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U.S. GEOLOGICAL SURVEY
MAY 29 1914
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WEEKLY BULLETIN
OF
Hawaiian Volcano Observatory

Vol. II. HONOLULU, HAWAII, JANUARY 7, 1914 No. 1.

From the Pacific Commercial Advertiser, Honolulu, December 28, 1913.

TECHNOLOGY STATION, December 25.—The Christmas season of the winter solstice brings no revival of activity in Kilauea as yet. The gradual rise of the lava of Halemaumau in October and November reached a stationary level at some time early in this month and the movement since, if there has been any, has been a sinking rather than a rising. Until this week the fumes have been too dense for measurement; an approximate measure of depth last Monday, December 22, shows that the present level of the bottom crust is about where it was last April.

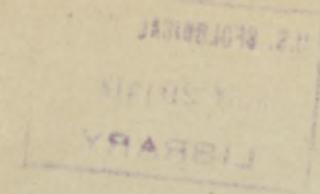
Saturday, December 20, with fair weather and northeast wind, the fumes appeared relatively light and the pit quiet. There was no seeing, but from the north edge faint puffs could be heard with the usual irregular intervals of from half a minute to a minute. Some rock sliding from the north side of the pit could be heard. Time of the observations, 10:30 a. m.

On December 21, at 5 p. m., conditions were much the same, but the fumes were very dense. No slides were heard, and in this respect the present week has been quieter than last week. At about 3 p. m., however, a pronounced rock slide was reported by one party.

At night three glow spots in the floor could be distinguished. A faint, steady glow could be seen from the Observatory, which brightened toward midnight.

Heavy Rock Slides.

December 22, at 10:30 a. m., good views of the bottom and the ring of fumaroles were obtained from the south and southeast stations. Occasional sliding noises and puffs were heard, and heavy rock slides occurred about 11:10 a. m. The sliding could not be seen through the fumes, but it sounded as though it were mostly from the west. Approximate measurements with alidade and plane-table were made from the south and southeast stations, determining the depth of the pit to a fuming hole at the south border of the floor to be 568 feet, and the depth to a fumarole on the south margin of the talus ring, almost under the south station, 394 feet. This would make the height of the rocky cliff, under the eastern A-frame near the automobile terminus, about 400 feet. The wind was very light and from the east, causing the fumes to rise in a column on the north and northwest walls, sometimes over-riding the north edge and burying the stations there in smoke clouds.



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Editor.....Howard M. Ballou
Professor of Physics, College of Hawaii

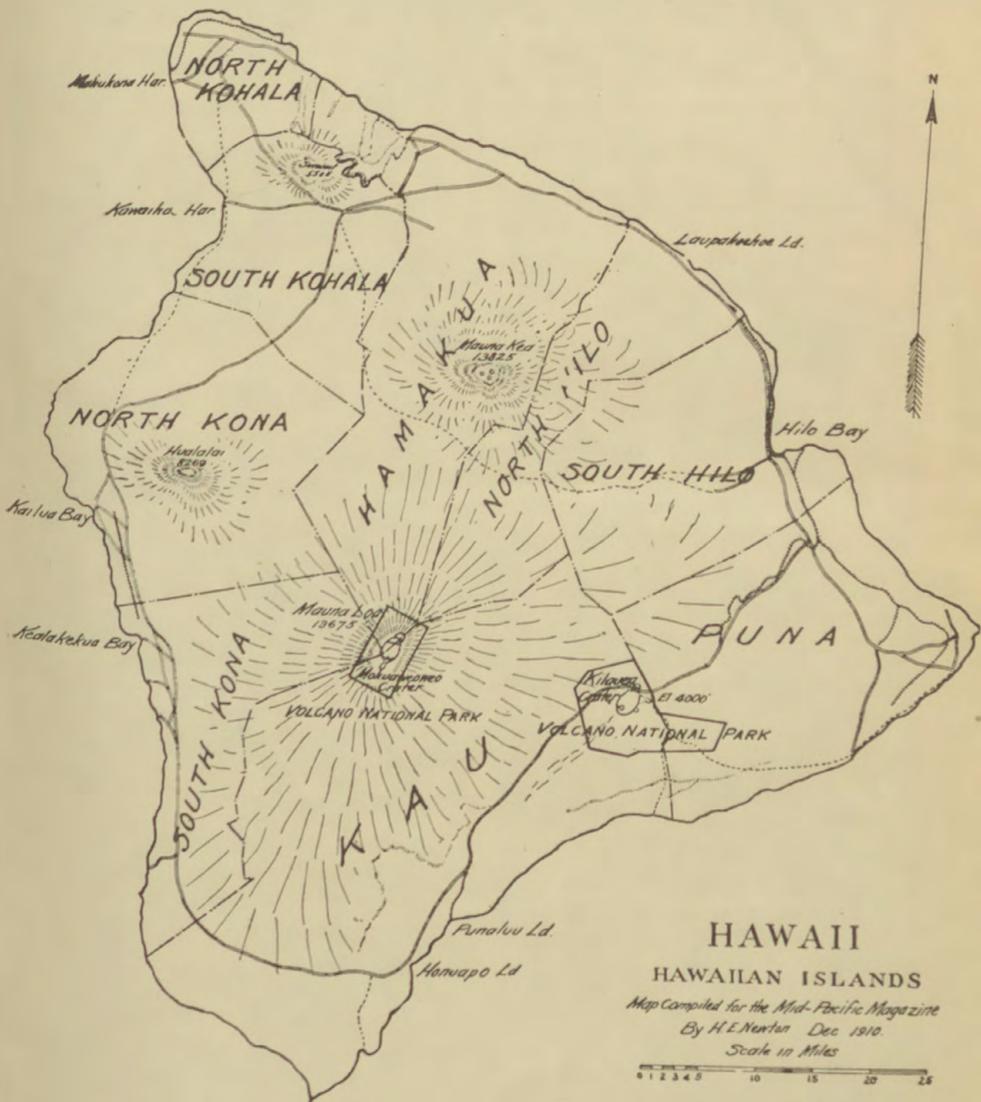
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second-class matter at the post-office,
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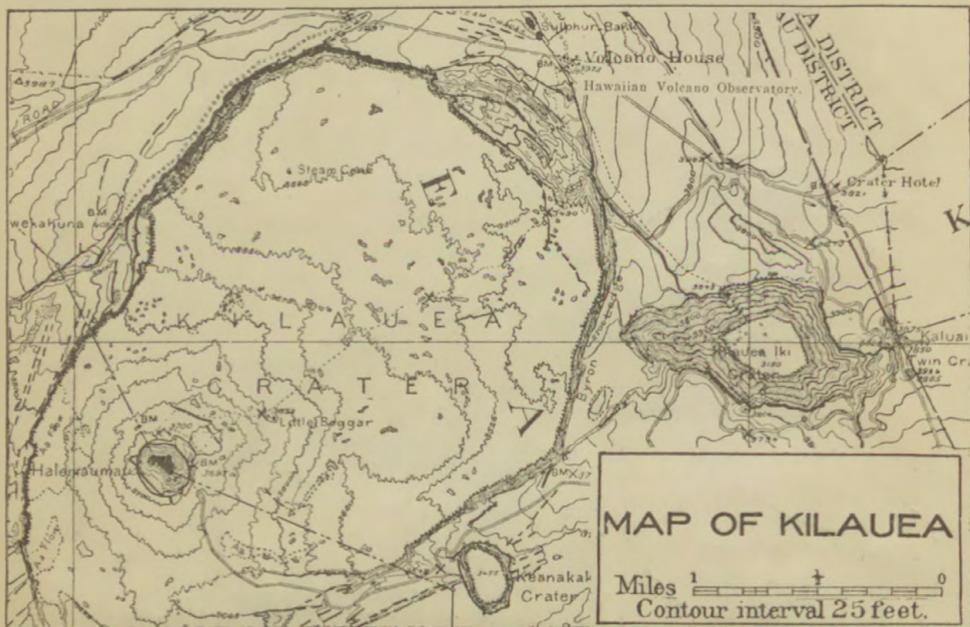
December 23 and 24 the glow seen
from the Observatory was very faint
at night. At 3 p. m. December 24, the
west wall was seen and faint puffing
was heard, but no slides.

Today, December 25, at 11:30 a. m.,
the wind was light from the southwest,
and from the southwest station puffs
could be heard, recorded at intervals
as follows: 65, 90, 27, 30, 17, 60, etc.,
seconds. One rock slide was heard at
11:40 a. m. From the northwest sta-
tion the floor and western fumaroles
could be seen. Large fuming patches
in the talus were seen west and north
of the bottom area, a high one in the
rock wall north, and dimly the lava
floor of the bottom could be made out,
apparently overridden by talus. The
two holes in the west wall now appear
about halfway up.

There have been no unusual seismic
happenings this week.

T. A. JAGGAR JR.,
Director.





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The Whitney Laboratory of Seismology is equipped with two Bosch-Omori 100kg tromo-

meters registering N-S and E-W motion, a heavy Omori trometer registering E-W motion and an Omori "ordinary Seismograph" designed for registering strong earthquakes in all three components of motion. These are seated on concrete piers in a closed basement room having practically constant temperature, beneath the chief Observatory building near the hotel. For the present, time is referred to a rated chronometer, loaned by the College of Hawaii. At the substation by the edge of the active pit an Omori two-component trometer with light steady masses is mounted on a concrete pier placed directly on the fresh lava surface. Hawaiian standard time (H. S. T.) is 10 hrs. 30 m. slower than Greenwich time.

CANCANI SCALE OF SEISMIC INTENSITY

Expressed by accelerations measured in millimeters per second per second.

| | | | |
|-------|-----------------------------|--------|---------|
| I. | Instrumental | 0.0 | 2.5 |
| II. | Very slight | 2.5 | 5.0 |
| III. | Slight | 5.0 | 10.0 |
| IV. | Sensible, mediocre. | 10.0 | 25.0 |
| V. | Rather strong | 25.0 | 50.0 |
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| VIII. | Ruinous | 250.0 | 500.0 |
| IX. | Disastrous | 500.0 | 1000.0 |
| X. | Very disastrous | 1000.0 | 2500.0 |
| XI. | Catastrophic | 2500.0 | 5000.0 |
| XII. | Great catastrophe. | 5000.0 | 10000.0 |

Grade IV. is ordinarily the minimum perceived by the senses; and in grade XII, the acceleration, or rate of change of motion (jerk) reaches that of terrestrial gravitation.

220(850)

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Vol. II.

HONOLULU, HAWAII, JANUARY 14, 1914.

No. 2.

From the Pacific Commercial Advertiser, Honolulu, January 5, 1914.

TECHNOLOGY STATION, January 1, 1914.—The last week of the year 1913 has shown no marked change in the Halemaumau lava pit. It is a huge funnel between 500 and 600 feet deep, with a thickly erusted lava pool in its bottom, flat slide-rock slopes around the pool, one and possibly two spatter cones showing glowing lava on the floor, and at least two glowing fumaroles in the talus, one at the floor level S.W. and another much higher in the N.W. slide-rock slope.

Vast quantities of white smoke rise from a ring of very hot and active fumaroles about the top of the talus from 100 to 150 feet above the floor level. Bluish smoke comes from the large central spatter cone in the floor, supposed to represent the site of Old Faithful fountain. Two fuming holes in the solid rock of the wall of the pit high above the talus occur N. and N.E. Two dark cavernous openings without fumes are in the W. wall halfway down to the talus.

There is no present activity in Mauna Loa. Earthquakes are not more prevalent than usual. It is worthy of note that Mr. J. L. Fleming reports that on December 11, 1913, at 1 p. m., the steamer Mauna Loa on the W. side of the Island of Hawaii off Hualalai, opposite McGuire's, encountered small dead rock-fish on the water scattered along about two miles of her course. For the past week the wind has been almost continuously from the S.W., blowing the fumes from the crater over the Observatory and the Volcano House, so as to make breathing difficult, wilting many plants and notably killing the slugs and cut-

worms. Today the wind has changed to the east.

A Glimpse of Activity.

Friday, December 26, at 10 a. m., the wind was light southerly and one good view of the bottom of Halemaumau was obtained from the old north rest-house. Glowing lava was seen in the westernmost of two built-up cones on the floor. Blue fumes were rising from the lava. Very active peripheral fumaroles were seen, the southern one on the edge of the floor, the N. and W. ones higher. The talus has slipped down until it is very flat. The noises are louder than on the previous day, and once spatter fall was heard on the rocks, and some splashing noise coupled with the blowing. One rock-slide was heard.

At 11:30 a. m. on December 27 atmospheric conditions were similar. There was no seeing from the east and southeast stations, but the puffing could be heard from the latter. From the N.W. station several views of the bottom of the pit were obtained, sufficient for photographic records, but not for good pictures. The fumes were not particularly disagreeable to breathe on the leeward side of the crater.

At the N.W. station the puffing was quite loud and irregular. The loud puffs came at intervals of from one to three minutes. In the intervals there were sometimes prolonged and faint soft blowing sounds. The loud puffs sometimes came in groups. No spatter fall was heard. A small fumarole in the rock high on the wall of the 1894 bench N.E. was noticed for the first

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time. Slight slides were heard N.E.
and W. At 11 a. m. the temperature
of the air was 17 degrees C., (62.6° F.)
and of the Postal Rift 315 degrees,
with the wind S.E.

December 28, conditions were simi-
lar. December 29, at 5:30 p. m., the
weather was still and foggy. The
fume column was rising almost vertic-
ally, hugging the walls of the pit, and
obscuring all view of the bottom and
of the glowing vents after dark. Rock
sliding was heard W., E., and S. and in
fact small rocks were moving on the
talus most of the time. At least five
strong slides took place in the course
of an hour. The noise of puffing was
rare and weak. The great increase of
sliding on this day suggested renewal
of subsidence.

December 30, at 8 p. m., three mark-
ed glowing spots in the pit could be
seen, one of them the high W.N.W.
fumarole at the top of the talus. The
other two are the S.W. fumarole at the

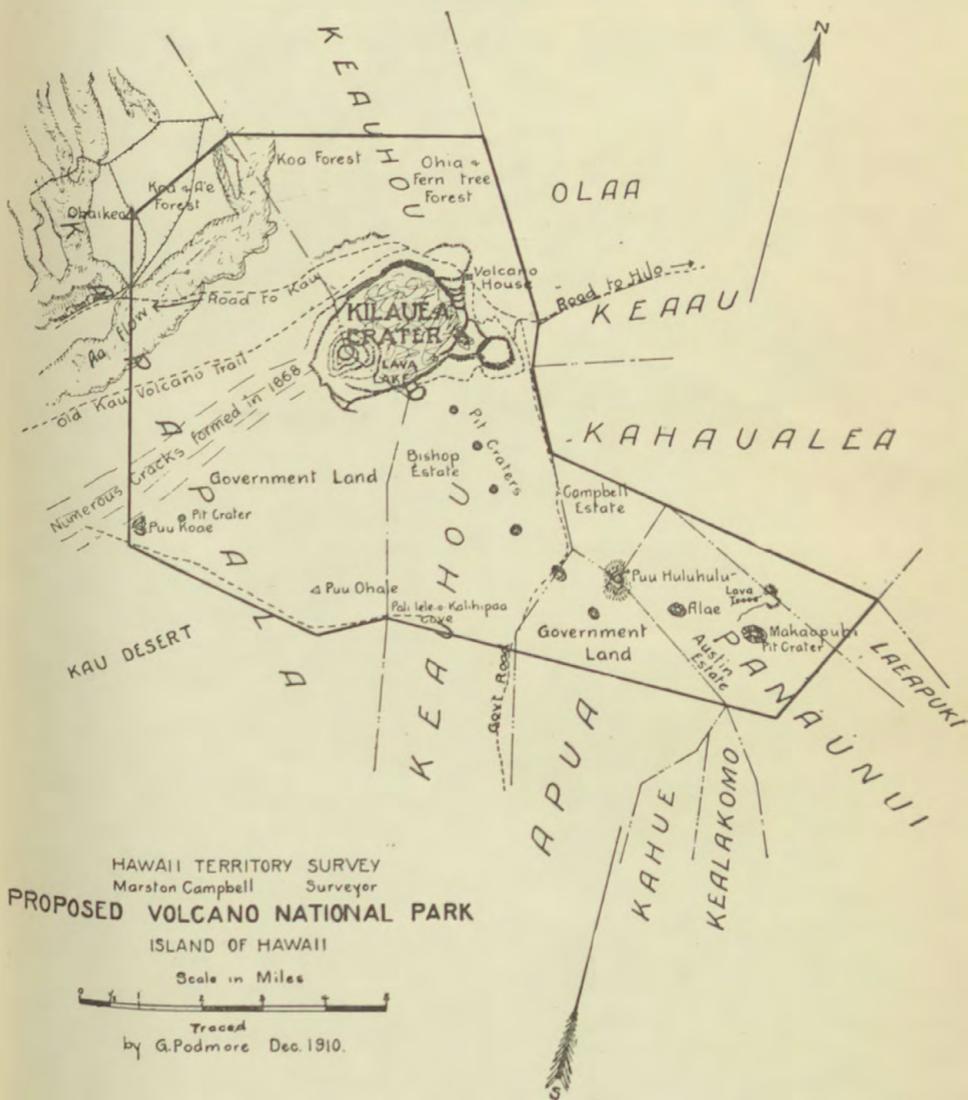
margin of the floor and one of the
spatter cones. These holes make con-
siderable glow on the fume cloud
when it rises and this can be seen
from the Observatory at night. The
puffing noises were as usual, and there
was little sliding.

New Year Phenomena.

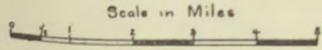
Today January 1, 1914, at 10:45 a.
m., measured intervals between the
puffs were 40, 20, 50 and 30 seconds.
The wind was N.E. and from the N.W.
a good view of the bottom was ob-
tained. There was little sliding and
the puffing was as usual. Fumaroles
N. and N.W. in the talus were cloudy
and giving off thin fumes. The west-
ernmost cone in the floor gave blue
fumes, N.E., W.N.W., W., and S.W.
were very active fumaroles giving
small hard outlined jets with caulif-
lower outlines of white vapor rising in
tails through the stones, and here
sulphurous incrustations appeared on
the stones. The floor was of brown
pahoehoe. The high W.N.W. fuma-
role was particularly active and ap-
peared to be undermining the slope
above it so that rocks would slide
down into it from time to time. This
is one of those which glow at night.

A few small earthquakes have been
recorded during the week, one of them
perceptible at the Volcano House.
They will be formally reported on
later by Mr. H. O. Wood, in charge of
the Whitney laboratory of seismology.

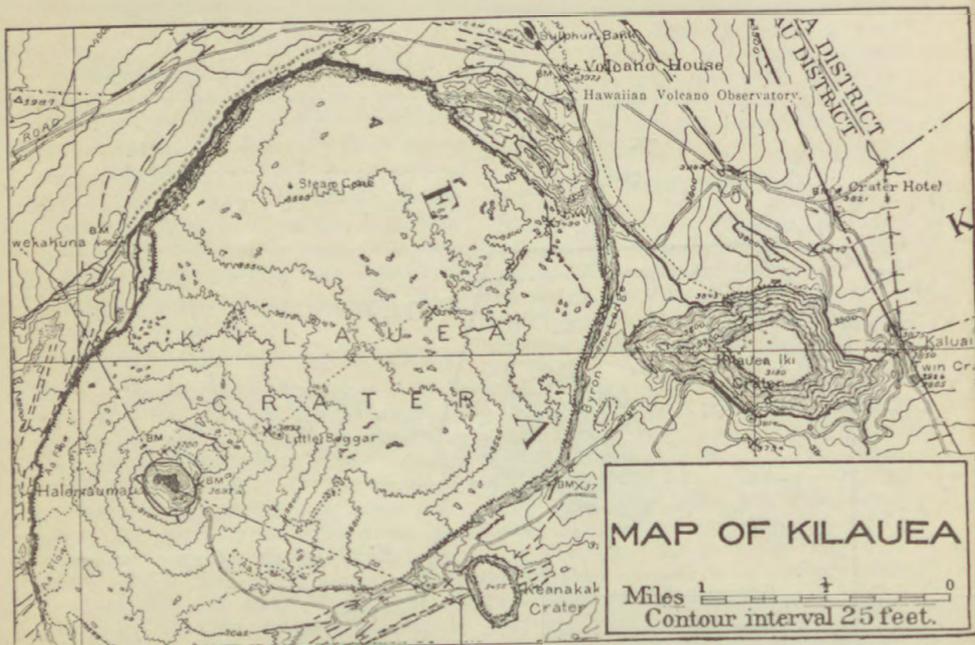
T. A. JAGGAR, JR.,
Director.



HAWAII TERRITORY SURVEY
 Marston Campbell Surveyor
PROPOSED VOLCANO NATIONAL PARK
 ISLAND OF HAWAII



Traced
 by G. Podmore Dec. 1910.



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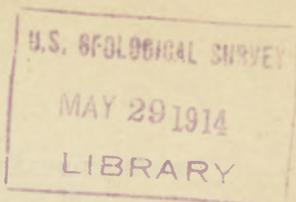
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HONOLULU, HAWAII, JANUARY 21, 1914.

No. 3.

From the Pacific Commercial Advertiser, Honolulu, January 11, 1914.

TECHNOLOGY STATION, January 8.—The new year has brought no change in the condition of Halemau-mau. The crater remains smoky, the fumes strong and difficult to breathe; the noises of blowing and splashing have diminished, and there is hardly any glow on the smoke-cloud at night visible from the Observatory. The bot-tom is generally invisible, except for partial openings through eddies in the smoke-cloud west and southeast.

Saturday, January 3, at 3:30 p.m., the wind S. E. and the weather misty, Halemau-mau was enveloped in fumes and mist and nothing could be seen. One rock-slide was heard and faint puffs from the floor vent.

January 5, at 4 p.m., the wind was strong from the NE with drizzle. Faint blowing noises could be heard at inter-vals of from one to three minutes. No sliding was heard and there was no seeing.

January 7, at 4 p.m., faint puffs could be heard at rare intervals, and a partial view of the west wall was ob-tained from the old resthouse. Once or twice a distinct splashing noise was heard, and there was a little sliding to-ward the west. The fumes were strong and not easily respirable.

The following report from the Whit-ney Laboratory of Seismology is sub-mitted by H. O. Wood:

Since the last systematic report earthquakes have been registered as follows:

1913—December 19, from 12:21:12 p.m. to 12:22:23 p.m. H. S. T. Inten-sity, II Cancani scale; about 40 per cent to 50 per cent of the minimum perceptible unit. Origin distant about 13 miles.

December 20, from 4:03:50 a.m. to 4:04:52 a.m. H. S. T. Intensity, I Can-cani scale; about 13 per cent of the minimum perceptible unit. Origin dis-tance indeterminate.

December 20, from 11:28:51 p.m. to 11:29:45 p.m. H. S. T. Intensity, I Cancani scale; about 20 per cent of the minimum perceptible unit. Origin dis-tant about 13.7 miles.

December 22, from 2:55:42 p.m. to 2:56:08 p.m. H. S. T. Intensity, II-III Cancani scale; about 50 per cent of the minimum perceptible unit. Origin distant about 12.5 miles.

December 26, from 2:26:03 a.m. to 2:28:29 a.m. H. S. T. Intensity, I Can-cani scale; about 13 per cent of the minimum perceptible unit. Origin dis-tant about 18.6 miles.

December 26, from 6:47:48 a.m. to 6:49:06 a.m. H. S. T. Intensity, I Can-cani scale; about 15 per cent of the minimum perceptible unit. Origin dis-tance indeterminate.

December 26, from 11:16:19 a.m. to 11:17:02 a.m. H. S. T. Intensity, III Cancani scale, less than the minimum perceptible unit. Origin distant about 13 miles.

December 26, from 12:16:33 p.m. to 12:19:10 p.m. H. S. T. Intensity, IV Cancani scale; about the value of the minimum perceptible unit. Felt at the Volcano House by one person lying down. Origin distance about 14.3 miles.

December 26, from 12:39:13 p.m. to 12:41:26 p.m. H. S. T. Intensity, I Cancani scale; about 7.5 per cent of the minimum perceptible unit. Origin distance indeterminate.

December 28, from 2:24:59 a.m. to 2:26:06 a.m. H. S. T. Intensity, III

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tant about 13 miles.

December 28, from 5:02:25 a.m. to

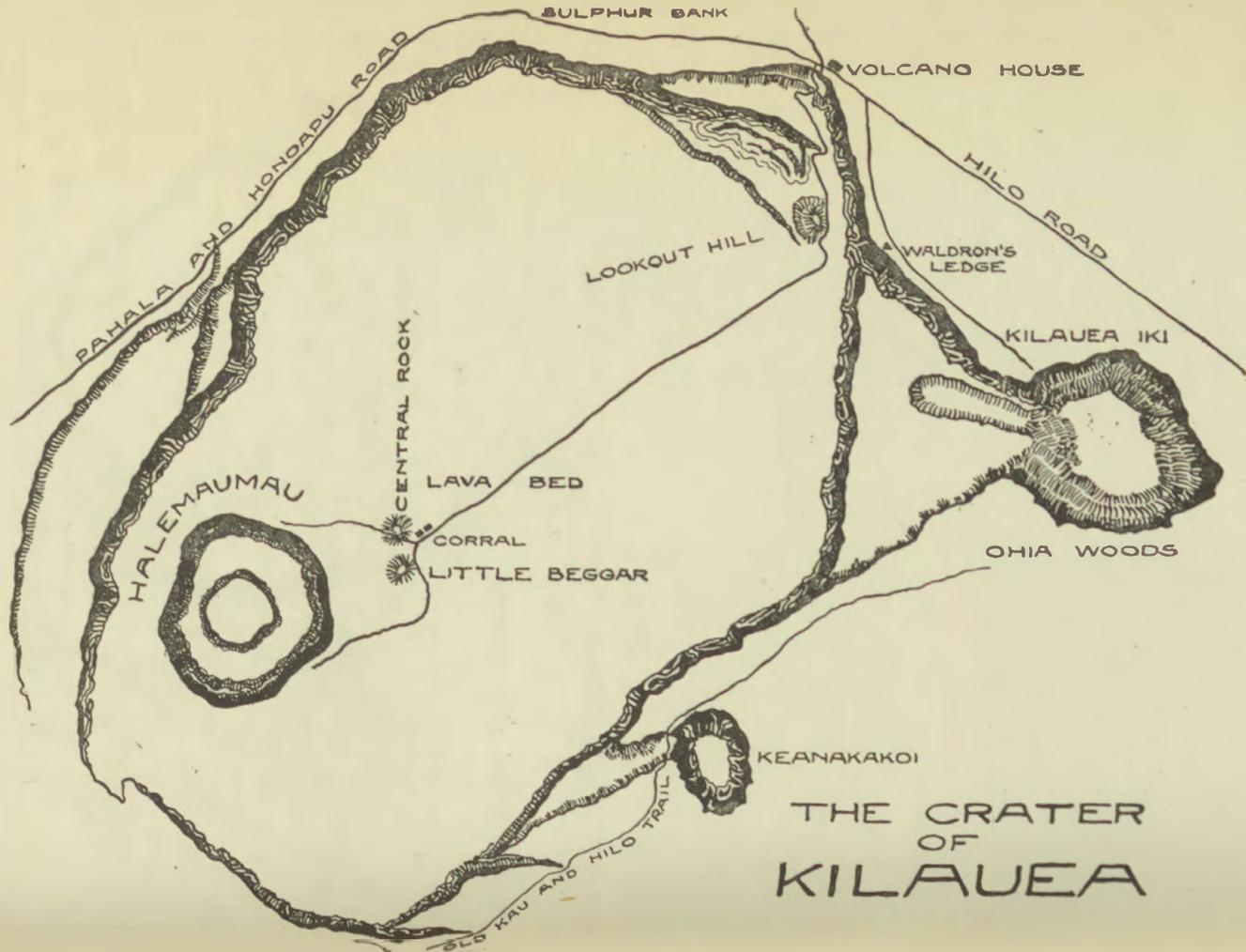
5:03:49 a.m. H. S. T. Intensity, I Can-
cane scale; about 20 per cent of the
minimum perceptible unit. Origin dis-
tant about 17 miles.

December 31, from 9:04:50 p.m. to
9:05:38 p.m. H. S. T. Intensity, II
Caneani scale; about 30 per cent of the
minimum perceptible unit. Origin
distant about 17 miles.

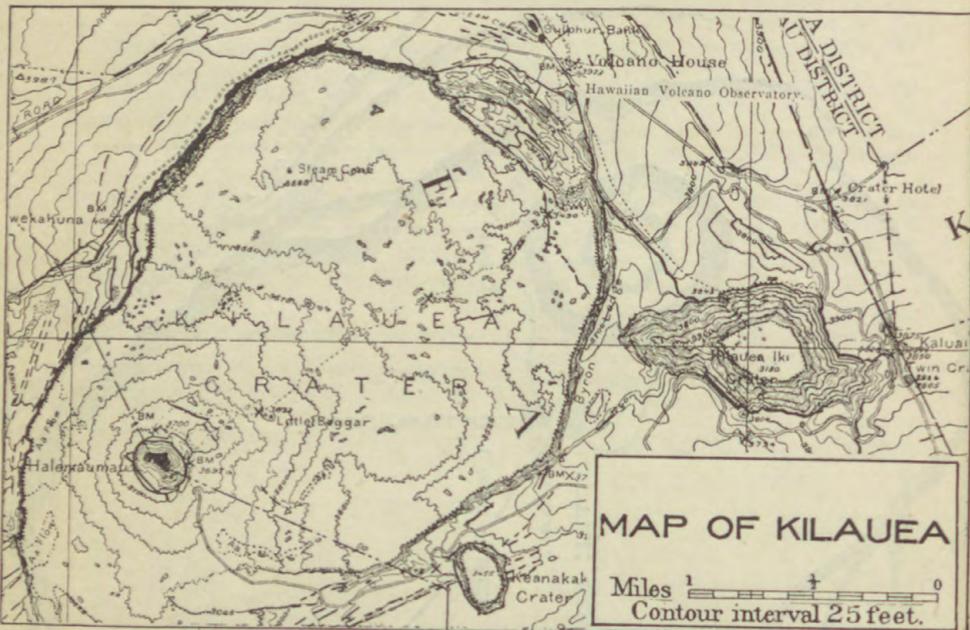
December 31, from 10:58:52 p.m. to
10:59:46 p.m. H. S. T. Intensity, I
Caneani scale; about 12 per cent of
the minimum perceptible unit. Origin
distant about 13 miles.

1914—January 2, from 12:30:41 p.m.
to 12:31:25 p.m. H. S. T. Intensity, I
Caneani scale; about 20 per cent of the
minimum perceptible unit. Origin dis-
tant about 13.6 miles.

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THE CRATER
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No. 4.

From the Pacific Commercial Advertiser, Honolulu, January 18, 1914.

TECHNOLOGY STATION, January 15.—The week has been very stormy, windy and cold at the volcano, the wind northeasterly, and there has been much rain and drizzle. The Halemau-mau pit has entered into a period of almost complete repose, so far as can be judged by the observers hearing nothing and seeing little at the edge. Even the talus has ceased active sliding, so that there is no sign of considerable rising or falling of the lava column.

The rock floor has not been visible this week, owing to the great volume of rain fog added to the volcanic fumes. There have, however, been times of clearing out of the southeast part of the pit, showing that part of the great circle of fumaroles actively spouting through the stones great jets of white vapor, about four hundred feet below the verge of the chasm, this vapor swirling into cumuli above, which incessantly roll away to leeward.

It should be borne in mind by those visiting the volcano that this vomiting of fumes in large volume is not wholly to be regarded as a disappointing mark of inactivity. It marks a new and interesting phase in the activity of Kilauea, which in times of real inactivity within the last twenty years has shown the bottom clear, with practically no fumes. Experienced observers of the volcano who have seen it for fifty years assert that this dense smoke is unprecedented.

The fumaroles whence the smoke rises appear to be places of multiple orifices through pores among broken stone, and in places the gases have recently been burning with blue flames,

the hottest and most active fumaroles yielding quick jets of bluish white vapor, while the less active vents give up slower purling whitish clouds. There has been no glow on the cloud seen from the observatory this week. There is every reason, however, to suppose that the liquid lava is not far below the floor, the hot fumaroles marking its location, for had the lava column subsided the bottom would have collapsed and produced noisy avalanches.

January 8 and 9, 1914, were rainy, with some slipping of stones in the crater, and no seeing. January 11, from 3 to 3:30 p.m., the southern part of the pit was open to view, and there were many small avalanches inside the talus ring. The fumaroles at the 400-foot level were photographed. Much blue smoke could be seen near the south end of the bottom area, but the floor could not be distinguished. Rare puffs of gas at intervals of from four to five minutes could be heard both from the southeast station and from the old north rest-house.

January 13, after a rainstorm with high northeast wind in the morning, the afternoon cleared partially, and at 4 p.m. imperfect views of the fumaroles were obtained from the southeast station. From the old rest-house no blowing or rock sliding was heard.

This morning, January 15, at 10 a.m., the wind was northeast and the weather cloudy to rainy. The fumes smelled acrid and there was no seeing nor hearing from any station. The temperature of the air at 10:30 a. m. was 13 degrees Centigrade (55.4 deg. Febr.), and of the Postal Rift 314 degrees Cent. (597.2 deg. Fahr.).

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Laboratory of Seismology that the
week has been very quiet seismically.

The eruption of Sakura is un-
doubtedly a great one. This volcano,
in Osumi Province, the southernmost in
Japan, must not be confused with On-
take, a volcano over 10,000 feet high
in Central Nippon. Sakura lies near
the north end of the long chain of ac-
tive volcanoes of the Luchu Islands,
and rises 3506 feet high, making an
island in Kagoshima bay, on which is
the village of Take. Kagoshima is re-

The Hawaiian Volcano Research As-
sociation at a meeting held Jan. 19
passed resolutions asking its director,
Dr. Thomas A. Jaggar, Jr., to proceed
at once to Kogoshima and the scenes
of the other volcano disasters in Japan
and render every aid in his power to
the Imperial Earthquake Investiga-
tion Committee in its investigations.

Following is a copy of the resolu-
tions adopted.

Whereas, The recent eruption of the
volcano of Sakura in the Empire of
Japan, involving great loss of life and
property, is of such a character as
should be scientifically investigated
and definite data concerning the same
secured and reliable records made
thereof, with a view, ultimately, to de-
vising ways and means of minimizing
the dangers incident to volcanic activ-
ity;

And Whereas, A large percentage of
the residents of this Territory are sub-

corded by Murray as having a popula-
tion of 59,000 and appears on the map
to be about six miles from the central
crater of Sakura. This relationship
makes Sakura one of the dangerous
volcanoes of the world.

Last Eruption in 1779.

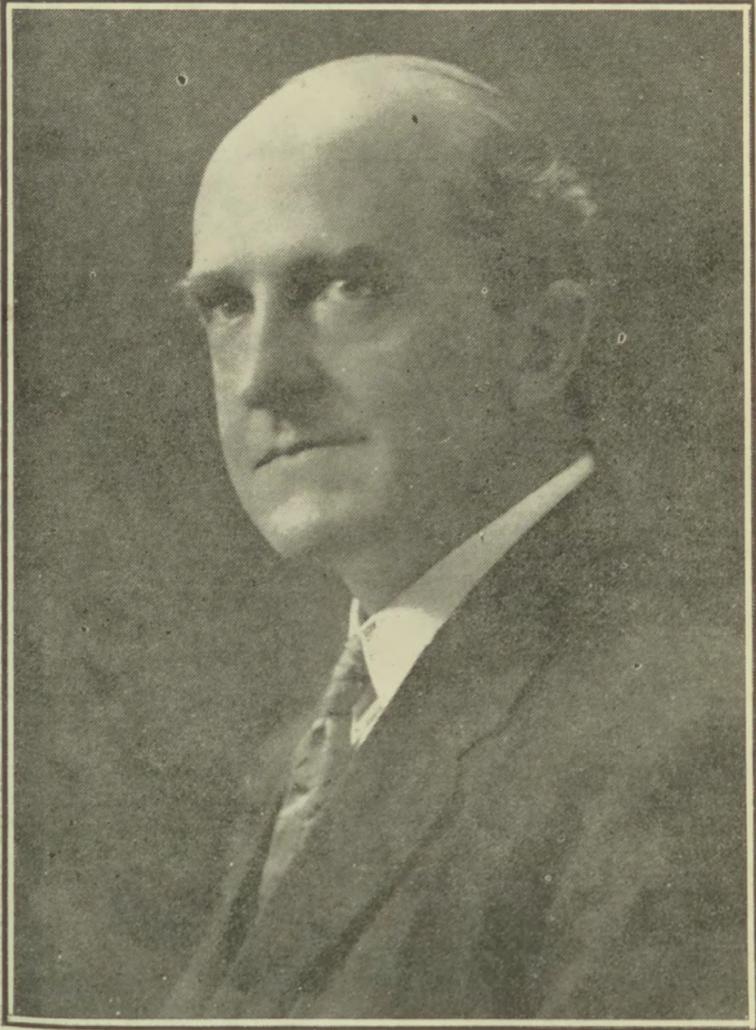
The last great eruption of Sakura
is said to have taken place in 1779, and
to have been commemorated at the is-
land by a monthly festival. This should
interest us in Hawaii, where the last
great explosive eruption of Kilauea
took place in 1790; and it will be re-
membered that prior to the terrific
earthquake of 1908 at Messina no such
disaster had been known there since
1783.

Sakura has two craters, northwest
and southeast respectively, the south-
east one, on the side remote from Ka-
goshima, being by reason of its hot
solfataras the one most probably in ac-
tion in the present eruption. There is
a line of important active volcanoes
extending north from Sakura into
Kyushu.

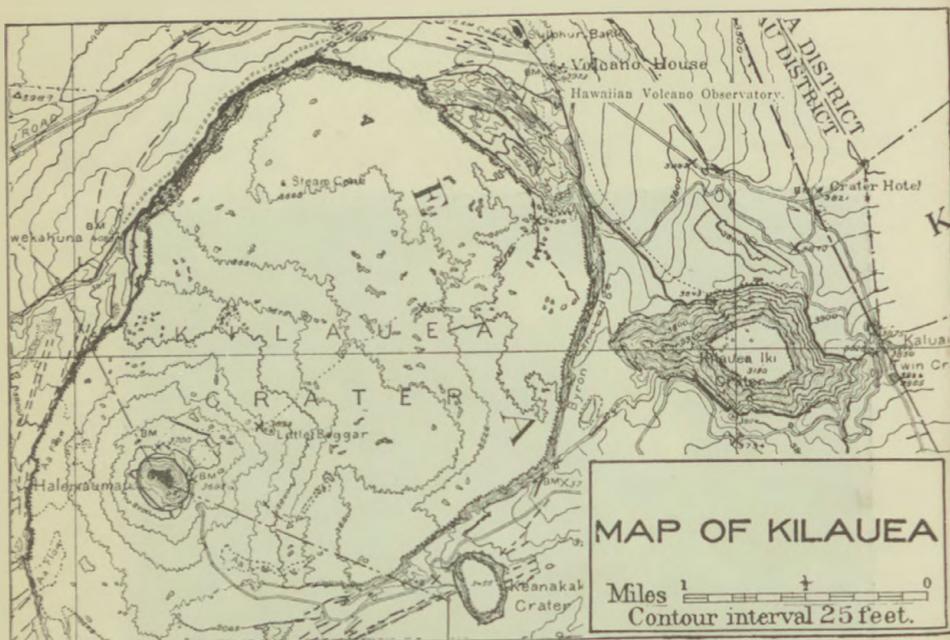
T. A. JAGGAR, JR.,
Director.

jects of the Empire of Japan, and it
is appropriate, both from a scientific
standpoint and as showing the friendly
interest which the people of Hawaii
feel toward their nearest neighbors on
the west, that this association should
offer to assist the Imperial Earthquake
Investigation Committee of Japan in
the work above set forth;

Now Therefore Be It Resolved: That
the Hawaiian Volcano Research Asso-
ciation hereby requests its Director, Dr.
Thomas A. Jaggar, Jr., to proceed as
soon as practicable to the scene of said
eruption, there to offer his services in
connection with the work aforesaid,
and cooperate with and assist the said
committee and such others as may be
engaged in such work, making such in-
vestigation and securing such maps,
photographs and other data and infor-
mation concerning the said eruption
and any matters incidental thereto as
he may think proper.



PROF. THOMAS A. JAGGAR, JR.



MAP OF KILAUEA
 Miles 1 0
 Contour interval 25 feet.

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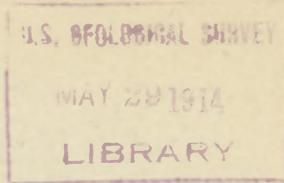
ters registering N-S and E-W motion, a heavy Omori tromometer registering E-W motion and an Omori 'ordinary Seismograph' designed for registering strong earthquakes in all three components of motion. These are seated on concrete piers in a closed basement room having practically constant temperature, beneath the chief Observatory building near the hotel. Time is referred to a rated chronometer, checked at intervals by solar observations with a transit. Both instruments are loaned by the College of Hawaii. At the substation by the edge of the active pit an Omori two-component tromometer with light steady masses is mounted on a concrete pier placed directly on the fresh lava surface. Hawaiian standard time (H. S. T.) is 10 hrs. 30 m. slower than Greenwich time.

CANCANI SCALE OF SEISMIC INTENSITY

Expressed by accelerations measured in millimeters per second per second.

| | | | |
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| V. | Rather strong | 25.0 | 50.0 |
| VI. | Strong | 50.0 | 100.0 |
| VII. | Very strong | 100.0 | 250.0 |
| VIII. | Ruinous | 250.0 | 500.0 |
| IX. | Disastrous | 500.0 | 1000.0 |
| X. | Very disastrous | 1000.0 | 2500.0 |
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WEEKLY BULLETIN
OF
Hawaiian Volcano Observatory

Vol. II.

HONOLULU, HAWAII, FEBRUARY 4, 1914.

No. 5.

From the Pacific Commercial Advertiser, Honolulu, January 26, 1914.

TECHNOLOGY STATION, Kilauea, January 22.—Cloudy weather and strong winds, at first from the N.E., later from the S.W., have prevailed during most of the week past, causing very unfavorable conditions for observations of all kinds. There has been no change in the behavior of the volcano.

On Friday evening, January 16, a brief glimpse of the central glow-hole was obtained. No avalanches were heard and the noises of eruption were very subdued.

On Sunday, January 18, nothing could be seen on account of swirling fumes. No sounds of eruption of any sort whatever could be heard. No avalanching or sliding of talus was heard.

On Monday, January 19, the same conditions prevailed.

On Wednesday, January 21, though

nothing could be seen, a short, sharp, but faint puffing sound was heard at considerable intervals, from twenty to thirty minutes, and during much of the time a low, grave, rumbling sound, suggestive of reverberations in a cave, could be heard. One heavy avalanche of short duration was noted, occurring under the northwest cliffs.

Fumes continue to pour out without abatement.

No sun observations for the correction of time have been possible since the last report from the Whitney Laboratory of Seismology; hence no systematic report can be included here. However, the week has been very quiet seismically—only two very trifling earthquakes have been registered, and no noteworthy earth-action of other sort.

H. O. WOOD, Associate.

Minutes of the Meetings of the Board of Directors.

The first meeting of the Board of Directors of the newly reorganized Hawaiian Volcano Research Association, was held at the University Club, Friday, Dec. 12th, 1913 at 12 m. Present: Messrs. Lorrin A. Thurston, Albert F. Judd, A. Lewis, Jr., W. R. Castle, directors, Richard Cooke, representing C. H. Cooke, J. L. McLean, representing J. A. Kennedy, Thos. A. Jaggar, Jr., and Howard M. Ballou.

The following officers of the Association were unanimously elected.

President, Clarence H. Cooke; 1st

Vice-President, Lorrin A. Thurston; 2nd Vice-President, Albert F. Judd; Treasurer, Robert W. Shingle; Secretary, Howard M. Ballou.

Voted: that the President be ex-officio member of all committees.

Voted: that the following members be appointed on the Finance Committee: Robert W. Shingle, Geo. F. Davies, Geo. R. Carter, A. Lewis, Jr.

Voted: that the following members be appointed on the Membership Committee: E. L. Withington, Albert F. Judd, J. L. McLean and Ed Towse.

Adjourned.

HOWARD M. BALLOU,
Secretary.

WEEKLY BULLETIN
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Hawaiian Volcano Research Association

Editor.....Howard M. Ballou
Professor of Physics, College of Hawaii

Application pending for entry as
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Honolulu, Hawaii.

At a meeting of the Board called by
direction of Vice-President L. A. Thurston
for Tuesday, Jan. 6, 1914, there
were present only L. A. Thurston, di-
rector, and H. M. Ballou, secretary.

Adjourned: No quorum.

The second meeting of the Board,
called by direction of Pres. C. H. Cooke,
was held at the University Club, Mon-
day, Jan. 19, 1914, at 12 m.

Present: Messrs. Cooke, Judd, Lewis,
Shingle and Thurston, directors, H. M.
Ballou, secretary, and Dr. T. A. Jag-
gar, Jr.

Minutes of the first meeting were
read and approved.

Dr. Jagggar addressed the Board on
the subject of the recent eruption of
Sakura volcano.

Mr. Thurston offered the following
resolution, which was unanimously car-
ried:

Whereas, The recent eruption of the
volcano of Sakura in the Empire of
Japan, involving great loss of life and
property, is of such a character as
should be scientifically investigated
and definite data concerning the same
secured and reliable records made
thereof, with a view, ultimately, to de-
vising ways and means of minimizing
the dangers incident to volcanic activ-
ity;

And Whereas, A large percentage of

the residents of this Territory are sub-
jects of the Empire of Japan, and it
is appropriate, both from a scientific
standpoint and as showing the friendly
interest which the people of Hawaii
feel toward their nearest neighbors on
the west, that this association should
offer to assist the Imperial Earthquake
Investigation Committee of Japan in
the work above set forth;

Now Therefore Be It Resolved: That
the Hawaiian Volcano Research Asso-
ciation hereby requests its Director, Dr.
Thomas A. Jagggar, Jr., to proceed as
soon as practicable to the scene of said
eruption, there to offer his services in
connection with the work aforesaid,
and cooperate with and assist the said
committee and such others as may be
engaged in such work, making such in-
vestigation and securing such maps,
photographs and other data and infor-
mation concerning the said eruption
and any matters incidental thereto as
he may think proper.

Dr. Jagggar read a cablegram from
President Maclaurin of the Massachu-
setts Institute of Technology approving
of his expedition.

Voted: that Dr. T. A. Jagggar, Jr.,
be elected Director of the Hawaiian
Volcano Observatory.

Voted: that there be an editorial and
publication committee consisting of
Messrs. Thurston, Jagggar and Ballou.

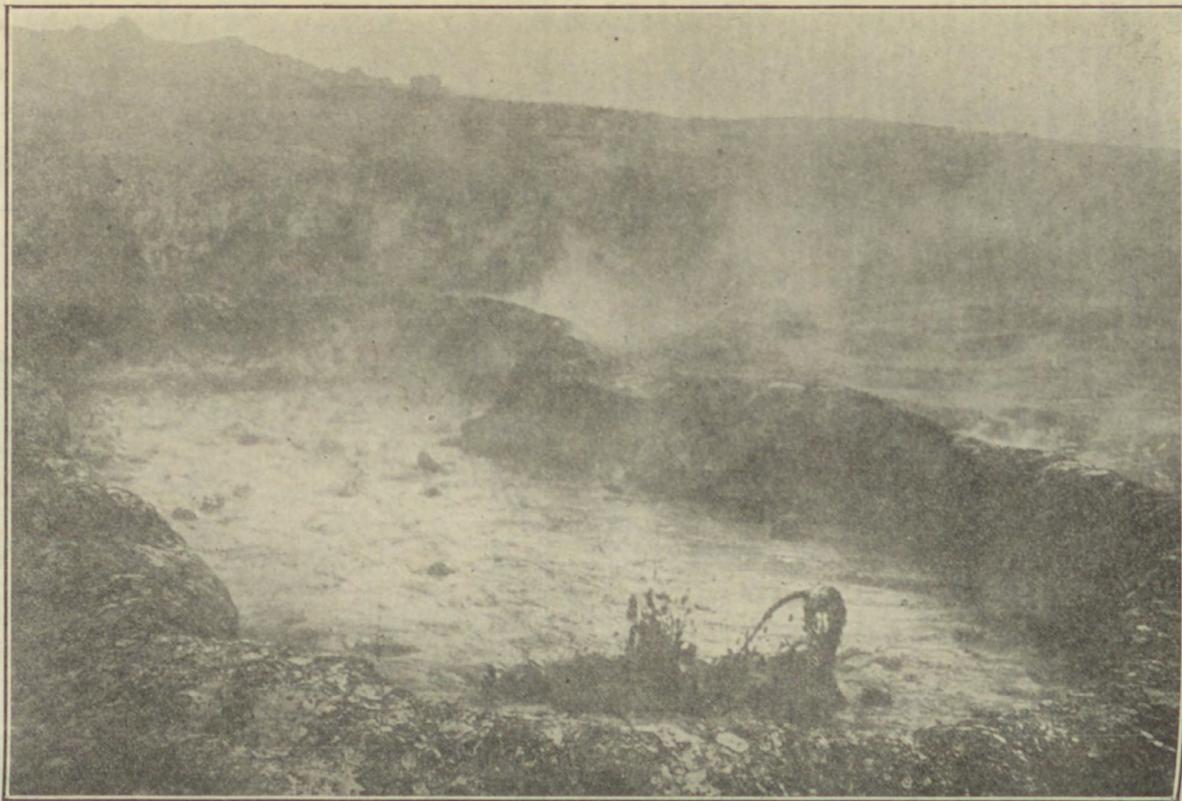
Voted: that the Secretary be direct-
ed to continue the publication of the
weekly reports of the Hawaiian Vol-
cano Observatory in a weekly bulletin
reprinted from the Advertiser, for free
distribution among members of the As-
sociation and scientific libraries.

Voted: that the bulletin be distribut-
ed only to patrons and members of the
Association and to such libraries and
scientific societies as may be designat-
ed by the publication committee.

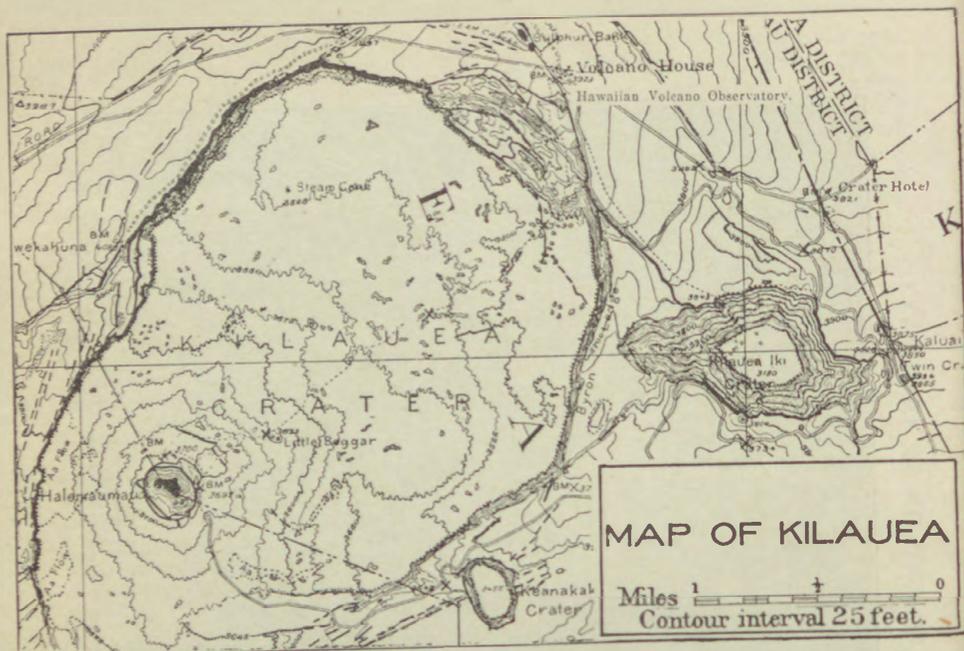
Adjourned.

HOWARD M. BALLOU,

Secretary.



LAVA LAKE AT KILAUEA AT THE BEGINNING OF SUBSIDENCE.



MAP OF KILAUEA

Miles 1 0
Contour interval 25 feet.

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220 (950)

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U.S. GEOLOGICAL SURVEY
MAY 29 1914
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WEEKLY BULLETIN
OF
Hawaiian Volcano Observatory

Vol. II. HONOLULU, HAWAII, FEBRUARY 11, 1914. No. 6.

From the Pacific Commercial Advertiser, Honolulu, February 5, 1914.

