUS:

On August 6 the Superintendent had occasion to visit Honolulu on official business and was given the privilege of making the trip as a passenger on board the Army Fokker plane, Bird of Paradise. Other persons making the trip at the same time were the members of the Territorial Airnautical Commission.

Very respectfully yours,

Thos. J. Allen Jr.

Thos. J. Allen Jr.,
Superintendent.

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HAWAII NATIONAL PARK

OFFICE OF THE SUPERINTENDENT [redacted], HAWAII

August 6, 1929

Director,
National Park Service,
Department of the Interior,
Washington, D. C.

Dear Mr. Director:-

Submitted herewith is the report of operations and activities in Hawaii National Park for the month of July 1929.

000 GENERAL:

The first month of the 1930 fiscal year brought good fortune to Hawaii National Park in the form of a splendid four day volcanic eruption. During this time all travel records to date were greatly exceeded. Crowds were so great that the regular park force was unable to handle them without help from the Hilo police department.

100 ADMINISTRATIVE:

110 Status of work.

Road maintenance and trail construction work in the Kilauea section is one week in arears due to emergency use of all laborers in clearing additional parking area at Halemaumau fire-pit to handle unprecedented crowds. Additional time will also be required to repair the Kilauea crater road after the recent heavy travel which was accompanied by rain through the forest sections.

The construction of the new Halemau trail into Haleakala crater on the island of Maui has been delayed by inability to secure a reasonable contract price for the project. It will be necessary to entirely equip and establish a force account crew to do this work. As we have no employees on this island supervision will be rather handicapped.

120 PARK INSPECTIONS BY:

121 Superintendent.

In addition to routine inspections of work in progress the superintendent made a special trip throughout the undeveloped park seacoast area.

127 F. L. Olmstead.

Mr. Frederick Law Olmstead visited the park during July and very kindly inspected the hotel and headquarters area with the superintendent. Mr. Olmstead made some very good suggestions for landscaping plans and later made a formal report to the Director.

150 EQUIPMENT AND SUPPLIES:

A new Ford pick-up truck was purchased during July.

200 MAINTENANCE, IMPROVEMENTS AND NEW CONSTRUCTION:

210 Maintenance.

The unexpected attendance during an eruption in Halemaumau pit created an emergency in traffic control. In order to provide parking space and keep lanes open for movement all laborers were used to rush through the clearing of parking area for two hundred and fifty cars. Total area available now will hold five hundred cars at one time.

The eruption also created the need of new trails around the pit to keep visitors spread out at various lookout points on the rim rather than having them all congregate at one point and thereby making a dangerous situation from excessive weight. A new trail was hurriedly cleared to safe areas along the high south rim.

220 Improvements.

The roofs of all park buildings were painted a dark green during July. The former color of the roofs was a dirty red.

230 New Construction.

A new cottage for which funds were appropriated partly in 1929 and partly in 1930 fiscal years was seventy-five per-cent complete at the end of July.

A new trail to Napau crater, at the south eastern corner of the park, has been located and cleared for construction.

400 FLORA, FAUNA AND NATURAL PHENOMENA:

410 Ranger-Naturalist Service.

Otto Degener of Honolulu has entered on duty as temporary ranger-naturalist pending examination for permanent filling of this position. Mr. Degener has conducted nineteen lectures to 1,208 persons at Uwekahuna Observatory and fourteen evening lectures to 2,000 persons at the Volcano House. After noon lectures are on volcanic action while evening lectures covers natural history topics.

420 Natural Phenomena.

For the second time within five months an eruption of lava occurred in Halemaumau pit of Kilauea Crater on July 25th. The lava flow started at about 6:00 A.M. and lasted steadily until 7:45 P.M. on the 25th. Ninety-four feet of lava fill was measured as being in the pit bottom at the close of the flow but this subsided to a final measurement of 60 feet when the pressure ceased. The pit floor is now 2100 feet by 1700 feet. Indications are that a third flow is possible during the present calendar year. A complete report has been forwarded separately.

500 USE OF PARK FACILITIES BY THE PUBLIC:

510 Increase in travel.

The eruption of this month brought to the park the greatest volume of travel ever known for the same space of time. All park roads were lined with cars for four days in succession. The largest proportion of this travel occurred between 6 and 12 at night when the lava flow is most spectacular. 25000 persons visited the volcano July 25th to 28th inclusive.

In addition to local travel steamship lines ran extra boats during the eruption period.

520 Weather.

Maximum temperature	9th	76	
Minimum "	3, 17, 29	54	
Rainfall for month of July		7.11	inches
" " " " " at Hilo		12.69	"
" to date Volcano District		43.67	"
" " " at Hilo		72.16	"

530 Other Conditions.

Four mine planters of the U. S. Navy anchored in Hilo Bay the last week in July. The crew member spent leave in the park.

540 Visitors.

Congressman and Mrs. L. C. Dyar of Missouri with Judge of the U. S. Customs Court of Appeals Oscar E. Bland and Mrs. Bland of Washington, D. C. were park visitors on July 12 and 13. During their visit a gust of wind threw the superintendent's hat into Halemaumau pit. Soon after their departure from the park a new hat was received as the gift of Mrs. Dyer.

600 PROTECTION.

610 Police Protection.

At a special session of the territorial grand jury held at Kailua, Hawaii on July 10th and 11th former ranger Geo. D. Douglas was indicted on three counts of malicious injury to property of the U. S., the park superintendent, and the superintendent's wife and on one count of unlawful entry to the quarters of a park laborer. Douglas is now held on a total of $1,730 bond on the above counts and $1,250 bond on other cases. Special Investigator Farland of the U. S. Dept., of Justice and Asst. Attorney General McGhee of the Territory of Hawaii attended the grand jury session.

650 Signs.

A shipment of standard signs for posting on roads and trails of the park has been received.

900 MISCELLANEOUS:

Clerk James K. Higashida is the father of a baby boy born June 27th.

Supt. Allen and Clerk Higashida received one-step increases effective July first.

Very respectfully yours,

Thos J. Allen Jr.

Thos J. Allen Jr.,
Superintendent.

Copy to Yellowstone National Park
" " "Field Headquarters".

TJA/hs

10-157

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

T R A V E L   R E P O R T

Hawaii National Park for the Month of July 1929

	This Month	This Travel Year To Date	This Month Last Year	Last Travel Year To Date	Increase for Travel Year: Number	Increase for Travel Year: Percent
PRIVATE TRANSPORTATION:						
Cars first entry, ...						
Cars reentry, ...						
Motorcycles, ...						
Total motor vehicles, ...						
Persons entering via motor vehicles, ...	32,600	77,948	5,670	51,186	26,832	.344
Persons entering via other private transportation, ...	430	2,317	455	3,140	- 832	.264
Total persons entering via private transportation, . . .	33,030	80,265	6,025	54,275	26,000	.323
OTHER TRANSPORTATION:						
Persons entering via Hotel stages, . .	2,120	12,169	1,262	11,203	966	.079
Persons entering via trains, . .						
Persons entering otherwise, . .						
Total other transportation, . .	2,120	12,169	1,262	11,203	966	.079
GRAND TOTAL ALL VISITORS, . .	35,170	92,434	7,287	65,479	26,956	.292

	This Year	Last Year	Increase: Number	Increase: Percent
Automobiles in public camps during month, ...	0	0		
Campers in public camps during month, ...	0	0		

10-158

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

STATUS OF AUTHORIZED PROJECTS

Hawaii National Park for the Month of July 1939

Description of Projects	Percent Constructed To Date	Percent Constructed This Month	Percent Constructed Last Month	Probable Date of Completion
405 - Ranger Cottage	75	75	NONE	August 25th
503 - Napau Trail	5	5	"	
502 - Halemau Trail	1	0	1	

10-159

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

STATUS OF PERSONNEL

Hawaii National Park for the Month of July 1929

	This Month	This Month Last Year
Number of employees beginning of month,	11	11
Number of additions, ...	18	12
Total, ...	29	23
Number of separations, ...	15	12
Number of employees close of month, . . .	18	11

	This Month	This Month Last Year
Number of promotions during month	2	0

	This Month	This Month Last Year
Aggregate amount of annual leave taken,	0	1
Aggregate amount of sick leave taken,	0	1
Aggregate amount of leave without pay,	0	0

10-160

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

REPORT OF PARK REVENUES

..........Hawaii.......... National Park for the Month of ....July 1929..........................

	This Year	Last Year
Park revenue on hand beginning of month, ...	0.00	0.00
Received, ...	50.00	50.00
Total, ...	50.00	50.00
Remitted, ...	50.00	50.00
On hand close of month, ...	0.00	0.00

Park revenues received this year to date, ...	$ 1,252.00
Park revenues received last year to date, ...	1,250.00
Increase, ...	2.00
Percent of increase, ...	16%

10-161

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

HAWAII NATIONAL PARK

REPORT OF SALES OF PUBLICATIONS

July 1929

	Number	Value
GOVERNMENT PUBLICATIONS:		
On hand beginning of month,	444	121.80
Received during month,	0	0.00
Total,	444	121.80
Sold during month,	19	7.30
On hand at close of month,	425	114.50
NON-GOVERNMENT PUBLICATIONS:		
On hand beginning of month,	10	25.00
Received during month,	0	0.00
Total,	10	25.00
Sold during month,	1	2.50
On hand at close of month,	9	22.50
Cash on hand beginning of month,		30.50
Sales during month,		9.80
Total,		40.30
Remitted during month,		0.00
Balance,		40.30

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No. 236 RELEASED WITHOUT COPYRIGHT RESTRICTION July 4, 1929

KILAUEA REPORT No. 910

WEEK ENDING JULY 3, 1929

Section of Volcanology, U. S. Geological Survey

T. A. Jaggar, Volcanologist in Charge

The Kilauea lava pit has remained quiet throughout the past week. At 9 a. m. June 29 a compact cloud of dust from an avalanche rose near the northeast rim. Because of its whiteness, the dust at first had the appearance of a cloud of steam. At 10 a. m. July 1 Halemaumau was so densely obscured in rain and fog that observations were impossible. All was quiet and no sounds were heard. A light dust cloud from a small slide was seen at 2:30 p. m. from near the Halemaumau seismograph station on the Kilauea floor.

Eight very feeble local earthquakes were registered on the Bosch-Omori seismographs at the Observatory. One of these, registered at 5:14 a. m. June 28, had an indicated distance to origin of 17.3 miles. In addition is the feeble record of a distant shock, beginning at 2:36:53 a. m. June 27.

Microseismic motion continued to be very slight, although a little stronger near the close of the week. Tilt accumulated slight to the WSW.

LASSEN REPORT No. 18

Lassen Volcano Observatory, Mineral, Calif.,

R. H. Finch in Charge

HOT SPRINGS OF THE COAST RANGES

The following table shows the result of hot springs measurements together with the Waring (G. A. Waring, Water-supply Paper 338, U. S. Geological Survey) data for comparison. (See Volcano Letter Nos. 120, 135, 136.)

Location	Temperature	1927	Waring Data
Calistoga:			
Throat of Plummer's Geyser	218(F.)	Mar. 22	
Pool at Plummer's Geyser	143		Highest of
Pacheteaus, side of capped geyser	213.5		natural vents, 173
Well back of Calistoga Hotel	143		
Harbin Hot Springs:			
Entrance of bricked-in pool	119	Mar. 26	122
Anderson Hot Spring:			
(Practically abandoned as a resort.) Highest temperature found in a board-covered spring on east side of hot spring canyon	116	Mar. 26	146
Castle Springs:			
In storage tank a little way from intake	152	Mar. 26	164
Seigler Springs:			
Magnesia	61	Mar. 27	72
Arsenic	96		90
Hot Iron	106		100
Sulphur	106		
Near Sulphur	118		119
do	125		126
Howard Springs:			
Borax	91	Mar. 26	95
Iron sulphur	110		110
Magnesia	108		102
Iron soda	88		
Excelsior lithia	72		
Sulphur Bask:			
Pool in old shaft near road	106	Mar. 27	120
Highland Springs:			
(Appeared to be abandoned.)			
Magic Bath	78	Mar. 28	
Diana Spring	78		80
Skagg Springs:			
Upper	132	Mar. 28	120
Middle	120		122
Lower	128		135

The average rainfall for the area in which the above springs are located is 48 inches, though the amount varies greatly from year to year.

The most recent volcanic activity in this section of the Coast Ranges took place at the Sulphur Banks, to the east of Mt. Konocti. Becker thought it might have occurred within the last 1,000 years, and mentioned Indian tradition of activity at Sulphur Bank. Judging from erosion, Mt. Konocti may have had its last activity much more than 1,000 years ago. The remnant of a crater is still discernible, however, on the south peak of Mt. Konocti. In the hills to the east of the Sulphur Bank there is a fairly well preserved crater. As one goes south from Clear Lake there appears to be a progressive increase in the ages of the last lava flow that capped a good deal of the country. There is, however, a well preserved crater above the Petrified Forest to the west of Calistoga. Considerable volcanic ash is found in its vicinity that has been faulted since its deposition.

The rock mass of the Coast Ranges in this vicinity has been greatly faulted, folded, and crushed, with the main faults trending northwest-southeast, the direction of the main valleys. Folds in the rock appear to be better preserved in the region to the southwest of Clear Lake than farther south.

From the summit of St. Helena, Napa Valley might once have extended much farther north, and drainage from the north was interrupted by lava flows from a small cone to the southwest of Mt. St. Helena. There appears to have been another interruption a little farther north caused by lava flows or upheaval. Above the Palisade Mine there is well preserved evidence of a fissure eruption. Judging from the numerous faults and the recentness of the last activity, it is surprising that this section of the Coast Range has so few earthquakes.

R.H.F.

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No. 237 RELEASED WITHOUT COPYRIGHT RESTRICTION July 11, 1929

KILAUEA REPORT No. 911

WEEK ENDING JULY 10, 1929

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

No noteworthy changes have taken place at Halemaumau. On Sunday, July 7, avalanches occurred, one about 12:30 p. m. filling the entire interior of the pit with dust. There were other slides later in the afternoon.

Observations on July 8 showed that the top fourth of the north talus was covered with fresh material. The north wall appeared to be the only site of avalanching.

On July 10 thick steam was rising out of the fire pit during the forenoon after several hours of good rain. Prior to this there had been a long dry period at Kilauea. At 3 p. m. it was noted that there were many very active steam jets in the Halemaumau bottom, making an interesting sight as they projected straight upward. A southerly rainstorm was in progress.

During the week there were registered on the seismographs 28 very feeble local shocks, one feeble earthquake at 11:04 p. m. July 9 with an indicated distance to origin of 23 miles, and three teleseisms. This is the greatest number of earthquakes registered in one week since the week ending November 28, 1928, when 30 very feeble local shocks were recorded.

Two of the teleseisms occurred on July 5, one at 3:57 a. m. and the other just after 4:08 p. m. They were not well enough recorded to distinguish phases. The third teleseism began at 11:01:06 a. m. July 7. A preliminary determination of distance to epicenter is 7,480 kilometers from Kilauea.

Tilt for the week was moderately south-southwest. Microseismic motion was very slight.

LASSEN REPORT No. 19

Lassen Volcano Observatory, Mineral, California,
R. H. Finch in Charge

Lava Flows

There are several post-glacial lava flows in the vicinity of Lassen Peak in addition to the three at Cinder Cone and the small one that started through the western gap of Lassen Crater in 1915. There is a series of flows along a north-south line extending south from Tamarack Peak.

Another fresh-looking flow had its origin between the two Prospect peaks. Another flow originates near the northeastern corner of the park east of Cinder Cone. The above flows were not very fluid and consist of broken blocks. A typical basalt flow that was quite fluid extends for miles in Hat Creek valley just below the Hat Creek fault scarp. It contains a great many lava tubes. About 15 miles to the east-southeast of Mineral there is a flow that contains both aa and pahoehoe and formed lava tubes.

Lassen Peak

An ascent of Lassen Peak was made on August 5-6, 1927, supplies being carried on a pack animal. Camp was made inside the main crater about 30 feet below the western rim, above and to the west of the lake in the crater. Rock falls from different walls were frequent. By 7 p. m. ice was forming over the lake, though at the camp, about 50 feet above the lake, the lowest temperature during the night was 46° F., and on the crater rim the temperature was still higher. Steam cracks afforded an easy method of heating food. Lassen Peak may be thought of as being composed of three lobes.

When the doming pressure incident to the 1914-15 activity became sufficiently great, the north lobe cracked away slightly from the other two and opened an east-west crack that probably was very superficial. From the gaps that already existed in the crater wall, it seems that the cracking was along an old break. A massive layer with scars shows that material broke off from it both into the crater and down the outer slope. The layer was in the same plastic condition when it was deposited as was the incipient flow that went through the eastern and western gaps. The flow through the eastern gap was blown or slid on down the mountain side while that through the western gap is still in place.

The flows had probably just started when the explosion blew away the source material. Mud deposits in the Lost Creek Valley indicate that there have been one or more explosions and mud flows from Lassen within the last 500 years. The 500-year limit was obtained from the conditions of preservation of tree trunks buried in the mud flow and recently unearthed by stream erosion.

Dacite pumice in the ash material of the 1915 eruption was scattered over a wedge-shaped area extending from Bumpass Hell nearly to Chaos Crags and from the Peak itself for 12 miles to Butte Lake on the northeast. Just to the north of Hat Mountain, near the center of the area, the ground appears to have been covered with the pumice. Great quantities of this pumice are to be found on the summit of East Prospect Peak, the rock of which is basalt.

Glass Mountain

Following several newspaper accounts of Forest Service officials discovering activity at Glass Mountain, which lies about 70 miles north of Lassen, and after telephone conversation with a Forest Service supervisor familiar with that country, it seemed advisable to investigate the acitivity. Accompanied by G. L. Collins of the National Park Service, an attempt was made to photograph and take temperature measurements at the scene of activity, but we were forced to go back on account of heavy snow. Contact was made with G. L. Courtright, of Dry Lake, about 12 miles east-northeast of Glass Mountain, and from him was obtained an account of an explosion on Glass Mountain in 1910. (Volcano Letter No. 144, 1928.) From other people was obtained an account of a small lake that had formerly existed on the mountain. Mr. Courtright said that he is now unable to find this lake. An explosion under the lake could account for the mud reported on vegetation after the explosion, as well as for the disappearance of the lake. R.H.F.

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No. 238 RELEASED WITHOUT COPYRIGHT RESTRICTION July 18, 1929

KILAUEA REPORT No. 912

WEEK ENDING JULY 17, 1929

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

There appear to have been no volcanic changes at Halemaumau throughout the past week. No slides have been noticed, nor are there signs indicating that stripping of the walls has occurred.

On July 13 a semicircle of moisture was noted at the top of the big west talus. This was like an arch just under the uppermost point of the talus which as a whole is shaped like an inverted V. The effect is as though a crescent-shaped crack marks a deep break in the talus cone. The crack emits some vapor, and there are steaming spots in the middle of the talus below. The south talus shows a linear up-and-down fissure steaming at its top.

A slight increase of steam at the center of the west talus was observed at 3 p. m. July 17.

A total of 18 local earthquakes was registered by the instruments at the Observatory during the week. Two of these were felt locally, one on July 10 at 1:27 p. m. and the other July 15 at 10:02 a. m. The felt shock of July 10 had an indicated distance to origin of 10 miles; that of July 15 had no distinguishable phases on account of being immediately preceded by the waning tremor of a very feeble earthquake. There was continuous tremor July 17 from 5:14 to 5:16 a. m.

Tilt accumulated moderately strong SSE. Microseismic motion was extremely slight.

LASSEN REPORT No. 20

Lassen Volcano Observatory, Mineral, California
R. H. Finch, In Charge

The following measurements refer to landslipping in progress at Supan's steam holes, Lassen National Park, and to temperatures at various hot springs. (Compare Day and Allen, 1925, Volcanic Activity of Lassen Peak, Carnegie Institution.)

The line of stakes across new cracks that was placed 50 feet apart in November, 1927, parallel with the valley containing the sulphur works was retaped on July 27, 1928. The following table shows that there was downhill slipping in the upper part of the 1,00-foot line that was practically compensated by over-riding lower down.

	Stake Intervals	New Measurement	Change
	0— 1	50.1 feet	+0.1
	0— 2	100.1 "	+0.1
	2— 3	51.4 "	+1.4
	3— 4	51.3 "	+1.3
	4— 5	50.0 "	0.0
	5— 6	49.4 "	—0.6
	6— 7	49.6 "	—0.4
	7— 8	49.8 "	—0.2
	8— 9	49.8 "	—0.2
	9—11	99.5 "	—0.5
(Note: †10 moved)	10—11	49.9 "	—0.1
	11—12	50.2 "	+0.2
	12—13	49.6 "	—0.4
	13—14	49.9 "	—0.1
	14—15	49.9 "	—0.1
	15—16	49.8 "	—0.2
	16—17	49.9 "	—0.1
	17—18	50.0 "	0.0
	18—19	50.0 "	0.0
	19—20	†20 moved	

The line was extended 300 feet and three lines run across the valley by transit: one at the upper end of the stake-line, one near the middle, and one at the lower end.

Temperatures of Hot Springs

Supan's.

The highest temperature found at the "Big Steamer" at Supan's solfatara on July 28, 1928 was 240°. The same vent on September 5, the driest part of the season, was but 235°. As the temperature of such hot springs varies inversely as the amount of water discharged, the slight cooling of the spring was contrary to what was expected.

Morgan Hot Springs, August 7, 1928.

No.		Fahr.	No.		Fahr.
1		177	12	muddy water	188
3	middle pool	185		mud	172
	lower "	196		clear water	195
			14		178
4	north "	190	17		201
	middle "	168	19		144
	south "	176	20		200
5		172	Between 12 and 14		
6		176		in black earth	160
7		196	23		192
8		156	24		198
9		106	Geyser		200

Live, wiggling larvae in mud algae at No. 3 with temperature of 120°. When temperature was 140° the larvae was dead.

Boiling Lake, August 11, 1928.

Water north end of lake	130 Fahr.
Mudpot north end of lake	198
Milky pool southwest edge of lake	192
Site of Cornpopper, south end of pool	204

(The ground at this site sank several feet since the fall of 1927.)

Devil's Kitchen.

Bluish-gray pool of water near northwest end	171 Fahr.
Deep pool just above one with stream flowing through it near upper end of "kitchen"	195
Splashing pool upper north side	169
Yellow pool northwest end	189
Pool in rock southwest edge	198
Small splashing vent southwest	199
Large splashing pool southwest	199

Bumpass Hell, September 5, 1928.

No.		Fahr.
8		194 Fahr.
9	mud pot	194
10	pool	174
11	steam vent	192
13	" "	194
14	east side	190
16		194
17		195
Several small vents depositing sulphur crystals		195

The highest temperature observed at Bumpass Hell in 1928 was considerably lower than the highest for 1927.

R.H.F.

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No. 239 RELEASED WITHOUT COPYRIGHT RESTRICTION July 25, 1929

KILAUEA REPORT No. 913

WEEK ENDING JULY 25, 1929

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

A quiet flow of lava broke out in the bottom of Halemaumau about 6 a. m. today. The flow at first was from two fountains loudly splashing just above the lower edge of the big west talus. About 8 a. m., before the new lava had covered the floor formed last February, a crack opened athwart its center with much gasrushings, releasing a line of fountains in direction approximately northeast-southwest. The fountains are about 200 feet high.

The eruption is one of a series of minor, short-lived flows characteristic of this period of cyclical events at Kilauea. It can not be stated how long the flow will continue, though at the present time it is strong.

The last activity in Halemaumau occurred on February 20 and 21, 1929. It filled the bowl-shaped bottom of the pit with lava to a depth of about 60 feet, forming a floor a little less than 1,200 feet below the rim. Few changes occurred at the volcano since that time. No great avalanches took place that might denote a great subsidence of the lava column, and it was therefore thought that magma lay not far below the surface of the volcano edifice, and another eruption during 1929 was accordingly considered possible.

The usual harmonic tremor indicative of flowing lava is registering on the seismographs at the Observatory. This began to be somewhat steady at 6:46 a. m. Beginning at 8 p. m. July 24 there were spells of tremor fairly regularly every 16 seconds and lasting nearly an hour.

The earthquakes for the week ending July 24 at 8 p. m. total 19. These were all of very feeble intensity and not large enough to be felt. At numerous times throughout July 21 the seismographs registered short spells of microscopic tremor. The seismograph on the crater floor near Halemaumau did not record this tremor, however.

Tilt accumulated moderately NNE. Microseismic motion remains very slight.

VESUVIUS IN JUNE 1929

The following is quoted from Nature, June 15, 1929, showing that Vesuvius has recovered from its 1906 engulfment to the stage where it makes external lava flows:

"After the great paroxysmal eruption of Vesuvius in 1906 there followed seven years of obstruction and comparative repose. In 1913 the conduit became open and the normal type of external activity began. Since then the crater has been steadily filling from a succession of central conelets, and at intervals in recent years there have been minor crescendos of explosive and effusive activity. By far the greatest and most spectacular of these broke out in the early hours of June 3. The outburst began with tremendous explosions and the hurling into the air of masses of incandescent material. The central conelet split and collapsed. As it fell back into the crater lava welled out and occupied the northeastern quadrant of the crater. (This was the lowest lip left in 1906. T.A.J.) Professor Malladra announced on June 3 that he considered the eruption to be one of the periodic recrudescences of activity; that it was unlikely to last more than two or three days; and that a disastrous eruption of the culminating type—such as those of 1872 and 1906—was not yet to be expected.

"On the morning of June 4 it became clear that for a minor eruption the manifestations were more than usually violent. The interior of the crater now became a lake of effervescing lava some 500 yards in diameter. The lava overflowed into the Valle dell Inferno and escaped down the outer slopes into the valley of Cuppaccio and towards the little town of Terzigno, following the course of the 1834 lava stream. After a short interval of quiescence from 2:30 to 7:30 p. m. there was a sudden paroxysm of activity for three-quarters of an hour. Incandescent matter rose 1,500 feet above the crater and fell in glowing showers on the slopes of the volcano. Afterwards there were loud and frequent explosions, followed by an ash cloud that rose to still greater heights. From 11 p. m. on June 5 to 3 a. m. on June 6 there were further tremors and explosions, and columns of lava were thrown into the air to break into incandescent bombs. Since then there have been (*at the moment of writing*) no further reports of activity. The lava stream has extended five miles down the southeastern slopes, widening to a frontage of 900 yards, destroying 110 acres of cultivated land and wiping out three small hamlets. Although Terzigno was evacuated with the prompt aid of the military, the township itself has fortunately been spared, the lava having halted 300-400 yards from the houses. It is estimated by Professor Malladra that the volume of lava approaches half that emitted during the 1906 eruption." T.A.J.

THE NEW ZEALAND EARTHQUAKES OF JUNE 1929

On Hogben's map (Geography of New Zealand, p. 243, by P. Marshall, Christchurch, Whitcombe and Tombs) of larger New Zealand earthquakes, eight principal shocks appear in the middle belt between the north and south islands, only two in the northern region of active volcanoes, and four in the southern mountains and fjords. The Wellington earthquake of 1855 elevated the shoreline. Now comes a series of disastrous shocks in the north mountains of the south island, the region extending southwest from Nelson, with the worst damage at Murchison, which was virtually destroyed.

The new series began on June 17 in the Buller Gorge, but within three months there had been another serious earthquake with many landslides in the Otira Gorge. These are sites of two of the south island's famous roadways. The new crash occurred all along the route between Greymouth and Westport, on the west coast of the north end of the South Island, and the north coast at Nelson, seat of a college. The college, a large masonry building, was wrecked. The roads were split open in huge crevasses, landslides wrecked quarries, railways, and homesteads, some peole were killed and wounded, even frame houses were lurched and collapsed, communications were destroyed, roads disappeared, bridges collapsed, and railway tracks were warped, twisted, and destroyed. (Auckland Weekly News, June 26, 1929.) All the chimneys came down, telephone poles fell over, and trains were derailed. Valleys were blocked and lakes formed. People were thrown off their feet. The time of the major shock was about 10:25 a. m. local time June 17.

Riverview Observatory at Sydney calculated the epicenter 100 miles east of the South Island, but the Wellington seismograph station did not agree to this: field evidence indicated an epicenter in the mountains. Messrs. Ferrar and Grange of the Geological Survey of New Zealand are investigating the movement, which is believed to be a fault displacement. T.A.J.

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No. 240 RELEASED WITHOUT COPYRIGHT RESTRICTION August 1, 1929

KILAUEA REPORT No. 914

WEEK ENDING JULY 31, 1929

Section of Volcanology, U. S. Geological Survey
H. A. Powers, Temporarily in Charge

The lava activity reported last week as beginning about 6 a. m. July 25 continued until 7:42 p. m. July 28, when all fountaining ceased. The lake formed during the flow reached a maximum depth of 94 feet in the center of Halemaumau, and nearly buried the south cone of 1927 which was well up the talus slope prior to the eruptions of 1929.

Following the cessation of flow there was still some activity in the lake as the sluggish liquid continued to seek its level, but cooling of the crust was rapid. The crust settled, and the cracking noises of this process can still occasionally be heard. There is glow at night from numerous scattered points. No avalanching has followed the eruption.

Seventeen very feeble local earthquakes were registered by the instruments at the Observatory. In addition was the harmonic tremor accompanying the lava activity. This tremor was continuous after 6:32 a. m. July 25, although the fume was first noticed at about 6:10 a. m. The tremor waxed and waned at times, but grew stronger on July 27. Fountain action was also stronger. About 7 p. m. July 28 the tremor weakened and after 7:11 p. m. it was unsteady. It ended entirely at 7:42 p. m., when the fountains also went out of action.

There was moderate WNW. tilt during the two days preceding the eruption, slight SSE. tilt during the flow of lava and until July 29, and very slight WSW. tilt for the next two days. The net accumulation of tilt for the week was moderate to the south. Microseismic motion is still very slight.

HALEMAUMAU OUTBREAK JULY 25-28, 1929

Halemaumau has again been the scene of volcanic activity. The eruption began on the morning of July 25 and continued until the evening of July 28. It was one of a series of short-lived, quiet rises of magma which has characterized the present cycle of activity in Kilauea. The lava column attained a maximum height in the pit of 2,640 feet above sea level, a gain over the fill of February 20-21, this year, of 94 feet.

The first indication of the renewal of activity was a series of very small earthquakes a few minutes apart beginning at 4:35 a. m., each accompanied by a slight tilt to the east. The shocks and the tilt made only a slight record on the north-south component of the instrument. They were followed by spasmodic tremor, caused by fountain action, which became stronger and continuous after 6:30 a. m. and lasted so throughout the eruption.

The first observed activity was a cloud of smoke noticed by the machinist of the Observatory at 6:10 a. m. At 6:40 a. m. two fountains of lava were spurting from vents above the lower edge of the middle of the large western talus bank. A high column of blue smoke, pungent with the odor of sulphur dioxide, rose continuously from the fountains, and occasionally spurts of brown sulphur fumes were mixed with the smoke. By 7 a. m. a moisture cumulus had gathered over the pit.

The fountains strengthened rapidly so that by 7:20 a. m. they were throwing pumice and bombs at least 200 feet in the air, and two-thirds of the old floor was covered with new lava.

At 7:45 a. m. steady blasts, sounding like gas rushing through small orifices, were audible above the pounding of the lava fountains. These increased until, at 8 a. m., several small lava fountains, yielding brown fumes and apparently flaming, broke through cracks at the eastern edge of the old floor. Simultaneously, the western fountains lowered slightly, though their fuming increased. A little later the rapidly foundering old floor west of the new fountains was split by a large crack. By 10:20 a. m. it was covered by a lava lake, but its position was marked by a linear fountain, most active at its eastern end.

The filling continued steadily until, at 12:45 p. m., the old floor was nearly covered by a lake 25 feet deep over its lowest points. Fountaining continued with increasing vigor in the western and central areas, but the gas blasting had ceased. Blue smoke still issued from the fountains, but little brown fume was in evidence. About this time two phenomena became evident which, with the fountaining, characterized the remainder of the activity, namely, the cracking and foundering of the surface crust, and the pouring of cascades over ramparts built up near the margins of the lake.

The western fountains gradually strengthened at the expense of the central fountains until, at 6 p. m., 12 hours after the start of activity, spouting was confined to the western marginal fountains. These remained constant and strong (throwing material 300 feet high) until the morning of the fourth day, July 28. During this day the vigor showed periodic increase and decline. About 4:30 p. m. fountaining ceased entirely for 15 minutes, then increased suddenly to nearly the former vigor. Spouting continued with constant force until about 7 p. m., then gradually decreased until it stopped completely at 7:42 p. m.

The influx of lava continued constantly during the life of the fountains. The margins of the lake were extended during the rise by cascading over the marginal ramparts. Tilting of the bench lava beneath the lake, and convection currents in the lake influenced the advancing of the lake margins in such a manner that cascading and spreading was strong first on one side of the lake and then on the other.

During the first 24 hours the lava rose 44 feet above the level of the old floor. At the end of 48 hours the depth had increased to 77 feet, and on the morning of the fourth day, Sunday July 28, the pit had been filled 88 feet. The maximum elevation of the lake surface, reached July 28 after 85 hours of flowing, was 2,640 feet above sea level, 94 feet above the old floor.

The lake, shaped somewhat like an ivy leaf with the broad stem lying toward the southwest, has a maximum width of 1,700 feet and a length of 2,100 feet. Its area is approximately 50 acres.

Soon after the cessation of activity, withdrawal of the supply of molten lava and some shrinkage accompanying crystallization of the crust permitted the surface of the middle of the lake to settle. A survey of the pit made the next day shows that the existing floor has an elevation above sea level of 2,600 feet. This central floor is bounded by in-facing fault scarps from 20 to 30 feet high. The narrow lake margin, between these scarps and the walls of the pit, varies in elevation from 2,615 to 2,630 feet. From these data it has been estimated that approximately eight million tons of rock have been left in the bottom of Halemaumau by this eruption. H.A.P.

10-23
(May, 1929)

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
Hawaii NATIONAL PARK

FILE No.

MONTHLY REPORTS
FISCAL YEAR
1931

IMPORTANT

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HORACE M. ALBRIGHT,
Director.

U. S. GOVERNMENT PRINTING OFFICE: 1929 6—7410

July 11, 1931

The Director,
National Park Service,
Washington, D. C.

Dear Mr. Director:

Following is a report of activities and operations in Hawaii National Park for the month of June, 1931:

000 GENERAL

Ideal weather conditions prevailed in the park throughout the month. The closing of the schools brought larger numbers to the park and vicinity, the summer cottages both in the park and outside being well occupied.

100 ADMINISTRATION

110 Status of work.

The office work was especially heavy during the month of June, particularly in the purchasing and accounting division. New work was getting under way and careful control had to be kept on the expiring appropriations to be sure that no over-expenditures were made. In general, however, the work has been kept fairly up to date and our development plans are up to schedule.

120 Park inspections by

121 The superintendent.

The superintendent kept in close touch with all activities at headquarters and made a number of important inspection trips to outlying sections during the month, as well as attending a number of meetings that were important from an administrative standpoint. He attended the meeting of the Federal Business Association in Hilo on June 5. On June 4 he attended a meeting of the representative business leaders of Hilo, at a dinner given by Captain K. Miyamoto, Commander of the Japanese training ship "Kaiwo-Maru". The dinner was given as a means of expressing appreciation for the courtesies extended, and in the short talks that were made after dinner, the principal theme was the friendship and good will that exists between the Japanese and American governments, and the important part that Hawaii is playing in fostering this relation.

On June 9, the superintendent was a guest of the Hilo Chamber of Commerce at a meeting in which Dr. Thomas A. Jaggar outlined the preparedness plans that he recommended Hilo should adopt in order to be prepared for any catastrophy that might occur on this island, either as a result of earthquake or volcanic activity. Dr. Jaggar particularly stressed the point that he was not an alarmist, but that Hilo and the island of Hawaii might profit by the disasters occurring in San Francisco, Santa Barbara, Tokio, and Napier, and that the loss of human life and suffering, as well as property damage might be very greatly lessened if proper plans were drawn ahead of time to be put into immediate operation in case of need.

Inspection of the Kilauea Military units was made on June 11, and the superintendent and his wife were dinner guests of Captain and Mrs. W. A. Heddin that evening. A visit was made to the Olaa sugar plantation on June 8, in company with Park Naturalist Doerr and Resident Engineer Handley of the Bureau of Public Roads and a trip through the mill was made in order that the group might become familiar with the process of sugar making.

From June 17 to 24 inclusive, an inspection trip was made to the Haleakala section of the Hawaii National Park. Detailed report on this trip was submitted in a separate letter. In additiãn to meeting with the members of the Chamber of Commerce of Maui and discussing plans for the handling of a tourist travel to the Haleakala section of the park to be expected as soon as the new road, now under construction,is completed, special study was made of the insect infestations on the rare Silver Sword ferns within the crater of Haleakala, and spraying of the plants was started with an insecticide, as recommended by the entomologist of the Hawaiian Sugar Planters Association. Samples of infested plants were also sent to the Association for further study and report as to the best methods of control. Work on trail maintenance was immediately started and plans made for construction of a new trail along the rim of the crater between the rest house and the Halemau trail where it touches the edge of the crater on its way up from the bottom. This trail will provide an interesting one-day horseback trip, the parties leaving the rest house in the morning, passing down onto the floor of the crater, and returning to the rest house the same afternoon. Inspection was made of the location of the National Park Service highway from the park boundary to the edge of the crater, for which final surveys were completed early in June. Tentative sites for the location of an entrance ranger station and utility buildings were inspected and the new road now being built by the Territory from Wailuku to the park boundary was gone over.

125 Other Governmental officers.

Congressman Joseph L. Hooper, of Battle Creek, Michigan, accompanied by Mrs. Hooper, was a visitor to the park on June 6 and 7. The superintendent gave him personal attention, conducting him to the various points of interest in the park, and as he was the first Congressman to visit the park this year, he took occasion to find out the needs of the park and the plans and estimates that have been submitted for the fiscal year 1933. Although Congressman Hooper is not a member of the Appropriations Committee, he volunteered to report to his colleagues on this committee the impressions that he received on his trip here.

130 Finance and accounts.

Following is a list of the funds appropriated for work in Hawaii National Park, with the unexpended balance shown as of the close of June 30, 1931. A new allotment and one that was especially appreciated, was the item of $360 allotted for forest protection and fire prevention, which permitted work to be started on the protection of the Silver sword fern in the Haleakala section of the park. The total appropriation for the current year for the park was entirely expended and much more could have been used to advantage if funds had been available, in providing for needs that are becoming more urgent all the time.

Name		Allotted	Expended	Balance
41/2415	Hawaii National Park 1931-32 - - - - - - - -	82,130.00	616.68	81,513.32
41/2405	Forest Protection and Fire Prevention - -	100.00	8.21	91.79
40/1415	Hawaii National Park 1930-31 - - - - - - -	34,625.00	34,543.66	81.34
40/1405	Forest Protection and Fire Prevention - -	990.00	945.00	45.00
40/1405	Emergency Reconstruction and Fighting Forest Fires in National Parks, 1930-31 - - - - -	17.25	17.25	00.00
4X436	Roads and Trails, National Parks, no year -	382,385.00	17,843.98	364,541.02

150 Equipment and supplies.

The most important equipment purchased during the month was two covered station wagons and one pick-up truck, all of one-half ton capacity. These were Ford cars and immediate delivery was made by the Ruddle Sales and Service Company of Hilo, whose bid was $27.00 higher than that of a San Francisco firm, but as it would have taken several weeks to secure delivery from the coast, and one day delivery was assured by the local bidder, the award was made as mentioned, as the trucks were urgently needed and were all put to work the day they were delivered. Delivery was also secured on desk chairs, file cabinets, typewriter, oil stoves, and numerous other minor items of equipment as well as supplies. Bids were taken on building material for the new ranger cottage, on which work was started on June 30.

Hawaii National Park and the Geological Survey made an effort to be included in the Navy contract for gasolene, kerosene and lubricating oils for this district but up to the present writing we have not heard whether or not we were included. In view of the delay in being advised, a local bid was sent out and has been accepted conditionally in order to take care of our needs, beginning with July 1, until such time as we are definitely notified whether we are included in the Navy contract.

The local bid was 16 cents per gallon for gasoline, maximum, as compared with 16½ cents for 1931, and the kerosene oil is to be furnished at 12 cents per gallon as against 19 cents last year. There are savings also on the prices for lubricating oil. However, the Navy contract provides for furnishing gasoline to the Kilauea Military Camp in the park at 10½ cents per gallon and we hope that we can avail ourselves of the privilege of buying our gasoline at this price.

170 Plans, maps and surveys.

We received preliminary plans for the new administration building and also for the residence for the U.S. Commissioner, both of the buildings to be of stone. The plans of both buildings are being carefully checked and studied at the present time. My general reaction to the plans for the administration building is that we do not have enough room for the offices that this building should contain and the plan, as submitted, does not fit our building site very well. Some changes will also be required in the plans for the Commissioner's residence. Our suggestions will be sent to the landscape division within a few days.

180 Circulars, placards, publicity bulletins, etc.

There are attached copies of the weekly Volcano Letter, issued during the month of June, also copies of the leaflet issued by the Inter-Island Steam Navigation Company advertising the Kilauea Volcano House, Kona Inn, and the Kilauea Summer Camp during the summer season, and quoting the special reduced summer rates that prevail. This leaflet was sent to some 5,000 school teachers and business and professional people on the islands and, in addition, the advertisement has been running in the Honolulu newspapers for several weeks and they have also advertised over the radio broadcasting station KGU twice weekly. There are also inclosed publicity articles from the Maui News which resulted from the Superintendent's inspection trip to the Haleakala section of the park.

200 MAINTENANCE, IMPROVEMENTS AND NEW CONSTRUCTION

210 Maintenance

The sky-lights in the new lecture hall at Uwekahuna Observatory were found unnecessary and as they interfered with the showing of motion pictures, they were removed and placed in the toilets at the Observatory and at the Halemaumau pit where they were particularly needed in order to provide additional light. The doors, which had shrunk, were also repaired and covered with tin. The Mauna Loa trail from Bird Park as far as the giant Koa, was cleaned up by the removal of loose stones, the cutting of overhanging branches, and the trail placed in good shape. A new sign was put up at the giant Koa, giving the approximate age and measurements. One or two signs were also placed at junction points on the trail.

The Studebaker car had a new gasolene gauge installed, a new electric windshield wiper, night driving lamp, a clock, and side wings.

220 Improvements.
Dr. Jaggar was given permission to build a seven car garage on the site of an old building, also to put in sky-lights in his machine shop and board up one end, all of which has added materially to the convenience and appearance of the Geological Survey utility area. A flag pole was put up at the entrance ranger station on the Hilo road.

A new telephone line was built from Park headquarters to the Hilo entrance station. This line was built on the poles of the Hawaii telephone company, with their permission. This provides telephone service to the quarters of Ranger Williams.

A concrete floor was put in the gas and oil house.

An extension was made to the telephone line and electric line service to provide service at the bachelor ranger quarters in the utility unit.

Sixty steel fence posts were ordered to fence an area near the sea coast where coconuts are to be planted.

Six miles of new trail were built from the Hilina Pali to the west toward the Kapapala Ranch, from which point it swings around, keeping within the park boundary, passing Mauna Iki, and terminating at the Uwekahuna Observatory. Attached are some pictures showing the reconnaisance party engaged in laying out the trail and some of the country over which it passes. The Keana Bihopa road under improvement during the month of May was finished about the middle of June and a worth while improvement has been made. A corral on the meadow was erected at Hilina Pali to serve for the holding of horses engaged on trail work at the present time and later this will provide a place for horses of visitors or park employees who stay over night.

230 New construction.
Work on the road improvement by the Bitulithic Concrete and Paving Company, Honolulu, has been very disappointing during the past month. A few men were started to work at clearing on the road near the fern jungle and as soon as a reasonable amount had been cleared to keep them busy for some time on construction, we stopped further clearing until the construction work could catch up, in order to avoid unsightly places standing for long periods of time. The crew was then transferred to shoulder work on the round-the-island road below the Kilauea Military Camp, and were thoroughly inexperienced in this type of work so that they were laid off and a new crew was engaged. Mr. Emil Mueller, the general superintendent, has been sick in bed at Wailuku with an attack of influenza, and all operations are almost at a standstill. Work should have been started on erecting their camp a month ago and while they have promised repeatedly to get started on this work, nothing has yet been done. Resident Engineer Handley has taken up the matter vigorously, not only with their local representatives but also with Engineer E. W. Wheeler, at Honolulu, and he has taken up the matter with the Honolulu office. They have been advised that if they do not get busy soon the Government will take over the prosecution of the work.

On June 18 they asked permission to open a new quarry site off the road between the Hilo entrance station and the Volcano House instead of using the material in the present camp quarry site, mentioned in the specifications. Their request was based on claimed better quality of rock, and a shorter haul. After investigation I disapproved of the plan on the ground that all bids were submitted with the idea of using rock from the present quarry, that without tests it was impossible to tell whether the rock at the proposed new quarry was of better quality, and there was not sufficient benefit to the Government to warrant considering this site, as it would mean a new quarry face and, in spite of all the care that might be taken, it would cause considerable destruction of ferns and trees and other vegetation. Fourteen thousand cubic yards of material is needed for this construction. The company was so advised by telegram.

The Park Service laid out the first of the ranger cottages for family use on June 30, and work will be carried forward rapidly during July.

240 Improvement of approaches to the park.
The largest contract on the Kona road is the Wheeler-Williams section and has been under construction since last year. Henry W. Hattema, superintendent of construction, reports that about 90 per cent of the cuts and fills have been completed and a start has been made in the placing of the asphalt surface on the north end.

The Ames-Wills contract is about 75 per cent completed. One mile of finished road is now ready for traffic. All of the cuts and fills have been completed. Otto Medeiros is working two sections in this district and is about half through with the work.

300 ACTIVITIES OF OTHER AGENCIES IN THE PARK

310 Public service contractors.
The Kilauea Summer Camp opened on June 20, as per schedule, but has entertained only a few guests at a time during the month. Mrs. William Baddaky, who has been in charge of this camp for the past four summers, is again managing the camp this year. The Inter-Island Steam Navigation Company seems to be making more effort to advertise the camp this year, attention being invited to the leaflets attached. They have also broadcasted their advertisement. The Volcano House hotel continued to serve the public with its usual service.

Mr. M. Earle Adams, publisher of the Healdsburg Tribune, of Healdsburg, California, a member of the California Press Association, in describing their trip to the islands in a newspaper article entitled "Vacationing in the Hawaiian Islands" and his only complaint is about the Volcano House.

Mr. Maehara operated the photographic service, and is providing good service at reasonable prices.

Mr. R. J. Chandler, vice president and general manager of the Los Angeles Steamship Company, conveyed his interest in improvement and development program of the park, as outlined to him in a letter written last April, in which he stated that the hotel problem in the park is a big one, and it is especially difficult to stir up interest in it during this period of depression. He expects to visit the islands next fall and promises to visit the park to look further into the matter.

The Canadian Pacific Railway liners, which call at Honolulu, will reduce their second-class passenger fares on August 1. From Vancouver to Honolulu and vice versa on the "Empress of Japan" and the "Empress of Canada" the fare will be $85 instead of $90, and on the "Empress of Russia" and the "Empress of Asia" $70 instead of $90. Reduction has also been made on the fares from Honolulu to Oriental points. Announcement was also made that these liners will resume their calls at the port of Honolulu on eastward voyages of the Vancouver-Orient run next March, in view of the steadily increasing appeal that Honolulu has for tourists. The Inter-Island Airways Company continues to handle a fair volume of tourist business to the park and they have recently announced that they have carried 15,129 passengers and flown 431,345 miles since the service was inaugurated on November 11, 1929. The Hawaii Tourist Bureau is continuing to advertise the Hawaiian Islands with their attractive ads and there is attached to this report a copy of their advertisement which appears in the magazine "Time" for July 1931, and in the "National Geographic Magazine" for September 1931. Particular attention is invited to the fact that they are now concentrating attention on the Hui o Pele organization in connection with the Hawaii National Park, instead of the Hole-in-One Club which I have induced them to eliminate from further ads.

317 Status of authorized projects of contractors.
The Bitulithic Concrete and Paving Company is not making satisfactory progress with their road work in the park. Details of the situation are to be found under the head of 230, New construction.

320 Cooperating Government agencies.
U. S. Attorney Sanford B. D. Wood, and Judge William B. Lymer were in the park June 13 to confer with the Superintendent on the appointment of a U.S. Commissioner. He advised that the principal difficulty in securing the interest of a satisfactory appointee appeared to be the lack of suitable living quarters, and that with the construction of quarters authorized by the last Congress, a satisfactory appointee could probably be selected. The views of the Superintendent as to the type of man and his qualifications were outlined and the cooperation of both Attorney Wood and Judge Lymer was promised.

400 FLORA, FAUNA AND NATURAL PHENOMENA

410 Ranger, naturalist and guide service.
The ranger department was engaged during the month on maintenance and repair of roads, trails, telephone lines and signs, making patrols, handling traffic, guiding visitors and giving special attention to park visitors on ship days when the crowds were larger.

Naturalist and guide service: Much of the time of the new park naturalist was spent in getting acquainted with the park, studying the educational program as it has functioned in the past, as well as studying the possibilities for improving and extending the educational service rendered to the public. During the month he took charge of the lectures at the Uwekahuna Observatory and has conducted a number of parties over various trails. The lecture given at the Uwekahuna Museum is introduced with the material suggested in Washington Office Order No. 230, on May 20, 1931, following which explanations are given of Hawaiian volcanic activity, as well as earthquake activity. The lecture is accompanied by slides and a motion picture reel. The numerous favorable comments made after the lecture indicate that the pictures shown and the explanations given contribute much to the visitor's appreciation of the natural phenomena.

The hike over the Halemaumau trail has been the most popular trail trip in the park. Its popularity is, to a certain extent, due to the fact that the hike works nicely into the program of the overnight visitor. Along this trail one sees typical park vegetation and the interesting lava formations on the floor of Kilauea Crater.

During the month special parties were conducted to Mauna Iki, an area of hot volcanic vents, to Bird Park, a region rich in interesting vegetation, and along the Chain-of-Craters road, a series of volcanic craters some of which have been recently active. As an experiment, on the night of June 27, the park naturalist invited a group of 16 to participate in a drive along the Chain-of-Craters road in the moonlight. Those making the trip expressed sincere appreciation for the opportunity of seeing not only the craters by moonlight, but also the steaming earthquake cracks and the fern jungle.

One of the outstanding events of the month was the week's visit of 36 boys and five leaders from Pearl Harbor and vicinity. Most of these boys were the sons of officers in the Navy. The group, headed by Commander William N. Thomas, Chaplain, U.S.N., were guests at the Kilauea Navy Camp in the park. Among the boys present were Lawrence Judd, son of Governor Judd, Harry Sterling son of Rear Admiral Sterling, U.S.N., and Ernest Scott, son of Colonel E. D. Scott, of the U.S. Army. During the week this group was in the park the educational department spent five half days conducting the party over various trails and giving special lectures. Since the group returned to their homes the Superintendent and Park Naturalist have received several letters expressing appreciation of the service of the park staff.

Fourteen field trips were conducted during the month, with an attendance of 260 and 19 lectures were given with an attendance of 463. Full details appear on Form A, attached to this report.

440 Insect control.
Peculiar parasites were found on some of the peach trees near headquarters and were removed by members of the ranger staff on June 29.

Preliminary spraying of the Silver Sword plants in the crater of Haleakala was started on June 22. There were quantities of flies hovering around the plants and evidence of a borer in the root as well as in the stalk, with worms in some of the seed pods. Specimens of the Silver Sword were taken and shipped to Mr. Otto H. Swezey, entomologist of the Hawaiian Sugar Planters Association, Honolulu, who is cooperating with the Park Service in plans to protect these rare Silver Sword plants from becoming extinct.

460 Birds.
Ranger Williams reports seeing a total of 43 cock pheasants and 12 hens during the month on his patrols, principally along the Chain-of-Craters road. They are known to be numerous also in other sections of the park.

480 Natural phenomena.
There is not much of special interest to report regarding the Kilauea volcano for the month of June. Weekly reports are prepared by Dr. Thomas A. Jaggar and are printed in the "Volcano Letter" attached to this report. The amount of steam and fume from the pit was small throughout the month. The amount of sulphur on the floor of the pit has been found to be steadily increasing during the past six months. Two small slides occurred during the month, and 117 volcanic tremors were recorded by the seismographs. Two feeble earthquakes were felt locally during the Month of June, the first at 6:51 P.M. on June 11, having its origin under Mauna Loa, and the second at 10:45 A.M. on June 16, calculated to have originated about eleven miles distant. Ground tilt for the month varied from WSW to ENE.

It is interesting to note the volcanic activity which occurred during the month in Japan. On June 23 Tokio was rocked by an earthquake a second time in less than a week, and the volcanoes Yakegatake and Mount Asama erupted violently. The following day Iogatake and Mount Hachido, on the island of Kuchiyerabu became active, making four Japanese volcanoes active within a week. As Hawaii National Park is on this same volcanic rift, we are looking forward to a period of activity here before long.

490 Miscellaneous
The ranger force has been destroying nasturtium plants along the roads and trails in order to eradicate this plant which is growing wild and spreading rapidly where not controlled.

500 USE OF PARK FACILITIES BY THE PUBLIC

510 Increase or decrease in travel.
There was a total of 7,647 visitors this month compared with 7,818 for the same month last year. The park shows a travel increase of 61.5 per cent for the year, however, due to the large number that came in last November and December when the volcano was active. Full details are shown on Form 10-157, attached.

520 General weather conditions.
The weather was ideal during the month of June. There was 1.85 inches of rain, compared with 6.82 inches for last year. The unusually low rainfall and the continuously cool breeze aided the bright weather in creating much dryness and dustiness.

The maximum temperature was 74° on June 3, and the minimum 49° on June 16, compared with 71° maximum and 52° minimum for the month of June last year. The total rainfall to date this year is 19.05 inches, as compared with 42.90 inches for last year. The humidity ranged from 71, minimum, to 95, maximum, which is a very high humidity.

As a result of the lack of rainfall there has been a shortage of water at the Kilauea Military Camp and Navy Camp during the month.

540 Visitors.
Congressman Joseph L. Hooper and wife, of Battle Creek, Michigan, member of the committee on public lands and insular affairs, was in the park June 3 and 4, as commented on under Paragraph 125.

W. P. Popham, landscape architect of the Iowa State College, was in the park June 23 and 24. Mr. George Lycurgus, proprietor of the Hilo Hotel, was a visitor to the park June 8 and again on the 16th, and called at the Superintendent's office each time. Mr. Lycurgus formerly operated the Volcano House, prior to its control by the Inter-Island Steam and Navigation Company and gave the park Superintendent a great deal of information concerning the park and the hotel operation. Mr. J. W. Waldron, president of the Volcano House Company, with his wife and daughter, was in the park June 8, remaining several days.

Professor A. C. Alvarez, who teaches structural engineering at the University of California, and Mrs. Alvarez were in the park for one week, June 22 to 29.

600 PROTECTION

610 Police protection.

Kazuo Okamoto, waiter at the Volcano House, was brought to the office and questioned concerning a charge of carrying a message from a bootlegger in Hilo to soldiers at the Military Camp. As he could not be definitely connected with bootlegging activities, and as he had been employed at the Volcano House for the past eleven years, he was penalized by being laid off by Mr. Gandy for a period of one week.

620 Fire protection.

A fire which burned about one-fourth acre started along the road near Makaopuhi crater on June 13, evidently having been started by a cigarette carelessly thrown by a visitor. The damage was nominal.

630 Accidents.

Two minor automobile accidents occurred during the month, one on June 15, when a car ran off the road near the Hilo entrance station because of attempting to make a left-hand turn while driving at a high rate of speed. A similar accident occurred on June 20, and the damage was nominal. On June 7, Asaye Kitahara, 14, a Junior High School girl, died at the Olaa Hospital from injuries received when the car in which she was riding went out of control and ran into a telephone pole. The girl was thrown through the windshield and her throat was so badly cut that she died a short while after being admitted to the hospital. Miss Kitahara was one of a group of about forty young people who had graduated from the Waiakea Japanese school and were en route to Hawaii National Park for a picnic and to spend the day, and for whom special arrangements had been made to give the lecture and show the motion pictures at the Government museum. The driver of the car and two other girls who were passengers were badly shaken and cut but their injuries were not serious.

640 Destruction of predatory animals.

One wild pig and two domestic cats running wild were killed during the month.

900 MISCELLANEOUS

Church services: Church services were held at the Kilauea Military Camp on June 21 by one of the chaplains of the U.S. Army.

Federal Business Association: Oren C. Wilson, of the Customs Service was elected president of the Hilo Federal Business Association, W. H. Silva vice president, and R. H. Anderson secretary, at the meeting held June 5.

Flag Day was observed in Hilo under the auspices of the B.P.O.E. on June 14.

Dr. Jaggar's plan for preparedness in case of earthquake or volcanic catastrophe, as outlined to the Hilo Chamber of Commerce, is printed in full in the Volcano Letter of June 18.

The old Lyman residence in Hilo was formally opened to the public as Hilo's first museum on June 20. Gathered beneath the roof of this old dwelling are invaluable relics of the old days of Hawaii. In yesteryears the kings and queens of Hawaii knew and loved the Lyman family and the Lyman residence.

The golf sign advertising the 19th Hole of the Hole-in-One Club, on the edge of the Halemaumau pit has been removed.

Mrs. Carmen Yardley who, with her husband Mr. Ralph J. Yardley of the Stockton Record, members of the California Press Association, visited the Hawaiian islands and Hawaii National Park in May, wrote a very interesting article describing the trip and the islands, which appeared in the Stockton Record of May 23.

Mr. J. F. Craemer, vice president of the California Press Association, of Orange, California, also has written a very interesting article about the trip, as has Mr. M. Earle Adams of Healdsburg.

There were 6 appointed and 19 non-appointed employees in this office at the beginning of the month, compared with 5 appointed and 9 non-appointed for the same month last year. At the close of the month there were 6 appointed and 21 non-appointed, compared with 6 appointed and 12 non-appointed last year.

Very respectfully,

E P Leavitt

E. P. Leavitt,
Superintendent.

Form No. 1009—Met'l.

U. S. Department of Agriculture, Weather Bureau.

COOPERATIVE OBSERVERS' METEOROLOGICAL RECORD:

Month of June, 1931, 192 ; *Station,* Volcano Observatory, *County,* Kau

Hour of Observation, 8:00 AM

State, Hawaii; *Latitude,* ; *Longitude,* ; *Time used on this form,* [illegible]

DATE.	TEMPERATURE. Maximum. (1)	Minimum. (2)	Range. (3)	* Set Max. (4)	PRECIPITATION. Time of Beginning. (5)	Time of Ending. (6)	† Amount. (7)	Snowfall, in inches. Humid. (8)	Wind / Depth of Snow on Ground at Time of Observation. (9)	Prevailing Wind Direction. (10)	Character of Day, Sunrise to Sunset. (11)	‡ Miscellaneous Phenomena.
1	73	56	17	66			14	90	Lt.	NE	PC	
2	73	59	14	67			02	80	"	"	"	
3	74	58	16	69			01	77	Variable		"	
4	75	54	21	70			T	73	Lt.	NE	Clear	
5	73	54	19	62			01	84	Mod.	"	PC	
6	73	55	18	62			05	94	Lt.	"	"	
7	76	59	18	67			5	80	Lt.	"	Clear	
8	75	56	19	66			02	84	"	"	"	
9	72	54	18	67			03	81	"	"	PC	
10	71	54	17	64			06	82	"	"	"	
11	72	59	13	62			04	84	"	"	"	
12	69	55	14	63			T	80	Str.	"	Clear	
13	70	56	14	60			04	89	"	"	PC	
14	72	57	15	66			T	71	"	"	Clear	
15	72	56	16	63			T	90	Mod.	"	PC	
16	72	49	23	62			55	89	"	"	"	
17	66	56	10	63			03	81	"	"	"	
18	69	56	13	65			19	80	Str.	"	"	
19	69	56	13	60			08	89	Mod.	"	"	
20	69	57	12	64			09	79	Str.	"	"	
21	71	56	15	64			08	85	Mod.	"	"	
22	73	56	17	65			17	84	"	"	"	
23	72	55	17	64			05	84	"	"	"	
24	70	56	14	62			06	89	"	"	"	
25	75	56	19	63			T	95	"	"	"	
26	73	57	16	62			04	85	Str.	"	Clear	
27	72	59	13	65			5	80	"	"	"	
28	71	54	17	62			T	83	"	"	"	
29	71	56	15	65			09	91	Mod.	"	PC	
30												
31												
Sum	[illegible]	[illegible]	482	1860			1.85	2433				
Mean	69.4	54	15.4	62			.60	80				

* Reading of maximum thermometer immediately after setting.
† Including rain, hail, sleet, and melted snow.
‡ Thunderstorms, halos, auroras, etc.

_______________, *Cooperative Observer.*

(IN TRIPLICATE.) See cover for instructions.

Post-Office Address, _______________

8—213 GOVERNMENT PRINTING OFFICE

MONTHLY SUMMARY.

TEMPERATURE.

Mean maximum, 69.4

Mean minimum, 54.0

Mean, 61.7

Maximum, 74; date, 3

Minimum, 49; date, 16

Greatest daily range, ____

PRECIPITATION.

Total, 1.85 inches.

Greatest in 24 hours, .55; date, 16

SNOW.

Total snowfall, ____ inches; on ground 15th, ____ inches; at end of month, ____ inches.

NUMBER OF DAYS—

With .01 inch or more precipitation, 22

Clear, 8; partly cloudy, 22; cloudy, 0

DATES OF—

Killing frost, ____

Thunderstorms, ____

Hail { Light, ____ / Moderate, ____ / Heavy, ____

Sleet, ____

Auroras, ____

REMARKS:

10-157
(July, 1929)

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

TRAVEL REPORT

Hawaii National Park for the month of **June, 1931**

	This Month	This Travel Year To Date	This Month Last Year	Last Travel Year To Date	Increase for Travel Year: Number	Increase for Travel Year: Percent
PRIVATE TRANSPORTATION:						
Cars first entry, ...						
Cars reentry, ...						
Motorcycles, ...						
Total motor vehicles, ...						
Persons entering via motor vehicles, ...	6,890	90,048	6,857	51,343	38,705	75.3
Persons entering via other private transportation, ...	320	2,805	269	2,158	647	2.9
Total persons entering via private transportation, ...	7,210	92,853	7,126	53,501	39,352	73.5
OTHER TRANSPORTATION:						
Persons entering via ~~stages~~ Hotel, .	421	6,026	692	7,724	-1,698	28.1
Persons entering ~~via trains,~~ Summer Camp .	16	16	--	--		
Persons entering otherwise, . .						
Total other transportation, .	~~437~~	~~6,042~~	~~692~~	~~7,724~~	~~-1,682~~	~~27.0~~
GRAND TOTAL ALL VISITORS, . . .	7,647	98,895	7,818	61,225	~~37,670~~	~~61.5~~

	This Year	Last Year	~~Increase~~ Decrease: Number	~~Increase~~ Decrease: Percent
Automobiles in public camps during month, ...	1	2	1	50
Campers in public camps during month, ...	4	4	-	-

10-158

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

STATUS OF AUTHORIZED PROJECTS

Hawaii National Park for the Month of June 1931

	Description of Projects	Percent Constructed To Date	Percent Constructed This Month	Percent Constructed Last Month	Probable Date Completion
405	Warehouse ——— ———	100	——	100	
406	Toilets (Kilauea) ———	100	——	100	
407	Toilets (Uwekahuna) ———	100	——	100	
408	Gasoline and oil building	100	2	98	
409	Ranger station, Entrance	100	——	100	
410	Naturalist's quarter ———	100	——	100	
411	Ranger's quarter ———	100	90	10	
451	Telephone lines ———	100	5	95	
502	Kilauea Iki Trail ———	100	——	100	
502	Mauna Loa Trail ———	100	——	100	
502	Summer Camp Trail ———	100	——	100	
502	Steaming Bluffs Trail ———	100	——	100	
502	Kipuka Bihopa Trail ———	~~x100~~	——	~~x100~~	
	Improvement and extension	100	20	80	
502	Extension of Auto Trail Uwekahuna to Halemaumau	100	5	95	
502	Hilina Pali - Mauna Iki Extension ———	30	30	000	July 15, 1931
	Road Survey, B.P.R. ———	100	——	100	
	Road Survey, B.P.R. Construction ———	03	02	01	

10-215
(July, 1928)

UNITED STATES
DEPARTMENT OF THE INTERIOR
National Park Service

45334

Hawaii National Park

REPORT OF NON-APPOINTED PERSONNEL
(TEMPORARY)

Changes outside the District of Columbia for the month of JUN [illegible] 19 31

Total at beginning of month	Additions	Separations	Net Gain or loss (a)	Total at ending of month
Permanent 28	1	1		[illegible]
Temporary 19	4	[illegible]	[illegible]	21
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

(a) If loss, indicate by minus sign.

10-159
(May, 1931)

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

STATUS OF PERSONNEL

Hawaii National Park for the Month of June, 1931

	This Month		This Month Last Year	
	Appointed	Non-Appointed	Appointed	Non-Appointed
Number of employees beginning of month	8	19	5	9
Number of additions	1	4	1	5
Total	9	23	6	14
Number of separations	1	2	0	2
Number of employees close of month	8	21	6	12
Number of promotions during month	0	0	0	0
Aggregate amount of annual leave taken	1 Day	0	3 hrs.	0
Aggregate amount of sick leave taken	0	0	0	0
Aggregate amount of leave without pay	0	0	0	0

10-160

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

REPORT OF PARK REVENUES

Hawaii National Park for the Month of June, 1931

	This Year	Last Year
Park revenue on hand beginning of month,	0.00	0.00
Received,	0.00	50.00
Total,	0.00	50.00
Remitted,	0.00	50.00
On hand close of month,	0.00	00.00

Park revenues received this year to date,	1,225
Park revenues received last year to date,	1,225
Increase,	None
Per cent of increase,	None

10-161

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

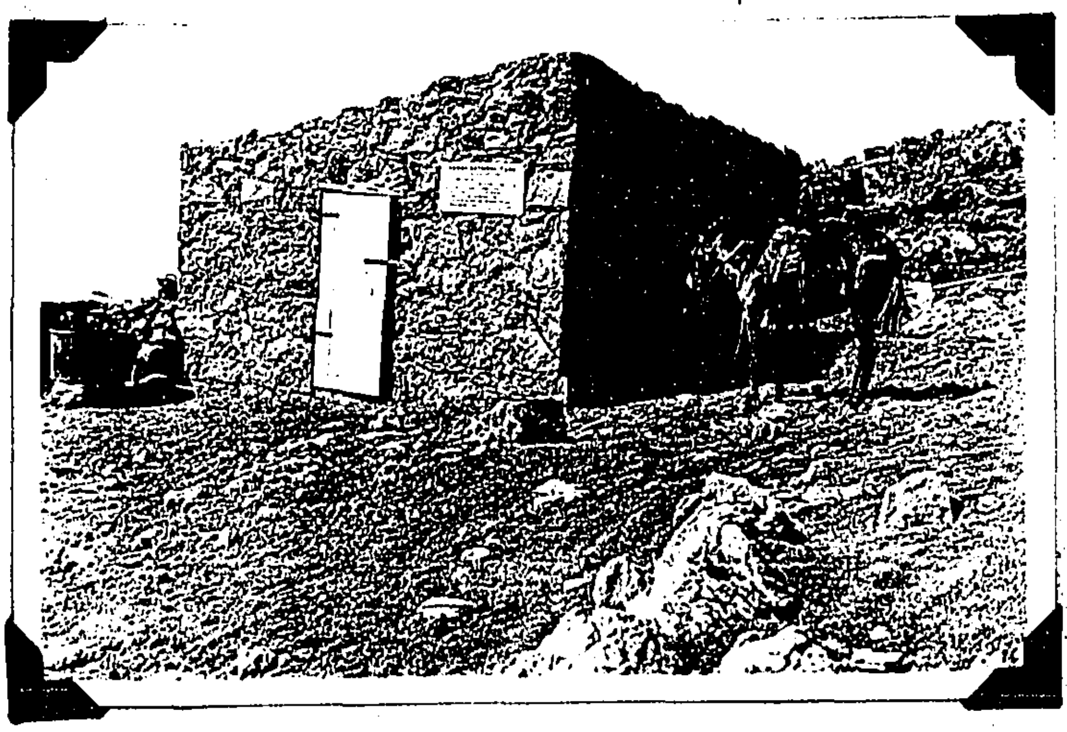
REPORT OF SALES OF PUBLICATIONS

JUNE 1 9 3 1

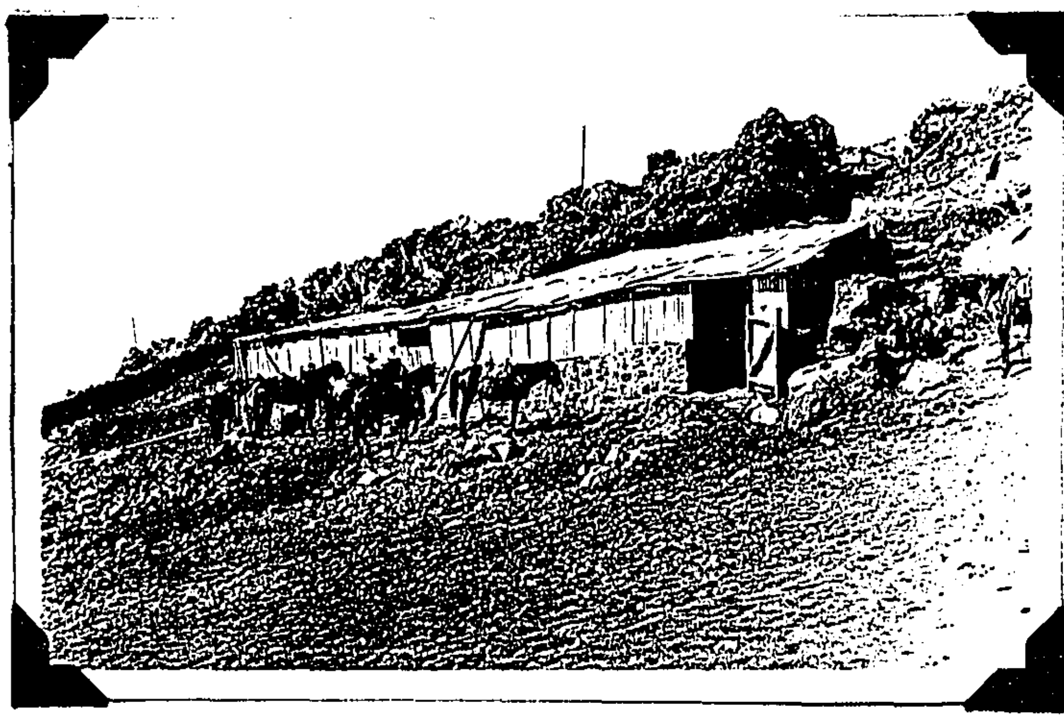
	Number	Value
GOVERNMENT PUBLICATIONS:		
On hand beginning of month,	309	56.85
Received during month,	0	
Total,	309	56.85
Sold during month,	5	4.85
On hand at close of month,	304	52.00
NON-GOVERNMENT PUBLICATIONS:		
On hand beginning of month,		
Received during month,		
Total,		
Sold during month,		
On hand at close of month,		

Cash on hand beginning of month,	25.90
Sales during month,	4.85
Total,	30.75
Remitted during month,	0.00
Balance,	30.75

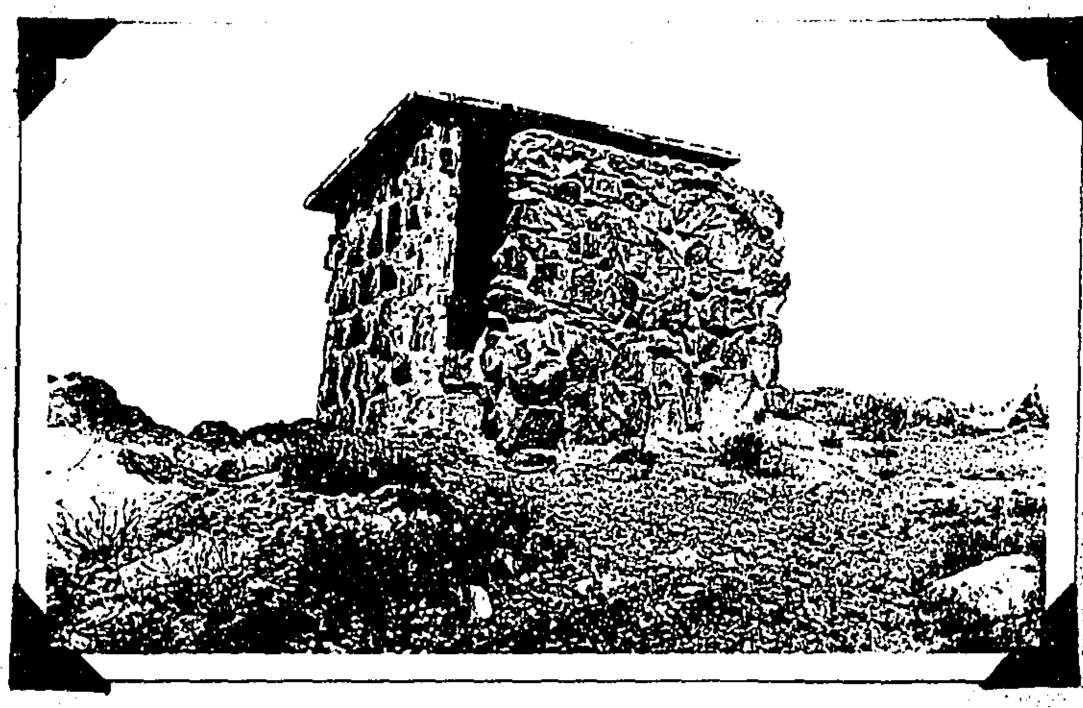
The main rest house building at Haleakala. It has maximum sleeping accommodations for sixty people. Oil cook stoves, oil heaters, oil lamps, cooking utensils, dishes, tables, chairs, double metal bunks, small library and water system and dry earth toilet facilities are provided. It was built by the Maui Chamber of Commerce and others interested in developing a tourist travel to Haleakala, and is operated by the Chamber of Commerce at the present. The charge for the use of these facilities overnight is $2.00 per person.



The original rest house on Haleakala, now used as a storage room for equipment and forage for pack and saddle horses used in taking tourists from Olinda, end of the present auto road, to Haleakala section of Hawaii National Park. 6/20/31/.

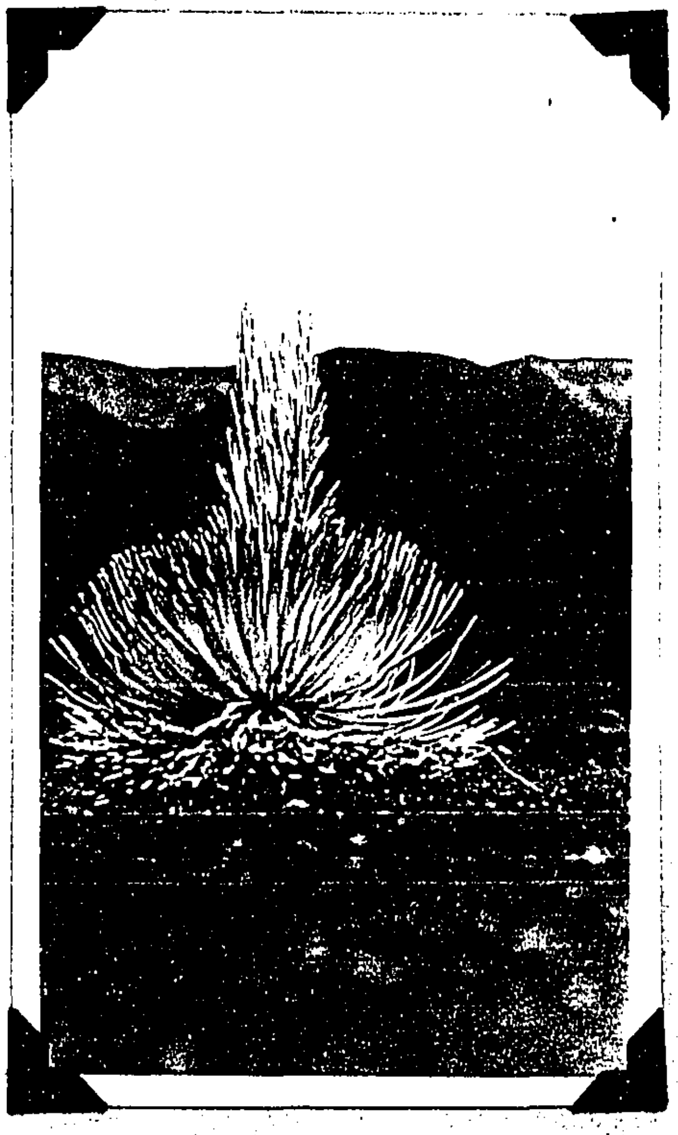


The stable at Haleakala. It is built against a lava bluff to afford protection from the strong winds that are very cold at this 10,000 foot elevation. It has a stone wall in rear, and roof and part of sides are of corrugated iron. The floor is uneven and rough and the whole layout is merely thrown together. It should be entirely rebuilt and a lot of rock work is necessary. It will shelter 16 animals at present. 6/30/31



Stone building comfort station for women at Haleakala section of Hawaii National Park.

A similar structure is provided for men. 6/20/31



Silver Sword in crater of Haleakala section of
Hawaii National Park about to bloom and seed. 6/21/31

MAUI NEWS, WEDNESDAY, JUNE 24, 1931

Begin Spraying Silver Swords Haleakala Pit

Work Begun Monday Under Ranger J. H. Christ In One Area Crater

CONDITIONS BETTER

No Immediate Danger For Extinction of Unique Haleakala Plant

Preliminary spraying of the silver sword plants in the crater of Haleakala is already under way, according to Hawaii National Park Superintendent Leavitt and Ranger J. H. Christ, who spent the week-end in a tour of investigation throughout the crater.

The party found quantitie of flies hovering around th plants, and evidences of a de structive root borer as well a insect depradation to the see pods of the plant.

On the whole, however, the found conditions better tha they had expected with regar to the plant so unique to th particular region. Worth (Aiken, a member of the part who is thoroughly familiar wit crater conditions for the pa 30 years, stated that in his o inion the silversword plan are now more plentiful in som areas than at the time of h last visit.

New plants are springing up, an there seems no immediate dange of extinction of the species. Lea vitt's party did find, however, tha great number of young specimen have died back from the effects o insect ravages.

Leavitt took with him several specimens of the infected silversword to be sent for examination and study to Otto H. Swezoy, entomologist with the H. S. P. A., who last year recommended the program which is now being carried out by the National Park service to protect the plants.

To Cover Blooms

Supt. Leavitt and most of his party returned to Wailuku Sunday, but Ranger Christ remained on the mountain to arrange with two local men to inaugurate the spraying system, designed to kill certain of the insect pests. He personally supervised the beginning of the work before sailing for Hilo yesterday with Supt. Leavitt.

Christ will return again in the near future and will divide the rest of his time this year between Kilauea Park and Haleakala, where he will keep in constant touch with the progress of the campaign against silversword pests, to be carried on intermittently.

Leavitt himself plans to return again during the summer months to inspect the progress being made and the effect of the spray on the plants. Then in the fall at flowering season he and Ranger Christ will see to the covering of the silversword blooms with netting or other fabric to protect them from insects destroying the seed pods.

Early next year the park director hopes to have funds for erection of permanent ranger's living quarters and park station on the boundary of Haleakala National Park, and thereafter Ranger Christ will be park representative on this island.

In the meantime, Supt. Leavitt said Monday, the National Park Service will greatly appreciate the cooperation of the local community with Ranger Christ in his work on Haleakala.

SAVING THE SILVERSWORD

Superintendent E. P. Leavitt of Hawaii National Park system and his chief ranger, J. H. Christ have taken definite steps to save the silversword of Haleakala from the ravages of pests.

Last weekend the chief of the park system and his ranger journeyed to the summit and for three and one half days investigated conditions in the crater.

On his return to central Maui Leavitt told newspaper representatives that evidences were found of destructive root borers and insects preying on the seed pods of the silversword.

On the week-end journey was Worth O. Aiken. Worth was making his 100th trip to the summit of Haleakala. It was the fourth time he had initiated a park superintendent to the beauties of the scenic spot and he is about as competent a guide as could be found.

His verdict regarding the pests is cheerful. "I think the plants are not in immediate danger og extinction," he declared, "but I am glad to see the interest displayed by Superintendent Leavitt and Ranger Christ. The glory of Haleakala will not suffer under their administration."

The words of Aiken are reassuring. Haleakala is not only the property of Maui, it is the property of every American who loves beauty and scenic wonders. To Messrs. Leavitt and Christ go the responsibility for keeping that natural and wild beauty intact. The zeal and efficiency with which they have tackled the job are convincing and they have the support and co-operation of Maui every inch of the way.

Maui News, Wed. June 24/1931

Leavitt Urges Developing Of Tourist Travel

Park Superintendent Advises Commerce Chamber Give Serious Study

PARK WORK STARTING

Repairs To Trails And Springs Get Under Way This Summer

"I believe the Chamber of Commerce should give serious thought and study to the development of a real tourist business on this island, so that an efficient service will be mapped out and ready to get under way just as soon as the road to the summit of Haleakala is completed.

"The trip to the mountain top is very worth while; the combination of crater views, cloud rack, sunrise and sunset effects, is most unusual. Indeed there is probably nothing else like it anywhere in the world.

"I can see a great future development for the entire Haleakala section which will benefit the community in countless ways."

Such was the opinion expressed by Hawaii National Park Superintendent E. P. Leavitt on returning this week-end from his first trip to the crater of Haleakala.

Such, too, was the trend of his remarks to the Maui Chamber of Commerce at the special luncheon meeting called for yesterday noon at the Grand Hotel.

Supt. Leavitt, accompanied by Park Ranger Joseph H. Christ, arrived on this island last Wednesday evening from Hilo on his first tour of National Park areas on this island.

In a party with E. J. Walsh of the Chamber of Commerce, Worth O. Aiken, and Forester William Crosby, the two park men left Friday for the summit, taking Arizumi and Joe Silva as their guests.

Both Friday and Saturday nights they spent at the Rest House, riding down into the crater Saturday, visiting cones and inspecting the silver sword, and returning by Halemau Trail late that afternoon. They came down to Wailuku on Sunday.

Plan Immediate Action

Monday morning Supt. Leavitt was enthusiastic about the possibilities of development in the Haleakala National Park Area.

Protection of the silversword from insect pests has already been started, and the new park director announced several other improvements which will get under way in the immediate future.

The trails he found to be in a good condition generally, save for thousands of loose rocks which he plans to have cleared away in the very near future. Most trails he finds to be very well located.

The park service, moreover, will start immediately on construction of a new horse trail connecting the Rest House with the upper end of the Halemau Trail. That will make an easy circular route for the horse-back traveler, down the Sliding Sands, across the crater floor, up the Halemau Trail, and back to the Rest House.

"We also plan to develop what-

The new structure would be located in the White Hill area, close to the old battleground which holds so much historic interest. The site affords plenty of space for automobile parking and also for horse stables.

Feed for the horses could be kept at that spot, and the Rest House would then be used as headquarters for an easy three-day ride down the Sliding Sands, through the Crater, and back by Halemau Trail—a trip which would not be too difficult for tourists unaccustomed to riding.

The Park Director also foresees some sort of hotel erected before very many years pass, probably just outside the lower boundaries of the park.

Stresses Element of Comfort

In talking of the probable tourist development of the Haleakala trip, and indeed of the entire Maui travel which he anticipates, Leavitt stressed the fact that comfort is probably the most essential feature demanded by visitors here.

Because of the time and money necessitated for a tour of Hawaii, the majority of tourists to these islands are beyond middle age. Such tourists are looking for comforts, and are not satisfied with hardships or the makeshifts that younger travelers accept without thought.

Such, then, are the tourists that Maui must prepare to accommodate at Haleakala park as well as on other sight-seeing trips.

"Sell" Longer Trips

Transportation companies, hotels both here and on other islands of the group, and such interested organizations should begin planning a cooperative tourist service, according to Supt. Leavitt who has had 20 years of experience with park service and tourist travel at Yosemite National Park.

Rates, care and attention to visitors' wants, should be uniform throughout the islands and should be of high standard, he said.

Leavitt especially urged that as many tourists as possible be "sold" to longer trips of three and six-day duration rather than the present hurried tour.

By allowing six days instead of two the tourist himself is more apt to leave with a feeling of having got his money's worth for he has had opportunity to get acquainted with the island, its people and institutions. Moreover, that will allow variation of schedule according to weather conditions.

Such trips too prove infinitely more profitable to the community, bringing in more money to shops, hotels, guides, and the like.

Probably a large number of the tourists to Hawaii, who are traveling at their leisure, would find much greater enjoyment in a six-day visit than a hurried two-day tour, said Leavitt.

Aiken Enthusiastic After 100th Trip To Haleakala Summi

Worth O. Aiken is still a Mau booster, though Hawaii directorie may state his residence as Hono lulu.

At present he is spending sever al weeks on this island, and from Friday to Sunday made the trip to the crater of Haleakala with Park Superintendent Leavitt and his party.

It was Aiken's 100th visit to the summit of the grand old mountain; yet in his case familiarity in no wise breeds contempt. On the contrary he returned Sunday afternoon at a high pitch of enthusiasm, claiming that weather conditions and the like were more perfect this week-end than during any of his other 99 trips to the summit.

Always an enthusiast as regards development of Haleakala and its environs, Aiken spent much of his time with Supt. Leavitt and Ranger Christ during their stay on this island.

Maui May Get Influx Visitors Other Isles For Summer Months

In addition to its regular summer quota of mainland tourists, Maui may have an influx of visitors from other islands of the Territory this summer.

That, at least, is part of the program which the Hawaii Tourist Bureau is sponsoring, according to word just received from headquarters in Honolulu.

The first step in this campaign for encouraging travel to Maui, Hawaii and Kauai, has been the distribution throughout Honolulu of large posters featuring the colored "cartographs" of the neighboring islands, drawn by Ruth Taylor White.

Most Maui residents are already familiar with the animated maps which have been appearing as full page color advertisements in main land magazines recently. The artist visited this island last year, along with all the other main isles of the Territory, while getting material for her clever cartoons.

Because the cartographs have been received with such interest throughout the mainland, the Tourist Bureau believe they will be just as effective in encouraging inter-island vacation travel during the summer months. The maps are accordingly being used in connection with regular tourist advertising in the new campaign posters.

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"We also plan to develop whatever springs may be located in the crater and around the outer rim," said Supt. Leavitt. "Right now several of the springs which usually carry water are dry. This will be done in connection with the trail repair work."

Locate Entrance Station

While at the summit, Supt. Leavitt and his party rode through the area to be traversed by the new Federal Road, and selected general sits for a new Rest House and the official Park entrance station.

The entrance station, with its accompanying dwelling for the resident park ranger and local headquarters office, will be located on the new road close to hte lower boundary of the park. A water supply is close at hand there, and plenty of pasturage is afforded.

Funds for this work will probably be available early next year. Work on this unit starts just as soon as the road is completed enough to facilitate transportation of building materials and the like, and thereafter Maui will have its permanent ranger and local headquarters.

Plan New Rest House

A new Rest House is also included in Supt. Leavitt's plans.

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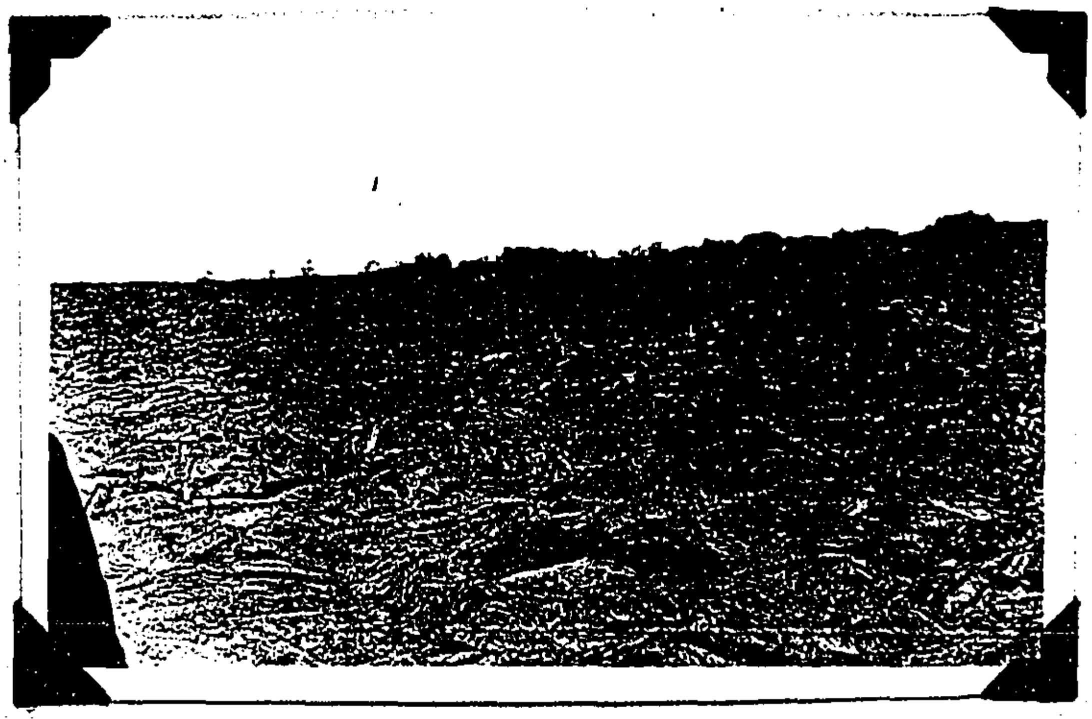
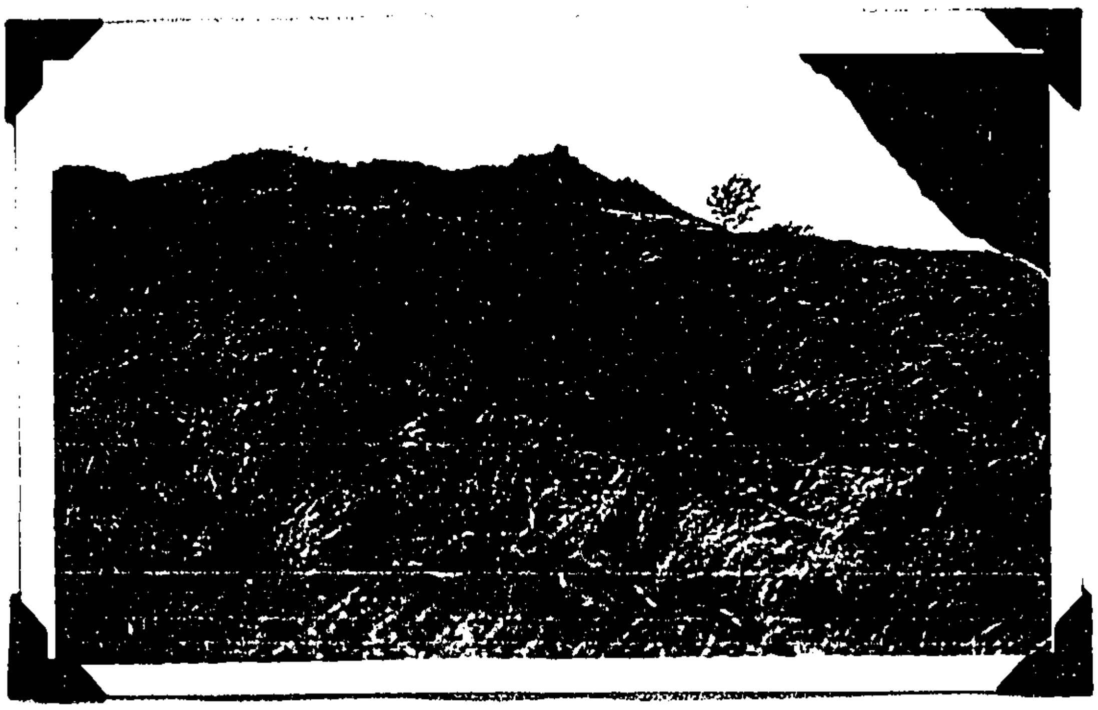
Three new Ford trucks received by Hawaii National Park June 25, 1931. Numbers 1137 and 1138 are station wagons providing shelter for the loads so necessary in this rainy climate, while 1135 is a pick-up express.

Reconnaissance party laying out a new trail extending from Hilina Pali Rest House toward the west to the park boundary, then turning north to the Uwekahuna Observatory. It keeps about a mile within the park boundary. It opens up a new park area and is interesting because of the ever-changing character of the country through which it passes. Starting out through a grassy open country, the trail passes through forests of ohia trees, then through kipukas or meadows, then over flows of lava, some rough and some smooth, and at all times are within sight of the indigo blue ocean with its white capped waves and white surf at the shore line. The trail will be used by visitors on foot and horseback and will be useful in park patrol.

The picture shows Foreman Albert MacKenzie at left, and Hawaiian guide Levi Kaiako at their camp near the Kapapala Ranch water tank near the end of the old Puna trail which follows along the southern side of the park between the ocean and the first pali or cliff. Picture by Ranger Joseph H. Christ.



Example of pahoehoe (smooth) lava over which the new trail will pass. This is part of the Kamooali lava flow. Most of this flow is aa, or rough lava. Picture by Ranger Joseph H. Christ.



This picture shows both grassy and lava country, and a triangulation station on the high point of the lava flow. Trail passes close to the tree shown. Picture by Ranger Joseph H. Christ.

Reconnaisance party on old Puna trail shown in foreground. The new trail as laid out is a few miles north of this one. Lava flows, earthquake cracks and no water were some of the difficulties encountered. Picture by Ranger Joseph H. Christ.

A volcano with a Membership!

Pele, Hawaiian goddess of volcanos, has signed and "sealed by fire" more than ten thousand certificates in the "Hui O Pele" (Society of Pele).

Hundreds of thousands more who have visited our great National Park in Hawaii have viewed Pele's awesome home and have seen her in many moods.

Whatever the mood, her vast estate is intensely interesting. Near the crater you will find formations of fine-spun lava (Pele's hair). You'll explore great lava tubes which she has tunneled, a chain of smaller craters (her children), lava moulds, native bird inhabited jungles, giant ferns, fantastic flows of lava—centuries old and two years new. The world is still in the making in Hawaii.

A trip to Hawaii need not be expensive. A round trip from the Pacific Coast, including all-expenses afloat and ashore can be made for less than $350.

The Hawaii Tourist Bureau will, upon request, mail you FREE, authoritative information about the Islands—costs, what to see and do, etc.

For a special book on Hawaii, profusely illustrated in full color, with picture maps, enclose 10c in stamps or coin to defray handling charges.

HAWAII

HAWAII TOURIST BUREAU
(OF HONOLULU, HAWAII, U. S. A.)
225 BUSH STREET, SAN FRANCISCO or 1151 SO. BROADWAY, LOS ANGELES

MATSON Line *from* SAN FRANCISCO

215 Market St., San Francisco	535 Fifth Avenue, New York	140 So. Dearborn St., Chicago
723 W. Seventh St., Los Angeles	814 Second Avenue, Seattle	271 Pine Street, Portland, Ore.

LASSCO Line *from* LOS ANGELES

730 So. Broadway, Los Angeles	140 So. Dearborn St., Chicago	535 Fifth Avenue, New York
685 Market St., San Francisco	213 East Broadway, San Diego	412 Thomas Building, Dallas

ANY TRAVEL AGENT WILL GIVE YOU FULL PARTICULARS

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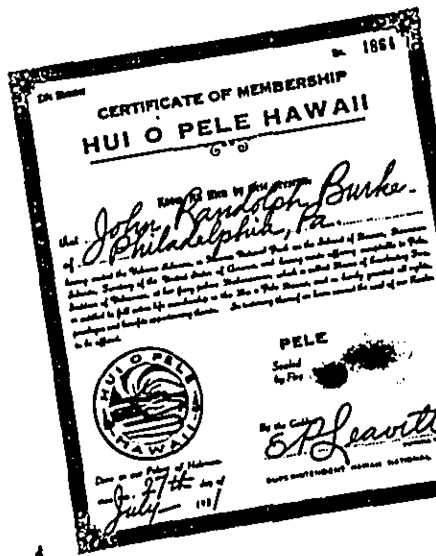

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The cost of the roundtrip from the Pacific Coast—all expenses—need not exceed $300. Write for details.

HAWAII

HAWAII TOURIST BUREAU
225-C BUSH STREET, SAN FRANCISCO
1151-C SOUTH BROADWAY, LOS ANGELES
MATSON Line *from* SAN FRANCISCO
LASSCO Line *from* LOS ANGELES

215 Market Street, San Francisco — 271 Pine Street, Portland, Ore.
730 South Broadway, Los Angeles — 535 Fifth Avenue, New York
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SF 52-C   2⅜x8½   NATIONAL GEOGRAPHIC   SEPT., 1931

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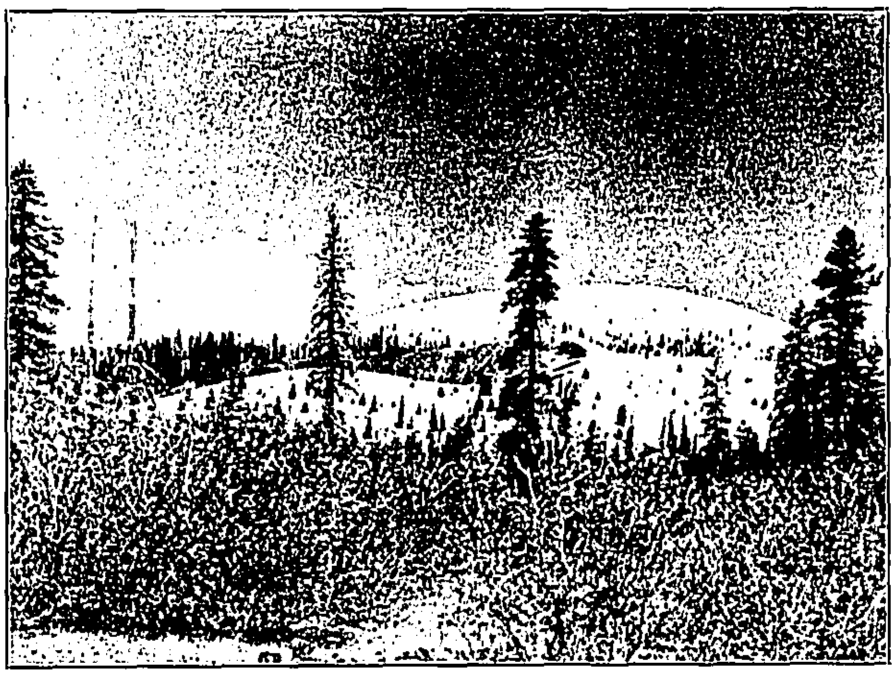
San Francisco

The Volcano Letter

Two dollars per year | Ten cents per copy

No. 336—Weekly | Hawaiian Volcano Observatory, National Park, Hawaii | June 4, 1931



Pumice Stone Mountain, west of Medicine Lake, California, seen from the south. The white pumice closely resembles snow. Photographed July 13, 1930.

LASSEN REPORT No. 29

SOME WORK OF THE LASSEN VOLCANO OBSERVATORY 1930

R. H. Finch, Associate Volcanologist.

Mount Harkness Seismographs

A two-component Hawaiian-type seismograph has been installed in the basement of the fire lookout observatory of the National Park Service on the summit of Mount Harkness, 12 miles east-southeast from Lassen Peak, California, elevation 8,039 feet. The instrument was started in operation on August 21, 1930, but owing to early snows Mr. H. C. Lind, the fire lookout and seismograph operator, was called away a little before the last of September and only a little over a month's record was obtained. The observatory building is located near the summit of a cinder cone that rests upon a lava base. Some earthquakes were recorded better on the Mount Harkness instruments than on the ones at Mineral.

Tilt

All instruments needed occasional attention to correct for tilting. The accumulation of tilt from the Mineral seismographs appears to be less during 1930 than in former years. Coincidental with a southwest tilt at Mineral there was a southeast tilt at Harkness. Of course, it is not yet know whether the Harkness tilt is local or not.

Earthquakes

The seismographs at Mineral recorded 74 earthquakes during the year. These disturbances by month were as follows:

January	5 shocks	July	7 shocks
February	7 "	August	5 "
March	5 "	September	4 "
April	4 "	October	4 "
May	5 "	November	14 "
June	0 "	December	14 "

The numbers recorded during the last four years are as follows:

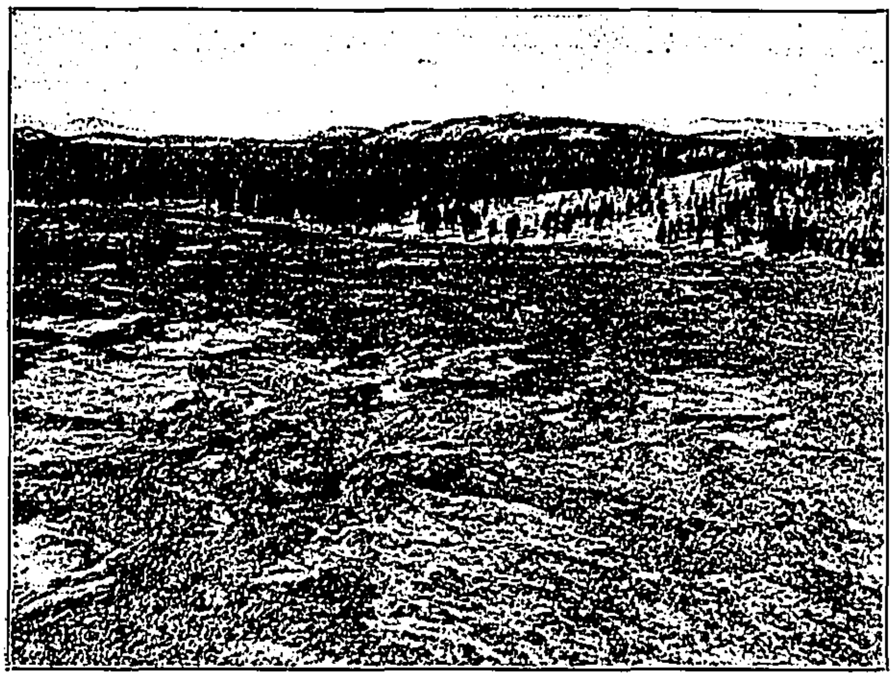
1927	266 shocks
1928	37 "
1929	96 "
1930	74 "

As in the preceding years, nearly all of the shakes had their origin in the Lassen massif.

Rainfall

The total precipitation for each of the last four years was as follows:

1927	43.32 inches
1928	42.10 "
1929	38.65 "
1930	38.94 "



View taken July 12, 1930, looking westerly across Burnt Lava Flow from edge of High Hole Crater.

Burnt Lava Flow

In July a topographic map of Burnt Lava flow, to the southwest of Glass Mountain and south of Medicine Lake, and 80 miles north-northwest from Lassen Peak, was made and specimens collected. Dr. C. A. Anderson, of the University of California, is to make a study of the specimens and a report of the flow will be prepared for publication.

Hot Springs Temperatures

Temperatures of springs at Morgan Springs on August 6, 1930, air temperature 88° F. follow:

Spring	Temperature	Remarks
No. 1	156°F	Algae and encrusted salts.
No. 2	125°	Very sluggish. Algae present.
No. 3 upper	196°	Less than normal flow. Some larvae present.
No. 3 lower	178°	
No. 4 east	195°	Flow very slight.
No. 4 west	164°	No. 4 area has been drained by ditching.
No. 4 clear pool	162°	
No. 9	.	No flow.
No. 17 steam at top	200.5°	
No. 17 hot water	201°	Volume as usual.
No. 20	200.5°	
No. 23 south	200°	
No. 23 north	196°	
Geyser	202°	Volume normal.

At Boiling Lake August 12, 1930, air temparature 82°:

Large mud pot northwest .... 196°
Boiler southwest edge of lake .... 195°
Boiling pool south edge of lake .... 194°
Dry steamer above south end of lake .... 201°
South end of lake .... 133°
North end of lake near outlet .... 121°

The water of boiling lake was about 12 inches below outlet. The lake level is the lowest it has been for several years according to Mr. Roy Sifford.

Temperatures at Devil's Kitchen August 12, 1930, were:

Mud pot northeast side .... 198°F
Mud pot north side .... 188°
Boiling pool north side, clear water 5 feet deep, small inflowing stream, no visible outlet .... 190°
Boiling pool north side, no visible inlet or outlet........ 196°
Large boiling pool north side with pyrite scum .... 194°
Steamer northwest end (poor exposure) .... 198°
Big boiler southwest side .... 196°
Steamer southeast side .... 198°
Big boiler east end. Pool 10 feet in diameter. Main part of boiling jets goes to a height of 46 feet, small jets reach 10 feet .... 196°
Steamer below Big Boiler .... 198.5°

At Bumpass Hell, air temperature 71°, the following were obtained August 14, 1930:

High western pool .... 193°
Mud pot west of No. 1 .... 194°
No. 14, East pool .... 188°
No. 14, Middle pool .... 191°
No. 14, Big steamer .... 201°
No. 16 .... 193°
Steam vent Bumpass Creek below Bumpass Hell........ 196°

Little Hot Springs Valley, August 14, 1930:

Clear pool east terrace .... 194°
Mud pot, east terrace .... 194°
Yellow pool .... 187°
Steam vent creek edge. Only fair exposure, steam emerging with considerable noise and pressure so that it was difficult to hold thermometer in vent even when tied rigidly to a stick .... 211°
Boiler surrounded by cold water in edge of stream...... 188°

At Supan's, August 15, 1930, air temperature 82°:
Big steamer (sometime in July this vent became more active and scattered mud for a distance of 40 feet from its edges) .... 194°F
Big steamer on October 31, Spring overflowing .... 192°

At Lassen Crater, August 20, 1930, air temperature 58°:
East vent near center of crater .... 132°
Middle vent under large rock .... 120°
Vent between two rocks north side of central area...... 162°
Steam vents above west edge of lake .... 146°

For earlier measurements of these temperatures at the various Lassen localities, see Volcano Letters Nos. 110, 162, 236, 238, and 279.

Land Slipping at Supan's

So many of the stakes were broken off that it was not possible to retape this area. Transit observations, however, failed to show any down-slipping. A new set of iron stakes was installed.

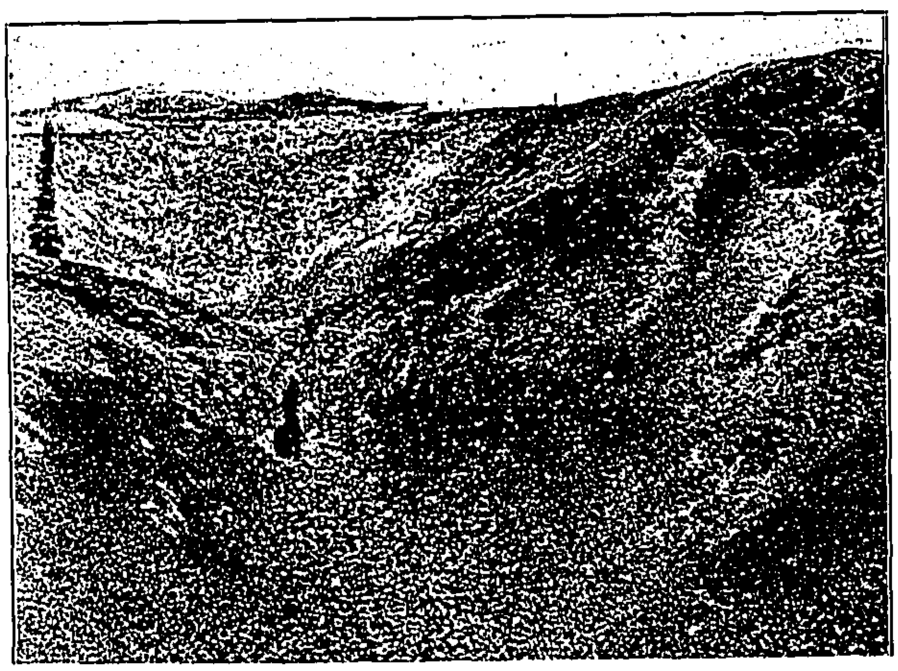
KILAUEA REPORT No. 1010
WEEK ENDING MAY 31, 1931

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

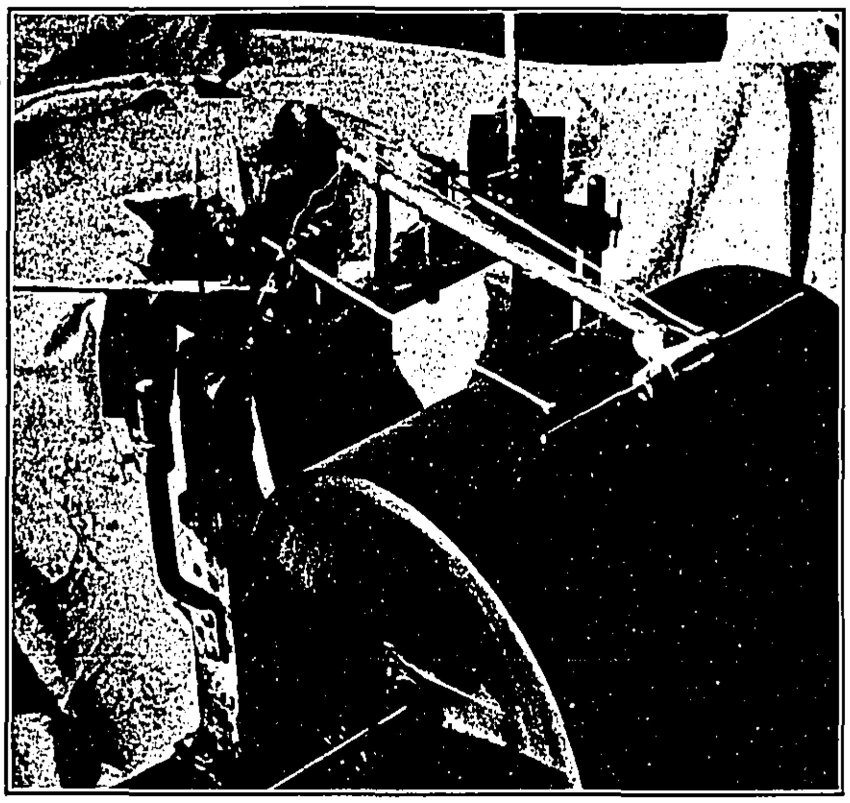
At the Kilauea fire pit on May 27, 11 to 11:15 a. m., steaming was slight at all the active vents, no steam showing on the south talus, a little on the west talus, and vigorous on the southeast rock bank. Fume was slight but steady at the west central sulphur area. A large scar from a slide showed on the north wall at the rim. At 1 p. m. a large dust cloud was seen rising north. On May 30 a very little steam showed on the south talus. Other conditions remained without changes.

The Observatory instruments registered 1 very feeble local seism and 33 volcanic tremors, including two and a half minutes of continuous tremor on May 25 and harmonic tremor from 4:06 to 4:24 p. m. May 29.

Tilting of the ground was moderate ESE. Microseismic motion was slight.



View showing the two parts of High Hole Crater in Burnt Lava Flow. Photographed July 12, 1930, by R. H. Finch.



Recording drum of Hawaiian Type Seismograph as installed at Mount Harkness. Drum covered with smoked "glassine" paper. Two pens write under the electromagnet, which lifts them every minute. They are connected with N-S and E-W arms. These are horizontal pendulums damped at the two small oil tanks. Drum moves along on its spindle.

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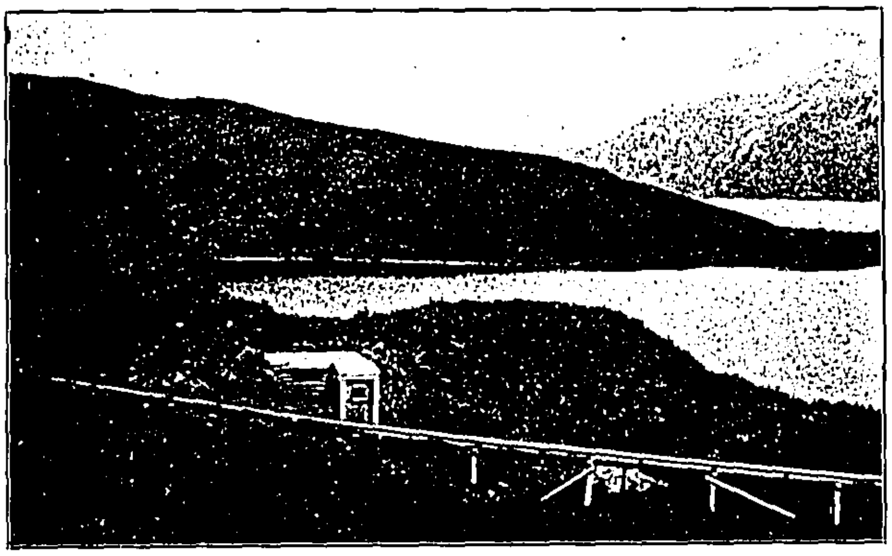


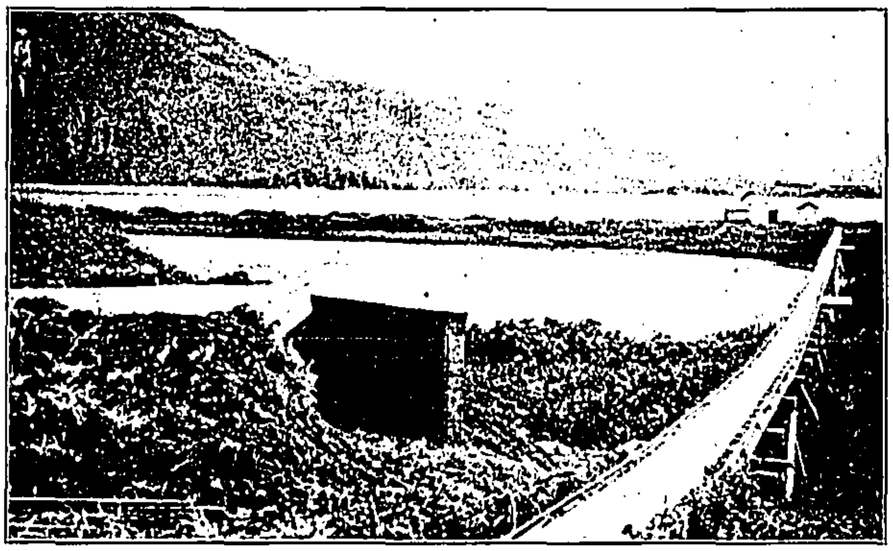
Dutch Harbor seismograph hut beside wharf tramway of Naval Radio Station as installed July 1929 by Austin E. Jones, so as to place instruments at some distance from the machinery. Looking east on Amaknak Island toward the entrance to Unalaska Harbor.

DIFFICULTIES OF ALASKAN EARTHQUAKE STUDY

The United States possesses one of the most important Volcano belts in the world in the Alaskan Peninsula and the Aleutian Islands. For a length of eighteen hundred miles from Attu at the west the ridge which separates Bering Sea from the Pacific Ocean extends in a pure curve northeast to Mount McKinley, rising higher and higher from islands at the west to the mightiest mountain in North America at the east. At the north is a shallow ocean, which is just as much a part of the combined Asia-America continent as is the Yukon Valley. It merely happens to be flooded with salt water in the present episode of geological time. At the south is the great Aleutian Deep reaching four thousand fathoms, a cleft or valley or sunken trough trending parallel with the Aleutian ridge, and in some way compensating the mysterious curved elevation. In like manner Japan is a curved ridge with the Tuscarora Deep east of it, with the outside of the curve toward the Pacific. Both places are famous earthquake belts with lines of volcanoes along the ridge. There are forty volcanoes reputed active in the Aleutian belt, many of them snowy peaks of greater and greater elevation as the line is followed northeastward to the upper part of the Alaskan Peninsula. The geology of the Peninsula and the islands shows folded sedimentary rocks of Mesozoic and Tertiary age, broken through by many igneous rocks, and overlaid by volcanic lavas and other accumulations along with glacial deposits.

The problem confronting the student of volcanology in such a place is to lay out a campaign for making use of the resident population to discover how many eruptions and how many earthquakes occur, where they occur in great number, what other movements like tilting of the ground are present, and in addition to explore individual volcanoes, promote mapping on land and sea, and gradually to acquire knowledge of places that may be used as strategic centers for continuous study of earth movements, hot springs, hot gases, and the action of lava underground.

The Section of Volcanology of the United States Geological Survey made a beginning in 1927 by establishing an Hawaiian-type seismograph in the Agricultural Experiment Station on Kodiak Island, shown on map of Alaska as the large island lying southeast of the upper part of the Alaskan Peninsula. In 1928 the volcanic area around Pavlof Volcano was mapped by the writer through an expedition conducted under the National Geographic Society. In 1929 another seismograph of the same type was established at the Naval Radio Station in Dutch Harbor on the island Unalaska (see Volcano Letter April 2, page one). Meanwhile an exploration had been made by way of reconnaissance all around the Peninsula and away out to Attu, in sequence upon a journey in a schooner through some of the eastern islands which had been made in 1907. All of this has shown us what the Aleutian lands are like, vast tundra flats with meandering streams on the north side of the Peninsula, rugged mountains and fjords crowned with



Seismograph hut at Dutch Harbor looking south, showing the harbor and mountains of Unalaska Island. Unalaska village just outside of picture on the right. Photo Jones.

volcanoes at the south, and these extending west through the grassy islands amid a climate of storms and fogs all the year around. There are a few villages of Aleut Indians and Eskimo, some canneries, huts occupied by winter trappers, and two or three sheep stations. Kodiak and Unalaska are the largest villages. In a few places there are resident white traders and officials throughout the year.

Until the present time, with between two and three years of record for the two seismographs at Kodiak and Dutch Harbor, there have been registered on the seismograms a few score local earthquakes and a very few distant ones. As a whole both places are disappointing in seismicity. Interruptions in operation due to storm and mechanical difficulties have been frequent. Storm microseisms are often so bad as to make seismic movements unrecognizable. Winter cold and wind and deep snow have produced rust and leakage and heaving at the unheated concrete huts, making endless trouble with the delicate clockworks, time pieces, electric contacts, wire connections and pivots which are essential parts of a complete two-component high-magnification seismograph. Neither Kodiak nor Dutch Harbor is actually at an active volcano, Kodiak being about 110 miles from Katmai and Dutch Harbor some twenty-five miles from Makushin.

The observers employed to tend the seismographs have all been devoted, conscientious women who were wives of officials or business men, and who do their utmost to keep the machines going even though the seismograph huts are buried under snow. The duties of these observers are fourfold: (1) to tend the seismographs, (2) to keep seismographs in repair, (3) to file and mail the seismograms, (4) to keep notes on volcanic happenings reported. It seems simple to anyone trained in physics to test the period, the damping ratio, the magnet adjustment, the tilt changes, the battery decline, and the time error of a pair of pendulums and an electrically connected eight-day regulator pendulum clock marking minutes and hours. It does not seem simple to untrained people buffeted by one of the most rigorous climates in the world, and with inspection by seismologists only at intervals of a year or more. All of this in a place without electric lights or watchmakers, where procuring supplies is difficult, where the building is unheated and the cold is intense, makes seismological registration a very different matter from Hawaii or California where supplies and assistance are abundant.

The following is from Mrs. M. V. Watkinson, the operator at the Kodiak station, who has to walk from her dwelling a mile or so up a hill to the seismograph chamber in an abandoned milk house of the Agricultural Experiment Station:

"February 21, 1930. We have had a great deal of trouble with the seismograph. The weather has been very severe, the natives say the worst for the last 40 years, so that all the water mains have been frozen. The storm has been almost continuous for twenty-eight days and has not broken yet. The time lift of the pens is not working right. The annunciator wire became saturated with moisture, in fact moisture was dropping down from walls and ceiling of room, and there were beads of water making a short between the wires. I changed the wires to waterproof covered ones, but this did not remedy the trouble. We found that the contact points of the clock were sticking, and fixed that. On February 4 and 5 the weather was so bad it was impossible to make my way up the hill. I started but had to turn back. Finally the seismograph went out of commission altogether owing to the heaving of the posts by frost. I have the machines running again, but not properly as the posts heaved diagonally. Yesterday I made the bumping test for period" (this is made by a light hanging weight giving a measured acceleration to the heavy mass).

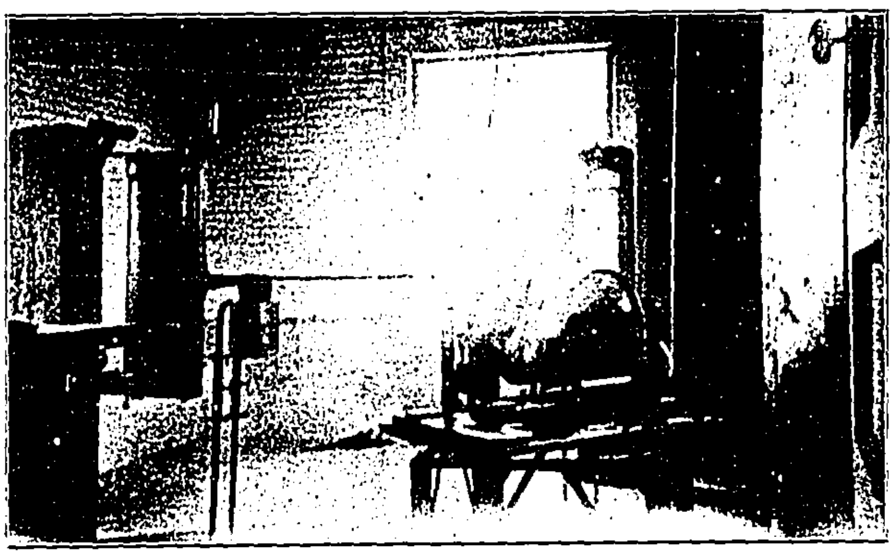
"March 22, 1930. The continual severe weather has driven a number of halibut boats into port for repairs. The weather has been so extremely cold, with regular blizzards of snow, that it has been impossible to stay in the chamber more than a couple of hours at a time in spite of the oil heater. The records I am now sending do not mean much beyond recording the process of trying to get the machine to run properly.' On another day came the news of an epidemic of influenza with the operator and her two sons ill. In January another violent storm was reported "raging so that it was impossible to face it up the hill." A note of December says "there is no record for the 15th as the new driving clock would not fit. We were so disappointed as there were earthquake shocks next day, and we had numerous inquiries from up and down the coast as to whether they were recorded here, and it kind of hurt to have to tell that our instrument was out of commission."

The following are human documents from the journal of Mrs. Esther Wendhab, wife of Naval radio operator at Dutch Harbor, who tends the seismographs:

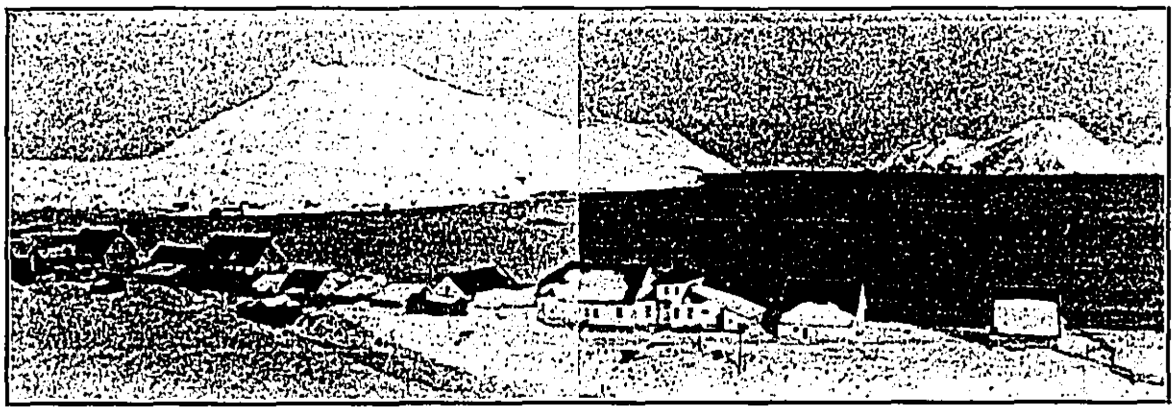
'March 18, 1931. Got 'stormed in' away from home and was unable to change the records. March 23: Was afraid to go out in the northwest wind on the icy trail. Captain Nelson of the Eunice reported a volcano smoking terribly with thick black fumes, where before he has only observed white steam, at Tulik on Umnak Island. He passed it March 21 and so unusual was its action he believes it is about to erupt. There was no record on the seismograph. March 29: Two earthquake shocks this morning, and the needle that has been causing trouble made the best record. April 2: The clock is going wrong again. The minute contact points are worn and get dirty very fast. I believe it will keep causing trouble, but I will do my best."

"February 18, 1931. Took mail to town and it stormed so badly I could not get home at all, so did not change record until following monrning. February 20: No trace of the seismograph building, had a hard time finding it, as all landmarks are under snow. Found it by the huge bank of snow that I've been piling up to get to the door recently. February 23: No chance of getting down to change record today. Terrible storm and blowing SE at seventy-five miles per hour. Will have to use the long stick again, to prod around to find the building, because even the snowbank will be gone now. February 26: The pen point came out again and stopped writing. Weather so bad nearly impossible to get down trail. Natives born and raised here (a year later than Mrs. Watkinson's report) call it the worst winter they ever witnessed, with the most snow, twenty feet deep in many places and getting worse. Have to find the building and dig it out every time now. March 2: Worked all day yesterday and fixed the arm. Put it on this morning after I finally got in. March 14: Had to fix the clock again as the points were dirty, but have it going. Weather still bad and sorry I have the work to do in such bad weather. They tell me this is the last month of that and then I believe it will be a pleasure again. It will be so much easier that it will make up for some times I've nearly frozen getting there, I'm sure. There is no news locally about any disturbances."

This sort of heroism in the cause of science deserves going on record, and was not contemplated when these stations were established in summertime. These documents show why the writer is so anxious to perfect a simple seismograph to register numbers and intensities of local shocks. Geographical distribution of shock-recorders is more important than attempts at precision where precision is impossible. Twenty shock-recorders placed with school teachers or trappers in different places in Alaska, some of these living very close to an active volcano, will tell more than precision instruments, until such time as a large observatory may be established there. T.A.J.



Early model Hawaiian-type, two-component, horizontal pendulum seismograph installed in dairy house Agricultural Experiment Station, Kodiak. In this model the damping vanes, in adjustable oil tank, are near the heavy masses, which are filled with sand and weigh approximately 160 pounds each. Magnifying levers write on smoked paper on the drum. Paper changed and shellacked daily. Time clock in same room, corrected by telephone from radio station. Photo Jones.



Unalaska in winter time. Seismograph station of U. S. Geological Survey is among the snowy hills on the left. Photo Yatchmeneff.

KILAUEA REPORT No. 1010

WEEK ENDING JUNE 7, 1931

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

On June 1 at Halemaumau pit of Kilauea Crater very faint fume could be seen at the sulphur spot on the floor, and vapor was thicker at the southeast rock wall at edge of floor than at the south talus. On June 3 the pit seismograph indicated quiet conditions and the rock wall steamed less. At 9:30 a. m. June 6 a slide occurred at the north wall.

Thirty tremors and one very feeble local seism were registered at the Observatory, the latter at 8:41 a. m. June 6, indicating distance of origin 25 miles. Tilting of the ground was slight WSW., and microseismic motion was slight.

TILTING OF THE GROUND FOR MAY

The following figures show the net amount of tilt by weeks at the Observatory on the northeast rim of Kilauea Crater, and its direction, computed from the daily seismograms by platting a curve smoothed by overlapping progressive seven-day averages. This is the departure of the plumbline in the direction given.

May 4-10	0.9 second E.
May 11-17	1.8 seconds SW.
May 18-25	11 seconds SSW.
May 26-June 1	7.7 seconds SSW.

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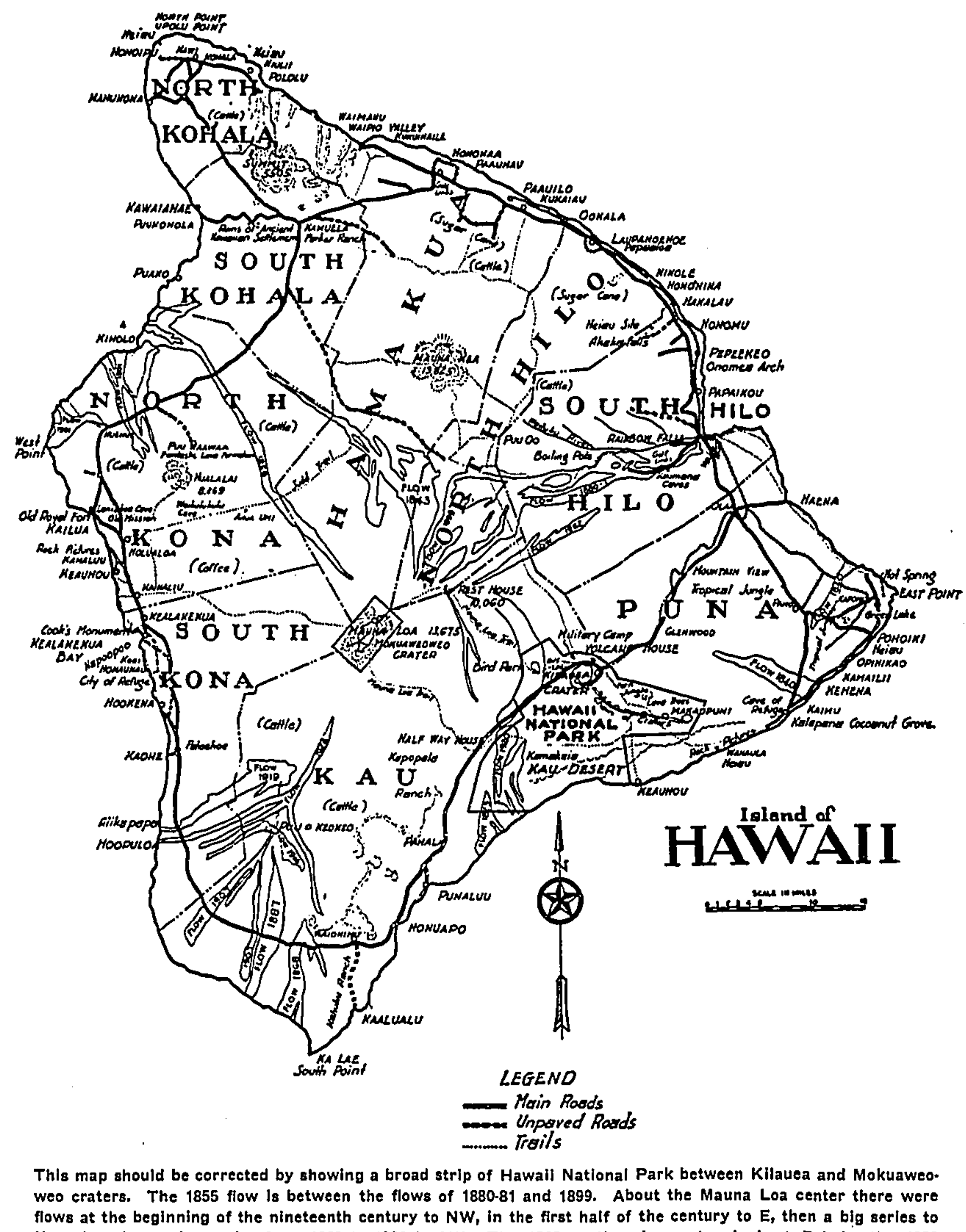

This map should be corrected by showing a broad strip of Hawaii National Park between Kilauea and Mokuaweoweo craters. The 1855 flow is between the flows of 1880-81 and 1899. About the Mauna Loa center there were flows at the beginning of the nineteenth century to NW, in the first half of the century to E, then a big series to N, and an increasing series from 1868 to 1926 to SW. The 1868 earthquake centered about Pahala, the 1929 about Hualalai. ("Flow 1901" at West Point is misprint for 1801.)

PREPAREDNESS AGAINST DISASTER

Address before Hilo Chamber of Commerce June 9, 1931, by T. A. Jaggar.

Recent Disasters

Recently there have been earthquake disasters in Japan, Mexico and New Zealand. The Napier earthquake in New Zealand has awakened the world again to the problems of fire following terrific earthquake at a place of population congestion, just as at San Fancisco in 1906, and at Tokyo in 1923.

Hilo, Hawaii

To the Associated Engineers of Hawaii January 16, 1918, I talked on the "index of danger from volcanoes," showing that the four classes of disaster to a volcanic land had happened in Hawaii. These are:

Class I, Explosion and volcanic blast
Example, Kilauea in 1924
Class II, Lava flow
Example, Hilo in 1881, Hoopuloa 1926
Class III, Earthquake
Example, Kau 1868, Puuwaawaa 1929
Class IV, Tidal wave, Example Puna shore 1868,
Hilo 1877, 1923

As each of these is represented by damage in this century, the topic is a live one. We have recently seen in addition terrific wind storms in Honolulu and rain floods damaging shops in Hilo. The wind combination along with lava flow or earthquake might be very serious for Hilo.

The 1918 lecture was published in Bulletin of Hawaiian Volcano Observatory January 1918, tidal wave damage in Hawaii was reviewed in Volcano Letter No. 321, and the cycles of Hawaiian volcanic happenings in Volcano Letter No. 325.

Napier Earthquake

The best way to envisage preparedness at Hilo is not to speak in hushed whispers because we are timid about frightening tourists away from our real estate. This is the attitude of some mainland cities. The insurance attitude is the correct one, expect fires, but put them out. If a terrific earthquake wrecks Hilo, let us in Hilo make a perfect demonstration of calm, unruffled preparedness, with the ready service of supplies that General Pershing had when he jumped in and helped at Chateau Thierry. There is no use in having hysterics about these things nor in publishing anything. The thing to do is to keep quiet and get action.

Now let us see what happened at Napier. Wherever you were, in your car, on the road, standing indoors, standing outdoors, suddenly there comes a tremendous crash like and explosion and down you go. Everything goes down, houses, bridges, gulches, cliffs, fires start, road fills crack open, automobiles fall into the cracks, wharfs are all down, some of the shipping is grounded, the breakwater has settled out of sight in places. In other words, the enemy has hit Hilo with a Big Bertha. The railway is out of commission, emergency telephones are called for as the wires are all down, the water mains have burst, the sewage is interrupted, the fire engines are pinned in their houses, the roads are interrupted by landslides. More than all, the people are struck dumb with shock, and until a warship arrives, to which this sort of thing is all in the days work, the population is dependent on whatever leaders happen to be soldiers.

Rescue parties are organized to dig out the wounded, portable cranes are in demand. Explosives must be used to demolish tottering masonry, which is likely to kill more people with the thousands of aftershocks that are coming along. Temporary wireless is one of the first requirements as the radio masts are down. Airplanes are summoned to rush anesthetics and medical supplies, for these things have given out. They have to be carried by air. A large number of tents are needed for temporary hospitals, and the roads interrupted by slides and cracks are not immediately available for carrying people to towns which suffered less. Sea transportation is organized as fast as possible by wireless, but that takes some time. The water supply being cut off, it is necessary to get in a chlorinating plant, organize a road survey immediately, and start work on pipes for an auxiliary water supply from a place where fresh water is available. The contents of the banks are laid wide open as well as many other valuable safes and cash drawers, and martial law is immediately organized by soldiers and constables who understand such things, a ring of pickets is run around the city, looters are shot on sight by marine guards. The jail prisoners are called out for digging, and do heroic work of rescue. Many motorists are caught in gorges and gulches and search parties have to be organized to seek them. The post office department is entirely disrupted and a quick reorganization is called for, as inquiries begin to pour in by mail as soon as any partial organization has been made; people inquire for the safety of their relatives. All lights go out at the very beginning and the organization of a temporary lighting plant and the cleaning up of wires is of first importance when the darkness of night settles over ruins, where work has to continue with the aid of flares, and where valuables have to be guarded.

Necessarily the Navy and shipping are of great use, and there were three ships which reached Napier. A small, compact, efficient, relief committee was found to be the first requirement at Napier and the organization of an information bureau to answer inquiries. Within a week when outsiders arrive to bring relief, there is need of quarters to correspond with the destroyed hotel, and there is need of increased wharf facility. Free meals have to be organized with the relief funds. Now there is need for a card record of hospital cases, of which there were 2,200 at Napier. The stoppage of the sewers and the bad water supply made it necessary to get together as many trucks as possible as soon as the road gangs had opened a way to get out of the district, and 5,000 people were evacuated from Napier and Hastings to a neighboring town which had not suffered, Palmerston. Palmerston organized itself to receive the transport of refugees. There was an acute clothing shortage, and notices had to be placed in newspapers of other towns instructing the public what to send, for they sent too many groceries and too little clothing. The loss at the central towns was of the order of $15,000,000. Fire insurance was simply not paid, for the situation was just the same as at San Francisco and Tokyo, and companies when they do write risks involving conflagration always reinsure with other companies. Only when earthquake is specified, and fire resulting from earthquake, and when these risks are paid for, can there be any expectation of restoration by insurance. After the event in all these cases, San Francisco, Tokyo, and Napier, insurance companies wrote earthquake risks. This is always done without any logic, on the part of the owners seeking insurance, who try to save the horses after the barn is burned down. Then after 45 or 50 years when there is real danger, everybody has forgotten it, insurance has been withdrawn, the building code has been relaxed, and it all happens over again. Such is human nature.

Organization for Preparedness

Every city should have a small committee of far-seeing men accustomed to administer discipline, representing commerce, public health, police and national guard, transport, and statistics. These people should have a clean-cut war problem with map of the city, just as war problems are worked out by General Staffs. The needs in time of disaster may be small or big, local or general, but the big possibilities should be looked at so that nobody will be surprised. The needs are:

(1) Organization of discipline and communication.
(2) Organization of rescue.
(3) Organization of relief.
(4) Organization of relief funds.
(5) Organization of camp for refugees.
(6) Organization of rebuilding.

(1) Discipline and Communication

This in Hilo would naturally fall to the Police service and the National Guard, and the communication side of it would call for the assistance and representation of the Naval and commercial wireless. Public Health agencies would be needed right away, and a representative of everybody possessing motor trucks.

(2) Rescue

This calls for large forces of laborers and truckmen, the National Guard to protect property, Boy and Girl Scouts to act as messengers, all the auxiliary police available, and all the resources of the Red Cross, including everybody who has had any nurse training.

(3) Relief

The prompt selection of camp grounds, creation of sanitation, and finding of auxiliary water, light if the main sources are destroyed, and assembling of food supplies have to be governed by circumstances. This sort of thing is best directed by some one familiar with organizing a camp on military lines and capable of enforcing martial law. There are needed food supplies, tents, surgical supplies, washing appliances, utensils, fuel, stoves, and competent cooks. Don't say 'get them at the hospital.'

The natural reaction of a committee is to say, "We have camp supplies in the armory, surgical things at the hospital, and trucks in the county stables.' Remember that for the extreme crisis contemplated, all three may be toppled over and burning, or under a lava flow, with 500 people dead, 1500 needing hospital treatment, and 5,000 homeless. The thing to face is the extreme possibility, the resources in water and supplies of Olaa and Hamakua, evacuation by sea to Maui or Kona, the place for a sanitary refugee concentration camp.

(4) Relief Funds

There have been cases of disaster where relief funds have been misapplied. One of the first things to happen when a catastrophe is announced is for subscriptions from elsewhere to pour in. The Red Cross is the proper center, with reputable financiers to act as custodians of money.

(5) Refugee Camp

Supposing Hilo partially destroyed under some great calamity, it is a matter of debate where to put a relief camp. The requirements are access to transportation, good water, supplies of food and clothing, policing, and communication by telephone and radio. If the wharves at Hilo were not destroyed or buried under lava, the place might be Waiakea or the airport. If a lava flow came through that side, the place would have to be in Hamakua.

(6) Reconstruction

The rebuilding after disaster has been a remarkable feature at San Francisco and Tokyo. The same is promised for Napier. As in the case of war, there are improvements in civilization, as well as evils, that result from a general clean-up.

One can imagine a new Hilo with a beautiful park all along the beach from the Wailuku River to the Wailoa, and with the railway moved back. One can imagine taking pride in a new city with no advertising signs visible from the harbor.

Actualities on the Island of Hawaii

Hilo is peculiar among cities in the world in that it is squarely in a volcanic belt, but happens to have been largely spared until now. So far as strong earthquake is concerned, this is equally true of Honolulu. Both of these places are liable to a terrific earthquake, when everybody will be surprised, and say, "This is the first we have ever had." Just that was said by the living generation at *Charleston, Santa Barbara and San Francisco. The reason* is that the earthquake interval overlaps several generations, and in Hawaii earthquakes in the 18th century before the coming of the whites made no impression on grass houses.

Hilo is definitely committed to future lava flows. The years 1801, 1843, and 1859 sent flows northwest, two of them building new land in the sea, from Hualalai and Mauna Loa. The years 1852, 1855, 1881 and 1899 sent flows towards Hilo, one reached Waiakea, and the one before it reached Kaumana (1855). The years 1868, 1887, 1907, 1919, 1919 and 1926 have sent flows at short intervals to the southwest from Mauna Loa, always different places, three of them reaching the shoreline, all destructive of ranches or roads or villages or all three. Earthquakes destructive and dangerous came in a swarm in October, 1929, shifting the area of underground activity of the enemy from Kahuku to Hualalai, and suggesting that the north side of Muna Loa as the center of it all will probably be the sector where he will concentrate his artillery for the next attack.

Apart from these dates history indicates that Mauna Loa will average activity about every four and a half years, so that we now are on the verge of a new outbreak. There are pros and cons that argue for a long interval in some parts of the century, but we know too little to apply them here. The fact is inevitable that Hilo will look up some evening and see what resembles a bright star on the northeast rift line of Mauna Loa, and a flow will start following the hollows among the flows of 1852, 1855, and 1881 in the direction of the valley of the Wailuku River. After it has been going a month we shall know whether it is likely to keep going for a year. It begins with rapid aa flows, the source cones make pahoehoe, the aa ceases, then the pahoehoe slowly tongues out from above past the earlier aa extremities, and pushing through tunnels to spreading leaflike fronts, the pahoehoe may creep through the forest downward for many months. This would invade and dry up the Hilo water supply. The lava would be fed through a source tunnel up around the nine thousand foot level, forking out into many tubes down below. If a flow once got started between the 1855 and the 1881 flows, or on the north side of the 1855 flow, it would pour down the line of the waterfalls of the main valley of the Wailuku, as it has done in prehistoric times in the past, and as it did in 1881.

The waterfalls were made by many lava dams. The visible tributaries are mostly from the north, those from the south being buried under lava, and flowing underground. On this course the lava flow would pour straight through Piihonua, and the fate of Hilo would depend on how long the tunnel supply of pahoehoe kept on flooding at the source.

Just at this point could be applied the project to stop a lava flow advocated by the late honored L. A. Thurston. And only at this point. No aa flow in its early and rapid stages could be arrested. A pahoehoe flow in the later stages of an eruption, by reason of the tunnel mechanism, could be blown up at the source tunnel about the nine thousand foot level, or just below the source cone, so as to dam the lava stream with rock and force it to start fresh. The eruption would continue just as before, with the lava starting to flow anew out of the blocked channel over the surface of the country by a slightly changed course. If the previous pahoehoe flow took five months to get down near the Hilo level, the renewed flow 30 miles up the mountain would require as much or more, and the city would be given five months respite. The main source would go out of action in that time, and Hilo would be saved. There would be no necessity of employing the army or "T.N.T." Any contractor with a couple of men and some blasting powder, carried by pack mules from the ranch, and guided by the volcanologists, can do the job. If the 1881 or 1855 situation were exactly repeated, this diversion of the flow at the source could be done. It could not possibly have been done for Hoopuloa or Alika. The 1855 flow lasted 15 months, the 1859 ten months, and the 1881 nine months. Such durations are quite possible now, for the tunnel flows on the Kilauea floor in 1919 lasted seven months, and so did the Kau desert flow in 1920.

The Observatory asks from the Chamber of Commerce its complete cooperation, with as many members of the Chamber becoming members of the Hawaiian Volcano Research Association as possible, and taking a real interest. Meantime we are devoting all our energies to learning how to predict volcanic eruption.

Contemplation of these possibilities is thoroughly sound economics for this community, and should make each firm ask, "Is our office earthquake-proof in its construction? Are our investments, our insurance, and our influence all they should be to prevent congestion, flood, or conflagration? Are we assisting those who are working on this problem? Or are we saying, "This is all nonsense. Life is too short. Such a thing couldn't happen to Hilo."

KILAUEA REPORT No. 1012

WEEK ENDING JUNE 14, 1931

Section of Volcanology, U. S. Geological Survey

T. A. Jaggar, Volcanologist in Charge

On June 8 at 9:40 a. m. seismic conditions were quiet at Halemaumau pit and the sulphur spots on the floor and small steam vents at edge of floor were as usual. The sulphur spots have gradually increased since December 1930.

A notable slight local earthquake was felt generally on the Island of Hawaii at 6:51 p. m. June 11, with motion stronger and quicker in North Kona near Honokahau than elsewhere. This was the only place where one or two small objects were overturned. The shock was felt as a slow motion at Waimea, Hilo, Kilauea, and in Kau, and the evidence of distance on the seismograms made the origin probably under Mauna Loa. There were other very feeble shocks felt at Keauhou Ranch at 4:29 p. m. the same day and at 9:03 p. m. felt in Hilo.

The seismographs of the Observatory registered four other very feeble local seisms at 9:08 p. m. June 12 with distance of origin 14 miles, at 9:22 a. m. June 8, at 3:06 p. m. June 13 and 6:11 June 14. In addition 28 tremors were registered during the week. The total of seismic disturbances for the week numbered 35. Tilting of the ground was slight WNW, and microseismic motion very small.