TECHNOLOGY STATION, Kilauea, January 29.—During the past week there has been no change in the activity of Kilauea.

Long watches were kept on January 22, 23, 24 and 28; a shorter stay at the crater was made on January 25; and a brief visit was made on January 26. On January 27 weather conditions, fog and wind, were so unfavorable that no visit was made. On January 28 a good view of the bottom of the pit was obtained. No other view has been obtained during this week.

The noises of eruption have undergone no change: faint, barely audible puffing can be heard at long, irregular intervals; a deep-toned rumbling sound, weak in volume, can be heard at frequent intervals. Either of these sounds is inaudible in a high, rushing wind.

One heavy, prolonged avalanche has been noted during the week on January 23, at about 10:30 a. m., lasting for about ten minutes. This took place at the south side of the pit.

Just before noon, on January 28 a lull and an eddy in the wind cleared the pit of fumes and permitted a good view of the bottom for about ten minutes. Fumes were issuing copiously from a low cone about "Old Faithful," but glowing lava could be seen in the orifice at the top of the cone. Also at the low cone near the west end on the

southern margin of the "frozen" surface, fumes were pouring out furiously, but glowing lava was seen. The peripheral fumaroles in the talus showed unabated activity, also the high fumarole in the wall under the north station. The floor remains unchanged in appearance—so, as yet, there is no evidence of conspicuous subsidence. Occasional slight movements of readjustment among the talus blocks are heard.

Owing to adverse weather conditions at apparent noon, no systematic report from the Whitney Laboratory of Seismology can yet be given. One earthquake not felt, but moderately strong instrumentally, was registered during the week.

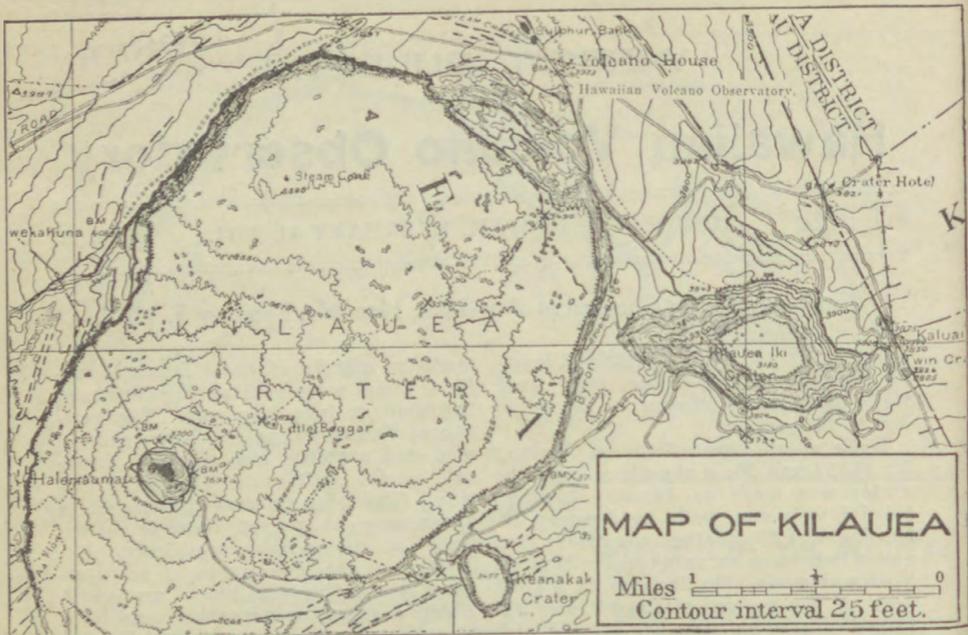
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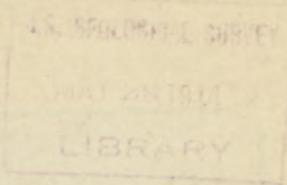
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220(950)

H 4

v. 2, no. 7
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WEEKLY BULLETIN OF Hawaiian Volcano Observatory

Vol. II.

HONOLULU, HAWAII, FEBRUARY 18, 1914.

No. 7.

From the Pacific Commercial Advertiser, Honolulu, February 9, 1914.

TECHNOLOGY STATION, Kilauea, February 5.—Still there is little or no change to report in the action at Kilauea. During the past week the winds have been light, allowing the pit to clear of fumes, so that several good views have been obtained. There has, however, been no opportunity suitable for photography.

On January 30, there were frequent views into the interior of Halemauau, but no view of the very bottom. At a little before eleven o'clock in the forenoon, and a few minutes after twelve noon, heavy and prolonged avalanches occurred, the first at the south near the west end, the second at the north; these lasted ten and eight minutes respectively. Throughout the intervening interval, and the remainder of the day, there were frequent slight slidings—probably only readjustments among the disturbed talus. Neither puffing nor rumbling noises could be heard.

On January 31, nothing was observed except small slides at considerable intervals. These also were probably only movements of readjustment.

On February 1, excellent views of the floor of Halemauau were had at frequent intervals for nearly two hours in the early afternoon. The black floor remained level and unbroken, though much material had fallen upon it at the SW and NW margins. The orifices where glowing lava has been seen during preceding weeks were clearly visible; blue fumes were issuing vigorously, but no glowing lava could be seen. A gash appears to be developing in the wall at the west as the avalanching

clears away the loose material of the wall. No slides were noted, except a few trifling readjustment movements. If any subsidence has been going on since the formation of the black floor in November, the floor has gone down as a whole without collapse or fracture. No depth measurement was undertaken because the views, while excellent, could be obtained only from the neighborhood of the old resthouse.

On February 2, quiet air again permitted good views. The conditions observed were similar in all respects to those of the first. No noises of eruption could be heard.

On February 3, on account of fog and wind from the southwest, no watch was maintained.

On February 4, again a good view was obtained; conditions were the same as on the first and second, except that small slides were more frequent, the rumbling sound of eruption was again audible, and glowing lava could be seen in small amount within the "Old Faithful" orifice.

Since the last systematic report from the Whitney Laboratory of Seismology earthquakes have been registered as follows:

January 7, from 9:00:17 p.m. to 9:01:05 p.m. H. S. T. Intensity, medium III Caneani scale; at least 70 per cent of the minimum perceptible unit. Origin distant about 12 miles.

January 10, from 8:52:29 p.m. to 8:53:09 p.m., H. S. T. Intensity, high I Caneani scale; 16 per cent to 21 per cent of the minimum perceptible unit. Origin distant about 27 miles.

January 15, from 5:26:52 a.m. to

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5:27:35 a.m., H. S. T. Intensity, med-
ium III Cancani scale; about 85 per
cent of the minimum perceptible unit.
Origin distant about 20 miles.

January 18, from 4:19:09 a.m. to
4:21:12 a.m. H. S. T. Intensity, med-
ium I Cancani scale; about 16 per cent
of the minimum perceptible unit. Ori-
gin distant about 13 miles.

January 21, from 7:13:09 p.m. to
7:14:09 p.m., H. S. T. Intensity, III-IV
Cancani scale; less than the minimum
perceptible unit, although it measures
higher; very rapid motion. Origin dis-
tant about 14 miles.

January 22, from 5:16:40 a.m. to
5:17:31 a.m. H. S. T. Intensity, I Can-
cani scale; about 7.5 per cent of the

minimum perceptible unit. Origin dis-
tant about 27 miles.

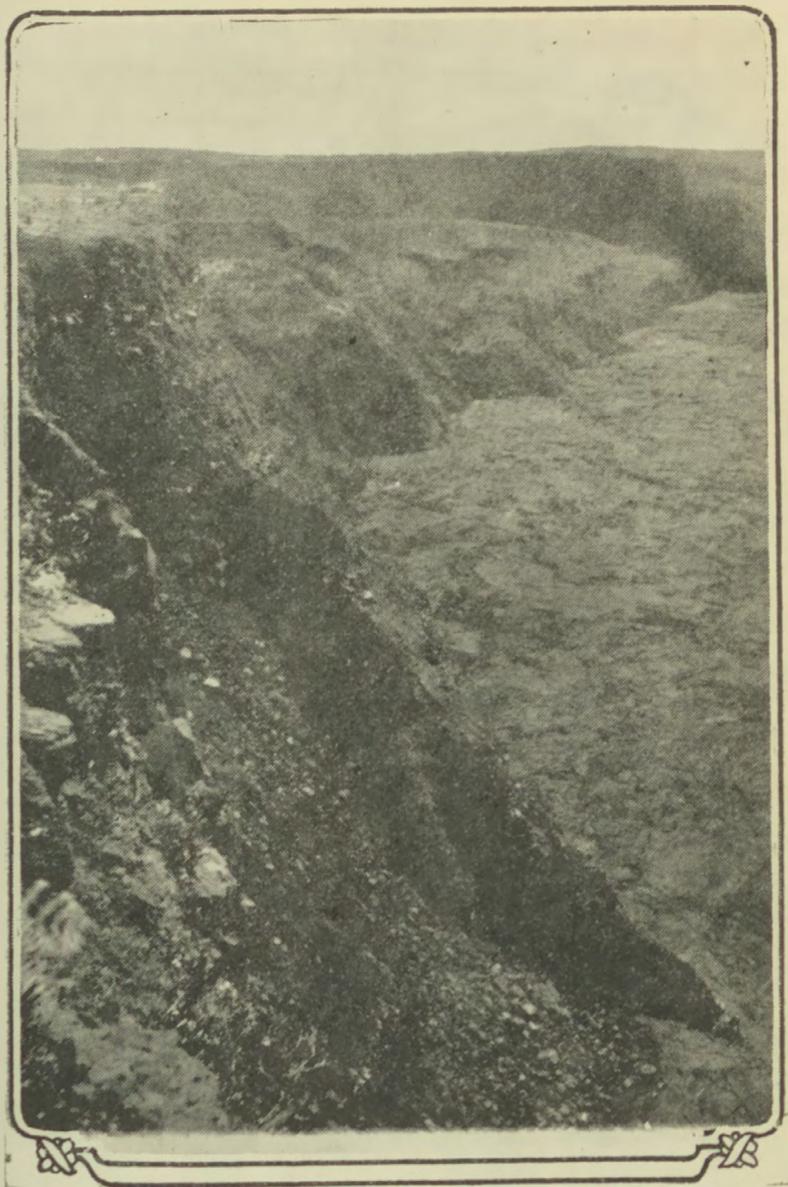
January 25, from 4:24:54 p.m. to
4:28:14 p.m. H. S. T. Intensity, here
only III Cancani scale; about 60 per
cent of the minimum perceptible unit.
Felt at Hilo, (but not felt at this
point), so that the origin probably lay
in the Hilo direction. Origin distant
about 20 miles.

January 29, from 10:29:58 a.m. to
10:31:29 a.m., H. S. T. Intensity III-
IV Cancani scale; this shock measures,
in acceleration value, from 120 per cent
to 180 per cent of the minimum percep-
tible unit, but it very definitely was
not felt at the Observatory. The writer
was sitting quietly at a writing table
when the "Ordinary seismograph" be-
gan recording, and definitely did not
feel any motion. Origin distant about
7 miles. The shock was felt distinct-
ly in Hilo.

February 1, from 4:48:50 p.m. to
4:49:26 p.m. H. S. T. Intensity, med-
ium II Cancani scale; about 35 per
cent of the minimum perceptible unit.
Origin distant about 10 miles.

February 3, from 5:01:21 a.m. to
5:03:03 a.m. H. S. T. Intensity, II Can-
cani scale; about 48 per cent of the
minimum perceptible unit. Origin dis-
tant about 26 miles.

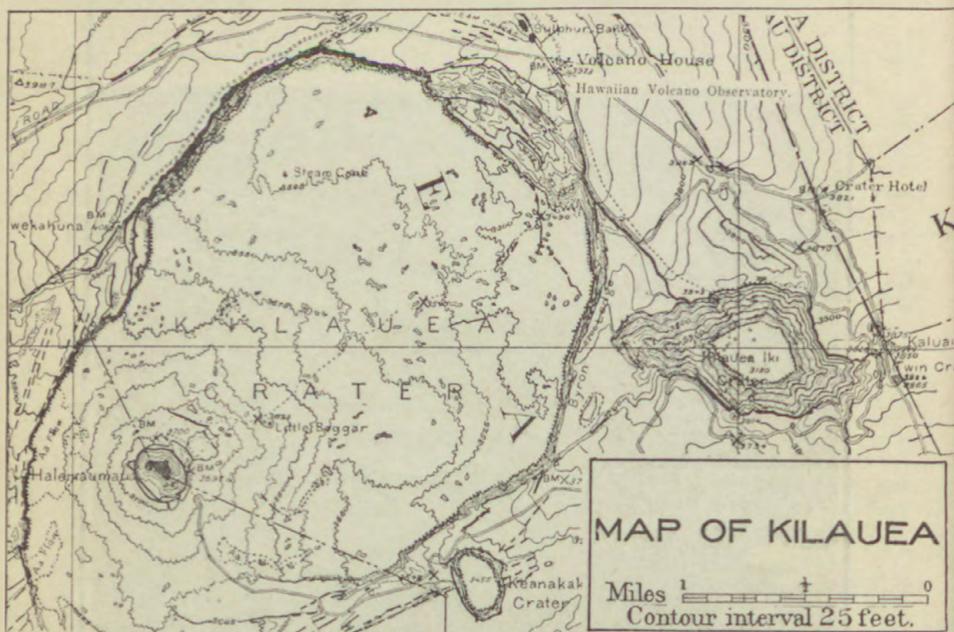
H. O. WOOD, Associate.



**Looking Eastward from the Northernmost Point of Margin of Halemau-
mau, Kilauea Volcano.**

The points of interest shown in this view are:

- (1) The spur, projecting southward in the middle foreground—thought to designate the northern entrance of the master, NE-SW, rift through Kilauea.
- (2) The broken irregularly subsided region in the distant middle ground—illustrating, at an unfinished stage, the mode of formation of the main sink-crater of Kilauea, by fracture and subsidence of segments of the summit dome.
- (3) The greatly fissured and exceedingly rough character, in miniature, of the floor of the crater at the north end.
- (4) The distant, high ground N-E of Kilauea-iki, thought to be a former summit point of Kilauea.



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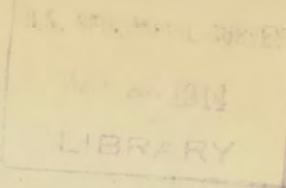
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CANANI SCALE OF SEISMIC INTENSITY

Expressed by accelerations measured in millimeters per second per second.

| | | |
|----------------------------------|--------|---------|
| I. Instrumental | 0.0 | 2.5 |
| II. Very slight | 2.5 | 5.0 |
| III. Slight | 5.0 | 10.0 |
| IV. Sensible, mediocre | 10.0 | 25.0 |
| V. Rather strong | 25.0 | 50.0 |
| VI. Strong | 50.0 | 100.0 |
| VII. Very strong | 100.0 | 250.0 |
| VIII. Ruinous | 250.0 | 500.0 |
| IX. Disastrous | 500.0 | 1000.0 |
| X. Very disastrous | 1000.0 | 2500.0 |
| XI. Catastrophic | 2500.0 | 5000.0 |
| XII. Great catastrophe | 5000.0 | 10000.0 |

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WEEKLY BULLETIN
OF
Hawaiian Volcano Observatory

Vol. II.

HONOLULU, HAWAII, FEBRUARY 25, 1914.

No. 8.

From the Pacific Commercial Advertiser, Honolulu, February 17, 1914.

TECHNOLOGY STATION, Kilauea, February 12.—The energy of eruption has increased definitely since the last writing. Just at the close of the previous week, on February 4, glowing lava had reappeared within the "Old Faithful" orifice.

On February 5, quiet air made good seeing possible from the north and northwest rim of the pit. Glowing lava was seen plainly both by day and by night in the "Old Faithful" orifice and, as well, in the orifice at the apex of a miniature cone near the southeast end of the lake area. No slides of any notable magnitude occurred and no noises of eruption were heard.

On February 6, again there was a good view from the northwest part of the rim of Halemaumau. Conditions were nearly the same as on the previous day, glowing lava being visible in both orifices. In the afternoon small avalanches were heard occasionally. Only one of these was notable, this lasting a little over two minutes. The low, rumbling noise of eruption could be heard again plainly.

On February 7, seeing was again possible and again the two glowing orifices were conspicuous. Up to late afternoon there were no noises of eruption except the low, rumbling sounds; but about nightfall explosive hissing sounds began to be heard at irregular intervals of two to three minutes.

In the afternoon of February 8, these sounds had increased in frequency and energy, occurring at intervals of five to sixty seconds, the usual intervals being those so common to "Old Faithful," 15-20 to 35-45 seconds. Fre-

quently this harsh blowing sound was almost continuous for minutes together. The noise was sharp and harsh at the same time, and rather loud—as loud as in the early part of October, 1913, though not nearly loud enough to be heard at a distance of from 100 to 200 yards from the rim of the pit, as was the case in the latter part of September. The rumbling noise was continuously punctuated by a muffled coughing sound. In the afternoon the two glowing orifices were seen. In the evening these two and three others were noted. It was reported by a visitor present in the early evening that jets of lava were thrown up from the orifice at the edge of the lake area just under the north station near the old rest-house. No glowing lava was seen in that orifice during the day. No avalanches were heard on this date.

On February 9, the harsh blowing and rumbling sounds were heard plainly, but a fresh breeze prevented seeing.

On February 10, a strong wind prevailed, with stormy and threatening weather. No prolonged watch was maintained. However, the blowing and rumbling continued, possibly a trifle increased.

On February 11, again there was a strong wind, preventing any good view into the pit. The loud, explosive, hissing sounds were occurring at intervals of from five to seven seconds. Some blasts were of considerable duration, the noisy outrush of gas continuing for about ten seconds.

Throughout the week there has been bright moonlight in the evenings. No glow has been discerned on the fume cloud. The fumes continue to pour out

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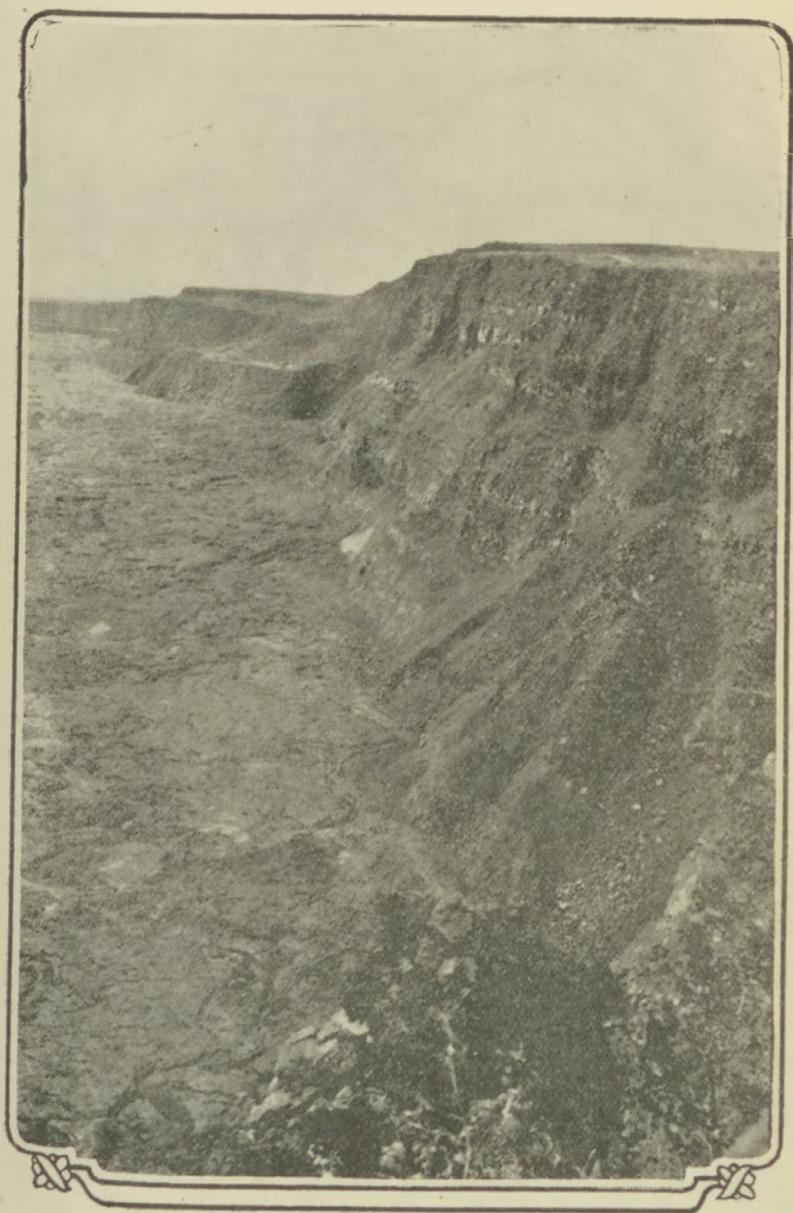
in undiminished volumes from fumaroles in the talus all about the margin of the lake area.

No observations for the correction of time have been secured during the week. Hence no systematic seismological report can be included here, but nothing notable in the way of seismic motion has been registered, though two or three extremely small local shocks have been recorded.

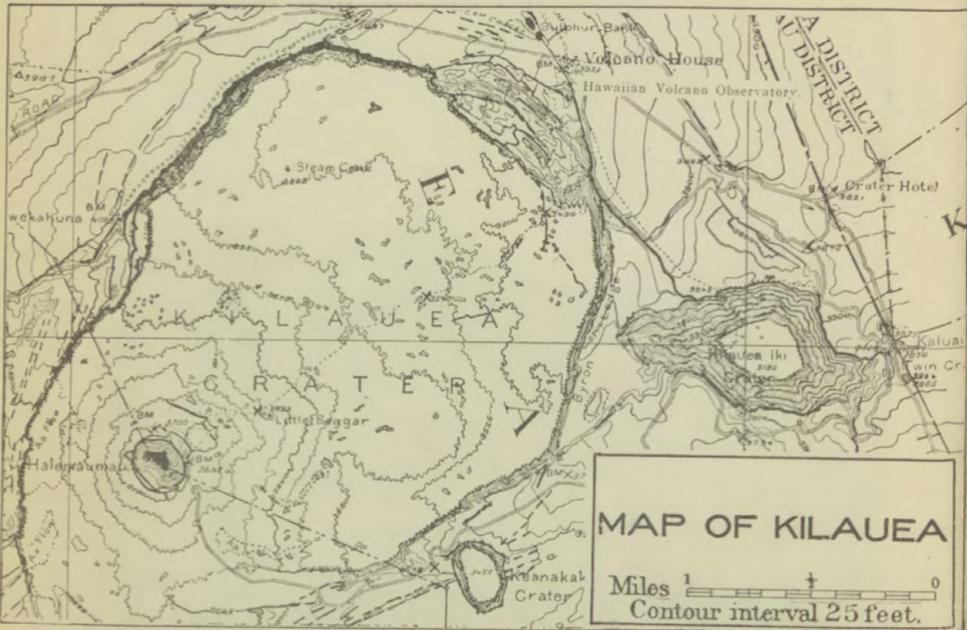
H. O. WOOD, Associate.



Northwest Station, rim of Halemaumau, taken July 16, 1913, showing A-frame used in temperature tests.



View of the Volcano, looking southwest from the most northerly point on the margin of the main crater, directly along the course of the cleft, or master rift, through Kilauea, showing the high northwestern wall with its cliffs and talus slopes; the summit point, Uwekahuna; and the partly down-faulted portions of the old summit surface in the middle distance.



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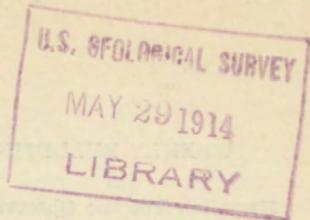
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| VII. | Very strong | 100.0 | 250.0 |
| VIII. | Ruinous | 250.0 | 500.0 |
| IX. | Disastrous | 500.0 | 1000.0 |
| X. | Very disastrous | 1000.0 | 2500.0 |
| XI. | Catastrophic | 2500.0 | 5000.0 |
| XII. | Great catastrophe. | 5000.0 | 10000.0 |

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220 (950)

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Vol. 2, no. 9
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WEEKLY BULLETIN

OF

Hawaiian Volcano Observatory

Vol. II.

HONOLULU, HAWAII, MARCH 4, 1914.

No. 9.

From the Pacific Commercial Advertiser, Honolulu, February 26, 1914.

TECHNOLOGY STATION, Kilauea, February 19.—There has been a further increase in eruptive energy at Kilauea since last week, though no marked change has been noted during the last four days. No molten pool has appeared nor have any fountains, jets or sprays been observed either by the writer or any other accustomed observer.

On February 12 no view was obtained on account of swirling fumes. Noises of snorting and prolonged sharp blasts, in quality like the sound of steam escaping from a safety valve, were audible for intervals of one to ten seconds, often at considerable distance from the margin of Halemaumau. Sounds of rumbling, with interrupted coughing noises, were almost continuous and appeared to come from the cleft region at the west end of the lake area. These sounds were louder than on previous days. No slides were heard.

Explosive Noises Become Louder.

On February 13 the fumes again prevented seeing. The sounds described above were heard but they were even louder than before—the loudest blasts at intervals of two or three minutes being plainly audible at the old corral on the trail, nearly a third of a mile northeast up the wind, from the edge of the pit. Thudding sounds like the patter of falling lumps of molten or viscous lava-spray were heard. However, these probably were muffled explosive coughings, because subsequent views have not revealed any sign of lava jetting during the present spasm of increased activity. For a short time in the late evening on this date the

fume cloud was definitely, though dimly, illuminated—seen plainly from the Volcano House. It is inferred that the top of one of the blowing cones collapsed, but soon coagulated again.

On February 14 there was no view. Loud blasts were audible at the old corral down the trail, and the rumbling noise was very loud. The noises of snorting and hissing seemed to emanate from several separate orifices at the bottom of the pit. Also the sound like that of falling lava spray was heard.

On February 15 a very brief daylight view revealed glowing lava in the orifice at the top of the "Old Faithful" cone. No other glimpse of "fire" was seen. The rumbling, snorting and hissing sounds were very loud.

On February 16 the gas blasts were still very loud and plainly audible at the old corral. Both rumbling and hissing sounds seemed to come from several different vents.

Glowing Lava Is Seen.

On February 17 a good view of the bottom area was secured for a very brief time. Glowing lava was seen in the "Old Faithful" orifice. The cone at the southeast margin and that at the north margin of the lake area were smoking furiously, emitting bright blue fumes, but, by daylight, no molten lava was discernible in their vents. Great quantities of bright blue fumes were rushing out of the cleft at the west, whence a loud and continuous rumbling noise emanated. As before, all the noises of eruption were very loud, the hard blasts still being audible as far away as the old corral. The sound of rumbling could be heard distinctly to

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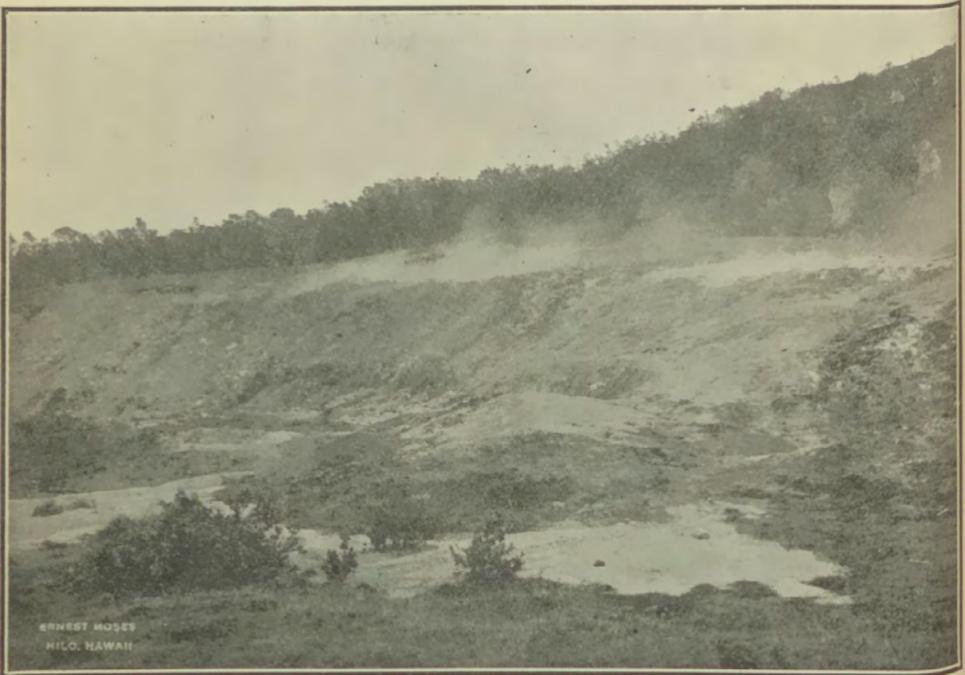
the north of the hot fissure situated
some forty to fifty yards from the mar-

gin of the crater. On this date the
blasts and hissing sounds all seemed to
come from the "Old Faithful" orifice.

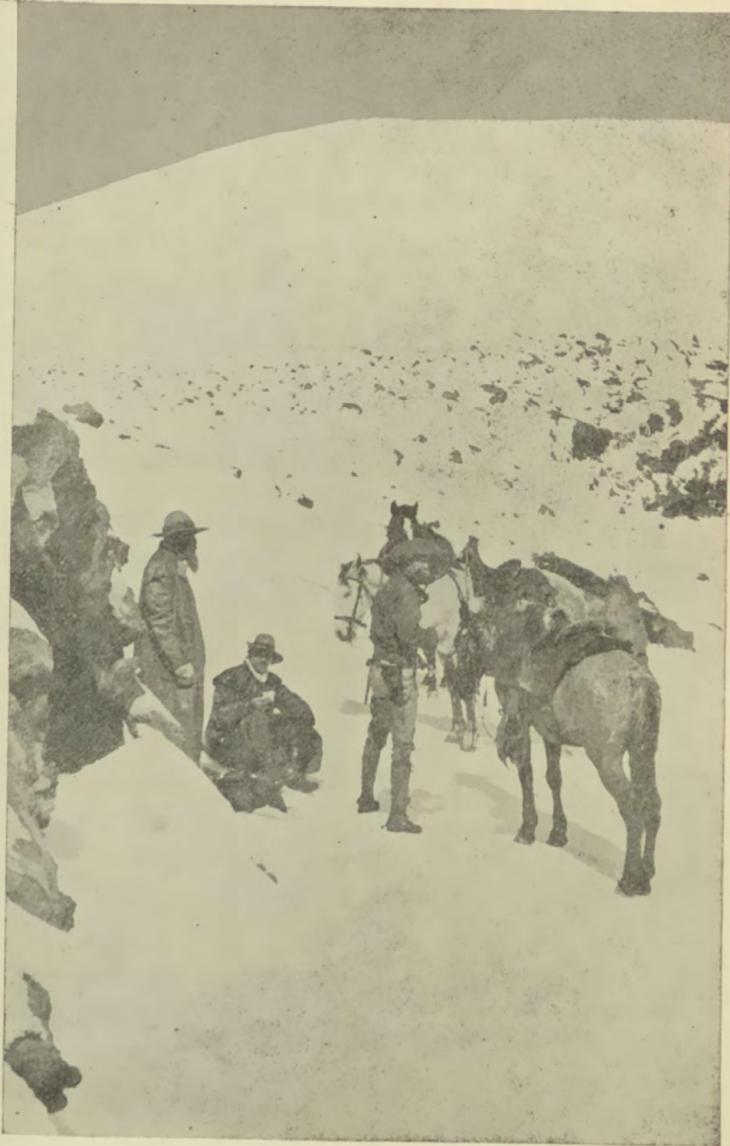
On February 18, on account of a
strong southwest wind, with frequent
showers, no visit was made to the pit;
for these weather conditions preclude
satisfactory observing.

Still no systematic seismological re-
port can be rendered. One weak and
three extremely feeble earthquakes
have been registered. No noteworthy
seismic motion of other sort has been
recorded.

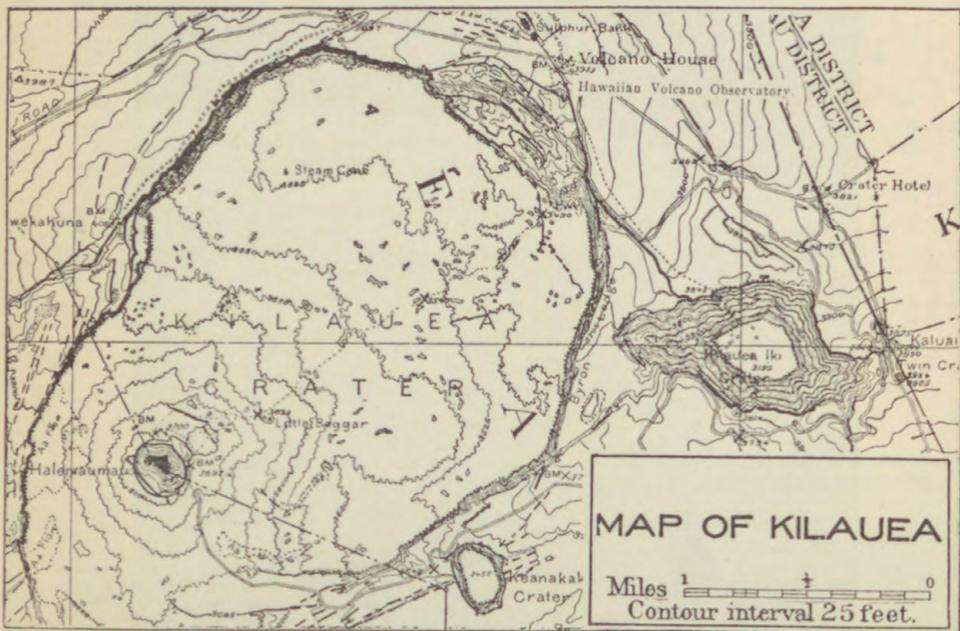
H. O. WOOD, Associate.



Sulphur Banks about 500 feet from the Volcano House, Hawaii.



Snow on the Summit of Mauna Kea, Hawaii.



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| XI. Catastrophic | 2500.0 | 5000.0 |
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220 (750)

H 4

Vol. 2, no. 10
cp. 1

U.S. GEOLOGICAL SURVEY
MAY 20 1914
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WEEKLY BULLETIN OF Hawaiian Volcano Observatory

Vol. II.

HONOLULU, HAWAII, MARCH 11, 1914.

No. 10.

From the Pacific Commercial Advertiser, Honolulu, March 2, 1914.

TECHNOLOGY STATION, Kilauea, February 26.—The energy of eruption has definitely increased during the past week. At night the fume cloud, as seen from the Volcano House, has been definitely illuminated, and the amount of illumination and the strength of the flaring has definitely increased. It is still, however, a very feeble illumination.

The latest date covered by the preceding report was February 17. No visit was made to the pit on February 18 owing to weather conditions unfavorable for observing.

On February 19, the pit was reached early in the forenoon, when it was remarked that a conspicuous diminution had come about in the harsh hissing and blowing sounds produced by spasmodic outrush of gases. The rumbling sound, however, had undergone no diminution—if anything it had increased in energy. During the forenoon many small talus slides were heard, and early in the afternoon one avalanche lasting for twenty-two seconds was noted. During the day no view of the bottom area was obtained on account of swirling fumes, but in the evening glowing lava was seen in the "Old Faithful" orifice.

On February 20, no view was obtained. The rumbling and hissing sounds were heard much as on the nineteenth. At considerable intervals small talus slides were heard.

On February 21, the blowing sound was again somewhat louder than on the two previous days. Brief but clear views of the bottom disclosed glowing lava, seen in daylight, in the orifice of the "Old Faithful" cone, and at the apex of a blowing cone under the

southeast station. The opening in "Old Faithful" was larger than heretofore during the present revival of activity. Nevertheless it was still a small opening, estimated at a little over three feet in diameter. Trivial talus slides were heard at irregular intervals. The greater part of the rumbling sound still seems to emanate from the cleft region nearly under the west station.

Jets of Molten Lava Seen.

On February 22 numerous clear views were obtained by many visitors. Both by day and night glowing lava was seen in the orifices of the blowing cones. In the evening four glowing orifices were seen—the two already mentioned, one nearly under the north station and one relatively high under the south station. Small jets of molten lava were seen by some visitors. The noises of eruption were as on the previous day. For the first time, during this revival, faint flaring in the illumination of the fume cloud could be definitely distinguished from the Volcano House.

On February 23, small lava jets, throwing molten spray, or "sparks" from "Old Faithful" were seen plainly in bright forenoon light. The glowing orifice at the top of the southeast cone was also seen plainly. The noises of eruption were continuing without change. Small movements of sliding in the talus, from twenty-five to forty-five seconds in duration, were heard from time to time. Many large and small boulders are seen resting on the frozen lake area, and its margins are nearly hidden by fallen talus. The southeast blowing cone appears as a small island in the talus. It was thought that glow-

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ing lava was visible by light of day
in the high south orifice, about one hun-
dred feet above the lake surface, but
this was uncertain.

On February 24 no visit was made to
Halemaumau.

On February 25, both by day and by
night molten spray was seen spurting
from both the "Old Faithful" orifice
and from that in the top of the south-
east cone. Fresh lava could be seen
all about the "Old Faithful" vent. In
the late evening a large orifice was ob-
served under the south station, about
one hundred feet above the floor of the
pit, out of which shone a bright light,
but no incandescent lava was seen in
this vent. No sliding was noted. The
noises of eruption were the same as
usual recently. The fumes continue to
pour out copiously through vents in the
talus at points all around the periphery
of the lake area.

Since the last systematic report from
the Whitney Laboratory of Seismology,
earthquakes have been registered as de-
scribed in the list below. Of these all
but one were very feeble shocks, ex-
cept instrumentally, and most of them
were feeble even from this point of
view. Even the one exception noted
was not perceived by the senses in this
neighborhood; but it was a smart
shock, nevertheless, and its acceleration
measures well above the perceptible
minimum, but the motion was exces-
sively rapid.

February 4, from 10:54:42 p. m. to
10:55:57 p. m.—H. S. T. Intensity, high
III Cancani scale; 80% of the mini-
mum perceptible unit. Origin distant
about 9.3 miles.

February 7, from 1:18:41 p. m. to
1:19:26 p. m.—H. S. T. Intensity, high
II Cancani scale; 45% of the mini-
mum perceptible unit. Origin distant
about 13 miles.

February 9, from 10:40:45 a. m. to
10:41:33 a. m.—H. S. T. Intensity, low
III Cancani scale; 65% of the mini-
mum perceptible unit. Origin distant
about 13 miles.

February 12, from 6:21:13 a. m. to
6:23:03 a. m.—H. S. T. Intensity, me-
dium III Cancani scale; 70% of the
minimum perceptible unit. Origin dis-
tant about 20 miles.

February 12, from 12:33:21 p. m. to
12:33:53 p. m.—H. S. T. Intensity, me-
dium I Cancani scale; 13% of the
minimum perceptible unit. Origin dis-
tance indeterminate.

February 12, from 11:26:00 p. m. to
11:26:59 p. m.—H. S. T. Intensity, me-
dium II Cancani scale; 35% of the
minimum perceptible unit. Origin dis-
tant about 11.2 miles.

February 13, from 10:23:20 p. m. to
10:24:04 p. m.—H. S. T. Intensity, low
III Cancani scale; 65% of the mini-
mum perceptible unit. Origin distant
about 11.8 miles.

February 14, from 3:13:18 p. m. to
3:14:00 p. m.—H. S. T. Intensity, high
II Cancani scale; 45% of the mini-
mum perceptible unit. Origin distant
about 10.5 miles.

February 14, from 7:49:04 p. m. to
7:50:53 p. m.—H. S. T. Intensity, (?)
III-IV (?) Cancani scale; measures
more than twice the minimum percepti-
ble unit, but vibratory movement is ex-
cessively rapid. Origin distant about
11.2 miles.

February 20, from 1:47:34 a. m. to
1:48:29 a. m.—H. S. T. Intensity, low
II Cancani scale; 30% of the minimum
perceptible unit. Origin distance in-
determinate.

February 20, from 1:53:27 a. m. to
1:54:15 a. m.—H. S. T. Intensity, me-
dium III Cancani scale; 75% of the
minimum perceptible unit. Origin dis-
tant about 6.8 miles.

February 21, from 2:04:59 a. m. to
2:05:47 a. m.—H. S. T. Intensity, high
II to low III Cancani scale; 40-70% of
the minimum perceptible unit. Origin
distant about 11.2 miles.

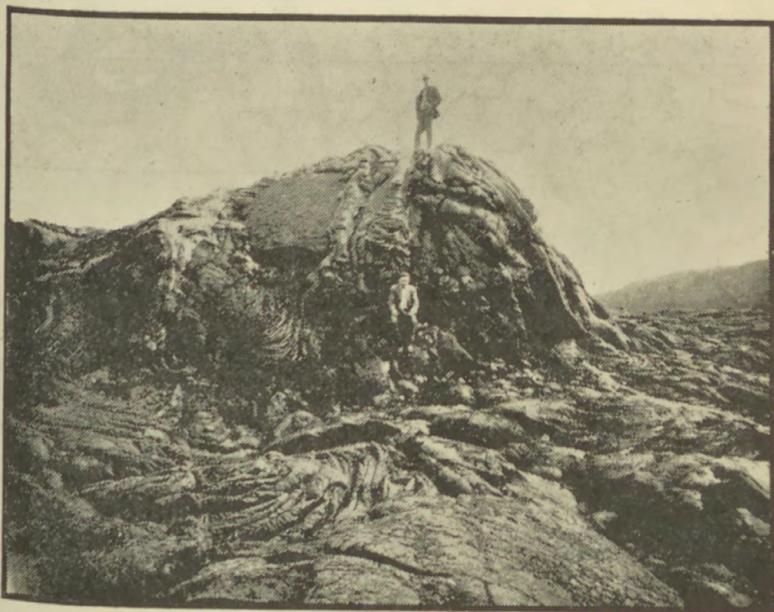
February 23, from 10:15:25 a. m. to 10:18:05 a. m.—H. S. T. Intensity, high III Cancani scale; 80% of the minimum

February 23, from 2:35:29 p. m. to 2:36:39 p. m.—H. S. T. Intensity, low III Cancani scale; 60% of the minimum perceptible unit. Origin distant about 13 miles.

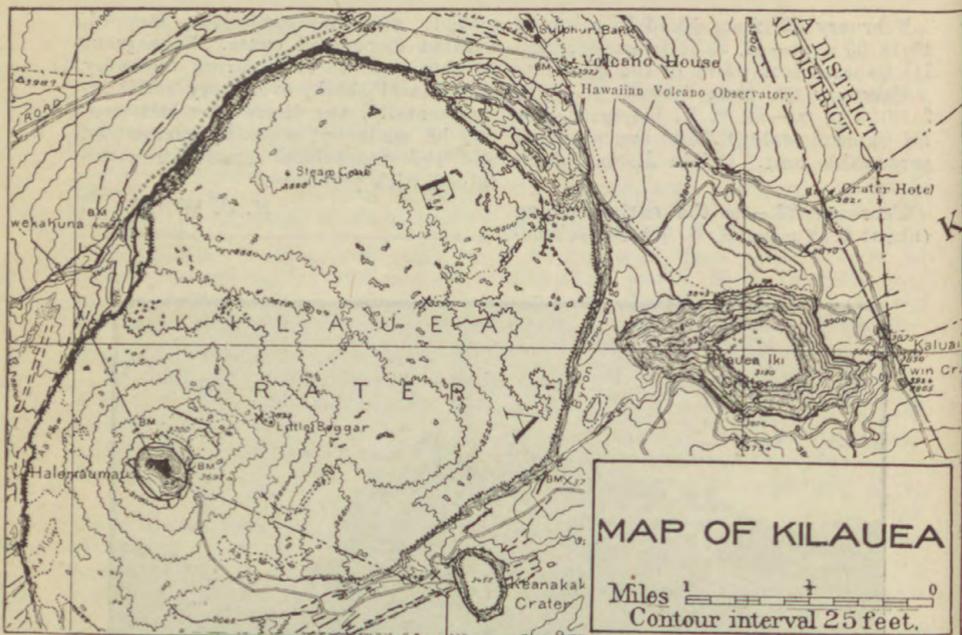
February 23.—In the early evening (about 6:38 p. m. H. S. T.) the seismo-

graphic time-marking clock stopped, without discovered cause. Subsequent to this time there occurred one very slight local shock, even very small instrumentally, the times of which cannot be made out even approximately, and the dimensions cannot be ascertained with precision.

H. O. WOOD,
Associate.



View of Driblet Cone northwest of Halemaumau, taken July 16, 1913.



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CANCANI SCALE OF SEISMIC INTENSITY

Expressed by accelerations measured in millimeters per second per second.

| | | |
|---------------------------------|--------|---------|
| I. Instrumental | 0.0 | 2.5 |
| II. Very slight | 2.5 | 5.0 |
| III. Slight | 5.0 | 10.0 |
| IV. Sensible, mediocre. | 10.0 | 25.0 |
| V. Rather strong | 25.0 | 50.0 |
| VI. Strong | 50.0 | 100.0 |
| VII. Very strong | 100.0 | 250.0 |
| VIII. Ruinous | 250.0 | 500.0 |
| IX. Disastrous | 500.0 | 1000.0 |
| X. Very disastrous | 1000.0 | 2500.0 |
| XI. Catastrophic | 2500.0 | 5000.0 |
| XII. Great catastrophe. | 5000.0 | 10000.0 |

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220 (950)
H 4
Vol. 2, no. 11
cp. 1

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WEEKLY BULLETIN

OF

Hawaiian Volcano Observatory

Vol. II.

HONOLULU, HAWAII, MARCH 18, 1914.

No. 11.

From the Pacific Commercial Advertiser, Honolulu, March 8, 1914.

TECHNOLOGY STATION, Kilauea, March 5.—Activity in Halemaumau continues to increase, though slowly and irregularly. As yet there is no molten pool, but, when the swirling fumes permit, glowing lava can be seen especially at night, in the "Old Faithful" place, in the apex of the cone at the southeast, in an orifice about one hundred feet above the floor at the south, in an orifice at the west, and in one at the north. An occasional jet of molten lumps is seen, and the sound of falling spatter has been heard at rather long, but irregular, intervals.

The fume cloud is faintly illuminated at night, punctuated by feeble but well-defined spasmodic flarings. The harsh blowing noise has again become very loud—at times almost explosively sharp. The deep-toned rumbling is loud and continuous. Sounds like those of surging and swashing of the heavy molten fluid can be heard plainly.

On February 26 a good view was obtained of the "Old Faithful" cone and the southeast cone. Several small cones were seen—one at the south-southeast, in the talus, between twenty and fifty feet above the floor. Talus slides were frequent and prolonged. The rumbling sound continued unabated, and the blowing sound, though not so loud as earlier, was the same as on the foregoing days.

On February 27 no view was obtained. The noises were as usual. There were frequent talus slides, some lasting fully half a minute.

Glowing Lava Cone.

On February 28 a good view of "Old Faithful" was obtained. Glowing lava

could be seen within the cone. No molten spray could be seen, even when the blasts were hard. The blowing sound was about the same as on the previous day. The rumbling was as usual. The southeast cone was seen, and glowing lava was visible in it at the apex; but no gas blasts were issuing from it—only from "Old Faithful." Blue fumes were issuing copiously from a large orifice on the floor between the south and southeast stations; also from the western crevasse.

On March 1 only a fleeting view was obtained. Three glow-holes, possibly each three to four feet in diameter, were seen at the apex of the "Old Faithful" cone. Thin and scanty blue fumes were seen to be rising constantly out of the talus at the south, less than one hundred feet below the summit rim. The rumbling was loud and continuous and had a pulsating quality. The blowing noise had greatly increased in energy and the blasts were occasionally prolonged, at irregular intervals, lasting from thirty to one hundred and fifty seconds. Blue and white fumes were issuing copiously from the southeast group of fumaroles in the talus.

Gas Blasts Frequent.

On March 2 a good view was obtained. Three large orifices exhibiting molten lava were seen plainly at the apex of the "Old Faithful" cone. Gas blasts were issuing from these every two or three seconds, and the noise was very loud. The rumbling was as usual. Every few seconds a flash of light was seen within the large crevasse at the west-northwest, and there were three blowing orifices close by.

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Editor.....Howard M. Ballou
Professor of Physics, College of Hawaii

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An Excellent View.

On March 3, in the early part of the day no view was obtained. However, visitors reported that just before nightfall there was an excellent and prolonged view. Glowing lava was visible in several orifices in the talus, as well as, probably, in the "Old Faithful" place. Small jets of molten spray were seen. On this day the blowing noises were much louder than on Sunday, the 1st, and the rumbling was as usual.

On March 4 no view of the bottom was obtained. Again blue fumes were seen rising from the talus less than one hundred feet below the southern rim, from the spot from 150-200 feet below

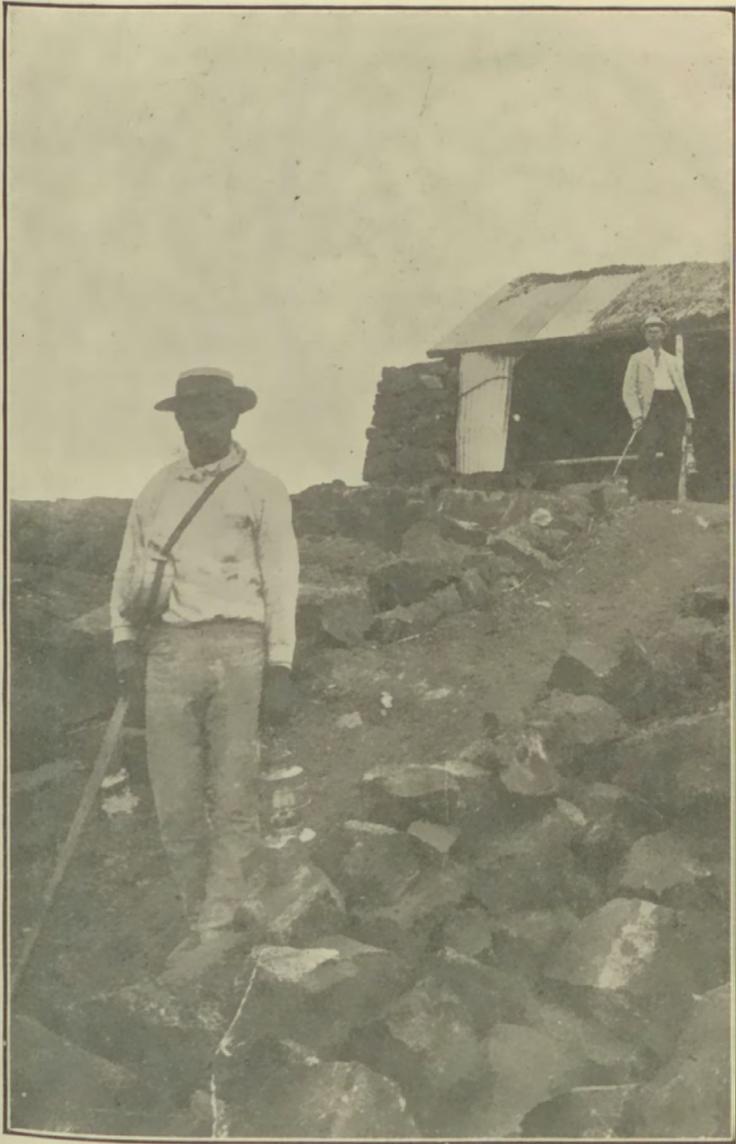
the rim under the north station, and in very great volume from the crevasse at the west. The sounds of blowing were much louder than on the first, and the quiet intervals were shorter, but no prolonged blasts were heard. Rumbling was heard as usual. One trivial talus slide occurred.

At night, in bright moonlight, distinct flaring was seen at the irregular short intervals so characteristic of the fountain action of "Old Faithful," but while the moon was shining no continuous illumination from the molten lava could be made out. After moonset, both on the third and on the fourth of March, a faint but steady illumination of the fume cloud was seen.

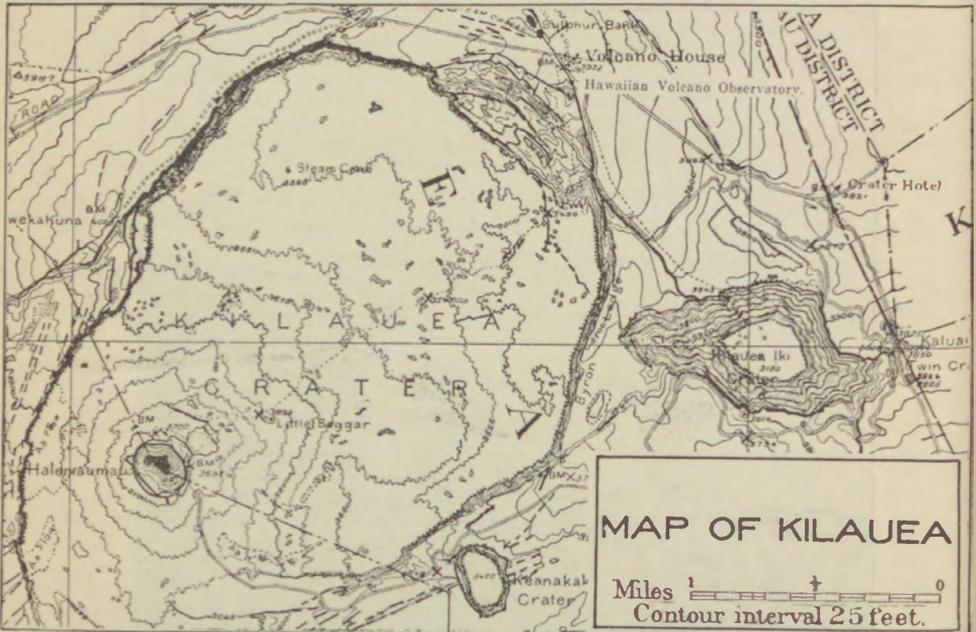
Slight Earthquakes.

During the week five slight local earthquakes have been registered. One, on March 1, was felt distinctly a few miles in the direction of Hilo, and was fairly heavy at Kapapala, but in the immediate vicinity of the Volcano House it was just barely perceptible under day conditions—about II Rossi-Forel. No systematic report upon these earthquakes can be rendered this week.

H. O. WOOD, Associate.



The Trail down into the Crater of Kilauea, Hawaii.



HAWAIIAN VOLCANO RESEARCH ASSOCIATION.

This society is a voluntary one, made up of subscribers to scientific work which is being executed by the Massachusetts Institute of Technology.

In 1913 there were 26 subscribers in Hawaii and Massachusetts, firms and individuals. A group of firms and persons in Hilo built the main observatory building in the spring of 1912. Publications to date have been weekly reports since the summer of 1911, a memoir by Daly in the Proceedings of American Academy of Arts and Sciences in 1911, articles by the director in the Technology Review 1911 and the Honolulu Chamber of Commerce Annual 1912, articles by H. O. Wood in the Bulletin of the Seismological Society of America, and articles by Perret in the American Journal of Science. The Massachusetts Institute of Technology will publish semi-annual reports.

This weekly bulletin as it appears in the Advertiser will be reprinted as a leaflet and sent to regular annual subscribers to the work of the association. C. H. Cooke is president of the Board of Directors of the association and R. W. Shingle is treasurer. New subscribers who are interested in our volcanoes will be welcomed in the association. The association aims: (1) To record volcanic activity and earthquakes in Hawaii; (2) to attract scientific men hither for special studies; (3) to promote the establishment of volcano observatories all over the world.

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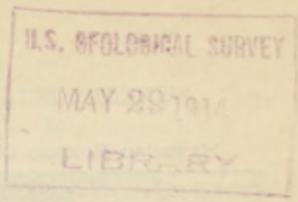
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H 4

V. 2, no. 12
cp. 1



WEEKLY BULLETIN OF Hawaiian Volcano Observatory

Vol. II. HONOLULU, HAWAII, MARCH 25, 1914. No. 12.

From the Pacific Commercial Advertiser, Honolulu, March 15, 1914.

TECHNOLOGY STATION, March 12. —During the past week, conditions at Halemaumau have undergone little change, but there has been no diminution in activity; probably a slight increase.

On Thursday, March 5, no visit to the active pit was made from the Observatory, but visiting tourists reported the blowing noise to be loud, the rumbling continuously audible, and views of glowing lava after nightfall visible in the usual orifices.

On March 6 a very prolonged watch was kept. Many brief views were obtained. Throughout the day and evening molten lava was ejected in flying lumps from the "Old Faithful" orifice, at an interval of about forty-five seconds. Some of these jets of molten spray shot up from forty to fifty feet. Brightly-glowing lava was seen in late afternoon and evening in the large gash, or crevasse, on the floor leading into the cliff under the northwest station. Glowing spots were seen on the floor at the southeast, and in the talus near the floor at the southwest. The blowing noise was louder and harsher than on previous days. The rumbling was much as usual. At night the fume cloud was illuminated brilliantly by flaring for instants, though there was bright moonlight.

Because of wind, and of the prolonged watch on the previous day, no visit was made to the pit on March 7.

On March 8 the blowing noise, though frequently prolonged and quite loud, had lost much of its harsh, shrill quality. This probably resulted from the enlargement of the orifices from which gas is escaping. The rumbling

was as usual. "Old Faithful" was seen plainly—three small orifices at the apex of the cone, within which glowing lava was visible. No lava jets were seen, nor no sound of falling spatter was heard. Glowing lava was seen at the southeast on the floor, at the southwest a little above the floor in the talus, and in the gash leading into the wall at the northwest. This latter was by far the largest and hottest orifice. Here the rock was snapping sharply from the increasing heat. At times flame appeared to be playing above it. Here blue fumes were exhaled in great abundance. Blue fumes were again noticed escaping from several orifices high up in the south talus, and from the high north fumarole. Brief slides were heard.

On March 9 the rumbling noise was not so loud, but the blowing was fully as loud, possibly louder than on the 8th. Lumps of molten lava were sprayed up from "Old Faithful," falling as spatter about the cone. Many small slides were heard, and several lasting from forty-five seconds to a minute were noted. The moving material in most of the small slides, and at least one of the longer ones, ran down into the gash orifice under the northwest station.

On March 10 wind prevented any view. There were many small slides, and one of about one minute's duration, which occurred at the southeast. The sounds of blowing and rumbling were as usual.

On March 11, in early evening, a brief view from the southeast station showed "Old Faithful" and the southeast cone, both with glowing orifices, and both ejecting showers of molten

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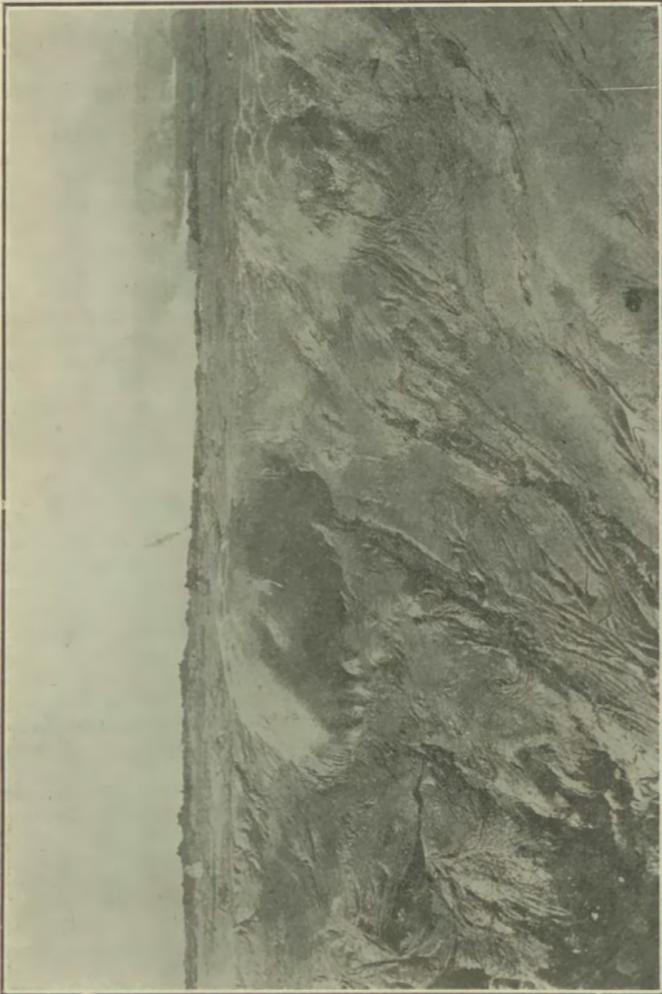
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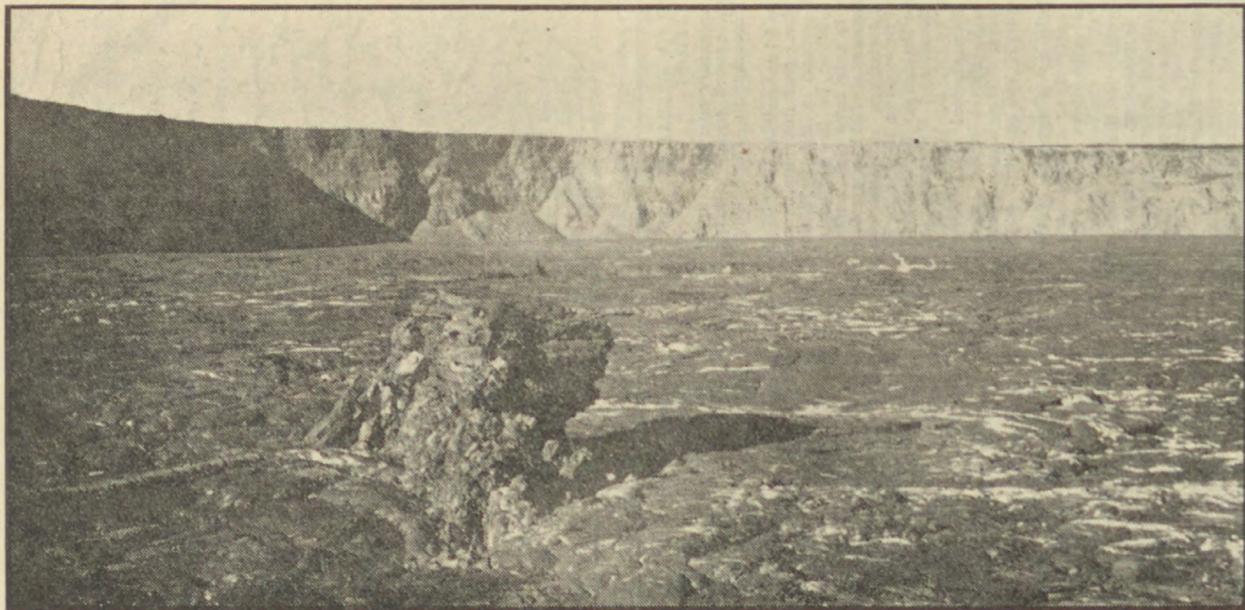
spray at intervals. The blowing noise was very loud, particularly the blasts from "Old Faithful." The rumbling was as usual. No slides were heard. Smoke prevented any view of the west-northwest orifice.

No systematic seismological report can be rendered this week. However, five slight earthquakes have been registered, one early in the morning of March 8 being strong enough to be barely perceptible to the senses.

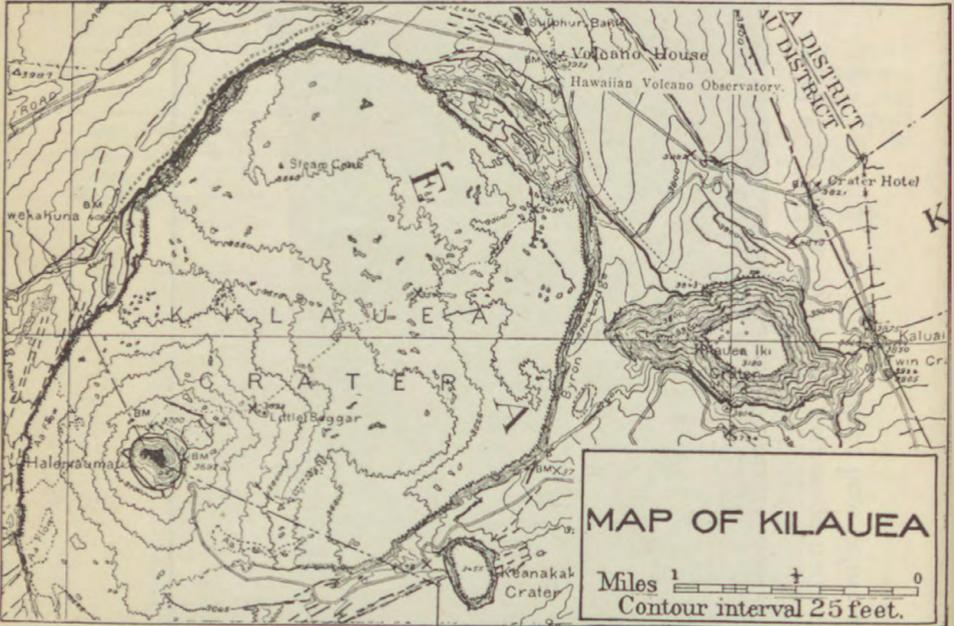
H. O. WOOD,
Associate.



Smooth Lava (Pahoehoe).



“Table” or “Stack” of lava in depression north of Halemaumau, showing former position of lava surface here before subsidence occurred.



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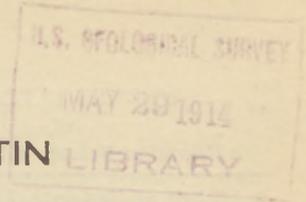
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220(950)

H 4

Vol. 2,
no. 13
cp. 1



WEEKLY BULLETIN
OF

Hawaiian Volcano Observatory

Vol. II.

HONOLULU, HAWAII, APRIL 1, 1914.

No. 13.

From the Pacific Commercial Advertiser, Honolulu, March 22, 1914.

TECHNOLOGY STATION, March 19.

—As a spectacle Kilauea is again in action—at night affording to the patient watcher, unless a strong wind blows, fitful views of jets of molten lava flung upwards to heights sometimes exceeding one hundred feet, these jets springing up every few seconds from three or four different orifices. The pit is theatrically illuminated by the glow from several small caves and orifices in its depths. As yet, however, there is no molten pool.

On March 12, at frequent intervals, lava was violently ejected, but in small quantity, from the "Old Faithful" orifice and from that in the southeast cone. Noise of blowing and rumbling was as usual. A large orifice was noted, for the first time, under the northeast station at the very edge of the lake area. Here the gas was issuing in spasmodic blasts, but no lava jets were noticed. The glow on the fumes here was very bright. No slides were heard. At times a blue flame was seen playing over "Old Faithful."

On March 13 jets of molten lava were seen issuing from "Old Faithful" and from the southeast cone, and glowing lava could be seen in the orifice of the northeast cave. The blowing sound was very loud indeed. The jets from "Old Faithful" were thrown up from forty to fifty feet. Blue flames were playing above its cone. No slides were heard.

On March 14 conditions had undergone no change, except that nearly all the marks of activity had slightly increased. No incandescence, however, could be seen at the northeast orifice, but simply bright illumination of the

fumes there. A new, small orifice was observed under the northwest station at the edge of the lake area, in which glowing lava was seen.

On March 15 wind prevented seeing in afternoon and early evening. It was noted that the blowing sound, remaining fairly loud, had become continuous, but that it was punctuated at intervals of from one-half to two seconds by explosive snorting and coughing sounds. Further, at intervals of twenty to one hundred seconds there occurred still other louder and heavier gas blasts. Rumbling was heard as usual. There were frequent snapping sounds, loud and sharp, as of rock cracking from heat. There was heard, doubtfully, the sound of falling spatter.

In the late evening, as reported by visitors, jets of molten lava were flung up from forty to fifty feet from "Old Faithful," and a flow cascaded to the floor from the low gash-orifice at the W. N. W. Though there was a southwest wind, blowing the fume cloud toward the Observatory, from here bright and prolonged flares were seen at times.

On March 16 a very strong southwest wind prevailed, preventing all views. This wind set up and maintained a state of vibration of the foundation piers of the seismographs exceeding in amplitude the vibrations commonly produced by violent activity in the pit. At Halemauau a few trivial slides were heard; also, as usual, sounds of rumbling and of continuous blowing punctuated by snorting and coughing sounds. There were subdued, but heavy, sounds as of considerable bodies of lava in motion. The sound of falling spatter was

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plainly heard, and the flaring, seen at
the pitside, was very bright.

On March 17 conditions had under-
gone no change. The large W. N. W.
orifice had partly closed, but the rum-
bling there was very loud. No glowing
lava could be seen in it until evening,
when very small incandescent holes
could be seen. Jets of molten lava,
sometimes in considerable amount, were
flung from "Old Faithful" at every
eruptive spasm. The blowing noise was
continuous, but the coughing and snort-
ing was less pronounced. Trivial slides
were heard, and much material was seen
to have fallen to the floor since the
early part of the week here under re-

port. The southeast cone was nearly
covered with talus. After nightfall
many small glowing orifices were seen
in the talus, and cliff wall, near the
edge of the lake area—up to one hun-
dred feet above the floor of the pit.
Despite the swirling fumes views, satis-
factory from the spectacular point of
view, were frequent throughout the
evening.

On March 18 general conditions re-
mained the same. Lava jets from "Old
Faithful" sometimes exceeded one hun-
dred feet (estimated) in height. At
these times tons of molten lava were
flung into the air from this orifice. In-
candescent lava was seen plainly in
the W. N. W. gash. Numerous small,
glowing places were seen again in the
cliff walls and in the talus high above
the bottom of the pit. The southeast
cone was seen to be almost buried un-
der talus. Jets of lava were springing
obliquely out from the northeast cave.
No blue flames were seen. A few triv-
ial slides were heard. The sharp sound
of rock snapping from heat was heard
plainly.

Seismically the week has passed un-
eventfully. No systematic report can
yet be rendered.

H. O. WOOD, Associate.

From the Pacific Commercial Advertiser, Honolulu, March 24, 1914

KAGOSHIMA, Japan, February 20.
—I have to report that I left Honolulu
per S. S. Korea, January 22; arrived
Yokohama February 2; spent February
3 in Tokio with Professors Omori and
Koto; sailed the same day; arrived
Nagasaki February 6 and remained
there until Monday, February 9.

On that day, accompanied by Mr.
Mihara, an employe of Holme, Ringer
& Company of Nagasaki as interpreter,
I left by rail for Kagoshima, arriving
the same night and stopping at the
Satsuma Hotel. Every possible court-
esy was shown me in Tokio and Nag-
saki.

Arrived at my destination, I was met
by Professor Sasamoto, a geologist and
teacher of this city, and by Mr. Atsumi,
an associate of Professor Omori and a
member of the staff of the Imperial
Meteorological Observatory at Kago-

shima. February 10 I called on the
acting governor of the prefecture, Gov-
ernor Tanaguchi being absent in Tokio
on official duty connected with the
eruption. The acting governor, Mr.
Hattori, immediately sent a guide about
the city with me and placed at my
disposal the training ship Nishiki Maru,
and extended other courtesies. Mr.
Wm. L. Schwartz, an American teacher
and man of letters here, has worked
for me most assiduously in accumulat-
ing photographs and records, as well
as offering me the hospitality of his
home. One and all have been most
kind, and I cannot say enough in praise
of the hospitality, scientific interest and
intelligent efficiency of the government
and people of Kagoshima.

As to the eruption of Sakurajima, it
proves to be an epoch-marking event in
Japan, and this expedition was amply

justified. I am glad to hear that Mr. Perret is coming, and I hope that some gas chemist will come when the more violent explosions now in progress have subsided.

The unusual feature of the eruption for Japan is the outflow of two floods of a lava of the composition of hypersthene andesite. It is not unusual for this volcano, for the same thing appears by the old records to have happened at Sakurajima in 1779 and 1476, but there are few volcanoes like it in Japan. At the time Professor Omori left, January 28, he estimated ten square kilometers had poured out, and the depth of the east flow in places is not less than 500 feet, as it fills a channel fifty-five fathoms deep and is piled two hundred feet high above sea-level.

Sakurajima is a wonderfully impressive peak, as it towers before the city of Kagoshima. It has a serrate summit, somewhat like the Dents du Midi as seen from the Lake of Geneva. It made a round island two miles from the city and right in front of it, in a bay which is elongate right and left as one faces the waterfront.

Back of Sakurajima a point of land jutted out from the province of Osumi within a quarter of a mile of the island. A population of 20,000 fishermen and farmers occupied sixteen villages along the shore of the island.

My first glimpse of the volcano was from the train at night, approaching the city, and I saw a great column of smoke rising from the east base of the mountain, with a fitful flare of dull red lava below. It appears that the mountain was rent asunder along an east-west vertical fracture. The summit craters played no part in the eruption, and six or eight new craters were formed east and west at elevations from 500 to 1500 feet above sea-level, ejecting first stones, gas and dust, and within a day, lava.

The eruption was essentially Vesuvian in quality. Premonitory were eruptions of Kirishima, the next volcano thirty miles north, in June, November and December last, and an unusual earthquake last July. The past year has been excessively dry here. Doctor Friedlaender published a warn-

ing in 1910 to the effect that an erup-

tion might be expected, heralded by strong earthquakes.

The phases of the eruption were:

Three hundred and seventy earthquake shocks during some 27 hours, January 11 to the morning of January 12. On January 12 at 8:30 a. m. curbed hot springs at Arimura, on the south shore of Sakurajima, rose suddenly about three feet.

Simultaneously with this gush of springs, white threads of vapor rose above the southern summit crater. At 2 p. m. the previous day similar white vapor had been seen.

At 10 a. m., January 12, an explosion with black "cauliflower" smoke took place on the side of the volcano towards Kagoshima, the west side, the earliest photographs indicating some obliquity of the jet westward.

About ten minutes later, according to the masters of vessels to the south, who could see both sides of the mountain, a similar column of black smoke rose at the eastern base of the volcano.

At first the rumbling noise was not very strong, but it increased during the day to tremendous detonations, and for three days those who stayed in the city were almost deafened by the detonations, coupled with the noisy jar of the screen-doors of the Japanese houses (shoji) incessantly vibrating by atmospheric concussion. The earthquakes continued. The explosion column of smoke and ash from the west side rose over 20,000 feet and bent eastward, while at first the eastern column appeared smaller and whiter under the overarching column from the west vents.

At 5:30 p. m., January 12, strong earthquake shocks were felt at Arimura on the southeast shore of the island and this time was said by the officers of the Nishiki Maru to be the culmination of the western explosions. There were tremendous revivals that night at midnight and on the next evening (13th) a marvelous fiery display, but this time was probably the maximum explosive gas pressure before the lava rose to the craters. And the southeast earthquakes of 5:30 p. m. probably marked the wider opening and rise of lava in the eastern vents.

At 6:30 p. m., January 12, a strong and somewhat prolonged earthquake shook Kagoshima, wrecked stone walls and killed about twenty persons. Others were wounded. The earth wave was east to west, from the direction of the volcano, north to south walls falling and east to west ones resisting.

A bright flare over the volcano was seen simultaneously with the earthquake. This I attribute to the fact that the lava wedge with its hot gases split its final passage to the craters at 6:30, cracking suddenly the foundation of the volcano along a W-NW vertical plane connecting the east and west craters and so producing the earthquake as a result of the sudden fracture. From the alignment of the east craters it is clear that such a rift exists, and this line accords with that of the two principal west craters. There are at least four main east crater vents and three western ones.

At midnight, January 12, there was a second special culmination of explosive activity with occasional flarings, visible incandescent blocks describing trajectories upward and outward and vanishing in their downward course to the earth. In daylight they left trails of smoke. The east craters were not carefully observed, as there were no scientific observers on that side. Lightning was seen in the cauliflower jets, first stellar, then linear flashes. They were not seen to pass from cloud to earth, or to the bay. Lightning was seen January 12, 13 and 14, that of the 13th being more elongate. There was rain and local thunderstorms the evening of the 13th.

The midnight crisis of January 12 may be attributed to the culmination of free flow of gas liberated by the lava which had risen to the craters at 6:30 that evening.

On January 13 there were few earthquakes and of no great strength. The crisis had passed.

The explosive activity continued, however, with great force, and the event of this date was the beginning of lava flow down the slopes of the mountain east and west, eventually burying the deserted villages at Yokoyama, Waki, Arimura and Seto. The

flow on the west side became visible soon after 3 p. m.

An earthquake sufficiently strong to be startling was recorded at the observatory at 4:09 p. m. At 7 p. m. the lava was flowing rapidly with colossal cauliflower explosions at the west craters and the greatest noise and fire of the eruption took place from 8 to 8:30 p. m. of this date January 13th.

Ship's officers on the Kagoshima waterfront at this time saw houses burning at Hakamagoshi, the promontory straight across the channel from Kagoshima. When I visited this place later, I found evidence of a horizontal blast outward and downward from the craters, and this is probably what ignited these houses, for the lava flow was not near them. Trees were uprooted and shredded and scarred with horizontally flying stones, and they were thrown over in lines directly away from the volcano. This blast of the Pelee type, therefore, probably took place about 8 p. m., January 13, when the explosion debris in the air was weighing down on the upjets and the atmosphere over the volcano had become surcharged with solid matter. This was the only locality where I saw evidence of such a blast, and moreover this blast was headed directly for Kagoshima only two miles across the strait.

Had the lava not flowed, and the explosions gone on increasing in violence on the west side, Kagoshima might well have suffered the fate of St. Pierre in Martinique. As it was, however, this small blast of the evening of the 13th was the only manifestation of this sort and the great display of 8:30 that night was the final performance so far as the western craters were concerned. It was probably occasioned by ebullition of gas released from the lava column when rapid overflow started great quantities of fluid from the depths.

January 14, the noises had changed. Up to the evening of January 13 continual quick detonations like artillery were the rule. After the lava flowed and the great display of 8:30 p. m. was over, the noise settled down to rumbles and growls, with detona-

tions and felt earthquakes increasingly rare. When I reached Kagoshima, February 9, the occasional noises from Sakurajima, best heard when the wind was easterly, were precisely like the rumbling of heavy balls in a bowling alley, and the duration of the rumble about that which precedes a ten-strike. Occasionally this was varied by one or more loud "booms," like cannon, and all the screens and shutters of the house would rattle with the concussion.

On January 14, the western lava flow was well back from the shore, and the cauliflower explosions of the west craters appeared still dominant over those from the east craters.

January 15 the western lava reached sea-level and started the building of what has become a large promontory of new land. Explosion on the west had now greatly diminished, while the explosion on the east maintained great violence, with lava flow as well.

About January 20 the small island Karasushima on the west was reached by the advancing promontory of lava and buried under it. At this time explosion practically ceased from the west craters, but it continued on the east, and is still in vigorous activity at this time (February 20, 1914), and the lava flows are still in motion on both sides of the volcano. From time to time minor explosions in the new lava fields took place after January 20 on the west, but most of these were due to local accumulation of gas and some of them to spring water which accumulated under the hot lava, made contact with it, and so produced superficial steam explosion. There are craterlets, doubtless due to this mechanism, in the fields of hot ash and stones on the western foot slopes.

February 1 was the historic date when Sakurajima ceased to be an island and became a peninsula. The eastern lava-flow had been coursing onward from January 13 presumably, balancing on the east side, the outflow on the west, and eventually piling up to much greater heights. The lava at sea level on the east is a chaotic mass of a-a 150 to 170 feet high, whereas it is only about 50 feet high on the west.

On February 1 the east lava front closed the channel and made contact

with the Osumi peninsula. February 13 a survey was made showing contact with the shore for two hundred feet and lava sixty feet high. February 19 I visited the place and found 330 feet of shore in contact with the lava and the latter piled up 150 feet high. For several hundred feet in both directions the lava was nearly on the shore, separated from it by a channel fifty feet wide of hot sea-water at a temperature of 138 degrees Fahrenheit. Earlier measurements of the temperature of water at the west lava-front were reported by the Navigation School to be 153 degrees Fahrenheit.

From February 1 to the present time the history of the eruption has been slow decadence. Earthquakes have diminished in number and intensity since January 15. During my stay (February 9 to February 20) the explosions of the east craters have shown diminished violence and the lowest of three prominent craters on that side has practically gone out of explosive action, though lava continues to pour from it.

The lava east and west flows slowly in tubes under heavy a-a crusts. The east lava is plastered deep with banks of sand, pumice and ash. Pumice floats in scums and patches all over Kagoshima bay, the larger stones being four inches in diameter. Ash fell all over the country, on January 14 even as far as Tokio, and ranges in depth from a fraction of an inch to seven feet. There was no sympathetic eruption of the Volcanoes Kaimon, Kirishima or Aso as at first reported. There were no geysers in the bay.

Mr. Katsuno, the efficient director of the meteorological observatory, remained at his post throughout the eruption, kept excellent record of everything, and is still at his post, and furnished me with much valuable information. The stories of his suicide were malignant gossip wholly without foundation or justice.

The loss of life was about twenty-four persons, missing about eighteen, wounded unknown. Most of the deaths were from earthquake. The death zone would have involved at least 20,000 persons if they had stayed in their homes. They migrated without panic and were cared for in neighboring towns. Then in a week, when reas-

sured, they came back, at least to Kagoshima. Probably on Tuesday, January 13, there were not 1000 persons, of a population of 70,000 in Kagoshima. In all about 90,000 people migrated. When we compare Messina with a death roll of 130,000, and St. Pierre, 26,000, the record here of forewarning and efficient self-protection is without parallel. The government immediately took control. Doctor Omori, of the Imperial Earthquake Investigation Committee, came to Kagoshima, examined conditions, and issued a statement, on the basis of which the people returned, and that statement has proved to be correct. Plans are now being perfected to

rehabilitate the Sakurajima people in a safer land in the Province of Hyuga.

The eruption is now a magnificent spectacle and should be visited by everyone coming to Japan. It is a scene not to be duplicated once in a century. There is no reason for nervousness nor apprehension of further outbreaks, at least in the Kagoshima district, for years to come, as the safety valve is open, lava has flowed freely, and the gases are pouring forth from an open vent. There may be earthquake shocks occasionally and some further lava and gas activity, but the essential features of a periodic volcanic eruption here are finished.

T. A. JAGGAR, Jr., Director.



VESTIGES OF THE MOLTEN GLOBE. PART II.
THE EARTH'S SURFACE FEATURES AND VOLCANIC PHENOMENA.

By Wm. Lowthian Green,
Honolulu, 1887, pp. 337, 8 vo.

A few copies of this important work, (new, though slightly shop-worn) are still obtainable. Price \$3.00, post free, Howard M. Ballou, Secretary Hawaiian Volcano Association, Box 353, Honolulu, Hawaii.

Dr. Jaggard writes of this book as follows:

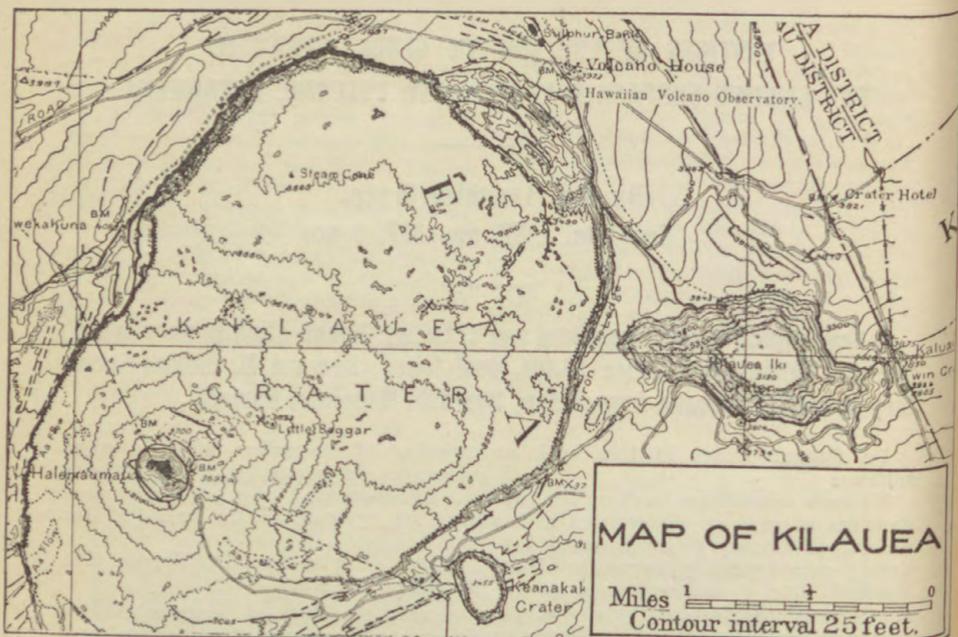
No more remarkable book on the fundamenta of geology was written in the nineteenth century than Green's "Vestiges," except possibly Darwin's "Coral Reefs." Mr. Green was a scholarly man of business, inspired by the unique volcanic environment of a home in mid-ocean islands, and his acute power of observation during many visits to Kilauea and Mauna Loa led to generalizations which have won acceptance from men of science the world over. Michel Levy and De l'Apparent in France, Emerson and Daly in America, and many others have followed Green in his ideas of a tetrahedral earth and a fluid substratum, while his studies of volcanoes must ever remain among the classics in the library of the volcanologist. The first volume dealt with the tetrahedral earth and is very rare. The second volume is of more interest to the general reader and summarizes the first, extending the work to special studies of volcanoes and of Hawaii in particular.

This book is all too little known and ought to be reprinted and in the possession of all the libraries of the world. It deals with the figure of the earth, special strains in tropic zones, distribution and origin of the oceans, the

meaning of volcanism and Hawaiian volcanism in particular, the chemistry of volcanoes and the peculiarities of fracture systems in the crust of the earth.

Later, in a lecture, Dr. Jaggard thus mentions the work:—

Green, the man of business, in his leisure moments student of volcanic life and of the inspiring heights and depths of the globe, conceived to scale, with its film of waters and its blanket of gas, wrote a remarkable book in two volumes, "Vestiges of the Molten Globe." His second volume deals especially with Hawaiian volcanoes, which he visited many times, and of it Professor Daly of Harvard writes: "It is certainly a pity that the second part of Green's work is not more generally known. The book is almost as remarkable a contribution to the philosophy of vulcanism as Part I, 'On the Tetrahedral Theory of the Earth,' is important in cosmogonic philosophy." Green's work foreshadowed theoretic conceptions which modern thought has fixed more firmly, and his interest, as a business man, in the affairs of pure science was forerunner of the wider interest of many business men (and intelligent women) of Hawaii who now make up the Hawaiian Volcano Research Association."



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CANANI SCALE OF SEISMIC INTENSITY

Expressed by accelerations measured in millimeters per second per second.

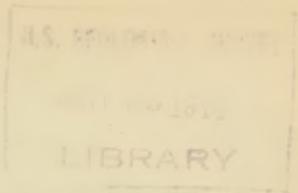
| | | | |
|-------|------------------------------|--------|---------|
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| III. | Slight | 5.0 | 10.0 |
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| V. | Rather strong | 25.0 | 50.0 |
| VI. | Strong | 50.0 | 100.0 |
| VII. | Very strong | 100.0 | 250.0 |
| VIII. | Ruinous | 250.0 | 500.0 |
| IX. | Disastrous | 500.0 | 1000.0 |
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220 (950)

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Vol. 2, no. 14
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WEEKLY BULLETIN OF Hawaiian Volcano Observatory

Vol. II.

HONOLULU, HAWAII, APRIL 8, 1914.

No. 14.

From the Pacific Commercial Advertiser, Honolulu, March 29, 1914.

TECHNOLOGY STATION, KILAUEA, March 26—Kilauea grows more spectacular, though no molten lava lake has yet formed. Up to the evening of March 22 the eruptive energy continued definitely to increase. Since that time the condition then reached has been maintained at practically a stationary point, but with minor increases and decreases in energy. The sound of rumbling continues unabated, but the blowing sound produced by the outrush of gases has markedly declined in harshness and volume, owing, probably, to the opening of new orifices. Correlatively, though jets of lava spring up at frequent irregular intervals, the molten lumps are not flung so high nor with such seeming violence, and seemingly the volume is not so great as at the time of the last report. No outflows of molten lava have been witnessed, but flaring, seen from the Observatory, has suggested flowing, and freshly cooled lava is seen on the floor of the pit.

On March 19 jets were seen to rise from "Old Faithful" to heights of fifty to one hundred feet or more, and incandescent streaks were seen all over the floor. The cone under the west station was blowing loudly. The glow was very marked at the northeast cave, and from the west-northwest orifice. Rumbling was as usual, and a few trivial slides were heard.

On March 20 a high southwest wind with heavy rain prevented observation.

On March 21 jets of lava from fifty to one hundred feet in height were flung

from "Old Faithful." Small jets were springing from the cone under the west station. Blowing was loud at the northeast orifice, and a brilliant glow was seen there. Incandescent lava was seen in the west-northwest orifice. During the evening the activity increased. The "Old Faithful" orifice became a long, narrow rent, at least twenty feet long by two to three feet wide, with a secondary opening about four by six feet. The jets of this evening were very violent. A blue flame played continuously at a minor orifice in the "Old Faithful" cone. Incandescent lava was seen at many points on the floor.

On March 22 no observations were made. Visitors reported conditions much as described above. It was said that seething, molten lava was seen in the west-northwest place.

On March 23 conditions were much as before, except that the jets were less energetic. Lesser jets were seen from "Old Faithful" and from the west cone, and incandescent lava was seen in the west-northwest orifice. Many cracks were seen in the frozen lake surface, through which incandescent lava shone. A new orifice had appeared under the east station, and many small orifices were seen on the floor.

On March 24 jets were seen from "Old Faithful," also, for the first time, from the west-northwest orifice. At the west cone the blowing and rumbling noises were decreased. Fresh lava was seen on the floor. "Old Faithful" was seen to have built a steep cone, with a broken-in top. The scene in early evening was unusually spectacular; also, in the night, the illumination of the fume cloud was striking and brilliant.

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Professor of Physics, College of Hawaii

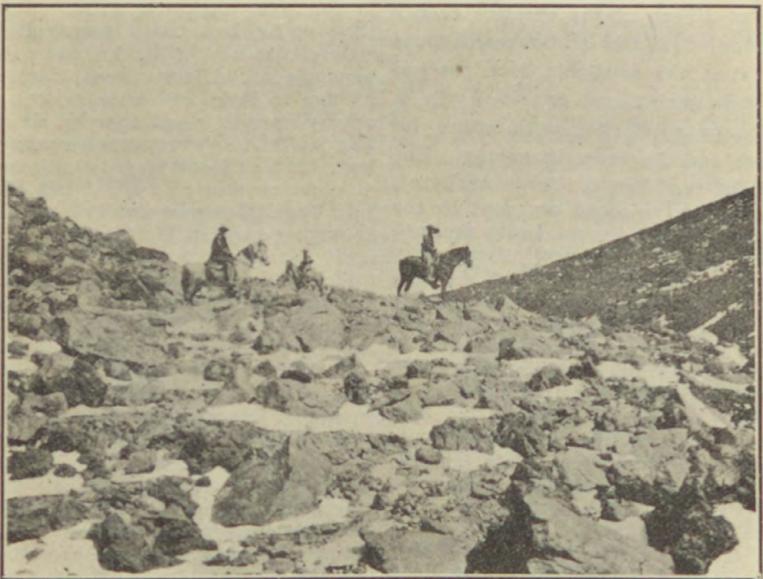
Application pending for entry as
second-class matter at the post-office,
Honolulu, Hawaii.

On March 25 jets from "Old Faith-
ful" were few and small, but the ori-

fices in the cone were of good size and
were glowing brightly. Bright glow
was seen at the west-northwest cave
and in that at the northeast. Numer-
ous small orifices were seen on the floor.
Rumbling was as usual, but the sound
of blowing was a trifle louder than on
the previous day. Many trivial slides
were heard. Blue fumes were issuing
copiously from all the usual orifices, but
no blue flames were seen.

Even yet no systematic earthquake
report can be rendered. One earthquake
strong enough to rattle gently the win-
dows in the Observatory occurred early
in the forenoon of March 25.

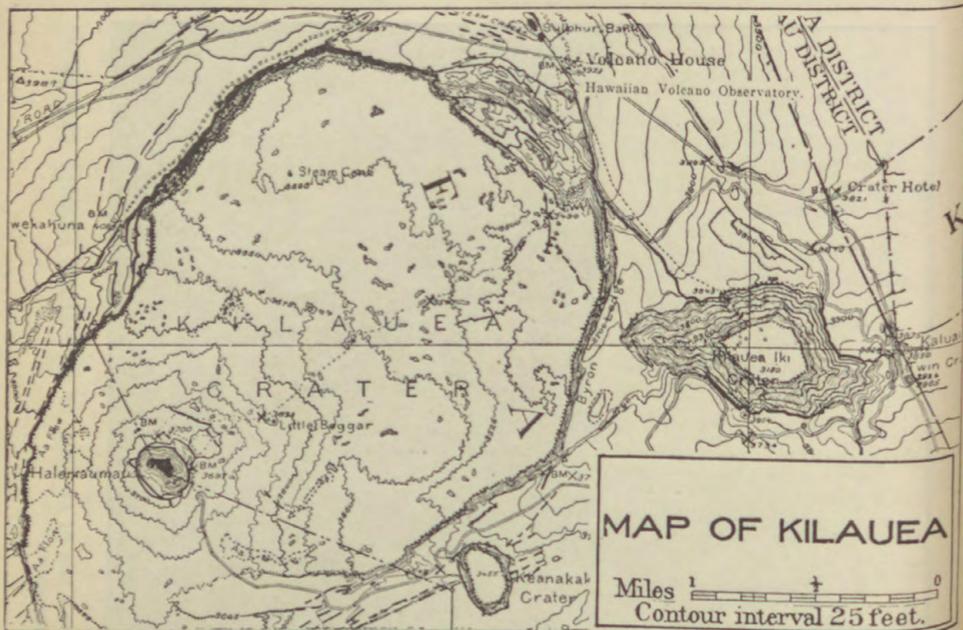
H. O. WOOD, Associate.



Rough Lava (aa) near the summit of Mauna Kea.



Cascade of pahoehoe, from region of Halemauau, over walls of an area of subsidence, situated one-quarter of a mile north of present pit. Tube and bubble surface structure.



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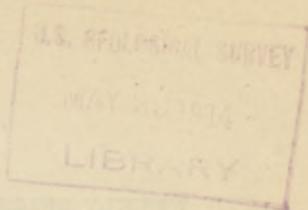
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H 4

Vol. 2, no. 15
cp. 1



WEEKLY BULLETIN OF Hawaiian Volcano Observatory

Vol. II. HONOLULU, HAWAII, APRIL 15, 1914. No. 15.

From the Pacific Commercial Advertiser, Honolulu, April 5, 1914.

TECHNOLOGY STATION, Kilauea, April 2.—A lull has followed the energetic activity in the Volcano which prevailed and was increasing up to about one week ago. The week just past has been exceptionally unfavorable for eye and ear observation at Halemaumau. High winds from the southwest, with fumes, fog and rain, have prevailed much of the time. Consequently views have been fewer, and watches less prolonged, than just previously.

However, the violent up-jetting of molten lava from orifices in the floor has greatly declined; has indeed ceased almost altogether, and the blowing sound has diminished in like manner.

Despite this, all the orifices previously mentioned remain open, and through them the brightly glowing lava shines. If anything, the bottom area appears hotter. It seems merely as though the spasmodic uprush of gases had diminished. On account of the cessation of jetting the scene is less spectacular and the illumination of fumes at night less brilliant on the average.

On March 26 the weather conditions were bad for observing. In early evening brief glimpses of the usual orifices were afforded at rare intervals. No slides were heard and no flames were seen. The sound of blowing had diminished, but the rumbling was as usual. No lava jets were seen.

On March 27 violent winds from the southwest made it futile to undertake observation.

On March 28 conditions for observation were very unfavorable. No views

were obtained. Small slides were heard, one under the south station lasting at least 45 seconds. The rumbling was as usual. The blowing, while diminished, was about the same as on the 26th.

On March 29 no watch was maintained, owing to bad weather, until early evening. Visitors obtained brief glimpses of the usual glowing orifices. No jets or flames were seen and no slides were heard. The noises of eruption were much the same.

On March 30 a good view of the bottom was obtained in early evening. The usual orifices were glowing brightly, but no jets were seen. The sound of blowing was very subdued. The rumbling was as usual. A few trivial slides were heard.

On March 31 no observations were undertaken, owing to unfavorable conditions for seeing.

On April first once again all the usual orifices were seen, with glowing lava showing brightly, in early evening. The brilliant appearance of the northeast, the "Old Faithful," and the west northwest orifices was particularly noted. No jets or flames were seen. The blowing was not loud. Rumbling was as usual. A few trivial slides were heard.

Owing to continued dull weather at noon no observations for the correction of time have been possible for nearly a month. In consequence of this the systematic seismic reports have necessarily been withheld. The week has been quiet seismically except that in the late afternoon, evening and early morning of March 29-30 several disturbances were recorded. One of these

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Editor.....Howard M. Ballou
Professor of Physics, College of Hawaii

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was the chief phase, with rudiments of
earlier motion, of a distant earthquake

which, while strong, was not a great
shock at its origin.

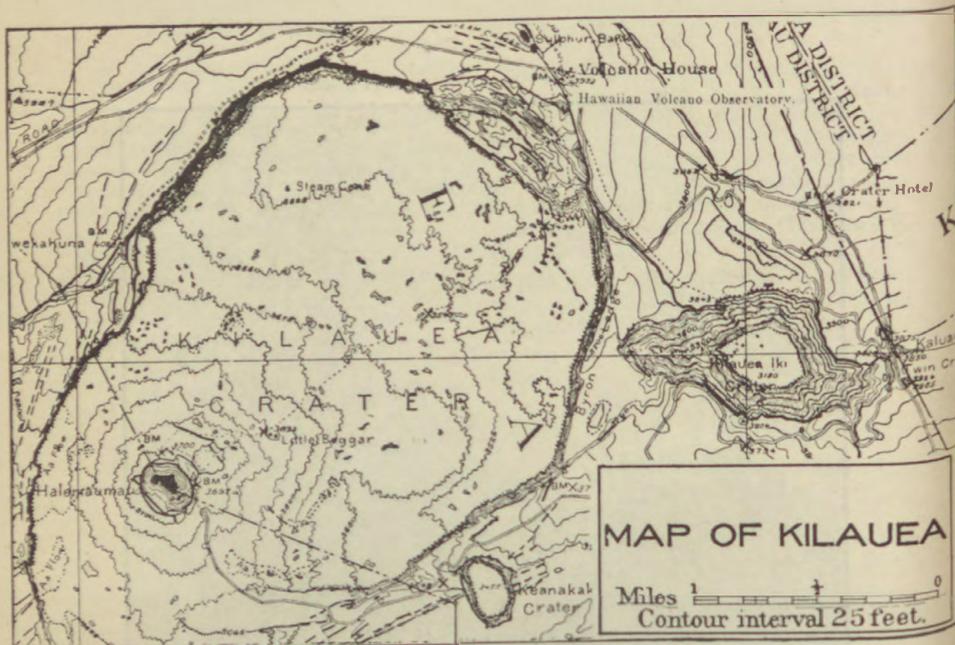
Another shock was of near origin, as
distinguished from local, its distance
not yet determined, which was of only
moderate energy—not felt in the neigh-
borhood of the Observatory, but felt
by Mr. L. A. Thurston lying in camp at
a considerable altitude on the south-
east slope of Mauna Loa. This was in
early evening.

The other shocks, three in number,
were very slight, and were strictly lo-
cal earthquakes.

H. O. WOOD, Associate.



Lava Tree Moulds, Island of Hawaii.



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Vol. II.

HONOLULU, HAWAII, APRIL 22, 1914.

No. 16.

From the Pacific Commercial Advertiser, Honolulu, April 12, 1914.

TECHNOLOGY STATION, KILAUEA, April 9.—Following the slight decrease noted last week, a slight increase in activity of Kilauea has been evident since that time. The orifices have slightly enlarged and jetting lava has been seen. The noises of blowing and rumbling have again increased slightly, as there have been short intervals during which these sounds were very loud. As a spectacle, however, the volcano is not so fine as it was just before the end of March. Nevertheless, though the behavior is not easy to interpret, the writer inclines to the opinion that the surface activity is still greater than at that time. The rising fumes seem much thinner during three or four days past, as noted by all accustomed to see the crater, though the phenomenon is impossible of measurement. This is considered to indicate rising temperature at the top of the magma column, a condition usually due to elevation of the column. There are more and larger orifices, and in at least two of these seething lava has been seen plainly.

Sulphur Fumes Heavy.

Also, at the east-northeast, along a system of deep cracks about 100 yards back from the rim of Halemaumau and peripheral to it, blue fumes of sulphur of a very acrid kind are issuing copiously. This phenomenon began to attract attention about the first of the year, but very recently the action has increased noticeably both in the amount of the fumes and in the degree of their

acridity. No sort of quantitative measurement has been possible with our equipment, but the discomfort caused by these fumes has greatly increased within a fortnight. It is possible, of course, that this aspect of the matter is accidental.

No observations were made on April 2. Visitors reported conditions much as usual. Views of the glowing orifices were obtained, and the blowing and rumbling was as usual.

On April 3 an excellent view of the floor region disclosed new lava a little to the west of "Old Faithful," in a position suggesting that it had welled up through a fissure in the floor. The orifice at the top of the "Old Faithful" cone appeared much enlarged. At considerable intervals jets were flung out from "Old Faithful." The lava thus ejected was in large amount, but it was not thrown very high. Small jets were springing from the west cone. Glowing lava was seen in the west-northwest orifice. In all, six orifices were seen, four on the floor and two, at the west-northwest and at the northeast, at a slight elevation above it. No flames were seen. Small slides were numerous. The sound of blowing was very subdued, and even the rumbling noise was less than ordinary.

Flaring Seen From Observatory.

On April 3 boiling and seething lava was seen in the west-northwest and in the northeast orifices. For all that the blowing and rumbling was less. Jets were seen springing from "Old Faithful" and from the west cone, but small in amount and height. In addition to the six orifices seen yesterday a small

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Professor of Physics, College of Hawaii

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glow hole was discovered under the southwest station, about 100 feet above the floor. No flames were seen. One or two trivial slides were heard.

On April 5 no routine observations were made. The usual conditions were reported by visitors.

On April 6 conditions were as above described, except that both the blowing and the rumbling sounds were much less than common. Jets from "Old Faithful" were rare and very small. A large blue flame was seen issuing from

this orifice, fluttering like a banner. Smoke concealed both the northeast and the west-northwest orifices. About midnight very bright flaring was seen from the observatory.

On April 7 in early afternoon there occurred a spasm of violent blowing; short, sharp gas blasts in quick succession, with greatly increased rumbling. This more violent phase wore away toward evening, but the sounds still remained louder than on previous days. Smoke concealed the west-northwest and northeast orifices. Small jets were thrown from "Old Faithful." No flames could be seen. Several small slides occurred.

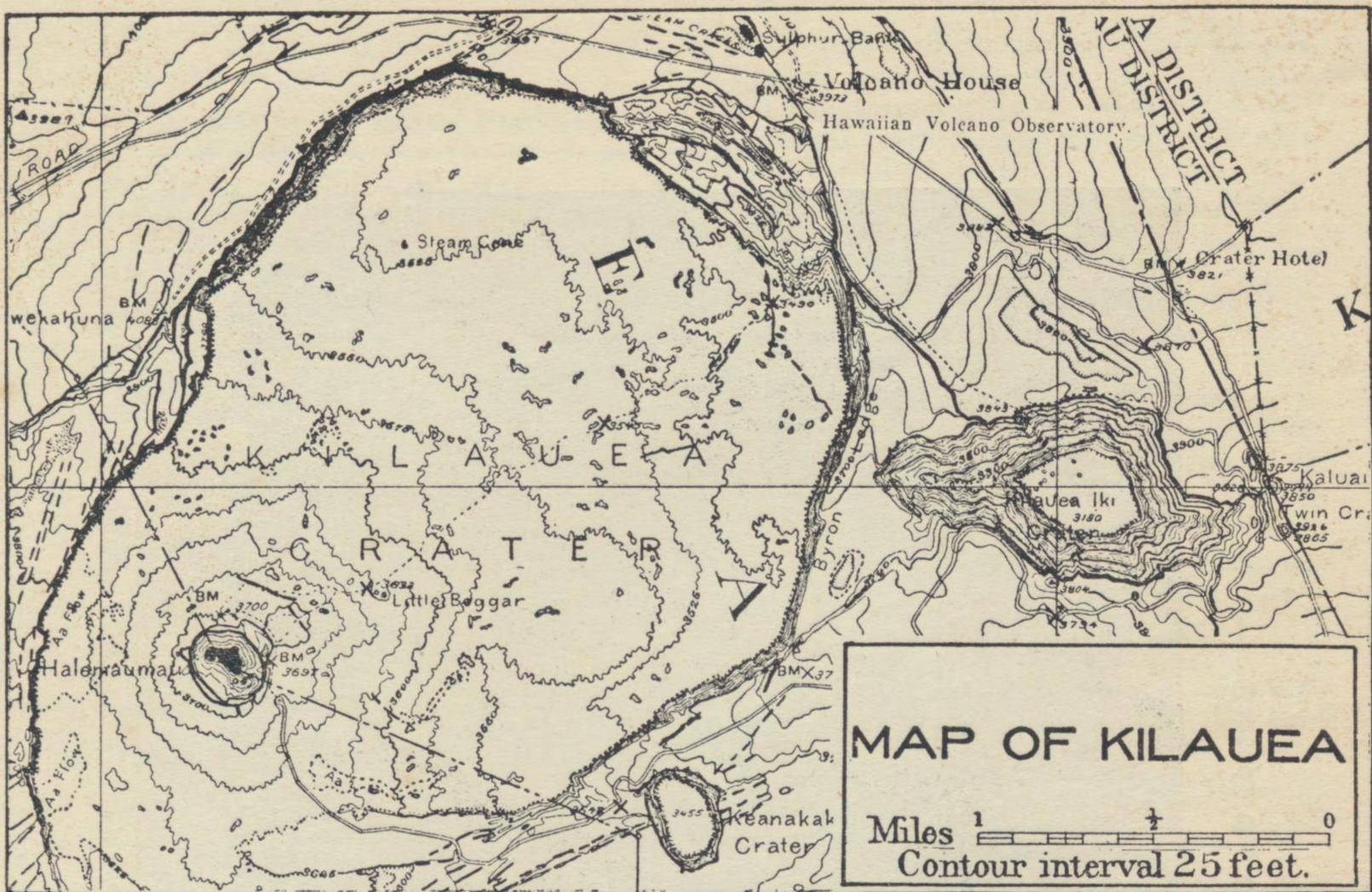
On April 8 conditions remained without significant change. Blowing and rumbling had decreased slightly in loudness. No lava jets were seen, though incandescent lava could be seen plainly in the usual orifices. No flames were seen. Small slides occurred frequently.