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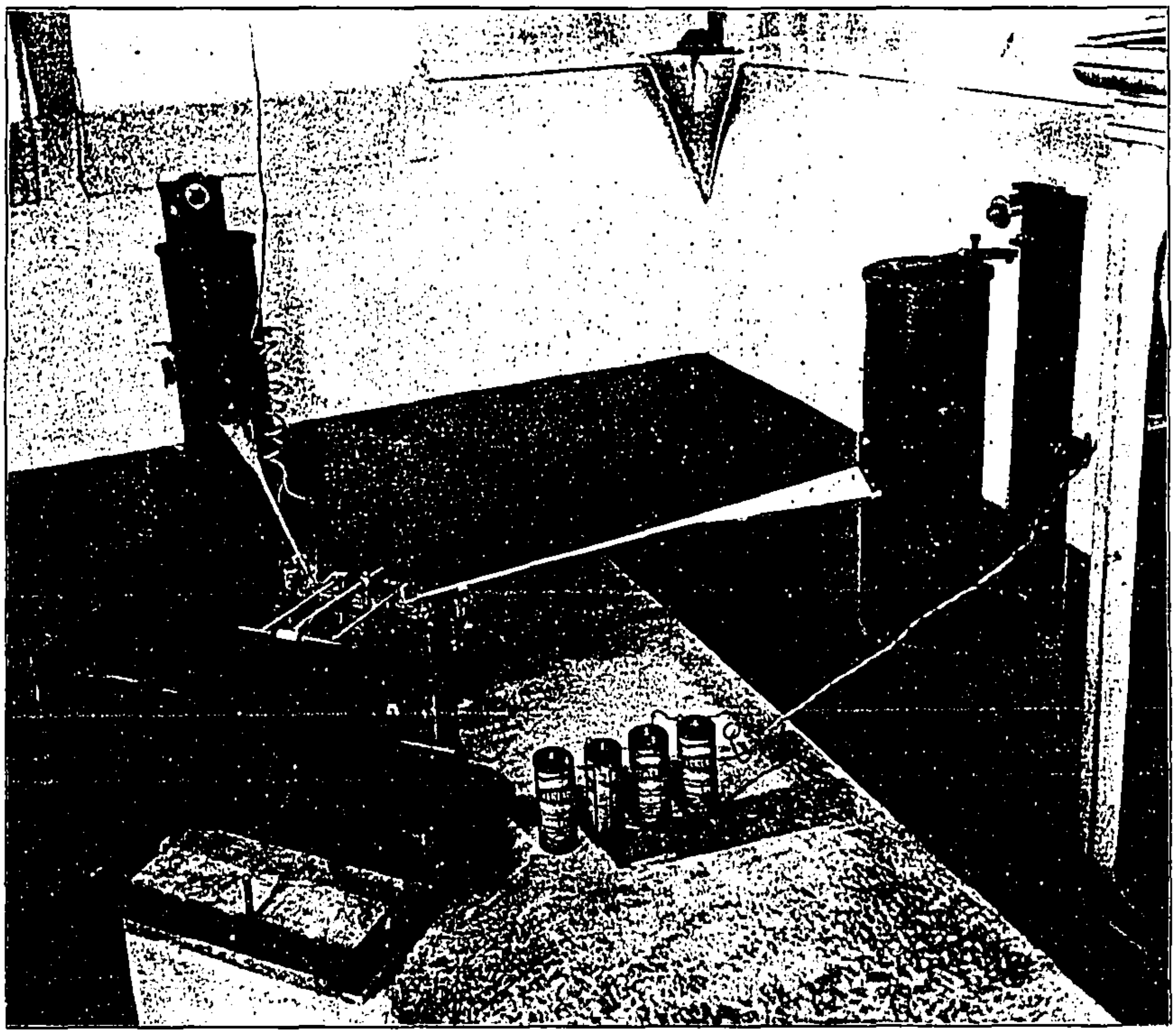
Two dollars per year — Ten cents per copy

No. 339—Weekly — Hawaiian Volcano Observatory, National Park, Hawaii — June 25, 1931



Pair of Hawaiian Type horizontal pendulum seismographs, designed and built at the Hawaiian Volcano Observatory. Two heavy masses are hinged against plates on the wall east-west and north-south. Aluminum pens connected with booms from these masses write on a drum driven by clockwork and moving along on a screw. Paper is smoked and changed on the drum every day. The cross-bar electro magnet lifts the pens every minute and hour. The paper is shellacked and stored as the seismogram of the day. Photo Maehara.

EARTHQUAKE INSTRUMENTS HAWAIIAN VOLCANO OBSERVATORY

When the original building of the Hawaiian Volcano Observatory was constructed in February 1912, a preliminary equipment of instruments had been secured through the Massachusetts Institute of Technology, and by a special order placed in Japan. There were a pair of 100-kg. Bosch horizontal-pendulum seismographs made in Strasburg, an Omori portable two-component small seismograph for ordinary earthquakes, an Omori strong motion seismograph recording three components with an automatic starter, and a large one-component Omori horizontal pendulum of high magnification for distant earthquakes. A cellar 18 feet square and 9 feet deep was finished in concrete under the Observatory on the northeast edge of the greater Kilauea Crater. This was equipped with several concrete tables adapted to the instruments. During the first year of occupancy the instruments were set up and tested for the peculiarities of the Hawaiian ground, and the portable seismograph was used for a time in the hut built near the north rim of Halemaumau. Mr. H. O. Wood had charge of seismology from the summer of 1912 to 1917.

The tests at the fire pit showed that the insensitive Omori portable pendulum would yield nothing distinctive of that place. A high magnification instrument was needed. Mr. Perret in the summer of 1911 with a delicately poised seismoscope had shown the presence of tremors at the pit edge when lava was fountaining inside the cauldron, and special pulsations recording the heavier gushes of the periodic fountain then called "Old Faithful." In September 1928 a one-component horizontal pendulum was installed in a shallow depression dug in lava 450 feet southeast of Halemaumau, covered with a very small shelter hut. This instrument was built at the station, and had first been used in Kona on the west side of the Island of Hawaii. It hangs so as to record tilt away from or towards the center of the pit, its heavy mass weighs 30 kg., and its magnification is 70. It records on smoked paper, and the drum covered with paper is smoked at the Observatory, is protected by a special box, and is carried to the pit by automobile and changed every two days. This pit registration has made valuable records at times of outbreak, and shows tremors and tiltings different from those at the Observatory two miles away.

This sort of evolution, with gradual change of instruments suited to special needs, has gone on with all the instruments. Seismometry on an active volcano is quite different from that of a station which devotes most of its energies to distant earthquakes. Most of the seismometric stations of the world are of the latter type. In Japan for many years the meteorological stations and other establishments have maintained instruments for the study of local earthquakes, but the main purpose of these stations in Omori's time was to record "ordinary" earthquakes, meaning registration of frequency, time, and intensity of the shocks that would ordinarily be felt, so that some scientific data could be gathered on the subject. This led to the making of more sensitive instruments of higher magnification and to the attempt to make a "universal" seismograph, which would satisfactorily record both local and distant shocks. Most of the German instruments make this attempt, and most of the earthquake lists do not distinguish satisfactorily between distant and local shocks. The "local' shock is a phenomenon still dubious and obscure, for if it is intense enough and deep enough to register on distant instruments, it may be "felt" over a wide area, and on the other hand very intense disastrous earthquakes like the one at Managua recently may be very local in perceptibility, and fail of registration at the remote stations. An earthquake may be accompanied by a massive movement of the ground with actual faulting of the sod at the place of sensation. What is felt in this case is not an "elastic wave." Many felt earthquakes are entirely elastic waves, with no discovered faulting of the ground. The natural history of this subject needs much research.

From this the reader should understand that it is an actual fact that no one knows what an earthquake is. Waves of compression, transverse waves due to the rigidity modulus of the rock, surface waves involving an up-and-down movement, waves reflected at different surfaces of change of density within the crust of the earth, waves traveling at different speeds, the ground or hill or cliff or plain under foot oscillating with its own period as an independent pendulum, spells of tilting, places of local tilting, mass movements of sideways shifting, mass movements of sudden uplift or depression, mass movements of sudden tilting—all of these things are supposed to exist in the crust of the earth, and a one-component pendulum, meaning a pendulum capable of swinging in only one direction, does not tell much about them. What little is known indicates that a house totally distorts the motion of the ground. The one-component pendulum totally eliminates all but one set of motions of the ground, tends to swing on its own account, and tells nothing by itself as to whether the motion is massive or elastic, irregular or harmonic, until subjected to rigorous experimental criticism. The result of years of registration of many local earthquakes on the Island of Hawaii quite denies the notion of an epicenter. The epicenter is supposed to be a place right over the source of a shock. At the epicenter the shock should be felt most strongly. It is quite true that on the Island of Hawaii many shocks are felt which are not felt in Honolulu 200 miles away. There is thus localization. But within the island there are hundreds of shocks felt equally at many places, with the seismographic evidence pointing to epicenters where there is no more intensity of perception than anywhere else.

Now what is this seismographic evidence? This is clearly important, for if we may harness an island with instruments, and that island has many earthquakes of a small and harmless type, we may really study the nature history of the earthquake. From the beginning this was the aim of the Hawaiian Volcano Observatory. People think they can tell the direction of an earth shock which they feel. All they can tell is the way the maximum of a hundred motions affected the particular room or chair or bed where they were placed. The seismograph is a rocking chair specially placed in a chosen room in the rock of the earth itself where the vibration of the building will not create a separate pendulum. The writing of the seismograph on smoked paper, when a little earthquake occurs, begins with a preliminary tremor as the paper moves along under the pen, then a movement of greater amplitude follows, or the "long waves,' and this is the part which is felt. This tails off to nothing in the course of minutes. A sensitive person standing outdoors might feel very faintly the preliminary as a mere tremble because it is quick. The long wave he would feel as a thud. The tail portion is slow and not usually felt. The writing levers of a seismograph, after magnifying the motion 100 times, have hardly any energy, hence the tiny pen tip pivotted and touching lightly a smoked surface to avoid friction. Even the restraint of a spider's web on the pen may spoil the record. The preliminary quick tremor has been proved to be a combination of the compressional and rigidity waves which reaches the instrument more quickly, by faster travel, than the long waves. The long waves are a combination of mass movement and wave motion. The sharp change from the preliminary to the long waves makes it possible to measure in seconds the duration of the preliminary. The longer its duration the farther away the place of origin of the disturbance. Hence with several seismographs in different places we may triangulate on the origin location underground. If we can find the origin location underground we do not need to trouble about "epicenters."

As shown in the accompanying pictures, the seismograph chamber at the Observatory contains now horizontal pendulums built right here registering all components, the electrically connected clock registers time on the drums, and there are other stations with similar instruments in Hilo and Kona for triangulation. The horizontal pendulums also record tilting of the ground. T.A.J.

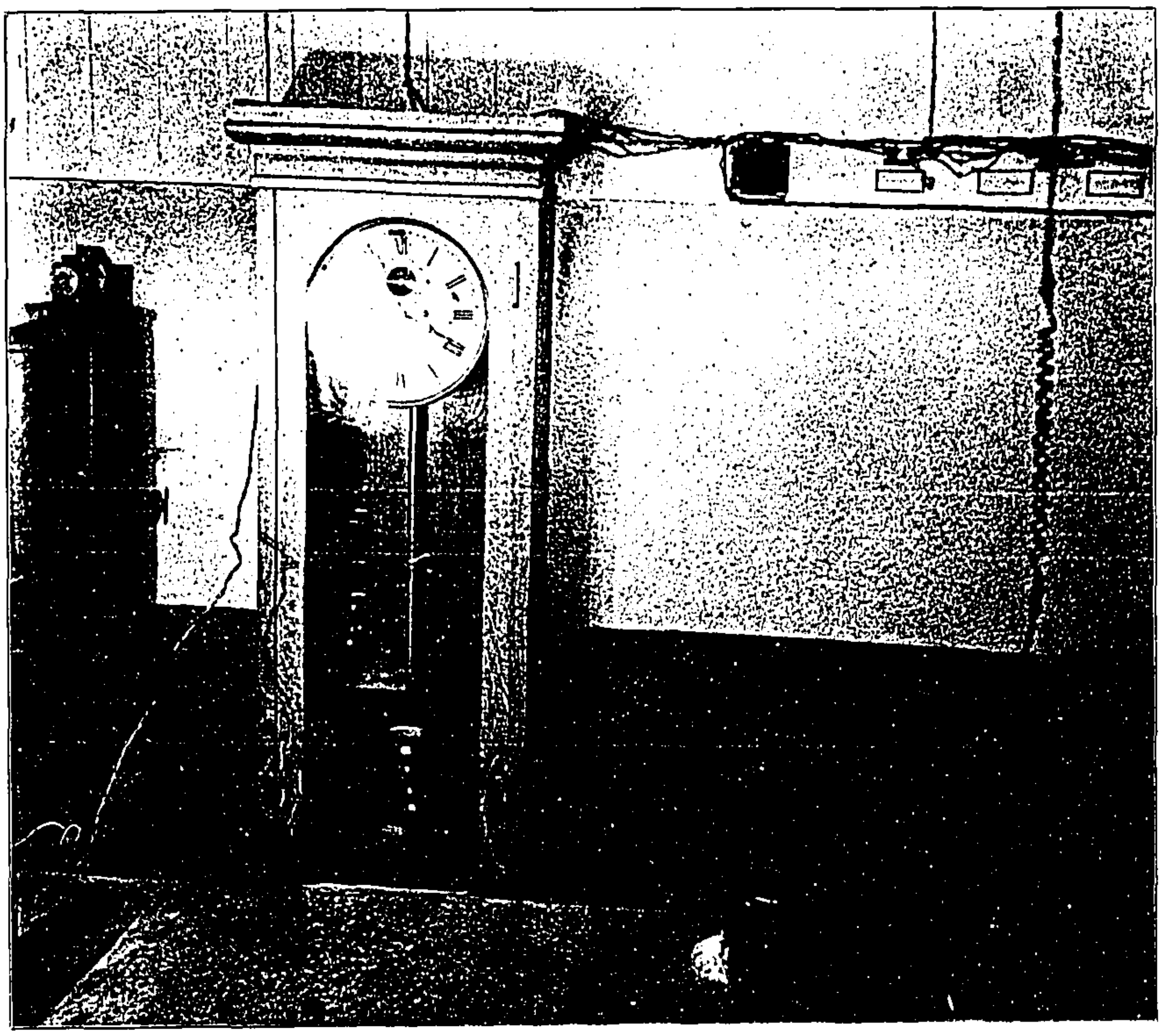
KILAUEA REPORT No. 1013

WEEK ENDING JUNE 21, 1931

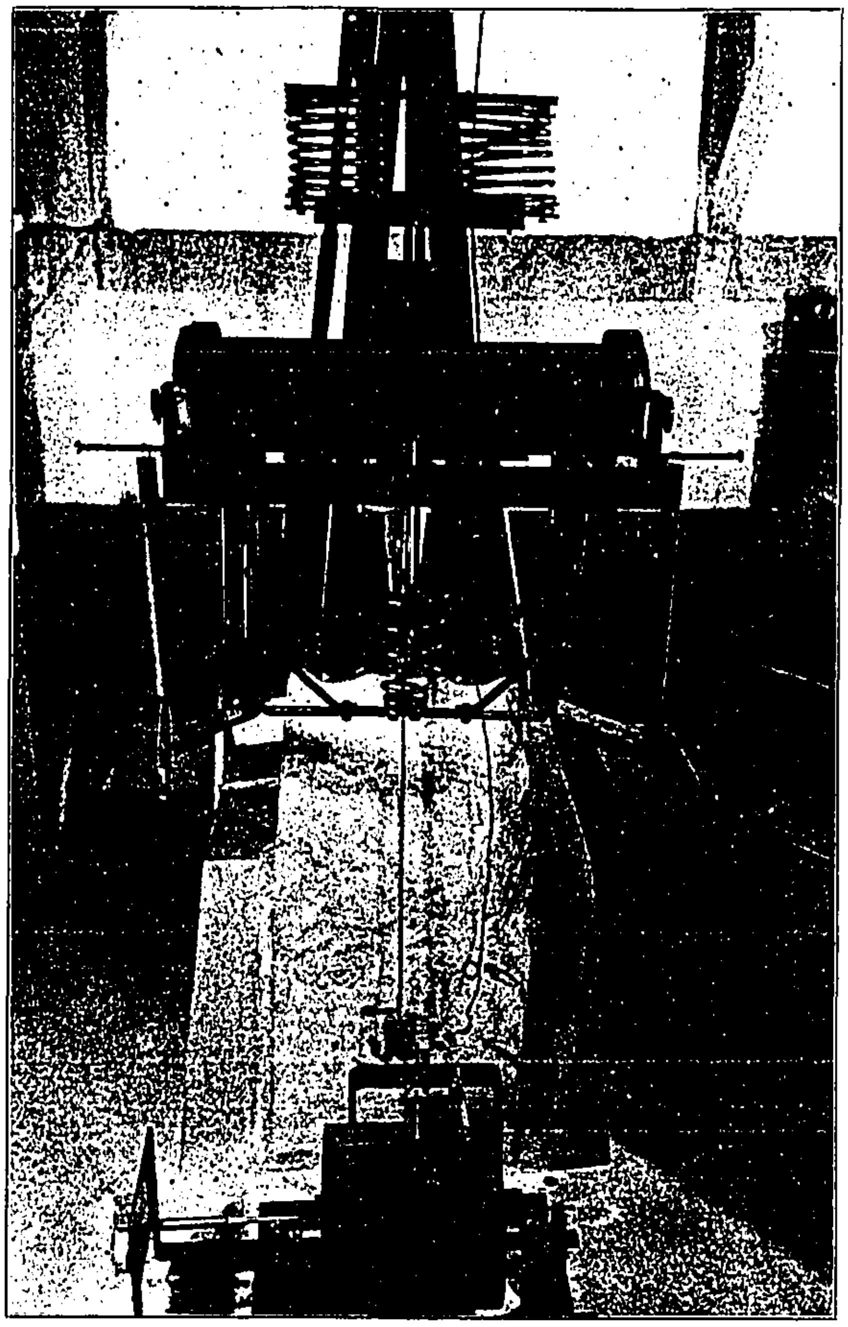
Section of Volcanology, U. S. Geological Survey
T. A. Jaggar, Volcanologist in Charge

On June 15 at 9:15 a. m. a small slide occurred at the north wall of Halemaumau. Steam is emerging at the southeast rock bank. Fume is notably absent at present.

The Observatory seismographs registered 26 tremors, one very feeble local seism, and one feeble shock felt locally. The last was at 10:45 a. m. June 16, with indicated distance of origin 11 miles. Tilting of the ground was slight ENE. and microseismic motion was slight.



Howard electrically fitted regulator clock connected with all the self-recording instruments of the Observatory. The error of the clock is compared with wireless time every day. The wireless signal is impressed with telegraph key on all the seismograph drums. The clock is compared daily with a chronometer, and the temperature of the chamber is recorded.



Vertical component seismograph built at the Hawaiian Volcano Observatory. The heavy mass is here hung on spiral springs, with temperature compensation from small springs. The heavy mass is free swinging and registers the up-and-down motion of the rock under the concrete cellar. The up-and-down motion is smaller than the horizontal motion in earthquakes. Photo Maehara.

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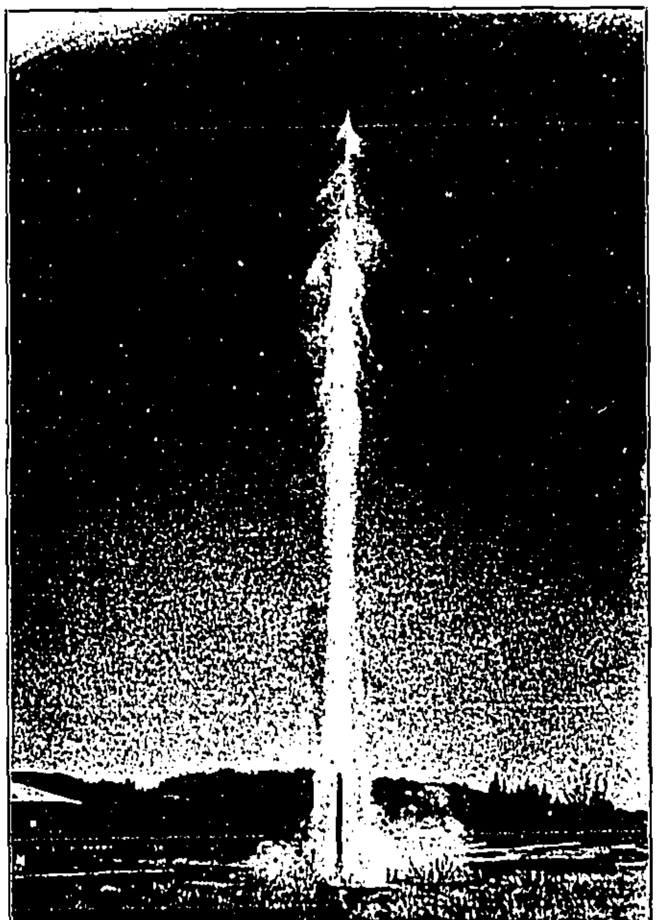


CALISTOGA

Myrtledale Geyser near Calitoga, Napa County, California. Made artificially by casing a well 180 feet deep, where a stratum containing boiling water is reached. The spouting occurs once every 45 minutes, when the release of steam pressure is satisfied, and it takes another interval to bring the replacement underground water to the boiling point.

VOLCANIC WATERS OF NAPA COUNTY, CALIFORNIA

In the Coast Range north of San Francisco, on the border between Lake and Sonoma counties, stands the St. Helena range marking some recent volcanic activity where there are hot gases and steam and sulphur which have been pouring forth from Teritary time until the present. "The northern and western ranges in these counties are composed largely of altered sedimentary rocks that probably belong to the Franciscan (Jurassic or Lower Cretaceous) formation. Glaucophane schists and serpentine are associated with them. The age of other altered sedimentaries here" is unknown, some geologists thinking them Lower Cretaceous.

"In Napa County and the southern part of Lake County several peaks and ridges are formed of lava that is probably of Teritary age. This lava overlies the altered sediments, and tuffaceous phases of it form prominent cliffs at a number of localities. Numerous carbonated springs of slight flow issue in this region north of San Francisco Bay, both from the sedimentary rocks and from the lavas, and hot springs exist in several places. A few springs of noticeably sulphureted water have also been examined but are less numerous and less important than those of the carbonated type."

So wrote Waring (Springs of California, Water-supply Paper 338, U. S. Geological Survey) in 1908, pointing out that upright fault or fracture lines have close relation to the hot springs of California. "At Calistoga, near the head of Napa Valley" (three to four hours' journey north of San Francisco) "are several hot springs at which during the seventies there was a large resort. The hotel burned in the early eighties, however, and since that time the springs have not been of more than local importance. The name 'Calistoga' is said to be formed from the words California and Saratoga, but the springs are not at all like those of Saratoga Springs in New York. In 1910 the caretaker of the property had provided two bath-houses of two tubs each, half a dozen small cottages on the place were rented, and a few campers had pitched their tents nearby. Hand pumps supplied hot water directly to the tubs, and cool water was piped from a tank.

"Four main springs rise at the base of a knoll of buff-colored tuffaceous material at the northern border of the meadow land, and a few pools and seepages appear in the meadow itself. The observed temperatures of the principal springs ranged from 126° to 173° and their flows from about one-fourth gallon to five gallons a minute. The hottest spring, which yields about one gallon a minute, appears to be the most strongly mineralized, though its mineralization is only slightly perceptible to the taste. Algae probably give it the slight flavor that has caused it to be called a "chicken-soup" spring.

"At Calistoga Hotel, about 400 yards west from the springs, a dug well supplies warm water for tub baths and a swimming plunge. Warm water is also obtained in several other wells nearby, and there is one strongly flowing artesian well."

The following analysis of the swimming pool water, having a temperature of 122° Fahr., is characteristic, made by W. Anderson in 1888; constitutents are by weight in parts per million:

Sodium	212.0
Potassium	8.2
Calcium	12.0
Magnesium	5.7
Iron	6.0
Aluminum	2.4
Manganese	Trace
Sulphate	110.0
Chloride	255.0
Iodide	13.0
Carbonate	27.0
Silica	62.0
	713.3
Hydrogen sulphide	42.0

Concerning the geology of the hot springs Waring writes: "The position of the springs near the base of the knoll of volcanic tuff that rises in the valley land and the fact that a fault has been traced along this part of the valley furnish suggestive evidence that faulting has here provided escape for deep-seated water. The lava may also produce a high temperature gradient that aids in giving the abnormal temperatures to the water. The amount of heated water that rises is probably better indicated by the area of meadow-land that is formed than by the visible flow of hot water, for there is doubtless much seepage that is not observable."

This last conclusion has been borne out by discoveries since 1910 which prove the valley to be underlaid by boiling water instead of hot water (Waring maximum 173° F.). The writer visited Calistoga July 31, 1926, and learned that in 1915 borings 180 feet deep in the flat valley floor produced artificial geysers which spout up through the casings of wells 100 feet or more at intervals of 45 minutes to two hours. One of these, the Myrtledale Geyser, is shown on Page One. For a mile of length the east side of the valley is over an artesian basin of boiling water, whereas the springs are cold on the west. Mr. Finch determined the temperature of Plummer's Geyser March 22, 1927, to be 218° F., and Pacheteau's capped geyser 213.5° F. (Volcano Letter No. 236).

On the mountainside, five miles to the west of Calistoga, in Sonoma County, is the Petrified Forest where immense sequoias have been silicified in volcanic ash, mostly fallen in pairs, and with their butts toward Mount St. Helena. The suggestion is strong that St. Helena was the source of a volcanic blast that overturned them in prehistoric eruptions. The fossil tree shown on Page Three is 110 feet long with a diameter of 12 feet. There is a crater higher up the hillside.

Finch reports (Volcano Letter No. 236) that Mount Konocti, near Clear Lake north of this Napa country, is the most recently active volcano in this part of California. It is believed to have erupted somewhat over 1,000 years ago, or well within the historic period of Europe. The hills east of Sulphur Bank, itself east of Mount Konocti, contain a fairly well preserved crater, there is one on the south peak of the mountain, and between this country and Calistoga the lava flows capping the hills appear progressively older. *Across the hills to the west at "The Geysers"* in Sonoma County is superheated steam used for power (Volcano Letter No. 62, Allen and Day Publication 378 Carnegie Institution) believed to rise from hot underground magma.

It is worthy of note that the San Francisco earthquake of 1906, apart from the massive shift of terrain from Santa Cruz to Point Arena on the great fault, the greatest intensity was at Santa Rosa, with extensions of the belt northward toward Geyserville and southward to Petaluma. In the Napa valley and about Clear Lake there were other belts of apparent intensity VIII-IX R. F. This region of present-day volcanic heat of highest temperature for California, and of volcanoes active in the historic period, made localized centers of disturbance of enormous intensity. Therefore we should not treat too lightly the possible connection between underground magma and great earthquakes. (Map 23, Carnegie Institution, California Earthquake.)

T.A.J.

KILAUEA REPORT No. 1014

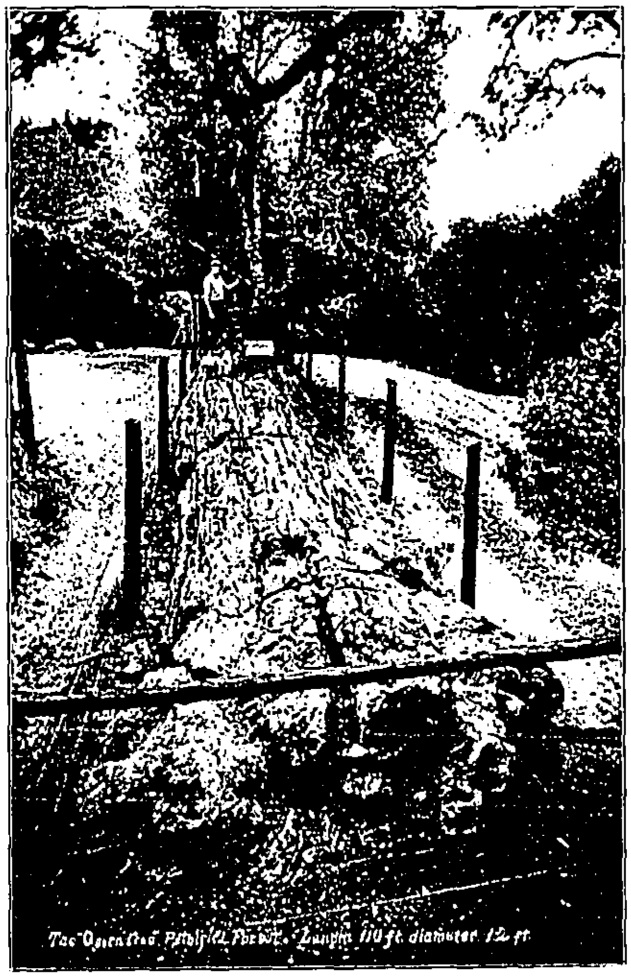
WEEK ENDING JUNE 28, 1931

Section of Volcanology, U. S. Geological Survey

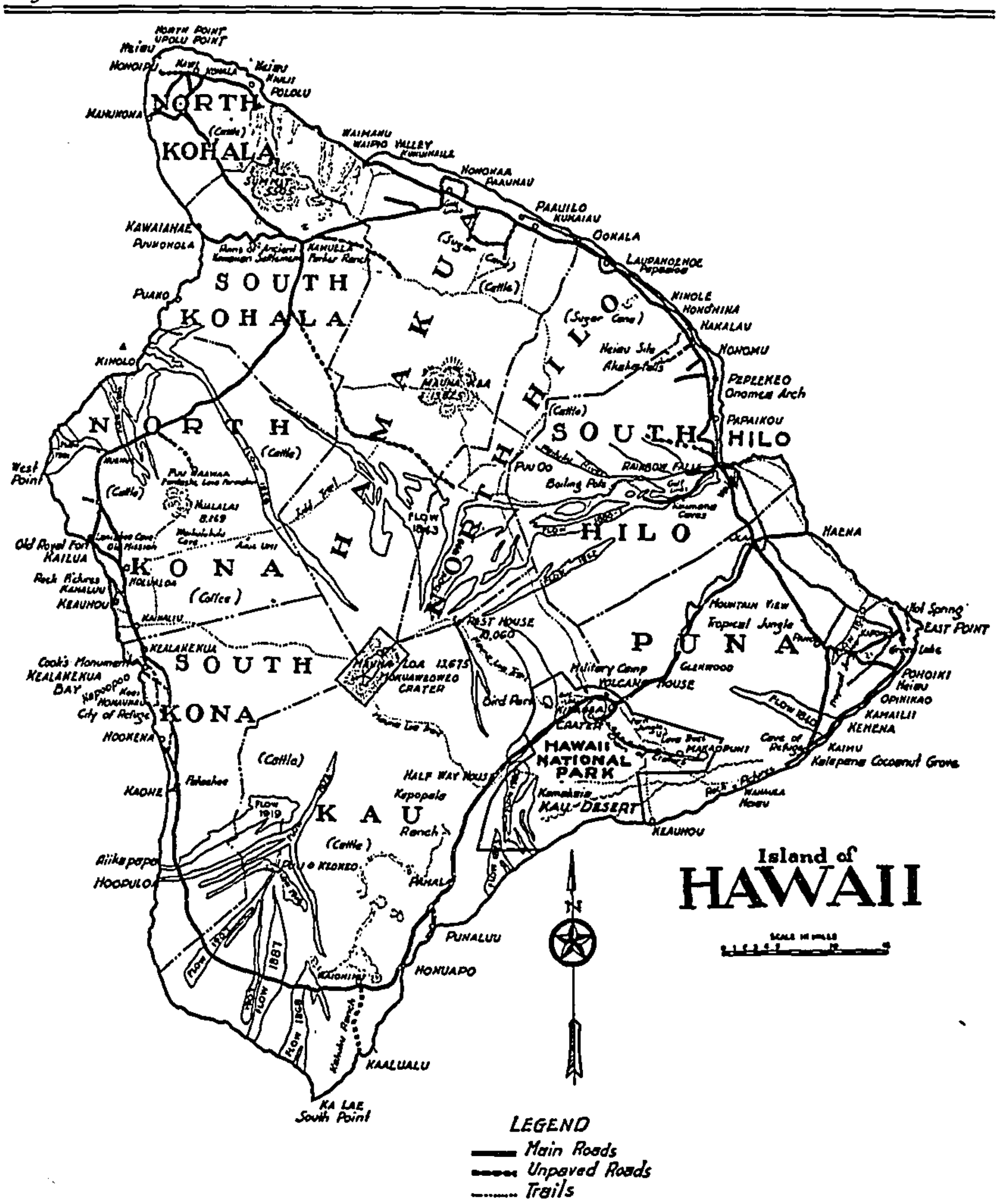
T. A. Jaggar, Volcanologist in Charge

The week at Kilauea has been quiet and uneventful. On June 22 there was a little steam on the south talus of Halemaumau, but none elsewhere. On June 23 no steam was seen. Dust was dense near the north talus, probably due to air currents, there having been moderately strong trade winds, without rain, blowing and creating much dryness. On June 27 the pit remained unchanged. Sulphur areas appeared less conspicuous except a bright spot on the west side of the floor.

Twenty-two very feeble tremors were the only seismic disturbances recorded by the instruments at the Observatory. Tilt was slight NW. Microseismic motion was slight.



Silicified big tree at the petrified forest in ash beds five miles west of Calistoga, California. This tree, "The Queen," is 110 feet long and 12 feet thick... The replacement of the wood fibre by silica was accomplished by hot waters. These sequoia trees were overturned in pairs, their tops pointing away from St. Helena volcano. Probably an ancient steam blast eruption did the work.



THE VOLCANO LETTER

The Volcano Letter combines the earlier weekly of that name, with the former monthly Bulletin of the Hawaiian Volcano Observatory. It is published weekly, on Thursdays, by the Hawaiian Volcano Research Association, on behalf of the section of volcanology, U. S. Geological Survey. It promotes experimental recording of earth processes.

Readers are requested to send articles, photographs, publications and clippings about volcano and earthquake events, instruments and investigations, especially around the Pacific.

Subscription for non-members two dollars per year of 52 numbers. Address the Observatory.

HAWAIIAN VOLCANO OBSERVATORY
Founded 1911

This laboratory at Kilauea Volcano belongs to the Hawaiian Volcano Research Association and is leased and operated by the United States Geological Survey.

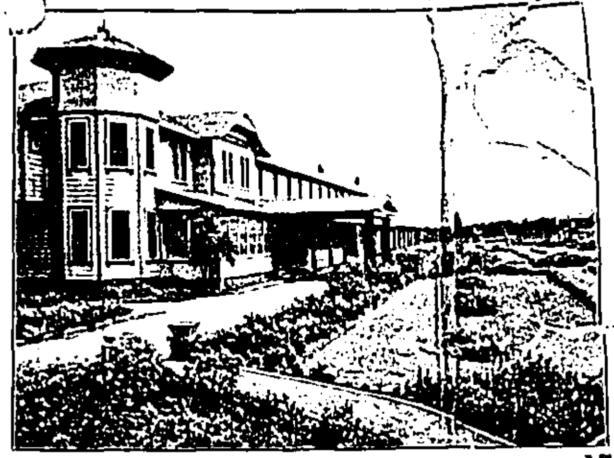
It maintains seismographs at three places near Kilauea Volcano, also at Hilo, and at Kealakekua in Kona District. It keeps a journal of Hawaiian volcanic activity and publishes occasional Bulletins.

Membership in the Hawaiian Volcano Research Association is limited to patrons of Pacific science who desire personally to aid in supporting the work.

The work of volcano research so supported is in collaboration with the work of the United States Geological Survey, but supplements it with buildings, research fellows, instrumental plants, explorations and special investigations for which there is no governmental provision. The Geological Survey maintains volcano stations in Alaska, California and Hawaii.

Persons desiring application blanks for membership ($5.00 or more) should address the Secretary, Hawaiian Volcano Research Association, 300 James Campbell Building, Honolulu, T. H.

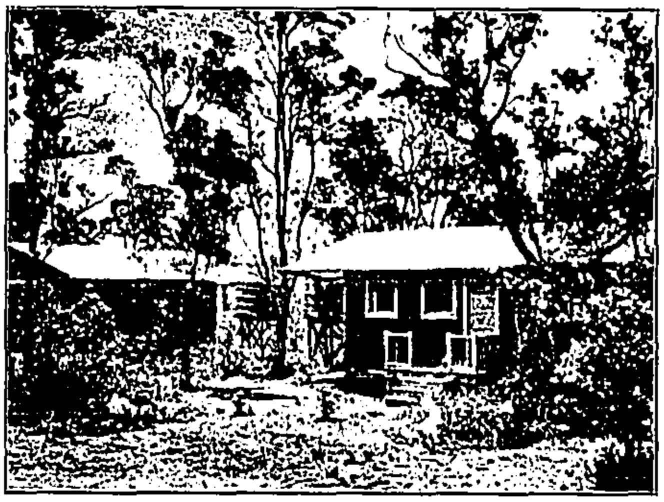
Spend Your Vacation on the Island of Hawaii . . .



KILAUEA VOLCANO HOUSE

in the cool and bracing climate of Hawaii National Park or amidst the charm and tranquillity of the Kona coast . . . where the spirit of old Hawaii still lives.

COTTAGES, KILAUEA CAMP



ASSEMBLY HALL, KILAUEA CAMP

Take advantage of the special reduced summer rate at "Kilauea Volcano House" and "Kona Inn" effective June 1st to September 30th, $35.00 weekly room and board. You may, if you wish, divide the days of your visit between the two hotels without extra cost. Children 6 to 12 years are charged three-quarter rate and under six, half rate.

Those who love outdoor life will enjoy vacationing at Kilauea Cottage Camp nestling in a grove of trees two miles from the Volcano House. The daily rate including meals is only $3.00 with rates for children in proportion.

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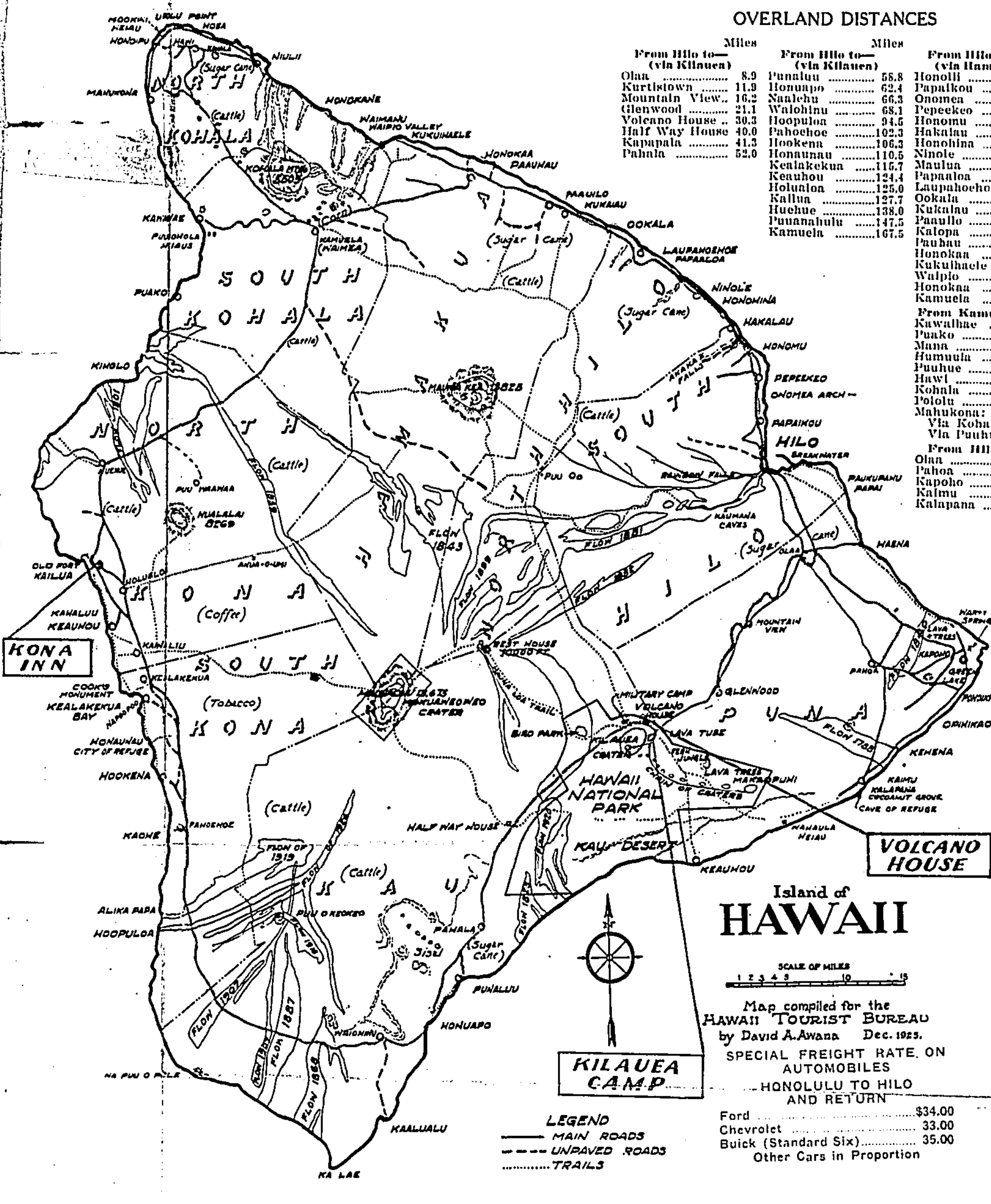

OVERLAND DISTANCES

From Hilo to— (via Kilauea)	Miles
Olaa	8.9
Kurtistown	11.9
Mountain View	16.2
Glenwood	21.1
Volcano House	30.3
Half Way House	40.0
Kapapala	41.3
Pahala	52.0

From Hilo to— (via Kilauea)	Miles
Punaluu	58.8
Honuapo	62.4
Naalehu	66.3
Waiohinu	68.1
Hoopuloa	94.5
Pahoehoe	102.3
Hookena	106.3
Honaunau	110.5
Kealakekua	115.7
Keauhou	124.4
Holualoa	125.0
Kailua	127.7
Huehue	138.0
Puuanahulu	147.5
Kamuela	167.5

From Hilo to— (via Hamakua)	Miles
Honolii	2.8
Papaikou	5.0
Onomea	6.7
Pepeekeo	9.6
Honomu	12.4
Hakalau	15.3
Honohina	19.1
Ninole	20.8
Maulua	22.8
Papaaloa	26.4
Laupahoehoe	27.5
Ookala	33.2
Kukaiau	33.8
Paauilo	41.5
Kalopa	45.3
Paauhau	47.6
Honokaa	19.3
Kukuihaele	57.3
Waipio	58.3
Honokaa	49.3
Kamuela	65.0
From Kamuela to—	
Kawaihae	11.8
Puako	12.0
Mana	7.7
Humuula	30.0
Puuhue	18.0
Hawi	21.0
Kohala	28.0
Pololu	32.1
Mahukona:	
Via Kohala	38.4
Via Puuhue	25.0
From Hilo to—	
Olaa	8.9
Pahoa	20.0
Kapoho	32.0
Kaimu	32.0
Kalapana	33.0

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Inter-Island Steam Navigation Company, Ltd.
Honolulu, Hawaii

June 6, 1931

The Director,
National Park Service,
Washington, D. C.

Dear Mr. Director:

Following is a report of activities and operations in Hawaii National Park for the month of May, 1931.

900 GENERAL

May Day is Lei Day in Hawaii. It is one of the most colorful fete days of the year, as Hawaii is a land of flowers, sunshine, and happiness. The custom of giving and wearing leis of colorful island flowers is observed all through the territory.

May Day was appropriately observed in Hilo this year but was given additional significance by the Hilo Woman's Club, which planted a jacaranda tree and dedicated it as a memorial to Stephen T. Mather, first director of the National Park Service. The ceremony took place on Friday afternoon, May 1, at 3:30 o'clock. The ceremonies and planting were on the grounds of the Federal Building and in addition to the members of the Woman's Club there were representatives present from all of the civic organizations including the Hilo Chamber of Commerce, the Rotary Club, fraternal organizations, and Governmental departments. I made the dedicatory address, in which the life and accomplishments of Mr. Mather were outlined. Mrs. E. N. Holmes is the president of the Club and Mrs. L. W. Bryan is chairman of the Outdoor Improvement Committee. Mr. L. W. Bryan, assistant territorial forester, spoke on "Why we plant a tree". The services were opened with the singing of "America" by the assemblage, and an invocation, and closed with a poem by Mrs. Holmes and with the singing of the song "Hawaii Ponoi".

Earlier in the day a tree was planted to celebrate the bicentennial anniversary of the birth of George Washington on February 22, 1932, at which time appropriate dedication ceremonies will be held.

100 ADMINISTRATION

110 Status of work.

The routine office work fell behind during the first part of the month because of the necessity of concentrating all efforts on the estimates for 1933, which were completed in final form and transmitted to the Washington office on May 13 by registered mail. These estimates were prepared in greater detail than previously and were supported by pictures that will be helpful in showing the need of the funds asked for.

As soon as the estimates were out of the way the regular park reports and other office work were completed and brought up to date, assistance being secured by the employment of Mrs. Eleanor M. Hodges on a field agreement in accordance with advice of the establishment of a clerk-stenographer position in Grade 8 at $1800 per annum, which was received by radio on May 8. By the end of the month all of the routine office work was current.

120 Park inspections by

121 The superintendent

Inspections were made daily of all work in progress around headquarters and a number of special trips were made to outside territory. On May 13, accompanied by Resident Engineer H. L. Handley of the Bureau of Public Roads, and Ranger Joseph H. Christ, we inspected the route for a proposed extension of the Chain of Craters road from Makaopuhi crater to the park boundary where it is proposed to connect up with a new road between the park boundary and Kalapana, to be constructed by the County of Hawaii. The request for the selection of a preliminary location and approximate cost was received by Mr. Handley through Bureau of Public Roads channels. The old Kalapana trail is followed as the approximate route, and the distance is 5,306 feet. However, I am going to recommend that any funds available be used elsewhere as the County of Hawaii has done nothing as yet towards the construction of the Kalapana-Hawaii National Park road and it does not appear likely that they will be able to do anything in the immediate future.

On May 15, in company with Ranger Christ and L. W. Bryan, Assistant Forester of the Territory of Hawaii, we drove as far as the Halina Pali on the south side of the park and went over part of the new trail being constructed from there toward the seacoast to connect up with the old Kalapana trail which follows the seacoast for many miles along the southern side of the island of Hawaii. This trail is being built for patrol purposes to protect that section of the park against illegal hunting and fishing and to open up and develop that section of the park to park visitors and also to provide a means of reaching the coconut grove that was planted by the park service on the seashore a few years ago. This trail is also of great importance in goat drives which are held every year to kill off as many wild goats as possible as there are thousands of them on the island of Hawaii and they do a tremendous amount of damage by eating the grass which would be otherwise available for cattle, and destroying plants, trees and shrubs by their browsing. On this inspection the final plans were completed for a goat drive which took place on May 19.

On May 27 I made an inspection of the location of the road improvement soon to be started, with particular reference to changes in the existing line, and gave administrative approval to one or two slight changes that made a reduction in the amount of curvature in the road without increasing the damage that would have to be done to the trees, ferns, and plants.

In the vicinity of the fern jungle, however, the question of a modification of the road line as approved last year, was again suggested by Mr. Wheeler, he believing that it would be worth while to make some changes at that point to reduce the sharpness of the curves and the number of curves even though it was necessary to re-locate the road. The reason that this particular place requires special study is that the road has many 40° curves and the grade at this point is seven per cent so that there is likely to be speeding by car drivers in order to make this grade in high gear, and with the sharp curves there is possibility of such drivers failing to keep on their side of the road, resulting in collisions with cars coming in the opposite direction.

While all of this is appreciated, the change involved would do so much damage to a large number of beautiful treeferns from ten to twenty five feet in height, that I decided that I would not be willing to recommend the change suggested. I believe we should build the road on the line as laid out, and if it should develop through actual use, that the road is dangerous, the question of a change to make the necessary improvements should then be given consideration, but not at this time.

125 Other Governmental officers.

Major General Bryant H. Wells, commanding the Hawaiian Division of the Army, Major Russel A. Osmun, and Major Stuart S. Wilder, aids to Governor Lawrence M. Judd, visited the Park May 15 to 20, inclusive, to take part in a goat hunt and a goat drive, and while here visited the Kilauea Military Camp and all of the points of interest in Hawaii National Park. With this party was Territorial Forester Charles S. Judd, Mr. George Brown, president of the Board of Forestry Commissioners, and Mr. Dwight, one of the members.

Colonel Amos W. Woodcock, director of Prohibition Enforcement, in the United States was a visitor to the park on May [illegible]. He was accompanied by Captain Walter F. King, deputy administrator of Honolulu, and Colonel S. A. Bowman, of Hilo, and other members of the staff.

On the same day Stephen A. Connolly and Glen W. Rose, representatives of the General Accounting Office, Washington, D. C., came into the park and checked over the disbursing accounts and records of myself as disbursing agent for the period January 10, 1931 to May 15, 1931, inclusive, and the accounts of James K. Higashida, who succeeded me as disbursing agent, for the period May 16 to 24, inclusive, and found everything in good order. The accounts of Mr. Richmond B. Hodges, of the U. S. Geological Survey were also checked by these men.

On May 16 Mr. A. B. Homar of Seattle, Washington, and P. H. Watson of San Francisco, California, customs agents, were visitors to the park.

127 Other agencies.
Mr. George T. Armitage and Mr. Charles R. Frazier, of the Hawaii Tourist Bureau, called at the park enroute to the coast.

130 Finance and accounts.
Following is a list of the funds appropriated for work in Hawaii National Park, with the unexpended balance shown as of the close of May 31, 1931.

	Name	Allotted	Expended	Balance
41/2415	Hawaii National Park 1931-32 - - - - - - -	52,130	548.16	51,581.84
41/2406	Forest Protection and Fire Prevention - -	100	8.21	91.79
40/1415	Hawaii National Park 1930-31 - - - - - - -	34,625	29306.61	5,318.39
40/1406	Forest Protection and Fire Prevention - -	630	630.00	----------
4X436	Roads and Trails, National Parks, no year	382,385	16441.59	365,943.41

140 Labor situation.
The park has had no difficulty in recruiting whatever labor has been required in carrying on its work.

150 Equipment and supplies.
For the purpose of furnishing the bachelor quarters of the park naturalist and in fitting up an office in which to work, etc., the following equipment was purchased during the month.

1 only	Reading lamp - - - - - - - - - - - - -	$2.00
1 only	#96 chiffonier (Ivory) freight included	30.46
1 only	#193 Reed chair, str. back - - - - - -	9.00
1 only	#193 Reed rocker, str. back - - - - - -	9.50
1 only	#1277 Amsterdam Ax. Rug, 9 X 12' - -	32.00
3 only	Bed sheets, "Pepperell" 81 X 90" - - -	3.00
3 only	Bed sheets, "Varsity" 63 X 90" - - -	2.41
3 only	Pillow cases "Varsity" 36 X 42" - - -	.72
3 only	Simmons pillows, silk floss - - - - - -	5.40
1 only	Mirror, white - - - - - - - - - - - -	5.60
3 only	Soup plates - - - - - - - - - - - - - -	.75
3 only	Dinner plates - - - - - - - - - - - - -	.75
3 only	Cups and saucers - - - - - - - - - - -	.90
6 only	Glass tumblers - - - - - - - - - - - -	.25
2 only	Vegetable dishes - - - - - - - - - - -	.90
3 only	Sauce plates - - - - - - - - - - - - -	.45

1 only	Pepper shaker - - - - - - - - - - - - - - - - - -	.09
1 only	Salt shaker - - - - - - - - - - - - - - - - - - -	.09
1 only	Sugar bowl with cover (glass) - - - - - - - - - -	.20
1 set	Knives, forks, spoons, etc. (26 pieces) - - - -	4.50
2 only	Cocoa door mats - - - - - - - - - - - - - - - - -	1198
1 only	Galvanized oil can, 5 gal. capacity - - - - - -	.99
1 only	Galvanized garbage can with cover, cap. 10 gals.	1.55

Other equipment purchased is as follows:

	Hand tools received from Supply Officer, U.S. Navy Yard (small hand tools) - - - - - - - - - - - - - - -	26.72
1 only	MacBridges Reading Lamp (Ivory) - - - - - - - -	4.68
2 only	#638 Reed chairs, reed back, at $9.50 - - - -	17.00
1 only	Unpainted table for kitchen - - - - - - - - - -	7.25
2 only	Cocoa door mats - - - - - - - - - - - - - - - -	1.98
1 only	Galvanized oil can, 5 gal. capacity - - - - -	.99
1 only	Feather duster - - - - - - - - - - - - - - - - -	.65
2 only	Canteens, 1 gal. capacity, with strap - - - -	2.90

Approximately $700 worth of telephone wires, brackets, insulators, and telephones was purchased and delivered during the month, to be used in extending the park telephone system.

600	Oak pole side brackets, with two spike holes - -	18.72
600	Single groove screw thread glass insulators - -	36.14
6	Desk telephone sets complete with 5 bar generator 1600 ohm ringer - - - - - - - - - - - - - - - - -	168.00
35	Coils No. 12 B.B. galvanized iron telephone wire (85 lbs. per coil) - - - - - - - - - - - - - - -	238.00
1	Telephone main frame - Kellogg No. L-10 - - - - -	10.00
2	"Kellogg" code No. H-51 Protectors of 10 pair sections, catalog #1040. - - - - - - - - - - - -	27.50
10	Used wall telephone magneto with battery compartment, 5 bar generator, 1600 ohm ringer, Kellogg -	175.00

160 Status of alienated lands.

Dr. Jaggar informs me that the deed of the house owned by Miss Fusao Takahashi has been signed and the matter of securing title in the name of the Hawaiian Volcano Research Association will soon be presented to Washington with the request for cancellation of the rental fee now charged.

170 Plans, maps and surveys.

Mr. H. L. Handley, resident engineer, B.P.R., has had a survey crew of three men establishing line, grade and slope stakes. The contractor was expected to be on the job long before this but I was informed by Engineer E. S. Wheeler when he visited here May 23, that the delay was due to the contractor furnishing individual sureties on the bond and that before approval of the bond could be given by the Washington office documentary evidence as to the sufficiency of the sureties was required and when this was asked for, one of the bondsmen withdrew, making it necessary to secure another surety who could furnish documentary evidence of his net worth. The contract was executed by the Secretary of the Interior on May 25, 1931, and bond approved, and on May 27 Engineer Wheeler advised the contractor, the Bitulithic Paving and Concrete Company, of Honolulu, that contract had been executed and bond approved, and that they should proceed with the construction within ten days. They have 430 calendar days to complete the work, which means that the job must be completed not later than July 31, 1932, unless extensions are granted.

Mr. Wheeler assured me that the survey of the National Park Service road from the park boundary to Haleakala would be completed the last week in May.

A recommendation that the new administration building for the park be constructed on the site of the present building was forwarded to our landscape division over two months ago but no reply has yet been received. We are awaiting approval of this site, also site for the Commissioner's residence, cottage for the chief ranger, and a married park ranger. The plans for the two cottages built last year will be used for the latter two buildings but plans will have to be drawn by the landscape division for the new administration building and the Commissioner's residence.

180 Circulars, placards, publicity bulletins, etc.

Because of the press of other duties, and lack of stenographic assistance, no publicity bulletins have been sent out to the press since January but with the arrival of our new park naturalist, John E. Doerr, Jr. on May 23, I am hoping to start the publication of Hawaii Nature Notes and other publicity bulletins in a short time.

200 MAINTENANCE, IMPROVEMENTS AND NEW CONSTRUCTION.

210 Maintenance.

Only a few men were employed on maintenance during the month, most of the crew being used on new construction. Window screens were refitted to the quarters of the park superintendent, and new screens installed at the quarters of the chief clerk and park Ranger Brumaghim. A partition in the kitchen of the park superintendent was taken out to provide more room and make a better layout, and the kitchen was painted. The usual maintenance and repair of roads, trails and telephone lines was carried on during the month.

220 Improvements.

The bachelor quarters for the park naturalist were completed on May 22 and the park naturalist arrived and moved in on May 23. The building now consists of a small entrance porch, a living room, bedroom, bath, kitchen and back porch. The building was painted throughout, both inside and out. Water, electric lights and telephone service were installed, and the house was furnished with such equipment as is authorized for bachelor, mess and dormitory accommodations in office order No. 175 of October 31, 1928.

Mrs. Leavitt assisted in the selection of the color scheme and in the purchase of furnishings. She also made and put up the drapes at the windows so that the house presented a very attractive and inviting appearance and Mr. Doerr, on his arrival, was very much pleased to find that he had such comfortable and pretty living quarters. Several of the local ladies had placed large bouquets of flowers in the rooms which of course added materially to their attractiveness. An office for the park naturalist was made in one end of the building erected some years ago at Uwekahuna Observatory by the Geological Survey for housing their equipment and apparatus. One room of this little building, which is close to the lecture hall and museum, houses a water tank and a Ford engine for driving the generator which makes electricity with which to charge the storage batteries which run the stereopticon and motion picture machine. The office space is approximately 12 feet square, with windows on two sides, and a new door was put in so that the entrance is direct from the outside without having to go through the utility room. It has a telephone and electric light, furnished from the storage batteries. The office has been furnished with a desk formerly used by the Superintendent and a file case but that is all the equipment that could be provided at the present time. Additional furniture and equipment will be provided from time to time as funds are available.

230 New construction.

One and one-eighth miles of trail from the rest house at Hilina pali toward the seacoast was completed by the middle of May and was used on May 19 to great advantage in the round-up of wild goats which was made on that date.

From the middle of May until the end of the month the road from the Devil's Throat to Halina Pali, which was just passable in a light Ford car, was improved very materially and when finished will be a worth while addition to the secondary road system. It will be possible to drive to Halina Pali in a larger car with a reasonable load, and without serious danger of damage to the car or tires. The Halina Pali will be the base from which many side trips may be taken and will be very useful in patrol.

The Hawaii telephone company's telephone pole line which follows the main round-the-island road is on the right of way between the Hilo entrance station and the Volcano House, and this line would have to be moved when the road is reconstructed.

I took up with the representatives of the company the advisability of moving the line far enough back from the road so that it could not be seen and they consented to do this. The new line follows an old railroad grade part of the way then crosses over the road at one point onto an old wood road, which it follows to the rear of the Volcano House. In this way very little cutting was required and the line is out of sight for practically the whole distance. Work was started on May 12 and will be completed by the first week in June. It is a very decided improvement in the landscape and we are grateful to the officers of the Hawaii telephone system for their cooperation.

240 Improvement of approaches to the park.
There are four contracts for road improvement on the round-the-island road which passes through the park, in the Kona district, one of them being for approximately nine miles and is a long time contract. Three of them were awarded under the emergency reconstruction funds allotted this spring and the work must be completed September 1, 1931. Over 300 men are employed on the various projects.

300 ACTIVITIES OF OTHER AGENCIES IN THE PARK

210 Public Service contractors.
W. P. Roth, president of the Matson Navigation Company, was a visitor in Honolulu in the early part of May and a radio message was sent to him urging him to visit Hawaii National Park before his return to the mainland to note improvements that are under way and to discuss improving the hotel accommodations. Mr. Roth was unable to come to the park, as he wired on May 15 that he was called back to San Francisco on urgent business.

During the visit of Mr. Stanley Kennedy of the Inter-Island Steamship company to Washington, conferences were held with the Director of the National Park Service, and Mr. Kennedy was informed that the constant and persistent criticism of hotel accommodations from park visitors was so outspoken that it had affected adversely travel to the park. He was advised that the Volcano House situation is about the only one at the present time where justifiable and persistent criticism from visitors occurs. He was advised that the rate of $9.00 per day for room without bath would be continued during 1931 but that the company would have to make some showing of cooperation toward improving conditions, and that they should at least connect the wash basins in the rooms with the hot water system so that visitors might have hot water to wash or shave. Mr. Kennedy has agreed to take the matter up further with his Board of Directors and do what he could to provide the minimum improvements requested for this year. In order to study this situation I have secured travel statistics from the Volcano House for the past three years, covering the period January 1 to May 31, inclusive, and these figures are as follows:

Year	Number of guests
1931	1812
1930	3207
1929	4492

320 Cooperating Governmental agencies.

On May 19, 3,048 wild goats were driven into a pen on the seacoast from the lands of the Hawaii National Park, Territorial forests, and privately owned stock lands, through cooperation of the National Park Service and the Territorial Board of Agriculture and Forestry, with the assistance of the ranch owners and other interested parties. The details of the drive were planned by Park Ranger Joseph H. Christ and Assistant Forester L. W. Bryan. The new trail under construction by the Park Service, which starts at Halina Pali, was the starting point of the drive for the National Park Service crew and contributed largely to making the drive the success that it was. Men on horseback and on foot closed in on the goats from three sides, using the ocean as the fourth side, and the goats were driven into a corral at Apuha Point, a long triangular-shaped point which juts into the ocean. Visitors from Honolulu taking part were Charles S. Judd, territorial forester, Mrs. George P. Cooke, Major Stuart B. Wilder, and Mrs. Wilder, Major Osmun, and Major General Wells, the commanding officer at Schofield Barracks. The goats were slaughtered for their meat and hides as they werecorralled.

400 FLORA, FAUNA AND NATURAL PHENOMENA

410 Educational service.

Mr. John E. Doerr, Jr. of the State College at Fargo, North Dakota, who was recently appointed naturalist for Hawaii National Park, arrived early Saturday morning, May 23 and entered on duty on that date. Mr. Doerr spent a few days with Chief Park Naturalist Hall and his staff in Berkeley, and also visited Yosemite National Park, where he had an opportunity to meet those in charge of educational activities and to learn first-hand of the program offered park visitors. While in Yosemite he was able to make a trip to Glacier Point. On his arrival in Honolulu he was met by Ranger Joseph H. Christ and two days were spent there under the guidance of Ranger

Christ, who took him around the city and introduced him to the many men there who are interested in the park and its activities. He called at the University of Hawaii and conferred with President D. L. Crawford and Theodore C. Zschokke, in charge of the Extension Forestry Department, who will have charge of the classes in natural history to be conducted cooperatively by the National Park Service and the University of Hawaii this summer and on his arrival in Hilo I met him at the dock and brought him to the park. Mr. Doerr is intensely interested in his work, seems to be thoroughly qualified, and I am sure that the educational service of the Hawaii National Park will make great strides under his direction.

Guide service.

During the month Ranger Brumaghim conducted 38 visitors from the Volcano House to the Halemaumau firepit over the trail.

Museum and lecture service.

Three hundred and twenty four visitors were given the lecture during the month. Two hundred and sixty eight visited the museum, and 548 visited the museum and saw the motion picture on the "Structure of the Earth" and how volcanoes are formed, and pictures of their activity. Fourteen lectures in all were given. Ranger Brumaghim travelled 526 miles by motorcycle and Ford truck during the month, and 22½ miles on foot. Ranger Williams covered 509.5 miles on motorcycle, 132 miles by light truck, 44 miles on horseback, and 10 miles on foot. Ranger Christ, who has general charge of outside activities, travelled 654 miles.

When not otherwise engaged, rangers were employed in traffic control, guiding visitors at the Thurston Lava Tube, painting work, repairing telephone lines, signs, installing new telephone and electric light wires, and other miscellaneous jobs.

480 Natural phenomena.

On the whole, volcanic conditions were quiet at the Hawaiian volcanoes during the month. Small quantities of steam and sulphur fumes were noticeable periodically and rocks were heard to fall from the walls occasionally with a small slide occurring every now and then. Quite a number of tremors were registered on the seismographs and there was some change in the tilt of the ground, but nothing of any particular importance.

500 USE OF PARK FACILITIES BY THE PUBLIC

510 There was a total of 8,746 visitors to the park during the month, which compared with a total of 6,199 for the same month last year, which is an increase of 2,547 . Full details are shown on table No. 1, attached.

The Hamburg-American liner "Resolute", with approximately 200 passengers aboard, visited Hilo on May 2 and the passengers taken to the park. The big Cunard liner "Franconia", a round-the-world cruiser, docked at Hilo on May 5 with approximately 300 visitors who came into the park. On May 6 a party of 80 Elks from Sacramento, California, arrived in Honolulu and about half of the party visited the park shortly thereafter.

The California Press Association party of 76, headed by Friend W. Richardson, former governor of California, who is president of the Association, visited the park in a body on May 1 and 2. Among the members of the party were quite a number of personal friends of the park superintendent, including Governor and Mrs. Friend W. Richardson, Mr. and Mrs. Justice F. Craemer of the "Orange News", Mr. and Mrs. Louis Meyer of the "Oakdale Leader", Mr. Irving Martin and Mr. and Mrs. Ralph O. Yardley of the "Stockton Record" and a number of others.

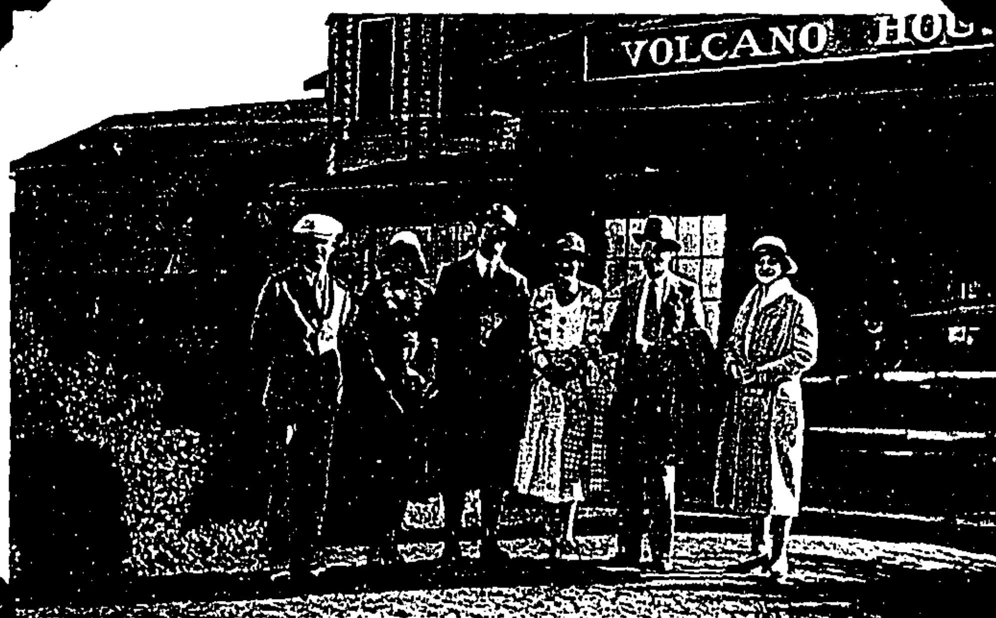
This group was given special attention during their visit to the park and they were the guests of the Hilo Rotary Club at the Volcano House on the night of May 1. Their trip here included, in addition to the park trip, a train trip along the Hamakua coast Saturday morning, luncheon at the Hilo Hotel, and an entertainment at the Hilo Yacht Club that afternoon. They sailed for Honolulu at 5 P.M. that same day.

On May 24 the flagship "Malolo" of the Matson Navigation Company called at Hilo and docked for the day while her 200 passengers visited the park and on their return sailed directly for Los Angeles. Special park lectures were provided for this group. On May 30 and 31 about 200 cadets from the Japanese training ship "Kaiwomaru" visited the park.

520 General weather conditions.
Rainfall for the month of May was 3.39 inches, compared with 8.38 inches for the same month last year. The total rainfall to date this year is 17.20 inches, compared with 36.08 inches last year. At Hilo the rainfall to date is 28.42 inches, compared with 87.92 inches last year. The humidity ranged from a minimum of 76 to a maximum of 94. The mean minimum temperature for the month was 55°, and the maximum 70°.

540 Visitors.
The more prominent visitors to the park during the month have been mentioned in other sections of the report.

Pictures on the following sheet will show some of the members of the California Press Association who visited the park on April 30 and May 1, and the delegation which accompanied the Rev. K. Kubo, Prelate of Kogi, Shingon, Japan, on his visit to the park on May 8, 1931.



Members of the California Press Association who visited Hawaii National Park on April 30 to May 1, 1931. Left to right: Mr. Justice Craemer, Orange News, vice-president of the Association; Mrs. Craemer; E. P. Leavitt, Superintendent of Hawaii National Park; Mrs. R. O. Yardley, Stockton Record; Mr. Irving Martin; Mrs. E. P. Leavitt.

The Rev. K. Kubo, Prelate of Kogi, Shingen Sect, of Mount Koya, Japan, who visited Hawaii National Park with his official party on May 8, 1931. He is the fourth from the left, shown in his robes of office.

600 PROTECTION

During the visits of round-the-world cruisers with their large numbers of passengers, the Hilo Police traffic squad assisted in handling the traffic on the road leading to the park, at the hotel, and at other points where special care was needed.

610

On [illegible] eight park signs were found missing on various roads and trails. These had been pulled up and thrown away or hidden. All but two were found and recovered. On May 15 it was found that two of the toilet seats and two paper holders in the comfort station for women at Uwekahuna Observatory had been broken off and thrown into the pit. There was no evidence to indicate the ones guilty of this damage but visiting soldiers at the Kilauea Military Camp were suspected. As the ones suspected had returned to Honolulu, the matter is being further investigated with a view to locating the guilty parties and taking appropriate action for their punishment.

620

A [illegible] to the eastern park boundary near the seacoast burned for several days in the early part of the month but as it was between two lava flows, it burned out without doing any damage.

640 Destruction of predatory animals.

Three wild pigs, 383 wild goats, and one stray dog running wild in the park, were killed during the month.

900 MISCELLANEOUS

The group of Hawaiians who came into the park last February in an effort to start volcanic activity in Halemaumau finally left around the first of May, all efforts that they made being unsuccessful. They explained their inability to start activity by the objection and resistance to their efforts by the kahunas, or high priests, of the islands, who were not in sympathy with them.

Efforts are being made to have the gasoline and oil requirements of the Hawaii National Park and the U. S. Geological Survey included in the advertisement of the War Department or Navy of this district in the hope that because of the greater quantity purchased lower prices may be obtained.

Memorial Day exercises were held in Hilo on May 30 and I attended as the representative of the National Park Service.

On May 6, Hawaii's first public demonstration of the new radio telephone service between California and Hawaii was successfully effected at the Rotary Club luncheon in Honolulu.

Congressman Harry L. Englebright, who visited Hawaii early in May, was requested to visit the park but was unable to do so.

On May 12 Mr. Lorrin A. Thurston, leader in Hawaiian affairs for half a century, and president of the Hawaiian Volcano Research Association, and prominently identified with the creation and development of Hawaii National Park, died after an illness of several months. He was 72 years of age.

Very respectfully,

E P Leavitt

Superintendent.

Form No. 1009—Met'l.

U. S. [illegible]partment of Agriculture, Weathe[illegible] [illegible]reau.

COOPERATIVE OBSERVERS' METEOROLOGICAL RECORD:

Month of May, 1931, 192 ; Station, Volcano Observatory; County, Kau

State, Hawaii; Latitude, 19-25-54; Longitude, 155-15-40; Hour of Observation, 8 A.M.; Time used on this form, T.M. Corrected by Pearl Thurber

DATE.	TEMPERATURE. Maximum.	Minimum.	Range.	* Set Max.	PRECIPITATION. Time of Beginning.	Time of Ending.	† Amount.	Humid. Snowfall in Inches.	Wind Depth of Snow on Ground at Time of Observation.	Prevailing Wind Direction.	Character of Day, Sunrise to Sunset.	‡ Miscellaneous Phenomena.
	1	2	3	4	5	6	7	8	9	10	11	
	81	53	23	67			T	93	Str.	SW	PC	
1	77	58	19	71			T	63	Lt.	NE	Cloudy	
2	74	55	19	61			23	89	"	"	PC	
3	64	57	7	61			50	90	Mod.	"	Cloudy	
4	67	52	15	57			01	82	Str.	"	PC.	
5	68	52	16	62			T	79	"	"	"	
6	69	52	17	61			03	85	Mod.	"	"	
7	71	52	19	58			02	88	"	"	"	
8	71	53	18	62			09	88	Lt.	"	"	
9	67	54	13	60			08	89	Mod.	"	"	
10	68	54	14	60			04	85	"	"	"	
11	69	54	15	58			08	93	"	"	"	
12	74	54	20	61			02	85	Lt.	"	"	
13	74	54	20	67			03	80	"	"	Clear	
14	65	55	10	59			10	93	"	"	PC.	
15	70	53	17	62			08	84	Mod.	Var.	"	
16	73	54	19	63			34	80	Lt.	SW.	"	
17	72	58	13	66			T	76	"	"	"	
18	73	57	16	65			19	80	"	"	"	
19	72	60	12	65			13	88	"	Var.	"	
20	73	58	15	63			02	84	"	"	"	
21	71	56	15	65			05	86	"	NE	"	
22	71	57	14	65			T	77	Mod.	"	"	
23	67	53	14	58			T	89	Lt.	"	"	
24	74	53	21	61			05	85	"	SW.	"	
25	69	56	13	64			04	89	"	"	"	
26	73	59	14	65			05	79	"	"	"	
27	73	57	16	67			83	82	"	NE	"	
28	71	54	17	67			04	81	"	"	"	
29	64	57	7	61			22	94	"	"	"	
30	69	56	13	62			12.	89	"	"	"	
31												
Sum	2193	1712	481	1942			3.39	2649				
Mean	70.3	55.2	15.5	62.6			10.9	85.4				

*Reading of maximum thermometer immediately after setting.
†Including rain, hail, sleet, and melted snow.
‡Thunderstorms, halos, auroras, etc.

(IN TRIPLICATE.) See cover for instructions.

8—213

______________, Cooperative Observer.

Post-Office Address, ______________

MONTHLY SUMMARY.

TEMPERATURE.

Mean maximum, 70.3

Mean minimum, 55.2

Mean, 62.75

Maximum, 81; date, 1

Minimum, 52; date, 5-6

Greatest daily range, 23

PRECIPITATION.

Total, 3.39 inches.

Greatest in 24 hours, .83; date, 28

SNOW.

Total snowfall, ______ inches; on ground 15th, ______ inches;

at end of month, ______ inches.

NUMBER OF DAYS—

With .01 inch or more precipitation, 25

Clear, 1; partly cloudy, 28; cloudy, 2

DATES OF—

Killing frost, ______

Thunderstorms, May 1

Hail: Light, ______; Moderate, ______; Heavy, ______

Sleet, ______

Auroras, ______

REMARKS:

10-158

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

STATUS OF AUTHORIZED PROJECTS

Hawaii National Park for the Month of May, 1931

Description of Projects	Percent Constructed To Date	Percent Constructed This Month	Percent Constructed Last Month	Probable Date Completion
405 Warehouse - - - - - - - - -	100	——	100	
406 Toilets (Kilauea) - - - -	100	——	100	
407 Toilets (Uwekahuna) - - -	100	——	100	
408 Gasoline and oil building	98	——	98	June 20, 1931
409 Ranger station, Entrance-	100	——	——	
410 Naturalist's quarters - -	100	10	90	
412 Rangers' quarters - - - -	10	10	——	June 20, 1931
451 Telephone lines - - - - -	95	——	95	
502 Kilauea Iki trail - - - -	100	——	100	
502 Mauna Loa trail - - - - -	100	——	100	
502 Summer Camp trail - - - -	100	——	100	
502 Steaming Bluffs trail - -	100	——	100	
502 Kipuka Bihops trail - - - Improvement and extension	80	60	20	June 15, 1931
502 Extension of auto trail Uwekahuna to Halemaumau-	95	95	——	June 15, 1931
Road Survey, BPR - - - - -	100	——	100	
Road Survey, BPR Construction - - - - - - -	01	01	——	

10-157
(July, 1929)

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

TRAVEL REPORT

Hawaii National Park for the month of May, 1931

	This Month	This Travel Year To Date	This Month Last Year	Last Travel Year To Date	Increase for Travel Year Number	Increase for Travel Year Percent
PRIVATE TRANSPORTATION:						
Cars first entry, ...						
Cars reentry, ...						
Motorcycles, ...						
Total motor vehicles, ...						
Persons entering via motor vehicles, ...	7,297	83,158	4,625	44,486	38,672	.869
Persons entering via other private transportation, ...	~~287~~	~~2,485~~	~~219~~	~~1,889~~	~~596~~	~~.315~~
Total persons entering via private transportation, . . .	~~7,584~~	~~85,643~~	~~4,844~~	~~46,375~~	~~39,268~~	~~.843~~
OTHER TRANSPORTATION:						
Persons entering via sHotel,	1,162	5,605	1,355	7,032	-1,427	.202
Persons entering via trains,	8746		5899			
Persons entering otherwise, . .						
Total other transportation,	~~1,162~~	~~5,605~~	~~1,355~~	~~7,032~~	~~-1,427~~	~~.202~~
GRAND TOTAL ALL VISITORS, . . .						

	This Year	Last Year	~~Increase~~ Decrease Number	~~Increase~~ Decrease Percent
Automobiles in public camps during month, ...	0	1	1	100
Campers in public camps during month, ...	1	4	3	75

24316

10-215

UNITED STATES
DEPARTMENT OF THE INTERIOR
National Park Service
Washington

Hawaii National Park

REPORT OF NON-APPOINTED PERSONNEL

(TEMPORARY)

Changes outside the District of Columbia for the month of May, 1931 192

	Total at beginning of month	Additions	Separations	Net Gain or loss (a)	Total at ending of month
Permanent	6	2	-	2	8
Temporary	11	11	3	8	19
	17	13	3	10	27

(a) If loss, indicate by minus sign.

10-159

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

STATUS OF PERSONNEL

Hawaii National Park for the month of May, 1931

	This Month	This Month Last Year
Number of employees beginning of month,	17	6
Number of additions, ...	13	8
Total, ...	30	14
Number of separations, ...	3	0
Number of employees close of month, . .	27	14
Number of promotions during month	0	0
Aggregate amount of annual leave taken,	0	0
Aggregate amount of sick leave taken,	0	0
Aggregate amount of leave without pay,	0	0

10-160

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

REPORT OF PARK REVENUES

Hawaii National Park for the Month of May, 1931

	This Year	Last Year
Park revenue on hand beginning of month,	0.00	0.00
Received,	125.00	100.00
Total,	125.00	100.00
Remitted,	125.00	100.00
On hand close of month,	0.00	0.00

Park revenues received this year to date,	1,225
Park revenues received last year to date,	1,175
Increase,	50
Per cent of increase,	.041

10-151

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

REPORT OF SALES OF PUBLICATIONS

MAY 1931

	Number	Value
GOVERNMENT PUBLICATIONS:		
On hand beginning of month,	327	68.10
Received during month,	0	
Total,	327	68.10
Sold during month,	18	11.25
On hand at close of month,	309	56.85
NON-GOVERNMENT PUBLICATIONS:		
On hand beginning of month,		
Received during month,		
Total,		
Sold during month,		
On hand at close of month,		

Cash on hand beginning of month,	14.65
Sales during month,	11.25
Total,	25.90
Remitted during month,	0.00
Balance,	25.90

The Volcano Letter

Two dollars per year Ten cents per copy
No. 335—Weekly Hawaiian Volcano Observatory, National Park, Hawaii May 28, 1931

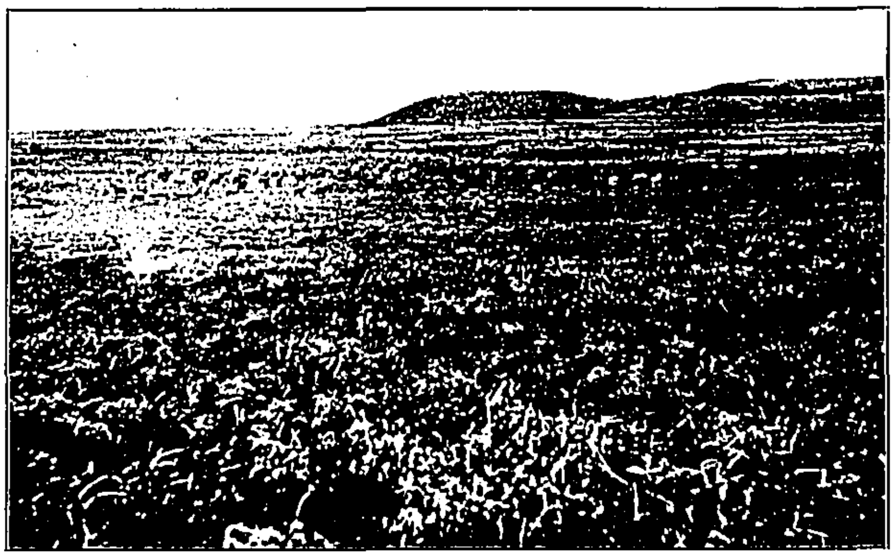
South end of St. Paul Island in the Pribilofs showing Gorbat rookery and Reef Point rookery with Otter Island in the extreme distance and St. Paul village beside the salt lagoon on the right. Photo Rauch.

ST. PAUL ISLAND IN THE PRIBILOF GROUP

During the writer's visit to the Aleutian Islands in 1917 he had the privilege of meeting Mr. William P. Rauch who kindly gave him specimens he had collected on St. Paul Island, the larger northwestern member of the seal islands, or the Pribilofs, where the fur seals are protected by the United States. St. Paul lies 200 miles north-northwest from Unalaska Island in the Bering Sea, and off the line of the Aleutian Islands. Mr. Rauch took photographs, some of which are reproduced herewith. The rocks of the Pribilof Islands have recently been described by Washington and Keyes (American Journal of Science, November, 1930). One of the pebbles collected by Mr. Rauch is described by these authors as hyalobasanite, a basaltic lava which would have contained much nephelite if the lava had been completely crystallized. This rock also contains olivine. Other specimens are ordinary fine-grained basalt.

Mr. Rauch writes: "I obtained a small piece of sedimentary rock containing shells, and have turned it over to Dr. P. S. Smith, Alaskan Branch, U. S. Geological Survey. This sedimentary rock was some ten to twelve feet above high tide, embedded in the perpendicular cliff just to the right of what is known as East Landing on St. Paul Island. I should judge that weathering and heavy seas had exposed it. The whole island gives one the impression of a sort of volcanic fairyland so many diminutive volcanic cones and craters, so small, and so different."

Black Bluff, a sea-dissected cone on the eastern coast, contains tuff with rounded, calcareous, or marly clay fragments with fossil shells of post-Pliocene age and of species now living including walrus bones. There is no glaciation. The island is volcanic and according to Stanley-Brown (Bul. Geol. Soc. Amer., Vol. 3, 1892, p. 496) was built up after the Tertiary with outpouring of lava from a central vent in a submarine eruption. "Its surface is diversified by at least a dozen cones and vents of unusual symmetry, surrounding in irregular fashion a true crater dome some 600 feet in height called 'Bogoslof'" (not to be confused with Bogoslof, the active volcano near Unalaska). Washington and Keyes say, "The island of St. Paul, the largest of the Pribilofs, has a greatest length of about 13 miles between its northeast and southwest points, and widths of from 6 to 8 miles. Its area is about 33 square miles. In its early stages it may have consisted of a group of 10 or 12 small islands, now joined together. The lava flows gradually built up the basement floor of the island, and these were vesicular basalt rich in olivine. There followed from the central vent great flows of basalt, with others from smaller cones, all together constituting an overlying sheet. It is more crystalline than the basement lava. The marked contact of the two sheets is near sea level. There are thin, unbroken lava domes" and small spatter heaps. No andesitic nor trachytic lavas are present and tuffs are rare. An analysis of the nephelite basanite by Washington and



Reindeer herd on St. Paul Island, looking southwest on the south side of the island in the region north of the salt lagoon. Photo Rauch.

Keyes shows a composition rich in iron, titanium, magnesia, lime, and the alkalies, with 44 per cent of silica.

St. George Island, about 40 miles southeast of St. Paul, reaches a height of a thousand feet, is bordered by bluffs, has a basement of dark basalt, and contains many breccias and tuffs as well as some non-basaltic lava. There is andesitic ash and possibly trachyte occurs.

As to activity in recent times, flames are said to have been seen to rise from the sea northeast of the Pribilof Islands, and a submarine eruption is recorded for 1815 northeast of St. George, where there are small circular shoals at depths of from three to eight fathoms. Out in the middle of Bering Sea Pinnacle Islet five miles south of St. Matthew Island, was cited by Elliott as having been in an almost constant state of activity since its discovery, and as being active at the time he was there in 1874. This author also thought Otter Island, a small rock southwest of St. Paul (faintly visible in the distance in the photograph reproduced on Page One), had been recently active. All of these facts are culled from Washington and Keyes.

Mr. Rauch made the accompanying sketch map on Page Four to express roughly the position of his photographs. The map should be turned so as to make the long right-hand point turned northeast, and not east. St. Paul village is thus at the south end of the island, Rush Hill 665 feet high is the highest point on the island at the west end, and the principal anchorage is in English Bay west of the village. The photograph on Page One shows Reef Point which projects south of the village, on the right are seen the village houses, and in front of them is the salt lagoon bordered by tundra flats. The entire island is grassy, without shrubs or trees, and the same is true of the Aleutian Islands. A considerable herd of reindeer is maintained on the island as shown on Page Two. There are two fur seal rookeries on the two points near the village, and on the lowland bars of the northeast point there is the largest seal rookery ground. Formerly a drum tractor was used for hauling the pelts across the island, now there is a wire cableway.

Looking into the interior of St. Paul Island from the village northward, one sees flat, grassy, rolling country with the salt lagoon in the foreground and four or five cones beyond, of which Bogoslof is the most dome-like. Standing on the top of Bogoslof and looking westward we see six or seven cones with marked tendency to horseshoe shape, the opening of the horseshoe generally facing toward the north as though the prevailing wind tended to build the higher heapings of the lava fountains toward the south. This is the scene photographed on Page Three. From this elevated point the expanse of flat tundra to the northeast covers about one-seventh of the island, all very slightly elevated above the sea. A large triangular lake of brackish water is inclosed by two bars which have shut off the lake by connecting an outlying islet with the main island at the northeast point. Such ponds are common partly as fresh water crater lakes and also as longshore lagoons as shown on the map by L. The letter V on the map indicates volcanic hills and craters. Looking southward from the summit of Bogoslof one sees a broad slope leading down to the southwestern embayments, all grassland over lava, with small lava pits in the foreground, the topography suggesting the pahoehoe of Hawaii. The lava conelets of the Pribilofs are much more Hawaiian in quality than the eastern islands of the Aleutians, but in some of the western Aleutian islands there are wide lava flats greatly resembling the photographs of St. Paul.

With reference to the opening northward of the horseshoe cones and the sweep from northeast to southwest of the barrier beaches that trail to the main island from the northeast point, it seems probable that the constructional action of the sea has been from northeast to southwest with the prevailing winds, thus smoothing the northern and southeastern shores, and leaving bays at the southwest. As there are three distinct embayments and two of them fairly deep on that side, it may well be that the volcanic tumescence which accompanied the outpouring of lavas had a tendency to uplift at the northeast and some drowning of topographic depressions at the southwest. The salt lagoon next north of the village, and the topography of the three bays adjacent to it, suggest drowned valleys among lava-flow ridges. T.A.J.

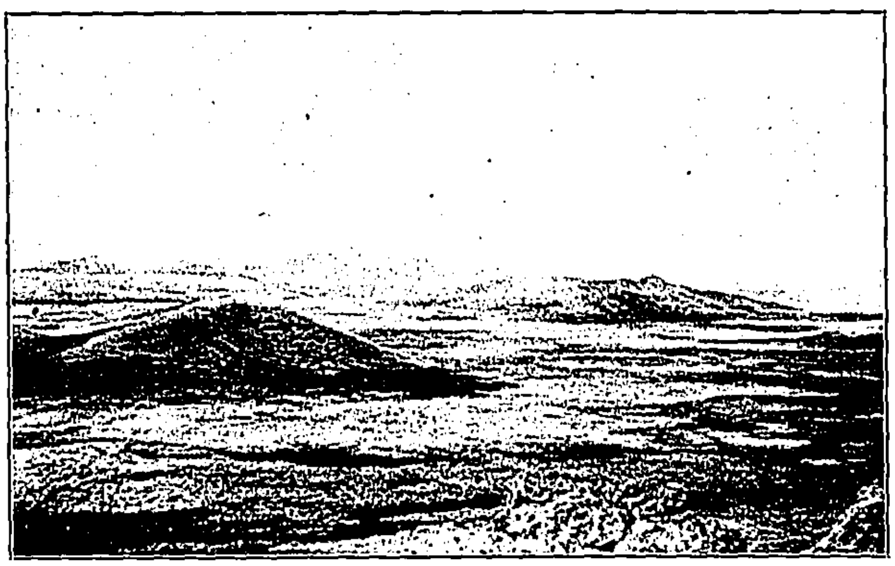
KILAUEA REPORT No. 1009

WEEK ENDING MAY 24, 1931

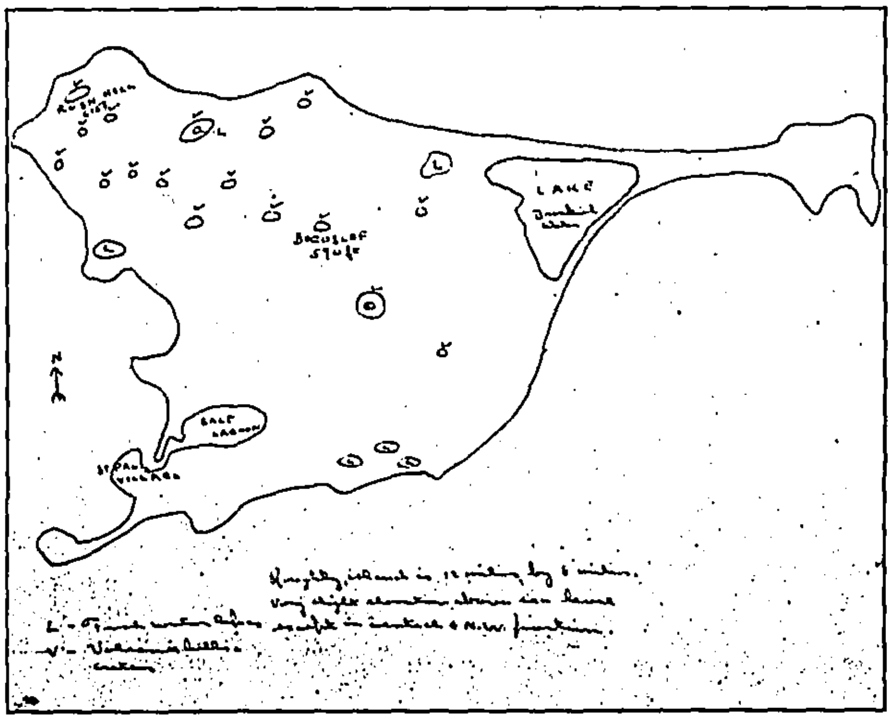
Section of Volcanology, U. S. Geological Survey
T. A. Jaggar, Volcanologist in Charge

At Halemaumau pit of Kilauea Crater a slide occurred on the northwest wall about 9 a. m. May 18 sending up a dust cloud. At 10:30 a. m. fume at the larger sulphur spot on the floor had slightly increased, but there was very little vapor rising from the wet area of the south talus. The avalanche was seen to have left a slight scar on the wall. Other sulphur spots besides the fuming one west of the center are bright yellow against the black floor, particularly one at the far western side.

The Observatory seismographs registered 25 tremors and one very feeble local seism, the latter at 12:18 p. m. May 23. Tilting of the ground was moderate SW, and microseismic motion very slight.



Photograph taken in July 1927 from the summit of Bogoslof hill in the middle of St. Paul Island looking westward toward Rush Hill in the extreme distance, that being the highest point of the island. At the right is shown a horseshoe cone resembling Diamond Head at Honolulu. Photo Rauch.



Sketch map by William P. Rauch in 1927 at St. Paul Island showing roughly the many volcanic cones (V), little fresh water lakes (L), the large northern lake of brackish water, and St. Paul village at the south. Map should be rotated to make the eastern point northeast. Compare charts 8802 and 8995, U. S. Coast and Geodetic Survey.

THE VOLCANO LETTER

The Volcano Letter combines the earlier weekly of that name, with the former monthly Bulletin of the Hawaiian Volcano Observatory. It is published weekly, on Thursdays, by the Hawaiian Volcano Research Association, on behalf of the section of volcanology, U. S. Geological Survey. It promotes experimental recording of earth processes.

Readers are requested to send articles, photographs, publications and clippings about volcano and earthquake events, instruments and investigations, especially around the Pacific.

Subscription for non-members two dollars per year of 52 numbers. Address the Observatory.

HAWAIIAN VOLCANO OBSERVATORY
Founded 1911

This laboratory at Kilauea Volcano belongs to the Hawaiian Volcano Research Association and is leased and operated by the United States Geological Survey.

It maintains seismographs at three places near Kilauea Volcano, also at Hilo, and at Kealakekua in Kona District. It keeps a journal of Hawaiian volcanic activity and publishes occasional Bulletins.

Membership in the Hawaiian Volcano Research Association is limited to patrons of Pacific science who desire personally to aid in supporting the work.

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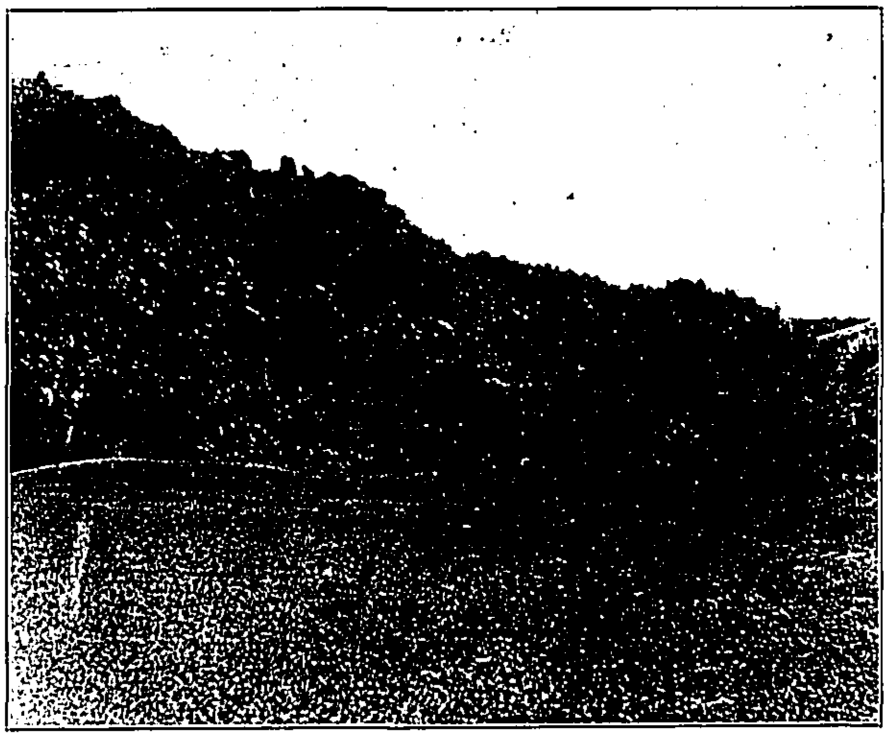
The Volcano Letter

Two dollars per year | Ten cents per copy

No. 334—Weekly | Hawaiian Volcano Observatory, National Park, Hawaii | May 21, 1931



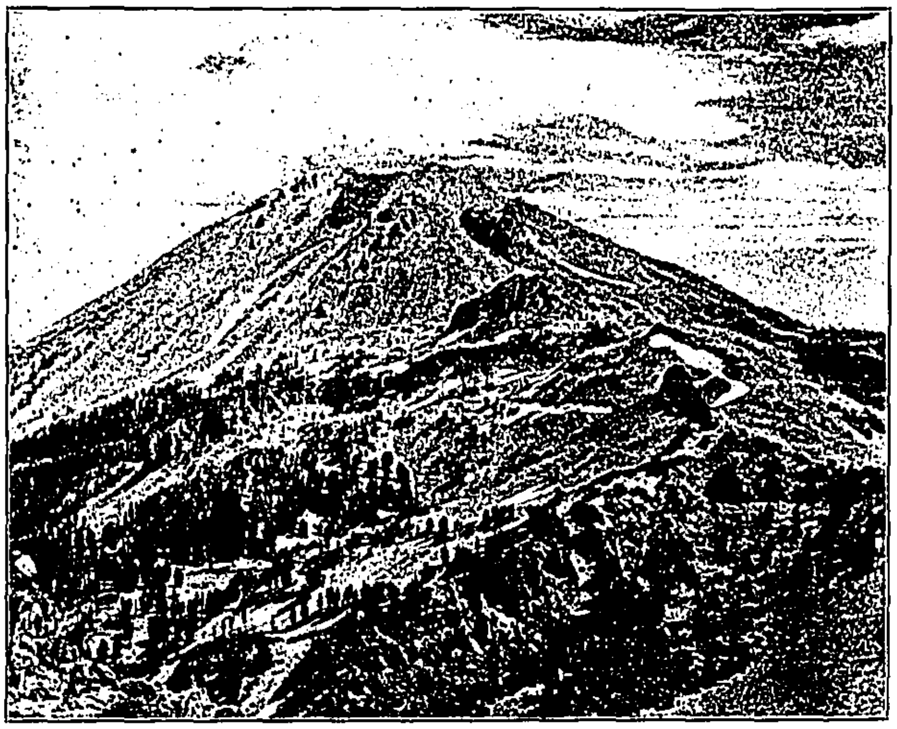
Edge of lava flow that poured out during the winter of 1850-51 at Cinder Cone, Lassen Volcanic National Park. Photo Finch.

THE YOUNGEST LAVA FLOW ON THE MAINLAND OF THE UNITED STATES

In the northwestern part of the United States there is a volcanic area covering about 25,000 square miles that extends from Lassen National Park, on the south, northeastward to Yellowstone National Park and northward to British Columbia. The eastern part of this volcanic area is the Columbia Plateau lava field, and the western part is the Cascade Range. In this range are Lassen Peak and other volcanoes that have been active in recent times. Mount Baker and Mount St. Helens were reported to have been smoking in 1843. Mount Rainier is said to have been feebly active in the nineteenth century, and steam still escapes from its summit crater. A volcanic eruption, possibly from Mount Shasta, was reported from a ship at sea in 1786. At the present time there are steam vents near the summit of Mount Shasta, 14,000 feet above sea level, so active that in a small area around them no snow can accumulate although a short distance away several glaciers have their sources.

In Arizona, New Mexico, and southern California there are very fresh-looking volcanic formations. The lava flow in the valley of the San Jose River in New Mexico is so fresh in appearance that it lends support to Indian traditions of a "river of fire" in this locality. Near Glass Mountain, in northern California, and at places in Oregon and Idaho, there are lava flows that appear to be less than 500 years old (Volcano Letter No. 292). At Cinder Cone, in Lassen National Park there are several recent lava flows, the latest of which (Page One) is believed to have poured out during the winter of 1850-51 (Volcano Letter No. 306).

It really was no surprise to those informed about the volcanic region of the northwestern United States when Lassen Peak became active in 1914. For a year the activity was largely confined to small explosions. Then during the night of May 19-20, 1915, Lassen produced the youngest lava flow on the mainland of the United States. The main crater was filled with new lava, and there were small overflows through low notches in the rim both to the east and to the west. The western branch of the flow is still in place, as shown on Page Two. Only remnants of the eastern branch of the flow remain, though there is good evidence pointing to the conclusion that it was the larger branch. Part of the eastern branch of the flow slid down the mountain shortly after it had been poured out, at the time of a mud flow during the same night. The photograph reproduced on Page Three, taken May 22, shows a remnant of the eastern flow, but most of this also slid down the steep mountain slope a few hours later. The most forcible explosion of the series took place during the after-



Lassen Peak from Mount Diller at the southwest August 27, 1927. The western branch of the youngest lava flow in the United States, produced in 1915, is the dark mass extending a short way down from the notch in the summit. Photo from Finch.

noon of May 22, 1915, after this photograph was made. Activity continued in varying degree until August 1917, but since then there have been no true volcanic eruptions of Lassen Peak.

Earthquakes that have their origin in the Lassen edifice are rather common as shown by the seismographs of the Lassen Volcano Observatory of the U. S. Geological Survey at Mineral, California. The fact that from 36 to 266 earthquakes are recorded each year at Mineral indicates that Lassen Peak is still somewhat uneasy.

Some references on Lassen Peak are as follows:

U. S. Geological Survey, Geologic Atlas, Lassen Peak folio (No. 15), by J. S. Diller, 1895.

The Volcanic activity and hot springs of Lassen Peak, by Arthur L. Day and E. T. Allen, Carnegie Institution of Washington, Publication 360, 1925.

Pictorial history of the Lassen Volcano, by B. F. Loomis, Anderson, California, Anderson Valley News Press, 1926.

The kingship of Mount Lassen, by Mrs. F. H. Colburn, San Francisco, Nemo Publishing Co.

The quartz basalt eruptions of Cinder Cone, by R. H. Finch and C. A. Anderson, Univ. Calif. Publ. Geol. Vol. 19, No. 10, 1930.

R.H.FINCH

HOT VOLCANISM OF NORTHWEST UNITED STATES AND CANADA

The article which precedes this is of great interest in presenting a newly discovered photograph (Page 3) by Mr. Loomis taken on May 22, 1915, at the same time as the one reproduced in Volcano Letters Nos. 266 and 304. The new one is different in showing the east side of the crater region of Lassen Volcano so clearly as to make it plain that the summit dark area is an unmistakable aa flow.

Lassen Volcano, therefore, produced in the end phases of its eruption May 19-20, 1915, stiff lava flows from its crater lips both east and west, and though the explosion of May 22 destroyed part of the eastern flow, fortunately Mr. Loomis was there in time to record its presence, and the remaining lava in the crater and on the west side was left in place to cool off where it may be seen today.

The history of the Cinder Cone and of Glass Mountain in that same volcanic district shows the area capable in recent times of pouring out extensive flows into the forest. It is still possible that within a few years activity may be renewed somewhere in northern California from the volcanic system represented by Lassen and Shasta, so as to pour out fresh lava flows. Mr. Finch shows how many places in the northwestern United States are active volcanoes with evidence of volcanic heat.

In addition to these places there may be mentioned the numerous hot springs of California thoroughly investigated by Waring (U. S. Geol. Surv., Water-Supply Paper No. 338, 1915), and some of these are boiling and accompanied by steam jets, as at Devil's Kitchen in Lassen Park shown on Page 4. Especially noteworthy is The Geysers canyon where steam is used for power north of San Francisco in the St. Helena range. Near Clear Lake there are old volcanoes, and there are boiling waters at Calistoga, and at the Little Geysers, and fumaroles at the sulphur bank, which is near to The Geysers. At The Geysers there is super-heated steam and volcanic gases, pointing to a magmatic origin (Steam Wells at The Geysers, California, by E. T. Allen and Athur L. Day, Publication 378 Carnegie Institution, 1927). This can only mean excessively hot gas-charged magma under the Coast Range close to San Francisco and not far from the center of the earthquake of 1906.

In addition to the abundant volcanoes of the Sierra Nevada and the Cascade Range from Lassen Peak to Mount Baker in Washington, Professor R. W. Brock (Proc. Third Pan-Pac. Sci. Cong. Tokyo 1926, Volcanoes of the Canadian Cordillers, p. 688) reports the discovery in 1909 of volcanic cones and lava flows 40 miles north of Vancouver, and also hot springs, marking an extension northward into Canada of the active volcanoes of the United States. The volcano Garibaldi is a cone rising 3,500 feet above the plateau to a total elevation of 8,700 feet, made up of cinders with some interbedded lava streams. In the Lillooet District there is andesitic pumice covering 1,500 square miles. On Naas River in British Columbia there is a lava flow consisting of olivine basalt, 20 miles long, and said by the Indians to be less than 200 years old. It dammed a river forming what is called Lava Lake, and there are explosion cones five in number, the description of which closely resembles that of Cinder Cone at Lassen. On the Unuk River there are other recent lava flows and vents so fresh that the volcanic ash can still be seen as black patches on the glaciers. Craters and flows on Ruby Creek in the extreme north of British Columbia, vast deposits of volcanic ash on the Yukon plateau, a volcanic cone north of the Pelly River, and some other places, lead Brock to the statement, "Complete exploration may show as much recent volcanic activity in western Canada as in most sections of the Pacific volcanic girdle." T.A.J.

DEATH OF PRESIDENT THURSTON

The editor records with the utmost grief the death on May 11, 1931, of the Honorable Lorrin Andrews Thurston, President of the Association, in Honolulu.

KILAUEA REPORT No. 1008

WEEK ENDING MAY 17, 1931

Section of Volcanology, U. S. Geological Survey

T. A. Jaggar, Volcanologist in Charge

Volcanic conditions are very quiet at the Hawaiian volcanoes and at Kilauea the only seismic movements of any consequence are very slight tremors. At Halemaumau pit on the inner floor of Kilauea Crater a visit at 10 a. m. May 14 showed everything quiet about the bottom lava of 1930, no steam was visible at any vents, and a little fume was infrequently detected at a yellow sulphur spot near the middle. *One or two* rocks were heard falling at the northeastern and northern walls of the pit. The same conditions were noted at 9:15 a. m. May 16, and a small slide occurred at the north wall at 9:25 a. m.

Twenty-eight tremors were registered on the Observatory seismograph during the week ending midnight May 17, and one very feeble local seism at 4:41 p. m. May 13. Tilting of the ground accumulated slightly SW, and microseismic motion was slight.

Lassen Peak from the northeast May 22, 1915. The dark area under the steam cloud is a part of the eastern branch of the lava flow that came out during the night of May 19-20, 1915. Photo B. F. Loomis.

Steam escaping with velocity in Devil's Kitchen, Lassen National Park, November 14, 1930. During the summer the seat of the principal vent was a boiling pool of water ten feet in diameter. The steam was above the boiling point for that elevation. A cold, disagreeable rain was always falling under the vapor cloud. Photo from Finch.

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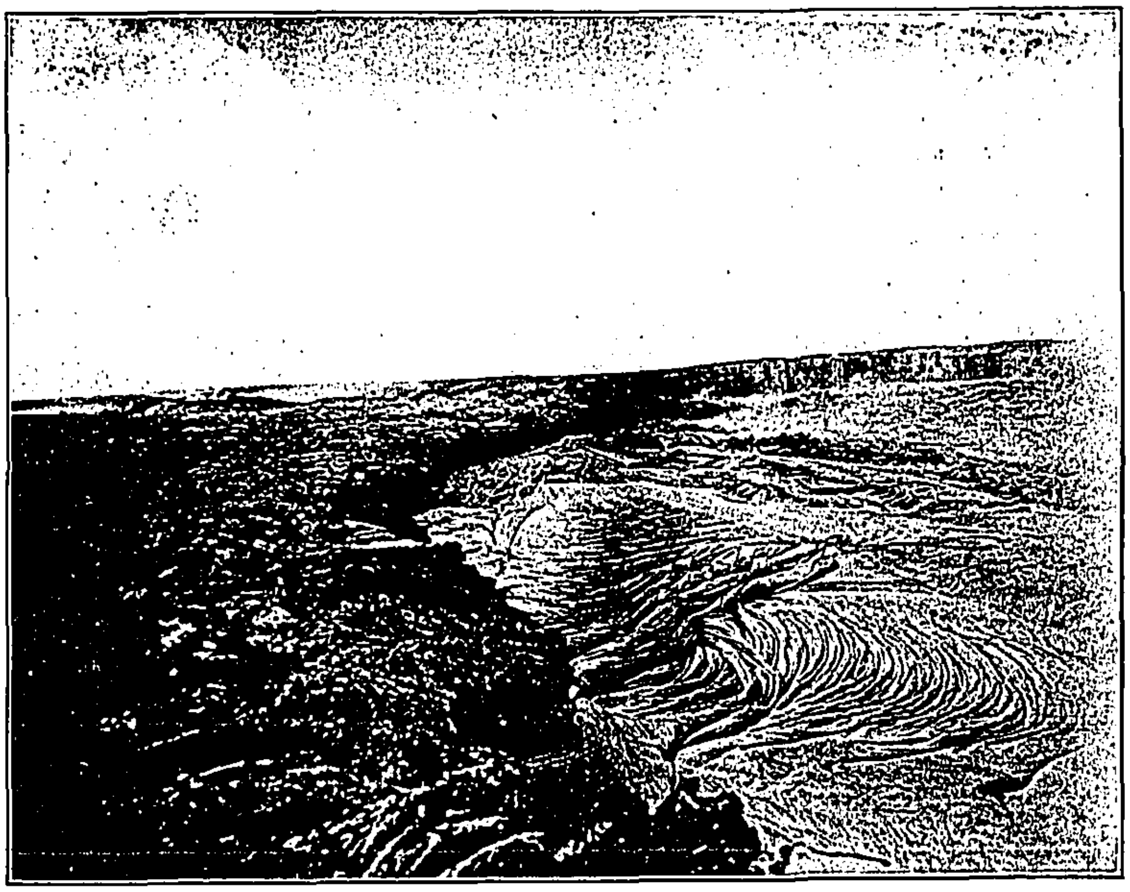
No. 333—Weekly — Hawaiian Volcano Observatory, National Park, Hawaii — May 14, 1931

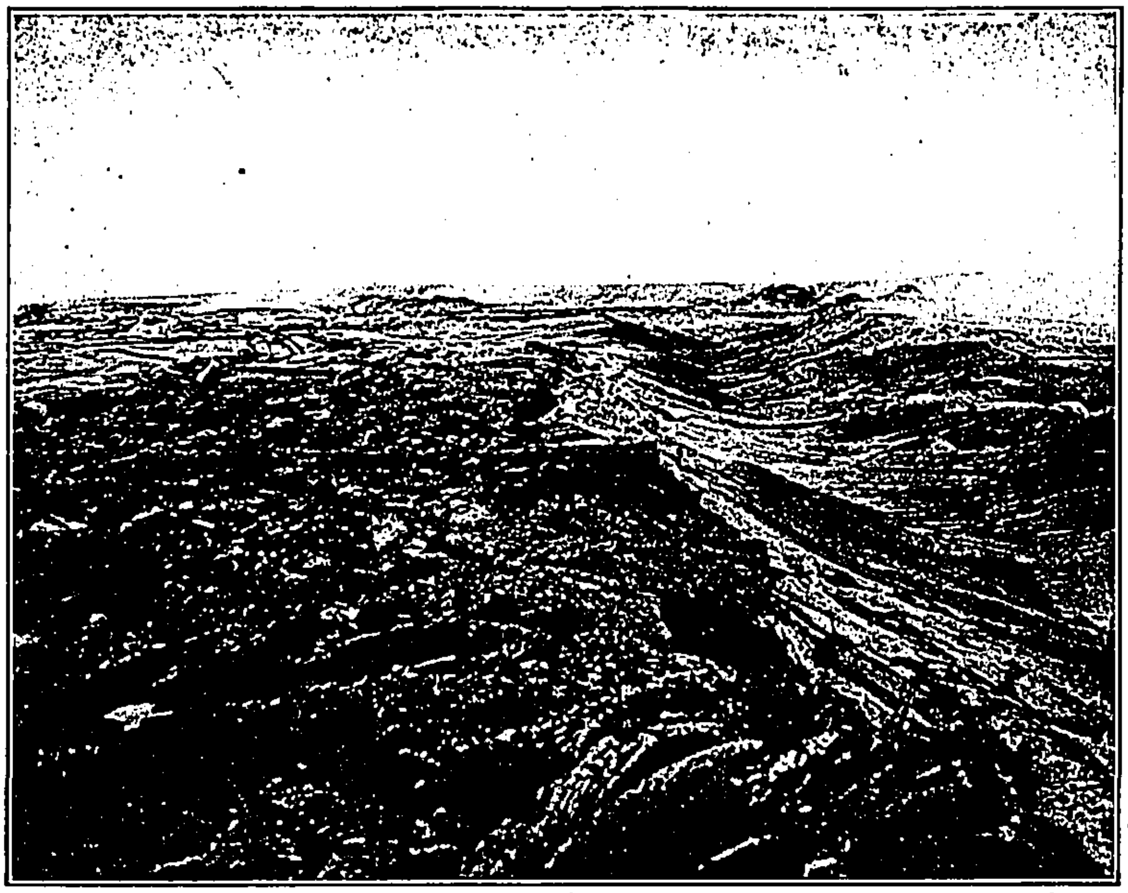


South rim of Halemaumau February 3, 1919, when it had begun to swell faintly, and on the right are seen live flows pouring along the wall crack from a small cone inside the pit. The live lava column of the pit is on the right. This margin of the pit was thrust up as the great pressure ridge February 25 and later.

HEAT AND UPLIFT AT KILAUEA 1919-21

In discussing the cycle of eleven years from 1913 to 1924, the story would be incomplete without a clear statement of the observed effects of increase of underground heat and the consequent uplift which was measured at the rim of the inner pit Halemaumau, and at the rim of the outer crater Kilauea. It is difficult for any one, who has not actually lived on the edge of such an active sink crater, to visualize as an actual fact the uplift of a mountain top by several feet in a few days. This is what truly happened at the edge of the pit Halemaumau when between February and May 1919, as shown in the sequence of pictures herewith, the liquid lava overflowed the rim of the pit, and a heaped tumescence from below swelled up the rim into a pressure ridge 15 to 20 feet high. And this was merely an index of what was happening on a larger scale to the whole inner floor of Kilauea Crater, and on a still larger scale to the whole top of the mountain outside of Kilauea Crater for a radius of 20 miles. (Tilt Records for Thirteen Years at the Hawaiian Volcano Observatory, by T. A. Jaggar and R. H. Finch, Bull. Seis. Soc. Amer. Mar. 1929.)

The swelling of volcanoes was reviewed in Volcano Letter No. 264, but it may be of interest here to summarize the facts about the top of Kilauea at the time of the peak of this active cycle. Leveling measurements of the summit in 1912, 1922, and 1926 showed that the top of the mountain rose two feet before 1922 and subsided from two to nine feet after 1922, the larger figure being that of the inner crater floor. We have seen that seven thousand million cubic feet of rim rock fell into Halemaumau pit during the explosive eruption of 1924. Taking the leveling data and assuming symmetrical subsidence about Halemaumau as a center for the 1921-24 period, the volume of land withdrawn amounted to twenty thousand million cubic feet. This is nearly three times the amount engulfed in Halemaumau. The weight of such decrease of volume of the island above sea level would amount to one and one-quarter thousand million tons. Adding the volume of rock engulfed at the pit we would get a void space created inside the mountain when the lava withdrew of twenty-seven thousand million cubic feet. The down-warping was at a maximum about the crater and the form of the area lowered, with gradual decrease of lowering twenty miles out from the crater center, suggests a horizontal lens of lava evacuated under the shell of the mountain. The suggestion for



Same view as Page One five days later, February 8, 1919, showing the overflow which destroyed the trail, and the sagging crusts of new lava inside the pit on the right.

the whole period of rising and falling is that the dome of Kilauea behaved like a boil or pustule, filling and swelling during the first half of the cycle, and evacuating through an underground crack below sea level at the end.

Early in February 1919 the lava lakes of Halemaumau exhibited brimming and overflowing conditions, and a southern heap inside the pit overflowed the rim February 7 (see cut Page Two) so as to pour across country 400 feet damaging a trail at the road terminus. The liquid lava was rising and the bench magma was sinking. An earlier January overflow had abstracted weight from the top of the lava column and deep effervescence followed as in the overflow of a geyser pool. A northeastern slag heap next took its turn of building up 27 feet just inside the rim of Halemaumau and flows from it threatened the eastern stone tourist shelter. The last week of February produced mass swelling of the lava column, eruptions of standing fountains of melt, extended overflows on three sides, the lakes as well as the slag heaps contributed to the flows, and all the lakes stood as ring-shaped basins, six in number, above the rim level of the pit.

Mashing of the previous rim upward and outward next occurred at the southwest, south, and east, so as to make a pressure ridge from eight to fifteen feet high of what had been the rim before, illustrated by comparing the photograph of February 3 on Page One with that of May 6 on Page Three. The formation of this ridge, however, occurred within a few days at the end of February and the beginning of March. The ground begins to smoke and becomes stained around such a trig station as is shown as a white, circular concrete platform on Page Four. This same southeastern station and all the ground about it then rose and tilted back gradually but very rapidly in the course of a few days, so that it was sloping away from the center of the pit. The ridge formed was 20 feet wide in places, with an elephant's back curve on the side away from the pit. The three most used surveying stations were destroyed, and the net rise of the eastern side of the lava column inside of the pit at the same time was from 10 to 15 feet.

Moderate flowing during the first half of April 1919 gave place to mass swelling the third week of the month, ending in strong overflow that broke up the wall crack through the south pressure ridge, itself the edge of the pit, and this produced the longest and most liquid flow of 1919 to date. It covered the trail and reached the road terminus, and was the third flow of the year that had extended about a half mile from the Halemaumau center.

Within the year prior to February of 1919, Halemaumau had exhibited overflowing of its rim on eleven separate occasions and at nine different places Six of these extended more than 100 feet away from the pit, and of these the southeast flows of February-March 1918 had been the most extensive, reaching a half mile or more in length. Those of November 1918 came next in volume, and the flows of January-February 1919 tended to fill the gaps between the two earlier localities. August of 1918 had produced some driblet overflows at the north and southwest.

The appearance of Halemaumau in April 1919 was that of a smooth curved dome 1,200 feet across, rising from the base of what was left of the northwestern rim cliff of the pit. The swollen top of the lava column rose 50 feet above the general level of the former rim, and fell off abruptly as an escarpment 40 feet high on the southeast at the pressure ridge (see Page Three). Known landmarks on the pressure ridge measured in profile on a telescope scale from the Observatory two miles away, were seen to move horizontally easward within a few weeks. The old edge of the pit after being raised bodily was then mashed until it fell backward in a talus, and the upper part of the escarpment was now the cross-section of the inner live lava layers of the stiff lava column, where the pit floor had been lifted clear above what was left of the pit rim.

April 20, 1919, inaugurated a series of big flows from cracks in the Kilauea floor outside of Halemaumau at the north. These flows were destined to continue pouring across the northern part of the Kilauea floor throughout most of the year. They were called the Postal Rift flows because they originated at a hot crack where travelers formerly scorched postal cards. The swelling up of the rim of the pit was now extended around to the west and north, tilting the west station 4.5 degrees to the southwest, and the north bench mark 8.5 degrees to the north, so that it was lifted approximately eight feet in the course of a few days. This lifting up of old rim rock was accompanied by more or less heating and smoking of the cracks, and the outflow of liquid lava 800 feet back of the pit occurred without seismic disturbance, and was unquestionably connected through cracks with the same lava column that occupied Halemaumau. The Halemaumau lakes did not lower, but rose and increased their gas pressure while the tumescence of the inner bench magma lessened. The Postal Rift flow had advanced 1.4 miles across the Kilauea floor by April 25. T.A.J.

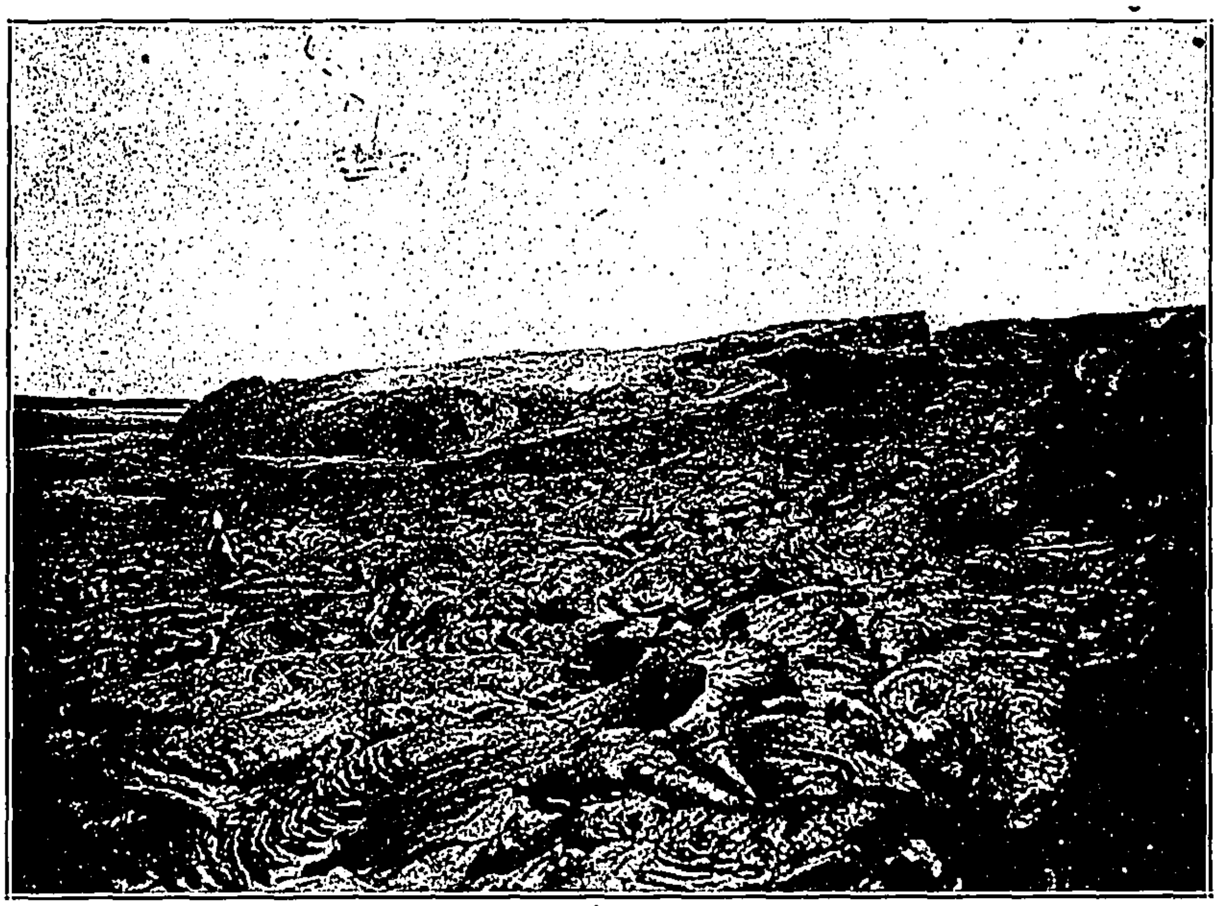
KILAUEA REPORT No. 1007

WEEK ENDING MAY 10, 1931

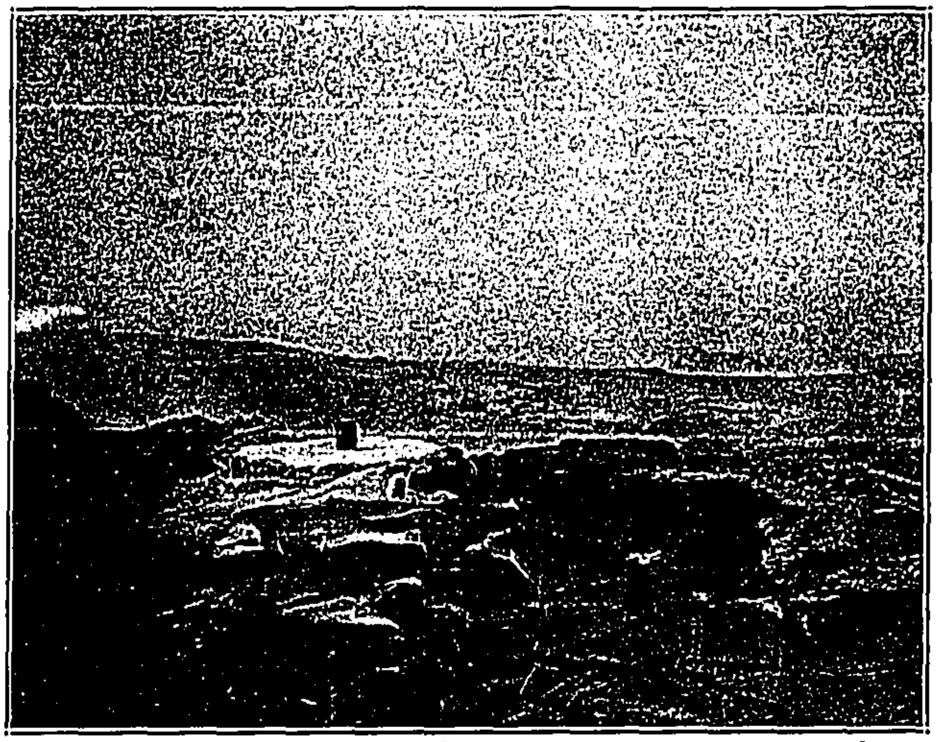
Section of Volcanology, U. S. Geological Survey
T. A. Jaggar, Volcanologist in Charge

On May 6 in the forenoon at Halemaumau pit of Kilauea Volcano there was little fume that could be detected at the sulphur spots on the floor of the pit, and very little steam appeared at the south talus. The pit seismograph indicated a gradual tilt away from the pit until May 2 and thereafter motion in the opposite direction. On May 9 some newly fallen rocks were observed at the base of the north talus.

The Observatory seismographs registered 38 tremors



May 6, 1919, showing the same southern edge of Halemaumau as in the photographs on Pages One and Two, but now quite unrecognizable. Halemaumau had become a dome, the rim had become a pressure ridge, the former eastern stone shelter lay under the flows in the foreground, and the main lake was in a hollow at the top of the dome on the right. The trig station shown on Page Four was lifted up until it fell to pieces on the "elephant's back" shown here on the left.



Southeast trig station at rim of Halemaumau when the ground was beginning to be heated, fumed, and stained by tumescence, February 21, 1919. This within two weeks was lifted up and overturned backwards away from the pit on the pressure ridge shown at the left of cut on Page Three. Photo Jaggar.

during the week and a very feeble distant earthquake was recorded at 9:24 a. m. May 10. Tilting of the ground for the week was slight ENE, and microseismic motion was slight but increased somewhat May 4-5.

TILTING OF THE GROUND FOR APRIL

The following figures show the net amount of tilt by weeks at the Observatory on the northeast rim of Kilauea Crater, and its direction, computed from the daily seismograms by platting a curve smoothed by overlapping progressive seven-day averages. This is the departure of the plumbline in the direction given.

April 6-12	0.3 seconds W.
April 13-19	1.3 seconds W.
April 20-26	2.5 seconds SW.
April 27-May 3	1.4 seconds SW.

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No. 332—Weekly | Hawaiian Volcano Observatory, National Park, Hawaii | May 7, 1931

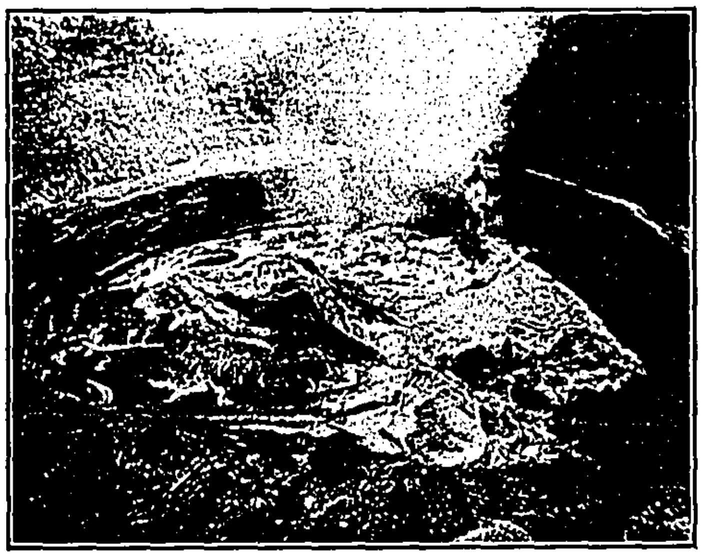
West rim of Halemaumau showing smoky conditions which were prevalent during the early years of the volcanic cycle 1913-1924. Taken from the south edge of the pit looking toward the region of the western source ponds, October 24, 1916.

BEGINNING OF THE VOLCANIC CYCLE

After reviewing twenty years of Hawaiian eruptions (Volcano Letters Nos. 319 and 320) and showing that the last cycle was 1913-24, we have recently described some details of this cycle, beginning at the end and going backwards. (Great Eruption 1924, No. 328, events preceding it, No. 329, Peak of Cycle, No. 330, rising of 1917, No. 331.) The beginning of the cycle was accompanied by two outbreaks of Mauna Loa in 1914 and 1916, and we have already described the remarkable subsidence of the latter year in Halemaumau (Volcano Letter No. 324). We have reason now in the cycle that began with influx of new lava in the bottom of Halemaumau July 1924, to make comparisons with the beginnings of the next preceding cycle. This might tell us something prophetic. But in doing so we must remember that 1913-24 ended with a gigantic collapse of about seven thousand million cubic feet of broken rock that fell down the Halemaumau shaft. This material is in the Halemaumau shaft now. No such fall of material occurred in 1913. At that time there was a solidified crust of live lava 600 feet down and the preceding cycle had been marked by slow risings with activity around the 300-foot level, and several sudden sinkings to depths not usually greater than 600 feet. Around the 300-foot depression level the lava column, therefore, of both bench lava and lake lava, was highly mobile, with an open shaft below into which it could sink. Now in 1931 the lava column 900 feet down is a pile of crusted layers, each not more than 60 feet thick, heaped up in five different years, and all comparatively stiff as a cake resting on top of the rock fill of 1924.

Such is the difference between the beginning of a new eleven-year cycle following the close of a supercycle, and the beginning of an eleven-year cycle which has many decades of mobility behind it. It is natural, therefore, that to some extent the years 1924-27 should be different in action from the years 1913-16. Both these periods, however, have been marked by gradual and somewhat intermittent rising of lava in the bottom of Halemaumau pit and by one or more outbreaks of frothy lava at the summit of Mauna Loa with eventual drainage in a Mauna Loa lava flow on the southwest flank of that mountain.

From May 1913 until just a year thereafter the lava lay 600 feet down in Halemaumau pit with great volumes of fume and steam making the bottom invisible. Slowly the lava rose in 1914, building spatter cones with glowing



Interior of Halemaumau from the southwest at 9 a. m. June 5, 1916, showing elliptical lake and the islands which on one occasion were seen to move horizontally. Depression of bench 253 feet, of lake 300 feet. Entire lava surface 780 by 675 feet in diameters.

trickles, the fume diminishing in proportion to the volume of lava fountaining. In the top crater of Mauna Loa big fountains burst out along a lengthwise north-and-south crack in November 1914, flooded the bottom of the crater and kept it up vigorously until the beginning of January 1915, the lava in Halemaumau meanwhile rising. There was no lateral outflow from Mauna Loa. When the summit activity of this big mountain ceased, Kilauea lava went down in Halemaumau 175 feet, but not very suddenly. This was the first of the occasions, that came under the observation of the Observatory, when in both rising and sinking, Kilauea showed sympathy with Mauna Loa.

The year 1915 produced a rising of lava in Halemaumau to a higher point than had been reached in 1914, and the peak of the rising in September was at the depression level 360 feet below rim of pit.

This September of 1915 produced a crisis of subsidence accompanied by many small earthquakes whereby the lava receded, the marginal bench cracked funnelwise and caved in, and the entire lava column lowered so as to leave a surging, liquid puddle in the bottom, destroying the integrity of the partially congealed saucer of bench magma. This saucer had consisted of four things: (1) The old slide-rock slopes of 1913, (2) the new liquid lava, (3) the overflow products of the lake, forming a bench, and (4) the partially congealed bottom material of the lake sometimes seen as shoals and islands. The measurements proved conclusively that these islands were part of the lake bottom and were not floating. The temperature of the liquid lava was proved quite incapable of melting the old slide-rock slopes of 1913. If we picture a cross-section of the top of the lava column at this time, we must imagine a stiff paste rising with the old talus breccia cemented in it, with a ring platform carried on its crest, the whole somewhat cylindrical in shape, and a shallow inside cup containing the lava lake fed by a well leading downward through the midst of the column of stiffer lava. Up the feeding well was coming the hot gas froth, which broke through the crust of the lake periodically about once a minute in what was known as *"Old Faithful" fountain.* This froth imported new fundamental magma from the depths, heated by gas reactions, and thereby this material was liquified and vesiculated to a fluid condition very different from the fundamental magma deep down under pressure, where it is presumably stiff, rigid, and heavy.

The September lowering was from depression 360 feet to depression 480 feet. The subsidence was like the one that had followed the Mauna Loa eruption in January of the preceding winter, but there was greater lowering in just such proportion as there had been greater clearing out of the throat below. The talus fragments had in a measure been appropriated as part of the bench magma column. This column had risen from a narrower throat below to a wider funnel above. Consequently with the uplift liquid lava occupies the ring channel and discharges through a border well into the upper saucer. By this process with every pronounced rising the throat is cleared bigger, and the pulsations of subsidence are permitted to go deeper. The lava entering loses its gas, becomes heavier and pours downward in some sinkhole wells, and the "Old Faithful" central well may reverse its flow and become a sinkhole at times.

The curve of rising and falling showed sudden drops in January of 1915, September 1915, and June 1916, each drop being bigger than the one preceding. As the first and the third of these followed the recession of lava into Mauna Loa after an outflow there, it appears altogether probable that the middle one of September stood for the same process. That is, lava rising into cracks under the center of the island, then escaping laterally by extending the cracks farther, thereby lowering its hydrostatic level, while Halemaumau as a gauge off to one side recorded the movement.

In early autumn of 1915 the circulation developed fiery cascades pouring into eastern coves and into a small outlying east pond connected by a tunnel with the main lake. At the west end was a source pond of rising lava, whence the lava streamed eastward to splashing border grottoes. Rising of liquid overflowed the floors around the lake after

October, and the floors as part of the fabric of the bench magma showed tendency to lift and tilt away from the lake while heavy floods weighted the margins of the floor so that the crags became escarpments with steep faces toward the center of the pit.

Watching the action of the upward pouring slag in Halemaumau pit in 1915-16 led to a fruitful conception to the effect that a lava lake in a pit is nothing more than what would be a flow if it were on a monutain side. In a pit, however, there comes about heat conservation and long preserved internal glow of the bench magma which is different from the overflow fields of the mountain flank. As the front can go nowhere, being confined in a pit, we get a side vent or well, several tunnels as crusts form, and an overturning circulation due to upflow of the light and gassy, downflow of the heavier gas-free fluid. The resemblance of the lake in 1915 to a lobate flow from west to east across the bottom of the pit was striking. The spring of 1916 developed tremendous overflows of the lake which poured between two broken halves of a crag seen gradually to split in two. The overflow on the bench duly became a pool with definite rounded shape in plan, until finally it appeared that the lake had changed its outline, and had developed a big extension. The temperature of the rising melt is not high enough to fuse the banks, but the gases and their reactions are what produce melting. When a mixture of gas and slag comes up rapidly, it enlarges the wells and lakes partly by gas-melting, partly by convectional erosion, and largely by determining the boundary change between two viscosities, that of the more liquid gas-charged lava, and that of the stiffer relatively gas-free paste.

From January to May 1916 the lava of Halemaumau rose rapidly so that the overflow of the floor, and the breakage of the bench magma column below developed in April a big S-shaped lake, then two crags became islands, and lastly the rising lake developed elliptical form around them. Finally the island crags exhibited horizontal movement, which is rare in Halemaumau. One of them migrated north bodily with rotation around its west point as a vertical axis. As the rate of rising was very rapid it seems probable that the island blocks of bench magma were undermined so as to execute a rotatory tilt, partially buoyed, and breaking away from a narrow stem. May 19 came the southwestern Mauna Loa eruption, and on June 5, after Mauna Loa ceased action, came the great subsidence in Halemaumau. T.A.J.

The western source pond filling the wall valley under the northwestern cliff in Halemaumau August 23, 1916, after recovery from the great subsidence. This shows a typical source well and the process by which crags of bench magma were tilted up.

Halemaumau from the south-southwest when the lava bottom was 225 feet below rim, fume was diminishing, lava was flooding, and benches and crags were being elevated bodily around the lava lakes. Photos Jaggar.

KILAUEA REPORT No. 1006

WEEK ENDING MAY 3, 1931

Section of Volcanology, U. S. Geological Survey

T. A. Jaggar, Volcanologist in Charge

Conditions at Kilauea remain with little change. Fuming is steady at the yellow sulphur area north of the 1930 cone. A few falls of rock and dust from slides were noted at the north wall on April 27. On this date a southerly wind storm doing much damage in Kau District blew thick dust clouds from the desert over Kilauea Crater in the early forenoon.

Cracks paralleling the southeast rim of Halemaumau were measured on the 27th. Nearly all the marked points showed widening, the greatest being 1 7/16 inches at a place in the roped-off area near the tourist shelter.

A total of 39 seismic disturbances were recorded on the instruments at the Observatory, viz: 33 tremors, 4 very feeble seisms, and 2 feeble seisms, all local to the island of Hawaii. The greatest number of disturbances in one day was 11 on April 27. One very feeble shock at 12:18 p. m. April 28 was felt at the Observatory as a sudden jerk, the record indicating a close origin.

Tilt for the week was moderate SW. Microseismic motion was slight.

THE VOLCANO LETTER

The Volcano Letter combines the earlier weekly of that name, with the former monthly Bulletin of the Hawaiian Volcano Observatory. It is published weekly, on Thursdays, by the Hawaiian Volcano Research Association, on behalf of the section of volcanology, U. S. Geological Survey. It promotes experimental recording of earth processes.

Readers are requested to send articles, photographs, publications and clippings about volcano and earthquake events, instruments and investigations, especially around the Pacific.

Subscription for non-members two dollars per year of 52 numbers. Address the Observatory.

HAWAIIAN VOLCANO OBSERVATORY
Founded 1911

This laboratory at Kilauea Volcano belongs to the Hawaiian Volcano Research Association and is leased and operated by the United States Geological Survey.

It maintains seismographs at three places near Kilauea Volcano, also at Hilo, and at Kealakekua in Kona District. It keeps a journal of Hawaiian volcanic activity and publishes occasional Bulletins.

Membership in the Hawaiian Volcano Research Association is limited to patrons of Pacific science who desire personally to aid in supporting the work.

The work of volcano research so supported is in collaboration with the work of the United States Geological Survey, but supplements it with buildings, research fellows, instrumental plants, explorations and special investigations for which there is no governmental provision. The Geological Survey maintains volcano stations in Alaska, California and Hawaii.

Persons desiring application blanks for membership ($5.00 or more) should address the Secretary, Hawaiian Volcano Research Association, 300 James Campbell Building, Honolulu, T. H.

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HAWAII NATIONAL PARK
HAWAII

OFFICE OF THE SUPERINTENDENT

May 12, 1931

The Director,
National Park Service,
Department of the Interior,
Washington, D. C.

Dear Mr. Director:

Following is a report of activities and operations in Hawaii National Park for the month of April, 1931.

000 GENERAL:

Although the drought that has existed in some parts of the island has been broken by rainfall, the amount is still about fifty per cent of normal, both for the month and to date. Two unusual weather events occurred during the month. On April 27 a wind storm swept through the Kau district with a force of from forty to sixty miles an hour. Six miles of flume was blown down on the Hutchison Sugar Plantation. Large flocks of Iwa birds were seen in Kau, having been blown inland by the heavy winds. About fifty trees were blown down, some of them across the road, among which was the companion monkey-pod tree to the famous Mark Twain tree.

The terrific wind brought up such an unusual dust cloud over the Halemaumau firepit that it looked as if the pit was in active eruption. The clouds would rise high over the pit and drift away, to be followed by other dense clouds.

100 ADMINISTRATION:

110 Status of work.
With great difficulty the office work has been kept fairly up to date although personnel work, purchases, and jobs getting under way, and particularly the final estimates for 1933, have made necessary a considerable amount of overtime. Several new jobs were started on the outside, mention of which is made further on in this report. There were six permanent employees holding formal appointment, and eleven per diem employees. The position of chief clerk in this office was re-allocated from Grade 7 at $1740 to Grade 9 at $2000, effective April 1, and the duty of disbursing work was added.

120 Park inspections by.

121 The superintendent.

Daily inspections were made of the roads and trails and building improvement in and around headquarters. A trip was made to the Kau section of the park early in April and toward the latter part of the month a trip was made to the Kalapana section.

130 Finance and accounts.

Following is a list of the funds appropriated for work in the park with unexpended balance as of the close of April 30, 1931.

Name		Allotted	Expended	Balance
41/2415	Hawaii National Park 1931-32	52,130	548.16	51,581.84
41/2406	Forest Protection and Fire Prevention	100	8.21	91.79
40/1415	Hawaii National Park 1930-31	34,625	26329.90	8,295.10
40/1406	Forest Protection and Fire Prevention	630	630.00	-----
4X 436	Roads and Trails, National Parks, no year	382,385	15079.50	367,305.50

150 Equipment and supplies.

The Ford truck purchased for use in the Haleakala section of the park was delivered at Wailuku and we had the von Hamm-Young Company of Wailuku take the truck and store it in their garage until called for.

The following equipment and supplies were delivered to the park during the month:

1 only #325 Amsterdam Rug, 36 X 63" color taupe,	$6.25
1 only Congoleum Silver Seal Rug, size 9 X 12 ',	7.85
1 only Crex Rug, size 9 X 12 ',	13.85
26 linear feet Congoleum "Linoleum" 6' wide,	14.82
1 only Bedspread	4.35
2 only Super Fyre Fyter Fire Extinguishers, quart size, polished brass, at $9.50	19.00
22 only Velvet Rugs, 36 X 63", color taupe, at $3.10	6.20

160 Status of alienated land.

The Hawaiian Volcano Research Association is proceeding with the purchase of the house owned by Miss Fusao Takahashi, and as soon as the deed is executed they will make application to have this property included with the other property that they lease from the United States Government at a nominal rental. They propose to keep title to this property in their own name in order that they may be able to maintain it and improve it for the use of the Geological Survey from time to time as necessary without requiring expenditure of Government funds.

170 Plans, maps and surveys.

Mr. H. L. Handley, resident engineer representing the Bureau of Public Roads on the road improvement in Hawaii National Park, arrived April 25 and selected a survey crew and has been busy establishing line and grade stakes with the expectation that the contractor would soon be on the job.

180 Circulars, placards, etc.

Copies of the weekly issue of the Volcano Letter are attached.

200 MAINTENANCE, IMPROVEMENTS AND NEW CONSTRUCTION

210 Maintenance.

The usual maintenance and repair of roads, trails, buildings, telephone lines, etc. was carried on during the month. The extension of the automobile trail from Uwekahuna bluff to Halemaumau firepit around the southern end of Kilauea crater has created a great deal of public interest and has met with unqualified approval. The road leads along the edge of the bluff for some distance, affording an interesting view of the far side of the pit which is not usually seen by the average visitor.

220 Improvements.

Further minor improvements were made on the Hilo road entrance station and work was started on the addition to the laborer's building to provide suitable quarters for the park naturalist who is to arrive the latter part of May. By enlarging the building on one side, a bedroom, bath and small back porch were provided for. Modern plumbing was installed in the bath, electric and telephone service provided, screens, shades and drapes provided for the windows and doors, and the whole building freshly painted inside and out. It is being furnished for use as bachelor quarters.

230 New construction.

The Bitulithic Paving and Concrete Co., Ltd., 854 Kaahumanu Street, Honolulu, Hawaii, was advised formally on April 4 that their contract for road improvement in Hawaii National Park had been accepted, the unit prices totaling approximately $174, 184.76, work to be started within ten calendar days after date of receipt of notice from the engineer to proceed.

The extension of the Halina pali trail from the rest house to the seacoast was started the latter part of the month and the improvement of the original trail built last year is under way.

240 Improvement of approaches to the park.

Road improvement of the round-the-island road in the Kona section of the road continues to make fair progress and this is of interest to the park because part of the round-the-island road crosses the park and all park visitors who make the trip around the island are required to travel over this road.

300 ACTIVITIES OF OTHER AGENCIES IN THE PARK.

310 Public service contractors.

The Kilauea Volcano House Company continued to render service during the month. The number of guests varied from one or two on days between boats to as high as 180 on such days as steamers visited Hilo. The character of service rendered the public was satisfactory.

314 Complaints.

Overnight visitors at the Volcano House have not taken the trouble to call at the Superintendent's office to complain about lack of modern facilities and conveniences at the hotel but they invariably mention it if they have an opportunity to talk to the Park Superintendent. One or two members of the California Press Association party were quite strong in their criticism of the lack of facilities and asked why it was that the park did not insist on the same standard of service here as is provided in other parks.

320 Cooperating Governmental agencies.

There were a number of cases of stomach and intestinal disorders among the families of Government employees in the park and Captain Best, the medical officer at the Kilauea Military Camp thought the trouble might be due to contaminated water. J. P. Caceres, Division Supervisor of the island of Hawaii, Territorial Board of Health, with headquarters in Hilo, was requested to have the suspected water analysed, and this was done on April 15. Samples were taken from three different tanks and were examined bacteriologically and chemically. Nothing was found to indicate that the water might have caused the sickness. Two samples were sterile and the third indicated such a small amount of B.coli that the water source of trouble was eliminated.

330 Cooperating non-Governmental agencies.

The Mutual Telephone Company, whose telephone pole line follows the right of way of the round-the-island road through the park will have to move most of these poles when this road is widened and improved and I have induced the company to move their line off the road right of way entirely, placing it on an old railroad grade and an old secondary road so that it will be out of sight of park visitors between the entrance station and the hotel.

400 FLORA, FAUNA AND NATURAL PHENOMENA.

Kilauea volcano: Nothing unusual has developed at the volcano during the month, there being about the same number of tremors and the same amount of fume and sulphur spots showing in the pit, as in the past. There has evidently not been any reduction in the pressure under the bottom of the pit as the tilt is approximately the same as before.