Seismically the week has passed uneventfully.

H. O. WOOD, Associate.



Part of the Crater of Haleakala, Maui.



HAWAIIAN VOLCANO RESEARCH ASSOCIATION.

This society is a voluntary one, made up of subscribers to scientific work which is being executed by the Massachusetts Institute of Technology.

In 1913 there were 26 subscribers in Hawaii and Massachusetts, firms and individuals. A group of firms and persons in Hilo built the main observatory building in the spring of 1912. Publications to date have been weekly reports since the summer of 1911, a memoir by Daly in the Proceedings of American Academy of Arts and Sciences in 1911, articles by the director in the Technology Review 1911 and the Honolulu Chamber of Commerce Annual 1912, articles by H. O. Wood in the Bulletin of the Seismological Society of America, and articles by Perret in the American Journal of Science. The Massachusetts Institute of Technology will publish semi-annual reports.

This weekly bulletin as it appears in the Advertiser will be reprinted as a leaflet and sent to regular annual subscribers to the work of the association. C. H. Cooke is president of the Board of Directors of the association and R. W. Shingle is treasurer. New subscribers who are interested in our volcanoes will be welcomed in the association. The association aims: (1) To record volcanic activity and earthquakes in Hawaii; (2) to attract scientific men hither for special studies; (3) to promote the establishment of volcano observatories all over the world.

WHITNEY LABORATORY OF SEISMOLOGY.

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meters registering N-S and E-W motion, a heavy Omori tromometer registering E-W motion and an Omori "ordinary Seismograph" designed for registering strong earthquakes in all three components of motion. These are seated on concrete piers in a closed basement room having practically constant temperature, beneath the chief Observatory building near the hotel. Time is referred to a rated chronometer, checked at intervals by solar observations with a transit. Both instruments are loaned by the College of Hawaii. At the substitution by the edge of the active pit an Omori two-component tromometer with light steady masses is mounted on a concrete pier placed directly on the fresh lava surface. Hawaiian standard time (H. S. T.) is 10 hrs. 30 m. slower than Greenwich time.

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Expressed by accelerations measured in millimeters per second per second.

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|-------|-----------------------------|--------|---------|
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| II. | Very slight | 2.5 | 5.0 |
| III. | Slight | 5.0 | 10.0 |
| IV. | Sensible, mediocre. | 10.0 | 25.0 |
| V. | Rather strong | 25.0 | 50.0 |
| VI. | Strong | 50.0 | 100.0 |
| VII. | Very strong | 100.0 | 250.0 |
| VIII. | Ruinous | 250.0 | 500.0 |
| IX. | Disastrous | 500.0 | 1000.0 |
| X. | Very disastrous | 1000.0 | 2500.0 |
| XI. | Catastrophic | 2500.0 | 5000.0 |
| XII. | Great catastrophe. | 5000.0 | 10000.0 |

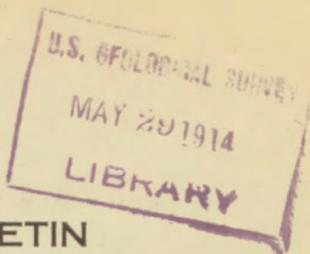
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Office of Earthquakes, Volcanoes and
Engineering, Branch of Seismology
345 Middlefield Rd., M.S. 977
Menlo Park, CA 94025

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Vol. 2, no. 17
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WEEKLY BULLETIN

OF

Hawaiian Volcano Observatory

Vol. II.

HONOLULU, HAWAII, APRIL 29, 1914.

No. 17.

From the Pacific Commercial Advertiser, Honolulu, April 23, 1914.

TECHNOLOGY STATION, Kilauea, April 16.—Since the last writing there has been a steady increase in activity at Kilauea, manifested by an increase in the size and the apparent hotness of the glowing orifices, by increased loudness in blowing and rumbling, and by jet action.

On April 9 a strong wind prevented seeing. Puffing, blowing and rumbling were as usual, and trivial slides were heard.

On April 10 no visit was made to the pit on account of an exceptionally strong S. W. wind, accompanied by fog and light rain.

On April 11 seething lava was seen in the W.N.W. orifice, above which wavered a blue flame. At intervals the puffing sounds, chiefly from "Old Faithful," were quite loud. Lumps of molten lava were flung from "Old Faithful" and from the cone under the southeast station. Blue flames were issuing from a subsidiary orifice in the "Old Faithful" cone. In all, nine glowing orifices were visible. Many trivial slides took place, some lasting for 30 seconds. The rumbling sound was loud.

On April 12 the orifices showed distinct enlargement. Molten lava was surging about, making a distinct rushing sound in addition to the louder blowing, puffing and rumbling noises. Seething lava was seen in "Old Faithful" and especially in the W.N.W.

orifice, now almost large enough to be called a pool, where in early evening a miniature flow was poured out. The illumination of the walls and the rising fumes was highly spectacular. At long intervals blue flames flashed above "Old Faithful." No jets were seen and no slides worth mention were noted.

On April 13 a good view of the W.N.W. center of activity was obtained where several orifices are now clustered; the larger, almost a pool, exhibited seething lava and blue flames. The sounds of blowing and rumbling were louder, but good views of "Old Faithful" and of the southeast cone did not disclose any jet action. Trivial rock falls occurred.

On April 14 jet action had begun again at the "Old Faithful" orifice but nowhere else. Blowing and rumbling was still louder than on the previous day. No flames were seen. No slides were heard. Swirling fumes prevented clear views so that the larger orifices were not seen.

On April 15 excellent views showed seething lava in the W.N.W. orifice into which loose talus was seen to be sliding—some of the slides lasting 40 seconds. Many trivial slides took place. Rumbling and blowing was very loud in the early evening, but jet action was not observed until later, when "sparks" were flung up from the southeast cone. In mid-evening the "Old Faithful" cone collapsed, making a large orifice where splashing lava was visible, thus greatly augmenting the illumination of the walls and fumes.

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Observations for the correction of time now permit the following systematic report from the Whitney Laboratory of Seismology, a report delayed for some weeks by adverse weather. Earthquake shocks have been registered as follows:

February 27, from 11:55:14 a. m. to 11:56:04 a. m. H. S. T. Intensity, II Cancani scale; 35 to 50 per cent of the minimum perceptible unit. Origin distant about 13 miles.

February 28, from 8:32:59 a. m. to 8:34:04 a. m. H. S. T. Intensity, III Cancani scale; above 78 per cent of the minimum perceptible unit. Origin distant about 12 miles.

February 28, from 10:04:07 a. m. to 10:05:44 a. m. H. S. T. Intensity III Cancani scale; 90 to 120 per cent of the minimum perceptible unit. Origin distant about 12 miles.

March 1, beginning about 9:22:03 a. m. H. S. T. a shock strong enough to throw the recording pens from the cylinders. The shock was not felt, but it caused the windows to rattle. Owing to its strength the records are defective and further information cannot be derived from them.

March 3, from 7:37:43 a. m. to 7:39:47 a. m. H. S. T. Intensity, II Cancani scale; 30 to 50 per cent of the minimum perceptible unit. Origin distant about 24 miles.

March 4, from 2:15:28 p. m. to 2:18:08 p. m. H. S. T. Intensity, III-IV Cancani scale; greater than the minimum perceptible unit, but not sensible at the Observatory. Origin distant about 5.6 miles.

March 5, from 1:43:28 a. m. to

1:43:59 a. m. H. S. T. Intensity, III-IV Cancani scale; greater than the minimum perceptible unit, but not noticed at the Observatory. Origin distant about 5 miles.

March 8, from 2:07:55 a. m. to 2:09:33 a. m. H. S. T. Intensity, about VI Cancani scale; several times the minimum perceptible unit; wakened one sleeping person. Origin distant about 6.8 miles.

March 8, from 2:33:18 p. m. to 2:33:58 p. m. H. S. T. Intensity, II Cancani scale; about 45 per cent of the minimum perceptible unit. Origin distance is indeterminate.

March 10, from 5:15:40 p. m. to 5:17:31 p. m. H. S. T. Intensity, II-III Cancani scale; less than 60 per cent of the minimum perceptible unit. Origin distant less than 4 miles.

March 21, from 1:21:57 a. m. to 1:24:17 a. m. H. S. T. Intensity, I Cancani scale; about 20 per cent of the minimum perceptible unit. Origin distance indeterminate.

March 25, beginning about 9:38:05 a. m., a shock strong enough barely to be felt at the Observatory; on account of its strength the records are defective and yield no further information. Intensity, probably VII Cancani scale; from 10 to 12 times the minimum perceptible unit.

March 25, from 11:25:07 a. m. to 11:26:56 a. m. H. S. T. Intensity, low I Cancani scale; about 8 per cent of the minimum perceptible unit. Origin distant about 37 miles.

March 25, from 7:49:41 p. m. to 7:50:18 p. m. H. S. T. Intensity, III Cancani scale; about 60 per cent of the minimum perceptible unit. Origin distant about 32 miles.

March 25, from 8:46:00 p. m. to 8:47:47 p. m. H. S. T. Intensity, low I Cancani scale; about 6 per cent of the minimum perceptible unit. Origin distant about 31 miles.

March 26, from 5:44:01 a. m. to 5:44:44 a. m. H. S. T. Intensity, high II Cancani scale; about 45 per cent of the minimum perceptible unit. Origin distant about 33.5 miles.

March 26, from 5:01:55 p. m. to 5:02:32 p. m. H. S. T. Intensity, low III Cancani scale; about 60 per cent of

the minimum perceptible unit. Origin distant about 13.7 miles.

March 26, from 5:06:30 p. m. to 5:06:34 p. m. H. S. T. Intensity, medium II Cancani scale; about 40 per cent of the minimum perceptible unit. Origin distance indeterminate.

March 26, from 5:06:49 p. m. to 5:07:42 p. m. H. S. T. Intensity, low IV Cancani scale; a little above the minimum perceptible unit, but not noticed at the Observatory. Origin distant about 13 miles.

March 27, from 5:47 a. m. to 5:57 a. m. there was registered a portion of the chief phase of a distant earthquake. Nothing could be made out concerning either the distance or the energy of this earthquake.

March 29, from 2:27 p. m. until later than 3:00 p. m. waves of the chief phase of a distant earthquake were registered. The origin distance of this shock could not be determined; but it could be seen that it was only a moderate strong shock.

March 29, from 3:47:41 p. m. to 3:49:34 p. m. H. S. T. Intensity, low I Cancani scale; about 14 per cent of the minimum perceptible unit. Origin distant about 14 miles.

March 29, from 8:04:12 p. m. to 8:12:53 p. m. H. S. T. Intensity, at Observatory, IV Cancani scale; about 1.5 times the minimum perceptible unit, though unnoticed here, probably owing to occupation and inattention. Origin distant about 180 miles. Felt on the southeast flank of Mauna Loa, and more strongly on Maui and Oahu.

March 29, from 11:08:27 p. m. to 11:09:13 p. m. H. S. T. Intensity, low I Cancani scale; about 9.5 per cent of the minimum perceptible unit. Origin distance indeterminate.

March 30, from 10:19:54 a. m. to 10:20:34 a. m. H. S. T. Intensity, low I Cancani scale; about 8 per cent of the minimum perceptible unit. Origin distant about 8 miles.

April 3, from 10:30:17 p. m. to 10:31:32 p. m. H. S. T. Intensity, III-IV Cancani scale; about the minimum perceptible unit, but not noticed at the Observatory. Origin distant about 12 miles.

April 4, from 8:14:15 a. m. to 8:15:50 a. m. H. S. T. Intensity, high I Cancani scale; about 19 per cent of the minimum perceptible unit. Origin distant about 12 miles.

April 4, from 7:06:21 p. m. to 7:07:37 p. m. H. S. T. Intensity, III-IV Cancani scale; about the minimum perceptible unit, but not felt at the Observatory. Origin distant about 14 miles.

April 6, from 3:20:35 p. m. to 3:21:22 p. m. H. S. T. Intensity, II Cancani scale; about 35 per cent of the minimum perceptible unit. Origin distant about 13 miles.

April 9, from 3:13:56 p. m. to 3:14:30 p. m. H. S. T. Intensity, high III Cancani scale; 80 to 90 per cent of the minimum perceptible unit. Origin distant about 12 miles.

April 12, from 11:27:36 p. m. to 11:28:24 p. m. H. S. T. Intensity, low III Cancani scale; about 60 per cent of the minimum perceptible unit. Origin distant a little over 11 miles.

April 13, from 00:48:23 a. m. to 00:49:01 a. m. H. S. T. Intensity, medium III Cancani scale; about 70 per cent of the minimum perceptible unit. Origin distant about 14.3 miles.

April 13, from 4:15:37 a. m. to 4:17:08 a. m. H. S. T. Intensity, IV Cancani scale; a little above the minimum perceptible unit, but not noticed at the Observatory. Origin distant about 29 miles.

April 13, from 1:01:58 p. m. to 1:03:03 p. m. H. S. T. Intensity, high II Cancani scale; about 40 per cent of the minimum perceptible unit. Origin distant about 10.6 miles.

April 13, from 9:58:37 p. m. to 9:31:31 p. m. H. S. T. Intensity, IV Cancani scale; a little over the minimum perceptible unit; barely, and at the time doubtfully, felt here. Origin distant about 30 miles.

April 15, from 1:57:28 a. m. to 1:50:52 a. m. H. S. T. Intensity, IV Cancani scale; a little above the minimum perceptible unit, but not noticed at the Observatory. Origin distant about 13.7 miles.

H. O. WOOD, Associate.

HONOLULU, April 15, 1914.—In continuation of the report published in The Advertiser March 24, 1914, I have to conclude my narrative of the journey authorized by the Hawaiian Volcano Research Association with some account of visits made to the volcanoes Kirishimayama, Asosan and Bandaisan and of cooperation started with Dr. Omori in the construction of certain earthquake instruments for general use by amateurs in Hawaii.

February 9 to February 24 I remained in Kagoshima and vicinity. I then went to Miya on the high slopes of Kirishima volcano, the eastern peak of which contains an active and somewhat dangerous vent which has destroyed life and property in the past. A Frenchman was wounded and his guide killed by flying stones here only a few years ago, so that it is sometimes difficult to get anyone to accompany the traveler to the summit. Fortunately just at present Kirishima is quiet, and I secured a guide and made the ascent to the crater on the afternoon of February 25. A great explosion took place November 8 last, which left a magnificent bread-crust bomb twelve feet in diameter on the edge. I looked down into a quietly steaming cauldron, with an inner circular black cavity, while outside of the high cone on the west was an extraordinary scour-gulch produced by volcanic avalanches accompanying recent eruptions. Gigantic boulders were buried and half-buried in the ground, or split in fragments about the depressions made by their fall.

The next day we crossed Kirishima past the middle and western peaks of the volcanic mass, which is as a whole a dome more than fifteen miles long crowned by cinder cones somewhat like Mauna Kea, and rising to a summit 1700 meters above sea-level. The whole mountain shows ash sections everywhere, indicating that explosive eruption has been dominant in its later up-building.

The eruption of November, 1913, was

followed by others December 9, and January 8, and then came the Sakurajima outburst January 12, which seems to have relieved the subterranean region of Kirishima so that the latter became quiet. The eruptive activity appears to be migrating southward, for in February the volcano island Iwojima still farther south in the Luchu chain broke out, and then about March 20 another volcano on the island Suwanose in the same line and more to the southward began exploding. The sequence was remarkable and the suggestion strong that some volcano still farther in the direction of Formosa might be heard from in April. All this activity in the Luchus must be relieving the magma of the under-earth at Kagoshima, and is favorable for an early cessation of the explosions and lava-flow at Sakurajima.

Asosan was reached and the active craters studied February 28. This volcano is intensely active as a cauldron of boiling mud and steam, and has been explosively active many times since the eleventh century, with culminations of lava activity in the fourteenth century, and of ash and lava in the seventeenth, eighteenth and nineteenth centuries.

The last considerable eruptions were from 1906 to 1908. Asosan has the reputation of being an ash volcano and of having the largest crater in Japan, and so of being "Japan's greatest volcano."

On close acquaintance several things about Asosan surprised me. Lava makes up the greater part of the dome, and is in evidence abundantly on the very summit and about the active vents, appearing as recent flows in the vicinity of the four active pits. Two of these pits contain warm lakes, and two are boiling violently, with hundreds of tails of white vapor rising with a roar from the bottom, three to four hundred feet down, amid pools of fountaining black mud. It is a mixed volcano, with both ash and lava in its structure, and very much lava.

As to its being "Japan's greatest

volcano," I think that conclusion is questionable. Its highest peak is only 1500 meters high. There is an outer ring of cliffs of elliptical plan with greatest diameter fourteen miles. This is called the "great crater." It is a collapsed dome of heavy lava flows, such as Kilauea would become if merged with Kilauea Iki and Keana-kakoi, and general collapse took place back of the Volcano House, so as to make the crater say ten by fourteen miles in dimensions. Then in Asosan four rugged inner volcanic mountains have been built up, and the active crater is a row of pits within one of these. The outer wall is in some sense a "crater" doubtless, just as the Nuuanu Pali is, but we can hardly gauge the size of volcanoes by the size of the hole made when they cave in or collapse.

The same mistake has been made by those who claim that the Plinian "crater" of Vesuvius in the year 79 A.D., when Pompeii was destroyed, can be reconstructed by prolonging Monte Somma circularly. Indeed in that case there is no evidence that the 79 crater was not within the present active cone. The resemblance of Asosan to Kilauea or Mauna Loa, partially buried under mixed accumulations, is striking, and leads one to wonder whether all volcanoes, could we dissect them, would not be found to possess a Kilauea for pediment.

I returned to Nagasaki March 2 and met there Mr. Frank A. Perret on his way to Kagoshima. He was at Kagoshima through March, and was slightly injured by exploding lava. He expects to come to Hawaii about May 1 and to visit again our volcanoes.

My next objective was Bandaisan, in northern Honshu, which I reached March 22, after visits to all the larger cities to collect copies of newspapers and of newspaper photographs dealing with the early days of the Sakurajima eruption. Bandaisan is on a line of active volcanoes in the central region of Japan, north of Tokyo, and is famous as the scene of a terrific explosion in July, 1888, when the whole north side of the mountain was blown out, and rocks and earth filled up deep basins

and valleys, flowed miles, and dammed drainage to produce numerous large lakes. Several hundred persons were killed and villages engulfed or swept away. The eruption was said to be from the end mountain of a group, to have exhibited no lava, and to be purely a steam explosion. These statements all seem to me questionable after seeing and exploring Bandai and its crater.

It is an isolated distinct volcano, surrounded by valleys and lowlands. There are scattered fragments of porous black lava, like complete units of an a-a surface, to be found here and there in the debris of the avalanche. The gases now rushing from the solfataras in the crater are full of sulphur, and at 205° Fahr., somewhat above the boiling point for that altitude (1100 meters), and hence it seems probable that they were much hotter and contained much besides water when the great eruption occurred. There is ample evidence in the topography that similar eruptions have occurred at Bandaisan before, and I believe the "avalanche-explosion" habit of this volcano to be merely a stage of decadence of volcanic activity more advanced than Sakurajima, but occasioned by the same under-mechanism of a rising lava surcharged with gas.

My adventures in the Bandaisan crater were somewhat Arctic, as there were eight-foot snowdrifts partially crusted and occasional rock avalanches occasioned by the war of snow and ice with hot vapors. Also there was dense fog, and my guides lost their way, so that we had to steer out of the snowy wilderness with the aid of the compass needle. Also there was much rain and some snowfall, but in the course of a four-day trip we saw enough and secured enough photographs to reward us for the journey. I had with me for interpreter Suito, a Japanese photographer, who rendered efficient service.

From March 26 to April 4 I gave much time to conferences with Professor Omori, chief of the imperial earthquake investigation committee of Japan. It has long seemed desirable to have a seismograph available for voluntary observers in Hawaii, which they would buy as they might a barograph, and which would record with

ink the time and relative intensity of ordinary earthquakes. Such an instrument we drew up a design for, with the aid of Mr. Mitsubori, chief engineer of the Educational Appliance Company of Tokyo.

A sample instrument is to be made and tested by Doctor Omori, and if satisfactory some of the instruments will be sent to our observatory and distributed in Kona, Kau, Hilo and Kohala. It is to be a horizontal pendulum, portable, with a twenty-four-hour drum wound with white paper rolled from a spool. The magnifying lever will write with ink on the paper, and minute and hour marks will be pricked in the paper parallel to the pendulum

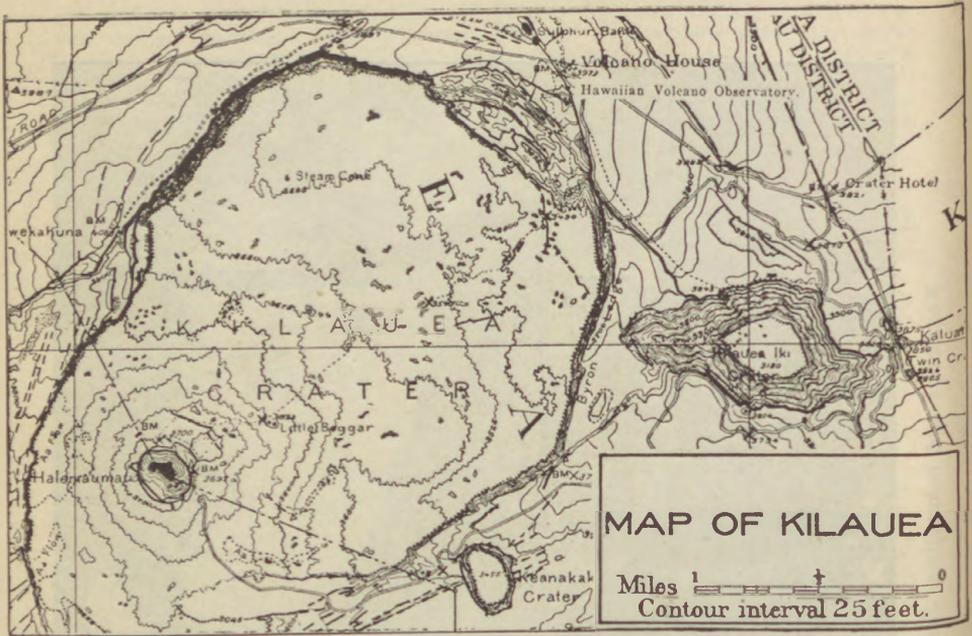
record. The magnification will be from fifty to seventy-five times the earth movement to be recorded. It is expected that the cost of the instrument will be under fifty dollars. If successful this instrument should fill a need long felt in places like California, where it is of the utmost interest to know what small earth movements take place locally and to know with some accuracy the time, number and intensity of such movements, apart from hearsay or the sensitiveness of individuals.

I sailed from Yokohama on the Mauchuria April 6, arriving at Honolulu April 15, 1914.

T. A. JAGGAR, JR.,
Director.



Kagoshima and Sakurajima, January 14, the volcano in active eruption.



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HONOLULU, HAWAII, MAY 6, 1914.

No. 18.

From the Pacific Commercial Advertiser, Honolulu, April 27, 1914.

TECHNOLOGY STATION, KILAUEA, April 23.—During much of the past week conditions for observing at Kilauea have been unfavorable. However, another halt in the increase of energy of eruption has occurred. For four or five days past the noises of eruption, and all the visible manifestations, have been undergoing sporadic increase and decrease either side of the condition reached on Saturday, April 18, as an average or stage of reference. There is no reason to think that any quasi-permanent diminution in eruptivity has occurred. The condition appears merely to be one of the customary lulls.

On April 16 continual small jets of lava were seen to spout from "Old Faithful" and blue flames played above it; and boiling magma was seen plainly in the west-northwest orifice, out of which small jets were seen to spring at considerable intervals. Incandescent lava was seen in the openings of all the cones hitherto described, being particularly brilliant in the northeast orifice. Also a new, brightly glowing orifice was seen about fifty feet above the bottom of the pit at the west-southwest.

The noise of rumbling was very loud. Blowing and rushing sounds were produced frequently and were of much volume, but were somewhat lacking in harshness and intensity. An unusually large number of medium-sized talus slides occurred, many of which lasted for nearly a minute. Most of these plunged down into the large west-north-

west orifice, causing the magma there to surge and splash. During the previous twenty-four hours a great deal of readjustment in the talus materials had taken place, in consequence of which the southeast cone was nearly buried. All things considered the activity on this date was greater than at any other time thus far during the present revival of eruption.

On April 17, so far as could be ascertained, the conditions of eruption were almost as on the previous day, but the rising fumes were kept aswirl by a fresh wind, so that no really good view was obtained. Sounds of blowing and rumbling were little if any diminished, and the fumes were brilliantly illuminated in the neighborhood of the larger orifices, particularly at the west-northwest. A brief view of "Old Faithful" showed the action there to be as on the day before. Only a few talus slides were heard.

On April 18 there was little if any further diminution in the intensity of the phenomena. Flaring, for instance, seen from the Observatory, was very brilliant, but no jets were visible at the pitside. Swirling fumes prevented any but brief glimpses, during which the conditions seen were much as on previous days. However, throughout the hours devoted to observation talus slides were occurring almost continuously, and many of them were of prolonged duration. Nevertheless it is considered that no fresh rock was dislodged, but merely an extensive readjustment of the loose material brought about.

On April 19, in the forenoon, swirling fumes prevented views, but noises

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Published at Honolulu, Hawaii, by the
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Editor.....Howard M. Ballou
Professor of Physics, College of Hawaii

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of rock-fall and the blowing and rumbling sounds of eruption were plainly heard, as also was the case in early afternoon. But as the afternoon wore on all sounds decreased and the interval separating eruptive spasms increased until in early evening no noises could be heard and nothing could be seen—not even a faint illumination of the fumes, which were eddying violently, not even in the neighborhood of the orifices. It was feared that a collapse had occurred.

On April 20, however, brief and poor views in early evening through the

fumes revealed incandescent lava in the chief orifices, "Old Faithful," the west-northwest and the northeast orifices. The usual rumbling sounds were audible, little if any subdued, but the blowing sound was faint and low. Probably the conspicuous readjustments in the talus during the day or two previous had the effect of choking the vent and of depressing the temperature of the top of the magma column. The fume cloud, seen from the Observatory, was definitely illuminated at night, with feeble flaring.

On April 21 conditions for observing were so unfavorable that no visit was made to the pit. At night the fume cloud was seen to be faintly but definitely illuminated, with feeble flaring.

On April 22 nothing could be seen on account of high winds and eddying fumes. The rumbling was as usual and the blowing noise was again very loud. At night blinding rain shut out the view of the pit from the Observatory.

No noteworthy seismic action has been recorded since the last report, merely two or three exceptionally small shocks. On these no systematic report can be made this week.

H. O. WOOD, Associate.

Minutes of the Meetings of the Board of Directors.

The third meeting of the Board, called by direction of Pres. C. H. Cooke, was held at the University Club, Tuesday, April 28, 1914, at 12 m.

Present: Messrs. Cooke, Castle, Lewis, and E. M. Campbell, representing R. W. Shingle, directors; H. M. Ballou, secretary; Dr. T. A. Jaggar, Jr., and T. Clive Davies.

Dr. T. A. Jaggar, Jr., presented the following report concerning his expedition to Japan, which was accepted and ordered to be printed.

To the Directors, Hawaiian Volcano Research Association.

Gentlemen:—Concerning my trip to Japan I have already reported in the Bulletins published in the Advertiser. I have in preparation a longer article with eighty illustrations to be sent on approval to the National Geographic Society. Last week I addressed four

audiences in Honolulu on different phases of the Japan work.

I brought back a full note-book, and purchases in Japan for the observatory to the amount of \$362.80. These include two light transits for crater surveys, between 400 and 500 photographs, a dozen charts, a number of new books, a nearly complete set of Transactions of the Seismological Society of Japan 1880-1894, about 800 feet of moving picture film of the Sakurajima eruption, 109 colored lantern slides from my own and other photographs, and files of Japanese and English journals dealing with Sakurajima. I also collected specimens on Sakurajima and three other volcanoes, and took photographs. I obtained a small model of Fujiyama and specimens from Vries Island. Dr. Omori gave me for the Observatory a list of all the publications of the Earth-

quake Investigation Committee of Japan, and on my checking the list, will make our set complete of both English and Japanese publications.

I trust that my visit to Japan will stimulate the Japanese to the establishment of more volcano observatories. A temporary observatory has been started on Sakurajima, and for some years an observatory has been in operation on Asama, but only during the summer months.

Dr. Omori is cooperating with me in having some new instruments made in Tokyo, for the use of voluntary observers in recording local earthquakes.

Mr. F. A. Perret is expected in Honolulu April 29th,* by the Mongolia from Japan, where he too has been studying Sakurajima, and I hope he will be with us here for some weeks. He plans to visit our volcano. He has with him, I think, lantern slides of his recent studies of Stromboli and Etna, and I hope he will give a lecture, the proceeds of which should be devoted to the benefit of his work.

The treasurer will show you the present condition of the finances of the Association. The Japan trip will not burden the Association at all. Ten subscribers subscribed for this expedition \$770, all paid. My travelling expenses cost \$802.60, and I made purchases in addition to the amount of \$362.80. No portion of the travelling expenses will be charged to the Association, and it would appear at present as though the Association could well afford these purchases, to judge from the estimated income and expenditures for the year.

There appears to me to be urgent need for action on the part of the membership and finance committees in recruiting new patrons and members. I ask permission myself to devote some months to steady writing of reports for publication, for this is all-important, and we are backward in this work.

It will be of interest to the Directors to know that the first part of a new and great work "Der Vulkanismus," by Professor Wolff, has just appeared in Germany; that Dr. Friedlaender has established his Volcanologic Institute in Naples with his own money, put up

a great stone laboratory, and begun the publication of a Journal of Volcanology.

With regard to the Japanese Earthquake Investigation Committee, I made careful inquiry of Dr. Omori in Tokyo, as to ways and means, and learned that he possesses extraordinary advantages due to low cost of labor: he has the direction of an appropriation of about \$9000 from the Earthquake Committee; but his plant is part of the University and he holds a professorship there. He can get extra appropriations of about \$1500 when he takes a trip for the inspection of a disaster, as to San Francisco in 1906. He has to do no systematic recording, as that is all done by the weather bureau stations, 135 of them in Japan, and some 1500 voluntary observers. He has at his own station 19 instruments. His staff includes one assistant professor, 5 scientific assistants at about \$20 per month, 4 skilled workmen at about \$12 per month, and he can publish a large memoir with 60 plates in color and collotype for \$450! His assistants include a draughtsman, an instrument man, a computer, a photographer, a woodworker, a machinist and a bookkeeper. He also has expert associates, university professors, who give their services to the Earthquake Committee free.

Splendid collotype work is done in Japan and I believe that, even with the duty added, illustrations could be made there better and cheaper than anywhere else, for publications here.

Very respectfully,

T. A. JAGGAR, JR.,
Director.

The Treasurer's report from January 1 to April 28 was read, accepted, and ordered placed on file.

On motion of Mr. Lewis it was voted that all patrons and officers of the Association be enrolled among the members, and that a firm contributing as a patron shall have the right to designate one of its members to be so enrolled.

On motion of the Secretary the following contributors, having been unanimously approved by the Membership Committee, were elected members of the Association.

* Prof. Perret did not arrive as expected.

Members of Hawaiian Volcano Research Association.

Mrs. B. M. Allen,
Mr. Carl B. Andrews,
Mr. R. W. Andrews,
Mr. Chas. H. Atherton,
Mr. F. C. Atherton,
Prof. Howard M. Ballou,
Dr. W. D. Baldwin,
Mr. Chester E. Blacow,
Mr. A. W. T. Bottomley,
Mr. Cecil Brown,
Prof. W. A. Bryan,
Mr. G. F. Bush,
Mr. J. W. Caldwell,
Mr. A. N. Campbell,
Mr. J. C. Cannon,
Mr. Geo. R. Carter,
Mr. Bruce Cartwright, Jr.,
Mr. Alfred L. Castle,
Mr. Geo. P. Castle,
Mrs. Geo. P. Castle,
Mr. J. B. Castle,
Mr. W. R. Castle,
Mr. Robt. Catton,
Mrs. H. C. Coleman,
Mr. A. F. Cooke,
Mr. Clarence M. Cooke,
Prof. R. A. Daly,
Mr. T. Clive Davies,
Hon. Sanford B. Dole,
Mr. Jas. D. Dole,
Dr. N. B. Emerson,
Mr. W. L. Emory,
Mr. Wm. C. Furer,
Prof. A. F. Griffiths,
Mr. J. F. Hackfeld,
Mr. J. F. C. Hagens,
Prof. C. H. Hitchcock,
Mr. Henry Holmes,
Dr. T. A. Jaggar, Jr.,
Mr. P. C. Jones,
Hon. Albert F. Judd,
Mr. F. A. Klamp,

Mr. C. H. Kluegel,
Mr. A. Lewis, Jr.,
Mr. Wm. A. Love,
Dr. A. Marques,
Mrs. E. M. O. Marques,
Mr. Benj. L. Marx,
Mr. Jas. L. McLean,
Dr. Iga Mori,
Mr. Wm. C. Parke,
Dr. J. S. B. Pratt,
Mrs. E. K. Pratt,
Mr. J. L. P. Robinson,
Mr. Mark P. Robinson,
Mr. Georg Rodiek,
Dr. W. G. Rogers,
Mr. F. A. Schaefer,
Mr. R. W. Shingle,
Mr. W. O. Smith,
Mrs. Edw. I. Spalding,
Mr. Walter T. Spalding,
Mr. F. M. Swanzy,
Hon. Wade Warren Thayer,
Mr. L. A. Thurston,
Mrs. Harriet P. Thurston,
Mr. Ed Towse,
Mr. James Wakefield,
Mr. J. W. Waldron,
Mr. Walter E. Wall,
Mrs. Edward E. Waters,
Mr. Norman Watkins,
Rev. Wm. D. Westervelt,
Mrs. W. D. Westervelt,
Master Andrew C. Westervelt,
Mr. Jas. A. Wilder,
Mr. J. N. S. Williams,
Mr. H. O. Wood,
Mr. H. P. Wood,
Mr. D. L. Withington,
Prof. John M. Young,

HOWARD M. BALLOU,
Secretary.

Scientists and societies favoring us with copies of their publications in exchange are requested to mail them to our observatory, Volcano House, Hawaii, and not to Honolulu.

WEEKLY BULLETIN
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HONOLULU, HAWAII, MAY 13, 1914.

No. 19.

From the Pacific Commercial Advertiser, Honolulu, May 4, 1914.

TECHNOLOGY STATION, Kilauea, April 30. — Again there has been a slight increase in activity in Halemau-mau. Readjustments among the talus blocks produce frequent trivial rock-slides, occasioned probably by the melting and subsequent fluid movement of the lower layers. Nevertheless, the state of heat at the bottom of the pit near the top of the magma column seems to be increasing steadily, though the balance of the surface conditions which make for spectacular display vary in a partly regular, partly irregular way.

It may be appropriate to call attention again to the tolerably close agreement between this observed change in activity and theoretical variations in earth-strain produced by the action of sun and moon components of attraction. It is a tentative opinion, or hypothesis, that this variation in apparent activity noted from week to week is controlled partly, or largely, by this variation in earth-strain.

On April 23 conditions at the pit were as usual; brief glimpses of the incandescent orifices were obtained, but no flames or jets were seen. A few trivial slides occurred. There was nothing specially noteworthy about the blowing or rumbling sounds.

On April 24, owing to weather conditions unfavorable for observing, no visit was made to the pit.

On April 25 nothing could be seen on account of swirling fumes. The blowing and rumbling had become loud.

On April 26 no watch was maintained at the pit, but visitors reported the usual conditions.

On April 27 intermittent lava jets

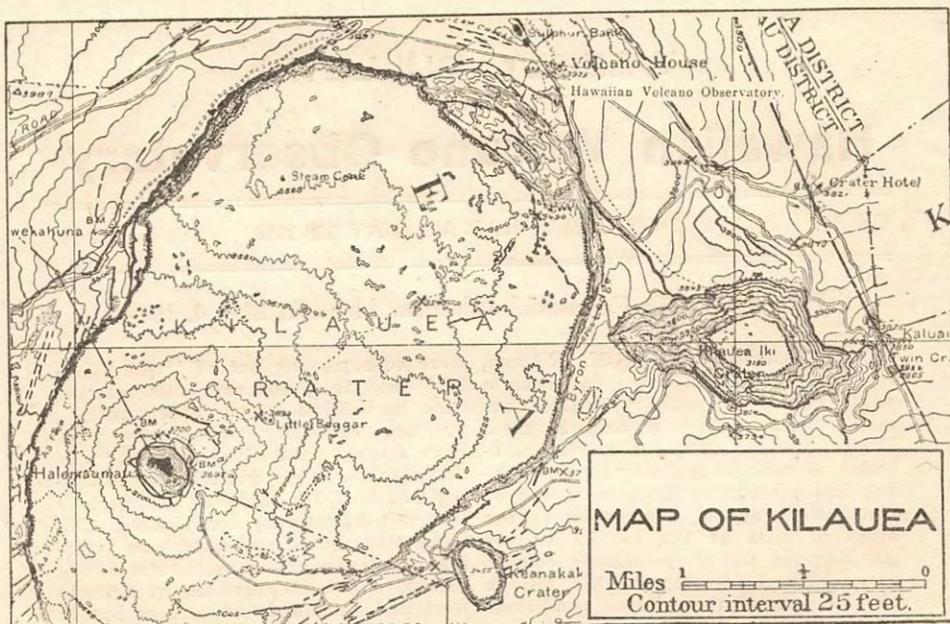
were seen playing out of "Old Faithful" and from the southeast blowing cone to heights closely approximating but not exceeding seventy-five feet. Blue flames wavered above the "Old Faithful" orifices. Rumbling and blowing was loud, the latter at considerable intervals being very loud indeed. No slides were heard and almost no symptoms of readjustment among the fallen blocks. Fumes obscured the west northwest and the northeast orifices but in the neighborhood of these the illumination of the fumes was brilliant.

On April 28 no lava jets were seen during the brief glimpses obtained of the "Old Faithful" and the southeast cones, but sounds of blowing and rumbling were very loud, the former of staccato quality. No prolonged slides were heard but the movement of individual rocks was noted frequently.

On April 29 an excellent series of views was obtained. Seething lava was again visible in the west northwest orifice. Small lava jets, twenty to twenty-five feet in height, were springing from the "Old Faithful" orifice, and blue flames were playing there. Nowhere else were jets noted. Blue flames were playing at the southeast cone also. Prolonged trivial slides were occurring frequently.

No systematic seismological report can be rendered at this time. The week passed without noteworthy seismic behavior until shortly before three in the afternoon of April 29, when a weak local earthquake, barely perceptible to the senses here at the Observatory, occurred.

H. O. WOOD,
Associate.



HAWAIIAN VOLCANO RESEARCH ASSOCIATION.

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This weekly bulletin as it appears in the Advertiser will be reprinted as a leaflet and sent to regular annual subscribers to the work of the association. C. H. Cooke is president of the Board of Directors of the association and R. W. Shingle is treasurer. New subscribers who are interested in our volcanoes will be welcomed in the association. The association aims: (1) To record volcanic activity and earthquakes in Hawaii; (2) to attract scientific men hither for special studies; (3) to promote the establishment of volcano observatories all over the world.

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The Whitney Laboratory of Seismology is equipped with two Bosch-Omori 100 kg tromo-

meters registering N-S and E-W motion, a heavy Omori tromometer registering E-W motion and an Omori "ordinary Seismograph" designed for registering strong earthquakes in all three components of motion. These are seated on concrete piers in a closed basement room having practically constant temperature, beneath the chief Observatory building near the hotel. Time is referred to a rated chronometer, checked at intervals by solar observations with a transit. Both instruments are loaned by the College of Hawaii. At the station by the edge of the active pit an Omori two-component tromometer with light steady masses is mounted on a concrete pier placed directly on the fresh lava surface. Hawaiian standard time (H. S. T.) is 10 hrs. 30 m. slower than Greenwich time.

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Expressed by accelerations measured in millimeters per second per second.

| | | |
|----------------------------------|--------|---------|
| I. Instrumental | 0.0 | 2.5 |
| II. Very slight | 2.5 | 5.0 |
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| V. Rather strong | 25.0 | 50.0 |
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WEEKLY BULLETIN

OF

Hawaiian Volcano Observatory

Vol. II.

HONOLULU, HAWAII, MAY 20, 1914.

No. 20.

From the Pacific Commercial Advertiser, Honolulu, May 10, 1914.

TECHNOLOGY STATION, Kilauea, May 7.—The week at Halemaumau has shown a marked increase of activity, culminating in a fiery display May 4 and 5, with lava flows from the conelets on the floor, but at a very great depth within the pit. All signs indicate a progressive slow rise of the lava from week to week, the fumarole action being very strong high up the walls, and the great mass of talus material being now in large measure consumed, so that bare rock walls extend nearly to the floor. For more than a year the low-lying lava column has been melting up this vast body of tumbled rock, its benches and overflows of 1912, the conflict between the heat supply and the inslipping slides proceeding by pulsations of about a fortnight's duration each, marked by alternations of quiet and activity.

Thursday, April 30, there was no seeing on account of smoke, but the rumbling was loud and the blowing noise very loud, with occasional exceptional blasts.

May 1 at 5:20 p. m., the pit was clearly visible from the north. The Old Faithful cone was blowing and rumbling and emitting blue flames from its cracks. A strong avalanche lasted 45 seconds. At 8 p. m. from the southeast station strong glow could be seen in the west-northwest cavity under the wall and at some other spots, but there were no lava drops or spatters ejected. Slides continued.

May 2, at 5:40 p. m., the Old Faithful cone was seen to be spattering and the

west-northwest hole was glowing, as seen from the north. Blowing and rumbling noises continued. At 6:10 p. m., from the same point of view a clearing out of the fumes revealed the fact that new lava flows had poured all over the floor, surrounding the Old Faithful cone, the source apparently being a conelet under the southeast station. Glowing streaks could be seen where the flows had cracked. Slides were still plentiful. The west cone on the floor was occasionally rumbling and blowing out glowing spatter. At 6:30 p. m., all the pots and craterlets were seen to be flaming, Old Faithful was vomiting spatter from its main lateral cavity, and blue flames from a crack on its crest.

May 3, from 6 to 8 p. m., conditions were similar, the various pots bubbling and flaming, with noises of puffing and splashing, the seeing being best from the southeast station. The fumaroles were very rapid in their puffing, one being seen not more than 100 feet below the south station. In the same zone of vapor as the postal rift, back from the edge of Halemaumau, but more to the eastward, east of the Volcano House trail, a fumarole has developed acid fumes which are like those of the floor, intensely disagreeable and probably injurious.

May 4, 3 to 4 p. m., the bottom area was plainly visible from the northwest for from twenty to thirty minutes. Old Faithful exhibited a small triangular orifice and the southeast cone was glowing. These were both spatter-heaps at the floor level, the floor being made up of flows. On the south side of the floor two small glowing spots were seen. In the large west-northwest orifice there

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was marked activity concealed by fumes. Two small glow spots appeared under the northwest station. The high fumarole in the north wall was very active. The northeast cave was glowing. No lava jets were seen. Rumbling was strong, and the blowing noise comparatively weak.

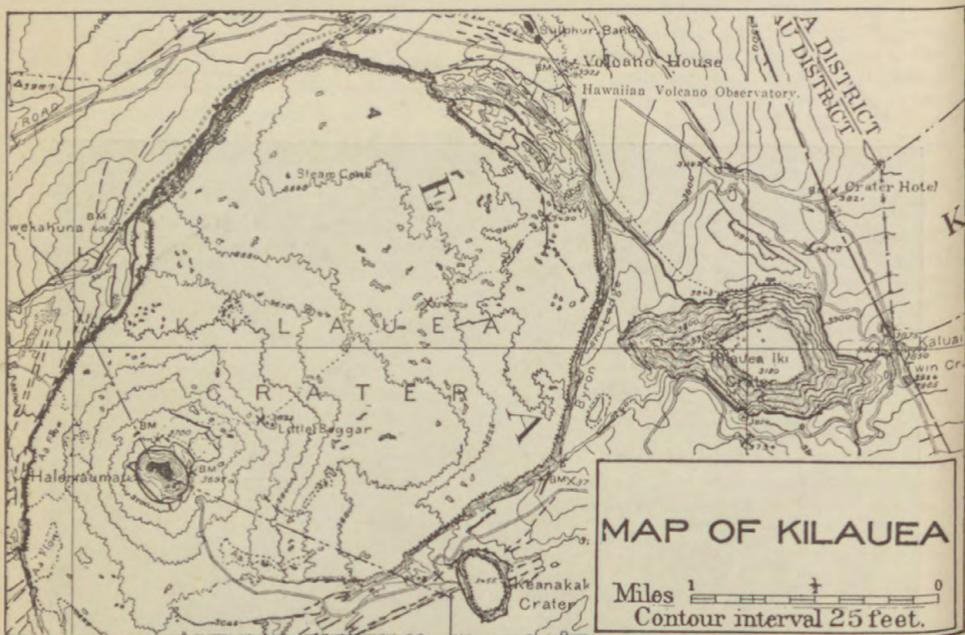
From 9 to 11 in the evening of May 4, and again at 4 a. m., the most intense glow which has been seen over the pit from the Observatory for many months was observed, due to extensive lava flows on the floor, as was proved next day. These were seen still in eruption on the afternoon and evening of May 5. As on May 2, the source of the principal flows was the southeast cone, now become an oven opening to the north and vomiting out an immense flow which covered the whole east end of the floor. There were other spattering flows from Old Faithful, nearer the middle of the floor, this also being an oven open to the north. There

was little sliding, and the noise was mostly splashing and puffing. Seeing was from the south and southeast, the whole southeast end of the pit being continuously clear, and in general the fumes less obstructive than of late, though the ring of fumaroles around the low talus adjacent to the floor was intensely active, emitting hundreds of tails of white vapor. Dimly the western holes could be seen in action, and there were western lava flows, but their detail could not be made out. High over the floor in the northeast wall a large craterlet was fuming and flaming. Under it near the floor level were several glowing holes and a black cone illumined by the incandescence of the lava flows. Now and again the flows would crust over, blacken and then rend asunder, the glowing orange-colored melt welling up in streaks and ribbons. Altogether it was a glorious display, and lasted for hours. There were at least three main flows and seven glowing craterlets.

May 5, 8 to 10 p. m., the depth was measured with the new Japanese simplex transits and very accordant results were obtained from three readings, making the elevation of the south and southeast stations above the Old Faithful and southeast cones 585 feet approximately.

May 6 the evening glow indicated diminished activity, confirmed May 7, 11 a. m., when the floor was concealed, the noises that of puffing, with one slow avalanche heard.

T. A. JAGGAR JR.,
Director.



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WEEKLY BULLETIN
OF
Hawaiian Volcano Observatory

Vol. II. HONOLULU, HAWAII, MAY 27, 1914. No. 21.

From the Pacific Commercial Advertiser, Honolulu, May 18, 1914.

TECHNOLOGY STATION, Kilauea, May 14.—The week at the fire-pit has been one of steady continuance of activity, with probably some rising.

May 7, at 11 a. m. a partial view of the interior of the pit was obtained. Under the south station for a depth of at least 300 feet is a bare insloping rock wall ending below in a V of talus rising on each side.

Much of the enormous quantity of slide-rock which filled the south end of the pit last year is gone, engulfed in the magma column below. There still remains a remnant of the high south bench sixty feet below the rim. On this date the wind was diffusing the fumes in the pit, Old Faithful was hissing continuously, there was no sound of very great activity, and a slow avalanche was heard tumbling toward the west.

There was some glow during the night of May 8-9, and at 1 p. m. May 9, Old Faithful was seen from the northwest station to be a small pool about 25 feet in diameter, with flows running over the edge on the floor toward the northwest and toward the southeast. The west cone on the floor was ejecting incandescent lava jets.

Blowing, rumbling, and breaking noises were very loud. At 1:15 streaming currents could be seen in the Old Faithful pool. The cavern in the wall westnorthwest was throwing out lava jets from time to time and the floor below it was covered with fresh lava. In the evening from 8 to 10 p. m., the seeing was best from the south station. The whole bottom was visible;

two cones with glowing flagree in the westnorthwest wall, the western floor-cone, Old Faithful an open pot with hanging stalactites, showing streaming within, and sometimes splashing out. The southeast cone of the two days before was now submerged under fresh lava-flow from Old Faithful.

The noise of strongest loud blowing seemed to come from the southwest margin of the floor, where were puffing fumaroles. The floor was divided into halves, the western evidently higher than the eastern, and a cascade of lava poured down a slope from west to east across the dividing line. This cataract was a narrow ribbon, and at its lower end was pouring into Old Faithful. The noise of the lava stream was a peculiar and characteristic crackling rumble. Other noises were sharp hisses and splashes, and a little rock-sliding. The whole east floor showed the glowing cracks of a fresh lava flow.

At 5 p. m. Sunday, May 10, there was no clear seeing and the noises were the same. At 3:20 p. m., May 11, the Old Faithful pot, with streaming lava within, was visible from the east station, and the noises were blowing and loud rumbling. From the southeast station at 4:20 p. m. the Old Faithful pot was seen to be overflowing, and there was glow in a southeast crack in the floor.

May 12 at 3 p. m., the seeing was poor; the noise was a continuous hiss, with rumbling and occasional loud puffs. The Old Faithful glowhole could be dimly seen splashing. Fumaroles around the bottom were very ac-

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Professor of Physics, College of Hawaii

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tive southeast and south, and one high one was noticed about 100 feet above the floor in the wall east. The rumble was loud enough to be heard at the Technology Station about 100 feet back from the edge of the pit. At 5 p. m. from the southeast station the east end of the floor could be seen; Old Faithful was an oven with hanging stalactites open to the east, there was another small beehive cone on the floor southeast, and a small glow spot could be seen in the west pool. A very high fumarole in the wall was discovered at the top of the talus just to the south of the west station.