410 Ranger, naturalist and guide service.

Park Ranger Kenneth J. Williams was appointed and entered on duty under a probationary appointment on April 2, at $1,980 per annum. Mr. Williams is from Honolulu and was the only available candidate on the Civil Service register in this district. Park Ranger Christ was promoted from Grade 8 at $1,920 to Grade 9 at $2,000, effective April 1. A new ranger naturalist position for service of one month was created to assist in conducting classes in geology and botany from the summer school of the University of Hawaii. John E. Doerr, Jr. was appointed park naturalist for Hawaii National Park in April and will arrive to take up his duties the latter part of May.

Ranger Brumaghim gave 12 lectures during the month to a total of 201 visitors, while 405 visitors called at the museum. Four trail trips were conducted during the month with 8 visitors guided over the Halemaumau trail. The round-the-world boats usually have only one day for sightseeing on the island of Hawaii and their time in the park is so limited that it has not been possible heretofore to give the visitors the lecture and motion picture exhibit showing how volcanoes are formed, and volcanic activity, and this is a real regret as it is the one thing that every visitor should have who visits the park while the crater is inactive. After he has seen this picture he can better understand that which he sees and gain some idea of the awe-inspiring sight of a volcano in active eruption.

An office for the new park naturalist has been fixed up on one side of the building that houses the electric generating plant for the museum but it needs to be equipped as soon as funds can be provided for doing so.

500 USE OF PARK FACILITIES BY THE PUBLIC:

There was a total of 6,667 visitors to the park during the month, which compares with a total of 5,785 visitors for the same month last year, which is a slight gain. The total visitors to date is 82,502, compared with 47,208 last year. A recent report of the president of the Matson Steamship Company was to the effect that he looked for a good travel during the coming summer.

520 General weather conditions.

The rainfall for the month of April was 3.92 inches, compared with 6.35 inches for the same month last year. The total rainfall to date this year is 13.81, compared with 27.70 last year, or approximately a fifty per cent decrease, both for the month and for the year to date. At Hilo the rainfall to date is 23.26 inches, compared with 46.43 for the same period last year. The humidity ranged from a minimum of 71 to a maximum of 95. Form 1009 U. S. Department of Agriculture Weather Bureau report is attached.

540 Visitors.

In addition to the passengers from the round-the-world cruise on the S. S. Columbus, arriving April 20, the members of the California Press Association visited the Hawaiian islands on their 43rd annual excursion, during the period April 22 to May 12, and arrived in Hilo on May 1 and left on May 2. Details of their trip will be included in the monthly report for May.

Mr. Jay H. Price, Assistant Regional Forester of the U. S. Forest Service, headquarters in San Francisco, arrived on April 29 and departed on April 30. He was met at the dock in Hilo the morning of his arrival and taken to the park, where he stayed until 2 P.M. on April 30, when District Forester L. W. Bryan called for him and took him to other parts of the island to observe reforestation activities carried on under the Clarke-McNary act. The new supervisor of this district, Gavien Bush, called on April 27, with W. M. Cabrinha. R. C. Brown, Secretary of the Territory of Hawaii, was a caller on April 1.

600 PROTECTION

During the visits of round-the-world cruisers with their large numbers of passengers visiting the park, the Hilo traffic squad assisted in handling the traffic on the road leading to the park, at the hotel, and other points inside the park where especial care was needed. In every case the crowd was handled smoothly and without difficulty.

Corporal W. O. Knipp and Private Albert Newman, visitors at Kilauea Military Camp, were arrested for cutting kopika trees in the park and making walking sticks. They were turned over to Captain Heddin, commander, with the suggestion that they, as well as other new arrivals, be especially warned against cutting live trees of any kind in the park.

620 Fire protection.

On April 28 a small campfire left burning at Makaopuhi by a park visitor was extinguished before it had spread.

630 Accidents.

On April 12, Masa Sumida, driving a Chrysler sedan No. 25-694, owned by Moses Kepua, lieutenant of policeat Hilo, wrecked his car just inside the park entrance by driving it into a telephone pole. Sumida, who held operator's license No. 10,887, miraculously escaped serious injury. He received a cut on the mouth, one on the knee, and a few bruises. The car was badly wrecked, the body being almost beyond repair. Sumida, who appears to have been at least slightly demented, was formerly employed by Kepua as a driver and had been in a similar accident a few weeks ago. He had been discharged, and on this occasion took the car without permission and claimed he was on his way to drive it into the Halemaumau firepit to wreck the car and kill himself. The accident was due to reckless and careless driving, as he was driving with the throttle wide open and failed to make a turn in the road, crashing into a telephone pole and a warning sign which caused the car to turn over and it finally landed right side up facing the opposite way, with the body practically ruined. A picture of the wrecked car is inclosed, with a danger sign that he ran into still fastened to the front of the car.

Photo 394

640 Destruction of predatory animals.

Among the predatory animals, or those which have become a pest, the following were killed during the month: 10 mongooses, 9 pigs, and 92 goats.

900 MISCELLANEOUS

Kona-Kau goat drive. One of the most successful goat drives on the island of Hawaii was held April 16 and 17 between the Kau-Kona boundary at the beach of Kaulanamauna. Visitors from Honolulu who assisted in the drive were Charles Judd, territorial forester, Glenn W. Russ, assistant forester, of Oahu, Albert Judd, trustee of the Bishop Estate, Major Stuart G. Wilder, of Schofield Barracks, Military aide to the Governor, who represented the Governor on the drive, Major E. A. Osmond of the Photo Division of the U. S. Army, who took motion pictures of the drive, G. W. Swart, Bishop Estate forester. From Hawaii were L. W. Bryan, district forester of Hawaii, Martin Martinson of the Kahuku Ranch, and Lieut. Sinclair, of Kilauea Military Camp, in charge of 40 soldiers from the camp. The forest rangers of the territorial forests of the island and a number of prominent citizens from Hilo and other points also assisted. The park service was represented by the superintendent, Ranger Joseph Christ, James N. Gandy, manager of the Volcano House, and Gilbert Lee.

The drive was conducted over an area which extended from the 81 mile post along the road to the 85 mile post down to the sea. On the first day from 500 to 600 goats were driven in and about 1500 the second day, a total of 2000 goats. Laborers from the neighboring plantations also assisted in making a party of approximately 200 in all. These drives are conducted each year under the direction of the Department of Forestry and Agriculture to rid the land of the wild goats that have become so numerous that they damage ranch and plantation lands and take food that should go to cattle. Much damage was done to the underbrush and other smaller growth also.

Publicity. Hawaii has been receiving widespread editorial attention from mainland newspapers and magazines, according to a recent report by the Hawaii Tourist Bureau. Clipping files show that photographs received widespread circulation in newspapers and rotogravure pages on the mainland. One picture in particular - Nighthawk, Hawaii's surf-riding dog - was exceptionally well played up by the coast editors. A Hawaii letter appeared on the Town and Country travel page for March 15, also one on February 15. The March 15 issue of Spur contained a Hawaii paragraph and a full page picture of a Honolulu scene. The Long Beach Press-Telegram, Chicago Evening American, and other publications also gave space. An article by former Governor Wallace R. Farrington on the Hawaii National Park, with illustrations, was published in the March issue of the American Forests. From a recent advertisement in the National Geographic Magazine, 718 inquiries were received.

Very respectfully,

E P Leavitt

Superintendent.

Inclosures.

Form No. 1009—Met'l.

U. S. Department of Agriculture, Weather Bureau.

COOPERATIVE OBSERVERS' METEOROLOGICAL RECORD:

Month of April 1931, 192 ; *Station,* Volcano Observatory *County,* Kau, Hawaii

Hour of Observation, 8 A.M.

State, Hawaii ; *Latitude,* ; *Longitude,* ; *Time used on this form,* Haw'n

DATE.	TEMPERATURE. Maximum.	Minimum.	Range.	* Set Max.	PRECIPITATION. Time of Beginning.	Time of Ending.	†Amount.	Humid.	Wind	Prevailing Wind Direction.	Character of Day, Sunrise to Sunset.	‡ Miscellaneous Phenomena.
	1	2	3	4	5	6	7	8	9	10	11	
1	65	54	11	58			11	94	Lt.	N.E.	P. C.	
2	59	53	6	56			06	94	Mod.	"	Cloudy	Thunder West'd
3	58	49	9	52			72	91	"	"	P. C.	
4	64	46	18	55			02	71	Str.	"	"	
5	62	52	10	54			20	74	Lt.	"	"	
6	61	52	9	57			23	90	Mod.	"	"	
7	68	49	19	58			02	88	Lt.	"	"	
8	69	53	14	61			T	83	"	"	"	
9	69	51	18	63			05	74	Mod.	"	"	
10	70	51	19	60			T	84	"	"	Clear	
11	68	50	18	58			T	83	Str.	"	"	
12	69	50	19	58			08	88	Mod.	"	P. C.	
13	68	50	18	57			06	87	Lt.	"	"	
14	62	49	13	62			11	81	"	"	"	
15	67	51	16	59			04	85	"	"	"	
16	62	52	10	59			20	95	"	"	"	
17	70	49	21	60			19	89	"	"	"	
18	68	52	16	56			17	90	Mod.	"	"	
19	71	53	19	60			04	80	Lt.	"	"	
20	64	53	11	62			02	88	"	S.W.	Cloudy	
21	68	53	15	62			20	84	"	N.E.	P.C.	
22	67	58	9	60			06	84	"	"	"	
23	64	56	8	59			06	94	"	"	"	
24	65	56	9	57			48	93	Mod.	S.W.	"	
25	68	52	16	61			26	78	"	"	"	Snow on Mountains
26	72	57	15	60			01	84	"	N.E.*	"	" " "
27	73	57	16	67			T	81	"	"	"	
28	70	56	14	60			06	89	"	" *	"	
29	71	54	17	62			T	83	Lt.	S.W.	"	
30	71	57	14	62			13	83	Mod.	"	"	
31												*Change to S.W., P.M.
Sum	2004	1577	427	1775			3.92	2582				
Mean	66.6	52.5	14	59			.13	86				

*Reading of maximum thermometer immediately after setting.
†Including rain, hail, sleet, and melted snow.
‡Thunderstorms, halos, auroras, etc.

(IN TRIPLICATE.) See cover for instructions.

(Sgd.) T. A. Jaggar, *Cooperative Observer.*

Post-Office Address, Hawaii National Park, Hawaii

MONTHLY SUMMARY.

TEMPERATURE.

Mean maximum, 66.63

Mean minimum, 52.5

Mean, 59.5

Maximum, 73 ; date, 27

Minimum, 46 ; date, 4

Greatest daily range, 21

PRECIPITATION.

Total, 3.92 inches.

Greatest in 24 hours, 72 ; date, 3

SNOW.

Total snowfall, ... inches; on ground 15th, ... inches;

at end of month, ... inches.

NUMBER OF DAYS—

With .01 inch or more precipitation, 25

Clear, 2 ; partly cloudy, 26 ; cloudy, 2

DATES OF—

Killing frost,

Thunderstorms, 2 - over Mauna Loa

Hail { Light, / Moderate, / Heavy,

Sleet,

Auroras,

REMARKS:

Apr. 27, gigantic dust clouds early forenoon from South over Kilauea, met by trades. One short-lived puff from South felt at Obser'y about 9 A.M.

Rainfall to-date Vol. District 13.61
this month at Hilo 11.22
to-date at Hilo 22.72

10-158

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

STATUS OF AUTHORIZED PROJECTS

Hawaii National Park for the Month of April, 1931

Description of Projects	Percent Constructed To Date	Percent Constructed This Month	Percent Constructed Last Month	Probable Date Completion
405 Warehouse - - - - - - - -	100	~~60~~ ——	100	
406 Toilets (Kilauea) - - -	100	——	100	
407 Toilets (Uwekahuna) - -	100	——	100	6/20, 1931
408 Gasoline and oil building	98	——	98	May 31, 1931
409 Ranger station, Entrance	100	——	—	
410 Naturalist's quarters -	90 100	10 90	90 —	May 15, 1931
411 Rangers' quarters - - -	— 10	10	—	6/20, 1931
451 Telephone lines - - - -	95	——	95	
502 Kilauea Iki trail - - -	100	——	100	
502 Mauna Loa trail - - - -	100	——	100	
502 Summer Camp trail - - -	100	——	100	
502 Steaming Bluffs trail- -	100	——	100	
502 Kipuka Bihopa trail- - -	80	60	20	6/15/31
Improvement and extension	20	——	—	May 31, 1931
502 Extension of auto trail				
Uwekahuna to Halemaumau-	95	95	—	6/15/1931 May 20, 1931
Road Survey, B.P.R. - - -	100	——	100	
Road Survey, PIP.R.				
Construction - - - - - -	01	01	—	

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

10-157
(July, 1929)

TRAVEL REPORT

Hawaii National Park for the month of April 1931

	This Month	This Travel Year To Date	This Month Last Year	Last Travel Year To Date	Increase for Travel Year: Number	Increase for Travel Year: Percent
PRIVATE TRANSPORTATION:						
Cars first entry, ...						
Cars reentry, ...						
Motorcycles, ...						
Total motor vehicles, ...						
Persons entering via motor vehicles, ...	5,719	75,861	4,500	39,861	36,000	90.3%
Persons entering via other private transportation, ...	211	2,198	222	1,670	528	31.6%
Total persons entering via private transportation, . . .	5,930	78,059	4,722	41,531	36,528	87.9%
OTHER TRANSPORTATION:						
Persons entering via Hotel .	737	4,443	1,063	5,677	- 1,234	21.7%
Persons entering via trains, .						
Persons entering otherwise, . .						
Total other transportation, .	737	4,443	1,063	5,677	- 1,234	21.7%
GRAND TOTAL ALL VISITORS, . . .	6,667	82,502	5,785	47,208	35,294	74.8%

	This Year	Last Year	Increase: Number	Increase: Percent
Automobiles in public camps during month, ...	2	1	1	100
Campers in public camps during month, ...	7	3	4	133-1/3

24316

10-215

UNITED STATES
DEPARTMENT OF THE INTERIOR
National Park Service
Washington

REPORT OF NON-APPOINTED PERSONNEL

(TEMPORARY)

Changes outside the District of Columbia for the month of April 1931

Total at beginning of month	Additions	Separations	Net Gain or loss (a)	Total at ending of month.
5	6	0	6	11

(a) If loss, indicate by minus sign.

10-159

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

STATUS OF PERSONNEL

Hawaii National Park for the month of April 1931

	This Month	This Month Last Year
Number of employees beginning of month,	10	9
Number of additions, ...	7	2
Total, ...	17	11
Number of separations, ...	0	5
Number of employees close of month,. .	17	6
Number of promotions during month	3	0
Aggregate amount of annual leave taken,	0	0
Aggregate amount of sick leave taken,	10	0
Aggregate amount of leave without pay,	0	0

10-160

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

REPORT OF PARK REVENUES

Hawaii National Park for the Month of April 1931

	This Year	Last Year
Park revenue on hand beginning of month,	0.00	0.00
Received,	0.00	25.00
Total,	0.00	25.00
Remitted,	0.00	25.00
On hand close of month,	0.00	0.00

Park revenues received this year to date, ... 1,100.00

Park revenues received last year to date, ... 1,075.00

Increase, ... 25.00

Per cent of increase, ...023

10-161

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

HAWAII NATIONAL PARK

REPORT OF SALES OF PUBLICATIONS

APRIL 1931

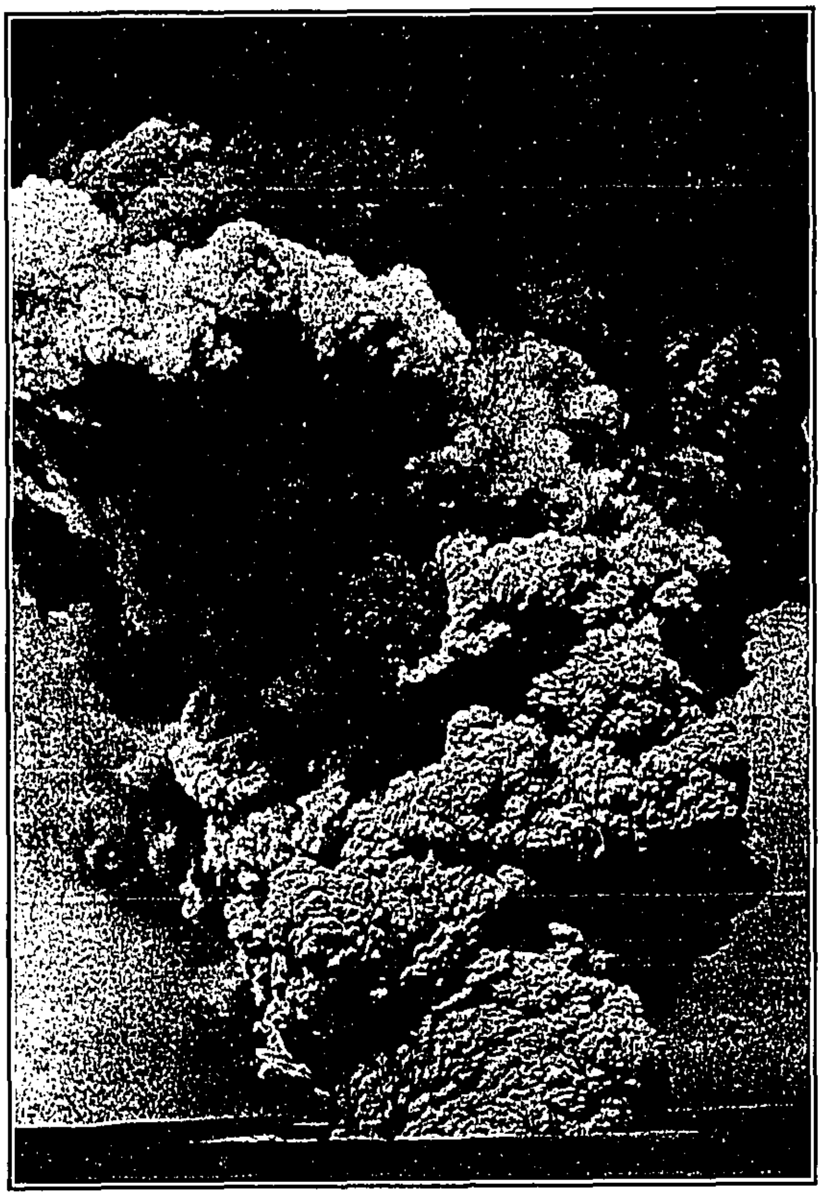
	Number	Value
GOVERNMENT PUBLICATIONS:		
On hand beginning of month,	334	68.50
Received during month,	5	4.25
Total,	339	72.75
Sold during month,	12	4.65
On hand at close of month,	327	68.10
NON-GOVERNMENT PUBLICATIONS:		
On hand beginning of month,		
Received during month,		
Total,		
Sold during month,		
On hand at close of month,		

Cash on hand beginning of month,	10.00
Sales during month,	4.65
Total,	14.65
Remitted during month,	0.00
Balance,	14.65

The Volcano Letter

Two dollars per year Ten cents per copy

No. 328—Weekly Hawaiian Volcano Observatory, National Park, Hawaii April 9, 1931



Steam-blast eruption at Halemaumau pit about 8:30 a. m. May 22, 1924, showing tendency to spiral vortex and dark electrical cloud forming above. Photo Tai Sing Loo.

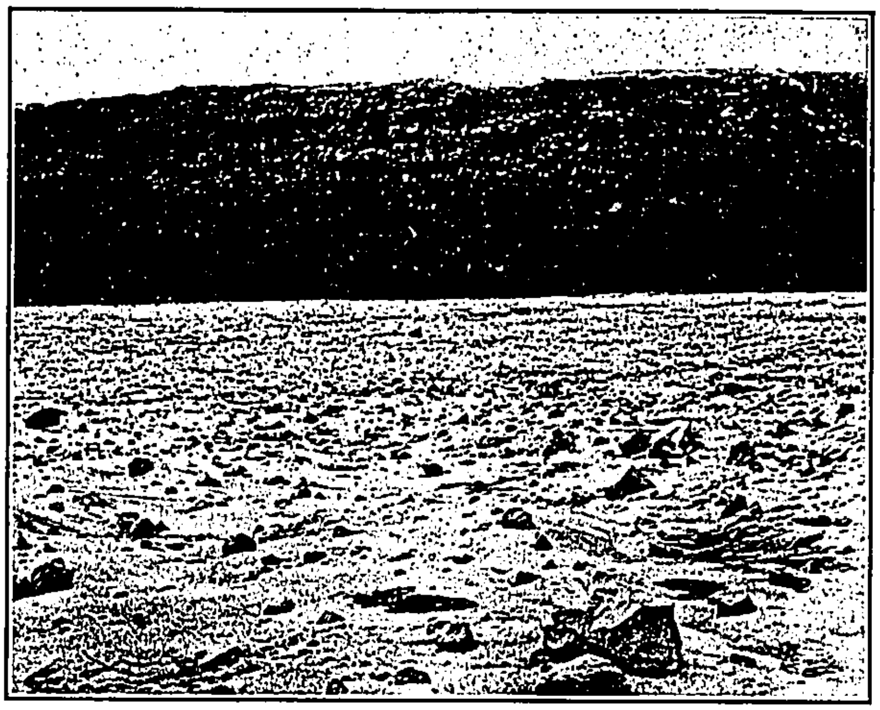
THE GREAT ERUPTION OF KILAUEA IN 1924

Much has been said in recent numbers of the Volcano Letter about the supercycle of 134 years which ended in the tremendous steam-blast eruption of Kilauea in the month of May 1924. The present covering of gravel and bowlders on the lava around the sides of Halemaumau was all thrown out during those three weeks in a series of violent upward jets of steam charged with rocks and sand, something which none of the present generation had ever seen in Hawaii. A much bigger ejection of this kind happened about 1790, and in 1823 there were steam jets that threw up gravel in the lava-flow crack east of Pahala. There are some fragmental stones evidently thrown out explosively around the crater Mokuaweoweo on top of Mauna Loa: no one knows their date.

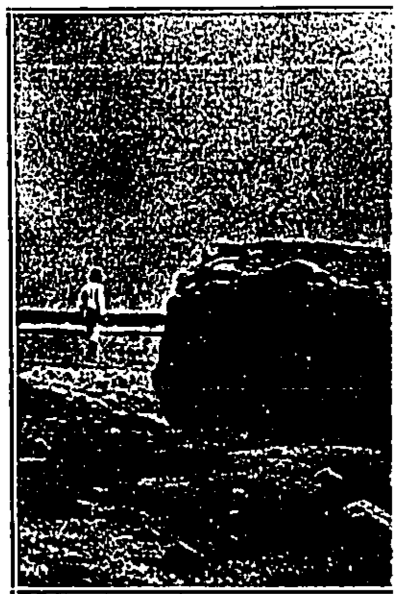
The sequence of events in 1924 was like what had happened in May 1922, when there had been:

(1) Sinking of the lava column.
(2) Great enlargement of Halemaumau pit with avalanches.
(3) Cracking open of the Puna rift to the east.
(4) Southerly tilt and many earthquakes at Kilauea.
(5) Cauliflower dust clouds rising.

What was different in 1924 was the subsidence farther away along the Puna rift (and no lava flow such as had broken out at Makaopuhi in 1922), this occurring in April of 1924 at the east point of the island with lowering of a big block of country, spreading open of cracks, and sinking of longshore vegetation below sea level. Then after the cauliflower clouds had been rising for several days from



Kilauea floor west from Halemaumau May 31, 1924. Shows bowlders and ash covering the lava surface. Photo Emerson.



Eight-ton bowlder thrown 3500 feet May 18, 1924. Photo

huge avalanches tumbling into Halemaumau early in May, people began to notice a booming concussion in their ears, and stones began to be flung up and out, instead of merely falling down and in. The so-called eruption was therefore a gradual growth beginning the end of April with a collapsing bottom of the pit that was not at all unusual, producing ejection of rocks first on the night of May 10-11 that was very unusual indeed, and then exhibiting a series of violent steam blasts, at intervals of several hours, for 10 days following May 13. This crumbled away the edge of the pit so that the former rim migrated back on all sides for 700 feet, as the geyser-like steam blasts accompanied gigantic engulfment of the walls of the shaft. May 24th was the last peak of explosive intensity, and thereafter the new type of activity waned and ended about May 28, with avalanches and earthquakes all that remained, these dwindling during June.

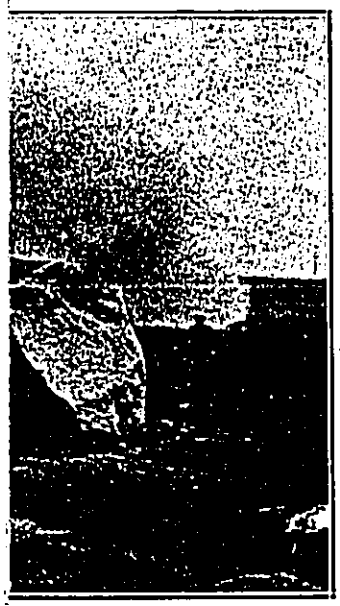
The summary of the 1924 sequence was then as follows:

(1) Sinking of the lava column in March.
(2) Cracking open of the Puna rift far to the east April 22.
(3) Subsidence of a fault block at Kapoho in Puna.
(4) Southerly tilt and increasing earthquakes at Kilauea.
(5) Great enlargement of Halemaumau pit in May.
(6) Avalanches at Halemaumau making cauliflower clouds.
(7) Same cauliflower clouds containing steam blasts upward, May 11.
(8) Engulfment of pit walls in May.
(9) Steam-blast spasms two hours apart May 13, thereafter less often.
(10) Ejection of stones, maximum May 19.
(11) Duration explosive spasms, maximum seven hours May 19.
(12) Electric storms maximum May 17-19.
(13) Felt earthquakes maximum May 22.
(14) Total earthquake frequency maximum May 24.
(15) Cessation of steam-blast phase May 28.
(16) Glowing intrusive body exposed in pit wall June 12.
(17) Adustment of pit walls June-July.
(18) Liquid lava in pit bottom July 19-31.

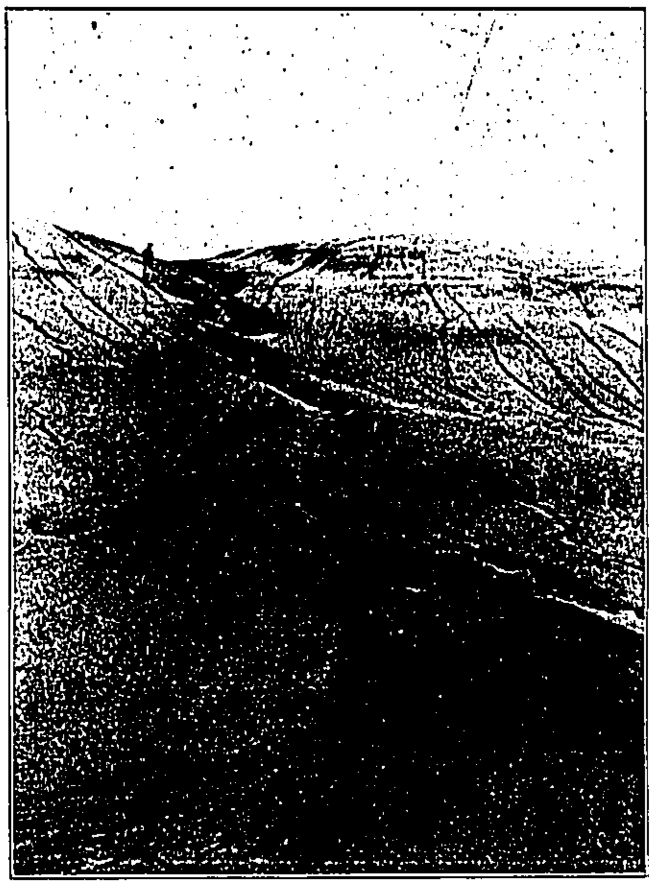
The diagram on Page Four shows how these various features waxed and waned between May 10 and May 27, the numbers of explosive spasms taking the lead at the beginning of the eruption and the numbers and intensity of earthquakes dominating the situation at the end of the eruption, when the other features were declining. The conspicuous mud rains accompanied electric storms of the period between May 15 and May 19. The caving-in of the rim of the pit began at the southwest where lay the Kau Desert rift of 1920, and where the enlargement had taken place in 1922. Then the breaking-in of the rim followed around the circle to the south, southeast, northeast, and north until the breakdown was balanced by collapse at the northwest. Then there was more collapsing all around the previous outline of the pit. The greatest engulfment was accomplished during the times of maximum steam blast, maximum duration of spasms, and maximum intensity of earthquakes. The greatest break-down of the walls observed took place May 21-22 when there were incessant avalanches. These were the two days following the explosive maxima.

To give the reader an idea of what happened we may quote from the journal of the Observatory a few items of May 17-18: "A station was occupied during the night May 16-17 on the gravel spit southwest of Keanakakoi. There were explosions at 1:20 and 1:27 a. m., a continuous roar from 2 a. m. on, an avalanche cloud at 2:28 a. m., increased roar 3:19 a. m., and at 3:20 a. m. the noise increased, an explosion occurred, a few red-hot rocks were thrown out southeast from the pit, and one minute later a few came out from the east side. At 3:32 a. m. the cloud had become enormous, the roar was continuous, pisolitic mud began to fall, and at 3:35 flashes were seen in the cloud over the pit. At 3:42 there was a roar lasting four seconds accompanied by a slight earthquake, and by now the cloud had spread out like a fan over almost the entire sky."

This sort of record was maintained for many days at the Observatory, and the seismographs showed tilts, prolonged tremblings, and numerous earthquakes, and required incessant attention restoring the pens to the drums. During the month ended May 31, 1924, 3,961 local earthquakes were registered, the maximum being 467 in 24 hours on May 24. Harmonic tremor appeared on the seismograms April 19, becoming moderate to strong after May 6, and decreasing May 16 so as to become very slight before the maximum of explosive activity was reached May 19. Probably the harmonic tremor was due to lava surging, which had receded to such great depths by May 17 that it



southeast from Halemaumau
Tai Sing Loo.



Rill-marked new ash May 29, 1924, south margin of Kilauea Crater. This ash lay over the country like drifted snow, and the rain gullies trench through to the old ash of 1790. Photo Emerson.

did not register. In 1924 the tilting of the ground at the Observatory in a south and southwesterly direction amounted to 88 seconds of arc between January and June, 58 seconds of this was during May, and the most rapid tilting took place just preceding, during, and immediately following the great engulfments and steam blasts. There was no good correlation between the number of earthquakes and the explosion days, true earthquakes increased on days when the steam blasts were inactive, but a peculiar shaking accompanied the explosions which gave long drawn out seismograms that built up gradually, without a preliminary tremor like a true earthquake, continuing for half a minute or so, with a period of 0.5 second, and then died away gradually.

Continuing the journal of May 17: "The pit was visited after 9 a. m. and found greatly enlarged so that rim had gone back 200 feet. Depth appeared over 1,000 feet, bottom was flat and covered with talus material, steam was rising without pressure and creeping across the floor irregularly in small continuous cottony clouds. The upper walls of the pit appeared to slope inward at 60°, approaching verticality farther down, so that the avalanches had a free fall to land with a tremendous crash at the bottom. Often the rocks fell with a pattering sound. The cracks across road 2,000 feet southeast of Halemaumau had widened and there were numerous other cracks between there and the pit. The Kilauea floor near the pit was now covered with bowlders in large numbers, locally extending a half mile from the pit and in places there was at least one fallen fragment for every square foot. Some bowlders weighed several thousand pounds."

"At noon came one of the impressive explosions, causing great consternation among visitors. At 12:02 p. m. came a roaring noise and a big dust cloud, accompanied by a moderate earthquake. At 12:32 p. m. there was a roar with sharp crashing noise lasting 50 seconds, and a very heavy black cauliflower cloud rose, much bigger than the one of the early morning hours. At 12:35 p. m. 15 explosive outbursts rose in the course of 11 minutes, accompanied by continuous roaring, and loud crashes of thunder made frequent lightning flashes very low over the Observatory. Showers of rocks were heard falling heavily. At 12:45 p. m. dust and sand fell for 25 minutes. A visit to the pit after this explosion showed newly fallen hot dust in a thick layer near the rim of the pit which had singed the grass farther away. The only gas noticed in the steam exhaled was a small amount of sulphur dioxide."

"May 18. At 11:07 a. m. began a great culminating explosion with tremendous dust cloud and ejected rocks. At 11:09 there was a second explosion plastering the area northeast of the pit with hot sand for several hundred yards. At 11:20 a. m. there was a steady loud roar and a fall of pisolitic mud at the Observatory. There was an Observatory party near the pit, and during the barrage of 11:09 a. m. Mr. Truman Taylor was fatally stricken down by bowlders and sand on the Kilauea floor about 1,800 feet southeast of Halemaumau. He was rescued, but died after being removed to a hospital. The observers were on the sand flat farther to the southeast and when sitting on the ground one could feel numerous quakes and a rumbling was heard. At the 11:09 explosion came a wave of increased air pressure that was painful to the ear drums. One of the rocks weighing over 300 pounds landed on the 1921 lava of the south embayment of Kilauea Crater, and another bowlder weighing eight tons fell at the landing field, made a deep impact cavity, and broke, the fragments bouncing and partially burying themselves on the side remote from the trajectory. An intense electrical storm followed."

T.A.J.

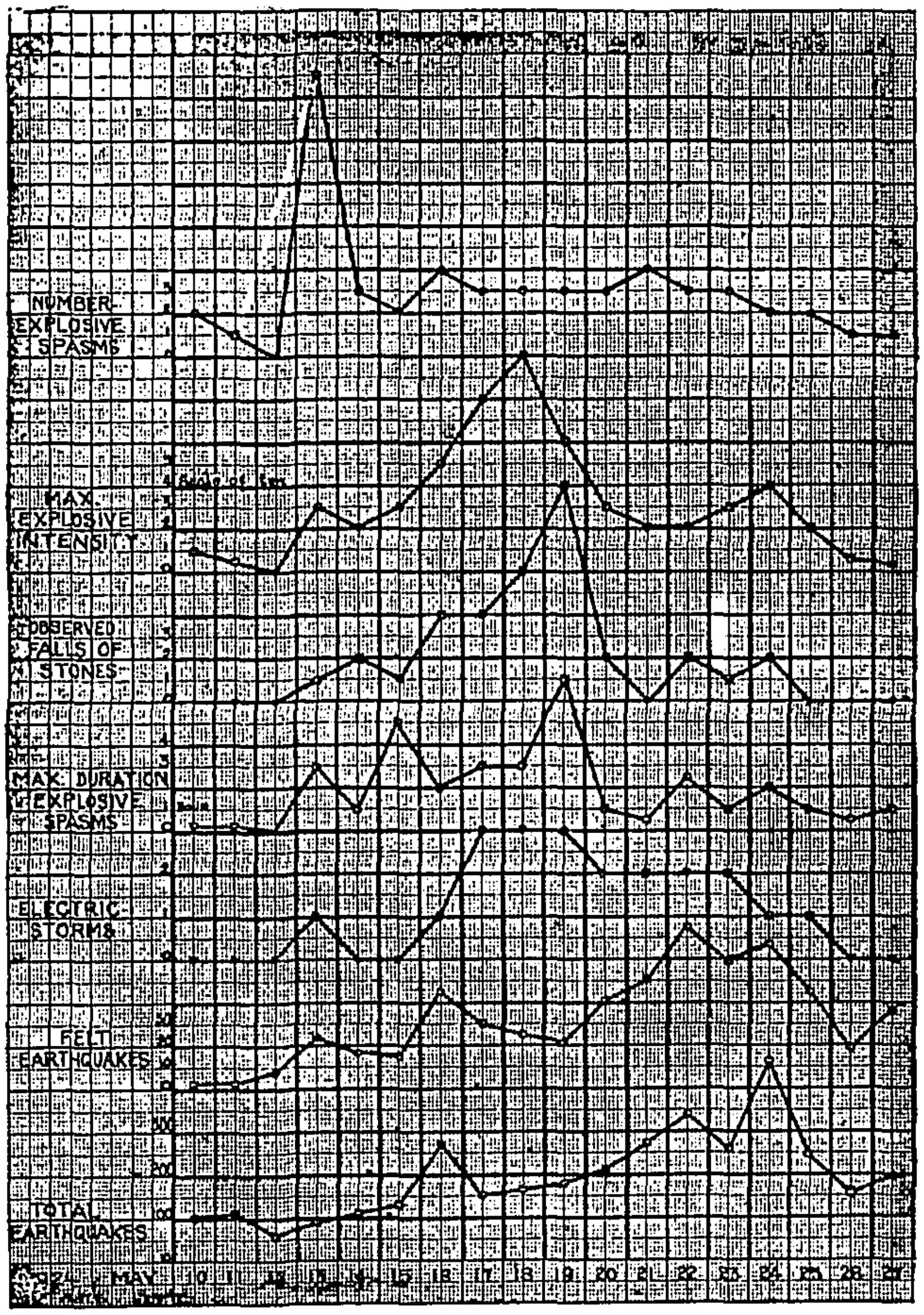


Diagram showing curves of measured activities taken from the tabular summary of the Kilauea steam-blast eruptions May 10-27, 1924.

KILAUEA REPORT No. 1002

WEEK ENDING APRIL 5, 1931

Section of Volcanology, U. S. Geological Survey

T. A. Jaggar, Volcanologist in Charge

Kilauea remains inactive and without noteworthy changes at the lava pit Halemaumau. There is still steady fume from vents near the north-central part of the pit floor. Steaming has lessened on the south talus.

A peculiar slow-period tremor recorded with more or less regularity on the pit seismograph 4 to 10 a. m. April 2 and again April 4. These were also noted on the instruments at Uwekahuna and the Observatory.

The seismographs at the Observatory recorded an increased number of disturbances during the week. There were 57 tremors, including 5 minutes of continuous tremor April 3 and 20 minutes of continuous tremor April 4; and there were 3 very feeble seisms, and 1 feeble shock occurring at 12:20 p. m. April 4. Phases of the last indicated 32 miles distance to origin. In addition on April 5 a very weak teleseism recorded at 8:30 p. m.

Tilt for the week was moderate to the south. Microseismic motion was moderate March 30 and 31 and at other times slight.

The Volcano Letter

Two dollars per year Ten cents per copy

No. 329—Weekly Hawaiian Volcano Observatory, National Park, Hawaii April 16, 1931

Halemaumau from the northeast rim, June 20, 1923, when the lava was liquid from cliff to cliff 129 feet below the edge. Photo Jaggar.

EVENTS PRECEDING THE GREAT ERUPTION 1924

As the steam-blast eruptions of Kilauea in May 1924 represented the end of the supercycle of 134 years and of the last of the 12 eleven-year cycles with its peculiar terminal characteristics, it is profitable to inquire what prophetic occurrences filled the years just preceding the eruption. For the similar eruption of 1790 we have only the hint in the tradition of the natives that there was a lava flow in Puna off to the east of Kilauea about 1788.

Until 1921 when in March there was a maximum of overflow from the actual lip of Halemaumau pit inside of Kilauea Crater, no very marked breakdown of the rim of Halemaumau had occurred, the pit outline enclosing the overflowing lava column was about as small as it had been in 1919, and the only outflow from the flank of Kilauea Mountain had been the Kau Desert activity of 1920. After the 1921 overflows the lava of Halemaumau subsided twice moderately with recovery of the lava following the sinking. Thus it may be said that until May 1922, or just two years before the great steam-blast eruptions, the only events that predicted those eruptions were (1) the supposition of a supercycle about 132 years long after 1790; (2) the general decline in volume of Hawaiian flows for the last half of the supercycle after 1855; (3) the down-hill progress of flank outflows from Mokuaweoweo 1914, to Puu o Keokeo 1916 and 1919, and then to Kau Desert 1919-20; this outflow from the flank of Kilauea was a suspicious new feature.

We read in the journal of the Observatory May 13, 1922, "This day was the end of the prolonged rise." The liquid lava had risen to a point 49 feet below the rim, fountaining and splashing activity varied, outer pools of lava between inner crags and the rim of Halemaumau often overflowed their banks, flames were abundant, and an oven cone on a crack outside of Halemaumau in the floor of Kilauea Crater showed glowing slag about 50 feet down. Then in the third week of May the rising which had started in November 1921 ceased, and by May 21 the lake level had dropped 300 feet steadily and majestically, the crag peaks between the pools maintaining their identity as they went down. Avalanches from crags and walls were numerous. There followed swarms of earthquakes, many of them perceptible over the island of Hawaii. The shelf of new lava caved away, making glowing avalanches. The crags and lava lakes were enveloped in debris slopes. Avalanches increased and sent up cauliflower clouds of dust. On May 26 this made a thunderous roar heard many miles away, the rim of the pit was generally carried away, and at the southwest the collapsed rift made a smoking

The Chain of Craters rift of August 25, 1923, with lava spatter in the trees and sulphur along the flow-crack in the forest. Locality west of Makaopuhi. Photo Emerson.

canyon extending Halemaumau 500 feet in that direction. The pit was enlarged from an oval of maximum diameter about 1,400 feet to an irregular cavity 2,000 feet long by 1,500 feet wide. By May 31 the top of the lava column had subsided at least 1,000 feet and the vacant cauldron was floored with debris 861 feet down. At 8 p. m. May 28 lava fountains broke out on the side of Makaopuhi Crater (end of Chain of Craters Road) along the rift east, and it was evident that the great eastern rift was receiving the underground drainage from Halemaumau and vomiting up a little of it in these local eruptions. This outflow was all at lower level than the Kau Desert outflows of 1920. In the map on Page Four Makaopuhi is near the letter "P" of Puna.

The lava column was executing pulsations of subsidence, but the mountain edifice had not yet yielded sufficiently to let the lava of Halemaumau escape under the ocean to the east. Superficially the lava crust solidified in Makaopuhi and Napau, in July and September of 1922 the liquid slag burst through the talus slopes of Halemaumau and started to fill the bottom of that pit, and pulsations of rising followed so that at the end of June 1923 a sea of lava with a narrow shelf around its border extended from cliff to cliff only 129 feet below the edge of Halemaumau. The sequence of events always suggests that the basaltic melt has an unconquerable gas potential actuating it, but the pressure of the big mountain slabs, now yielding a little to the gas expansion, and now again reasserting itself under gravitation, controls what the gas in solution can do. According as the edifice breaks down or splits apart in spasms through the ages, the so-called eruptions of lava break out or fill the pits as directed by the yielding of the mountain slabs. A glance at the map of Kilauea shows that it consists of a series of big slabs on the southeastern slope of Mauna Loa which have been slipping seaward for ages.

On August 24, 1923, the lava in Halemaumau was still high, only 220 feet down, but a subsidence had begun. Local earthquakes became numerous, by August 26 the bottom of the pit was full of enormous jagged and tilted blocks and hardly any fire was visible except where lava was streaming out of a crack at the southeast. By August 28 Halemaumau was floored with a tumbled mass of broken blocks 564 feet down, and a new crack in the Chain of Craters country was spouting lava and sending up white fumes full of poisonous sulphur vapors. This was in the forest west of Makaopuhi, and the photograph on Page Two shows the sulphurous stain along the flow-crack and the lava spatter in the trees. The belt of cracks extended north and south for a width of 500 feet and a length about 2,000 feet. Patches of sluggish pahoehoe developed at both ends of the crack belt, round holes were produced along the rift lined with new lava, small cones and innumerable tree molds were formed, and patches of sulphur appeared in certain places. In September the lava reasserted itself in the bottom of Halemaumau and began to rise. The oozing up of lava near Makaopuhi lasted only a few days, the visible steam there continued for months, and hot vapor along the crack developed blue-green algae, these hot places still persisting in 1931.

Again there was revival in Halemaumau, and again the great sea of lava was only 121 feet below the rim of the pit on January 27, 1924. This was followed by the same kind of lowering which had occurred in August of 1923, leaving in February and March a collapsed tumble of debris with a glowing hole about 400 feet down.

The event of April 21 at Kapoho near the east point of the island of Hawaii was unprecedented for the present generation of men. Prolonged, mild quaking began, there were several hundred shocks for three days, the ground cracked open in several directions, cracks from six inches to nine feet across yawned athwart the roads with a gradual process of opening, and the principal movement proved to consist in a lowering of the fault-block south of the Kula cliff shown in the photograph on Page Three. This was an old fault-scrap facing southward. The block which moved was about four miles long east and west, by a mile wide north and south, and it apparently hinged about the cracked zone on its south side near Kapoho village, and lowered the most along the Kula cliff on its north side, where the ground at the foot of the cliff gently dropped in the course of a few hours from 9 to 13 feet. This movement extended all the way to the sea at the east, with gaping cracks along the line of the cliff, and the lowering at sea level made new salt water lagoons and drowned the longshore vegetation. There was not a single big earthquake in the whole series of shocks. The fault block moved almost as though it were plastic. Houses and tanks which stood at a quarry against the fault cliff were lowered bodily and remained erect. Releveling of the ground showed a new profile 9 feet lower than before south of the quarry, and one foot lower than before at Kapoho station.

This April crisis at the east was the last premonitory happening before the Kilauea steam-blast eruption. It was led up to by earthquakes along the eastern rift which seemed to indicate that the lava was splitting its way in that direction. When the great crash came in Halemaumau in May, the supposition appeared to be justified that the lava escaped under the ocean to the east. The diagram at the top of Page Four exhibits one of the characteristic lava pulsations that led up to the great engulfment. T.A.J.

TILTING OF THE GROUND FOR MARCH

The following figures show the net amount of tilt by weeks at the Observatory on the northeast rim of Kilauea Crater, and its direction, computed from the daily seismograms by platting a curve smoothed by overlapping progressive seven-day averages. This is the departure of the plumbline in the direction given.

March 2-8	0.7 second	SSW
March 9-15	2.5 seconds	SW
March 16-22	1.0 second	S
March 23-29	1.9 seconds	SSW
March 30-April 5	1.1 seconds	E

KILAUEA REPORT No. 1003

WEEK ENDING APRIL 12, 1931

Section of Volcanology, U. S. Geological Survey

T. A. Jaggar, Volcanologist in Charge

On April 7 at 3:30 p. m. no changes were observed at Halemaumau pit, no tremors were recorded on the pit seismograph, and there was a little steam on the south talus. On April 8 at 2:40 p. m. a small avalanche caused dust to rise from the pit. A little fume still rises from the sulphur spots, and the western of these is brighter yellow than the others. On April 11 at 10 a. m. the 1930 cone at the top of the new lava heap of last November had caved in a little at its upper edge. The pit seismograph indicated a sudden tilt away from the center between the 7th and 9th of April.

The Observatory seismographs indicated 17 tremors for the week ending at midnight April 17, two of these on April 10 being continuous for periods of 2.5 minutes and 7 minutes, respectively. Tilting of the ground was very slight NNE, and microseismic motion very slight.

Kula fault of April, 1924, near Kapoho, east point of Hawaii. The foreground dropped about 10 feet, the country was seamed with cracks, and scores of earthquakes occurred. Photo Emerson.

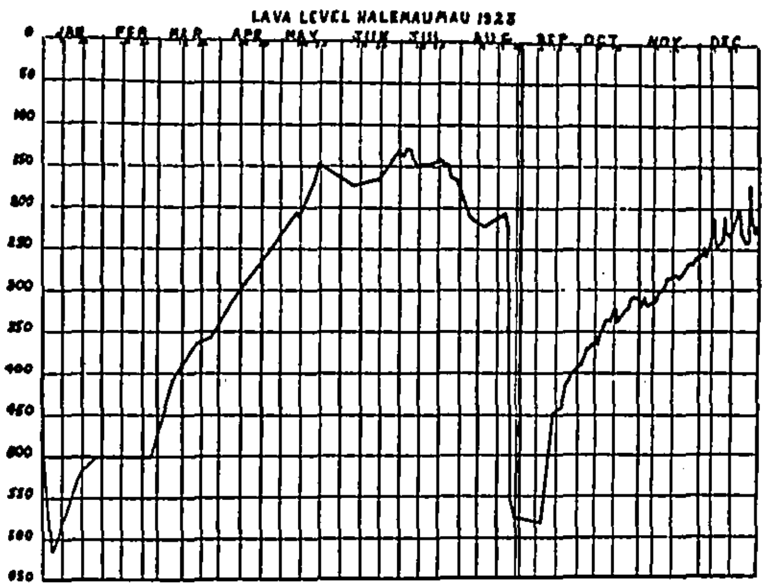
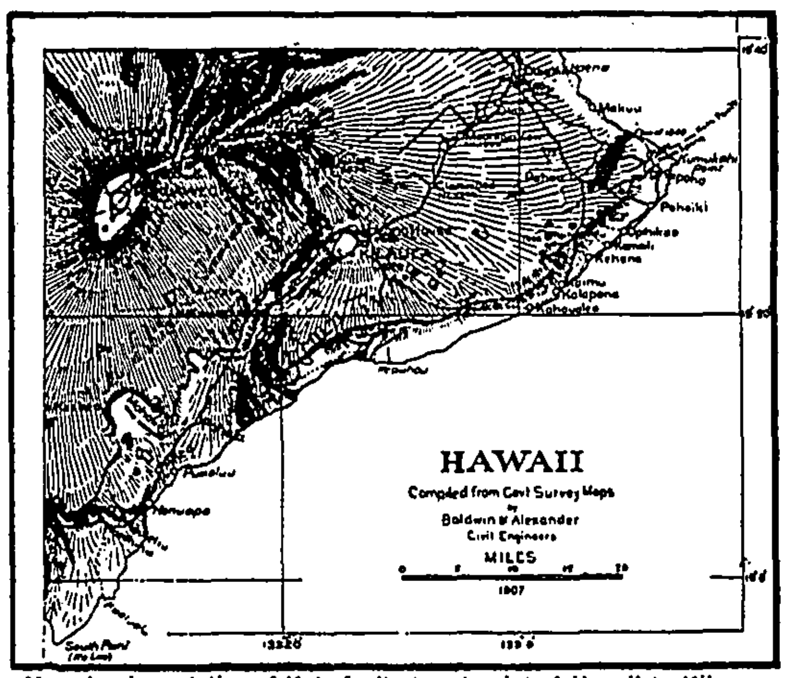


Diagram showing depression in feet of lava level below rim of Halemaumau during 1923. Shows sudden depression to 575 feet before the Chain of Craters outflow.



Map showing relation of Kula fault at east point of Hawaii to Kilauea and Mauna Loa. Here occurred the depression of April 1924.

THE VOLCANO LETTER

The Volcano Letter combines the earlier weekly of that name, with the former monthly Bulletin of the Hawaiian Volcano Observatory. It is published weekly, on Thursdays, by the Hawaiian Volcano Research Association, on behalf of the section of Volcanology, U. S. Geological Survey. It promotes experimental recording of earth processes.

Readers are requested to send articles, photographs, publications and clippings about volcano and earthquake events, instruments and investigations, especially around the Pacific.

Subscription for non-members two dollars per year of 52 numbers. Address the Observatory.

HAWAIIAN VOLCANO OBSERVATORY
Founded 1911

This laboratory at Kilauea Volcano belongs to the Hawaiian Volcano Research Association and is leased and operated by the United States Geological Survey.

It maintains seismographs at three places near Kilauea Volcano, also at Hilo, and at Kealakekua in Kona District. It keeps a journal of Hawaiian volcanic activity and publishes occasional Bulletins.

Membership in the Hawaiian Volcano Research Association is limited to patrons of Pacific science who desire personally to aid in supporting the work.

The work of volcano research so supported is in collaboration with the work of the United States Geological Survey, but supplements it with buildings, research fellows, instrumental plants, explorations and special investigations for which there is no governmental provision. The Geological Survey maintains volcano stations in Alaska, California and Hawaii.

Persons desiring application blanks for membership ($5.00 or more) should address the Secretary, Hawaiian Volcano Research Association, 300 James Campbell Building, Honolulu, T. H.

The Volcano Letter

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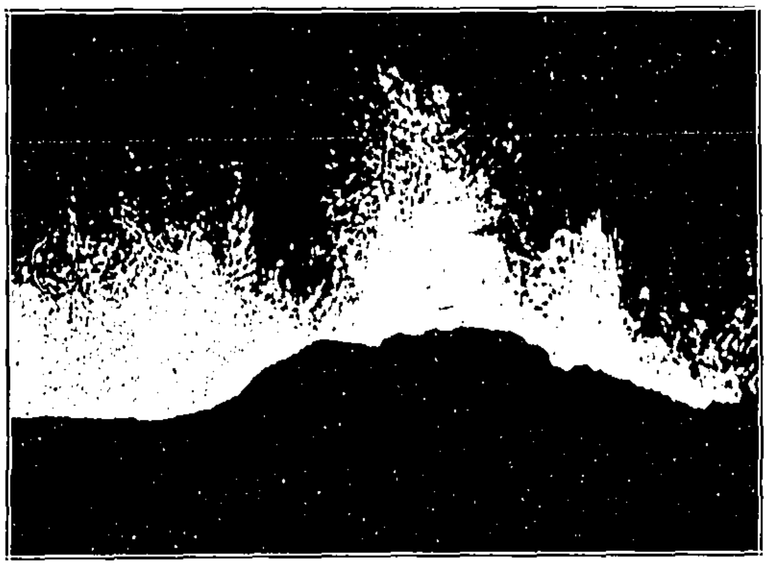
No. 330—Weekly Hawaiian Volcano Observatory, National Park, Hawaii April 23, 1931

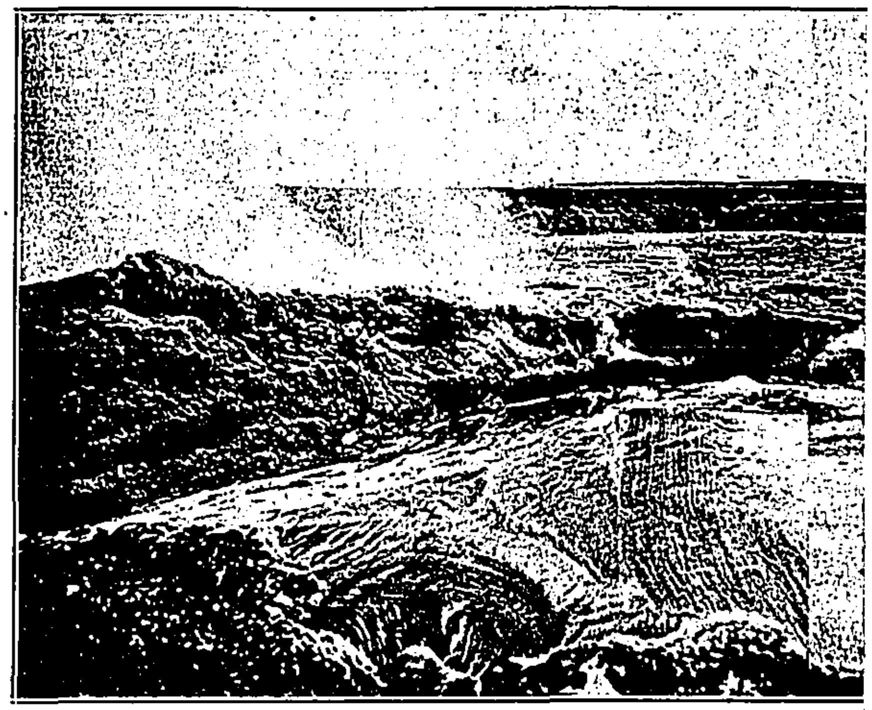


Source fountains of the main lake in the rift crack of the Alika flow, October 1, 1919, SW flank of Mauna Loa, 7000 feet elevation. Photographed by T. A. Jaggar 600 feet away, at night. "The great fountains 200-300 feet high were spouting continuously along the fissure for a thousand feet of length like a wall of red flames. In detail they were made of incandescent, light, crumbly material, yellow when it shot up, red when it came down. The noise was a roar like surf."

THE PEAK OF THE VOLCANIC CYCLE

In recent numbers of the Volcano Letter, beginning with No. 319, there have been reviewed the events of the last twenty years of Hawaiian eruptions, this review leading to a discussion of the eleven-year cycle from 1913 to 1924 as a type of twelve such cycles since 1790. Last week we discussed prophetic events which preceded the great steam-blast eruption of 1924, and in No. 328 that remarkable eruption was described. Pulsatory risings of about a year each followed by collapse and flank outflow were the features forecasting the grand crisis, and that crisis itself was an unusual collapse over lava that receded deeply. The immediate recovery of the lava and its appearance in the bottom of Halemaumau in high spouting fountains within two months after the time when the steam blasts ceased inaugurated a new cycle. We are living in the midst of that cycle, now characterized by small manifestations of spouting lava in 1924, 1926, 1927, 1928, 1929 (twice), and 1930. The 1926 happening began at the very top of Mauna Loa, so that the conclusion seems justified that the gas energy within the underground lava itself was not exhausted in 1924. Within two months hot and very vigorous lava was spouting in the Kilauea pit, and within two years it was bursting out through cracks 13,000 feet above the sea in Mauna Loa. What was exhausted, then, was the patience of the mountain in consenting to yield, now here, now there, more and more until 1919-21 when both Mauna Loa and Kilauea were inflated and let the lava squirt up through cracks. Then the great mountain blocks had been so uplifted and loosened that they even let the lava ooze out under the ocean somewhere east of Puna in 1924 about May and June, when the ground water flowed into the chamber under Halemaumau, and the steam puffed up like a freight engine. But the coldness of the Pacific conquered the submarine oozing slag, the frothing melt backed up into the Halemaumau conduit and reappeared in July 1924, the mountain blocks settled down hard owing to what had been withdrawn, and to their enormous weight, and the gas in the deeper magma was no longer able to lift them. The weight control of gravitation had again asserted itself.

This weight control of gravitation in a volcanic mountain, or better in a volcanic island consisting of several mountains, is like the spring control of a safety valve on an engine, opening only when the internal lava pressure has passed a certain minimum. The internal pressure under the volcanic island may be thought of as accumulating at a steady rate through the ages. The island safety valve has two or three openings, Mauna Loa, Kilauea, and Hualalai, with a heavy shell over cracked blocks determined in weight by the accumulation of the ages. This weight accumulation is operating against the pressure accumulation. Once in eleven years the underground lava gradually and irresistibly forces itself up into cracks under the several openings and extends out along the rift belts that break up the mountains into blocks. How this hot matter grades down into a pudding having horizontal extension we do not know. There may be subordinate puddings under each volcano dome led up to by old cracks extending down into bigger and deeper puddings representing



May 10, 1919 looking NE. across main lava lake in Halemaumau from the top of th and indistinguishable. The photographer was thus standing on the top of the mo right and left are live lava, wholly inside the pit. Central part of lava dome

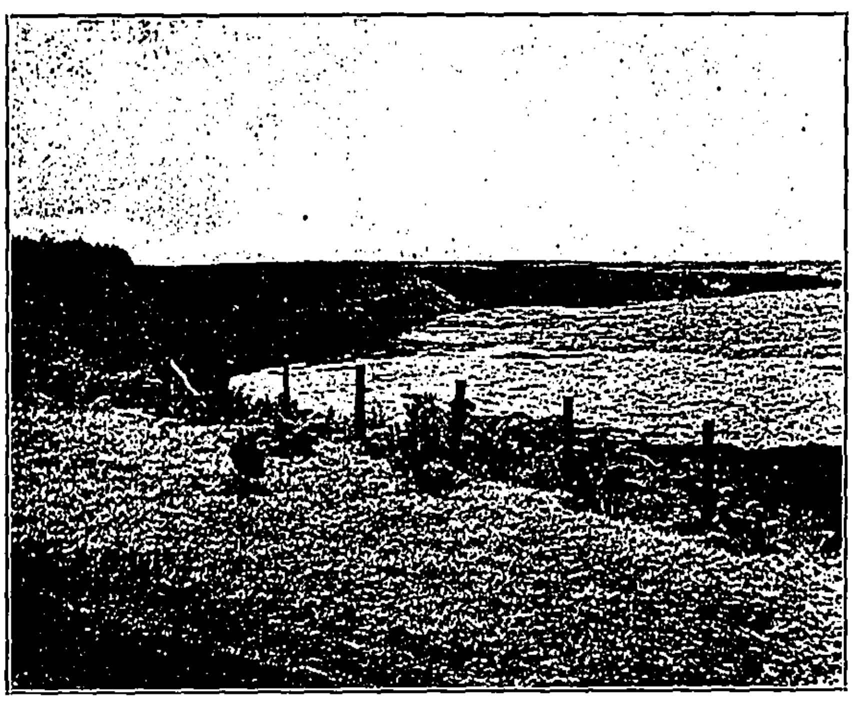
ancestral domes. The height and size of the mountain puddings inside the island, and their supply of gas from the larger and deeper pudding, are what determines whether Mauna Loa or Kilauea shall erupt. If the weight control of Kilauea, the lower mountain, relative to its private pudding, is greater than that of Mauna Loa relative to its higher and larger internal pudding, it will be the higher mountain Mauna Loa which erupts. The yielding of each particular edifice relative to its internal lava expansion is what determines eruption. For the lava is not to be thought of as a rising liquid, but rather as a local expanding body of paste full of frothing gas.

The yielding of the edifice needs clear definition. If a mountain block merely lifts on the flank of a pudding of underground slag, it does not weigh any less, and moreover solid basalt is heavier than pasty lava. Therefore what happens is an arching up or a tilting of blocks, and if new lava from below inserts itself into a mosaic of blocks up vertical cracks, it must spread the mountain apart horizontally. The eleven-year yielding is merely an average resultant of arching and tilting of blocks, swelling and penetrating of the lava, permission by the blocks to be pushed sidewise, slipping downward of those blocks which are on the slope toward the sea, breaking open of cracks at the surface to release pressure and start foaming in some parts of the lava, letting out of a large volume of paste, and re-assertion of weight to restrain the foaming by new flows on the upland or settling of crater fills. By "blocks" are here meant the big slices of mountain shell that lie between the important fault-rifts. These shells are miles wide and tens of miles long.

As there are big blocks of rock in this sense between the flow rifts of Kilauea and those of Mauna Loa which tip and squeeze the Kilauea pudding when Mauna Loa outflows come to an end, having lifted the shells and released the Halemaumau lava while the Mauna Loa flows were in action, it is easy to understand underground connection between the two volcanoes such as was described in the subsidences at Kilauea of 1914, 1916, and 1919 (Volcano Letter No. 324). Each of these sinkings came just at the end of a Mauna Loa flow period. Each Muna Loa flow period was accompanied by a gradual gushing of lava and rising in the Halemaumau pit of Kilauea.

The peak of the volcanic cycle 1913-24, measured by internal pressure, was the intense gushing of lava over the Kilauea floor from Halemaumau pit, full to overflowing in October-November 1919. During this same time Mauna Loa was giving vent to the Alika flow. Throughout 1919 this flooding of the Kilauea Crater floor had been going on, with very slight ups and downs in the central pit, but from the very day when Mauna Loa broke out at the end of September, the Kilauea flooding increased. The process that led up to the nearly continuous overflowing of Halemaumau had been a very strong rising of lava in the pit at an increasingly rapid rate after the subsidence which had followed the 1916 outbreak of Mauna Loa. The year 1917 was intensely spectacular at Halemaumau, the observers could walk down on the lava floor surrounding the liquid lakes, and many experiments were made of taking temperature, collecting the gases, and sounding the slag pools with steel pipes. The year 1918 began a series of overflows of Halemaumau, first in one direction, then in another, from the lip of the pit, so that by 1919 the overflowing was virtually continuous. This all culminated in the Mauna Loa eruption of the autumn, which came to an end gradually, and at no very definite date, some time in November. It is impossible to name the day when such an eruption comes to an end, for the lava is flowing in tunnels beneath surface shells of hardened slag, the rift-source region is usually crusted over and may show glowing cracks for

'e dome of live lava, when the eastern edge of the pit was completely overflowed
ving lava column. Edge of pit underlies small cone in background. Benches
was at this time 87 feet above what had been hitherto the edge of the pit.



November 30, 1919 looking south from Observatory across Kilauea crater. The light colored nearer part of the crater floor is the fresh, then-glowing frontal portion of the live overflows from Halemaumau which had been pouring forth for seven months. The flows went west, north and bent east, filling the north corner of Kilauea crater 60 feet deep. Photos Jaggar.

Middle stream of the Alika flow of 1919 early in October at road crossing in South Kona, showing the standing waves of rushing golden melt travelling eleven miles per hour. This stream was forty feet wide, within fields of consolidation of its own aa overflooding. These fields also moved, but very slowly. Mauna Loa flow, elevation 1570 feet above sealevel.

weeks, and there is no evidence left of any particularly sudden down-sinking at the source cone of the flow. Possibly some such reaction would be seen there if there were inhabitants.

At Kilauea, however, as has been often described in these pages, a remarkable, quiet, and sudden sinking 600 feet of the entire lava column in Halemaumau pit occurred November 28, 1919, as though it were a definite reaction from the Mauna Loa cessation. Then immediately the violently foaming Kilauea lava rose in the bottom of Halemaumau pit until in three weeks it was nearly at the top, then in three weeks more it had burst out in the Kau Desert southwest of Kilauea, and a long series of flank outflows of Kilauea began which lasted seven months. This, however, was not the end, for in 1920-21, December to March, there were again very intense overflowings of Halemaumau, after temporary reactions of subsidence. The March gushing of 1921 was accompanied by a flooding of the entire southern part of Kilauea Crater, so that one flow passed through a gap in the sand hills which bound the crater on that side. The fountaining was so violent that forty-pound blocks of crust were flung up into the whirlwinds over the fountains and dropped 300 feet away. Halemaumau was a surface saucer full of rushing, golden melt, building up a big spatter rampart at one side, with islands out in the middle. Then there came moderate subsidences, followed by the big ones of 1922 and 1924.

T.A.J.

KILAUEA REPORT No. 1004

WEEK ENDING APRIL 19, 1931

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

At Halemaumau pit in Kilauea Crater the only change observed on the forenoon of April 13 was that the sulphur spots on the new lava floor of 1930 seemed brighter yellow. The weather was dry and no steam was observed on the south talus. Dust from a slide rose at the pit at 3:30 p. m. April 13, and at 10:30 a. m. April 17 a fairly large avalanche fell from the middle of the wall above the northeast talus, sending up a thick cloud of dust.

A slight earthquake at 5:58 a. m. April 17 was strongly felt in the Volcano District and in Hilo, observed near the volcano as a slight preliminary bump followed in about two seconds by a stronger shaking occupying several seconds. This was sufficient to alarm a dog and in the region three miles toward Hilo from Kilauea the motion appeared to be northeastward. The Observatory seismograph indicated distance of origin 14 miles. Another feeble earthquake felt locally indicated distance of origin 23 miles, at 10:09 a. m. April 16. In all the Observatory instruments registered 26 local disturbances, of which six were very feeble seisms and 18 were tremors. A very feeble shock at 10:23 a. m. April 14 indicated origin distance 12 miles. Tilt for the week was slight WNW, and microseismic motion was slight.

THE VOLCANO LETTER

The Volcano Letter combines the earlier weekly of that name, with the former monthly Bulletin of the Hawaiian Volcano Observatory. It is published weekly, on Thursdays, by the Hawaiian Volcano Research Association, on behalf of the section of Volcanology, U. S. Geological Survey. It promotes experimental recording of earth processes.

Readers are requested to send articles, photographs, publications and clippings about volcano and earthquake events, instruments and investigations, especially around the Pacific.

Subscription for non-members two dollars per year of 52 numbers. Address the Observatory.

HAWAIIAN VOLCANO OBSERVATORY
Founded 1911

This laboratory at Kilauea Volcano belongs to the Hawaiian Volcano Research Association and is leased and operated by the United States Geological Survey.

It maintains seismographs at three places near Kilauea Volcano, also at Hilo, and at Kealakekua in Kona District. It keeps a journal of Hawaiian volcanic activity and publishes occasional Bulletins.

Membership in the Hawaiian Volcano Research Association is limited to patrons of Pacific science who desire personally to aid in supporting the work.

The work of volcano research so supported is in collaboration with the work of the United States Geological Survey, but supplements it with buildings, research fellows, instrumental plants, explorations and special investigations for which there is no governmental provision. The Geological Survey maintains volcano stations in Alaska, California and Hawaii.

Persons desiring application blanks for membership ($5.00 or more) should address the Secretary, Hawaiian Volcano Research Association, 300 James Campbell Building, Honolulu, T. H.

The Volcano Letter

Two dollars per year | Ten cents per copy

No. 331—Weekly | Hawaiian Volcano Observatory, National Park, Hawaii | April 30, 1931

Northeastern corner of Halemaumau pit showing lava overflows, from northern and eastern sides of the lake, uniting to fill the wall-valley depression. Lava lake outside of picture at the left.

RISING OF PIT LAVA KILAUEA 1917

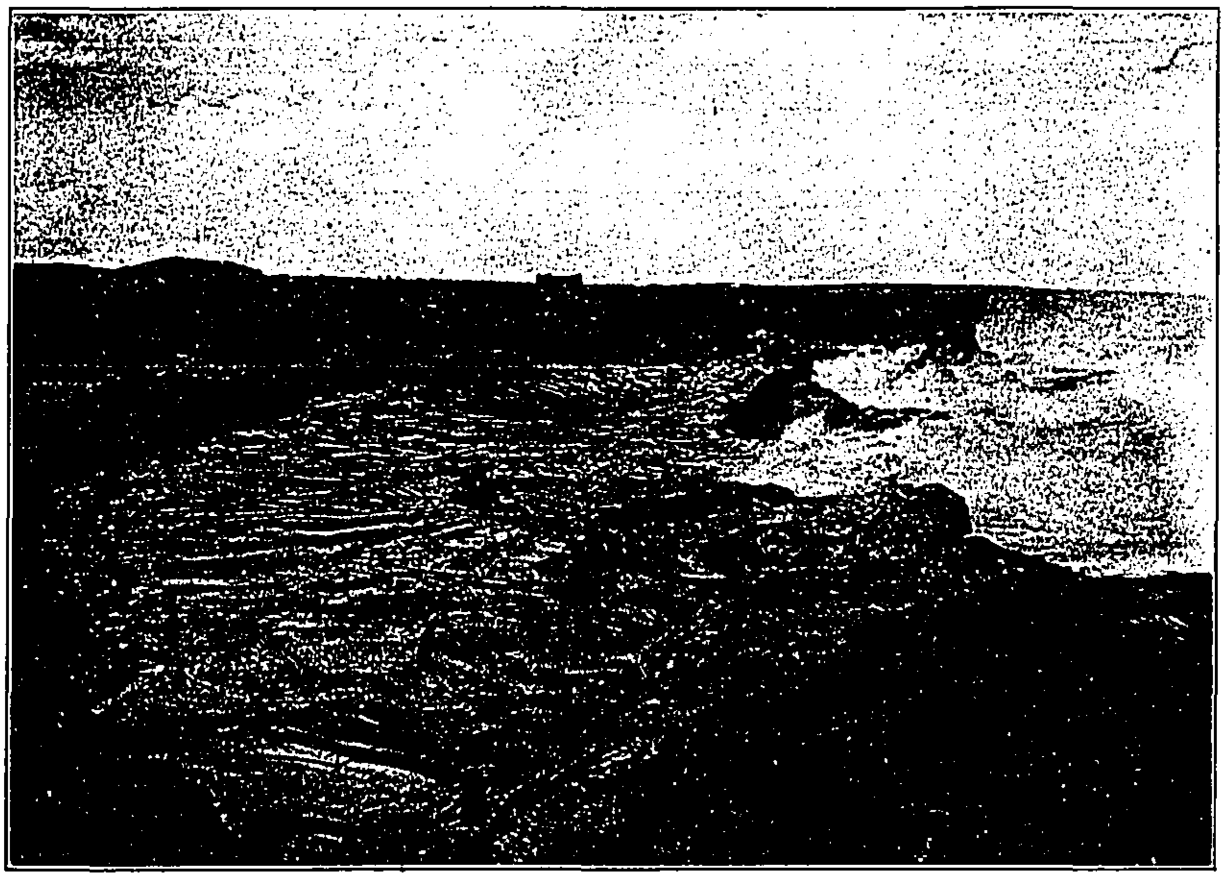
The first half of the cycle 1913-1924 was characterized by increasingly rapid rising. This showed itself by three, progressively more voluminous, lava ejections from Mauna Loa, and by a general rising of lava in Halemaumau pit, the inner well of Kilauea Crater. In order to understand the detail of the processes involved in the spectacular overflows of the inner lava lakes of Halemaumau pit, alternating with recessions of the lava from month to month, we here present a map and some photographs to exhibit the relation of the bench magma to the liquid lava. This is one of the hardest subjects for an outsider to understand.

The outline map of Halemaumau on Page Four has below it a true scale structure section showing what we saw and measured at the Observatory January 12, 1917, when with transit we went from one trig station to the next, as indicated by the little triangles around the rim of the pit. At the bottom of the structure section there is indicated a true scale extension downward of the pit profile as it was June 23, 1916, just after the liquid lava had come back vigorously, following the subsidence of June 5, which was described in Volcano Letter No. 324. The liquid lava at that time had filled a saucer in broken rocks, and then made its own spatter bench around the edges. The shape then of the liquid shown in black if we filled in the bottom would be that of the contents of a saucer, and as the lava was fed upward through small holes in the talus below, the only wells extending downward would be those holes, and everywhere else the liquid would be streaming over a hardened shell of its own glassy substance which had congealed against the cold broken rocks beneath it. The bench around the edges, then, was nothing more than the border expression of the hardened bottom lava.

What happened thereafter when the lava rose 500 feet filling the pit nearly to the top? The supply of liquid lava up the wells carries a certain amount of gas in vesicles which is reacting to keep it hot, but the air above, the sides of the pit, and its own congealed bottom lining are all tending to freeze the hot froth. The heat energy available can keep a saucerful liquid and streaming, the saucer in question being roughly of the size of the first pool. The rest that congeals under the pool is like the lava fields, that congeal on either side of a small medial stream, in a Mauna Loa flow. The congealing may be only partial so that this semicongealed substance is still mobile, and the upright wells are maintained through it. The rising then resolves itself into an uprush of the liquid froth through the wells, an overflow in pulsations of the liquid in the top saucer, and such additions of gas and heat to the under substance, as will cause it to swell or tumesce, under the hardened shells of overflow, that form the benches or platforms around the lava lake, or lakes.

If now we examine the map and section of January 1917, we see the main lava lake in black streaming from three coves at the west, and back of these, two source ponds, which are over wells. At the north, and at the south, there are overflow benches, the northern ones wide, and the southern ones narrow. There is a small wall pond at the south. There is a big crag-mass between the northwest pond and the lake which exhibited a tendency to rise gradually, as the tip of a northwestern sector of overflow shells. There is another such crag at the east, and a more complicated group of them making a peninsula, and southward tilted hills of uplifted overflow lava, at the southwest. At the southeast there is a line of big spatter grottoes along the edge of the lake, with inflowing liquid lava, as indicated by the white arrows. There is the same thing at the northeast. During subsidences these were revealed to be cascades into sinkhole wells, and the bottom of the lake of liquid was revealed to be a paste only 45 feet below the overflow bench.

This paste, under the shells of overflow, and under the crags created by the swelling up from day to day of the shells of overflow, is the substance spoken of as bench



Depressed northeastern floor of overflow in Halemaumau pit May 16, 1917, from north station, to be compared with elevated floor northwest shown on Page Three. These illustrate the balance whereby the weighted side of the floor goes down and the other side comes up creating a tabular crag of bench magma. The lava lake is in the fume at the right.

magma, and this semicongealed substance rises and falls from week to week as constituting the greater part of the lava column, apart from the mere wells, as shown in the section under the map. The depression of the lava at this time was 87 feet below the southeast trig station, and the bench marks (B.M.) east and north of the pit on the floor of Kilauea Crater stood at elevations 3,697 feet and 3,700 feet respectively above sea level.

The Journal of December 30, 1916, says: "The lava lake is a very different object from the elliptical pool of last June. It appears like a mighty river of fire amid hills and tilted crags, shaped in general like a "W." Roundish coves are bordered by high ramparts built up by overflow and by splashing fountains which have constructed huge domes, with glowing grottoes inside. Back of these ramparts, the overflow surface slopes back to the walls of the pit, so that the lake is really at the top of a low, flat, inner cone. Higher than these floors on three sides of the lake, but wholly within the pit, are craggy hills benched and fissured, which stand from 40 to 80 feet above the liquid lava."

"Other irregularities which add interest to the scene are high, flaming and puffing chimneys, outlying ponds of lava, and driblet cones built up over fissures in the floor. Following all the bends the lake is fully 1,800 feet long, with channels varying in width from 50 to 200 feet. The scene is magnificent from any side of the pit, and there is hardly any obstructing fume."

On April 6, 1917 we find the statement, "The rising of the crags is symmetrical about a central point in the pit, where the three arms of the lake lie at about 120° to each other. The sectors of bench, between these arms, are sinking around the circumference of the pit, and lifting their convergent points near the center. The marginal sinking is started by weight of the overflows, and increased by weight of debris fallen from the outer walls. As a result the south island peninsula, the crag-mass, and the east island are now all rising, and the floors are sinking. The inner bench confining the lake is therefore highest near the center of the pit. As usual the northwest and west ponds are the conduits of uprising liquid lava."

The beautiful symmetry of tumescence or swelling in the center, overflow of the lakes to weight down the wall valley around the edges, and up-tilting of the crag sectors to rise highest in the center, has appeared again and again, during the measurements conducted by the Observatory, so that the sectors of shell may be thought of as eternally overturning, away from the center of the pit. No solidified lava, except possibly light pumice, is capable of floating on liquid lava. The solidified crags, however, in some sense do float upon the bench magma paste beneath, or are of almost the same specific gravity, but this paste is not liquid lava. In addition to the circular symmetry, however, there would often develop a bilateral symmetry as shown on the map, whereby the three source wells are in the southwest half of the pit, and this southwest half was uplifted; whereas in general the northeast half was covered with overflows and tended to subside, except for the temporary east crag, which afterwards became overwhelmed and sank down.

The picture on Page One gives a clear idea of the northeast quadrant of the pit being filled by lava overflows from the lake in May 1917, the observation hut of the Observatory, and the old horse corral, showing in the background. This heavy flow is weighting down the wall valley, and tending to lift up the crag shown on the left-hand side of the photograph. If now we turn to the photographs on Pages Two and Three, we see a very striking illustration, on May 16, 1917, of a downweighted northeastern overflow bench (Page Two) which by a series of floods from the lake had subsided. This is looking from the north station straight southeast across the northeast overflow bench. The photograph on Page Three is looking from the same place straight southwest, across a new elevated northwest table crag, which for many days was in process of mass uplift. The following are Journal quotations from the history of this uplift.

"On May 12, 1917, the lakes had risen from 11 a. m. to 12:30 p. m., the main lake much faster than the southeast pool so that the northwest cove and the southwest shore were overflowing. The west cone was gushing incandescent lava and the crags had continued to rise. The tabular northwest crag was rising strongly while the north chasm was sinking. This was shown by a cracked ridge of fresh flow lava, lifted on the side of the crag, and though only two days old it showed a vertical displacement of about six feet from its original position. On May 25 the northwest table crag showed an extraordinary uplift of 15 feet since the previous day, carrying with it a bench of fresh flows around its base on the east and north. Instead of tilting, this tabular mass is rising bodily owing to inflow beneath it of pasty bench magma impelled by the weight of lava floods much larger than it in area in the lake basin itself and on the floors northeast and northwest. On May 28 a sudden readjustment of the bench magma was accompanied by a brilliant flare with opening of crevasses into which perhaps the lake magma flowed so as to lower it temporarily while the central crags were uplifted. The east crag rose bodily 10 feet, and the northwest tabular crag was now above the rim of the pit. The large crag-mass rose so much with westward tilt that its northeast peak suddenly became its summit, whereas only that morning the middle peak had been the highest. The spatter markings along its base on the lake side were fully 40 feet high."

The northwest table here referred to, and shown on Page Three, occupied what in January was the north-northwest overflow bench, between lake and rim of pit (map Page Four). The photographs on Pages Two and Three were taken from the trig station, on north rim of pit, south of the letter "N". The balance between the rising crags and the weighted portions of the pit floor might be called "isostatic," but not because the crags are lighter. T.A.J.

KILAUEA REPORT No. 1005

WEEK ENDING APRIL 26, 1931

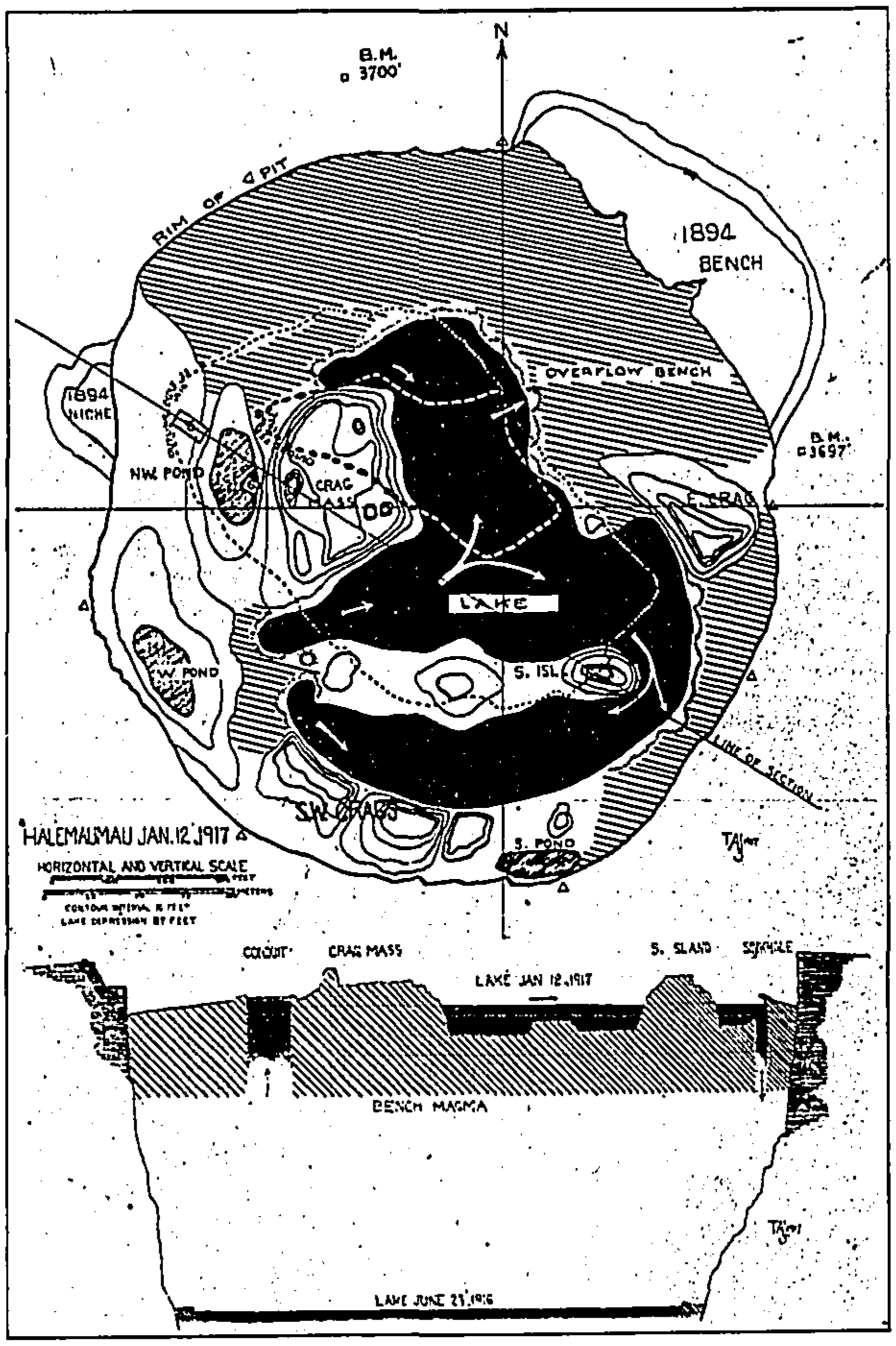
Section of Volcanology, U. S. Geological Survey
T. A. Jaggar, Volcanologist in Charge

Practically no changes have occurred at Halemaumau during the week ended at midnight April 26. Fume continues to escape steadily from the sulphur area north of the 1930 cone, which area is bright yellow. The instrument at the pit showed no volcanic tremors.

A total of 27 seismic disturbances were registered at the Observatory. Of this number were 23 brief tremors, three very feeble shocks, and one distant earthquake. The last recorded on April 24 for 10.5 minutes following 7:03 a. m. One of the very feeble shocks, at 11:25 p. m. April 25, indicated 25 miles distance to origin and was accompanied by tilt to the north; it was not reported felt.

Tilt was moderate WSW. Microseismic motion increased on April 21 from slight to moderate.

Elevated northwest table crag May 16, 1917, from north station, showing a block of bench magma in process of rising bodily by tumescence, or by the flowing in of paste beneath it, so that in two weeks its top was above the rim of the pit. This side of the floor rose, while the portion shown on Page Two was overflowed and subsided.
Photos Jaggar.



Plan and profile of Halemaumau pit January 12, 1917, when the great rise was in progress. Dotted outlines in map show progress of the rising and enlarging February 18, 1912, and June 23, 1916. Lower profile in section shows lake of June 23, 1916, in contrast to great development of bench magma, at higher level, six months later. Liquid lava black, source ponds shaded. Lake level 87 feet below southeast trig station. Crags with ten-foot contours.

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UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HAWAII NATIONAL PARK
HAWAII

OFFICE OF THE SUPERINTENDENT

April 8, 1931

The Director,
National Park Service,
Department of the Interior,
Washington, D. C.

Dear Mr. Director:-

Following is a report of activities and operations in Hawaii National Park for the month of March 1931.

000 GENERAL:

There is nothing of outstanding importance to be reported during the month of March under this heading. There was sufficient rain in nearly all sections of the island to provide water for growing crops and for domestic purposes, although the Kau section adjoining the park is still suffering to some extent. Travel to the park has been lighter than in former years and everyone seems to be waiting for a renewal of volcanic activity. There have been no special changes in the conditions at Kilauea crater but Dr. Jaggar is still of the opinion that a renewal of activity may be expected at any time.

100 ADMINISTRATION:

110 Status of work.

The office work has been kept up to date through a considerable overtime and plans for the usual spring work for the last quarter of the fiscal year as well as for the new construction authorized in the 1932 appropriation have been under way. The outside work is all practically up to date also.

120 Park inspections by.

121 The superintendent.

Inspections were made daily of the roads and trails and other operations in and around headquarters. Frequent trips were made to Hilo in connection with park business. During the month a thorough inspection of all of the units and operations at the Kilauea Military Camp was made in company with Captain Heddin, commander at the camp.

A trip was made to Honolulu to confer with the Board of Directors of the Kilauea Volcano House Company, Ltd. regarding proposed improvement of the services and facilities of the hotel in the park. The company refused to agree to any plan of improvement at this time on the ground that they were financially unable to do so and prospective business did not justify. The matter is covered in detail in correspondence that has been sent to your office. While in Honolulu conference was had with Mr. C. S. Judd, territorial forester, regarding plans for the cooperation of the National Park Service in a goat drive to be held April 16 and 17.

I had a visit also with Dr. David A. Crawford, president of the University of Hawaii, regarding the educational work of the park, and particularly plans for a proposed summer school for classes in geology and botany, to be held in the park for a period of four weeks next summer. Plans for helping in tourist travel and for park publicity were discussed with Mr. George T. Armitage, manager of the Hawaii Tourist Bureau, Mr. Riley H. Allen, editor of the Honolulu Star Bulletin, and Mr. L. A. Thurston, editor of the Honolulu Advertiser. I also discussed with Mr. Allen plans for the Pacific Foreign Trade conference, which was scheduled to be held in Honolulu in October and learned that this has now been postponed until the spring of 1932. The meeting will be held with the National Foreign Trade conference in Honolulu.

I met a great many other men in Honolulu who are interested in the park and found the opportunity while there to go around the island of Oahu in order to familiarize myself with its attractions and conditions generally. Notes were made of the trip and a special report will be forwarded later.

130 Finance and accounts.

Following is a list of the funds appropriated for work in the park with unexpended balances as of the close of March 31, 1931.

Appropriations	Allotted	Expended	Balance
40/1415 Hawaii Nat'l Park	36,025.00	[illegible]	10,[illegible]
41/2415 Hawaii Nat'l Park	83,130.00	—	83,130.00
[illegible] Roads & Trails, Nat'l Pks	104,000.00	14,900.11	100,333.09
40/1405 F.P. & Fire Prevention	630.00	619.21	10.79
41/2405 F.P. & Fire Prevention	100.00	—	100.00

150 Equipment and supplies:

The following equipment and supplies were delivered to the park during the month.

1 only #325 Amsterdam Rug 8¼ X 10½	———	$37.50
3 only #325 " " 36" X 63"	at $6.25	18.75
1 only Galv.Wash Tub, capacity 16 gal.		.90
1 only Picture Frame 11½ X 20"		1.66
1 only " " 12" X 16"(supply of glass)		.60
3 only Galv.iron tray 12"X12"X1½" high at .50		1.50
1 only #1239 Victory Rug 8¼ X 10½	———	28.00
1 only #900 Ivory Dresser		34.00
1 only #225 Smoking Stand		5.50
		128.79

160 Status of alienated land.

Mr. Otis E. English, who represents the Shipman interests and lives near the park, advises that negotiations with Land Commissioner Bailey for the exchange of lands containing the Thurston lava tube for territorial lands adjoining the Shipman estate have been about completed and the actual transfer can be expected within the next two or three months.

Dr. T. A. Jaggar, volcanologist of the U. S. Geological Survey, has been authorized to purchase the house owned by Miss Fusao Takahashi, located on leased lot covered by contract No. I 6p-24, with a view to acquire this property by purchase by the Hawaiian Volcano Research Association to be used for official purposes by the Geological Survey.

180 Circulars, placards, publicity bulletins, etc.

Copies of the weekly issues of the Volcano Letter are attached, together with copies of circular letters, etc. that have been sent out from this office. Attention is invited to the circular that has been addressed to a number of visitors who stayed at the Kilauea Summer Camp last summer. So far as I have been able to ascertain, the accommodations, service, and rates at the camp have been satisfactory but the patronage has been small and appears to be growing less each year. The Volcano House Company is discouraged and will ask authority another year to discontinue the operation of the Summer Camp unless a better showing is made. I hope that we can stimulate more interest in and a greater use of this summer camp and perhaps we will get some worth while suggestions from those who have patronized it.

200 MAINTENANCE, IMPROVEMENTS AND NEW CONSTRUCTION.

The usual maintenance and repair of roads, trails, buildings, telephone lines, signs, etc. was carried on during the month.

In accordance with the suggestion of the landscape division and to meet a need on the part of park visitors, an auto trail was graded between Halemaumau firepit and the Uwekahuna Observatory, a distance of about 3½ miles. The work was very light and easily done, it being necessary to run a grader over the trail and the work was done in about a week's time. It is used by about 30 to 40 visitors every day, particularly soldiers from the Kilauea Military Camp, who otherwise had to climb down the steep, dangerous trail on the face of the cliff under the Uwekahuna Observatory and make their way across the rough lava on the floor of Kilauea crater. The new road, while a little longer, provides easy walking and opens up an interesting section of the Kilauea area and provides many fine views. It is possible to drive an automobile over it and undoubtedly there will be some use of it made by tourists as well as by officials of the Park Service and Geological Survey. From park headquarters to Halemaumau pit, via the Uwekahuna Observatory and the new trail is 5.2 miles as compared with 7.2 miles by way of the Chain-of-Craters road.

I predict that this route will receive more use from time to time and it will probably be necessary to make improvements as the use increases until this connecting auto trail is built to the same standards as the other park roads. It would have the advantage of a circular trip around the crater for the pleasure of visitors so that it would not be necessary to go over the same road twice, as at present, and during periods of volcanic activity travel could be made to go only one way thus greatly increasing the factor of safety when handling hundreds of automobiles, especially at night. It also has great administrative value to both the National Park Service and the Geological Survey.

230 New construction.

A small garage for the shelter of a Ford or motorcycle was erected in the rear of the ranger station on the Hilo road entrance for the use of Ranger Kenneth J. Williams, notice of whose appointment was received on March 27.

Bids for improvement of the roads in the park were opened on March 4. The lowest bidder was the Bithulithic Paving and Concrete Company, Ltd., of Honolulu, whose figure was $174,164.76.

300 ACTIVITIES OF OTHER AGENCIES IN THE PARK

310 Public Service contractors.

The Kilauea Volcano House Company, Ltd. was authorized to purchase and erect a telescope on their own premises for the benefit of park visitors, and to make a charge.

A conference between the park superintendent and the officers of the Board of Directors of the Kilauea Volcano House Company, Ltd. was held in Honolulu on March 23, in connection with improvement in facilities and services offered at the hotel in the park but the company could not be induced to agree to make the improvements requested at this time. The approved schedule of rates has been transmitted to them with the formal notification that approval of the $9 per day rate, American plan, without bath, has been given for 1931 on condition that improvement be made in the facilities of the hotel, with the request that they advise in writing what their position would be in the matter.

Dr. T. A. Jaggar, volcanologist in charge of the U. S. Geological Survey work in the park, has been helpful to the park superintendent in many matters concerning the park and his help, advice and suggestions have been appreciated. Captain W. A. Heddin, commanding the Kilauea Military Camp, and Lieut. A. W. Benner also cooperated with the park in many ways during the month.

330 Cooperating non-governmental agencies.

The Detective Bureau of the Hilo Police force was called on twice in connection with investigation of theft that occurred in the park. In one case the guilty party could not be located but in the second case the guilty party was found, confession secured, and restitution made.

The traffic squad of the Hilo Police Force also cooperated in handling the traffic on March 24 when the Empress of Australia docked in Hilo with 377 visitors to the park, who came in and had lunch and returned to Hilo, embarking the same day.

340 State, county or municipal legislation affecting parks.

Dr. Jaggar has received assurance that the item of $10,000 authorized in a bill now pending in the Hawaii Legislature for cooperative work with the Geological Survey is undoubtedly going to be passed and he is making plans now for the work to be carried on when the money becomes available.

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The pit, Halemaumau Crater, continues quiet. A slide on the north wall was observed on March 18. Fuming was observed at two new sulphurous spots on the north side of the 1930 floor on the forenoon of March 19. The seismographs continued to record slight earthquakes during the month and the upward pressure away from the volcano has been more or less constantly maintained since December. The general trend of the tilt of the ground since the activity of November 1930 has been very gradually away from the center. They have never shown backward tilting toward the center such as would happen if the lava column subsided.

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Ranger Brumaghim gave 13 lectures during the month at the Uwekahuna Observatory to a total of 394 visitors, 377 of which were at the museum. He made six trail trips across the Kilauea Crater, conducting 57 visitors. The balance of the time he was patrolling, policing grounds, shelters and comfort stations, repairing telephones, lines, etc.

From a list of 3 eligibles for appointment as associate park naturalist at $3200 per annum, Mr. John E. Doerr, who received the highest rating and was immediately available, was recommended for the appointment and the matter is now receiving consideration by the Washington office.

500 USE OF PARK FACILITIES BY THE PUBLIC

There was a total of 6,700 visitors to the park during March, compared with a total of 6,079 a year ago. Total visitors to date this year are 69,126 compared with 41,423 for last travel year. The increase all took place during the period of volcanic activity in November and December.

520 General weather conditions.

The following weather data is of interest.

Maximum	(This year)	73	(Last year)	79
Minimum	(" ")	46	(" ")	45

Precipitation for month 1.87 inches. To date 9.49 inches; last year 21.53 inches

600 PROTECTION.

Kenneth J. Williams was nominated during March for appointment as permanent park ranger to fill the vacancy that has existed for many months due to the lack of eligibles from Civil Service, and notice of his appointment was received on March 27 and he entered on duty on April 2.

620 Fire protection.

A fire above Bird Park along the Mauna Loa trail about eight miles from headquarters occurred on March 24 and burned over thirty acres before it was extinguished. The damage was slight.

630 Accidents.

Although there has not been any accident in the park, almost every week there is an automobile accident on the road between the park and Hilo and in most cases there is one or more fatalities. The accidents, in nearly every case, are due to excessive speed, carelessness and poor driving.

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There were 106 wild goats and 47 mongooses killed during March. Eight wild pigs and two stray dogs were disposed of.

900 MISCELLANEOUS.

Arthur Crites, district governor of Rotary International, visited Hilo on March 21 and spoke at the Rotary Club on that evening. The park superintendent was invited to the meeting and at its conclusion took Mr. and Mrs. Crites with him back to the park and entertained them as his guests the following day.

Very respectfully,

E. P. Leavitt

Superintendent.

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HAWAII NATIONAL PARK
HAWAII

OFFICE OF THE SUPERINTENDENT

April 8, 1931

The Director,
National Park Service,
Department of the Interior,
Washington, D. C.

Dear Mr. Director:-

Following is a report of activities and operations in Hawaii National Park for the month of March 1931.

000 GENERAL:

There is nothing of outstanding importance to be reported during the month of March under this heading. There was sufficient rain in nearly all sections of the island to provide water for growing crops and for domestic purposes, although the Kau section adjoining the park is still suffering to some extent. Travel to the park has been lighter than in former years and everyone seems to be waiting for a renewal of volcanic activity. There have been no special changes in the conditions at Kilauea crater but Dr. Jaggar is still of the opinion that a renewal of activity may be expected at any time.

100 ADMINISTRATION:

110 Status of work.

The office work has been kept up to date through a considerable overtime and plans for the usual spring work for the last quarter of the fiscal year as well as for the new construction authorized in the 1932 appropriation have been under way. The outside work is all practically up to date also.

120 Park inspections by.

121 The superintendent.

Inspections were made daily of the roads and trails and other operations in and around headquarters. Frequent trips were made to Hilo in connection with park business. During the month a thorough inspection of all of the units and operations at the Kilauea Military Camp was made in company with Captain Heddin, ommander at the camp.

A trip was made to Honolulu to confer with the Board of Directors of the Kilauea Volcano House Company, Ltd. regarding proposed improvement of the services and facilities of the hotel in the park. The company refused to agree to any plan of improvement at this time on the ground that they were financially unable to do so and prospective business did not justify. The matter is covered in detail in correspondence that has been sent to your office. While in Honolulu conference was had with Mr. C. S. Judd, territorial forester, regarding plans for the cooperation of the National Park Service in a goat drive to be held April 16 and 17.

I had a visit also with Dr. David A. Crawford, president of the University of Hawaii, regarding the educational work of the park, and particularly plans for a proposed summer school for classes in geology and botany, to be held in the park for a period of four weeks next summer. Plans for helping in tourist travel and for park publicity were discussed with Mr. George T. Armitage, manager of the Hawaii Tourist Bureau, Mr. Riley H. Allen, editor of the Honolulu Star Bulletin, and Mr. L. A. Thurston, editor of the Honolulu Advertiser. I also discussed with Mr. Allen plans for the Pacific Foreign Trade conference, which was scheduled to be held in Honolulu in October and learned that this has now been postponed until the spring of 1932. The meeting will be held with the National Foreign Trade conference in Honolulu.

I met a great many other men in Honolulu who are interested in the park and found the opportunity while there to go around the island of Oahu in order to familiarize myself with its attractions and conditions generally. Notes were made of the trip and a special report will be forwarded later.

130 Finance and accounts.

Following is a list of the funds appropriated for work in the park with unexpended balances as of the close of March 31, 1931.

Appropriations	Allotted	Expended	Balance
40/1418 Hawaii Nat'l Park	36,623.00	26,410.05	10,212.95
41/2418 Hawaii Nat'l Park	52,120.00	—	52,120.00
4X476 Roads & Trails, Nat'l Pks	164,600.00	14,208.11	150,391.89
40/1408 F.P. & Fire Prevention	630.00	619.21	10.79
41/2408 F.P. & Fire Prevention	100.00	—	100.00

150 Equipment and supplies:

The following equipment and supplies were delivered to the park during the month.

1 only #325 Amsterdam Rug 6¾ X 10½	———	$37.50
3 only #325 " " 36" X 63"	at $6.25	18.75
1 only Galv.Wash Tub, capacity 10 gal.		.90
1 only Picture Frame 11½ X 20"		1.04
1 only " " 12" X 16"(supply of glass)		.80
3 only Galv.iron tray 12"X12"X1½" high at .50		1.50
1 only #1239 Victory Rug 6¾ X 10½	———	26.00
1 only #300 Ivory Dresser		34.00
1 only #225 Smoking Stand		6.80
		128.79

160 Status of alienated land.

Mr. Otis E. English, who represents the Shipman interests and lives near the park, advises that negotiations with Land Commissioner Bailey for the exchange of lands containing the Thurston lava tube for territorial lands adjoining the Shipman estate have been about completed and the actual transfer can be expected within the next two or three months.

Dr. T. A. Jaggar, volcanologist of the U. S. Geological Survey, has been authorized to purchase the house owned by Miss Fusao Takahashi, located on leased lot covered by contract No. I 6p-24, with a view to acquire this property by purchase by the Hawaiian Volcano Research Association to be used for official purposes by the Geological Survey.

180 Circulars, placards, publicity bulletins, etc.

Copies of the weekly issues of the Volcano Letter are attached, together with copies of circular letters, etc. that have been sent out from this office. Attention is invited to the circular that has been addressed to a number of visitors who stayed at the Kilauea Summer Camp last summer. So far as I have been able to ascertain, the accommodations, service, and rates at the camp have been satisfactory but the patronage has been small and appears to be growing less each year. The Volcano House Company is discouraged and will ask authority another year to discontinue the operation of the Summer Camp unless a better showing is made. I hope that we can stimulate more interest in and a greater use of this summer camp and perhaps we will get some worth while suggestions from those who have patronized it.

200 MAINTENANCE, IMPROVEMENTS AND NEW CONSTRUCTION.

The usual maintenance and repair of roads, trails, buildings, telephone lines, signs, etc. was carried on during the month.

In accordance with the suggestion of the landscape division and to meet a need on the part of park visitors, an auto trail was graded between Halemaumau firepit and the Uwekahuna Observatory, a distance of about 3½ miles. The work was very light and easily done, it being necessary to run a grader over the trail and the work was done in about a week's time. It is used by about 30 to 40 visitors every day, particularly soldiers from the Kilauea Military Camp, who otherwise had to climb down the steep, dangerous trail on the face of the cliff under the Uwekahuna Observatory and make their way across the rough lava on the floor of Kilauea crater. The new road, while a little longer, provides easy walking and opens up an interesting section of the Kilauea area and provides many fine views. It is possible to drive an automobile over it and undoubtedly there will be some use of it made by tourists as well as by officials of the Park Service and Geological Survey. From park headquarters to Halemaumau pit, via the Uwekahuna Observatory and the new trail is 5.2 miles as compared with 7.2 miles by way of the Chain-of-Craters road.

I predict that this route will receive more use from time to time and it will probably be necessary to make improvements as the use increases until this connecting auto trail is built to the same standards as the other park roads. It would have the advantage of a circular trip around the crater for the pleasure of visitors so that it would not be necessary to go over the same road twice, as at present, and during periods of volcanic activity travel could be made to go only one way thus greatly increasing the factor of safety when handling hundreds of automobiles, especially at night. It also has great administrative value to both the National Park Service and the Geological Survey.

230 New construction.

A small garage for the shelter of a Ford or motorcycle was erected in the rear of the ranger station on the Hilo road entrance for the use of Ranger Kenneth J. Williams, notice of whose appointment was received on March 27.

Bids for improvement of the roads in the park were opened on March 4. The lowest bidder was the Bithulithic Paving and Concrete Company, Ltd., of Honolulu, whose figure was $174,184.76.

300 ACTIVITIES OF OTHER AGENCIES IN THE PARK

310 Public Service contractors.

The Kilauea Volcano House Company, Ltd. was authorized to purchase and erect a telescope on their own premises for the benefit of park visitors, and to make a charge.

A conference between the park superintendent and the officers of the Board of Directors of the Kilauea Volcano House Company, Ltd. was held in Honolulu on March 23, in connection with improvement in facilities and services offered at the hotel in the park but the company could not be induced to agree to make the improvements requested at this time. The approved schedule of rates has been transmitted to them with the formal notification that approval of the $9 per day rate, American plan, without bath, has been given for 1931 on condition that improvement be made in the facilities of the hotel, with the request that they advise in writing what their position would be in the matter.

Dr. T. A. Jaggar, volcanologist in charge of the U. S. Geological Survey work in the park, has been helpful to the park superintendent in many matters concerning the park and his help, advice and suggestions have been appreciated. Captain W. A. Heddin, commanding the Kilauea Military Camp, and Lieut. A. W. Benner also cooperated with the park in many ways during the month.

330 Cooperating non-governmental agencies.

The Detective Bureau of the Hilo Police force was called on twice in connection with investigation of theft that occurred in the park. In one case the guilty party could not be located but in the second case the guilty party was found, confession secured, and restitution made.

The traffic squad of the Hilo Police Force also cooperated in handling the traffic on March 24 when the Empress of Australia docked in Hilo with 377 visitors to the park, who came in and had lunch and returned to Hilo, embarking the same day.

340 State, county or municipal legislation affecting parks.
Dr. Jaggar has received assurance that the item of $10,000 authorized in a bill now pending in the Hawaii Legislature for cooperative work with the Geological Survey is undoubtedly going to be passed and he is making plans now for the work to be carried on when the money becomes available.

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The following weather data is of interest.

Maximum	(This year)	73	(Last year)	79
Minimum	(" ")	46	(" ")	45

Precipitation for month, 1.57 inches; last year 11.79 inches. To date 9.89 inches; last year 22.33 inches

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Arthur Crites, district governor of Rotary International, visited Hilo on March 21 and spoke at the Rotary Club on that evening. The park superintendent was invited to the meeting and at its conclusion took Mr. and Mrs. Crites with him back to the park and entertained them as his guests the following day.

Very respectfully,

E P Leavitt

Superintendent.

CC to Chief Engineer, N.P.S. (2)
CC to The Superintendent, Yellowstone Nat'l Park. (1)

DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HAWAII NATIONAL PARK
HAWAII

March 16, 1931

OFFICE ORDER NO. 3

SUBJECT: EMPLOYMENT OF PER DIEM LABOR.

1. No per diem employment of any kind is to be made by Department heads or others, without first securing the authority of the Superintendent.

2. All per diem employees must sign a Memorandum of Employment in the park office before they can be put to work, or taken up on the park payroll.

3. A Hiring Card will be made out for each per diem employee by the park office, and kept in alphabetical order for making out and checking time slips, payrolls, etc.

4. No change in designation or pay can be made without prior authority of the Superintendent, and every change either in designation or pay requires a new Memorandum of Employment to cover.

E P Leavitt
E. P. Leavitt,
Superintendent

DISTRIBUTION:

		Copies
To	Ranger Christ	1
	" Brumaghim	1
	Foreman Craik	1
	Clerk Higashida	1
	Director, National Park Service	1
	E. P. Leavitt, Superintendent	1
	Monthly Report for March 1931	6
	Park Files	2
	Totals	14

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HAWAII NATIONAL PARK

OFFICE OF THE SUPERINTENDENT

VOLCANO HOUSE, HAWAII

MAR 3 0 1931

Dear Sir or Madam;

The register of the Kilauea Summer Camp shows that you were a guest of the camp last summer.

As the new superintendent of Hawaii National Park, I am interested to learn why this summer camp is not patronized to a greater extent than it is. From all I can learn locally the camp management, meals, lodging, general service, rates, etc., appear to be satisfactory.

I would greatly appreciate it if you would write me regarding your experience at the camp. Tell me what you especially liked and why and also tell me about anything you disliked. I would also like to have your ideas as to how the camp might be made more popular, etc.

I will appreciate it if you will write me fully and frankly. If you so state, I will treat your letter as confidential.

The National Park Service policy is to provide various types of accomodations at different rates in the parks to meet the desires and the purses of all classes of park visitors, but the camp service has been so poorly patronized in the past, contrary to the rule in the mainland parks, where the camps are more popular than the hotels, that unless there is some improvement, the camp may be closed next year for lack of sufficient patronage. If your experience at the camp was satisfactory and you believe it fills a need here, perhaps you will help the National Park Service to make it more popular and increase the patronage.

Thanking you, I am,

Sincerely yours,

E P Leavitt

E. P. Leavitt,
Superintendent

P.S. A self-addressed envelope which requires no postage is enclosed for your reply.

EPL.

Form No. 1009—Met'l.

U. S. Department of Agriculture, Weather Bureau.

COOPERATIVE OBSERVERS' METEOROLOGICAL RECORD:

Month of March 1931, *192* ; *Station,* Volcano Observatory; *County,* Kau, Hawaii

Hour of Observation, 8 A. M.

State, Hawaii; *Latitude,* ; *Longitude,* ; *Time used on this form,* Haw'n

Date	Temperature: Maximum (1)	Minimum (2)	Range (3)	* Set Max. (4)	Precipitation: Time of Beginning (5)	Time of Ending (6)	† Amount (7)	Humid ~~XXXXX~~ (8)	Wind ~~XXXXXXX~~ Time of Observation (9)	Prevailing Wind Direction (10)	Character of Day, Sunrise to Sunset (11)	‡ Miscellaneous Phenomena
1	59	47	12	55			02	85	Lt	N.E.	P. C.	
2	66	50	16	53			05	86	"	"	"	Snow on Mountains
3	64	51	13	55			05	88	Mod	"	"	
4	67	[illegible]	18	56			07	87	Str.	"	Clear	Lt. old snow Mauna Kea
5	68	47	21	58			T	82	Lt.	"	P. C.	
6	65	46	19	55			03	75	"	"	"	
7	67	48	19	53			02	81	Str.	"	"	
8	70	49	21	60			03	83	Lt. ~~Xxxx~~	Var.	"	
9	66	52	14	58			18	92	"	"	"	
10	67	49	18	56			06	86	"	N.E.	"	
11	65	51	14	64			07	76	Mod.	"	"	
12	71	48	23	55			04	89	Lt.	"	"	
13	72	48	24	57			02	83	"	"	"	
14	72	49	23	57			T	87	"	"	Clear	
15	70	50	20	57			T	83	"	"	"	
16	72	53	19	58			01	89	"	"	P. C.	
17	72	52	20	58			10	88	"	"	"	
18	71	51	20	54			T	91	" ~~Xxx~~	Var.	"	
19	70	50	20	59			07	84	"	"	"	
20	69	50	19	58			03	83	Mod.	N.E.	Clear	
21	70	49	21	59			01	75	Lt.	"	P. C.	
22	69	47	22	57			T	81	Mod.	"	Clear	
23	66	50	16	58			05	88	Lt.	"	P. C.	
24	67	55	12	58			04	89	"	Var.	"	
25	69	52	17	57			08	93	"	"	"	
26	68	53	16	55			18	94	"	N.E.	"	
27	67	53	14	56			14	92	"	"	"	
28	73	52	21	58			01	83	"	Var.	"	
29	71	57	19	62			03	89	"	S.W.	"	
30	68	55	13	57			15	94	"	"	"	
31	70	51	19	61			03	84	"	Var.	"	
Sum	2122	1564	558	1775			1.57	2658				
Mean	68.4	50.4	18	57			.05	85.7				

* Reading of maximum thermometer immediately after setting.
† Including rain, hail, sleet, and melted snow.
‡ Thunderstorms, halos, auroras, etc.

(Sgd.) T. A. Jaggar, *Cooperative Observer.*

(IN TRIPLICATE.) See cover for instructions.

Post-Office Address, Hawaii National Park, Hawaii

MONTHLY SUMMARY.

TEMPERATURE.

Mean maximum, 68.4

Mean minimum, 50.4

Mean, 59.4

Maximum, 73; date, 28th

Minimum, 46; date, 6th

Greatest daily range, 24

PRECIPITATION.

Total, 1.57 inches.

Greatest in 24 hours, 0.18; date, 9th 26th

SNOW.

Total snowfall, inches; on ground 15th, inches;

at end of month, inches.

NUMBER OF DAYS—

With .01 inch or more precipitation, 26

Clear, 5; partly cloudy, 26; cloudy,

DATES OF—

Killing frost,

Thunderstorms,

Hail { Light, Moderate, Heavy,

Sleet,

Auroras,

REMARKS:

Several days wind varied from trade to Kona, with increasing cloudiness through the day, and very light rains at night. Water shortage in tanks averted in April

Rainfall to-date Vol. District 9.89"
" this month Hilo 0.98"
" to-date at Hilo 11.50"

10-157
(July, 1929)

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

TRAVEL REPORT

Hawaii National Park for the month of March 1931

	This Month	This Travel Year To Date	This Month Last Year	Last Travel Year To Date	Increase for Travel Year: Number	Increase for Travel Year: Percent
PRIVATE TRANSPORTATION:						
Cars first entry,						
Cars reentry,						
Motorcycles,						
Total motor vehicles,						
Persons entering via motor vehicles,	5,644	70,142	4,855	35,361	34,781	98.4%
Persons entering via other private transportation,	287	1,987	166	1,448	539	37.2%
Total persons entering via private transportation,	5,931	72,129	5,021	36,809	35,320	95.9%
OTHER TRANSPORTATION:						
Persons entering via ~~stages~~ Hotel,	778	3,706	1,058	4,614	RE 908	19.7%
Persons entering via trains,						
Persons entering otherwise,						
Total other transportation,	778	3,706	1,058	4,614	RE 908	19.7%
GRAND TOTAL ALL VISITORS,	6,709	75,835	6,079	41,423	34,412	45.4%

	This Year	Last Year	Increase: Number	Increase: Percent
Automobiles in public camps during month,	3	2	1	50
Campers in public camps during month,	12	3	9	300

10-158

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

STATUS OF AUTHORIZED PROJECTS

..................Hawaii.................... National Park for the Month of ......March 1931.........................

Description of Projects	Percent Constructed To Date	Percent Constructed This Month	Percent Constructed Last Month	Probable Date Completion
405 Ware House	100	---	100	
406 Toilets, (Kilauea)	100	---	100	
407 Toilets, (Uwekahuna)	100	---	100	
408 Gasoline & Oil Building	98	---	98	April 15, 1931
451. Telephone Lines	95	---	95	
502 Kilauea Iki Trail	100	---	100	
502 Mauna Loa Trail	100	---	100	
502 Summer Camp Trail	100	---	100	
502 Steaming Bluffs Trail	100	---	100	
Road Survey, B.P.R.	100	---	100	

10-159

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

STATUS OF PERSONNEL

Hawaii National Park for the Month of March 1931

	This Month	This Month Last Year
Number of employees beginning of month,	10	9
Number of additions, ...	0	0
Total, ...	10	9
Number of separations, ...	0	0
Number of employees close of month, . .	10	9
Number of promotions during month	0	0
Aggregate amount of annual leave taken,	0	0
Aggregate amount of sick leave taken,	0	0
Aggregate amount of leave without pay,	0	0

10-160

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

REPORT OF PARK REVENUES

Hawaii National Park for the Month of March 1931

	This Year	Last Year
Park revenue on hand beginning of month,	0.00	0.00
Received,	25.00	25.00
Total,	25.00	25.00
Remitted,	25.00	25.00
On hand close of month,	0.00	0.00

Park revenues received this year to date,	1,100.00
Park revenues received last year to date,	1,050.00
Increase,	50.00
Per cent of increase,	.048

10-161

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

Hawaii National Park

REPORT OF SALES OF PUBLICATIONS

March 1931

	Number	Value
GOVERNMENT PUBLICATIONS:		
On hand beginning of month,	352	72.10
Received during month,	0	0.00
Total,	352	72.10
Sold during month,	18	3.60
On hand at close of month,	334	68.50
NON-GOVERNMENT PUBLICATIONS:		
On hand beginning of month,		
Received during month,		
Total,		
Sold during month,		
On hand at close of month,		

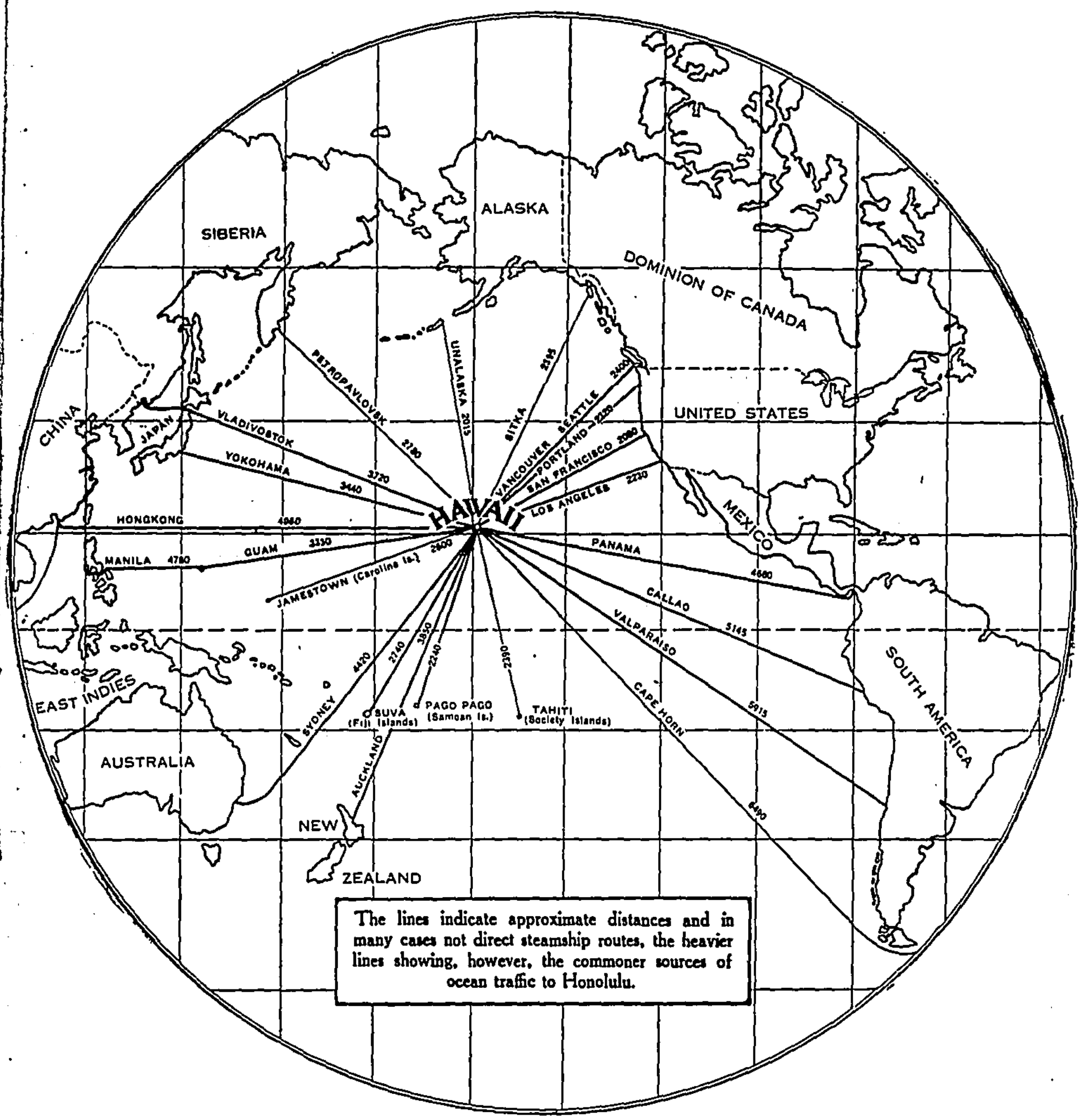
Cash on hand beginning of month,	6.40
Sales during month,	3.60
Total,	10.00
Remitted during month,	0.00
Balance,	10.00

The Volcano Letter

Two dollars per year

Ten cents per copy

No. 337—Weekly — Hawaiian Volcano Observatory, National Park, Hawaii — April 2, 1931



Map of the Pacific Ocean showing New Zealand at the southwest. Hawke's Bay is at the southeastern end of the North Island. Napier is at the southwestern end of Hawke's Bay. This is the eastern border of a continental mass which falls off to deep water east of New Zealand.

GREAT NAPIER EARTHQUAKE NEW ZEALAND

On Frebruary 3, 1931, at 10:47 a. m. local time, a terrific earthquake occurred destroying the cities Napier and Hastings at the southwest end of Hawke's Bay, an indentation in the middle of the southeastern end of the North Island of New Zealand. This had been registered perfectly on the seismographs at the Hawaiian Volcano Observatory with indicated distance 8,040 km. SSW., which checks satisfactorily with the New Zealand location.

Seimographs at the Dominion Observatory in Wellington show that 588 shocks originating in the Hawke's Bay district occurred during February, the after-shocks diminishing more quickly than those recorded after the Murchison earthquake in 1929. For the first day following the initial mark of the heavy shock 151 earthquakes were registered in 24 hours. Most of the after-shocks were not felt in Wellington, but the large shock was.

Hawke's Bay is 60 miles southeast of the Taupo volcanic belt and lies on the NE-SW mountain axis of New Zealand well to the east of the belt which was stricken at Murchison in the north end of the South Island June 17, 1929. In fact that Murchison fault belt if projected to the northeast would have passed through the Taupo volcanic belt. The New Zealand Herald reports official and other investigations about February 21 as follows:

Napier and Hastings are at the southwest end of Hawke's Bay, Mohaka is in the middle of the long curve of the bay, Wairoa is at the north, Mahia is at the northern peninsula enclosing the bay, Gisborne is farther north, and Morere hot springs lie in between. Waipukurau lies farther southwest than Napier. Remarkable changes in configuration were found on the coast near Mohaka in the middle of the bay. Here the coast line has taken a new contour and owing to its uplift, residents state that one may now travel dryshod along a new, wide, sandy beach as far as Napier, a feat that would have been impossible before even at lowest tide. The upheavals, however, have seriously affected only a narrow strip of coastal land around the bay. Wairoa was much less seriously afflicted than Hastings and Napier.

The land was most shattered along cliffs and hills between Napier and Mohaka. Inland a short distance no trace is found of the crumbled hilltops with deeply fissured sides which are conspicuous at the shore. In some of the gorges, however, loose hillsides have fallen away, just as did the Bluff Hill at Napier. In these places the road is blocked or annihilated. Alluvial formations in rivers have subsided and cracked, and this is what happened to the embankment road at Napier.

At Mohaka there is evidence of a strong upthrust. The correspondent felt an earthquake while there, giving the sensation of somebody tapping upward beneath the earth's crust with a huge hammer, and workmen said that was how all the shakes had felt around Mohaka. There was direct evidence of an upward and downward movement. In the hills above the Maori village the floor of an entire valley has sunk at least 50 feet in a crumpled mass. Many of the ridges for miles around resembled newly made fillings, while the main road has disappeared entirely for about half a mile. The most remarkable evidence of the tremendous forces brought into play is seen near the mouth of the Mohaka River. Within a distance of about five miles three new peninsulas have been thrown out from the shore, and there has been a general rise in the level of the beach. Where the river enters the sea a bluff has been shaken down into a heap of dust and clay bowlders.

A huge area of the sea is discolored with the discharge from the river which, after the middle of February, began to overflow a huge landslip dam which had blocked it for about 10 miles inland. Northward there juts out a promontory of what was formerly about 200 acres of pasture, and southward a bluff lies in ruins on one of the longest peninsulas formed by the upheaval. There are several of these upheavals along the coast. On the bluff in question about 160 acres of land were lost, and plants which originally grew just above the water level at the foot of the cliffs, were subsequently found growing near the top of the landslip. This indicates that the hills were thrown out from the base dropping down a block of the back land, and carrying beach shingle, sand, and driftwood up so as to overlap the sunken land behind. A big fish was found 50 feet above the water, shells and flotsam can be seen at a height of about 70 feet on the new ground, and this earth is so convulsed and contorted that the journey over it is like climbing in a miniature mountain range.

Homesteads and farm buildings all along the coast suffered severely, but the effects on buldings diminish rapidly toward the north and toward the interior After-shocks were common and residents say they were accompanied by booming noises among the hills. They sound like heavy objects dropping. While there are blockages in the rivers, most of them are open except in the case of the uplift of the coast above noted. When rain comes the whole country will be subject to tremendous surface changes.

An investigation by the Geological Survey reports that the main fracture lies east of Napier, passing through the principal earthquake centers under the sea in Hawke's Bay as determined by the seismographs. There is a pronounced uplift of the sea floor and of the coast west of the fracture line. "So many factors influence the height of the tide that it is difficult to determine a change of a few feet in the level of a coast. No change was detected at the mouth of the Ngaururoro River. At Napier the uplift was about six feet decreasing southward. At Petane just to the north of Napier it is six to eight feet, and at Whakaari still farther north, perhaps seven feet. The harbormaster at Wairora is sure there has been no change in level there. These scanty observations make it appear that the coast has arched gently on a northeast line, the crest of the arch being north of Napier. Assuming that the amount of coastal uplift is a measure of the violence of the earthquake, the center of the disturbance was some miles northeast of Napier below the floor of Hawkes Bay."

Napier suffered greater damage than Hastings, Hastings more than Waipawa, and Waipawa more than Wairoa. The report states that fissures in alluvium were remarkably abundant along rivers and in localities where there was no lateral support for filled-in material. In places the ground had stretched 12 feet in a few score yards, water and sewer pipes having been disrupted, and dwellings greatly damaged. The West Shore causeway built across a mud flat area had spread and the roadway split and collapsed through lack of lateral support. The banks of the chief tidal channel had closed in on a bridge, forcing the top of one set of piles from under the ends of the girders supporting a span of the bridge. At many points along the coast shingle beaches had slumped either toward the sea or backward toward the lagoon behind them, and the surfaces were ridged by a series of parallel steps and trenches.

The displacement of alluvium narrowed the river channels, and raised their beds, making it likely that their discharging capacity during floods will be seriously diminished. During the earthquakes large quantities of water, sand, and silt issued from fissures in the ground. The origin was a water-saturated sand layer below the surface. Land slides were not nearly so prominent as they were in the Murchison district in 1929, where the hills were steeper and the climate wetter. Their distribution showed that they depended largely on local conditions ranging in quality from vast landslips involving many millions of yards of rock to mere downward creep of the soil mantle on the hills. Pressure ridges appear to mark the surface trace of an important earth fracture through the Poukawa Valley extending northeast about six miles. The ground northwest of the fracture is fissured and swollen and that on the southeast side unaffected. It appears probable that the earth block on the northwest side moved. The movement was toward the east. Probably it follows a weak layer interbedded with the strong limestone bands. Probably also, movement occurred along several weak layers. This suggests that the movement was distributed over a zone several miles wide.

An investigation by a government vessel taking soundings for three days north from Napier indicated that the bed of the roadstead had risen in parts from six feet to seven feet, but in places the soundings gave the same depth of water as is shown on the charts. Nothing less than 33 feet of water was found from two miles off shore to half a mile from the breakwater at Napier, the sounding being on the line of beacons leading to the roadstead. The investigations show that the anchorage in the roadstead is just as safe for shipping as it was before the earthquake.

With reference to earthquake-proof construction, the following quotations from a sensible article by Archdeacon K. E. MacLean are pertinent quite as much to other places as to New Zealand. The Archdeacon asks whether sufferers by the earthquake need believe that the disaster was a divine punishment. He cites the case of a man who gets sunstroke by going out without his hat. We are sorry for him, but we say bluntly, "It was his own fault."

"To be quite honest is not our position much the same? We know what eartnquakes are. We know a good deal about how and why they happen. We know there are faults in the earth's surface and that the countries near those faults are liable to earthquakes. We know—we always have known—that New Zealand is one of these countries, and that a bad earthquake might come at any time. Yet we came knowing this and lived here and shrugged our shoulders about earthquakes."

"Our fathers, who remembered the earthquake in Wellington in 1855, warned us against brick houses and high chimneys, but the years went by and more and more brick houses and tall chimneys were built, and the years went on and they stood. It was quite possible to build earthquake-proof houses in wood or brick, or concrete, but it was expensive, and we wanted money for other things. It was quite possible to build chimneys in ordinary houses which had not got a tight collar of wood around them at the flashing, but we did not bother."

"It was quite possible to follow sound principles of construction in building shops and offices, but no one cared and no one asked for it. So up went the flimsy, showy walls and the heavy copings. It is not the fault of anyone in particular. *Architects, builders, and workmen just* shared the common mind and built their own houses in just the same way that they built houses for other people. We are all in this together. It was public opinion that it did not matter."

"Two years ago the Murchison earthquake happened and we said, or nearly all of us said, 'Poor beggars! Come and live in Hawke's Bay and be safe.' And we went on living happily in the death trap we had built. Then, on February 3, the earth wriggled for a minute. The fault settled down a bit more. Who caused the death and suffering? Only if we face this honestly shall we live more wisely in the future."

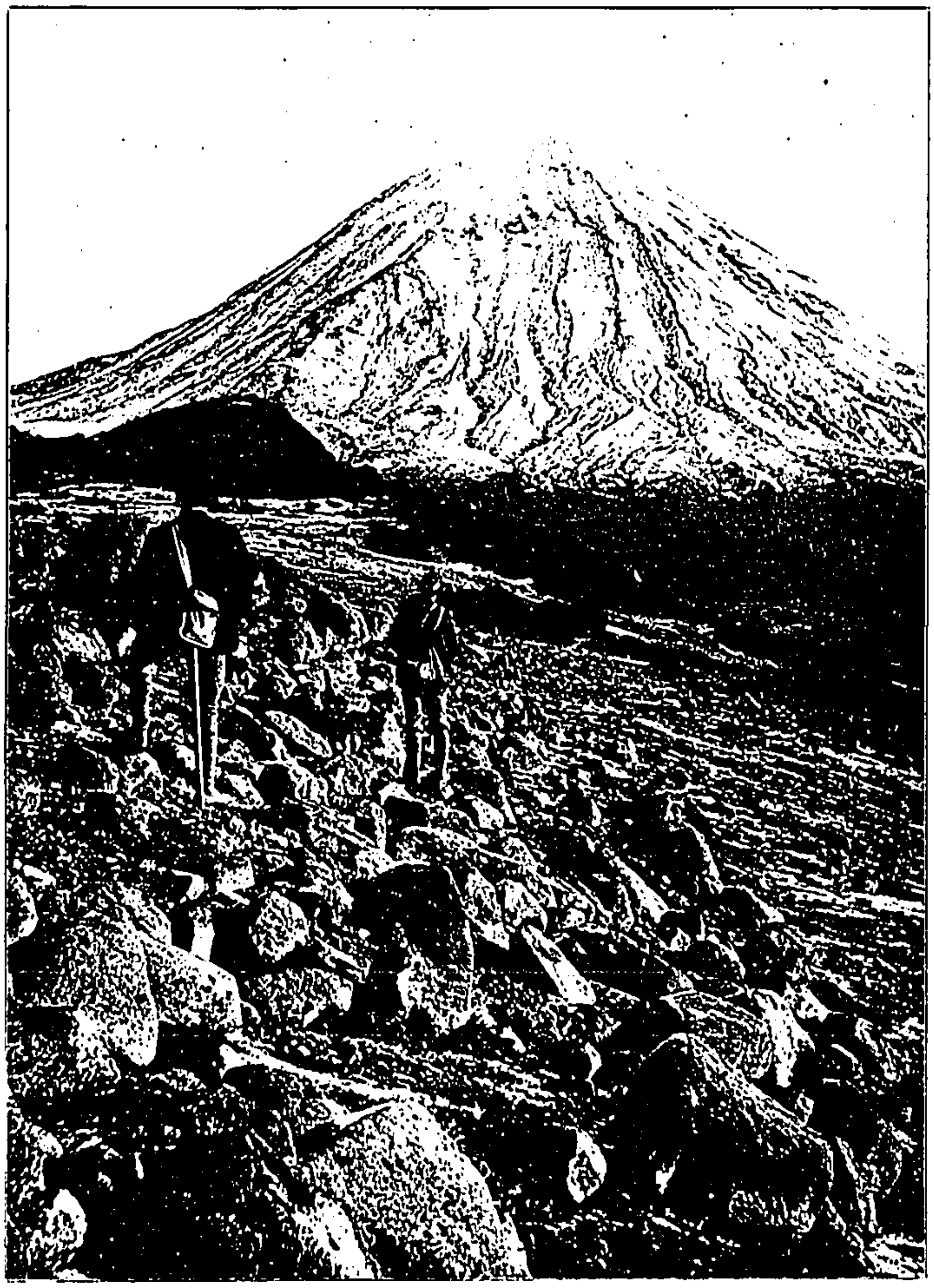
This wise comment applies equally to all lands around and in the Pacific Ocean. T.A.J.

KILAUEA REPORT No. 1C01
WEEK ENDING MARCH 29, 1931

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

No significant changes have happened at the Hawaiian volcanoes and the fire pit at Kilauea is quiet. Thirty tremors were registered on the seismographs of the Observatory at Kilauea and three very feeble local seisms, one of these at 7 p. m. March 25 indicating origin distance 28 miles, and one at 8:11 a. m. March 29 a distance of five miles. A tremor at 9:05 p. m. March 27 lasted eight minutes. A strong distant earthquake began at 2:21 a. m. March 28 local time (10 hours, 30 minutes slower than Greenwich) and indicated origin distance 8,830 km., apparently WSW. from station, which would locate it near the west end of New Guinea or the eastern part of the Dutch East Indies.

Tilting of the ground was moderate to the south, and microseismic motion was slight for the week.



Ngauruhoe Volcano in the Taupo belt of the central part of the North Island of New Zealand. This shows the volcano as seen in winter from the east, marking the line of active volcanoes which lie 60 miles northwest from Napier.

THE VOLCANO LETTER

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The Volcano Letter

Two dollars per year — Ten cents per copy

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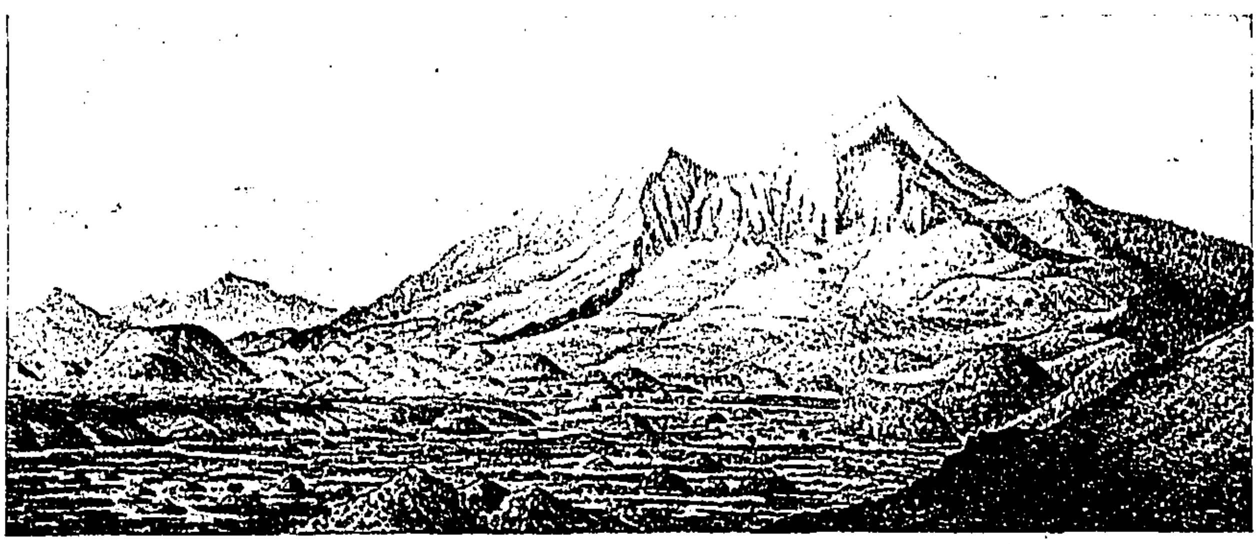


Crater of Bandaisan after eruption of 1888 showing the steaming cleft in the mountainside, bare hillsides that were scored by the terrific avalanche, and mounds left by settlement of the debris. After Sekiya and Kikuchi.

JAPANESE VOLCANOES ARRANGED IN SERIES

In order to classify volcanoes intelligently it is necessary to know the deeper mechanism that gave birth to the crater or mound or mountain. In Volcano Letter No. 164 was reviewed the classification given by Sapper, (1) Hawaiian liquid lava flow, (2) liquid lava combined with steam jet as at Stromboli, (3) stiffer lava combined with steam and black dust as at Vulcano, (4) stiff lava plug combined with Vulcanian paroxysms of steam and dust as at Pelee in Martinique, and (5) steam explosion alone throwing up fragments of old rock as at Bandaisan in Japan. These are usually described as (1) Hawaiian, (2) Strombolian, (3) Vulcanian, (4) Pelean, and (5) Bandaian. Numerous unhappy Greek words have been invented by Schneider and others, which unfortunately some Japanese geologists are repeating, but clear descriptive language is best in the present stage of the science.

A recent essay by H. Tanakadate (Eruptive Types of Japanese Volcanoes in recent Years, Proc. Fourth Pac. Sci. Cong., Java, 1929, p. 621) is a sound attempt to arrange the eruptions of Japan in series. The author uses some technical terms which would much better be replaced by plain language. He distinguishes eleven types as follows:

Bandaisan	1.	Sudden explosion without lava.
Shiretoko	2.	Sulphur eruptions.
Kusatsu-shirane	3.	Crater lake eruptions.
Tokachidake	4.	Explosive avalanches with explosive lava.
Ususan	5.	Swelling mountain with explosive lava.
Tarumai	6.	Explosive jets and rising plug.
Asama	7.	Aa lava in crater with explosive jets.
Sakurajima	8.	Ruptured mountain flank with aa outflow.
Oshima	9.	Fluctuating crater lava and flows.
Minami-iwo-shima	10.	Submarine eruptions.
Hakone	11.	Subterranean lava movement making earthquakes.

(1) Bandaisan in interior central Japan had some solfataras on top of one of its peaks, elevation 1840 meters. July 15, 1888, subterranean roaring began at 7 a. m. and three-quarters of an hour later a gigantic steam blast rushed out at these solfataras and engulfed or threw out about half of this particular peak, avalanching 1700 million cubic meters of rock down the northern foot of the mountain, leaving a horseshoe crater 1 km. wide, 400 m. deep, and open to the north like a quarry with rushing steam in its bottom. The process dammed a river and made a lake. If there were fragments of new lava, they were in small amount.

(2) Sulphur eruption. In the eastern part of Hokkaido, the north island of Japan, Shiretoko-Iwo-san is a volcano of active solfataras where sulphur was mined. August 9, 1889, at 1 p. m. an explosion in a solfatara threw out sulphur both as blocks and liquid, forming a craterlet 40 m. long. The activity decreased at the end of two weeks, leaving a lake of boiling water, but sulphur production augmented. The next year on June 15, boiling water was thrown out. The accumulating and melting of sulphur coupled with geyser action influence such eruptions; the liquifaction temperature of sulphur is 114.5° C.

North side of Asama Volcano, central Japan, showing the great aa lava flow of 1783 and the fuming crater in the background. After Omori.

(3) **Crater lake eruptions.** Kusatsu-Shirane is a volcano 2,162 meters high in central Japan with three circular crater lakes and hot gases, amid sulphur mines. In July 1897 there were earth tremblings, a steam blast occurred in the middle of the largest lake and continued to mid-August. There were similar outbursts in 1900, 1902, and often between 1905 and 1925. Such eruptions in crater lakes are not rare in Japan. An explosive paroxysm of subterranean gas burst through Noboribetsu crater lake in southeast Hokkaido in the spring of 1927. The lake shows a temperature of 50° C. on the surface and 133° C. at the bottom. This place contains melted sulphur.

(4) **Explosive avalanches.** Tokachidake is a volcano in central Hokkaido 2,077 meters high with fumaroles so active that sulphur could be extracted from the fume by condensing it. Explosions began December 23, 1925, and culminated in two blasts May 24, 1926, upsetting the western half of a solfataric hill and causing it to avalanche down so as to leave a crater 130 by 300 meters and 50 meters deep. On May 25 a new sudden explosion threw up fresh lava and was accompanied by an earthquake, the scoriae falling on the avalanche debris. The activity waned except for renewed explosions September 8 and 10 ejecting high-temperature ash. Asosan in Kyushu and Kirishima are similar volcanoes beginning eruption by ejection of old rocks, ending with red-hot scoriae, this last phase continuing for a long time and declining gradually.

(5) **Swelling mountain.** Usu Volcano of elevation 725 meters in southern Hokkaido lies between the sea and a volcanic depression containing Lake Toya. After numerous earthquakes in 1910 it cracked along its flank for three kilometers, developed 45 explosive craterlets, and lifted a hill 700 meters long and 200 meters wide to a height of 100 meters (Volcano Letter No. 302). The lapilli thrown out were of new lava, and it is conceived that an intrusive mass of magma was pushing its way like a lens outward and upward, and by occasional recession permitting ground water to fill voids and turn to steam.

(6) **Rising plug.** The activity of Tarumai was described in Volcano Letter No. 317. This volcano also is in Hokkaido, is 1023 meters high, and after 15 years repose sent up a steam blast in 1909 with increasing violence for three months accompanied by the rise of 20,000 cubic meters of lava that formed a dome. This dome was quite like the andesite domes of Bogoslof, described in the last Volcano Letter (No. 322). The dome was 134 meters high, and several explosive outbursts have traversed it since April, 1917.

(7) **Lava in crater and gas blasts.** Asama Volcano in central Japan is the type, a big cone 2,542 meters high, much like Vesuvius, and in 1783 one of the greatest eruptions in the history of Japan spread volcanic detritus and ashes over a large area, followed by an aa lava flow. In recent years, between 1910 and 1915, and again 1919-23, the crater bottom welled up slowly by accumlation of new lava and there were repeated explosive eruptions proportional in frequency to the pulsations of rising of the lava. After big eruptions the bottom lava sank. There was a new eruption in September 1929.

(8) **Lava outflow from mountain flank.** Sakurajima is the type, described in Volcano Letter No. 308. This volcano is a peninsula in Kagoshima Bay at the south end of Japan and stands 1,060 meters high. It was shaken by earthquakes for two days in January 1914, then great cauliflower clouds arose, and two stiff, blocky lava flows of andesite poured from newly formed craterlets on both sides of the mountain. The volume of lava was estimated at 1.56 cu. km., the explosive materials 0.62 cu. km., and the area covered with lava 23.73 sq. km. The lava flowed for several months and the effusion ended gradually with weak explosions in the craterlets.

(9) **Crater lava and flows.** The volcano Miharayama,

755 meters high, constitutes the island of Oshima in Sagami Bay southwest of Yokohama. It had eruptions from 1912 to 1923 just before the Tokyo earthquake. In 1912 explosions of incandescent scoriae began in the central crater, in April it was filled with lava, in July its central part lowered 30 meters, in September pahoehoe lava poured up filling the crater by mid-October, fed by a cone of scoriae just as at Vesuvius at present. Then the lava field sank, on May 15, 1923 a Strombolian steam eruption occurred; thereafter the crater bottom rose and this was followed by a sinking and active border fissures in 1915. Lava eruptions were repeated in 1919, 1920, and 1923. In January of 1923 the lava field in the crater rose, with a cone 40 meters high standing upon it. Then there was a lowering, followed by the Tokyo earthquakes which had some of their epicenters close to Oshima. As shown by the changing pattern of the pit, the lava activity of Mihara is more like Kilauea than most Japanese volcanoes.

(10) Submarine eruption. In the ocean to the south of Oshima extends a line of volcanic islands. At Minami-Iwo-shima a small island was built up after detonations and uprush of fume for 20 days in 1904. This was December 5, and in February 1905 the circumference was 5 km. and height 150 m. The cone was crowned with a crater of 120 m. diameter. It was eroded away soon after June 1905. In 1911 the water there was 400 m. deep, but on January 25 after two days of explosions a new cone arose, similar to the former one, and this had disappeared by June 1915. There were other eruptions along this line of the Ogasawara islands, making banks of pumice in 1906 and 1915.

(11) Volcanic intrusion. As a last stage in manifestation of magmatic energy, the Hakone Volcano, 1,439 meters high, near the beautiful lake of the Miyanoshita district so much visited by tourists, has been the scene of many earthquakes. Disastrous ones have occurred in the last few weeks. They were numerous in 1917, and also this district was terribly shaken by the great Tokyo earthquake of 1923. It lies on the Fujiyama volcanic zone. The earthquakes at Hualalai in Hawaii in 1929 marked another case of volcanic energy underground.

Professor Tanakadate shows analyses of lava from all these volcanoes, with silica increasing from No. 9 to No. 1, alumina decreasing, and decrease also in iron, magnesia, and lime. In other words the series is more basic the greater the fluidity of the lava.

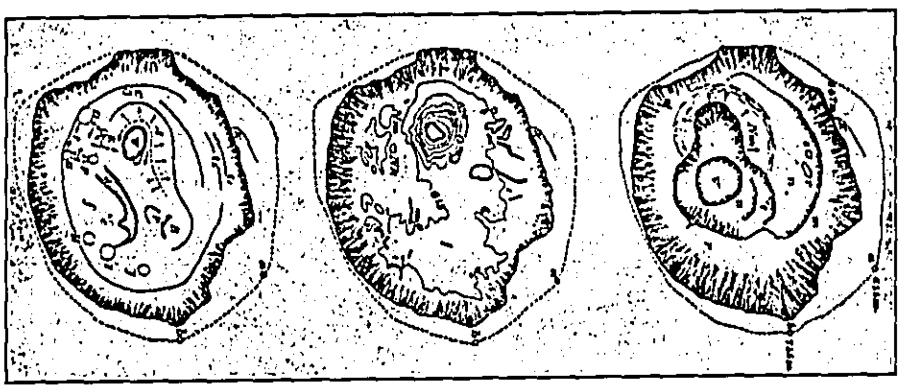
T.A.J.