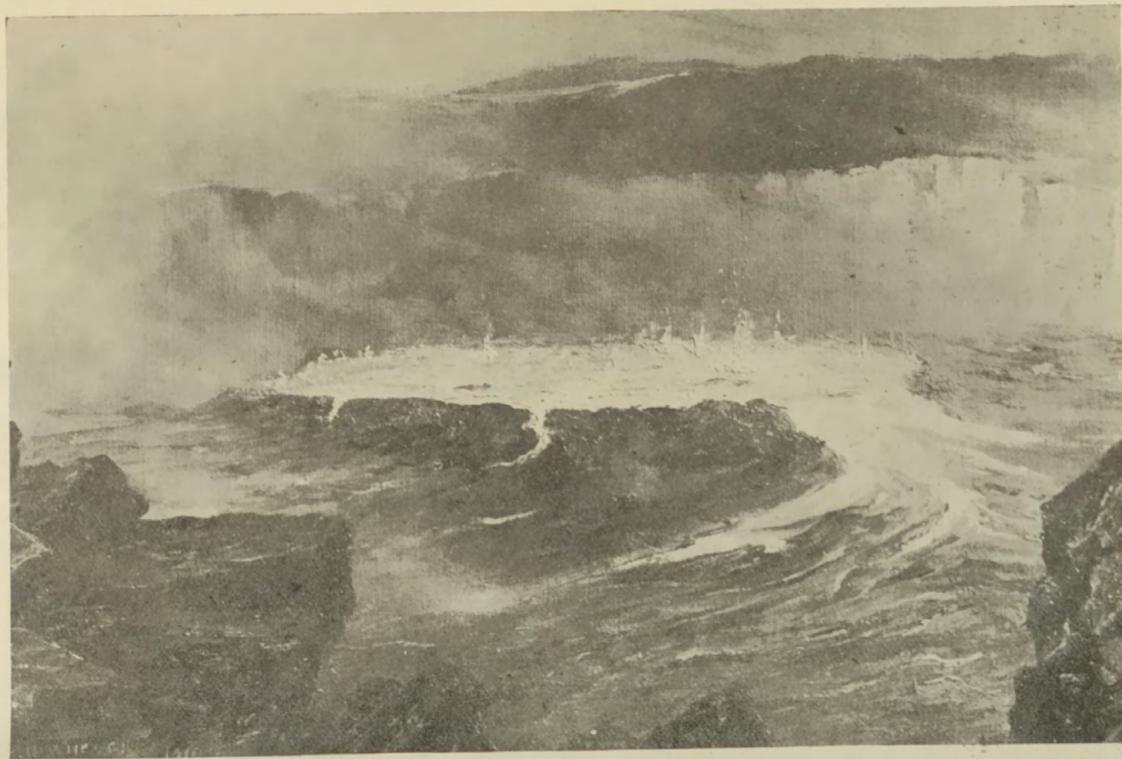
May 13 at 4 and 6 p. m. seeing was bad, the triangular orifice of Old

Faithful could be made out from the southeast station, and the noise was the usual loud rumbling and blowing. The blowing of late has had no very definite period, but has been continuous, with sporadic louder puffs. I have never yet been able to identify visible jets of vapor with the sounds perceived, nor by any other means satisfactorily to localize the sounds.

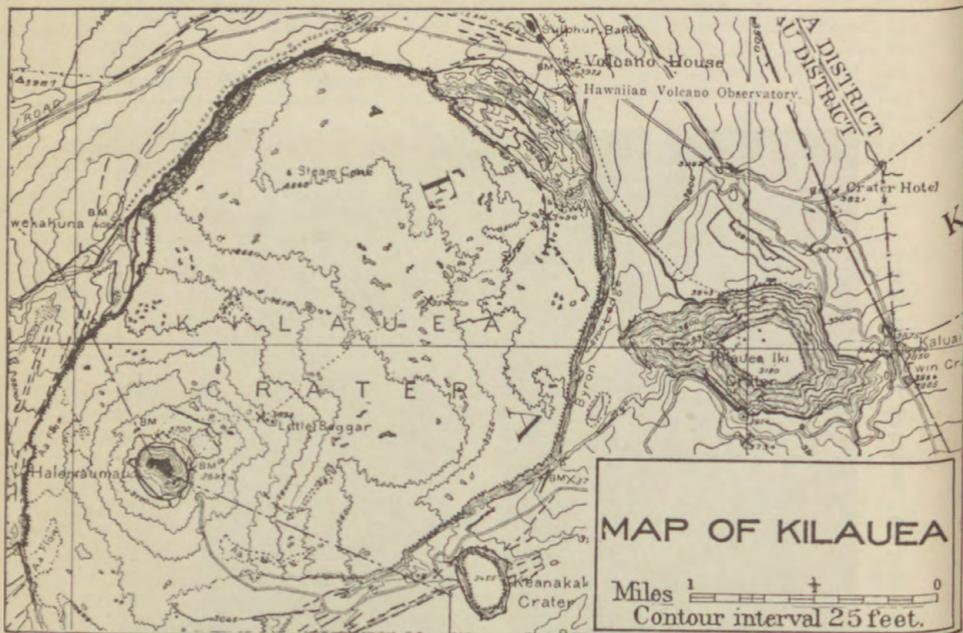
H. O. Wood reports that continued cloudy weather at noon has prevented observations for the correction of time, so that no systematic report from the Whitney Laboratory of Seismology can yet be given. The week has been quiet seismically except for a shock at about 9:05 p. m. May 12. This was sufficiently energetic to start the ordinary seismograph, and barely to be perceived in the vicinity of the Observatory. Vague reports indicate that it was stronger to the senses on the southern slopes of Mauna Loa, a circumstance considered probable, since its origin would appear by the trace on the seismogram to be 30 to 40 miles from the Observatory.

The director, on the evening of May 14, is to repeat in Hilo the lecture on the eruption of Sakurajima, with illustrations, previously delivered in Honolulu.

T. A. JAGGAR, JR.,
Director.



Hitchcock's painting, (1910), of "The Lake of Fire," Halemaumau, Hawaii.



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WEEKLY BULLETIN
OF

Hawaiian Volcano Observatory

Vol. II. HONOLULU, HAWAII, JUNE 3, 1914. No. 22.

From the Pacific Commercial Advertiser, Honolulu, May 25, 1914.

TECHNOLOGY STATION, Kilauea, Hawaii, May 21, 1914:—

The rise at Halemauau continues, though the bottom of the pit is over six hundred feet below the rim in places, according to recent measurement. The deepest parts are at the west end of the floor. Flows over the floor from various vents have made a brilliant flaring glow at night, seen from the Observatory, while in the daytime seeing has been variable, the fume-cloud sometimes being obstructive. In general it has been a week of brilliant nocturnal displays for visitors. It should be noted that the temperature of the Postal Rift was unusually low last week; on May 12, at 4:30 p. m., the temperature of the air was 20 degrees C., (68 degrees F.); of the hot gases in the rift 308 degrees C. (586 degrees F.); usually in the past two years the Postal crack has given a temperature measurement of from 315 to 323 degrees C. (599 to 613 degrees F.)

At 3:52 p.m., May 14, a long slide was heard from the southwest part of the pit, lasting about 45 seconds, and small slides thereafter. At 6:25 p.m. the Old Faithful oven was spouting lava; three holes in a line appeared beyond as seen from the southeast station, one of them emitting blue flames. The southeast cone on the floor occasionally blew out spray. A bright glow-hole appeared under the northeast station, another under the east station, and the blowing and rumbling noises continued as of late. At 6:50 p.m. a flow appeared on the floor pouring from the west toward Old Faithful.

May 15 at 4:30 p.m., seeing from the southeast and south stations was sufficiently clear for a partial survey of the bottom with a transit. The floor was very active from at least eighteen points. A flow from the southeast cone showed glowing cracks and rim, and covered the eastern floor. The principal active holes visible were the west cone, Old Faithful, a pot just west of Old Faithful, the southeast cone, the northeast chimney, a glowing spot on the east side of the floor, and the two high west chimneys. By "chimneys" I refer to craterlets in the wall at some height above the floor, and exhibiting glow. The noises were sharp hisses, bubbling and rumbling and some rock-slipping southwest. I was able for the first time to identify the hisses with jets from the southeast cone, which visibly coincided with the noise, and this place was clearly at the source of the lava flow spreading over the east floor under its own crust.

The flow in solidifying tended to choke its orifice, hence the hisses of hot gas which kept the orifice open, and kept pumping a narrow stream of incandescent lava under the crust to swell and spread the accumulation on the floor. The west cone and Old Faithful were both splashing pots occasionally ejecting spray.

The measurements revealed a rise of the eastern floor of from seven to eight feet in the past fortnight, the mean depth below the south-southeast rim being 575 feet to the southeast cone, 574 feet to Old Faithful, 583 feet to the pot just west of Old Faithful, and 605 feet to the southwest cone.

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Editor.....Howard M. Ballou
Professor of Physics, College of Hawaii

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The long downward slope here revealed from Old Faithful, as a built-up cone toward the west end of the floor, indicates how much the activity of the eastern floor during the past few weeks has been constructive by overflow, in contrast to the west end. The distance from Old Faithful to the southeast cone was 110 feet, and to the southwest cone 243 feet. The whole flat cone of overflow, which we have been calling "floor," is at least 550 feet long from east to west and perhaps 200 feet wide.

May 16 at 11 a.m., conditions were the same, seeing poor. May 18 at 6 p.m. activity was strong, Old Faithful was blowing out jets of lava, the front of a flow was in motion at the east end, the southeast cone was puffing spray, and the noises were loud. At 6:10 a flow was pouring from the north toward Old Faithful.

May 19 at 1:30 p.m., there was continuous hissing and puffing with no definite period that could be timed. There was some rumbling and what little could be seen of the floor from the southwest and south stations showed a black surface with gaping, glowing pots at Old Faithful and vicinity. There were no flows seen in motion. Two high fumaroles at the top of the talus occur east and west of the southwest station. Further down in the pit there is a flat remnant of the 200-foot bench of 1912, its top cracked in many directions, fuming, and discolored with sulphur. East of the bench under the south station, at the foot of the vertical wall that bounds the pit there is an extraordinary downsloping gully, almost a crevasse,

probably produced by the sagging outward toward the pit of a block of bench or wall material.

May 20 at 6 p.m. from the southeast station a flow was again seen to be pouring from the west into Old Faithful. This would imply that the summit region of the floor is slowly migrating westward. A cone under the east station was blowing jets of lava 40 to 50 feet into the air. The southeast cone was emitting blue flames. Bright glow showed in the northeast chimney, and the floor showed the cracked glowing pattern of the recent lava flow. Two orifices appeared in the Old Faithful position.

Owing to bad weather preventing solar observation for the correction of time, the report of the Whitney Laboratory of Seismology will be deferred. The week has been quiet seismically.

T. A. JAGGAR, Jr., Director.

Harold Bauer, the distinguished musician, who has been visiting Madame Pele and viewing the entrancing spectacle that the Fire Goddess is now presenting at Kilauea, has become a patron of the Hawaiian Volcano Research Association and has subscribed liberally towards the fund by means of which the scientific work at the Volcano is now being carried on. Mr. Bauer, who spent the evening of Friday, May 15, with his wife on the edge of Halemau-mau, entranced with the gorgeous display of spouting lavas, fire fountains and brilliant flows, is enthusiastic over the Volcano itself and as much so over the work being done in the study of the Volcano and its phenomena by Professor Jaggard and his associates, writing as follows:

"The value of this experience is something I can never over-estimate, for it has been truly a revelation. Such work undertaken in the cause of humanity cannot fail to inspire the sympathetic and enthusiastic interest of every observer. I cannot believe that the lack of financial support will prove of long duration, for I am convinced that the time is ripe for every human being to understand the far-reaching importance of scientific research into the underworld, more immediate and

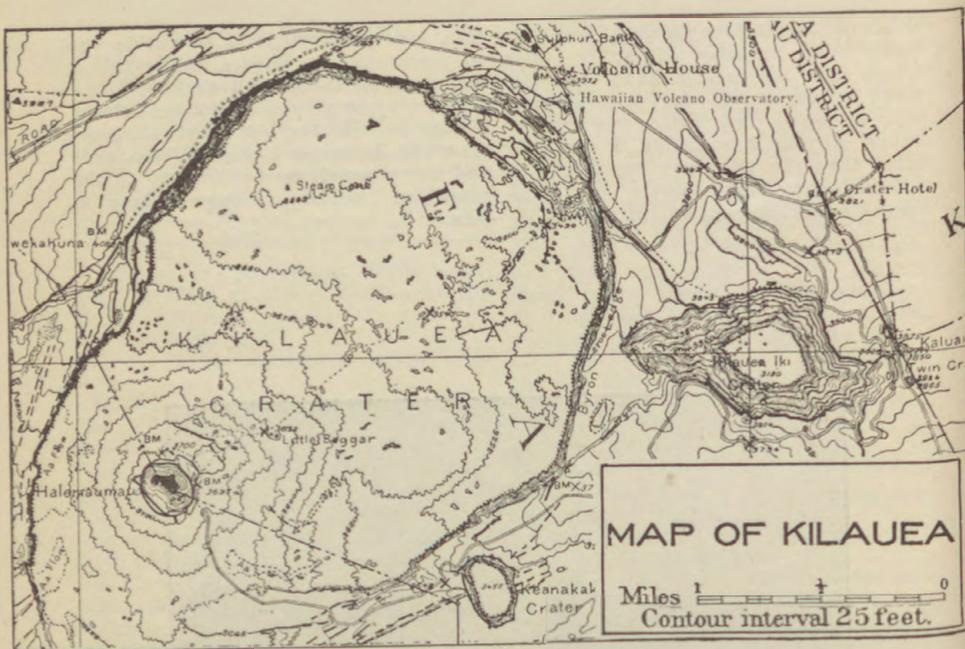
vital in its relation to our lives than many other branches of study upon which time and wealth have been lavished in abundance. In enclosing herewith a modest contribution towards the funds of your Association, I earnestly trust that the necessary movement in public feeling may shortly be manifested and your endowment rapidly at-

tain such proportions as to enable you to prosecute your labors to the fullest and most permanent advantage."

A very large audience attended the lecture in Hilo May 14 by the director on "The Japanese Volcanic Disaster," and the proceeds netted \$123.00 to the Hawaiian Volcano Research Association.



Rough Lava.



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HONOLULU, HAWAII, JUNE 10, 1914.

No. 23.

From the Pacific Commercial Advertiser, Honolulu, June 1, 1914.

TECHNOLOGY STATION, Kilauea, May 28, 1914.—The week at Halemau-mau has been one of continuous activity of the same order as that recently reported, with lava jets and spatter from time to time from the pots in the floor, and flaming chimneys around the border of the floor area. There was a slight subsidence, to judge by depth of lava in the pots, from May 21 to 23, and thereafter some rising, but this appearance needs checking by measurement, as the pulsatory overflow and spatter on the floor may be building up simulate lava-sinking, just as the engulfment of slide-rock and floor crust when it all slides down may simulate lava-rising. There is evidence in the south talus of such a downslip in the latter part of the period, probably on the night of May 24-25, and this was immediately followed by renewed overflow of lava jets from the Old Faithful oven.

May 21, 1914 at 8:30 p. m., seen from southeast and south stations, a narrow vent just west of Old Faithful emitted a rapid-flowing ribbon of glowing lava down a steep slope as seen from the south into Old Faithful. The lava within the Old Faithful pot appeared to be streaming rapidly eastward, and to be from eight to twelve feet below the solidified crust. There were many dull red cracks all over the eastern half of the floor, apparently persistent. The southeast cone was quietly glowing, but there was greater activity in two northeast places at and just above the foot of the wall. At

the north was one conspicuous orifice and two or three were dimly seen in the fumes to the west. There were rare low jets from Old Faithful, tinkling sounds of cracking crust, occasional local rock falls, and bright illumination of the fume-cloud and walls.

May 22 at 11:20 a. m. the high northwest chimney was seen from the north rest-house to be surmounted by a cone about ten feet high, with a large orifice at the top, an opening in its side, and boiling lava within which occasionally surged up to high levels without overflowing or jetting. Five other chimney vents in a line beyond this one showed glow. Rumbling noises were more marked than hissing, and there were many slides. At noon from the same point Old Faithful could be seen, a roundish hole in the floor about 20 feet wide, its edge some five feet above the surging lava within, which occasionally spattered out. Fire showed also in the northeast chimney. At 4:20 p. m., the various vents were more active, and at 8 p. m. from the southeast station the cracks in the floor east were glowing, the east cone ejecting moderately high jets, and the lava pots and chimneys generally active, but there were no moving flows seen.

May 23 at 6 p. m., dim views from the south station showed the usual glow-holes and a bright flame in the northeast chimney. The west end of the floor area exhibited a bright flare, but what occasioned it was obscure. The noises were a continuous puffing and splashing. The southeast fuma-

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roles in the talus exhibited a smoking rift trending northeast, gaping open and lined with whitish sulphur, as though the lower portion of the talus had started to slide away from the upper portion. Two days later this was all changed and the whole slide had gone lower, implying that the hot lava under these most active vents is rapidly consuming the slide-rock. From the northwest station at 6:30 p. m. there was no seeing, but the bright flare over the west end of the bottom area was accompanied by a splashing and booming which sounded like the fountains of a pool. Conditions on the evening of May 24 were fummy; the usual glow-holes were seen.

May 25 at 3:30 p. m. from the north rest-house the noises were steady hissing and a thudding rumble like the boiling of a viscous fluid. At 4:20 p. m. from the southeast the floor was seen to be black without moving flows, with conelets east and southeast, a triangular orifice at Old Faithful, a similar smaller one in the northeast vent, and the great V of insloping wall under the south station had extended down much lower than on the 23rd, in consequence of bodily subsidence of the fumarole talus beneath. The sulphurous crevasse was gone, only some whitish bowlders revealed where it had been. The southeast wall has by the recession of the talus become remarkably high and steep, and about 100 feet down a great red protuberant portion actually overhangs.

May 26 at 6:30 p. m., the Old Faith-

ful hole appeared about 3 x 5 feet in diameter, with surging lava within, and the other glow-holes appeared scattered about the floor. At 7 p. m. Old Faithful was splashing lava out on to the floor, the northeast chimney was flaming, and the east cone was jetting spray. Rumbling and blowing noises continued.

May 27 was a rainy day, and a weak glow was seen over the pit in the evening, at which time also a southwest wind began, carrying the fumes over the Observatory and the Volcano House. This has today, May 28, developed into a southerly storm. There has been much rain for months past at the Volcano House.

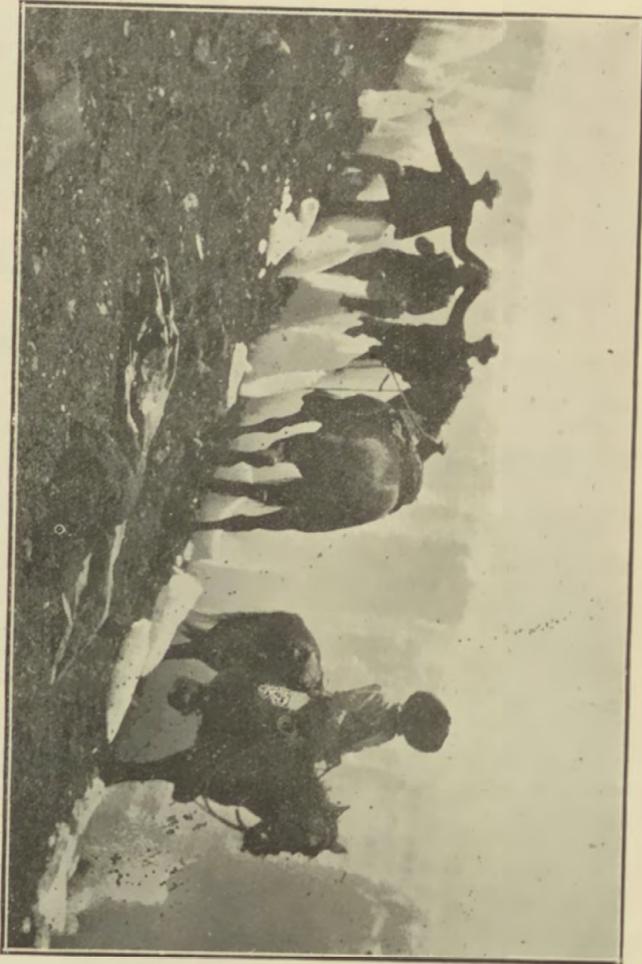
Changes in the cracks back of the rest-house at Halemaumau have accompanied the low level floor (about 600 feet plus) of the past year and the rising lava of the past few months. Evidently the cracks concentric to the pit bound immense spalls of rock, crescent-shaped in plan, like the 1894 bench, which tend to sag out into the pit and subside. The outer ring of fumaroles, of which the Postal Rift is the type, is a continuous echelon of such cracks extending down to the hot lava probably, and recently movements on this ring east and southeast have opened the way to the passage of very acid fumes which are intensely irritating. One place straight back of the east rest-house shows bluish fume. Probably lava is rising beneath this ring just as in the case of the inner ring of talus fumaroles. Moreover cracks parallel to the edge of the pit from ten to thirty feet from the edge between the north rest-house and the northwest station have gaped a few inches, and in one case at least, the outer block has subsided, these cracks being from three to thirty inches wide. The rock on the pit side of a twelve-inch crack forty feet in front of the Technology Station has settled four inches in sixteen months. The rock filling of a thirty-inch crack in the trail back from the northwest station has settled three inches in the same period, indicating that the crack has gaped. No motion can be detected at the north station, the trail from the

north to northeast stations, nor about the east station.

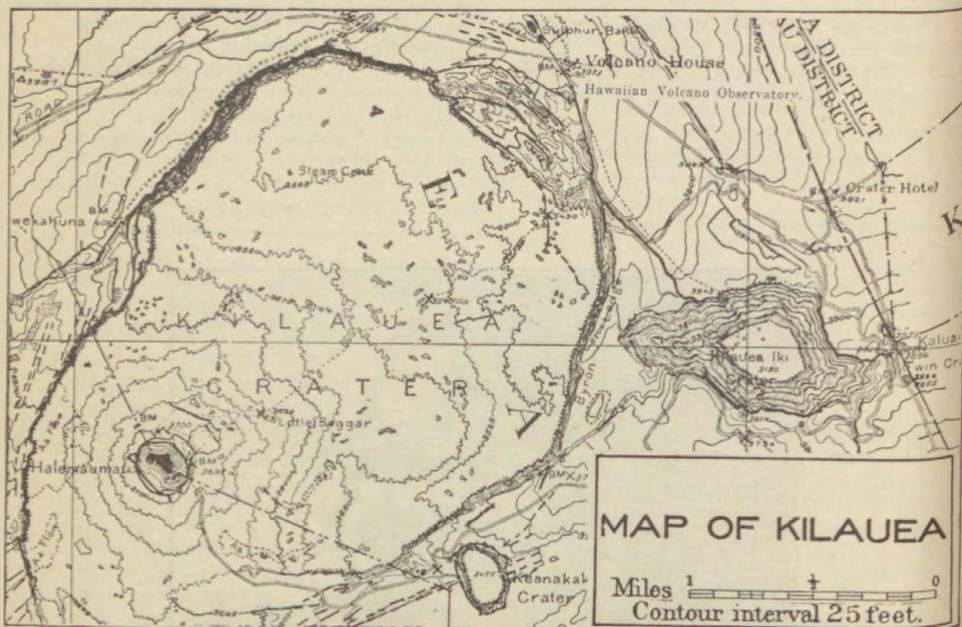
The seismological report will be deferred until clear weather at noon per-

mits a time observation. One distant earthquake was recorded May 25-26.

T. A. JAGGAR, JR.,
Director.



On the Summit of Masna Loa.



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Hawaiian Volcano Observatory

Vol. II.

HONOLULU, HAWAII, JUNE 17, 1914.

No 24.

TECHNOLOGY STATION, Kilauea, June 4, 1914.—The week at Kilauea has passed uneventfully. No unusual phenomena have been observed nor any fluctuation in activity of noteworthy sort. Owing to rain and wind the volcano has been less under observation than ordinarily.

No visit was made to the pit on Thursday, May 28.

On Friday, May 29, fitful glimpses were obtained showing the usual orifices on the floor as well as those at the northwest and east, higher than the floor. All were brightly incandescent, exhaling fumes copiously but with comparatively little noise of eruption. Frequent trivial slides were heard, indicative, in the judgment of the writer, of slow rising disturbing the lower stratum of talus blocks and thus producing sliding readjustments. Snapping sounds, as of rock cracking from heat, were heard very frequently, indicative of increasing heat at the top of the magma column. Neither lava jets nor flames were seen.

On Saturday, May 30, conditions indicated a slight rise. Jets were springing from the west-northwest, the northeast, and the east cones and the noises of eruption had much increased. In the course of the evening the top of the northwest cone was blown off and a flow poured out, gradually covering the floor of the pit. No flames were seen. Short slides were frequent.

On May 31, no flowing lava was seen. Lava jets were visible and the

noises of eruption were relatively loud. No flames were seen and slides were comparatively rare.

On June 1, no visit was made to the pit.

On June 2, conditions indicated a slight decrease. Jets, or sprays, of molten lava were thrown from "Old Faithful" and all the usual orifices were glowing brightly, particularly a long fissure in the wall under the east station. But no flows occurred, no slides were heard, and no flames were seen. Noises of eruption were not quite so loud.

On June 3, again a slight increase appeared to be indicated. Jets were springing to greater heights and the sounds had increased in volume. Swirling magma was visible in "Old Faithful," which exhibited a somewhat enlarged orifice. No slides were heard and no flames were seen.

H. O. WOOD, Associate.

WEEKLY BULLETIN

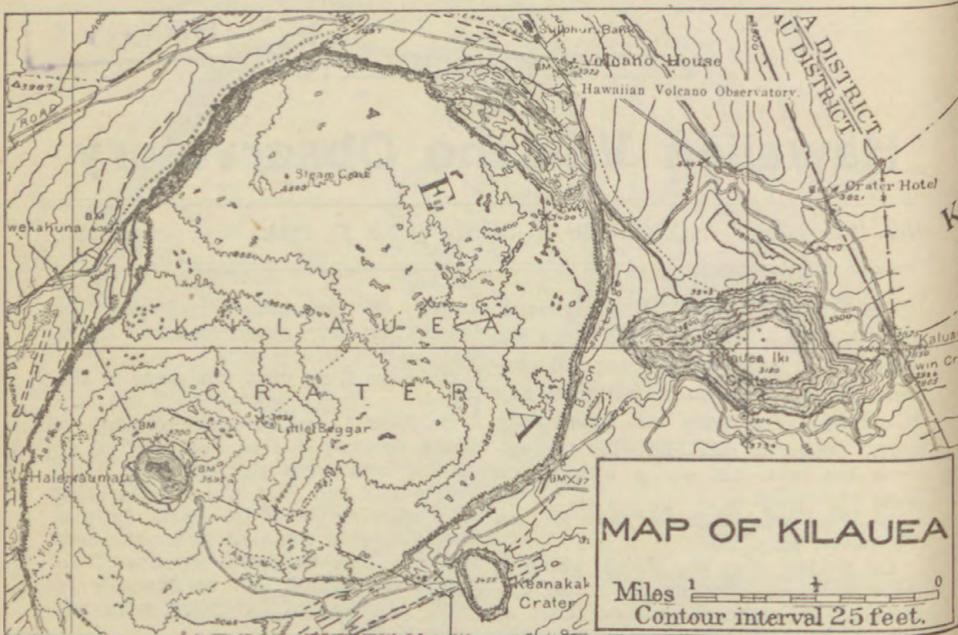
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meters registering N-S and E-W motion, a heavy Omori tromometer registering E-W motion and an Omori "ordinary Seismograph" designed for registering strong earthquakes in all three components of motion. These are seated on concrete piers in a closed basement room having practically constant temperature beneath the chief Observatory building near the hotel. Time is referred to a rated chronometer, checked at intervals by solar observations with a transit. Both instruments are loaned by the College of Hawaii. At the station by the edge of the active pit an Omori two-component tromometer with light steady masses is mounted on a concrete pier placed directly on the fresh lava surface. Hawaiian standard time (H. S. T.) is 10 hrs. 30 m slower than Greenwich time.

CANANI SCALE OF SEISMIC INTENSITY

Expressed by accelerations measured in millimeters per second per second.

| | | |
|----------------------------------|--------|---------|
| I. Instrumental | 0.0 | 2.5 |
| II. Very slight | 2.5 | 5.0 |
| III. Slight | 5.0 | 10.0 |
| IV. Sensible, mediocre | 10.0 | 25.0 |
| V. Rather strong | 25.0 | 50.0 |
| VI. Strong | 50.0 | 100.0 |
| VII. Very strong | 100.0 | 250.0 |
| VIII. Ruinous | 250.0 | 500.0 |
| IX. Disastrous | 500.0 | 1000.0 |
| X. Very disastrous | 1000.0 | 2500.0 |
| XI. Catastrophic | 2500.0 | 5000.0 |
| XII. Great catastrophe | 5000.0 | 10000.0 |

Grade IV. is ordinarily the minimum perceived by the senses; and in grade XII the acceleration, or rate of change of motion (jerk) reaches that of terrestrial gravitation.

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WEEKLY BULLETIN OF Hawaiian Volcano Observatory

Vol. II. HONOLULU, HAWAII, JUNE 24, 1914. No 25.

TECHNOLOGY STATION, Kilauea, June 11.—The week at the observatory on Kilauea has been notable for a very welcome visit from Frank A. Perret, K. I. C., the distinguished volcanologist of the Springfield Volcanic Research Association who started our work here in Hawaii in 1911, and who has since published in the American Journal of Science a remarkable series of articles on the results of his Kilauea studies. He is on his way back to Naples from Sakurajima in Japan, where he made an investigation for the Volcanologic Institute founded in Naples by Immanuel Friedlaender. It was an inspiring experience to have a few days in the field at Kilauea with Mr. Perret, collecting gases and specimens and making photographs.

The lava during the week has continued rising vigorously, though the floor is still much obscured by fumes, and it has not yet developed an open liquid pool. There are signs, however, that such a pool is forming by collapse of the crust in the west part of the floor. The mechanism of spouting cones has been replaced by quiet welling up of flows which spread over the floor, emitted either from cracks or from conelets. There are two well marked open pots with splashing lava within at the extreme border of the floor north and east northeast. Blazing chimneys with glowing lava within are increasing in size along great tangential cracks at the east and west ends of Halemaumau, high above the bottom, as though slices of the wall-rock were there splitting away with lava rising behind them.

June 4 at 3 p. m. from the old north

resthouse the noises in the pit were of bubbling, hissing and thudding. Walking around the pit by the northwest, west and southwest stations, a fifteen inch open crack was found between the two latter, parallel to the edge of Halemaumau and fifty feet back of it, with warm sulphurous gas rising from it and the walls coated with a yellow deposit that is waxy in appearance and tastes like alum. It appears to be a mixture of alum and sulphur. This same deposit was found in the eastern fissures which have recently been newly emitting acrid fumes. On test by Mr. Perret, the cracks in question gave no reaction for hydrogen sulphide or hydrochloric acid. From the south station at 6 p. m. partial views of the floor showed a flow pouring toward its east northeast margin, where it ended by cascading downward—apparently into a pot which has since been seen there. This flow was approximately eighteen feet wide and sixty feet long, and the visible glowing part poured from under a crust or skin having a zigzag edge. Several gash-like glowing chimneys appeared in the east wall.

On June 5 an expedition was made with Mr. Perret to the Cone Crater and pits in the Kau desert. June 6 he took me to a spatter cone near the Kau road on the edge of Kilauea crater in its northwest corner, where it is possible to collect glass droplets of many different shapes, as they were ejected from this cone and fell unbroken into the soft soil.

June 7 at 10 a. m. from the south station Halemaumau was puffing loudly and the noises indicated great activity. A pot in the east northeast

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border of the floor was belching and splashing with liquid lava. There was a continuous roaring hiss west. The south and southwest fumaroles under the cliff appeared more active than of late. On the sloping remnant of the 200-foot bench southwest a fumarole increasing in activity has developed in a network of cracks on the surface of the bench with yellow deposits. A similar yellow stained fumarole is in the talus just east of this bench. The southeast talus fumaroles were very active, one of them appearing to puff softly. The southeast cone on the floor was ejecting a flow from an oven on its southeast side. The northeast pot was boiling very actively and Old Faithful was a cone spouting lava from a triangular opening in its southeast side. The west and west northwest holes could not be seen, but were heard hissing like a freight engine, four puffs at a time.

The northeast gashes in the wall were glowing and the whole floor was a glistening black pahoehoe surface of fresh basalt. Everything indicated active rising. At 4 p. m. the pit was much quieter, the noise a mild plashing and blowing. The main blowing noises came from northeast and west. At 4:30 p. m. a flow was seen pouring over the surface from Old Faithful westward, the cone of the latter being submerged, but there was some jetting at the source of the flow. Cones were seen southeast, east and northeast. Occasional sharp hisses came from the west. Mr. Perret made collections of the mixed gases from the pit and the

gas from the Sulphur Banks near the Volcano House.

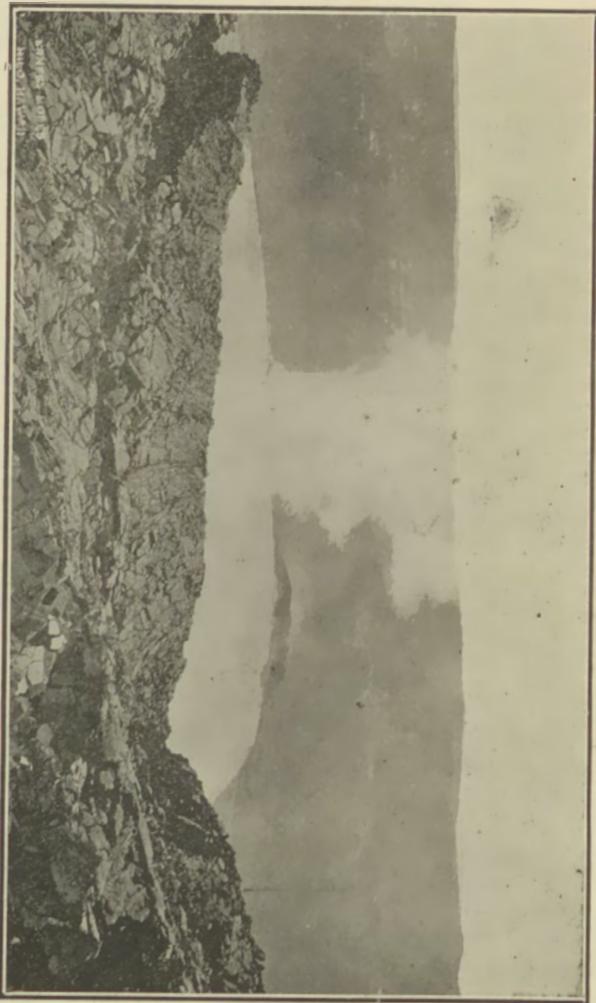
June 8 at 6:30 p. m. from the south-east station a long lava flow was seen pouring out of the southeast cone on the floor and flowing northeast. It appeared to be 20 feet wide. From the south station at 7 p. m., many small flows were seen welling up in different parts of the floor, Old Faithful was occasionally spouting, and the noises were as usual.

June 9 at 5:30 p. m. the transit was set up at the south station, but fumes prevented sufficient continuous seeing to secure a measure of depth. Occasional glimpses revealed the east end of the floor where a very large black spatter cone has been built up, with glistening rounded surfaces and a hole on top. The east northeast pot had grown very large, it was at the edge of the floor against the wall and lava was splashing within. The southeast cone could be seen, but not Old Faithful. There were many glowing cracks and points of flame on the floor, indicating the outlines of recent flows and the noises of blowing and splashing were loud.

June 10 at 6:30 p. m. from the northwest the bottom could be seen. A strong flow which appeared to be thirty feet wide was pouring eastward over the floor. The whole floor appeared to be made up of recent glowing flows. At 7 p. m. small flows were welling up in different places, and from the south station a small cone under the east station was seen to be jetting lava. The noises were loud. At 9 p. m., occasional seeing from the south station showed the whole floor covered with crackling, glowing and flaming crusted flows. Hot lava welled up from cracks here and there. The open pot against the east northeast wall was smaller than the day before. Another was seen at the northern edge of the floor. Beside the large cone in the eastern part of the floor and a little to the north of it was a smaller one with multiple openings emitting blue spears of flame. Old Faithful could not be identified. The long vertical north-south gash was glowing and flaming high above

the floor in the east wall. Another larger than ever before during this one is high above the floor at the west year: active rising is evident. The end. In the west part of the floor illumination of the fume-cloud was was a foundering crust area with zig-zag edge and flows welling up cracks, appearing like a lake or a pooled part of a large flow. The floor appeared moderate.

T. A. JAGGAR, JR.,
Director.



Halemauau from Northeast rim, Autumn 1909.

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about the Old Faithful position, with a flow flaring out westward from it. Dimly a big cone could be seen on the western end of the floor. The large cone on the eastern floor described June 9 and 10 had disappeared. At many points small holes on the surface were seen, apparently each at the source of flows, with confined gases rushing out in puffs and spitting lava. The wall pots east, northeast and north, were small but very active. The high gashes in the eastern wall were flaming and glowing within as usual. There was a fountaining pot in the middle of the western floor.

The noises in general were unusually loud at 5 p. m., and diminished markedly at 7 p. m.

As darkness approached, the west end was seen to be a large body of liquid lava with ragged flow-lines. The two high chimneys at the west were glowing. A narrow cascade developed at the east end from a half-cone built up against the wall, and the orifice discharged a flow which flared out below with festoons, the spatter from the craterlet appearing like dross from an anvil.

Finally, when darkness was complete, the whole floor was revealed, and a great fountain was seen welling up at the extreme northwest end of the floor area, sending a mighty flood of molten basalt like a river eastward over the whole bottom, forking into two leaf-like lobes north and south, and doubt-

less eventually making a new layer over the entire floor. The west central pot maintained its fountaining right through the surface of the new flow. The flow showed the usual zigzag lines bounding semi-crusted areas, these lines being mostly drawn out in the direction of flow.

June 15, at 2:20 p. m., the noises in general had diminished. The gases were hissing continuously at the east end. Strong puffing and spouting sounds came from the west. At 5:15 p. m. a change of wind made some seeing possible from the south station, and vertical and azimuth angles were obtained with transit from the south and southwest stations on a boiling pot in the floor against the northeast wall. These gave a depth of 528 feet below the south station and 531 feet below the southwest station, which is slightly higher. No incandescent flows were seen.

Since this time it has been rainy and the seeing has been unsatisfactory. At 6 p. m. Tuesday, June 16, from the south station a glimpse of the floor showed no flows, but a little jetting from the middle of the floor and the northeast border. The noises were as usual.

There has been glow of moderate brightness on the fume cloud during the week as seen from the Observatory. June 17, at 11:30 a. m., there was no seeing southeast or northwest. The wind at times seems to blow in convectionally from both sides of the pit, and no eddy whatever forms to make an opening. On this date the puffing was toward the west; a steady hiss could be heard in the central region and toward the east, and the fumes which rose around the Old Resthouse were very acrid. At 5:30 p. m., from the southeast station, a central pot was seen to be blowing lava out on to the floor, and some orifice under the east station was puffing very loudly. The noises of this date compared in intensity with those of June 14.

The week has been quiet seismically.

T. A. JAGGAR, JR.,
Director.

WEEKLY BULLETIN
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Vol. II.

HONOLULU, HAWAII, JULY 1, 1914.

No. 26.

TECHNOLOGY STATION, KILAUEA, June 18.—The lava column of Kilauea, during the week June 11-18, has overflowed the floor and risen rapidly, and a measurement secured June 15 shows depth to the floor below the south rim of 530 feet, indicating since the last measurement a rise of the eastern floor of forty-five feet in thirty-one days, or an average rise of 1.45 feet per day.

This marked rise on the approach of the summer solstice is quite in accord with the rule of the last seven years. Another phenomenon of the week which is in agreement with records of the last decade is the boiling up of the melt in the west and flow towards the east, and it now seems probable by all signs that if the present rise continues the first open pool will appear in the west end of Halemaumau. The thick fumes are still very obstructive to good seeing, but on Sunday night, June 14, the whole floor was revealed, covered with spectacular flows.

Thursday, June 11, 1914, at 7 p. m., from the south station, a small cone at the east end was seen to be blowing spray of incandescent lava out on the floor, and the floor was streaked with fire. From the old north resthouse, at 7:15 p. m., a cone on the floor west-northwest was seen to be ejecting jets, and so was a central fountain, presumably Old Faithful. The rumbling and blowing noises were loud, but no slides were heard and no flows seen.

At 5:45 o'clock on the evening of June 12 an attempt at surveying from the south station was defeated by the thick fumes. A glowing crack could be seen on the southeast part of the floor, and stalactites hung in front of

glowing caverns on the north and northeast edges, while in the eastern part a small pool on the surface of the floor, with zigzag edges, was discernable from time to time, apparently a flow. A slide of talus west was heard about 5:40 p. m. The principal noise was moderate puffing and a continuous hiss at the west end. On the evening of June 13 the seeing was poor.

At sundown and long thereafter on June 13 three vapor jets were seen in the usual place on the high northeast flank of Mauna Loa, estimated by Mr. H. O. Wood to be at least 600 feet high. There were some others of smaller size. These jets are seen frequently at this time of the year when the air is still on the heights and the sinking sun in its summer northing gets behind the highest cones of the northeast rift, this being the place where the jets are seen. Mr. Perret tells me he frequently saw them in 1911.

Sunday evening, June 14, from 5 p. m. on, the pit exhibited a wonderful spectacle as darkness revealed its glowing depths. At first very loud roaring blasts were heard in rushing spasms, the sound coming first from one place, then from another, as heard from the southeast station, where the seeing was at first cut off by the curtain of vapor from the southeast fumaroles. From the south station there was occasional lifting of the curtain.

Everything indicated rapid rising; the loudest blasts were heard from the west. A flow covered with festoons of skin was seen pouring from the Old Faithful region to the south talus. As the flow crusted over, new toes would push out from under its skirts. A bubbling small fountain was seen at

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T. A. JAGGAR, JR.,
Director.

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Vol. II.

HONOLULU, HAWAII, AUGUST 1, 1914.

No. 27.

TECHNOLOGY STATION, June 25.—The time of the solstice of June 22 has been, as usual, marked by volcanic and seismic happenings. There have been volcanic eruptions in California and in the Philippines, the lava of Kilauea displays rising activity, and for June 19 and 20 the seismographs recorded two local and one distant earthquakes.

Halemau mau crater continues to exhibit rising lava with occasional brilliant displays, the whole floor, about 520 feet down, being occasionally visible at night, dotted with spouting and flaming cones. There has been fair seeing recently from the Old Resthouse, with thinner fumes. The rising proceeds in pulsations of two orders, the one of a few hours and the other of about a half-weekly period; that is, there is a marked diurnal fluctuation, and there are brilliant displays of overflow of the bottom about twice a week. This suggests accumulation and periodic expulsion of hot gas from the lava column.

Thursday, June 18, from 5 to 8 p. m., there was at first little seeing from the south station, but with a slight change of wind from northeast to north as the evening advanced, the eddy carried the fumes up the west wall and revealed the bottom. The eastern floor, from 6:30 to 7:30 p. m., showed many spitting holes and small wall-pots northeast and north. There appeared to be a cavern at the border of the floor east under the high flaming gashes. The southeast conelet had developed a high inclined spatterhorn. Old Faithful was spurting incandescent "tears" fifty feet high at forty-second inter-

vals. A spot just west of Old Faithful showed pasty lava bubbling sluggishly.

At nightfall a magnificent spectacle was presented near the southwest border of the floor, where a large flat dome burst into eruption like an artesian well of fire, with a lava fountain on top which poured radial flows down all sides, the largest flowing eastward, where it widened and forked into lobes. At the west there was a spouting cavern under the wall which ejected splash down a half-cone onto the floor. At the northwest and west flaming cones could be seen. Pierce hissing noises came from a northeast cone on the floor and from Old Faithful. Everything pointed to intense rising activity, and the southeast talus fumaroles appeared to be ever creeping higher, widening radially, and consuming the slide.

From 4 to 10 p. m., June 19, conditions remained as on the previous day and the evening display was very brilliant. The noises were loud, the eastern cone and Old Faithful ejected lava spray, a flow was pouring past the south side of Old Faithful eastward, the floor was streaked with incandescent cracks and dotted with flaming holes, and the flaring glow on the fume-cloud was bright as seen from the Volcano House.

A lull in this activity occurred during the next two days. June 20, from 5 to 6 p. m., from the south station, the floor appeared black, without active flows, there was slight puffing, and fire could be seen in the northeast pot, the east cone, the high east gashes and at Old Faithful. June 21, at 5 p. m., from the Old North Resthouse continuous blowing could be heard east and west, and in the middle Old Faithful uttered a great blast once in from forty to sixty seconds. After some of these puffs the

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spatter could be heard falling on the floor.

Occasionally there was a secondary puff from Old Faithful after from 10 to 12 seconds. As a whole the pit was noisy and sometimes a deep thud or rumble could be heard. Two rock slides were heard from the northeast wall. Fumes from the southeast fumaroles were very acrid east, southeast and south of the pit. All the conditions point to temporary subsidence. Between 6 and 7 p. m. there was some seeing from the northwest station.

For the first time in many months I obtained a good view of the west corner of the floor. This was seen to extend westward into a sharp point in plan, with three cones along the west-northwest border flaming and spurting sluggishly, the noises having diminished markedly within two hours. These west cones on the floor are what were taken for high chimneys in the wall as seen through the fumes from the south station recently. The round black crater-like hole high in a projection of the west wall was seen to be wholly without activity, unchanged since last year.

Monday, June 22 at 3 p. m., from the southeast station a flow was seen pouring from the middle of the floor toward the southeast. Noises were very loud from the west. At 5 p. m. Old Faithful was spouting and the flow had stopped.

June 23 at 8:30 p. m., the noises were loud and the seeing was altogether from the west and northwest. The noises had decreased by 10:30 p. m.

From the northwest station the whole floor was revealed, shaped like a bogt, with the toe at the west, the instep bending around the great southern talus slopes, and the back, heel and sole at the foot of immense cliffs, east, north and northwest. Sluggish pots were bubbling along the northeast wall. The western cones were all spurting, and glowing cracks made a network in the floor. It was impossible to tell whether the floor was level, though it appeared so, and banners of flame waved over many vents.

On June 24 from 8 to 9 p. m., the appearance was much the same but less active; two spatter cones were building on the floor under the northwest wall, jetting spray which partly hardened before it fell to distances of ten or twenty feet. Around the actual orifices liquid lava splashed out. A large cone with an open orifice was spouting west-northwest and another smaller oven at the point of the west cove. Flames were numerous, the blowing was mild, and but one small slide was heard on the west. The greater activity of these western spouting cones over the eastern suggests what has been the rule for years past in the case of the open pools, that the rising under the crust is at the west and the streaming and down-sucking towards the east. In the crusted condition, then, these most active cones correspond to the "baby fountains" of the liquid pools.

This week has produced the brightest glow on the fume cloud at night which has been seen this year.

There was a small local earthquake about 11:14 a. m., June 19, a distant earthquake was recorded about 7:53 p. m., local time, June 19, which wrote its record for about one hour, and a moderate local shock which was felt in Hilo and disturbed the Ordinary Seismograph took place about 1:40 p. m. June 20, 1914. Another local shock took place this morning, June 25, strong enough to start the Ordinary Seismograph.

T. A. JAGGAR, JR.,
Director.

TECHNOLOGY STATION, July 2.—The end of June 1914, presents Kilauea in a state of pronounced rising activity, the maximum following the solstice being not yet reached. The highest measured level of the year was recorded as 517 feet below the south southeast rim, the lava in a lateral conelet on the south talus reaching 39 feet higher; this record being of date June 28.

Friday, June 26, from the southeast station at 4 p. m. the floor could be seen without incandescence, while the sounds of puffing and hissing were mostly from the west. At 7:30 p. m. from the south station there was evidence, in the glowing outline and fire streaking, of a recent flow within three hours covering the whole floor and apparently having origin at the west end. Border cones west northwest and northwest were spurting lava out on the floor. The noises were loud.

June 27 at 6:30 p. m. from the southeast station a cone on the floor at its east end was seen to be blowing out jets of lava. The noises were loud. As darkness approached, at 7 p. m., from the south station the floor was seen to be streaked with glowing lines, two northwest cones were spitting, and some rock sliding was heard.

June 28 from the south and southeast stations at about 7 p. m. measurements were made with transit. A recently developed cone on the lower slope of the south talus proved to be 478 feet below a mean point of the south southeast rim, while an open pot in the middle of the eastern part of the floor at about the Old Faithful position measured 517 feet down. This would make the talus conelet 39 feet above the middle of the floor, and probably still higher above the border, supposing the floor to be flatly conical. This conelet had poured lava down the slope below it to the floor level in a cascade now frozen, showing one of those remarkable mechanisms whereby the basalt foam may be pumped by its contained expanding gas 40 to 50 feet above the average level of the presumed liquid lake un-

der the crust at the top of the main lava column.

The bottom of the crater at this time was mildly hissing, fresh small flows could be seen at various places on the floor, fanning out and glowing on the northeast portion. There were two open pots in the middle, an openwork glow cone at the east end, wall pots along the eastern border, and the strongly glowing edge of a new flow southeast.

June 29 at 5:30 p. m. the floor could be seen clearly from the northwest station, and eleven cones, some of them quite high, could be counted on the floor. Only a few were jetting lava. The hissing noises were moderate, and a few rock slides were heard towards the west. These continued at 7 p. m., and darkness revealed the usual network of glowing cracks on the floor.

July 1 indicated that the temporary lull of two days before was being replaced by renewed activity. Loud rhythmic puffs and strong hissing could be heard all the afternoon and rock falls were heard at 6:15 and at 7 p. m. From the south station the many glowing cones were seen, and open pots at the west end, at Old Faithful, east of Old Faithful and at the east end. The glowing cone on the south talus had increased in size. About 7:15 Old Faithful caved in and became a large pot, almost a pool, about 40 feet long in a north to south direction and 25 feet wide. A liquid pool within surged violently, making a bright glow which flared on the cloud above.

The eastern pot appeared also as an opening with liquid lava splashing within, and with huge stalactites hanging within its lip. The eastern high chimneys appeared to have diminished in size and brightness. A fresh flow was glowing on the southeast floor, and the southeast talus fumaroles were emitting very voluminous smoke.

The earthquake record of the Whitney Laboratory of Seismology for the week has shown nothing unusual, and the summit of Mauna Loa appears sparkingly clear and free from vapor in the evening light on this date, July 2, 1914.

T. A. JAGGAR JR.,
Director.

TECHNOLOGY STATION, July 9.—The lava of Halemaumau continues to rise slowly and the flat floor of black lava to increase in size. It is now about one thousand feet long, with partly vertical walls five hundred feet high, east, north and west, and sloping remnants of talus and benches on the south. A gigantic gas-cone built of spatter, fully thirty feet high, has been raised within two weeks on the south talus, its base being about twenty feet above the floor, and it is surrounded by frozen cascades of lava that extend down to the floor.

The crust that forms the floor, while it has been built of flows from many vents, now appears like the flat, frozen surface of a large lake, the more so in that a pool about eighty feet long and twenty feet wide appeared around the fountain Old Faithful July 6, with very active bubble fountains in the intervals of the larger explosions, this time being coincident with great seismic activity, as reported by Mr. Wood hereafter; at present the activity and size of the Old Faithful pool has somewhat diminished.

Both volcanic and seismic activity thereby coincided remarkably with expectable luni-solar strain. This season's results, added to those of the past three years, promise important conclusions to the effect that Kilauea is in some sense a barometer of earth tides.

July 2, at 7 p. m., the activity was moderate with hissing noises, a cone over Old Faithful, an open pot east, numerous flames, and the cone in the south talus spurting gas and spatter and increasing in height. On the evening of July 3 the puffings were louder, Old Faithful had developed a splashing pot by collapse, ten or eleven cones could be counted, besides the high one on the south talus, and the great chimneys east were flaming. A fountain could be seen in the Old Faithful pot, and lava stalactites hung on its rim. July 4 conditions were the same, the noise of plashing fountains being added to the hissing and puffing sounds.

From six to seven o'clock on the evening of July 5, the Old Faithful pot had enlarged to the northwest and the fountaining was more violent. July

6, from 5 to 7 p. m., from the south station (all the foregoing observations were from this station) the high south cone was spitting lava from the southwest side of its summit, and Old Faithful had broken away into a long pool in the floor trending northwest to southeast, about eighty by twenty feet in dimensions and with walls eight or ten feet above the liquid flood within, pointed at the ends in plan. The glowing lava of the pool was boiling with many baby fountains, and occasionally the great fountain would dome up and splash the walls. The noise at the east end was a continuous hiss, but the south cone emitted loud puffs of gas every three to four seconds. The southern high fumarole, at about the 200-foot level below the rim, was emitting very dense fumes. The east flaming chimneys were very active, with much blue smoke.

July 7 at 5:30 p.m. the temperature of the Postal rift was 308 deg. C. (586 deg. F.) and of the air 22 deg. C. (72 deg. F.). The noises from the north were general bubbling, rumbling and hissing. From the south station at 6 to 8 p.m., conditions were as before with possibly greater activity, the Old Faithful interval twenty-five to thirty seconds, and the walls of the pool about twelve feet high hanging with stalactites. The south cone appeared to be about thirty feet high. July 8 the appearances were the same, with glowing cracks over the floor probably indicative of new overflow, and hence rising.