KILAUEA REPORT No. 997
WEEK ENDING MARCH 1, 1931

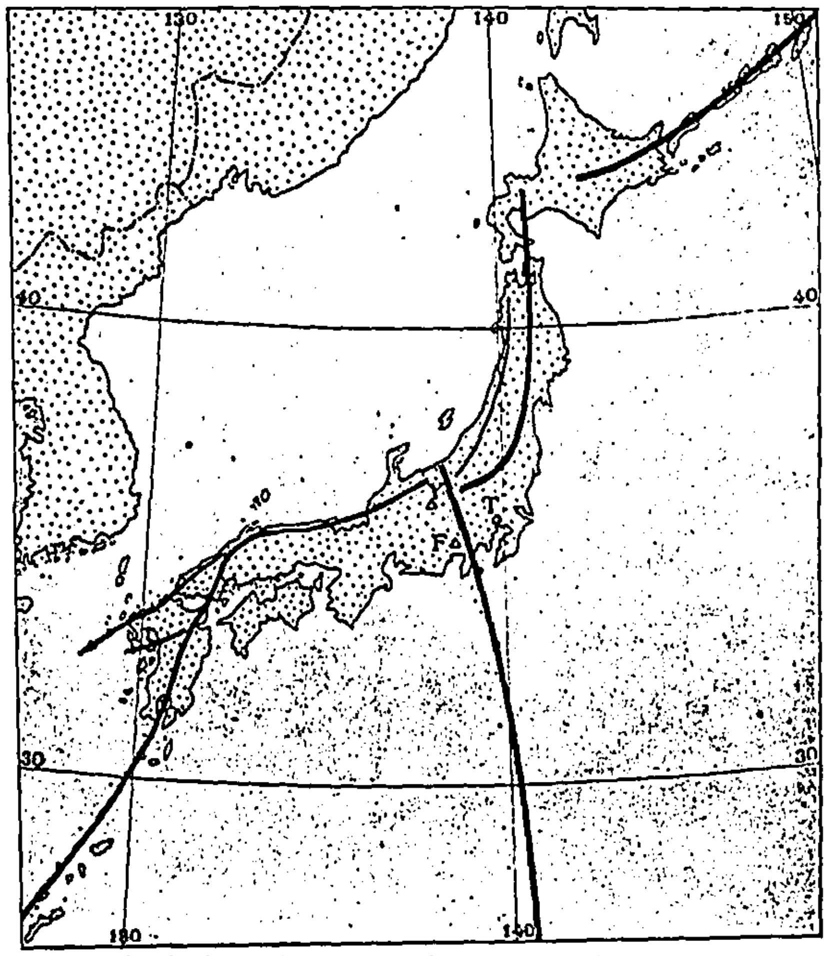
Section of Volcanology, U. S. Geological Survey
T. A. Jaggar, Volcanologist in Charge

On February 23, 1931, no changes were observed at the pit Halemaumau of Kilauea Crater, the pit seismograph showed no tremors, and the tilting of the ground at the pit since the activity of November 1930 has been very gradually away from the center. It has never shown backward tilting toward the center such as would happen if the lava column subsided. On February 26 after heavy rain there was much steaming on the new crater floor near the cone of 1930 and some of the sulphur spots were somewhat washed away. Two spots on the northwestern part of the new floor appear to be fuming with blue sulphur smoke, the one in puffs and the other continuous, first observed on the afternoon of February 25.

Observatory seismographs have registered 25 tremors, one feeble local earthquake, and two very feeble ones, the distances shown being 9 and 11 miles from the station. Tilting of the ground was moderate to the south, a direction seasonally expectable at this time of the year. As a whole however this seasonal tilt has been delayed, as though upward pressure away from the volcano had been maintained here since December. Microseismic motion has been almost absent.



Three maps of the crater pit of Mihara Volcano in Sagami Bay near Tokyo. North is at the right. Right-hand sketch is the summer of 1907, in the middle is shown the condition of January 1, 1913, and on the left the block lava, terraces, spatter cones, ditches, pits, and fuming holes of 1916. After Tsuboi.



Map of volcanic rifts of Japan with Tokyo (T) and Fujiyama (F). The rift extending southeast underlies from north to south Asama, Hakone, Oshima, and Minami-Iwo-shima. The rift at the left underlies Sakurajima and Aso-san. The rift at the extreme northeast underlies Usu, Tarumai, Tokachi, and Shiretoko. Shirane and Bandaisan are over the rift north of Tokoyo. After Omori.

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The Volcano Letter

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No. 324—Weekly Hawaiian Volcano Observatory, National Park, Hawaii March 12, 1931

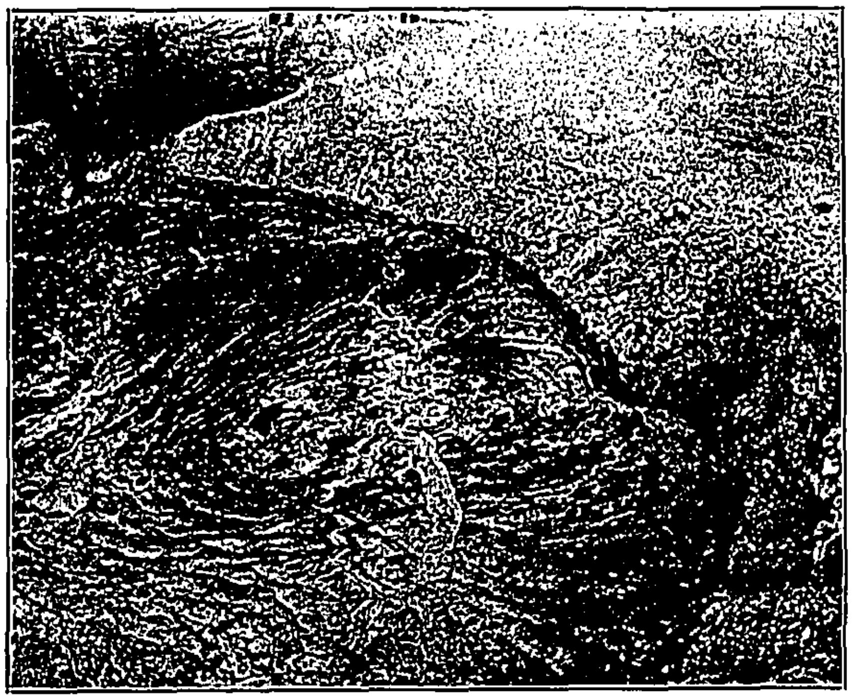
Looking down into the pit about noon on the day of the great subsidence of June 5, 1916. The east bench had collapsed, and a small island was shown to have a large extension of its mass under the lake which toppled over sideways as the lake sank. This is shown on the left. Bench cracking on the right.

WHEN THE PIT LAVA SINKS

In another number of the Volcano Letter (No. 291) the flooding action of boiling slag rising into Halemaumau pit was reviewed. Gas effervescence was shown to be the impelling agent. The question was asked, "Is the sinking of lava a reversal of the process that makes it rise?" The rising process is dependent on expansion and combustion of gases in the slag, a foaming up along with extra heating. It was shown that the foaming depends on release of pressure that otherwise confines gas in solution. Deep pressure is maintained by the weight of the accumulated mountains of lava, and these in turn are supported by blocks of the crust of the earth believed to rest on a substratum of basalt. Release of pressure is attained by periodic or occasional yielding of fault blocks of the mountain, or yielding of the crust blocks of the globe. The mountain is a strained heap of lava we call a volcano. The straining of the crust of the earth is complicated with the trigger-pulling forces of the tides, the atmosphere, and of the sun, moon, and earth.

When the lava subsides in Halemaumau pit, there are several explanations, and they may all apply at different times. If the slag loses its gas the remaining glass shrinks, and if the glass crystallizes underground, it shrinks still more. It changes from a foam to a rock. If a flank of the mountain opens a deep crevasse, or a fault block thousands of feet deep slips a little toward the sea, the lava which has been standing in the pit may drain away into an underground fissure. If a crust block of the earth hundreds of miles long and 30 miles deep moves ever so slightly by some tidal breathing of the globe, with its equatorial protuberance, its northing and southing of the sun, its fluctuations of the moon, its approach and recession to the sun in its orbit, and with the possible but unsolved mysterious relations of sunspot periods to magnetism and gravitation, it is likely that an increased pressure on the substratum would quickly show itself by a lessening of gas at the relatively tiny lava column represented by the pit.

The loss of gas and reestablishment of deep pressure to make the lava column recede should be gradual. The opening of the mountain to drain the lava into a crack, or through a fissure out to a submarine lava flow should be rapid. The diminution of gas, followed at other times by its increase, owing to astronomical controls, should be periodic and rythmical. The actual movements of the lava column when it subsides have suggested all three of these processes at different times; in 1912 there were striking quarter-yearly changes from high to low as though equinox and solstice were in control. Again and again a period of about three weeks has been observed from one sinking spell to the next. Earthquake frequency has shown a similar periodicity. From 1914 to 1917 during general rising of the lava there was a systematic series of risings and fallings with each complete wave about eight months long, each rising higher than the one before, and each sudden sinking lower than the one before. There were similar movements punctuated by sudden sinkings between 1917 and 1924. And in 1919 a critical investigation gave evidence of a daily tide in the lava.



New pool of lava in the bottom of Halemaumau November 30, 1919, after subsidence, looking southeast. The lake was rising very rapidly and the talus at the right turned out to be a ring crag of the bench magma which has subsided November 28, developing within two weeks into the ring island (Volcano Letter No. 282).

The sudden sinkings are accompanied by marked increase in numbers of local earthquakes. Four specially conspicuous ones were in 1916, 1919, 1922, and 1924. The first two were immediately after a lava flow from Mauna Loa, as though the sinking back of the lava in that volcano tended to drain Kilauea. The last two accompanied times when Kilauea itself tended to make lava flows, in 1922 a visible outpouring at the chain of craters, in 1924 a probable outpouring under the sea to the east. We may conclude that sudden subsidences justify the suspicion that the mountain mass has opened somewhere and created a true hydrostatic drainage of the lava. The seismical proof of this is illuminating. Earthquakes are few during the rising. They come in swarms during the sinking and in 1916 they showed Mauna Loa distances on the seismograms in May, and much shorter distances as though Kilauea Mountain were breaking on June 5.

On May 21 and thereafter, 1916, lava flows broke out on the southwest rift of Mauna Loa preceded by an explosion of gas and foamy lava high up the mountain May 19. The flows ceased about June 1. Kilauea lava had been rising vigorously for three months until May 25, when it was 265 feet below the rim of the pit. It then turned and lowered a little, and fluctuated until June 5. There was a ring-shaped lake with two islands within a black ledge of overflow. On June 5 the lake started to lower along with the islands, red-hot falls of bench matter from the black ledge crumbled and flowed into taluses around the receding pool of liquid, and finally terrific avalanches of old wall material made purple, white, brown, and black cauliflowers of dust that boiled up from the funnel below. The depression of the lake was 302 feet June 4, 340 feet 8:30 a. m., 380 feet 10:30 a. m., 540 feet 3 p. m., June 5, and 673 feet at noon June 6. There were occasional perceptible earthquakes, but a remarkable feature of the whole cataclysm was the rigidity of the upper walls.

In October 1919 Mauna Loa gave vent to the Alika flow southwest. Some time in November the flowing stopped. On November 28 a sudden, quiet drop of the Kilauea lava column took place amounting to at least 600 feet in a single morning. The subsidence was accompanied by almost continuous light local quaking of the ground, again with distances of origin shown on the seismograms much shorter than those which had indicated a distance of 35 miles or more for the earthquakes of Mauna Loa a month previously. It was as though the sinking back under Mauna Loa had brought the full force of the lava column to bear upon splitting open Kilauea, and then after filling the split by drainage, the lava column began to rise under Kilauea. The same thing had happened in 1916, for a very rapid Kilauea rise had followed the June subsidence. Now in December 1919 the rising in Halemaumau amounted to 30 feet a day after the drop of 600 feet mentioned above. This continued until in mid-December the rising wedge split the mountain clear to the surface, and the Kau Desert flow of Kilauea built up the slag heap Mauna Iki.

The 1922 subsidence in Halemaumau was so exactly parallel in its happenings to these two subsidences which had accompanied the termination of Mauna Loa eruptions, and the occasion of the subsidence was so clearly a Kilauea outflow accompanying a splitting open of the deep mountain mass, as to contstitute a proof that the connection between Mauna Lóa and Kilauea need no longer be doubted. With each flow from Mauna Loa, the Halemaumau subsidence followed; with each flow from Kilauea, the Halemaumau subsidence preceded.

The liquid lava May 13, 1922, was less than 50 feet below the rim of Halemaumau. By May 21 the lake level had dropped 300 feet with a steady but majestic sinking carrying down peaked crags, lava lakes, and adjacent floors. Avalanches from crags and walls were numerous. Swarms of earthquakes were registered by the seismographs. On May 26 began spells of general caving in of the pit wall, sending up cauliflower clouds of brown and salmon color, and making a thunderous roar. This continued for two days, and the pit was greatly enlarged. A swaying earthquake about 8 p. m. May 28 heralded the appearance of bright glow over Makaopuhi Crater nine miles away in Puna. A crack in the side of this pit, on the Chain of Craters rift line leading from Kilauea, was vomiting up the lava stolen from Halemaumau by the splitting open of the mountain along the rift. Cascades poured from the top of the talus in Makaopuhi and made a pool in the bottom. This flowing dwindled, but a new eruption broke out in Napau Crater farther east and in the upland beyond for two days, showing that the rift was splitting open eastward.

This underground wound healed, the lava rose in Halemaumau, and again it lowered suddenly and split the eastern rift with outflow in the forest near Makaopuhi in August 1923. Then the rift healed again and by January 1924 an enormous lake of liquid lava filled Halemaumau pit, now 2,000 feet across, to within 121 feet of the rim. Here were pulsations year by year, of this wedging agent, the basalt of the crustal substratum, welling up into the pit, and then splitting open the eastern rift, after the work for the cycle was finished in building at the higher rifts of Kahuku on Mauna Loa, and of the Kau Desert on Kilauea. The final splitting open of the eastern rift was exhibited by cracks in the ground and swarms of earthquakes at Kapoho on the extreme eastern point of the island in April 1924, after the lava in Halemaumau had sunk more than 300 feet.

Then came the grand crash of lava subsidence and engulfment of the walls of Halemaumau in May of 1924, with every episode closely parallel to what had happened in 1922 and 1923 except that the outflowing lava on the rift did not appear above sea level. There could be no question but that it did flow out a few miles beyond the east point of the island under the deep cold water of the Pacific. Each incident of breakage of the island mass 1919, 1920, 1922, 1923, and April 1924 had been farther downhill, and eastward from Mauna Loa to the sea. The swarms of earthquakes and their distances on the seismograms plainly told the story of the splitting open of the eastern rift in the depths of the mountain mass. There was added the episode of steam explosion, (the great cataclysm of 1924), then the lava rose and appeared 1300 feet down Halemaumau in July 1924, and the system entered into repose.

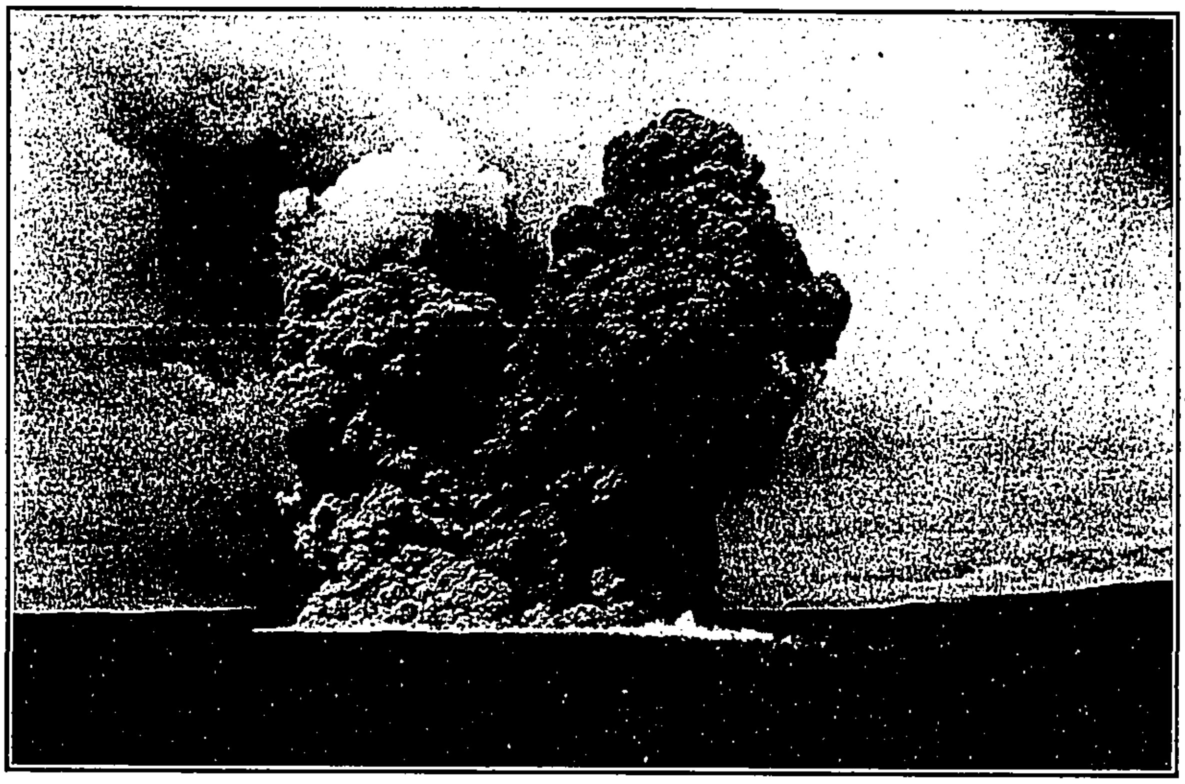
T.A.J.

TILTING OF THE GROUND FOR FEBRUARY

The following figures show the net amount of tilt by weeks at the Observatory on the northeast rim of Kilauea Crater, and its direction, computed from the daily seismograms by platting a curve smoothed by overlapping progressive seven-day averages. This is the departure of the plumbline in the direction given.

February 2-8	0.36 second	ESE
February 9-15	1.21 seconds	WNW
Feburary 16-22	1.31 seconds	SSW
February 23-March 1	1.74 seconds	SSW

The left-hand cut shows southwest wall of Halemaumau May 25, 1922, when the great subsidence had revealed a tunnel on the Kau Desert rift line through which the lava had flowed in 1920. The right-hand picture is the bottom of Halemaumau July 17, 1922, when the lava returned through a cup at the top of the talus slope pooling in the bottom. Photos Jaggar.



Halemaumau from Volcano House, 8:15 a. m. May 22, 1924, showing cauliflower cloud of one of the paroxysms of explosion and engulfment with bowlders bombarding the Kilauea floor. Photo Tai Sing Loo.

KILAUEA REPORT No. 998

WEEK ENDING MARCH 8, 1931

Section of Volcanology, U. S. Geological Survey

T. A. Jaggar, Volcanologist in Charge

Very slight fuming continues in the bottom of Halemaumau. New debris material was seen at the southeast edge of the floor on March 2, and on the 7th rocks were heard falling from the north rim. The pit is otherwise quiet.

A total of 19 seismic disturbances were recorded on the instruments of the Observatory during the week, as follows: 16 short tremors; 2 very feeble seisms, one at 9:04 a. m. March 7 originating 32 miles from the station; 1 slight shock at 6:53 a. m. March 8, 30 miles distant, felt in Hilo.

Tilt for the week accumulated slight NW. Microseismic motion was slight.

THE VOLCANO LETTER

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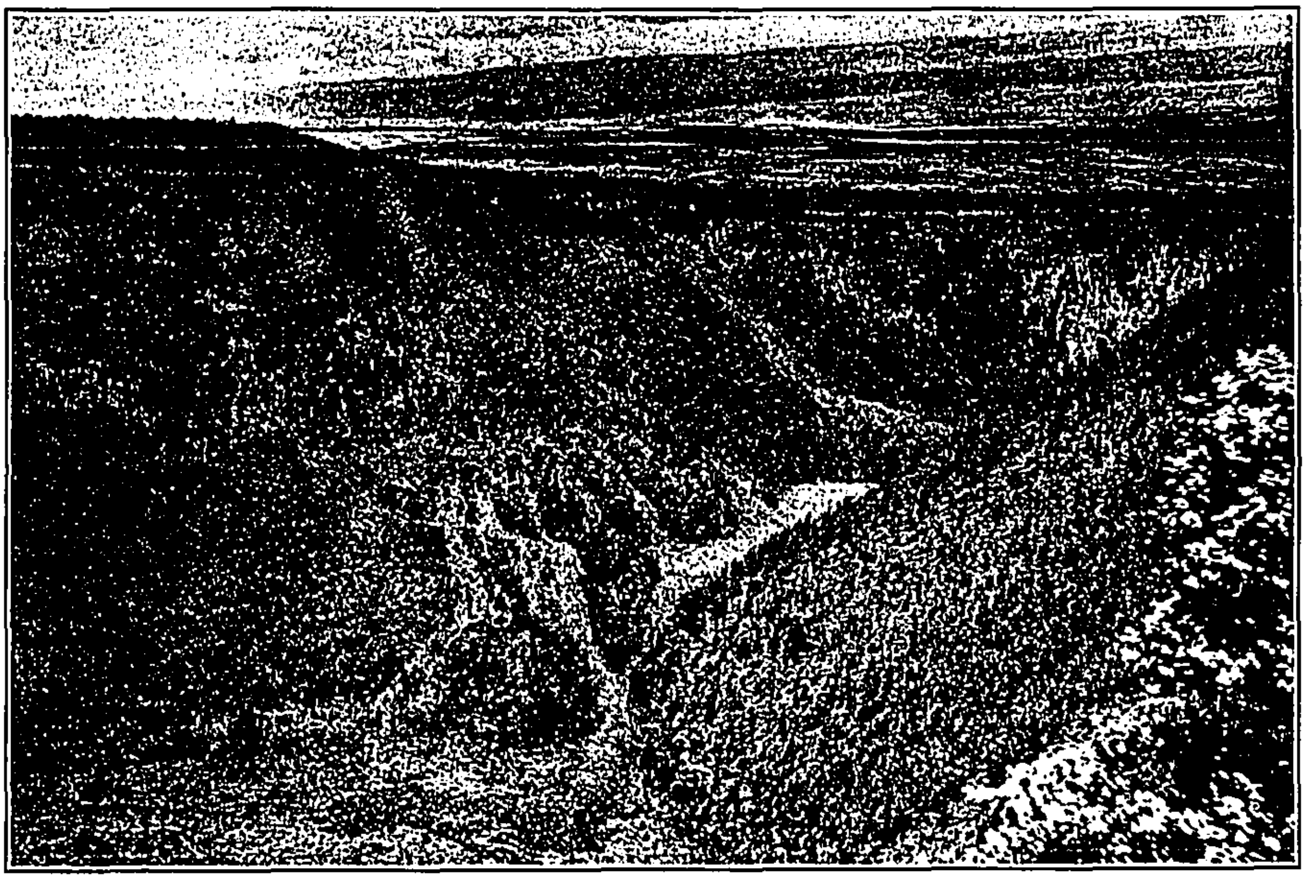
The Volcano Letter

Two dollars per year Ten cents per copy

No. 325—Weekly Hawaiian Volcano Observatory, National Park, Hawaii March 19, 1931



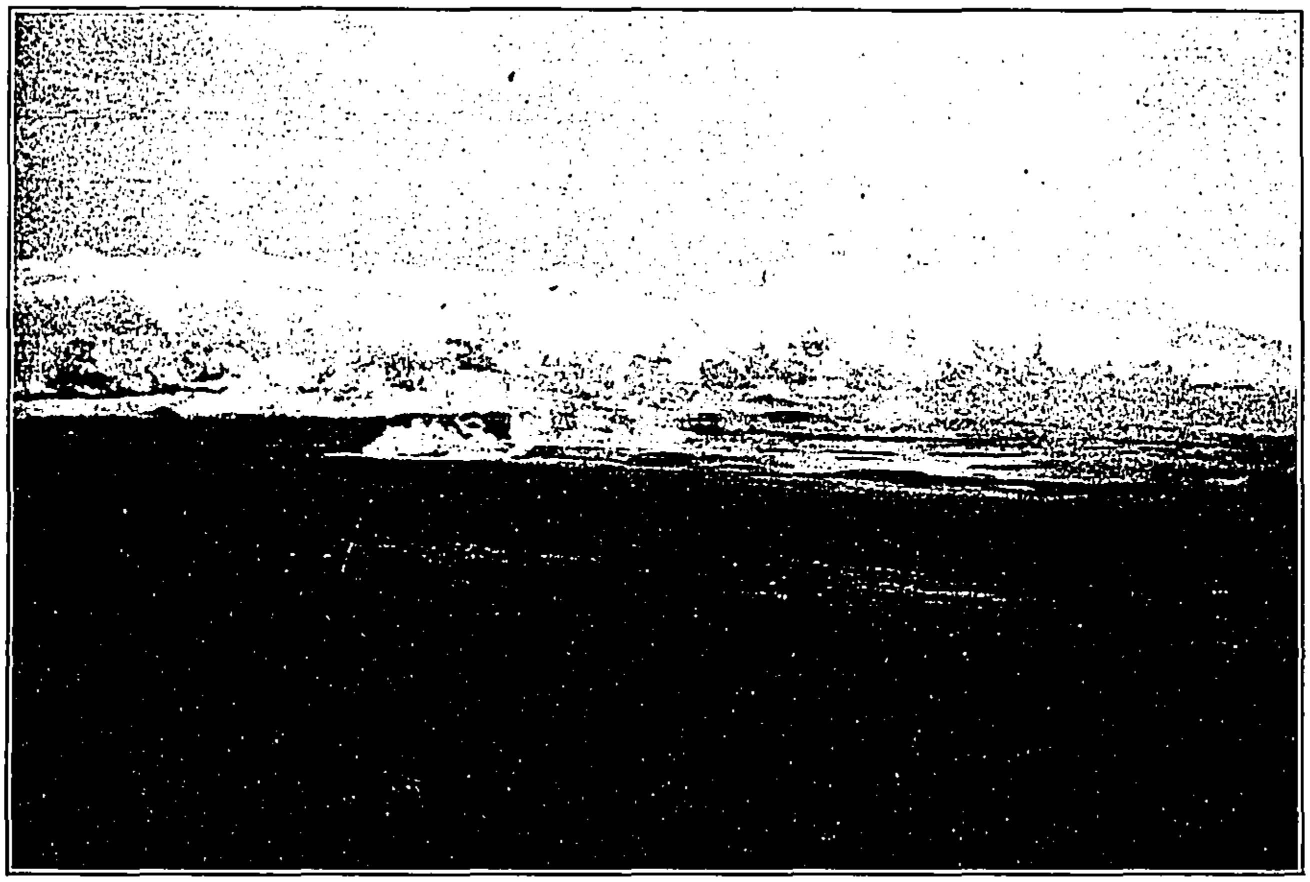
Looking across Kilauea Iki and Kilauea craters. The 1832 flow broke out on the ledge between the two. The 1868 flow made the frozen cascades shown. Photo Wilson.

THE HAWAIIAN VOLCANIC CYCLE

The summary of 20 years of Hawaiian eruptions in Volcano Letters Nos. 319 and 320, and the account last week (Volcano Letter No. 324) of the somewhat systematic repeated sinkings of the lava in Halemaumau pit from 1916 to 1924, naturally suggest to the reader the inquiry, "What can be made out of the sequence to suggest a definite cycle of accumulation and release of lava gas?"

William Lowthian Green (Vestiges of the Molten Globe, Honolulu, 1887), and more recently Wood (On Cyclical Variations in Eruption at Kilauea, Second Report of the Hawaiian Volcano Observatory, Cambridge, Mass., 1917), have commented on possible periodicities of 7 years, 9 years, 18.6 years, 65 years, and 130 years, and Wood has also suggested a semi-annual variation, or a possible variation during a term of about 14 months. Astronomical causes have been suggested. The possibility of a 9-year period, or roughly a decade, involving both Mauna Loa and Kilauea, became more and more plain after the Hawaiian Volcano Observatory was founded. The history of a century and a quarter from the end of the 18th century to 1925 strongly suggested a long term between explosive eruptions, here recorded about 1790 and in 1924, and a maximum volume of lava flowing (1855) in the middle of the term.

When we talk about cycles it is well to have a definite idea of what we mean. What was said in Volcano Letter No. 324 of the weight of the mountain bearing on one body of lava, of the weight of crust blocks of the earth bearing on a substratum of lava, and of the globe as a whole warping under the pull of the sun and moon, involves at least three possible units of volume to heave and sink, to be compressed and be released, and so to produce three different orders of magnitude of eruptive cycles at the same group of vents. It is thus entirely possible at the Hawaiian volcanic system, involving both Mauna Loa and Kilauea, to have a shorter cycle of puffs of the engine, so to speak, about 11 years long; and this superimposed upon a much longer cycle about 132 years long, at the end of which the engine opens its safety valve and produces a prolonged steam blast. Just this, to put the matter in round numbers, is the theory of cycles on which we are working at present, and if it is true, then the 12 episodes of 11 years each from 1792 to 1924 should approximately cover twelve similar eruptive periods of Mauna Loa and



Looking down on Kilauea, with Halemaumau smoking from 7000 feet elevation on Mauna Loa. Photo. Wood.

Kilauea combined. And if the 132-year cycle is itself made up of prolonged accumulation and release, then its first half for 66 years might well be expected to show increasing lava flow with perhaps some logical geographical sequence from Kilauea to Mauna Loa, and its last half should show decreasing lava flow with a progress to lower levels from the top of Mauna Loa downward past Kilauea to the east. It is also conceivable that the quarter period of 33 years may have some significance, for it happens that 1823, 1855, and 1894 produced extraordinary crises of eruption, the first and last on Kilauea, and the middle one on Mauna Loa.

Now let us examine the individual eleven-year cycles:

For the cycle 1781-1792 we know only that a lava flow in Puna east of Kilauea is reported for 1788, and that a major steam-blast eruption killing natives occurred at Kilauea about 1789-90, marking the end of one of our assumed supercycles approximately 132 years long. We thus begin a new supercycle.

The cycle 1792-1803 (end of each year named) involves report of a Puna lava flow 1793, and the very exceptional events which occurred on the west side of the island, lava flows from Hualalai Volcano in 1800 and 1801, the former at Huehue and the latter at Kaupulehu.

The cycle 1803-1814 we know nothing about, except that mariners reported fume continuing at Hualalai, and it is even said that fume was seen near Molokini west of Haleakala. Kilauea was presumably piling lava into its crater.

The cycle 1814-1825 was certainly a time of construction by lava up-building in Kilauea Crater, for the early missionaries after 1823 found a black ledge around the crater not covered with the debris of 1790. Therefore this was post-1790 lava. The year 1923 produced a tremendous breakdown in Kilauea, with the Keaiwa flow into the ocean below Pahala and low crater levels for two years thereafter.

The cycle 1825-1836 was a time of great activity and rising in Kilauea, a remarkable eruption on Byron's Ledge with lava flowing into Kilauea Iki and over the cliff into Kilauea Crater in 1832, a flow for three weeks on the top of Mauna Loa the same year, and a Halemaumau breakdown followed by recovery. Here is our first mention of Mauna Loa since 1790, and it will be seen that for 40 years the outpouring of lava had been from low levels in Kilauea and Hualalai.

The cycle 1836-1847 begins with Kilauea dull and unmentioned, then follows a rising to "terrific" effervescence there in 1840 and a breakdown with outflow far to the east in Puna, the lava reaching the sea at Nanawale. Kilauea pit recovered but slightly when Mauna Loa again took part, making a big northern flow piling a huge volume of lava in the saddle between Mauna Loa and Mauna Kea.

The cycle 1847-1858 involves the most tremendous flooding of lava which occurred in the nineteenth century. There were over 400 days of lava flow from Mauna Loa between 1851 and 1855. This was led up to by a dome forming over Halemaumau 1848, fluctuations of Kilauea activity until 1854, excessive flooding of Kilauea Crater in 1855, and lowering thereafter. Mauna Loa had outbreaks in 1849, 1851, 1852, and 1855, the last flowing for 13 months toward Hilo.

The cycle 1858-1869 is the beginning of the decline, showing 307 days of flowing lava, but is still characterized by enormous flooding from Mauna Loa. Kilauea was quiet, but Mauna Loa in 1859 made a big flow for seven months into the ocean in North Kona. Then Kilauea revived, the lava in Halemaumau rose and overflowed, the summit crater of Mauna Loa broke out for four months 1865-66, and in 1868 came a startling crisis with flows into Kilauea Iki, a world-shaking earthquake, a big breakdown of the

Kilauea floor, and outflows for the first time from the southwest flank of Mauna Loa, with a small outflow southwest from Kilauea. These events were accompanied by landslips, tidal waves, and shore lowering.

The cycle 1869-1880 was distinguished by great flooding of Mokuaweoweo, the summit crater of Mauna Loa, at the very top of the volcanic system. Kilauea recovered to low levels, then Mokuaweoweo was reported active in 1871, 1872, 1873, 1874, 1875, and 1876. Kilauea came to an overflowing with great activity in 1874, broke down and recovered in 1875, fluctuated and erupted at the small pit Keanakakoi in 1877. In that year Mauna Loa produced a submarine eruption in Kealakekua Bay on the west side of Hawaii. Then Kilauea built up crags and lakes and overflows with a collapse in 1879 followed by recovery.

The cycle 1880-1891 like the preceding produced more than 200 days of lava flowing, with Kilauea hard at work building up its floor until 1886, when it reached a crisis of breakdown. Mauna Loa in 1880-1881 produced the great flow that almost destroyed Hilo. Again in 1887 Mauna Loa had a short-lived but voluminous southern flow, Kilauea recovered and reached a breakdown in 1891.

The cycle 1891-1902 was distinguished by a great decline in numbers of flow days (only 37), yet there was activity in Mokuaweoweo in 1892 and 1896 and a northern flow from Mauna Loa in 1899. Kilauea increased its crateral activity to immense floods in 1894, when it broke down completely and remained dormant or very dull for 13 years. There is good reason to think that Kilauea had an outflow under the ocean.

The cycle 1902-1913 was marked by summit crater activity of Mauna Loa in 1903 and a flow to the southwest in 1907, only 28 flow days in all. Kilauea revived in 1905, reached very high effervescence in 1910 and 1912, and then lowered to a dormant year.

The last cycle 1913-1924 had somewhat higher flow duration, 71 days, and was the concluding cycle of the supercycle that led to the Kilauea explosive eruption of 1924. The lava pressure was marked by a steady climb of the lava in Kilauea fire pit from 1914 to 1919, and a pulsating subsidence with outflow from 1919 to 1924. Meanwhile Mauna Loa was active on the summit in 1914, and on the southwest flank with increasing floods in 1916 and 1919, but all small as compared with 1855. Kilauea exhibited increasing breakdowns until the grand crisis of 1924 when the east point of the island sank, Halemaumau exploded and probably there was submarine outflow. T.A.J.

KILAUEA REPORT No. 999

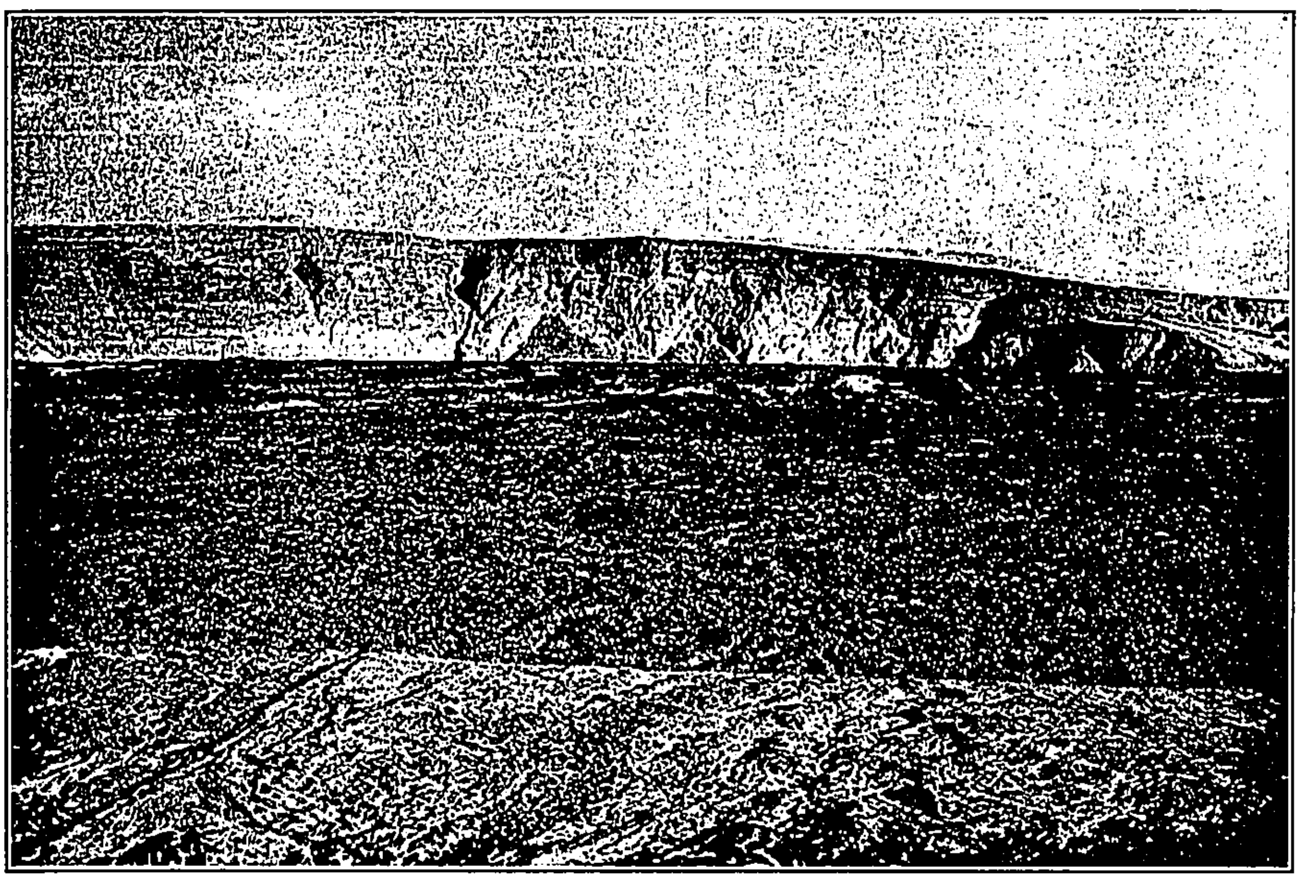
WEEK ENDING MARCH 15, 1931

Section of Volcanology, U. S. Geological Survey

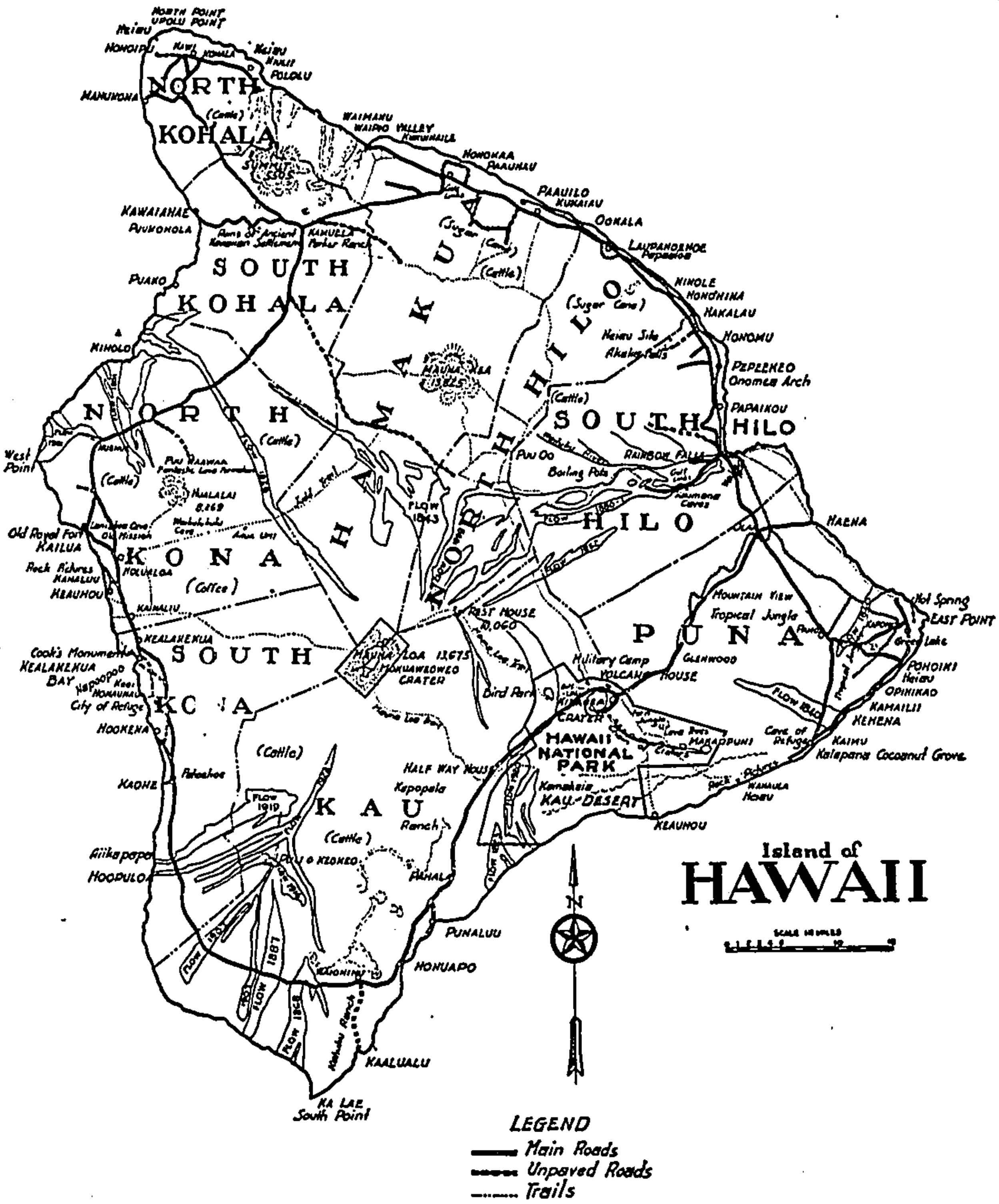
T. A. Jaggar, Volcanologist in Charge

The only noteworthy features of Halemaumau pit in Kilauea Crater which suggest any change are sulphur spots north and west of the cone that was left standing on the lava floor of 1930. These spots on March 12 were observed to be fuming steadily. A small slide was observed at the southwest. The seismograph at Halemaumau indicated rather rapid tilting of the ground away from the pit between February 28 and March 3, and a gradual accumulation of tilt away from the pit at other times.

The Observatory seismographs registered 34 tremors during the week and 3 very feeble local seisms, one of these at 4:43 a. m. March 14 being accompanied with tilt to the southeast. Tilting of the ground was otherwise moderate SSW, and microseismic motion was very slight. The fluctuation of tilting within a few days was strongly marked during the first half of March.



West wall and floor of Mokuaweoweo, the summit crater of Mauna Loa. Photographed 1915 by Wood.



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The Volcano Letter

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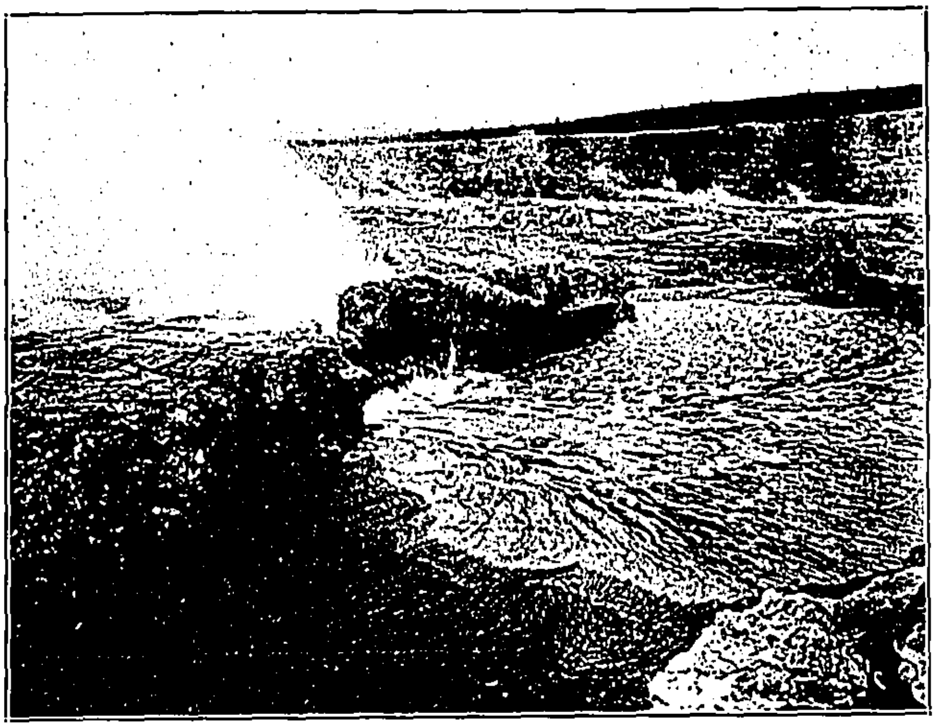


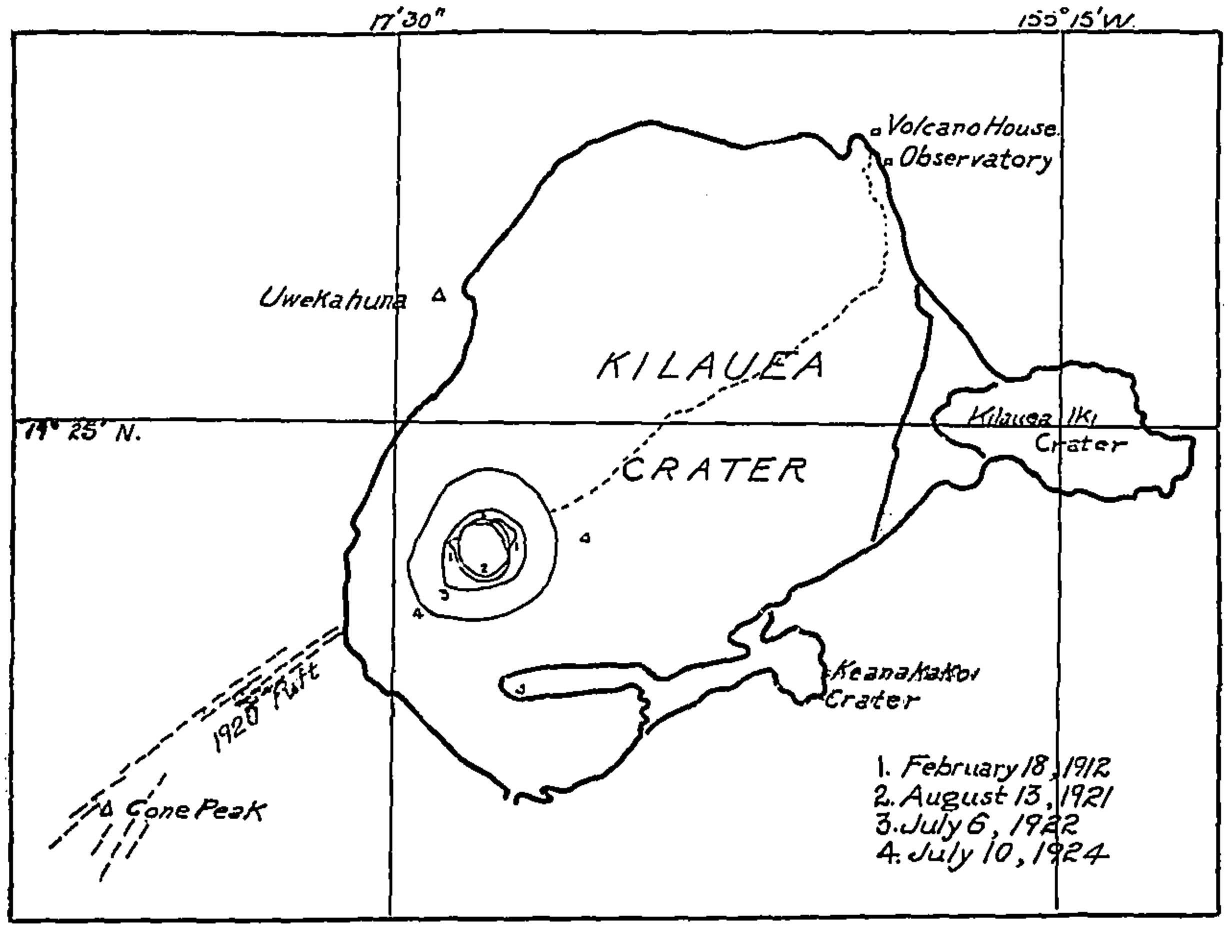
A high level in the cycle. Looking northwest across Halemaumau January 23, 1921, showing the rush of surface currents of bubbling lava into a grotto. Shows the fuming surface of the half solidified lava column, and in the background the Halemaumau wall and the Kilauea wall. Photo Jaggar.

VOLCANIC CYCLES AND SUNSPOTS

In the Volcano Letter Nos. 172 and 302, some notes are presented concerning a general similarity between curves of frequency of sunspots and of frequency of volcanic eruptions. Students of this subject who have taken the volcanic eruptions of the whole earth have published contradictory results, some finding more eruptions and some finding less eruptions for the time of sunspot maxima. Sapper found that gigantic volcanic explosions sometimes correspond with either high or low numbers of sunspots, but his curve shows a number of good correspondences between eruption frequency maxima and sunspot minima. For the period between 1790 and 1825, when sunspots were notably infrequent, volcanic eruptions were unusually inconspicuous.

Confusion in attempting to compare statistics is bound to result if such a word as "eruption" remains undefined. To take the great lava-flooding cycle of Kilauea 1913-1924 as an example, the peak of the lava pressure was 1919 when both Mauna Loa and Kilauea were vomiting floods of slag. This was also a time near sunspot maximum of frequency. To the layman, however, or to the ordinary geological traveler, the crisis of "eruption" was 1924 when Kilauea made tremendous steam explosions. And this was the time of sunspot minima. Which was the "eruption" of the decade for the statistician of the textbooks?

This leads us to examine critically the list of eleven-year cycles for Hawaii cited in last week's Volcano Letter, and to ask, "What are the distinguishing features of a cycle?" Probably Mercalli in his Italian book on "Active Volcanoes," and with his many years of experience as an observer of Vesuvius, hit the nail on the head when he said that the most distinctive feature of a volcanic cycle is the short repose period at its end. And this repose is often initiated by explosion, so as to be called "eruption" popularly. It is only on volcanoes such as Vesuvius and Kilauea, where the magma is visible most of the time, that these repose periods become striking. It is only when we can see the repose period in contrast to a high pressure period that has preceded, that we recognize its existence. If the high pressure has asserted itself by intrusion under a dormant volcano, seemingly always in repose except for a sudden explosion which goes unexplained, nobody will know about it. There may be a tide of flux and flow in the underground magma which has lifted the mountain and let it down again, but nobody has measured it. The sudden explosion may be the let down, as it certainly was at Kilauea in 1924. It is clear that even for the well recorded



Map showing successive outlines of Halemaumau pit in the southwest part of Kilauea Crater during a cycle. (1) Pit of 1912 with niches northeast and west. (2) Smaller pit of 1921 after nine years of building up. (3) Larger pit of 1922 after the first big collapse. (4) Very large pit of 1924 after steam-blast eruption and breakdown.

century of Hawaiian events, the only cycles that will bear intimate analysis are the recent ones where the descriptions are full.

The first reason for adopting eleven years is that this figure exactly fits the carefully observed cycle between two times of complete repose in 1913 and 1924 at Kilauea. The second reason for approving eleven years is by trial and error; if we apply nine, ten, twelve, or thirteen years as possible cycles for the events between 1790, the last great explosive eruption, and 1924, the newest one, none fits so well the division based on recorded repose periods as the number eleven. The third reason for approving eleven years as a cycle is that if we divide the 134 years from 1790 to 1924 into twelve cycles, we get 11.1 years as the average for each cycle, and each group of about three cycles leads to an unusually big crisis of lava breakdown or subsidence. And a reason for taking an interest in the sunspot analogy is that 11.1 years have been found by astronomers to stand for the average interval between sunspot maxima.

If we take the cycles at Kilauea and Mauna Loa immediately preceding the 1913-1924 period, we find 1902-1913 beginning and ending with complete repose, exhibiting Mauna Loa lava first in the summit crater and four years later pouring out of the south flank, and Kilauea lava rising to repeated maxima with effervescence and then sinking away. We find 1891-1902 beginning and ending with complete repose, exhibiting Mauna Loa lava twice in the summit crater and finally pouring out of the north flank, and Kilauea lava rising to a tremendous maximum so as to break the mountain and drain off. We find 1880-1891 following a repose in 1879 and leading to one at the end, exhibiting Mauna Loa lava twice in the summit crater and then pouring out of both the north and the south flanks in discharges six years apart; Kilauea builds up its floor with one of the greatest pressures of its history and then executes a series of breakdowns. These histories accord with the eleven-year cycle as a time of stress followed by a time of release, and with the conception that this cycle commonly involves both Mauna Loa and Kilauea as outlets for the same lava column. The details of sequence vary to such extent as the breakage of the island varies in yielding to the internal stress. The remarkable feature of these histories is that in spite of the incompleteness of the observations, there is such striking accord in showing two repose periods separated by an intervening high pressure period for both Mauna Loa and Kilauea.

Now when it comes to sunspots, let us keep in mind Mercalli's principle that the breakdown, whether it be explosive and conspicuous or not, begins a repose period, and the short repose or low period is the important punctuation mark in the cycle. The following two tables serve to compare low level quiet times in Hawaii with years of minimum numbers of sunspots:

Low Levels Hawaiian Lava	Sunspot Minima
1924 End of supercycle	1924
1913 Quiet year	1913
1902 Quiet year	1901
1891 Kilauea breakdown preceding great drainage of 1894	1889
1880 Follows Kilauea breakdown, starts Mauna Loa floods	1878
1869 Follows big breakdown both mountains	1867
1858 Quiet year following greatest lava floods of history	1856

1847	Quiet year	1843
1836	No mention in records, therefore quiet	1833
1825	Quiet year after great drainage of Kilauea 1823	1822
1814	Unknown	1810
1803	Quiet time following Hualalai outflows	1797
1792	Repose following supercycles crisis of 1790	Declining Sunspots

In these tables the Kilauea years are at arbitrary regular eleven-year intervals beginning at 1924 and going backward, and it will be seen that for this century the intervals between sunspot minima where notably longer than eleven years. In most cases if the actual years given in the sunspot column had been taken for the Hawaiian low levels, they would have been as near to the lava breakdowns as the years given in the Hawaiian column, but some of them would have preceded the breakdown instead of following it. If the observational data for Hawaii in the early years were as good as in the later ones, the bends of the Hawaiian curve might match many of the sunspotless years more perfectly. But the volcano record is very imperfect. What this shows is that the repose periods are remarkably systematic.

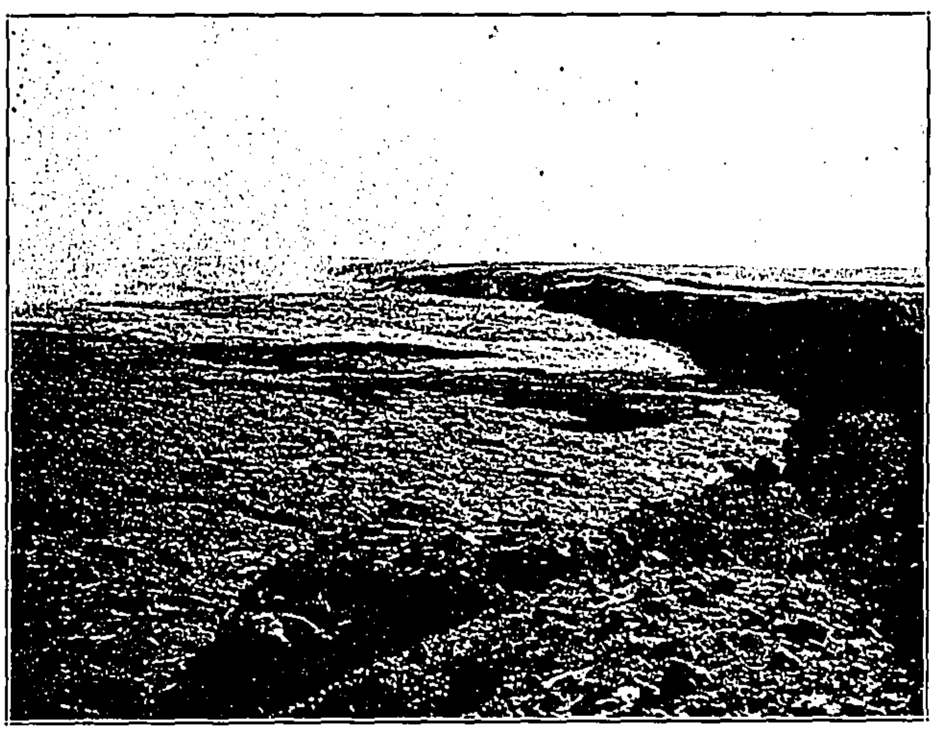
When it comes to the sunspot maxima, we find them in the midst of the Hawaiian periods of lava pressure, when within a cycle both Mauna Loa and Kilauea were flooding:

High Pressure Hawaiian Lava		Sunspot Maxima
1917-20	Kilauea and Mauna Loa flooding	1918
1903-07	Two flows Mauna Loa and Kilauea rising	1905
1892-99	Three flows Mauna Loa, Kilauea 1894 maximum	1893
1881-87	Kilauea and Mauna Loa big floods	1884
1869-77	Kilauea rising, continuous summit eruption Mauna Loa	1870
1859-68	Three flows Mauna Loa, Kilauea rising, overflowing	1859
1851-55	Mauna Loa maximum, Kilauea maximum	1848
1836-47	Kilauea flood 1840, Mauna Loa flood 1843	1837
1825-36	Kilauea and Mauna Loa floods 1832	1828
1814-25	Kilauea flood 1823, Mauna Loa unknown	1816
1803-14	Unkown, but Hualalai floods 1800-01	1804
1788-93	Probable Kilauea floods preceding 1790 explosions, and two flows reported in Puna	1787

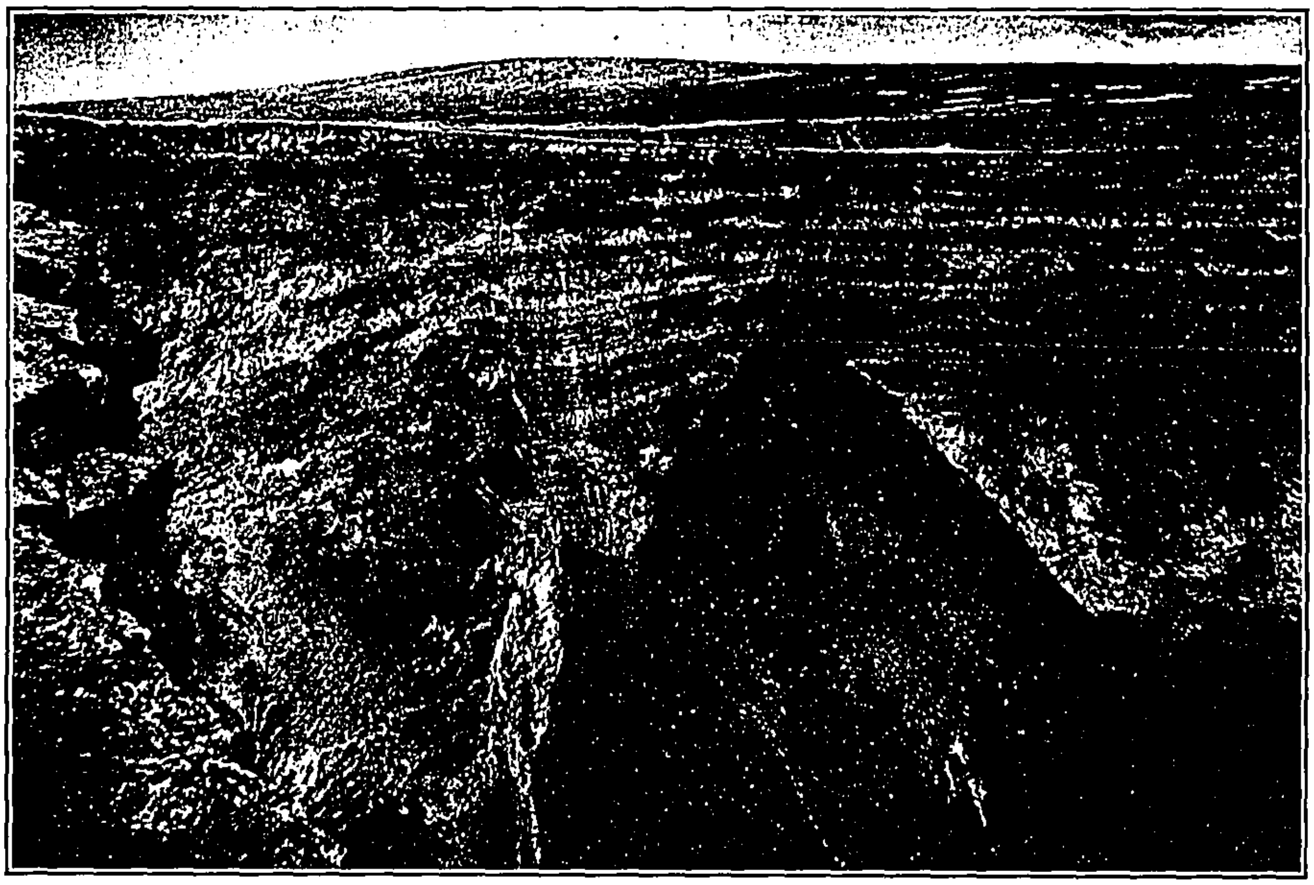
The sunspot maximum exhibited a very long interval between 1787 and 1804, and this was a turning point from high numbers to low numbers of sunspots for the maximum years. It was also the turning point at Kilauea for the supercycle that ended with the explosive eruption of 1790.

Referring to the low numbers of sunspots for some sunspot cycles and high numbers for others, the Humphreys curve (Sapper, Vulkankunde, page 272) shows low values 1790-1820, increasing values 1820-30, very high values 1830-80, declining vaules 1880-1920. The Hawaiian number of flow days roughly figured from existing descriptions was very few 1790-1820, about seven 1820-30, 132 1832-43, 411 1852-55, and then for six eruptive periods from 1859 to 1923 the figures 307, 207, 247, 37, 28, and 71. In other words the flooding of lava in Hawaii to the high maximum in the middle of the supercycle about the year 1855 corresponded to the higher maxima of sunspots in the nineteenth century.

If the reader asks why sunspots should have anything to do with volcanoes, the answer is that nobody knows. Times of maximum sunspots affect radio reception on the earth, magnetism on the earth, and auroras in the arctic regions. Sunspots are accompanied by gigantic eruptions of gas on the sun and colossal electrical phenomena in the solar system. If earth magnetism and electricity are in some way associated with gravity, volcanism may be affected. If heat by the earth's radio-activity affects volcanism, the sun may in turn affect the earth's radiations. Finally, if volcanic emanations on the earth are a last remnant of solar processes here, those processes by unknown means may be sympathetic with the sun. T.A.J.



Looking toward Kau Desert from high bluff west of Kilauea Crater January 3, 1921, when the white glistening flows from Halemaumau were filling the southwest corner of the crater. A maximum of flooding. Photo Jaggar.



Looking west across the vast void of Halemaumau in 1928, after the breakdown of 1924 was complete, showing the distant wall of Kilauea Crater beyond the Halemaumau wall, and still farther away the snake-like flow of 1881 on the smooth dome of Mauna Loa. Photo Wilson.

KILAUEA REPORT No. 1000

WEEK ENDING MARCH 22, 1931

Section of Volcanology, U. S. Geological Survey

T. A. Jaggar, Volcanologist in Charge

The pit Halemaumau Crater continues very quiet. A slide on the north wall was observed at 3:10 p. m. March 18. Fuming was observed at the two recently developed sulphurous spots on the north side of the 1930 floor the forenoon of March 19, and some rocks were heard falling on the north wall. The pit seismograph indicated two very small tremors about March 15.

The seismographs at the Kilauea Observatory registered a slight earthquake felt at Kilauea, at Hilo, and in Kona at 5:29 p. m. March 20, with indicated distance of origin 28 miles from the Observatory, and strong enough to dismantle the east-west stylus. Very feeble shocks were registered at 3:09 p. m. March 20 and 6:57 a. m. March 16, the last accompanied by tilt to the southeast. Twenty-two local tremors were registered. Weakly recorded distant earthquakes occurred at 10:47 p. m. March 17, at 9:56 a. m. March 18, this indicating a probable distance of origin of 800 miles; and at 8:08 p. m. March 18. Microseismic motion was slight with some increase March 19-20, and tilting of the ground was slight SW.

THE VOLCANO LETTER

The Volcano Letter combines the earlier weekly of that name, with the former monthly Bulletin of the Hawaiian Volcano Observatory. It is published weekly, on Thursdays, by the Hawaiian Volcano Research Association, on behalf of the section of Volcanology, U. S. Geological Survey. It promotes experimental recording of earth processes.

Readers are requested to send articles, photographs, publications and clippings about volcano and earthquake events, instruments and investigations, especially around the Pacific.

Subscription for non-members two dollars per year of 52 numbers. Address the Observatory.

HAWAIIAN VOLCANO OBSERVATORY
Founded 1911

This laboratory at Kilauea Volcano belongs to the Hawaiian Volcano Research Association and is leased and operated by the United States Geological Survey.

It maintains seismographs at three places near Kilauea Volcano, also at Hilo, and at Kealakekua in Kona District. It keeps a journal of Hawaiian volcanic activity and publishes occasional Bulletins.

Membership in the Hawaiian Volcano Research Association is limited to patrons of Pacific science who desire personally to aid in supporting the work.

The work of volcano research so supported is in collaboration with the work of the United States Geological Survey, but supplements it with buildings, research fellows, instrumental plants, explorations and special investigations for which there is no governmental provision. The Geological Survey maintains volcano stations in Alaska, California and Hawaii.

Persons desiring application blanks for membership ($5.00 or more) should address the Secretary, Hawaiian Volcano Research Association, 300 James Campbell Building, Honolulu, T. H.

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HAWAII NATIONAL PARK
HAWAII

OFFICE OF THE SUPERINTENDENT

March 7, 1931

The Director,
National Park Service,
Department of the Interior,
Washington, D. C.

Dear Mr. Director:-

Following is a report of activities and operations in Hawaii National Park for the month of February 1931.

000 GENERAL:
The long drouth which has been quite serious in some parts of the Island of Hawaii was broken by rains which fell at the latter part of the month. While these rains were not heavy enough to entirely relieve the situation, they were very helpful. However, some localities are still in need of rain to continue sugar cane harvesting and mill operation.

100 ADMINISTRATION:
110 Status of work.
All office work is up to date but considerable overtime has been necessary to keep it so. The work outside the office is also in good shape. All new construction projects for the fiscal year 1931 have been practically completed, and operations are now confined to administration, protection and maintenance operations, until our new appropriation becomes available.

120 Park inspections by.
121 The superintendent.
Early in February a trip was taken to Halina Pali over an auto trail which wends its way over lava flows for a distance of nine miles to the sea coast on the southern side of the park where a shelter was recently constructed. Two toilet buildings were put up here this month.

A trip was also taken by foot to Mauna Iki, where the lava is still so hot that a stick placed in a crack in the rocks immediately busts into flame. The trail is about three miles long from the automobile road and is an interesting trip but much more work should be done as soon as funds are available to improve it.

Inspections were made almost daily of the roads and trails in and around headquarters. Trips were made to Hilo, 30 miles distant about once a week in connection with park business. A complete inspection of the Army and Navy Camp was made with Captain Hedden, Commanding the Army Camp and Lieutenant Bonner, in charge of the Navy unit.

130 Finance and accounts.

Following is a list of the funds appropriated for work in the park with unexpended balances as of the close of February 29, 1932.

Appropriations	Allotted	Expended	Balance
40/1415 Hawaii Nat'l Park	34,623.00	22,534.68	12,088.32
4X436 Rds & Trails, Nat'l Parks	157,600.00	14,266.11	143,333.89
40/1406 F.P. & Fire Prevention	630.00	619.21	10.79

After careful study of the accounts, the allotment funds were all rearranged in accordance with a revised program of fund expenditures for the balance of the present fiscal year.

The cost account allotments are now receiving attention and recommendations for such changes as are necessary are being submitted during March.

140 Labor situation.

Hawaii being essentially an agricultural state, labor is kept busy on the big plantations throughout the year and there is not the same amount of unemployment here with all of its miseries and suffering, as on the mainland. At the same time, commercial organizations feel the effect of the worldwide economic situation and economize in every way possible. There is therefore some unemployment. Three laborers in the park laid off at the end of January were unable to secure work elsewhere, and were taken back on Government payrolls again during the current month to carry out new necessary work planned for.

150 Equipment and supplies.

The following equipment was delivered to the park during the month;

1 only	Simmons #416 Bed & spring, Ivory
1 only	" Beautyrest mattress.
1 only	#300 Ivory Chiffonier
1 only	#300 42" Ivory Dresser
1 only	#300 Ivory night table
1 only	#328 Amsterdam Ax. Rug 9 X 12
1 only	Bridge lamp, complete
1 only	Junior lamp, complete
1 only	End Table, Walnut finish
2 only	Rag rugs
1 set	#937 Overstuffed "Krahler" Parlor Suite, 3 pieces. (1 settee, & 2 chairs) color - taupe.

100 Status of alienated land.

Land Commissioner Bailey has advised that negotiations involving an exchange of land with the Bishop Estate so as to secure for the park certain essential areas containing the Thurston Lava Tube, are progressing, and he hopes to be able to report a satisfactory conclusion soon.

Dr. T. A Jaggar has made application to the Service to have the Hawaiian Volcano Research Association buy for official use of the Geological Survey for office use of an enlarged staff, the house located on leased Lot No. I Op - 24 within the park and now owned by (Miss.) Fusayo Takahashi.

The boundary lines of the park are not clearly marked and since being run, the tropical growth has been so heavy that it is impossible to follow the boundary in many places, or to recognize it. It is proposed to have these lines cleared out as labor is available from time to time.

160 Circulars, placards, publicity bulletins, etc.

Copies of the weekly issue of the "Volcano Letter" are attached. Also attached are copies of circular letters Nos. 1 and 2 establishing a system of general and special office orders for Hawaii National Park. Such a system of orders has been found useful in local administration of the parks elsewhere.

200 MAINTENANCE, IMPROVEMENTS AND NEW CONSTRUCTION:

The usual maintenance and repair of roads, trails, buildings, telephone lines, signs, etc was carried on during the month. A new grease rack for automobiles was built. Racks and shelves were built in the warehouse. Some painting was done. Ferns and trees growth was cut from roadsides and drainage ditches opened.

230 New construction.

The new gasoline and oil house was finished except for the laying of a concrete floor which was decided on after the building was erected. The old building was torn down and removed, the site cleaned up and some planting done. A picture of the building is attached to the back of this report.

300 ACTIVITIES OF OTHER AGENCIES IN THE PARK:

310 Public Service Contractors.

Contact was made with Mr. Stanley Kennedy, secretary of the Kilauea Volcano House Company Ltd., to induce him to make improvements in the hotel by providing running hot water in the rooms, heat in the rooms, better lighting, more toilets and baths, etc., but no commitments could be secured. He promised to see about the purchase of a heater for the dining room which now has no heat whatever and is cold at times, but nothing further has been heard from him. He agreed on a meeting between the park superintendent and the board of directors of his company some time in March to further discuss the situation. I fear a discussion is all that will result from the meeting unless the Park Service makes written demand for the improvements desired and enforces compliance.

I also wired Mr. Ralph J. Chandler, Vice President and General Manager of the Los Angeles Steamship Company, and Mr. J. H. Ryan, General Manager of Operations of the Matson Navigation Company while they were in Honolulu, urging them to visit the park before their return to the mainland. I had a short conference with Mr. Chandler in Hilo on the subject and he promised support in improving hotel accomodations. Mr. Ryan could not get over having been called back to San Francisco sooner than he expected. A letter outlining my views on the matter was sent to Mr. Ryan, Mr. Chandler, and Mr. Kennedy.

313 Schedule of rates.

The schedule of rates for the hotel service based on $9.00 per day, American plan, without bath, were approved for 1931. These are the same rates as previously approved. Approval for 1931 has been given, however, conditional on improvements being made in the hotel service.

330 Cooperating governmental agencies.

Dr. T. A. Jaggar, Volcanolist in charge of the United States Geological Survey work in the park, continued to give the cooperation of himself and the members of his staff, in every possible way.

Captain W. A. Hedden, Commanding the Kilauea Military Camp, and Lieutenant A. W. Benner, both gave splendid cooperation in many ways during the month.

340 State, county, or municipal legislation affecting parks.

A bill has been introduced in the Hawaii legislature which is now in session, appropriating $10,000 as a contribution of the Territory toward the work of the United States Geological Survey in the Park.

400 FLORA, FAUNA, AND NATURAL PHENOMENA:

Kilauea Volcano.

Halemaumau pit remains very quiet. There is only slight steaming on the south talus. Slight tremors and feeble earthquakes were registered at the Observatory during the month. Tilting of the ground was moderate to the south west.

410 Ranger, naturalist and guide service.

Ranger Brumaghim gave fourteen lectures during the month at the Uwekahuna Observatory to a total of 499 visitors. He made seven trail trips across the Kilauea Crater conducting 32 visitors. The balance of the time he was patrolling, policing grounds, shelters, comfort stations, repairing telephones and lines, etc.

500 USE OF PARK FACILITIES BY THE PUBLIC:

There was a increase of 521 visitors to the park during February compared with a year ago. Full information isshown in Table No. 1.

520 General weather conditions.

The following weather data is of interest:

Maximum	(This year) 68		(Last year)	79
Minimum	(" ") 47		(" ")	47
Precipitation for month	6.40 inches	To-date	8.32 inches	

600 PROTECTION:

610 Police protection.

Theft: A ladies purse with money and a gold watch was stolen from an automobile parked at the golf course. The thief was not caught.

A $20.00 bill was stolen from the purse of an employee of the hotel, but he was caught, confessed, and made restitution.

In both cases the detective force at Hilo was called on to cooperate with the park ranger service.

640 Destruction of predatory animals.

There were 40 wild goats, 3 wild hogs, 4 wild dogs and 1 rat killed during February.

900 MISCELLANEOUS:

Kilauea Volcano.

On February 17th, Mrs. Kaoliiokalani Pihanaokalani an aged Hawaiian woman from Honolulu who claims to be 100 years old, together with five generations of her own immediate family, arrived in the park bearing letters of introduction from the Hawaii Tourist Bureau, asking my support and cooperation in her efforts to induce "Madam Pele" the ancient Hawaiian goddess of the Halemaumau Volcano, to return to her abode and renew activity in the fire-pit. Through members of her family who interpreted for her, (for the old woman speaks no English) she said she was a direct descendant of "Madam Pele" and knew the proper chants and prayers and offerings necessary to persuade the goddess to bring about an eruption. She was sure she could bring the volcano into activity immediately or cause its cessation after activity had once been produced. She asked for the special presence of the park superintendent as well as other witnesses to see a demonstration of her powers and there were over a hundred to see her on the day of her arrival, publicity having been given the matter through the press and over the radio.

She and her party were given every courtesy and consideration possible. The volcano failed to show any special signs of life in spite of her offerings or prayers, and she explained that it would take a little time — maybe that ~~night or the~~ next day before the Volcano would erupt. She and all the members of her family have been camping near the pit ever since and each day an eruption is promised soon, but we are all still waiting. The faith and apparent sincerity of these as well as all other Hawaiian people, is remarkable. All are very superstitious and have every belief in the legends that have been handed down through generations. One copy of the newspaper articles about her is attached.

Dedication of tree to Memory of Stephen T. Mather.

The Women's Club of Hilo in cooperation with the World's Federation of Women's Clubs is to plant and dedicate a Christmas tree to honor the memory of former Director Stephen T. Mather. The site for the tree is to be chosen at a later date. William Bryan, Territorial District Forester, has a beautiful and interesting tree to provide when the ceremony takes place.

Very respectfully,

E P Leavitt

Superintendent.

CC to "Field Headquarters" (2)
CC to "Yellowstone National Park" (1)

New Gasoline and Oil Building

Form No. 1009—Met'l.

U. S. Department of Agriculture, Weather Bureau.

COOPERATIVE OBSERVERS' METEOROLOGICAL RECORD:

Month of February 1921 ; *Station,* Volcano Observatory; *County,* Kau, Hawaii

Hour of Observation, 8 A.M.

State, Hawaii; *Latitude,* ; *Longitude,* ; *Time used on this form,* Haw'n

DATE.	TEMPERATURE. Maximum. 1	Minimum. 2	Range. 3	*Set Max. 4	PRECIPITATION. Time of Beginning. 5	Time of Ending. 6	†Amount. 7	Humid. 8	Wind 9	Prevailing Wind Direction. 10	Character of Day, Sunrise to Sunset. 11	‡Miscellaneous Phenomena.
1	68	50	18	54			.03	88	Mod.	N E	P. C.	
2	66	47	19	51			.12	87	Lt.	"	"	
3	65	47	18	55			.04	86	"	"	"	
4	64	50	14	54			.03	93	"	"	"	
5	61	49	12	52			.02	91	Str.	"	"	
6	59	49	10	54			.06	91	"	"	Cloudy	
7	62	49	13	53			.13	91	Mod.	"	P. C.	
8	62	47	15	55			T	81	"	"	"	
9	61	49	12	52			.02	90	Str.	"	"	
10	64	49	15	52			.04	90	"	"	"	
11	62	48	14	53			.03	79	Mod.	"	"	
12	64	48	16	53			T	75	Str.	"	"	
13	67	48	18	55			T	71	"	"	"	
14	65	49	17	59			.05	92	Mod.	"	"	
15	68	50	18	57			.02	82	Lt.	"	Clear	
16	64	52	12	53			.05	94	Str.	"	P. C.	
17	64	50	14	54			.04	95	Mod.	"	"	
18	65	50	15	55			.16	87	"	"	Clear	
19	68	49	19	58			.02	81	"	"	P. C.	
20	63	51	12	56			.96	95	Str.	"	Clear	
21	65	51	19	58			.01	83	Mod.	"	P. C.	
22	58	52	06	56			.24	90	Str.	"	"	
23	62	50	12	53			.73	92	Lt.	"	"	
24	64	49	15	53			.06	91	Mod.	"	"	
25	55	52	03	55			1.68	93	Lt.	"	"	Snow on Mountains
26	59	49	10	59			.96	92	"	"	"	
27	63	51	12	55			1.38	92	".	"	"	Lt. snow on Mountains
28	57	49	08	57			.04	73	"	"	"	" " " "
29												
30												
31												
Sum	1759	1385	380	1530			6.40	2423				
Mean	62.8	49.4	13.6	54.6			.23	86				

*Reading of maximum thermometer immediately after setting.
†Including rain, hail, sleet, and melted snow.
‡Thunderstorms, halos, auroras, etc.

(IN TRIPLICATE.) See cover for instructions.

Hawaiian Volcano Observatory, *Cooperative Observer.*

Post-Office Address, Hawaii Nat'l Park, Hawaii

MONTHLY SUMMARY.

TEMPERATURE.

Mean maximum, 62.8

Mean minimum, 49.4

Mean, 56.1

Maximum, 68 ; date, 15th, 19th

Minimum, 47 ; date, 2, 3, & 8

Greatest daily range, 19

PRECIPITATION.

Total, 6.40 inches.

Greatest in 24 hours, 1.68 ; date, 25th

SNOW.

Total snowfall, ... inches; on ground 15th, ... inches;

at end of month, ... inches.

NUMBER OF DAYS—

With .01 inch or more precipitation, 25

Clear, 3 ; partly cloudy, ... ; cloudy, ...

DATES OF—

Killing frost,

Thunderstorms,

Hail { Light, Moderate, Heavy,

Sleet,

Auroras,

REMARKS:

Rainfall for to-date Vol. Dis. 8.32"

" " month at Hilo 8.30"

" " to-date at Hilo 10.52"

10-157
(July, 1929)

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

TRAVEL REPORT

HAWAII National Park for the month of February 1931

	This Month	This Travel Year To Date	This Month Last Year	Last Travel Year To Date	Increase for Travel Year: Number	Increase for Travel Year: Percent
PRIVATE TRANSPORTATION:						
Cars first entry, ...						
Cars reentry, ...						
Motorcycles, ...						
Total motor vehicles, ...						
Persons entering via motor vehicles, ...	5,648	64,498	4,741	30,506	33,992	111.4%
Persons entering via other private transportation, ...	245	1,700	265	1,282	418	32.6%
Total persons entering via private transportation, . . .	5,893	66,198	5,006	31,788	34,410	108.2%
OTHER TRANSPORTATION:						
Persons entering via ~~XXXXXX~~ Hotel, .	560	2,928	926	3,556	RE 628	17.7%
Persons entering via trains, .						
Persons entering otherwise, . . .						
Total other transportation, .	560	2,928	926	3,556	RE 628	17.7%
GRAND TOTAL ALL VISITORS, . . .	6,453	69,126	5,932	35,344	33,782	95.6%

	This Year	Last Year	Increase: Number	Increase: Percent
Automobiles in public camps during month, ...	1	0	1	100
Campers in public camps during month, ...	8	0	8	100

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

STATUS OF AUTHORIZED PROJECTS

Hawaii National Park for the Month of February 1931

	Description of Projects	Percent Constructed To Date	Percent Constructed This Month	Percent Constructed Last Month	Probable Date Completion
405	Ware House	100	—	100	
406	Toilets, (Kilauea)	100	—	100	
407	Toilets, (Uwekahuna)	100	—	100	
408	Gasoline & Oil Building	97	1	98	March 31, 1931
451	Telephone Lines	95	—	95	
502	Kilauea Iki Trail	100	—	100	
502	Mauna Loa Trail	100	—	100	
502	Summer Camp Trail	100	—	100	
502	Steaming Bluffs Trail	100	—	100	
	Road Survey, B.P.R.	100	—	100	

10-159

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

STATUS OF PERSONNEL

Hawaii National Park for the Month of February 1931

	This Month	This Month Last Year
Number of employees beginning of month,	9	12
Number of additions, ...	1	0
Total, ...	10	12
Number of separations, ...	0	3
Number of employees close of month, . .	10	9
Number of promotions during month	0	0
Aggregate amount of annual leave taken,	1	0
Aggregate amount of sick leave taken,	0	0
Aggregate amount of leave without pay,	0	0

10-160

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

REPORT OF PARK REVENUES

Hawaii National Park for the Month of February 1931

	This Year	Last Year
Park revenue on hand beginning of month,	0.00	0.00
Received,	0.00	0.00
Total,	0.00	0.00
Remitted,	0.00	0.00
On hand close of month,	0.00	0.00

Park revenues received this year to date,	1,075.00
Park revenues received last year to date,	1,025.00
Increase,	50.00
Percent of increase,	.049

10-161

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
Hawaii National Park

REPORT OF SALES OF PUBLICATIONS

February 1931

	Number	Value
GOVERNMENT PUBLICATIONS:		
On hand beginning of month,	359	75.50
Received during month,	0	0.00
Total,	359	75.50
Sold during month,	7	3.40
On hand at close of month,	352	72.10

	Number	Value
NON-GOVERNMENT PUBLICATIONS:		
On hand beginning of month,		
Received during month,		
Total,		
Sold during month,		
On hand at close of month,		

Cash on hand beginning of month,	3.00
Sales during month,	3.40
Total,	6.40
Remitted during month,	0.00
Balance,	6.40

DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HAWAII NATIONAL PARK
HAWAII

February 16, 1931

OFFICE ORDER NO. 1

SUBJECT: HAWAII NATIONAL PARK OFFICE ORDER SYSTEM.

1. A system of office orders applying locally in Hawaii National Park will be instituted this date.

2. They will be divided into two classes:
(a) General Office Orders.
(b) Special Office Orders.

3. General Office Orders will be defined as permanent orders, which once issued will be followed regularly and continuously, until changed, modified, or revoked. They will be continuing orders.

4. Special Office Orders will be defined as of a special or temporary nature, which lapse after the instructions given are carried out. They may be informative in character, for use of park employees or the public; and will be regarded as completed when received, acted on, used, or understood, by those to whom addressed.

5. These office orders will supplement but will in no way supersede the Office Orders issued by the Washington Office for the information and guidance of the various national parks as a whole.

E. P. Leavitt,
E P Leavitt
Superintendent.

DISTRIBUTION:

	Copies
TO Appointed Employees, Hawaii National Park	12
The Director, National Park Service	1
Monthly Report for February 1931	6
Park Files	1
Totals	20

DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HAWAII NATIONAL PARK
HAWAII

February 16, 1931

OFFICE ORDER NO. 2

SUBJECT: FILING HAWAII NATIONAL PARK OFFICE ORDERS.

1. A complete set of General and Special Hawaii National Park Office Orders will be filed in the official files of the park. Covers front and back will be provided and Acco fasteners will be used.

2. An index of each set of orders will be kept. This index will be kept in two ways, numerically and alphabetically. The alphabetical index will be cross-indexed in every possible way.

3. A complete set of these orders properly indexed, will be kept by the following department heads:

The Superintendent.
The Park Naturalist.
The Chief Ranger.
Ranger Christ. (For use at Haleakala)

4. All other employees will keep orders as are addressed to them in a special folder for ready reference.

E. P. Leavitt

E. P. Leavitt

Superintendent.

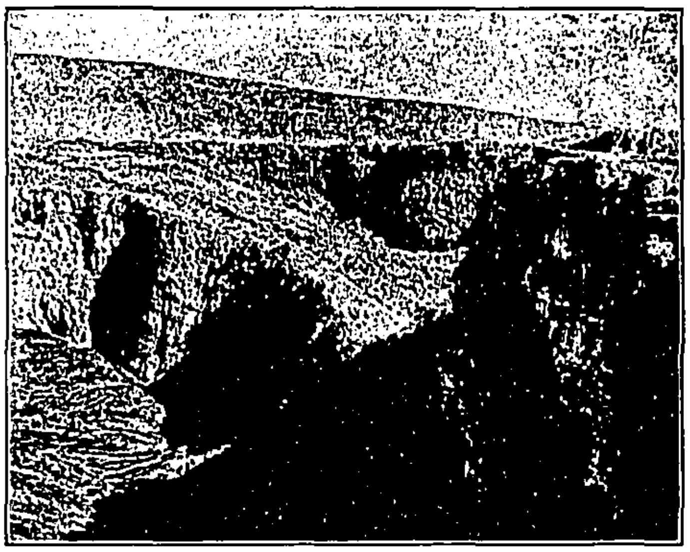
DISTRIBUTION:

		Copies
To	Appointed Employees, Hawaii National Park	13
	The Director, National Park Service	1
	Monthly Report for February 1931	5
	Park Files	1
	Totals	20

The Volcano Letter

Two dollars per year | Ten cents per copy

No. 319—Weekly | Hawaiian Volcano Observatory, National Park, Hawaii | February 5, 1931



Halemaumau looking north from the southeast rim December 15, 1916, showing the northeastern inner shelf which had been left for many years as a feature of the pit rim by the collapse of 1894. The pit circle measured only 13C0 by 1400 feet at this time. The inner lava is seen below, and in the background is Uwekahuna bluff of Kilauea Crater. Photo Jaggar.

TWENTY YEARS OF HAWAIIAN ERUPTIONS

The Hawaiian Volcano Observatory, which was first financed in 1909 and began research in the summer of 1911, has observed about twenty important crises in the three volcanoes Kilauea, Mauna Loa, and Hualalai in the course of twenty years. This means an average of one a year, and with each new event the public is apt to forget the vastly important and exciting events that went before. Therefore very briefly we recount here the sequence.

Kilauea Activity of 1909-13

After the southwestern Mauna Loa flow of 1907, lava rose and fell in Halemaumau pit, then much smaller than at present, at depths 200 to 300 feet below the rim. In 1910 and 1912 three remarkable risings occurred with hundreds of roaring liquid lava fountains. Then came subsidence with much smoke, the lava 600 feet down, from May 1913 to May 1914.

Mauna Loa Summit Eruption 1914

Slowly the melt rose with glowing trickles, sputter, and fume in Halemaumau. In November 1914 Mokuaweoweo, the summit crater of Mauna Loa, suddenly split athwart its bottom and gave vent for two months to high spurting fountain jets of frothy lava, which flowed in the crater only, and became dormant.

Kilauea's Rising 1914-16

Halemaumau now began a cycle of steadily increasing inflow of lava, which was destined to last for 10 years. There was sinking just after the Mauna Loa event, then the upbuilding of a lake in the Kilauea pit, with overflow floor, crags and islands.

Southwest Flow Mauna Loa 1916

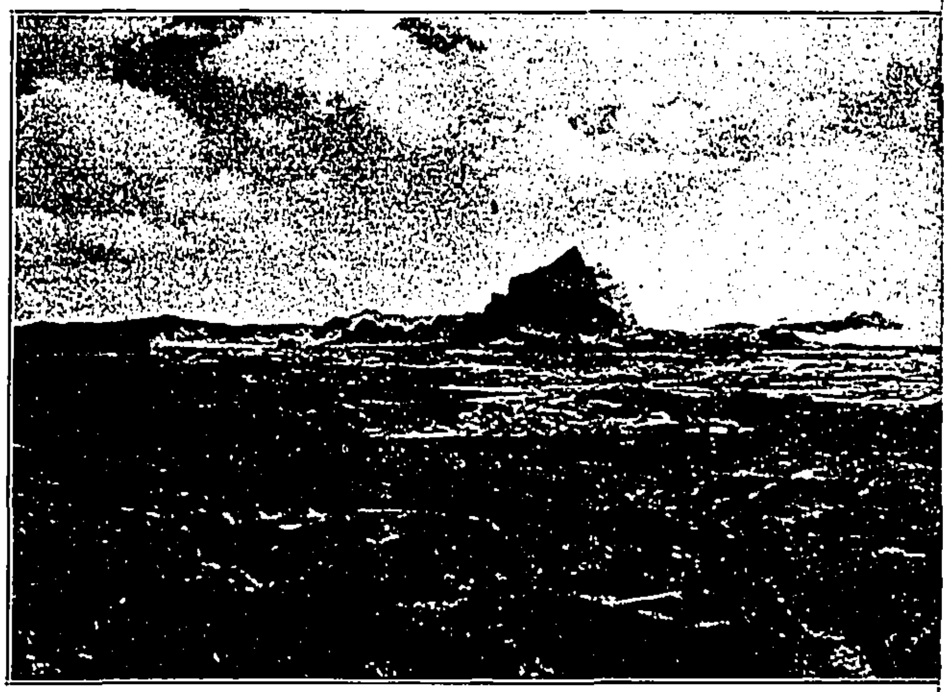
With an astonishingly beautiful mushroom of fume that shot up from about the 10,000-foot level southwest on Mauna Loa May 19, 1916, a new lava flow began making short streams of aa into the forest of Kahuku and Honomalino. This never reached the road and ceased about June 5.

Kilauea Subsidence and Recovery 1916-18

On the same day the lava of Halemaumau, which had just shown a spurt of rising, with the Mauna Loa eruption, sank nearly 400 feet in 24 hours with a magnificent display of red-hot avalanches tumbling into the void 673 feet deep. Immediately lava boiled up in the bottom, and with chiefly rising tendency built up lakes, platforms and crags to the point of overflowing the rim of Halemaumau in February 1918.

Overflows Into Kilauea Crater 1918-19

These two years exhibited the lava in Halemaumau with huge craggy peaks of uplifted floor between the lakes, and whenever there was overflow, reactions of subsidence followed. Overflowing was continuous for seven months in 1919, flooding the Kilauea floor north.



Halemaumau brim full of lava December 31, 1920. This photograph shows the whole pi[t] toward the south. Where the photographer was standing would now be about 600 f[eet]

Alika Flow Mauna Loa 1919: peak of the Cycle 1913-1924

Kilauea flows spurted when Mauna Loa erupted again September-November, 1919, beginning with gushing near Mauna Loa summit southwest. The Mauna Loa flows came out about the 8000-foot level above Puu o Keokeo and poured to the sea at Alika in south Kona.

Kilauea Grand Subsidence 1919

About when Mauna Loa ceased action, Halemaumau, when full to the top, on November 28, 1919 suddenly withdrew its lava column like a piston into a cyclinder 400 feet in an hour. The lava lowered farther for a few hours, immediately recovered, then rose 30 feet a day.

Kau Desert Outflow Kilauea 1919-20

Halemaumau lava rose to the top again December 15, 1919, flooded the southwestern Kilauea floor, burst open the mountain in the Kau desert 6 miles away, and during the next 8 months built the slagheap hill there Mauna Iki, making aa and pahoehoe flows five miles long. Lava in Halemaumau lowered.

Kilauea's Great Overflows March 1921

From 320 feet below rim Halemaumau executed a tremendous rise again for its inner lava lakes between October 1920 and March 1921. There was increasing effervescence, gigantic fountains spouted up in myriads, crags, floors, lakes and wells rose en masse, and the pit overflowed to the Kilauea floor in three great floodings with 5 overflows at one time on March 18, 1921. A small flow went out through the southern Kilauea wall to the desert.

Chain of Craters Outbreak from Kilauea 1922

Kilauea lava subsided three times, with intervening rises, during 1921-22, the last being the greatest engulfment of the Halemaumau walls which had yet occurred in this century. This in May 13-27, 1922, enlarged the pit from a diameter of 1400 feet to 2000 feet. Then May 28-29 came short-lived outflow in Makaopuhi and Napau pits in Puna 9 miles from Halemaumau.

Second Chain of Craters Outflow 1923

Kilauea pit was dormant until lava burst from the talus and began to fill Halemaumau July 17 and September 2, 1922. Then came pulsations of rising to a point 127 feet below rim July 4, 1923, followed by another big subsidence in August and an outflow up a long crack in the forest near Chain of Craters trail west of Makaopuhi. This is the flow shown to tourists where the vent is still hot and lava spatter clings to the trees.

Great Rise and Collapse of Kilauea 1923-24

These oscillations of rising and sinking at Halemaumau, with outflow somewhere down the mountain, reached a grand climax in 1924. This was the end of the eleven-year cycle, and this cycle was the end of an 134-year supercycle. In the pit greatly enlarged by numerous collapses, the lava rose to within 121 feet of the rim January 27, 1924, making the largest continuous sea of lava ever measured by the Observatory. Then it lowered to dormancy February 15-21, 1924, left a collapsed tumble with a glowing hole about 400 feet down, leading to a demonstration on the eastern or Puna rift of Kilauea Mountain.

Kapoho Coast Subsidence April 1924

This eastern rift crack extends beyond the Chain of Craters through the forest to be crowned with a line of clinker cones 30 miles east of Kilauea. Here at Kapoho April 21, 1929, began continuous shaking, then extensive

rim with the enclosed liquid lava lake and a high crag standing in its midst, looking
t inside the north rim of the present pit, and 30 feet up in the air. Photo Jaggar.

cracks opened with settling of the country along a four-mile strip to the coast. There was possibly slight increase of steam there at the always steaming Puulena pit craters. No heat was detected in 20 new chasms. The country sank 11 feet, at the ocean a new salt water lagoon extended 200 feet inland, and coconut trees stood in eight feet of water.

Kilauea Explosive Eruption 1924

The series of subsidences in Halemaumau was now breaking down the mountain, the lava retreated into a deep void, and immediately after the eastern rift subsidence Halemaumau pit began to cave in with increasing avalanches beginning April 28, 1924. Through the cloud of rising dust steam blasts began to fling up rocks May 11, this accentuated the collapse of the funnel and the breaking down of the walls, and a grand climax of explosive eruption was reached May 18. The steam blasts came in pulsations like geyser eruptions every few hours. One man was killed through being too venturesome. The pit was enlarged from 2000 feet to 3500 feet diameter and was left 1300 feet deep. Red-hot walls were revealed below. Steam blasts ended May 27.

Return of Lava July 1924

Except for avalanches Kilauea was dormant until July 19, 1924, when frothy pumiceous lava shot up through the talus of the bottom of Halemaumau with much burning gas, made torrents of melt into the cup of debris at the bottom of the pit, and kept up the action gradually declining for two weeks. This was followed by prolonged dormancy at Kilauea for three years. T.A.J.

(To be continued)

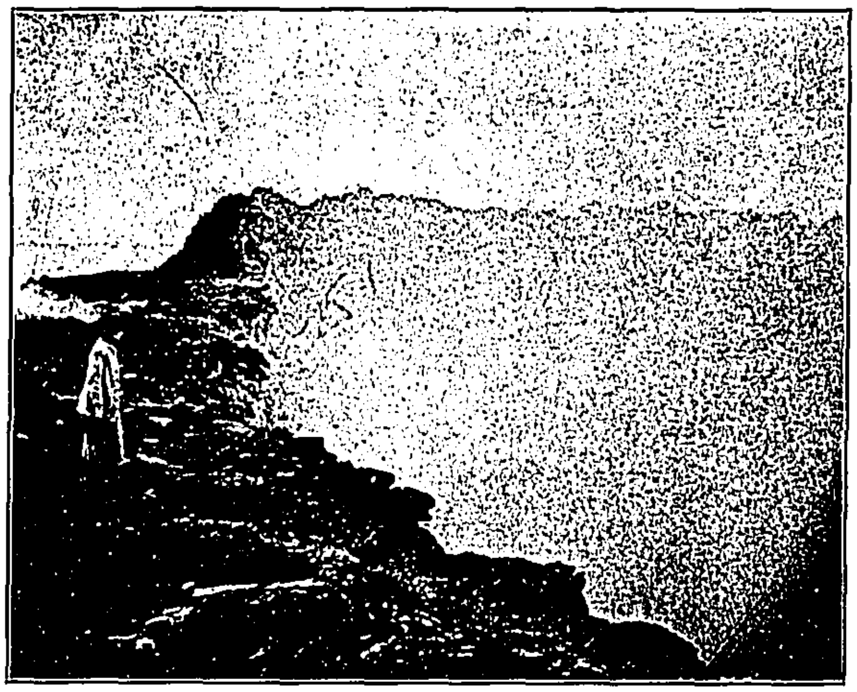
KILAUEA REPORT No. 993
WEEK ENDING FEBRUARY 1, 1931

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

The week was notable on Hawaii for two felt earthquakes noticed generally all over the island suggesting origins under Mauna Loa. These in sequence upon the similar earthquake of January 16, which by careful analysis showed signs of originating deep under the northeastern slope of Mauna Loa, make the watching of that mountain for possible volcanic activity a matter of interest in the near future.

During the prolonged slight earthquake of 11:39 p. m. January 29 rocks were heard falling in the direction of Halemaumau. Prior to that time there were no changes at the pit, but the seismograph there had recorded a few slow-period tremors. At 9:30 a. m. January 30 a few rocks fell from the north wall of the pit where there was a small red scar from earlier falls. The steaming at the south talus was slight and no fume was detected at the sulphur crack south.

The seismographs at the Observatory registered 1 slight earthquake January 29, 11:39 p. m., 1 classed as feeble 11:56 a. m. February 1, the former showing distance 14 miles, the latter 55 miles. Very feeble shocks were registered to the number of 26 as well as 39 tremors. Ten of the minor shocks indicated distances around 30 miles, as in the case of the earthquake of January 16. The increase of total frequency over the preceding week is from 44 to 67 disturbances. Microseismic motion for the week changed from moderate to very slight. Tilting of the ground was strong to the east.



Halemaumau on the forenoon of November 28, 1919, just after the early morning subsidence which had lowered lakes and crags like a piston drawn into a cylinder. The previous evening the lava had been up to the level of the rim shown so that one could walk out on the inner floor. Ridge in background was the pressure rim crushed up during the previous year. Photo Jaggar.

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The Board of Directors includes Lorrin A. Thurston, President; Frank C. Atherton and Walter Dillingham, Vice-Presidents; L. Tenny Peck, Treasurer; Wade Warren Thayer, Arthur L. Dean, and Richard A. Cooke.

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The Volcano Letter

Two dollars per year | Ten cents per copy

No. 320—Weekly | Hawaiian Volcano Observatory, National Park, Hawaii | February 12, 1931

How the old lava mountain of the Kau Desert split open December 22, 1919 through sand and rock and the roots of a tree, in order to give vent to the lava which later piled up into Mauna Iki.

TWENTY YEARS OF HAWAIIAN ERUPTIONS
(Continued)

Hoopuloa Lava Flow Mauna Loa 1926

While Kilauea remained dormant, Mauna Loa on April 10, 1926, opened its southwestern rift about 3 a. m., with lava splitting its way upward and gushing at first just outside of the summit crater. Frothy pahoehoe flows from this summit source poured several miles southward. Then at about 8,000 feet elevation and east of the Alika source cones of 1919 three cups opened along the southwestern rift of Mauna Loa, a big brown fume column shot up, and lava flows started along the rift 15 miles southwest of the Mauna Loa summit. The flood of slag spread both east and west from the rift crack, the western flow finally taking control, pouring down through the forest in South Kona, crossing the main road at 12:22 p. m. April 16, pooling back of Hoopuloa village at the coast as a mass of heavy aa, and completely burying the village, wharf, and harbor between 4 and 9 a. m. April 18.

The source region on top of the southwest ridge of Mauna Loa had developed a line of activity along the rift five miles long with cones and fountains 50 to 100 feet high, the activity progressing along the crack from above downward, and settling down to steady flow at one of the lower cones. Flowing stopped at the Hoopuloa shore April 19, but continued in new streams in the upper Honomalino forest until April 30, when the eruption ceased. There were swarms of earthquakes during and after the outbreak, the frequency diminishing after April 17.

Return of Lava Kilauea July 1927

Halemaumau remained dormant until July 7, 1927, when lava returned to the bottom of the pit, declining in activity to dormancy July 20. The spraying fountains of pumiceous lava attracted attention by their illumination at 1 a. m., and were found to be in a line of four vents trending northeast-southwest across the lava floor of 1924. The persistent vent which became the main source of the bottom fill originated up the southwestern talus and built a pumice cone. About 100 feet of new lava was deposited over an area in the bottom of the pit 1700 feet long northeast-southwest by 1400 feet wide.

Return of Lava Kilauea January 1928

After a series of heavy avalanches in Halemaumau culminating in a monstrous one which caused the north-

Halemaumau Pit during its recovery September 7, 1920, showing the rising pahoehoe liq
Taken from an inner si

western talus to develop into a landslip over the lava floor at 12:26 a. m. January 11, 1928, glow suddenly appeared at the pit coincident with this landslip. New lava had spouted up cracks in the 1927 floor which was brightly incandescent at first, but the rosy over the pit disappeared in 20 minutes. By 1 a. m. the glowing areas indicated cooling flows with a hint of blue flame at a northern cone vent, but there was no observable motion. Slides from the walls continued on all sides. There was no fountaining seen, but no observer was present during the first half hour.

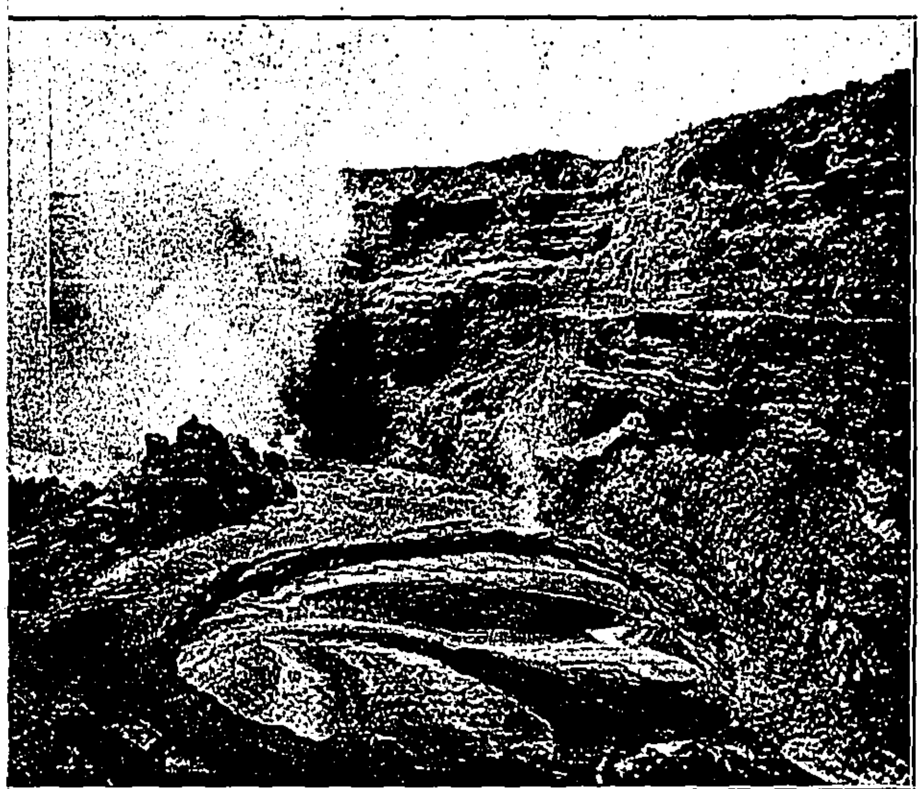
This upflow was believed at the time to be the result of loading down the crust of July 1927, and squeezing up the lava that remained still fluid below. This explanation is doubtful as the frequency of volcanic earthquakes had been unusual for two months, and an eruption was expected.

Return of Lava Kilauea February 1929

Halemaumau was dormant until February 20, 1929, when inflow of lava in the bottom of the pit lasted a day and a half. This was heralded by a striking record of tilt with small earthquakes at the pit seismograph. The ground suddenly tilted away from the pit, and at the end of the eruption tilted back again. Again the outbreak was just after midnight, in the early morning hours of February 20 along a fracture in a straight line across the northwestern side of the bottom lava in Halemaumau. As the landslip of January 1928 had diminished the size of the cup of talus, the new fill, only 45 feet deep, was smaller than that of 1927, measuring only 1600 feet in diameter. The action was marked by a line of continuous fountains with a big fountain of the Mauna Loa type shooting up frothy lava 200 feet at the north end of the live crack, and making a streaming with bright line pattern out into the lake which covered the bottom. There was a steady roar, blue fume arose, while pumice and Pele's needles fell outside of the pit. There was almost no avalanching. The northern fountain built up a pumice and lava heap from which cascades poured down, and this broke down to an "arm-chair niche" at the end.

Return of Lava Kilauea July 1929

After a shorter period of dormancy Halemaumau again produced a spurting eruption in its bottom lasting three days July 25-28, 1929, so as to diminish the depth of the pit by another layer of lava 55 feet deep. This left Halemaumau approximately 1,000 feet deep. Again the outbreak was in the early morning. The time was about 4:35 a. m. as shown by sudden tilt and earthquakes. The center of activity was a fracture through the western talus tangential to the bottom plug. Big fountains spouted up there, and the seismograph at the pit showed inward tilt toward the center on the first day, followed by outward tilt thereafter. In all these short eruptions of lava in Halemaumau a characteristic harmonic tremor of the ground was registered at the Observatory during the days of actual fountaining, and was absent before and afterwards. At the end of July there remained visible glow from cracks in the floor for a few days, as usual with these eruptions, but none of these outbreaks left hissing gas or other signs of continued activity. The eruption stopped abruptly and the new lava solidified.



ıld lava of the lakes making overflow platforms as the lake lava gained upon the crags.
ıelf looking south.

Hualalai Earthquake Crisis Autumn 1929

Suddenly small earthquakes began to be felt in North Kona near Hualalai Volcano September 19, 1929, though Kilauea remained dormant, and no volcanic activity appeared elsewhere. Puuwaawaa, a large cone on the north flank of Hualalai, became the center of maximum motion. Large destructive earthquakes about Grade IX Rossi-Forel occurred September 25 and October 5. Six thousand two hundred eleven earthquakes were registered in Kona between September 21 and October 16. Great damage was done though no lives were lost: houses, roads, stone fences, fills, tanks, and masonry of every description were broken. Everything indicated that this seismic spasm was connected with volcanic movement of lava underground tending to shift from the Mauna Loa region to the Hualalai region. An Hualalai outbreak was expected, for this volcano had been active in 1800. No lava flow came and the seismic movements gradually died away in November.

Return of Lava Kilauea November 1930

Another eruption began in the bottom of Halemaumau at 1:29 p. m. November 19, 1930, and this proved to be the longest of this series of intermittent eruptions, bringing also a much greater amount of lava into the bottom of the pit. The activity lasted until December 7 and added a layer to the bottom averaging 70 feet deep. The bottom floor was greatly enlarged to become a leaf-shaped structure 2200 feet long northeast-southwest by 1700 feet wide with a large source cone near its southern margin. The remnant half cone of July 1929 still persists at the base of the western talus.

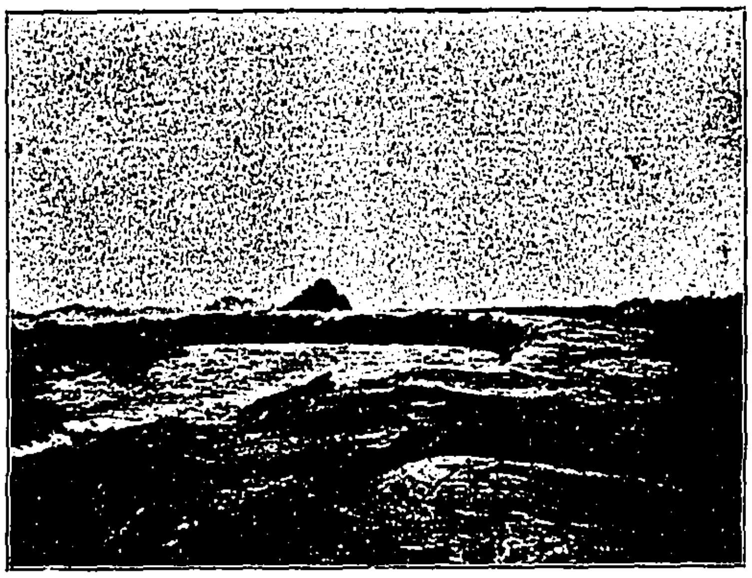
The new lava fountains broke through the floor in front of the grotto niches of 1929 and several fountains developed, one dominating the others as usual, and this in the region of the south edge of the 1929 floor. Here there were developed spraying jets 100 feet or more high, pumice and Pele's hair fell outside of the pit, a crescent heap was built around the south side of the fountain and this gradually enlarged to become a big cone more than 100 feet high. A lake was developed north of the source cone with changing ramparts around its margin, and this at the top of a slag heap which constituted the entire fill of 1930. From the lake the slag heap sloped down in all directions, steeply at the south and more gradually at the north. The activity developed streaming across the lake from the source cone, and trickling flows now here, now there, from the lake out to the margin of the fill. The decline of activity was gradual, and the region of lake and source cone was left thicker and higher than the border fill. Halemaumau was now 930 feet deep, and at the top 3400 feet long by 3000 feet wide. T.A.J.

KILAUEA REPORT No. 994

WEEK ENDING FEBRUARY 8, 1931

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

Conditions at Halemaumau remained without change during the week. A few quick-period tremors recorded on the pit seismograph early in the week.



Upper part of one of the flows from Mauna Iki January 9, 1920, showing a bend in the lava stream, placidly flowing along like a river. This lava had come out of the same crack shown on Page One, and six miles away was draining the pit shown on Pages 2-3. Photos Jaggar.

Fourteen local disturbances and one distant shock were recorded on the instruments at the Observatory, the former classified as follows: 11 tremors, 2 very feeble seisms, and 1 feeble seism. The feeble shock occurred at 7:10 p. m. February 4 and had an indicated distance of 23 miles from the Observatory. It was felt at Kapapala, Hilo, and vicinities.

The teleseism, which began recording at 12:27 p. m. February 2, had an indicated distance of 8,040 kilometers; direction as determined by the record of the vertical component was south-southwest (New Zealand disaster).

Tilt for the week accumulated strong northwest Microseismic motion mas slight.

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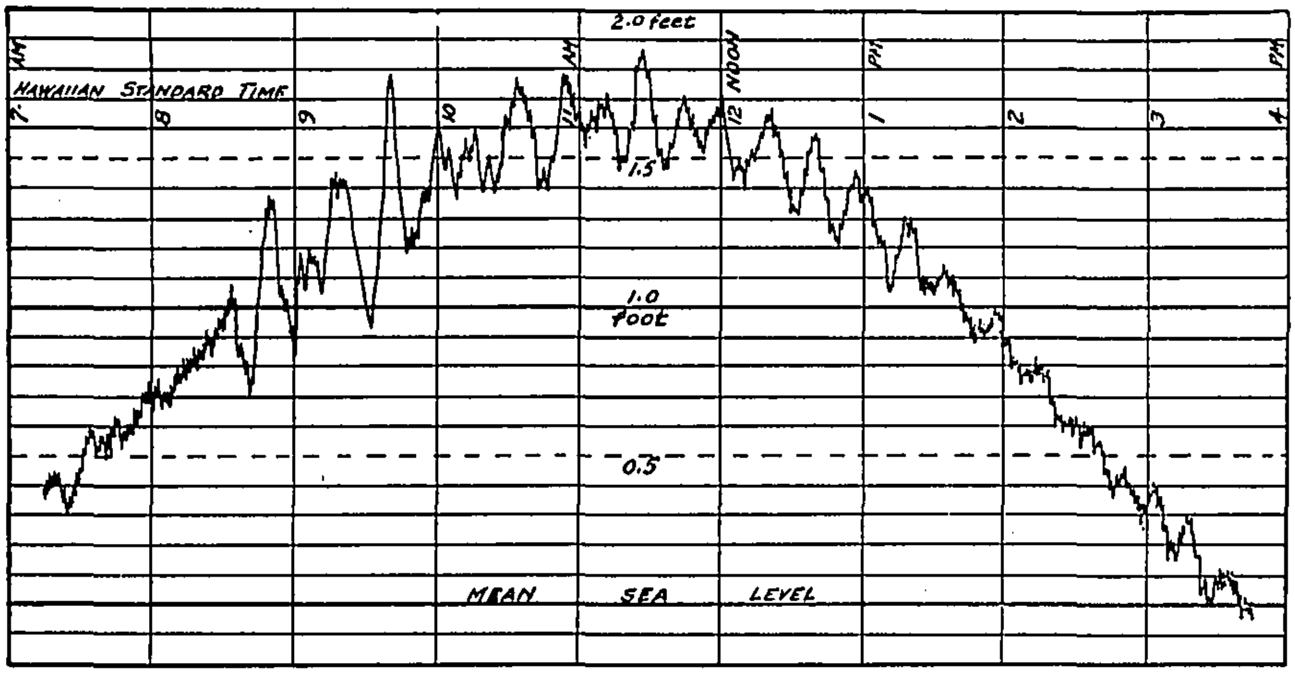
No. 321—Weekly — Hawaiian Volcano Observatory, National Park, Hawaii — February 19, 1931



TIDAL WAVE, NOVEMBER 4 1927
HILO, HAWAII.

Tide gauge record showing the beginning of an earthquake wave series at 8:30 a. m. with maximum range of about a foot, from an earthquake under the sea off the coast of California November 4, 1927. This earthquake was 3,925 km. from Hilo, and the sea wave traveled 7.8 statute miles per minute. The quake was felt in California and on a ship at sea.

HAWAIIAN DAMAGE FROM TIDAL WAVES

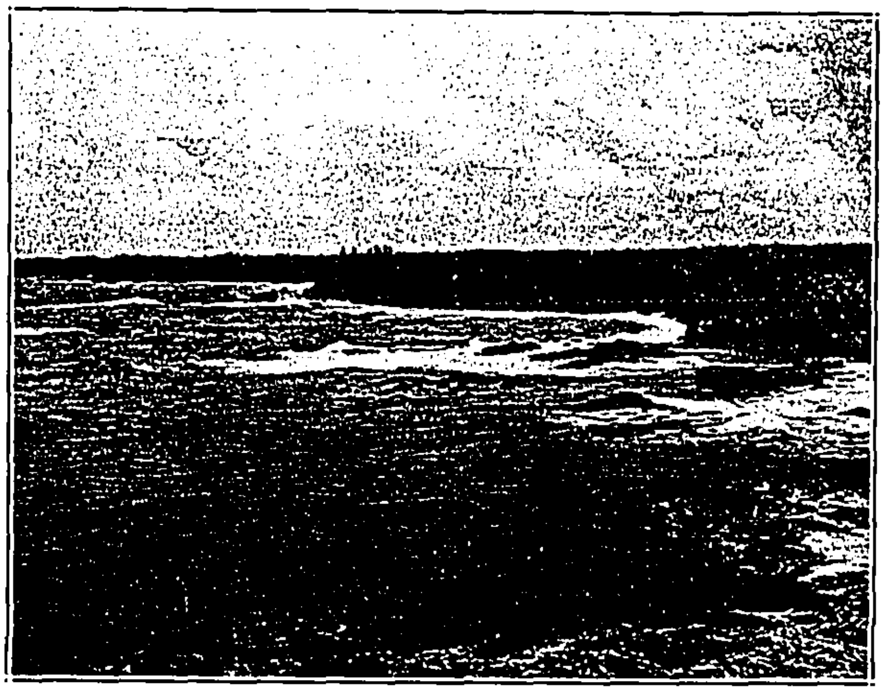
In Volcano Letter No. 274 the general conditions, under which a "tsunami" or earthquake wave is generated by a seismic movement of the sea bottom, are reviewed. These are commonly called tidal waves, a name protested by geologists, but after all not wholly inappropriate, for tides do enter into resonance with the harmonic oscillations of water that make catastrophes popularly called tidal waves. Moreover not all such damaging movements are due to earthquakes, as this piling-up of rhythms to make flood on a shelving shore may be due to landslip, to volcanic engulfment under the sea, to submarine lava flow, or to hurricane. In the earthquake wave proper, a sea-bottom shift like the dropping of a fault block of earth crust sends an impulse across the deep ocean, the trough or crest of which travels from 300 to 500 miles an hour, and so is quite comparable to the travel of the crest of the tide actuated by the pull of the moon. We have proved here in Hawaii that two tremendous deep-sea earthquakes off the Aleutian Islands in one case made disaster in Kahului and Hilo, in the other did not. Both made measurable waves, but probably the one augmented a tide, and the other was in some way compensated by a tide.

Facts about tsunami in Hawaii may be found in the well known books of Brigham, 1866 (Mem. Bost. Soc. Nat. Hist., Vol. I, pt. 3), Hitchcock, Hawaii and Its Volcanoes (Honolulu, 1911), and Brigham, Kilauea and Mauna Loa (Bishop Museum 1909).

In May 1819 the ocean was seen to recede in Hawaii and executed about 13 oscillations before it came to rest again.

On November 7, 1837, a big earthquake off the Chile coast made a disastrous wave about the shores of the Pacific Ocean which was described by Coan as arriving at Hilo so as to cause retirement of the sea about 7 p. m. The surge returned in a few moments "breaking on the beach with a noise like thunder." Lowlands were submerged. Houses were swept away. People were left struggling in th water. The sea remained high for 15 minutes. Then a series of oscillations occurred, the water moving slowly out and in again. There was a meeting of the natives on the shore at the time, and the flood caused great consternation, the people shouting to find their lost relatives and rushing about in panic. An English whaler which was anchored in the bay lowered boats for relief. Canoes were all washed out to sea. The water ran past the ship with an eight-knot current, and soundings were reduced from five to three and a half fathoms, so that much of the bay was dry.

At Kahului in Maui the water retired widening the beach 120 feet so that the delighted natives ran out on the reefs that were left bare in order to pick up stranded fish. But they were terrified to see a wall of water returning



Lowered shore line with drowned pandanus trees where the coast subsided east of Kapoho in Puna April 23, 1924. The land back from the shore was cracked for a distance of four miles, and these events preceded by a fortnight the collapse of Halemaumau 30 miles to the west. This coast subsided in 1868 also, when a wave disaster was produced. Photo Emerson.

which engulfed them and the village. As they were good swimmers only two lives were lost. The back-and-forth disturbance of the water continued for more than 24 hours.

At Honolulu this 1837 tsunami lowered the water eight feet so as to leave the reef dry; returned slowly in 28 minutes; then fell six feet again; and the ebb and flow continued at intervals of about 28 minutes. The third of the flood-water spells reached about four inches above high water mark.

The next account is of a retirement of the waters at Honolulu May 17, 1841, at 5:20 p. m., when the ebb was sudden, leaving the reef bare, and the movement occurred twice in 40 minutes. This earthquake wave was especially sudden at Lahaina in its sucking down of the sea level, and it was reported as affecting the coast of Kamchatka also.

The year 1868 produced two disastrous tsunami on the island of Hawaii, the first accompanying the terrific local earthquake in Kau in April 2, the second from a submarine shock off Arica, Peru, August 13.

The local disaster of April 2, 1868, made a wave on the shore all the way from Kahuku to Kapoho, swept away the houses on the Puna shore, the Pahala shore, and the Honuapo shore, and with the earthquake the Puna coast subsided from four to seven feet. At Punaluu the stone church, the wooden houses, and all the coconut trees except two were washed down. Floating rubbish was driven inland "about a quarter of a mile," and large bowlders were washed in at Pohoiki. On the whole coast 108 houses were destroyed and 46 persons perished by the sea wave. At Hilo the sea receded horizontally 150 feet and when it returned rose about 10 feet above high-water mark.

The big Pacific wave of August 13, 1868, from near Peru, reached Hilo in about 14 hours, traveled about 350 miles per hour, and was reportedd to have been marked on a coconut tree somewhere near the present railway station as reaching 15 feet above ordinary low water and 5 feet above the ground. Hilo is 5,460 miles from Peru. At windward Maui the flood of this tsunami was reported 12 feet high. The damage was of the usual sort and must have been considerable in Waiakea and Kahului. The records of it are probably to be found in the newspapers of the time.

On August 27, 1872, just after a remarkable lava outbreak had begun in the summit crater of Mauna Loa which was destined to last some years, a small tsunami occurred at Hilo during calm weather, the water rising four feet, then six minutes later three feet, and diminishing for about 14 oscillations. The short period of this water wave, six minutes as contrasted with 20 to 30 minutes for the ones of distant origin, makes it likely to have been a local disturbance on the sea floor.

The earthquake wave of 1877 was the most disastrous on record for Hilo and closely resembled that of 1837. Like that one and the one of August 1868, it originated off the coast of South America between Chile and Peru in the evening of May 9, 1877, and reached Hilo at 4 a. m. May 10. At 5 a. m. it penetrated the shops on Front Street at a height reported by Luther Severance 12 feet 3 inches above ordinary low water. Every house within 100 yards of the water was swept away in Waiakea. Five lives were lost, seven persons were injured, 163 were left destitute, and 17 horses and mules were drowned. A vessel which had been anchored in four fathoms of water found itself on the ground. The rise and fall of the waters continued all day. At 7 a. m. one complete swing from low to high was measured 14 feet vertically. The sea swept completely over Coconut Island. Thirty-seven dwellings were destroyed and 17 badly wrecked. Lumber was washed away to the value of several thousand dollars, and the total damage was estimated at $13,000.

There have been several small local waves doing some damage in Hawaii, occasioned by submarine volcanic disturbances, of which the wave at Hoopuloa in 1919, at the time of the nearby Alika lava flow into the sea, is typical. There was a succession of short period shallow tidal waves ranging from 3 to 14 feet in height, with maximum nearest to the flow delta on the third day of the eruption. The Hoopuloa wharf was flooded.

On February 3, 1923, a destructive tidal wave at Kahului in Maui and at Hilo occurred about seven hours after a big earthquake under the Gulf of Alaska, 2,500 miles away. In Honolulu the waters receded revealing the reefs for 20 minutes and then there were in-and-out surges at intervals of 15 to 20 minutes. In Hilo sampans in the Wailoa River were smashed over the railroad bridge, the bridge was destroyed, a man was killed, and the railroad embankment between Hilo and Kuhio Wharf was washed down and houses and wharves were upset. The major wave was the third of the series and was said to pile up more than 20 feet in the funnel of the bay at Waiakea.

We have mentioned pronounced damage in 1837, twice in 1868, again in 1877, and 1923 in Hilo, say five times in the century or an average of once in 20 years, mostly waves from Alaska or South America. One great disaster in Puna and Kau was due to a local submarine disturbance. Nine measured large or small waves between 1918 and 1929 on the Hawaii coast have been discussed in publications of the Hawaiian Volcano Observatory, and only since 1927 have we operated the Hilo tide gauge. Probably waves occur to the number of more than one a year, disregarding the question of damage. There is no record yet of serious tidal wave damage in Honolulu, but waves from the west and northwest have recorded as strongly on the Honolulu tide gauge as on the Hilo gauge. T.A.J.

TILTING OF THE GROUND FOR JANUARY

The following figures show the net amount of tilt per week at the Observatory on the northeast rim of Kilauea crater, and its direction, computed from the daily seismograms, by platting a curve smoothed by overlapping progressive seven-day averages. This is the departure of the plumbline in the direction given.

December 29-January 4	0.97 seconds	W
January 5-11	0.96 seconds	S
January 12-18	0.91 seconds	WNW
January 19-25	1.33 seconds	WSW
January 26-February 1	1.33 seconds	ENE

KILAUEA REPORT No. 995

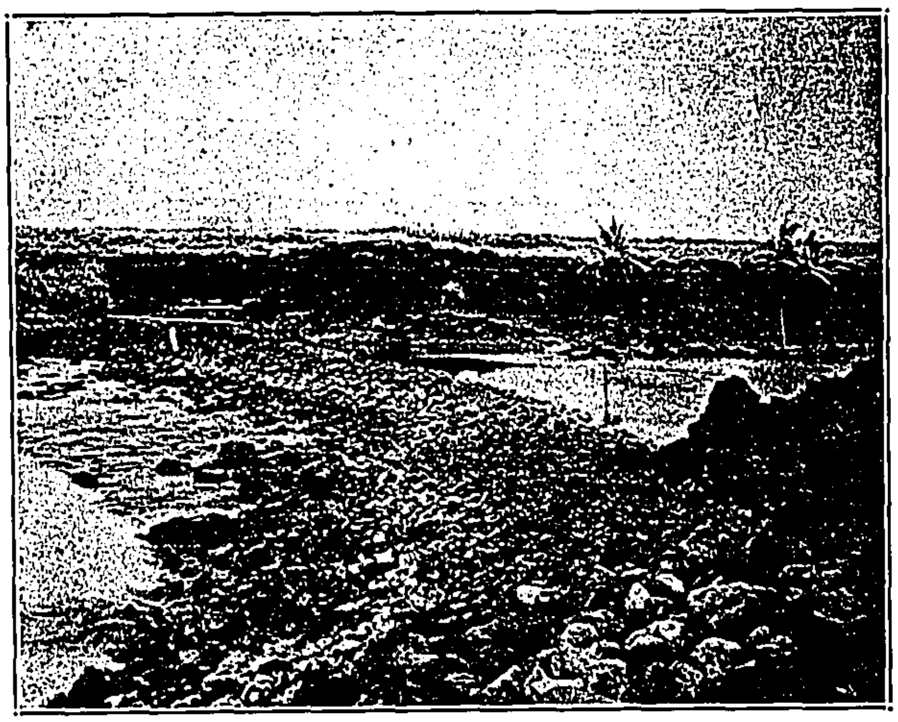
WEEK ENDING FEBRUARY 15, 1931

Section of Volcanology, U. S. Geological Survey

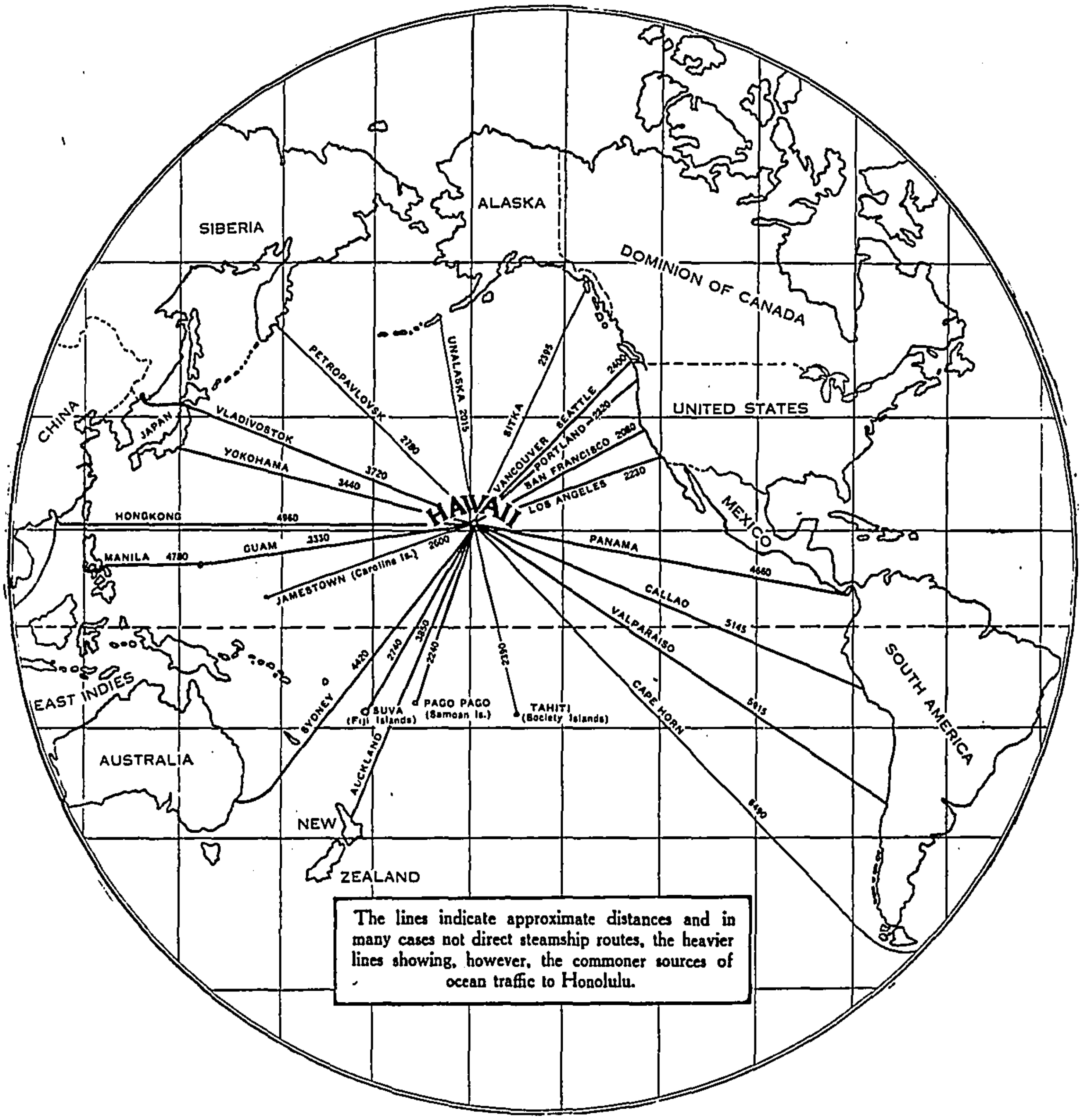
T. A. Jaggar, Volcanologist in Charge

The island of Hawaii is at present very quiet and practically no changes have occurred during the week at Halemaumau pit of Kilauea Volcano. Measurement of cracks at the edge of the pit on February 10 revealed a very slight widening. There is but little steam on the south talus and a few rocks have slid down to the edge of the lava floor at the south.

Only two very feeble local earthquakes were registered at the Observatory, of which one at 4:51 a. m. February 11 indicated distance of origin 28 miles. In addition 12 tremors were recorded. Tilting of the ground was slight NNW, and microseismic motion was very slight.



Detail of lowered shore line of 1924 near east point of Hawaii showing new lagoon of salt water over 12 feet deep with submerged coconut palms. Photo Emerson.



Map of Pacific Ocean. Submarine earthquakes making destructive tidal waves in Hawaii originate generally in the northeastern semicircle of the ocean from Kamchatka to South America.

THE VOLCANO LETTER

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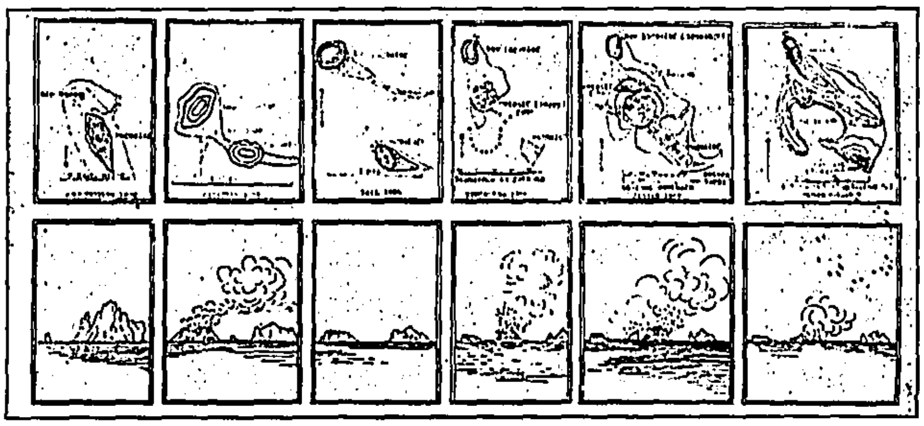
Subscription for non-members two dollars per year of 52 numbers. Address the Observatory.

The Volcano Letter

Two dollars per year | Ten cents per copy
No. 322—Weekly | Hawaiian Volcano Observatory, National Park, Hawaii | February 26, 1931



Sketch maps and profiles of Bogoslof of dates from left to right as follows: (1) Krusenstern 1826, (2) Cantwell 1884, (3) Dall 1895, (4) Stromberg 1906, (5) Jaggar 1907, (6) Camden October 1907. These show the gradual growth of the island, and the lower cut in each case is the view from the south.

EVOLUTION OF BOGOSLOF VOLCANO

The scientific investigation of our vast American domain of active volcanoes in the Aleutian Islands and the Alaskan Peninsula is the largest task before the Section of Volcanology of the Geological Survey. Gradual advancement of this work is provided for by act of Congress, and during the coming summer Akutan Volcano, which has exhibited frequent activity, will be investigated. Akutan is next to the east of Unalaska (see map Page Four), and just to the northwest of Unlaska Bogoslof has been building up during the last 150 years by processes of squeezing up of lava domes similar to that of Tarumai Volcano (Volcano Letter No. 317).

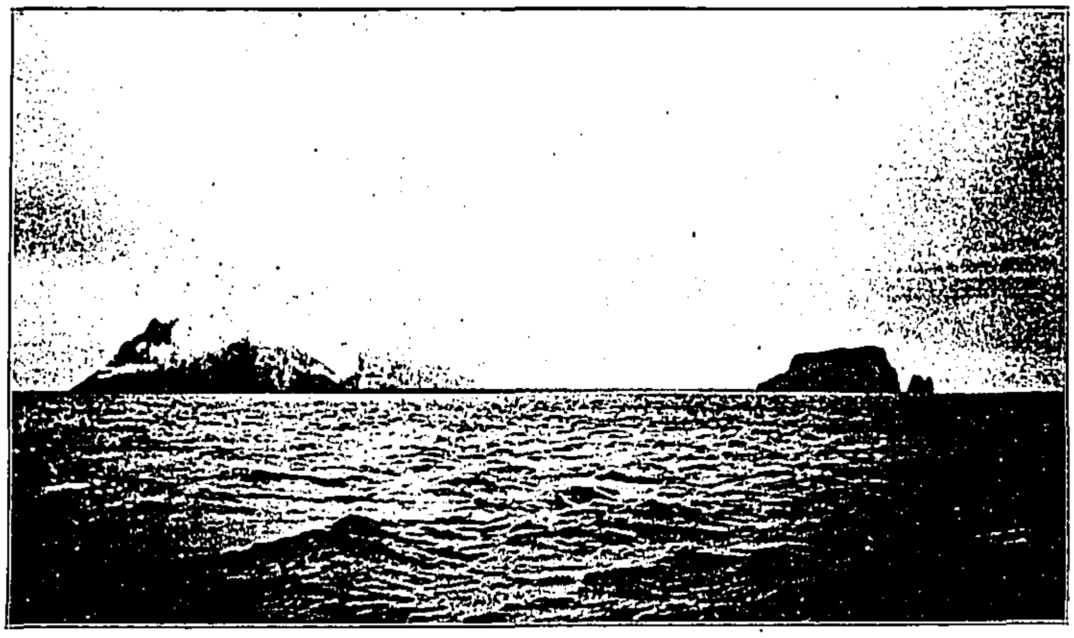
The gradual enlargement of Bogoslof island from 1826 to 1907 is shown in the succession of maps and sketches illustrated on Page One. Bogoslof is a big cone on the sea floor like Falcon Island and Niuafoou in Tonga, but only the tip of it is building above the waves. Under the ocean it is 6,000 feet high. The group of rocks that make the islet have been enlarging by alternations of rising lava and explosive steam jets, the former making domes, and the latter spreading gravel.

Ship Rock was first noticed by sailor men in 1768. Bogoslof proper or Castle Rock was thrown up in 1796. Grewingk or New Bogoslof rose about 1884 and the older Ship Rock was demolished, but Castle Rock still remained in 1891. In 1896 and 1899 there were two islands with water between. In May 1906 the "Albatross" reported a new volcano Metcalf Cone midway between Castle Rock and Grewingk, and attached by an isthmus to the latter. The cutter "Perry" in July 1906 reported 40 feet of water between the new dome and Castle Rock.

In July and August 1907 the writer visited the islands. A new cone McCulloch Peak had risen south of Metcalf Cone and adjacent to it. Metcalf had split in two showing an andesite horn rising through the split cone. This closely resembled the Pelee spine of Martinique. The rock was hornblende augite andesite with inclusions of sulphides and of diorite, some forms resembling pumice. There were also horn-like processes projecting from the summit of McCulloch dome, which was approximately 450 feet high above the sea. The channel between the islands was entirely filled so that Castle Rock, McCulloch, Metcalf, and Grewingk formed a single island a mile and a half long. McCulloch Peak was nearly surrounded by a steaming salt-water lagoon at about 90° F. and was itself steaming quietly. The following describes the adventures of the writer's party from the schooner "Lydia" of the Technology Expedition (Technology Review Vol. X, No. 1, 1908):

"Wednesday August 7, 1907. At 8 a. m. Bogoslof was in full view ahead, the weather fair, a steady southwest wind blowing. It was determined to land two dories and have the vessel stand off, while three or four hours if possible were spent in examination of the island. (The photograph on Page Two was made from the "Lydia" at this time looking west, and corresponds to the next to the last map of the series on Page One.)"

"The landing was made at 10:30 a. m. Hundreds of immense sea lions, bellowing with voices that well justify their name, swam within a stone's throw of the dories, when they would raise themselves high in the water, stare at the boat, and then plunge frantically beneath the waves. When we landed on the beach, most of the animals there had floundered into the water; but one immense bull re-



The northern hills and connecting sand bars of Bogoslof Island, looking west August 7, 1907, showing McCulloch dome on the left, Metcalf half-dome, and Grewingk. Castle Rock is out of the picture at the left. Photo Jaggar.

mained, apparently asleep. One of the party ran toward him with a camera, the monster awoke, and with awkward gait flopped down into the sea.

"The hours spent on Bogoslof were the most interesting of the whole expedition. The rocky cliffs are covered with millions of birds, their eggs and their chicks, chiefly murres and herring gulls. On startling them from the face of the cliff of Castle Rock, the swarm of winged creatures literally darkened the air. To members of the party climbing among the rocks the stench from offal and decayed eggs was intense. The island exhibited four rocky hills 350 to 500 feet high, Castle Rock peaked and prominent at the southeast, McCulloch dome circular and steaming actively in the middle, Metcalf crag half destroyed and adjacent to McCulloch on its north side, and Grewingk a flat table rock at the northwest end of the group. These were all connected by continuous gravel and sand strips where a year before there had been a broad channel and seven fathoms of water about the site of McCulloch dome."

"Around the base of McCulloch hill was a lagoon of hot salt water steaming quietly and yellow with iron stained mud. This hill was 450 feet high at the time of our visit, conical in outline by reason of the talus slopes, and showing great lumps or horns of what appeared to be ledge rock jutting out from the upper slopes, while the slide-rock slope of bowlders all around the base was straight in profile standing at 30 degrees. The entire mass was steaming from many fissures, and in places there were bright yellow sulphur coatings at the steam vents."

"Metcalf hill was a half-cone with its south side broken down where an explosion had destroyed it prior to the beginning of the welling up of the McCulloch lava. This rupture left Metcalf with a vertical precipice on the side opposite the remnant of its cone slope still steaming on the north side. Neither Grewingk at the north nor Castle Rock at the south was volcanically active at the time of this visit. The steep cliff of Metcalf revealed in cross section up its middle a great horn of congealed lava, which had risen into the midst of the cone with a smooth curved surface toward the west, and at the top a broken vertical surface toward the east. Seen from the north, this horn looked like a shark's fin or a parrot's beak; seen from the west like the horn of a rhinoceros."

"McCulloch and Metcalf domes were both products of the slow pushing up from beneath the waves of a mass of refractory lava, semi-solid, crusting and breaking into blocks as it rose, with only the central portions retaining a semblance of fluidity. The horns were doubtless such central portions. The same mechanism produced the extraordinary spine which rose 1,000 feet above the dome of Mont Pelee in Martinique in 1902."

"Between 1891 and 1895 Grewingk had changed its form from a large irregular cone to a small flat-topped table. I believe this change was due (1) to its being leveled by the waves and covered with beach deposits, and (2) to its being subsequently uplifted. Beach bowlders and sands could now be seen in 1907 on its flat top and in section at the edge of the top of the cliffs. An extraordinary feature of the rocky wall of Castle Rock was a sea cave at the north end surmounting a rock bench or platform 25 feet above the ocean level. This notch and floor had evidently been made by the surf, but the present surf was beating the strand at a much lower level. On comparison with photographs of 1906, a year before, it was found that the uplift of 25 feet had taken place during the last year, for those photographs showed the same rock bench and cave at sea level. Evidently Castle Rock had been rising slowly during eight months, while the lava pressure under McCulloch hill was heaping up that dome over 400 feet, with a base measuring 2,000 feet across at the beach level. The effects of mass uplift were in evidence all over the island. While a half plastic lava was pushing up rapidly in the middle cone, the adjacent, older, hard rock summits of the submarine mountain were slowly heaved up."

"On September 1, 1907, after we had left the islands, a steam blast and an engulfment destroyed McCulloch hill, sand and dust fell 100 miles to the eastward, and a visit by the Coast Guard cutter in October 1907 revealed a watery lagoon at the south base of the Metcalf remnant, McCulloch dome was gone, and all of the rocks were shrouded in a heavy mantle of volcanic debris."

There was probably another explosion lowering the remains of Metcalf hill in 1908, leaving a bay surrounded by beaches between Castle Rock and Grewingk, and in September 1909 two small lava islands arose here, a new lagoon was formed shut off from the sea, and these in June 1910 had united into a single lava hill standing 178 feet above the sea. A true crater was opened by explosion in this hill September 18, 1910, which ceased fuming in 1914. This Tahoma hill, as it was called, had been eroded away in 1922 and a channel was again opened between Castle Rock and Grewingk so that a boat could sail through. Grewingk had diminished in size and Castle Rock was changed to two rocky horns with a big accumulation of sand and gravel piled round about which trailed off into a long sand spit at the north. In July 1926 an explosive eruption heralded new activity, another occurred in December, and then a new lava dome piled itself up in the middle region within a warm salt-water lagoon at 70° F. completely shut off from the ocean by a ring of sand and bombs, and gravel heaps connecting Castle Rock and Grewingk as before. Since that time the island has quieted down. T.A.J.

New lava heap of Bogoslof Volcano about June 28, 1928, looking southwest showing warm salt lagoon and ring of explosion debris in about the same location as the active domes of 1907. Photo Wheeler.

KILAUEA REPORT No. 996

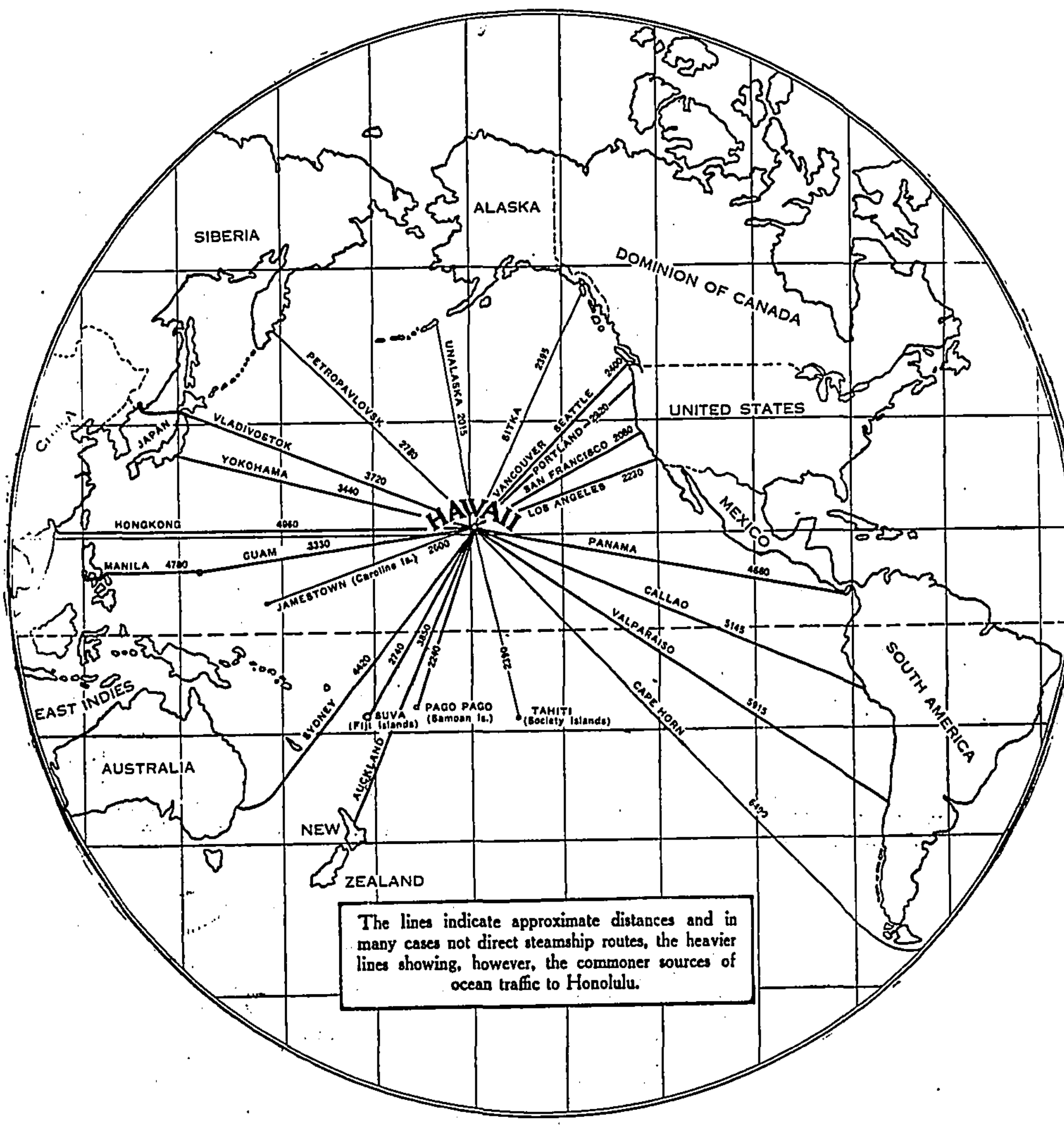
WEEK ENDING FEBRUARY 22, 1931

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

Halemaumau pit remains very quiet, there is only slight steaming on the south talus, and dust was noticed from slides at the north wall of the pit about 3:10 p. m. February 19.