The following report from the Whitney Laboratory of Seismology is submitted by H. O. Wood:

During the week ending July 8 sixteen local earthquakes were registered. All but two of these occurred within a period of forty-eight hours on July 5, 6 and 7, eleven of them between 2:44 p.m. July 5 and 1:41 a.m. July 6. It is interesting to note that this group of shocks occurred at the maximum of the hypothetical fortnightly variation in earth strain due to the action of lunar declination compounded with that of solar declination. Also, on the basis of this hypothesis, which we are testing at Kilauea, the maximum in question is one of the six high maximums of the year. The shocks of the week occurred at the following approximate times:

July 1, 6:39 p.m.; July 2, 5:32 p.m.; July 5, 2:44 p.m. 3:18 p.m., 3:54 p.m., 4:38 p.m., 6:45 p.m., 7:20 p.m., 7:32 p.m., 8:06 p.m., 9:39 p.m.; July 6, 1:41 a.m.; July 7, 11:07 a.m., 12:47 p.m. (noon), 1:25 p.m.

Of these, four, all of the July 5-6 group, were instrumentally strong or moderately strong. All the others were instrumentally feeble shocks. The shock at 7:20 p.m. on July 5 was distinctly felt by people staying in cottages about

two miles toward Hilo from the Observatory, but no one in the close neighborhood of the Observatory noted it with certainty. Besides this the shocks at 3:18 p.m. and 4:38 p.m. on July 5 were instrumentally strong enough to belong to the perceptible class, though they passed unnoticed. This was true also of the shock which occurred at 1:41 a.m. on July 6.

T. A. JAGGAR, JR.
Director.

TECHNOLOGY STATION, July 16.

—The week July 9 to 15, inclusive, at the lava pool of Kilauea volcano shows no diminution in the tendency to rise by overflow and the building of dribble cones. The main lava pool around Old Faithful fountain grows no larger, but other pots have from time to time increased in size so as to merit the name of pools, and the floor area has distinctly increased in size and encroached on the talus. The fumes have probably diminished somewhat in volume during the week and there have been several occasions of good seeing in the daytime from both the southeast and northwest rims of the pit. From the old north resthouse it has been possible to see the whole floor and even to obtain photographs of part of it, although its approximate depth is still five hundred feet.

At night there have been fine spectacles of lava-flow welling over from the pots and cones onto the floor, and in one instance pouring down into a pot where the liquid was engulfed amid bubbling fountains.

On July 9, Thursday, at 11:30 a. m., there was partial seeing from the south station under the veil of fumes. The noises were light puffing from the west and hissing from the east. At 12:30 p. m., from the north resthouse, the wind veered for an hour to the east and opened the floor to good seeing. A small fuming talus appeared under the north wall; otherwise the walls of rock east, north and northwest descended directly to the lava floor. A glowing vertical crack in the wall, parallel to the border of the floor, was flaming a few feet above it on the northwest

side of the bottom. Three cones had been built on the floor near the west end, the middle one, the largest, piled like a haystack against the wall. The west corner was now nearly a right angle in plan; when last seen it was acutely pointed. Old Faithful was an elongate pot with black stalactites hanging in its lip, with sluggishly boiling lava within like thick, black mush. All was coated with a mobile black skin, and the activity was mild, without high domings. The south cone was emitting sharp puffs, and Old Faithful was rumbling. A little talus-sliding was heard west-southwest and south, all the conditions indicating temporary stagnation.

Twelve fuming places were counted in the periphery and on the floor. There were two cones on the middle part of the floor in a line west from Old Faithful. The gas cone on the south talus could be plainly seen across the floor, and it appeared certainly thirty feet high, its base well up the talus slope, with black flows from it down to the floor.

Old Faithful sluggishly exploded every thirty-five to forty seconds, with an occasionally subordinate interval of twelve to fifteen seconds. Sometimes it would splash incandescent lava over the whole rim of its pot. The length of the pot was about one-twentieth of the floor, or say fifty feet. The inactive round craterlet high up the northwest wall remained unaltered. The larger west-northwest cone on the border of the floor showed openwork glow. The floor exhibited glossy, thin surface flows of pahoehoe of different luster from those beneath, and the whole floor appeared very flat.

On the evening of July 10, 7 to 8

o'clock, from the south to east stations, Old Faithful was seen boiling and spurting to some height and the south cone was noisily ejecting spatter. July 11 at 3 p.m., and at other times that day the smoke from the pit seemed unusually brown. There were hissing noises east and west in the pit. At four p.m. Old Faithful could be seen, and a northeast cone on the floor, while the northernmost of the three west cones had three openings and a small frozen flow around them. In the evening a thin flow was seen covering the west half of the floor, with two or more sources in the west cones.

Sunday, July 12, seeing was poor, while the hissing noise was loud especially from the west, but no rock sliding was heard. July 13, from 5 to 6 p.m., there was faint seeing from the south station. The south and southeast fumaroles in the talus were belching dense vapor, the south cone was hissing strongly in blasts every three to five seconds and occasional puffs could be heard from the west end. The large east chimney was glowing, as well as a line of three or more cavities back of a thin slab of the vertical eastern wall. A cone could be seen east-northeast and an open pot against the northeast wall, the east end of Old Faithful was pointed, and a cone occupied the middle of the southeast floor.

The evening of July 14 was spectacular. From 8 to 9 p.m. the floor was completely visible from the Old Resthouse (north). Along the northeast wall from northwest to southeast poured a sheaf of lava over the floor, fountaining continuously at its source and cascading down into a large pot about thirty feet in diameter at its termination. The pot terminus boiled with baby fountains. This stream was perhaps 100 feet long, and shaped like a spindle. From it a large lobate flow spread over the southeast floor. Another small flow, with much spatter at its source, bubbled out of a northeast

wall orifice at the edge of the floor. Old Faithful was a round 30-foot pot fountaining violently in the middle region, most of it was a cone with a gash-like opening up which lava surged and spouted spray to a height of forty feet or more, and the western cones and wall chimney flamed with a blowpipe brightness. A small openwork cone in the southwest part of the floor bubbled feebly.

Old Faithful was at first overbrimming, but later sank a foot or two into its pot. This performance of intense activity, with rising, lasted a half-hour with something like ten-minute pulsations of alternate rising and ebbing; then the ebbing became dominant, activity diminished at all the vents and the west cones became less luminous at their flame vents. The northeast flow totally ceased, its source became a dim cone, and its terminus became an open pot like Old Faithful in size and shape, containing many baby fountains continuously active. There were two glowing holes under the north talus; in all 23 glow holes of all sizes were visible on the floor and walls. At 10 p.m. a flow started from the west corner, spreading around the two southwest cones on the floor. The most intense heat on this evening, to judge by the glow, was the yellow incandescence about the flaming west cones and wall chimney.

July 15 at 4 p.m. from the east station a strong avalanche was heard and the Old Faithful and northeast pots were seen to be low and sluggish. In the evening Old Faithful and a hole west of it showed bubble fountains about ten feet down, the noises were steady hissing, and three light slides were heard.

Mr. H. O. Wood reports for the Whitney Laboratory of Seismology that the week has been quiet seismically.

T. A. JAGGAR, JR.,
Director.

TECHNOLOGY STATION, Kilauea, July 23.—During the week ending with July 22 the action of Kilauea has been more than commonly instructive, though perhaps a little less brilliant and spectacular than just previously.

On July 16, for over an hour, from noon to one o'clock, there was good seeing from the northeast, north and northwest stations. From the north station the cone on the floor in the west corner, some twenty feet high, was seen clearly. From this cone came the flow seen at 10 p.m. on July 14. Against the west-northwest wall there was a cone with a long east to west slot-like opening out of which lava was slopping. North of this there was a north to south chimney in the wall. "Old Faithful" was an open pool with active glowing lava at a depth of about ten feet below the adjacent surface. It was rimmed with stalactites. In it were bubble-fountains playing continuously and moving from east to west, and with occasional large fountaining movements. The east end of the "Old Faithful" pool was crusted over and surmounted by a low cone in which there showed a small opening. From the south cone came a loud, steady, hissing sound. The base of this cone was still high above the floor on the talus. At the northeast there were five open pots and cones. One avalanche was heard in the talus in the eastern part of the pit.

On July 17 there was good seeing a little after noon from near the Old Rest-house. Conditions were practically the same as on July 16. Most of the noise of eruption came from the south cone, a steady, sharp hissing.

In the afternoon on July 18 the seeing was not very good. From the south station conditions were seen to be much the same as on July 16 and 17. A triangular pot was noticed on the floor at the northeast. The "Old Faithful" pool was smaller, but it still showed active fountain action. The sounds of eruption were as usual.

In the early morning of July 19 the fume cloud was brilliantly illuminated with a steady light, punctuated with very bright flaring. From 10 a.m. till

after noon there was partial seeing from the north station. "Old Faithful" was an active, fountaining pool the size of which enlarged considerably during the interval of watching. There was sound of steady hissing, probably coming from the south cone.

On July 20 in the early morning hours there was a very prolonged and very brilliant illumination of the fumes, with bright flaring, indicating, probably, a large flow of considerable duration. From about 4 p.m. until 9:30 p.m. there was good seeing from the vicinity of the Old Rest House. Before nightfall there were a number of prolonged intervals, some of several minutes duration, during which the pit was almost free of fumes. The floor area was covered with coarsely festooned, fresh, bronze-tinted lava the surface of which presented a "cheeked" appearance somewhat like the "check" patterns in cross-sections of dry wood, or the bark of some trees. A very fresh flow, probably that of the morning, from the two cones at the north edge of the floor covered from two-thirds to three-quarters its area, extending to the edge all along the northern and eastern borders of the floor. This had almost obliterated, temporarily, the "Old Faithful" orifice, which now consisted of a narrow crack with an aureole of very small cracks marking its periphery, all evidences of a cone having disappeared. The central crack perceptibly enlarged during the watch, but the pool did not re-open. There were two active "bee-hive" cones in a line northwest from "Old Faithful," from both of which at considerable intervals small red-hot lava fragments were ejected. Similar ejections took place from the northwest and west-northwest cones, in the neighborhood of which were small fresh flows with complexly draped surface forms. There were several gash orifices in the floor along its east-northeast margin and at the north and northwest. Besides these, the high east-northeast chimney and an orifice a little lower down at the south were seen very distinctly.

From this latter orifice a fresh lava cascade fell down the talus slope to and out onto the floor. Though well developed when first seen this cascade was still in action, and continued to

work throughout the stay at the pit. Its action was very instructive. No description of such behavior has come to the writer's notice, though it must have been observed many times in former days at this volcano. The cascade was seen clearly by daylight and the surface color of its lava, where cooled, was strongly suggestive of a straw-yellow transparent color laid over a metallic bronze. Its surface structure, or miniature physiography, appeared as a system of tubes, probably from six to eighteen inches in external diameter, some leading in a fairly straight line down the slope, but many very completely contorted and so arranged as to suggest a badly tangled knot of fire-hose or hawsers, all leading down fan-fashion to the floor and then out upon it, appearing there as a group of "toes" or "pushes." An incessant crackling sound, with a subdued tinkling note, proceeded from this cascade, due to the rending of cooled crusts as the action described below went on.

First from one and then from another of these tubes tiny, sluggish flows were seen oozing out. These soon cooled over, thus extending and complicating the tube system. Some of these out-breaks occurred at or near the ends of the tubes on the floor, others broke out higher up the slope forming new tubular segments branching from a small parent tube. The supply of lava welling up at the source was scanty, and it appeared to be very viscous, oozing slowly down the tubes. This action, while much less spectacular than a "waterfall of lava," and in no sense like such a down-pouring, was extremely instructive, illustrating clearly the mechanism and manner of formation of the tubular cascades, so many of which may be seen in various parts of the main crater.

An intermittent flame was flaring at the orifice at the head of the cascade, while a yellowish-white flame burned for some seconds at a small orifice in the surface of the fresh northern flow early in the evening. The usual blue flames were flaring from all or nearly all the well defined orifices.

Rhythmic gas discharge sounds were heard coming from the south cone and a continuous surging sound punctuated

with booming noises from all parts of the floor. Relative to earlier stages of the present revival of activity these sounds were not loud. A few very trivial rock-falls occurred.

In the afternoon and evening of July 21 there were excellent views of the floor from the Old Rest House. All the cones and orifices seen on the previous day were seen clearly. The "Old Faithful" place had again become a small pool with incessant boiling and occasional doming-fountain action when large splashes of molten lava were thrown out upon the floor. Similar action was seen in the cone under the west northwest station. Altogether there were fifteen orifices in the floor area in which boiling lava was plainly visible. Besides this there were many cracks in the floor, through which brightly glowing lava could be seen. More than at any time of late the appearance of the floor suggested a great lava lake beneath, with a comparatively heavy "ice" of lava-crust breached by numerous cracks and "breathing holes."

No flows occurred and no avalanches were heard, though steady hissing was heard from the south cone, interrupted by loud puffing sounds.

In the late afternoon and early evening of July 22 there was good, but interrupted, seeing of the eastern part of the pit-bottom from the south and southeast stations. "Old Faithful" was a pool of nearly rectangular form with rounded corners, about twenty-five by thirty-five feet in dimension, in which at a depth of from six to ten feet below the adjacent surface there was incessant boiling with appearances of streaming from west to east. Occasionally at irregular intervals of more than one minute, there was the characteristic doming-fountain action, but no out-splashing was observed. Heavy stalactites rimmed the pool. Small, short radial cracks were seen leading from the high active east-northeast chimney. The gash orifices in the floor at the east and northeast were as usual, and the usual hissing and puffing emanated from the south cone. Brief glimpses of parts of the western part of the pit disclosed the conditions seen on July 20 and 21 without significant change.

Just before 8 p. m. a slight change in the wind drove the fumes up over the southeast margin of the pit, necessitating a somewhat prolonged exposure to them, which fixed attention on the fact that the fumes from the pit itself are now much sharper, though thinner, than earlier in the year.

Following is a report from the Whitney Laboratory of Seismology: During the fortnight ending with July 22 sixteen earthquakes were registered all of which, except one, were imperceptible to the senses of persons in the vicinity of the Observatory, and all except three were shocks of very, very small magnitude.

Two of the number were simply the chief-phase portions of feeble distant earthquakes; one, on July 16, vaguely beginning at 8:51:04 p. m. H. S. T. and ending even more vaguely about fifteen minutes later; the other, on July 21, beginning quite clearly at 12:15:09 p. m. H. S. T. and ending vaguely at about 12:36:09 p. m. H. S. T.

All the rest were local shocks occurring at the following times:

July 8, from 11:47:39 a. m. to 11:48.5 a. m. H. S. T.; 7:21:45 p. m. to 7:23:28 p. m. July 9, 9:36:43 a. m. to 9:38:25 a. m.; 1:31:57 p. m. to 1:33:11

p. m.; 1:38:04 p. m. to 1:39:46 p. m.; 2:18:19 p. m. to 2:19:02 p. m.; 5:24:51 p. m. to 5:25:29 p. m. July 14, 9:19:23 p. to 9:20:51 p. m. July 16, 6:17:07 a. m. to 6:17:50 a. m. July 17, 12:11:20 a. m. to 12:13:28 a. m.; 8:39:55 p. m. to 8:41:23 p. m. July 19, 8:50:47 a. m. to 8:51:22 a. m. July 20, 4:03:20 a. m. to 4:06:33 a. m. July 22, 9:09:24 a. m. to 9:10:08 a. m. H. S. T.

The shock at about 9:37 a. m. on July 9 had a maximum acceleration in the east to west component just below the least perceptible value, but less than a third this strength in the north to south component. The shock was not felt.

The shock on July 19 was not felt by anyone; it measures just higher than the theoretical least perceptible value in the east to west component, but only half this value in the north to south component.

The shock on July 20 was distinctly felt by two persons lying awake and one or two more were wakened at the time of its occurrence but did not realize the cause. These were probably sleeping very lightly. It probably reached an intensity of only II-III R.-F.

H. O. WOOD, Associate.

A systematic report from the Whitney Laboratory of Seismology covering the period beginning April 21, 1914, and ending July 22, 1914, is submitted here. Systematic reports upon the shocks of earthquake registered during this interval were delayed for a long time by repeated failure to secure measures for the correction of time, and subsequently owing to a short absence from the Observatory of the writer.

April 21, from 7:24:13 a. m. to 7:25:08 a. m. H. S. T. Intensity, medium III Cancani scale; 30% to 70% of the minimum perceptible unit. Origin distant about 12.4 miles.

April 29, from 2:50:10 p. m. to 3:15 approx. H. S. T. Intensity, II R.-F., VI-VII Cancani scale; a felt shock; from 5 to 25 times the minimum perceptible unit. Origin distant about 20 miles.

April 29, from 2:59:36 p. m. to 2:59:54 p. m. H. S. T. Intensity, V-VI

Cancani scale; about 4 times the minimum perceptible unit: the second maximum in the felt shock.

April 29, from 6:37:25 p. m. to 6:38:15 p. m. H. S. T. Intensity, low I Cancani scale; 5% to 6% of the minimum perceptible unit. Origin distance indeterminate.

April 30, from 3:18:42 a. m. to 3:19:46 a. m. H. S. T. Intensity, low III Cancani scale; about 65% of the minimum perceptible unit. Origin distance indeterminate.

April 30, from 11:28:30 a. m. to 11:30:00 a. m. H. S. T. Intensity, low III Cancani scale; about 70% of the minimum perceptible unit. Origin distant about 18.6 miles.

May 12, from 11:12:30 a. m. to 11:13:00 a. m. H. S. T. Intensity, III-IV Cancani scale; about the minimum perceptible unit, but not felt. Origin distance indeterminate.

- May 12, from 9:10:14 p. m. to 9:12:34 p. m. H. S. T. Intensity, I R-F., III Cancani scale; but less than 90% of the minimum perceptible unit. Origin distant about 15.5 miles.
- May 12, from 9:59:36 p. m. to 10:00:13 p. m. H. S. T. Intensity, high II Cancani scale; about 45% of the minimum perceptible unit. Origin distant about 12.4 miles.
- May 13, from 3:41:54 p. m. to 3:42:31 p. m. H. S. T. Intensity, medium IV Cancani scale; about 2.5 times the minimum perceptible unit, but yet not felt. Origin distant about 10 miles.
- May 15, a feebly registered teleseism, distance indeterminate, E. at 9:50 approx. a. m. H. S. T. F. wholly indefinite.
- May 22, from 4:38:26 a. m. to 4:39:25 a. m. H. S. T. Intensity, medium II Cancani scale; about 35% of the minimum perceptible unit. Origin distant about 13 miles.
- May 23, from 7:52:24 p. m. to 7:54:01 p. m. H. S. T. Intensity, II Cancani scale; about 30% of the minimum perceptible unit. Origin distant about 25 miles.
- May 24, from 5:57:35 a. m. to 5:28:59 a. m. H. S. T. Intensity, II-III Cancani scale; about 50% of the minimum perceptible unit. Origin distant about 13 miles.
- May 26, from 2:01:49 a. m. to 2:02:24 a. m. H. S. T. Intensity, high II Cancani scale; about 40% of the minimum perceptible unit. Origin distant about 13 miles.
- May 23, from 4:05:17 a. m. to 5:16 approx. a. m. H. S. T. A teleseism. Intensity, locally negligible, at origin uncertain, but not a very great shock. Distance of origin about 6,000 miles.
- May 27, from 3:30:18 p. m. to 3:31:58 p. m. H. S. T. Intensity, medium I Cancani scale; about 14% of the minimum perceptible unit. Origin distant about 30 miles.
- May 28, from 9:17:27 a. m. to 9:18:57 a. m. H. S. T. Intensity, high I Cancani scale; about 24% of the minimum perceptible unit. Origin distant about 9.3 miles.
- May 29, from 8:23:26 p. m. to 8:24:22 p. m. H. S. T. Intensity, medium III Cancani scale; about 80% of the minimum perceptible unit. Origin distant about 10 miles.
- June 1, a felt shock, III R-F., began 6:29:28 a. m. H. S. T., then pens off. Intensity, beyond instrumental range.
- June 1, from 12:16:03 p. m. to 12:16:51 p. m. H. S. T. Intensity, II-III Cancani scale; 50% to 60% of the minimum perceptible unit. Origin distant about 6.9 miles.
- June 2, from 5:15:02 a. m. to 5:15:40 a. m. H. S. T. Intensity, low I Cancani scale; about 6.5% of the minimum perceptible unit. Origin distance indeterminate.
- June 2, from 5:25:37 p. m. to 5:26:28 p. m. H. S. T. Intensity, medium III Cancani scale; about 65% of the minimum perceptible unit. Origin distant about 7.5 miles.
- June 2, from 6:24:45 p. m. to 6:25:22 p. m. H. S. T. Intensity, medium III Cancani scale; about 65% of the minimum perceptible unit.
- June 5, from 4:54:14 p. m. to 4:55:35 p. m. H. S. T. Intensity, medium-II Cancani scale; about 32% of the minimum perceptible unit. Origin distant about 15 miles in a northeasterly direction.
- June 11, from 10:06:49 p. m. to 10:08:37 p. m. H. S. T. Intensity, medium I Cancani scale; about 11% of the minimum perceptible unit. Origin distant about 27 miles.
- June 15, from 1:54:50 p. m. to 1:55:10 p. m. H. S. T. Intensity, medium to high I Cancani scale; 20% of the minimum perceptible unit. Origin distance indeterminate.
- June 17, from 8:43:03 a. m. to 8:44 approx. a. m. H. S. T. Intensity, low I Cancani scale; 5% to 6% of the minimum perceptible unit. Origin distant about 12 miles.
- June 19, from 11:20:20 a. m. to 11:21:29 a. m. H. S. T. Intensity, III-IV Cancani scale; 60% to 100% of the minimum perceptible unit, but not felt. Origin distant about 19.4 miles.
- June 19, a feebly registered teleseism from 8:59:26 p. m. to 9:32 approx. according to H. S. T. Origin distant about 3,700 miles. Phases measured.
- June 20, from 12:47:30 a. m. to 12:48:18 a. m. H. S. T. Intensity, II-III Cancani scale; about 50% of the minimum perceptible unit. Origin distant about 11.7 miles.
- June 20, from 1:46:00 p. m. to 1:48:38 p. m. H. S. T. Intensity, IV Cancani

scale; nearly 2 times the minimum perceptible unit, but not felt. Origin distant about 10 miles.

June 22, from 5:22.8 p. m. to 5:40.7 p. m. H. S. T. A teleseism, no phases. Origin distance indeterminate.

June 25, from 9:29:08 a. m. to 9:32:25 a. m. H. S. T. Intensity, III-IV Cancani scale; 90% to 120% of the minimum perceptible unit, but not felt. Origin distant about 20 miles.

June 25, from 6:28.9 p. m. to 8:06.9 p. m. H. S. T., a weakly registered teleseism, with defined phases. Origin distant about 3,500 miles.

July 1, from 2:28:01 a. m. to 2:28:55 a. m. H. S. T. Intensity, low I Cancani scale; about 5% of the minimum perceptible unit. Origin distant about 20 miles.

July 1, from 5:37:09 p. m. to 5:38:30 p. m. H. S. T. Intensity, II-III Cancani scale; about 50% of the minimum perceptible unit. Origin distance indeterminate.

July 2, from 5:30:13 p. m. to 5:31:13 p. m. H. S. T. Intensity, II-III Cancani scale; about 50% of the minimum perceptible unit. Origin distance indeterminate.

July 5, from 2:42:15 p. m. to 2:44:11 p. m. H. S. T. Intensity, medium I Cancani scale; 11% to 19% of the minimum perceptible unit. Origin distant 12.4 miles.

July 5, from 3:16:01 p. m. to 3:21.6 approx. p. m. H. S. T. Intensity, V Cancani scale; about 3 times the minimum perceptible unit, probably perceptible but unnoticed. Origin distant about 12.4 miles.

July 5, from 3:51:43 p. m. to 3:53:05 p. m. H. S. T. Intensity, III-IV Cancani scale; about the minimum perceptible unit, but not noticed. Origin distant about 12.2 miles.

July 5, from 4:36:00 p. m. to 4:37:27 p. m. H. S. T. Intensity, low II Cancani scale; about 27% of the minimum perceptible unit. Origin distant about 13 miles.

July 5, from 6:42:25 p. m. to 6:44:04 p. m. H. S. T. Intensity, low I Cancani scale; about 11% of the minimum perceptible unit. Origin distance indeterminate.

July 5, from 7:18:14 p. m. to 7:20:58 p. m. H. S. T. A felt shock. Intensity,

VI Cancani scale; from 3 to 6 times the minimum perceptible unit. Origin distant about 13 miles.

July 5, from 7:25:42 p. m. to 7:27:38 p. m. H. S. T. Intensity, low III Cancani scale; about 54% of the minimum perceptible unit. Origin distant about 11.3 miles.

July 5, from 7:30:02 p. m. to 7:31:50 p. m. H. S. T. Intensity, very low I Cancani scale; 8% to 9% of the minimum perceptible unit. Origin distance indeterminate.

July 5, from 8:03:49 p. m. to 8:04:16 p. m. H. S. T. Intensity, low I Cancani scale; about 13% of the minimum perceptible unit. Origin distance indeterminate.

July 5, from 9:37:06 p. m. to 9:39:17 p. m. H. S. T. Intensity, low I Cancani scale; 5% to 8% of the minimum perceptible unit. Origin distant about 20 miles.

July 6, from 1:39:03 a. m. to 1:40:37 a. m. H. S. T. Intensity, III Cancani scale; 75% to 95% of the minimum perceptible unit. Origin distant 13.7 miles.

July 6, from 11:05:19 a. m. to 11:07:01 a. m. H. S. T. Intensity, low I Cancani scale; about 7% of the minimum perceptible unit. Origin distant 13 miles.

July 6, from 12:45:34 p. m. to 12:47:18 p. m. H. S. T. Intensity, high I Cancani scale; about 22% of the minimum perceptible unit. Origin distant 20 miles.

July 6, from 1:23:15 p. m. to 1:24:56 p. m. H. S. T. Intensity, low I Cancani scale; 6% to 7% of the minimum perceptible unit. Origin distant about 13 miles.

July 8, from 11:47:29 a. m. to 11:48.5 approx. a. m. H. S. T. Intensity, low I Cancani scale; 5% to 6% of the minimum perceptible unit. Origin distance indeterminate.

July 8, from 7:21:45 p. m. to 7:23:28 p. m. H. S. T. Intensity, low I Cancani scale; about 8% of the minimum perceptible unit. Origin distant 13 miles.

July 9, from 9:36:43 a. m. to 9:38:25 a. m. H. S. T. Intensity, III Cancani scale; about 80% of the minimum perceptible unit. Origin distant about 6.9 miles.

July 9, from 1:31:57 p. m. to 1:33:11 p. m. H. S. T. Intensity, low I Cancani scale; about 7.5% of the minimum per-

ceptible unit. Origin distant about 6.9 miles.

July 9, from 1:38:04 p. m. to 1:39:46 p. m. H. S. T. Intensity, low I Cancani scale; about 19% of the minimum perceptible unit. Origin distant about 13 miles.

July 9, from 2:18:19 p. m. to 2:19:02 p. m. H. S. T. Intensity, low II Cancani scale; about 30% of the minimum perceptible unit. Origin distance indeterminate.

July 9, from 5:24:51 p. m. to 5:25:29 p. m. H. S. T. Intensity, low II Cancani scale; about 30% of the minimum perceptible unit. Origin distant about 10 miles.

July 14, from 9:19:23 p. m. to 9:20:51 p. m. H. S. T. Intensity, medium I Cancani scale; about 16% of the minimum perceptible unit.

July 16, from 6:17:07 a. m. to 6:17:50 a. m. H. S. T. Intensity, low I Cancani scale; about 9% of the minimum perceptible unit.

July 16, a feebly registered teleseism no phases, e. 8:51:04 p. m. H. S. T. and F. 9:06:04 p. m. H. S. T.

July 17, from 12:11:20 a. m. to

12:13:28 a. m. H. S. T. Intensity, I Cancani scale; about 11% of the minimum perceptible unit. Origin distant about 19.3 miles.

July 17, from 8:39:55 p. m. to 8:41:23 p. m. H. S. T. Intensity, low I Cancani scale; 3% to 6% of the minimum perceptible unit. Origin distance indeterminate.

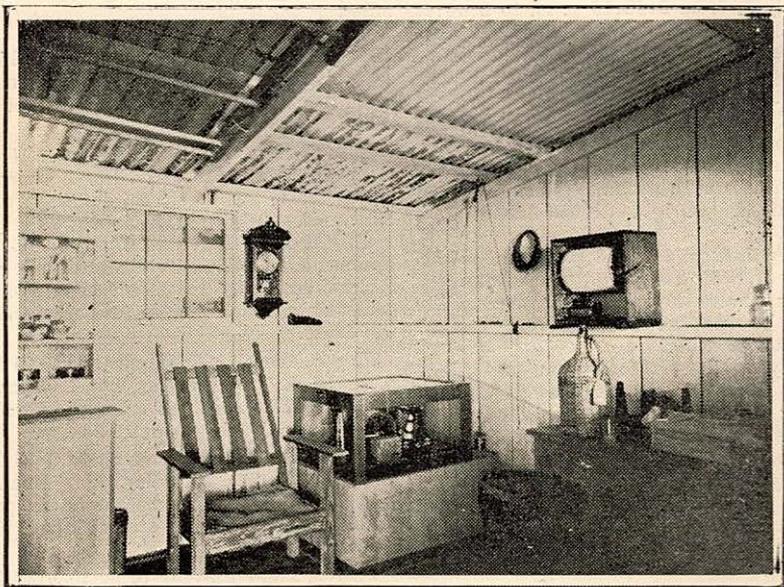
July 19, from 8:50:47 a. m. to 8:51:22 a. m. H. S. T. Intensity, III-IV Cancani scale; 50% to 110% of the minimum perceptible unit, but not felt. Origin distant about 11.8 miles.

July 20, from 4:03:20 a. m. to 4:06:33 a. m. H. S. T. A felt shock. Intensity II R.F., IV-V Cancani scale; about 2.5 times the minimum perceptible unit. Origin distant about 20 miles.

July 21, from 12:15.9 p. m. to 12:36.9 p. m. H. S. T. The chief phase only of a feebly registered teleseism.

July 22, from 9:09:24 a. m. to 9:10:08 a. m. H. S. T. Intensity, high II Cancani scale; about 40% of the minimum perceptible unit. Origin distance indeterminate.

H. O. WOOD,
Associate.



Interior of Technology Station at Halemauau, Showing Crater Seismograph.

WEEKLY BULLETINS
OF THE
Hawaiian Volcano Observatory

Vol. II.

HONOLULU, HAWAII, SEPTEMBER, 1914.

No. 28.

TECHNOLOGY STATION, KILAUEA, July 30.—Until the very end of the week under report there had been very little change in the eruptive behavior at Kilauea. But in the last two days, ending with July 29, avalanches in the talus were noted with increasing frequency of occurrence and large increase in the volume of rock fragments set in motion. Fitful glimpses of the east end of the pit-bottom in the late afternoon of July 29 showed that the fresh pahoehoe in this area was traversed by ugly peripheral and radial cracks, and that large amounts of coarse talus blocks had run down upon and out onto the floor in this part of the pit.

As most of the observed avalanching has been in the west part of the pit, similar phenomena have probably taken place there. Such action is considered to mean sinking of the magma column. Such sinking is expectable in this part of the year. However, on this afternoon "Old Faithful" was a large, open pool in which surging magma was seen, in size comparable with the magnitude observed on the previous day, mentioned below. The east-northeast chimney, high on the wall, also emitted its usual bright glow and seemed as active as ever. All the rest of the pit was hidden in the fumes. Large avalanches occurred at the west and at intervals of several minutes. A few tinkling rock-falls occurred under the east wall. The eruptive noises were much as usual, except that no rhythmic blasts were proceeding from the south cone.

During the past week work at Halemaumau has been hindered and interrupted by the heaviest fall of rain since the establishment of the observatory—a total precipitation of 20.94 inches for the week, with a maximum

daily fall of 12.75 inches from 9:30 a. m. July 26 to 9:30 a. m. July 27.

In the evening of July 23 a small, fresh flow, about sixty feet long by thirty feet wide, was observed running from an orifice in the south cone out onto the floor. A smaller flow poured out onto the floor at the northeast, and a still smaller flow was seen in the center of the floor area. The entire floor area showed streaks of fire, and small jets sprang occasionally from many small cones, most of which were near the edge of the floor area. Both rumbling sounds and noises of blowing were very loud, especially the blasts from the south cone. Here a blue flame was flaming steadily. No slides were occurring. Late in the evening a considerable flow took place, illuminating the fume cloud more brilliantly for about twenty minutes than at any time during more than a year previously. This flow was crusted over and had apparently ceased moving before it came under observation. Incandescent streaks over its entire surface marked its area completely.

In the afternoon and evening of July 24 conditions, so far as observable, were as on the previous day, except that flowing was less in evidence. Yet small flows were seen.

In the afternoon of July 26, in the midst of the heavy downpour, a clear view of the entire pit-bottom was obtained. All the boiling pots and cones recently described were seen, most of them somewhat enlarged, except for "Old Faithful"; in all but one or two, at the northwest, boiling lava was seen, again strongly suggesting a great molten body thickly crusted over at the bottom of the pit. At this time "Old Faithful" was no larger than several other openings in this crust. A few

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trivial rock-falls occurred. Sounds of eruption were much as usual, except that a distinct sizzling sound, doubtless due to the excessive downpour of rain, was added to the rest. So heavy was the rain at this hour that water in considerable volume was cascading down the terraces below Uwekahuna to the crater floor, a veritable waterfall. Steam was rising from the Perret cone in unusual abundance, and nearer Halemaumau the response to this unusual rainfall was very positive and interesting. Where the trail from the Volcano House divides, near the northeast margin of Halemaumau, is a well-known region of peripheral crevasses from which steam and fumes of sulphur constantly arise. On this day the behavior of these cracks, from the trail or a little northwest of it on to the region of the Devil's Kitchen and thereabouts, was much as usual. Little or no additional steam was issuing. Around the Devil's Kitchen, however, there was marked increase, and from the trail along the belt of cracks toward the motor depot the increase in steam emanation was very marked, the steam issuing so violently as to produce a roaring sound of considerable volume at a spot only a few paces eastward from the trail. At the west-northwest of Halemaumau, also, there was a region showing marked increase in steam output. In general there seemed to be increase in steam emanation along radial tracts leading north-northeast and east-northeast from the center of the pit. These observations were made during an interval when rain was falling at a rate surely in

excess of five-tenths inch per hour, with momentary showers far heavier.

On July 27, in early evening the "Old Faithful" orifice was again considerably enlarged, and in it boiling magma was seen plainly. At considerable intervals molten lava was flung out onto the floor. The usual cone orifices were glowing brightly. No flows occurred. There were a few small talus slides, chiefly at the south and southwest. Rumbling and blowing sounds were quite loud, particularly at the south cone. It was still raining plentifully, though not as on the previous day, and the steam phenomena were much as described above. In addition it was noted that much steam was coming from a great number of cracks in the hanging 1912 shelf or platform under the south station.

On July 28 "Old Faithful" was still more enlarged, again measuring about thirty feet in the east to west direction by about twenty feet in the north to south direction. No change in its behavior was observed. A circular orifice about fifteen feet in diameter was seen under the east station, and in this molten magma was surging to and fro. The many small cones were glowing brightly. Rumbling and blowing noises were loud, but the pronounced blasts from the south cone were no longer heard, but only a feeble wheezing. No flowing was observed. Very many short, small slides took place at the south, southwest and west. One was noted under the northeast wall.

The phenomena observed in the afternoon of July 29 have been detailed in the opening paragraph of this report.

In the Whitney Laboratory of Seismology but two very small shocks of earthquake have been registered during the week ending July 29.

July 22, from 8:36:20 p. m. to 8:37:36 p. m., H. S. T. Intensity, II-III Cancani scale, thirty per cent to fifty-five per cent of the minimum perceptible unit. Origin, distant about thirteen miles.

July 23, from 3:41:59 a. m. to 3:43:33 a. m., H. S. T. Intensity, medium I Cancani scale, ten per cent to fourteen per cent of the minimum perceptible unit. Origin, distant about six and nine-tenths miles.

H. O. WOOD, Associate.

TECHNOLOGY STATION, August 6.

—For the first week in August the active lava column of Kilauea shows pronounced subsidence, with small avalanches of talus, open pots where there were recently cones of overflow, the molten matter very deep within the pots, and while Old Faithful still fountains up and flares fitfully upon the dense fume-cloud above, the general appearance of the floor indicates a sinking. The week has been so rainy and the fumes so dense that it has not been possible to obtain a measurement of depth, but I estimate the lava surface to be about 550 feet down. The red glow on the fume-cloud at night is still visible from the Volcano House.

July 30 and 31 were rainy. On the evening of the 31st the only seeing was from the southeast station where Old Faithful and the other eastern pots and chimneys exhibited no marked change. Two avalanches were heard and the glow on the cloud was moderate.

On the morning of August 1 there was no seeing on account of the dense fumes, and the noises were very faint. The smoke from the east and southeast fumaroles rose above the edge of the pit in rapid puffs, and even in the evening at 8 p.m. with a northerly wind there was no seeing from either side of the pit. There was some flaring, indicating the usual fountains in the pot of Old Faithful, and splashing noises could be heard from the east station. One slight rock slide was heard. The fumes were very dense and acrid.

At 9 p.m. the party of Dr. Wm. T. Brigham, who has honored us with a visit this week, saw the Old Faithful pot boiling, with stalactites hanging around the rim, and also the eastern pots and chimneys, and heard small talus slides.

August 2, the wind was strong from the northeast and the pit was filled

with fumes. August 3, at 11 a.m., there was a little seeing from the southeast and south stations, though there was still a high wind blowing from the northeast which drove the fumes down into the pit. The southeast end of the floor was piled with new fallen talus. A part of the eastern high chimney on the wall appeared caved away, making an overhanging cavernous recess at the base of the wall. The V-shaped area of the rock wall southeast was extended much lower than when last seen and the talus on either side of it was continuously sliding. Faint puffing could be heard from the floor, but the noises are incomparably fainter than in early July. The south conelet on the talus could not be distinguished. The general effect is pronounced subsidence.

August 4, at 9 p.m., the weather was calm and the fumes were rising straight upward with indraught east and west, making seeing difficult. One glimpse from the old north resthouse showed a very low floor, with four pots along the northeast wall, apparently funnel-shaped and deep, one or two of them showing surging lava far down. Old Faithful was quite large, perhaps 70 feet long as a pot, the lava within fairly active, skinning over and then rending the skins, and fountaining. This made brilliant flares on the cloud. There were two open pots northwest, where recently there have been cones, and two near the foot of the north slope. The plashing noise was fairly pronounced.

Mr. H. O. Wood reports for the Whitney Laboratory of Seismology that the week has been very quiet seismically. Mauna Loa exhibits no unusual phenomena, the vapor jets on the high northeast slope were seen one evening against the sunset.

T. A. JAGGAR, JR., Director.

TECHNOLOGY STATION, August 13.—After a nine-days' subsidence ending about August 4, the lava of Halemaumau has risen for eight days so as to restore a condition of activity and overflow from cones on the floor quite similar to the conditions of June and July, except that the period of sinking caused much new slide-rock to tumble from the walls and bury the borders of the floor. Again the dominant place of overflow at the beginning of the new rise is at the west end.

The rising and falling movements of 1914 to date have been between levels 700 feet and 500 feet below the rim. Below 600 feet, measurements are generally impossible because of the dense fumes, and at the end of 1913 the pit was a funnel over 600 feet deep with dim glowing cones on a small lava floor. The floor remained stationary with a subsiding tendency from December 28, 1913, to February 3, 1914.

From February 4 to March 15 a definite rise was inaugurated with increasing puffing from the vents, lava spatter thrown high from the conelets on the floor, increased glow on the fume cloud and finally lava flows on the bottom. This period lasted forty days.

A period of subsidence followed from about March 16 to May 2 (forty-eight days), inaugurated and characterized by many rock slides, and what was described as "a lull" or "a halt" in the energetic activity which had started, with marked diminution in jets of lava and blowing noises. Cones collapsed and pots increased in size, characteristics of subsidence.

From May 3 to June 22 (51 days) we find "a marked increase in activity with lava flows," and a definite rise by overflow measured with transit.

May 5, 1914, 585 feet below rim.

May 15, 1914, 574 feet below rim.

June 15, 1914, 530 feet below rim.

The net movement of the lava column since that time has been upward, for we find,

June 28, 517 feet below rim.

August 12, 501 feet below rim.

After the solstice for thirty-four days to July 26, the rising progressed more slowly with pronounced stationary intervals, with the average per day for a month, following June 28, of only one-half foot, as against a rise per

day of one and three-quarters feet the preceding month (before June 15). From June 15 to June 28 the average rise was about one foot per day. In general the July activity showed fewer overflows on the floor than the May-June activity, enlarged pots, and very large spouting gas-cones.

From July 27 to August 4 there was a sharp subsidence, with a tendency for the floor to collapse funnelwise and crack around the border, while the latter became strewn with fallen debris. From about August 5 to the present a reverse movement of rising appears to have lifted the floor bodily, and overflow has started again from the western corner of the floor.

Summed up and divided roughly by months, the record of Halemaumau for the year to August shows a stagnant period in January following the winter solstice, a revival in February, a lull in March and April around the time of the equinox, a revival in May to a maximum of activity about the summer solstice June 22, and a high level maintained through the greater party of July.

From 6 to 7 p. m., August 6, 1914, a puffing noise could be heard occasionally from some northeastern vent, a plashing noise from the bubble fountains in Old Faithful pot, and a heavy splash at intervals from the periodic large fountain of Old Faithful. From the southeast and south stations the floor could be seen at dusk. Old Faithful appeared a nearly circular pot with steep walls plastered on the west side with big stalactites hanging down into the surging lava within. The pot was about sixty feet in diameter, bubble fountains played actively on the lava, there was streaming from west to east, and the large fountain broke at the usual intervals. Three deep pots in a line parallel to and near the northeast walls showed glare on their inner walls, but the lava within was too deep to show. This suggests that if the lava under the floor is at a common level, the Old Faithful pot in the center, which shows the lava, is at the lowest part of a funnel-like subsidence of the floor.

There was a pot under the east northeast wall, and the high east chimney was glowing brightly. Be-

tween the southeast fumaroles and the wall behind them a flat gray place has been left bare by the sliding talus, which appears like solid rock, almost horizontal; the south rock wall appears to bell inward toward the middle of the pit. The high south conelet, which formerly rose from the talus, appears to have been destroyed. A western pot, probably the west central one in the floor, was seen dimly.

August 7 from 6 to 7:30 p. m., conditions were about the same. Heavy stalactites bordered Old Faithful all around, and the surface streaming in Old Faithful was still to the east. The southern of the three northeast pots showed some lava in its bottom, there was very bright flaring and loud splashing from Old Faithful, and in general the lava was a little higher than on the previous day. There were no avalanches and the eastern chimney was very bright.

August 8 there was no marked change reported. On August 7 the lava in Old Faithful pot was from 12 to 15 feet down beneath the rim of the pot, but on August 9 at 8:30 p. m. it was only 2 to 3 feet down and splashing over the rim. The streaming had reversed its direction and was now from east to west. Evidently a marked rise had taken place. The pot had diminished its diameter to about 50 feet, a common result of rising and rampart building, with a straight edge on the southwest, circular otherwise. Explosions of the main fountain were recorded at intervals of 30, 45, 55, 40 and 35 seconds. In the interval there were bubble fountains, but thick black skins often formed before the main explosions, the latter being very heavy, with a noise like surf breaking on a rocky shore. There was hissing toward the west, and from the southeast station two glow holes could be seen beyond Old Faithful, at the west end. Two others appeared southwest from Old Faithful, two under the north wall, four along the northeast wall, one with a beehive conelet near it under the east northeast wall, while the high east chimney was flaming brightly, with the highest luminosity shown anywhere in the pit.

The fumes appeared less than of late. Lava did not show in any pot but Old Faithful, but spatter jets could be seen

in two pots northeast. The largest northeast pot appeared almost dark with a few sparks jetted up far down it now and then. The great dome explosions of Old Faithful filled the whole pot; in the intervals spears of blue flame could be seen from under the skin around the borders. Blue flames also appeared at other pots north, northeast and southwest.

The Observatory was honored this week by a visit from Professor E. C. Franklin, a distinguished chemist of Stanford University. Professor Franklin has had experience on the Selby Commission for investigation of damage resulting from smelter fumes, and after going to leeward of Halemaumau and breathing the direct fume cloud as it emerges from the crater, he expressed the opinion that roughly the content of sulphurous acid gas cannot be more than from twenty-five to seventy-five parts in a million, for it is quite respirable, and one hundred parts in a million is the utmost limit of human endurance, according to the tests of that commission.

Monday, August 10, there was very heavy rain. On both August 10 and 11 there was strong glare from the pots on the fume cloud. August 12 from two to three o'clock the wind blew from the eastward and opened to view the floor from the northwest and north stations so as to make possible a brief survey for depth. Readings were obtained on the west end and the pot in the center next west of Old Faithful, which determined the floor to be essentially level, and at a depth below the north rim of 501 feet. A large cone at the west northwest border was determined to be about eight feet high.

New talus overlapped the floor west, west northwest, southwest and northeast. A great new sheet of glistening brown lava flows covered the western half of the floor, in marked contrast to the gray and dusty older surface, and the source was three border vents in the extreme west corner. Old Faithful was an oval pot with longer axis northeast to southwest, and with a distinct rampart built around it. Fire holes appeared in the northeast talus. Two spurting pots southwest of Old Faithful had maintained themselves through the new lava flows. Two cones and a

slot chimney appeared along the northwest border of the floor, with the great haystack dome beyond to the west, all these features being persistent from a month ago. A southeast cone on the floor could be dimly seen, and a strong

fumarole was smoking through the southwest talus. The noises were pounding, spatter, fall, splash and puff. Two heavy rock slides were heard from the east, and one southwest.

T. A. JAGGAR, JR., Director.

TECHNOLOGY STATION, August 20.—The new rise at Halemaumau, reported last week, continued to August 13 inclusive; then there was slight subsidence to August 16, which then ceased, and the lava column remained almost stationary, with slight rise, to the 19th. The week has been rainy, and in consequence apparently of the extraordinarily heavy rain of the last week in July, a large steaming patch has developed on the Kilauea floor between the Volcano House and Halemaumau. This is in the region of the group of largest lava domes, and the steaming area covers over three hundred acres. The development of this steam in sequence upon the heaviest rainfall we have recorded here gives additional weight to the view that the outlying steam vents of Kilauea are from heated rain cisterns.

After midnight following August 13, a very bright glow on the fume cloud over Halemaumau was visible from the Observatory, suggesting new flows on the floor. Such flows could not afterwards be identified, but the seeing of the week has not been good.

From 9 to 10 p. m. Friday, August 14, the floor could be seen from the old north rest-house. Twenty glowing spots were counted. Seven cones on the floor at the west end were brightest and emitting flames. The lava of Old Faithful was low, in a long, narrow pot, pounding among heavy stalactites. In a large glowing pot with double orifices, west of Old Faithful, there was steady high glow without motion, except some sparks thrown up at rare intervals. This appears to be either incandescence in the inner walls or mere reflection of lava beneath, more probably the latter, though the very high glow, even in the daylight, is suggestive of incandescence. Spurting was taking place also at the west "haystack" cone and at Old Faithful. The bubble fountaining in the intervals of the larger explosions goes on

in Old Faithful, but the streaming is no longer noticeable. Liquid lava could be seen in one of the northeast pots.

It should be noted that the orifices along the west and northwest walls are spatter cones, those on the floor and at the north are pots with more or less rampart built around them, and those along the northeast wall are distinct pits. This has been the general arrangement for months past, and the highest glow and the greater number of flows have come from the west end.

August 15, from 3 to 4 p. m., the floor could be seen from the northern station. It showed no marked change, the lava in Old Faithful was very low and lava could be seen streaming within a northeast pot. The noises were splashing at Old Faithful and hissing to the west. No new flows could be identified on the floor. A long avalanche was heard from the northeast, and there was much new talus on the northwest floor.

On this day I crossed the area of new steam near the large lava domes in the northeast central part of Kilauea. Very hot steam was coming out quietly from numerous holes in the vicinity of collapsed caverns, and it seems probable that this is a cavernous region of lava tubes where rain water accumulates below, is heated, and its vapor accumulates and condenses in the tubes so that it emerges as an excess of visible vapor even on dry days.

In the evening of August 15 a- lanching extended around to the high north wall and several tons of rock from the high edge of Halemaumau in front of and to the left of the Old Rest house fell in, leaving there a distinct notch. The sliding of debris on the inner slopes responds with extraordinary sensitiveness to a slight sinking of the lava.

August 16 at 5:45 p.m. the lava appeared a little higher in the Old Faithful pot, which had become oval in shape,

and the stalactites were smaller. The double orifice of the hole west of Old Faithful had changed to a single L-shaped orifice, with steady glow within. The large cone at the west end was hissing and spattering and had an open oven on its north aspect hung with stalactites. The larger northeast pot had changed its shape. The main fountain of Old Faithful made heavy surging noises. There was a fumarole under the north wall of the pit which may by its undermining have induced the fall by the Old Resthouse. One stone was heard sliding toward the east on this evening, but no avalanches. Eighteen glowing places were counted on the floor and the high chimney at the east end was seen to be still flaming. The cumuli of vapor

from the eastern inner fumaroles were on this day rising very rapidly.

August 17 the glow at night was steady and moderate.

August 18 from 8 to 9 p. m. a dim view of the bottom was obtained. There were no avalanches, Old Faithful was flaring, there was slight spatter from the western "haystack," which had changed the shape of its summit to a double orifice on opposite sides of an arch separating them.

August 19 at 10:30 a. m. there was no seeing, the splashing was loud from Old Faithful and the hissing from the west cone was somewhat louder than the night before. In the evening the glow was bright, with flaring at the usual Old Faithful intervals.

T. A. JAGGAR, JR., Director.

TECHNOLOGY STATION, August 27.—Again the week has been very rainy at the volcano, making the seeing bad, but there has been little change in the condition of the top of the lava column; however the aggregate movement of the week has been in the direction of rising, shown by new flows on the floor and entire absence of such symptoms of subsidence as avalanching or noises of talus sliding.

At 7 p. m., Friday, August 2, the floor could be dimly seen from the southeast station. The site of the former southeast cone on the floor was occupied by a small glow-hole shaped like a figure eight. The Old Faithful pot was about sixty feet long, pointed in plan west, and rounded east, the lava bubbling up to the edge and splashing over during the dome explosions very actively, with surface streaming eastward in the intervals. In the northeastern pots and chimney there was glow.

August 23 at 9 p. m. there was a fine view of the pit from the south station. Old Faithful had eaten away its north wall to become somewhat more circular. The activity was very great and in the course of an hour the surface streaming changed directions, first southward, then westward and then to the more usual direction eastward. This change in direction

of surface streaming is frequently coincident with rapid rising, and probably later on this night there were overflows from the west end. The southeast locality had changed to an oval pot fully thirty feet long, full of lava, with a brightly glowing cave in its north border, where the incandescent liquid boiled and splashed. The lava in Old Faithful appeared to be at a little higher level than in this southeast pot. Several cones were dimly seen at the west end and there a constant blowing noise could be heard. In an openwork glowing cone to the northeast a prolonged hissing roar revived every six to eight minutes, lasting for a minute or so with gradual weakening; there was clearly some sort of a gas chamber with accumulation beneath.

August 25 at 11 a. m. from the south station, the lava of Old Faithful was seen to have subsided about twelve feet. The wall of the pot was hung with heavy stalactites, and the lava could be seen extending into cavernous spaces underneath them. New fresh brown lava flows were identified, surrounding Old Faithful and extending to and submerging the southeast pot. Whether they came from Old Faithful or the west end could not be determined owing to the fumes. The southeast pot had been filled and converted into a blow-cone with a small glowing orifice.

A remnant of the south spatter-cone, which formerly stood on the talus, was seen to be still standing, now on the edge of the lava floor, the flows having built up to its level. It showed no activity. The new flows extend much farther east than those described on August 12.

There was much talus on the eastern and southern parts of the floor. The remnant of the 200-foot bench southwest has diminished in size and increased its inward slope; it has fumes still rising from sulphur-stained cracks at its upper border. Very bright blue semi-transparent fumes were rising rapidly from the high east flame-chimney in marked contrast to the dense and more sluggish white fumes from the southeast fumaroles, which are blown aside when their volutes mingle with the gases rising from the chimney. There are very thick, white, ac-

tive fumes rising from the talus southwest. A strong splashing noise was coming from Old Faithful, but there was no marked blowing anywhere. Blowing noises indicating increased gas pressure always accompany rising in the present crusted condition of the pool.

At 11 a.m., August 26, from the southeast station there was dim seeing of Old Faithful and the southeast hole. No change was evident. The noise was splashing, without blowing. There has been no rock sliding heard during this week.