Eighteen tremors and one very feeble local earthquake were registered at the Observatory during the week, the earthquake at 12:56 a. m. February 20 indicating distance of origin nine miles. Another at 12:26 a. m. February 21 was only a tremor at Kilauea but was felt as a single bumping jolt at Kealakekua in Kona accompanied by a slight noise.

Tilting of the ground was moderate to the southwest at Kilauea, and microseismic motion was slight.



Map of the Pacific Ocean showing position of Unalaska southwest of Alaska in the Aleutian Islands. Bogoslof is 40 miles northwest of Unalaska.

THE VOLCANO LETTER

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UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HAWAII NATIONAL PARK
HAWAII

OFFICE OF THE SUPERINTENDENT

February 8, 1931

The Director,
National Park Service,
Department of the Interior,
Washington, D. C.

Dear Mr. Director:-

Following is a report of activities and operations in Hawaii National Park for the month of January, 1931.

000 GENERAL:

In accordance with instructions contained in Service letter of October 13, 1930, I began to plan my work in Yosemite so as to be able to sail for my new position as Superintendent of Hawaii National Park on December 31st 1930.

On December 1st, I was relieved of detail duties as Assistant Superintendent of Yosemite National Park and thereafter my services were utilized in an advisory or consulting capacity by those affected by the change, while most of my time was taken up in preparing for the transfer to Hawaii.

I left for San Francisco on December 28th and spent the 29th and 30th in conference with officials in the Chief Civil Engineer's office, with the officials of the Bureau of Public Roads, with H. B. Hommon of the Public Health Service, and the Civil Service Commission.

I sailed from San Francisco on December 31st at noon on the Steamship Maui of the Matson Navigation Company, arriving at Honolulu 7:30 A.M. January 6th. I was met on arrival by Superintendent Allen and a number of friends, and I spent the 6th, 7th and 8th in Honolulu meeting people interested in or connected with the services or operations in the park, and reached the park on January 10th. Superintendent Allen left Hawaii Park for his new station in Zion the following day.

100 ADMINISTRATIVE:

130 Park Inspections by.

131 Superintendent.

During the time I was with Superintendent Allen in Honolulu, we discussed as many things as we could, and following my arrival in the park we made a hasty inspection of the headquarters unit, and went over all the roads. We discussed the needs of the park and particularly the estimates for 1933.

As all the construction items authorized in the 1931 appropriation have been completed, only a limited amount of maintenance work is now under way. I have, however, made a careful inspection of all the park buildings, covered several of the trails, and have been over the roads system several times.

I have also made inspection of the hotel property, and the Army and Navy camps. Several trips have been made to Hilo and one return trip to Honolulu since my arrival. I am gradually getting acquainted with the people and the park operations. Much time was spent in preparing the 1933 estimates.

125 Other Government Officers.

Mr. E. S. Wheeler, Principal Highway Engineer, U. S. Bureau of Public Roads, with headquarters in Honolulu was a visitor to the Island of Hawaii on January 31st to inspect the Federal Aid road projects and called at the park office to discuss the road improvement in the park, for which bids are now being advertised for.

130 Finance and accounts.

The financial situation of the park made it necessary to lay off three per diem men at the close of January, two being retained.

Following is a report of the appropriations available:

Name	Allotted	Expended	Balance
40/1415 Hawaii National Park	34,025.00		
4X436 Roads & Trails, Nat'l Parks	157,000.00	20,875.49	13,740.11
40/1406 F.P. & Fire Prevention	630.00	14,[illegible].11 619.21	143,5[illegible] 10.79

There appears to be a shortage of over $25,000 in the Roads and Trails appropriation between the amounted allotted for the contemplated road work and the engineers estimate.

150 Equipment and supplies.

Some of the furniture required for furnishing the superintendent's quarters was purchased early in January, and some has still to be delivered. The articles received are as follows:

1 only Large size kitchen cabinet
1 only Dining-room table 48" X 42", with 3 extension boards
1 only China cabinet with glass doors and sides
1 only Buffet, top 60 x 20 inches, 2 drawers and 2 side cupboards
1 only Host or arm chair with leather seat
8 only Chairs with leather seats
1 only Woolen rug 8' X 10', neutral color
1 pair Beds, twin, complete with double coil bed springs & mattresses
1 only Chiffonier, ivory finish
1 only Wicker fernery, gray, 38" high with box 10" by 26"
5 only Chairs, oak, straight back.
1 only Stool, bathroom, green enamel
1 only Stool, kitchen, high, finished in green
1 only Chair, "Windsor" type, walnut finish
1 only Rocker, " " " "
1 only " wicker, with upholstered back, coil spring seat and upholstered cushion, color frosted brown.
1 set Desk-bookcase combination, with 2 sectional bookcases with glass front and 1 18" sectional desk-unit, with base and top.
1 only Flower stand of oak, 27" high and with 10" diameter top.

160 Circulars, placards, publicity bulletins, etc.

Copies of the weekly issue of "The Volcano Letter" are attached.

200 MAINTENANCE, IMPROVEMENTS AND NEW CONSTRUCTION:

210 Maintenance.

Maintenance and repair of roads, trails, telephone lines, water system, etc., was carried on as usual during the month.

230 New Construction.

A new gasoline and oil storage tank and building was started and about completed by the end of the month.

300 ACTIVITIES OF OTHER AGENCIES IN THE PARK:

310 Public service contractors.

311 Character of service rendered to the public.

Regular hotel service was furnished by the Volcano House, although travel was very light, especially during the first part of the month. Photographic service was also available from Mr. Maehara.

400 FLORA, FAUNA, AND NATURAL PHENOMENA:

410 Ranger, naturalist and guide service.

As travel to the park was light during the month, the Ranger-Naturalist took only seventeen people over the trail from the hotel to the pit, and two hundred fifteen heard the lecture at the Uwekahuna Observatory. Four trail trips and twelve lectures were given.

460 Natural phenomena.

Volcano.

Kilauea Volcano remained quiet during the month, there being no special changes. Slight earth tremors were constantly recorded on the seismographs, and a series of feeble earthquakes were also recorded. The pressure under the pit has apparently not subsided and renewed activity may be looked for at any time.

500 USE OF PARK FACILITIES BY THE PUBLIC:

510 Travel.

Tourist travel to the Hawaiian Islands has been lighter than for the same period last year but toward the end of the month, steamers began arriving with larger numbers, and this has tended to increase travel to the park. Mr. J. H. Ryan, General Passenger Agent of the Matson Steamship Company expects travel for 1931 to be fully as good as for 1930.

520 Weather.

The Island of Hawaii has had less rainfall during the past six weeks than for a decade. On the Kona side of the Island the situation is serious. Crops are being ruined. Water for domestic use has run short and it has been necessary to haul or carry it long distances. Cattle had to be moved, etc.

In the park the hotel got along very nicely because of large storage capacity and light travel. The Army and Navy camp was short all during the month and managed to get along only by extreme conservation. The supply of the Park Service has failed at some quarters, but by pumping from auxiliary storage tanks at utility buildings, we managed to get along.

There was an unusual cold with the clear dry weather too. On January 14th and 20th, there was a killing frost. The vegetable gardens of the hotel company suffered slightly but the greatest damage was to the ferns of the park, especially in certain areas. All the fronds have turned brown or black and apparently are killed. Of course new shoots will grow again soon. However, this was a most unusual occurrence as no one around here could remember a similar frost as heavy as this one. The following data is of interest.

Maximum temperature — 23rd	70	degree
Minimum " — 29th	46	"
Rainfall for month of January	1.02	inches
" " " " " at Hilo	2.22	"
" " to-date Volcano District	1.02	"
" " " at Hilo	2.22	"

600 PROTECTION:

Aside from the usual patrols there were no unusual happenings during the month.

Three soldiers got out too far from camp and were reported lost and Rangers Christ and Brumaghim headed a detail from the Army camp and the boys were found about 9:00 P.M.

640 Destruction of predatory animals.

There were 104 wild goats killed during the month, 4 wild hogs, 1 wild dog and 0 wild cats. These are all domestic animals that have gotten away and become wild, or the increase of such animals. The number of wild animals is gradually decreasing.

650 Signs.

There is the same tendency in this park as elsewhere to use signs for targets and some damage to signs was done during the month. The guilty persons could not be determined.

900 MISCELLANEOUS:

It is proper to record here that on every hand I have received a hearty welcome from individuals and organizations interested in or connected with the services or operations in the park, and every courtesy and consideration has been shown me. Everyone has offered fullest cooperation in developing and improving the park and in anything that pertains to park welfare. There is still so much to be done here to bring this park up to the standard of other parks that I am sure I will be very busy and will have a real opportunity to make worth while accomplishments if I can secure and hold the combined support of the community, the Park Service, the Bureau of the Budget and Congress. In taking over my new duties I pledge my best efforts to that end.

Very respectfully yours,

E P Leavitt

Superintendent.

Copy to "Field Headquarters" (2)
" " "Yellowstone National Park" (1)

10-157

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

TRAVEL REPORT

Hawaii National Park for the Month of January 1931

	This Month	This Travel Year To Date	This Month Last Year	Last Travel Year To Date	Increase for Travel Year Number	Increase for Travel Year Per cent
PRIVATE TRANSPORTATION:						
Cars first entry						
Cars reentry						
Motorcycles						
Total motor vehicles						
Persons entering via motor vehicles	5,835	58,850	5,895	25,765	33,085	128.4%
Persons entering via other private transportation	268	1,455	260	1,017	438	43.1%
Total persons entering via private transportation	6,093	60,305	6,155	26,782	33,523	125.2%
OTHER TRANSPORTATION:						
Persons entering via ~~stages~~ Hotel	670	2,368	876	2,630	- 262	9.9%
Persons entering via trains						
Persons entering otherwise						
Total other transportation	670	2,368	876	2,630	- 262	9.9%
GRAND TOTAL ALL VISITORS	6,763	62,673	7,031	29,412	33,261	113.1%

	This Year	Last Year	Increase Number	Increase Per cent
Automobiles in public camps during month	0	0	0	0
Campers in public camps during month	0	0	0	0

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

STATUS OF AUTHORIZED PROJECTS

Hawaii National Park for the Month of January 1931

	Description of Projects	Percent Constructed To Date	Percent Constructed This Month	Percent Constructed Last Month	Probable Date Completion
405	Ware House	100	—	100	
406	Toilets, (Kilauea)	100	—	100	
407	Toilets, (Uwekahuna)	100	—	100	
408	Gasoline & Oil Building	97	97	—	February 10, 1931
451	Telephone Lines	95	—	95	
502	Kilauea Iki Trail	100	—	100	
502	Mauna Loa Trail	100	—	100	
502	Summer Camp Trail	100	—	100	
502	Steaming Bluffs Trail	100	—	100	
	Road Survey, B.P.R.	100	—	100	

10-159

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

S T A T U S   O F   P E R S O N N E L

Hawaii National Park for the Month of January 1931

	This Month	This Month Last Year
Number of employees beginning of month,	12	13
Number of additions, ...	2	1
Total, ...	14	14
Number of separations, ...	5	2
Number of employees close of month, . .	9	12
Number of promotions during month	1	0
Aggregate amount of annual leave taken,	0	0
Aggregate amount of sick leave taken,	0	0
Aggregate amount of leave without pay,	0	0

J-160

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

REPORT OF PARK REVENUES

Hawaii National Park for the Month of January 1931

	This Year	Last Year
Park revenue on hand beginning of month,	0.00	0.00
Received,	1,075.00	1,025.00
Total,	1,075.00	1,025.00
Remitted,	1,075.00	1,025.00
On hand close of month,	0.00	0.00

Park revenues received this year to date,	1,075.00
Park revenues received last year to date,	1,025.00
Increase,	50.00
Percent of increase,	.049

10-161

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
Hawaii National Park

REPORT OF SALES OF PUBLICATIONS
January 1931

	Number	Value
GOVERNMENT PUBLICATIONS:		
On hand beginning of month,	364	80.50
Received during month,	0	0.00
Total,	364	80.50
Sold during month,	5	5.00
On hand at close of month,	359	75.50
NON-GOVERNMENT PUBLICATIONS:		
On hand beginning of month,		
Received during month,		
Total,		
Sold during month,		
On hand at close of month,		

Cash on hand beginning of month,	20.90
Sales during month,	5.00
Total,	25.90
Remitted during month,	22.90
Balance,	3.00

The Volcano Letter

Two dollars per year | Ten cents per copy

No. 315—Weekly | Hawaiian Volcano Observatory, National Park, Hawaii | January 8, 1931

The eruption in Halemaumau November 19, 1930, at about 5 p. m. The smaller fountains directly in front of the large talus in the center background, and the main fountain to the left, are pouring out lava which is rapidly spreading over the old floor formed in July, 1929. Photo Maehara.

LAVA IN HALEMAUMAU SINCE MAY, 1924

It may be of interest at this time to review briefly the stages of the volcanic activity of Halemaumau since the great explosive eruption and collapse of May, 1924.

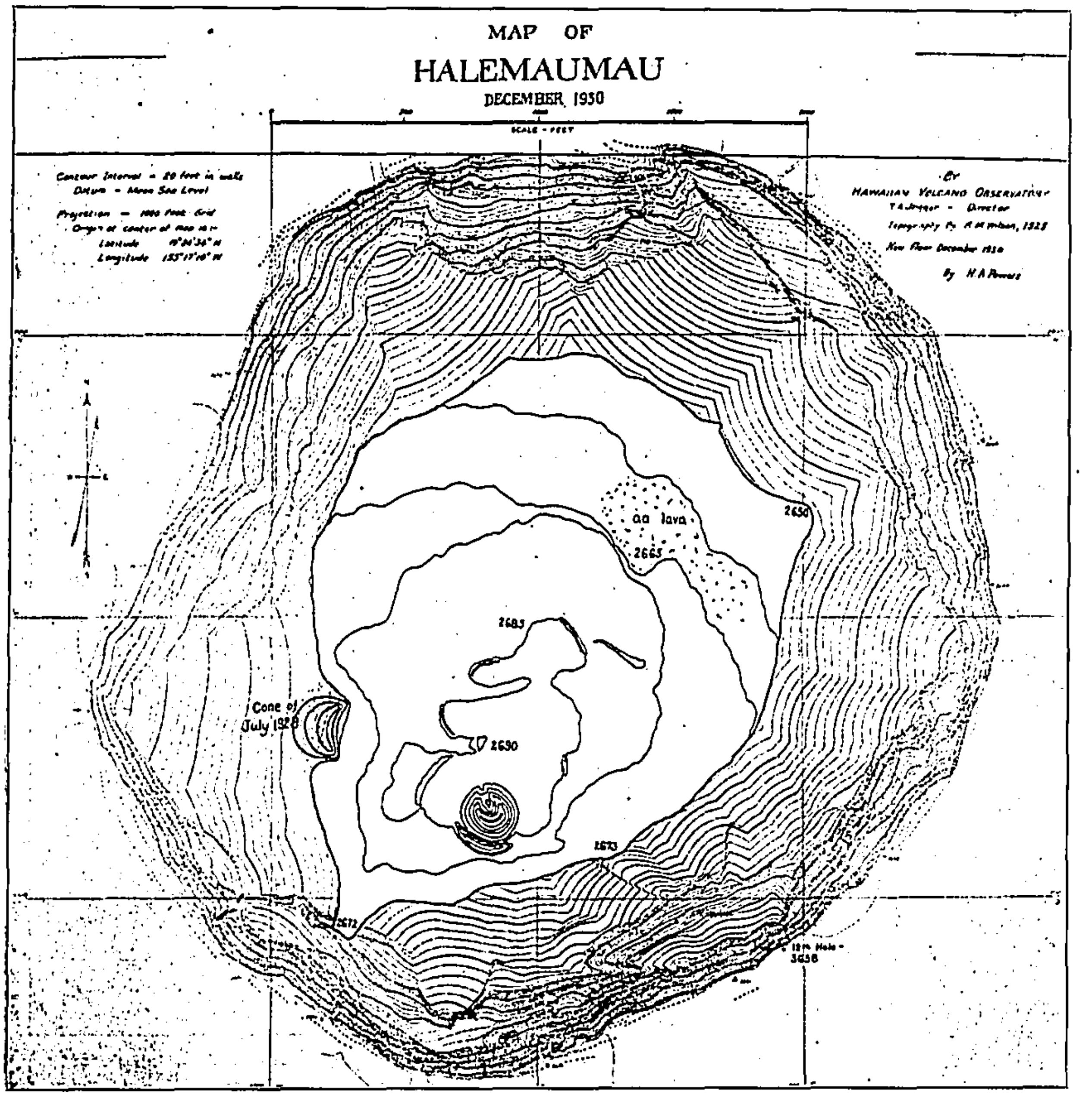
At the end of this explosive phase, no live lava was visible in the pit. Its appearance may be described by quoting from the Monthly Bulletin of the Hawaiian Volcano Observatory for July, 1924:

"The cauldron left by the May eruption was at the upper rim by measurements platted early in July, 3,400 feet long northeast-southwest by 3,000 feet wide. It remained an irregular oval with edges that had gone back about equally in all directions. The lowest part of the bottom flat was towards the north apporximately 1,335 feet below a datum station on the eastern rim. This bottom area was diamond-shaped and gravelly, of dimensions 1,000 by 700 feet. . . . The site of the center of the new pit was indentical with the old Halemaumau, which had merely been enlarged and deepened."

Shortly after 1 o'clock on the afternoon of July 19, 1924, live lava appeared in the new pit, breaking out in a source fountain through the west talus at a point about 125 feet higher than the bottom of the pit. The lava flowed from the source fountain down the talus slope and then outward over the floor of the pit. This activity continued 10 days, until July 29. The new lava floor built by this eruption was 1,100 feet long by 800 feet wide. The center of the floor had piled up some 25 feet higher than the margins to a point 1,305 feet below the station on the east rim or about 2,390 feet above sea level. Thus the new lava floor was 35 feet thick in the center over the lowest point of the old rock floor.

Lava did not reappear in the pit until July 7, 1927, almost exactly three years later, but during all of this interval the pit was being enlarged by cracking and avalanching of the rim.

About 1 o'clock the morning of July 7, 1927, lava broke out in four fountains aligned along the edge of the 1924 lava floor at the base of the southwest talus. The southern-



Map of Halemaumau revised to show the shape and elevation of the 1930 lava floor.

most fountain broke through the talus above its base in the manner of the 1924 fountain. This eruption came to an end on July 19, after 12 days of moderate but continuous activity. The new floor formed by the lava which poured over the bottom of the pit was 1,700 feet long and about 1,400 feet wide at its greatest dimensions, with its long axis lying in a northeast-southwest direction. It covered a space of approximately 30 acres. An average elevation of the center of the floor was 2,515 feet above sea level. Thus somewhat over 100 feet of new lava had been deposited on top of the old floor by this eruption.

The last of the year (1927) was marked by a series of very heavy avalanches. After one enormous slide from the north wall of the pit, live lava oozed out from several cracks in the floor at the edge of the avalanche debris. No fountaining accompanied this gush of lava, and many other facts seemed to indicate that the activity was no more than a squeezing-up by pressure of remnant liquid lava from the July eruption. This gush of lava took place on January 11, 1928.

The collapse of the rim of the pit by avalanching continued with some violence during the early months of 1928. In the summer of 1928 a survey of the pit by Mr. Wilson showed that it had changed somewhat in shape since the summer of 1924. Quoting from the Volcano Letter No. 184: "In its (the pit's) present condition it is almost circular in shape, though the northeast-southwest diameter is slightly greater. Its diameters are 3,240 by 2,980 feet. The perimeter is 1.96 miles. The depth of the lowest part of the floor below the average rim elevation is 1,170 feet. The area of exposed lava floor and the cones with their spatter is now about 19 acres. The horizontally projected area of all the taluses is 87 acres, and the area of the horizontal projection of all the walls is 81 acres; the slope areas are of course much greater. This makes the total area of the pit 187 acres.

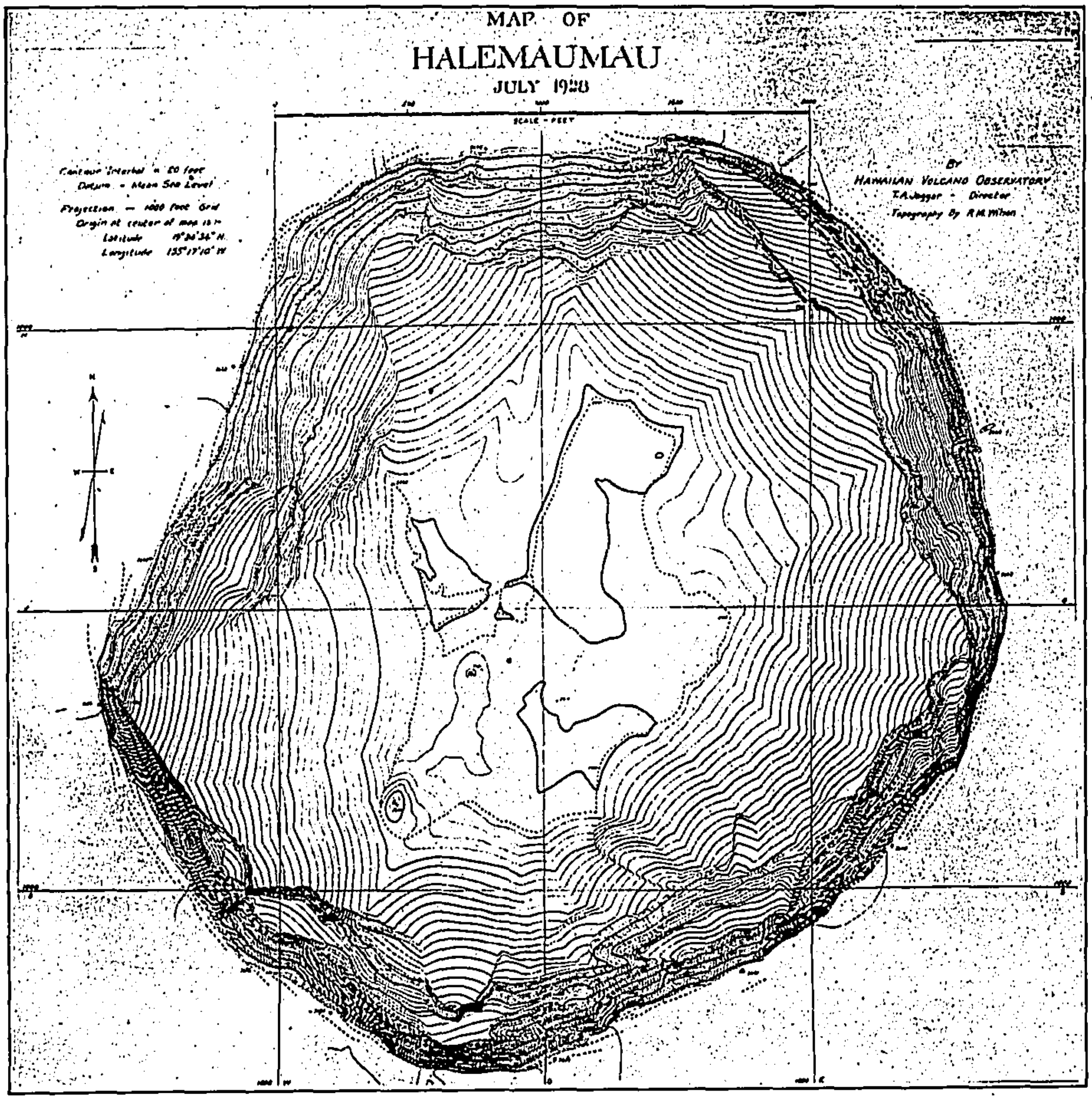
Lava reappeared in the pit at 12:45 a. m. February 20, 1929, and the fountaining occurred along a thousand-foot rift in the old floor trending N. 63° E. about 270 feet out from and parallel to the northwest edge of the floor. The activity continued until 1:15 p. m. February 21, about 36 hours. The new lava spread completely over the old floor and extended itself up on the bounding talus slopes.

At the end of the eruption the new lava fill had an average diameter of 1,600 feet and covered 40.5 acres. After solidification of the new fill, the surface averaged 45 feet above the average surface of 1927 lava.

After a much shorter period of repose, fountaining lava again appeared in the bottom of the pit about 6 a. m. July 25, 1929, the source fountains breaking through the southwest edge of the old floor near the big talus very close to the center of the 1927 fountaining area. Lava flowed from the source fountains until 7:42 p. m. July 28. During the first 24 hours the lava rose 44 feet above the level of the old floor. At the end of 48 hours, the depth had increased to 77 feet, and on the morning of the fourth day, July 28, the pit had been filled 88 feet. The maximum elevation of the surface of new lava was reached at the end of 85 hours activity, 94 feet above the old floor and 2,640 feet above sea level. Withdrawal of some molten lava, and shrinkage due to crystallization, caused some collapse of the surface of the new lava after the eruption stopped. The final cooled fill of new lava had a surface area of 55 acres and an average depth of 55 feet. The average elevation of its surface was 2,600 feet above sea level.

The recent activity, November 19 to December 7, 1930, has been the longest of this series of intermittent eruptions, and it has also brought a much greater amount of lava into the bottom of the pit. The new floor formed during this activity covers 62 acres and has an average depth of about 70 feet. It was estimated that somewhat over 15,000,000 tons or about 229,000,000 cubic feet of new lava is contained in this fill. The surface of the new fill varies from 2,650 to 2,690 feet above sea level.

In the six years from 1924 to 1930 the dimensions of the flat bottom of the pit have been increased from 1,000



Map of Halemaumau as drawn in 1928, showing the elevation s and shape of the floor of lava formed by the 1927 eruption.

New National Park Service lookout house on Mount Harkness, California. The Lassen Volcano Observatory has installed a two-component seismograph in the basement of this building. (See Volcano Letter No. 305, October 30, 1930.) Photo Finch

by 700 feet to 2,200 by 1,700 feet by the rise of the level of the lava fill. The elevation of the lowest point of the bottom has changed from 2,360 to 2,650 feet above sea level, giving a lava fill of 290 feet. Thus a total volume of over 463,000,000 cubic feet of lava has been poured into Halemaumau by the five eruptions which have a combined duration of 46 days of activity. In a circular pit 1,000 feet in diameter, about the size of Halemaumau before 1920, this volume of lava would make a column about 600 feet deep. H.A.P.

KILAUEA REPORT No. 989

WEEK ENDING JANUARY 4, 1931

Section of Volcanology, U. S. Geological Survey
H. A. Powers, Temporarily in Charge

The strong trade winds blowing across the dry crater and the edge of the Kau Desert during the first three days of the week whipped up huge clouds of dust which gave a fair imitation of the dust clouds from Halemaumau during the explosive eruptions of May, 1924. Then during the latter part of the week, beautiful cumulus clouds formed above the pit at night which lacked only the glow on their under side to duplicate the steam cloud of the recent eruption. Within the pit the emission of blue fume from the fountain site has ceased entirely, and but a small amount of steam is now being given off from the cracks in the new lava floor. Steaming was fairly strong from the south talus and the big southwest talus during the later part of the week.

One feeble quake was recorded on the Observatory seismographs at 4:01 p. m. December 30 which had a distance to its origin of 9 miles; and one very feeble shock was registered on January 4 at 9:33 p. m. On January 1 the seismograph was disturbed at 11:39 p. m. by the preliminary wave from a distant earthquake, and the stronger shock waves from this quake kept the pens in motion for 55 minutes. The Observatory instruments recorded 56 small tremors of probable volcanic origin during the week. The non-volcanic microseismic motion was moderate during the first three days, then dwindled to slight intensity for the last four days.

The average of the tilt record for the week shows a very slight inclination to the west since last week. This average gain was made up of several slight tiltings in various directions, showing that no single strong factor is controlling the tilt at the present time. There still has been no sign of a notable decrease in the pressure under Kilauea since the end of the last eruption which would have been indicated by a notable tilting of the ground in toward the pit.

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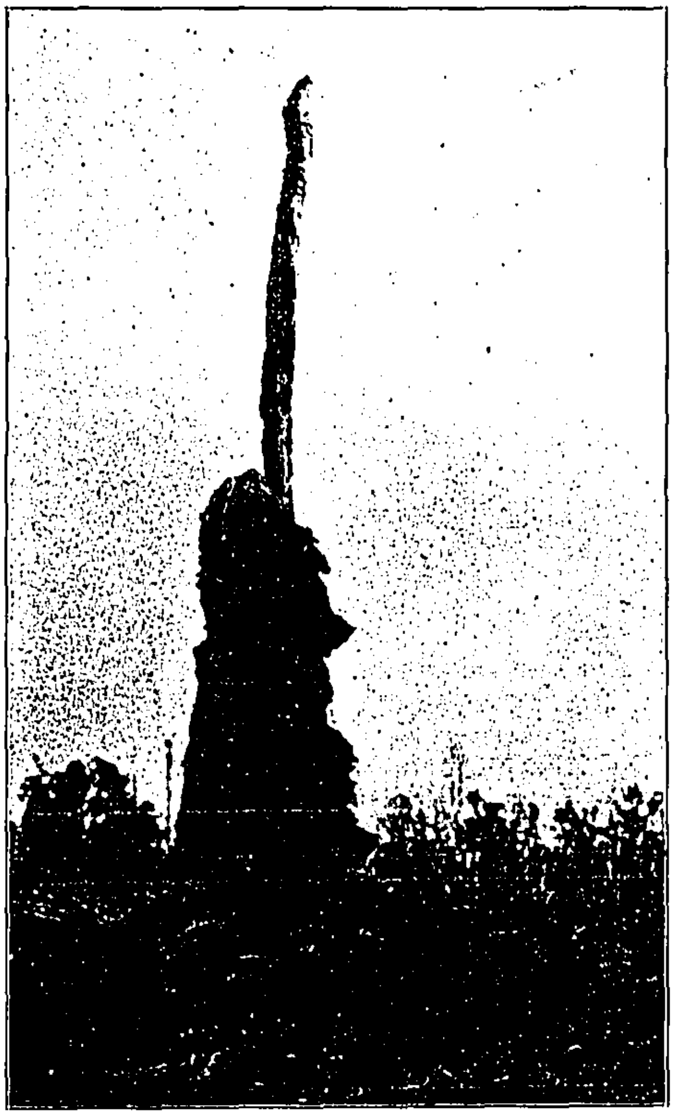
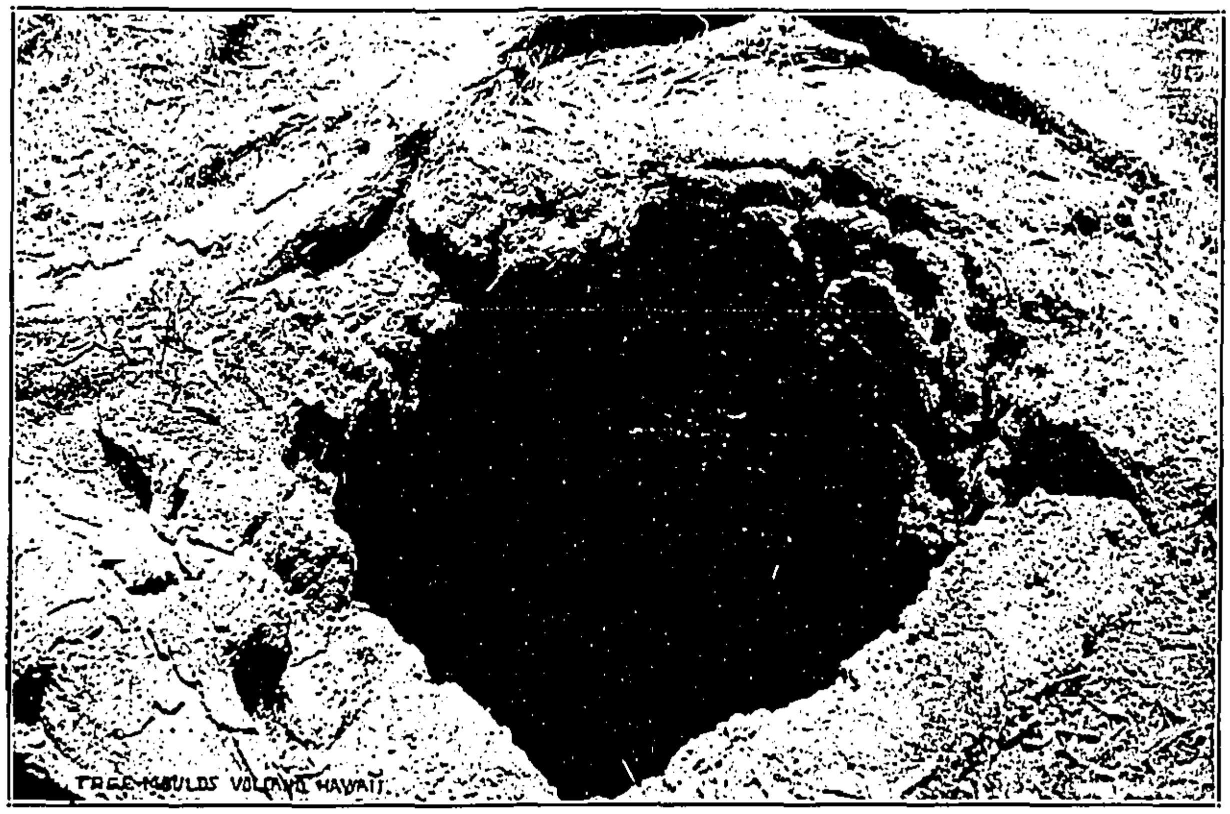
No. 316—Weekly | Hawaiian Volcano Observatory, National Park, Hawaii | January 15, 1931



Lava tree with wooden trunk still standing in it, formed by flow enwrapping the base of tree from left to right and then lowering. 1923 flow from Kilauea, Chain of Craters Road. Photo Boles.

LAVA TREE CASTS AND TREE MOLDS

Lava trees, Figure 1, and tree molds, Figure 2, are very much the same thing, but the one stands in relief, while the other is left a hole in the ground. To understand these tree molds we must remember that lava is very stiff and plastic when it is flowing, like molasses candy, and that contact with any cool substance like wood may, it is true, set fire to the substance, but none the less the lava will instantly congeal. It is really a glass, and molten glass solidifies very quickly. When the wood which is surrounded by lava flames up and burns away, the glass mold may retain very perfectly the pattern of the bark (see Volcano Letter No. 212, Page Three). Both lava trees and tree-molds contain cavities where the wood has burned out. There is a possible third type which would be formed where fresh lava filled up one of these cavities and made a true cast or stone tree by utilizing the natural mold created by the earlier lava flow. A fourth type was described by Mr. Bartrum in Monthly Bulletin of the Hawaiian Volcano Observatory for July, 1925. Here in the North Auckland district of New Zealand a carbonized tree trunk had been trapped by very liquid lava, by shrinkage radial cracks had developed the ring structure and radiation



Tree cast making a well three feet across, with bark pattern molded on the walls. Roots of a modern tree shown above. Here the lava surrounded a tree that burned out. Golf links at Kilauea Volcano. Photo Kanemori.

structure of the wood, the molten glass had penetrated these cracks forming lamellae of finely vesicular basalt in a sort of honeycomb preserving the texture of the original tree. Some of the partitions are no thicker than a sheet of paper.

Both lava trees and tree-mold wells are formed when a fluid lava flow invades a tree-covered area. The lava is chilled upon surrounding a tree and solidifies. If the flow is one of great fluidity, the level of the lava surface is apt to lower greatly after the source of supply has given out. This is because the flowing does not cease, out from under the high crust first attained. Consequently this flood level of the lava in the forest leaves its mark on all the trees, and its mark is nothing less than a casing or shell around each trunk. The original crust over the flow as a whole sinks much lower than the level where it stood when the hot lava was impeded by the forest. The outer edges of the flow during the closing stages sent out tongues which drained away the under substance. Hence the casts of trees, or better the frozen shell of lava around trees, remain to mark the original height of the flow.

Figure 3 shows the southern edge of the floor of Kilauea Crater in March, 1921, where the level of the lava was adjusted after the source fountain ceased action. No trees were present, but the lava plaster on the cliff marks the height of the flood when the fill was made. The cliff is composed of old horizontally bedded ash layers. At the foot is seen the downward broken or slumped field of lava, robbed of its under substance by outflow from under the crust.

If a flow is not so fluid and there is no way for the lava to escape around the edges, the surface does not lower so much after activity at the source has ceased, and instead of a plastered rock tree above the surface, there may be left merely a well or hole in the rock, molding the tree that has burned or rotted away after being surrounded by the melt. Figure 1 shows the wooden bole of the tree still standing in the embrace of the plastered layers of lava which are wrapped around its base.

Occasionally tall lava trees are found on hillsides for which fantastic explanations have been offered. It must be remembered that a grove of trees is a substantial and resistant object in a landscape. A lava flow is a sluggish mass of porridge which will pile up against such an obstruction. This is illustrated by Figure 4 where the obstruction was a cone on the southwest slope of Kilauea. The flow of 1823 plastered the slope of the cone to a considerable height as the flood divided around it. The cone is about 30 feet high and if trees had existed at its base so as to be trapped in the lava, these might have been molded and stand as monoliths today of considerable elevation, while but a few feet away other trees might have escaped uninjured.

Tree casts and molds are found in many places. In the Craters of the Moon National Monument in Idaho there are excellent examples. In the "Burnt Lava Flow" south of Glass Mountain in northern California there are several tree casts, most of which were pushed over by later flows. These casts of woody matter by lava are not confined to recent volcanic activity, for they are found preserved in ancient volcanic strata.

The tree molds near the golf links at Kilauea Volcano are wells lined with a selvage of glassy lava which often preserves the pattern of the bark of the koa trees which were molded by an ancient Kilauea flow. These wells where the tree has burned out are from 6 inches to 6 feet in diameter and from 3 to 12 feet deep. The ground round about is covered with ash soil, and this somewhat obscures the real significance of these molds. This ash was the fallen volcanic dust of the explosive eruption of Kilauea in 1790. Where the original lava shells around the trees stood slightly in relief in these places, the ash drifted over the country in sufficient volume to fill up the ground around the tree casts, but not sufficient to fill up the holes themselves. Therefore the shells do not appear to stand up, but are preserved merely as pits in the ground modelled after the original single, double, or triple trees whose roots were far below where the tourist stands today. On the nearby slopes of Mauna Loa there are some of these tree molds shaped like a trough, where the lava trapped a fallen or recumbent tree, and the divergent roots at the end are now marked by divergent tubes where the roots were modelled in stone and then burned away to ashes.

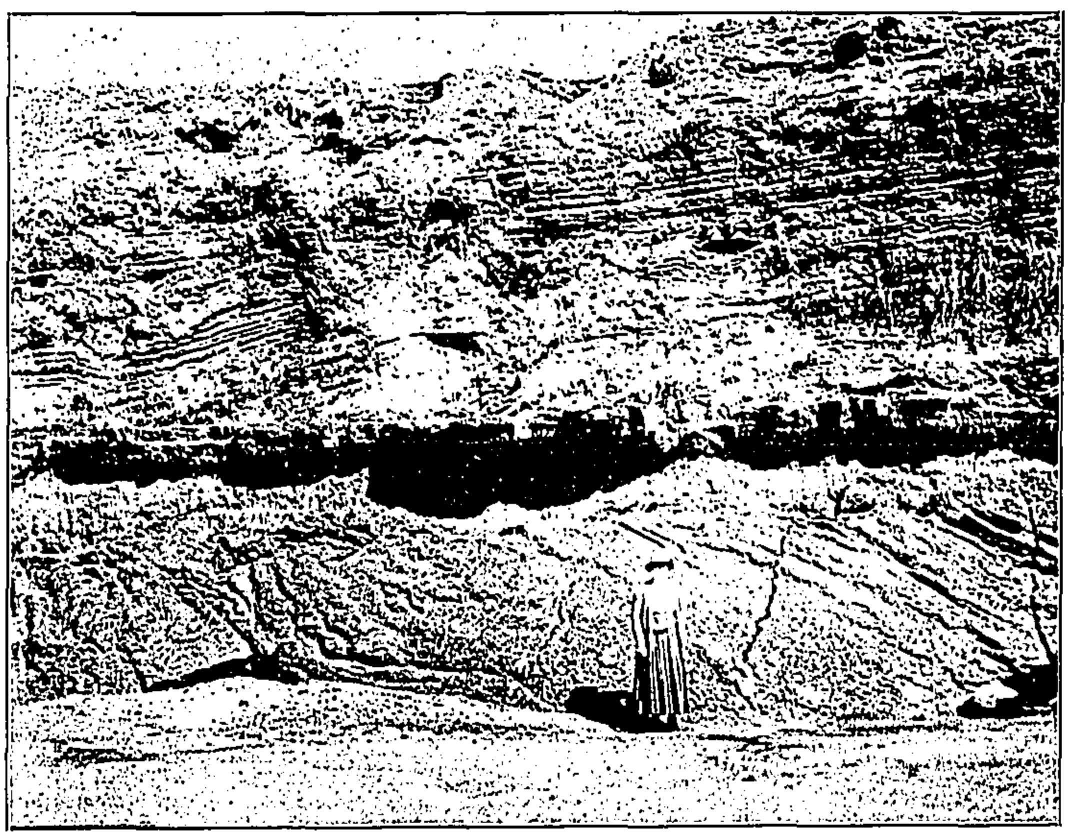
R.H.F.

TILTING OF THE GROUND FOR DECEMBER

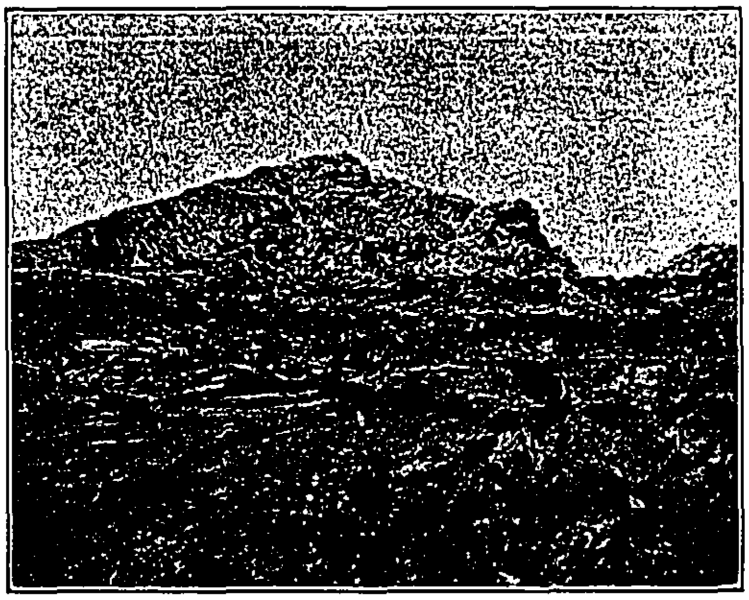
The tilting movement of the ground under the Hawaiian Volcano Observatory during the month of December, 1930, and following the eruption of lava in the bottom of Halemaumau pit beginning November 19 and ending December 7, has amounted to more than 5 seconds of arc in a northeasterly direction. This is a tilt away from the pit and it will be seen that it increased during the eruption and increased greatly the second week after the eruption. While still being northerly the tilt had a westward trend during the last week of December. The suggestion is strong that the upward pressure of the lava continued after the visible outflow ceased. There has been nothing around Halemaumau as yet to indicate that the lava column is lowering.

The following figures show the net amount of tilt on the northeast rim of Kilauea Crater, and its direction, computed from the daily seismograms, by platting a curve smoothed by overlapping progressive seven-day averages.

November 24-30	1.2 seconds	NNE
December 1-7	1.8 seconds	NNE
December 8-14	0.2 second	NNE
December 15-21	2.5 seconds	NE
December 22-28	1.2 seconds	WNW



Lava bench at base of ash cliff, south bay of Kilauea Crater. The 1921 flow slumped after rising to the level of this bench, as the feeding source had become inactive. Photo Finch.



Lava plastered cone where the 1823 Kealwa flow from Kilauea piled up on the hillside and then lowered. Photo Emerson.

KILAUEA REPORT No. 990

WEEK ENDING JANUARY 11, 1931

Section of Volcanology, U. S. Geological Survey

T. A. Jaggar. Volcanologist in Charge

There have been no changes at Halemaumau during the week. Steam is as usual at the vapor vents. No renewal of fume has occurred.

The instruments at the Observatory recorded a total of 28 seismic disturbances. Of these 25 were tremors and 3 were very feeble local earthquakes, all unfelt. One shock occurred at 6:27 p. m. January 6 with indicated distance 18 miles; another was at 7:38 p. m. January 7, indicated distance 37 miles.

Tilt for the week accumulated moderately strong SSW, a change from the prevailing northerly direction during previous weeks. Microseismic motion was stronger than normal, probably due to high winds at the end of the week.

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No. 317—Weekly Hawaiian Volcano Observatory, National Park, Hawaii January 22, 1931

Lava dome of Tarumai Volcano in Hokkaido, the north island of Japan, two hours after the eruption of October 30, 1926. The dome was formed in 1909, but was rent asunder by a new gas eruption in 1926. Photo K. Shibahara.

THE LAVA DOME ERUPTION OF TARUMAI

In Volcano Letter No. 276 an airplane photograph of 1926 was shown exhibiting a new gas outbreak through the crater dome of Tarumai Volcano in Hokkaido, the north island of Japan. Tarumai is 3,300 feet high amid the forests and lakes of the "Canadian" wilderness of Japan. The map on Page Three shows the four islands of Japan and the black lines represent the arcuate rifts in the crust of the earth along which are grouped the belts of active volcanoes. The southwestern curved line follows the arc of the Riu Kiu islands, which passes through Sakurajima Volcano in the southernmost bay of Kiushu (Volcano Letter No. 308). This ends with subordinate offshoots in the west end of Japan proper, and then comes the arc of that island, with eastern and western belts of volcanoes at the north. These belts converge at Yakedake Volcano (Y in cut), and there meet the great arc extending to the south which passes through Asama Volcano in central Japan. (Volcano Letter No. 297) Fujiyama, (F in cut), Oshima in Sagami Bay southwest of Tokyo (T in cut, see Volcano Letter No. 299), and the Ogasawara volcano islands and the Bonin group far to the south in the direction of Guam. Another bend starts a new arc in western Hokkaido and this extends outside of the map to the northeast along the line of the Kurile island volcanoes which lead in turn to a new arc in Kamchatka. Tarumai is at the southwestern end of the black line marking the Kurile arc, and not far east from Usu Volcano, described in Volcano Letters 298 and 302. (See Simotomai, Zeitchr. fur Erdkunde zu Berlin, No. 9, 1912).

The eruption which lifted the crater floor of Tarumai and converted it into a lava dome occurred in the spring of 1909, and the writer was privileged to make the ascent of the mountain and study the dome while it was still hot and steaming on May 9 of that year. He carried with him a Bristol pyrometer for measuring high temperatures in the cracks of the lava dome. He was accompanied by Professors Oinoue, Sato, and H. Tanakadate, who furnished valuable photographs and information. He stayed at the sawmill and match factory in the forest at the base of the mountain, operated by Mr. Haruta, who had watched the activity from its beginning.

We arrived by rail May 8th at Nishitap near the south shore of Hokkaido, and walked two miles across open flats to the mill which is on a brawling trout stream. The valley is enclosed by a marked marine terrace at least 200 feet above sea level. In the afternoon the clouds rose and showed the east rampart of Tarumai to be saddle-shaped, with pure white steam clouds rising behind it. The mill is 7 miles from the crater, and its function is to make thin strips of pine for match boxes.

At 6:30 a. m. we started on foot through the woods for the mountain, and after leaving the forest crossed several step-like ridges at the base of the outer cone, these being followed by a 35° slope of pumice and cinder which made laborious climbing. Arrived at the high rim of the outer crater we were surrounded by clouds, but saw a great fallen block of andesite in the inner crater. In the afternoon the summit cleared and the huge lava dome was revealed 1500 by 1800 feet in diameters and 600 feet high above its visible base. There was an inner crater pit 2200 by 1300 feet in diameters, and the dome of the new lava was west of the center of this inner crater with its talus overlapping the crater edge on the southwest. The whole surface of the dome was pinnacled with many small pillars rising all over it. These dimensions were from a survey by Oinoue of April 23 and there had been some changes during the fortnight succeeding. The picture on Page One shows the general aspect of the dome, but with much more talus than was present at first. The writer had studied the dome of Bogoslof in 1907, and was impressed by the greater height and steepness of the Tarumai dome, and the protruding crags of hot lava.

At the north where the lava dome was rounded and did not overlap the rim of the inner crater, no falling of rocks was observed, but at the south the dome was very steep and overlapped the rim, there were great fallen blocks at its base, and Dr. Oinoue reported he had seen a block 30 feet in diameter come down. Several rocks were heard falling. At a sulphur patch amid the cracked andesite of the dome, a maximum temperature of 457° C. was measured, while the steam temperature gave 430° when the terminal did not touch the rock.

The history of the eruption was as follows: On the night of January 11, 1909, a column of fire rose over the crater, in the night of January 22 ash fell on the snow at the mill, in the morning of February 6 there was an ash fall and smoke was visible over the mountain, and at 3 p. m. February 10 sounds were heard twice, much steam arose, and ash fell. At 1 p. m. February 18 much steam was visible, and on March 3 rumbling noises were heard three times by the miller Haruta. In the morning of March 30th detonations began at 7:18 a. m., rumbling continued for an hour, stones fell the size of peas, and the smoke from the crater rose in a very slender whitish column which later became darker. After an hour the activity diminished, and in the afternoon the eruption ceased.

April 12 at 11:40 p. m. came loud rumbling and lightnings; at a place two and a half miles from the crater stones fell 5 to 7 inches in diameter, and an earthquake occurred lasting two minutes. April 15 and 17 the column of brown smoke was seen at Sapporo in central Hokkaido. Close at hand strong rumblings, smoke, and glow were perceived, and April 18 with southerly wind the ash fell to leeward 25 to 30 miles away. The cauliflower clouds rising above the mountain assumed wonderful spiral form. There was no life lost in the eruption. The glow increased and the explosive activity dwindled to steam jets April 22.

April 23 Oinoue climbed the mountain, found the steaming dome, and made photographs and sketches. The dome had first been noticed by a fisherman on Lake Shikots on April 20 and had developed at some time after the explosions of April 12 and 17. On April 4 the inner crater pit had been 200 feet deep, floored with gravel, the floor sloping gently toward the north, and steaming chiefly around the west and southwest borders. The pit had shown lava sheets in its wall. There was a small depression in the northern part of the bottom. The lava dome had come up through this bottom. Mr. Oinoue observed glow in the crevices of the dome. Several cracks were found in the rim of the inner crater near the edge of the dome. Rocks were constantly falling off the western side from the many pinnacles of this rude aa of andesite lava, of which the dome was formed. When a huge block fell away from the upper part of the dome a glowing spot was left where it broke off.

On May 1 a sketch from the western mountain showed increased talus all around the dome except on the northeast side where the jagged rock ledge extended all the way to the base. The profile had become flatter on top, but still showed pinnacles, and an inner comb or fin rose slightly above the flat top. There were many immense fallen blocks, but the slides of rock matter were small and few.

When I saw the dome on May 9 the sulphur-coated blocks of rock near the level of the edge of the crater on the south side of the dome averaged 2 to 3 feet in diameter and the odor was of sulphur dioxide. Quiet steam was rising. There was an area of sulphur stains 30 feet across. The wind was from the south, and a faint crackling was audible in the hot rocks.

The following notes on temperature of crevices in the dome, made with the thermo-couple, indicate the heat at this time:

(1) The base-metal couple was inserted without touching the rock one foot into a cavity nine inches in diameter full of rising steam. The terminal was at least three inches from the rock in four directions. Temperature 430° C.

(2) A narrow steaming fissure was measured, the terminals touching the rock, and inserted 24 inches from the outer surface. Temperature 450° C.

(3) A big wedge-shaped cavity was measured, under a large bowlder, with a very large opening on the outside. Temperature 390° C.

(4) A small cavity, lower down the slope under No. 2 above, received the terminals 12 inches inside laid against the rock. Temperature 457° C.

(5) A small cavity 6 inches across the mouth, admitted the terminal for a distance of 4 feet. Temperature 398° C.

(6) A small area of secondary solfataric action, stained rocks across an area 7 feet in diameter, a 2-inch fissure among the fragments, the terminal inserted one foot. Temperature 200° C.

This volcano is famous for the large amount of pumice which it has ejected. It has an outer ring wall like Somma at Vesuvius. There was a faintly defined inner cone surrounding the inner pit. In July of 1739 the mountain rumbled and emitted fire, volcanic ash fell heavily during two or three days and nights, all this being preceded by a shock of earthquake. In 1804-17 there was a great eruption of fire, sand, and ash, many lives were lost and some people were wounded, and the emission of smoke continued for 40 years. (This record is somewhat doubted.) December 25, 1871, Tarumai vomited sand and ash for three days and two nights; this destroyed a small cone on top, left a cavity 100 meters deep with a small pond in the bottom, and changed the summit in other respects. February 8, 1874, there was another eruption lasting three days with a revival February 16. Ash fell in Sapporo November 5, 1883, from another eruption, and there were two other outbreaks during that decade. There was unusual black smoke August 17, 1894, and thereafter there was always steam at the crater until the big eruption of 1909. T.A.J.

KILAUEA REPORT No. 991
WEEK ENDING JANUARY 18, 1931

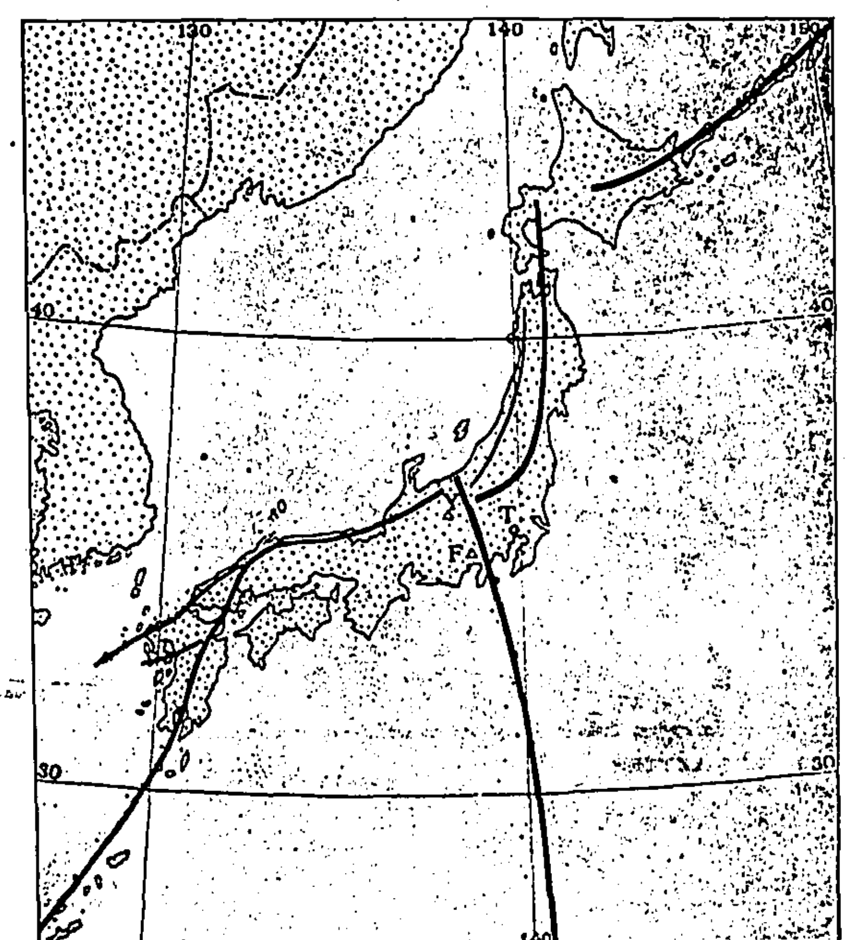
Section of Volcanology, U. S. Geological Survey
T. A. Jaggar. Volcanologist in Charge

Few notable changes have occurred at Halemaumau during the week. Fume remains absent at the 1930 vents. There are many scattered sulphur areas with whitish coatings, but the main area southeast is bright yellow. On the 14th steam was strong on the south talus.

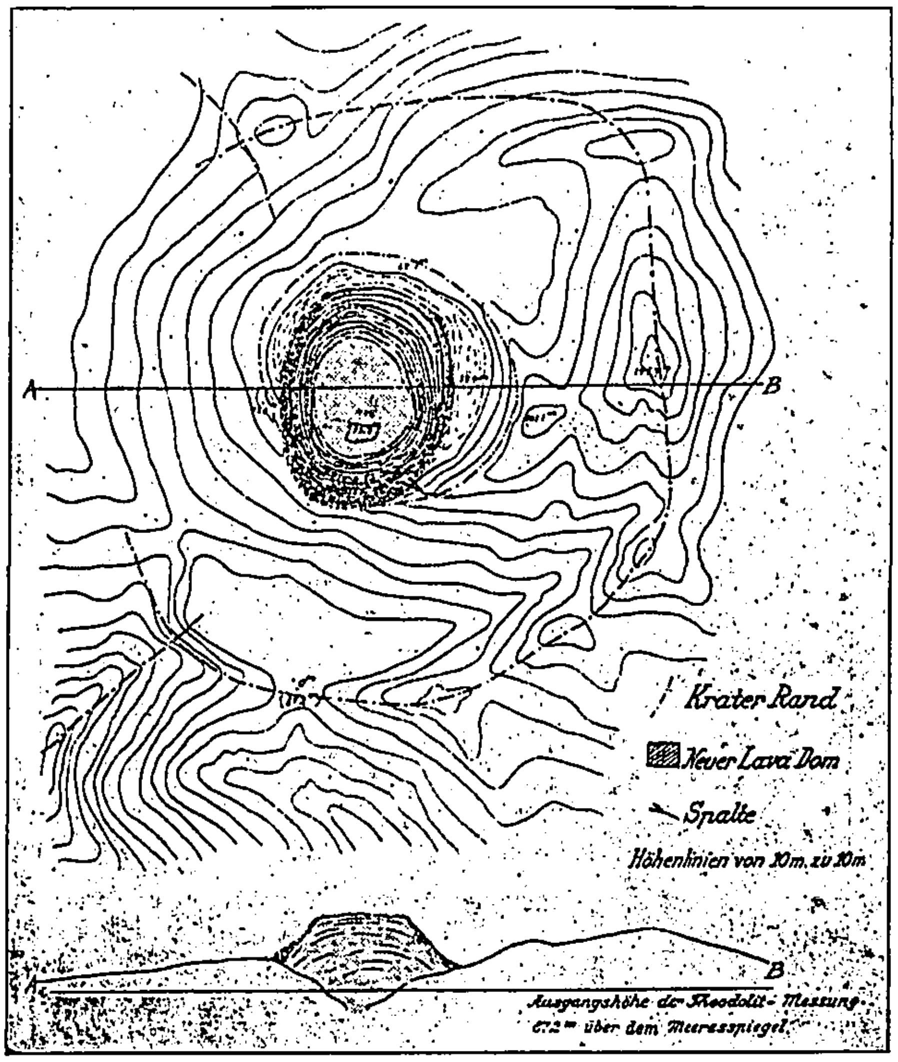
Thick dust clouds over the region southwest of the fire pit, caused by extremely high trade gales, gave rise to rumor of an eruption January 12.

The seismographs registered 29 local tremors and earthquakes and 2 teleseisms during the seven-day period ending at midnight January 18. Two of the first group had indicated distance to origin 18 miles, and another (3:03 a. m. January 12) was reported felt in Hilo. A local earthquake at 8:44 p. m. the 16th originated 30 miles from the Observatory, apparently under the center of the island. It was felt generally, and was more perceptible in Hilo and Hamakua districts than elsewhere. The first of the two teleseisms registered 3:31 p. m. to 4:04 p. m. the 14th; its indicated distance was about 6,000 km. ESE (Oaxaca, Mexico). The second recorded feebly 4:40 p. m. the 16th, duration 21 minutes.

The direction of tilt again changed, accumulating slight NNE. Microseisms were moderate at the beginning of the week, decreasing to slight.



Map of Riu Kiu, Japan, Bonin, and Kurile arcs and their volcanic rifts. T=Tokyo, F=Fujiyama, Y=Yakedake. After Omori.



Map and profile of Tarumai lava dome of 1909, after Simotomai (H. Tanakadate). The diameter of the outer crater is more than a mile. The figures are meters above the contour line 872 m. Contour interval 10m. The new lava dome is shaded

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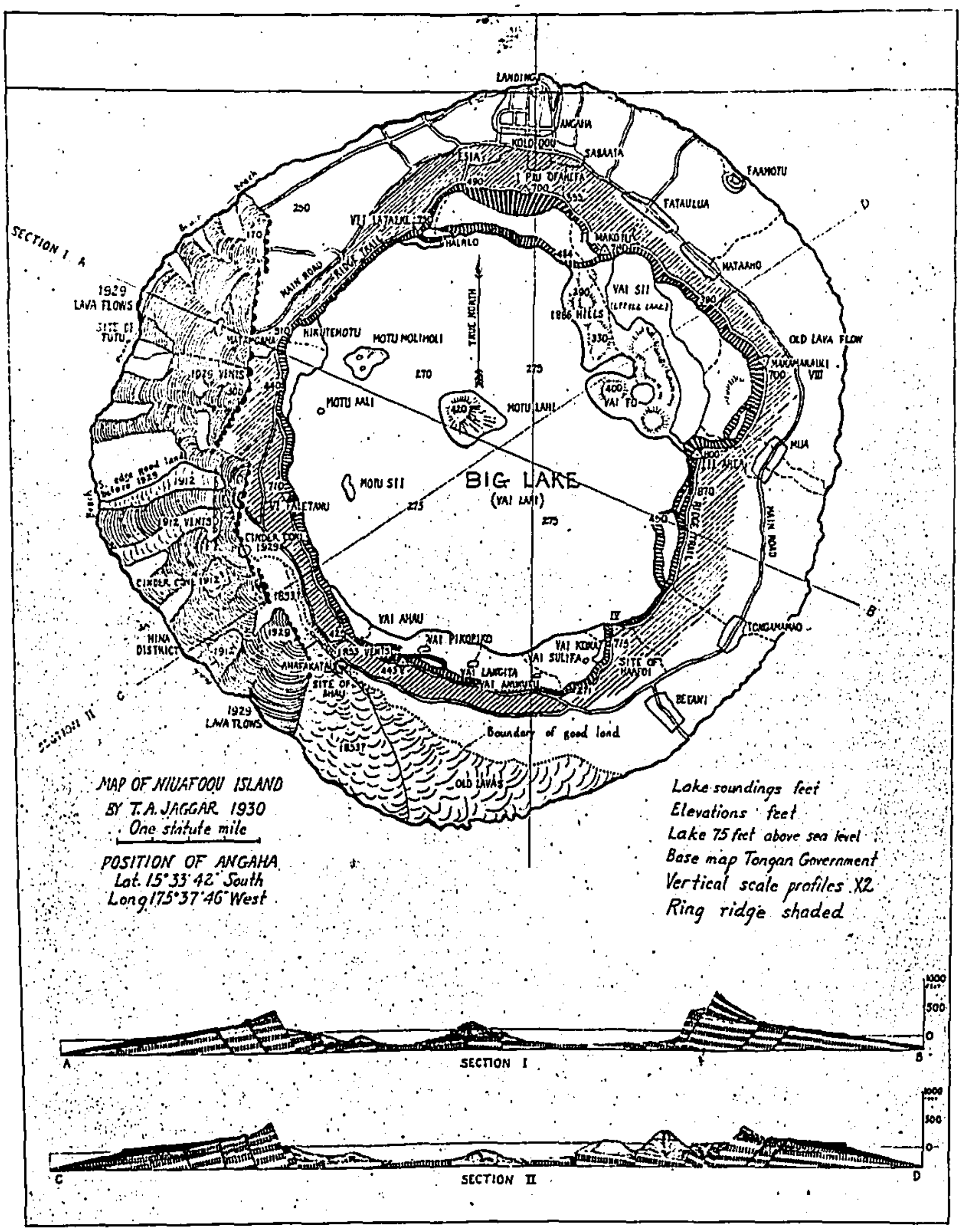
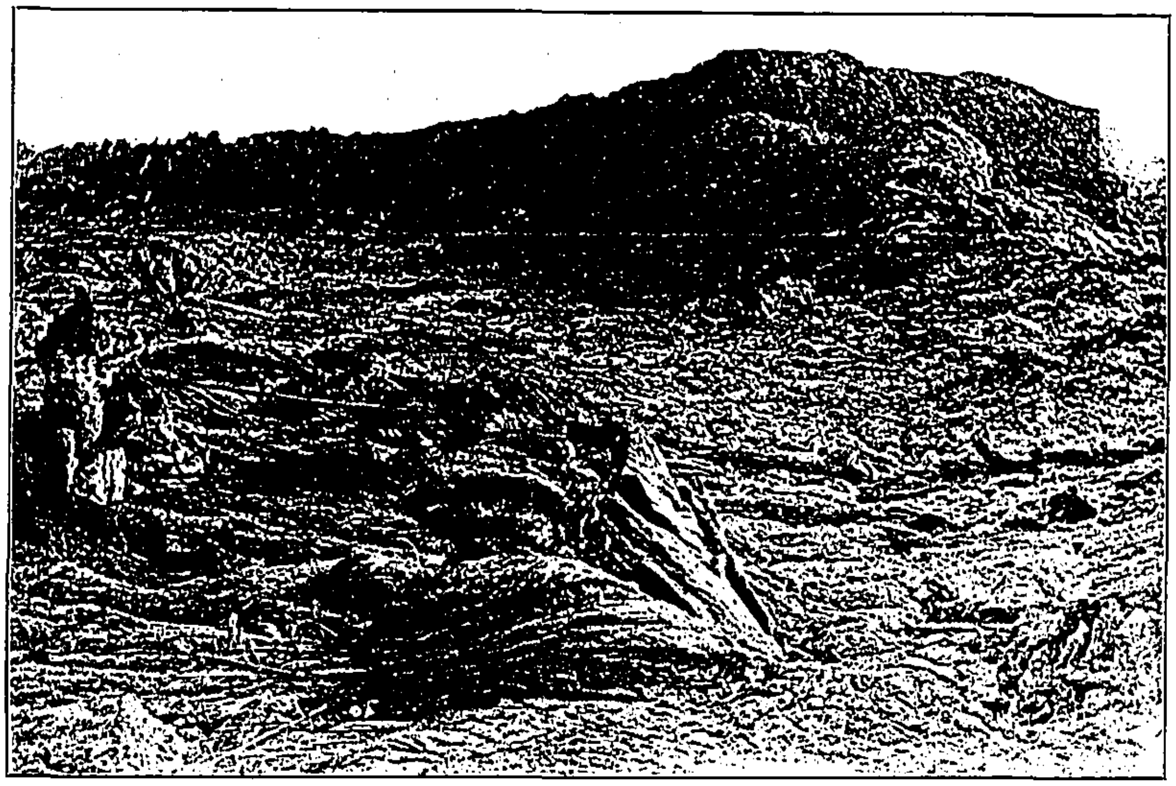


Volcanologic map of Niuafoou Volcano, a ring island in the Pacific Ocean visited by the U. S. Naval Observatory Eclipse Expedition in 1930. Shows profile structure sections, the positions of the villages, roads and trails, and the lake soundings and land elevations in feet. Survey by T. A. Jaggar.



Pahoehoe lava and spatter ridge, with some coconut tree molds of 1912, photographed in 1913 when the lava was fresh. Compare 1929 eruption Volcano Letter No. 312. Photo from Captain Crawford.

GEOLOGY AND GEOGRAPHY OF NIUAFOOU VOCANO

The accompanying map and profiles were made by the writer on the basis of a recent outline map of the Tongan government and serve to show the perfect ring shape of the island Niuafoou, which as described in previous numbers of the Volcano Letter (265 and 312) is a prosperous copra island in the triangular space of the South Pacific Ocean between Samoa, Fiji, and Vavau. The big lake in Niuafoou is a crater sink fed by rain water and made somewhat brackish by hot volcanic gas springs, by evaporation, and probably by more or less connection with sea water. The lake is 275 feet deep and stands only 75 feet above sea level, so that 200 feet of its waters are below the ocean level, and that in a porous basaltic dome greatly cracked. As there is no drainage, and salt water is heavier than rain water, the bottom of the lake might be salt without that fact showing on the surface.

It will be seen by the profiles that the structure of the island, here shown with the slopes and dips exaggerated to double their normal inclination, and the heights to double the true elevation with reference to the horizontal scale, is that of a very flat lava dome. The island is entirely basaltic and the submarine slope seaward is from 4° to 7°. The cross sections of the inner cliffs around the lake show very massive columnar sheets of basalt at the bottom of deep sections 600 feet thick. The upper ring ridge shows mixed eruption with alternations of about 20 feet of ash and agglomerate representing one phase, followed by 20 feet of thin-bedded lava flows representing another phase. These upper beds have dips of from 13° to 18°, whereas the lava layers seen in the sea cliffs of the border platform dip radially away from the center at from 4° to 8°.

This implies that the lower dome of Niuafoou was built up of heavy sheets of liquid basalt, and that the development of explosive eruption was a later feature recorded chiefly in the upper layers. The angle between outer platform and ring ridge is accented by the modern flows of lava which have come up concentric fractures as shown in the profile, but this angle is also produced structurally by the presence of the steeper mixed cone of the ring ridge resting on an older dome pediment of lava, like the present Vesuvian cone. This angle is probably a belt of weakness concentric to the crater lake, as indicated by the western 1929 fractures shown on the map with lines of black half-domes along the rift fissures from which the flows poured to the sea.

In the ejecta of the two most modern eruptions of Niuafoou, those of 1912 and 1929, both of which emerged through what appear to be tension fractures of northerly trend on the southwest side of the island, pieces of coral were thrown up. This ejection was during a minor steam-blast phase at one locality ("cinder cone" on map), all the rest being pure lava flow. The coral fragments are mixed with dike rocks and lava clinker, at cinder cones containing unusually deep circular pits along the line of lava source vents, and at the 1929 locality three-quarters of a mile from the sea. Ash and sand accumulated to leeward. This ejection of coral fragments recalls Vesuvius, which flings up limestone, and the 1823 explosions along the lava rift near the sea at Kilauea. The coral at Niuafoou indicates that coral rock exists under the southwest slope of the island, though there is no coral reef around the island at the present day. Coral does not occur in the explosive fragments of the 1886 hills, produced by the big eruption of that year northeast of the lake. There may have been a fringing reef at some inactive stage when the island was smaller. The elevations of the two vents where the coral fragments were found are approximately 150 and 200 feet above sea level.

The cross section of the island shows an outer lava slope all around, (black in the profiles) the ring ridge, the inner cliff, three platforms of explosive materials making islands and sandy hills at the lake level, and the lake bottom. The latter is probably floored with down-sunken blocks of the former cone, overlaid by explosive fragments and sand. This material is shown in heaps in the sections. The outer lava slope at the west and south is modern. It will be seen that each of the three inner lake shore lowlands, including the islands as attached to the northwestern one, is backed by a notching outward of the ring of cliffs. Each of these lowlands stands for an explosive eruption, the northwestern one prehistoric, the southern one probably 1814, and the northeastern one 1886. These steam blasts probably represented subsidences of the lava column at the end of a cycle of upward pressure and outflow. Ground water entered the void, the retreat of the lava into the depths being along the wall-crack of the more or less circular plug under the lake, steam blast shot up and loosened fault blocks, and the sinking of these notched the ring of cliffs outward. The biggest notch is that back of the 1886 hills.

The modern lava flows of the last century started at the south and extended the process of opening fissures northward up the west side of the island. The mechanism of breakage of the cone appears to be by lava flows outside the ring ridge and engulfment eruptions of steam inside of it. There are no fresh lava flows on the lake side of the ring ridge. There are only minor evidences, as cited above, of steam-blast cinder cones on the ocean side of the ring ridge. The cycle at Kilauea appears to involve shorter pulsations of lava flow at 11-year intervals, and a longer cycle of six or twelve of these (66 or 132 years). This longer cycle may culminate in explosion, which means lava subsidence. Something of the same sort exists at Niuafoou.

Summarizing the list of eruptions of Niuafoou we find known outbreaks in 1814 (steam blast), 1853 and 1867 (lava flows), 1886-87 (steam blast), 1912 and 1929 (lava flows). Apparently the 1814 eruption was a steam-blast phenomenon, and it seems likely that its center was at Vai Kona, on the south side of the lake, for there are still warm gases there smelling of hydrogen sulphide, depositing alum, and bubbling up through lagoon waters. Like the Kilauea eruptions of 1790 and 1924, the years 1814 and 1886 may mark the opposite ends of one supercycle, in which case the next explosive eruption for Niuafoou might be expected 72 years after 1886, or about 1958.

It will be seen that the doubt about lava flows on Niuafoou (Thomson, N. Z. Jour. Sci. Tech. 1926, p. 369) is definitely dismissed. The modern lava flows of 1853 and 1867 were at the south (see map), 1912 farther north, and 1929 much farther north. Naturally the clustered settlement at Angaha is anxious about the next eruption, which is likely to extend the concentric fractures around the northwest side of the island in the direction of the villages. The explosive eruption of 1886 notched the rim of the big crater outward where that rim was highest, and therefore heaviest (over 800 feet above sea level). It followed lava flows of the 19th century on exactly the opposite side of the island. If this mechanism maintains a balance of concentric breakage about a cone, it is logical for the explosive eruption about 1958 to follow after flank outflows on the opposite side of the volcano. The highest and heaviest rim of the caldera next to be expected to subside in a steam-blast eruption is southeast (870 feet high). The flank outflows then to be expected between now and 1958 will be at the northwest. As the maximum lava gushing of 1929 was west-northwest, and the trend of a century appears to be extension of cracks northward, there appears to be every reason to expect the next lava eruption to invade the lands west of Angaha.

Sapper (Vulkankunde, p. 336) cites a doubtful date 1840 for a Niuafoou eruption. Supposing this to have been a lava flow, there were six volcanic events in the 115 years following 1814, with intervals respectively:

After 1814 explosive eruption: 26, 13, 14, 19, years
After 1886 explosive eruption: 26, 17, ? ? years

It thus appears that an extra long interval may follow an explosive eruption, and this is true of other volcanoes. The average interval otherwise for Niuafoou by this table is 16 years. This would place the next probable lava flow following 1929 about the year 1945. If the eruption is normal it will fracture open a fissure about a mile long, and if it should start at the big steam vent back of Futu, and spread a mile to the northeast, it would do no damage to Esia, nor to Angaha, but it would be much too close for safety. The next eruption after that is likely to be ejection of steam and ash about 1958, possibly at the Ahea ridge, with damage like that of 1886. The records are very imperfect and it should be understood that there is a range of from three to five years on each side of the year mentioned for the expectancy based on statistics.

These forecasts are not accurate, for our knowledge of the 19th century is very imperfect. They are merely suggestive experiments in volcanologic reasoning, based on such imperfect data as those figures by which the 1924 explosive eruption of Kilauea was forecast on historical data in 1918, with an error of four years (Bull. Hawn. Volc. Obsy., Jan. 1918, p. 17). They may rightly be used by those governing Niuafoou as stating facts based on past statistics.

T.A.J.

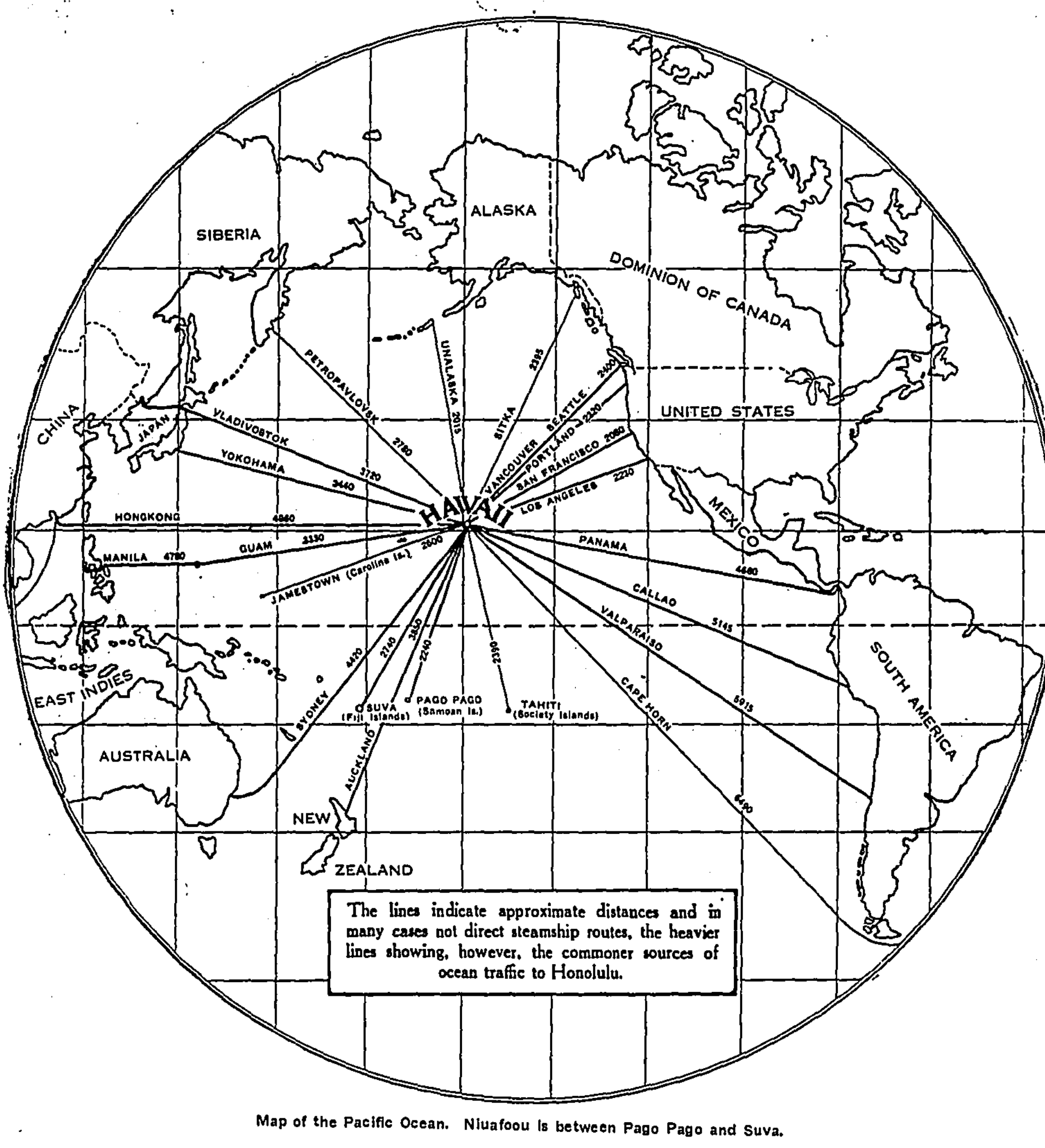
KILAUEA REPORT No. 992

WEEK ENDING JANUARY 25, 1931

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

On January 19 no changes were observed at Halemaumau and steam rose from the south talus as usual. The pit seismograph indicates that conditions are quiet. A little dust rose from the north rim of the pit at 3:45 p. m. January 22. This was seen to have been a slide at the north talus and on January 24 a little fume rose at the southeastern sulphur crack and the pit seismograph showed a few volcanic tremors.

The Observatory seismographs for the week ending midnight January 25 registered 30 tremors, one of which lasted two minutes. Fourteen very feeble local earthquakes occurred, three of them on January 25 indicating origin about 30 miles from the station. Tilting of the ground was slight to the WSW, and microseismic motion was slight.



Map of the Pacific Ocean. Niuafoou is between Pago Pago and Suva.

THE VOLCANO LETTER

The Volcano Letter combines the earlier weekly of that name, with the former monthly Bulletin of the Hawaiian Volcano Observatory. It is published weekly, on Thursdays, by the Hawaiian Volcano Research Association, on behalf of the section of Volcanology, U. S. Geological Survey. It promotes experimental recording of earth processes.

Readers are requested to send articles, photographs, publications and clippings about volcano and earthquake events, instruments and investigations, especially around the Pacific.

Subscription for non-members two dollars per year of 52 numbers. Address the Observatory.

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HAWAII NATIONAL PARK
HAWAII

OFFICE OF THE SUPERINTENDENT

January 5, 1931

Director,
National Park Service,
Department of the Interior,
Washington, D. C.

Dear Mr. Director:

The report of activities and operations in Hawaii National Park for the month of December 1930 is herewith presented.

000 GENERAL:
The eruption of Kilauea volcano continued during the first week of December and then visible lava flow quietly ceased. The balance of the month contained no unusual happenings.

Orders have been received transferring Thos. J. Allen, Jr., from superintendency of this park to that of Zion and Bryce Canyon National Parks and Asst. Supt., Ernest P. Leavitt of Yosemite as superintendent here. These changes to take effect in January.

100 ADMINISTRATIVE:
120 Park inspections by
121 Superintendent
A close supervision was made of all traffic work and handling of crowds at the volcano during the early part of the month. Routine inspections were the rule otherwise.

200 MAINTENANCE, IMPROVEMENTS, AND NEW CONSTRUCTION:
210 Maintenance
Considerable rush maintenance was necessary on all park roads and particularly on the Kilauea volcano road during heavy travel. The Kau road is again losing its shoulder material during rainy periods and must once more be repaired pending contract for shoulder reconstruction.

300 ACTIVITIES OF OTHER AGENCIES IN THE PARK:

310 Public Service Contractor.

311 Character of service rendered public.

Regular hotel service at Volcano House and photographic service at the new Volcano Studio were available.

313 Schedule of rates.

Recommendation was made by the superintendent that the basic day rate at Volcano House be lowered before receiving approval for the 1931 calendar year. Final action has not as yet been had.

400 FLORA, FAUNA AND NATURAL PHENOMENA:

410 Ranger-naturalist service.

A quiet travel period following the eruption made comparitively little demand for our ranger naturalist service. Only thirty-six persons were conducted over the trail and two hundred eighty visitors were taken care of in twelve lectures.

430 Volcano.

Kilauea Volcano was in action at Halemaumau fire-pit until December seventh. On that date all visible fountaining and inflow of molten lava ceased after an eighteen day period of continuous activity. This is the longest action since 1923. Blue fume was visible rising from the pit all during the month and tilt readings on instruments indicated that pressure has not left the volcano but is still present and again accumulating. A further lava flow at any time would not be at all unexpected.

500 USE OF PARK FACILITIES BY THE PUBLIC:

510 Travel.

Ordinary travel to the Islands and to this park was much less than it has been for a period of years. Our records have been saved by the presence of a lava flow with unusual local crowds arriving.

530 Weather.

Two periods of extreme high winds occurred during December but otherwise weather was normal.

Maximum temperature	6th	74	degree
Minimum "	31st	47	"
Rainfall for month of December		6.01	inches
" " " " " at Hilo		7.00	"
" " to-date Volcano District		107.47	"
" " " at Hilo		180.09	"

540 Visitors.

Col. Perry M. Smoot, Adjustant General of Hawaii spent two weeks in the park.

Dr. A. J. Hodgson and Mrs. Hodgson were here enroute home from the Orient. Both of these were at one time connected with the medical service at Yellowstone Park.

600 PROTECTION:

610 Police protection.

Many reprimands were given careless or speeding car drivers during the early part of the month. One independent taxi driver Geo. Correa of Hilo was requested not to drive cars in the park for a period of thirty days December 3rd to January 3rd for repeated violations. This same man had a pay load of United States sailors who possessed liquor in small quantity and were reported to their ship officers.

630 Accidents.

Mr. James Gandy, manager of Volcano House accompanied Ranger Brumaghim on a trip collecting rock specimens for the Paris exposition. Ranger Brumaghim by means of a knotted rope and main strength brought so many fine specimens from an underground cavern that Mr. Gandy descended to explore. His strength was unequal to the pull back up the rope and, in slipping down to rest, a loose rock dislodged and striking his head knocked him unconscious. The ranger secured help and Mr. Gandy was hoisted to the surface. An examination by the local army doctor revealed nothing more worse than a bad head bruise.

Very respectfully yours,

Thos. J. Allen, Jr.,
Superintendent.

Copy to Field Headquarters (2)
" " Yellowstone National Park (1)

10-157

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

TRAVEL REPORT

Hawaii National Park for the Month of December 1930

	This Month	This Travel Year To Date	This Month Last Year	Last Travel Year To Date	Increase for Travel Year	
					Number	Per cent
PRIVATE TRANSPORTATION:						
Cars first entry.						
Cars reentry.						
Motorcycles.						
Total motor vehicles.						
Persons entering via motor vehicles.	8,927	53,025	5,280	19,870	33,155	166.9%
Persons entering via other private transportation.	346	1,187	185	757	430	56.8%
Total persons entering via private transportation. . . .	9,273	54,212	5,465	20,627	33,585	162.8%
OTHER TRANSPORTATION:						
Persons entering via ~~stages~~ Hotel . .	417	1,698	710	1,754	- 56	3.2%
Persons entering via trains . .						
Persons entering otherwise. . .						
Total other transportation. .	417	1,698	710	1,754	- 56	3.2%
GRAND TOTAL ALL VISITORS. . .	9,690	55,910	6,175	22,381	33,529	149.8%

	This Year	Last Year	Increase	
			Number	Per cent
Automobiles in public camps during month	0	0	0	0
Campers in public camps during month	0	0	0	0

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

STATUS OF AUTHORIZED PROJECTS

Hawaii National Park for the Month of December 1930

Description of Projects	Percent Constructed To Date	Percent Constructed This Month	Percent Constructed Last Month	Probable Date Completion
405 Ware House	100	—	100	
406 Toilets, (Kilauea)	100	3	97	
407 Toilets, (Uwekahuna)	100	—	100	
451 Telephone Line	95	—	95	
502 Kilauea Iki Trail	100	—	100	
502 Mauna Loa Trail	100	—	100	
502 Summer Camp Trail	100	—	100	
502 Steaming Bluffs Trail	100	—	100	
Road Survey, B.P.R.	100	—	100	

10-159

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

STATUS OF PERSONNEL

Hawaii National Park for the Month of December 1930

	This Month	This Month Last Year
Number of employees beginning of month,	13	12
Number of additions, ...	5	2
Total, ...	18	14
Number of separations, ...	6	1
Number of employees close of month, . .	12	13
Number of promotions during month	0	0
Aggregate amount of annual leave taken,	6	0
Aggregate amount of sick leave taken,	0	0
Aggregate amount of leave without pay,	0	0

10-160

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

REPORT OF PARK REVENUES

............Hawaii............ National Park for the Month of ....December 1930..................

	This Year	Last Year
Park revenue on hand beginning of month, ...	0.00	0.00
Received, ...	25.00	25.00
Total, ...	25.00	25.00
Remitted, ...	25.00	25.00
On hand close of month, ...	0.00	0.00

Park revenues received this year to date, ...	1,500.00
Park revenues received last year to date, ...	1,477.00
Increase, ...	23.00
Percent of increase, ...	1.5%

10-161

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

Hawaii National Park

REPORT OF SALES OF PUBLICATIONS

December 1930

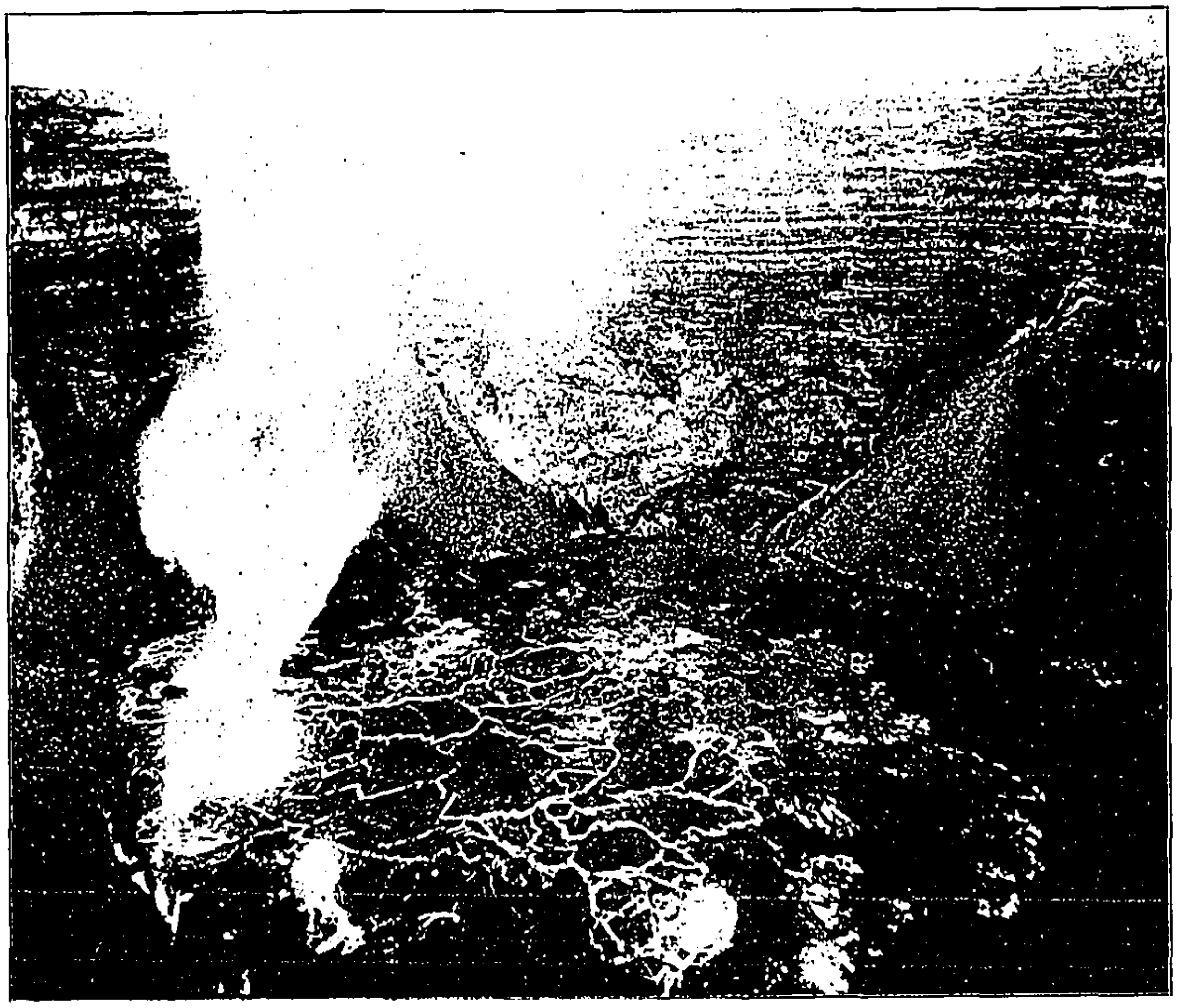
	Number	Value
GOVERNMENT PUBLICATIONS:		
On hand beginning of month,	381	85.80
Received during month,	0	0.00
Total,	381	85.80
Sold during month,	17	5.30
On hand at close of month,	364	80.50
NON-GOVERNMENT PUBLICATIONS:		
On hand beginning of month,		
Received during month,		
Total,		
Sold during month,		
On hand at close of month,		

Cash on hand beginning of month,	15.60
Sales during month,	5.30
Total,	20.90
Remitted during month,	0.00
Balance,	20.90

The Volcano Letter

Two dollars per year | Ten cents per copy

No. 310—Weekly | Hawaiian Volcano Observatory, National Park, Hawaii | December 4, 1930

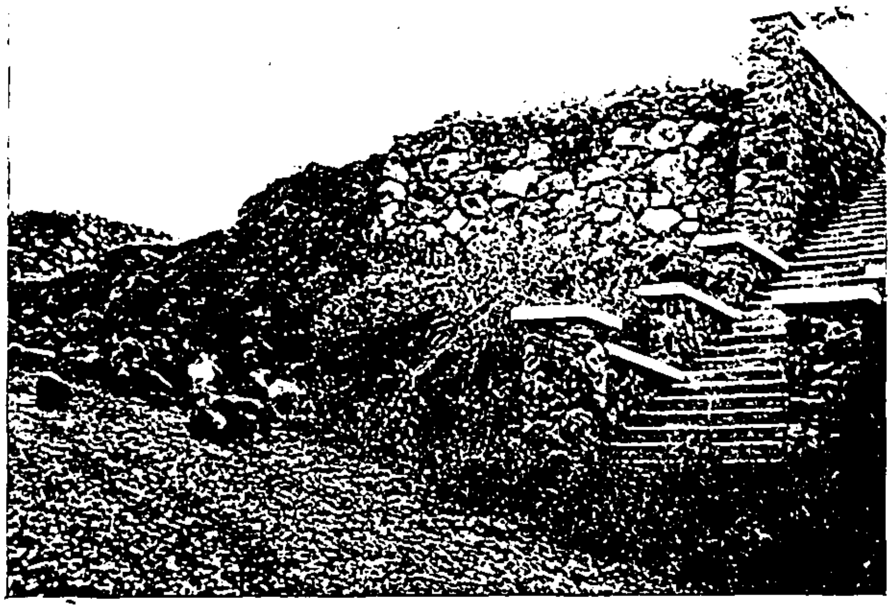


New lava in Halemaumau November 20, 1930. Photo Maehara.

HUALALAI EARTHQUAKE CRISIS
(Continued)

The earthquake crisis of 1929 on Hawaii, as described statistically in Volcano Letter No. 309, produced two earthquakes of grade IX Rossi-Forel. Grade ten is the intensity of a great disaster like those of San Francisco and Tokyo. Nine is disastrous; there are many grades of quick jerking between nine and ten, as represented by the earthquakes of history, some of them slow with wide amplitude and fatal continuity, others very sudden and quick with terrible results on weak structures. The greater earthquakes of the Hawaiian crisis were always led up to by numbers of minor ones, and by more or less continuous tremor which culminated from time to time in increasing numbers of large shocks, which happened both before and after the major ones. The earthquakes of this crisis were very impressive in demonstrating to an observer the difference between experiencing a large earthquake in a house or on the ground out of doors. In a house with an iron roof the rattle of the roofing, of the furniture, of the doors and windows, and the creaking of the timbers all made the quaking perceptible to the ear. Also the artificial structure acted as an inverted pendulum and magnified the motion. The writer was kindly permitted to dwell at Puuwaawaa Ranch House during the period of greater shaking, and to make experimental tests of earthquakes indoors and out. Shocks that were considered strong indoors, with much preparatory rattling leading up to a culminating jolt, were wholly imperceptible to an observer standing on the grassy lawn outside, except for a slight upward thudding sensation at the moment of the final jolt. Meanwhile the outdoor observer, with his feet planted firmly on the sod, could hear the roof of the house roar, and feel nothing during the rattling stages.

An interesting experience during the greater earthquake of 6:20 p. m. September 25, 1929, demonstrated that even a disastrous earthquake in a wooden house might go unperceived in an automobile in motion. This earthquake was so strong that it seriously damaged the Kealakekua



King residence, Honokahau, after the earthquakes of September and October, 1929. The retaining wall of the terrace was shaken down, being built at too steep an angle. Photo Jaggar.

seismograph, stone walls were thrown down, furniture was displaced and overturned, some buildings were moved, landslips were produced on steep slopes, masonry was cracked, and some water tanks burst. The road fills on steep hillsides were generally cracked and in many cases retaining walls on the downhill slope collapsed. The damage was enhanced by the weakening effect of the hundreds of large and small earthquakes, mostly with vibration from the mountain outward which preceded the larger shock for six days. These had loosened foundations, cracked the soil, and by minor damage had weakened structures through much swaying. The writer in his car was driving northward through Honokahau along the government road north of Holualoa and turned into a private driveway to stop for a moment at a residence there. He had felt nothing. The big earthquake had happened a few minutes before, and he found the house in a turmoil, with furniture overturned and strong aftershocks still in progress. It was demonstrated later, when many people left their houses and slept in their automobiles, that a modern car is an admirable earthquake-proof building. Even at rest a sedan on springs and rubber tires produced almost no sensation to the occupants, while adjacent homes were rattling and roaring with the aftershocks.

Prior to the big shock of October 5, 1929, there was a marked lull in frequency during the daylight hours, the big earthquake coming at 9:22 p. m. The effects of this shock were stronger than those of September 25, and the damage to buildings was extended northward into Kohala. Conspicuous effects were the cracking of road fills in new places, the overthrowing of embankments at the tips of road spurs, and the sliding downhill of rocks and vegetation on cliffs.

The intensity relations, obtained by counting the numbers of strongish shocks, indicate that these clustered around September 26 and October 5. There were about 200 earthquakes recorded as sharp between September 19 and October 5 in the North Kona region. September 23 at Puuwaawaa there were nine, September 24, twenty-six, with one in the morning described as the strongest yet, and the next morning came one described as still stronger.

The following figures show three series about the frequency maxima, September 26, October 5, and October 8. The lists show computed numbers of earthquakes as registered instrumentally at Puuwaawaa, and in each case the figures rise to a maximum on the date above mentioned, and decline afterwards.

First Series		Second Series		Third Series	
Sept. 21	39	Oct. 3	97	Oct. 7	136
" 22	237	" 4	114	" 8	387
" 23	258	" 5	141	" 9	353
" 24	432	" 6	89	" 10	235
" 25	513			" 11	203
" 26	599				
" 27	541				
" 28	400				

In the first and second series, the dates September 25 and October 5, both in the evening, were the occasions of great earthquakes. For the third series there were one strong and five moderate quakes October 8, one strong and one moderate October 9, two strong October 10, and one moderate October 11. There was an increase in numbers of strongish shocks October 14-15 accompanying a slight increase in frequency. It is worthy of note in the above second series that the total frequency on either side of the day of the biggest shock (Oct. 5) is much less than the daily frequency of the earlier and later periods.

There is reproduced on the last page the photograph of a model of Hualalai Volcano by kind permission of Mr. W. T. Pope of Honolulu. The scale of the photograph is approximately four miles to the inch. The model shows the linear character of the belt of cones that constitutes the summit ridge of Hualalai, and the trace of an old sink crater at its summit. The two recent lava flows indicated on Hualalai are both believed to date from 1800-1801. The fluted cone at the northeast is Puuwaawaa; and the hill north of it Puu Anahulu is made of very old basaltic rocks extending in a curved ridge southward through Puuwaawaa, as though the latter were a parasitic cone built on the edge of part of an old sink crater. The 1859 flow from Mauna Loa is shown at the northeast. The regions tremendously shaken in 1929 lay on the north and south slopes of the Hualalai ridge, and it may be seen from this model that these two regions are symmetrically balanced about a volcanic fissure. It seems reasonable, therefore, that the disturbance was due to intrusion.

It may be remarked that this region and these earthquakes of 1929 were the theme for the story recently published, "Lava" by Armine von Tempsky. T.A.J.

LASSEN REPORT No. 28

Lassen Volcano Observatory

R. H. Finch, Associate Volcanologist

On November 3 and 4, 1930 a spasm of small earthquakes were recorded on the seismographs at Mineral. The shaking began at 11:39 a. m. November 3, and when the trembling ceased at 3:31 a. m. November 4, ten shakes had been registered. None was reported felt though three showed an intensity well within the range of perceptibility. The indicated distance to origin was 11 miles or nearly equal to the distance between Mineral and Lassen Peak.

TILTING OF THE GROUND DURING NOVEMBER

The following presents a record of the tilting of the ground at the Hawaiian Volcano Observatory on the northeast rim of Kilauea Crater, showing the net amount for each week computed from the daily seismograms obtained by platting a curve which is smoothed by overlapping progressive seven-day means. As shown in Volcano Letters 302 and 306, the tilting of the ground in September and October was generally northeastward, as is usual for the autumn season. Therefore the tilt to the southwest for the week of the outbreak of Halemaumau (November 19) may have been stimulated by the release of gas and the inward dip of the country resulting therefrom.

Oct. 27-Nov. 2	0.72 second	N.
Nov. 3 - 9	0.48 second	S.
Nov. 10-16	1.57 seconds	NE.
Nov. 17-23	1.20 seconds	SW.

KILAUEA REPORT No. 984

WEEK ENDING NOVEMBER 30 ,1930

Section of Volcanology, U. S. Geological Survey

T. A. Jaggar, Volcanologist in Charge

The pouring in of basaltic lava at the bottom of Halemaumau pit has continued during the week. On November 24 the fountain was building outer spatter ramparts on the side of the lake preparatory to formation of a spatter cone. The lake lava showed pahoehoe skins which wrinkled like satin. Festooned pahoehoe flows poured voluminously to the northeast and northwest. Small typical aa streams were sluggishly pushing out from the floor slag heaps in two places. The great delta-like fronts of the flows against the talus were half aa carrying pahoehoe crusts. Such crusts were cracking and sinking at the edge of the lake and elsewhere as the liquid lava welled up and weighted down the hardened surfaces.

Measurements made the floor 2,200 feet long south to north by 1,800 feet wide. The lake was one-fifth as large as the floor. The total area of new lava was 55 acres, covering the 1929 bottom 15 feet deep about the edges and 90 feet deep at the lake. The lake was thus at the top of a heap 100 feet high.

The same type of activity continued during the week, the heat diminished, the fountain enclosed itself with a spatter dome more than 100 feet high, the overflows of the lake rim dwindled, and the glow of the outer slopes of the slag heap became less. Sulphur stain increased along a steaming crack at the southeast edge of the floor.

The Observatory seismographs registered feebly two teleseisms at 9:22 p. m. November 27 and 11:23 a. m. November 30. There were no local earthquakes. Volcanic tremor was harmonic and continuous throughout the week, with a spasm at 5:56 a. m. November 29 accompanied by easterly tilt, and another spasm at 6:55 a. m. November 29. The tremor was weaker November 30. Tilt was very slight to the southeast, and microseismic motion was slight but somewhat increased November 26-28.

Collapse of partitions in cellar of Puuwaawaa Ranch House resulting from earthquake damage October 5, 1929. Note the wooden posts diagonally braced and footed in concrete, which saved the house when the cellar walls gave way.

Model of Hualalai Volcano, 1930, by Willis T. Pope Summit 8,251 feet. Shows trace of old sink crater and NW-SE summit rift marked by cones. Distance from Kailua bay to Keauhou in southwest corner six miles.

THE VOLCANO LETTER

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The Volcano Letter

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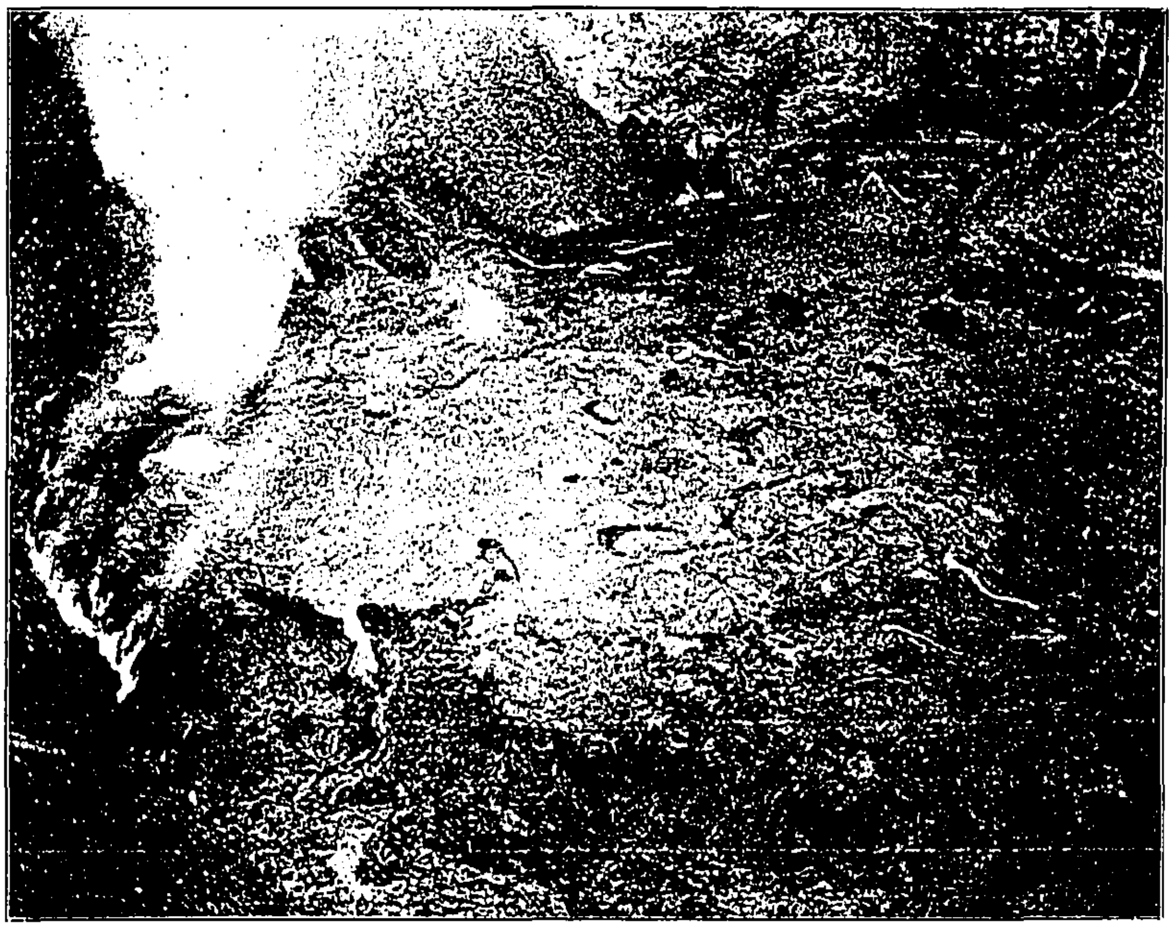
No. 311—Weekly | Hawaiian Volcano Observatory, National Park, Hawaii | December 11, 1930



Floor of Halemaumau from the east at 3 p. m. November 20, 1930. Shows the smooth lake area, the sulphur-stained crack with line of steam jets at the left, the fountain and its rampart under the large fume column, the 1929 lava heap against the talus at the back and numerous pahoehoe overflows from the terraced lake. Photo Powers

JOURNAL OF HALEMAUMAU ERUPTION 1930

As the eruption of lava in the bottom of Halemaumau pit of Kilauea Volcano came to an end so far as appearances go about noon December 7, 1930, it is appropriate here to show some pictures of special features and to review the daily sequence of events.

November 13. Pit seismograph recorded tilting of the ground away from the pit and many small tremors.

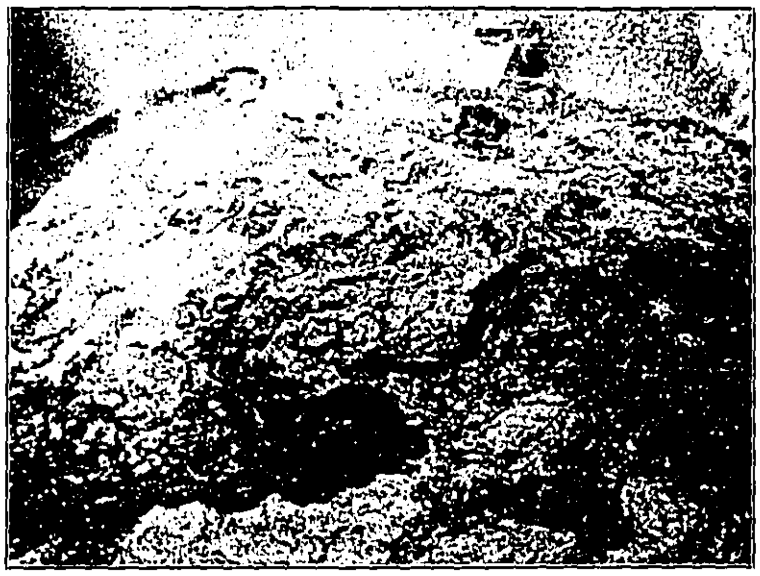
November 19. Tilt away from pit at 12:15 p. m. had accumulated to five seconds of arc. Then for an hour and a quarter 35 small earthquakes were registered and rim of pit tilted up and out five seconds more. This had been preceded in the forenoon by 57 small jarrings with slight tilting of the pit inward. This became continuous tremor after 1:29 p. m., becoming stronger at 1:38 p. m. moderating from 4 to 7 p. m., and thereafter continuing throughout the eruption, which had started with gushing of lava and gas at 1:29 p. m. Thereafter during the first 18 hours of lava activity the release of gas and escape of lava caused the pit rim to tilt back toward the center through 7.5 seconds of arc.

The lava broke its way up through the 1929 floor in the southwestern part of the pit. The floor swelled, broke, and the gush of lava carried up blocks of rock. Then seven fountains broke out southeast and finally a big fountain developed 100 feet from the south talus. The first fountains were 20 to 50 feet high, the big one was sometimes 200 feet high. The flood of lava spread over the 1929 floor and the smaller fountains dwindled. Oozing lava broke out back of the 1929 cone at the west. These events suggested that the new lava welled up through the 1929 paste, still hot under its thick crust.

The main fountain built a crescent grotto 40 feet high by 8 p. m., and the western fountains covered themselves with hoods. The outspreading flow began to pile up a slag heap with overflows northwest and southeast. Ramparts formed around a pool on the top of the heap.

November 20. At 1:30 p. m. the slag heap was 90 feet high, there was slow movement of crusting lava away from the big fountain, which now spurted from 60 to 100 feet into the air. The hooded vents of first action were smoking. About 12:30 p. m. a large flow cascaded over the southeast lake rampart and continued until the evening. By 8 p. m. most of the eastern remnant of the 1929 floor was covered, other flows crept toward the north, and by midnight only a little of the old floor was still uncovered.

November 21. The single large fountain continued its



Southwest corner of floor November 24, 1930, showing at the back the fume from the fountain vents which had sealed themselves, the 1929 heap at the right and the increasingly smooth lava from the border region *in the foreground* to the lake on the top of the heap. The small dark colored flow is the northeastern brown aa stream of November 24. Photo Powers.

activity and an inner lake rampart outlined an inner pond of lava with slow moving crust, the outer coves of the northern extension of the lake appearing like terraces at a lower level. At 1:30 p. m. the new lava covered 2,000,000 square feet and the lake was about 100 feet above the 1929 floor under it. The lake covered 650,000 square feet. The fountain was breaking up into two or three jets. At 11:30 p. m. a large cascade broke over the rampart at the northeast and produced a flow of such velocity that no crust had a chance to form so that 5 acres was soon covered with glowing lava.

November 22.. In forenoon the northern stream on the floor was flooding in two branches northeast and northwest. The drainage of the lake and the settling of the slag heap had lowered the lake level 10 feet while the margins of the floor were building up against the border talus of the pit. The fountain had become a group of spraying jets of the Mauna Loa type. The lake was oval feeding a flow which poured downhill spreading like a delta northward in the forenoon, and to the WNW in the evening. The flows were pahoehoe above and half aa below with a coke-like appearance. The fountains were quiet, but sometimes made a surf-like noise and puffed up brown fume, spurting up from 50 to 100 feet. The fragments were light pumice, for they floated down slowly, and much of this material along with Pele's hair fell to leeward of the pit. In evening glow edges appeared under the western lake rampart. Lava toes pushed out at the edge of the floor all along its western edge. There were three or more crust islands in the lake and irregular elevations in the lava slope west of the lake. Some 1929 lumps and terraces were detectable at the north side of the bottom. Smell of sulphur dioxide rose with the fountain gas.

November 23. The fume from the pit rose in a transparent brown veil these days, with a moisture cumulus above varying at different times and sometimes disappearing. The fume was blue in reflected light. A brown trail of smoke spread westward and northward over the valley between Mauna Loa and Kilauea. The glow at night over the pit was sometimes yellow, and at other times rosy. Large crowds of people visited Halemaumau.

At 9 a. m. the fountains continued with a deep rumble and occasional very high spurts. A scar up the west wall of the pit had been left by avalanches of November 20-21. The grotto at the fountain caved in continuously. Overflows from the lake poured south as well as north and northwest, the last appearing as a big stream. A protruding spur extended the slag heap of the lake toward the northeast, where chasms were caving in leaving red-hot aa walls, and lava trickles pushed out at the edge of the floor. The floor edge was building up so as to touch the WNW, S, and SE walls between the taluses. Bright yellow sulphur stain extended along a steaming crack at the edge of the floor nearest to the fountain to the south of the lake. Bluish-white salt appeared at seven steaming cracks in the slag heap to the NW and NE. Pumice of mossy green appearance lay on the backslope of the fountaining grotto.

At 5 p. m. the northwest stream had crusted, leaving V-shaped bright areas. The lake was covered with bright lines in flow pattern without apparent motion. The fountain showed none of the inrush and foundering of crusts toward its center characteristic of the old Kilauea fountains. The puddle around the fountain was thinly liquid on the side toward the grotto, but otherwise the jets seemed to rise from stiff quickly congealed material, sometimes flinging fragments in a high spire apparently 150 feet into the air. The glow of the crack pattern in the aa slag heap to the northeast was different from the lake. An aa flow from it to the northeast talus was like a forked coral or fungus with a herring-bone pattern which remained glowing like a coal quite different from the festoons of pahoehoe. The whole floor looked rigid but very bright, a fan of flows with two outstretched arms enclosing a dark space. The foundering blocks of the rampart next to the fountain rolled over and grounded on a shallow bottom. The dark areas of the floor were W and S and N.

November 24. Measurements at noon made the lake 90 feet above the former bottom and 435,600 square feet in area. The outlying slag heap was 40 feet deep, covering 1,306,800 square feet. The edge flows averaged 15 feet thick, covering 653,400 square feet. The total volume was estimated at 93,000,000 cubic feet. The diameters of whole floor were 2,200 by 1,700 feet.

At 10 a. m. two sloping ramparts outside of the fountain marked its enclosure by a cone. The lava was changing to true pahoehoe with spatter of glistening black glass. The lake was covered with pahoehoe festoons, but on the outer slag heap northeast and west two short brown typical aa flows emerged from cracks. Otherwise the pahoehoe overflows from the lake turned into large semi-aa areas at the edge of the floor NE and NW. The continuous fountaining of the active center was more suggestive of

1917 Kilauea activity than anything yet seen. All the 1929 floor was now covered except the big west spatter heap. At 5 p. m. the glow pattern was darker than before owing to the pahoehoe skins. The rampart around the fountain was closing in to a horseshoe and the overflows were dwindling.

November 25. Activity was more sluggish, flows were shorter, and the edge of the floor was building up.

November 26. The fountaining niche was becoming a cone, there was fresh lava along the east and northeast edge of the floor and also against the south wall of the pit. A new overflow from the lake poured NW.

November 28. The fountain had spells of high spurting and other times of unusual quiet. Flowing was weaker. The fountain cone was growing.

November 29. Weakening action continued. Fumes were strong. Eastern lobe of floor had raised 50 feet while the lake level remained the same; an intervening point stood 64 feet above the 1929 floor. The horseshoe cone around the fountain stood 75 feet above the lake with an opening toward the west and a frothing pool which cascaded steeply through the opening to the lake of cloverleaf shape. The cone had an outer crescent ridge at the south. There was glow around edges of the floor, strong at the NE and weak at the W and N. A flow broke out through a crust on the northeast side of the fountain cone. A dull flow pattern extended from the lake across the northeast floor, but outside pahoehoe flows had ceased. The glow and fume were lessening.

November 30. The fountaining cone was now the main feature. The heat at the edge of the pit had greatly diminished. There was festooned skin streaming across the lake. The edge of the floor had risen all around and the steaming sulphur crack southeast had increased in sulphur deposits. The cascade poured out of the cone growing weaker and crusting over, and the top of the cone caved in. The border lava was rising around the 1929 heap at the west.

December 3. After two weeks of action the area of the top of the slag heap containing lake and fountaining cone was roughly 500 by 800 feet. The cone was about 75 feet high and 200 feet in diameter at the base. The entire new bottom area was leaf-shaped 2,300 feet long by 1,700 feet wide and covered 62 acres or 2,710,000 square feet. The deepest fill was 175 feet at the top of the cone, or 100 feet at the lake level. The shallowest fill over the 1929 floor at the north side of the bottom was 50 feet. The volume of molten lava was 229,000,000 cubic feet which had come in during the first three days of the eruption at the rate of 25,000,000 cubic feet per day, and the last 11 days at 14,000,000 cubic feet per day. The process had been first piling up the center, and then spreading out at the edges. The weight of new lava was slightly more than 15,000,000 tons.

KILAUEA REPORT No. 985

WEEK ENDING DECEMBER 7, 1930

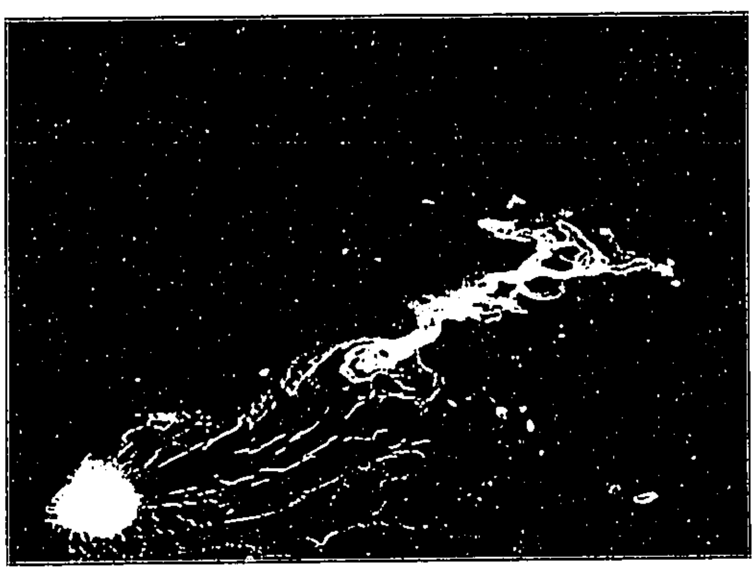
Section of Volcanology, U. S. Geological Survey

T. A. Jaggar, Volcanologist in Charge

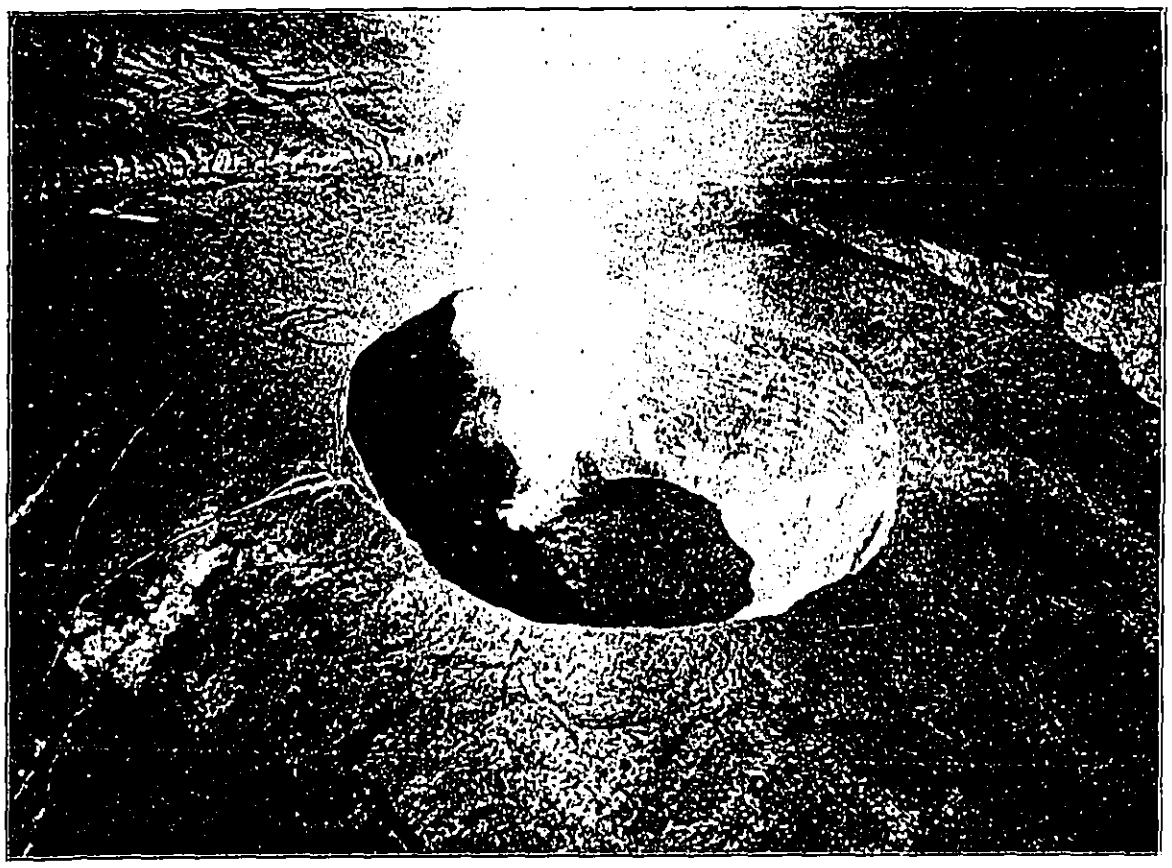
On December 1 the fountain in a cone of lava at the bottom of Halemaumau about 900 feet down was spouting variably. Its cone had grown big and the cascade down its side tended to crust over. The spectacular activity of the week came at times when the crust over the lake broke up and a rapid seething of glowing lava extended itself all over the surface along with sinking of the crust blocks. This process at intervals of from three-quarters of an hour to two hours continued until the evening of December 6, with increasing intervals. December 2 a stream from the big cone poured in a loop northward across the lake. December 3 a flow was building up the south edge of the floor. December 4 the cone was breaking down the edges of its cup. The break-up spells of the lake crust were brilliant accompanied with crackling noise. Bright yellow sulphur made a spicy smell at the southeast edge of the floor. The cascade from the fountaining cone renewed itself and poured flows over the lake crust. The fountain occasionally revived to high spurts. Then it dwindled to mere bubbling last seen the morning of December 7, and about noon that day all action ceased.

Volcanic tremor at the Observatory seismographs gradually weakened and stopped about 3:30 a. m. December 7. Two very feeble local earthquakes occurred December 1, one of these 8:55 p. m. indicated origin distance 32 miles and was felt from Hilo to Kona. Spasmodic tremors occurred four times December 4 to 7. Microseismic motion was moderate and tilting of the ground was moderate NE.

The action of tilting and trembling on the Halemaumau seismograph showed none of the sudden phenomena accompanying the end of the eruption which were observed when the lava ceased action in February, 1929. Strong trembling ended about 8 p. m. December 6, but minor tremor gradually dying away continued on December 7. At the end of that day it was nearly gone. There was no pronounced tilt of any kind. The effect is as though the lava pressure were still there without evident fountaining.



Night view of eruption November 21 at 11:30 p. m. This shows the spectacular cascade over the rampart, the bright line pattern of the lake, and the streaming away from the fountain. Photo Powers.



Halemaumau from the air at 9:30 a. m. November 25 showing the new fill in action burying up the talus slopes. The crescent at the base of the great western talus is the 1929 lava heap. Note the concentric cracks close to the rim of the pit showing how perfectly the caving tends to maintain a circle. All of the layers shown in the walls poured out during the 19th century. This picture shows that the floor of Kilauea crater is a dome. Photo by 11th Photo Section, Air Corps, U. S. Army.

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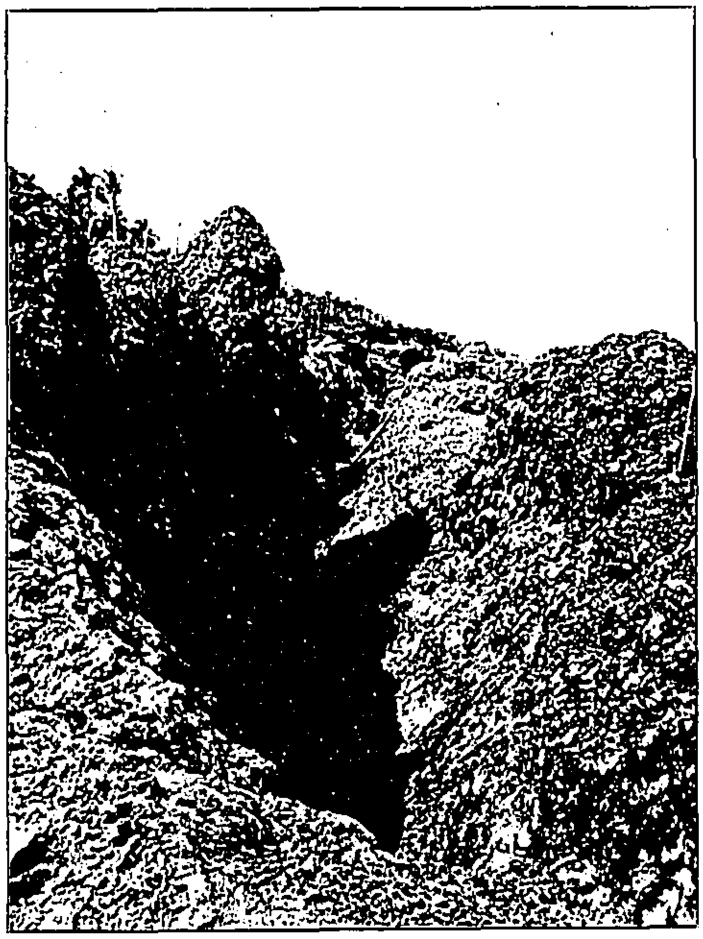
No. 312—Weekly Hawaiian Volcano Observatory, National Park, Hawaii December 18, 1930



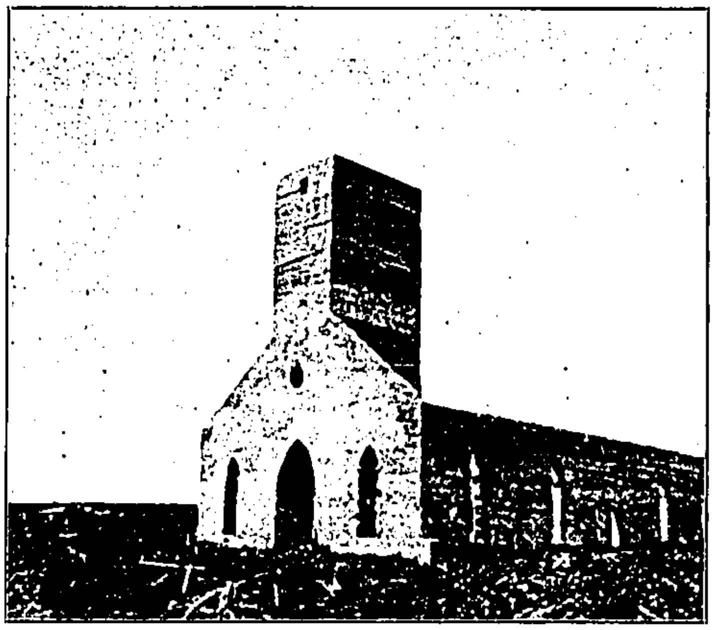
The great lava rift 30 feet deep back of Futu on the northwest side of Niuafoou Island, source of the destructive flows of 1929. The lava floods poured down to the right, and on the left are the uninjured cocoanut palms of the ring ridge. There are spatter heaps on both sides of the chasm. Photo looking south September, 1930, by Jaggar.

THE ISLAND VOLCANO NIUAFOOU

Niuafoou, an active volcanic island belonging to Tonga, was described in Volcano Letter No. 265 in connection with the eruption of lava that poured out on the west side of the island and destroyed the village Futu July 25, 1929. The writer was privileged to visit the island as a member of the joint eclipse expeditions of the United States Naval Observatory and the New Zealand government from August to October, 1930.

Niuafoou is a splendid example of a crater ring, with lake in the crater, crowning a 6,000-foot volcano, most of which is below the level of the sea. It stands on the northeastern corner of the submerged portion of the Australian continent between Samoa and Fiji. It is an inhabited island, a paradise of coconut palms, the soil wholly volcanic, and lies 15½ degrees south of the equator. It is almost a perfect ring five miles across. The lake inside the ring is three miles across, of brackish water, surrounded by a ridge 600 feet high, with cliffs facing the lake and a gentler slope outside. It has islands and is much like Crater Lake in Oregon. Outside of the ring ridge there is a wider lava platform with cliffs facing the ocean. It is on this platform most of the people live in nine villages traversed by lovely avenues amid coconuts, ironwoods, mangoes, and other tropical trees and shrubs, and the usual pandanus near the shore. Copra is the principal crop, but there is much planting of yam, taro, papaia, sweet potato, bananas, melons, and manioc.

Seven villages are a short distance inland from the shore, two are on the ocean, one was destroyed by lava in 1853, one by hurricane in 1909, and Futu by lava in 1929. Futu is at the west, where the eruptions of the 19th century had created a lava desert with eruptions creeping northward. There are no lava flows about the crater lake, but here in 1814 and 1886 there were steam-blast eruptions which piled up sand islands and peninsulas, strewed the island with heavy blankets of dust and sand, and broke down the coconut trees with plastered mud that destroyed the crops and occasioned much suffering. About 1840, 1853, 1867, 1912, and 1929 the lava eruptions broke out along cracks trending chiefly north and south at the base of the ring ridge on the west side of the island and sending short flows for from half mile to a mile into the ocean. The 1853 eruption broke up through the center of the village Ahau and killed half the inhabitants. In 1929 the natives of



Church of the Marist Catholic Mission at Futu, a stone structure which was surrounded by aa lava and burned out July 25, 1929, and all the village houses around it were buried. Only a cross in the graveyard was left standing intact. Photo Jaggar.

Futu saw the fiery cracking of the flank of the hills in the distance, and fled to the heights in time to save themselves. But the northern half of their cluster of warehouses, churches, and habitations was buried under aa lava. They removed to a new village near Angaha on the north shore.

A remarkable adaptation of natural history to the uses of warm volcanic sand is the malau bird, a unique inhabitant of this island. At several places around the lake, and especially where the afternoon sun heats the explosion-made sand hills of 1886 this bird dwells amid the ironwoods and other growth. It is a small bush hen of the tribe Megapodius, meaning "big footed," which has another representative in Australia. It has large, yellow legs and claws adapted for digging in the sand. Its body is black, its head small and scrawny, and its size that of a small Leghorn hen. It whistles like a quail.

The malau hen digs a hole three to five feet deep in the sand slope, lays her egg in the bottom, scratches her way out filling the hole behind her with sand, and Nature does the rest. The sun heats the sand to from 85° to 95° F. Different hens reoccupy the same holes over and over again, even though the natives dig up the eggs for food. When a more fortunate egg hatches, the young bird digs its way out and is said to fly at once. The egg is long and pink, as big as a goose egg.

The people of Niuafoou are Polynesians with a civilization much like that of Samoa, and they are strictly governed by a high chief, a magistrate, and police service representing the Queen of Tonga. There are usually seven or eight white people at Angaha, the principal port, where a rough landing may be made with boats. The people are completely Christianized, members of three denominations, are constant church attendants and lovers of religious music. The population is about 1,100, there are several motor cars, and the trails are broad and kept in good condition. Every man has his plantation, the people are splendid physical specimens, they are fond of tennis, cricket, croquet, boxing and swimming, and are very hospitable and friendly. They are not afraid of sharks, and meet the mail boat with swimmers. Hence the name "Tin Can Island."

The geology of Niuafoou indicates that it is the peak of a big lava dome under the sea, and thus it represents a more advanced stage of the same kind of volcano growth as White Island in New Zealand, or Falcon Island (Volcano Letter No. 265) farther south in the Tonga group. The central crater has been engulfing its walls along with explosive eruptions in recent geological ages. The lava plug under the crater tends periodically to erupt around its edges, or along the 'wall-crack" as we say at Kilauea, but the fractured caldera rim makes it easier to find a fissure up a crack in the outer lava platform than in the crater lake. Once in a long period, just as at Kilauea, the lava pressure is relieved and the plug lowers, letting in water and making a steam-blast eruption through the crater lake. The known last interval between these steam eruptions for Niuafoou was 72 years, whereas for Kilauea it was 134 years.

The ring ridge is made up of lava layers alternating with ash dipping a little more steeply away from the center than the heavy lava layers shown at the foot of the cliffs around the crater lake. The history, therefore, implies a lava dome below, becoming an alternation of lava and explosive eruptions in the later stages.

The eruption of 1929 was typical of all the western lava eruptions. The lava is a feldspar basalt similar to those of Hawaii except that olivine is not conspicuous. The southwestern desert of Niuafoou is what Kahuku and the Kau Desert are to Hawaii. In 1929 the old NNW-trending rifts of 1853 and 1912 at the inner border of the southwestern lava platform of the ring island were suddenly extended northward with an unheralded splitting of the mountain athwart its flank. Fiery slag shot up the crack without warning except for a few tremors. The frothy outflow swept west down to the sea. This happened about 4 a. m. July 25 by Tongan time, almost exactly 24 hours before a similar lava eruption occurred in Halemaumau pit.

The rifts in Niuafoou propagated themselves northward in overlapping gashes. These gashes showed such sympathy with the wall-cracks of the caldera as to indicate that if the intervening ring ridge broke down, the lava source cracks would promote the natural enlargement of the crater lake basin. The lava floods were pahoehoe above and aa near the sea. A dozen of them reached the water with islands of untouched forest in between. The length of the active spouting belt was approximately three miles. About 4,000 acres of coconut plantations were destroyed and traders' property estimated at $10,000. The eruption lasted only a little over a day.

The action was quite like the Kilauea flows of 1920 and 1923, fountains shooting up 20 to 50 feet, making Pele's hair and glassy needles, and building, as shown in the photographs herewith, long spatter ridges along straight chasms, fields of pahoehoe and aa, multitudes of coconut tree molds, and sand heaps along the sea front which were later converted into beaches. There was a little steam-blast action at the southern end of the rift belt, flinging up pieces of coral along with clinker. There were burning hydrogen and other gases at the vents making secondary glazes of many colors.

The straight wall of vents along the source crack was frequently double with heaps of glistening slag on both sides of the crack except where a torrent had maintained a flow gap. Steam still rises back of Futu and deposits sulphur and sulphates. The lava heaps there are 6 to 20 feet high above the former surface of the country, the visible V-shaped chasm in places is 30 feet deep, and collapse has revealed a cross section of old lava and ash beds where the original slope was rent asunder when the rift opened.

The explosive eruption of 1886 was a great event in the history of Niuafoou. It ranks the volcano in Class II among about 43 of its kind including Vesuvius. There was no direct loss of life owing to the good fortune, probably due to the trade wind, which forced the great cauliflower clouds of debris westward over the lake so that only 2½ feet of ash fell on the settlements. An earthquake gently swayed the island at 7 p. m. August 31, 1886, and shocks continued until midnight causing great alarm. Then with detonation a "rocket" ascended from the lake 3,000 feet, the shaking ceased, violent lightning storms developed striking the trees in many places, and big steam-blast vents piled up sand hills and shut off lagoons about an engulfment notch that was formed in the rim of the caldera on the northeast side of the lake. On the leeward side the deposits on the ring ridge were 20 feet deep. The material was broken fragments of rock, pumice, sand, and fine dust. The hills of this next to the lake are 200 to 400 feet high. The eruption lasted 18 days. It was accompanied by subsidence of border benches of the caldera. The Tarawera eruption in New Zealand happened only two months before, in June, 1886, was similarly explosive, and on the same line as the Tonga islands to the south. Here was another of the many cases of volcanic sympathy hundreds of miles apart where the same rift in the earth's crust is concerned. Falcon Island and submarine eruptions in Tonga were in action in 1927 and 1928, this activity continued into 1929 and so was sympathetic with Niuafoou in that year. Similarly Falcon Island had begun eruption in October, 1885, preceding Niuafoou in 1886.

The writer carried a shock-recorder this year to Niuafoou and set it up in a quiet place on concrete, and operated it in September and October. The records in 1930, 13 months after the activity of 1929, were singularly free from earthquakes, none was felt by any member of the expedition from August 19 to October 22, and earthquakes were not reported by the natives. They did, however, report underground rumbling in the lava belt October 3, and 9 small shocks during 4 minutes following 6:38 p. m. that day were registered on the shock-recorder. Felt earthquakes had been more numerous during the last half of 1929 and were reported as late as January, 1930, but thereafter seismic quiet ensued. T.A.J.

KILAUEA REPORT No. 986

WEEK ENDING DECEMBER 14, 1930

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

The week at Halemaumau pit following the recent lava eruption in the bottom of this inner cauldron of Kilauea Crater has produced no new visible activity, but the glow of the hot basaltic fill may still be seen in cracks through the floor, and the bluish fume continues to rise around the vents and at the sulphurous wall-crack at the southeast.

On Monday December 8 there was abundant fume rising from the pit as seen in the afternoon light when the sun is on far side of the vapor as seen from the Observatory. With the sun behind the observer in the morning

Interior of a coconut tree mold showing the bark pattern made by the pahoehoe lava of 1929 on Niuafoou. Thousands of coconut trees were molded so as to leave groves of stone trees 5 to 13 feet high. Photo Jaggar.

Glimpse of the crater lake of Niuafoou from the largest island, showing the eastern ring ridge in the distance, the ironwoods and coconuts on the island, and the black sand beach. Singular limey concretions are deposited on these lake beaches, containing tiny crabs a half inch in diameter. Photo Jaggar.

light the fume is less evident. At 8 p. m. there was no glow over the pit, but from the edge the recent lake area was seen to be well marked with orange-colored incandescent cracks. One spot at the northwest emitted a trail of light as though from an open grotto. There were small glow spots at the edge of the floor, N, NE, SW, and W. There was no noise. Fume rose from the side of the fountain cone, the southwest side of the floor, and at the bright yellow sulphur SE. December 13 there appeared to be settling of the lake area. Glow in cracks was still visible at night.

The pit seismograph December 8 showed no sign of inward tilting toward the pit and recorded spasms of tremor. At 3:45 a. m. December 13 it recorded an immediately local shock with tilt away from pit. At 5:07 a. m. December 14 a tremor at the Observatory was accompanied by east tilt. The Observatory instruments registered three very feeble local earthquakes for the week, one at 6:18 p. m. December 13 with origin 9 miles away. Four spells of continuous tremor occurred and 29 spasdomic tremors, probably a continuation of eruption tremor. Microseismic motion was moderate on the 8th and otherwise slight. Tilt was very slight north. The evidence suggests continued lava pressure upward.

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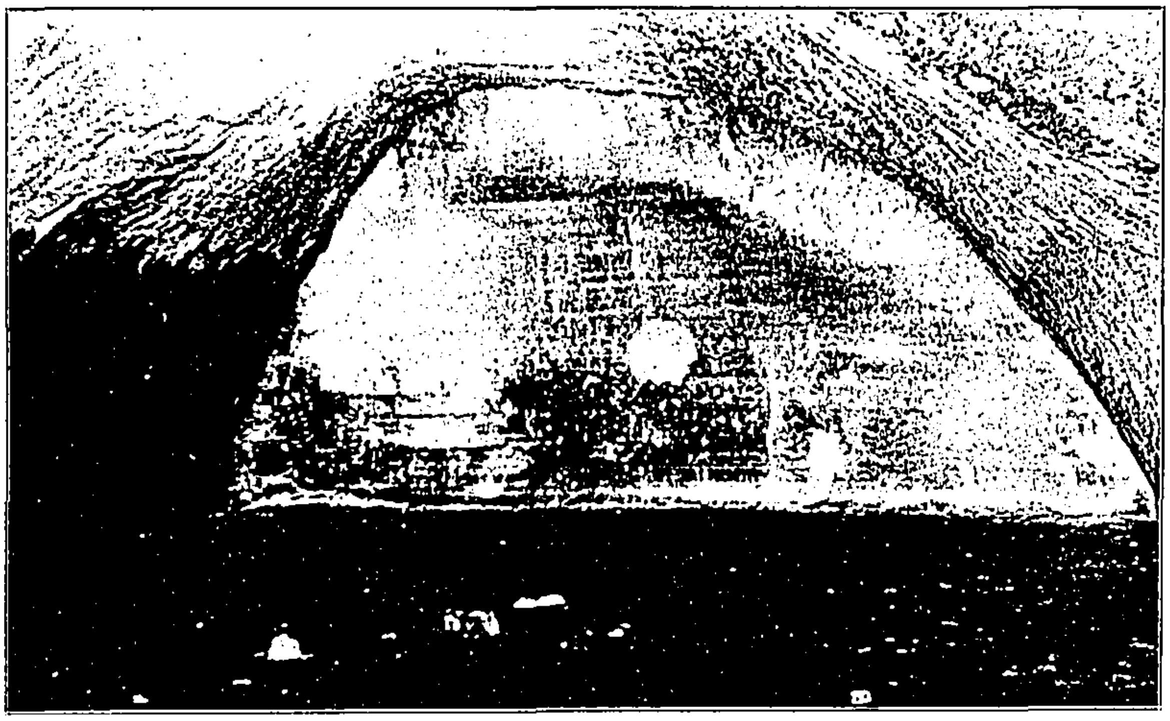
The Volcano Letter

Two dollars per year Ten cents per copy

No. 313—Weekly Hawaiian Volcano Observatory, National Park, Hawaii December 25, 1930



Flash light photograph of ice wall 30 feet high and 40 feet wide at inner end of Shoshone Ice Cave. Note horizontal stratification, ice floor, and ice crystals on roof and on the face of the ice wall. Photo February 15, 1930, by Bruns.

NOTE BY THE EDITOR

The following paper may be prefaced by a brief summary of the ice cavern situation. This lava tube in recent basalt is 30 miles north of Shoshone in Idaho. It is 80 miles south of the Craters of the Moon National Monument. It is a pahoehoe flow with tubes leading from collapse-basins. Several of them foster ground ice in roof crystals, stalactites and stalagmites, and floor coatings.

The ice cave is 400 feet long in a south-westerly direction from one of the sinks, where it starts 100 feet below the level of the country, and progresses underground downward in steps at a flat angle. The inner part is floored with several inches of ice, the roof variously develops hoar frost and ice crystals, there is a rock pile 80 feet from the inner end, and at the end the cavern is abruptly terminated by a wall of solid ice. This wall of ice is 30 feet high, according to Miss Robinson's diagram (Volcano Letter No. 296), 40 feet wide, and its middle is 100 feet underground. There is a drop with a ladder 50 feet from the entrance. The coldest air temperature was always found just inside the entrance chamber, about 32° F. The innermost chamber was usually 2 to 5 degrees higher. On summer visits there was some water on floor and water drip. Accumulation of ice 4 inches deep went on between two visits of February and April, over paper which had been left.

It may be mentioned that the excessive radiation of solar heat at night, with rapid evaporation if the nights are dry, in contrast to solar melting of ground ice from snow in cracks and chasms daytimes, would be assisted by convection in a cavern system. The finding of the lowest temperature at the narrow entrance, the highest part of the floor of the cave, implies a rush of cold air confined in the narrow passage from within outward. This was found in daytime when the outside air was at 80° F. This shows that an ice box circulation is maintained with seepage of air from outside refrigerated along the same passages that bring down the water in daytime. Probably the night reaction freezes this new water at a lower level, and possibly the convectional circulation, aided by evaporation chilling, becomes stagnant or changes direction. It seems certain that the ice wall is fed by an unseen ground ice reservoir, operated by some such mechanism, and it would be interesting to know what air currents are present, night and day.

T.A.J.