The Whitney Laboratory of Seismology has been undergoing repair. There have been no felt earthquakes, and there is no sign of activity on Mauna Loa, as seen from the Observatory.

T. A. JAGGAR, JR., Director.

TECHNOLOGY STATION, September 3.—During several days of the week preceding September 2 the surface activity in Halemaumau has been decidedly more spectacular than usual. Small sprays of molten lava have fountained from the cones, and numerous small flows have welled out from them onto the floor of the pit. Also in brilliant moonlight the fume cloud has been illuminated with a more persistent and lively glow than at any time since the revival of activity a little less than a year ago. But this manifestation of increased activity has begun already to decline.

It is interesting to note that this spasm of rising and increased surface action has corresponded almost precisely with a fortnightly maximum of solar earth strain, computed on the basis of a hypothesis which we are evolving and testing, which fell near the moon's first quarter. Such a correspondence is more than usually favorable to the hypothesis because, when the maximum falls near the moon's quarter its effectiveness is hypothetically less than when it falls near conjunction or opposition. Hence a definite increase and decrease in action when the variation in strain is hypothetically less effective indicates the probable reality of action according to

this hypothesis in preference to others hitherto proposed.

It was reported that the molten lava was standing at a higher level in the "Old Faithful" pot in the evening of August 27 than on previous days.

On August 28 lava was spurting from most of the holes in the floor that could be seen from the east and southeast margins of the pit. During its explosions the lava in "Old Faithful" rose and overflowed the margins of the orifice. At 7:45 p.m. a flow from the cone at the west end began. Up to this time a strong blowing noise was heard here which now was replaced by the gentle rushing sound of the flow.

The illumination produced was strong enough to penetrate the fumes rising as a curtain along the wall under the Old Rest House. The flow divided at the cone into two branches, the larger and longer making along the south margin of the floor, the smaller along the north margin. The south branch flowed some 400 feet in about half-an-hour.

The flows on this evening were considered by Director Jaggard to be the most spectacular witnessed by him this year. Later in the evening, from 9 to 10 p.m., the whole floor of the pit was seen clearly from the east and southeast stations.

A triangular hole west of "Old Faithful" was partially overwhelmed by the lava flood, but it was maintained as an open orifice of diminished size by the action of gas blowing up through it.

The "Old Faithful" pot grew smaller by the building about it of a flat cone by the cooling of the outwelling gushes or splashes, many of which amounted to small flows on all sides.

The glow in the east chimney appeared less than usual. The holes at the northeast showed brightly and were blowing. The streaming action in "Old Faithful," from north to south previous to 7 p. m., changed at about that time to from west to east. At 10 p. m. the flow along the south margin was moving in pulsations like meal from a sack, not nearly so rapidly as earlier, when it ran as a heavy liquid, like mercury.

At about 11 a. m. on August 29 the lava in the "Old Faithful" pot was ten to twelve feet below the surrounding margins. The flow had covered nearly all the floor, except a relatively small strip at the southeast. It had surrounded "Old Faithful." At 11:30 a rock slide occurred in the northeast part of the pit. Blowing sounds were heard from the holes at the northeast, and pounding and splashing sounds from "Old Faithful."

At noon the lava had risen to the brim in "Old Faithful" and the southeast cone. The orifice of this cone had grown larger. Strong blowing was now heard at the west end. The east chimney was seen plainly, and a blue flame was playing out of it. No glow was seen in it in daylight. Two vertical gashes were seen in the northeast wall. These appeared to be undermining the wall here. They were immediately over blowing cones on the floor. In the early afternoon jets of lava were

springing from the west cone and splashes were welling out of "Old Faithful."

In the early and middle evening of August 30 lava flowing from cones and orifices at the west end of the pit covered all the floor, according to reports by visitors accustomed to the action in Halemaumau.

In the forenoon of August 31 a good view of the floor showed a carpet of new lava everywhere. Lava was splashing out of "Old Faithful." At long intervals loud puffing and rumbling sounds could be heard. The east cone also was very active, and from another cone, at the west-southwest, sprays of lava were jetting out. Very small rock slides were frequent, and occasionally a short, heavy slide took place.

On September 1, in the late afternoon and early evening, the "Old Faithful" pot was still large, and from it splashes and sprays of molten lava were thrown out upon the floor. It was a surging pool of quadrangular outline, possibly forty feet across. All the holes in the floor were glowing brightly. Many long, glowing cracks were seen. No flows were occurring, however, and no evidence could be seen of flowing on the previous day. Evident decline in surface action had begun. Blowing and rumbling sounds were quite loud, and a few small slides occurred from time to time.

On September 2 the "Old Faithful" orifice had become nearly clogged. Sound of blowing had become very faint. However, rumbling and surging sounds remained quite loud. No slides were heard. All the usual holes in the floor were glowing brightly. A strong wind prevented more than momentary glimpses into the bottom of the pit.

H. O. WOOD, Associate.

TECHNOLOGY STATION, Sept. 10.—The activity in Halemaumau during the week ending with September 9 has undergone little change. First was noted a slight gradual decrease in vigor of action, soon followed by an apparently stationary stage with minor temporary increases and decreases. With the date of the equinox only two weeks off it may be well again to draw attention to the fact that since the early part of July—up to which time there was pronounced rising and increase of surface action, which then halted—there has been little or no sinking of the magma surface, and the decrease in surface activity, while sufficient to be noticeable, has as a whole been slight. This is construed to indicate a gradual increase in the action of Kilauea independent of the semi-annual variation and it encourages an expectation of pronounced rise and increase of surface action during the fall season. This is in no sense put forward as a prediction. It is simply a statement made to enable readers of these reports to comprehend our interpretation of the observed conditions in terms of our tentative hypothesis.

In the late afternoon and early evening of September 3 views obtained showed the "Old Faithful" opening to be about fifty feet long, east and west, by twenty feet wide, and of quadrangular shape. In it molten magma was boiling vigorously over a surface sufficiently high for small amounts of the molten material to surge over the brim occasionally. A small cone under the east station was throwing out molten lava spray at irregular intervals. Blowing noises and sounds of surging and swashing were quite loud. Small glowing holes and cracks were seen in all parts of the floor. No avalanches were heard.

On September 4 general conditions had not changed, but the fountain action in "Old Faithful" was a trifle more vigorous; also, at the east cone, and at a cone on the floor between the east and northeast stations molten spray was being ejected more forcibly. The noises, too, were louder. Early in the evening lava was swashing over the

brim of a pot under the northwest station.

On September 5 it was observed that the "Old Faithful" orifice was much smaller. In other respects no change was noted. Twelve cones with glowing orifices were seen on the floor. Out of several of these molten spray was spurted at intervals. Blue flames were seen playing from them. The noises, if anything, were louder than on the previous day.

On the sixth of September the noises had become very conspicuous—not so loud as when the entire bottom was choked with talus, but still very loud. More than at most times they took on something of a terrifying quality. The blowing sounds were very sharp and short and came from several different cones in so rapid succession as to seem almost continuous. The other noises were merely louder than usual. The small open pot under the east station was surging furiously, and almost continuously flinging very small amounts of lava over its brim. "Old Faithful" showed as a very small, comparatively quiet opening. Several small cones along the north margin from the northeast to the northwest were almost every instant throwing out small, spray-like jets with obvious force.

In the middle evening of September 7, after hard rain, a bright, steady illumination of the fumes, indicating a flow on the floor, led to an impromptu visit. When the rim was reached the flow had ceased. It was very small, covering only a portion of the floor in the vicinity of the eastern margin, where many brightly glowing cracks marked its limit. The noises were very loud and could be heard very distinctly for about two hundred yards back to the northeast from the margin of Halemaumau. There was only a light breeze blowing. In all other respects the action was as on the previous day.

On the eighth of September there was a slight decline in action in that molten lava was being thrown out from "Old Faithful" only, and then only at considerable intervals. Also the blowing and rumbling noises were less loud.

The cracking sound of rock breaking from heat was heard.

On the ninth of September small quantities of molten spray were being ejected feebly from "Old Faithful," and the magma was seen to be surging

furiously in the pot under the east station where masses were frequently swashed out over the brim. This pot is now the largest orifice in the floor. The noises were still very loud.

H. O. WOOD, Associate.

TECHNOLOGY STATION, September 17.—At Kilauea the week ending with September 16 has been marked by a conspicuous minor increase in activity, followed by a short lull, which has given place to a further minor increase. These variations tally with expectable behavior on the basis of lunisolar stress control, the first subsidiary maximum of activity corresponding well with a declination stress maximum, the second with a stress maximum, probably of less effectiveness, due to the practically coincident occurrence of perigee and conjunction. In addition, as hitherto mentioned, there appears to be a slow, steady increase apart from these short-term fluctuations.

In the afternoon and evening of September 10 symptoms of increased activity were observed. At the orifice of the cone under the northeast station the magma was boiling vigorously and frequently splashing over the brim. The blowing sound from "Old Faithful" was very loud, its pot was boiling actively, and now and then blue flames could be seen flaring from it.

During the afternoon the sound of cracking of the lava crusts could be heard occasionally, and in the early evening about half the floor was marked by glowing cracks, indicating that a small flow had taken place. Molten lava was jetting from several cones. From a small one under the east station, about a hundred feet out from the edge of the floor, the jets were leaping forty to fifty feet into the air. In mid-evening "Old Faithful" was seen to be larger, with an irregular opening about sixty feet east and west by thirty feet north and south. Rumbling became very loud.

On September 11 lava was boiling and splashing out upon the floor from "Old Faithful" and the northeast cone almost continuously, and this was happening also at all of a group of eight small orifices close together under the east station. Marked activity was apparent at all the open spots on the

floor. Blowing and rumbling sounds were conspicuously loud. Also the high cone under the south station, which has been quiet for a few weeks past, was blowing feebly at intervals and glow holes were seen at its top. Although no flow occurred during this period of observation the action appeared more vigorous than on the tenth.

On September 12, late in the afternoon, a small flow was seen running over the floor from the north and north-northwest margin toward the middle of the pit. Later it was seen that a larger flow, proceeding from the cones under the west to northwest stations, had run all the way to the margin under the southeast station. This flow, as indicated by glowing streaks, had a width of nearly or quite half that of the floor itself. At the southeast margin it bent around and sent a tongue along the edge to a point under the east station. All the cones on the floor showed boiling lava, which was slopping out almost continuously onto the floor. Every place in the pit was in unusually vigorous action. The noises were sharp and very loud.

On September 13 there had come a lull in the activity. The "Old Faithful" opening was of much less size, but still a pot with lava boiling vigorously in it some feet below the adjacent surface. No other boiling pot was seen, but all the usual orifices showed glowing lava. Under the east station, smoking steadily, were two "beehive" cones, whose domes were traversed by cracks arranged in something like a mud-crack pattern. A similar cone stood about midway between "Old Faithful" and the southeast margin. A single lazy jet of lava was seen to spring from one of the subsidiary orifices in the floor. The noises were subdued. Fresh lava in great folds was seen to cover the southeast and east parts of the floor.

On September 14 lava was splashing out onto the floor from "Old Faithful" and small jets were springing

from the small beehive cones under the east station. The noises from "Old Faithful" were quite vigorous. Elsewhere only boiling pots were seen. In early evening a heavy avalanche, the rock tumbling continuously for upwards of three minutes, took place under the west station, and a little later a short slide, only some four seconds long, but very heavy, started from the very brim between the east and southeast stations.

On September 15 activity was again slightly increased. Much molten lava was splashing out of the "Old Faithful" orifice, and the whole floor was marked by glowing streaks. In late afternoon considerable avalanches, starting from the very brim between the east and southeast stations, broke through the crust and thus caused a

small flow of short duration. A little later a larger flow, of slow motion, was seen running toward the middle of the pit from the northwest station. Lava was seen boiling vigorously in all the open holes.

On September 16 a considerable flow was seen moving on the floor of the pit at the east end, from the cone under the east station toward the southeast. This flow, when first seen, was estimated to be some twenty feet wide and seventy long. The cone it started from was boiling over steadily. Small jets were springing up in many places. All the sounds were loud. Blue flames were playing above nearly all the boiling pots. No avalanches were observed, but occasionally a few boulders would drop from various parts of the walls.

H. O. WOOD, Associate.

TECHNOLOGY STATION, Kilauea, September 24.—During the week ending with September 23 the activity in Halemaumau has undergone only slight changes. There have been no conspicuous increases or decreases, merely slight variations, in both directions, from day to day.

On September 17 all the usual glowing orifices were seen, and out of several molten lava was splashing at intervals. No flows were seen and no talus slides were heard. Occasional jets were spurting up but without any great force. All the noises were loud. Blue flames were flaring conspicuously from several boiling pots.

On September 18, while no lava was seen flowing there were other indications of a slight increase. The noises of eruption were much louder, and molten jets were being flung out with much force, sometimes to estimated heights of fifty feet. There was no open pool on the floor, but several of the orifices were much enlarged. At these places boiling lava could be seen vigorously splashing over the brim.

On September 19, the activity, as regards most of the manifestations, was only ordinary, but a small flow occurred at the west end.

On September 21 the noises were conspicuously loud, but no flowing or

spouting lava was seen. Unusually large blue flame-banners were flaring from the larger orifices. These orifices were at the tops of well marked cones in every case. There was no pool on the floor.

On September 22 a fine view of the floor region by daylight showed that several small, short flows, proceeding from the cones under the northwest to west rim, had taken place in previous days without being observed. Molten spray was issuing from these cones at intervals. Magma was splashing out of the top of the "Old Faithful" cone, now about twenty feet high and with a large top. Small amounts of lava were being flung from the cones under the east and southeast stations, but only at intervals. Eighteen cones from ten to twenty feet high were counted. The noises of eruption were very loud. Blue flames flared from many of the orifices.

On September 23 lava was splashing so vigorously out of the northwest cone that at one time a small flow made away from it. All the cones at the west and south, as well as "Old Faithful," were blowing vigorously. The noises continued to be very loud. Flames were seen as usual. A few small talus slides were heard.

H. O. WOOD, Associate.

WEEKLY BULLETINS
OF THE
Hawaiian Volcano Observatory

Vol. II.

HONOLULU, HAWAII, OCTOBER, 1914.

No. 29.

Honolulu, Hawaii, September 21, 1914.

Volcano research at Kilauea, which has been in progress since 1909, has produced important discoveries published in the United States, Italy, Switzerland, Germany, France and England. Specialists who have worked here during the last six years are Daly and Curtis from Harvard, Jaggar from the Massachusetts Institute of Technology, Brun of the Sorbonne and of Geneva, the late Tempest Anderson of York, Day and Shepherd of the Carnegie Institution, Birdseye and Green of Government bureaus in Washington, Wood of the California Earthquake Committee, Perret of Springfield, Friedländer of Naples, and Arnold Heim of Zurich. The results give positive experimental data on measurement, circulation, rise, fall, flow, temperature and consolidation of lava, on gas action and composition, water vapor, magnetism and earth motions. This knowledge is revivifying the science of volcanology, and new text-books, societies, experiment stations and expeditions, especially in Germany, Italy and Japan, attest the growth of a definite propaganda. The Kilauea observatory this year materially extended its influence by sending an expedition to Japan.

The Hawaiian Volcano Research Association maintains a station hospitable to workers of all nationalities. The published results bear on the origin of our soils and waters, on minimizing disaster from lava or earthquake, and on fundamental subjects of pure science. The publicity from this laboratory, financed within the Territory, is much wider than could be obtained from one supported by some mainland institution.

The Research Association is supported by the voluntary subscriptions of patrons. Over and above the membership fee of \$5.00, the subscriptions range from one dollar to two thousand dollars. New lists were subscribed in October, 1911, and July, 1912, and owing to recent decline in support it becomes necessary for the Directors of the Association to appeal earnestly to firms, business men, planters and the general public in the Territory of Hawaii to make new subscriptions for the years 1915 and 1916.

(Signed)

CLARENCE H. COOKE,
L. A. THURSTON,
ALBERT F. JUDD,
A. LEWIS, JR.,
WILLIAM R. CASTLE,
JAMES A. KENNEDY,

Board of Directors Hawaiian Volcano Research Association.

Executive Chamber,
Honolulu, Hawaii, Sept. 26, 1914.

I approve of this work, and of legislation providing for trails, refuge houses, maps and scientific studies in the regions of active lava flows on Mauna Loa, with a view to preventing disaster, as well as the advancement of science.

(Signed) LUCIUS E. PINKHAM,
Governor of Hawaii.

Honolulu, September 28, 1914.

The Advertising and Subscription Committee of the Chamber of Commerce of Honolulu, approves of the work herein outlined and approves, also, of the campaign for additional funds.

By order of the Committee.
(Signed) RAYMOND C. BROWN,
Secretary.

MINUTES OF THE MEETINGS OF
THE BOARD OF DIRECTORS.

As directed by the President, the fourth meeting of the Board of Directors of the Hawaiian Volcano Research Association was held at the University Club, Friday, September 18, at 12:15 p. m. Present: W. R. Castle, C. H. Cooke, A. F. Judd, L. A. Thurston, directors; H. M. Ballou, secretary, and T. A. Jaggar, Jr., director of the Observatory.

The membership committee presented the following list of patrons and members who were duly elected to membership in the Association: Harold Bauer, George Carroll Curtis, Mrs. Harold G. Dillingham, Dr. I. Friedlaender, Hilo Board of Trade, Hilo Electric Light Co., Miss Harriet C. Hitchcock, Mrs. Mary T. C. Hitchcock, Hilo Railroad Co., Inter-Island Steam Navigation Co., Juan I. de Jongh, Kilauea Volcano House Co., H. A. Morss, L. Tenney Peck, Robert W. Sayles, Alfred M. Tozzer, A. S. Wilcox, and G. N. Wilcox.

The following report from the Treasurer was received and accepted:

STATEMENT OF CASH RECEIPTS
AND DISBURSEMENTS FROM
JANUARY 1 TO SEPTEMBER 15,
1914.

RECEIPTS.

| | |
|--|-----------|
| Check from C. M. Cooke, retiring Treasurer | \$ 217.45 |
| From Donations | 4900.00 |
| From Patrons | 441.00 |
| From Membership Fees | 390.00 |
| From Lectures by Dr. Jaggar.. | 189.50 |
| | <hr/> |
| | \$6137.95 |

DISBURSEMENTS.

| | |
|-----------------|-----------|
| Salaries | \$3000.00 |
| Services | 1642.85 |
| Purchases | 445.35 |
| Printing | 361.69 |
| Repairs | 125.20 |
| Freight | 66.35 |
| Travel | 26.50 |
| | <hr/> |
| | \$5667.94 |

Balance on hand\$ 470.01
E. & O. E.: E. M. Campbell, for R. W. Shingle, Treasurer.

The following report from the publication committee was read, accepted, and ordered printed. The publication committee was authorized to prepare the pamphlet suggested therein:

To the Directors, Hawaiian Volcano Research Association.

Gentlemen:—Your editorial and publication committee have to report that there have been published in 1914, to date, by this Association, twenty-six weekly bulletins and two monthly bulletins. The monthly form has been adopted since July. In association with the Massachusetts Institute of Technology a first Boston report has been issued, covering the years 1909 to 1911 inclusive at Kilauea, this publication being printed at the expense of the Institute. Other such reports are in preparation for the years 1912, 1913 and 1914. The publications are sent to about 250 addresses.

A scientific paper has been published in the Bulletin of the Seismological Society of America by H. O. Wood, dealing with the limits of sensibility of meas-

ured earthquakes, and a paper on "Education and the Philosophy of Change" by the Director as the commencement address at the College of Hawaii.

In finished manuscript there are three articles awaiting publication—one by Professor Jaggar on "The Eruption of Sakurajima," with 114 illustrations, and two by Mr. H. O. Wood, dealing respectively with the 1868 earthquake in Hawaii, and with the response of Kilauea to earth strain.

There are now on hand the following publications, some of which are available for distribution, which have appeared from time to time since 1911:

- Weekly Bulletins, Vol. I, of the last half of 1913.
- Weekly Bulletins, Vol. II, 1914.
- 1st Report of the Hawaiian Volcano Observatory. Boston:1914.
- The Hawaiian Volcano Observatory, by T. A. Jaggar. Boston:1912.
- The Hawaiian Volcano Observatory, by H. O. Wood. Bull. Seis. Soc. Amer., 1912.
- Scientific Work on Hawaiian Volcanoes, by T. A. Jaggar, Jr. Honolulu: 1913.
- The Cross of Hawaii, by T. A. Jaggar, Jr. Chamber of Commerce Annual, Honolulu:Jan., 1913.
- Constitution of the Hawaiian Volcano Research Association.
- Investigations at Kilauea in the Summer of 1911, by F. A. Perret. American Journal of Science, 1913.

There is no comprehensible statement of the aims and organization of the Hawaiian Volcano Research Association in print. Your committee would recommend the preparation of such a book to be freely distributed to tourists, scientific men, and at the San Francisco Exposition. A placard should also be printed inviting prospective patrons and members to join the Association, and exhibited at such places as the hotels and the Promotion Committee rooms.

A member of your committee has interviewed Mr. H. P. Wood concerning an exhibit of volcano photographs at San Francisco, and Mr. Wood offers for our use a large koa revolving stand with hanging frames. He also suggests that the directors submit a proposition to the Fair Commission for Hawaii concerning the cost of an exhibit, with a view to

getting from the Hawaiian Fund an appropriation for the volcano exhibit.

There can be no question but that such an exhibit will be a benefit to the Association, and there is ample material obtainable to make a fine photographic display, showing the activity of Kilauea and Mauna Loa for the last thirty years.

Very respectfully,
 H. M. BALLOU,
 L. A. THURSTON,
 T. A. JAGGAR, JR.,
 Publication Committee.

Dr. Jaggar read the following report as to the financial outlook, which was accepted, and ordered printed:

To the Directors, Hawaiian Volcano Research Association.

Gentlemen:—The principal subjects to come before this meeting are the finances of the Association and the reports of membership and publication committees. In the absence of the treasurer, I have asked Mr. Campbell to submit a statement of receipts and disbursements to September 15 for 1914, which is before you. The pledges of 1914 amount to \$7381, which would permit an expenditure of \$615 per month. The average cost of the work per month, January-June, was \$635.67, not including the Japan expedition, and with practically no purchases during my absence in Japan for three months. The pledges of 1915 amount to \$6631 if all are paid, permitting only \$552 average expense per month.

To show the gradual retrenchment, and consequent decline in our equipment, and increase in our burden of work since 1912; the average expense per month was:

| | |
|---------------------------|-----------|
| First half of 1912..... | \$1219.35 |
| Second half of 1912..... | 923.28 |
| First half of 1913..... | 746.71 |
| Second half of 1913..... | 851.49 |
| First half of 1914..... | 635.67 |
| Prospective in 1915 | 552.58 |

By dint of continual watchfulness we have avoided deficits. A small deficit of \$216 against the Japan expedition will be met by funds coming in in the autumn, and I anticipate no deficit at the end of this year. But the reduction of income has steadily been met by reduction of field work, which is expensive, and this, of course, means reduced efficiency in the end. We are not properly prepared for

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Published Monthly at Honolulu, Hawaii,
by the Hawaiian Volcano Research Association

Editor.....Howard M. Ballou
Professor of Physics, College of Hawaii

Entered as second-class matter January 20, 1914, at the post-office at Honolulu, Hawaii, under the Act of August 24, 1912.

an eruption of Mauna Loa, and we are undermanned for proper study of Kilauea. Fortunately, the activity of Kilauea has been moderate of late, and we have marked time and devoted ourselves to writing reports; labor relatively inexpensive.

The reduction of income is due to death, withdrawal and retrenchment of patrons. About \$4000 per annum has been withdrawn, in the last two years. We cannot do the work without money. Of the original Hawaiian subscribers of 1911, there are only seven left, making \$3600 of the guaranteed \$5000. By my personal solicitation the additional funds have been obtained, with the aid of the approval of the Chamber of Commerce, so that actually the Hawaiian subscription fund has never fallen below \$5000, but it will do so next year, unless it is vigorously recruited. The Hawaiian Volcano Observatory cannot be operated on \$552 per month, therefore a new subscription blank must be issued, endorsed by whatever leading commercial and social bodies we can interest, and new patrons must be obtained.

I submit a letter in form to be signed by the President and Treasurer of the Association, as a basis for a statement to be drawn up by the finance committee and made the heading of a new sub-

scription list. It is suggested that the approval of the Governor, the Regents of the College of Hawaii, and the Chamber of Commerce be sought and their comment subscribed on this heading.

We undertook last year to increase the income of the Association to \$12,000 per annum and failed on account of sugar depression. This year should be more favorable, and now is the time also to make clear to the community that the work must be made permanent or it will fail of its object. I have just returned from lecturing on Kauai, and expect to lecture there again in December, and also in Honolulu, on "Recent Discoveries at Kilauea Volcano."

Very respectfully,

T. A. JAGGAR, JR.,
Director of Observatory.

Adjourned to Monday, September 21,
at 12:15 p. m.

HOWARD M. BALLOU,
Secretary.

The fifth meeting of the Board of Directors of the Hawaiian Volcano Research Association was held at the University Club, Monday, September 21, at 12:15 p. m. Present: W. R. Castle, C. H. Cooke, A. F. Judd, L. A. Thurston, Directors; H. M. Ballou, Secretary, and Dr. T. A. Jaggar, Jr., Director of Observatory.

Voted: That a circular be sent out, signed by the Directors, soliciting support for the Association.

Voted: That the Pacific-Panama Fair Commission be asked to appropriate \$250 for a photographic exhibition of the Volcano.

Voted: That a stated meeting of the Board of Directors be held Friday, December 4, 1914.

Voted: That the President appoint a committee to nominate members of the Board of Directors for the ensuing year, this committee to report December 4.

Adjourned.

HOWARD M. BALLOU,
Secretary.

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WEEKLY BULLETIN
OF THE

Hawaiian Volcano Observatory

Vol. II.

HONOLULU, HAWAII, NOVEMBER, 1914.

No. 30.

TECHNOLOGY STATION, October 1.—During the week ending with September 30, the activity in Halemaumau has stood still, nearly—there has been no symptom of increase and no well-marked symptom of decrease, though an interval of halt always seems to carry the suggestion of decreasing vigor of action. At this season such a stand is expectable.

September 25 there were no flows, but lava is jetting from "Old Faithful." All the active cones were blowing loudly, and from several blue flame-banners were steadily flaring. Rumbling noises were very loud. No slides occurred.

September 26 there was no boiling lava visible in any of the breathing holes or cones, though the incandescent walls were plainly visible. No lava jets were seen, save one very feeble outburst from one of the minor cones under the northeast rim. The blowing sound had decreased to a soft hissing, and the rumbling had become very deep-toned and far-away. These sounds were incessant. All the open holes were at the tops of cones from fifteen to thirty feet high, from which thin blue fumes rose. Cave-like openings in the wall under the northeast were seen fully 100 feet above the floor. These were dark. The high east-northeast chimney was glowing brightly. In general the fumes were thin.

September 28 sounds of blowing and rumbling were very low, and the molten lava was deep within the cones; but it was plainly visible. Only at the west-north-west was molten lava splashing out, with a loud boiling sound. Fifteen breathing holes, with flame-banners, were counted.

September 29 the sounds of eruption were hardly audible and the molten lava had sunk too low within the cones to be seen. No jets were seen. No slides occurred.

September 30 the noises of eruption had grown comparatively loud again and from the cones along the margin of the floor from east to north-east blue flames were flaring, and molten lava spray was occasionally thrown out. "Old Faithful," and the cones to the south, were relatively quiet. Those from the west to the west-north-west were concealed by the fumes.

The Whitney Laboratory of Seismology, which had suspended registrations about the middle of August, owing to the necessity of renovation and repairs, has now been put in order after a prolonged intermission due to unforeseen delays. Routine registration was resumed Monday, September 28, and there was an interval of trial registration, beginning early on the twenty-seventh of September.

During the past week a seismic spasm has occurred, beginning on the morning of the twenty-seventh. Before the seismographs were started writing two earthquakes occurred, both strong enough to operate the starting mechanism of the ordinary seismograph. These occurred at ten-ten and ten-twelve in the morning approximately. A little later the seismographs were set writing and, with one or two intermissions of an hour or more, for work of readjustment, they continued to write until Monday forenoon. Seven additional earthquakes were registered during the afternoon and night of September 27-28. Monday forenoon was devoted to readjusting the instruments and the writing of test seismograms. Continuous registration was resumed just before noon. During the remainder of the run, up to early forenoon of September 29, four shocks were registered. It was reported to the writer that at Kapapala twenty-nine shocks were felt from the morning of the twenty-seventh to the evening of the twenty-eighth. None of these shocks

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was felt at the observatory, but, despite the interruptions in registration,

about one-half as many were registered here.

Without question the forty-eight hours from ten a.m., September 27, to ten a.m., September 29, was a period more active seismically than any interval of like duration since the establishment of this station. Details of time and magnitude for these shocks will be given later in systematic form.

Despite the continuation of rainy weather several clear views of Mauna Loa have been obtained, covering all times of day. No sign has been seen of any response to this seismic spasm on the part of the big mountain.

H. O. WOOD, Associate.

TECHNOLOGY STATION, Kilauea, October 8.—During the week ending with October 7, following the stationary stage described in the previous report, there has been a marked and apparently "permanent" increase in the action in Halemaumau. About the "Old Faithful" orifice as a center an open pool of magma has formed, which has enlarged rapidly—without symptoms of down-sinking or of marked rise—until at the date of writing it has become a lake of the kind so well known in Kilauea, a semi-molten surface, upon which thin black crusts form continually, only to be torn up and engulfed every minute or so by the uprush and fountain-doming of large magma lumps, or so-called bubbles. Also there are many small fountains in it, and a conspicuous action of surging against and up onto the banks of the spatter ramparts which confine the pool. No clear streaming in definite directions has been observed as yet.

Needless to say the opening of this "permanent" lake has made the scene much more spectacular and brilliant. In bright moonlight the fumes are illuminated by an unquenchable ruddy glow, more fiery than in any previous displays since March, 1913. A continued, fluctuating increase is expectable.

On October 1 conditions were very much as described previously. Early in the afternoon small amounts of magma were being flung as spray out of the "Old Faithful" cone. Blue flames were flaring conspicuously in broad daylight from the cones under

the east and northeast stations and from an orifice close by about twenty-five feet above the floor. Later on, in the evening, molten spray was being flung from nearly all the cones on the floor. The action had definitely increased over that of the previous day.

On October 2 there was little change in behavior, but more orifices were seen than at any previous time in recent weeks. Twenty-two brilliantly glowing cones were counted. Blue flames were flaring from nearly all and many were spouting molten spray vigorously—particularly the cones under the northwest station.

On October 3 the "Old Faithful" cone structure had collapsed, resulting in the formation of a pool about fifty feet long by forty feet wide, of triangular shape, with its sharpest apex to the west. In this the magma was boiling violently and splashing over the margin in considerable amount. Molten spray was being flung from the east cones. In all respects increase of action was noted.

On October 4 the "Old Faithful" pool had enlarged, despite the active building of spatter ramparts, until its dimensions were at least one hundred by seventy feet. It was still triangular, with the sharp apex to the west. At intervals of no great length portions of the spatter banks collapsed into the pool, thus continually enlarging it. Furious boiling and surging followed such collapses. The more or less regular fountain action of "Old Faithful" was going on as formerly. All the ori-

ffices, together with some newly formed ones, were glowing brightly, but no molten spray was seen. A high orifice showing a bright, but deep, red glow was seen in the talus under the southwest station.

On October 5 the dimensions of the pool were estimated to be two hundred by one hundred feet. It had become egg-shaped, with irregular boundaries. The action in it was very vigorous, but the spatter walls had grown so high that only occasionally were small amounts of the melted rock flung out beyond these onto the floor. The surf-like rushing roar had become very loud. In other parts of the pit the action was as usual.

On October 6 the roaring sound was still louder, and despite the spatter walls a considerable amount of the molten lava was being flung out onto

the floor. The lake area was still larger than on the previous day, but the increase in size was not so great as during the first two or three days after its formation. At the smaller orifices all was as usual, except that no lava jets were seen.

On October 7 a very high wind accompanied by rain made seeing impracticable. In the early morning hours of October 8 the glow on the fumes indicated that the activity was undiminished.

The seismic spasm of last week was quickly over. Nothing unusual has occurred during the past week. Several small shocks have been registered. All these shocks will be reported upon in systematic form as soon as the necessary time and instrumental corrections can be worked out.

H. O. WOOD, Associate.

TECHNOLOGY STATION, October 15.—The month of October has inaugurated the return of Pele's active and spectacular lava pool. The mechanism of the return of the lake recalls its disappearance in March of 1913, the conditions being strikingly similar, except that it is rising now and was sinking then. The new pool as at that time is about 470 feet down, its shape is elongate northwest to southeast, with surface streaming also in this direction. Old Faithful boils in the east central region, and smoking wall fumaroles encircle the lake. The volume of smoke is still large, but may be confidently expected to diminish greatly if the lake rises another hundred feet. A gradual rise from now on until December, after the equinox and approaching the sol-

stice, is quite in order if the habit of previous years is preserved.

During the past few days the weather at the Volcano has been sunny and dry, and Mauna Loa has been under inspection for many hours at a time with perfectly clear seeing. There is not a trace of smoke or vapor visible over any part of the mountain. No earthquakes have been felt in a camp of cattlemen on the northeast slope.

The week has greatly increased the size of Halemaumau lake by temporary subsidence and collapse of the lake walls.

October 8, 1914, at four-forty-five p. m. Old Faithful was fountaining violently and splashing over the banks of a pool estimated 300 feet long north-west by southeast, by 150 feet wide, south-west by north-east. At six p. m.



The Summit Lake on Mauna Kea, (From a Painting by D. Howard Hitchcock).

in the gathering darkness fifteen fiery cones could be counted on the floor of overflow surrounding the molten lake, especially along the base of the steep north-east and north-west walls at the border of the floor. These showed glow within numerous orifices, from which generally banners of blue flame shot up, and there was some blowing noise. In the transition stages of this week, from a small to a large pool, and consequently an increasingly large open surface of boiling lava, this blowing of the outlying cones has ceased, just as the subsidence of the lava at the end of last week caused it to cease spattering out of the blowing cones.

October 9 from five to six-thirty p.m. conditions were much the same with the pool lengthening towards the north-west. A large cone at the north-west border of the floor was ejecting lava spray. Two open pots lay in a line northwest of the pool near it, and two others away from the border of the floor lay east and south of the lake. The eastern one showed lava boiling within. The Old Faithful fountains occasionally splashed over the rim.

On October 10 from four to six p.m. the pool seen from the southeast station had extended itself to include the two north-west pots. It now appeared 400 feet long. At six-ten p.m. a noisy traveling fountain was seen to start near the middle of the lake and migrate to the east bank.

At four p.m. on October 11 the lake as seen from the south-east was shaped like a balloon with narrow neck toward the west end, from which a steady surface streaming proceeded to the open oval of the south-east end. The surface of the lava was covered with skins occasionally rending along zigzag lines. Old Faithful burst sluggishly toward the east end, there were some small fountains in the narrow west neck, and a place of fountaining bombardment on the north bank. At three-thirty p.m. a portion of this north bank, which was quite high, fell in with a crash, followed by a great surging and boiling around the engulfed fragments. This in turn was followed for a time by a chilling and stagnation of the lava in that region. The pool appeared to be 500 feet long and subsiding, with considerable enlargement going on by the process of caving of the walls. There

were glow holes in the eastern floor and a large black hole in the floor just south of the pool. The east wall was smoking very actively from cracks high up in the face of the precipice.

Measurements made with transit between 4 and 5 p. m. October 12 showed a glowing cone on the northeast floor to be 471 feet below the southeast rim of Halemauau, and the northeast edge of the active lava to be 498 feet down, or twenty-seven feet below the floor level. A very clear view obtained for a few minutes showed a vertical wall over 25 feet high around the pool, with stalactites on the north side hanging into the flood beneath, and at a point further west in the north wall a cascade of molten lava was rushing out from under the wall into the pool.

The streaming was from the west and south away under the northeast wall. Streaming lava could be seen at the bottom of the black southern hole in the floor which was fully twenty feet in diameter. The glowing eastern chimney in the outer wall appeared not more than twenty feet above the floor level, showing how the floor has risen by overflow in the last two months.

October 13, at four forty-five p. m., the pool was at least 600 feet long with extensions which included the two black pits in the floor to the east and south. This completely changed its shape to an irregular T, with Old Faithful at the meeting point of arms extending northwest, southeast and south. The streaming proceeded from the narrow west neck southeastward, under the northeast bank opposite Old Faithful, and into the southeast and south coves. There were few fountains, slow streaming skins and a splashing noise only. At six p. m., intervals of Old Faithful counted were thirty-five, fifty-five and fifteen seconds. I saw the southwest wall of the west arm of the lake cave in and the west wall of the new south cove. There was in each case a violent attack on the place of engulfment, for from one to three minutes with streaming toward the place of inbreak. This was followed by stagnation and crusting. There was a very bright pit in the floor about 10 feet in diameter

near the east border in the line of the new east extension of the pool. This extension occupies the site of what was a black pit the preceding day. The whole lake appears like a great river of lava pouring from west to east.

On October 14, from ten to twelve a. m., a change in wind permitted the floor to be seen from the northwest station. The active pit-lake within the black ledge which we have hitherto called the floor was now seen to be bordered by a broad floor remnant southwest and north. A group of five glowing cones, the largest at least 15 feet high, occupied the northwest end

of the floor. Several of these had annular tops with wide cavities within. Along the east wall on the floor was a row of big black holes of ragged caved-in aspect, each with a ring of white gypsum stain around it. The walls of the lake were high and continually falling in and the eastern cove was longer than yesterday. The west and northwest wall of Halemau- mau showed evidences of recent falls, in that a small high cavern and a vertical hole in a projection of the wall have both disappeared.

T. A. JAGGAR, JR.,
Director.

TECHNOLOGY STATION, October 22.—Slow subsidence accompanying the development of a large pool by the caving in of its banks has continued this week, as last week, with a total sinking of the liquid lava surface of about twenty feet in nine days. Such subsidence has commonly followed the opening of new pools, owing perhaps to the chilling effect of the engulfed material from the collapse of the cones. The floor as a whole has subsided somewhat, this being indicated by border cracks and cracks near the edge of the inner pit. The general condition at present is a large oval floor fully 1000 feet long in northwest-southeast direction, a little less than 500 feet down. Four glowing and fuming "hay-stack" cones are along the northwest border. Four or five roundish black pits, luminous within and ten to twenty feet across, are along the southeast border.

In the middle and with extensions east and south, is the great fiery lava lake in a pit of its own, twenty feet deep and over six hundred feet long. It is nearer the southeast border of the floor than the northwest. In plan it is pointed toward the west, and a round cove extending south, and a ragged cove eastward, continually lengthening as brown avalanches tumble into the flood. This extension is now almost undermining the vertical east wall of Halemau- mau. Very active fumaroles are working in that wall high up, the lower ones glowing, so that now and then falls of rock take

place. The southeast patch of fumaroles has greatly diminished its activity, but the bench remnant southwest is smoking more than ever, with the development of two crater-like chimneys in the slope above the floor at different elevations. The lava lake is streaming from west to east, with changes about the east end, where sometimes a torrent pours westward and joins the main current about the Old Faithful fountain, where with tumultuous upheavings and splashings the streaming melt rushes under the north bank. At other times the united current flows under the southeast bank, or else the south cove is stagnant and there is a majestic march of the whole surface of the pool west to east, black skins tearing zigzag over blood-red slag in daytime, a flood of liquified gold lace at night.

The total volume of fumes from Halemau- mau slowly diminishes with the growth of the hot lake. The heat of the lake can now be felt on the edge, and in the early morning forms a high raincloud to leeward over the desert.

Thursday, October 15, at ten-thirty a. m., the east and southeast coves appeared enlarged. There was a line of fountains up the middle of the pool with streaming west to east into the east cove. Spatter benches of black lava could be seen around the lake shore, suggesting temporary rise relative to the banks. The liquid surface was mantled with patches of black lava skin. The seeing was from the southeast.

October 16 at noon subsidence was going on. The streaming was into both the east and south coves, and the lava was pouring with violent ebullition into a cavern between the two coves. There was much falling in of broken rock from the banks into the lake. At four p. m. the cavern had become submerged under a temporary rise, or what would produce the same effect, a relative sinking of the whole floor.

October 17 at four p. m. the inner wall around the pool was reported to be only about fifteen feet high. There was some rumbling and occasional very strong fountaining at the west end. The streaming was from west and east, meeting and pouring southeast under the point between the two coves. It was reported lower in the evening, so that the record for this day appears to have been rising in the morning and sinking in the evening.

From eight to nine p. m. October 18 a marvelous golden torrent, almost a cascade, was pouring from the northeast under and into the end of the east cove, meeting the west-flowing stream opposite the point between the two coves in a line of fountains, the united current pouring under the point of rock. The surface stream from the west also poured into the south cove, bombarding its inner end. On the rapid flowing surface of the east torrent scintillating points of light appeared, brighter than the golden flood, probably bubbles of gas which burst and oxidized in small flashes of flame. After about forty minutes a dark skin formed over the pool and the torrent disappeared as though the lake had risen. At nine-fifteen it reappeared again, but this time it bent northward and joined the current from the west in flowing under the northeast bank, and the flow into the south cove was replaced by quiet scum.

A pot under the east wall of Halemauau was glowing very intensely within, and a high banner of bluish flame played above it. From the lurid glow within these eastern pots the lava inside would appear to be at about the level of the main pool, fifteen or twenty feet down. A small fall of rock took place from the high fuming east wall of the greater Halemauau crater.

October 19 the pit was obscured by

fumes in the afternoon; in the evening the glow was strong as usual.

October 20, six to seven p. m., the surface activity was sluggish and all signs pointed to a sinking. Crusts formed over the west end, which broke away and floated eastward from time to time. There were bubble fountains along the north bank and the east-setting current streamed under the north side of the east cove. The south cove was stagnant. A ragged edge of skin lay over the liquid at the point of origin of the flowing, west. Four glowing cones were seen on the border of the floor west and north. The surface of the lake showed alternations of apparent active flow and stagnation. A night photograph of the lake was obtained for the first time in nineteen months.

October 21 at three p. m. seeing was clear from the north and northwest stations. Transit measurements made the depth to the lava surface between the east and south coves 518 feet. That the floor as a whole has subsided as well as the liquid lava appears from the fact that the inner wall appeared relatively low, and from cracks around the periphery of the floor and near the edge of the inner pit. Heavy caving was seen to take place at the end of the east cove, sending up clouds of brown dust. There was continuous fountaining near Old Faithful and east of it, where the streaming from the west and east met and poured under the northeast wall. Spatter rims showed on the bank for six or eight feet above the lake, indicating temporary apparent rise. The south cove was rather stagnant, but at four p. m. two big fountains, one near Old Faithful and one in this cove, began to boil furiously and continuously with much noise, this phenomenon lasting some minutes. The two new chimneys in the southwest talus are elongate slots parallel to the edge of the floor, fuming vertical holes, about twenty and fifty feet long, respectively, below and above, the lower about twenty feet above the floor, the other 100 feet.

For the Whitney Laboratory of Seismology, H. O. Wood reports that during the week ending October 21 two very slight local earthquakes have been registered, as follows:

October 18, from 3:08:39 p. m. to 3:10:39 p. m., H. S. T.; intensity medium I Cancani scale, seventeen to eighteen per cent of the minimum perceptible unit. Origin distant about twenty miles.

October 21, from 2:50:29 a. m. to 2:51:14 a. m., H. S. T., intensity medium I Cancani scale, about sixteen per cent of the minimum perceptible unit. Origin distant about sixteen and two-tenths miles.

T. A. JAGGAR, JR., Director.

TECHNOLOGY STATION, October 29.—The past week has been one of renewed rising and greatly increased activity within the inner pit of Halemauau, with some overflow of the western part of the floor. A survey of the lake October 23, 1914, gives the following dimensions: Length of lava pool, 375 feet; width of pool, 150 feet at Old Faithful; length of floor, east-west, 660 feet; width of floor, 550 feet, approximately; wall of inner pit at noon on this date, ten feet high at west end, level with lava at east end.

The floor slopes down from west to east, being about 460 feet below the north station at the west end, 470 feet in the middle and 480 feet down at the east end. The three cones at the border of the floor west, are respectively, from south to north, nineteen feet, twelve feet and seven feet high. The east and south coves of the lake extend for from eighty to ninety feet from their entrances.

The change from sinking to rising within the inner pit happened about October 22. October 23 the lake rose until it was brimming at noon, and two small flows poured out of the west-northwest cone. Throughout the morning the activity was tremendous, the surface currents rushing in various directions and pounding on the banks with formation of spatter ramparts. The noises of puffing, splashing, pounding and rumbling made the pit seem like a manufacturing city in full activity as one looks down the smoke from a hilltop. At ten a. m. there was a wall about ten feet high at the west end of the lake. At noon there was only a low rampart west, and the liquid was up to the edge on the east. Heavy bombardment was going on on the north side of the lake. In the west-northwest cone the lava was throwing up spray within an opening ten feet across.

This became roofed over in the form

of a dome in the course of the day, leaving a filagree pattern of openings. There is a very marked gradation in the height and form of the border cones going from west to east around the north wall. The highest are at the west, they are half broken down in the middle region, and at the east they are wholly broken in, to form ragged-edged pots. High in the northeast wall there is a black chimney without fumes.

The streaming was mostly from under a blanket which formed about the junction of the two coves with the main pool, the currents pouring into the two coves and westward in the main pool, against the northwest bank and under the bank at the extreme west end—an exact reversal of the prevalent streaming. This appeared characteristic of rising stages, for at two-thirty p. m., during a temporary subsiding stage the east flow was resumed and the blanketed area was engulfed, while the current poured under the north shore near Old Faithful. Rising was resumed at four p. m., again with westward flow.

The fumes of this period are extremely acrid and hard to breathe. At noon the pool was rising so fast it could be seen to well up its edges. Very much Pele's hair was seen; in one case a tangle floated by in the hot fumes which was fully fourteen inches long by five wide.

At one-thirty p. m. there was a temporary sinking with bombardment against the southwest bank. At one-forty-five a flow on the floor began from both sides of the largest western cone; at two-thirty this flow had stopped, after traveling about fifty feet on the lake side. On the wall side the flow was only ten or fifteen feet long.

The Old Faithful fountainings were not very large during this activity, and the interval was long, about sixty seconds. About one p. m. a pot in the

floor near the northeast wall was seen to be full of liquid lava almost to brimming, and lava was also welling up northeast between the wall and the edge of the floor. At three-thirty p. m., during the sinking phase, the lava in the northeast pot had sunk about five feet.

From eight to ten p. m. blue flames were very conspicuous, playing over the bank above the splash of the grottoes and out of the glowing cones. There was a rise, with tremendous noisy bombardment, from nine to ten p. m. The heat of the lake was plainly felt on the rim. Some stones were heard falling. The streaming was west to east, with rush into the south and east coves. The east wall chimney still glows and a glowing spot is visible at the extreme southwest border of the floor.

This kind of activity continued during the ensuing days. On the evening of October 24 the lake was spattering over its ramparts and changing its streaming, rising and falling within a small range.

October 25, at three p. m., the lake appeared about ten feet under its rampart on the west, five feet on the east. It was active and streaming from west to east. There is one large active fumarole still in the southeast talus. The high southwest fumaroles remain as they were in the summer. Some spatter construction has taken place around the east pots. In the evening seeing was fair from the north, and about ten p. m. a collapse of the bank of the pool caused much noise, violent fountaining and bright glare. The illumination of the fumes at night is at present very brilliant.

October 26, between four and five

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TECHNOLOGY STATION, November 5.—The lava pool about the 480-foot level in Halemaumau has held its own during the past week, with a subsidence the first of the week and later some rising, the activity continuing about the same, the fumaroles smoky, and the shape of the lake undergoing no essential change. There has been no overflowing onto the floor observed. The weather has been fair, Mauna Loa is clearly seen free from smoke, and seismic activity is slight.

p. m., the high activity continued, though there was no evidence of new overflows. There were cavings of the bank from both the north and south sides. In the evening the seeing was poor. From the southeast the pool could be discerned streaming from west to east, bombarding the north shore and east end, with occasional traveling fountains that migrated along with the streaming as though a confined gas pocket were pushed along beneath the surface layers of viscous lava. Several flaming grottoes were the scenes of splashing and puffing under the bank in the south cove. A skin lay over the pool at the west end, where the lava was from fifteen to twenty feet below its bank.

October 27 the pit appeared smoky, and no change was reported in its action.

October 28, at ten-thirty a. m., the pool was high and active, but very fummy. At noon the surface streaming was into the south and east coves; the lava appeared to be six feet below the bank in the south cove, where it was bombarding. The noise was a steady bubbling with an occasional puffing in the south grottoes. At eight-thirty p. m. the pool was down about eight feet lower, and at nine p. m. the northeast bank collapsed, causing great ebullition and disturbance for forty minutes.

H. O. Wood reports for the Whitney Laboratory of Seismology that early in the week ending with October 28 two trivial local earthquakes were registered. Since their occurrence there has been no disturbance. Microseismic waves have been unusually strong during the greater part of the week.

T. A. JAGGAR, JR., Director.

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October 29, at six-thirty p. m., from the south station the whole pit was seen in spectacular grandeur. The pool was lowered within its banks about twenty feet. There was slow streaming from east and west toward Old Faithful and thence from a dividing point a little east of Old Faithful the current poured in two directions, under the north bank and into the south cove. The noises were of rumbling and splashing, mostly from grottoes of inrush under the northeast wall and in the south cove. Stalactites were seen in

the overhang at the east end. Slow skins formed over the lake's surface and were rent apart, and traveling fountains appeared from time to time in the Old Faithful region. On the floor or black ledge there were flaming cones west and six flaming pots east. Two of the latter were under the east wall, the larger exhibiting for its full width, possibly ten feet, a blue flame which flared up steadily fully eight feet. The talus fumaroles were active, southeast and southwest. From time to time some tinkle of falling stones could be heard.

October 30, at one p. m., the level of the lava appeared still lower, about twenty-five feet within the inner pit along the west wall of the same, and the streaming was eastward into the east and south coves. The northwest cones were puffing, but not visibly spurting. Glow was seen in a northeast and an east pot. At three p. m. the lake was in noisy ebullition all over its surface.

At one-thirty p. m. October 31 the lake had risen about ten feet and the activity was greater than on the previous day. The streaming was still to the south and east coves. At three p. m. the activity was high, the lava splashing up onto the banks. At four p. m. the northwest cone on the floor was ejecting spurts of lava and the cones farther west were puffing.

November 2, at noon, from the old north rest-house a fall of rock from the bank into the lava was seen, followed by great activity. The west banks appeared about fifteen feet high, and the northwest blowing cone occasionally threw out a spurt of liquid. The glowing pot northeast, which a week ago was full of lava, has become a dark, cavernous hole. At three p. m. the level was lower, with twenty feet of bank west and fifteen feet east. There has evidently been caving around the shores of the east cove and along the promontory between the east and south coves, as shown by notches in the high bank and the recession of the promontory so that it is no longer a pointed cape. At this time there was continuous boiling and some traveling fountains in the Old Faithful locality, the fountains traveling into the south cove. In addition there were the peri-

odic explosions of Old Faithful. There was noisy boiling under the bank east and south, and quiet outflow from under black skins at the west. Along the edges of the lake, southwest and northwest, small bubble fountains appeared from time to time. Northeast of the pool in the floor were fuming cracks more or less parallel to the edge of the bank. A cone at the north edge of the floor was glowing and flaming, in addition to the northwest cone, and a new glow-cone was forming in the talus west-northwest. No fresh flows could be detected on the floor. Three northeast pots were dark. A heavy spatter border had formed at the lake's edge between the east and south coves, as though from a long stationary stand of the lava. The fumes hugged the east wall of Halemaumau and appeared to rise very rapidly and to be very brown. At three p. m. from the northwest the streaming was from the west end to Old Faithful and thence northeast, east and south.

November 3, at eleven a. m., from the southeast station the bank of the south cove was only about five feet high, showing continued rising. A change of current again accompanied the rise, the streaming from the east cove being westward, from the west end being eastward, and from the union of these currents southward into the cove. The east cove was completely blanketed over except for some small fountains at its inner end. There was a river-like flow with much fountaining from the west end into the south cove. At the end of the south cove there was bombardment. The noise was moderate, without rumbling. At five p. m. the streaming was similar, with two additional places of bombardment against the northeast bank of the pool. The lake was so high that it splattered over onto the flat east and south, while at the northwest end it splashed up against a higher wall. It was very active in spells, but not noisy. At one time the south cove became stagnant, the flow being directed against the northeast wall.

November 4 was windy and smoky and there was no seeing, but the usual noise, not very loud. In the evening the glow over the pit was moderate.