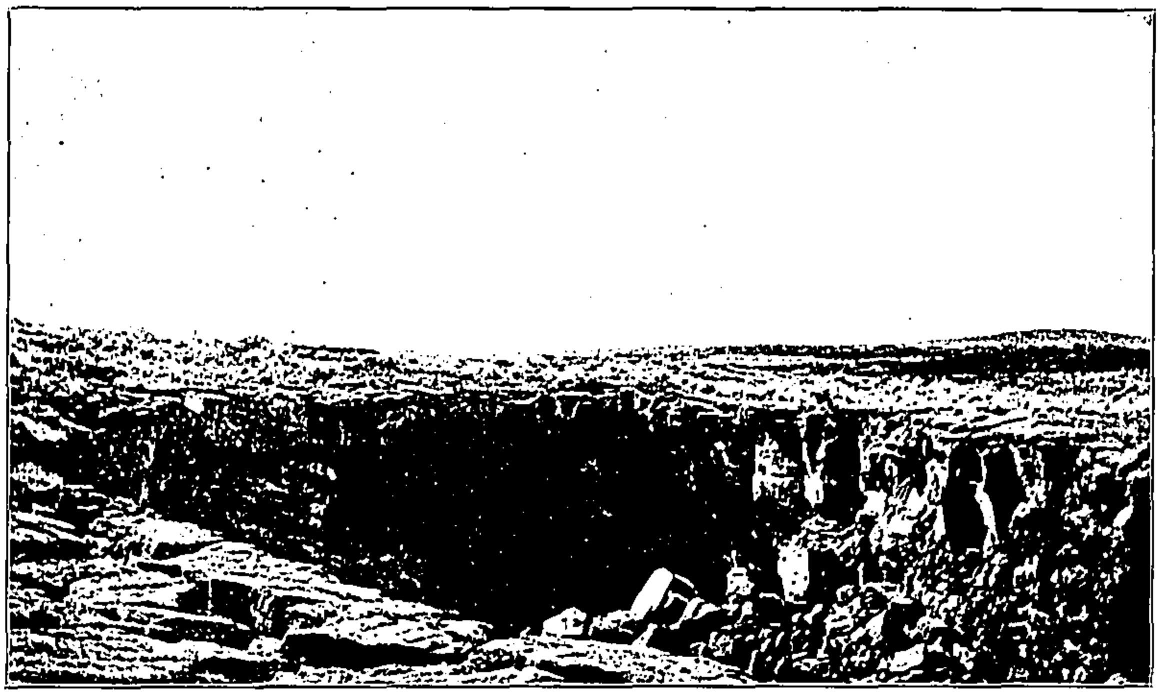
THE SHOSHONE ICE CAVE, IDAHO
(Second Paper)

By H. G. ROBINSON

In the Volcano Letter for August 28, 1930, this ice cave was described briefly, and an account was given of a series of visits paid to it in the early part of 1930. Since then another trip has been made which resulted in the discovery of several additional facts.

This last visit was made on Sunday, September 7, 1930. The outside temperature was approximately 80° F. The day was clear and hot. In the outermost entrance cave, the ceiling was very damp, and water was constantly dripping. Deep in the cracks which crossed the roof at intervals could still be seen slushy ice crystals. Since there had been no rain for a long while, the water must have come from the melting of those crystals deep in the wall. The floor was still covered with ice, but on top of this ice was a thin film of water which in places measured as deep as half an inch. At the sides of the entrance cave, where the ceiling is very low, formerly there had been thick deposits of clear ice.

It was at once apparent that much melting had taken place at these points, and the ice which remained was no longer clear but looked much like slushy snow. As we approached the ladder we noticed water-cut channels in the ice of the floor, through which small streams of water were running rapidly toward the ladder. They formed a very considerable water-fall just behind and beside the ladder. Right at the foot of the ladder was a depression in the floor ice, worn by the constant stream of visitors usual in the summer time. This depression was filled with



Outer sink and entrance to Shoshone Ice Cave. Photo May 18, 1930 by Bruns.

water. But the floor elsewhere, between this point and the rock pile, was dry.

In view of the amount of water constantly pouring over the edge by the ladder, this indicates rapid freezing conditions in the cave. The floor, previously of clear ice, was now covered with a thin film of ice crystals which sparkled faintly in the flashlight. As we neared the rock pile, a slight film of water was again noticeable. It was not more than a quarter of an inch deep, except in depressions apparently caused by the drip of water from the ceiling, or by melting about some foreign object. Just the other side of the rock pile the drip from above was again noticeable. The stalagmites had in all cases melted away until only slight humps could be distinguished.

Over the rock pile the ice which had been clear enough to enable us to read the newspaper a few months ago was now crocked like old china, forming a mottled pattern all over the surface. It was thinner than before also, for the paper, one which was left behind by accident in January and noticed in April, covered to a depth of about six inches with crystal-clear ice, was now only a few inches below the surface. Nowhere was the ice as slippery as it had been on the previous trip.

The ice wall at the rear was much the same as usual, except that a large part of the wall near the bottom had been dug away, apparently with a pick-ax. Like all other such efforts made in the past, it proved useless, and rather worse than useless, since it revealed no end to the wall and helped to destroy a thing of beauty. We found also that all of the iron stakes driven in at various places to aid us in measurement of the ice thickness had been removed, except those on the right and left floors which were so well concealed as to be unseen by the average sightseers.

There were no ice crystals at all on the ceiling of the entrance cave. At the foot of the ladder the roof was covered with ice which had lost its crystalline form, having apparently melted and refrozen into clear ice drops. Farther back in the cave the percentage of real ice crystals increased, and their presence was noticed much farther back than on any previous visit. It was also noticed that they were much more abundant and extended farther back on the left, or inside, curve of the wall than on the right.

The temperature of the cave at the foot of the ladder was almost exactly freezing. This fact explains the freezing of the water flowing in from the entrance cave, and the reformation of the drops of ice from the crystals on the ceiling. However, the crocked condition of the ice at the rock pile, the original melting of the crystals, and the slushy, snowlike appearance of the ice at the entrance, certainly indicate that considerable thawing had taken place during the summer months.

On this visit a survey of the ground above the cave was attempted by a rough estimate of distances and compass readings. At the point where we believed the underground rock pile to be the ground surface was much disturbed, being composed mainly of loosely piled chunks of lava rock which left many cracks, crevices, and holes leading downward. Though there was a party in the cave at the time, no sound of their voices or other noise could be heard at this place, thus showing that though these cracks are extensive, they do not form any open channel into the cave. Just the same, a network of cracks leading into the cave is almost certain, and the outer loose rock would form, of course, an excellent reservoir for snow, which on being melted by the sun's rays would find its way into the cave below, thus forming the persistent drip at the inner rock pile.

Farther on outside, at the place where the ice wall starts underneath, a sharp V-shaped depression cuts across the surface at right angles to the general direction of the cave. This depression is about 20 feet across and about 50 feet long. It looked as though support had been withdrawn from beneath a crack at right angles to the cave direction, thus causing the two sides to slope in gently toward it. However, no opening could be detected at this point.

On following across country the line of the cave still farther, a very small cave was located. In the eastern wall of this nearest the ice cave were several very small tunnels leading downward and eastward. From these there came drafts of very cold air. By much effort Mr. Bruns, our photographer, wriggled into one of them for some little distance, but saw no ice. However, several other small caves in the vicinity had a little ice in their far recesses. The discovery of these other caves, with their possible connection with the ice cave on the other side of the ice wall, together with the very small opening of the ice cave itself to the exterior, makes one wonder whether the original formation of the ice wall might not be explained by the hour-glass theory advocated by Balch, although the fact that the ice wall is now entirely solid makes the theory of little value in explaining present conditions.

The absence of all ice crystals in the roof in the dead of winter and their appearance later in the spring may be accounted for as a phenomenon of condensation. The cool moisture-laden air of the cave coming in contact with the roof, which has been warmed both by penetration of the sun's rays and by convectional circulation, deposits moisture on the roof where it immediately freezes into crystals. This will of course take place only when the cave air is cooler than the outside air.

As a result of this study, the method by which the ice on the floor is renewed is plain. Its source is ground water from snow and rain, and the presence of the ice wall itself is at least one factor in maintaining a freezing temperature. And yet air currents must play a considerable part, too, since the table of temperatures indicates that the coolest place is always just at the foot of the ladder. From a study of the stake measurements a constant very slow melting may be observed during the interval of study, which is what one would expect.

Though the cave has been observed during the greater part of a year's cycle, the seasonal changes of the local accumulations being roughly recorded, still the phenomenon of the ice wall is not yet explained, and the only conclusion is that detailed and careful study is needed before it can be. Such study might prove to be profitable in opening up new possibilities in refrigeration.

KILAUEA REPORT No. 987

WEEK ENDING DECEMBER 21, 1930

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

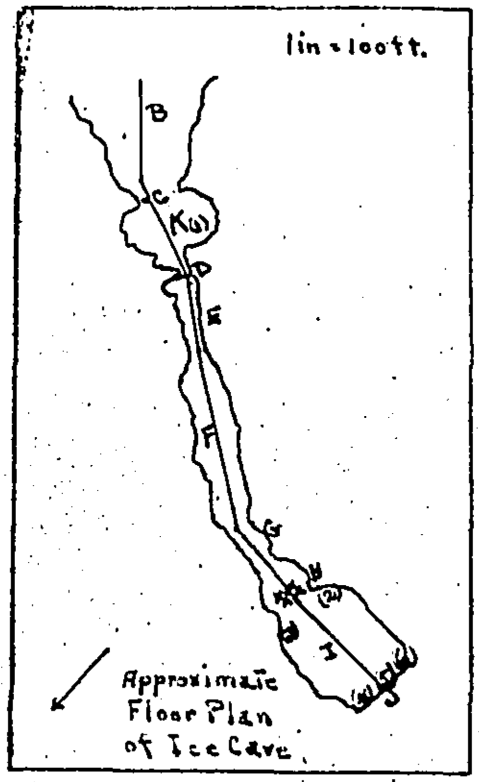
The fuming from the new lava fill in Halemaumau has been somewhat less during this past week, but has been constantly noticeable. The fume cloud has been added to by clouds of steam on several rainy days. There has been no further slumping of the surface of the new lava, though a few more fragments from the rim of the spatter cone have collapsed. A feeble earthquake was felt by several persons in the National Park at 4:24 a. m. Saturday, December 20.

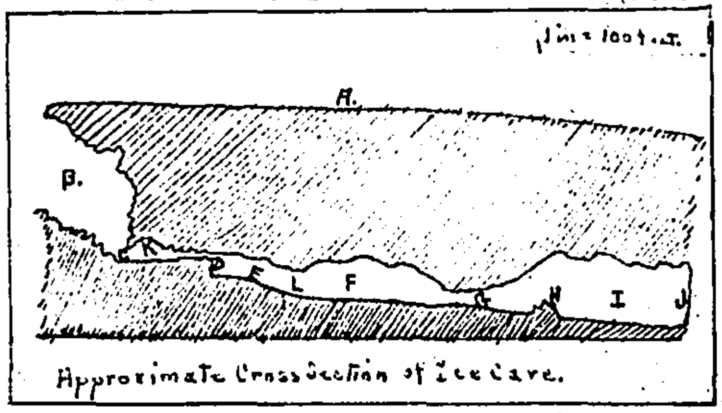
The seismographs at the Observatory recorded 3 very feeble shocks and 1 feeble quake as follows: December 17, 12:21 a. m., very feeble, distance to origin 9 miles; December 18, 8:49 p. m., very feeble; December 19, 11:42 p. m., very feeble; and December 20, 4:24 a. m., feeble, distance to origin 4 miles, felt in the National Park. Thirty-six small tremors of volcanic origin were registered during the week, and during the last 3 days there has been a good deal of tiny spasdomic tremor which appears volcanic but may be due to the strong winds of that period. The non-volcanic swaying of the island indicated by the microseisms has been slight to moderate during the week accompanying the trade-wind storm.

The average tilt of the Kilauea rim under the Observatory has been slight NE, up and away from the center of the crater. During the same time, the rim of Halemaumau has been tilted upward and outward by a slightly greater amount. A notable tilting of the rim upward and outward from the pit accompanied the Kilauea quake of Saturday.

The normal tilting of the Kilauea rim is to the northeast at this season of the year, but the fact that the instrument on the edge of Halemaumau shows tilting toward the southeast at the same time indicates that at least some *of the tilt is due to volcanic pressure under Kilauea.* If the tilt was entirely due to the seasonal effect, both instruments should show simultaneous tilt to the northeast.

Giant stalagmite of ice two feet high on the rock pile inside of Shoshone Ice Cave. Photo. May 18, 1930, by Bruns.





Key

A - Surface
B - Part of "Crater"
C - Where Ice Begins
D - Abrupt Drop
E - Incline
F - First "Room"
G - Tunnel
H - Rock Pile
I - Second Room
J - Ice Wall
K - Entrance
L - Foot of Slide

	Temperatures in Degrees Farenheit.							Amount of Stake Protruding in Inches					
Date	Outside	Entrance K	Foot of Ladder D	Foot of Slide L	Tunnel G	Rock Pile H	Ice Wall J	Entrance (1)	Left Floor (2)	Right Floor (3)	Right Wall (4)	Center (5)	Left Wall (6)
Jan. 4	13°	32°	35°	39°	34°	34°	34°	Flush	1¼"	1"	4½"	3¾"	1¾"
Feb. 15	50°	28°	30½°	33°	31½°	33¾°	31°	¼"	1¾"	⅞"	2½"	3¼"	1⅛"
Apr 6	78°	32½°	35°	—	—	34°	33½°	½"	1¾"	1½"	2¾"	Removed	2⅛"
May 18	80°	34°	35°	—	—	—	37°	⅜"	1⅜"	1½"	Removed	"	2⅜"

Plan and section of Shoshone Ice Cave. Scale reduced here to ⅞ inch to 100 feet. Statistics of earlier visits in 1930.
By H. G. Robinson.

THE VOLCANO LETTER

The Volcano Letter combines, after January 1, 1930, the earlier weekly of that name, with the former monthly Bulletin of the Hawaiian Volcano Observatory. It is published weekly, on Thursdays, by the Hawaiian Volcano Research Association, on behalf of the section of Volcanology, U. S. Geological Survey. It promotes experimental recording of earth processes.

Readers are requested to send articles, photographs, publications and clippings about volcano and earthquake events, instruments and investigations, especially around the Pacific.

Subscription for non-members two dollars per year of 52 numbers. Address the Observatory.

HAWAIIAN VOLCANO OBSERVATORY
Founded 1911

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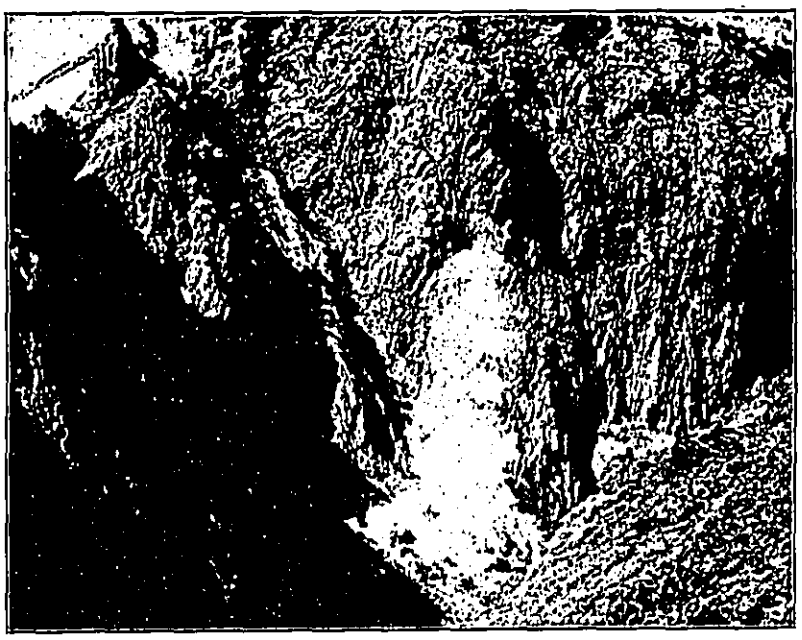
No. 314—Weekly | Hawaiian Volcano Observatory, National Park, Hawaii | January 1, 1931



One of Dr. Stone's photographs made during his ascent of Calbuco January 19, 1930, a year after the eruption described by Dr. Reichert on January 6, 1929. This is looking down into the new crater of the volcano, from the north side of the summit, showing thick white fume issuing from the bottom.

1929 ERUPTION OF CALBUCO, CHILE

By Dr. Federico Reichert

(Translated by J. B. Stone from Riel y Fomento, No. 87, July 1929).

It was in the afternoon of the 5th of January, 1929, when, accompanied by a friend, I undertook to climb the peak Derrumbo situated to the south of Lake Todos los Santos, a body of water well known to those making the trip between Bariloche and Puerto Montt. On the accompanying map of the Pacific Ocean these places may be found just where the longshore islands begin on the west side of South America, in the great valley of Chile, about 600 miles south of Valparaiso.

The prospect for the projected climb was very favorable. The sky was completely clear. The sun was brilliant and the calm absolute. Only the barometer marked an extraordinary and inexplicable minimum. In spite of this abnormal low pressure we resolved to begin the trip, and were able to climb that afternoon to an altitude of approximately 1,200 meters, where we stopped and were overtaken by night.

At about 2 o'clock of the following morning we were awakened by a strange noise and, on looking toward the horizon, we saw a thick mass of clouds, which was approaching rapidly from the west. The rarefaction of the atmosphere was clearly manifested. We supposed that a storm was approaching, a phenomenon often occurring in these regions. The stars still shone. Believing that it was a temporary atmospheric disturbance, we decided to wait until the clouds should discharge themselves, and then continue the interrupted ascent.

But this plan was rudely changed at 5 a. m. when we saw that the clouds were taking forms ever more curious and strange, and were approaching our position like phantasms, threatening to envelop the whole neighborhood and the summit of the peak we were trying to scale. At the same time there was heard a distant detonation different from the report of thunder, and the sky darkened thickly. We thought it would rain, but it did not do so. We decided then to abandon our plan and to return to the shore of the lake, where we had left a boat tied. This we did.

After setting out downhill and about 7 a. m., we found ourselves faced by a strange condition. At first we had the sensation that it was raining, but very quickly found we were mistaken. We looked up and verified the fact that it was a volcanic eruption, which in my judgment proceeded from the mountain Calbuco, situated some fifteen or twenty kilometers distant from the spot, and the only volcano at that time characterized by periodic activity in this region.

Little by little the sky was darkening more. The south

Overturned trees in the valley of Rio Caliente half buried in ash and swept by the blast that had rushed out from the eruption of Calbuco. Just such effects were found on the west side of Sakurajima in 1914. Photo Stone.

cove of Lake Todos los Santos was wrapped in an impenetrable blackness. Only in the north there were seen patches of faint light which quickly disappeared. At 9 a. m. we reached our moored boat. Meanwhile volcanic ash fell intermittently. We embarked at once bound for the south corner of the lake to seek refuge. We rode ten minutes and found ourselves in the dark, as in the middle of a starless night. Something marvelous! In the north, too, were extinguished the little lights gleaming until then in the bosom of the cloud masses. Under such conditions like blind men we kept on rowing anxious to gain the shore.

Ordinarily this could be done in 20 minutes, but now we rowed madly for two hours and a half. We seemed to navigate in a vacuum. The rain of ash bathed our bodies and faces and hindered our looking upward. The situation became complicated a little later by another pheonomenon no less strange. We were wrapped in the "fire of Saint Elmo" produced by the high electric tension. From our clothes and flesh we gave off sparks, and our heads seemed to be surrounded with aureoles. Suddenly the lightning flashed, followed immediately by thunder. The light of the celestial discharge, however, was not bright enough to tear the curtain of ash and nocturnal darkness which covered everything. Simultaneously the discharges from our bodies stopped and we found ourselves again in a chaos. We went on for a stretch and the phenomenon of the "fires" was repeated.

Without warning we reached the shore. To orient ourselves we lit matches and debarked not without difficulty. We were absolutely ignorant of the point where we had arrived. At last at 11:30 a. m. the sky began to clear and we distinguished smokily some outlines of the vicinity. To our surprise we found that we were scarcely 100 meters from the place where we had set out.

The spectacle which presented itself to our gaze was breath-taking. All the landscape, usually so magnificent, was covered by the gray colors of mourning. The fresh green forest had disappeared under cloaks of volcanic ash. The panorama was like a desert. The summits of the mountains Osorno, Puntiagudo, and Tronador, so majestic, had also received the rain of ash from the volcano. The snowy whiteness of their snow-clad peaks was now blackened. Carried by the blast from Calbuco the ash had traveled to the end of the state railways of Argentina, covering all the region of Lakes, Gutierrez and Mascardi of the Argentine Southern National Park. An area consequently of thousands of square kilometers.

Our expedition had aspects, therefore, that were unexpectedly dramatic, but it served for scientific observations. We analyzed the ash which had encircled us for so many hours, to see if it contained fertilizing substances. From this study we can say that it has a specific gravity of 2.66, and that the average thickness of the blanket was 1.5 centimeters. Thus every square meter of surface received about 40 kilograms of ash, contributing lime and phosphoric acid in appreciable quantities. For the 40 kilograms of crude ash will eventually add to every square meter of ground 740 grams of lime and 84 grams of phosphoric acid in the form of easily assimilable compounds.

(Dr. Stone points out that no rain fell at Calbuco for two weeks after this eruption, confirming Finch's conclusion (Amer. Jour. Sci. Feb. 1930) that steam from volcanoes is not the cause of accompanying showers, which depend rather on atmospheric humidity.)

VOLCANOES AND VOLCANOLOGY IN KAMCHATKA

The following is summarized from an interesting letter sent by Dr. P. T. Novograblenof, Director of the Kamchatka Museum, Petropaulovsk, Kamchatka, U. S. S. R.

Writing May 5, 1930, he states that in September, 1929, a great eruption began of Gorely Volcano, a peak 1,830 meters high lying 85 kilometers southwest from Petropaulovsk. The eruption reached its maximum December 30-January 2, and ended in March, 1930, lasting nearly seven months. Gorely, like most of the Kamchatka volcanoes or "sopka" as they are called there, is in uninhabited country. The result of this eruption was that a large area of southern Kamchatka was covered with ash. This is not to be confused with Gareloi of the Aleutian Islands.

Kluchevskaya Volcano, the Vesuvius of Kamchatka, was in a severely active condition throughout the whole of 1929. There were, however, no considerable earthquakes at Petropaulovsk. There are 18 active volcanoes in the peninsula and one in eastern Kamchatka. In the beginning of 1930 the massive northerly volcano Shiveluch, 3,291 meters high, began to throw up clouds of ash and lapilli. It is not known whether there were lava flows.

The Academy of Sciences of U. S. S. R. proposes to establish two volcano observatories in Kamchatka, one near Avachinsky Volcano, the other near Kluchevskaya. The Geological Committee of the Union has informed the Kamchatka Scientific Society that a volcanological expedition is being sent to Kamchatka under Professor A. N. Zavaritsky for exploring Avanchinsky Volcano (elevation 2,720 m.) and Koriatsky (3,462 m.), both these cones being near Petropaulovsk. This expedition will work for two years. It will be the second volcano expedition sent to Kamchatka, as the first one under Conradi and Kehll worked there in 1908-10. T.A.J.

KILAUEA REPORT No. 988

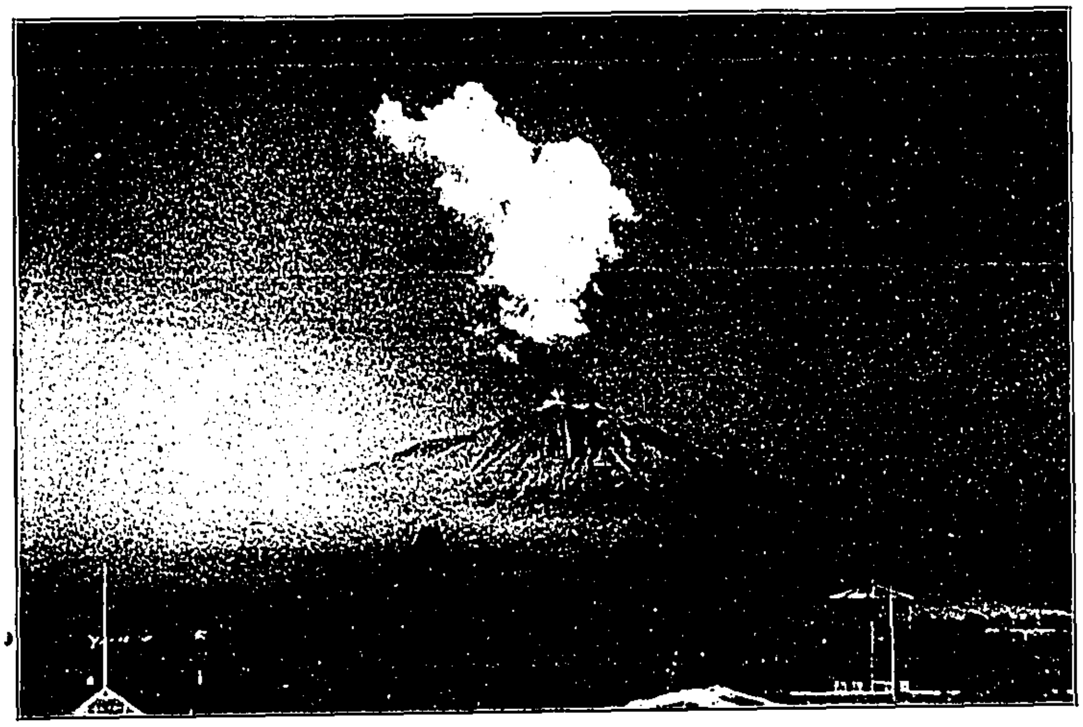
WEEK ENDING DECEMBER 28, 1930

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

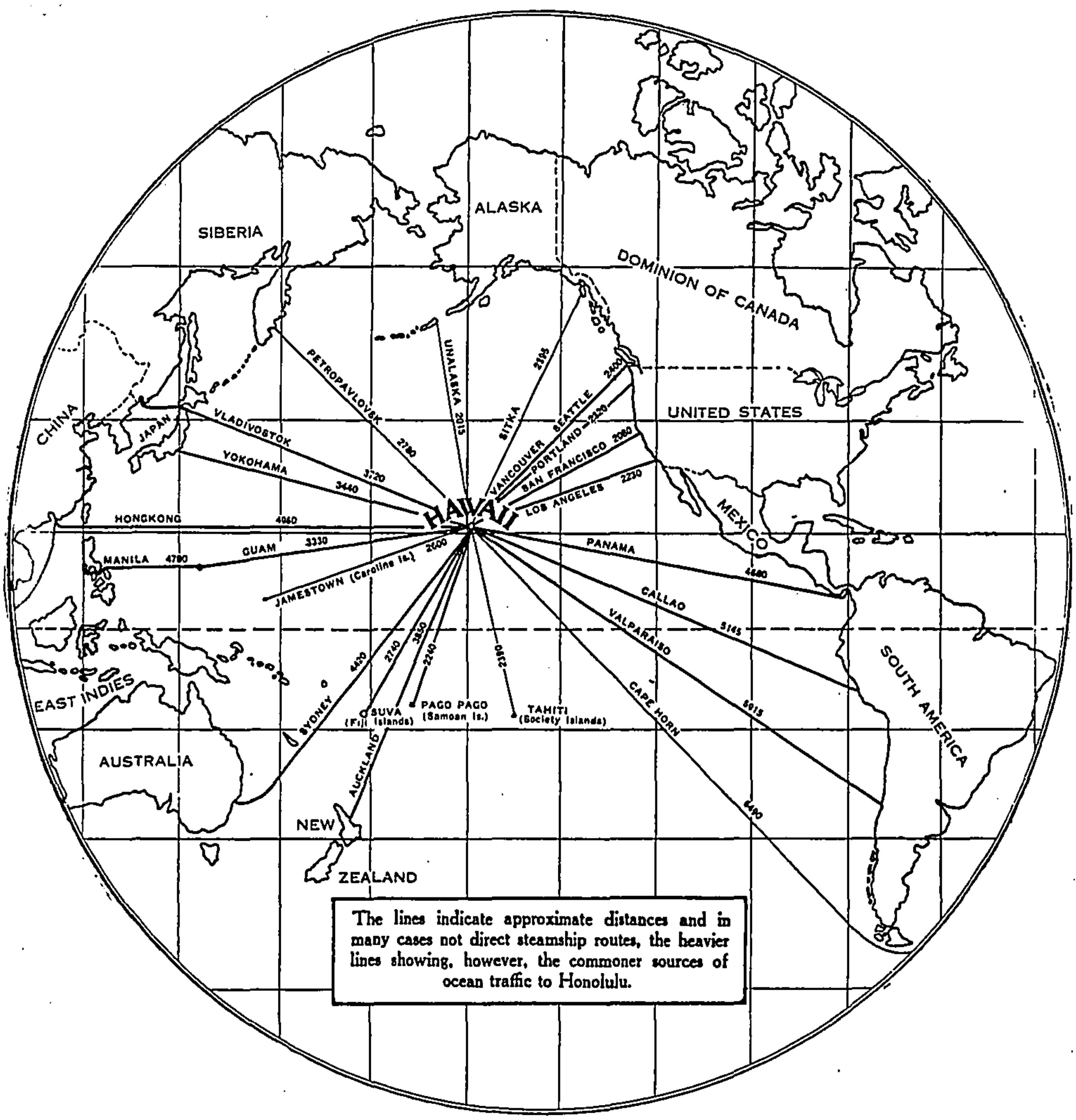
The situation at Halemaumau pit after the recent eruption of lava which filled the bottom and ceased activity December 7, 1930, still suggests continued upward pressure of the lava without sufficient gas potential to make it break out with visible lava flowing. This is indicated by tilt eastward at the pit seismograph and northward at the Observatory instruments, both of these directions implying a tipping away from the volcanic center; also bluish sulphur fume continues to rise.

December 24 the fume had greatly diminished in quantity as seen at 9:15 a. m. when one looked down at the side of the new cone and the sulphur crack at the southeast edge of the new floor. The lava December 26 seemed to have settled and cracked a little at the aa area. The pit seismograph showed tilt away from the center. December 28 at 4 p. m. fresh red debris was conspicuous on the north and east taluses. The pit as seen from a distance showed faint blue fume rising, otherwise was clear. This was identified as coming actively from the base of the outer ridge around the new lava cone, from the southern end of the sulphur crack, and from whitish spots at the southwest. The lava lake area has slumped as much as would be expected from loss of gas in the underlying lava pool.

The seismographs have registered 42 tremors, two of them continuous for several minutes, and two accompanied by easterly tilt. One feeble earthquake was registered at 12:55 a. m. December 25. Tilt at the Observatory was moderate north and microseismic motion was slight.



The eruption of Calbuco January 6, 1929, looking east from Puerto Varas on the morning of the day described by Dr. Reichert. Puerto Varas is on the railway at the south end of Lake Llanquihue, and the pall of ash is here shown at the north in the direction of Lake Todos los Santos. Photo Karl.



The lines indicate approximate distances and in many cases not direct steamship routes, the heavier lines showing, however, the commoner sources of ocean traffic to Honolulu.

This map of the Pacific Ocean shows one radius leading to Petropaulovsk 2,780 nautical miles from Honolulu, and another to Valparaiso which is 600 miles north of Calbuco Volcano. Niuafoou, described in Volcano Letter No. 312, is midway between Suva and Pago Pago.

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HAWAII NATIONAL PARK
HAWAII

OFFICE OF THE SUPERINTENDENT

December 5, 1930

Director,
National Park Service,
Department of the Interior,
Washington, D. C.

Dear Mr. Director:

Submitted herewith is the report of activities and operations in Hawaii National Park for November 1930.

000 GENERAL:

For the third time within two years Hawaii National Park is demonstrating its spectacular feature of active volcanic lava flow. On November 19th a fountaining flow began in Kilauea crater at Halemaumau fire-pit and at the time of this report the flow is starting on its third week of continuous action. The present eruption is the longest and best activity since the explosion and drainage period of May 1924. Park forces augmented by emergency employees have been required to work night and day to handle traffic and crowds and prevent accident. Crowds assemble on the natural edge of the sheer walls of a pit 1000 feet deep and view the inflow of lava on the pit bottom.

100 ADMINISTRATION:

120 Park inspections by.

121 Superintendent.

The superintendent made regular inspection of all construction and maintenance activities throughout the park. In addition numerous inspections were made of the special task of handling crowds and traffic at the volcano fire-pit and numerous safety inspections of the pit edges were undertaken. An inspection trip to the Haleakala area was called off due to the eruption at Kilauea.

150 Equipment and supplies.

We have received delivery of two sets of bookcases, a map case, a desk, and two stationery sections all of metal construction. Part of this is to equip a naturalist's office and part for administrative purposes.

180 Publicity etc.

Despite the fact that the 1927 corrected boundary of this park has been previously called to their attention, recent publications from advertising mediums are still being issued with old areas shown. In order to attempt correction a special outline map of the island of Hawaii with the park properly shown has been blueprinted and sent to the Tourist Bureau, steamship, and other agencies. Copy has been forwarded to Director's office.

200 MAINTENANCE, IMPROVEMENTS AND NEW CONSTRUCTION:

230 New Construction.

Public Toilets.

Construction of a set of public toilets at Halemaumau was completed with the exception of interior painting. Due to need of operating these buildings while crowds view the eruption, painting will be postponed. Completion of these structures has been very timely.

Trails.

The new short Steaming Bluffs trail leading from Volcano House around the near edge of Kilauea Crater to Uwekahuna is complete and already in active use both night and day.

240 Improvement of approaches to the park.

Actual work has begun on the Federal Aid project to reconstruct the worst fifteen mile of road between this park and Kailua in the Kona district. This is part of the island belt road. The superintendent recently inspected this work in company with Mr. E. S. Wheeler, district engineer for the Bureau of Public Roads.

300 ACTIVITIES OF OTHER AGENCIES IN THE PARK:

310 Public service contractors.

317 Status of authorized projects.

Building work on the new Volcano Photo Studio was entirely completed in time for the operator Mr. K. Maehara to take advantage of the start of volcanic action in the park. No formal opening has been held but a satisfactory business has been enjoyed from the beginning. Photos of the studio have already been forwarded you.

330 Donations.

Uwekahuna Lecture Hall

The new lecture hall being erected and donated by Hui O Pele is now attached by runway to the Uwekahuna Observatory and with the exception of minor details and seats is completed. Until funds for theatrical seats accumulate we will utilize the folding chairs now on hand and make use of the hall soon.

400 FLORA, FAUNA, AND NATURAL PHENOMENA:

410 Ranger-naturalist service.

Although guided hiking trips across the crater have been discontinued due to handling of eruption visitors we have managed to proceed with regular lectures. The new film Volcanoes is now in use and is a fine aid in explanation of the volcanic action going on at present. Visitors first see the pit in action by daylight, then hear the lecture and later see the lava flowing after dark. 618 persons were shown the educational film in 18 lectures during November.

420 Natural phenomena.

As before stated lava activity is now going on in Kilauea crater at Halemaumau. The flow commenced at 1:30 P.M. on the 19th and has been continuous since that time. A detailed account of the first week of eruption is given in the attached Volcano Letter dated November 30th. Action since that date has been similar and the pit floor has increased greatly in area and risen approximately 100 feet in height over all sections. The sight is of course a wonderful thing and will bring the park much publicity. Continuation of the flow is expected.

Related to the lava flow is the appearance of a new steaming area and sulphur deposit in Makaopuhi crater eight miles from Kilauea at the end of the Chain of Craters road.

500 USE OF PARK FACILITIES BY THE PUBLIC:

510 Increase in travel.

This months travel report forms show a decided and unusual increase in park attendance. The return of lava to Kilauea is, of course, responsible for this. Kilauea is the one volcano in the world which people run toward instead of away from when in eruption. Analysis of our travel figures will show a high average number of persons per car. Each car arriving at the fire-pit this month has carried extra capacity loads. Car count is actual and taken by hand counter as cars arrived for parking.

530 Weather.

Despite the occurrence of floods and washouts on all of the Hawaiian Islands including our own the Hawaii National Park area has enjoyed exceptionally fine weather all of November.

Maximum temperature — 4th, 19th, & 22nd —	74	degree
Minimum " ———— 29th ————	51½	"
Rainfall for month of November ————	8.51	inches
" " " " " at Hilo ———	18.50	"
" " to-date Volcano District ———	103.46	"
" " " at Hilo ————	143.09	"

540 Visitors.

A lava flow always brings with it an influx of influential park visitors. The past month has been no exception. Included in our guests for November have been:-

Mr. and Mrs. S. Parker Gilbert of New York. Mr. Gilbert was agent general for German reparations payments.
Major General Wm. Lassiter - U. S. Army. General Lassiter is the new commander of the Hawaiian Department.
Rear Admiral Yates Sterling. Admiral Sterling recently took command of the naval forces at Pearl Harbor.
Col. Llewellyn Oliver, Chief of Staff - Hawaiian Department U. S. Army.
John Mason Young - President Honolulu Chamber of Commerce. Mr. Young is spending a month in the park and has shown especially enthusiastic interest in development.
L. A. Thurston. Mr. Thurston is a member of one of the oldest families of white residents in the Islands and was active in creation of this park. He still retains his interest although at present very feeble physically. Is pushing Mauna Loa road propoganda.
Mr. Bert Tarleton - Collector Internal Revenue for Hawaii
Mrs. Jeanette Hyde - Collector of Customs.

All of the above were shown special attention by the superintendent.

550 Public Camps.

One hundred and ninety persons have used our public camp grounds either for picnic or overnight stay during November.

600 PROTECTION:

610 Police protection.

Although numerous persons were reprimanded for careless driving in heavy traffic no arrests were made.

630 Signs.

Three standard "Stop" signs with auxiliary red reflector glass have been installed at important approaches to the main highway passing through the park.

900 MISCELLANEOUS:

The superintendent assisted Mr. John A. Burty, of the San Francisco Civil Service office, in conducting oral tests of park ranger applicants at Honolulu and Hilo.

Dr. T. A. Jaggar of the Volcano Observatory returned to the park on November 22nd after and absence of five months in Honolulu and as a member of a scientific expedition to the South Seas for purpose of observing and eclipse.

Very respectfully yours,

Thos. J. Allen, Jr.,
Superintendent.

Copy to Field Headquarters (2)
" " Yellowstone National Park (1)

P. S.

The attached data in regard to flow measurements and quantities has just been presented after two weeks of lava outpouring into Halemaumau and is of interest to show the tremendous forces at work.

T.J.A.

HALEMAUMAU

DATA AT END OF FIRST TWO WEEKS

By Dr. H. A. Powers

Maximum diameter of new lava - 2,300 feet

Minimum diameter of new lava - 1,700 feet

(Roughly a circle 1,800 feet in diameter)

New lava covers 62 acres, 2,710,000 square feet; 252,000 square meters.

Deepest fill at fountain and lake - 100 feet - 30.5 meters.

Shallowest fill - edge opposite - fountain - 50 feet - 15.2 meters.

Volume of molten lava. Total - 229,000,000 cubic feet.

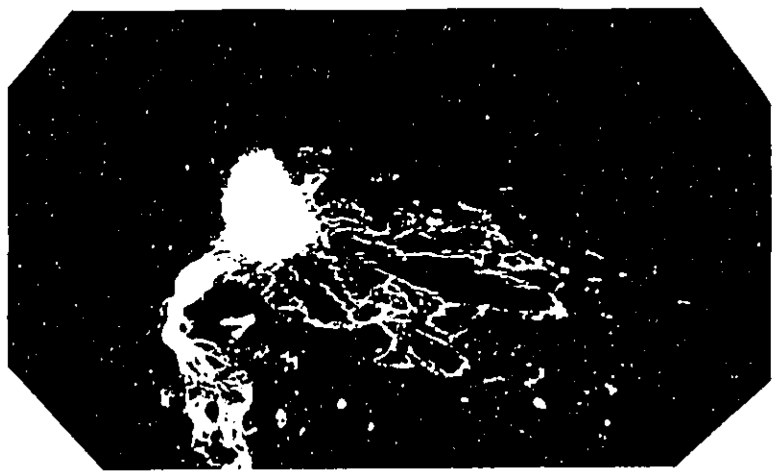
Flow first three days - 75,000,000 cubic feet - 2,124,000 cubic meters - 25,000,000 cubic feet per day.

Flow balance of 1st two weeks - 154,000,000 cubic feet - 4,360,000 cubic meters - 14,000,000 cubic feet per day.

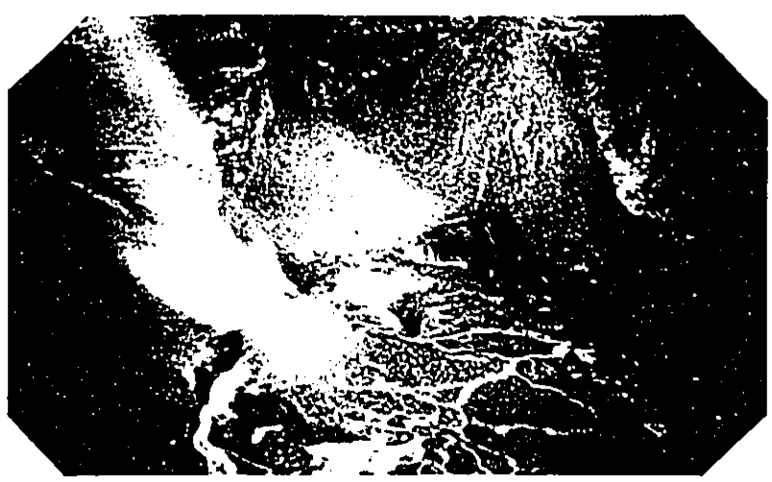
Weight of new lava.
Slightly more than 15,000,000 Tons or about 15,250,000,000 kilometer kilograms - 13,600,000 milliers (metric tons).

Lake at fountain - roughly 500 by 300 feet. Cone about 100 feet high and 200 feet in diameter.

INFORMATION FOR SUPERINTENDENT ALLEN.



Night View
November 21, 1930



Day View
November 21, 1930

10-157

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

TRAVEL REPORT

Hawaii National Park for the Month of **November 1930**

	This Month	This Travel Year To Date	This Month Last Year	Last Travel Year To Date	Increase for Travel Year: Number	Increase for Travel Year: Per cent
PRIVATE TRANSPORTATION:						
Cars first entry.						
Cars reentry.						
Motorcycles.						
Total motor vehicles.						
Persons entering via motor vehicles.	37,993	44,098	9,340	14,590	29,508	202.2%
Persons entering via other private transportation.	493	841	214	572	269	47.0%
Total persons entering via private transportation. . . .	38,486	44,939	9,554	15,162	29,777	196.4%
OTHER TRANSPORTATION:						
Persons entering via ~~xxxxxx~~ Hotel . .	897	1,281	469	1,044	237	22.7%
Persons entering via trains . .						
Persons entering otherwise. . .						
Total other transportation. .	897	1,281	469	1,044	237	22.7%
GRAND TOTAL ALL VISITORS. . .	39,383	46,220	10,023	16,206	30,014	185.8%

	This Year	Last Year	Increase: Number	Increase: Per cent
Automobiles in public camps during month	0	1	- 1	- 100
Campers in public camps during month	0	2	- 2	- 100

10-158

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

STATUS OF AUTHORIZED PROJECTS

Hawaii National Park for the Month of November 1930

	Description of Projects	Percent Constructed To Date	Percent Constructed This Month	Percent Constructed Last Month	Probable Date Completion
405	Ware House	100	—	100	
406	Toilets (Kilauea)	97	90	7	Dec. 15, 1930
407	Toilets (Uwekahuna)	100	1	99	
451	Telephone Line	95	—	95	Dec. 31, 1930
502	Kilauea Iki Trail	100	—	100	
502	Mauna Loa Trail	100	—	100	
502	Summer Camp Trail	100	—	100	
502	Steaming Bluffs Trail	100	50	50	
	Road Survey, B.P.R.	100	—	100	

10-159

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

STATUS OF PERSONNEL

Hawaii National Park for the Month of November 1930

	This Month	This Month Last Year
Number of employees beginning of month,	17	7
Number of additions, ...	7	5
Total, ...	24	12
Number of separations, ...	11	0
Number of employees close of month,. .	13	12
Number of promotions during month	0	0
Aggregate amount of annual leave taken,	0	2
Aggregate amount of sick leave taken,	0	0
Aggregate amount of leave without pay,	0	0

10-160

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

REPORT OF PARK REVENUES

Hawaii National Park for the Month of November 1930

	This Year	Last Year
Park revenue on hand beginning of month,	0.00	0.00
Received,	125.00	125.00
Total,	125.00	125.00
Remitted,	125.00	125.00
On hand close of month,	0.00	0.00

Park revenues received this year to date,	1,475.00
Park revenues received last year to date,	1,452.00
Increase,	23.00
Percent of increase,	1.6%

10-161

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
Hawaii National Park

REPORT OF SALES OF PUBLICATIONS

NOVEMBER 1930

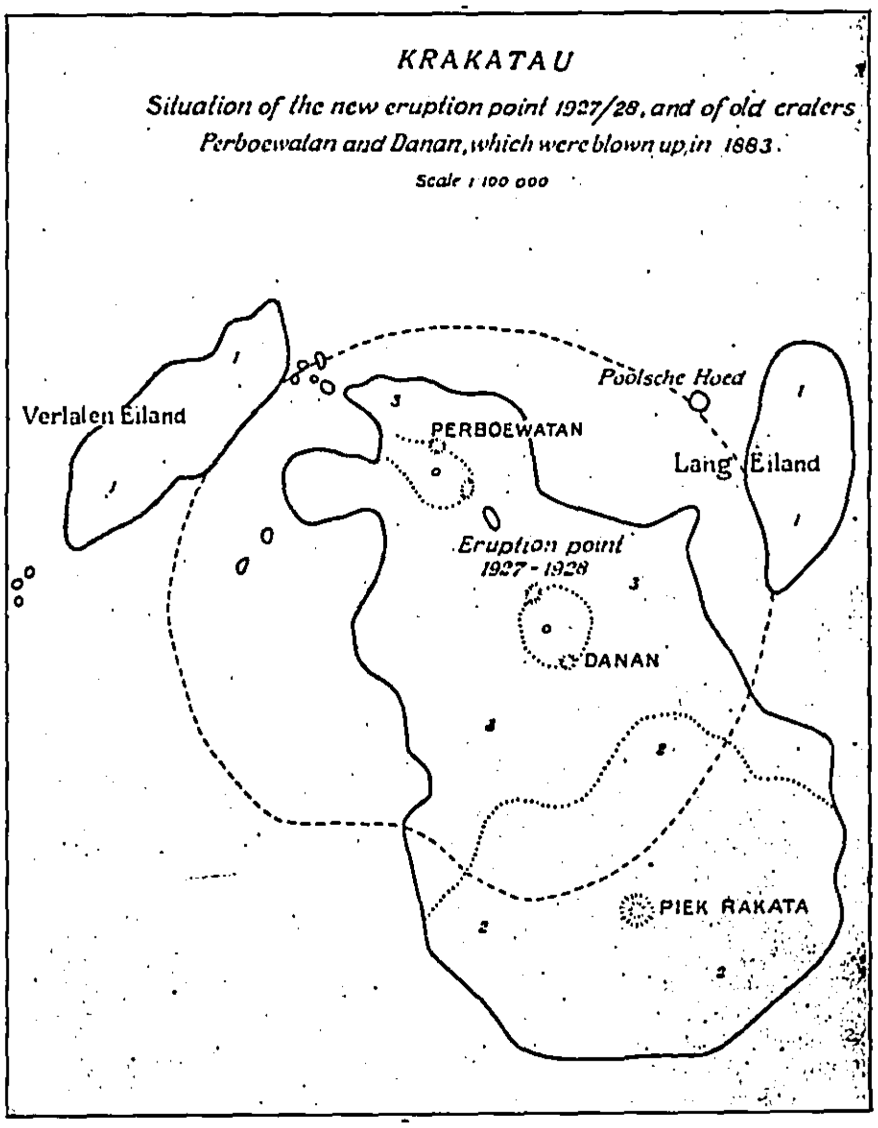
	Number	Value
GOVERNMENT PUBLICATIONS:		
On hand beginning of month, ...	408	100.20
Received during month, ...	0	0.00
Total, ...	408	100.20
Sold during month, ...	27	14.40
On hand at close of month, ...	381	85.80
	17	5.30
	364	40.50
NON-GOVERNMENT PUBLICATIONS:		
On hand beginning of month, ...		
Received during month, ...		
Total, ...		
Sold during month, ...		
On hand at close of month, ...		

Cash on hand beginning of month, ...	56.20
Sales during month, ...	14.40
Total, ...	70.60
Remitted during month, ...	55.00
Balance, ...	15.60

The Volcano Letter

Two dollars per year | Ten cents per copy

No. 306—Weekly | Hawaiian Volcano Observatory, National Park, Hawaii | November 6, 1930



.Arrangement of the three craters Perboewatan, Danan, and Rakata of Krakatoa in 1883. The area enclosed within the heavy broken line is that region which was engulfed in the 1883 eruption. The location of the 1927-28 activity also shown. After Stehn.

THE ERUPTION OF KRAKATOA, 1883

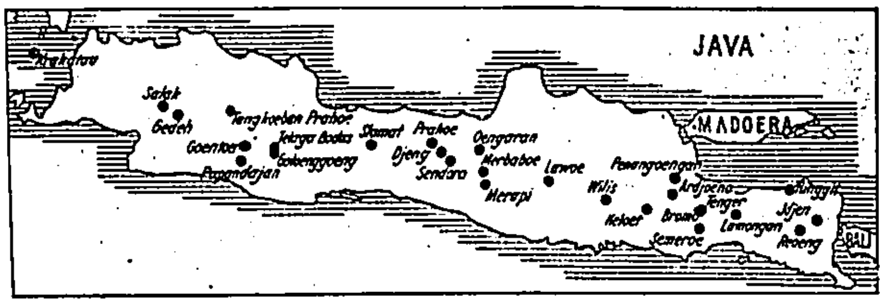
Review by R. A. Miyake of the Report of the Krakatoa Committee of the Royal Society.

Krakatoa is only a fragment of a great crater-ring rising out of the Sunda Strait, which separates Java from Sumatra. Along the line of this Strait we have evidence of a transverse fissure crossing the main fissure nearly at right angles. Upon this transverse fissure, a number of volcanoes have been built, namely: Pajung, in Java, with a height of 1,500 feet; the cone of Princes Island, 1,450 feet; Krakatoa, 2,623 feet; Sebesi, 2,285 feet; and Rajah Basai, in Sumatra, 4,308 feet.

In spite of the significance of its position at the point of intersection of these two great lines of volcanic fissure, Krakatoa had, until the year 1883, attracted but little attention.

On the afternoon of the 26th of August, and through the succeeding night and day till the early morning of the 28th of August, it was evident that the long-continued moderate eruptions (Strombolian stage) which had for some months been growing in intensity, had passed into the paroxysmal (Vesuvian) stage.

About 1:00 p. m. on August 26, the detonations caused by the explosions attained such violence as to be heard at Batavia and Brutenzorg, about 100 English miles away.



Distribution of active volcanoes in Java from Bali to Krakatoa. After Stehn.

One hour later, Captain Thomson of the Medea, then sailing at a point 76 miles east-northeast of Krakatoa, saw "a black mass rising up like a smoke in clouds" to an altitude which has been estimated as being no less than 17 miles. The great detonations at this time were said to be taking place at intervals of about ten minutes.

By 3:00 p. m. the explosions had so increased that their sound was heard at Bandong and other places 150 miles distant, and by 5:00 p. m. they had become so tremendous that they were heard all over the island of Java. The noise is described as being like the discharge of artillery close at hand, causing rattling of the windows and shaking of pictures and other objects hanging on the walls. Nearly all observers agree that there was nothing in the nature of earth-quake shocks, but only strong air-vibrations.

At 7:00 p. m., when the dense vapor and dust-clouds brought on early darkness, the whole scene was lighted up from time to time by the electrical discharge, and at one time the cloud above the mountain presented "the appearance of an immense pine tree, with the stem and branches formed with volcanic lightning." The air was loaded with excessively fine ashes, and there was a strong sulphurous smell. The steamer G. G. Loudon passed to the northwest and west of the volcano within a distance of 20 or 30 miles. It was seen to be "casting forth enormous columns of smoke" and the vessel passed through "a rain of ashes and small bits of stone."

The explosive bursts of vapor beginning on the afternoon of Sunday and continuing at intervals of ten minutes, increased in violence and rapidity, and from sunset till midnight there was an almost continuous roar which moderated somewhat towards early morning.

The constant augmentation of tension beneath Krakatoa in the end gave rise to a series of tremendous explosions on a far grander scale than those resulting directly from the influx of the sea-water into the vent; the four principal of these occurred at 5:30, 6:44, 10:20 and 10:52 Krakatoa time on the morning of August 27. Of these, the third occurring shortly after ten was by far the most violent, and was productive of the most wide-spread results.

After the great outbursts of the early morning of the 27th, it appears that there was a lull for a time inasmuch as no explosions were heard at Brutenzorg during the afternoon. At 7:00 p. m. the explosions began again, increasing in violence until 10:00 or 11:00 p. m., when they again declined and finally ceased to be heard at 2:30 a. m. on Tuesday, the 28th of August.

The soundings of the ocean bottom around the volcano after the eruption showed that a great depression or fissure had been formed, which extended eastward from Krakatoa for a distance of seven or eight miles, and extended nearly in the direction of the great line of volcanic activity which crosses Java and Sumatra.

The greatest outburst of Krakatoa in 1883 was the excessively violent though short paroxysm with which it terminated. The phenomena displayed during this eruption are to be accounted for, according to Judd, by the situation of the volcano and its liability to great inrushes of water from the sea.

KILAUEA REPORT No. 980

WEEK ENDING NOVEMBER 2, 1930

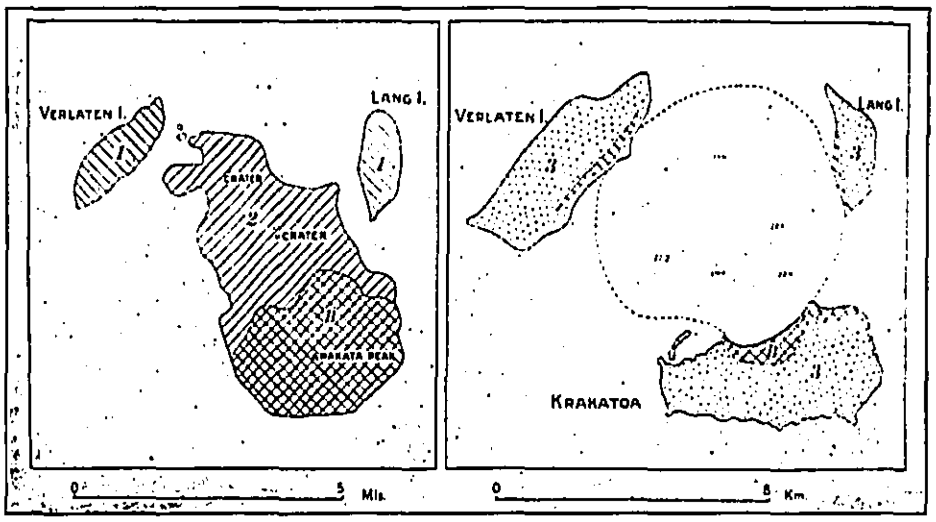
Section of Volcanology, U. S. Geological Survey

H. A. Powers, Temporarily in Charge.

Halemaumau still persists in showing no signs of reawakening activity. Even avalanching from the walls has been conspicuously absent during the past week, and the dry, sunny weather has permitted the steam from the wall and floor cracks almost to disappear. A slight earthquake on Friday evening was felt by many people in the National Park, and by some of the residents of Hilo. Probably it was felt in Kau and Kona, but was not sufficiently disturbing to cause comment.

The instruments recorded this quake at 6:23 p. m., October 31, as a shock of slight intensity. The distance to its origin was determined as 32 miles, which would place it as a Mauna Loa disturbance. Three very feeble quakes were also recorded by the Observatory seismograph as follows: October 28, 4:19 a. m.; October 29, 1:35 p. m.; and October 31, 7:41 p. m. None of these has been reported as felt, and the records were not clear enough to establish the distance to any of their origins. Small tremors which may have been of volcanic origin were more numerous this week, the instrument having recorded 42 of them in the seven days. Non-volcanic trembling of the island was slight during much of the week, but increased slightly with the strong winds of the week-end.

The average of the tilt readings for the week shows a very slight increase in a north-northwest direction. However, an analysis of the daily readings of tilt shows that there has been no consistent directional movement which would be the case if there had been a definite change in pressure conditions under either volcano. This makes the second week of apparent stagnation since the Kilauea earthquake of October 20. Some change, either an increase or a relaxation of pressure, may be expected during the coming week.



Plan of Krakatoa volcano before and after the great explosive eruption of 1883. After Daly.

THE ERUPTIONS OF CINDER CONE, LASSEN VOLCANIC NATIONAL PARK, CALIFORNIA

The existing knowledge of the eruptions of Cinder Cone, a small basaltic volcano near Lassen Peak, and descriptions and theories as to the origin of its rather remarkable lava are very well summarized in a recent paper by R. H. Finch and C. A. Anderson, "The quartz basalt eruptions of Cinder Cone, Lassen Volcanic National Park, California," University of California Publications in Geology, Vol. 19, No. 10, 1930, pp 245-273. The general descriptions of the eruptions is of considerable general interest inasmuch as the last lava flow from this vent is found to be one of the most recent flows in North America.

The first account of activity of Cinder Cone is a paper, published in 1874, by H. A. Harkness, "A recent volcano in Plumas County." He quoted statements from a number of independent observers which establish the fact that lights were seen in the Cinder Cone area on many different nights during the winter of 1850-51. Also two prospectors reported passing by an active volcano and hot rock in that region in the summer of 1851. On the strength of these reports and his own observation a little later, Harkness attributed all of the cinders and lava of Cinder Cone to activity in the winter of 1850-51.

J. S. Diller of the United States Geological Survey described a detailed investigation of Cinder Cone in several papers which appeared between 1890 and 1900. Diller showed that the volcanic features of this area are the product of two main periods of activity with a considerable time interval between. He showed that trees about 200 years old were growing near the old cinder cone, but that the more recent second period of activity might have occurred at some late date, though prior to 1840. He dismissed the Harkness evidence as in adequate proof of an eruption in 1850-51.

A. L. Day and E. T. Allen of the Geophysical Laboratory at Washington studied Cinder Cone in connection with their work on the Lassen Peak eruptions, and published their findings in 1925. They accepted Diller's idea of two periods of activity, but showed that a tree over 200 years old was growing at the edge of the younger flow. This new evidence was advanced against both Harkness' and Diller's dating of the late activity.

In 1927, R. H. Finch issued a preliminary statement to the effect that the later "flow" actually was made up of two or three flows of different age and that the youngest of these might be of very recent date.

In the same summer, A. E. Jones made a reconnaissance study of the magnetic properties of the flows at Cinder Cone. He found lava flows of at least five different ages; the three oldest belong to Diller's early activity, and the two youngest flows, to the late activity. The youngest flow was given an approximate date of 1846, and the oldest flow was dated about 500 A. D.

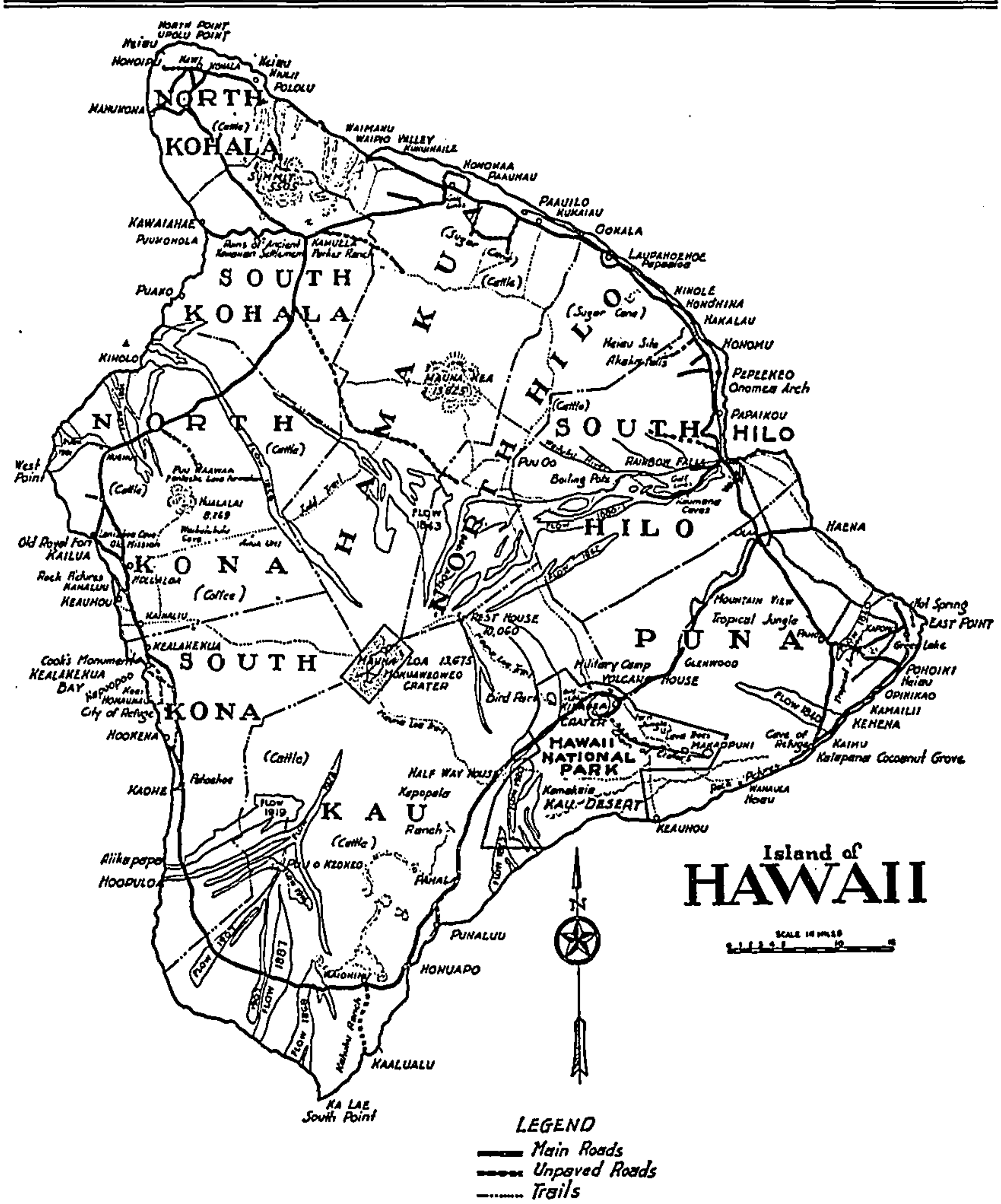
Finch and Anderson add a number of facts to this previously existing information. They show that the main cinder cone is the product of several different eruptions of pyroclastic material, probably separated by considerable intervals of time. Further several small cinder cones are found in different parts of the lava field, indicating that a number of vents were involved in the eruptive activity of the region.

They give a detailed discussion of the latest flow of black lava which is easily distinguished from the older flows by its fresh black color and its unweathered surface. This latest flow lies entirely on top of the older flows from Cinder Cone so that its hot margins never had an opportunity to destroy the vegetation which grows at the edges of the whole lava field. In view of this fact, the evidence offered by Day and Allen and by Diller to prove that the lava must be over 200 years old is not applicable to the youngest flow. Therefore Finch and Anderson conclude that this flow was formed by activity in the winter of 1850-51.—H. A. P.

TILTING OF THE GROUND DURING OCTOBER

A review of the tilt record for the month of October shows several features of interest. During the first few days of the month there was an extremely heavy rainfall at the Volcano. Accompanying this heavy rain, and perhaps caused by it, the ground tilted considerably to the south. Beginning about October 7, the ground tilted steadily and strongly in a north-northeast direction, which is up and away from the active center of Kilauea. Tilting in this direction has been found usually to accompany an increase of lava pressure in this volcano. This phase of the tilting was culminated by the earthquake of October 20 which produced a sudden tilt to the northwest. Since that date, there has been no consistent tilting of the ground, but only a very small amount of apparently aimless wandering. A tabulation of the amount and direction of tilt by weeks is as follows:

Sept. 20—Oct. 5	1.7 sec. of arc	—S.
Oct. 6—Oct. 12	1.3 " " "	—N.N.E.
Oct. 13—Oct. 19	3.1 " " "	—N.N.E.
Oct. 20—Oct. 26	1.1 " " "	—N.



THE VOLCANO LETTER

The Volcano Letter combines, after January 1, 1930, the earlier weekly of that name, with the former monthly Bulletin of the Hawaiian Volcano Observatory. It is published weekly, on Thursdays, by the Hawaiian Volcano Research Association, on behalf of the section of Volcanology, U. S. Geological Survey. It promotes experimental recording of earth processes.

Readers are requested to send articles, photographs, publications and clippings about volcano and earthquake events, instruments and investigations, especially around the Pacific.

Subscription for non-members two dollars per year of 52 numbers. Address the Observatory.

HAWAIIAN VOLCANO OBSERVATORY
Founded 1911

This laboratory at Kilauea Volcano belongs to the Hawaiian Volcano Research Association and is leased and operated by the United States Geological Survey.

It maintains seismographs at three places near Kilauea Volcano, also at Hilo, and at Kealakekua in Kona District. It keeps a journal of Hawaiian volcanic activity and publishes occasional Bulletins.

Membership in the Hawaiian Volcano Research Association is limited to patrons of Pacific science who desire personally to aid in supporting the work.

The work of volcano research so supported is in collaboration with the work of the United States Geological Survey, but supplements it with buildings, research fellows, instrumental plants, explorations and special investigations for which there is no governmental provision. The Geological Survey maintains volcano stations in Alaska, California and Hawaii.

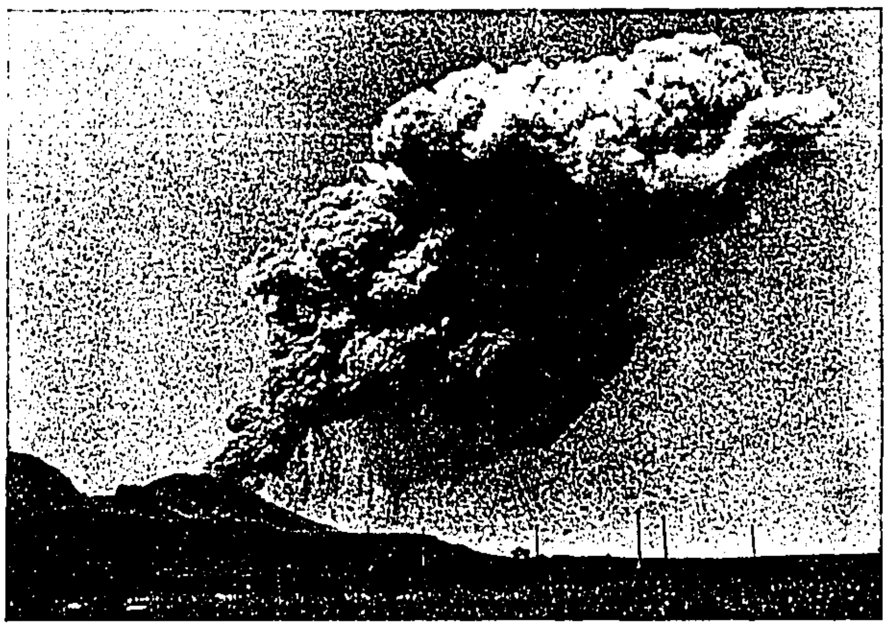
The Board of Directors includes Lorrin A. Thurston, President; Frank C. Atherton and Walter F. Dillingham, Vice-Presidents; L. Tenney Peck, Treasurer; Wade Warren Thayer, Arthur L. Dean, and Richard A. Cooke.

Persons desiring application blanks for membership should address the Secretary, Hawaiian Volcano Research Association, 300 James Campbell Building, Honolulu, T. H.

The Volcano Letter

Two dollars per year — Ten cents per copy

No. 307—Weekly — Hawaiian Volcano Observatory, National Park, Hawaii — November 13, 1930



An explosive eruption from Asama-yama in 1911. Much greater eruptions of this type from this volcano, Bandai-san, Krakatoa, Katmai, and others have thrown huge quantities of fine dust into the upper layers of the earth's atmosphere, creating a universal haze which affects the temperatures of the surface of the earth. Photo Uozo.

EFFECT OF VOLCANIC DUST ON EARTH TEMPERATURES

By H. C. HANNA

In June 1912, C. O. Abbot of the U. S. Geological Survey was in Algeria making measurements on the quantity of heat coming to the earth from the sun. At the same time, F. E. Fowle of the Geological Survey was engaged in making similar measurements at Mount Wilson in California.

At Bassou, Algeria, during Abbot's observations of June 19, 1912, he noticed streaks of dust lying along the horizon. These were joined by others and in a few days the sky appeared "mackereled" although no clouds were present. Finally the phenomenon became so marked that any observations were discontinued. On June 29, the whole sky was filled with haze which continually became worse until the expedition departed on September 10.

Thinking that this was merely a local condition, Abbot returned to the United States to learn of the eruption of Mt. Katmai in Alaska. He also found from reports of the Weather Bureau and European journals that these same atmospheric conditions had been noticed elsewhere.

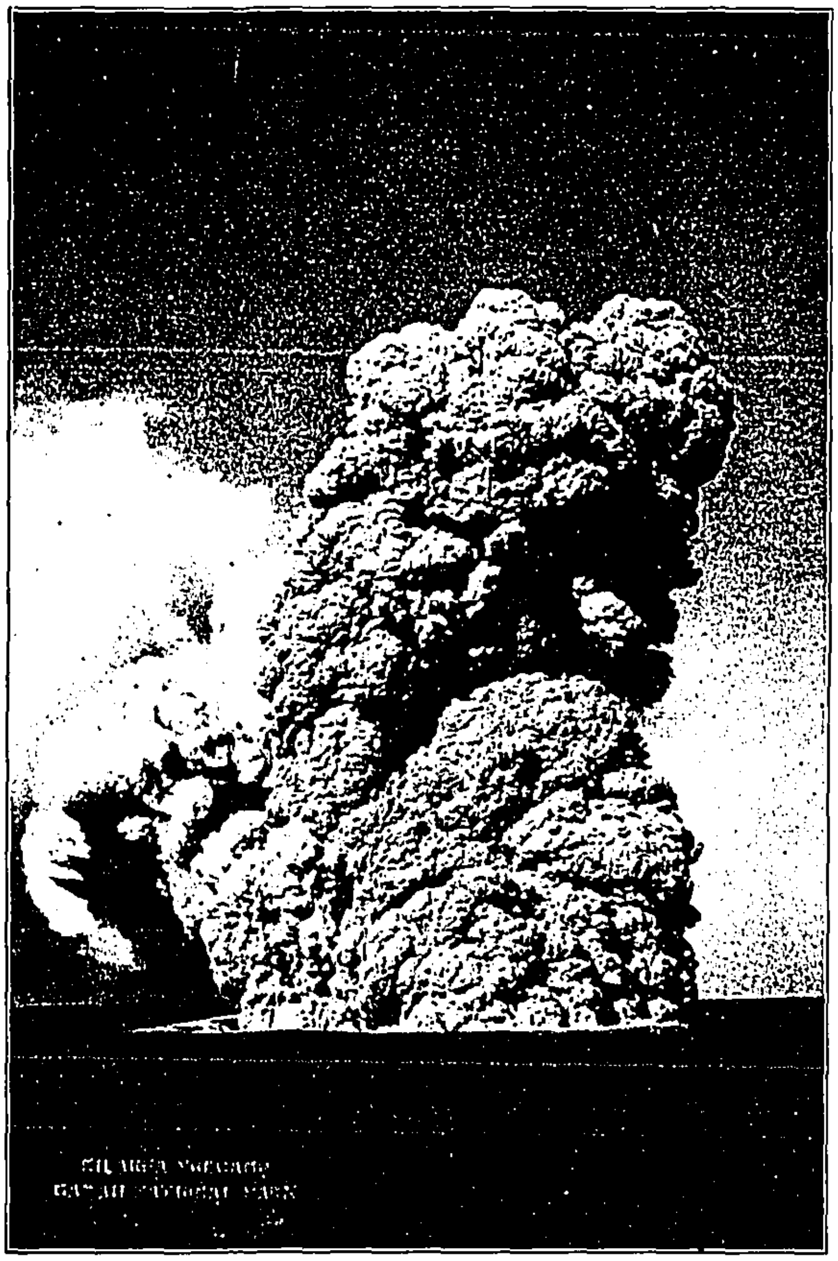
This effect was naturally assumed to have been caused by the Katmai eruption, and immediately estimates were made to discover the speed with which the dust reached certain distant points. Roughly the dust had moved at a rate of 40 miles per hour toward Washington; 25 miles per hour toward Basson; and 3 miles per hour toward Mt. Wilson. The small average speed toward Mt. Wilson probably is to be accounted for by the fact that it is more nearly south of Katmai and the high velocity winds follow a general course from east to west.

The nature of the observations made and the apparatus used should be considered; first, the pyrheliometer was used to measure the heating effect of the sun at the earth's surface; and second, the spectro bolometer, a device of Langley, was used to observe the excessively minute heating effects of the rays of different color in the solar spectrum. Using a thin, blackened thermometer, the heat produced by each ray of the spectrum from the ultraviolet to far beyond the red was measured.

Measurements were made at intervals of several hours. Then knowing the angular distance of the sun from the horizon at each time of observation, the thickness of the layer of atmosphere traversed by the solar beam was computed. After this it was possible to determine how much greater the heat intensity of the rays would have been had the observations been made outside of the earth's atmosphere—"for instance on the moon." Then it was possible to determine how much the ray of each part of the spectrum had been diminished by passing through the dust-laden atmosphere on its way to the earth's surface.

From these measurements it is shown that the haziness of the atmosphere during the summer of 1912 produced a very marked decrease in the direct solar radiation for all parts of the spectrum which reached nearly 20 per cent of the total heat at high sun.

There was naturally an increased brightness of the sky for this loss of heat in 1912. This was due to the



One of the explosions from Halemaumau in 1924. The Hawaiian volcanoes are not in the habit of erupting with a violence sufficient to throw dust into the uuper atmosphere.

reflection of the sun's rays from the dust in the air, thus making the sky bright as do the particles of dust in a room reveal the path of a sunbeam in it. One can easily see that since the light of the sky and the loss of heat by reflection into space both depend on the presence of the particles of dust in the atmosphere, an increase of the dust must make the sky brighter and the loss to space of sun heat greater.

In the main it is this that interested the observers for they wished to inquire how much heat was lost to the earth by the reflection of the atmosphere, owing to the dust which came from Katmai volcano. Abbot and Fowle constructed a formula involving the following factors: (A) is the direct solar beam; (B) is the skylight; (C) the rays absorbed by atmospheric water; (D) rays reflected into space from upper atmosphere; and (E) heat of solar beam outside the earth's atmosphere, approximately the sum of A, B, C, and D.

Measurements of (A), the direct sun rays, and (C), the absorbtion by water and other atmospheric vapors, are made each day. Abbot built an apparatus to measure (B), the direct light of the sky. Knowing, then, the value of (E), (D) could be found readily by subtracting from (E) the sum of (A), (B), and (C).

Following this proceedure, the results obtained at Bassou on the 5th, 6th, and 7th of September, 1912, were as follows, stated in calories per square centimeter per minute:

(A) Heating effect of direct beam of zenith sun.. 1.250
(B) Heating effect of entire sky .... .245
(C) Heating effect of rays absorbed by atmospheric vapors .... .175
Total of (A), (B), and (C) 1.670
(E) Heating effect of sun outside earth's atmosphere 1.950
(D) Heat lost by reflection from dust in atmosphere 0.280

Thus 0.280 calories per square centimeter per minute represents the heat reflected to the atmosphere in 1912. In previous years, it was found from experiments at Mount Wilson and Mount Whitney that this heat reflection was less than .050 calories. From these results, Abbot draws the following conclusion: "I am of the opinion that the difference between these results of 1912 at Bassou and those of earlier years at Mt. Wilson and Mt. Whitney (about 0.200 calory) represents approximately the radiation reflected away to space by the volcanic dust of 1912, or, in other words, the loss of heat available to warm the earth which we must attribute to the great haziness which prevailed in 1912. Hence I conclude that the dust of Katmai diminished the heat available to warm the earth in the north temperate zone about ten per cent during the summer of 1912. In accordance with the laws of heat and radiation, this might produce a fall of seven degrees Centigrade in the temperature of the earth as a whole if it were effective for a long enough period of time."

The question naturally arises as to whether volcanoes can really produce such world wide haze. Going back to the records of times of the great volcanic actions of the last 150 years, we have the eruption of Asama-yama, Japan, in the year 1783. In the same year occurred another extraordinary eruption, that of Skaptar Jokul in Iceland which took place on June 8 and 18th.

Arago records dry fogs in the upper atmosphere on about the same date at places distant from each other such as Paris and Avignon, Turin and Padua. It extended from the north coast of Africa to Scandinavia and lasted more than a month. In Languedoc, its density was such that the sun was not visible until it had reached a position 17 degrees above the horizon, and at the time of new moons the nights were so bright that small print could be read even at midnight.

In 1815 occurred the eruption of Mayou in the Philippine Isuands and on April 7 to 12, 1815, the eruption of Tamboro Sumbawa. For three days there was absolute darkness for a distance of 300 miles. Then came the long twilights and sunsets for which the year of 1815 is so notable in Europe.

Hecla and Vesuvius erupted in 1845 and 1846, and Merapi in 1872. In 1883 occurred the eruptions of Krakatoa and St. Augustine in Alaska. The extraordinary atmospheric phenomena which followed these remarkable volcanic eruptions were so in relation of effects to causes that there can be no doubt as to the reasonableness of ascribing the haze of the summer of 1912 to the volcanic eruption in Alaska.

Very great departures from the usual intensities of solar radiation occurred from 1803 to 1807, 1888 to 1893, and from 1902 to 1904. We have only to look back to the history of such volcanic eruptions as Wulano and Mayon in 1888, Meharaizan in 1889, Mt. Zoo in 1890, Bandaisan and Etna in 1892, Pelee and Santa Maria in 1902, Colmira in 1903 to see that the decrease in solar radiation over these periods had much volcanic action to cause it.

Abbot assembled data on recorded temperatures during the year 1912 which show that the surface of the earth was appreciably cooled, especially in the high mountain regions, by the haze from the explosion of June 1912.

He studied the temperature departures for Pic-du-Midi, Puy-de-Dome, and Lchneekoppe for the years 1882 to 1884 inclusive to determine the effect of the Krakatoa eruption. These results, however, were not so satisfactory, although, at some of the stations, daily temperature depressions were found beginning in September 1883. He says:

"The fact is that the temperature of the earth is a function of so many variable quantities that general or cosmical effects are often greatly obscured by local ones. Studies, however, are being made by several authors to detect if there is a periodicity of terrestrial temperature corresponding in time to the sun-spot cycle of about 11 years. It has been found that there is indeed an increased *temperature at times of minimum sun-spots. This increase* of temperature is greater than would be caused directly by darkening of the sun by sun-spots, so that it seems that there is accompanying the spots, some secondary influence affecting terrestrial temperatures."

These fluctuations in temperature not being accounted for by the variation of sun-spots, Abbot and Fowle have endeavored to see whether a combination of the effect of the sun-spot cycle with the effect of volcanic haze will produce a more exact correspondence between the cosmical phenomena and the temperature curve of the earth's surface.

Their work gives a set of curves comprising the sun-spot curve from 1880 to 1909, the curve of departures from the mean temperatures at 15 stations in the United States and a similar curve of departures for the world. These three curves show, quoting Abbot, "a considerable degree of correspondence yet it is not hard to see that there is also much discordance." This diagram tends to lead to the conviction that terrestrial temperature varies in accordance with fluctuations in the number of sun-spots and, in addition, that the intensity of the sun's direct radiation as measured at the earth's surface is much modified by such terrestrial phenomena as the dust of volcanic eruptions.

Humphreys follows a line of reasoning similar to the above writers though he carries his conclusions farther. The main differences between his views and those of Ellsworth Huntington (another student of the subject) are that (1) he regards variations in solar activity as of negligable importance so far as our present knowledge is concerned and (2) he strongly emphasizes the importance of volcanic dust. In his own words,

"Variations in the average temperature of the atmosphere depend jointly upon volcanic eruptions through the action of dust on radiation and upon sun spot members, through, presumably, some intermediate action they have upon the atmosphere.—Hence, as there appear to have been several periods of great volcanic activity in the past with intervening periods of quiesence, it is inferred that volcanic dust in the upper atmosphere was at least an important factor in some, if not all, the great universal climatic changes."

Huntington does not agree entirely with Abbot, Fowle, or Humphreys. After a lengthy discussion of facts, he concludes that the variations in the sun are the main factor in modifying terrestrial temperature, but their effect may be much modified by the presence of volcanic dust in the atmosphere.

It is thought that if volcanic explosions continue active through a more or less long geologic time they could alone, or in part, cause cold or even glacial climate. We should, therefore, expect an extremely cold climate at the end of a mountain-making era during the "critical periods." Huntington points out that we have had ice ages at the close of the Paleozoic and Cenoxoic eras, but that the close of the Mesozoic (an era of extreme mountain making and volcanic activity in North America) did not result in a glacial but only a slightly cooled climate. There is also evidence that volcanism was renewed in the Cordillera of North America throughout much of the Eocene, and yet there was no glacial climate at the end of this time. In the same way there was a marked temperature decline at the close of the Cenozoic in the Pleistocene. Equally extensive movements were going on in Europe in the rise of the European Alps and earlier movements did not affect the climate.

It seems however, although there is some difference of opinion among the authorities on the importance of volcanic dust, that the most logical conclusion to draw from these discussions is that volcanic dust in the isothermal regions of the atmosphere has caused serious effects upon the temperature of the sun's rays at the surface of the earth.

References

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KILAUEA REPORT No. 981

WEEK ENDING NOVEMBER 9, 1930

Section of Volcanology, U. S. Geological Survey
H. A. Powers, Temporarily in Charge.

Halemaumau is still remarkably quiet. Steaming has been almost nil during the daylight hours of the week. A rather striking cumulus cloud was noticed above the pit the evening of November 4 which was formed when the column of warm air rising from the pit was interrupted by a layer of cold air blowing across the summit of Kilauea. No avalanches in the pit have been noticed or reported.

The seismographs recorded only one very feeble earthquake on November 9 at 5:14 a. m. The distance to its center could not be determined. Forty-four small tremors registered during the week and the non-volcanic microseisms have been of moderate size accompanying the rather heavy surfs which have been pounding on the coasts of the island.

The average of the week's tilt record shows a very slight tilt to the northeast, up and away from the crater. However, there has been no marked change in the tilting of the rim which would indicate a change of pressure conditions under the volcano.

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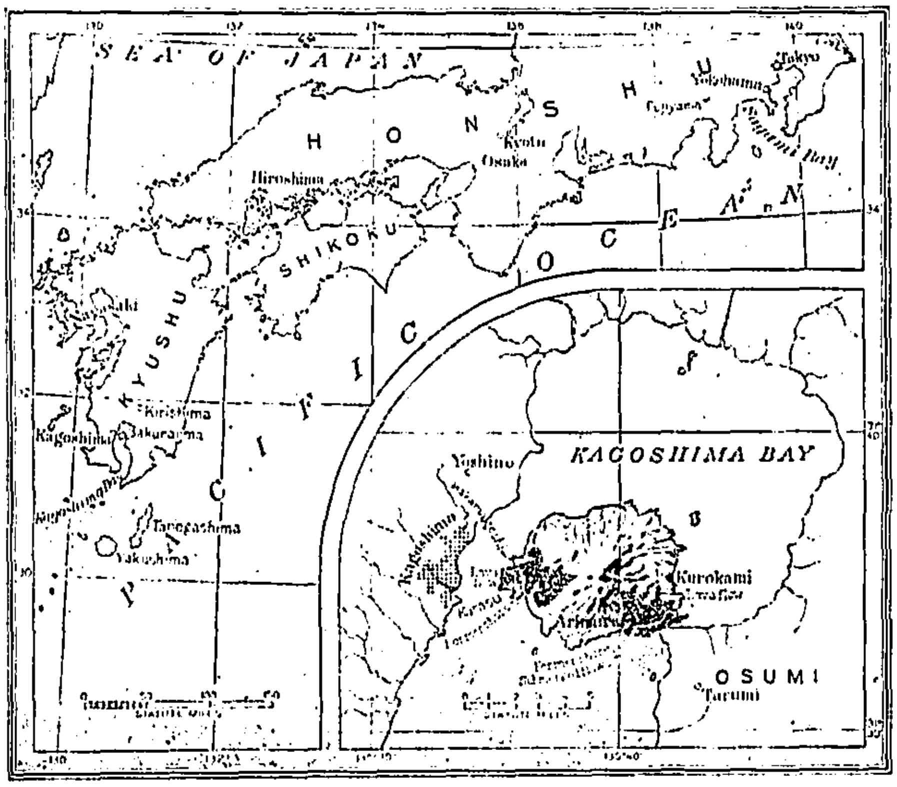
No. 308—Weekly | Hawaiian Volcano Observatory, National Park, Hawaii | November 21, 1930



Map of southern Japan and of Kagoshima Bay, showing Sakurajima and its 1914 lava flows. From National Geographic Magazine, April 1924.

ERUPTION OF SAKURAJIMA, 1914

Review by K. Onishi of F. Omori's article in the Bull. of the Imperial Earthquake Investigation Committee, Vol. VIII, No. 1, Sept. 1914.

Sakurajima volcano forms a small island in Kagoshima Bay on Kyushu, the southermost island of Japan proper. It is located on the great Kyushu rift, a crack which runs in a southeasterly direction from Japan to the Bonin Islands. The volcano has two high peaks, Minamidake and Kitadake, and a parasitic cone on the eastern flank called Nabeyama. A number of hot springs rise from its slopes. At the time of the eruption, the population of the island exceeded 23,500.

Investigations of the occurence of volcanic activity seem to point to a cycle of about 130 years in the Japanese volcanoes. In the years 1777-92, about 130 years previous to the year 1914, Oshima, Sakurajima, and Asama-yama had had tremendous outbreaks. Since Asama-yama, in 1908, and Oshima, in 1912, had produced numerous earthquakes and lava flows, Sakurajima was expected to follow suit not long after. Kirishima-yama, some 45 km. to the north of Sakurajima, finally burst out in November and December of 1913, and Sakurajima followed with an eruption two months later.

Warnings that Sakurajima was ripe for an eruption came in the forms of smoke, earthquakes, and an increased flow of water from the springs on the mountain. On the island, earthquakes were felt from the night of January 10, while the city of Kagoshima (on the shore of Kagoshima Bay) was mostly unaware of them until early in the morning of January 11. The frequency of the shocks increased with the progress of time, the greatest hourly numbers 28 and 27 being reached resepectively at eight to nine p. m. on the eleventh and three to four a. m. on the twelfth. As many as 66 shocks in one hour were felt on Sakurajima.

Early the morning of the 12th, the people noticed that water with a high temperature had started to issue from a number of places, and more could be seen bubbling up through the sea. On the opposite end of the island, the volume of water from the natural cold springs increased considerably while many wells had their water levels raised two to three feet.

At 8:00 a. m. on the 12th, a column of white smoke was seen rising from the top of Minamidake. Earlier in the morning, observers from Kagoshima had noticed slender filaments of white vapor above the mists that shrouded the mountain. Two hours after the smoke from Minamidake was seen, the first eruption occurred.

The unmistakable signs of the approaching disaster were sufficient to alarm the inhabitants who immediately began to desert their homes and seek refuge in Kagoshima

The eruption of Sakurajima on January 12, 1914 as seen from the heights back of Kagoshima. The peak is clear and the smoke and ashes are rising from rifts on the near and far sides of the cone. After Omori.

and the neighboring villages. The evacuation of the island was so exceptionally well handled that the whole population of over 23,500 was safe from harm when the final break came.

The first outburst came from the western side of the mountain facing Kagoshima about 500 meters up the slope, at 10:00 a. m. July 12. An interval of some 10 minutes followed when the east side of the island burst open with huge columns of smoke which rose to a vertical height of over 20,000 feet above sea level. This explosion completely enveloped the island in a mass of white and black smoke within a few hours.

On the evening of the first day of the outbreak, at 6:30, a strong quake took place. After this shock, the hot lava became stronger, reaching its maximum between 11:00 p. m. of the 12th and 5:00 a. m. of the 13th. After ten o'clock of the morning of the 13th, the violence of the explosions gradually decreased.

On the eastern and western sides of Sakurajima were formed seven small craters from which issued a lava of very high viscosity. The stream on the west reached the sea on the 16th, averaging 45 meters per hour during the first two and a half days. The lava continued to flow into the sea until it had invaded about two and one half square kilometers of former sea-bottom. The flow on the eastern (Nabayama) side was much faster, the lava finally blocking the narrow strait and joining the island to Osumi, intensity of the volcanic noises and the projection of red converting Sakurajima into a peninsula.

The total area covered by the western flow amounted to 8.33 sq. km., while the eastern portion covered approximately 15.41 sq. km. The estimated total volume of lava that was ejected was 1.6 cu. km., the western half contributing .33 cu. km. and the remaining 1.27 cu. km. being the contribution of the eastern flow.

The showers of hot pumiceous lava fragments and ashes did considerable damage to the whole island, the villages of Koike and Akobaru on the west and Kurokami being especially hard hit. The ash precipitation was slight in Kagoshima (about 3mm, deep) whereas the northern and central parts of Osumi on the opposite shore of the bay received from 3 inches in places to over 3 feet. The total amount of pumice and ashes which fell has been estimated to be in the neighborhood of .62 cu. km. or 40 per cent of the total volume of the lava output.

The total amount of material exuded from Sakurajima is thus 2.2 cu. km. which is equivalent to one twelfth of the volume of the whole mountain.

The strong quake of January 12 must have been one of very deep origin and not a shock immediately connected with the eruption, because the intensity of motion was nowhere in Kyushu excessively severe. It was probably caused by the stress accumulation along the whole volcanic chain in southern Kyushu. This quake took the only lives which were lost in the activity, 19 persons being killed.

Considerable excitement prevailed in Kagoshima during the course of the eruption. The fear of asphyxiation by the poisonous volcanic gases was reason enough for immediate evacuation. Rumors of a huge tidal wave helped to aggravate the fears of the nearly panic stricken people. The only real source of danger came from the one great earthquake. This quake was registered on very distant seismographs in Europe and America.

ACTIVITY OF A CALIFORNIA VOLCANO IN 1786.

The following quotation was brought to the attention of the writer by Dr. Max Ferrand, Director of Research of the Huntington Library and Art Gallery.

La Perouse, in voyaging along the California coast in 1786 witnessed a volcanic eruption, and the location given on his map is roughly in the Lassen region. A direct quotation from his observations is as follows:

> " . . . . our latitude, observed at noon, was 40° 48' 30" north; our longitude, according to the timekeeper, was 126° 59' 45" west. I continued my course to near the land, from which, at night-fall, I was only four leagues distant. We there perceived a volcano on the top of a mountain, which bore east of us; its flame was very lively, but a thick fog soon deprived us of this sight. . . . '"

As Mt. Shasta might be visible from a ship at sea in the position given, it, as well as Lassen Peak, should be considered as a possible source of the witnessed eruption. Both peaks would be nearly east from the stated latitude. If the eruption were from Lassen, nothing but an explosion cloud would have been visible. Considerable volcanic activity occurred at the summit of Mt. Shasta since the time of general glaciation, and nothing on the peak at present indicates the impossibility of there having a minor eruption in 1786. R. H. Finch.

LASSEN REPORT No. 27

Lassen Volcano Observatory

R. H. Finch, Associate Volcanologist

The western half of the Lassen edifice was shaken by a series of earthquakes on October 29, 1930. The shocks were strongly felt at Redding on the west and as far southeast as Mineral. The distance to the origin of the shakes from Mineral as determined by the seismograph of the Lassen Volcano Observatory was 27 miles, which makes the seat of the shaking to the northwest of Lassen Peak, or in the vicinity of Millville. Press reports indicate that the shake were stronger at Millville than elsewhere.

The series was ushered in by a very small and not generally felt shake at 4:10 a. m. The plainly felt shakes occurred at 4:34 a. m., 11:48 a.m., and 8:28 p. m. A light roar accompanied the shaking at many places.

On the 29th of April, 1930, a shake that was much stronger than any of the recent series occurred in the same region.

KILAUEA REPORT No. 982

WEEK ENDING NOVEMBER 16, 1930

Section of Volcanology, U. S. Geological Survey

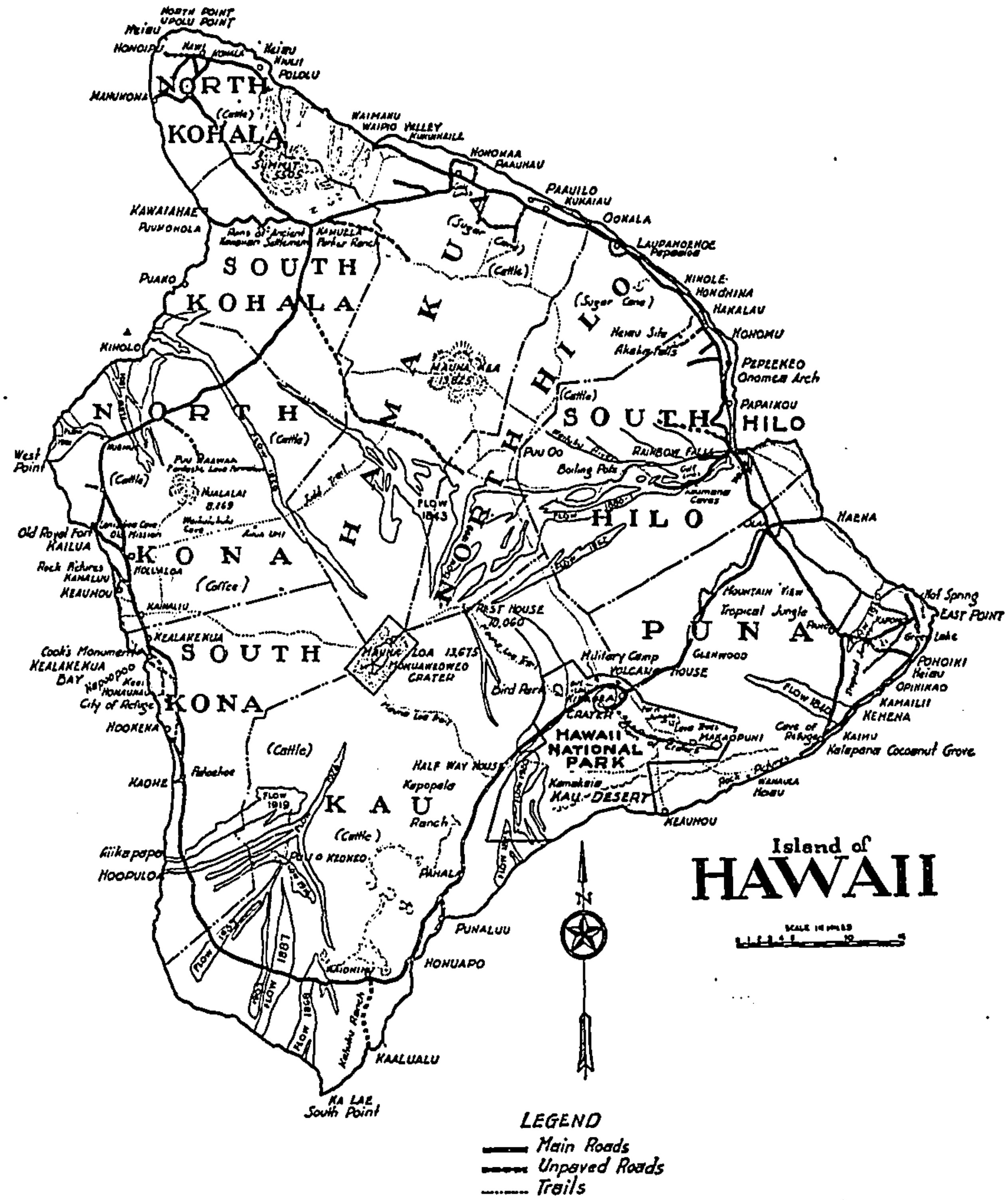
H. A. Powers, Temporarily in Charge.

Steam has risen from the floor of Halemaumau and the amount of visible steam from the wall and floor cracks of Kilauea has increased several times during the heavy rains of the week. A few rocks have been heard tumbling from the walls of the pit, but there have been no avalanches large enough to attract attention.

A distant earthquake wrote a very small record on the seismogram at 8:57 a. m., November 12. There were ten local shocks of very feeble intensity timed as follows: November 11, 11:26 a. m.; November 12, 5:38 p. m.; November 13, 8:50 a. m. distance 22 miles, and 10:11 p. m.; November 14, 2:57 a. m., and 1:30 p. m.; November 15, 6:57 a. m.; November 16, 3:52 a. m. center in Halemaumau, 1:34 p. m., and 7:55 p. m. The Observatory seismograph on the rim of Kilauea crater also recorded 48 small tremors, of which 30 occurred during the last four days of the week. During these same days, the instrument at Halemaumau recorded 42 tremors. Many of them were stronger at the pit than on the Kilauea rim, suggesting that they had their origin in Halemaumau. The non-volcanic trembling of the island was moderately strong during most of the week.

The average tilt for the week showed a slight movement in an east-northeast direction, all of which was gained through a marked tilting of the Kilauea rim up and away from the pit during the last four days. During this same period, the Halemaumau seismograph indicated that the rim of the pit was also tilting up and away from its center.

The latter half of this week showed the first definite change of conditions from the "stagnation" which has existed since the earthquake of October 20. The tilt change and the increase of tremors suggest an increase of pressure and movement of lava under Kilauea.



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Camp of ranch people at Puu Anahulu during the earthquakes of October, 1929. Looking toward Puuwaawaa from the northwest, with Hualalai volcano in the haze at the right. Photo Jaggar.

THE HUALALAI EARTHQUAKE CRISIS OF 1929

What Happened

During the week ending September 18, 1929, the seismographs at Kilauea Volcano, at Hilo and at Kealakekua on Hawaii island registered nothing remarkable. Then came a really tremendous swarm of earthquakes in North Kona on and near Hualalai volcano. Sudden shaking began September 19 and continued, racking the countryside, reaching culmination in big earthquakes September 25 and October 5, and destroying hundreds of thousands of dollars worth of property in houses, walls, tanks, stone fences and roadways. No volcano eruption followed on Hawaii until now, November 19, 1930, when lava returns quietly into the bottom of Halemaumau pit of Kilauea volcano, on the opposite side of the island from Hualalai.

The spasms of earthquake September 20 and 21, 1929 were at intervals of several hours. Then the intervals shortened and the spasms lengthened in duration. The area of felt earthquakes extended itself. Maximum motion was within a circle of 35 miles radius around the summit of Hualalai. The force of shaking increased. The strongest motion and greatest destruction was near Puuwaawaa. The highest frequency of shakes was on the southwest flank of Hualalai. Rumbling was heard there but not at Puuwaawaa.

At Kilauea 221 shocks were recorded for the week ending September 25, as compared with only 9 for the previous week. As to epicenters or places of origin measured from the seismograms by the distances from the instrument station indicated by formula: at the Kilauea Observatory, for four weeks to October 16, the successive average weekly distances of epicenters were 23, 28, 35 and 44 miles. This looked like a progression of underground jolts from about Mauna Loa to about Hualalai.

Big earthquakes of Grade IX Rossi-Forel occurred at Puuwaawaa September 25 and October 5. These were felt throughout the Hawaiian Islands.

Airplane inspection of all the craters revealed no eruption of lava. The shaking continued for a month but gradually quieted down in November.

Statistical Data

At Kilauea the weekly frequency of shocks as indicated by numbers of earthquakes counted on the seismograms, beginning with the week ending September 25, was as follows for four weeks: 221, 244, 129, and 97. The maximum was thus the week ending October 2, between the two strong earthquakes. The frequency and intensity varied together. The Kilauea total of shocks to October 16 was 691, many of them felt.

For the four days between the two greater earthquakes different places with seismometric instruments registered the following numbers of shocks:

	Oct. 1	Oct. 2	Oct. 3	Oct. 4
Kilauea	19	13	15	18
Hilo	38	26	13	74
Kealakekua	155	110	96	138
Puuwaawaa	241	117	97	114

The frequency increases just before the big shock of October 5. The geographical gradation is not wholly accordant with distance form Hualalai. Thus Hilo has more shocks than Kilauea, yet is farther from Hualalai.

The instrumental record of decline in frequency was as follows:

	Oct. 8	Oct. 9	Oct. 10	Oct. 11	Oct. 12
Kilauea	16	15	14	10	9
Kealakekua	94	61	42	41	43
Puuwaawaa	387	353	235	203	139

This is reasonably consistent as a decline with the passage of time, and as showing geographical decrease of numbers with distance from the center.

The shock recorder at Puuwaawaa of the type described in Scientific American for November, 1929, with magnification x25, registered numbers of shocks as follows during the first part of the time of maximum frequency:

September 26	599 shocks
September 27	541 "
September 28	400 "
September 29	334 "
September 30	321 "
October 1	241 "

The computed instrumental total for the central region for 26 days from Sept. 21 to Oct. was 6211 shocks. This averages 239 per day or 10 per hour. Most of these could have been detected by a person at rest indoors. Much of the time there was continuous jiggling of windows. Puuwaawaa registered nine times as many earthquakes as Kilauea. And that in a place not known as an earthquake district before this year.

The average of felt shocks listed by observers September 23-24 was 2.2 shocks per hour at Huehue, 3.3 at Puuwaawaa. and 6.0 at Honokahau on the southwestern slope of Hualalai. Observers listed about a third as many as the shock recorder.

Theoretical

The big earthquakes of September 25 and October 5 showed no preliminary tremor on seismographs forty and sixty miles apart. Both Hilo and Kealakekua in Kona behaved as though they were right over the center of the earthquake. So did Kilauea. In this they behaved quite differently from their registration of the ordinary earthquakes of the period, these always showing a preliminary tremor accordant with the theoretical distance of the focus or origin.

The absence of preliminary tremor is usually explained on the ground that these greater earthquakes are very deep. If such jolting is profound in origin, it may shake the whole of a small area like the island of Hawaii equally.

But even if the earthquake were a hundred miles underground the horizontal impulses at the pendulums of Kealakekua, Hilo and Kilauea would have been sufficient to exhibit something of the preliminary if the compressional waves had been present. There was no slightest trace of them, unless they were so enormous that they themselves dismantled the seismographs. This is improbable, by analogy with other records of earthquakes of like intensity, showing preliminaries, which have clearly registered with small amplitude before the long waves dismantle the instrument. The pens at places sixty miles apart simply shot off the drums at the first impulse. Meanwhile the Honolulu seismograph registered a preliminary accordant with the distance of Hawaii.

If this failure to record preliminaries were due to depth of focus, the depth would have to be several hundred miles, and even in that case a vertical component instrument ought to register an excellent preliminary, characteristic of compressional elastic waves arriving vertically. There is no suggestion that such waves were present. Even a horizontal pendulum would give some thickening of the line.

There is another possibility. If hot magma were present under Kilauea. Mauna Loa and Hualalai equally, like a vast cake of dough, with localized injections of its substance as protuberances with each mountain, it is conceivable that the protuberance under Hualalai moved to make the localized earthquakes; and that the larger mass shifted the whole island shell for the greater and more generalized shocks.

Comparison with 1868

The 1868 cataclysm on Hawaii was a parallel to this. A new series of eruptions at the southwest was then begun, unheard of before. A great earthquake swarm began on the south flank of Mauna Loa culminating in a terrific shock.

On March 9 of 1868 there was an earthquake in Kona. On March 27 in Kau quaking became continuous and the next day there was a big shock of Grade IX. On April 2 came the big earthquake of Grade X, making a landslip back of Pahala, a tidal wave along the Honuapo shore, and bringing about the immediate collapse of very active lava in Kilauea Crater. April 6 the south rift of Mauna Loa vomited lava to the sea, the eruption lasting six days. Other big shocks occurred and a lot of aftershocks.

This combination of clustered quakes, big shocks and lava outpouring in a new district suggests that the underground shift of magma from the old northern district made the mountain labor. The same thing is suggested in 1929. There is a shift of activity from south to north. Recent Mauna Loa flows have all been in Kau. The Hualalai earthquake swarms were quite like those of Kau in 1868. But lava outbreak has not yet occurred on Hualalai. Presumably lava intrusion did occur.

In both 1868 and 1929 there were big shocks that were different from the small ones. Probably the small ones accompanied shifting of the blocks of the smaller mountain, and were shallow. Probably the big ones accompanied a shifting of the whole island shall and were relatively deep. But it may well be that mere depth was less important than the size of the shell which was shifted.

The present outbreak of Halemaumau November 19, 1930 is the first eruption in Hawaii which has followed the Hualalai earthquake crisis of September-October, 1929. The last outbreak known at Hualalai volcano was in 1801, about a decade after an explosive eruption which occurred at Halemaumau. A decade after our last explosive eruption of Halemaumau will be 1934. Is the present return of lava in Halemaumau preparing for a new activity on the north or northwest sides of Mauna Loa or Hualalai?

T.A.J.

THE CURRENT ACTIVITY IN HALEMAUMAU

Lava came back in Halemaumau at 1:29 p. m.. Wednesday, November 19. It broke through first in two fountains about one hundred yards out in the pit floor in front of the horn between the two grotto niches of 1929. According to Craik. of the National Park, the floor started to swell rapidly under this spot, then huge blocks of the old crust were thrown into the air by the first gush of fountaining lava. Craik immediately left to spread the news so he did not see the next fountains break through. When next seen half an hour later, lava was spouting perhaps fifty feet high from these two fountains; from twenty to fifty feet high from seven fountains closely grouped near the edge of the 1929 flow about half way between the old 1927 cone and the sulphur stain on the south edge of the pit floor; and about 150 to 200 feet high from a main fountain through the sulphur stained patch about 100 feet out in the 1929 floor from the edge of the south talus. The whole southwest corner of the old floor soon was covered by flows from all of the fountains, but the main flood came from the large fountain and spread rapidly out to the center of the floor.

By 4:00 p. m., the old cone peak of 1927 had disappeared in the south cove, and the main flow had reached a point three fourths of the way across the old floor. New lava covered about half of the area of the 1929 floor at this time. One fountain had disappeared from the south-southwest group leaving six small ones together, also the two near the 1929 grotto, and the main fountain. The small ones showed about their original strength, but the large one had increased so that it was throwing slag over 200 feet into the air. A crack opened along the contact of the northern small 1929 grotto and the talus behind it. and it was soon filled with a small ooze of glowing lava. All of the fountaining activity was still concentrated in the southwest part of the 1929 floor.

As the depth of the lava around the fountains increased, some of the smaller ones were drowned, so that by 6:00 p. m. only two remained of the original group of seven. The two near the 1929 grotto had built up spatter cones through which they only occasionally were able to spout visible spray. The main fountain had become more constant, and was throwing slag steadily to heights of about 100 feet. The main flow was still very strong, but was beginning to pile up on top of itself rather than spread farther over the old floor.

The main fountain was slowly building a crescent shaped grotto on its south side which had reached a height of about forty feet by 8:00 p. m. At this time only one fountain remained of the original cluster of seven. and the two near the 1929 grotto broke through their "hoods" only at long intervals. The activity of the main fountain remained constant throughout the evening. The big flow was definitely building a rampart over which small flows were cascading to the lower level of the floor. The main overflow seemed to concentrate on the northwest and the southeast sides of the lake near the main feeding fountain, with only an occasional flow over the northeast wall most distant from the fountain. The situation did not change materially during the rest of the night.

At 7:00 a. m., November 20, the vigor of the main fountain had not changed, but the smaller ones showed only an occasional spurt. They continued to smoke vigorously. The main flow from the big fountain was feeding a well defined lava-lake which covered approximately 25 acres, a little over one million square feet, of the 1929 lava floor and was oblong in shape with the long axis running northeast from the main fountain. The greatest overflow still took place near the fountain over both the northwest and the southeast ramparts. The level of the lake had been rising more rapidly than the grotto was being built by the main fountain so that it was not as conspicuous as it had been during the previous evening.

A measurement at the end of the first 24 hours, 1:30 p. m. November 20, showed that the surface of the lake at the big fountain was 90 feet above the level of the old floor at that point. The surface of the lake still sloped away considerably to the rampart walls so that there was a constant but slow movement of the cracking crust away from the big fountain. Overflows from the lake had covered about ten acres (435,000 square feet) of the old floor, so that flows and lake of new lava together covered an approximate area of 35 acres. The big fountain continued its steady spouting, throwing slag from 60 to 100 feet in the air. The two fountains near the 1929 grotto still smoked but no fountaining was visible. The one isolated small one had built a cowlshaped hood with the opening to the northwest so that its spray could not be seen from the main observation point.

It was reported that nine noisy explosions occurred at regular intervals of a few seconds about 11:00 a. m. No unusual behavior was noticed in the fountain but the sound seemed to have come from the large fountain.

Shortly after noon, a large stream of lava began to cascade over the southeast lake rampart and flowed toward the base of the east talus. It kept up a steady flow till after 6:00 p. m. and gradually formed a secondary lake between the talus pile and the main lake-rampart. Secondary flows from this small lake poured out along the flat between the east talus and the old pressure ridge and by 8:00 p. m. had covered the rest of the 1929 floor in this part of the pit. More overflows from the northeast end of the lake occurred during the late afternoon and evening, and slowly crept toward the north and northeast talus. By midnight November 20, only a few acres of the north part of the old floor remained visible.

This steady fountaining and overflowing from the main lake characterized the activity during the next morning, November 21. A second lake rampart had been built up inside of the northeast end of the lake during the night. Its location probably was determined by the position of a number of pressure ridges and domes in the old floor which may have obstructed the free flow of new lava and piled up blocks of the new crust. This inner rampart was built to a point at which the surface of the inner lake was very nearly level. As a consequence the migration of the cracking lake crust became so slow that it was not noticeable to the eye.

At the end of 48 hours of flow, 1:30 p. m. November 21, the surface of the lake at the fountain was 100 feet above the old floor, and the whole lake averaged a depth of almost 100 feet. It covered an area of about 15 acres (about 650,000 square feet). The overflows had encroached on the talus walls on the south side of the pit behind the big fountain, and had nearly covered the old 1929 lava floor. Thus the total area covered by new lava was about 50 acres (over two million square feet).

The main fountain began to show a tendency to break into two separate fountains of about equal size and a third one of small size and irregular frequency. The vigor of the fountaining appeared to remain the same. The activity of the afternoon and evening continued after the fashion of the previous day, with most of the overflow occurring on the northwest and the southeast sides of the lava-lake.

About 11:30 p. m. of November 21, a large cascade broke over the rampart at the far northeast end of the lake. It was falling down a steep incline of nearly fifty feet so gained in size very rapidly. Within fifteen minutes it had become the most spectacular feature of the eruption to date. It yielded a flow of such velocity that no crust had a chance to form, so that more than five acres was soon covered with the glowing red lava.

This river was still flowing the forenoon of November 22, but had split into two main branches, one of which was flooding the low area toward the northeast talus and one was pouring new lava into the depression at the foot of the northwest cliff.

Spouting from the small south-southwest fountain was no longer visible, but it and the two near the 1929 grotto still emitted a continuous volume of fumes. The large fountain continued its constant activity but the amount of lava taken from the lake by the three main overflow channels equalled the amount fed in by the fountain so that the level of the lake became fairly constant at 90 feet above the old floor.

During the evening of November 22, the spouting of the big fountain became slightly irregular. For a period of several minutes it would spout huge fans of slag over 300 feet in the air, and then it would relax for a time and resemble a bubbling mass of porridge. In these periods of relative calm, it could be seen that as many as seven separate spots were bubbling, which united in the larger spurts to give the appearance of one huge fountain. Overflow still continued from all three sides of the lake,, first one side showing the most active flow and and then another. The same general condition held during the night and all of the next day, Sunday, November 23. H.A.P.

SEISMIC FEATURES OF THE ERUPTION

The seismic events leading up to the eruption of lava in Halemaumau were not unusual but are none the less of interest. On November 13, the seismograph on the rim of the pit began to register a definite tilting of the rim up and away from the pit. It also recorded many small tremors which were not of sufficient strength to influence the instruments at the Observatory on the rim of Kilauea crater. These facts supplied the information that lava was moving and pressure was increasing under the volcano.

During the six days previous to the appearance of the lava, the rim of Halemaumau pit was tilted upward and outward through 10 seconds of arc. Half of this accumulated slowly, while the balance of 5 seconds of tilting took place in an interval of one hour and fifteen minutes immediately preceeding the gush of lava. As soon as the outlet to the surface was gained, the lifting force of the rising lava was lost and the pit rim tilted back through 7.5 seconds of arc during the first 18 hours of lava activity. Since then, equilibrium has been maintained and the tilting of the pit rim has been negligible.

On the morning of November 19, the pit seismograph recorded a series of 18 small shocks which culminated in a very feeble quake at 11:06 a. m. There was a slight tilting of the rim in toward the pit accompanying this quake. A series of 30 small shocks followed in rapid succession, many of them producing a little inward tilting. At 11:42 a. m., a quake of feeble intensity occurred under Halemaumau, causing a slight sudden inward tilt of the rim. During the next half hour eight small tremors were recorded, but no tilting took place. Then, between 12:15 and 1:29 p. m., 35 small shocks occurred and at the same time the rim of the pit was tilted up and outward through 5 seconds of arc.

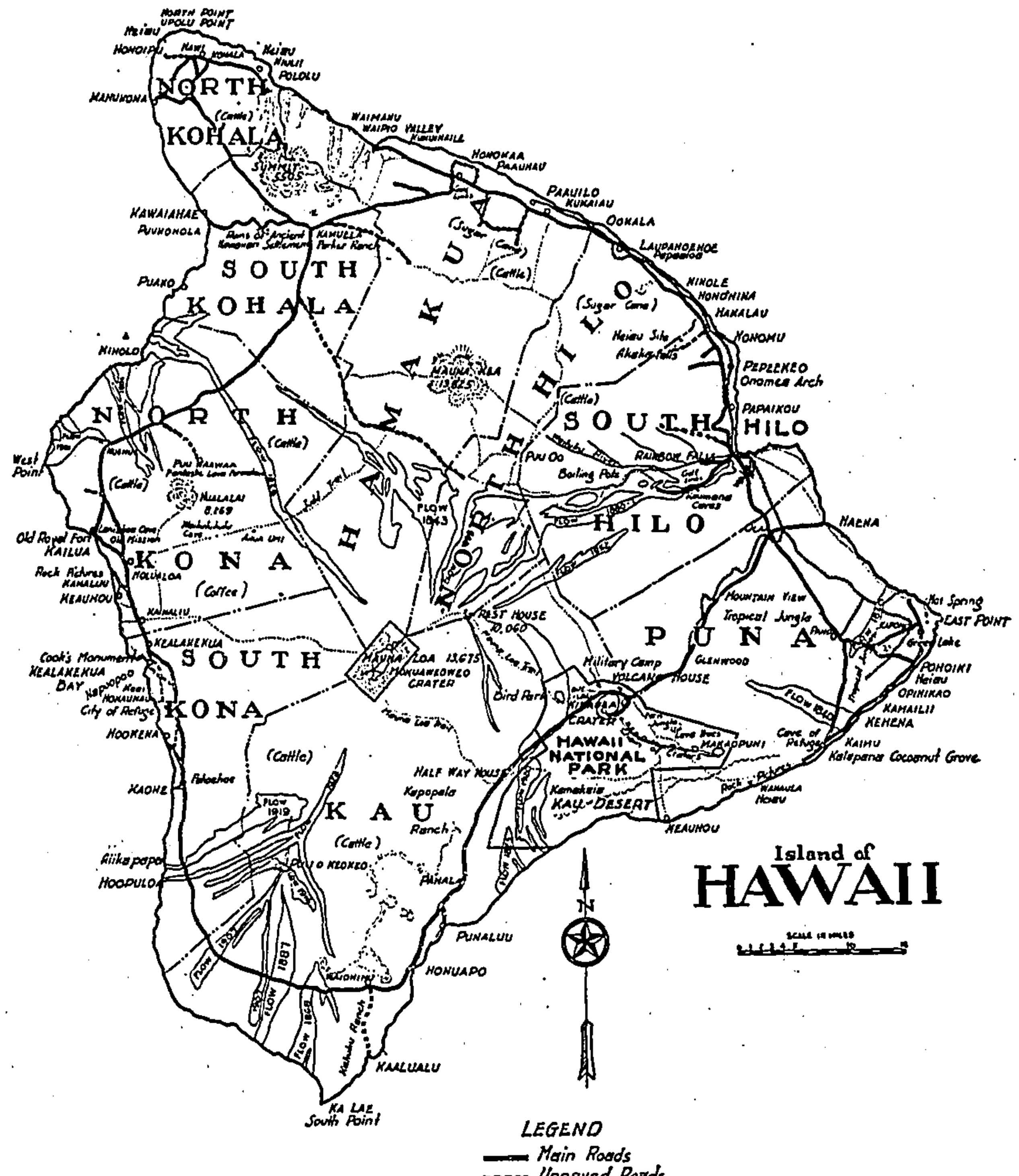
Continuous tremor began at 1:29 p. m. and gradually increased for nine minutes. Then, at 1:38 p. m., the amplitude of the tremor suddenly increased. This sudden increase may mark the breaking of the lava through the bottom of the pit and the beginning of surface fountaining. The tremor continued with a constant intensity till about 4:00 p. m. when it gradually moderated until 7:00 p. m. From that time on it has continued evenly, except for an occasional more violent burst of a few moments duration. H.A.P.

KILAUEA REPORT No. 983
WEEK ENDING NOVEMBER 23, 1930
Section of Volcanology, U. S. Geological Survey
T. A. Jaggar, Volcanologist in Charge

Lava appeared in Halemaumau at 1:29 p. m. November 19. It broke through in three fountain groups, two of small size which disappeared during the first two days, the third remaining as the main fountain which is still spouting vigorously. Lava from the fountains spread rapidly over half of the 1929 floor in the first four hours. Then a central lake of molten lava was formed which is being fed by the main fountain. The lake rapidly built its ramparts upward until a depth of molten lava of about 90 feet was reached. This depth has been maintained, with overflow on three sides of the lake removing the new lava as rapidly as it is supplied. These overflows have completely covered the old floor of the pit and are encroaching on the surrounding talus piles.

During the two and one half days of the week preceding the appearance of lava on November 19, the Observatory seismographs recorded seven very feeble earthquakes: November 17, 2:29 a. m., 2:56 a.m., centering in Halemaumau, 8:11 p. m., and 8:19 p. m.; November 18, 5:47 a. m. distance to center 4 miles; and November 19, 8:13 a. m. and 11:06 a. m. One quake of feeble intensity, felt at Uwekahuna, was recorded at 11:42 a. m., November 19, with a distance of 4 miles to its origin. One very feeble shock was recorded after the eruption started, i. e. at 7:34 p. m., November 19. There were thus nine earthquakes for the week at the Observatory. A total of 24 short tremors were recorded before the lava broke out, and 17 minutes of continuous tremor registered during November 18. Continuous tremor caused by the fountaining of lava is accompanying the eruption. The non-volcanic microseisms were slight during the entire week.

The average tilt for the week shows a slight westward tilting of the Kilauea rim compared to last week. Some southward tilting has accompanied the flow of lava as the lifting force of the lava is lost by its access to the surface.



UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HAWAII NATIONAL PARK
HAWAII

OFFICE OF THE SUPERINTENDENT

November 18, 1930

Director,
National Park Service,
Department of the Interior,
Washington, D. C.

Dear Mr. Director:

The report of operations and activities in Hawaii National Park during October 1930 is herewith submitted.

000 GENERAL:

Of very particular interest to this park and to the entire tourist industry of Hawaii is the recent announcement that the Matson Navigation Company has purchased the Los Angeles Steamship Company. This forms one of the largest steamship corporations in the United States and should prove of great advantage in improved service and schedules of vessels operating between San Francisco, Seattle, Los Angeles and Hawaii. Details of new operating plans are not as yet available.

100 ADMINISTRATION:

120 Park inspections by.

121 Superintendent.

In addition to regular inspections of park operations the superintendent kept in close touch with authorized construction activities of Hui O Pele.

150 Equipment.

This park has taken delivery of a desk and filing cabinet for use of the park naturalist and three chairs for general office use.

180 Circulars etc.

The annual correcting and revision of the park circular of information has been completed and material forwarded to Washington.

200 MAINTENANCE, IMPROVEMENTS AND NEW CONSTRUCTION:

220 Improvements.

In order to permanently better and improve the trail leading from the road into Kaula Crater and the Thurston Lava Tube, the trail grade has been entirely rebuilt by widening, construction of dry walls, and surfacing with a cold asphalt emulsion. This trail is used by all park visitors and has assumed more the character and needs of a walk way for persons in usual street clothing rather than a trail for those equipped to hike. For this reason an improved type of grade and surface were considered needed and installed.

230 New Construction.

Public Toilets

Practically nothing was done on the Public Toilets at Halemaumau as all skilled laborers were in use by Hui O Pele on their new lecture building.

Trails

Another new short trail to be part of an eventual Kilauea Crater Circle was 50% completed during October. This trail to be known as the Steaming Bluffs trail leads from near Volcano House to Uwekahuna Bluff and traverses the highest cliff edges of Kilauea passing enroute the largest and most consistently steaming cracks and caverns in the park.

Telephone System

New phone lines have been completed to Bird Park and to Ainahou Ranch area.

300 ACTIVITIES OF OTHER AGENCIES IN THE PARK:

317 Status of contractors projects.

The building of the new Volcano Photo Studio are completed with exception of tiling on the roof. Delay in delivery of this item prevents completion.

350 Donations.

Film

The new film "Volcanoes" for use in our lecture programs has been received. This item was secured for us by Mr. James Henderson of Hilo.

Uwekahuna Lecture Hall

Construction of the new lecture hall by Hui O Pele is progressing rapidly and was 90% complete at the end of the month. This building is of masonry and corrugated iron, and lined with Celotex.

400 FLORA, FAUNA AND NATURAL PHENOMENA:

410 Ranger-naturalist service.

The light travel of this time of year has lessened the demand for lecture and guiding services allowing time for a larger number of individual contacts. 16 lectures were given to 233 persons.

480 Birds.

The increase in the number of pheasant and quail seen in the forested areas of the park is quite noticeable over previous years and is directly due to our protection activity.

450 Volcanoes.

Earthquakes of noticeable force alternate frequently between Mauna Loa and Kilauea sources and serve to encourage expectancy of lava appearance but no definite predictions are possible.

500 USE OF PARK FACILITIES BY THE PUBLIC:

510 Increase or decrease in travel.

Steamer travel during October was extremely light. This condition obtained all through the Island tourist industry.

520 Weather.

October enjoyed weather which should have occurred during the past summer months.

Maximum temperature —— 10th, 30th	————	76 degree
Minimum " ———— 19th	————	51 "
Rainfall for month of October	————	13.85 inches
" " " " " at Hilo	————	9.10 "
" " to-date Volcano District	————	94.98 "
" " " at Hilo	————	124.55 "

600 PROTECTION:

630 Accidents.

Following a final flight over the seacoast and Kau desert areas by three army planes the search for Private Michael Rubenstein, whose loss was reported last month, has been abandoned as hopeless.

900 MISCELLANEOUS:

Capt. K. W. Thom for two years the commanding officer at Kilauea Military Camp completed his tour of duty here and on October 21st was relieved bu Capt. Richard Heddin.

Very respectfully yours,

Thos. J. Allen, Jr.

Thos. J. Allen, Jr.,
Superintendent.

Copy to Field Headquarters (2)
" " Yellowstone National Park (1)

10-157

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

TRAVEL REPORT

Hawaii National Park for the Month of October 1930

	This Month	This Travel Year To Date	This Month Last Year	Last Travel Year To Date	Increase for Travel Year Number	Increase for Travel Year Per cent
PRIVATE TRANSPORTATION:						
Cars first entry						
Cars reentry						
Motorcycles						
Total motor vehicles						
Persons entering via motor vehicles	6,105	6,105	5,250	5,250	855	16.3%
Persons entering via other private transportation	348	348	358	358	- 10	2.8%
Total persons entering via private transportation	6,453	6,453	5,608	5,608	845	15.1%
OTHER TRANSPORTATION:						
Persons entering via ~~xxxxxx~~ Hotel	384	384	575	575	-191	33.2%
Persons entering via trains						
Persons entering otherwise						
Total other transportation	384	384	575	575	- 191	33.2%
GRAND TOTAL ALL VISITORS	6,837	6,837	6,183	6,183	654	10.6%

	This Year	Last Year	Increase Number	Increase Per cent
Automobiles in public camps during month	1	1	0	0
Campers in public camps during month	2	2	0	0

10-158

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

STATUS OF AUTHORIZED PROJECTS

Hawaii National Park for the Month of October 1930

	Description of Projects	Percent Constructed To Date	Percent Constructed This Month	Percent Constructed Last Month	Probable Date Completion
405	Ware-house	100	—	100	
406	Toilets (Kilauea)	7	5	2	Nov. 30, 1930
407	Toilets (Uwekahuna)	99	1	98	Nov. 10, 1930
451	Telephone Line	95	15	80	Nov. 30, 1930
502	Kilauea Iki Trail	100	—	100	
502	Mauna Loa Trail	100	—	100	
502	Summer Camp Trail	100	—	100	
502	Steaming Bluffs Trail	50	50	—	Nov. 15, 1930
	Road Survey, B. P. R.	100	—	100	

10-159

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

STATUS OF PERSONNEL

Hawaii National Park for the Month of October 1930

	This Month	This Month Last Year
Number of employees beginning of month,	24	7
Number of additions, ...	0	1
Total, ...	24	8
Number of separations, ...	7	1
Number of employees close of month, . .	17	7
Number of promotions during month	0	0
Aggregate amount of annual leave taken,	0	0
Aggregate amount of sick leave taken,	0	0
Aggregate amount of leave without pay,	0	0

10-160

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

REPORT OF PARK REVENUES

Hawaii National Park for the Month of October 1930

	This Year	Last Year
Park revenue on hand beginning of month,	0.00	0.00
Received,	0.00	0.00
Total,	0.00	0.00
Remitted,	0.00	0.00
On hand close of month,	0.00	0.00

Park revenues received this year to date,	1,350.00
Park revenues received last year to date,	1,327.00
Increase,	23.00
Percent of increase,	1.7%

10-161

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HAWAII NATIONAL PARK

REPORT OF SALES OF PUBLICATIONS

OCTOBER 1930

	Number	Value
GOVERNMENT PUBLICATIONS:		
On hand beginning of month, ...	423	105.30
Received during month, ...	0	0.00
Total, ...	423	105.30
Sold during month, ...	15	5.10
On hand at close of month, ...	408	100.20

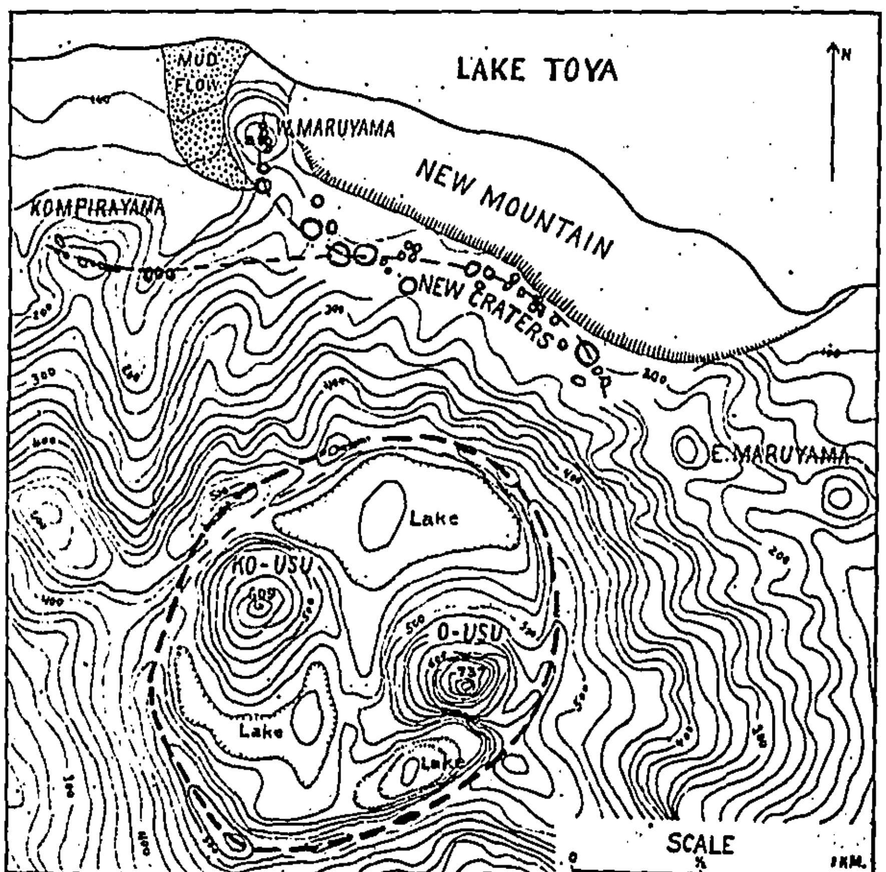
	Number	Value
NON-GOVERNMENT PUBLICATIONS:		
On hand beginning of month, ...		
Received during month, ...		
Total, ...		
Sold during month, ...		
On hand at close of month, ...		

Cash on hand beginning of month, ...	51.10
Sales during month, ...	5.10
Total, ...	56.20
Remitted during month, ...	0.00
Balance, ...	56.20

The Volcano Letter

Two dollars per year — Ten cents per copy

No. 302—Weekly — Hawaiian Volcano Observatory, National Park, Hawaii — October 9, 1930.



Map showing old somma ring and domes of Usu, the line of active craters of 1910, and the uplifted segment which makes the "New Mountain" escarpment. After Daly.

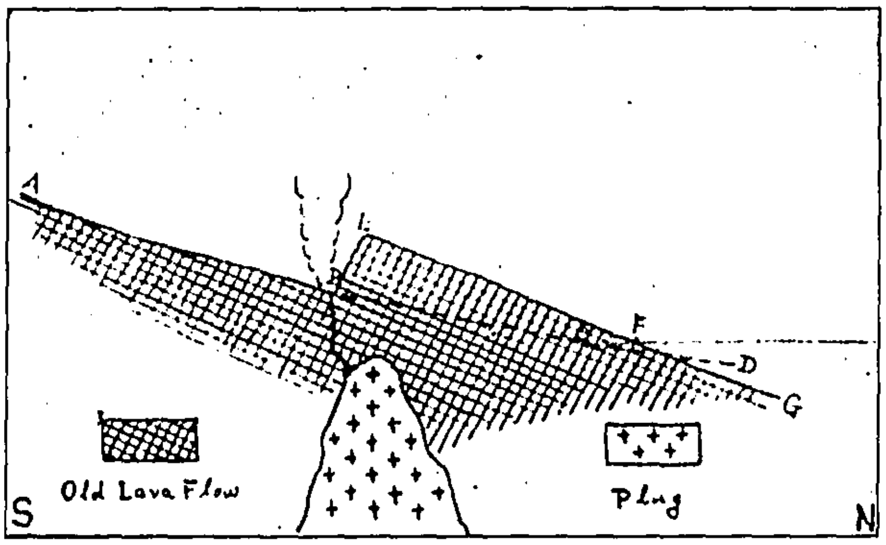
CHANGES OF ELEVATION AT USU VOLCANO, JAPAN

(Review by D. Malone of the paper by F. Omori, Bull. I. E. I. C., 5, 1913)

The volcanic outbursts in 1910 of the Usu-san volcano were followed by the formation of the "New Mountain." The elevation phenomenon was not confined to Usu-san but in November, 1910, in the town of Auta on the southwest base of Usu-san, a fence surrounding a field which had been level was at the time invisible from one side to the other. The Military Survey Department, in 1911 and 1912 undertook the determination of the heights of the first order benchmarks on the lines of precise-levelling running along the northeast coast of Volcano Bay and along the western foot of Usu-san.

In the summer of 1911, the height was examined along the Volcano Bay coast from the vicinity of the town of Benbe southeast to Abuta-Tokatan, then along the southwestern base of Usu-san to Tokotan on the Toya Lake and then to Muko-Toya along the western coast of Toya Lake. The total distance was about 25 km. In the summer of 1912, the measurement was repeated, being further extended 12 km. southeast along the coast of the bay to the town of Nishi-Monbets which is about 8 km. southeast of the central crater of Usu-san.

As may be expected from the proximity to the site of the "New Mountain," the benchmark at Tokatan was elevated 2.4244 meters, while benchmark Number 6596, situated midway between Toya Lake and Volcano Bay, was elevated 1.1601 m. At Abuta-Tokotan, on the coast of Volcano Bay, the elevation was 0.358 m., although the distance from New Mountain is 6 km. On the other hand, the benchmark No. 6597, not far from 6598 (at Tokatan), suffered a depression of 0.0739 m. while Nos. 7192 and 6599, at the distance of 2 km. to the northwest of Abuta-Tokotan and



Profile of uplift of the "New Mountain" segment at Usu Volcano in north Japan, as conceived by Ouinoue.

Tokotan respectively, were each depressed about 0.022 m. It will be seen that marked elevation took place at all benchmarks between Tokotan and Abuta-Tokotan, with the exception of No. 6597, and also at those between Abuta-Tokotan and Nishi-Monbets. As the southeast corner of the lake shore in front of the West Kohan School indicated an upheaval of some 1.333 m., it may be assumed that the whole mountain mass of the Usu-san and its base suffered an elevation, doubtlessly extending some distance beneath Toya Lake.

A comparison of the heights of the different benchmarks determined in 1911 with those again determined in 1912 shows that a sort of a level adjustment was going on both in the upheaval and the depression regions to no small degree. It may be seen that the three benchmarks Nos. 6596, 6598, and 6597 (the first two of which had been elevated by the greatest amount of 1.16 and 2.4244 m.) now indicated depressions of 18.4 to 29.2 millimeters. On the contrary, the three others, Nos. 7192, 6599, and 6600, which had been depressed by the maximum amount of 22 mm. were now raised to the amount of 2.0 to 3.1 mm. The ratios of the downward and the upward restitutions were thus greater than the former. It is likely that the process of the level fluctuatio ncontinues for many a year to come or at least as land as the volcano is in more or less active condition.

The problem of level change in volcanic districts forms an exceedingly interesting branch of geophysical research. Seismologically it is exceedingly desireable to investigate the changes in level which may take place in districts belonging to active earth-quake zones, previous to the occurence of destructive disturbances.

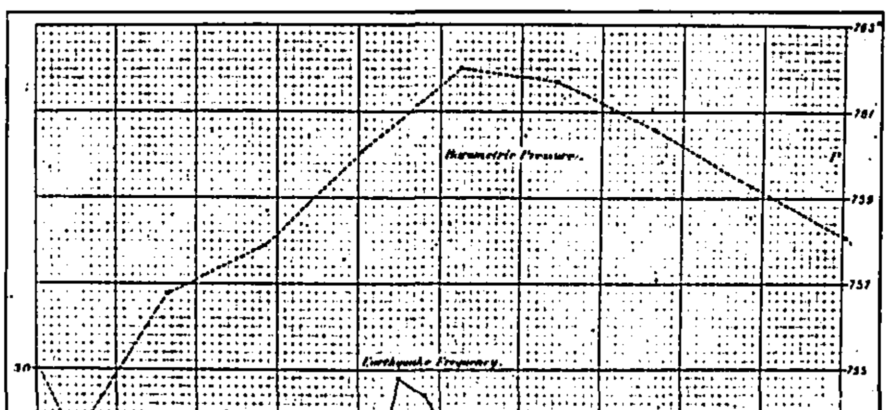
CYCLES OF VOLCANIC ACTIVITY

K. von Sapper, pp. 270-74. Translated from the German by H. C. Flattery.

The cycles of volcanic outbreaks and their possible connections with cosmic or terrestrial occurences are a subject that has been brought nearer to a solution by the keeping of statistics. Above all, a connection with sunspots has been accepted. J. Jensen finally came to the conclusion, through various experiments, that the greater frequency of outbreaks occurred simultaneously with the maxima and minima of sunspot coverage. Later W. Koppen, who has gone over this field again, found by studying the outbreak statistics of E. Kluge and de Marchi that the outbreaks were most frequent at the time of sunspot minima and most rare at the time of maxima. However, the record of outbreaks of K. Schneider gave a greater number of outbreaks for the time of maxima than for the time of minima. On account of these contradictory results, I have tried to examine my material with this in view: are the periods noticeable for the whole earth, or does an increase in certain districts equalize to some extent the decrease in others? For this purpose I have determined year by year the number of known activity units, and for the smoothing of the curve, I have, in each instance, considered the preceeding and the following figure at its weighted value—b equal ¼ (a plus 2b plus c). I ignored the continuously active volcanoes as they do not influence the curve. The southern hemisphere, on account of the greater number of continuously active volcanoes, is ahead of the northern hemisphere in general frequency of activity. But it shows a lower frequency figure, if one disregards the continuously active volcanoes, which is in keeping with its smaller land surface. Only seldom does the southern hemisphere gain a preponderance. The beginning of the list is in the year 1749 as only from this time on is the sunspot curve known through observation. The absolute number of outbreak units is continually getting higher, the nearer we approach the present time. This can be explained through better reporting and the addition of new volcanic districts. The frequency curve plainly shows a number of periods. They are not of equal duration, but vary from six to twelve years. Very often they approach the duration of sunspot periods, so it is not remarkable that several times a high frequency of outbreaks coincided with sunspot minima and at other times with maxima. According to my figures there were seventeen frequency periods from 1749 to 1914. During the same time there were only fifteen sunspot periods. This shows that a fundamental connection cannot be established between the two. Nevertheless, a certain relation is not out of the question for it is noticeable that during a time of the pronounced flattening of the sunspot curve (1798-1825) the frequency curve too is less sharply defined. Gigantic outbreaks sometimes correspond with a high, and sometimes with a low point of the curve, or even in between, so that no particular regularity can be read from this material for the occurence of great volcanic catastrophes.

Even though the sunspot theory may fail to be proved, positive causes of terrestrial or astronomic nature may yet be found in the course of time for the periodical volcanic outbreaks. Perrey and Falb (during the second half of the 19th century) believed to be able to predict the earthquakes and volcanic outbreaks under the supposition that there was a flow of the molten liquid of the earth's core. This theory has now been abandoned, but there is still much speculation as to the influence of the constellations of sun, moon, and planets on these phenomena.

F. A. Perrett came to the conviction, after careful observation of the activity of various Italian craters, that the position of the moon and also the sun to each other and to the earth has a decided influence on volcanic activity. Perret took into consideration the distance of the moon from the earth, the quadratures and syzygien, and the changes of the declination of sun and moon. He found fortnightly and half yearly maxima. The first show a stronger swing. H. O. Wood, who was at the Kilauea Volcano Observatory from 1912-1917, criticised Perrett's curve, because it showed the fortnightly amplitude as greater than the half yearly one. He emphasized the great value of declination. The observations at Kilauea showed that high lava levels and strong surface activity occurred at solstice, low lava level and little activity at equinox. T. A. Jaggar, who has had charge of the Kilauea Observatory since 1917, calls attention to the fact that from 1911-1913 the lava measurements may have corresponded with these data, but not so from 1914-1918. He shows that occassionally solstice and equinox have high lava levels, but at other times they may be accompanied by low lava levels. He found that on the average the lava in Kilauea had a tendency to rise in April-May and October-November, and to fall in July-August and January-February. From these various views one might well draw the conclusion that the observations have not been recorded for a sufficient length of time to show reliable results. H. O. Woods pointed out that in a cycle of 18.6 years the moon exerts an increased influence on the earth. This is caused by the regression of the occuring moon (nutation) while the change of breadth of the same is completed in



Curve showing the rise of barometric pressure and of earthquake frequency just before the first explosion at Usu eruption. After Omori.

a seven year cycle. It is remarkable that the multiplication of these two periods is about 130 years. Half of this is 65 years. Woods notes that Omori, in examining the eruption history of Asama-yama, finds the mean interval to be 63.5 years and in doubling it, 127 years. Dr. Jaggar prophesied in 1918 that in 1920 (the 130th year after the great eruption of Kilauea) another such eruption would take place. In fact, great lava flows occurred in this year and the explosive outbreak repeated itself in 1924. As such successes lead us to hope that through the careful collection of observations of all kinds and through the consideration of the outbreak history of the various volcanoes it may yet be possible to shed light on the causes and the origin of these eruptions.

For a long time one has tried to connect eruptions not only with astronomic events but one has also thought of the possibility that atmospheric influences, above all heavy rainfall, at least in case of explosively active volcanoes, might be the cause of eruptions.

Systematic observations were first made by G. de Lorenzo at Mt. Vesuvius. He found that heavy precipitations increased the activity of this fire mountain. F. Stell-Starrabba extended the observations to Etna and later on to Japanese volcanoes on information furnished by H. Tanakadate's paper "On the Activity of Japanese Volcanoes from January 1914 to August 1924." Lately the work referring to Japanese volcanoes was continued, using Karl Sapper's catalogue of the historical volcanic eruptions. This gave information on volcanic outbreaks since earliest times. Both sources showed the coinciding of rainy and eruption times. In looking over the entire eruption activity, the maximum seems to be delayed several months, during the short period from 1914 to 1924. This retardation is explained, according to Starrabba, by the fact that the general eruption list shows only major eruptions while in Tanakadate's compilation, even less important manifestations of activity are recorded.

KILAUEA REPORT NO. 976
WEED ENDING OCTOBER 5, 1930

Section of Volcanology, U. S. Geological Survey
H. A. Powers, Temporarily in Charge

On Monday and Tuesday a few dust clouds were caused by small avalanches from the walls of the pit. Since then it has been so rainy that any slides which might have occurred did not raise clouds of dust. The heavy rains which began on Wednesday, October 1, and have continued all week have caused an excessive amount of steaming from Halemaumau. A number of times, large cauliflower steam clouds have given a perfect imitation of eruption clouds.

One feeble earthquake was recorded on October 1 at 7:14 a. m. with a distance to its origin of 28 miles, and three very feeble shocks were recorded as follows: September 29, 12:31 a. m.; October 1, 1:05 p. m.; and October 5, 10:51 a. m. Twenty-five small tremors registered on the Observatory instrument during the first four days of the week, and three were recorded on October 5, the last day of the week. On two days there were neither tremors nor quakes. The microseisms, which indicate the non-volcanic trembling of the ground, were slight during the early part of the week but increased to moderate intensity over the weekend.

The Kona and Hilo records of the earthquake of September 28 give additional evidence which shows that the quake had its origin at great depth under the crater, Mokuaweoweo, on the main Mauna Loa rift line. Late reports also show that the quake was felt by some people in all parts of the island.

During the past week the ground under the Observatory has tilted moderately in a south south-west direction. Unfortunately, the heavy rainfall of the latter part of the week has caused some tipping to the south, which tends to obscure the significance of the tilt record so far as volcanic pressure is concerned. Only one thing is certain, that is, if any excessive change of pressure had followed the deep seated quake of September 28, it would surely have made itself evident in the tilt record in spite of the obscuring outside influences.

TILTING OF THE GROUND FOR SEPTEMBER

The general movement of the ground under the Observatory during the month of September was a slight tilting back and forth along a northeast-southwest direction. The net amount of tilting for each week, taken from the curve which is smoothed by calculating progressive seven-day means, is given in the following table:

September	1— 7	N. E.	.97	seconds	of	arc
"	8—14	N. E.	1.20	"	"	"
"	15—21	S. S. W.	.90	"	"	"
"	22—28	N. N. E.	1.33	"	"	"

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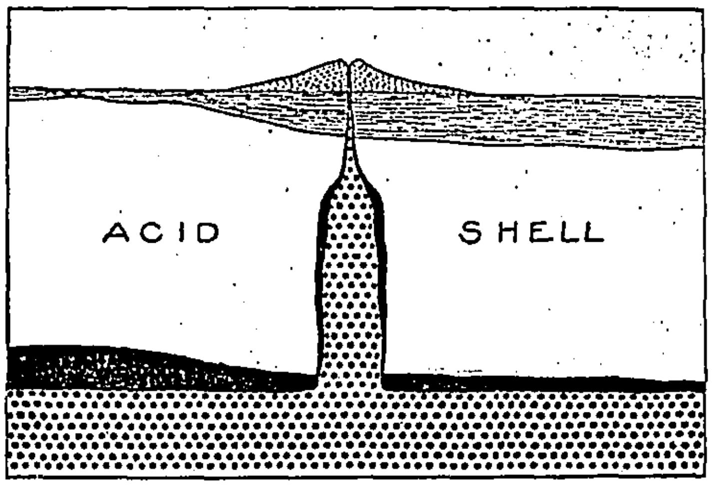
The Volcano Letter

Two dollars per year Ten cents per copy

No. 303—Weekly Hawaiian Volcano Observatory, National Park, Hawaii October 16, 1930



Diagramatic section through the earth's crust showing sediments under a volcano, siliceous (acid) shell, black solidified layer of basalt, dotted liquid basalt of the substratum partly crystallized on the walls of the fissure leading to the volcano. The volcanic cone is represented as 5 km. in height. After Daly.

JOLY'S THEORY OF SURFACE CHANGES OF THE EARTH

(Reviewed by M. Gauntlett. The appendix of "Surface History of the Earth" by John B. Joly.)

After a sinking of the earth's crust with inflowing of the seas over the land masses, sedimentation takes place and then a gradual rising of the continental blocks again. Before the final climax of the renewed rising, floods of basalt arise and flow out through the cracks in the earth's surface. The geosynclines, or places which have received the most sedimentation, are lifted up to form mountain ranges. These periods of great crustal movement, or Revolutions, have occurred about four times, the last ushering in the present geologic age with the rising of the Eurasian chains.

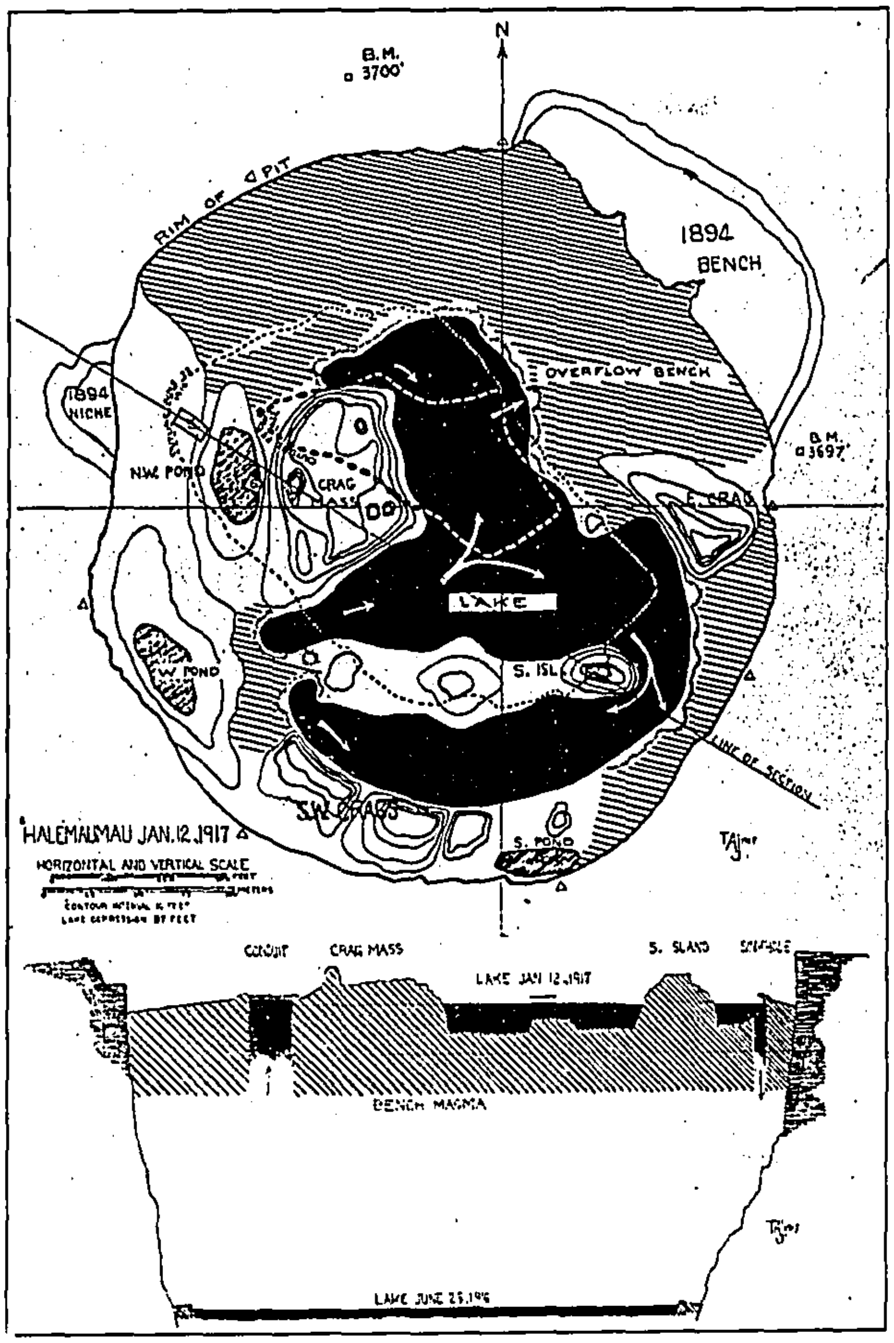
In the article, the origin and interrelations of these events, the sinking and rising of continental blocks, is traced in reference to: (1) the existence of a general basaltic magma-ocean or isostatic layer in which the continents float and upon which the oceans rest; (2) the presence of a certain amount of radioactive materials throughout this magma-ocean; (3) the maintainence both in past and present of isostatic equilibrium of the land masses; (4) certain forces acting on the earth's surface crust.

The general distribution in the rocks of energy-producing or radioactive elements was demonstrated by Lord Rayleigh about twenty-two years ago. This shows that there is everywhere in the rocks a perpetual source of heat which is unfailing whether the heat is accumulating or escaping. More thermal energy was evolved in past ages. Joly feels that this accumulated energy has been a dominating factor in the history of the changes of the earth's surface for all time.

The question of isostacy connoted the existence near the earth's surface of a layer of dense, plastic material in which the continental masses of lighter rock float and upon which the oceans rest. The law of compensation works here to a marked degree, the continental masses displacing more than the lower oceans. The greater mass of the mountain ranges is permitted because the lighter rock which makes up the mountains also extends downward to a great depth beneath the mountains. The Himalaya mountains are about 80 per cent compensated by this method.

The evidence that basalt or basaltic magma composes this isostatic layer are very strong. It is found that during disturbances on the earth's crust vast amounts of intensely heated, fluid basalt come up through the fissures. Basalt has a very high density. It is the most prevalent effusive rock on the globe. The oceanic islands are predominantly basaltic. Experimentally it has been found that basalt directly underlies the oceans. Joly designates the continents as a granitic scum which has separated out. The continents float in this underlying magma layer and the oceans rest upon it as oil on water.

From astronomical study and seismology it is found that at present this substratum must be solid and behave as an elastic solid towards rapidly changing physical forces. However, it is in the solid state very near its melting point, and in the past it has been in the fluid state just above its melting point. Now heat is being generated by



Pit plan and profile of Halemaumau. Shows in profile the bench magma shaded) as a narrow rim in June, 1916, and as the principal fill of the pit in January, 1917. Map shows lake, crags and western source wells. After Jaggar, A. J. S., Sept. 17, 1917, p. 168.

radioactive elements, and heat from a solid is given off only by slow conductivity, so heat is accumulating since it has no rapid means of escaping. It will take some 30 million years for enough heat to accumulate to change the basaltic magma back into the liquid state.

When this takes place there will be an uprising of the entire earth's crust due to the expansion of the basalt during melting which is 11 to 12 per cent, but there will be a sinking of the continental blocks because of the decrease of density of the basalt during melting. After liquifaction is complete, the rate of loss of heat is enormous due to the convection currents in the liquid mass. The heat will be lost mostly through the ocean floor. The loss of heat causes the magma to solidify again and the entire surface of the earth sinks again with the continents rising due to the change in density of the supporting magma-layer. This is a cycle which occupies from forty to sixty-five million years as well as may be judged with the scarcity of known facts.

It is quite probable that, during this time of liquifaction, there are great tides in the magma and the continents shift with the ocean in respect to the deep lava.

In the formation of mountain ranges, Joly holds to the theory that the folding and over-thrusting of the layers of sediments are done long before the mountains are elevated. The sedimentation in large geosynclines, or troughs, forces these areas to bear down much more heavily into the superheated isostatic layer beneath, and later, when the horizontal mountain-making forces come into action, they do not push the mountains up but rather further down. The mountains do not rise until solidification of the underlying magma increases its density and the forces tending toward compensation become great enough to force the whole crushed mass of sediments upward as elevated mountain ranges. This elevation is due to vertical forces and not horizontal as has been stressed in earlier theories of mountain building. The energy comes from the expanded magma and is traceable to the accumulated radioactive heat.

According to astronomers this liquid layer of basalt has tides and the tidal movements greatly exceed in energy those of an ocean of water. There arises a west-to-east pressure transmitted from the rotating earth in opposition to the lunar and solar gravitational forces. This acts on the submerged westerly coasts of the continents. It is a fact that all of the great lava flows have occurred on the western sides of the mountain ranges and continents. The magma expanding about ten per cent would increase the equatorial width of the Pacific about thirty miles and that of the Atlantic eleven miles. The approximated thickness of the ocean floor would be twenty miles in twenty-five million years, and the thickness in inter-revolutionary times would be fifteen miles. During the period of thermal dissipation it will be attacked by super-heated currents and greatly reduced in thickness by melting of the bottom. It will rupture along the coasts of the continents, and the fractures will be filled rapidly by congealing basalt, forced in under pressure. During this time the heat is being dissipated and the ocean floor again thickens and strengthens. Then, when this thickened and enlarged oceanic crust sinks due to the cooling of the underlying magma layer it pushes against the coasts of the continents and causes buckling.

Earth movements and volcanism must result from this breaking down of solid to liquid. Also it is difficult to separate horizontal and vertical movements because of the tensional properties of the rocks and the fact that molten lava fills all cracks preventing return to the original dimensions. The vertical oscillatory movements become a source of ever-extending lateral pressures.

The relative amounts of land and water are explained by thermal equilibrium. If the temperature becomes too great, the continental rocks liquify and either rise vertically in great intrusive bodies called batholiths or expand laterally until the thermal equilibrium is reached again.

By the theory as represented many great facts of earthly tectonics are explained. Such cyclic changes not only arise consistently and naturally, but it may be said inevitably from the conditions present. "The events of the past cease to be mysterious, but become the natural outcome of the physical structure of the earth's surface."

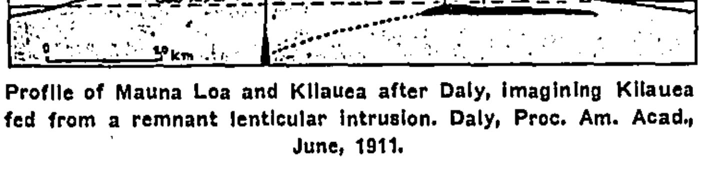
TILT AND RAINFALL

In Kilauea Report No. 969, August 17, the remark was made that abrupt tilting of the ground to the south was coincident with a period of heavy rains in the region around Kilauea crater. Additional data have thrown more light on this occurrence.

On several different occasions during the past few months, rainfall has been so heavy that streams of water have formed numerous short-lived water falls over the walls of the crater, and the crater floor has been dotted with countless pools of standing water which last for several hours after the rain ceases. One of these water-catching basins is located about 30 feet south of the building which houses the Halemaumau seismograph, and during the heavy rains it holds a pool of water perhaps 20 feet in diameter and one foot deep on the average. Thus approximately 4000 pounds of load are added to the surface of the ground just south of the seismograph.

The observer at the pit has noticed that this small basin has been filled on five different occasions, and, at each time, the seismograph has registered abnormal tilt to the south.

Date	Amount of tilt	Duration of abnormal tilting
Aug. 10, 1930	S—1.2 sec. of arc	4 hours
Aug. 11,	S—1.1 " " "	3 "
Sept. 10,	S—3.1 " " "	5 "
Sept. 19,	S—0.3 " " "	2 "
Oct. 8,	S—3.0 " " "	5 "



Profile of Mauna Loa and Kilauea after Daly, imagining Kilauea fed from a remnant lenticular intrusion. Daly, Proc. Am. Acad., June, 1911.

The exact amount and duration of these rains is unknown, so that a quantitative correlation between rainfall and tilt of this instrument cannot be made. However, observations have been sufficient to make certain that these short periods of abnormal southern tilting of the Halemaumau seismograph are coincident with the heavy rains which form the pool of water just south of the instrument pier.

The heavy rains at the pit on August 10 and 11 were a phase of a very heavy general rain which affected the whole area. During the three days, August 10, 11, and 12 about 12.5 inches of rain were recorded at the Observatory. On these same three days, the Observatory seismograph showed an abrupt tilt to the south which amounted to 3.5 seconds of arc. The other three instances of sharp tilt at the Halemaumau instrument were not coincident with any unusual rainfall or tilt at the Observatory. However, during the three days, October 3, 4, and 5, about 6.8 inches of rain fell at the Observatory, and a rather abrupt tilt to the south of 1.2 seconds of arc was recorded. These two instances from the Observatory are not sufficient basis for any generalizations on the correlation of rainfall with the general tilting of the Kilauea rim. It is evident, however, that abnormal tilt may be shown on the Observatory instruments which does not affect the Halemaumau station, and vice versa.

In an article appearing in the Bulletin of the Seismological Society of America in March, 1929, T. A. Jaggar and R. H. Finch discuss the relation of regional tilting to regional rainfall distribution. They point out that the northeast slopes of Kilauea receive many times as much load from rainfall as do the southwest slopes of the mountain. They conclude that "such a loading might be expected to give a northeasterly tilt at the Observatory. There is, (judging from their study of a three-year record) however, practically no correlation between tilt and rainfall, either daily or seasonal.—If the winter irregularities (in the tilt curve) were due to rainfall, we would expect that in 1918, the wettest year, the winter curves would be more irregular than for 1919, the driest year, but such is not the case."

The local instances cited in the present article do not affect, in any way, this conclusion on regional rainfall and tilting. They indicate simply that local loading of the surface may cause a temporary local bending of the lava structure of sufficient magnitude to show up as abnormal tilting on the seismograph records.

KILAUEA REPORT No. 977
WEEK ENDING OCTOBER 12, 1930

Section of Volcanology, U. S. Geological Survey
H. A. Powers, Temporarily in Charge

There have been no conspicuous avalanches from the walls of Halemaumau during the week. Large steam clouds have accompanied or followed several heavy showers, and on the evenings of Oct. 8 and 9 very striking cauliflower clouds rose over the pit. The wind was light enough so that they were not blown away immediately upon their formation.

At 12:04 a. m., Hawaiian Standard time, October 8, the instruments recorded a very small disturbance which was caused by a distant earthquake. The record is so poor that it is impossible to estimate either the distance or probable direction to the source of this teleseism.

Three very feeble earthquakes of local origin were recorded as follows: October 8, 8:16 p. m., and 10:30 p. m., no distance determined; and October 9, 7:46 a. m., distance to origin 35 miles. A total of 17 small tremors occurred during the week. This is the smallest number of these tremors recorded since the week ending August 17, 1930. The microseismic, or non-volcanic trembling decreased the early part of the week and has remained slight to the present.

The week's average of the tilt record shows that the ground under the Observatory has been tilted slightly to the northeast. The southwest rift of Mauna Loa still seems to be controlling the tilt movements, but there has been no notable increase or decrease of pressure to suggest movement of lava on a large scale since the deep earthquake of September 28.

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The Volcano Letter

Two dollars per year | Ten cents per copy

No. 304—Weekly | Hawaiian Volcano Observatory, National Park, Hawaii | October 23, 1930

One of the explosive eruptions of Mt. Lassen as seen from the northeast. The explosion is from the newly formed gash crater. The snow to the left of the crater is grey from the falling ash. Photo by B. F. Loomis.

ACTIVITY OF LASSEN PEAK, CALIFORNIA, UP TO 1915

By H. C. HANNA

References: Popular Science Monthly, March 1915, Professor Holway. Lassen Peak Folio, U. S. Geologic Atlas, Folio 15. U. S. Dept. of Interior Bulletin, June 1 to Sept. 15.

It is almost certain that no white man had ever witnessed an eruption of a volcano in the State of California until May 30, 1914. On that date Lassen Peak, a well known volcanic cone about seventy-five miles southeast of Mt. Shasta, suddenly burst into explosive action. During the six months that had elapsed when Professor Holway presented his article there had been an average of one eruption every three days, and no indication at that time that the activity had ceased.

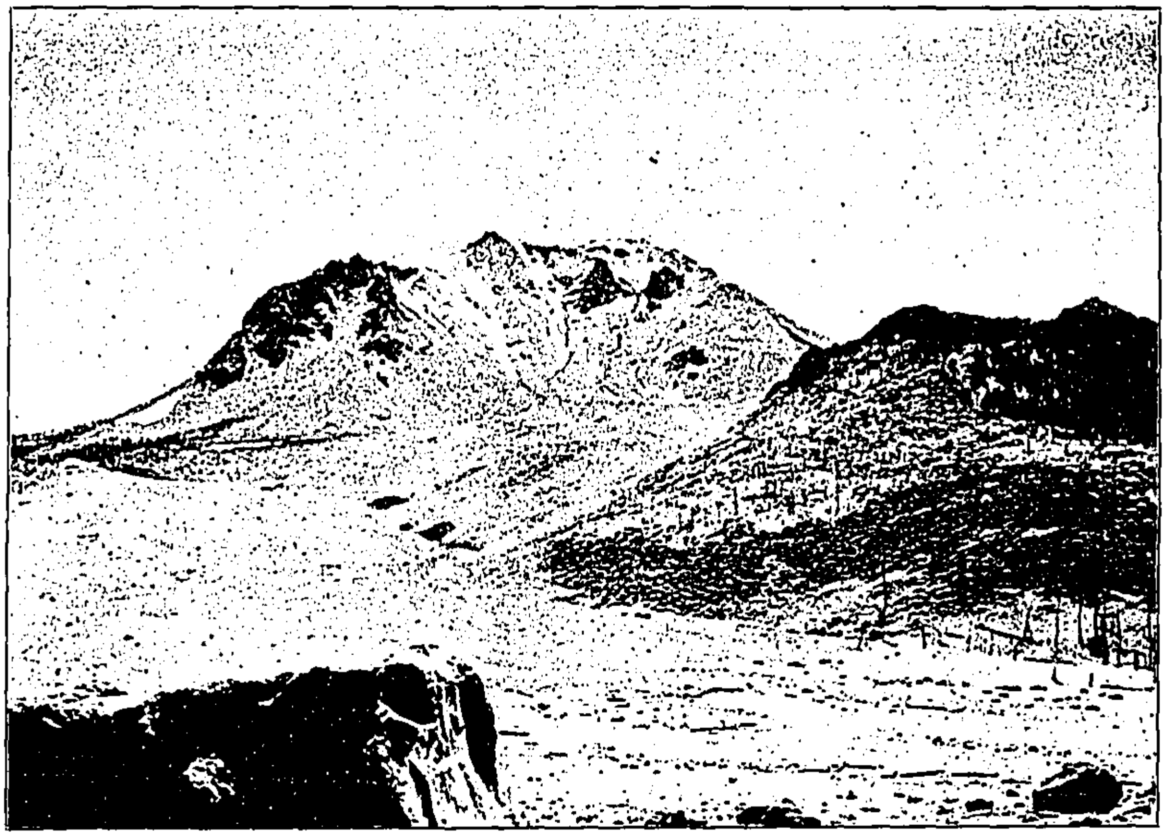
A natural curiosity exists concerning the event that took place in view of probable developments of the future. Was this activity a sign of rejuvenation of a long quiescent volcano? Will this volcano again erupt lava?

Lassen Peak is located in the extreme southeastern corner of Shasta County, nearly two hundred miles from San Francisco. It lies on the southern tip of the great Tertiary lava field, some 250,000 square miles in extent, which covers not only northeastern California, but parts of Oregon, Washington, Idaho, and Nevada as well. Lassen marks the southern end of the Cascade Range and is the last of a series of volcanoes of which Rainier, Adams, Hood, Three Sisters, Pit, Mazama, and Shasta are familiar examples. South of this mountain range are the Sierra Nevada Mountains which were caused more by great faulting and uplift than by volcanic accumulation.

Until this recent outbreak (1914), Lassen Peak belonged to the class of doubtfully extinct volcanoes. As shown by the following statement, Diller did not consider the volcano extinct: "That volcanic activity is not yet extinct in Lassen Peak is shown by the presence of numerous solfataras and hot springs. At Bumpass' Hell, near the southern base of the peak, there are boiling mud pools and vigorous solfataric action."

Previous to the eruption of 1914, there have been several accounts of eruptions reported by the Indians who claim to have witnessed them shortly before the coming of the white settlers. Following is a report of Dr. J. W. Hudson of Akiak, California.

"I was in that region in 1904 collecting for the Field Museum of Natural History, Chicago, and heard much of



Lassen volcano in the summer of 1924 after all eruptions had ceased. Most of the light colored material on the flanks of the volcano and in the foreground is powered rock which was erupted during the activity of 1914 and 1915. Photo by B. F. Loomis.

Lassen Butte. An old Indian told me that when a child, an earthquake occurred at Lassen one summer day. The sun rose, but finally faded to the darkest night——. In many localities along the Pit River watershed, I heard similar reports amongst the aged Indians. The name of this volcano in Palinikau tongue is "Am bilikai," ie. "Mountain-ripped-apart."

Prompt investigation of the first eruption is due to the fortunate fact that the mountain is included in Lassen Peak National Forest, and that the U. S. Forest Service had built a fire look-out station on the topmost crag of Lassen Peak itself. When the eruption began in 1914, the lookout stations had not yet been occupied for the summer season. It can be seen that the interests of the forestry service made the activity on Lassen almost immediately investigatable.

The following is a report made by W. J. Rushing of the Forestry Service:

"Such wild stories are being circulated concerning Mt. Lassen that I am sending you the results of our observations to date. Saturday, May 30, the first outbreak occurred at 5 p. m. This was witnessed by Bert McKenzie of Chester who was looking directly at it when it occurred. Ranger Abbey investigated it on Sunday, May 31, finding a hole 25 by 40 feet in size and of unknown depth. Sand, rocks as large as a sack of flour, and mud were ejected. The heavier material was thrown over an area 300 feet across, while the ash was scattered over an area a quarter of a mile across. No molten material was thrown out. At 8:05 a. m., June 1, a second outburst occurred, throwing out large quantities of the same sort of material. Boulders weighing a ton were ejected. The vent was enlarged to 60 by 275 feet. On June 8, heavier volumes of steam were noted, and at night, another eruption took place, throwing out more ashes and fine material.

"Heavy volumes of steam are coming out of the vent today. We have watched it carefully, and at no time have we been able to see any flame or indication of fire. The vent is about one quarter of a mile from the fire look-out house, and if it continues eastward, as it has so far, it will finally break out on the east side."

Mr. Macomber, a member of the Forest Service spent the night of June 4 at the fire lookout house and reports: "The crater measured 275 feet long. It was then in a pause between explosions. Cracks appeared in the ground and sulphur smoke was rising from them. The walls of the crater were perpendicular and about 60 or 70 feet in height. In the center of the crater floor there appeared a pile of rocks."

On June 14, there occurred the heaviest eruption up to this time, and it was from this explosion that the only injuries during the whole six months period were incurred.

Mr. B. F. Loomis gives a brief summary of the experiences of the party that was caught by this eruption:

"Mr. Phelps party reached the rim of the old crater and sat down to rest a short time, watching the smoke from the crater, when the eruption began. Without any warning or explosion that could be heard, a huge column of black smoke shot upward with a roar, such as would be caused by a rushing mighty wind, and in an instant the air was filled with smoke, ashes and flying rocks from the crater. They all ran for their lives. Mr. Phelps hid under an overhanging rock, which sheltered him from the rocks which brushed past him as they fell. Lance Graham was a few feet away and was struck by a flying rock, which cut a great gash in his shoulder, piercing the thoracic cavity, and broke his collar bone. He was left on the mountain as dead for a time, but was then removed with great difficulty. He is now recovered. Another of their party ran down the mountain and coming to a snow drift, slid down the mountain like a shot. The cloud of smoke kept pace with him and when he reached the bottom of the snow drift, he found a clump of bushes and diving into it, buried his face in the snow to keep out the blinding smoke and ashes. The smoke is described as causing the blackest darkness, black as the darkest night."

Volcanic dust or ash from the different eruptions has been reported as falling from ten to twenty miles from the peak, the amount and direction varying with the wind. The limits of the heavier falls of ash were within a circle of less than a mile. The direction of the dust outbursts varied, irregular streaks of ash such as that of June 26 showing minor outshoots of dust in various directions. Exaggerated reports of the distance to which stones were thrown were based on the distance they were found on the outer slopes of the old crater. To avoid mistaking such stones for those thrown out by the eruptions, careful search was made on level patches of the old snow so located that it was impossible for stones to roll down on to them. Wherever such places were found, there was no evidence that ejected stones fell at a much greater distance than to the lookout house, and certainly no further than one-half mile from the crater.

The winter's snow had largely disappeared and near the top of the mountain snow was to be found only in patches and beneath a covering of ashes. These areas appeared black in contrast with the light grey of the greater part of the mountain crest due to the presence of dust. This dust was so fine that it was easily moved by the wind and at times a strong gust would send immense clouds into the air, thus giving the appearance of an eruption which would fool observers at a distance and to these probably were due the many false reports about new eruptions that never existed.

During the month of August there were eight eruptions, fewer than either of the preceeding months. Seven out of eight of these threw dust as high as 10,000 feet and were considered quite severe. The record for September showed 17 eruptions, the largest number for any of the six months covered in this report. During this month there was an enlargement of the crater and new vents were opened.

The most remarkable change in the crater (new on the northeast side) occurred in September. The inner vent was 900 feet in length. The severity of these September eruptions is confirmed more or less by the fact that the lookout house there was completely demolished on the 29th of September. The forest lookout on Turner Mountain reported having seen red hot stones ejected. This was confirmed by other observers who claim to have seen flames. This, therefore, is the only observation during these eruptions that indicates such temperatures as molen lava.

The records of October and November are incomplete due to the severe storms in the vicinity which prevented observations. However, these two months are credited with 16 eruptions which shows that the volcano was by no means becoming quiet. Later in January 1915, the San Francisco Chronicle reported an eruption from a new crater on the east as equal to any that had gone on before. The article also stated that no one had visited the volcano for a period of three months.

Mr. Rushing in a letter to the author made some observations during November and states that the eruptions could be classed as medium. He gives a suggestion that this fact may be explained by the fact that a new vent had been opened at a lower level. A comparison of distant observations from the north and from the south would be necessary to test the correctness of Rushing's supposition.

The action of the "smoke" from Lassen is well described by Prof. C. F. Shaw who says:

"The smoke rolled up until practically the entire height of 12,000 feet was reached before any change in its form occurred, when just below the top of the column there was a tendency to stratification and a layer extended out toward the south and toward the north. When this appeared, the smoke column began to lean toward the north and, from our point of vision apparently toward the northeast, distortion took place with the inclination of the column, the upper part spreading out into streamers. As soon as the inclination of the smoke column became very plain, we could readily distinguish indications of falling material. The lower two-thirds of the column seemed to be dropping some material that was falling in a slightly oblique line, the obliqueness pointing back toward the mountain peak. As the eruption continued and the smoke column blew out more toward the north, the streaked condition indicating falling material become more and more apparent, but as the light was failing it became rather hard to distinguish the exact outlines of the lower portion of the column." c

The falling matter must have been the stones and coarser material in distinction to fine ash forming the top of the column of "smoke." Professor Shaw's observation is the only one received by the author that indicates the height to which the heavier fragments were thrown. His statement indicated a total height for coarser material of 8,000 feet.

All of the observers agree that there was no molten lava ejected. Samples of the ash were submitted to Professor A. S. Eakle of the University of California and his report states that the ejected material was composed entirely of fragments and dust particles formed by the shattering of the old volcanic rock which makes up Lassen Peak. The activity, accordingly, must have been all steam explosion, with no eruption of new lava to the end of 1914. (A plug of new lava did make its appearance in the crater of Lassen at a later date).

KILAUEA REPORT No. 978
WEEK ENDING OCTOBER 19, 1930
Section of Volcanology, U. S. Geological Survey
H. A. Powers, Temporarily in Charge

The early part of the week passed with no happenings of interest at the Volcano. About noon on Saturday, October 18, several medium-sized avalanches fell from the north wall of the pit, and small slides were noticed occasionally on Sunday. Steaming from the wall and floor cracks was very light during the entire week.

At 8:25 a. m., October 20, a moderate earthquake dismantled all of the instruments at the Observatory. The quake was felt over the entire island, with localities on the slopes of Kilauea receiving the strongest shock. This evidence corroborated the data from the seismograms which indicated that the center of the quake was under Kilauea crater. It is not yet possible to form an intelligent opinion as to whether or not this shock is the forerunner of an appearance of lava in Halemaumau.

There were two quakes of very feeble intensity during the week, recorded as follows: October 13, 4:12 a. m., and October 17, 7:31 p. m. Neither of them has been reported as felt anywhere on the island. Seventeen tiny tremors which may have been of volcanic origin registered on the seismograph at the Observatory. The non-volcanic trembling of the island which is reported as microseismic motion was slight throughout the week.

The average of the week's tilt recorded shows that the northeast rim of Kilauea has been tipped moderately (about 1.5 seconds of arc) in a north-northeast direction, ie. away from the pit. Tilting in this azimuth has usually been associated with changes of pressure under Kilauea crater, and the tipping away from the pit is considered as an indication of increase of volcanic pressure. The earthquake of Monday morning was accompanied by a sudden tilt of nearly 1.5 sec. of arc in the same direction, suggesting that the quake was associated with upward pressure under Kilauea.

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The Volcano Letter

Two dollars per year — Ten cents per copy

No. 305—Weekly — Hawaiian Volcano Observatory, National Park, Hawaii — October 30, 1930

Novarupta Dome, of siliceous lava, from the southwest, showing parts of the Valley of Ten Thousand Smokes beyond. Photo, National Geographic Society, 1919, from Katmai Series, No. 1.

THE ERUPTION OF KATMAI, ALASKA, 1912

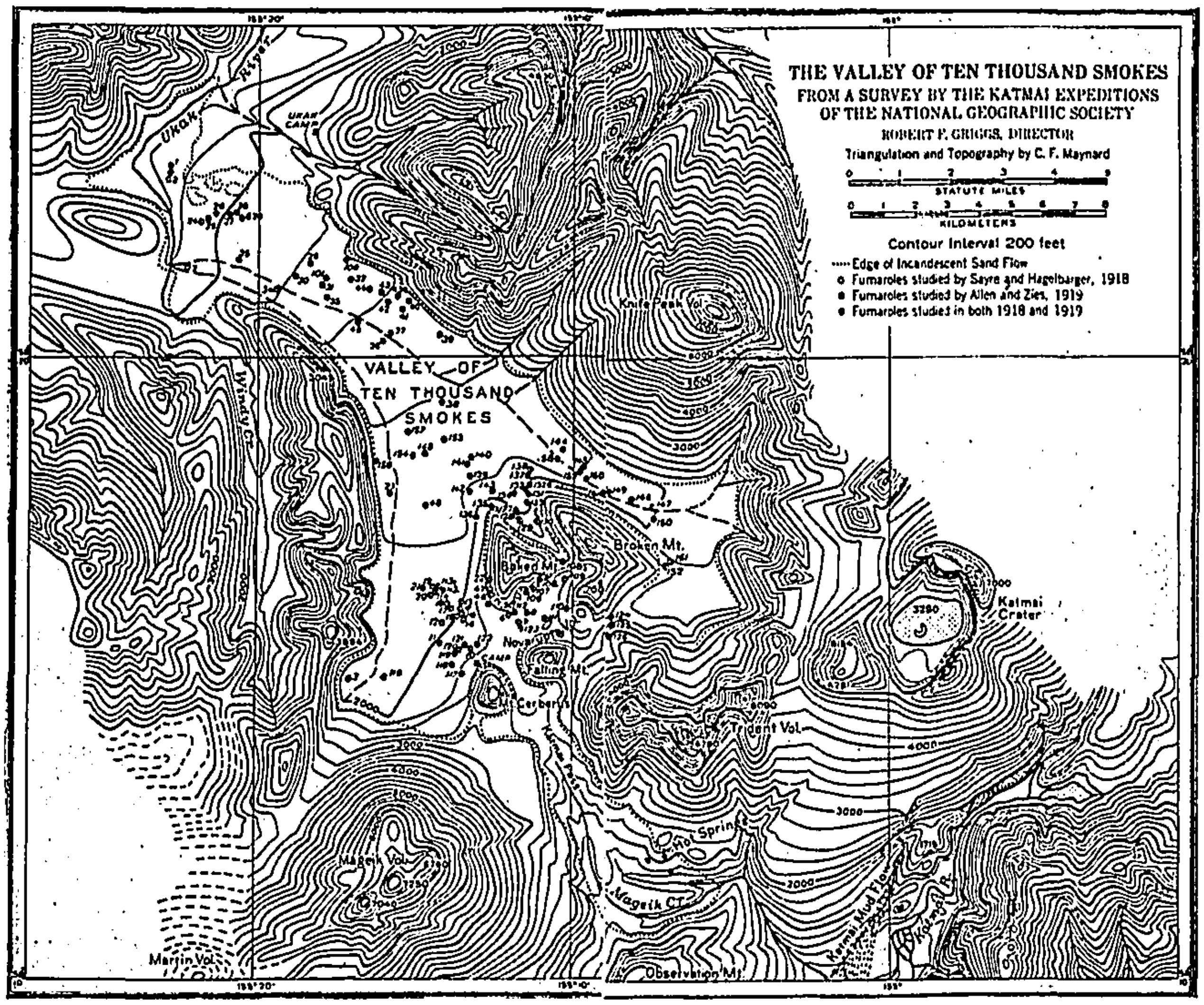
By H. Okimura. Reference: Robert F. Griggs, National Geographic. September 1921, pp. 219-292.

The explosion of Katmai Volcano in Alaska in June 1912 is ranked among the twelve greatest historic eruptions of the world. It is easy to see the justification of giving this rank when it is shown that as a result of this eruption, a town a hundred miles away was buried under a foot of ashes; that so loud were the concussions that the comments of people at a distance of 750 miles were excited; and that the quantity of dust thrown into the upper atmosphere was such that the intensity of the sunlight was diminished for many months throughout the northern hemisphere. The eruption giving rise to the Valley of Ten Thousand Smokes was a sequel to eruptions from the floor of valleys at a considerable distance from Katmai as shown by the fact that the stratified ashes from Katmai everywhere lie on top of the deposits of this earlier phase of eruption.

Lack of any eye-witnesses and any recorded happening resembling this sort of eruption made difficult the interpretation of the events of this great explosion. True, there was one, "American Pete" as he was called, who had witnessed the occurrence but aside from stating that it was dark and hot ashes fell, the only eye-witness could not much enlighten the explorers. The host of small volcanoes or vents which burst forth destroying the once beautiful green valley, presented a feature unusual in volcanic phenomena, for here no dormant vents had awakened, but volcanoes had been formed in areas where none had existed. The new volcanoes, made simply of holes blown through the floor of the valley, began to thrown out ash and pumice in enormous quantities soon after their formation.

It is believed that in addition to myriads of fumaroles, hundreds of vents must have been belching forth incandescent material in veritable torrents of fire. Quantities of red-hot solids and liquids, sands and stones, masses of fluid or semi-fluid lava rushed out of the vents and poured out on the ground to roll down the slope and consume everything along its path. It is also believed that had one been able to witness the scene, there would have been seen many separate volcanoes each pouring forth its own mass and giving rise to great black clouds to a considerable height in ever-expanding convolutions. The smoke, instead of deriving its source from the mass of incandescent material around the vent, originated from the gases that boiled out of the semi-molten lava. The quantity of gas given off was so great as to be able to puff up the lava into pumice and entirely disrupt it by the expansive force of escaping gas.

The valley was overgrown to an altitude of 1500 feet by a dense forest and except for the ancient lava flow the rocks of the valley are not volcanic, consisting of sand and shale full of fossils of marine shell-fish of Jurassic age. Long before fires that consumed the surrounding vegetation had time to run their course, the mass of incandescent fragments accumulating round the separate vents coalesced until they covered the whole area of the valley,



Map showing Katmai crater on the east, Novarupta Dome in the middle, and the pumice-filled Valley at the left. From National Geographic Society, Katmai Series, No 1.

converting it into a single fiery torrent of red-hot sand and rock which began to roll down the valley under gravity for seventeen miles and even at that distance the heat was so intense as to reduce every stick it touched to charcoal. This fiery mass is not comparable to ordinary lava, although undoubtedly a liquid in the beginning, it did not remain so, for the escaping gas converted it to solid fragments suspended by the enormous quantities of gas given off.

The main arm is toward Naknek Lake for seventeen miles while another completely encircles Broken Mountains. The greatest length is twenty miles while the greatest breadth is nine miles, the total area covered being 53 square miles. The magnitude of the operation by which it was produced could be conceived if it is said that the sand flow is equivalent to the output of all the stone crushers in the United States for a period of 100 years.

The highest temperature was 645 degrees Centigrade and a stick thrust into the hole was changed to glowing coal within a few seconds. Big fumaroles furnished any degree of heat that might be needed for cooking, while snowdrifts behind the tents gave water and provided refrigeration. The steam from the fumaroles was highly charged with either hydrochloric or hydrofluoric acid which ate the rope to pieces and made holes in aluminum pots. Bacon was fried in no time, while corn bread was baked satisfactorily in Nature's oven.

In some places, columns of very hot steam came out under considerable pressure. The emerging gas came with such a rush that when a cup of water was poured over it, the water was vaporized before it had a chance to touch the bottom and a hat thrown in was tossed up thirty inches in the air.

Although the explorers had been able to get a fair idea of the "Smokes" themselves, they had no adequate conception of the marvelous coloration of the valley. One of the men who had lived on the brink of the Grand Canyon was impressed with the striking colors which were altogether different from those of the Canyon. The colors of the Canyon being remarkable at a distance, the coloration is produced entirely by the wonderful atmosphere and brilliant light which floods its recess. The colors of the valley are more brilliant when seen at close range, but at a distance they are grayish or brownish due to the fact that all the colors of the spectrum, being present close together, blend into a neutral color. In some places considerable areas are leached out to a gleaming white by the acid fumes, while in some places pure yellow sulphur overlies other colors, and in still other spots where the ground is not too hot a bright green color is produced by the growing algae.

LASSEN REPORT No. 26

Lassen Volcano Observatory.
R. H. Finch, Associate Volcanologist.

During the summer of 1930 the National Park Service built a modern fire lookout building on the summit of Mt. Harkness, 8,039 feet above sea level. The United States Geological Survey installed seismographs in the basement of the building on August 21, 1930.

Eighty-eight tremors were recorded during the month that the seismographs were in operation. In addition to these tremors, there were, on many days, more or less slight continuous vibrations with a period of two seconds. This continuous shaking was stronger in the north-south direction than in the east-west. This type of vibration appears to be peculiar to the mountain top.

The entire mountain top is shaken by strong winds and the seismographs show a very irregular record on windy days. Puffs and gusts of wind produce records of tremor with considerable amplitude.

Good records were written of the southern California earthquake of August 30, 1930. The record of the Eureka, Cal., shake of August 23, 1930 was larger than that written by the instruments at Mineral. Several of the shakes that were recorded at Harkness were not recorded at Mineral.

Some time during July, the "Big Steamer" or uppermost large vent in the Supan Solfatara increased in activity and scattered mud for a distance of forty feet around the vent.

What was hitherto a large steam vent in the southeastern end of the Devil's Kitchen is now a boiling pool about 10 feet across. It boils constantly raising the main body of water to a height of four or five feet and occasional jets reach a height of 10 feet.

The Boiling Lake was the lowest during the summer of 1930 that it has been for several years.—R.H.F.

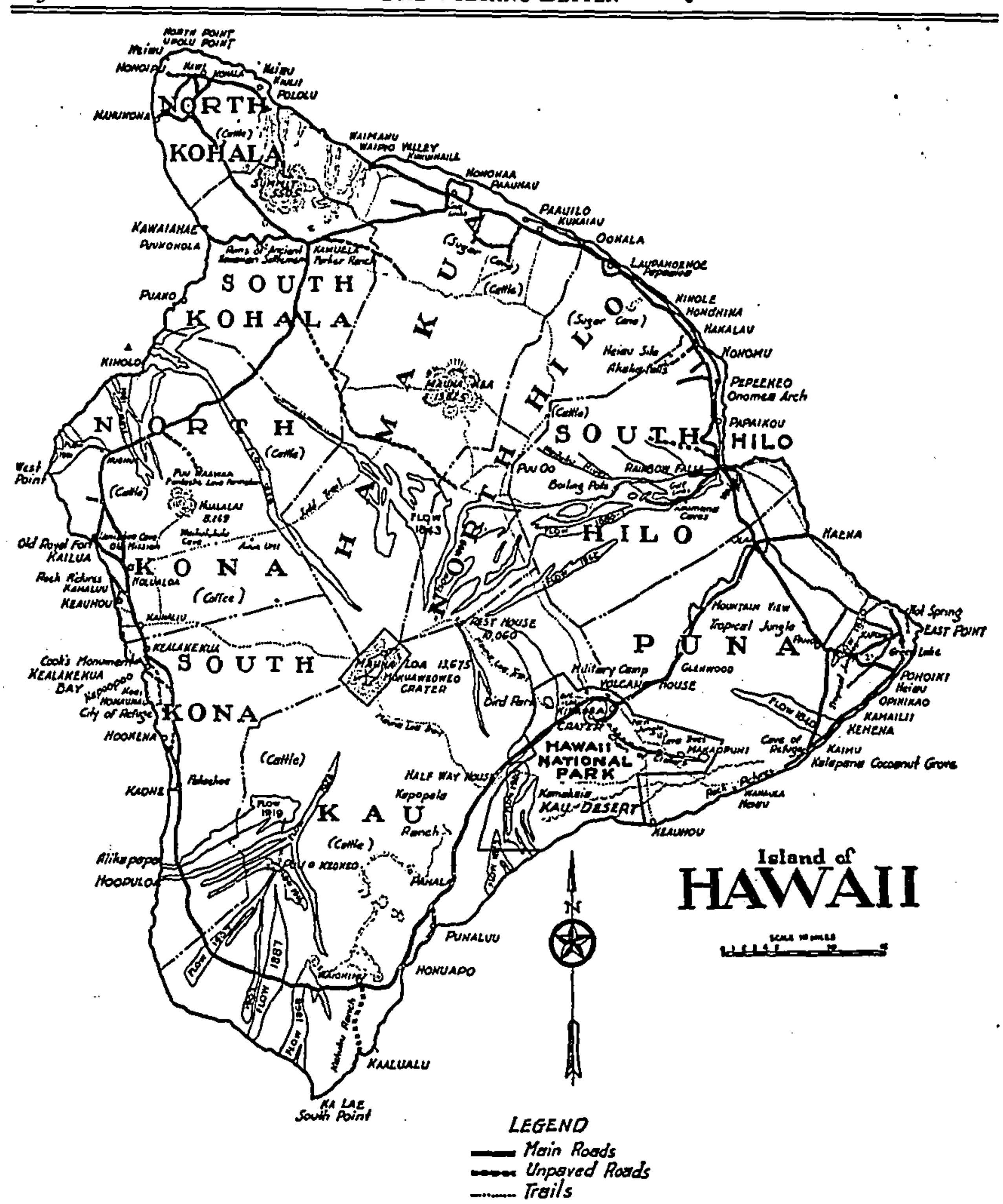
KILAUEA REPORT No. 979

WEEK ENDING OCTOBER 26, 1930
Section of Volcanology, U. S. Geological Survey
H. A. Powers, Temporarily in Charge

A few avalanches in Halemaumau occurred simultaneously with the earthquake on Monday morning, October 20, which are thought to have been started by the quake. Since that time, no rock falls of noticeable size have been seen. The steaming of the wall and floor cracks has been very light except for short periods during rains.

The seismographs at the Observatory registered very slight traces of a distant earthquake on October 24. The record started at 9:55 a. m., Hawaiian Standard time. *Only two local shocks* were recorded during the week, the one moderate earthquake at 8:25 a. m. October 20, and one very feeble shock at 6:27 p. m. October 24. Fifty-seven very small tremors registered on the seismographs during the week, and the microseismic trembling of the island increased a moderate amount the later part of the week accompanying the few days of high wind and heavy surf.

During the earthquake of Monday morning, the ground under the Observatory was tilted to the north-northwest (erroneously stated last week as north-northeast). But since the quake, there has been practically no tilting of the ground as registered by the instruments. It would appear that the increasing pressure which caused the northeasterly tilting last week had culminated in the big quake. It will be interesting to see whether the first major change of pressure after this temporary standstill will be a decrease or a further increase.



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UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HAWAII NATIONAL PARK
HAWAII

OFFICE OF THE SUPERINTENDENT

October 13, 1930

Director,
National Park Service,
Department of the Interior,
Washington, D. C.

Dear Mr. Director:

Following is the report of activities and operations in Hawaii National Parks during the month of September 1930.

000 GENERAL:

This month ends our travel year and although it is regretted that a loss is shown in the number of visitors compared with last year that condition of travel is considered merely temporary and part of a general poor year in the tourist industry. Nothing of special importance has occured in September.

100 ADMINISTRATION:

120 Park inspections by

121 Superintendent.

Usual routine inspections were made, by the superintendent, of all work in progress. A special trip was made to our seacoast area in company with Mr. Wm. Bryan of the Territorial Forestry Department for purposes of a count and study of goat movements.

Ranger Christ was sent to the Haleakala section on the island of Maui to investigate and report on insect infestations of the silversword plant.

170 Plans.

E. S. Wheeler, district B. P. R. engineer for Hawaii has completed plans and specifications for reconstruction of park main roads and has forwarded them to San Francisco for tracing, blueprinting and approval.

200 MAINTENANCE, IMPROVEMENTS & NEW CONSTRUCTION:

210 Improvements.

The area around all buildings at Uwekahuna Bluff has been given a uniform slope and graded in such manner to enlarge and better parking facilities and improve appearances. No growth has been disturbed.

The power house at Uwekahuna was repainted the same color it previously had.

230 New Construction.

PUBLIC TOILETS.

With the exception of a few minor touches the public toilets at Uwekahuna Bluff were completed. These two buildings are of galvanized corrugated iron with lava masonry corner trim and are quite attractive. Toilets of chemical type.

A similar set of public toilets is under construction at the end of the road near Halemaumau fire pit but only a small percentage, consisting of excavation, is complete.

MAUNA LOA TRAIL.

One and a half mile of trail leading, from the Rest House on Mauna Loa at 10000 foot elevation, down the mountain was rebuilt and another mile from Bird Park up the mountain to a corner on the boundary at elevation 4437 feet was relocated and rebuilt. This concludes the present years work on Mauna Loa, it being planned with later funds to connect these two points by a trail entirely within our exterior boundaries. In the meantime the present trail as shown just outside the boundary on the map will be used as is.

TELEPHONE SYSTEM.

Telephone lines have been constructed to Halemaumau, the end of Chain of Craters road, Uwekahuna Bluff, Kau boundary on the main road and Thurston Lava Tube. All pertinent points on these lines have been connected by phones on a metallic system. Work of building phone lines to other points will continue until funds are exhausted. All lines are being carefully hidden where possible without too great expense.

SUMMER CAMP TRAIL.

Construction of a short trail along the edge of Byron Ledge, and skirting the foot of Waldron ledge in order to connect the Volcano House and Summer Camp by trail has been completed. Slightly over one half mile of new trail was required.

240 Improvement of approaches to park.

After many months delay a contract has been awarded for a Federal Aid project for reconstruction of nine miles of the worst section of the main road between the park and Kailua in the Kona district.

300 ACTIVITIES OF OTHER AGENCIES IN THE PARK:

310 Public service contractors.

Kilauea Summer Camp closed for the season on September 15th. The year was not a great sucess but at least showed a growing public interest in the camp.

315 Schedule of rates.

A plan for use of special rates to visitors at times when overcrowding of Volcano House rooms cannot be avoided was submitted to the operators a month ago and no definite reply has yet been made.

316 Modification of existing contracts.

Volcano House company has notified us of their desire to charge us effective December 1st a rate of ten cents per K.W.H. for electricity. Our contract requires them to furnish us with electric service at cost and there appears no reason why such charge cannot be made as long as certification is made that it does not exceed cost and providing accurate metering is had. Reply to that effect has been made them. The present rate is $5.00 flat per month for total power used and no measurement is made.

317 Status of contractors projects.

The Volcano Studio building of K. Maehara is rapidly nearing completion and should be open by the middle of October. This building is much more attractive than the plans indicate and will be one of our best appearing structures.

330 Donations.

<u>NEW FILM</u>

Mr. James Henderson of Hilo has donated to our educational work a three year lease of an educational film titled "Volcanoes". The cost of this lease was $125.00 The film is expected here shortly and will make possible a more coordinated and instructive lecture than is now being given to visitors each afternoon.

<u>UWEKAHUNA LECTURE HALL.</u>

Hui O Pele Hawaii has started construction of a new lecture hall capable of seating 168 persons and fitted with storeroom, projection room, stage, and stage rooms. This building is being erected upon approved plans and location adjoining our present museum and temporary lecture quarters at Uwekahuna Bluff. When complete it will be donated to the government. Cost is estimated at $4,400.

400 FLORA, FAUNA AND NATURAL PHENOMENA:

410 Ranger naturalist service.

A total of 274 persons attended 13 lectures during one of the quietest travel months of the year. 51 persons were explained the volcanic features and history of the Worlds Wierdest Walk and the extinct craters.

440 Insect Control.

Ranger Christ on a special trip to Maui investigated insect attacks on the silversword and brought to headquarters infected plants. These were sent to the research plant of the Hawaiian Sugar Planters Association and Mr. Otto Swezey, entomologist submitted a report and recommendations. A copy is attached. The recommendations will be followed as far as possible with regular park funds and request for additional funds will be made if needed as the silversword is native only to Haleakala crater and no where else in the world.

490 Volcanoes.

Two rather heavy earthquakes and considerable ground tilting were the only unusual indications of volcanic activity. The earthquakes appear to be from Mauna Loa sources. The tilting has caused considerable area of the edge of Halemaumau to avalanche into the pit.

500 USE OF PARK FACILITIES BY THE PUBLIC:

510 Decrease in travel.

The decrease shown in our years total travel as compared to 1929 is due to three reasons namely; lack of any lava flows during 1930 as compared to two periods of flow in 1929, a general slump in travel in all of the tourist industry, and an unusual rainy year.

530 Weather.

Maximum temperature	——— 1st ———	78 degree
Minimum "	—— 15th, 26th, 27th, ——	53 "
Rainfall for month of September	———	9.62 inches
" " " " "	at Hilo ———	15.00 "
" " to-date Volcano District	———	81.12 "
" " "	at Hilo ———	115.33 "

540 Visitors.

Delegate to Congress from Hawaii Victor K. Houston visited the park during September and conferred with the Superintendent on park problems and future estimates.

The annual good-will tour of members of the Los Angeles Chamber of Commerce was here under guidance of Field Secretary Chas Bayer.

600 PROTECTION:

630 Accidents.

On Monday, September 29th, Private Michael Rubenstein of Fort Shafter U. S. Army, a visitor at Kilauea Military Camp hiked over the Kau Desert to the seacoast in company with three other soldiers. A long hike had not been planned and these men carried no food or water. Rubenstein apparently played out and the three of the party spent the night on the coast. One man returned to report and the next day search parties went out. Two of the men were met on the way home and returned to camp for food and rest. They reported Rubenstien of being exhausted, unable to walk, without food or water and that he had insisted they return for help without him. They also reported he had been drinking sea water against their advice. Search parties of soldiers, park service men, civilians, and army aviators have hunted without success up until the date of this report. Evidence is divided between whether Rubenstein actually did play out on a short nine or ten mile hike and either starved to death or crazed by salt water jumped into the sea or whether he tricked his companions and has deserted the Army. The place he agreed to wait was visited several times and no trace found. If he remained on the coast or Kau Desert he has died but it seems strange that he should play out in the afternoon of a single day trip and then insist that both of his companions leave him. Conclusions as to what actually occurred is open to conjective until either his body is found or he turns up alive at some other location than here. Rubenstein's father has offered $500.00 reward for his son's body or his son.

640 Destruction of predatory animals.

A count of goats on the parks seacoast area revealed more than 1,000 animals at this time. The territorial forestry department is co-operating by planing and arranging a drive by local cowboys to herd these animals out of the park and exterminate them along with others in adjoining areas. The goats are predatory as preventing natural growth of vegetation.

Very respectfully yours,

Thos. J. Allen, Jr.,
Superintendent.

Copy to Field Headquarters (2)
" " Yellowstone National Park (1)

SILVERSWORD PESTS:

I have made an examination of the plant and found several kinds of insects, some of them in considerable numbers as follows:

Leafhopper (Ilburnia argyroxiphii): This small insect has been known on silversword for a good many years. Is not considered particularly harmful.

Egg-parasite (Polynema sp.): Quite a number of this minute insect were recovered from the plant. It is a parasite in the eggs of the leafhopper.

Plant bug (Nysius sp.): A few adults of this plant bug were found, also a few freshly hatched nymphs. Not numerous enough to be harmfull.

Trypetid fly (Tephritis cratericola): The maggots of this pretty little fly were numerous in the flower heads where they were feeding on the immature seeds. Thus are an important factor in preventing seed production.

Phycitid caterpillars: Caterpillars of an undescribed species of moth of the Phycitidae were very numerous, feeding in the flower heads, and also boring in the stem of the plant. This is by far the most injurious of the insects found. Of the numerous flower heads on the plant, there was hardly a one that was not injured by these caterpillars. From appearances these flower heads were so badly eaten that there would have been no seeds produced at all. I am hoping to rear moths from some of these caterpillars, so that we may determine what it is.

The insects that I have found in the plant sent in do not kill the existing plants. The whole plant dies anyway after flowering. Two of the insects, as noted above prevent seed production. If all flowering plants are as badly infested as the one sent in, there is little chance of seeds being formed for the production of new plants. If it is desirable to encourage seed production by the silversword, the plants that are going to flower should be protected so that the flower heads do not become infested by the seed-destroying insects. They could be covered by cages of fine wire screen, or of cloth, to keep the adult insects off and thus prevent them ovipositing on the new flower when they appeared. This experiment might prove successful. If so, thousands of seeds should be procured per plant. These could be scattered or planted in favorable places, or it might be desirable to establish little nurseries where the young plants could be well taken care of, then transplanted to desirable locations when they had become sufficiently large. By some such way it might be possible to bring about an increase of this peculiar plant in the crater, providing the weather did not prove too unfavorable, or the goats too destructive, or that human visitors did not lend an exterminative hand.

I was in the crater once, more than twenty years ago. I am hoping to make the trip again sometime. It will be of interest to compare the present numbers of silversword there with what it formerly was. A better notion of the prevalence of insects and their importance in the reduction of these plants can be obtained by studying them in the open, if it can be done at the proper time.

(Sgd.) O. H. Swezey,
Entomologist.

10-157
UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

TRAVEL REPORT

Hawaii National Park for the Month of September 1930

	This Month	This Travel Year To Date	This Month Last Year	Last Travel Year To Date	Increase for Travel Year Number	Increase for Travel Year Per cent
PRIVATE TRANSPORTATION:						
Cars first entry.						
Cars reentry.						
Motorcycles.						
Total motor vehicles.						
Persons entering via motor vehicles.	6,587	75,510	5,820	92,483	- 16,973	18.3
Persons entering via other private transportation.	338	3,343	381	3,072	271	8.9
Total persons entering via private transportation. . . .	6,925	78,853	6,201	95,555	- 16,702	17.5
OTHER TRANSPORTATION:						
Persons entering via ~~stages~~ Hotel . .	1,025	10,725	682	14,302	- 3,577	25.0
Persons entering via trains . .						
Persons entering otherwise. . .						
Total other transportation. .	1,025	10,725	682	14,302	- 3,577	25.0
GRAND TOTAL ALL VISITORS. . .	7,950	89,578	6,883	109,857	- 20,279	18.5

	This Year	Last Year	Increase Number	Increase Per cent
Automobiles in public camps during month.				
Campers in public camps during month	0	0	0	0

10-158

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

STATUS OF AUTHORIZED PROJECTS

Hawaii National Park for the Month of September 1930

Description of Projects	Percent Constructed To Date	Percent Constructed This Month	Percent Constructed Last Month	Probable Date Completion
405 Ware house	100		100	
406 Toilets (Kilauea)	2	2		Nov. 15, 1930
407 Toilets (Uwekahuna)	98	93	5	Oct. 15, 1930
451 Telephone Line	80	80		Oct. 30, 1930
502 Mauna Loa Trail	100	25	75	
502 Summer Camp Trail	100	50	50	
Road Survey, B. P. R.	100		100	

10-159

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

STATUS OF PERSONNEL

Hawaii National Park for the Month of September 1930

	This Month	This Month Last Year
Number of employees beginning of month,	26	15
Number of additions, ...	6	2
Total, ...	32	17
Number of separations, ...	8	10
Number of employees close of month, . .	24	7
Number of promotions during month	0	0
Aggregate amount of annual leave taken,	0	0
Aggregate amount of sick leave taken,	0	0
Aggregate amount of leave without pay,	0	0

10-160

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

REPORT OF PARK REVENUES

Hawaii National Park for the Month of September 1930

	This Year	Last Year
Park revenue on hand beginning of month,	0.00	0.00
Received,	75.00	25.00
Total,	75.00	25.00
Remitted,	75.00	25.00
On hand close of month,	0.00	0.00

Park revenues received this year to date,	1,350.00
Park revenues received last year to date,	1,327.00
Increase,	23.00
Percent of increase,	1.7%

10-161

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

HAWAII NATIONAL PARK

REPORT OF SALES OF PUBLICATIONS

SEPTEMBER 1930

	Number	Value
GOVERNMENT PUBLICATIONS:		
On hand beginning of month,	448	118.60
Received during month,	0	0.00
Total,	448	118.60
Sold during month,	25	13.30
On hand at close of month,	423	105.30
NON-GOVERNMENT PUBLICATIONS:		
On hand beginning of month,		
Received during month,		
Total,		
Sold during month,		
On hand at close of month,		

Cash on hand beginning of month,	37.80
Sales during month,	13.30
Total,	51.10
Remitted during month,	0.00
Balance,	51.10

The Volcano Letter

Two dollars per year | Ten cents per copy
No. 297—Weekly | Hawaiian Volcano Observatory, National Park, Hawaii | September 4, 1930

View of the great aa lava flow of 1783 on the north side of Asama Volcano, Central Japan. Photo Omori, 1911, Bull. E. I. C., VI, No. 1, 1912.

ERUPTIONS OF ASAMA-YAMA, JAPAN IN 1873

(A Review by I. Toyama of part of "The Eruptions and Earthquakes of Asama-yama" by F. Omori, Bull. Imp. Earthquake Investigation Comm., 6, 1912.)

Date of Occurrence. The series of explosions of Asama-yama, in third year of Temmei (1783) ended in a tremendous catastrophe of August 5. It is a memorable circumstance that the great Calabrian earthquakes were recorded in the same year on February 5.

The frequency of the eruptions of Asama-yama is subject to an annual variation which indicates two maxima occurring respectively in April and August.

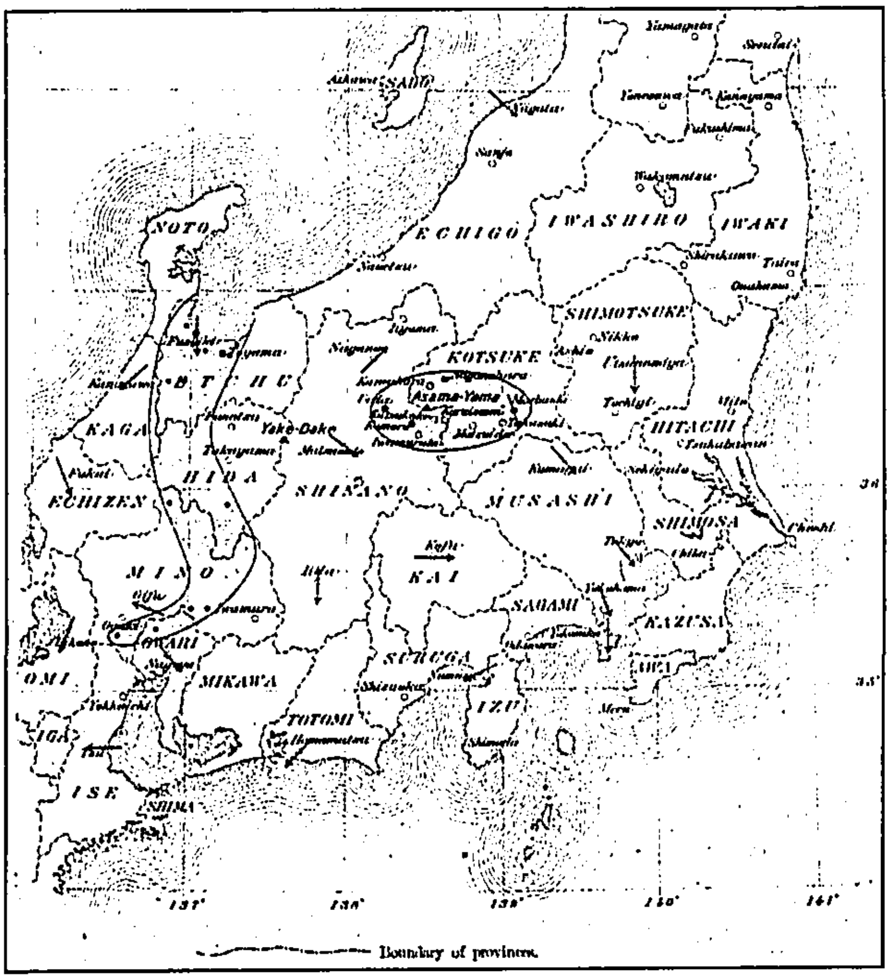
Weather at the time of Eruptions. It rained slightly in Yedo, the present Tokyo, on the 28th of July; in the province of Kotsuke which lies east of Asama, the weather was clear on July 31 and August 1, and fair on August 2 and 3. Considering all reports, the weather was dry and fair in the central part of Japan during the one week period before the main eruptive period, while on the 3rd, 4th, and 5th of August the weather was calm in the vicinity of the volcano. This shows that an area of high barometric pressure existed over Asama and the central part of Japan during the later part of the eruption. Immediately after the catastrophe, a strong cyclone swept across the country.

Course of the Eruptions. The eruptions which lasted for 88 days, began on May 9. On June 24 detonations like distant thunders began to occur at about 7:00 a. m. On the 25th, between 10 and noon, loud detonations were heard, accompanied by a strong explosion. The sounds also occurred the next day, June 26, between 4 and 6 p. m. The mountain then remained quiet for twenty days until July 16, when loud detonations occurred during that night and the night of the next day. After eight days, on the 25th, detonations continued from 8 a. m. to noon, although smoke emission was slight during the day. This marked the beginning of the last stage of the great eruption.

On the 26th of July, at 4 p. m., there were detonations accompanied by an explosion which threw out smoke toward the east. The detonation lasted until evening. On the 27th, when it rained heavily, there were detonations and emission of smoke toward the southeast at 4 p.m. Volcanic manifestations became greatly intensified in force on the 28th when, in fair weather, there occurred at noon a powerful explosion which was stronger than that of June 25th, and which threw out smoke toward the east. From this time, the effects of the eruptions could be felt in such distant places as Yedo, where ashes fell on July 28. The people of this region wondered why the houses and doors were shaken, although the ground and the water remained undisturbed.

On July 29th, burning began at 3 p. m. which continued until 5 p. m. On the 30th, the explosion which began at noon became excessively great between 2 and 8 p. m. and came to a temporary end at 4 a. m. July 31. The eruptive activity continued to increase during that day and on the following day.

On August 2, the weather was fair and clear. The eruption reached its maximum violence and the volcano emitted fire from 6 p. m. until midnight. A large quantity of stones and sand were thrown out and Maikake-yama, which was near by, was converted into a litteral sheet of fire. The eruption ceased for a short while in the morning of the 3rd of August and resumed its violence on the same day from 2 to 10 p. m., covering Kiba-yama, another nearby mountain, with red hot stones of different sizes.



Map of Central Japan, showing Asama Volcano in the shaded ellipse, which is the area of strong sound during the eruption of April 3, 1911. Wind direction is shown by arrows, and black dots indicate spots where detonations were heard. There was a zone of silence or sound shadow between the two shaded areas. From F. Omori, Bull. E. I. C. VI, No. 1, 1912.

On the 4th, explosions began with detonations at 8 a. m. and caused such an excessive fall of ashes between 1 and 4 p. m. that people as far distant as Fukaya in the province of Musashi had to use lanterns during the day to see their way through the darkness caused by the falling ashes and sand. On the 5th the weather was fair. Outbursts which began at 4 a. m. became extremely violent from 8 to 11 a. m. A little after 10 a. m. a huge mass of burnt rocks, lava and hot mud descended with deafening detonations from the crater and swept down the northern side of the mountain, rushing into the valley of Azuma-gawa.

The Course of the Eruptions in Four Stages.

First stage, commencement, May 9.
Second stage, outbursts, June 24 to 26.
Third stage, outbursts, July 16 to 17.
Fourth stage, outbursts, July 25 to August 5.

The Lava. The great lava flow of 1783 which forms an imposing spectacle on the northern flank of Asama-yama, descended into the Rokuriga-hara plain. The lava mass terminated in an abrupt manner, forming a slope of about 40 degrees which runs for a considerable distance. Its height varies from 30 to 50 meters. The area covered is somewhat of the shape of a triangle, 6 kilometers along the base of the flow.

The Great Volcanic Avalanche. The great torrent of volcanic material, which swept down the slope with a very high initial velocity, caused much damage and devastation in all the villages along the northern slopes and base of the Asama-yama and those along the Azuma-gawa. The principal course of the flow was along the deeply cut ravines that run from the foot of the mountain toward the north.

The volcanic avalanche blocked the flow of the Azuma-gawa for a while, producing a temporary decrease of water in the lower course of the river. At about 11 a. m. August 5th, the water broke forth through this newly formed dam of debris, and together with the steaming volcanic material, rushed down sweeping and carrying with it houses, furniture, and everything that blocked its way.

Ash and Smoke. Ash fell at Yedo, Choshi, Maebashi, and the surrounding regions during the morning of August 6. Mud rain fell in Karuizawa, Sakamoto, and Isobe on the fifth of August. In the city of Takasaki, 44 kilometers away from Asama-yama, ash accumulated to a thickness of 6 inches. The old and weakly built houses were crushed, and endangered the lives of the occupants.

The area covered by the fallen ash and stones measured about 220 kilometers long and 100 kilometers wide, or about 11,000 square kilometers. The thickness ranged from one to six inches, and taking the mean thickness as 2 inches, the quantity of fallen volcanic material will be about 0.9 cubic kilometer.

Conclusion. This great eruption of Asama-yama was not the beginning but the result of the outburst of the volcanic energy accumulated during the course of many years. The eruptions were caused by powerful underground explosive forces, that were suppressed until the last stage.

The shallowness of the crater caused the immensely large mass of molten and burning rocks and lava and mud to overflow and cause the dreadful volcanic avalanche. Had the crater been deeper and larger, the catastrophe and disaster caused by the eruption would not have been as severe nor as terrible.

KILAUEA REPORT No. 971
WEEK ENDING AUGUST 31, 1930

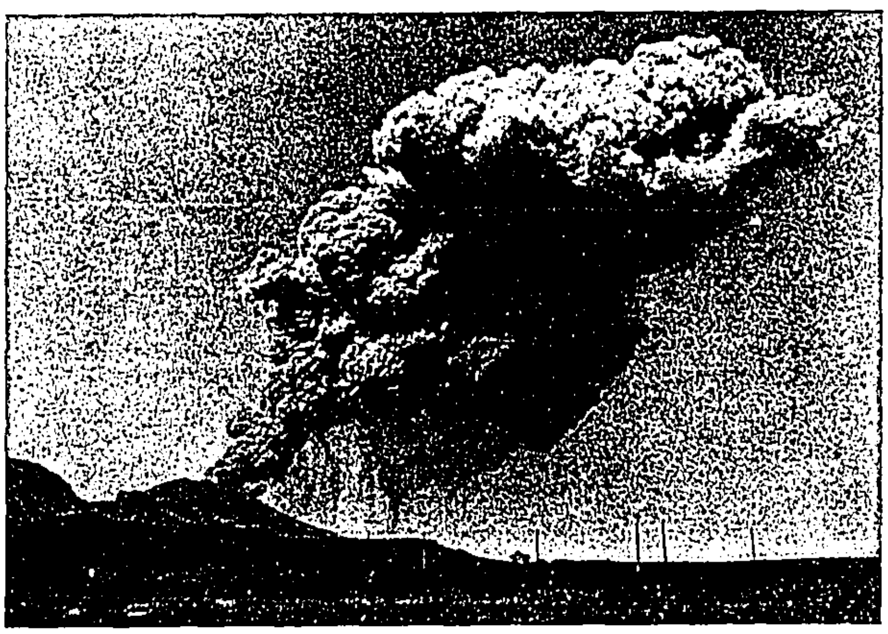
Section of Volcanology, U. S. Geological Survey
H. A. Powers, Temporarily in Charge

But one thing of interest has happened at Halemaumau during the week from August 24 to 31. On Saturday, August 30, about 3:30 p. m., a large slab of the wall between the 14 Ton Bowlder and the pit loosened itself and made an avalanche which was heard at the Military Camp over a mile from the pit. Other than this, the fire pit has been exceedingly quiet. The amount of steam from the wall and floor cracks has been variable but has averaged even less than usual. A number of small quakes were felt in Pahala and other nearby towns of the Kau district.

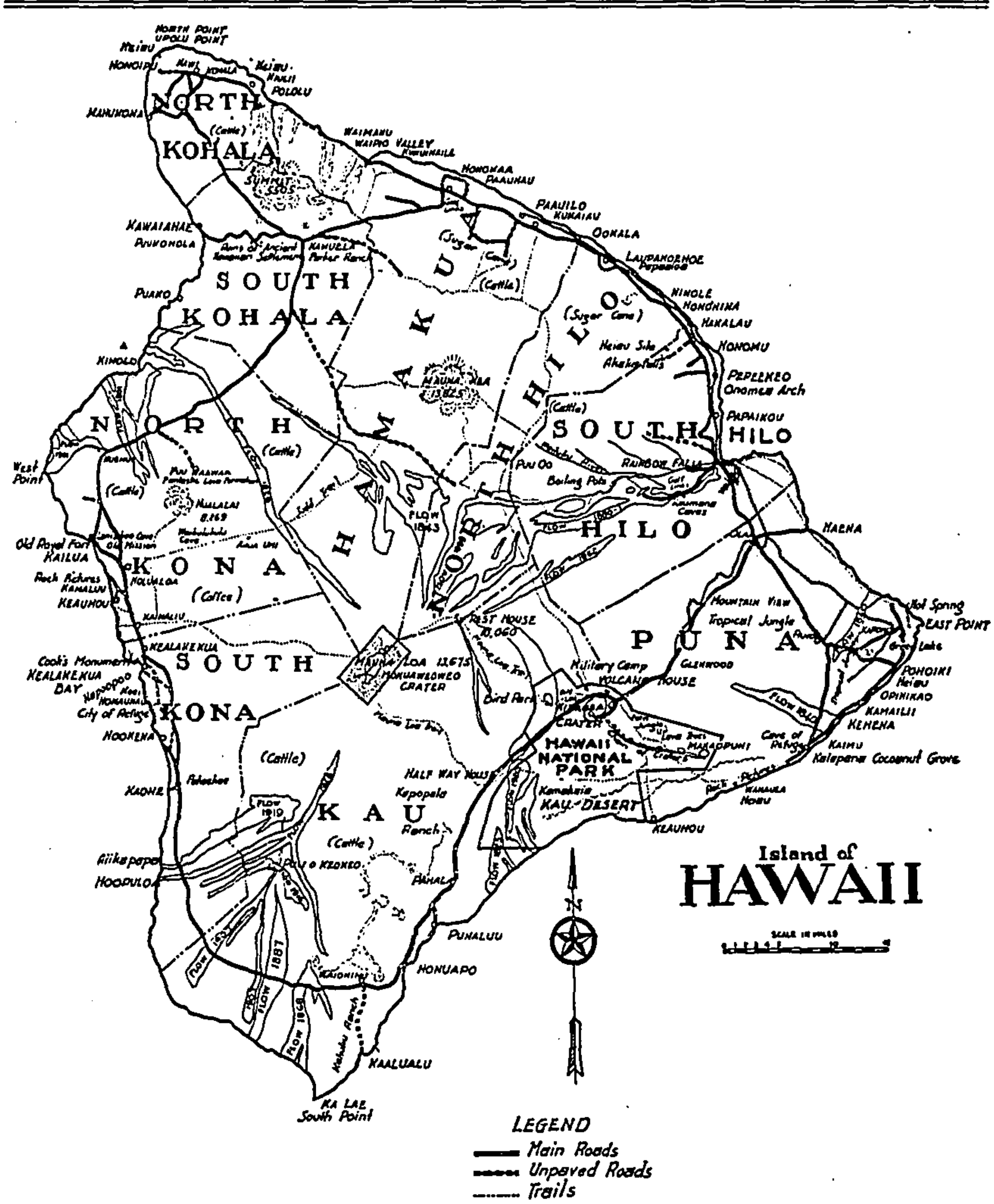
The seismographs at the Observatory registered five very feeble shocks as follows: August 26, 4:19 a. m., 5:01 a. m., 10:26 a. m., and 2:38 a. m.; and August 30, 8:54 a. m. distance 32 miles. Judging from all the available information, these quakes probably had their centers somewhere in the region of Puu o Keokeo. The instruments also recorded 31 very small tremors of less than a minute duration. Of these, 17 occurred on August 30 during the time that several avalanches were observed in the pit. Some of the tremors may have been caused by these rock slides. The continuous trembling of the earth (microseisms) which is probably not of volcanic origin has been very slight during the week.

Measurement of the tilting of the ground under the Observatory show that there has been a slight accumulation of tilt to the southwest. In other words, if one imagines a vertical wand placed on the ground at the Observatory, the tilt during the week would have inclined this wand a little bit toward the southwest. The ground at the edge of Halemaumau has shown a similar movement, which suggests that this tilting has not been caused by any changes of pressure under the fire pit.

It may be concluded that there has been no measurable change in the volcanic conditions at Halemaumau. However, slight movements of the flanks of Mauna Loa similar to a series which occurred last spring have been resumed.



A modern strong eruption of the Asama-yama, May 8, 1911, seen from Komoro looking northeast. Photo Uozu, from Bull. E. I. C. VI, No. 1, 1912.



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The Volcano Letter

Two dollars per year | Ten cents per copy
No. 298—Weekly | Hawaiian Volcano Observatory, National Park, Hawaii | September 11, 1930

Eruption of the north flank of Usu Volcano in Hokkaido, north island of Japan, August 2, 1910. West Maruyama is the forested hill on the left. From Omori, Bull. E. I. C. vol. I, 1911.

ERUPTION OF USU VOLCANO IN 1910

(From Oinouye, "1910 Eruption of Mt. Usu," J. G. 25, 1917, pp. 258-88. Reviewed by K. Onishi.)

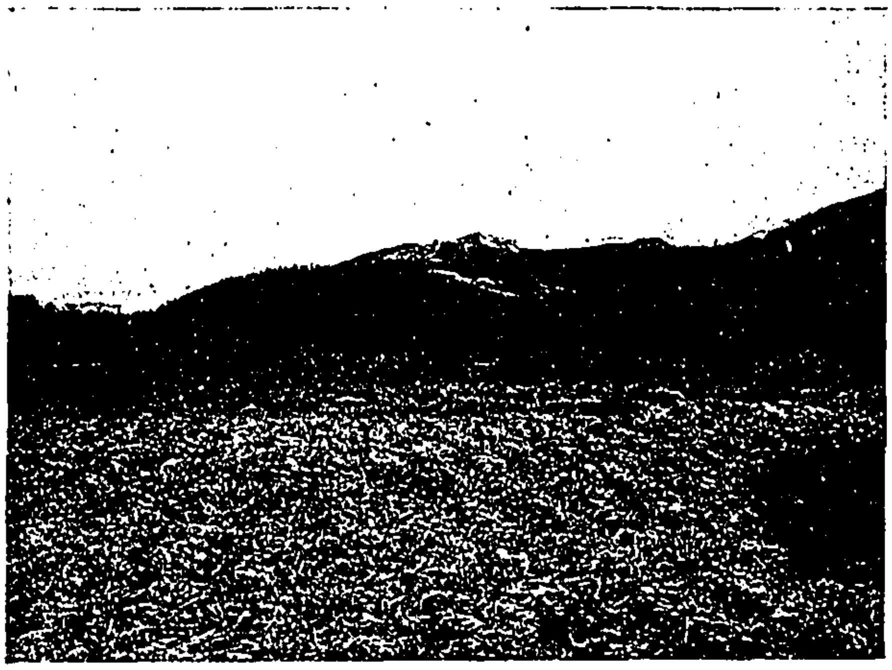
Mt. Usu, a volcano located in northern Japan on the island of Hokkaido, rises 736 meters above sea level and is approximately two kilometers in diameter. Two domes crown the top of the volcano, their names and elevations being O-usu and Ko-usu and 736 meters and 609 meters respectively. Since the craters resemble in shape the "usu," a Japanese mortar used in making "mochi" a kind of pounded rice cake for festivals, the people have named the two craters "usu" with the prefixes "O" and "Ko" to indicate the sizes, the former signifying big and the latter small. Hence O-usu is the larger of the two craters.

The clear and able report by Oinouye deals particularly with the interesting phases of the eruption. The author narrates in detail the following observations of the outbreak: earthquakes, mud cones, explosions and their processes, explosion craters, the changes in topography of the land, and the damage done by the overflow of mud and the scattering of ash and other material from the pits.

Prior to the eruption, four days to be exact, frequent earthquakes had disturbed the people. The occurrence of these undulations of the earth's crust grew more numerous as the days passed after the first shock. On July 23, 1910, 110 shocks were recorded, about 350 on the following day, and 163 on July 25, the day of the first outbreak. Two violent shocks, one on July 24 at 4:30 p. m. and the other on the following day at 5:00 p. m., thoroughly alarmed the people. The results of the quakes were some fissures made on the west side of the volcano almost parallel to the coast line. These varied in width from 3 cm. to 40cm. There also resulted two faults going in an east and west direction on the western foot of the mountain.

Another result of the quakes was the formation of mud cones on the flat land north of the volcano. The first resulted from the severe shock of July 24. The cones were formed of mud and sand, well stratified and flat and conical in shape and ranging from 6cm. to 3 meters in diameter and from 3cm. to 60 cm. in height. The water level in the neighboring wells rose and the volume of the water was doubled. Several new springs were formed but the water everywhere was turbid and dirty.

The first explosion took place on July 25 at ten o'clock in the evening from the northwest slope of the main volcano. Red hot bombs were thrown into the air. July 26



View from the same point as Figure 1 taken on November 9, 1910. The "New Mountain" is shown elevated back of the right shoulder of West Maruyama. From Omori, Bull. E. I. C. vol. I, 1911.

witnessed the explosion accompanied by black and white smoke that rose to a height of 700 meters. July 28 was a dreary day with two explosions, rain, thunder, intense lightning, huge columns of dense smoke, and low roaring noises contributing to the general atmosphere of gloom.

The explosions were quite remarkable. A cannon-like sound announced the arrival, a "V" shaped vent opened the path, and a procession headed by black smoke, sand, and ashes came into view. This material helped to form the cones, each requiring a day or a week to complete one, the time depending on the amount of matter ejected and the size of the vent.

During the period of greatest activity, from July 25 to August 2, fifteen new craters were formed, the number increasing to 45 for the ten weeks of the eruption. These craters were grouped into two groups of 16 and 29 lying in two parallel lines. The distance between the two lines of vents was about 800 meters. All of these craters emitted quantities of black smoke, ash, sand, and bombs. Five of them spit mud and hot water as well. The greatest distance to which the ash was carried was 44 km. In places the land was covered to a depth of 30 cm. A mud flow to the lake at the foot of the mountain measured 200 meters in width, 500 meters in length and 1.5 meters in thickness.

The chemical composition of the mud flows, the sand of the seashore, and the substance in the mud cones was practically identical, showing evidence that all the material came from the same source, a brown pumice at the base of Mt. Usu.

Bombs hurled into the air produced a sound like a firecracker when they were struck in midair by other ascending bombs. They were basaltic in composition, dark grey, porous, somewhat round, and not more than 25 cm. in diameter. An abundance of pores filled with ash and sand on the exterior of the bombs was contrasted with a scarcity of pores in the interior.

The topography of the land was changed materially. The water in Lake Toya rose 30 cm. on the north margin of the lake and the slope of the south shore tilted to 30 degrees from the original 5 degrees. Before the eruption, Nishimaruyama could be seen from the village of Nishikohan, but after the activity of the volcano, the view was obstructed by the so-called "New Mountain." The maximum height of this newly constructed ground is 120 meters.

Professor Omori is of the opinion that an intrusion of lava in the form of a dome or spine caused the elevation of this new mountain. Sato believes the intrusion to be a laccolith. Oinouye, the author of this article, thinks that the uplifting of the new land was caused by a plug which was intruded in the midst of the activity, the intrusion being materially helped by the faulting of the land.

The damages incurred included the destruction of a fine forest on the slope of the mountain, and the burial of houses and farm lands within a radius of two kilometers.

Many houses suffered cracks in the walls and a number were completely destroyed.

TILTING OF THE GROUND IN AUGUST

A graph showing the tilting of the ground from day to day is plotted at the end of each month. The position of the tilt recorder with respect to an assumed fixed point in space is read each day. However, these daily tilt readings are affected to a certain extent by causes other than true volcanic tilt such as rapid temperature changes, heavy rainfall, and slight instrumental errors. To eliminate as many as possible of these outside influences, the curve showing the daily tilting is "smoothed" by computing "overlapping seven day means." This means that the tilt reading plotted on the graph for each day is actually the average of seven days, ie. the three days preceeding and the three days following the day in question. This smoothed curve thus shows a truer picture of the tilting of the ground as caused by volcanic forces of comparatively long duration. The curve obtained by this method of plotting may be figuratively described as being the curve traced by a wand placed rigidly in a vertical position in the earth at the observatory, with the upper tip of the wand writing the curve on a piece of paper held above it in a fixed position in space. As the earth tilts, the wand is tipped from its vertical position and the tip of the wand writes a curved line on the paper. The net change in position of the top of this wand for each week in August is expressed in a compass direction and angular degrees of arc in the following table. For example, from July 28 to August 3 the wand had tipped through 0.96 seconds of arc in a northeasterly direction.

July 28-Aug. 3	N.E.	0.96 sec. of arc.
Aug. 4-Aug. 10	S.S.E.	0.87 " "
Aug. 11-Aug. 17	S.E.	1.45 " "
Aug. 18-Aug. 24	S.E.	0.72 " "
Aug. 25-Aug. 31	S.W.	1.45 " "

KILAUEA REPORT No. 972
WEEK ENDING SEPTEMBER 7, 1930

Section of Volcanology, U. S. Geological Survey
H. A. Powers, Temporarily in Charge

The famed 14 Ton Bowlder has advanced one more step on its journey back into Halemaumau. The sliver of th rim which supports the bowlder has slipped downward until the top of the bowlder is several feet below the level of the solid rim behind it. This slipping occurred during a spell of almost continuous avalanching which began about noon on Thursday, September 4, and stopped sometime Saturday evening, September 6. Most of the larger avalanches, however, fell from the northeast part of the rim a considerable distance from the 14 Ton rock. Aside from this, at the risk of being very monotonous, it must be reported that little excitement has happened at Halemaumau.

National Park Rangers have reported that two avalanches have fallen from the walls of Kilauea Iki during the past ten days. It is entirely possible that these resulted from blasting which has been done in the course of the construction of a new trail into this crater.

Six very feeble quakes, probably originating in the Puu o Keokeo area, have been recorded during the week as follows: Sept. 1, 7:41 a. m.; Sept. 3, 6:45 a. m.; Sept. 4, 8:34 p. m.; Sept. 5, 3:17 a. m.; Sept. 6, 6:28 a. m., distance questionably 20 miles; and Sept. 6, 6:51 a. m. Twenty-six small tremors were recorded on the Observatory instrument. The larger number of these occurred during the spell of avalanching and probably are records of these rock falls. Microseismic motion was slight during the entire week.

Tilting, both of the Kilauea rim and of the Halemaumau rim, was slight to the southwest.

It must be concluded that pressure under Halemaumau is decreasing from the maximum attained during the second week in August. There is no evidence as yet that lava pressure is building up under Puu o Keokeo even though there have been a number of recent quakes which seemed to center in that region.

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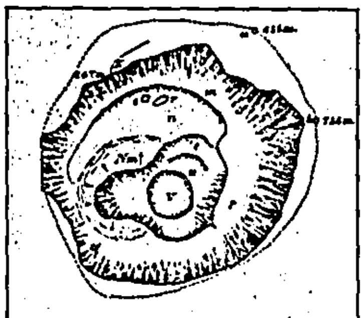
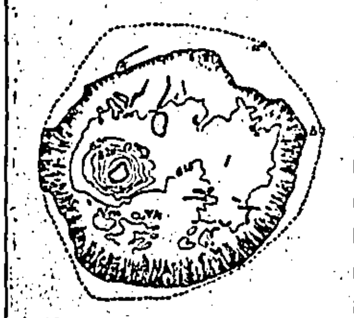
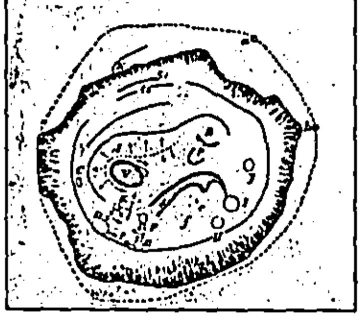
No. 299—Weekly | Hawaiian Volcano Observatory, National Park, Hawaii | September 18, 1930



Mihara Crater in the summer of 1907. Diameter 825 meters E-W. (Nakamura)



The same crater, January 1, 1913. (Okamura)



The same, 1916, showing block lava, terraces, spatter cones, ditches, pits, and fuming holes. (Tsuboi)

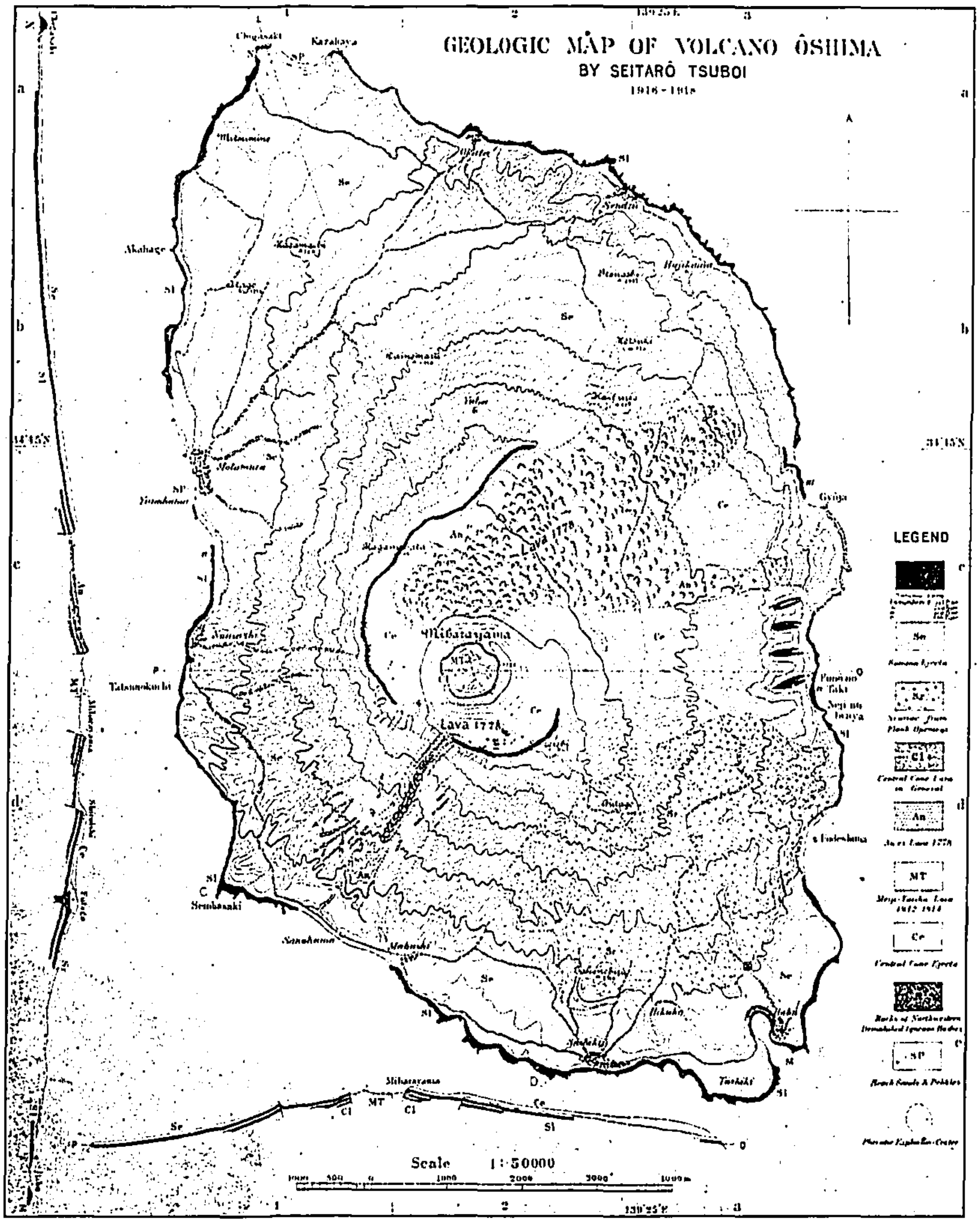
STRUCTURE AND ACTIVITY OF OSHIMA VOLCANO

(Review by Y. Yamamoto of "Volcano Oshima, Idzu," Seitaro Tsuboi, J. C. S., Imperial Univ. of Tokyo, Vol. 43, 1920.)

Geographic Sketch. Oshima is the largest number of a group of volcanic islands off the Idzu peninsula, and lies in the sea of Sagami about 110 km. southwest of Tokyo. The island itself is a gigantic lava and ash volcano with an elevation of 755 m. above sea level. It consists of a central cone called Miharayama, with an active crater at its summit. The outer slopes of the insular volcano vary greatly in different directions. On the western side the slope is regular and makes a fine concave curve. On the eastern side it is abnormal, varying from 15 to less than 5 degrees, and continuing from the summit half way down, until on approaching the shore, it becomes suddenly as steep as 40 degrees. The relief of the cone surface is further diversified by a number of parasitic knobs on its flanks, but as a whole, the shape of the island is that of a cone, and its outline viewed from a distance conveys a strong impression of the volcanic origin of the island.

Structural Outline. The volcano is a composite stratified one consisting of double cones—a somma and a central one—and is built up of numerous layers alternately accumulated of lava and fragments of basaltic nature. The somma has several satellitic bodies. On the flanks of the main body of the somma there are eight parasitic knobs. The top of the somma is truncated with a ring-wall that surrounds a huge oval caldera. The wall is not completely closed but there are two gaps, a greater one on the northeastern and a smaller one on the southwestern side. The active central cone, Miharayama, stands in the caldera, and its volcanic products not only cover the ground within the encircling wall but have also spread down to the sea shore through the gaps in the wall.

The Central Cone. The central cone, Miharayama, which is a perfectly preserved undissected heap, stands somewhat to the south of the center of the caldera. The cone is very simple in its structure, being composed of superfluent lavas and ejecta, the alternately accumulated layers of which may be well observed on the inner wall of the summit. The volcanic products of the central cone, both lavas and ejecta, not only fill the caldera but are also spread down to the sea shore through the northeastern and southwestern gaps of the ring-wall of the somma. Especially on the



Geologic map of Oshima Volcano in Sagami Bay near Yo kohama, with profiles N-S and E-W. After Tsuboi, Jour. Col. Sci. Tok. 43, 1920.

eastern part of the island, the products of the central cone are so distributed over the surface of the somma body as to conceal its original slope. The present crater seems to have attained its size in 1684 according to historic records. The features of the inside of the crater are always changing. It is habitual that when the volcanism displays its full energy, lava fills the crater, and on declining, the layer of lava depresses more and more due to its own weight, leaving the peripheral parts in the form of terraces.

The Meiji-Taisho eruption (1912-14) began with the outpouring of lava from the vent. During this interval, the extrusion of lava took place intermittently, five times, of which the second and fourth can be considered as the after effects of the first and third respectively. In the first period during March-June 1912, the lava reached a level of 62 meters below Kawajiri, burying half of Naumann's cone and forming a new Nakamura's cone. The second eruption in July was the squeezing out of a new molten lava due to the depression of the lava layer at the crater bottom and resulted in the breaking up of Nakamura's cone. In the third activity, *September-October* 1912, the extrusion of the lava took place from a new vent at the western part of the crater bottom and was accompanied by the formation of a new spatter cone, Omori's cone, around the vent.

The whole crater is at present in a state of deep tranquility. No motion is seen and no sound is heard to cause any uneasiness. Activity is only indicated by fumes with a faint peculiar choking odour of sulphur dioxide. The fumes rise calmly at varying places from pits and clefts of the elevations on the crater bottom and from cracks and fissures traversing the lava which fills the crater floor, depositing sulphur in a yellow crust on any objects.

Volcanic Activity in Historic Times. The first eruption ever recorded in Japanese chronology took place on November 29, 684 A. D. Several authors are of the opinion that the area now occupied by the villages of Motomura and Nomashi was formed by this eruption. During the period from the eighth to the eleventh century there was no eruption at all. In the twelfth century, on November 18, 1112, there was one eruption. Two eruptions took place during the fifteenth century. In the seventeenth century there were four eruptions. There was one eruption in the eighteenth century in the years 1777-78. This eruption of the An-ei era was the most violent one ever recorded in the history of the volcanic activity of Oshima. Five eruptions were recorded in the nineteenth century. The last one of this period which occurred in 1876-77, was a rather violent eruption. The activity lasted forty days. Lava was poured out in the crater of Miharayama but it did not run over the brim of the crater. The eruption of 1912-14 lasted for two years and three months. During this eruption, lavas were extruded in five periods with short intervals of quiet between spasms of activity. They did not run over the brim of the Miharayama crater, but they changed the state of the inside of the crater. The activity in the month of October in 1915 continued about twenty days but ceased without having poured out any lava.

KILEAUEA REPORT NO. 973
WEEK ENDING SEPTEMBER 14, 1930

Section of Volcanology, U. S. Geological Survey
H. A. Powers, Temporarily in Charge

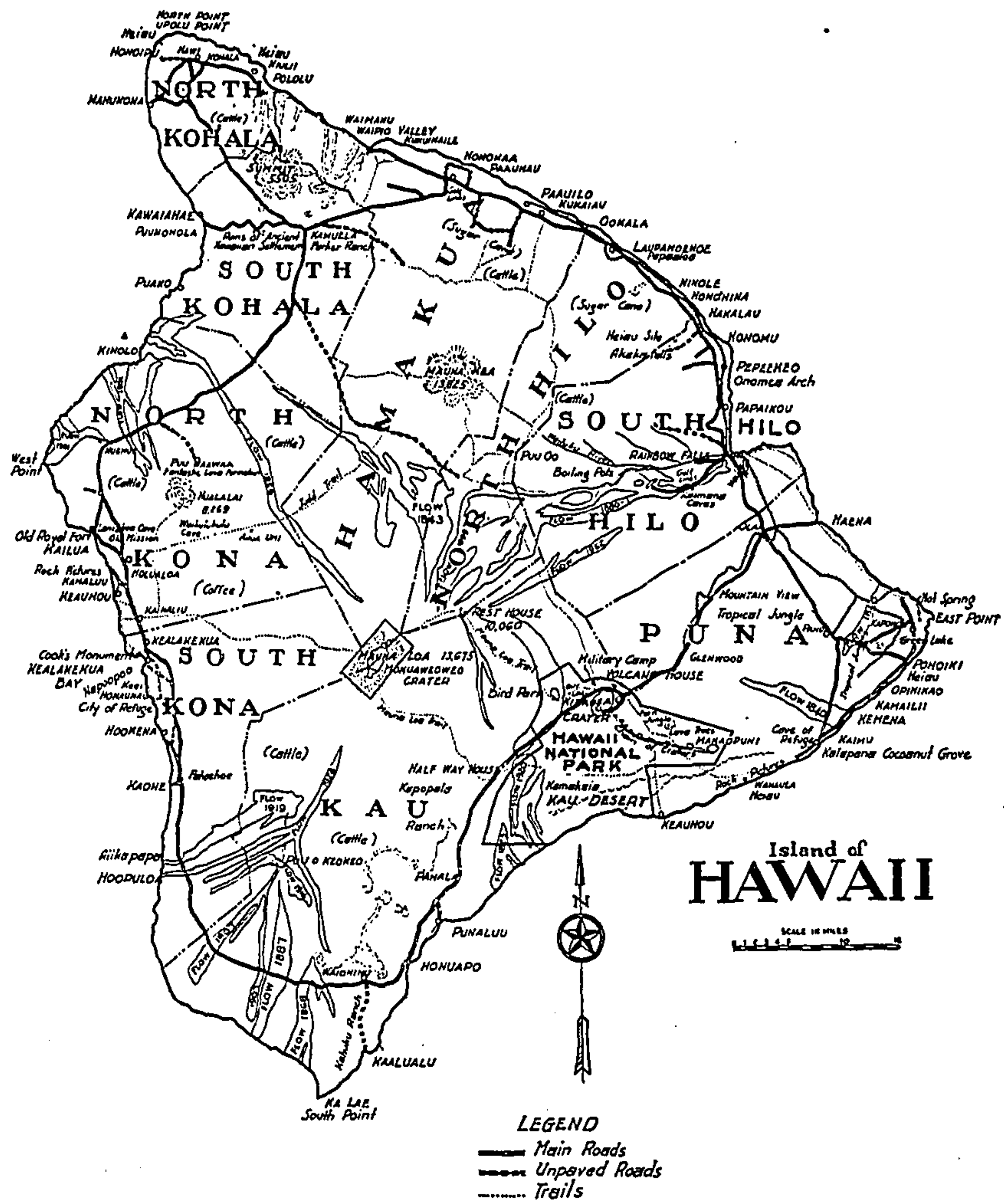
The 14 Ton Bowlder fell to the bottom of Halemaumau during the evening of September 10. No one was present to watch the manner of its going, but a little news was yielded by the seismogram from the pit instrument. About 9:30 p. m. a landslide initiated a series of fourteen different slides large enough *to record on* the instrument. Two of the largest occurred at 10:30 p. m. It is probable that the 14 Ton Bowlder was carried in by one of these two. A section of the rim over fifty feet long and thirty feet wide dropped in during these avalanches. As a rough estimate, over 65,000 tons of rock fell from the wall of the pit.

Aside from the series just mentioned, there has been little avalanching during the week, and the steaming from the cracks in the pit has been slight except during one half day of rain.

Only one very feeble earthquake was recorded on the instrument at the Observatory on September 11 at 11:39 p. m. A total of 46 small tremors were registered during the week, of which a small number are probably avalanche records. Microseisms have been slight during the entire week.

The average tilt for the week showed a slight gain to the north at the Observatory. A careful analysis of the records suggests that the tilting is being influenced more by Mauna Loa than by Halemaumau. The tilt seems to be a series of small movements to and from Mauna Loa, and gives no evidence of increasing pressure under that mountain.

Again it must be concluded that things are very quiet at Halemaumau ,and that nothing of obvious consequence is happening at Mauna Loa.



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The Volcano Letter

Two dollars per year | Ten cents per copy

No. 300—Weekly | Hawaiian Volcano Observatory, National Park, Hawaii | September 25, 1930

Tower of the stone church of Sataputu, Savaii, all that remains to mark the site of a village buried under thirty feet of lava. There is subsidence around the tower, probably due to fluid lava entering the building below. After Tempest Anderson, Q.J.G.S. London, 1910.

ERUPTION OF MATAVANU, SAMOAN ISLANDS, 1905-10.

(Review by L. Smith. Reference: The Volcano of Matavanu in Savaii, Tempest Anderson, Quart. Jour. Geol. Soc., 66, 1910, pp. 621-639.)

Before the eruption of 1905, a sort of elevated plain surrounded by mountains stood where the crater of Matavanu is now. A deep valley extended from near this place down to the sea. On the western side of its coast were the villages of Saleaula, Salago, and Toapaipai. Farther to the east of Toapaipai was a stretch of "iron-bound" coast, or a coast made of old lava not protected by an encircling coral reef. Still farther east were the villages of Malaeola and Sataputu. These were on a part of the coast protected by coral reefs.

The eruption began August 4, 1905 with an explosive phase, sending forth mostly solid ejecta which did not cover an extensive space.

September 2 to September 4 saw molten lava pouring out and extending for a distance of two miles.

October 28 found the lava at Saleaula, and on November 3, this lava-stream was a quarter of a mile across. The side of the crater fell out and from the collapsed part a flood of lava issued.

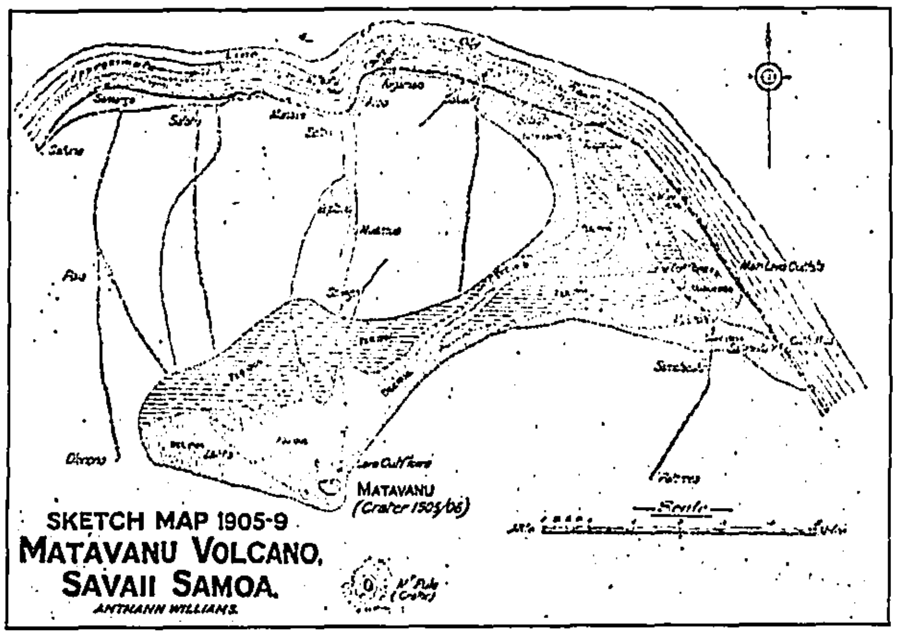
The lava reached the sea at Toapaipai on December 7, filling up the lagoon between the shore and the coral reef, then taking a westward turn along the reef, leaving untouched a part of the lagoon which was not filled up until later.

From January 28, 1906 to the middle of February, there was a great increase of activity. The lava extended along the coast from Salago to Saleaula, filling the space between the shore and the reef. Farther east, half the town of Malaeola was destroyed.

The lava ceased running in the swamp behind Saleaula on March 3, 1906. Near the coast about half the town of Saleaula had been destroyed. The lava filled up the space between the shore and the reef at Saleaula and extended westward, blocking up one of the entrances to the lagoon. The lagoon between the shore and the reef was not filled up until later.

On March 6, 1906, the lava extended eastward along the coast to two hundred yards from Sataputu which was destroyed somewhat later. Where the coast was "iron-bound" its formation was little changed for the lava flowed directly over the sea cliff into deep water.

Around the first of September, 1906, the lava-flows near



Map of the northeast side of Savaii Island showing the region of the crater and lava flows (shaded) of 1905-9 of Matavanu Volcano. After Tempest Anderson.

the sea coast extended eastwards, overwhelming the village of Sataputu, filling up the lagoon which was thirty feet deep in places, and pushing the coast-line seawards about 3000 feet. The total length of sea-front covered at different times by the lava was nearly nine miles.

It was noted on August 7, 1908, that the lava continued to run strongly into the sea, making its course mainly in the direction of that district where Toapaipai formerly stood.

A visitor to Savaii in the year 1910 or thereabouts would have seen a crater, 2000 feet high, surmounted by a canopy of white steam shaped a little like a pine tree, often breaking into cauliflower lobes, rising to a height of 8000 to 10,000 feet. Great fields of black lava, whose rough and irregular surface had large areas of both the aa and pahoehoe variety, comprised a considerable area around the cone, but on its southern and eastern sides their journey has been checked by hills. They are greater toward the west and north where they have filled the upper parts of several valleys. In the northeast, toward the sea, is the most extensive field of the fresh lava.

Of course, all vegetation overwhelmed by the lava was killed, but much more damage was done by the "Ua Sami," or poisonous gases, discharged from the crater or formed by the action of the hot lava on the sea water. Descending the crater from the west, the destruction of trees was complete, and for a distance of nearly two and a half miles, their bleached skeletons alone were left. It was only in a few sheltered places that the low undergrowth was beginning to return from the old roots. The towers and other parts of two churches are nearly all that remains of the villages of Saleaula and Sataputu.

The bottom of the crater is oval, entirely occupied by a lake of liquid lava, all in rapid motion and of such fluidity that it continually beats in surging waves against the wall. The lava is at a brilliant white heat with a darker scum continually forming on the surface, especially when the trade wind blows strongly on it. These pieces of scum break up and flow down to the north-eastern end of the crater where they disappear along with the liquid lava down a tunnel about 30 feet at the foot of the cliff. The surface of the cone is composed mostly of a series of flows of basaltic lava, and a number of bombs or ejected blocks of lava of similar character are scattered over the surface.

KILAUEA REPORT NO. 974

WEEK ENDING SEPTEMBER 21, 1930

Section of Volcanology, U. S. Geological Survey

H. A. Powers, Temporarily in Charge

A large part of the badly cracked section of the southeast rim, near the old site of the 14 Ton Bowlder, has fallen into the pit. Starting last Sunday, September 14, the avalanching was almost continuous until daylight the morning of Thursday, September 18. Between midnight and 4:30 a. m. of the 18th, a number of very heavy slides formed the climax to the series and produced the most visible changes in the rim. The edge of Halemaumau moved back about fifty feet through a distance of more than one hundred feet as a result of the avalanching.

Other than this sliding from the wall, there have been no events of interest at the fire-pit. Steaming has been very light and none of the earthquakes of the week has had its origin under Halemaumau.

The seismograph at the Observatory registered five very feeble earthquakes during the week, one of them on September 20 being felt in Kau. The times of the shocks were: September 15, 7:27 a. m.; September 18, 2:50 a. m. and 4:14 a. m.; September 20, 5:24 a. m.; and September 21, 6:08 p. m., distance 28 miles. During the spell of avalanching, 36 small tremors were recorded at the Observatory, while the pit instrument showed a total of 90 small shocks caused by the rock slides. During the last three days of the week, 13 tremors registered on the Observatory instrument of which none seems to be due to avalanching. The ordinary microseismic trembling of the ground which is thought to be of non-volcanic origin was slight for the week.

The tilt of the Kilauea rim under the Observatory gained slightly to the southeast, and the rim of Halemaumau showed the same amount and direction of movement. The daily tilt diagram shows continued small movement back and forth from the south ridge of Mauna Loa, but no gain of pressure under that mountain is indicated. Kilauea does not seem to be affecting the tilt to any appreciable extent at this time.

LAVA "SQUEEZE-UPS"

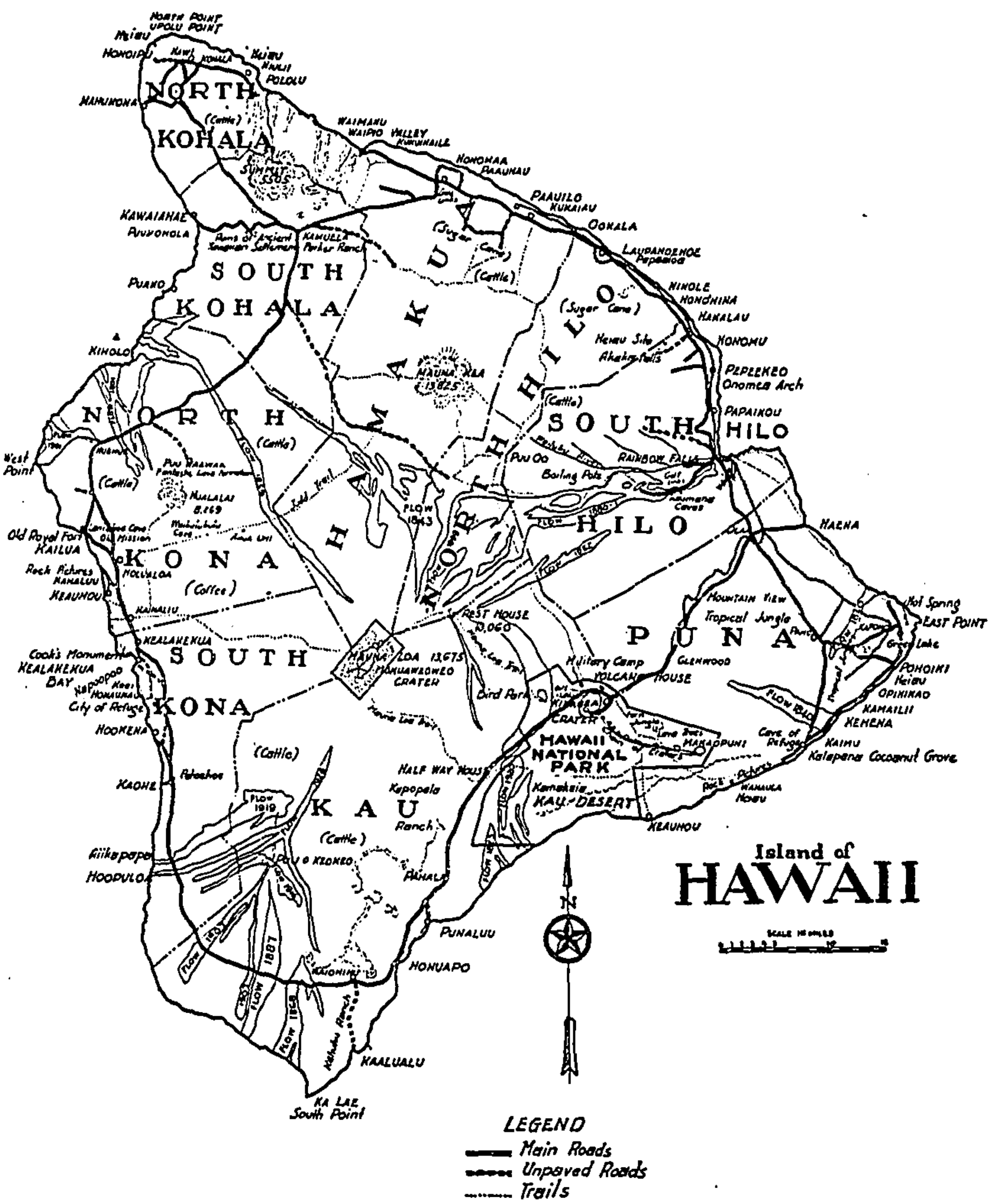
The Sunset Crater Lava flow, northeast of Flagstaff, Arizona, not only presents the most recent evidence of volcanic action in the San Francisco Mountain area but also contains a curious phenomena on the surface of the flow. These are fissures filled with basalt which have been given the name of "anosma," or "squeeze-ups." Through the middle of the main flow from Sunset Crater is a fissure, varying in width from a few feet to seventy feet, and a mile and a quarter in length. Through this fissure, basalt, apparently in a plastic condition, has been squeezed, under pressure, several feet into the air. The sides of the protruding basalt tongue are grooved conforming to the walls of the fissure, and slickenside surfaces are usually present. In the wider fissures, the more plastic inner layers of the mass have slid over the outer less plastic plates so that we get a condition of a series of vertical layers pushed into the air.

That the mass was plastic like stiff clay is evident from the rough surface of the sides of the mass that have been in contact with the walls, a condition often seen in the moulding of bricks. Further, the plates of basalt, as they have been thrust into the air, have bent under their own weight to form graceful arches in some places.

Besides the long squeeze-up, others are known of which many are less than 100 feet long. Most of these squeeze-ups are found on or near the edge of the main lava flow and form the source of smaller secondary flows. These secondary flows must have been more or less contemporaneous for in many cases they have coalesced.

It is thought that the formation of the squeeze-ups is related to the fact that the lava is contained in an inter-cone basin, a basin with no outlet surrounded by cinder cones. Into this basin, lava has poured from a vent near the high side of the basin. The remains of numerous fumeroles and the altered condition of, much of the surface of the primary flow indicate that the main flow was deep and long in cooling. The squeeze-ups, in some way, seem to be associated with this condition.—HAROLD S. COLTON.

Lava of Matavanu entering the sea through a tunnel near Toapalpai, Fragments are being thrown up, each with a trail of steam, by the force of the explosions which occur when the lava enters the water. Photo Allen, after Tempest Anderson.



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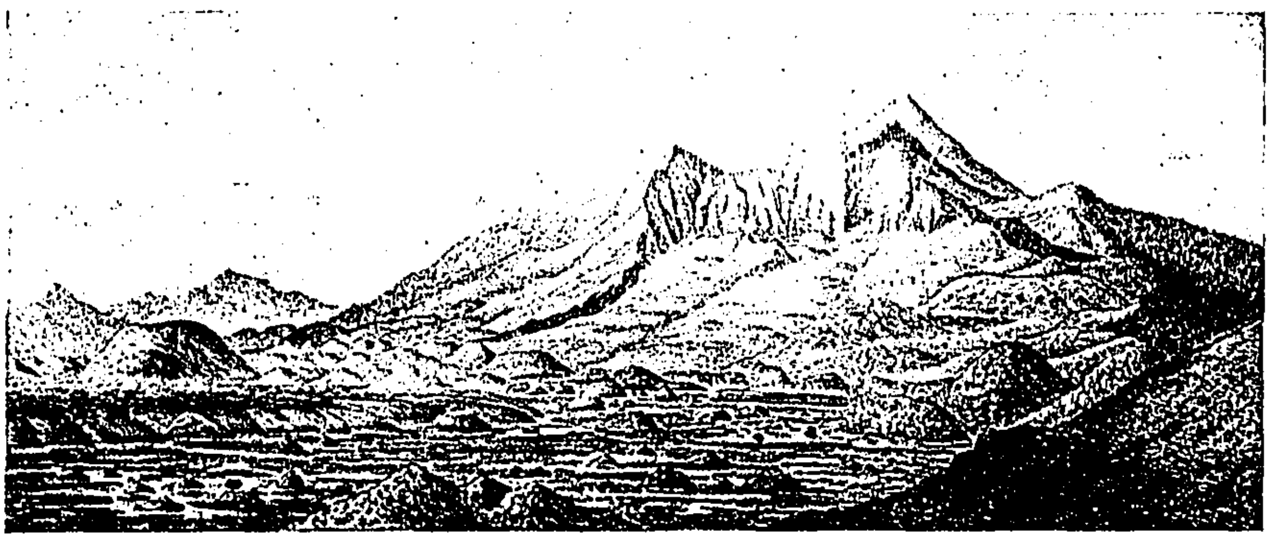
No. 301—Weekly | Hawaiian Volcano Observatory, National Park, Hawaii | October 2, 1930.



Crater of Bandai-san three weeks after eruption, looking south, showing the many conical mounds, similar to Galounggung (Vol. Letter No. 286). Bare hillsides on the right were scored by the mud torrent. After Sekiya and Kikuchi.

THE ERUPTION OF BANDAI-SAN, CENTRAL JAPAN, 1888.

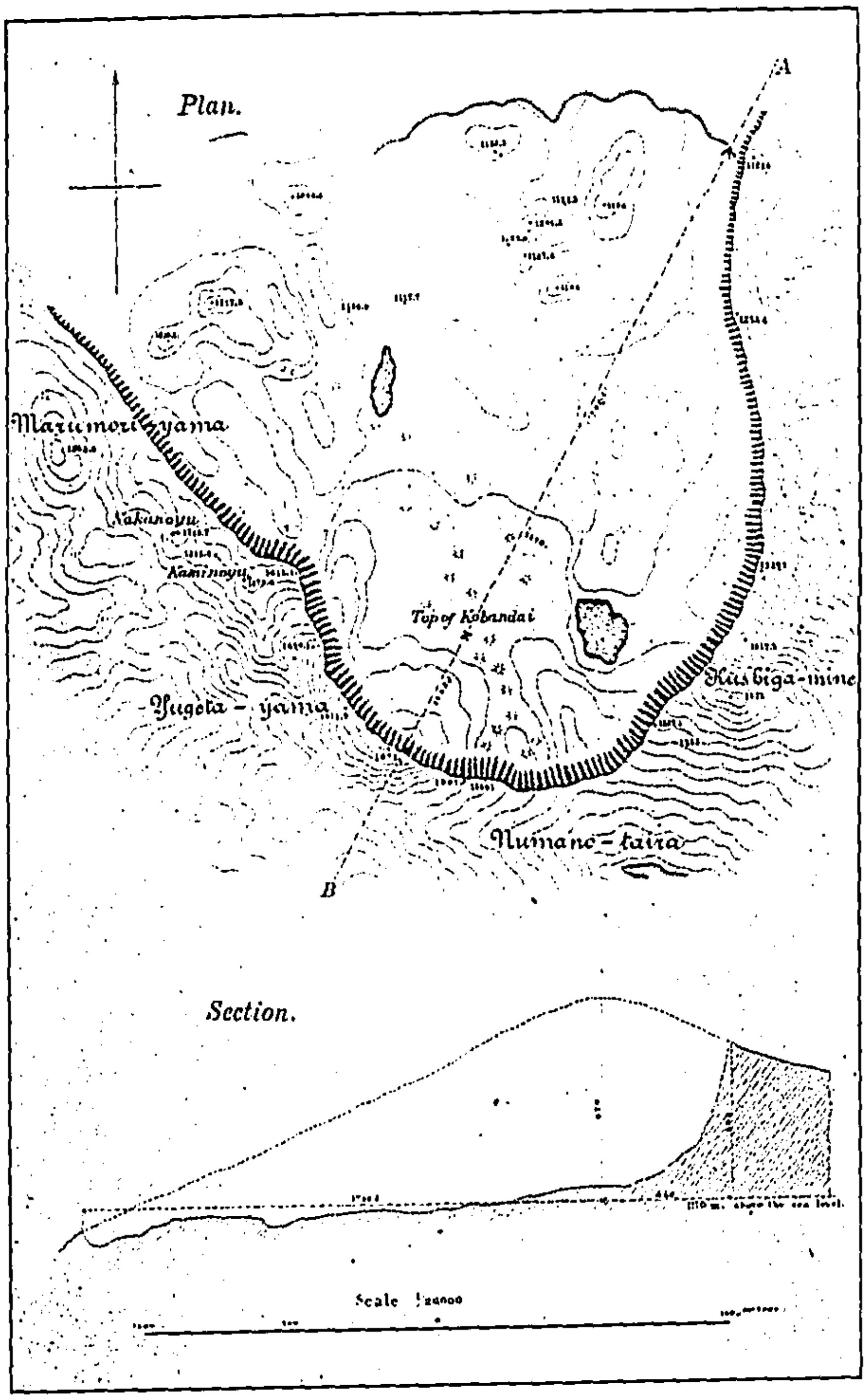
(Reviewed by L. K. Fo. Reference: Sekiya, S. and Kikuchi, Y.. Jour. Sci. Coll. Tokyo, Vol. 3.)

The eruption of Bandai-san in the Province of Iwashiro took place on the morning of July 15th, 1888. The weather was clear and a gentle breeze was blowing. Soon after 7:00 o'clock, curious rumbling noises were heard which the people thought to be the sound of distant thunder. At 7:30, there occurred a tolerably severe earthquake which lasted more than 20 seconds. This was followed by a most violent shaking of the ground. At 7:45, while the ground was still heaving, the eruption of Kobandai-san took place. A dense column of steam and dust shot into the air, making a tremendous noise. Explosions followed one after another, the steam on each occasion except the last attained the height of 1280 metres or 4200 feet.

The last explosion, however, is said to have projected its discharge almost horizontally towards the valley on the north. It is probable, from the topography and form of the crater, that previous discharges were also more or less inclined to the vertical in a northerly direction. The main eruptions lasted for a minute or more and were accompanied by thundering sounds which continued for nearly two hours. Meanwhile the dust and steam rapidly ascended and spread into a great cloud like an open umbrella in shape. At the immediate foot of the mountain there was a rain of hot scalding ashes, accompanied by pitchy darkness. A little later while darkness was still great, a shower of rain fell, lasting for about five minutes. The rain was quite warm. While darkness still shrouded the region, a mighty avalanche of earth and rock rushed at a terrific speed down the mountain slopes, buried the Nagase Valley with its villages and people, and devastated an area of more than 70 square kilometres or 27 square miles.

The most striking feature in the whole of this eruption was the deluge of rock and earth. The destructive agency was merely the sudden expansion of imprisoned steam, unaccompanied by lava flows or pumice ejection. When the explosion took place, a considerable amount of rocks and earth was projected into the air, and a part diffused in the form of dust, but by far the greater part of the bulk of Kobandai was just split into mighty fragments which were thrown down much after the manner of a land-slip.

The stream of materials of July 15th, ran down the slopes of Bandai-san, dividing as it went into two principal branches. The main branch flowed northward. Kobandai sloped on the north towards Nagase Valley in an unbroken descent, and as the mountain burst on this side, the debris dashed with great violence down this northern slope in the direction of Hibara, 9 km. away. One part of the rock torrent actually ran up the valley, toward the source of the River Nagase, burying on its way the three hamlets of Akimoto, Hosono, and Osuzawa. A part, however, ran down the valley reaching Kawakami spa and submerging it to a depth of probably more than 40 metres. The other and



Plan and profile of Bandai-san as destroy ed by the steam blast eruption of July 15 1888. Heights given in meters, dotted lin e shows former profile. After Sekiya and Kikuchi.

much smaller branch took quite a different route making an angle of 120 degrees with the main stream.

The combined volume of these two great streams entirely covered an area of 27 square miles with a solid sea of mud and rock, beneath which were buried all features of the landscape together with cattle, people, and all other living things.

The mud current also carried along numerous big boulders, some of them measuring from 5 metres to 10 metres each way.

The explosions were accompanied by terrible wind blasts. In some exposed parts, houses were levelled to the ground and trees torn up by their roots. Marumori-yama, situated near the mouth of the crater, and fully exposed, received the most severe damage. This hill was formerly covered with a thick forest, but now presents a melancholy appearance, the few trees which were left standing being as naked as telegraph poles.

This eruption of Bandai-san was more destructive than constructive. The materials which had accumulated in past ages gave way and were thrown down from a higher to a lower level in less than an hour in a gigantic landslide. The loss of property is said to have been immensely great. There is absolutely no hope of recovering or reclaiming the buried land.

Formation of new lakes due to the damming up of the river Nagase by the shattered mountain was also a striking effect of the eruption. There were four lakes formed in this manner, called Osuzawa, Hibara, Onogawa, and Nakatsu. Fifteen days after the eruption, the village of Onogawa was covered with water from the gradual accumulations in these lakes.

Out of the total of 461 dead, only 116 bodies were recovered, the rest remaining buried under the mud from the avalanche. Seventy individuals were injured by the hurricane of hot ashes and falling stones.

TEMPERATURE OF STEAMING CRACKS

The steaming cracks on the rim and floor of Kilauea Crater are, at present, the most visible indications of the presence of latent volcanic forces. They inspire numerous questions and are worthy of considerable study. Where does the steam come from? Are all of the cracks of the same temperature? Does the weather have any effect on the amount and temperature of the steam? These and many other questions of a like nature easily come to mind.

Since the beginning of the constant observation of the volcano, some notice has been taken of the steaming cracks. Measurements of temperature both at the surface and in holes bored beneath the surface have been made at a number of different times since 1912. At the present time, a daily record is being kept of the temperature and behavior of three accessible steaming cracks.

In February and March, 1912, a comprehensive survey was made of the temperature of steaming cracks in the entire crater area. The results of this survey are reproduced here in the following table:

Locality	No. of Cracks	Maxima	Minima.
Sulphur Banks	6	95.5 C. (204 F.)	66.0 C. (151 F.)
North edge Kilauea	2	70.0 C. (158 F.)	55.0 C. (131 F.)
Steaming Cliff	13	80.5 C. (177 F.)	47.8 C. (118 F.)
Observatory	2	59.0 C. (138 F.)	25.5 C. (78 F.)
North floor Kilauea	11	89.0 C. (192 F.)	36.7 C. (98 F.)
Northeast floor Kilauea	5	81.7 C. (179 F.)	57.8 C. (136 F.)
East floor Kilauea	7	84.0 C. (183 F.)	39.0 C. (102 F.)
Southeast floor Kilauea	7	94.5 C. (202 F.)	43.4 C. (110 F.)
South floor Kilauea	2	73.3 C. (164 F.)	66.6 C. (152 F.)
Around Halemaumau	6	145.5 C. (294 F.)	64.0 C. (147 F.)

The table does not include the Postal Rift which maintained temperatures varying around 320 C. (608 F.) for a number of years before it was buried beneath a flow of lava in 1919.

In June 1922, a hole was bored in the Sulphur Bank to a depth of 50 feet, and the temperature was found to be consistently about 96.0 C. at the bottom of the hole. A surface reading in one of the steaming cracks was made at the same time which showed a temperature of 95.5 C., identical with the maximum temperature of these cracks in 1912.

At the same time, temperatures of about 65.0 C. (149 F.) were measured at the bottom of an eighty-foot hole drilled in the south floor of Kilauea Crater. A surface crack gave off steam at a temperature of 55 C. Two cracks measured in this area in 1912 had temperatures of 73.3 C. and 66.6 C.

In January 1925, temperatures were recorded from cracks on the rim of Halemaumau as follows: west rim, 75 C. (167 F.); southwest rim, 86 C. (187 F.); south rim, 72 C. (162 F.); and southeast rim, 76 C. (169 F.). These temperatures taken when there was no lava in the pit contrast with those of 1912, taken when lava was present, which showed a maximum of 145.5 C. and a minimum of 64.0 C. Two cracks on the south floor of Kilauea showed temperatures, in 1925, of 87 C. (189 F.) and 90 C. (194 F.).

A reading of 66.4 C. was obtained from the bottom of the eighty-foot hole in January 1926, and the steaming crack near the hole showed 57 C. These compare with 65.0 C. and 55.0 C. for the two localities in 1922.

Three generalizations are obvious from these earlier records. First, the temperature of the steaming cracks in the vicinity of Kilauea varies over a wide range. Second, three individual "hot spots" show very little change over a period of several years. Third, the temperature shows no definite relation to the presence of lava.

Since May 1930, a continuous record has been kept of the temperature of a narrow steam crack about one hundred yards south of Halemaumau. During May the temperature averaged about 71 C. (160 F.); during June, 70.5 C; during July, 70.0 C.; and during August, 69.5 C. (157 F.). For comparison with the curve of variation of the temperature of the steam crack, records have been kept of the daily rainfall, daily average air temperature, daily range of air temperature, daily barometric pressure, daily wind condition, and air temperature at time of reading the steam temperature. The results obtained so far seem to indicate that the temperature of the steam from the crack does not depend on any one of these outside influences.

In an effort to test this information more fully, daily records have been started on two more steaming cracks, one about 100 feet south of Halemaumau, and one on the Steaming Cliff on the northeast Kilauea rim. It is hoped that comparison of all of these records will permit some definite conclusions as to the origin and control of the temperatures of the steaming cracks.—H.A.P.

KILAUEA REPORT No. 975

WEEK ENDING SEPTEMBER 28, 1930

Section of Volcanology, U. S. Geological Survey

H. A. Powers, Temporarily in Charge

There have been very few avalanches, and steaming from the cracks in the crater has been very light during the past week. Sunday evening, September 28, at 8:35, a few people in the National Park felt an earthquake which was also reported as felt in Kona.

Between September 22 and September 27, four very feeble quakes were recorded on the Observatory seismographs as follows: September 23, 5:09 p. m. distance 37 miles; September 24, 4:16 a. m. and 9:03 a. m.; September 25, 7:55 a. m. None of these was felt in the Park. At 8:35 p. m., September 28, a quake of moderate intensity dismantled (this means that a small safety device is disconnected which prevents serious damage to the writing pens) all of the instruments at the Observatory and was followed by a number of feeble and very feeble shocks as follows: 8:59 p. m. very feeble, 9:05 p. m. feeble, 9:08 p. m. very feeble, 9:13 p. m. very feeble, and 10:56 p. m. feeble.

The moderate shock at 8:35 gave some interesting but puzzling records. On several of the instruments, the distance to its center was measured as 12 miles, while on the others its distance was 20 miles. It had a strong vertical movement, yet it was felt as a very gentle rocking motion by a very few people. The best guess which can be made from the conflicting records is that the quake had its origin at great depth under the island and cannot be assigned definitely to either volcano.

Twenty-three short tremors, probably of volcanic origin were recorded during the week, and the non-volcanic microseismic trembling was somewhat stronger in the middle of the week.

The tilt for the week still seems to be controlled more by the southern part of the main Mauna Loa rift than by Kilauea. The ground at the Observatory was tilted moderately to the northeast.

The deep seated earthquake probably indicates deep movement of lava, but it is too soon to tell whether the lava is rising into one of the volcanoes.

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UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HAWAII NATIONAL PARK
HAWAII

OFFICE OF THE SUPERINTENDENT

September 18, 1930

Director,
National Park Service,
Department of the Interior,
Washington, D. C.

Dear Mr. Director:-

Following is the report of operations and activities in Hawaii National Park during August 1930.

000 General:

August which should have been the finest month of the year in this park was one of the poorest. Rainy, cloudy days and several storms were the rule.

100 ADMINISTRATION:

120 Park inspections by.

121 Superintendent.

Routine inspections were made, by the superintendent, of all road and trail maintenance and construction, road surveys, building construction and maintenance, and administrative and protection activities.

170 Plans.

Plans for construction of a lecture hall by Hui O Pele and to be located at Uwekahuna Bluff have been approved by the Director and received from the landscape division. Hui O Pele is expected to construct in the near future and donate the building to the National Park Service.

200 MAINTENANCE, IMPROVEMENTS AND NEW CONSTRUCTION:

210 Improvements.

Chimneys have been built on two residence buildings heretofore without proper means of winter heating. Oil heaters will be replaced by wood stoves.

The parking area at Uwekahuna is undergoing levelling and extension in order to enlarge it and conform to locations of new toilets and proposed new lecture hall. This is all power grader work.

230 New Construction.

Park Roads

District Engineer H. S. Wheeler and his party completed, by August 15th, surveys for reconstruction of all main park roads. Mr. Wheeler is now working up plans and specifications, at his Honolulu office, in preparation for approval and proposals for construction.

Warehouse

The new park warehouse, the first such building to be erected here, has been completed. This warehouse is of frame construction with galvanized iron roof and concrete floor with loading platform. Size is 30 feet by 40 feet.

Mauna Loa Trail

During August the 14 miles of new trail, between the rest house at 10000' and the summit of Mauna Loa at 13675', were completed and a first class trail established. Trail is 30 inches wide and on standard grades and alignment. Work is now being proceeded with from the rest house down the mountain.

Kilauea Iki Trail

The trail into Kilauea Iki crater has also been completed. This is probably the most popular trail project ever completed here and was in immediate use even before being entirely finished. It leads into one of the largest and most historical craters in the park and has much scenic as well as botanical interest.

Telephone System

Telephone line construction is well under way. Lines are now in operation between park buildings, to Halemaumau fire-pit, to the Lava Tube and the Kilauea Summer Camp. The line across Kilauea crater floor to Halemaumau is strung upon 2 inch iron pipe poles cemented into the solid lava and having the usual brackets bolted at the top. This greatly reduces visibility of the pole line and a carefully picked location practically hides it except at its terminus. Pipes were secured from local army discard.

Summer Camp Trail

As part of a program to construct a complete net work of trails leading from headquarters and Volcano House to all points in and around Kilauea Volcano construction has been started on extension of the present trail from Kilauea Summer Camp on Byron Ledge. This trail will utilize the outer edge of Byron Ledge along the rim of Kilauea crater until it meets the talus slopes at the foot of towering Waldron Ledge. Crossing the talus it connects with the existing trail between Volcano House and the floor of Kilauea crater. The trail will be useful in making possible direct travel entirely by trail between Volcano House or the Military Camp to Kilauea Summer Camp, Byron Ledge and Kilauea Iki. It will also permit a combination of several different short circle trips not now available.

DOCUMENT CAPTURED AS RECEIVED

<u>Public toilets at Uwekahuna</u>

Following approved plans two public toilet buildings are under construction at Uwekahuna Bluff. The building are of corrugated iron with masonry trim to conform with existing structures. Toilets are to be of chemical type as water at this location cannot be stored without construction of unhidden and unsightly tanks.

300 ACTIVITIES OF OTHER AGENCIES IN THE PARK:

310 Public Service Contractors.

Volcano House and Kilauea Summer Camp were both in operation during the month. Toward the close of August rangers reported that the employees in charge of the summer camp had received notice that their services would not be required after August 31st and that the camp would close on that date. The superintendent phoned the hotel manager that the approved dates for camp operation did not call for closing before September 15th and that as such date had been advertised and listed approval for earlier closing could not be made. No definite reply was made but orders to camp employees were changed and the camp kept open. It has not been learned why early closing was attempted without request for approval.

Kilauea Military Recreation camp has had the busiest season since its establishment in the park. This camp is becoming increasingly popular with army people - especially officers and their familys. The Navy section heretofore undeveloped to take care of officers is now planing erection of several cottages for that purpose. The Army is now finishing construction of a small camp hospital.

317 Status of authorized projects.

The building of K. Maehara's Volcano Photo Studio is now progressing rapidly. Mr. Maehara plans to open for business on October 18, 1930.

400 FLORA, FAUNA AND NATURAL PHENOMENA:

410 Ranger-naturalist service.

The past month 938 persons were in attendance at 19 lectures at Uwekahuna observatory while 106 persons were explained the features on trail trips.

440 Insect Control.

An serious insect attack on the silverswords of Haleakala has just been reported an investigation is under way at time of this report.

430 Volcanoes.

August was a month of expectancy of volcanic eruption but beyond unusual ground tilting and a large amount of avalanching in Halemaumau nothing of note occurred. The famous 14 ton boulder has dropped several feet but has not as yet been hurled into the pit.

500 USE OF PARK FACILITIES BY THE PUBLIC:

510 Travel.

Despite the rain our months travel is slightly in excess of this month last year. This increase is from use of the park by island residents as the tourist year to Hawaii remains a backward period.

520 Weather.

August proved to be a regular winter month as regards rainfall. A total of 24.46 inches of rain fell with one day alone receiving 5.43 inches. Complete records follow.

Maximum temperature	——	18th; 30th; & 31th	— 76 degree
Minimum "	——	7th; & 8th	—— 55 degree
Rainfall for month of August		——————	24.46 inches
" " " " "	at Hilo	——————	20.80 inches
" " to-date Volcano District		——————	71.80 inches
" " "	at Hilo	——————	100.24 inches

540 Visitors.

Most prominent among parties visiting the park was a group of 50 students from the University of Oregon.

900 MISCELLANEOUS:

Mr. Curtis Nagle and Mr. Claude Fleming with a party of camera men and equipment spent enough time in the park to film interesting points in "Multicolor" movies for use as part of a series of moving pictures being obtained by the Hawaii Tourist Bureau and the steamship companies. The films will be used partly for news reel production and partly for direct travel promotion.

Capt. George Armstrong, medical officer at Kilauea Military Camp has finished his tour of duty in Hawaii and been relieved by Capt. Best.

Very respectfully yours,

T J Allen

Thos. J. Allen, Jr.,
Superintendent.

Copy to "Field Headquarters" (2)
" " "Yellowstone National Park" (1)

10-157

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

TRAVEL REPORT

Hawaii National Park for the Month of August 1930

	This Month	This Travel Year To Date	This Month Last Year	Last Travel Year To Date	Increase for Travel Year: Number	Increase for Travel Year: Per cent
PRIVATE TRANSPORTATION:						
Cars first entry						
Cars reentry						
Motorcycles						
Total motor vehicles						
Persons entering via motor vehicles	9,330	68,923	8,715	86,663	- 17,740	20.5
Persons entering via other private transportation	420	3,005	374	2,691	314	11.6
Total persons entering via private transportation	9,750	71,928	9,089	89,354	- 17,426	20.2
OTHER TRANSPORTATION:						
Persons entering via Hotel ~~stages~~	844	9,700	1,451	13,620	- 3,920	28.5
Persons entering via trains						
Persons entering otherwise						
Total other transportation	844	9,700	1,451	13,620	- 3,920	28.5
GRAND TOTAL ALL VISITORS	10,594	81,628	10,540	102,974	-21,346	20.7

	This Year	Last Year	Increase: Number	Increase: Per cent
Automobiles in public camps during month	1	3	- 2	66 2/3
Campers in public camps during month	2	6	- 4	66 2/3

10-258

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

STATUS OF AUTHORIZED PROJECTS

Hawaii National Park for the Month of August 1930

	Description of Projects	Percent Constructed To Date	Percent Constructed This Month	Percent Constructed Last Month	Probable Date Completion
405	Ware-house	100	10	90	
407	Toilet (Uwekahuna)	5	5	—	Sept. 30, 1930
502	Mauna Loa Trail	75	25	50	Sept. 20, 1930
502	Kilauea Iki Trail	100	10	90	
502	Summer Camp Trail	50	50	—	Sept. 30, 1930
	Road Survey by B.P.R.	100	20	80	Aug. 15, 1930

10-159

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

S T A T U S   O F   P E R S O N N E L

Hawaii National Park for the Month of August 1930

	This Month	This Month Last Year
Number of employees beginning of month,	32	16
Number of additions, ...	0	5
Total, ...	32	21
Number of separations, ...	6	6
Number of employees close of month, . .	26	15

Number of promotions during month	0	1

Aggregate amount of annual leave taken,	0	0
Aggregate amount of sick leave taken,	0	0
Aggregate amount of leave without pay,	0	0

10-160

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

REPORT OF PARK REVENUES

Hawaii National Park for the Month of August 1930

	This Year	Last Year
Park revenue on hand beginning of month,	0.00	0.00
Received,	0.00	50.00
Total,	0.00	50.00
Remitted,	0.00	50.00
On hand close of month,	0.00	0.00

Park revenues received this year to date,	1,275.00
Park revenues received last year to date,	1,302.00
Increase,	RE 27.00
Percent of increase,	2.1%

10-161

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

HAWAII NATIONAL PARK

REPORT OF SALES OF PUBLICATIONS

August 1930

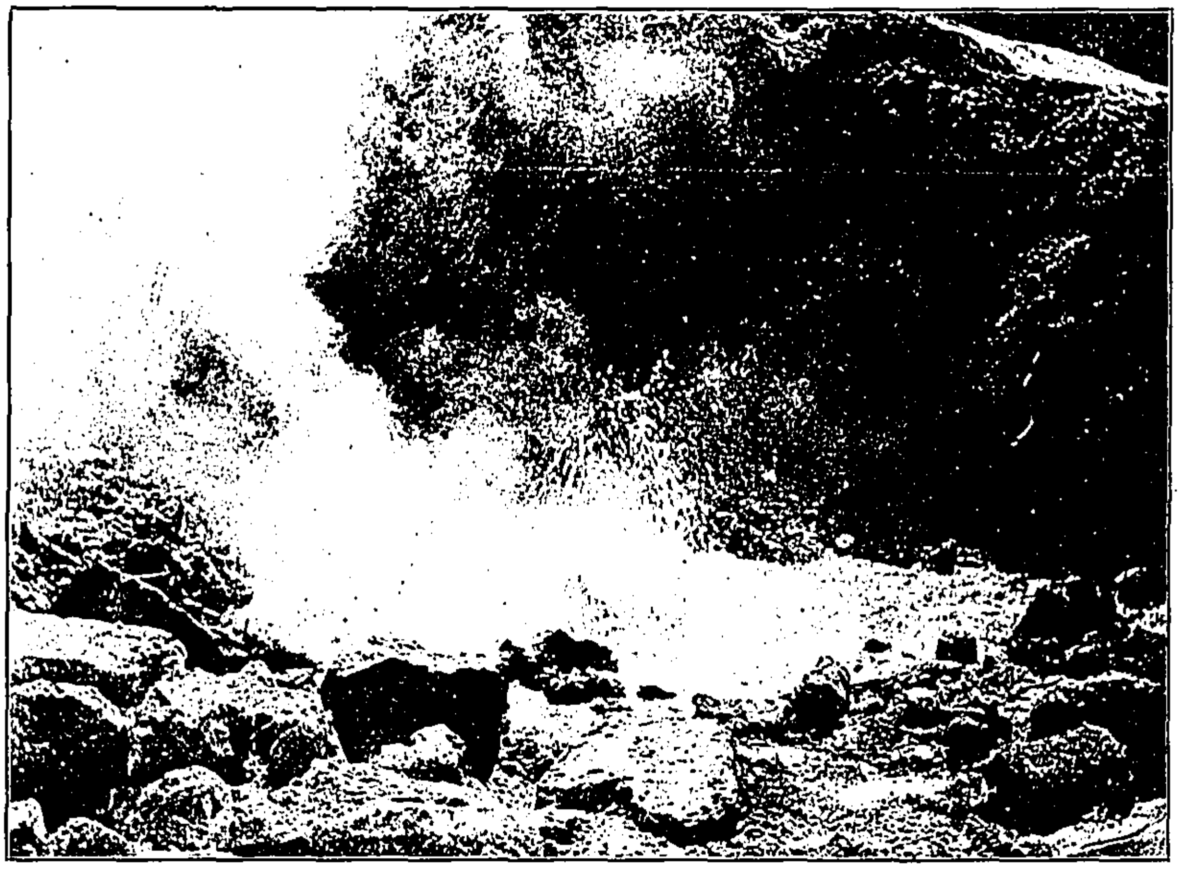
	Number	Value
GOVERNMENT PUBLICATIONS:		
On hand beginning of month,	465	123.90
Received during month,	0	0.00
Total,	465	123.90
Sold during month,	17	5.30
On hand at close of month,	448	118.60
NON-GOVERNMENT PUBLICATIONS:		
On hand beginning of month,		
Received during month,		
Total,		
Sold during month,		
On hand at close of month,		

Cash on hand beginning of month,	32.50
Sales during month,	5.30
Total,	37.80
Remitted during month,	0.00
Balance,	37.80

The Volcano Letter

Two dollars per year | Ten cents per copy

No. 293—Weekly | Hawaiian Volcano Observatory, National Park, Hawaii | August 7, 1930



A pool of boiling, solfataric water in Devil's Kitchen, Lassen Volcanic National Park, California. Photo Huff.

HOT SPRING PHENOMENA OF LASSEN VOLCANIC NATIONAL PARK

(From "Volcanic Activity and Hot Springs of Lassen Peak," by Arthur Day and E. J. Allen.)

Location

The springs are located mostly in Lassen National Park in northeastern California. Geologically, they are found in a region of thick lava flows, composed mainly of andesite and dacite, with a little basalt on the edges. The springs themselves are all found in the dacite areas. They occur on the line of faults between the Sierra Nevadas and the Klamath mountains. For the most part they are found on normal faults.

Number

There are about eight groups at intervals of a few miles, their alignment suggesting that they follow two intersecting fissures, A. and B.

Fissure A:

1. Geyser springs.
2. Boiling Lake.
3. Drake Springs.
4. Devil's Kitchen.
5. Bumpass Hell.

Fissure B:

1. Mill Creek Springs.
2. Supan's Springs.
3. Morgan's Springs.

Most of the work here discussed was done upon the Boiling Lake, Devil's Kitchen, and Bumpass Hell, but the springs all seem to have similar characteristics.

Description

1. The Geyser: This is the principal spring of a group of three connecting pools, about 25 feet in diameter, the Geyser being the first. The temperature ranges from 20° C. to the boiling point, which is 94° C. Sometimes it spouts as high as eight feet, though it is often without action.

2. Boiling Lake: It has an oval basin of hot water. Its greatest diameter is 200 yards. The banks are steep for the most part, and it suggests its origin as the basin of an ancient crater. There is a small inlet of cold water at the south end, and a larger outlet of warm water at the north. Both of these become entirely dry in summer. Gas bubbles rise over the surface of the lake. The temperature is about 50° C. Much muddy sediment makes it appear shallow. Algae may be present. It is almost encircled by

a chain of small springs and mud spots, most of which are near the boiling point in temperature. Most of them are near the lake shore, but a few are farther up the slopes. The northern shore is red in color and composed of decomposed lava which has been dyed by iron oxides.

3. Drake's Springs: These are three-fourths of a mile north of the Boiling Lake. They differ in appearance from all of the others. They have a much lower temperature, the highest noted being 62°C. They are, probably because of this lower temperature, choked with bright green vegetation. They are all small, and the individual ones are not well marked. Their mineral content is similar to that in the other springs, but they contain no free acid, or H_2S.

4. Devil's Kitchen: Its site is a deep narrow valley, with a swift, cold stream, called Warner's Creek. The Kitchen, which is rather a flat area, is surrounded on nearly all sides by high steep walls. There is almost no sign of activity on these slopes, but there are many mud pots and hot springs upon the floor. There is no vegetation near them, but the area is forested elswhere. The temperature is about that of Boiling Lake, but the amount of the hot water indicates much greater thermal activity. The Devil's Kitchen also shows an area of precipitated sulphur, while there is almost no free sulphur at Boiling Lake. The Kitchen has many pools which are covered with pyrite as a thin scum, of dark material. The ground near Warner Creek is reduced by decomposition to a dangerous thin crust of earth over hot, sticky mud.

5. Bumpass Hell: This has a crater-shaped basin which is 500 by 1,400 feet in area. It is located high in the mountains, and has almost no vegetation. The thermal action is more concentrated, and the spectacle much more striking in appearance than the others. It contains many boiling fountains, sulphur springs, etc. The rocks are much decomposed at the surface, and the ground is undermined, and easily broken through. The pools are large in size and few in number. There is much free sulphur as a precipitate in some of the pools, and it is also found in needle crystals in many small fumaroles in the west. There are fewer mud pots here than in the Devil's Kitchen. The temperature is usually just below the boiling point, but one fumarole in 1916 gave a temperature of 117.5° C.

6. Supan's Springs: These cover a small area, and most closely resemble the Devil's Kitchen, but they are much smaller. The temperature range is like that of Bumpass Hell. There are many sulphates present, and previous to man's entrance much free sulphur, but this has much of it been removed, though there is apparently not enough present to pay the expenses of a real mine.

7. Morgan's Springs: These were not studied by this party, but the description of them has been taken from Waring. They occupy an area in a meadow, and are composed of quiet pools with a small flow, which are quite shallow and contain some algae, native sulphur, and deposits of calcium and silicon. There are also many chlorides present. The highest temperature is 95.6° C., thus showing the boiling point of springs at this altitude to be lower than that of the others.

Types of Springs

1. Hot Springs. The Lassen hot springs are of the solfataric type.

2. Mud pots. The characteristics of these are a limited water supply, large amount of heat, and no visible outlet. The mud itself may be the result of local chemical action, or may be transported.

3. Mud Volcano. This is caused by drying of mud pot to allow escaping steam to force out clods of mud which build up the cone.

Field Work

1. Maps were made.

2. Temperatures were measured by means of a thermometer in a brass cage. There was no great attempt at accuracy. Their findings showed that the variations in temperature were too great to be accounted for on the basis of change in barometric pressure.

3. Tests for H_2S with $Pb(C_2H_3O_2)_2$ paper showed that though H_2S was widely distributed, only small quantities were escaping from the springs. Also the rise of the gas was not uniform over the entire surface of a pool.

4. Rough litmus paper tests, later borne out by titrations in the laboratory, proved most of the springs to be either neutral, or slightly acid, only a very few being slightly alkaline.

5. Ferrous iron was also tested for at camp, and conclusions were that practically all the iron was in the ferrous form.

6. The amount of free acid was also determined in camp.

7. The water was then carefully bottled and sent to *the laboratory.*

Laboratory Conclusions

The water was found to consist of sulphates almost entirely, and to be practically free of Cl and Al. The Al present seemed to depend upon the acidity of the water, the greater the acidity the more Al. The springs had no ferric iron present at all, while Boiling Lake had no ferrous, being entirely ferric iron.

The volume of gases given off was found to be very small. The analysis showed the presence of CO_2, H_2S, CH_4, H_2, N_2, A, O_2, and the order of these as given indicates roughly the order of the amounts found.

Deposits of soluble salts are to be found about the springs at various times, though no one has been able to determine as yet just what causes them to appear and disappear when they do. These salts upon analysis gave tests for Al, Fe^{++}, Mg, Na, K, and SO_4 in all cases, and for these additional ones in some cases: Fe^{+++}, Ti, Mn, Ca, Li, NH_4, H, S_2O_6. One case showed Cl. S was also usually present. (It is rather surprising that, if the statement that these springs showed the presence of NH_4 as salts is true, the gas analysis showed no NH_3 present in the water.)

Pyrites were found at Geyser, Boiling Lake, Devil's Kitchen, and Bumpass Hell. They were not looked for elsewhere.

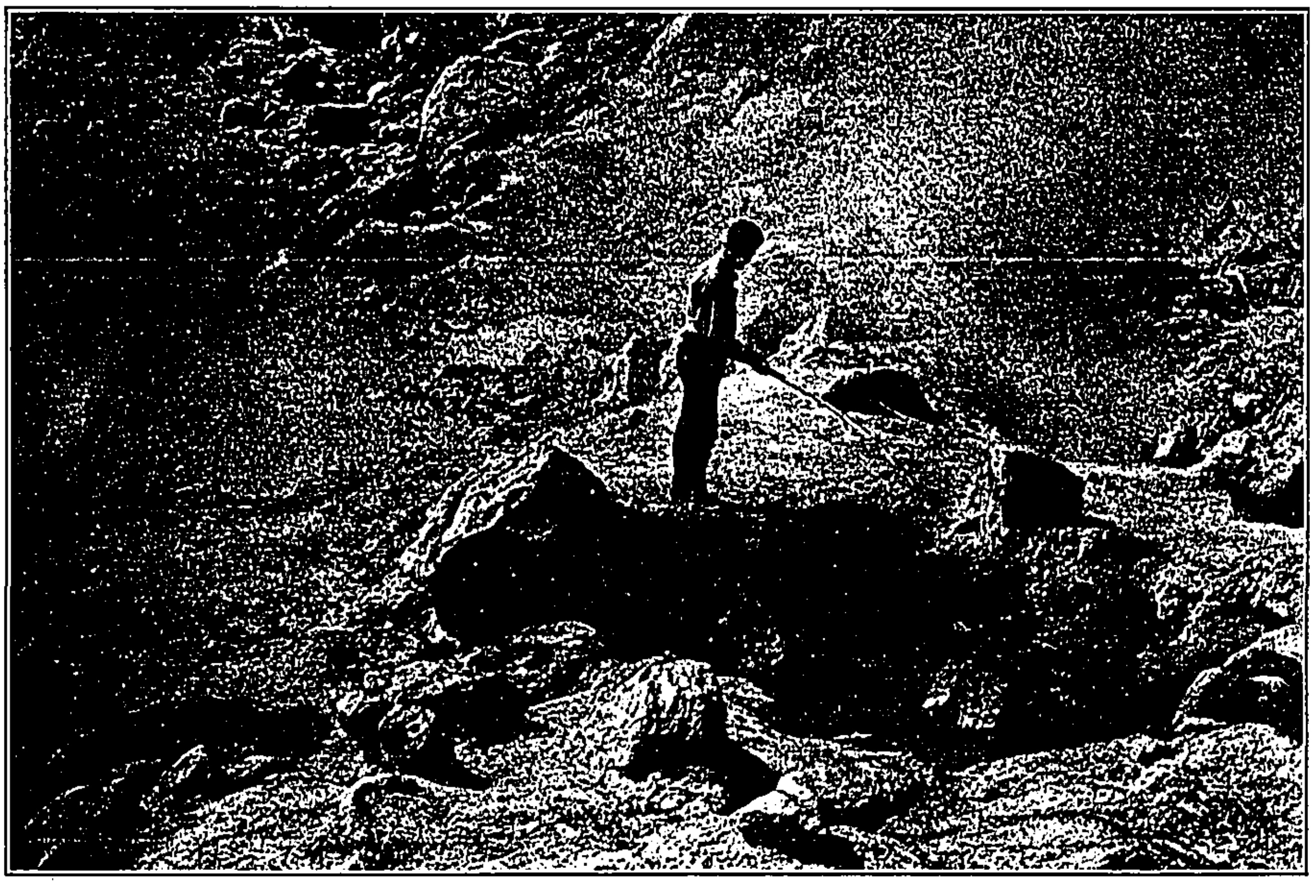
Chemical Effects

1. The formation of pyrite. Problematic, possibly from $FeSO_4$.

2. The formation of H_2SO_4. From S by oxidation. (Park—possibly from oxidation of pyrite.) (Bunsen—by oxidation of SO_2 and combination with water.) But this last would also produce H_2SO_3 and there is none at all present. There is evidence, however, that H_2S is directly changed to H_2SO_4.

Chemical Decomposition of Lavas

Silica is always the final residue. There are two types of reaction: (1) Those which produce kaolin and no $Al_2(SO_4)_3$; (2) those which produce silica and $Al_2(SO_4)_3$.



Method of taking pool temperatures by immersing thermometer in the scalding water. Pool at Bumpass Hell. Photo Finch, Lassen Volcano Observatory.

Pentathionate is probably the decomposition product of lava due to the action of SiO_2 and H_2S.

Original of Hot Springs and Their Relation to Igneous Activity

The heat supply must be great. Possible sources are:

1. Radioactivity. This has absolutely nothing to do with it since it was shown that the cold water in the Yellowstone was slightly more radioactive than the warm.

2. Chemical Processes. This is a minor factor, and the reactions are not rapid enough or extensive enough to yield either a heavily mineralized water or much heat.

3. Volcanic. Therefore since the other possibilities have been proved false, the only possible explanation is that of heating by means of magma. That this is the fact may be proved by the location of these springs along cracks or fissures, and the fact that gases are emitted.

Conclusion

The conclusions reached are that the springs are fed chiefly by surface water, derived from precipitation, and that another portion of the water rises in the form of very hot water or steam, from an underlying batholith, which mingles with the other and thus heats it. This shows the close relation of the hot springs to fumaroles, and explains both the variations in temperature of the water and in size, and appearance on the basis of the amount of precipitation.

Hazel G. Robinson.

JULY TILTING OF THE GROUND

At the Hawaiian Volcano Observatory on the northeast rim of Kilauea Crater, the tilting or tipping of the ground in the seismograph cellar, expressed by overlapping seven-day means, in terms of angular change and direction of motion of the plumb line, was as follows:

June 30-July 6	0.60 second	SW.
July 7-13	1.09 seconds	S.
July 14-20	0.36 second	NW.
July 21-27	0.48 second	NE.

KILAUEA REPORT No. 967

WEEK ENDING AUGUST 3, 1930

Section of Volcanology, U. S. Geological Survey

H. A. Powers, Temporarily in Charge

No changes were observed at Kilauea Volcano throughout the week. Steam was absent from the interior of Halemaumau except a little seen on the south talus at 2 p. m. August 1.

In addition to three very feeble seisms recorded by the seismographs were 10 minute volcanic tremors, three showing tilt to the east during registration.

Tilt for the week accumulated moderately NNE. Microseismic motion continues to be light.

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The Volcano Letter

Two dollars per year | Ten cents per copy

No. 294—Weekly | Hawaiian Volcano Observatory, National Park, Hawaii | August 14, 1930

Front of the 1926 flow of aa lava from Mauna Loa as it crossed the government road above Hoopuloa. The resemblance to a pile of huge cinders is shown well in this picture. Photo Boles.

A REVIEW OF THE AA-PAHOEHOE QUESTION

(By G. L. CHANG)

Most of the lava flows at the basaltic vents of Kilauea and Mauna Loa in Hawaii assume surface forms known commonly to us as "aa" or "block" lava and "pahoehoe" or "ropy" lava.

The rough aa surfaces are formed by material which is essentially crystalline, while the smoother pahoehoe surface is formed by a definite layer of glass. This glassy skin varies greatly in thickness; also in vesicularity it varies from a froth to an almost continuous solid. A surface that is not glassy is commonly more or less rough and aa-like, and not infrequently such surfaces are found in pahoehoe flows where cracking of the surface crusts has exposed crystallizing lava.

That there is no noteworthy difference chemically between aa and pahoehoe is generally accepted. The crystalline parts of a lava mass generally have a higher proportion of ferric oxide than the glassy ones, and the cause of the difference may be complex. A flow frequently starts as pahoehoe and changes to aa, but the reverse apparently never occurs, although in a great eruptive period like that of Mauna Loa in 1880 and 1881 the earlier discharges are dominantly aa and the later ones pahoehoe. In the transition zones the two forms are often intimately mixed, and, further more, hand specimens can be found having the glassy pahoehoe skin on one side and the rough features of aa on the other.

By several experiments it has been proven that the formation of aa is due to crystallization while the flow is in motion. When a given mass of lava has crystallized to the extent that it ceases to flow readily, and the forces acting on it are sufficient, it crumbles into loose blocks, some of which subsequently stick together giving the fantastic shapes so characteristic of aa. In the field, crystallization must frequently take place rapidly as the transition from a liquid stream to blocks of solid aa is often very short both in time and distance. However, if the flow is slower, allowing skins of chilled glass to form over the surface and if the force of the flowing lava is insufficient to break them, pahoehoe is formed.

The flank eruptions of Mauna Loa start with giant fountains which pour out enormous and rapid streams of lava. They may flow a short distance as pahoehoe, but usually soon change to aa. The Alika flow of 1919, which broke out from the southwestern flank of Mauna Loa at an elevation of about 8,000 feet, was fed by a series of fountains some 200 feet high, and the lava which cooled near the source was a glassy and frothy pahoehoe. Farther down, the lava flowed in a definite channel at a rapid rate, and where it crossed the government road in Kona 10 miles from the source it was still intensely hot and liquid. At times the stream rose and overflowed its banks and the resulting flood cooled as aa. Dr. Jaggar, who observed all this, said that at no time was there any tendency to form glassy pahoehoe skins. A thin section of some of the lava, collected where the main Kona road now crosses the flow, contains about 10 per cent of phenocrysts (large crystals), chiefly feldspar, enclosed in a matrix made up largely of glass (lava which has frozen too rapidly to crystallize). This composition indicates that comparatively little crystallization had actually taken place before the overflow.

It is in the declining phases of the Mauna Loa activity that most of the pahoehoe is formed. Crusts form over the lava until the stream of liquid lava flows continuously in tunnels and so may flow for long distances without los-

Airplane view of Hoopuloa flow of April 18, 1926, showing the incandescent lava stream flowing through a field of aa already frozen from the same flow. Transition from pahoehoe to aa lava is shown in the upper right. Photo Eleventh Photo Section, U. S. Army Air Service.

ing much heat. The flow advances by pushing out bright toes along the edges, which flow gently compared with a raging torrent like the Alika lava river.

In Kilauea crater there is little aa. Most of the overflows of Halemaumau have spread out over the gentle slope in large sluggish sheets or have been the thin shelly variety without any body. However Dr. Jaggar has observed several times that when the lakes in Halemaumau are drained, the bottom is covered with aa.

The eruptions from the flank of Kilauea in 1823 and 1840 appear to have been similar to the Mauna Loa outbreaks and much aa was produced. A significant feature of the 1823 flow is that the change from pahoehoe to aa took place just as the lava reached the edge of the gentle slope upon which it was discharged and started down a much steeper incline. An excellent record was kept of the 1920 flow which was probably the greatest discharge from Kilauea during historic time. The main activity took place some six miles southwest of Halemaumau where there was a rapid and voluminous flow which in a very few days travelled six miles. The extreme upper part of this was pahoehoe, but farther down it quickly changed to aa. Subsequently this vent poured out a series of short pahoehoe flows which built up a broad low dome. The summit crater behaved very much like Halemaumau with its bubbling and fountaining, and all of the flows from it were pahoehoe. Occasionally the flank of the slag heap was ruptured, discharging a mass of aa which resembled a landslide more than a flow.

An attempt was made to see what differences there are in the crystallinity of pahoehoe interiors and aa. Accordingly thin sections were made of representative types of lavas from the flows of 1868, 1887, 1880, 1881, 1907, 1919, and 1920. There was also a sample of aa from the bottom of Halemaumau which was exposed in May, 1917. This brief study indicated little tangible difference between the two.

It has been suggested that gases dissolved in the melt, of which water is the most abundant, are important agents in controlling crystallization and the formation of aa and pahoehoe, the theory being that aa is formed from lava containing and releasing the greater quantity of gas. Concerning this view, Dr. Jaggar said, "I know of no quantitative proof. Flames about aa are very apt to be due to

Toes of pahoehoe lava advancing slowly in the Mauna Iki flow of July 23, 1920. Kau Desert, near Kamakaia. Photo Jaggar.

burning vegetation. Pahoehoe crusts over so much that it confines its gas rather than gives it off. Pahoehoe pools remote from the source region often form blowing cones with flames at the orifices. Live streams of both pahoehoe and aa show bubbling, the former making blisters or small fountains, and the latter, occasional heavy, viscous bursts." In vesicularity, both aa and pahoehoe vary within wide limits, but the total volume of vesicles in aa is inclined to be less in a unit volume of rock than in pahoehoe, and the individual aa vesicles are inclined to be more irregular in both size and shape.

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KILAUEA REPORT No. 968
WEEK ENDING AUGUST 10, 1930

Section of Volcanology, U. S. Geological Survey
H. A. Powers, Temporarily in Charge

To the casual observer, there have been no important changes in the appearance of Halemaumau during the week August 3 to August 10. Some new scars left by small rock slides were noticed on the north and east walls on August 5, and the steaming from the wall and talus cracks was slight during the early part of the week. During the heavy rain of the week-end intense steam clouds rose continually from the pit and from the cracks of the Kilauea floor.

However, the instrumental records show a number of interesting features. Two feeble earthquakes, one at 8:52 a. m. August 5 and one at 11:14 a. m. August 8, were felt in the National Park area. The center of the first was located 9 miles from the Observatory and that of the second was located at Kilauea. There were three very feeble shocks which were not felt in the Park timed as follows: 10:03 a. m. August 4 distance 14 miles, 3:09 p. m. August 8 distance not known, and 5:50 p. m. August 9 distance not known. There were several small tremors recorded (each lasting a fraction of a minute), with more of them showing on the two instruments close to Halemaumau than on the instrument at the Observatory which is nearly two miles from the pit. This would seem to mean that the feeble tremors had their origin in or under Halemaumau. They were recorded as follows:

Date	Observatory	Uwekahuna	Pit
August 4	1	2	2
August 5	0	7	5
August 6	2	2	2
August 7	0	1	0
August 8	0	5	2
August 9	2	4	3
August 10	0	0	1

Measurements of the tilting of the ground under the Observatory show that the average accumulation for the past week has been a slight tilt to the northeast. In other words, the rim of Kilauea crater under the Observatory has been tilted up and away from the pit, possibly by an increase of lava pressure under Halemaumau. Heretofore, the weekly tilt report has been taken from the difference in tilt between the last day of the current week and the last day of the preceeding week. From now on, the tilt report will express the difference in average accumulation of tilt between the current week and the preceeding week.

The small seismograph on the edge of Halemaumau indicates that the rim at that place has been tilted up and away from the pit. If one imagines a vertical wand standing on the edge of the pit, the tilting of the ground under it during the past week would have inclined the wand over 10 seconds of arc from the vertical position away from the pit. This is an extremely strong tilt and is much more than the Kilauea rim under the Observatory has been tilted during the same time.

Microseismic motion was strong from August 7 to August 10 accompanying the high wind and the heavy surf. This microseismic motion is a very slight vibration of the earth which causes the seismograph pens to write a wavy line, but is probably not caused by any volcanic forces.

The conclusion drawn from all this evidence is that lava pressure is increasing under Halemaumau. It is impossible to say whether or not this will result in an eruption, but it can be said confidently that conditions look more favorable now than at any time in the past several months.

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The Volcano Letter

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No. 295—Weekly Hawaiian Volcano Observatory, National Park, Hawaii August 21, 1930

Dr. E. S. Shepherd and Alec Lancanster collecting gases with vacuum tubes from the edge of a lava lake in Halemaumau. From Journal of Geology, April-May, 1925.

COMPOSITION OF GASES OF KILAUEA

(A review by A. N. LIKE)

The search for the sources of energy back of volcanic phenomena requires not only a continuous observation of the physical activities of the volcano but also an examination of the material thrown out from the crater, i. e., lava in all its forms and gases. It is the latter with which we are concerned in this review. The gaseous emanations have necessarily attracted much attention.

The chief gas collections made at Kilauea in 1912 were from a flaming cone on the floor by Day and Shepherd. The somewhat crude apparatus used in this collection was a train of collecting tubes and pumps. On account of the condensation of water in the tubes, quantitative results could not be reported on the gas as a whole. In 1917, Shepherd endeavored to collect gases by thrusting vacuum tubes into flaming holes in the crust of the lava lake. The difficult part of such collecting is to get the gas in the tube sealed off without having the tube filled with air during the process. During 1918 and 1919, Dr. Jaggar made a number of gas collections from various sources at Kilauea with intent to discover not only the nature of the gases evolved but also the most favorable sources.

In 1912, the gases collected at Kilauea by Day and Shepherd had the following approximate average composition by volume for one thousand liters of gas:

H_2O	CO_2	SO_2	CO	H_2	S_2	N_2
.04	.25	.50	.02	.03	.02	.14

This collection by Day and Shepherd demonstrated the presence of the three combustible gases, CO, H_2, and S_2, and of the products of combustion, CO_2, and H_2S. There was an abundance of nitrogen in these collections.

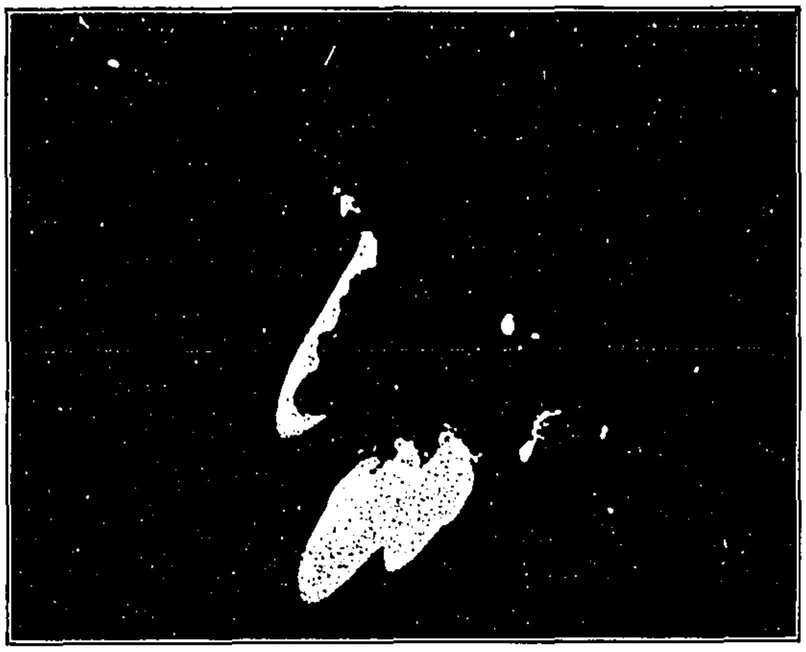
The samples collected in 1917 gave the following analyses:

Table I, volume per cent at 1200° C.

Tube	CO_2	CO	H_2	N_2	A	SO_2	S_2	CL_2	H_2O
1	2.65	1.04	4.22	23.22	n.d.	0.16	0.70	n.d.	67.99
2	17.95	0.36	1.35	37.84	n.d.	3.51	5.49	n.d.	38.48
3	33.48	1.42	1.56	12.88	0.45	29.83	1.79	0.17	17.97
4	11.12	3.92	1.42	......	0.51	......	8.61	0.02	77.50
5	9.54	1.12	1.53	10.47	......	9.90	2.72	......	64.71
6	1.97	0.82	0.21	3.50	0.07	0.95	2.70	......	89.77
7	17.25.	0.62	0.76	5.88	0.18	9.75	1.07	0.25	64.18
8	15.27	0.45	0.70	0.87	0.14	6.98	0.49	......	75.08
9	8.32	0.82	1.82	8.92	0.29	16.80	2.49	1.01	59.97
10	1.54	0.43	0.37	2.44	0.39	......	3.56	1.34	89.93
17 (°)	11.61	0.37	0.58	1.29	0.04	6.48	0.24	0.06	79.31

(°) Collected by T. A. Jaggar, March 17, 1919.

These analyses bring out certain relations. CO is usually present in less quantity than H_2. Next to H_2O, CO_2 is the chief constituent and often the rare gases (computed as argon) are no more than would be required on the assumption that the nitrogen came in as air. The chlorine content is surprisingly low. On the other hand, tube 4 shows over 7 per cent of sulphur which agrees with the observation that at times fountains break which set free violent brown fumes which look like sulphur vapor. The water is surprisingly high in all the samples and it is always present. Either we must allow some validity to the thesis that salt water diffuses through the earth's crust and reappears in the volcanoes, or admit a thesis by Dr. T. A. Jaggar that the combustible gases are burned at and below the lake surfaces by air carried down by sinking crusts, air sucked by fountaining, and oxygen diffusing into the lava as it rises in the conduit. These analyses



Direct photograph with a Wratten Panchromatic Plate of pale yellow-green flames about five inches long from a distance of five feet, August 23, 1918. Photo Jaggar.

indicate perhaps that all three of the processes postulated by Dr. Jaggar are active. Trapped air would call for a great deal more of nitrogen, but this does not apply to oxidation along the conduits or at the lake surface. Dr. Shepherd tends to accept the surface combustion as an important factor in the maintenance of the lake's heat supply. On the other hand, the great variations in composition of all samples collected lends support to Day's thesis that a part of the energy may be derived from the shifting of gas equilibria due to a lack of equilibrium among the gases rising in the magma.

Tube	CO_2	CO	H_2	N_2	A	SO_2	S_2	SO_3	CL_2	H_2O	A/AN
2	5.97	0.00	0.00	7.92	nd	4.76	0.00	2.41	4.08	75.03	0
3	6.63	0.22	0.15	2.37	0.56	3.23	0.00	5.51	1.11	80.31	0.191
4	6.79	0.14	0.17	2.33	0.00	1.38	0.15	3.43	0.62	84.98	0.000
6	0.87	0.16	0.07	20.01	0.00	0.01	0.00	0.13	0.03	78.71	0.000
8	47.68	1.46	0.48	2.41	0.14	11.15	0.04	0.42	0.04	36.18	0.054
10	16.41	0.11	0.10	15.03	0.21	13.57	0.05	3.56	0.03	50.88	0.013
11	20.93	0.59	0.32	4.13	0.31	11.42	0.25	0.55	0.00	61.56	0.039
12	1.42	0.05	0.08	0.68	0.05	0.51	0.07	0.00	0.03	97.09	0.068
13	16.96	0.58	0.96	3.35	0.66	7.91	0.09	2.46	0.10	67.52	0.139
14	14.81	0.47	0.17	2.91	0.00	3.65	0.10	1.03	0.00	76.84	0.000
15	11.53	0.13	0.10	6.20	0.16	6.14	0.03	1.70	0.10	73.89	0.025
16	18.03	0.56	0.67	3.11	0.08	8.53	0.15	2.53	0.08	66.25	0.025
17	11.61	0.37	0.58	1.29	0.04	6.48	0.24	0.00	0.05	79.31	0.030
18	17.55	0.74	0.83	4.50	0.12	10.81	0.22	3.22	0.13	61.88	0.026

Table II. Gases collected from Kilauea, 1919. Volume per cent at 1200° C.

A comparison of these figures with the Shepherd collection of 1917 and with the two gases from Mauna Loa shows a general agreement in major constituents, a general agreement in the degree of oxidation, and a lack of any uniformity in the quantities of the minor constituents. One can definitely say that there is no evidence of equilibrium obtained from among the various sources.

Summary

The analysis of some 25 samples of gas taken at Kilauea between 1912 and 1919 shows that:

1. The major emanation from this volcano is water (H_2O), the average of water in all analyses being about 70 per cent of the gas evolved.

2. Second in order of magnitude comes carbon dioxide (CO_2) with sulphur dioxide (SO_2) following in the third place.

3. Sulphur trioxide (SO_3) occurs in variable amounts, in one instance rising to five per cent, whereas, in the two samples from Mauna Loa, it reached the high value of near eight per cent

4. Sulphur, while usually small in quantity, sometimes makes up as much as eight per cent.

5. In general, the 1917 collection, obtained from passing crusts at the lake edge, contains higher amount of hydrogen and carbon monoxide than that of 1918-1919. The general inference is, however, that, quite regardless of the

source from which the gas is obtained. It reaches the surface almost completely burned or else is actively burning in the upper layer of the lake.

6. In general the ratio of argon to nitrogen is about three times as great as in atmospheric nitrogen.

7. Chlorine occurs in relatively small amount The presence of fluorine could not be tested satisfactorily in the volumes of gas which were analysed. In the 1912 collection there was evidence that fluorine was present in about twice the volume or amount of chlorine.

8. Hydrocarbons are apparently absent or else present in inappreciable amounts.

9. The water present may well be partly due to oxidation of evolved hydrogen, but such oxidation must occur in the body of the lake presumably near the surface. It does not seem probable that this combination could occur at the actual surface since any such quantities of hydrogen as would be implied by the great amount of water would certainly show marked explosion phenomena. Certainly the highly oxidized condition of these gases taken as they are from all sorts of promising sources argues *strongly for the hypothesis that combustible gases are* burned at and below the lake surface.

The outstanding fact about the samples of gases from Mauna Loa is the high degree of oxidation. Hydrogen is practically absent and carbon monoxide is nearly as minute in quantity. Certain unexplained eccentricities in the analytical data might indicate very small amounts of hydrocarbons but with such minute quantities, a definite decision is impossible In any case, everything that could oxidize has done so yet the amount of nitrogen is not excessive. Here, as in Kilauea gases, the amount of nitrogen is insufficient to account for the water present. Perhaps the next important fact is that SO_3 is present in relatively large amount and this accounts for difficulties both in breathing and smelling. It is common experience that SO_3 particles or even sulphuric acid particles are not easily removed from the air. Rare gases computed as argon are relatively high, and chlorine is notably lacking. On the whole the Mauna Loa gases seem to be like those from Kilauea.

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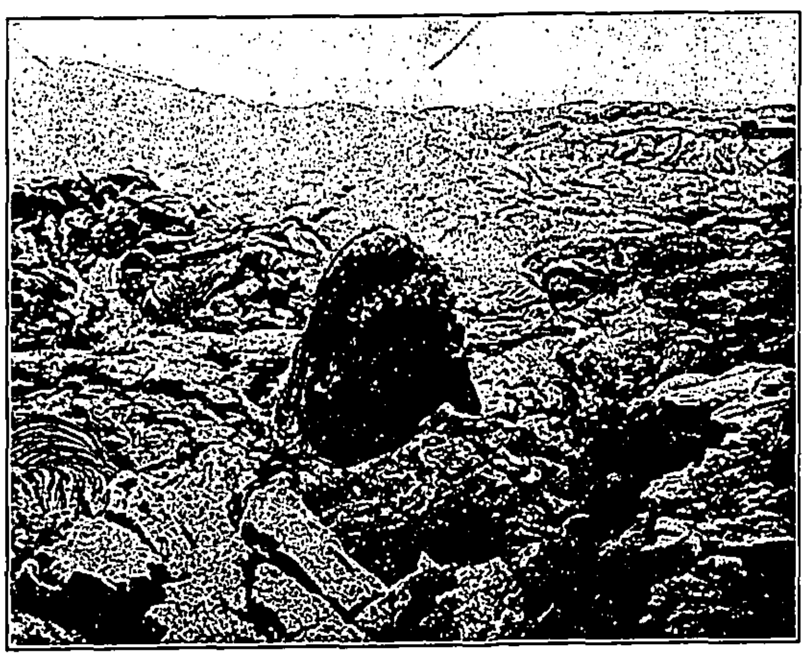
KILAUEA REPORT No. 969
WEEK ENDING AUGUST 17, 1930

Section of Volcanology, U. S. Geological Survey
H. A. Powers, Temporarily in Charge

*On Monday and Tuesday of last week, during and im*mediately following the heavy rains, huge clouds of steam were rising from Halemaumau. They were so unusual in appearance that they formed the basis of a rumor circulated in Hilo to the effect that the pit was active again. By Wednesday, the steaming of the Halemaumau floor-cracks had ceased except in the small sulphur-stained area in the southwest part of the pit. Even these had stopped their steaming by Sunday. There has been no avalanching from the walls, and the weekly measurement of the cracks around the 14-ton bowlder showed that no movement has occurred at that point.

The average accumulation of tilt at the Observatory for the week was moderate to the S-SE, which would indicate a depression of the Kilauea wall toward the south.



Northwest cone from which gas was escaping under high pressure and burning as soon as it reached the air. The photograph on page two was taken on the side of this cone at 11 p. m. Photo Jaggar.

It was interesting to note that much southerly tilt was recorded on August 10, 11, and 12, during the heavy rain, but slight recovery to the north began on the 13th after the rain had stopped. Two very feeble quakes which seemed to center on Mauna Loa were accompanied by tilt to the east as if the ground at the Observatory had moved a little up and away from the center of the quakes. The ground under the instrument at Halemaumau sagged slightly toward the pit on Wednesday after the rain ceased, and has remained almost stationary for the rest of the week.

Three very feeble earthquakes, not felt in the National Park, were recorded as follows: August 14, 12:12 a. m. distance not known; August 16, 3:46 a. m. distance doubtfully 23 miles; and August 17, 7:30 p. m. distance doubtfully 55 miles. Small tremors lasting less than a minute have not been as numerous as during last week, but more of them still are recorded on the Pit and Uwekahuna instruments than on the one at the Observatory. Between 9:16 and 9:45 p. m., August 15, all three instruments recorded about twenty minutes of slight but continuous tremor. Microseisms, caused by the constant vibration of the earth, have been slight since August 11, which date seemed to mark the end of the heavy storm of last week-end.

It would seem from this information that the pressure under Halemaumau has moderated during this past week. The coincidence of the abrupt tilting to the south with the heavy rainfall suggests that the weight of the water added to the surface of the mountain may have caused the tilting, but this cannot be proved without a number of parallel cases to support it.

THE VOLCANO LETTER

The Volcano Letter combines, after January 1, 1930, the earlier weekly of that name, with the former monthly Bulletin of the Hawaiian Volcano Observatory. It is published weekly, on Thursdays, by the Hawaiian Volcano Research Association, on behalf of the section of Volcanology, U. S. Geological Survey. It promotes experimental recording of earth processes.

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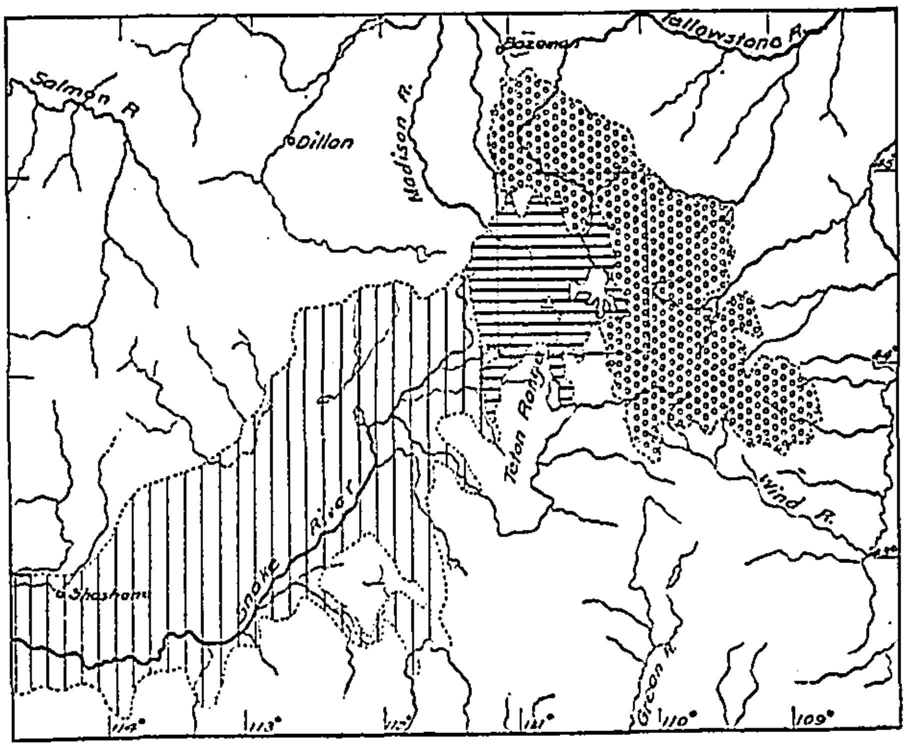
The Volcano Letter

Two dollars per year | Ten cents per copy

No. 296—Weekly | Hawaiian Volcano Observatory, National Park, Hawaii | August 28, 1930



Region of Shoshone and the Snake River Basalt (vertical lines) in relation to (Pliocene) Yellowstone Rhyolite (horizontal lines), and andesites of the early Tertiary (circles). Proc. Amer. Acad. Arts and Sci., June, 1911, p. 64

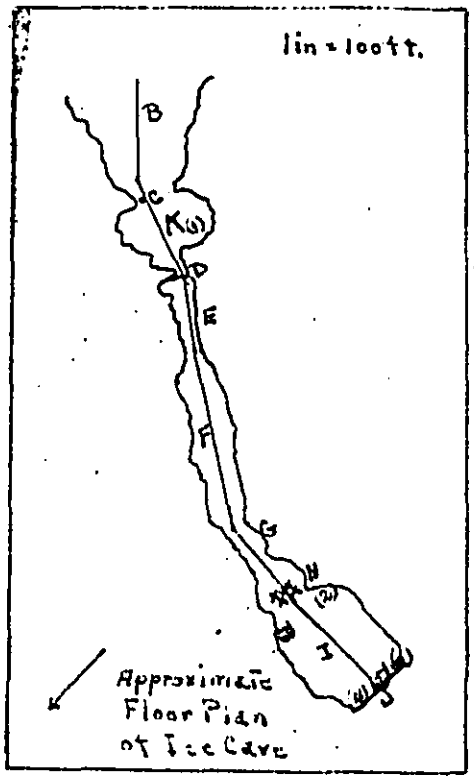
THE SHOSHONE ICE CAVE, IDAHO

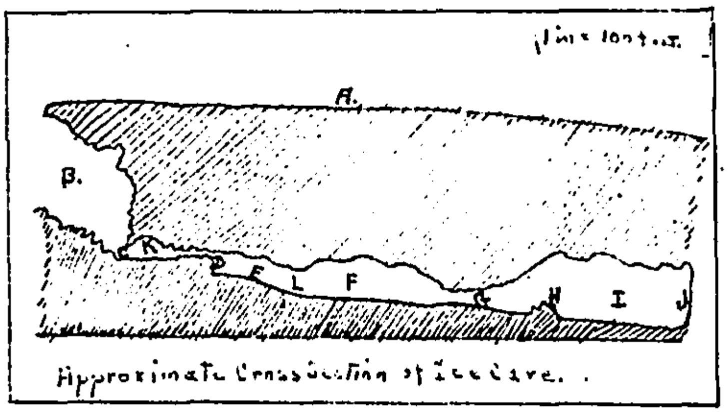
(By H. G. ROBINSON)

This ice cave is located in south central Idaho about thirty miles north of Shoshone, just off the state highway leading to Hailey. The entire region is underlain by Pleistocene lava, but in several places there are Recent lava flows. The most famous of these are the Craters of the Moon, which are located about eighty miles north of the Shoshone Cave. The cave is situated in another small Recent flow, the surface of which has been undermined by huge gas bubbles, which have subsequently caved in, leaving the otherwise fairly smooth surface of the flow broken by many crater-like depressions from one to two hundred feet in diameter. Several caves, or apparent remnants of the old tubes, lead off from these "craters," and one other of these besides the Ice Cave has ice in it near its entrance at certain times of the year, thus obtaining the name of Little Ice Cave.

The Shoshone Ice Cave opens at the bottom of the western end of one of these craters, and extends back in a southwesterly direction for four hundred feet, where it is abruptly terminated by a solid wall of ice. A study of the cave was made during the first part of 1930 in an attempt to determine the causes of the phenomenon.

The first visit was made Saturday, January 4. The weather was clear and cold. The temperature outside the cave was -7 degrees Centigrade (seven degrees below freezing). There was a fall of several inches of snow upon the ground. The party set iron stakes in the ice at various points, measuring the amount which protruded, in the hope of obtaining some idea of the amount of melting or freezing during the succeeding months. Measurements of the length and breadth of the cave were also made and heights were estimated. The party took several flashlight pictures also. There was much hoar frost on the ceilings and walls, and many ice stalactites and stalagmites might be observed. There was no water to be found upon the floor of the cave, but instead a sheet of solid ice, several inches thick, covered the entire floor between two points marked "C" and "J" on the diagram. This fact was noticed with great interest, since the local tradition is to the effect that "the ice melts in winter, and freezes in summer." This was proved untrue by the absence of water on the floor during this visit in the dead of winter—one of the very few, if not the only one, that has been made at that time of year. There were, however, two places near the rock pile marked "H" where a slight dripping from the ceiling was noticed, sufficient to make the ice somewhat slippery under foot.





Key

A - Surface
B - Part of "Crater"
C - Where Ice Begins
D - Abrupt Drop
E - Incline
F - First "Room"
G - Tunnel
H - Rock Pile
I - Second Room
J - Ice Wall
K - Entrance
L - Foot of Slide

	Temperatures in Degrees Farenheit.							Amount of Stake Protruding in Inches.					
Date	Outside	Entrance K	Foot of Ladder D	Foot of Slide L	Tunnel G	Rock Pile H	Ice Wall J	Entrance (1)	Left Floor (2)	Right Floor (3)	Right Wall (4)	Center (5)	Left Wall (6)
Jan. 4	13°	32°	35°	39°	34°	34°	34°	Flush	1¼"	1"	4½"	3¾"	1¾"
Feb. 15	50°	28°	30½°	33°	31½°	33¾°	31°	¼"	1¾"	⅞"	2¼"	3¼"	1⅛"
Apr 6	78°	32½°	35°	—	—	34°	33½°	½"	1¾"	1½"	2¾"	Removed	2⅛"
May 18	80°	34°	35°	—	—	—	37°	⅜"	1⅜"	1½"	Removed	"	2⅜"

A plan and section of the Shoshone Ice Cave (above) and the table of measurements showing changes of temperature and amount of melting ice. H. G. Robinson.

The second visit was made on Saturday, February 15, 1930. There was still much snow on the ground. The members of the party had to wade through knee-deep drifts in the "crater." The weather was clear but not as cold as on the last visit, the thermometer registering about 50 degrees Farenheit in the sunlight. Conditions at the entrance seemed much the same as on the last trip, despite the much warmer weather outside. But we had not gone far into the cave before we heard the sound of dripping water. Hurrying through the first cave, at the end of the tunnel which leads into the larger room we found several ice stalagmites from six inches to a foot in height on the floor of the tunnel. A little farther, at the rock pile "H," water was dripping steadily from above, and there was enough water on the floor to wet the feet and splash a little as we went through it. This was the same point at which the moisture was noticed on the last visit, but at this time it was much more abundant. At all other parts of the cave the floor was solid ice as on the first visit.

More pictures were taken of the ice wall at the rear, and some excellent views of the stalagmites were obtained. On throwing the beams from our flashlights upon the roof we noticed much more crystallization there than on the first visit. In fact both the walls and roof were covered with the most glorious and fantastically shaped ice crystals. Several flashlight pictures were attempted but proved to be disappointments. It was not until a few months later when we got a portrait attachment for the camera that we were able to get anything like satisfactory pictures of these crystals, and even they do not do justice to the original.

The third visit was made on Sunday, April 6, 1930. The thermometer registered about 78 degrees F. The day was clear and hot. No icicles were seen on this trip. Stalagmites were still present and much crystallization on the roof. A new feature of this visit was the presence of great quantities of ice on the rocks outside the entrance between "C" and "B." This was not present on any of the previous visits, and is hard to explain since the ice-covered rocks were under the overhang of the "crater" wall where the drip from the melting snow could not have easily reached them. Patches of snow were seen occasionally. The dripping at the rock pile "H" had almost entirely ceased, the floor being only a little slippery from the presence of a thin film of water on the surface. The ice was everywhere as thick as usual, in fact, we have reason to believe that it was thicker than on our first visit. A newspaper brought in with the flashlight powder on the first trip had been left on the rock pile. This paper was now covered with ice to a depth of at least four inches, the ice undoubtedly having come from the freezing of the water which dripped in above the rock pile.

The fourth visit was made on Sunday, May 18, 1930. The weather was clear and quite warm. Upon this, the last visit, several more pictures were taken, in particular several of the crystals, with the portrait attachment, and one of a huge stalagmite at the top of the rock pile. There was still ice to be seen at the entrance outside, though it seemed to be melting rapidly. The crystals were not as perfect as on the previous visit, but some very fair pictures were obtained. There was no water at all in the bottom of the cave, though the ice was very slippery for an extensive area about the rock pile, and the rock pile itself was so slippery, being practically covered with ice, that it was almost impossible to climb it. Since there was no drip from above, this seemed to indicate a true thaw.

The accompanying table gives the temperatures of the cave as recorded on the several visits, and also the readings of the lengths of iron stakes projecting beyond the surface of the ice. It can be seen that no appreciable melting took place during the season observed. Also, though the temperatue of the cave varies, it is invariably colder right at the entrance than at any other point, even when thawing is apparently taking place as on May 18.

As a result of this study it is easy to understand the method by which the ice on the floor and sides of the cave is renewed. The water from the melting snow upon the surface of the ground seeps down into the cave, where the low temperature maintained by the wall of ice in the end causes it to freeze in the winter and spring. People who have been there in the early summer state that the floor of the cave is then covered with water, and that this water disappears later in the summer leaving the floor entirely dry during the late summer and early fall. This may be explained by the fact that early in the summer the level of the water table is high enough to prevent the water escaping, and as the water table lowers during the dry summer, the cave floor becomes dry. However, it is easy to see how this condition has led to the local tradition that "it melts in the winter and freezes in summer," since the first people to go there in the spring often find it full of water, which indicates thawing to them, and later the dryness makes them think it is freezing again. Though this study has outlined the cycle of the yearly accumulations, it has given us no clue to the method by which the great ice wall itself was formed, and that remains, at least for the present, a mystery and a matter for speculation.

KILAUEA REPORT No. 970
WEEK ENDING AUGUST 24, 1930

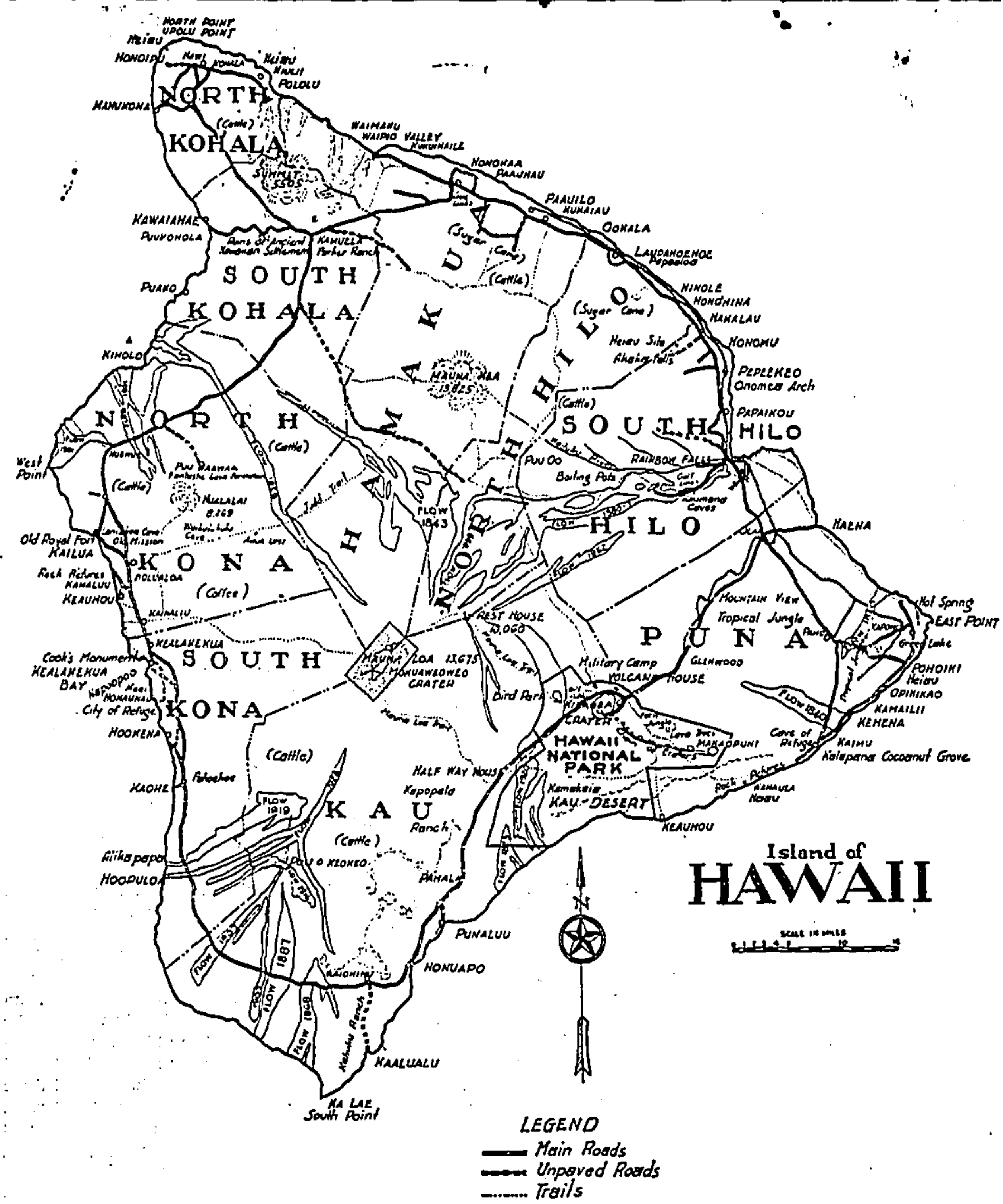
Section of Volcanology, U. S. Geological Survey
H. A. Powers, Temporarily in Charge

There have been no visible changes in the condition of Halemaumau during the week ending August 24. No avalanching from the walls of a magnitude sufficient to cause dust clouds has been noticed, though isolated rocks are still dropping from the rim almost continually. Steaming from the wall cracks and talus piles has been much less than usual, in fact, during two visits to the pit, no steam could be seen issuing from the cracks within the pit.

The number of earthquakes recorded is very small. One feeble shock which was felt only by a few parties in the National Park was registered at 10:43 a. m. August 21. The distance to its origin was measured as 8 miles. Three very feeble shocks which were not perceptible were registered at 7:47 p. m. August 21, 11:39 p. m., August 23, and 5:52 a. m. August 24. It was not possible to measure the distances from these records, but two of them were accompanied by tilt to the east. There were 25 records of small tremor of volcanic origin during the week. Most of these tremors lasted for less than a minute, but at 11:00 p. m. on August 22 a vibration started which continued for 18 minutes. The non-volcanic continuous vibration of the island has been slight during the entire week.

There was no significant tilting of the crater rim under the Observatory during the week. The tilt reading varied slightly from day to day and the average of the week compared to that of last week showed a slight accumulation to the southeast. The instrument at the pit recorded no conspicuous movement of the walls of Halemaumau.

The number of small tremors recorded is somewhat greater than the usual number for the past few months. The tilt record suggests that there has been no notable swelling or settling of the crater walls. It must be concluded from this that lava is neither rising nor falling at present.



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UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HAWAII NATIONAL PARK
HAWAII

OFFICE OF THE SUPERINTENDENT

August 11, 1930

Director,
National Park Service,
Department of the Interior,
Washington, D. C.

Dear Mr. Director:-

Herewith is submitted the report of activities and operations in Hawaii National Park during July 1930.

000 GENERAL:
The first dry, sunshiny month which the park region has enjoyed since last summer resulted in July being a popular one for delayed summer vacation trips both to the park and surrounding areas of cottage sites.

100 ADMINISTRATION:
120 Park inspections by superintendent.
All operations and activities were inspected by the superintendent at numerous intervals. Especial attention has been given to obtaining reactions of visitors to the educational services offered them and to the accomodations available to them through public utility operators.

160 Equipment and Supplies.
A Pacific Type "N" water pumper together with accessories and eight hundred feet of hose has been received for the principal use of protection of park buildings from fire loss. Also received were two Indian motorcycle side cars and a light Ford commercial type truck. The truck is for use of Bureau of Public Roads engineers on survey and construction work.

200 MAINTENANCE, IMPROVEMENTS & NEW CONSTRUCTION.
230 New Construction.
Park Roads
District Engineer E. B. Wheeler of the Bureau of Public Roads has personally taken charge of survey work in connection with reconstruction of all principal park roads. Mr. Wheeler arrived early in July with a party of engineers and has pushed surveys all during the month. Although handicapped by insufficient personell, Mr. Wheeler has made rapid progress and field work was 80% complete on August first.

Warehouse

Construction of a warehouse from approved plans was ninety percent finished during July. This building which is of sufficient capacity to serve our needs for several years is of frame construction with concrete floor and loading platform.

Mauna Loa Trail

Construction has been started on a horse trail over the upper slopes of Mauna Loa to its summit at 13675. Although horse and foot travel have previously been possible over the rough aa lava slopes which completely cover the high mountain sides it has been travel as a hardship both to men and animals. The aa lava and pumice reduced shoe leather to shreds after a few hours and scarred the legs of animals. The lava will be broken and leveled over a most direct route location, lava bubbles will be broken and filled and the entire trail graded to proper standards. Should funds prove adequate work will be continued from the rest house down the mountain after the bad 14 miles above have been constructed.

Kilauea Iki Trail

A trail is under construction descending into Kilauea Iki Crater from Byron Ledge. This trip has long been a popular one for the trip to the crater floor alone. The trail will make it more so and will permit of the trip being available to all hikers of ordinary ability. In addition to the volcanic features this trip passes through heavy forests of semi-tropical growth. Kilauea Iki is a crater of great historical attraction.

Telephone System

Supplies and materials have been purchased and received for installation of park system of telephone lines and erection will begin early in August.

240 Improvement of approaches to park.

Bids have recently been received by the Territorial officials for re-construction of 15 miles of park approach from the Kona side. This section of road does not touch our boundary but is at present the worst of the island Belt road. The work is a Federal Aid project known as Papa-Kona road. Low bid was $165,000.

Haleakala Road

The territorial work on the Haleakala road continues satisfactory.

500 ACTIVITIES OF OTHER AGENCIES IN THE PARK.

510 Public service contractors.

Both Kilauea Volcano House and Kilauea Summer Camp were in operation all of July.

314 Complaints.

Complaints continue to be received regarding accommodations and service at Volcano House. As action can be taken only through a general revision of the operation and as recommendations to this effect have already been made some time ago no action on individual criticisms is possible.

350 Donations.

Hilina Pali shelter which was built through the Hui O Pele committee of the Honolulu Ad Club has been completed at a cost of $325.00 This shelter will be formally tendered to the National Park Service as a donation from Hui O Pele funds.

400 FLORA, FAUNA AND NATURAL PHENOMENA:

410 Ranger-naturalist service.

More and more is felt the need of filling the permanent park naturalist position here but lack of civil service lists prevents it. Rangers assigned to this work serve very creditable and to increasing audiences. During July 18 lectures were given to 950 persons at Uwekahuna Observatory and 800 persons conducted over trails.

430 Volcanoes.

No visible lava action has occurred from either Mauna Loa or Kilauea but trail workers on Mauna Loa have witnessed thick smoke clouds and heavy steam from a cinder cone near their work and upon investigation found heavy sulphur fumes and a surface so hot that shoes were burned. Although this condition was for only a day on each of two occassions it indicates lava very near the surface on the mountain. Also considerable of the edge of Halemaumau fire-pit has falling in during July due to pressure earth movements. The 14 ton boulder lately a considerable distance inland is now tottering on the edge and ready to fall into the pit.

500 USE OF PARK FACILITIES BY THE PUBLIC:

510 Travel.

Travel to Hawaii National Park shows considerable decrease from that in July 1929. This is due to the occurrence of volcanic action last year at this time and the absence of it now. Usual travel continues to be better than normal.

520 General Weather.

Maximum temperature ———	14th ———	78 degrees
Minimum "	——— 10th, 11th, 12th,	58 "
Rainfall for month of July	———	4.14 inches
" " " " "	at Hilo ———	8.90 "
" " to-date Volcano District	———	47.04 "
" " "	at Hilo ———	70.44 "

540 Visitors.

Dr. and Mrs. Wallace Krugler of New York were in the park July 5th and 6th. Dr. Krugler is a national park enthusiast and prominent conservationist.

A group of University of Washington students under Dean Henry Landes spent a week end here.

On the 26th and 27th a group of Sierra Club member under leadership of Mr. and Mrs. C. L. Drew of San Francisco were in the park and regretted that their stay could not be longer.

600 PROTECTION:

610 Police protection.

Michael W. Slutak, a soldier of Kilauea Military Camp was accused by Tong Borges local transportation company representative of attempting to harm his small daughter on July 18th. Slutak was identified at the camp by the little girl and admitted talking to her, but denied any harmful intentions or attempts. As no harm did occur, but as evidence indicated intent, Capt. Thum of the military camp, upon request of the superintendent, returned the man to his company at Schofield Barracks with the notation to be placed on his record that he was undesirable here and should never be again allowed the privelege of returning.

620 Fire protection.

Due to hot dry weather and consequent fire danger in the tall grasses at Bird Park it has been found advisable to post signs and issue an order forbidding smoking in that area during July to October of this season.

630 Accidents.

Clarence E. Burns, a soldier from Kilauea Military Camp was lost in the fern jungles below Thurston Lava Tube for five days during July. Search parties of rangers and soldiers failed to find him until he happened on to the road and was picked up by Ranger Christ at 6:00 A.M. July 23rd. He had subsisted upon ohelo and thimble berries and was unharmed but rather worn out.

900 MISCELLANEOUS:

Norman C. Smith received appointment as temporary ranger July 21st terminating emergency employment dating from June 21st.

Capt. Roy West, U.S.M.C., commanding the Naval Recreation Camp was relieved during the month and replaced by Lt. Brenner, U.S.M.C. Officers at this camp seldom are assigned for more than four month periods.

The superintendent made a trip to Honolulu on official business July 27th to 30th.

Very respectfully yours,

Thos. J. Allen, Jr.,
Superintendent.

Copy to "Field Headquarters" (2)
" " "Yellowstone National Park" (1)

10-157

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

TRAVEL REPORT

Hawaii National Park for the Month of July 1930

	This Month	This Travel Year To Date	This Month Last Year	Last Travel Year To Date	Increase for Travel Year: Number	Increase for Travel Year: Per cent
PRIVATE TRANSPORTATION:						
Cars first entry						
Cars reentry						
Motorcycles						
Total motor vehicles						
Persons entering via motor vehicles	8,250	59,593	32,600	77,948	- 18,355	-23.5
Persons entering via other private transportation	427	2,585	450	2,317	268	11.5
Total persons entering via private transportation	8,677	62,178	33,050	80,265	- 18,087	-22.5
OTHER TRANSPORTATION:						
Persons entering via ~~XXXXXX~~ Hotel	1,132	8,856	2,120	12,169	- 3,313	-27.2
Persons entering via trains						
Persons entering otherwise						
Total other transportation	1,132	8,856	2,120	12,169	- 3,313	-27.2
GRAND TOTAL ALL VISITORS	9,809	71,034	35,170	92,434	- 21,400	-23.1

	This Year	Last Year	Increase: Number	Increase: Per cent
Automobiles in public camps during month	0	0	0	0
Campers in public camps during month	0	0	0	0

10-158

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

STATUS OF AUTHORIZED PROJECTS

Hawaii National Park for the Month of July 1950

Description of Projects	Percent Constructed To Date	Percent Constructed This Month	Percent Constructed Last Month	Probable Date Completion
405 Ware House	90	88	2	August 10,,1950
502 Mauna Loa Trail	50	50		" 30, "
502 Kilauea Iki Trail	90	90		" 15, "
Road Survey by B.P.R.	80	80		" 15, "

10-159

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

S T A T U S   O F   P E R S O N N E L

Hawaii National Park for the Month of **July 1950**

	This Month	This Month Last Year
Number of employees beginning of month,	12	11
Number of additions, ...	22	18
Total, ...	34	29
Number of separations, ...	2	13
Number of employees close of month, . .	32	16

Number of promotions during month	2	2

Aggregate amount of annual leave taken,	0	0
Aggregate amount of sick leave taken,	0	0
Aggregate amount of leave without pay,	7	0

10-160

UNITED STATES

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

REPORT OF PARK REVENUES

Hawaii National Park for the Month of July 1930

	This Year	Last Year
Park revenue on hand beginning of month,	0.00	0.00
Received,	50.00	50.00
Total,	50.00	50.00
Remitted,	50.00	50.00
On hand close of month,	0.00	0.00

Park revenues received this year to date,	1,275.00
Park revenues received last year to date,	1,252.00
Increase,	23.00
Percent of increase,	.018

10-161

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
HAWAII NATIONAL PARK

REPORT OF SALES OF PUBLICATIONS

July 1930

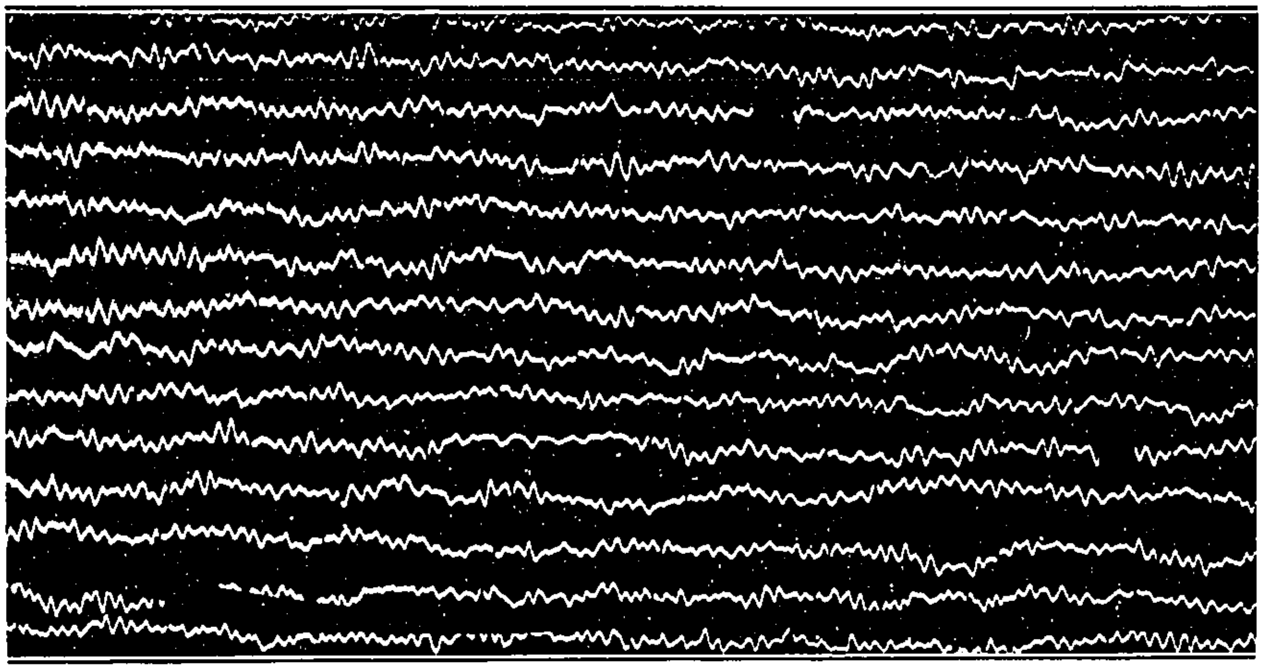
	Number	Value
GOVERNMENT PUBLICATIONS:		
On hand beginning of month,	476	133.10
Received during month,	0	0.00
Total,	476	133.10
Sold during month,	11	9.20
On hand at close of month,	465	123.90
NON-GOVERNMENT PUBLICATIONS:		
On hand beginning of month,		
Received during month,		
Total,		
Sold during month,		
On hand at close of month,		

Cash on hand beginning of month,	23.30
Sales during month,	9.20
Total,	32.50
Remitted during month,	0.00
Balance,	32.50

The Volcano Letter

Two dollars per year | Ten cents per copy

No. 288—Weekly | Hawaiian Volcano Observatory, National Park, Hawaii | July 3, 1930



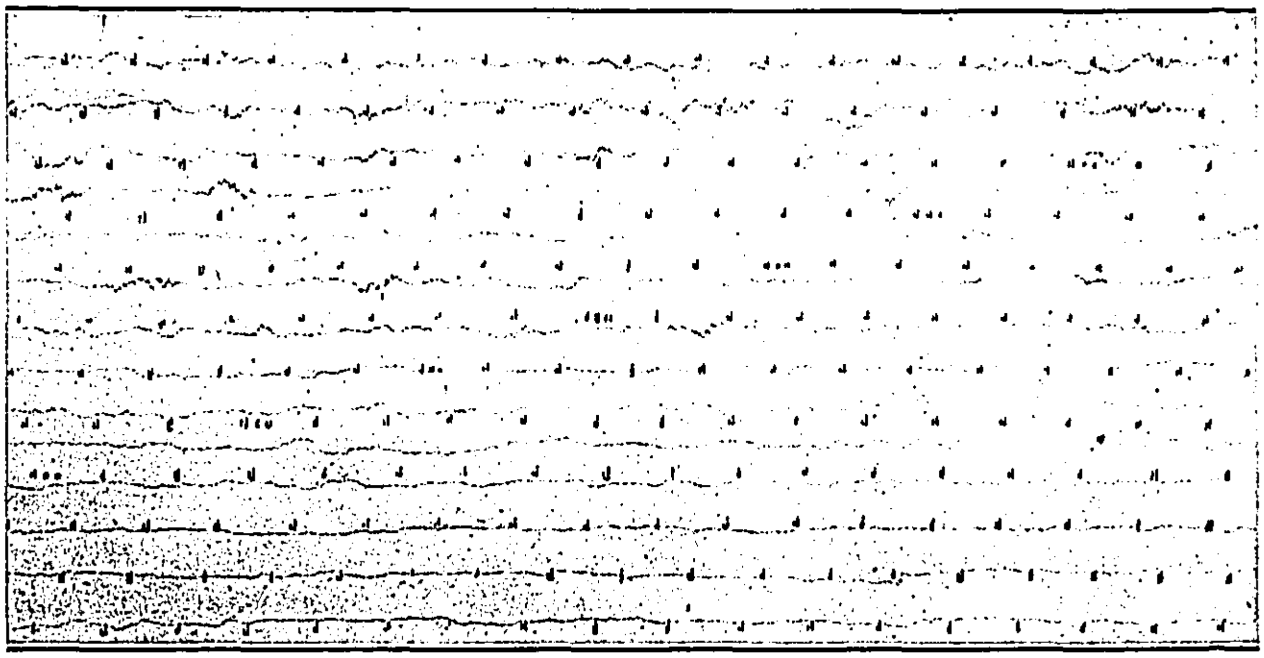
Seismogram, showing the lines written with a beam of light on a Kodak film in June, 1918, exhibiting microseisms as the principal wave movements. Minute marks are exhibited as gaps in the line. Registration of experimental seismograph pendulum of high magnification, Hawaiian Volcano Observatory.

SOME TECHNICALITIES OF VOLCANO STUDY

The reader of the bulletins and reports of the Hawaiian Volcano Observatory will be helped to understand the descriptions of the seismic movements at Kilauea, and of the rising and falling lava in the inner pit Halemaumau, and of the flowing of lava down slopes, if the observers at the stations of the Geological Survey will turn aside occasionally from technical description in order to explain the meaning of terms. Harmonic tremor, local seisms, avalanche vibrations, microseisms, streaming, fountaining, the wall crack and rim cracks are everyday structures, processes, and events at a volcano station equipped with seismographs. But the visiting traveler finds even such a simple word as "tilt" incomprehensible. He is not accustomed to a land which is tilting, and even if the house he lives in tilts back and forth between noon and midnight under the stress of the neighboring ocean tide and the weight of the changing water on the shore, he probably does not know it.

It has been the purpose of some recent numbers of the Volcano Letter to explain lava flows, rim cracks and crater slides, pahoehoe and aa, the bubbling, gushing, and cascading of lava, the swelling of the mountain, the seismogram of a distant earthquake as foretelling a tidal wave, the distinction between lava froth and lava paste, the working of a seismograph, and the heating of lava tunnels and wells by gas. Tilting or tipping of the ground was described last week in Volcano Letter No. 287 as an interesting chronic motion whereby a volcano is breathing through the weeks and months and its breast is accordingly rising and falling (Volcano Letter No. 264).

The present article is designed to show some seismograms and a diagram exhibiting movement of the ground in the shell of a mountain which is over a hot lava column. By lava column is meant an upright body of natural slag charged with gas in solution and occupying a natural shaft or well which goes down many miles and widens out in subterranean forms which it is the object of Volcanology to discover. Just as General Gorgas and Walter Reed discovered by experiment in Cuba that the mosquito carried yellow fever, so by experiment is it possible to show eventually that the lava under these great volcanic mountains swells out into a bulb, or a dome, or a lens, or a net of upright cracks. Experiment at the Kilauea Observatory has already shown that the mountain swells with rising lava and that the local ground always swells at the crack where rising lava is coming out. Leveling has shown that this swell extends down Kilauea Mountain to within 14 miles of Hilo, and that after the great collapse at the crater in 1924 there was subsidence of a foot or more at two stations in the National Park near Volcano House, and farther down the road very little effect. During the gradual rising of lava in Halemaumau from 1912 to 1921, the marked stations along the road



Seismogram printed directly from smoked paper, the quick tremors shown here and there being spasmodic volcanic vibrations. The slower waves are microseisms. Minute marks are dots. Hawaiian Volcano Observatory.

from Hilo to Kilauea showed in tenths of feet a rising approximately as follows:

Distance from Hilo Wharf		Change Between Levelings of 1912 and 1921
10.9 Miles		+ 0.0 tenths feet
14.1 "		+ 1.3 " "
17.2 "		+ 2.4 " "
20.4 "		+ 4.1 " "
31.3 "	(Park entrance)	+ 8.1 " "
32.5 "	(Volcano House)	+10.1 " "

The graded increase of change in these figures as the crater is approached leaves little doubt of actual rising of the ground that has been discovered to a still greater degree close around and within the crater of Kilauea (Monthly Bull. Hawn. Volc. Obsy. Vol. XV No. 6, p. 40). The tilt measurements of a single year at the Observatory are shown in the diagram on Page Four as though the trace of a hanging fountain pen were enormously magnified. The bend July 8 coincided with an eruption.

There is suggestion that the underground lava rising in Kilauea Crater between 1912 and 1921 was spreading out underground as a wedge for 16 miles in the direction of Hilo. The implication is that the tipping up of the country over this wedge grows less and less so that 21 miles away it is zero. There is a quantity of other information derived from running levels in the direction of Pahala and across the Kau Desert. The placing of instruments in small chambers in the solid rock in many places that would measure this tipping from year to year would furnish evidence of the rate at which the changes in level take place and the times of sudden changes if any.

As explained in Volcano Letter No. 268, the seismograph may be made to measure several things. Here are some of the terms used: A microseism is a slow, wavy movement in the ground consuming about four seconds to each wave as shown in the optical seismogram on Page One. Each line there represents a part of a different hour, the minutes are marked by gaps in the lines, and the lines were written by a tiny spot of light on a moving Kodak film, the light beam being reflected from a little mirror oscillated by a pendulum, and the pendulum registered the movement of the ground. It will be seen that the wavy movement comes in spells which wax and wane every minute or two. Microseismic movement is common everywhere and is variously explained.

Volcanic tremor is shown in the seismogram on Page Two, where the lines were written by a scratching pen on smoked paper and the time marks for minutes are closer together and are made by little double dots from a mechanical marker. Many spasmodic groups of tremors are shown, much quicker than microseisms, and these are common at Kilauea when there is active lava in Halemaumau. Such was the case when this seismogram was made by a pendulum set up two miles away from the pit. A complete wave motion for this tremor occupies two tenths of a second. Sometimes the tremor becomes continuous and even, when it is spoken of as "harmonic," and this has been found to agree with times of fountaining lava in the pit.

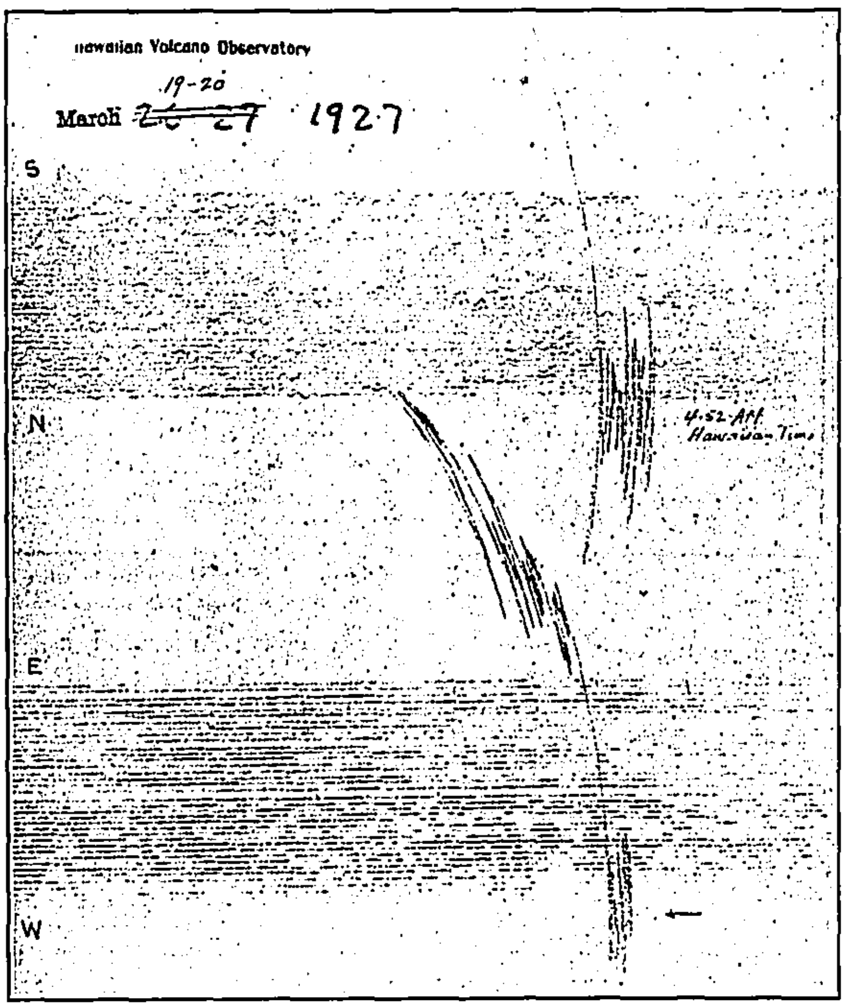
Local seisms are merely local earthquakes and the ordinary ones registered on instruments at Kilauea are technically defined as very feeble (of which we have thousands), feeble, slight, and moderate. The first two are totally unfelt, but when an instrumental earthquake gets so big as to be "slight" it is usually felt by everybody. To those who do not understand technical grades of intensity, it is hard to understand how seismologists can say to each other, "Do you mean to say that earthquake was slight at Hilo? At Kilauea it was only feeble." In other words, slightness is stronger than feebleness. In the same way "moderateness" is quite big, dismantles the high magnification instruments by throwing the pens clear of the drum (see seismogram Page Three), and the shock is referred to by inexperienced people as "terrible" or "strong." It is not "strong" technically, because it does not knock over anything, and we have to reserve some words like strong, very strong, and disastrous for the grades of very big earthquakes.

The "indicated distance" for the moderate earthquake shown on Page Three is indicated by the duration in seconds of the preliminary motion. In the upper south-north band of lines, just to the left of "4:52 a. m.," there is registered a group of vibrations about an inch wide up and down and occupying a quarter inch in the direction of the lines. Then there comes a big sweeping movement where the pen goes off the paper. In the lower band of lines (east-west) the pen starts to go off sooner. The quarter inch corresponds to so many seconds of time of preliminary motion, or the first phase of the earthquake, and by Omori's formula for local earthquakes four seconds means 18 miles, eight seconds 37 miles, 12 seconds 55 miles, etc., of distance horizontally to the place on the earth (or on the map) which lies over the place underground which bumped or scraped or snapped. The place underground is called the center or origin, and the place above it the epicenter. Sometimes the ground at the instrument tips suddenly at the time of the earthquake and this widens or narrows the space between the lines on the seismogram, while gradual tilt of the ground widens or narrows the lines gradually (see seismogram Page Four, Volcano Letter No. 276). Avalanche vibrations are occasioned by the falling of great masses of rock from the crater walls (see Volcano Letter No. 269), and these write their records on the seismogram as quick waves gradually increasing to a maximum and then dying away. An earthquake is different, with a small preliminary, and then the sudden wide movement of the long waves, followed by gradual decline. T.A.J.

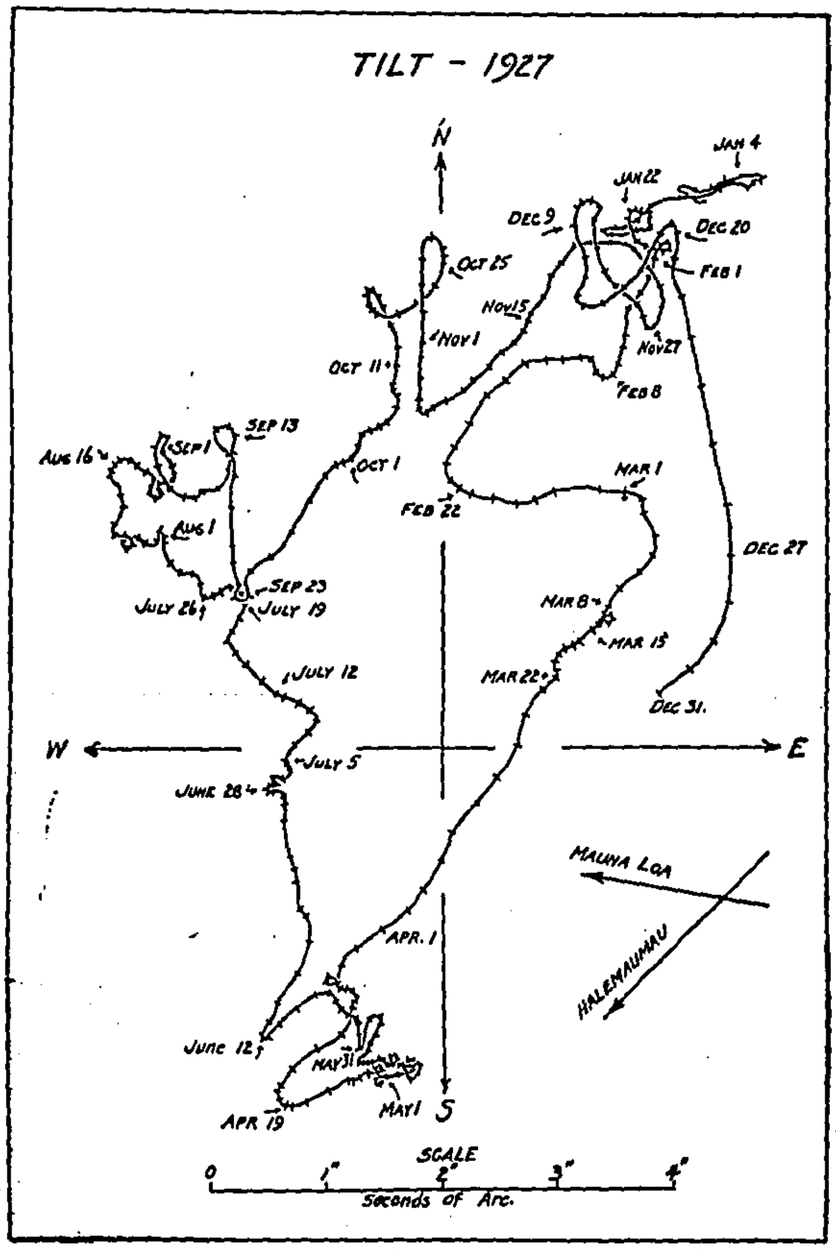
KILAUEA REPORT No. 962
WEEK ENDING JUNE 29, 1930

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

Kilauea Volcano remains quiet and without visible changes. On June 28 a small scar at the top of the west Halemaumau wall appeared to mark the location of a



Seismogram showing two bands of lines registering horizontal motion, the upper south-north, the lower east-west, made on smoked paper originally, and showing a local earthquake 4:52 a. m. March 20, 1927, of moderate intensity. Shows preliminary tremor, and then the pens are flung off. Magnification about 100 times.



Tilt diagram, Hawaiian Volcano Observatory, calculated from the seismographs for direction and amount of departure of a plumb bob in seconds, as though the plumb bob were writing its record in ink, enormously magnified. Linear distance on the line shows daily change of tilt, direction of line shows direction of change, and a marked bend to the northwest July 8 corresponds to the outbreak of Halemaumau the previous day. Seasonal tilting to the southwest in spring, and to the northeast in autumn is normal here. The two arrows indicate the directions from the Observatory of the Mauna Loa and Kilauea crater centers. Comparing January 1 and December 31, net change for the year was four seconds south.

slide seen from the Observatory a day or two before. No steam was to be seen on the pit bottom. Crack measurements on the same date indicated no changes.

Only six seismic disturbances were recorded by the instruments at the Observatory, of which five were volcanic tremors and one was a very feeble local seism. Tilt accumulated slight WNW. Microseismic motion was slight.

THE VOLCANO LETTER

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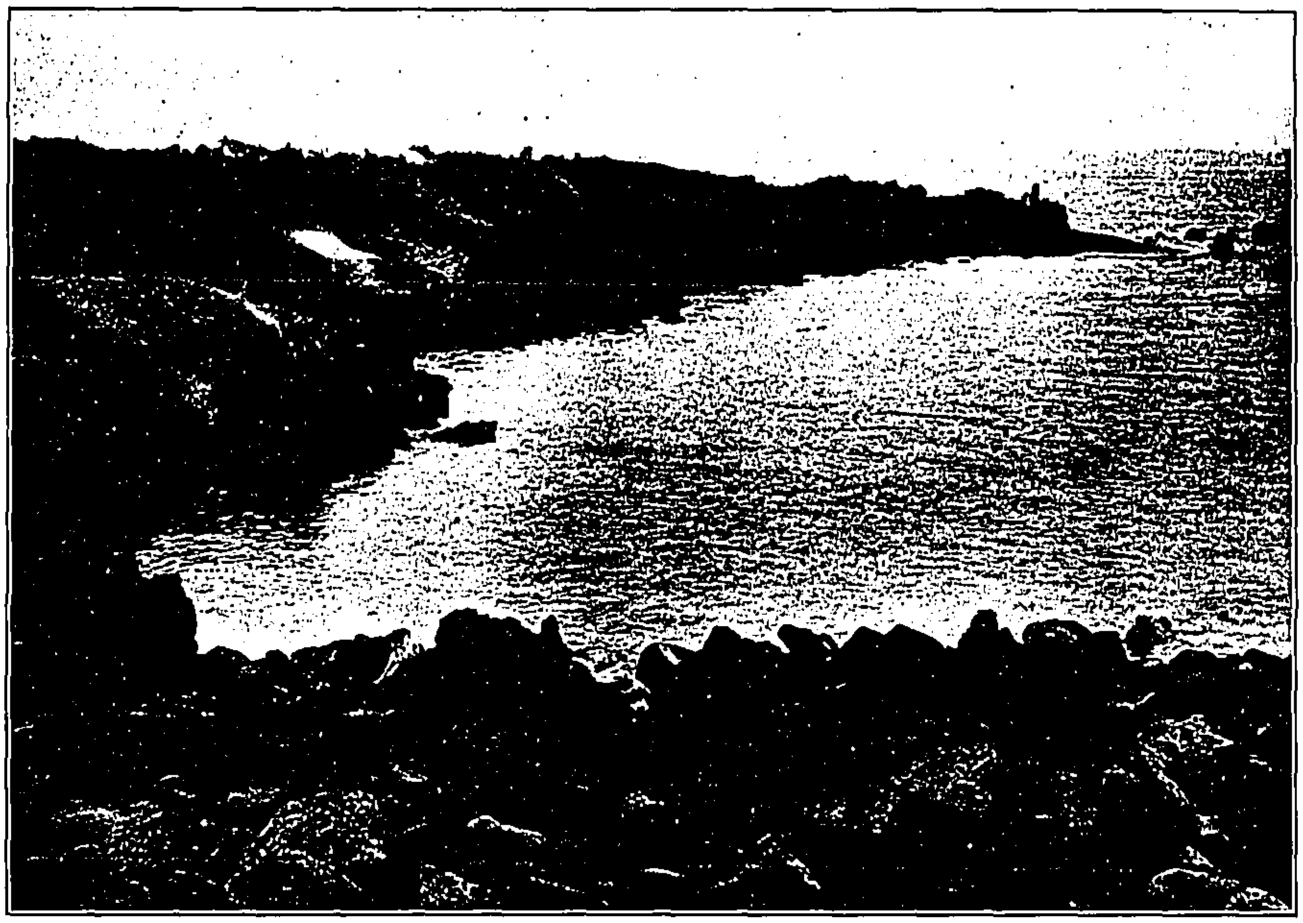
The Volcano Letter

Two dollars per year | Ten cents per copy
No. 289—Weekly | Hawaiian Volcano Observatory, National Park, Hawaii | July 10, 1930

Hoopuloa when the first buildings were burning and the lava front had just reached the sea, at 6:21 a. m. April 18, 1926, looking south. Photo Tai Sing Loo.

MARINE EROSION AT HOOPULOA FLOW

In 1926 during the month of May Mauna Loa produced one of its periodic displays with outpouring of molten lava, first from near the summit, then spreading down the southwest rift, and finally settling down to a steady flood of basalt from a vent at about the 8,000-foot level. This puddled on the flattish upland as usual for this district, the edge of the pool spilling in several directions before settling down to a final flow. The progressive feeling for an outlet in such a flow is partly conditioned by the tendency of the source crack or rift to open its way down the mountain. A vent is formed at a certain place on the crack, builds up a cone, overflows to the east, the cone-building clogs the hole, the crack opens a new vent farther down the mountain, and the escape of lava there is easier than at the first hole. The new cone overflows to the west, where the country is flatter, the slagheap backs up, the source is impeded, and a new place on the crack still farther down makes a freer outlet. In this way vent after vent is opened down the rift line. Finally a lower series of vents clog themselves and force the oncoming fluid from the depths to adopt one of its first openings a little farther uphill. The spouting melt is now dammed above and dammed below, and keeps flowing at one place. The flood



The site of Hoopuloa April 26, 1926. The foreground is old rock. Notice beginning of sand spit at point. The lava is still steaming. This is the cove which was later shut off. Photo Jaggar.

accordingly feels its way to the nearest declivity where finally it crushes a path for itself down a steeper grade through the forest, and this flow forms an adjusted canal through its own clinker fields to the ocean.

The flow of 1926 adopted this program, and the canal selected was a slight sag in the steep mountain slope of South Kona. This sag or valley, between old lava flows (see airplane pictures Volcano Letter No. 270, Page Four, and No. 285, Page Three) ended as is natural, in a shoreline indentation. This bay was where the fishermen naturally had chosen a landing for their canoes, here in some shelter had been built a wharf for the steamer landing, a beach had accumulated at the head of the bay, and dwellings had followed the demands of fishing and transportation. So this was the ancient fishing village of Hoopuloa, built to be sure on old and desolate rough lava flows, and only a short distance away from where in 1919 the Alika flow cascaded over the shore platform into the ocean, and made some short-lived tidal waves which wrought havoc at the Hoopuloa wharf. There was threat of danger, but why worry? There are lava flows everywhere.

The choice of a bay of the coast by men is also the choice of the fire goddess for good sledding on her lava. The aa flow of 1926 pushed right through the village ruthlessly, spared neither wharf nor dwellings, and nearly filled up the bay. There was left only a small cove at the northern quarter of the indentation where the wharf had been. Our pictures show the sequence of events.

At 6:21 a. m. April 18, 1926, we would have looked southward across Hoopuloa Bay (Page One), as the spectators and photographers in the foreground of the picture are doing, and we would have seen the crumbly incandescent front of the lava enveloping the village houses with flames, and just touching the water to start columns of white steam. The palms and the dock in the foreground are soon to be swallowed in molten rock. Jets of gravel will shoot up in zigzag trajactories, and the great steam-cloud will be blackened with exploded sand, while the heated and poisoned sea-water will kill small fish by thousands.

Within twenty-four hours, by 9 a. m. of April 19, all motion in the flow at the sea front had stopped, and the new point of lava, thirty to forty feet high, extended out 300 feet. The photograph on Page Two, taken a week later, shows the old sea worn rocks in the foreground, and the new lava promontory still steaming. Not a single building was left of Hoopuloa village. The destruction could not have been more complete if it had been a deliberate engineering enterprise. Of the original harbor there was now only a small cove shown in the picture. A canoe reposed in this cove. A large beach had been formed by the sea on the flow itself. Some of this is shown at the tip of the cape. These new beaches were evidently growing very rapidly in several places.

The hot gas rising, smelling strongly of ammonia and carbonaceous products, appeared to indicate that buried wood of the forest and the habitations was still smoldering under the flow. These smells were common at places remote from former habitations. When the large number of heavy sap-filled trees which the flow overwhelmed are taken into account, and when it is realized that they had no time to burn when they were smothered in the lava, it appears reasonable to suppose that all this carbonaceous matter may continue to burn slowly, with what oxygen it can get from the lava vesicles, for many months. This process will supply heat as well as gas, and the many explosions which are heard at old caverns when a flow is progressing through vegetation are occasioned by mixture of carbon monoxide, from the burnt wood, with air. Such explosions do not occur at the lava front when it advances over bare rock, where it has not travelled through vegetation.

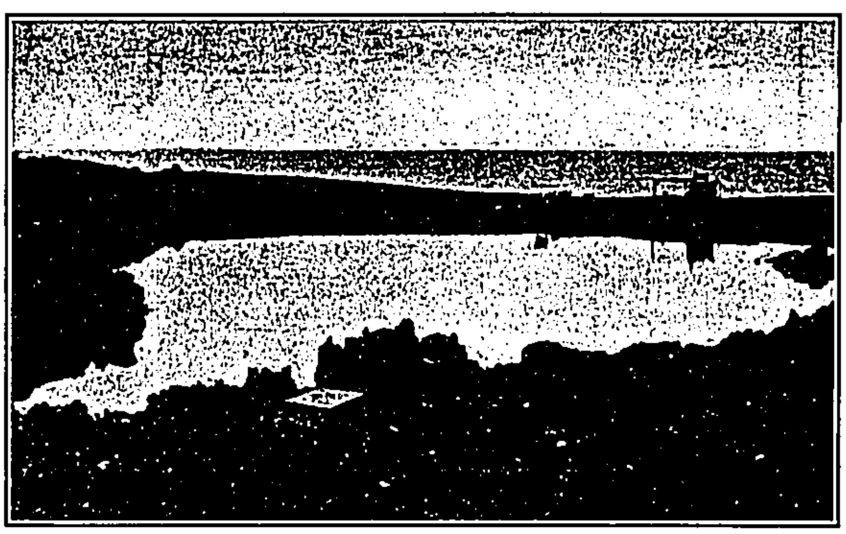
Less than a year after this destruction of Hoopuloa even their little cove was denied the fishermen. The abundant loose material of triturated and tortured clinker that forms the upper surface of an aa flow, furnished a rich harvest to the mowing machine and reaper of the winter storms from the south in 1926-27. This building of beaches, so rapid within a month, created big sea-walls within the year and a barrier beach was thrown straight across the entrance to the cove, straightening up the entire shore-line. The cove became an enclosed fish-pond of the type prized for mullet storing by the Hawaiians, but all trace of a harbor was lost. The new beaches are of gravel and sand with steep fronts sloping rapidly into comparatively deep water (Pages Three and Four). The observation of this rapid shore process of erosion and filling acting on a fresh lava flow, suggests the possibility of interpreting the age of a past lava flow by the amount of wear of the stones and the arrangement of the beach fills.

T.A.J.

JUNE TILTING OF THE GROUND

At the Hawaiian Volcano Observatory on the northeast rim of Kilauea Crater, the tilting or tipping of the ground in the seismograph cellar, expressed by overlapping seven-day means, in terms of angular change and direction of motion of the plumb line, was as follows:

June	2- 8	1.08 seconds NE.
"	9-15	0.48 second NW.
"	16-22	0.97 second NNW.
"	23-29	0.48 second N.



Looking west at Hoopuloa Cove converted by barrier into a fish pond. Hut is on the new beach ridge. Compare Page Two. Photo Godfrey.

May 29, 1927, shore wash of the new flow at Hoopuloa thirteen months after. Sea wall beaches built up from winter storms. Looking north, showing barrier beach that cut off Hoopuloa. Photo Godfrey.

KILAUEA REPORT No. 963
WEEK ENDING JULY 6, 1930

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

Very few slides have occurred at Halemaumau during the week. White dust was twice seen rising on July 4. A little steam was observed on the south talus early in the week. The south sulphur area had a little whitish color.

The instruments remained very quiet seismically. The only disturbances were three volcanic tremors, each of one-half minute duration. Tilt accumulated slight WSW. Microseismic motion was slight.

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HAWAIIAN VOLCANO OBSERVATORY
Founded 1911

This laboratory at Kilauea Volcano belongs to the Hawaiian Volcano Research Association and is leased and operated by the United States Geological Survey.

It maintains seismographs at three places near Kilauea Volcano, also at Hilo, and at Kealakekua in Kona District. It keeps a journal of Hawaiian volcanic activity and publishes occasional Bulletins

Membership in the Hawaiian Volcano Research Association is limited to patrons of Pacific science who desire personally to aid in supporting the work.

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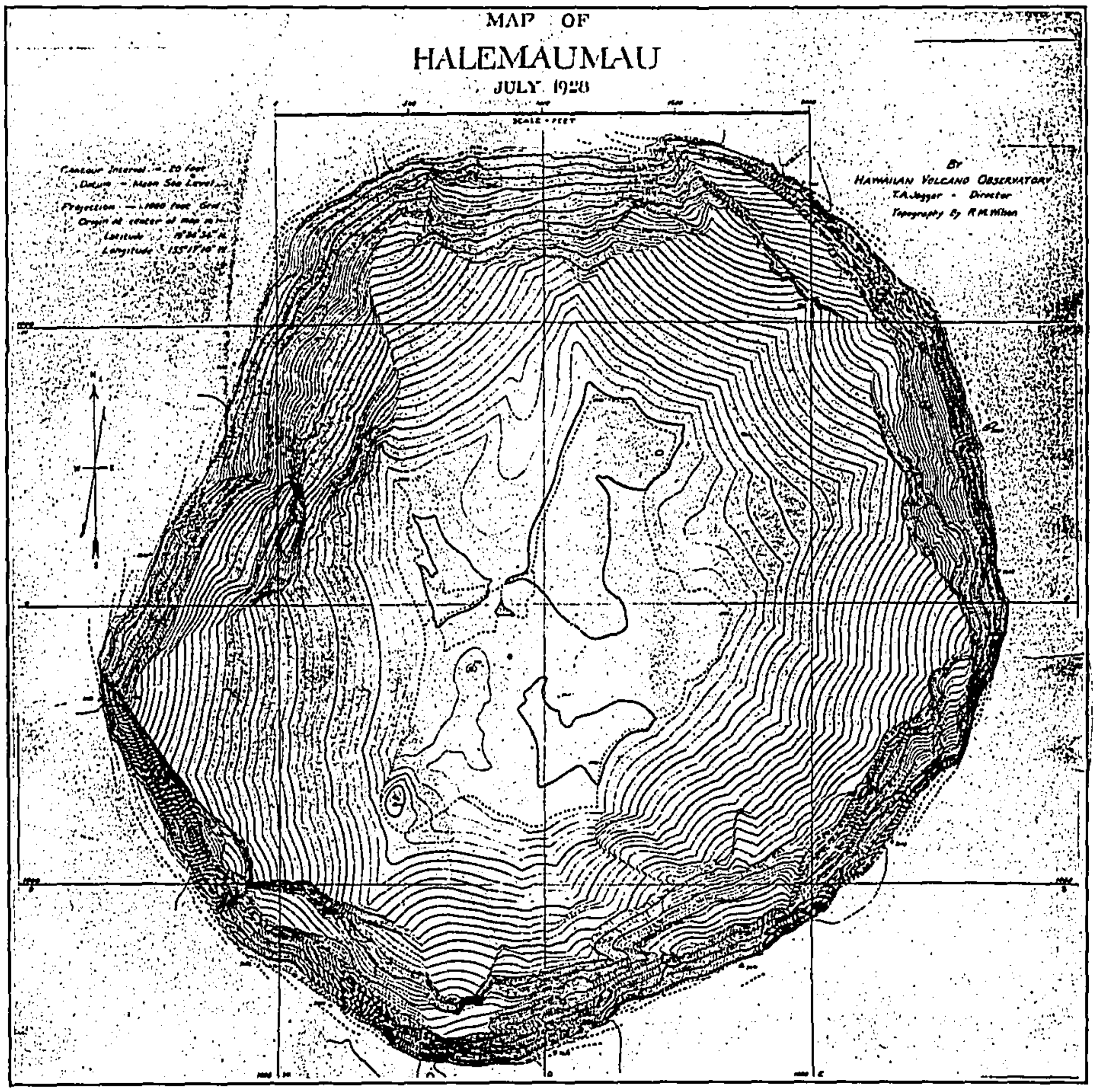
The Volcano Letter

Two dollars per year | Ten cents per copy

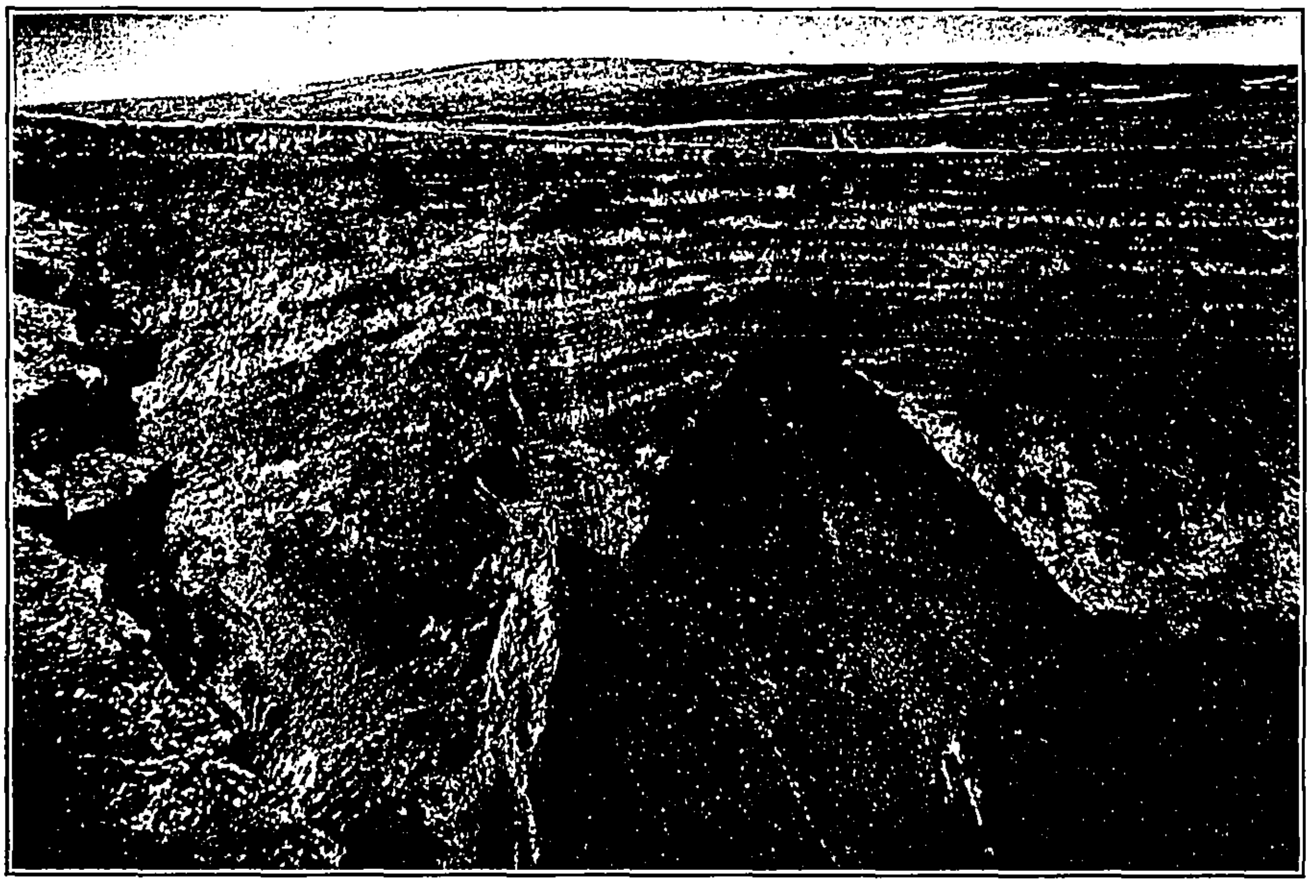
No. 290—Weekly | Hawaiian Volcano Observatory, National Park, Hawaii | July 17, 1930



Map of Halemaumau, with twenty-foot contours, showing pentagonal form and star-shaped peaks of the big talus conoids at the five angles of the pentagon.

THE WALL PLANES OF HALEMAUMAU

There is much evidence in the manner of eruption of the lava pits of Hawaii to prove that these pits, although apparently circular, are really guided by definite upright planes. This applies equally to the large sink craters, like Kilauea and Mokuaweoweo, and to the small pits, such as Halemaumau or Makaopuhi. It is clear enough, from an inspection of the map, that the Chain of Craters extending to the southeast from Kilauea, is on a curved line, and this curved line must be guided by some geometrical echelon of cracks, if not a single crack. The outstanding event of the last twenty years at Halemaumau, which



Angle between southwest and south walls of Halemaumau showing the big west talus and Mauna Loa in the distance. Photo Wilson.

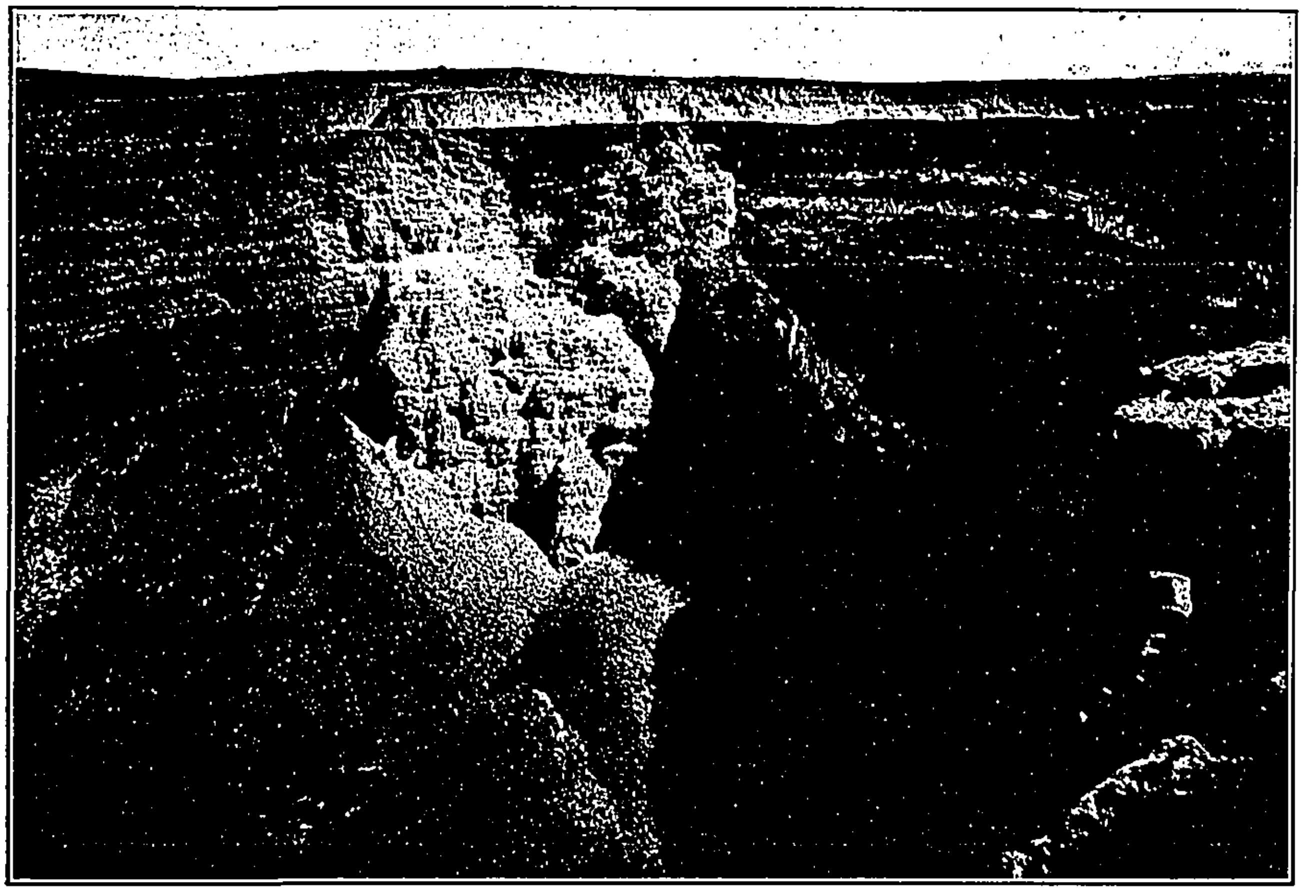
proved connection between a deep crack in the mountain and the opening of the pit, was the cracking open of the southwestern desert flank of Kilauea in 1919 to make a flow, and the visible drainage of Halemaumau at the same time through an upright crack in the wall of the pit (see the two black caverns in southwest wall, map on Page One above).

This map was made in July, 1928, with much care, and reveals a five-sided cauldron, with well marked angles between the five sides, and the light shade of open contours rising into a point at each of these angles indicate the peaks of conical talus slopes. In between these taluses there are rock walls. Four of these walls are fundamentally important planes in the mechanism which has generated the pit. These are the ones northeast, northwest, southeast and southwest. The fifth side is the north wall (Page Three), a remnant buttress between two gulches which are tending to join behind it at the extreme north corner of the map. That buttress has been undermined by avalanches right and left for years past, and threatens some day to fall into the pit and make a big avalanche, which would leave the pit four-sided.

If the reader will consult the outline map on Page Four, and there study the shape of Kilauea Crater, within the floor of which Halemaumau is an inner pit, he will find that the larger sink is also five-sided, with the two longer dominant walls northwest and southeast, and two shorter end walls northeast and southwest. Here also at the north there is a cross wall between the Volcano House and the Military Camp which is backed by the Sulphur Banks platform, an ancient remnant of a former crater floor, which if removed, along with the downfaulted Byron's Ledge, would leave the crater four-sided. Byron's Ledge is the triangular piece separating Kilauea from Kilauea Iki. It is thus clear that the outline of Halemaumau is a miniature of the outline of Kilauea, and both have their longer axes in a northeast-southwest direction on an extension of the 1920 rift. This rift is a deep fracture in the mountain, which has given vent to many lava flows off to the southwest.

The appearance of the Halemaumau walls is clearly shown by the photographs on Pages Two and Three. The picture on Page Two shows the great western talus with the western angle of the pit above it, a small talus cone adjoining it on the left, and this immediately below the rift caverns of 1919, and on the extreme left the south angle of the pit. Here are shown three of the wall planes, the ragged edge of the left hand foreground being part of the southeastern wall.

The picture on Page Three exhibits the north wall of the pit in bright sunlight, with a talus on each side of it, and this shows what is meant by referring to that wall as a lumpy buttress likely to fall away and leave a single angle behind it where the northeast and northwest walls meet. These two wall planes are shown right and left, the right hand one exhibiting the great white sill with a talus athwart it in the shadow, while in the foreground on the right is seen a craggy bit of the southeastern wall.



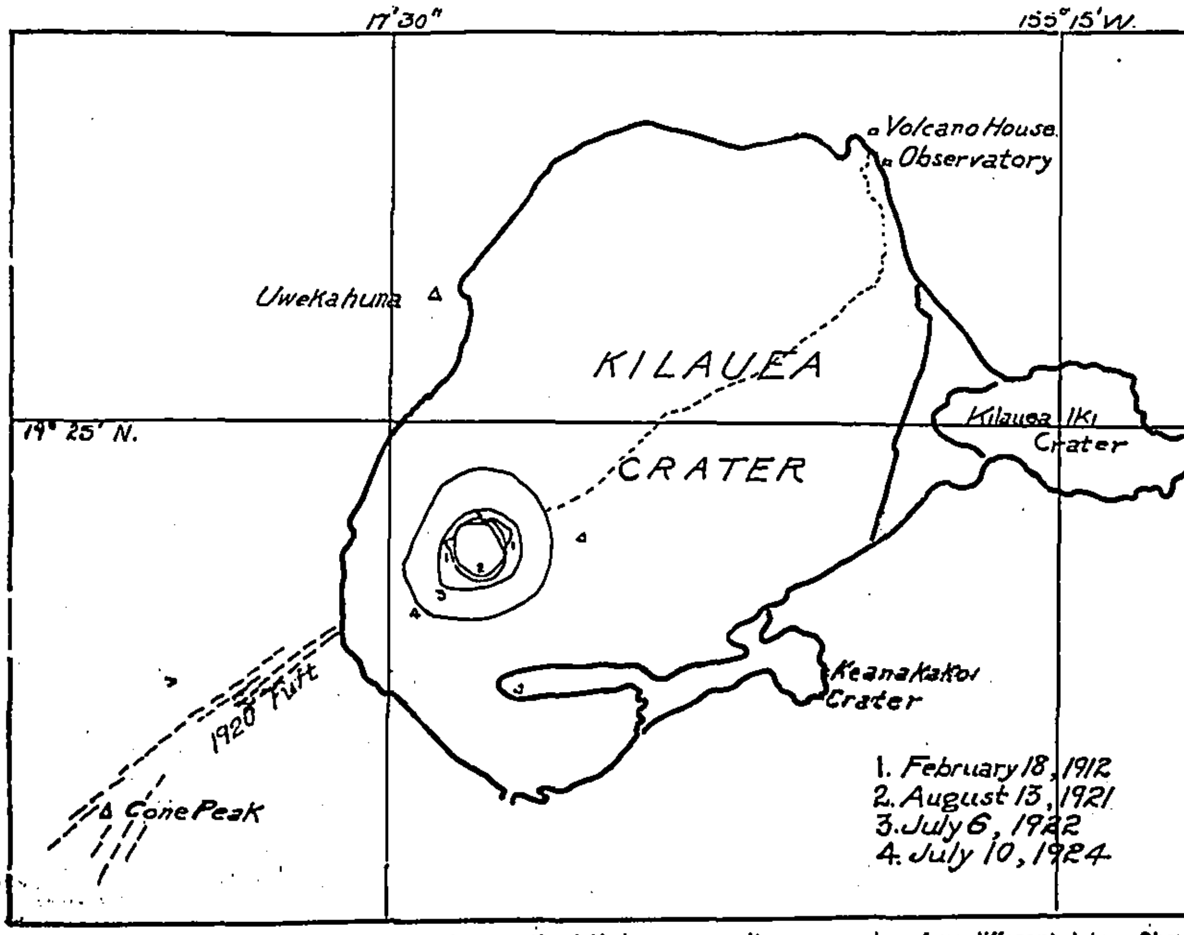
North wall of Halemaumau showing north and northwest taluses and protuberant buttress at north corner of the pit. Uwekahuna bluff in background. Photo Wilson.

Now if we go back to the map of Halemaumau, there will be seen across the bottom of the pit four small circles in a NE-SW line, which line if extended coincides with the rift tunnels at the southwest, and with a dyke or fissure filling which extends up and down the northeast wall (see upright line athwart the great sill on the right of the talus in the shadow in cut on Page Three). These bottom vents lay along the crack which opened in the bottom of Halemaumau July 7, 1927, the southern one building up into a big cone. A huge landslip from the north fell on the floor which was left January 11, 1928, and apparently cracked the floor in a semicircle around the lobate front of the landslip so as to let fresh lava ooze up and well out in a short-lived eruption. The fundamental crack of 1927 was approximately parallel to the northwest wall of the pit, and also to the northwest wall of Kilauea Crater. We may conclude from this that when Halemaumau revived after three years of repose, the deep rift which guided the revival was the great southwestern crack. And this great crack, in the original downbreak that formed Kilauea Crater, guided the production of the northwest and southeast walls of that crater.

The map on Page One shows that the northwest and southeast walls of Halemaumau have comparatively gentle slopes toward the center, and in plan they tend to converge toward the southwest. The northwest and southeast walls of Kilauea Crater (Page Four) also converge in plan toward the southwest. Apparently the great southwestern rift tends to have its cracks fan out or diverge in the direction of the rounded dome of the summit of the mountain and this is what has shaped the breaks which have determined the longer axis of both inner and outer craters.

All of the activities of rising lava in the pit since 1924 appear to have been controlled largely by the southwest rift. The big lava cone of July, 1924, was at the base of the western talus. The line of active vents of February, 1929, was at the base of the northwestern talus. The line of activity of July, 1929, was again at the base of the western talus. The surface fractures in each of these cases were doubtless determined by the breaking of the cake of lava left in each case at the bottom of the pit by the next preceding eruption. But there is no evidence in any of these outbreaks of lava that the northeast and southwest walls lay parallel to the crack which ruptured under the pit in order to permit the extrusion of lava.

The northeastern and southwestern wall planes of Halemaumau have very different quality from the walls of the pit which lead to the southwestern rift. They lie right athwart this rift and they are almost vertical down to the places where they join the talus. (See left wall, Page Two and right wall, Page Three). In plan these two steep walls also tend to converge, and this time it is to the southeast that the convergence points, which would take us to the Chain of Craters in Puna District off beyond Keanakakoi and Kilauea Iki. This is the second great flow rift of Kilauea mountain, and the two walls northeast and southwest of Kilauea Crater also trend in that direc-



Outline of Kilauea Crater and the stages in growth of Halemaumau pit as mapped on four different dates. Shows control of longer axis by southwest rift.

tion, as though the Chain of Craters rift tended to fan open into several major cracks as it approached Uwekahuna, the summit of the Kilauea dome (see Page Four).

If now we imagine the primitive Kilauea dome covered with lava flows from a summit well at the height of the top of Uwekahuna bluff and over the middle of Kilauea Crater, it appears likely that the flank of the mountain fractured and let out floods of lava southeast and southwest. When this period of big flooding ceased in prehistoric times, the top of the mountain tended to cave in about the meeting points of these two sets of rifts, each of which tended to finger apart and to cross each other at the summit region. This crossing of convergent southeast and southwest cracks determined the polygonal outline of Kilauea Crater as a sink, and it in turn determined the polygonal outline of its inner pit as a secondary sink.

T.A.J.

KILAUEA REPORT No. 964

WEEK ENDING JULY 13, 1930

Section of Volcanology, U. S. Geological Survey

T. A. Jaggar, Volcanologist in Charge

There are very few changes to be reported at Kilauea Volcano. The sulphur area on the south floor of Halemaumau remains whitish and appears to be spreading slightly. Steam vents within the pit remain inactive. On July 10 thin, light dust rose at 2:50 p. m. and at 3:25 p. m. Small rock slides at the north corner were observed July 11 and 12. The west wall has had additional dusting from small slides.

The seismographs recorded eight disturbances on the 7th, 8th, and 9th. Of these four were tremors of less than one minute each, and four were very feeble local seisms. Two of the latter showed distance phases of 14 and 18 miles from the Observatory. One was accompanied by tilt to the east. No disturbances were recorded after the 9th.

Tilt accumulated moderately NNE, with movement strongest to the north. Microseismic motion was slight.

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The Volcano Letter

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Rising lava lake and crag mass December 15, 1916, from northeast rim of Halemaumau. The several terraces on the crag mass are overflow benches which have slowly tipped up. A time of strong rising. Photo Jaggar.

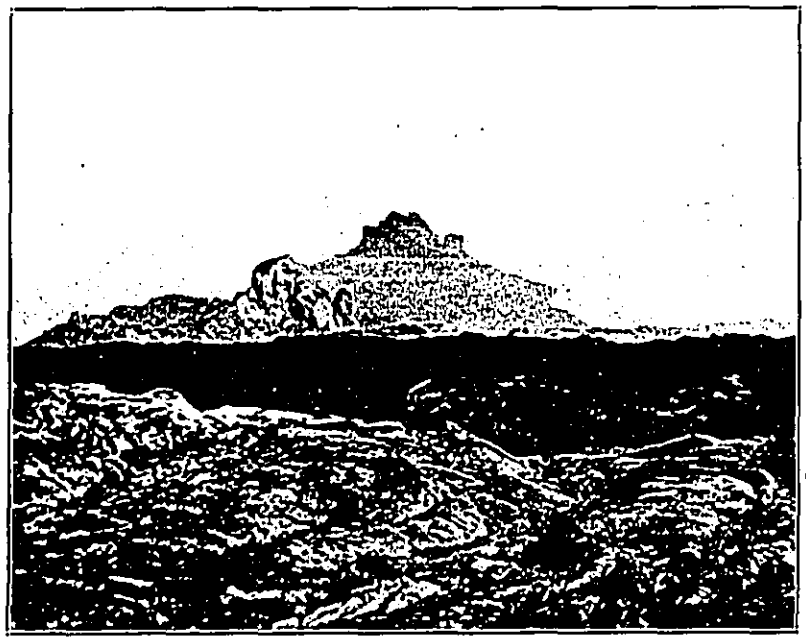
WHEN THE PIT LAVA RISES

To the observer on the brink of Halemaumau, that vast cauldron of the present day some 3,400 feet in diameter and 1,000 feet deep, the rising of the lava in the bottom is a very slow process. At present the bottom has shallowed more than 300 feet since June of 1924, but this has proceeded entirely by the building of layers in several eruptions in 1924, 1927, etc. The rising of the lava column in the bottom of Halemaumau becomes a continuous process very different from this piecemeal building of layers when the inpouring of the slag behaves as it did between 1914 and 1924. This was a real rise of the lava column, and the phenomena distinctive of rising lava are worth examining.

During the six years beginning with 1914 the top of the live lava in the bottom of Halemaumau pit rose gradually from a position 600 feet below the rim of the pit to the top, so that the rim was building up, lava flows occasionally poured over the rim, and other lava flows in great volume poured for months at a time up cracks a little way back of the rim. These last were just as much "overflows" as the spillings which crossed the actual rim of the pit. They equally were draining the pit lava, but by mechanism of internal expansion of lava gas which permits the fluid to well up small outlying cracks to higher levels than are occupied by the broad open effervescing lakes. The mechanism of lava overflow as contrasted with flank outflow has been reviewed in Volcano Letters Nos. 280 and 282.

The rate of rising during a big rising spell was thus approximately 100 feet per year, but this is merely the statistical result, for the actual risings were often much quicker, and the prolonged rising spell was interrupted by many sinkings of hundreds of feet, each occupying either a few days, a few weeks, or several months. Sudden subsidences of from 50 feet to 400 feet occurred repeatedly, and rapid risings averaging about 30 feet per month were common.

These risings of 30 feet per month were themselves



Halemaumau full of lava in September, 1918, showing lifted crags from the west. Observer is at level of pit rim. Looking across fresh flows dating from March, 1918. Photo Jaggar.

punctuated by risings and fallings of 10 or 15 feet from week to week, this being particularly noticeable at times when the curve of major rising tended to flatten out to a spell of relatively stationary lava preparatory for a temporary decline. The same thing was true of a stationary period at the end of a temporary decline, when the lava would fluctuate more from week to week than during a term of steady strong rising. There were times during the early years of work at the Observatory (and something of the same sort has been noticed for earthquake frequency during recent years) when the observers thought they detected a periodicity of three weeks in the fluctuations.

The most rapid rise ever recorded at the Observatory was during the month following November 28, 1919, when both liquid lava and crag lava rose 30 feet a day, making the crag lava into a ring-island as recorded in Volcano Letter No. 282. Excessively rapid rising of this sort is accompanied by unusually strong effervescence of gas, implying an exceptional release of pressure on the underlying magma. In this particular case, Mauna Loa had just finished an eruption, its underground lava had presumably sunk back into the depths, and this in connection with the Kilauea lava had released pressure by causing an enormously rapid subsidence of the Kilauea lava column of some 400 feet in two hours, which was immediately followed by the rapid rising above referred to. Such happenings as this lead to the inquiry, "What makes the lava column rise at all?" This in turn leads to a second query, "Is the sinking of lava an exact reversal of the process that makes it rise?"

These are very pregnant questions. What Dana called the "ascensive force" in lava has been a subject of much controversy and much doubt. This was because the early observers of the Mauna Loa lava fountains describe them as glistening jets like molten metal ejected hundreds of feet into the air, and these observers did not perceive that they were impelled by gases. They were looking for steam, the traditional gas of the Italian volcanoes, and when they saw no steam condense, they inferred that the spouting must be hydrostatic. To get hydrostatic spouting in a molten slag free from gas, on the top of Mauna Loa 13,000 feet above sea level, it was necessary to imagine expanding forces within the liquid itself, or else to imagine a pressure on the reservoir deep under the mountain such as might be produced if blocks of the earth's crust were settling on top of the liquid.

All of this presumed liquidity for the underground lava as a matter of course, and such an assumption created great difficulty if one attempted to connect Mauna Loa with Kilauea hydrostatically. If Kilauea were open at 3,500 feet elevation, necessarily it ought to drain Mauna Loa if the two were connected. Both were open at times and erupting together, yet Kilauea did no draining. Therefore, so ran the argument, the two are totaly unconnected. William Lowthian Green combated this, and insisted that the two show a sympathy of alternation of eruptions.

These difficulties disappear when lava is understood to be a dense glass at high temperature, with many times its volume of hydrogen, sulphur and carbon gases dissolved within it. Deep in the cracks under the mountains this glowing gas-charged glass is so compressed as to be almost a solid. In such condition it may be thought of as an enormously expansible and combustible paste. If Nature pulls apart the crack which it occupies, the gases puff it up like beaten foam. If the gases thus by release of pressure unite in bubbles, they mix with air and burn. If they burn they heat the foam more than before and make the mass more liquid. Greater liquidity means more mobility and a foam pressure capable of opening cracks and doing work like a steam engine. But here we have rather a chemical engine, a multiple expansion engine and a heat engine all combined in one. This engine is dependent on Nature for cranking it, and for supplying the gas-charged glass, or "magma." Given an age-long supply of magma up the cracks, and a systematic self-starter which will pull the cracks apart once in so often, and volcanic eruptions will result.

The supply of magma in Hawaii and similar basaltic volcanoes is unquestionable; it builds new layers of land and new promontories in the sea, and swells up the islands by intrusion. It makes the island ridge bulker than it was before. Probably this is at the expense of the sea bottom round about, which may sink proportionately lower than it was before. If so, the magma is the matter of the primitive substratum of rock-forming glassy paste under the crust 30 miles down. It is eternally rising until the ridge of its own building becomes so massive that its weight balances the downsinking blocks of sea floor. Then and then only will volcanic eruption become "extinct."

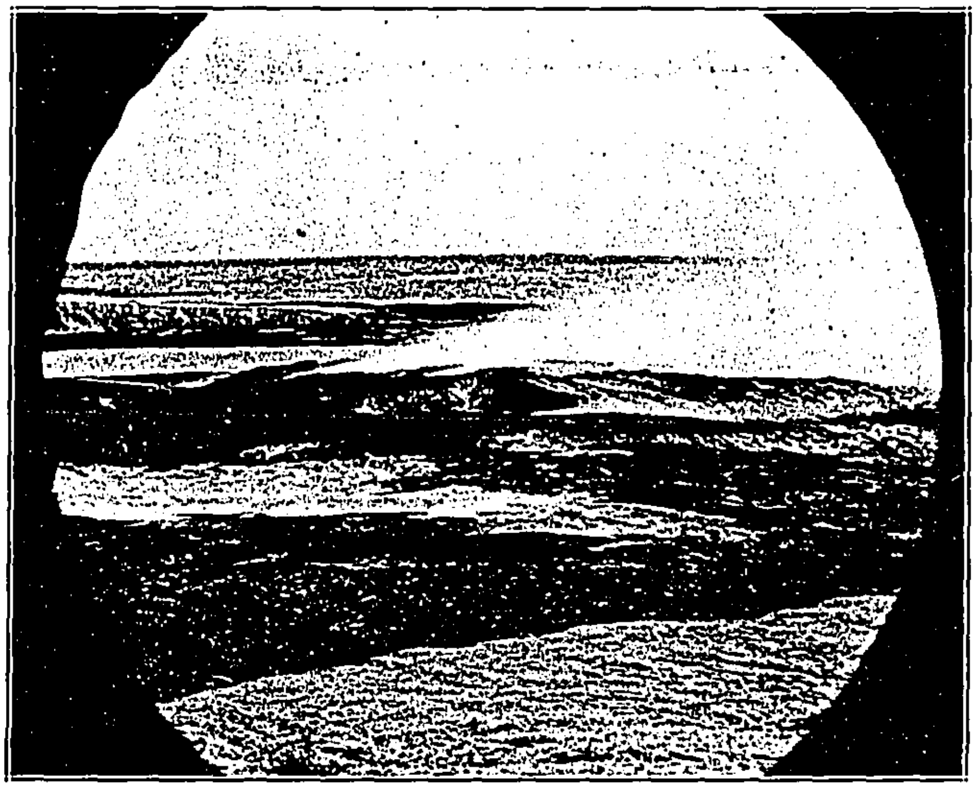
After outpouring of lava ceases, intrusive irruption of lava in cracks and among strata may continue and swell the country and heat the springs, long after the volcanoes have ceased to give vent to lava. This continuity of internal activity ought to be measurable on the surface of the country, if we study changes of the plumb line, changes of elevation, relation of these to earthquakes, and changes of temperature and composition of hot springs. There is little sense in laboriously studying things like earthquakes and hot springs unless we study them IN RELATION to something. These time and change relations are worth while. There is no fixed observatory in the hot spring belt north of San Francisco to tell us how the ground changed its tilt, and how the ground-water changed its salt content, its temperatures, and its flow after the great earthquake of 1906.

But what is the systematic self-starter that makes lava rise? In 1924 in Hawaii the "eruption" came to an end. Lava immediately reappeared in the bottom of the pit. It froze there. In 1926 it reappeared in great force on the top of Mauna Loa. In 1927, 1928, and 1929 it reappeared mildly in Halemaumau. In the autumn of 1929 its intrusion shook up Hualalai. Perhaps after all nothing came to an "end." Perhaps after all the engine is always running and Nature puts her foot on the accelerator rather than on the self-starter. Her accelerator is any force that will pull the trigger to ease the pressure on the gas-charged paste.

There are the crust blocks of the sea bottom acted on by centrifugal force as the globe whirls. There are the changes in that force as the sun and moon make tides in the earth itself. There is the greater diameter of the equatorial protuberance of the globe, acted on angularly by these forces. There is the cracking down of the great Hawaiian ridge along its old fault or rift planes as the lava flows drain its reservoirs, or fracture it with steam blasts, or upset its water drainage, or settle its crater wedges, or weight down its flanks. The "yielding of the edifice," as an engineer would say, is probably the most potent control of the accelerator, and a cone would not build itself in a circle without a geometrical law of control of the vent by the arrangement of the structure. It is the final task of volcanology through the ages of man to discover this law.

T.A.J.

North rim of Halemaumau November 2, 1918, with floods of fresh lava pouring from an outside crack at a level higher than the lava lakes in the pit. These flows as shown were cascading inward to the pit on the right. Photo Jaggar.



Telephoto of Halemaumau May 9, 1919, from west bluff of Kilauea. Fresh overflows in foreground. The lava column was now topped with a swollen dome above rim of pit, punctured with lava lakes. Photo Jaggar.

KILAUEA REPORT No. 965
WEEK ENDING JULY 20, 1930

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

Steam continues to be absent from the vents in Halemaumau pit. This may mean that the top of the Kilauea lava column lies close to the surface of the volcano edifice and thus dries up moisture seepage. Dry weather has been prevalent, however.

A large section of the east rim fell on July 15 at 10 a. m. This leaves the 14-ton bowlder of 1924 nearer the edge of the pit. Small rock falls on the north wall were noticed from time to time. Some slides southeast on July 19 were caused by visitors dropping rocks.

Thirteen seismic disturbances were recorded by the seismographs during the week, classified as follows: Six tremors, the longest having duration two and one-quarter minutes; six very feeble local seisms, two showing origin distance 23 miles from the Observatory and one showing 14 miles; and one teleseism which registered faintly at 12:41 p. m. July 14. No disturbance was perceptible.

The net accumulation of tilt was very slight SW. Microseismic motion was slight.

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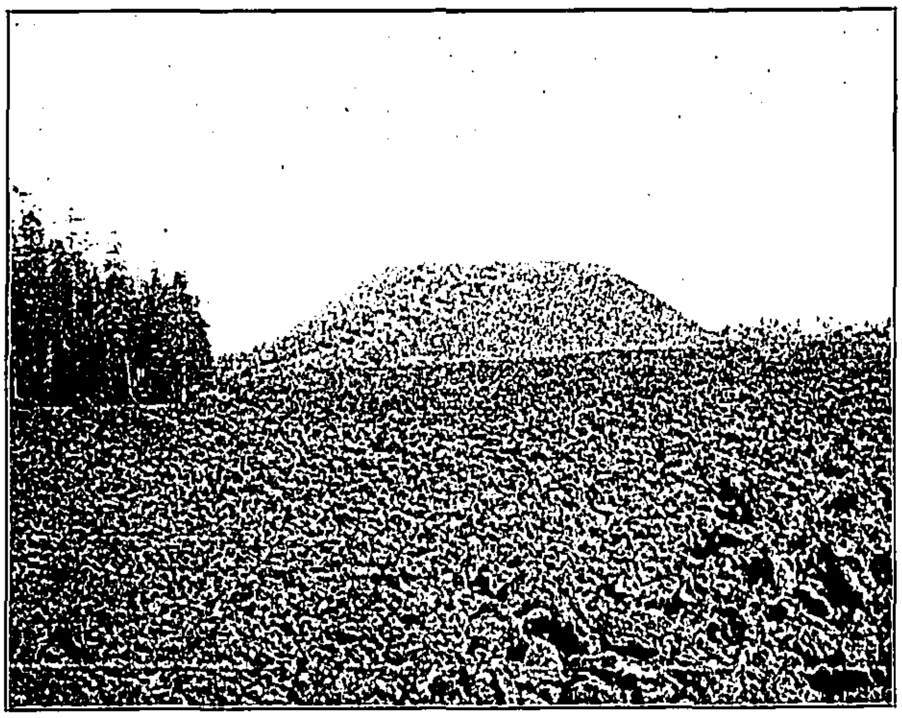
No. 292—Weekly | Hawaiian Volcano Observatory, National Park, Hawaii | July 31, 1930



An aa flow of basaltic lava and the cinder cone associated with it called Burnt Lava Flow. Photo Powers.

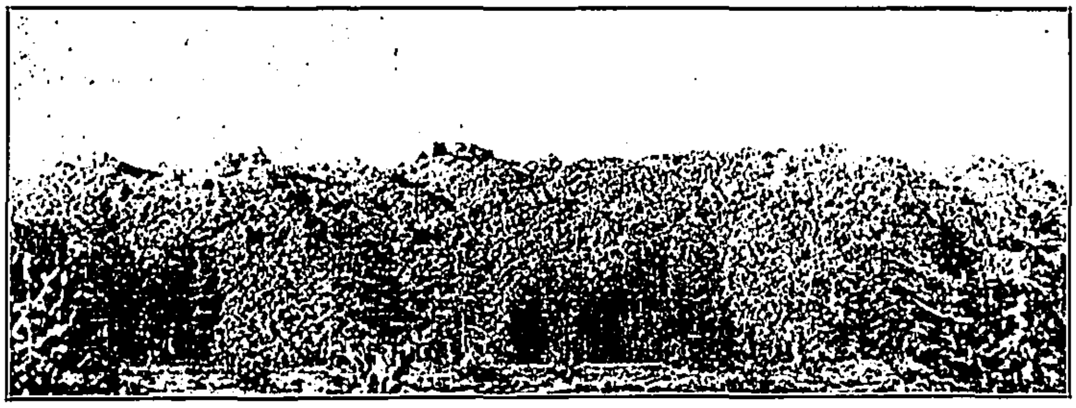
THE GLASS MOUNTAINS OF NORTHERN CALIFORNIA

Among the legends of the Modoc Indians of northern California are stories of an ancient time when their hunting grounds trembled beneath their feet, when the silence of the forest was broken by strange thunder, and the mountains around their Medicine Lake were lighted up by unearthly fires. Today, the presence of a number of flows of fresh looking lava and mountains of pumice in this area suggests that the Indian legends describe the last activity of a small volcano. Medicine Lake, in the heart of this region of recent volcanic activity, is located north of Lassen Peak and about 30 miles east of Mount Shasta in northern California.

This interesting volcanic region may be easily reached by automobile from Shasta City, California. Since it lies within the boundaries of the National Forest Reserve, one must first obtain permission to build fires in the forest from the Forest Supervisor at Shasta City, who also makes sure that every automobile in the party is equipped with a shovel and an ax as a rough and ready fire control. This is a regulation passed for the protection of public property and is very rigidly enforced. On one occasion two prominent government officials were ordered out of the National Forest because they had failed to equip their car with an ax and shovel.

Leaving the Pacific Highway near the city, one passes over a long ridge built up by lava flows from Mount Shasta. The flows are of great age and their surface is mantled with a rich soil which supports a luxuriant growth of pine and fir. The road soon drops down into the valley of the McCloud River and passes through the flourishing little lumber town of McCloud.

A few miles beyond, the road becomes extremely dusty and many dead and dying trees are noticed in the forest. This is the country which was buried by a so-called mud flow from Mount Shasta in 1925. This mud flow was not of volcanic origin; in fact, quite in contrast, it was caused by a glacier on the high slope of the mountain. As the river of ice moved slowly down its valley, it ground up quantities of rock into a very fine powder called rock flour. At the lower end of the glacier, this rock flour piled up with unpowdered rocks and other debris to form a sort of dam called a terminal moraine. During a period of very hot weather in 1925, a great deal of the ice of



A flow of rhyolitic lava north of Medicine Lake, with a flat but rugged top and a nearly vertical flow front over 100 feet high. Photo Peacock.

the glacier was melted and this terminal moraine became so saturated with the water from the melting glacier that it became a huge pile of very slippery mud. It immediately began to slide and the slope of the valley was so steep that it became a veritable river of mud which flowed for several miles, burying the underbrush and piling up around the trunks of the forest trees in its path.

Soon after leaving the mud flow, the road begins a long, gradual climb up the gentle slopes of an old volcanic dome. This was built up by lava flows from a little satellitic vent on the eastern slope of the mighty volcano which formed Mount Shasta. After the lava stopped flowing from this little volcano, the top of the dome began to settle and a circle of cracks was formed around the summit. If this settling and cracking had continued it would have yielded a large crater in the top of the dome very comparable to the large crater on the top of Kilauea. However, the sinking of the top was interrupted by another outburst of lava which issued from a number of places along the circle of cracks around the top of the dome. These numerous small eruptions built up a circle of cinder and lava cones which formed a crown upon the top of the older volcano. Futhermore, the crown of small volcanoes formed the rim of a large basin-like depression, which was filled with water to form a large lake. The water for the lake was supplied by the melting of many small glaciers at the end of the Ice Age. Since that time, the supply of water by ordinary rain and snow fall has not been great enough to keep pace with the evaporation from the lake, and the original large lake gradually decreased in size until it became the present Medicine Lake. Thus it is that Medicine Lake is located on top of a volcano and yet is not a simple crater lake.

Long after the end of the Ice Age, the old volcano took a new lease on life and broke out with many small eruptions on its flanks and its top. Those from its top emitted lava and pumice of rhyolitic composition. They are very rich in silica and low in iron and magnesia, contrasted to a basalt which is low in silica and high in iron and magnesia. While all of these summit eruptions happened much more recently than did the main eruptions of the volcano, they did not all take place at the same time.

The earliest of the late flows came out of a crack in the top of the volcano just north of Medicine Lake and spread out over a square mile of the old lake bed. The lava was extremely viscous and spread somewhat after the fashion of very cold tar. As a consequence the outer edges of the flow were maintained as nearly vertical walls over 100 feet high. Since the lava cooled, the rock has been broken a good deal by freezing and thawing and by the prying action of the roots of trees which grew on the flow. These broken blocks have fallen to the foot of the flow front and form talus piles which hide much of the original steep wall of the flow. However, the slopes are much too steep for safe climbing, especially in view of the fact that the lava is almost like a glass and breaks into knife-edged fragments. The photograph on Page Two shows the edge of this flow. It also brings out the fact that the top of the flow is very rugged. Broadly viewed, the surface of the flow is quite as flat as the surface upon which it spread, but in detail it is made up of a maze of crags and depressions. During the movement of the lava, the upper parts of the flow cooled quickly into a thick crust, but the lava beneath was so viscous that it could not flow quietly beneath this crust as does the Hawaiian basalt in a pahoehoe flow. Therefore,the movement of the flowing lava continually shattered the frozen crust and carried the blocks along on the surface of the lava stream. These blocks were titled and jumbled together, and when the flow ceased its movement and all of the lava consolidated, the blocks were frozen in the top of the flow in every conceivable position. It is this haphazard chaos of broken blocks which makes the top of the flow so rugged.

In the last phase of the summit eruptions, which is probably the one described in the Indian legends, there were both flows of lava and ejections of pumice. At one locality west of Medicine Lake and just outside of the cones which form the crown of the mountain, the explosions were so violent that they built up a mountain of pumice about 800 feet high. This huge pumice cone is the white knoll in the right background of the picture on Page Three. It is formed entirely of white and grey pumice in pieces ranging in size from that of small peas to that of a man's head. All of it consists of volcanic glass blown so full of volcanic gas bubbles that even the largest pieces will float on water.

Two of the lava flows of this last eruption are of enormous size and thickness and form what are called Big and Little Glass Mountains. Both mountains are almost entirely devoid of vegetation. Big Glass Mountain lies to the east of Medicine Lake and its lavas cover more than nine square miles and are piled up in the center to a height of about 1,000 feet. It is not easily accessible, but it is actually only a larger model of Little Glass Mountain which is passed by the road into the lake. Little Glass Mountain is made up entirely of volcanic glass with the chemical composition of a rhyolite. The outer edges of the flows are very similar in structure to the edge of the older flow shown in the photograph on Page Two. The broken edges of the glass from this flow are even sharper than those described before. The lava of the Little Glass Mountain flow has frozen in a great many different forms. Much of the top of the flow is really a froth of volcanic glass and looks very much like a rubber bath sponge except that it is made of glass. At the other extreme, much of it is a dense, black glass which is called obsidian. This is the material from which the Indians made many of their arrowheads and cutting implements. Then between the two extremes can be found all intermediate stages, from obsidian with a few large bubble holes to bath sponge stuff with streaks of solid obsidian drawn through it.

The frothy top of the flows have been thrown into waves and troughs by the movement of the flows so that the surface of the mountain when viewed from the forest lookout on Little Mount Hoffmann presents somewhat the appearance of a lake of froth with ripples roughly concentric about the center from which the flow issued. This phenomenon is poorly apparent in the photograph of Little Glass Mountain on Page Three.

The many small eruptions from the flanks of the old volcano yielded lava and cinders of basaltic composition, very similar to the lavas of Kilauea. Most of the flows are small and incline more to the aa than to the pahoehoe surface texture. Over each small vent from which a lava flow issued was built a cone of cinders and slag. The small vents were so numerous and so close together that large areas of the mountain flanks are covered with rough basaltic lava and dotted with cinder cones. This broad waste land on the north flank is called the Modoc Lava Beds and formed excellent hiding ground for the small band of Indians which resisted a large force of American troops in the Modoc Indian War.

One of the youngest flows of this basaltic lava with its associated cinder cone is called Burnt Lava Flow and is located on the southeast flank of the mountain. It is so young that it supports almost no vegetation as can be seen from the photograph on Page One. Mr. Finch and a party from the Lassen Volcano Observatory are planning to determine if possible the exact age of this flow. Its eruption probably occurred within the last 500 years, though it is actually older than the pumice eruptions from the top of the volcano near Medicine Lake since little pockets of the pumic can be found on the surface of Burnt Lava Flow. H.A.P.

KILAUEA REPORT No. 966

WEEK ENDING JULY 27, 1930

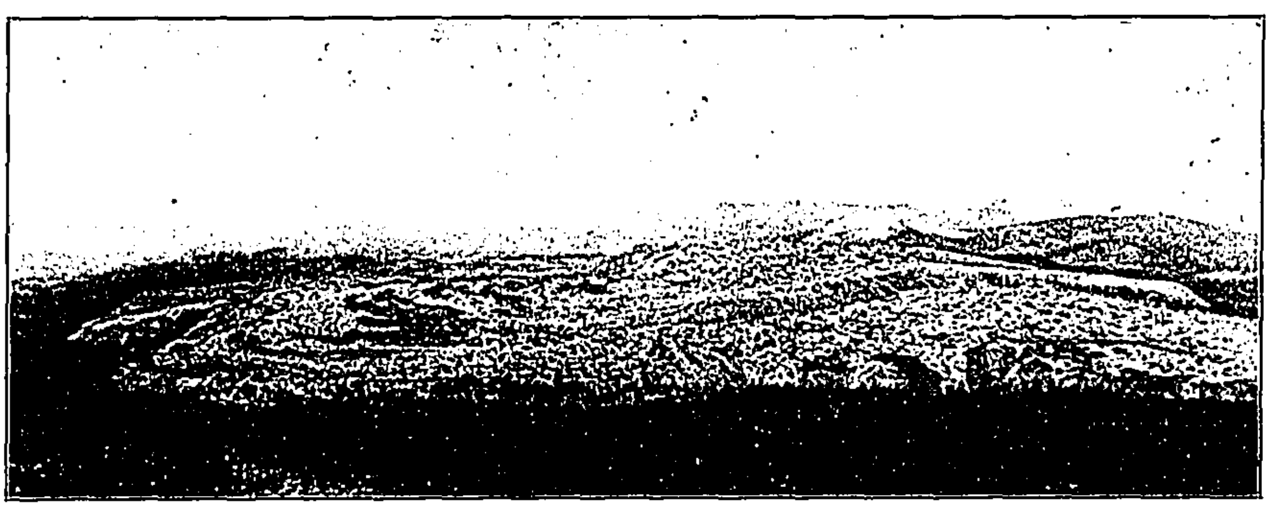
Section of Volcanology, U. S. Geological Survey
T. A. Jaggar, Volcanologist in Charge

On July 21, after week end rains, steam reappeared on the south talus in Halemaumau. Still more steam was noticeable in the pit during rain on July 26. A few wall slides occurred during the week, notably one at 5:50 p. m. July 25. There was no change at the 14-ton bowlder.

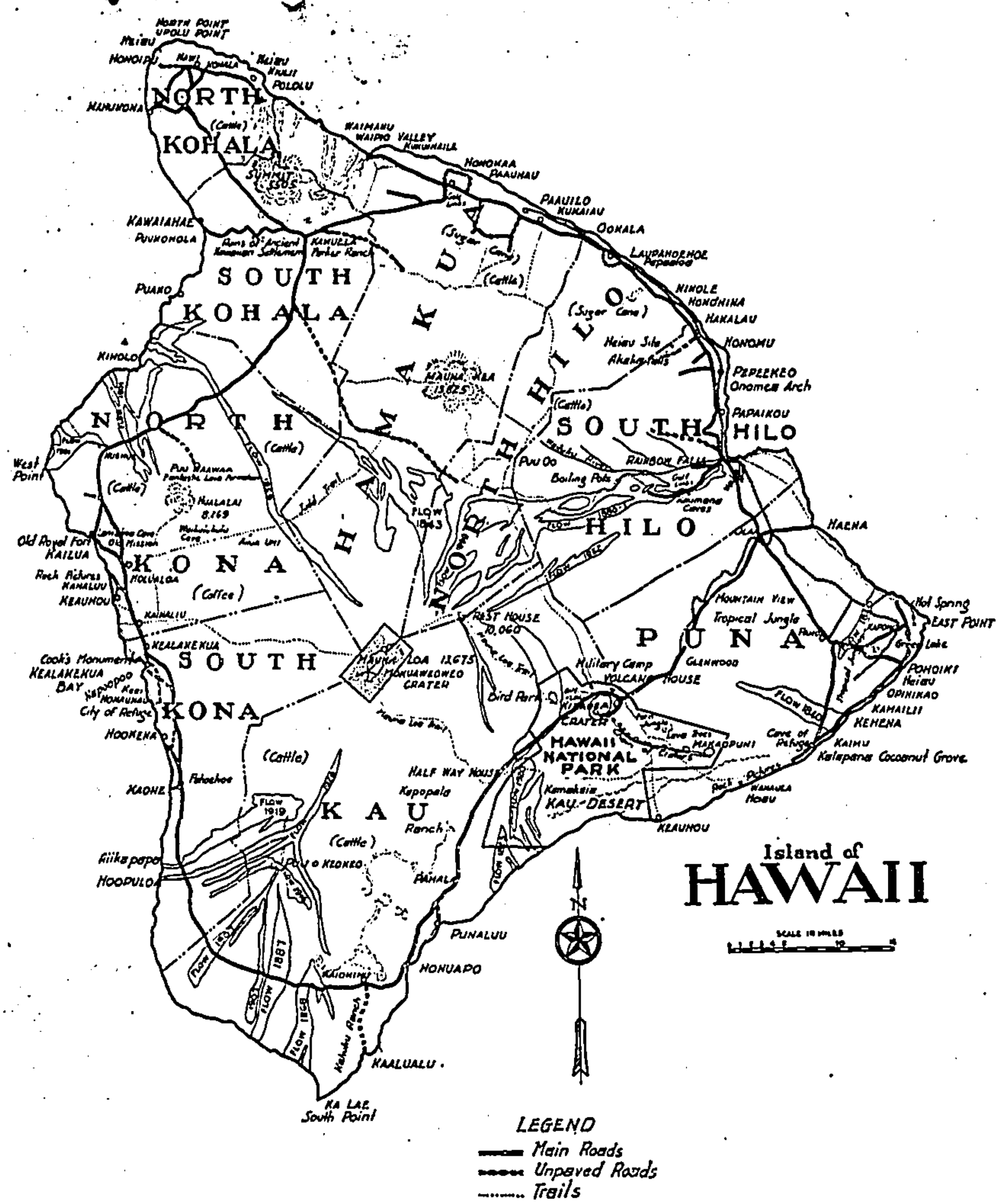
An earthquake at 1:53 p. m. July 22 was felt generally all over the island, especially in North Kona. Workmen at the halfway house on the Mauna Loa trail were severely jolted. No damage was reported, but the shock was alleged to have been the strongest since the Hualalai series of the previous autumn.

The instruments recorded a total of 10 seismic disturbances for the week. Four of these were short tremors, five were very feeble seisms, and one was a moderate shock felt as described above. Its epicenter appears to have been in the saddle between Hualalai, Mauna Kea, and Mauna Loa. Two of the very feeble seisms were also perceptible; one at 3:10 p. m. July 22 at Paauilo, and one at 3:54 p. m. July 27 at Kapapala Ranch, Kau.

Tilt for the week was slight ENE. Microseismic motion was slight.



A birdseye view of Little Glass Mountain, built up of flows of rhyolitic lava. A mountain of pumice appears in the right background. Photo Powers.



THE VOLCANO LETTER

The Volcano Letter combines, after January 1, 1930, the earlier weekly of that name, with the former monthly Bulletin of the Hawaiian Volcano Observatory. It is published weekly, on Thursdays, by the Hawaiian Volcano Research Association, on behalf of the section of Volcanology, U. S. Geological Survey. It promotes experimental recording of earth processes.

Readers are requested to send articles, photographs, publications and clippings about volcano and earthquake events, instruments and investigations, especially around the Pacific.

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HAWAIIAN VOLCANO OBSERVATORY

Founded 1911

This laboratory at Kilauea Volcano belongs to the Hawaiian Volcano Research Association and is leased and operated by the United States Geological Survey.

It maintains seismographs at three places near Kilauea Volcano, also at Hilo, and at Kealakekua in Kona District. It keeps a journal of Hawaiian volcanic activity and publishes occasional Bulletins

Membership in the Hawaiian Volcano Research Association is limited to patrons of Pacific science who desire personally to aid in supporting the work.

The work of volcano research so supported is in collaboration with the work of the United States Geological Survey, but supplements it with buildings, research fellows, instrumental plants, explorations and special investigations for which there is no governmental provision. The Geological Survey maintains volcano stations in Alaska, California and Hawaii.

Persons desiring application blanks for membership should address the Secretary, Hawaiian Volcano Research Association, 300 James Campbell Building, Honolulu, T. H.