H. O. Wood reports that during the

two weeks ending with November 4 six local earthquakes, all of trivial magnitude, have been registered at the Whitney Laboratory of Seismology, as detailed below. During the past week there has been no noteworthy seismic motion of other sorts.

October 21, from 6:49:58 p. m. to 6:50:52 p. m., H. S. T. Intensity high I Cancani scale; about 24% of the minimum perceptible unit. Origin distant about twenty-one miles.

October 23, from 8:29:31 p. m. to 8:30:56 p. m., H. S. T. Intensity medium I Cancani scale; about 14% of the minimum perceptible unit. Origin distant about fifteen miles.

November 3, from 9:03:37 p. m. to 9:03:55 p. m., H. S. T. Intensity me-

dium III Cancani scale; about 70% of the minimum perceptible unit. Origin near, distance indeterminate.

November 3, from 9:03:54 p. m. to 9:05:08 p. m., H. S. T. Intensity high I Cancani scale; about 21% of the minimum perceptible unit. Origin near, distance indeterminate.

November 3, from 9:08:22 p. m. to 9:08:37 p. m., H. S. T. Intensity low I Cancani scale; about 9.5% of the minimum perceptible unit. Origin near, distance indeterminate.

November 4, from 3:03:37 a. m. to 3:05:09 a. m., H. S. T. Intensity medium I Cancani scale; about 17% of the minimum perceptible unit. Origin distant about fifteen miles.

T. A. JAGGAR, JR., Director.

TECHNOLOGY STATION, November 12.—The lava pool of Halemaumau continues gradual rising, with overflow from the border cones and hence some building up of the floor. The activity during the week has been strong, with vigorous fountains from Old Faithful, traveling fountains and streaming from west to east, along with splashing and bombarding in the grottoes. Outrushes of gas and flame with hissing and puffing take place over the rim grottoes of the lake and the border cones of the floor. New glowing cones and chimneys have formed in the last three weeks in the southwest and northwest talus, and the new flows on the floor are slowly encroaching on the talus and widening the floor area.

Thursday, November 5, at 5:30 p. m., the pool from the east was dimly seen streaming like a curve in a river from the west end to the south cove, the east cove being stationary with some bombardment in the grotto at its end. The lava stood at a high level about five feet below the floor.

At 6:30 p. m. the lake, seen from the north rest-house, was rising. Signs of this were seen in the dark flexible blanket which had formed over the whole surface of the pool west of Old Faithful, the quiet liquid here streaming east and south from under a ragged edge of skin. In the eastern part traveling fountains and shore bombardments were lively, with shifting positions of activity, first in the south cove, then the east cove, then the northeast bank and lastly the north bank.

The fluid welled up until on a level with the floor, brimming but not overflowing, between the south and east coves.

At 7:30 the maximum height was reached and then subsidence went on for an hour to a depth of about six feet below the floor east, with increased boiling and more rapid streaming. The motion tore up the western surface blanket and the whole pool resumed its more usual aspect. With the loss of support, a great accumulation of built up rampart, almost the whole length of the bank between the east and south coves, caved in with commotion. Such a rampart in the south cove formed a shell over the grotto there, with a small hole in the bank perhaps two feet wide spouting lava spray. This evening the blowing of spray under gas pressure from the grottoes and the sputter phase of Old Faithful were very pronounced. In the south cove the spurts shot up over thirty feet.

The northeast pots glowed dimly and the western cones were all very active, five of them glowing. The two larger ones northwest and westnorthwest showed lava pools bubbling and slowly streaming within. The westnorthwest one had a large window with a stalactitic screen across its north side, which had grown from the dribblets of the fountains at work inside.

Blue flames played above all these cones. The noises this evening were quiet plashing during the rising stage, and plashing with rumbling during the

sinking. The south grotto was more open during the subsidence.

November 6 in the afternoon a climax of rising for the week was reached, which took effect in overflows around the periphery of the floor rather than from the pool. The maximum overflow was from the west end. From 4 to 5 p. m. the lake was brimming and a large flow was pouring eastward from the extreme west end along the southwest floor. A glistening black zone of festoons widening downstream extended down the middle of the flow from the source, while the lower part of the flow was a wide series of overlapping puddles of bronzy sheen. There were glow lines at the sides of the zone of festoons and about the front, where toes put out from time to time, making the aggregate movement of the front as viewed from the south station, about 100 feet in thirty minutes.

The source of this particular flow was an opening in a cone at the extreme west corner of the floor, but at least three other northwest cones were overflowing. The greater flow was fully 450 feet long. At 8:30 p. m. the lake was very active, with rumbling, blowing and splashing, and a rapid rush into the south cove and sometimes into the east cove. A blue flame was flickering from a pot at the base of the eastern cliff. At this time a large area in the great southwest flow foundered in a circle, increasing its diameter by concentric inbreaking. The yellow fluid welled up within an area about 100 feet in diameter, and as new cracks formed back from the edge of this well, the fresh liquid melt would rise in the cracks along a feather shaped line or band, spreading from a glowing midrib right and left. Quickly the circle cooled leaving a texture different from the festooned flow around it. Some glowing toes pushed out from the circular pudding, which appeared to be slightly higher than the flow in the midst of which it had arisen. The streaming in the main lake was from the west end into the south cove, the east cove and the west end being both covered with skin.

November 7 in the morning the flows on the floor had ceased to move, the seeing was poor, the pool was high, and the noise a splashing. At 2:15 p. m. from the southeast the lake appeared to be about ten feet below the floor and

stalactites were hanging in the south grotto. At 4:30 it was rising again, the west end was skinned over, and the east cove was seen be decidedly smaller by reason of the building inward of its banks by spatter during the recent rise. The shore fountains were splashing over on the floor northeast and east and there were many bubble fountains.

At 3 p. m., November 8, the pool appeared a little lower. The point between the east and south coves has receded until the shore is almost a straight line.

The streaming was from the west into the south cove. The lake was very active with blowing noises strong and continued. There were baby fountains around the Old Faithful region. The glowing chimney in the southwest talus was puffing. At 4 p. m. the lake was covered with quiet blankets of partly solidified lava and was rising, with stagnant surface in the east cove and streaming from the west end into the south cove.

November 9 at 3 p. m. measurement with transit showed the lake in the south cove to be 469 feet below the north rim of Halemaumau. Clear seeing from the north and northwest stations showed that the rising and overflowing had taken place from one at least of the northeast pots as well as from the west cones during the recent rising spell, and all of these east pots had been converted by spurting into cones.

Six cones could be counted along the northeast wall at the edge of the floor, and fifty feet above the floor the northeast high chimney, a flaming crevice in the rock, was still glowing. There are still higher strongly fuming crevices in this wall. The new east flow was from the middle of the row of cones northward along the wall. Large cracks have developed along the floor northeast near and parallel to the row of cones, between them and the lake. The northwest cones were puffing, and new flows were seen to have poured out from under three of them, both toward the lake and along the wall northward. The great northwest cone was domed over with a glowing filagree. The lake appeared about five feet down with a spatter rim all around, streaming from the west into the east and south coves.

November 10 at 2:30 p. m. conditions

were the same, the lava being lower in the early afternoon and rising at 4:30, about five feet below its banks. Seven cones were counted northwest and seven northeast. The streaming was as usual from the west into the east and south coves. The noise at 2:30 was plashing and rumbling with bubble fountains; at 4:30 the lake was very quiet with skins east and west. Greater noise and ebullition accompanies temporary subsidence, though an increase in the aggregate noisiness is a characteristic of rapid rising. The reason for this is that during rapid rising the elevation of the lava column proceeds

in pulsations, the upward movements being short, swift and quiet, with intervening longer movements of noisy retirement of the lava and escape of gas.

A small earthquake shock was felt at the volcano house before midnight November 10. At 4 p. m., November 11, the lake appeared about ten feet below the floor, enlarged by caving shores. The streaming was as usual and there were hissing noises from the south cove and the west cones. The large northwest cone was again open with spurting lava within.

T. A. JAGGAR, JR., Director

TECHNOLOGY STATION, November 19.—The week November 12-18, inclusive, at the lava pit of Kilauea has been an eventful and very spectacular one with great and irregular enlargement of the lake of liquid lava and some overflows. There have been many small local earthquakes recorded on the seismographs. Mauna Loa remains clear and free from smoke. There have been at least two thunder storms during the week, one on Mauna Loa November 12, and one in the Hilo district November 18.

November 12 it was becoming evident that the lake lay in a depression of the floor surrounding it, and not at the apex of a flat cone as is more usual. This accounts for the lack of overflow away from the edges of the lake; the lake brims over but against an insloping shore, so that the only effect is a slight enlargement temporarily of the lake area, followed by a subsidence. At two p. m. the pool was very active and about twelve feet below its rim. The eastern cove had widened greatly by collapse of its north bank, whither the current streamed under the bank rapidly in the direction of the northeast cones. At three p. m. the lake was only five feet down below its bank at the west end, where there were fuming holes eight or ten feet back from the edge of the bank. At this time there was tremendous bombardment of the shore between the east and south coves. Large lumpy accretions of lava spatter had accumulated on the banks of the east cove. At three-thirty p. m. the lava was brimming along the western shores, showing that there has been general

subsidence of the western floor or an equivalent rise east during the last fortnight, for in its recent brimmings the west end has always shown a cliff while the east nearly overflowed.

The northwest and west-northwest cones had openings above and the west-northwest one was spurting lava jets. The northwest cone was very large, high and symmetrical. A large cone east-northeast had collapsed and was now a pot full of lava, while between it and the lake at the east cove dense fumes were rising from cracks; this fuming in less degree extending all along the northeast cracks and cones. Yellow sulphurous deposit appeared around a pot at the edge of the floor east. The large cracks across the northern part of the floor were fuming. The noises on this day were splashing, blowing and rumbling. The streaming was from west to east.

November 13 at four p. m. conditions at the pool were much the same. The streaming was from the west end into the south and east coves. Subsidence was in progress, the lake about five feet below its banks, and tremendous ebullition with traveling fountains migrated from the Old Faithful region towards the east cove. The east lava pot was an oven-shaped half-cone puffing and spurting, and the west-northwest cone was also in commotion. The south side of the east cove was overhung with stalactites. The grotto at the end of the south cove was roofed over with two spouting apertures above. The promontory between the south and east coves as seen from the north appeared to be a five-foot crust

over a continuous pool. At four-twenty p. m. rising recommenced. The high east chimney was glowing, and the cracks in the northern floor appeared to be growing in number and width. About seven-fifty p. m. a light earthquake was felt at the observatory.

From the southeast station at four p. m. November 14, the pool appeared to be bordered by a six-foot cliff and very active, with streaming from west to south and heavy spatter banks. The noise was variously blowing and splashing, and the current poured under the point between the east and south coves. The "spouting horn" over the south cove has built up into a cone and the eastern oven now appeared to be a closed cone. A block of the bank on the north side of the east cove appeared cracked away and just ready to topple into the flood. At four-fifteen p. m. the lake was rising.

On the afternoon of November 16 a great change had taken place in the lake. There is some ground for supposing that this happened in the small hours of the early morning of November 15, when the seismograph at the pit station recorded excessive tremors for an hour. The entire line of northeast cones and three or more of the northwest cones were engulfed in lava which rose from below, converting the northeast line into an elongate arm of the lake trending from the east cove northerly, and the northwest line into a separate pond of sluggish lava. The streaming in the main pool was from the west end around the new point formed between the main pool and the east arm and northward into this arm. The streaming in the northwest pond was eastward. A small outlying pot of lava boiled a few feet north of the northern end of the east arm.

At eleven to twelve a. m. November 17 and thereafter in the afternoon the enlarged lake was clearly seen and photographed from the northwest station. The east arm, extending northward along the border of the floor, occupies what before was a crusted extension of the lake along the peripheral cracks of the floor lava. It was fissures in this crust which had been smoking so violently, and here had been the line of pots, then cones of spatter, and finally all had caved in and made an arm of the lake. In like man-

ner a pond had been made by the collapse of cones underlaid by lava north-west. In view of these developments revealing positive sub-crustal channels filled with liquid lava locally, which announced themselves long in advance by flame and smoke and lava jets, it seems doubtful whether the main floor where these phenomena are absent is a crusted pool. The first impression of a scientific observer is that the liquid lava extends outward everywhere under the floor, the latter being a crust over a much larger pool than appears liquid. The writer has doubted this for some time, observing that this floor was constructed by repeated flows from various vents, which merely masked talus below by a smooth filling which has the appearance of a crusted lake. The actual lake from the start has grown by the coalescence of collapsed vents, these maintaining rather constant positions, the start being from the Old Faithful vent, as usual. New vents are formed over cracks, which break across the floor from time to time, and here may be expected new developments of the lake, beginning as coves.

Accompanying the developments of November 15 to 16 three flows along the floor border, one from the sulphurous east border pot southward, one from the end of the new east arm northward, and one from the north side of the new northwest pond northward. These are all short flows not more than 100 feet long. From time to time they are added to, and the flow from the east arm was seen in motion on this day November 17. The streaming was to the east in the northwest pond as well as in the main lake, in the latter bending into the three coves to pour into grottoes at their ends. The east cove has enlarged in the directions of its south bank, that is, in the direction opposite to the east arm, which extends northeastward, and this east cove will hereafter be called the south-east cove. A small pond of lava and great cracks extended northward from the end of the east arm. The sag around the edge of the floor which had received the small flows appeared to be due to a gradual sinking inward towards the center of the floor area. The great cracks in the northern part of the floor gaped more than ever. The

pool was rising and falling every few minutes, with excessive fountaining and rumbling on the fall and quiet plashing on the rise. The west cones, of which three persisted, were puffing and spurting, and occasionally a long whistling puff would come from one of them. Spatter ramparts were built along the east side of the east arm and in the south cove.

The east arm was about 150 feet long and the northwest pond about 100 feet long. The little northeast pond was about twelve feet long. Estimating the length of the main pool at 400 feet, the entire length around the bend with the east arm added would be over 500 feet. There is no evidence of any marked change in the height of lake, which by last measurement was 469 feet below the rim of Halemaumau.

At two-thirty p. m. it was evident that the entrance to the east arm was widening and that the southeast cove was enlarging itself by bombardment. The blast from the west cone was growing louder. From nine to ten p. m. the lake was a splendid sight. It had sunk about twelve feet below its rim, and stalactites hung over the western grotto of inflow and the south, southeast and east grottoes of outflow. The southeast grotto was undermining the actual foot of the east cliff of Halemaumau, and with the subsidence falling stones, loosened from the preci-

puce above, fell into the lake. At one time the northwest pond, which was crusted over, suddenly broke up with a seething noise and the crusts foundered rapidly, gliding northward under the bank and being replaced with bright yellow liquid. This in turn cooled rapidly and the pond skinned over and resumed a slow eastward streaming. Flames were playing from all the cones and grottoes. A lava curtain had formed in front of the grotto on the east side of the east arm, where the lava was rushing under the bank. The current in the afternoon had been swiftest in the channel leading from the main lake into the southeast cove. This evening it was swiftest in the east arm. There was much rumbling. Heat from the lake could be plainly felt on the face at the northern stations.

The east high chimney was ejecting a high flame. An oven had formed over the east end of the northwest pond. There was a glowing cone at the north border of the floor, and also over the south cove. Bubble fountains sometimes formed in the rapid part of the surface of the lake, but these little fountains have not been so active this year as in 1912-13. There was dense fume rising, red in the transmitted light of the pool, from the north end of the east arm and from the east end of the northwest pond.

T. A. JAGGAR, JR., Director.

The following report from the Whitney Laboratory of Seismology is submitted:

Local shocks were registered as follows:

July 29, from 10:45:39 p. m. to 10:46:15 p. m. H. S. T.

Intensity, medium I Cancani scale; about 10% of the minimum perceptible unit. Origin distant about 26 miles.

August 6, from 1:24:42 a. m. to 1:26:00 a. m. H. S. T.

Intensity, medium I Cancani scale; about 17% of the minimum perceptible unit. Origin distant about 26 miles.

August 6, from 7:15:03 a. m. to 7:15:51 a. m. H. S. T.

Intensity, medium I Cancani scale; about 12% of the minimum perceptible unit. Origin distant about 19.3 miles.

August 6, from 8:19:24 a. m. to 8:20:12 a. m. H. S. T.

Intensity, III-IV Cancani scale; about the minimum perceptible acceleration but not perceptible to the senses. Started the ordinary seismograph, but definitely not felt in the Observatory work-room. Origin distant about 12.4 miles.

August 8, a shock of moderate energy from an origin at moderate distance. The beginnings of the earlier phases are not very surely delineated, as is often the case with shocks of moderate energy, so the determination of origin-distance is less sure than usual. The best approximation possible fixes the origin at a distance of about 140 miles from the Observatory. The distance is not less than this amount. The vague beginning of the first phase occurred at 8:57:49 a. m., and action was perceptibly registered until a few minutes after 10 a. m. by the Hawaiian

Standard Time. The second phase began, probably, at 8:58:14 a. m., the chief phase at 8:58:40 a. m. quite definitely, and the greatest amplitude at 9:00:12 a. m. The direction of the origin cannot be estimated from the seismogram. No report has come to notice of the shock having been felt.

August 10, from 2:30:00 a. m. to 2:30:32 a. m. H. S. T.

Intensity, low III Cancani scale; about 60-75% of the minimum perceptible unit. Origin distance indeterminate, but very small; probably less than one mile.

August 10, from 4:00:43 p. m. to 4:01:59 p. m. H. S. T.

Intensity, high II Cancani scale; 30-40% of the minimum perceptible unit. Origin distant about 13 miles.

August 12, from 7:20:41 a. m. to 7:21:29 a. m. H. S. T.

Intensity, medium I Cancani scale; about 16% of the minimum perceptible unit. Origin distant about 19.3 miles.

Registration suspended until September 28, 1914.

H. O. WOOD,
Associate.

The following systematic report from the Whitney Laboratory of Seismology is submitted, registration having been resumed after an interval of about six weeks:

Sept. 27, at about 10:06 a. m., a shock strong enough to exceed the range of the sensitive seismometers; not registered, but observed.

Sept. 27, at about 10:08 a. m., an instrumentally strong shock; not registered, but observed.

Neither of these shocks were felt at the Observatory but were felt at neighboring places.

Sept. 27, from 1:11:27 p. m. to 1:14:29 p. m. H. S. T.

Intensity, IV Cancani scale; 145% of the minimum perceptible unit, but not felt here. Origin distant about 21 miles.

Sept. 27, from 1:58:53 p. m. to 2:00:03 p. m. H. S. T.

Intensity, I-II Cancani scale; about 27% of the minimum perceptible unit. Origin distant about 21 miles.

Sept. 27, a shock in mid-afternoon; the record is so overscored that the time and dimensions cannot be worked out.

Sept. 27, from 9:54:23 p. m. to 9:56:11 p. m. H. S. T.

Intensity, high I Cancani scale; about 25% of the minimum perceptible unit. Origin distant 20-21 miles.

Sept. 28, from 1:38:40 a. m. to 1:40:08 a. m. H. S. T.

Intensity, I-II Cancani scale; about 27% of the minimum perceptible unit. Origin distant 21-22 miles.

Sept. 28, from 1:50:17 a. m. to 1:51:21 a. m. H. S. T.

Intensity, medium I Cancani scale;

about 12% of the minimum perceptible unit. Origin distant 20 miles.

Sept. 28, from 6:40:48 a. m. to 6:41:44 a. m. H. S. T.

Intensity, low I Cancani scale; about 8% of the minimum perceptible unit. Origin distant 16 miles.

Sept. 28, from 6:45:30 p. m. to 6:47:42 p. m. H. S. T.

Intensity, low II Cancani scale; about 38% of the minimum perceptible unit. Origin distant 20 miles.

Sept. 28, from 8:40:52 p. m. to 8:42:44 p. m. H. S. T.

Intensity, low I Cancani scale; about 8% of the minimum perceptible unit. Origin distance indeterminate.

Sept. 28, from 10:41:31 p. m. to 10:42:01 p. m. H. S. T.

Intensity, II-III Cancani scale; about half the minimum perceptible unit. Origin distant 19.3 miles.

Sept. 28, from 11:17:49 p. m. to 11:18:37 p. m. H. S. T.

Intensity, medium II Cancani scale; about 35% of the minimum perceptible unit. Origin distant 14.3 miles.

Sept. 29, from 12:45:15 p. m. to 12:46:59 p. m. H. S. T.

Intensity, high III Cancani scale; about 95% of the minimum perceptible unit. Origin distant 18.5 miles.

Sept. 29, from 5:05:31 p. m. to 5:07:16 p. m. H. S. T.

Intensity, medium I Cancani scale; about 12% of the minimum perceptible unit. Origin distant 18.6 miles.

Oct. 2, from 12:56:54 p. m. to 12:58:42 p. m. H. S. T.

Intensity, I-II Cancani scale; about 28% of the minimum perceptible unit. Origin distant 14.3 miles.

Oct. 2, from 6:50:31 p. m. to 6:50:57 p. m. H. S. T.

Intensity, medium I Cancani scale; about 16% of the minimum perceptible unit. Origin distance indeterminate.

Oct. 3, from 12:46:57 a. m. to 12:49:13 a. m. H. S. T.

Intensity, high II Cancani scale; about 40% of the minimum perceptible unit. Origin distant about 15 miles.

Oct. 3, from 7:15:.. a. m. to 7:22:.. a. m. H. S. T. The very feebly registered chief phase of a teleseism of no great original energy.

Oct. 4, from 5:20:06 a. m. to 5:21:06 a. m. H. S. T.

Intensity, medium I Cancani scale; about 11% of the minimum perceptible unit. Origin distant about 20 miles.

Oct. 6, from 3:33:21 p. m. to 3:34:04 p. m. H. S. T.

Intensity, II-III Cancani scale; less than 31% of the minimum perceptible unit. Origin distant about 16.8 miles.

Oct. 7, from 2:21:26 a. m. to 2:22:25 a. m. H. S. T.

Intensity, low I Cancani scale; 5 to 6% of the minimum perceptible unit. Origin distance indeterminate.

Oct. 10, from 1:28:40 a. m. to 1:29:48 a. m. H. S. T.

Intensity, low I Cancani scale; about 8% of the minimum perceptible unit. Origin distant 18 miles.

Oct. 10, from 3:24:17 a. m. to 3:26:04 a. m. H. S. T.

Intensity, medium I Cancani scale; 16 to 18% of the minimum perceptible unit. Origin distant 16.75 miles.

Oct. 12, from 3:03:51 a. m. to 3:04:46 a. m. H. S. T.

Intensity, high II Cancani scale; about 45% of the minimum perceptible unit. Origin distant 9.3 miles.

Oct. 13, from 11:56:43 p. m. to 11:58:15 p. m. H. S. T.

Intensity, medium I Cancani scale; about 15% of the minimum perceptible unit. Origin distant 17.4 miles.

H. O. WOOD,
Associate.



The new outbreak of Mauna Loa. View from motor road near Keanakekoi, Friday, Nov. 27, 1914, 12 midnight to 12:25 a. m. In the middle right is the Halemaumau cloud, illuminated. Above it, towards the left is the illuminated cloud above Mokuaweoweo. In the upper left hand part is the streak of the moon, traveling downwards for twenty-five minutes. Note the dim profiles of the mountains, due to moonlight illumination.

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WATER AND VOLCANIC ACTIVITY.

By A. L. Day and E. S. Shepherd. A Review by Frank T. Dillingham.

(Read Before the Hawaiian Chemists' Association.)

The authors, Day and Shepherd, begin their paper on "Water and Volcanic Activity" by quoting from two distinguished observers of volcanic activity, namely Wm. L. Green, an Englishman, for many years in the service of the government of these Islands, and Albert Brun, a Swiss chemist.

Green's conclusion from his study of the activity of Kilauea was as follows: "What we mainly wish to contend for and to impress upon geologists—for reconsideration, at least—is, that it may be a mistake to assert, as is so often done in the most positive manner, that water and steam are inseparably connected with volcanic activity. On the contrary it would appear that elastic vapors have nothing to do with the liquidity of the Hawaiian basic lavas, and that as a matter of fact they do not seem to come up with them from below, whilst the basic minerals themselves give no indications in the main eruptions of having been in contact with water, highly susceptible as they are to such an influence." This conclusion, which was supported by many facts of observation, has received much consideration from geologists in general.

Brun's conclusions are entirely similar. He says: "It is therefore absolutely certain that the active volcano does not give off water. The proof is complete. The large white cloud is composed of solid and anhydrous particles. The water theory must therefore disappear from science."

With the exception of these two in-

stances students of volcanoes have generally concluded that water is usually, if not always, the chief agent of volcanic activity.

The authors, Day and Shepherd, next proceed to discuss in some detail what they call the novel conclusion of Green and Brun; the conclusion, namely, that water has no part in the volcanic activity of Kilauea. They produce evidence to show that while the observations of the facts noted by both Green and Brun may be exactly as described, yet their conclusion, that water is not exhaled by the volcano, may well be erroneous.

Some of their arguments are as follows: "When the lava is high enough to completely flood the floor of the basin, these cracks (in the inclosing banks) are closed, and all the gases emitted emerge directly from the surface of the lava into the atmosphere and have the temperature appropriate to the surface of the liquid (1000° to 1200°). At this temperature the gases (sulphur and hydrogen, for example) burn promptly on contact with the oxygen of the air and remain nearly or quite invisible." (This is the condition of no cloud described by Green).

"When the lava level in the lake has fallen ten or twenty feet (which is an almost daily occurrence and often takes place within an hour), only part of the gases set free come from the free surface of the lava, and considerable quantities now appear through the shattered floor surrounding the basin. The gases bubbling out from the lava basin re-

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main as transparent as before, and for the same reasons; but the gases appearing from the cracks in the floor and from the surrounding talus are now cooled to such an extent in passing through the cracks that they no longer burn on reaching the oxygen of the air. Free sulphur is then set free in considerable quantities, unburned; this we were able to collect without trouble, both at the point of emergence and on the crater rim. It is this finely divided free sulphur which is mainly responsible for the beautiful white cloud above the crater, and not crystalline chlorides as supposed by Brun. In fact only a minute quantity of chlorine or its salts (less than 0.02%) could be found in the emanations from the Kilauea basin during the period of our visit."

"Our observation of the appearance and behavior of this cloud is therefore in full accord with the observations of both Green and Brun, so far as recorded; but there is nothing in the facts thus established to show whether the sulphur is accompanied by water vapor or not."

The remainder of Brun's observations of the apparent absence of water vapor may find appropriate explanation in the fact that they were made in an **unsaturated** atmosphere at a distance of more than 250 feet from the point of emergence of the gases, and the further fact that the cloud not only carries sulphur, but two of its oxidation products, SO₂ and SO₃, both of which in these circumstances are effective drying agents. It may very well happen that water is given off in considerable amount by the volcano and yet remains invisible; for, in addition to the por-

tion disappearing as vapor in the unsaturated atmosphere, a considerable additional quantity will condense about the finely divided sulphur particles serving as nuclei of condensation. . .

The authors decided that it was a matter of great importance to collect gases from Kilauea before they had come into contact with air at all. In this connection they state: "Hot gases of more or less complex composition discharged from an active volcanic vent into the air undergo immediate and violent chemical and temperature changes, the consequences of which, with our present limited knowledge of gas relations at these temperatures, can be only partly inferred. It is, therefore, a matter of the first importance to collect the gases directly from the liquid lava or the explosive vents before contact with the air has given opportunity for these alterations to occur."

To make such a collection it was necessary to go down upon the floor of the pit directly adjacent to the liquid lava. In the interval between May 1st, 1912, and January 1st, 1913, there occurred but two favorable opportunities for such a purpose.

About the last of May, 1912, it was noted that a column of liquid lava had worked its way up through the floor close beside the large active basin and had there formed an active lava fountain several feet in diameter. This fountain quickly built for itself an inclosing wall which soon formed a completely inclosing dome. The gases escaping from narrow slits in the dome could be seen burning at night with a pale blue flame which showed that there was an excess of pressure within the dome and that the gases released from the liquid lava first came in contact with the air on passing out from these openings.

Regarding these domes, the authors state: "The domes from which these gases were collected were built up by the lava itself on the floor of the crater and were both chemically and physically ideal gas collectors, being lined with fresh splashes of liquid lava of the same temperature and chemical composition as that from which the gas had just emerged. They formed at the level of the lava lake and, as could be plainly seen after the collapse of the domes,

were directly connected with the lake by channels of liquid lava just below the surface crust."

The descent into the crater was made in safety and the gases were collected in a continuous series of ten glass tubes of about one-half liter capacity each. To one end of this series of tubes a glass pipe line was attached which led directly into one of the cracks of the dome. That portion of the pipe line which led into the dome consisted of an iron tube, partly lined with glass, so that, except for twelve inches of iron pipe within the dome, the gases came into contact with no substance other than cold glass and a few short rubber connectors. The other end of the system of tubes was connected with a piston pump which insured a rapid passage of the gases through the entire system. The gases entered the pipe line at a temperature of about 1000° C. Pumping was kept up for fifteen minutes in order to completely displace the air originally contained in the pipe line and connecting tubes, after which the pipe line was sealed off with pinch-clamps.

It was noted that water began to condense in this pipeline with the first stroke of the pump. At the end of fifteen minutes about 300 c.c. had accumulated in the collecting tubes. This water was clouded with free sulphur, partly from the original gases and partly from the action of the iron tube on the SO₂ of the gases.

Knowing Brun's conclusion, the authors state that in making this first collection of gases they had provided apparatus for collecting fixed gases only. They were not prepared for the reception of any gases which might condense during passage through the collecting tubes.

What they actually obtained at this time was a quantity of fixed gases and water. The water was in considerable excess owing to the fact that it was not pumped through the tubes with the fixed gases, but condensed and remained principally in the first three or four tubes. Hence there is no way to estimate from the results of this collection the proportion of water to the total quantity of volatile matter discharged from the lava. Shepherd and Day regard this as a fortunate mischance inasmuch as they were thus able to collect a sufficient quantity of water to estab-

lish its existence without doubt among the volatile substances exhaled by the volcano.

Steps were at once taken to prepare vacuum tubes for the collection of a further supply of the volcanic gases. These tubes were of one-half liter capacity each, and were provided with a long stem, on the further end of which a thin glass bulb was blown. The plan was to attach these tubes to a long pole and thrust the end having the thin bulb into the dome where the heat might be expected to explode the thin glass at once, allowing the tube to fill with the gases and as quickly be sealed again by melting down the broken end. But by the time these tubes were prepared the top of the dome had fallen in and there was no more opportunity at that time to collect gases under conditions which would avoid contamination from the air.

A second opportunity for the collection of gases occurred in December of the same year. A second dome formed on the edge of the lava lake. This time the gases were collected in the vacuum tubes exactly as was planned. Six tubes were filled with gases under these conditions.

On descending into the crater for this second collection of gases, it was found that in addition to a long crack across the top of the dome from which the gases were escaping, there was a second opening near the base which was not noticed before the descent. This opening gave access to air at the base of the dome and thus behaved like an air-blast in a furnace. The gases were therefore partly burned within the dome, and the tubes which were filled at the upper opening were consequently found to contain mainly burned gases.

Hence, although the identity and something of the relation of the gases can be established from a study of the material collected in May, the determination of the exact proportion of water to the other gases present must wait for another favorable opportunity.

The authors, however, have carried on and are still carrying on a laboratory study of the relations between the gases already found; and in their paper offer a preliminary discussion of the results thus far attained. This discussion offers evidence that the composition of

the gases varies within considerable limits, so that the exact proportions of the gases given off at any given moment may prove to be of less importance than was at first believed.

Their analyses of **liquid lava** dipped from the middle of the lake and of **solid lava** taken from the floor of the crater near the pit are substantially identical, and agree well with other recent analyses of Hawaiian lavas. The most noteworthy feature of the new analyses is the presence of a small amount of Molybdenum (Mo. O₃, trace to 0.01%) which appears to have escaped detection previously.

The following analyses were made of the **fixed gases** collected in the series of glass tubes, May, 1912. The tubes were numbered from 1 to 20 in the order in which the gases entered from the volcano. All the tubes contained condensed water; number one contained nearly 100 cubic centimeters.

Table 2.

The Gases from Halemaumau (Kilauea), May, 1912.

| | Percentage by volume. | | | | |
|---------------------------|-----------------------|---------|---------|----------|----------|
| | Tube 1. | Tube 2. | Tube 8. | Tube 10. | Tube 17. |
| CO ₂ | 23.8 | 58.0 | 62.3 | 59.2 | 73.9 |
| CO | 5.6 | 3.9 | 3.5 | 4.6 | 4.0 |
| H ₂ | 7.2 | 6.7 | 7.5 | 7.0 | 10.2 |
| N ₂ | 63.3 | 29.8 | 13.8 | 29.2 | 11.8 |
| SO ₂ | none | 1.5 | 12.8 | none | none |
| Rare gases | none | none | none | none | none |
| Hydrocarbons | none | none | none | none | none |

During the fifteen minutes pumping in the first collection of gases, the short length of iron pipe which extended into the dome was partly destroyed by the joint action of the sulphur and SO₂. Owing to the high temperature and the splashing of the molten lava, neither glass nor porcelain would have withstood the ordeal, and a silica tube was not at hand.

The authors, however, present abundant proof to show that the effect of this small section of iron pipe on the relations between the gases collected in the tubes is not as great as might at first appear.

Among other things they say: "It might be assumed, further, that the free hydrogen present would be partly oxidized to water in reducing the ferrous oxide formed from the SO₂ and iron (this is one of the reactions when these

components are brought together at this temperature in the laboratory), but if this reaction has had a share in the disposition of our exposed bit of iron, we must admit its presence in overwhelming magnitude over the entire inner surface of the dome, which is everywhere lined with liquid lava containing nearly 10% of ferrous oxide. The assumption of this reaction would, therefore, have the immediate effect of establishing the presence of water in quantity among the volcano gases and at the same time relegate the influence of the iron tube to a position of entire insignificance." . . .

To this reaction assumed to be going on between hydrogen and ferrous oxide may be added another and much more important one in which the iron has no part. The free hydrogen liberated by the volcano reacts with sulphur dioxide at 1000° to form water and free sulphur. . . . It will also be remembered that carbon dioxide and hydrogen undergo a similar reaction at this temperature, as in the manufacture of water gas. . . .



It follows as a result of this that the chemical analyses of volcano gases offered by Brun in support of his contention that the emanations from Kilauea and other volcanoes are anhydrous, show on their faces the clear proof that his conclusion is erroneous. Neither CO₂ nor SO₂ can be associated with free hydrogen at temperatures of approximately 1000° without the formation of water.

The relative quantity of the gases discharged by the volcano is not well established by these samples because of the unexpected presence and condensation of water in the collecting tubes. After the collection of gases had been made, the tubes each contained a quantity of the condensed water in which the fixed gases are individually soluble in different degrees both during and after cooling. There is also some reaction between the gases and water. Nearly a year elapsed between the date of collecting the gases and their analysis in Washington, and this gave opportunity for such readjustments to proceed practically to completion. For example the SO₂ has gone over in part or altogether to SO₃, and entered into solu-

tion, as a result only two out of the five tubes analyzed now show SO₂ as such.

For this reason some importance may be accredited to a preliminary and very hasty analysis of the contents of tube number three, made only four days after the collection. This examination was made in the chemical laboratory of the College of Hawaii. Owing to the limited facilities, at that time, it was not possible to make a complete analysis; but on shaking the tube with water the total volume of the gas was reduced by 51.6%, which may fairly be assumed to represent the SO₂ in this particular tube, in excess of that quantity of SO₂ which had already gone into solution in the condensed volcano water of that tube. The carbon dioxide of this tube amounted to 39.8%, but was probably contaminated with some SO₂. The carbon monoxide amounted to 5.5%. The hydrogen and nitrogen could not be determined, but there was not enough hydrogen in the residual gas to form an explosive mixture when mixed with an equal volume of air. The water in this tube gave only a very slight turbidity with acid silver nitrate.

The water which was collected in the first tubes of the series may fairly be assumed to contain practically all of the halogens. The analyzes of this water is given in the following table, No. 3.

Table 3.

Analyses of Material contained in the Water collected in the Tubes.

| | Amounts in Grams. | |
|--|-------------------|------------|
| | Tube 1 | Tube 2 |
| Na ₂ O | 0.0214 gms. | 0.031 gms. |
| K ₂ O | 0.0102 " | 0.011 " |
| Ca O | 0.0120 " | 0.14 " |
| Fe ₂ O ₃ | 0.080 " | 0.010 " |
| Al ₂ O ₃ | 0.080 " | 0.010 " |
| (The major portion of these may have come from the glass or from Pele's hair.) | | |
| Cl | 0.220 " | 0.206 " |
| F | 0.565 " | 0.492 " |
| NH ₃ | 0.0018 " | none " |
| Ti O ₂ | 0.005(?) " | none " |
| Total S as SO ₃ .. | 0.480 " | 0.508 " |

In speaking of this table the authors say: "It is not improbable that most of the alkalis, lime, and alumina have resulted from the action of the acid liquid on the glass tubing, but it is of the greatest importance to establish the

fact that the entire quantity of gas pumped through the "wash bottle" (i.e. condensed water) yielded no more than 0.4 grams of chlorine. If this be calculated in the form of gas, it will correspond at most to 0.02%, assuming that approximately 1000 liters of gas were drawn into the tubes. Fluorine seems to be present in about twice this quantity, but in no sense can these halogens be regarded as forming more than a very minor part of the crater exhalation.

After all the active gases had been removed from the various tubes during the analyses, there was found to be an inactive residue which consisted mainly of nitrogen. This volume of residual gas was brought into contact with oxygen in a spark tube and subjected to an alternating current spark discharge of considerable intensity for several hours. The final residue of gas thus obtained was subjected to a thorough spectroscopic examination by Prof. R. W. Wood of Johns Hopkins. No trace of any rare gases could be found. The residual gas was therefore composed entirely of nitrogen. It is thus shown that the gases collected from Halemaumau in May contain nitrogen, but no argon. This, the authors state, furnishes a most desirable confirmation of their belief that the volcano gases were successfully collected before they had come into contact with atmospheric air at all. It also offers support to the view that the volcanic nitrogen is not of atmospheric origin.

The gases which were collected in vacuum tubes in December, 1912, afford less information than was obtained from those of the May collection. This was due entirely to the fact, already stated, that the second dome proved on closer examination to be an imperfect one, in that it allowed the entrance of air and a partial combustion of the gases within the dome. On opening these tubes they were found to contain mixtures of volcano gases and air, as was expected. Concerning these gases the authors say: "The analyzes at best add but little to the knowledge already obtained."

Several collections and analyses of gases from a number of the hot cracks which occur outside the rim of the Halemaumau pit were made for purposes

of comparison with the gases exhaled from the liquid lava.

Concerning these the authors state: "With regard to the chemical products along this circular track about the crater basin of Halemaumau, we can sum up by saying that water, although no doubt partly of meteoric origin, was always present at the time of our visit, and the gases were prevailing high in carbon dioxide, sulphur dioxide, and sulphur trioxide. Only at the automobile road terminus was chlorine found to be present in an amount sufficient to show appreciably in a field test. Cracks farther removed from the Halemaumau pit show in some cases small amounts of SO₂, but more frequently exhale merely steam. Thus in caves where stalactites are forming at a temperature of about 40°, the gas present was, in all the cases examined, merely air and steam and contained no more CO₂ than is normally contained in the air. The formation of the stalactites in this cave is accompanied by the formation of gelatinous silica in the presence of some kind of green algae. As might be expected, neither carbon monoxide nor hydrogen was detected in the gases taken from these cracks."

To sum up the evidence presented; it has been shown that the gases given off from the hot lava are N₂, H₂O, CO₂, CO, SO₂, free H, and free S, with comparatively small quantities of Cl, F, and possibly NH₃. (No argon or other rare gases and no hydrocarbons). It follows then, that this particular group of gases cannot be associated together in equilibrium at a temperature of 1000°, and that chemical action is still going on between them.

For example, free sulphur could not remain long in stable association with CO₂, nor could free hydrogen exist in stable relations with CO₂ and SO₂ at 1000°. Furthermore as the pressure continues to lessen during the upward progress of the gases, the quantity of gas released from solution, and consequently free to enter into new relations, must constantly and rapidly increase, up to the moment of discharge into the air.

Two consequences follow from this action. First, the rapid expansion of the gases with the release of pressure is a cooling phenomenon, which, if the expansion takes place suddenly from a

high pressure into the air, may be extremely rapid. Second, the interaction between the gases thus set free in constantly increasing quantity is accompanied by evolution of heat, which naturally raises the temperature of the surrounding lava as long as the reacting gases remain in contact with it. The heat generated by these reactions, in the region near the surface where the amount of gas is large, may easily be much more than enough to counteract the cooling effect of the expansion within the rising lava column, which may thus become hotter and not cooler as it approaches the surface. We have here, therefore, an enormous store of volcanic energy which reaches its maximum temperature at the surface itself.

In accordance with the positive conclusion that these particular gases can not exist together in stable equilibrium at the temperature at which they are found, the statement of their analyses (already given) shows that their composition varies from one tube to another. The successive tubes of gases collected at the same time show that the individual gases are not present in the same proportions, but rather in proportions which change with every bubble which bursts from the liquid lava.

If it now be granted that water is present as an active constituent of the liquid lava, it is necessary to inquire whether this water is magmatic or meteoric in its origin. No positive answer can be given to this question as yet. Three views are possible; first, water may have entered by infiltration of sea water from the surrounding ocean; second, by deep seated infiltration of water originally meteoric; third, the water may be considered to be entirely magmatic in character and an original constituent of the lava.

Owing to the conditions surrounding the volcano it is somewhat arbitrary to attempt to assign the water found in the lava to one or other of these three possible sources. None the less, the authors point out some definite indications towards one specific source; as follows: "First and most important, in our opinion, is the fact that the nitrogen found in the emanation is free from argon. It is plain that if atmospheric water is to reach a hot lava column at a temperature of 1000°, or higher, it must do so as a gas, and therefore on the same

terms as other atmospheric gases. Argon is invariably contained in the air in measurable quantity and forms no chemical compounds. Whence it follows that if the gases of the atmosphere had reached the liquid lava in any manner whatsoever, the argon would be released with the others; but no trace of argon was found.

"The second difficulty is to conceive a mechanism whereby atmospheric or surface water of whatever origin can make its way into a lava column or basin at a temperature of 1000° or more. . . . This temperature passed (374°, critical temperature of water), water must make its way precisely like any other gas by diffusion through pores or by overcoming whatever chemical or mechanical conditions it may encounter. The prospect is not an encouraging one.

The hydrostatic pressure at great depths of the sea would appear to be the only sufficiently powerful agent to drive water against a high adverse temperature gradient, but to invoke this would be to invite nice distinctions of where magmatic water begins and meteoric water ends. The presence or absence of chlorine is not a conclusive factor one way or the other, because the physical processes of infiltration through porous rock and of distillation are alike of such a kind as gradually to leave the dissolved salts behind.

"To us, therefore, such evidence as there is appears to indicate that the water released from the liquid lava when it reaches the surface is entitled to be considered an original component of the lava with as much right as the sulphur or the carbon."

TECHNOLOGY STATION, Kilauea November 27.—The past week culminated in an outbreak of lava and fume columns in Mokuaweoweo at about three forty-five Wednesday afternoon, November 25, 1914, the beginning of the belated eruption of Mauna Loa which has been expected for three years past at this observatory, and especially of late, owing to increased numbers of local earthquakes recorded by the seismographs and felt in Hamakua, Hilo, Kau and Kona.

The first column of white vapor was seen shortly before four p. m. at Pahala, rising rapidly from the north side of the summit of Mauna Loa, then four other columns rose in rapid succession beside it and next south of it, and when night came these quiet slender vapor stems were brilliantly illumined by bright yellow light from the lava below. The spectacle was splendid from Halemaumau and from the Kau road a short distance from the observatory.

At the Observatory there was a thin rain cloud. The fume jets merged above into a broad cloud mushroom of tabular form, themselves making collectively a wide stem to the mushroom, apparently from four main fountaining centers within the whole length of Mokuaweoweo. The vapor columns were rising rapidly, but with no trace of explosion cauliflowers or of black

dust. In the distance they appeared almost still, as though the dome of Mauna Loa were crowned with a delicate luminous halo coronet.

The glow over Kilauea was much more conspicuously red, making the Mauna Loa illumination appear white by contrast. In the light of the western moon, seen from the gravel banks near Halemaumau, the spectacle of the two craters one above the other, with the hard profile of the great mountain between, and the billowy fumes moving silently southward from Kilauea, was surpassingly beautiful. Kilauea continued its activity with some rising, but as yet with no effect sympathetic with the sudden awakening of Mauna Loa.

The week at Kilauea, as might be expected after the rising activity of last week, has shown subsidence and same caving and enlarging of the great double lake which was created by the collapse of the eastern cones. As the report of the Whitney Laboratory shows, the seismic activity of the last three weeks in Hawaii has been the strongest yet recorded at this station; there has been an unusually large number of local earthquakes.

November 19, at 10:45 a. m., the lake seen from the northwest station was about ten feet below its rim (which is about 460 feet below the edge of Halemaumau), and was streaming ac-

tively from the west to the south, east and northeast coves. Traveling fountains were moving from the region of Old Faithful toward the eastern arm. The current swept around the point very rapidly into the east arm, with hard boiling in the entrance to the east arm. Some of the traveling fountains migrated into the east cove.

At eleven a. m. the lake had risen five feet. The northwest pond was very quiet, covered with a skin of lava, which moved lazily occasionally. The cone in the west corner of the floor puffed at intervals. At two p. m. the lake had sunk again to ten feet below the bank, showing that the rise observed happened about noon. Activity was very great in the south cove and at the end of the east arm. The general changes of this day, noted about five p. m. from the north rest-house, were a lengthening of the east arm northwestward, and of the west end of the northwest pond by the collapse of the next western cone. Also the western part of the main lake appeared wider.

November 20, the seismograph record showed a large number of local earthquakes for the preceding twenty-four hours. Mauna Loa was clear on the afternoon and night of this day, and showed absolutely no vapor or glow.

At eight p. m. from the south and southeast stations there was clear seeing. The lake appeared fully fifteen feet below its banks.

The streaming was, as usual, from the west to the east and south. The torrent poured under the east cliff at the end of the east cove, and under the northeast cliff near the end of the east arm of the lake. These two points of impouring are nearly under the two ends of the 1894 bench, and if much undermining went on there this bench might well subside farther. The high eastern chimney flame was very bright. The northwest pond appeared low within its walls and to be elongating itself eastward. The east arm was elongating westward in the direction of effecting a junction with the northwest pond. The portion of it which lay under the northeast cliff appeared as straight as an artificial ditch.

A group of small fountains played incessantly at the Old Faithful locality,

and Old Faithful burst at intervals, sometimes in multiple domes. The most rapid streaming was in the east arm at the point of outrush under the northeast bank. No falling stones were heard, but the general nature of the activity suggested a subsiding phase, rapid streaming and fountaining, and no sluggish skins. About half way up the northeast cliff there is a very active fumarole, back of a slab which protrudes high above the east chimney.

November 21, the pool again presented the phenomenon of a noon rise. At 11:15 a. m. from the south station it appeared about twenty feet below its banks, actively fountaining and rumbling, some of the fountains traveling around the bend into the east arm. At two p. m. the activity was much less, as befits a rising phase, with some fountaining in the middle, east and northeast. By 2:15 the lake had risen to within five feet of the floor level. This was seen from the north, whence the north end of the east arm was seen to be prolonged into a trench bordered by great cracks. The northwest pond was boiling and streaming eastward under a cone at its east end slowly. The west-northwest cones were blowing noisily. At three p. m. the lava level had settled down again to ten feet below the rim with strong activity.

November 22 from 2:30 to 4 p. m., as seen from the north, the pool appeared to be down only from ten to fifteen feet below its bank and rising, with quiet skins on its surface and slow streaming and fountaining. A striking change accompanying this rise was the reversal of direction of streaming in the east arm, now from north to south from under the zigzag edge of a skin within the cove. Otherwise the streaming was from the west as usual, into the south cove, and through a rather constricted channel into the southeast cove. There was a large cone over the east end of the northwest pond, and the overflow along the edge of the floor eastward from that pond appeared to be augmented. The lake as a whole appeared to be growing larger.

At one p. m. Monday, November 23, from the southeast station the lake appeared twenty-five feet below the floor level and very active with a strong renewal of bubble fountaining or baby

fountains over much of the surface. The streaming was toward the east and northeast, the current running around the bend into the east arm. The south cove was quiet. At three p. m. conditions were the same, with much rumbling and plashing.

On the afternoon of November 24 there was no clear seeing on account of high wind and rain. Glimpses indicated a low lake and much fume.

T. A. JAGGER JR.

The report of earthquake shocks recorded at Whitney Laboratory of Seismology at Kilauea from November 4 to November 24 tells plainly the story of the subterranean struggle that was going on in the immediate vicinity of Mokuaweoweo. There is scarcely a day in that time but the director in charge, did not discover the tracings of from one to four temblors on the delicate instruments which are installed at the observatory to detect earthquakes and locate as near as possible their source.

In the three weeks ending November 24 the observatory secured records of fifty-six earthquake shocks, all of them with one exception ranging from five to thirty miles of Kilauea. On November 20 there were ten distinct shocks recorded there.

The one quake which did not originate close to Kilauea was recorded on the morning of November 24 and had a duration of about five minutes. It was what the scientists class as a "weak shock of the strong class," possessing only moderate energy for a shock of the strong class at the origin. It was figured that the shock originated at a distance of about eighteen hundred miles from the observatory.

In the seismic report, Professor Jagger says:

"Besides these, eight or more shocks occurred early in the afternoon of November 25, beginning shortly after noon with a continuous shaking, having several maxima, extending over several minutes—or, perhaps better, several shocks in rapid succession. These were followed at longer intervals by the others. Later in the afternoon, at about four o'clock, it was noticed that white smoke columns were rising from the summit of Mauna Loa. This was reported from several sources, but, owing to driving mists, nothing was noticed at the observatory until about six-fifteen p. m. when the glow was plainly seen through the curtains of mist. These shocks of the afternoon of November 25 have not yet been measured. No shocks were registered after the mid-afternoon.

"While as yet experience and the body of knowledge is not developed far enough to have justified a prediction, based on the increase in earthquake frequency and energy, that a state of eruption was culminating—nevertheless, there is little doubt that the earthquakes here reported constitute a seismic prelude to the volcanic outbreak. Any discussion of the geophysical meaning of this is too long to be included here. However, this prelude was anticipated by the writer, despite the strongly substantiated statements that outbreaks in Mokuaweoweo are frequently unheralded by shocks of earthquake. Bearing on this point it is noteworthy that, so far as has been learned, the shocks of the afternoon of November 25 attracted no attention on the eastern slope of Mauna Loa, except instrumentally."

TECHNOLOGY STATION, December 3.—The week that has passed since the outbreak in Mokuaweoweo, ending December 2, has proved unfavorable, on the whole, for observation of Mauna Loa, either from the observatory or from nearer vantage points. Many brief views have been afforded but, both by night and day, rains, clouds, and driving mists have sadly interfered with seeing. Also the party led

up the mountain by Director Jagger came to grief, being stopped and driven back by a very severe wind and snow storm when near the summit, but before the crater was reached—forced, in fact, to abandon the camp equipment temporarily. So far as is known, only one party has reached the summit as yet.

They reported fire fountains to be playing there, as is customary in such

outbreaks. At second hand, their report stated that they witnessed twelve fountains, of which one was spurting to heights of from three hundred to four hundred feet, that there was no molten lake, or flow, merely fountains with pools about them.

Neither of the members of this party has been interviewed directly by the writer, and consequently no attempt can be made here to introduce their testimony responsibly. Also, the report of the attempted ascent by Director Jaggar must await his return. At a distance of a mile, or upwards, from the crater a deep-toned murmuring sound was heard, which was considered to emanate from the activity there.

It can be stated as a virtual certainty that no flows on the mountain slopes have yet occurred.

At Halemaumau nothing has been observed that could be thought to indicate any response in activity to the outbreak in Mokuaweoweo. The usual oscillations in height, and minor changes in activity, of the molten surface have gone on, but the configuration of the magma lake and pool and the disposition and behavior of the blowing cones remain as before, no marked changes having taken place.

Since the cluster of earthquakes which immediately preceded the outbreak only two (with possibly a third) small shocks have been registered.

On November 26, a clear view of the summit profile of Mauna Loa at about nine a. m. showed a cluster of fume columns, merging into a fluted curtain of thin bluish-white fumes rising quietly to a position subtending an angle above the summit about two-thirds as great as that subtended by the summit above the level of Kilauea, hence attaining an altitude of 6000 to 7000 feet above the summit, where a scanty cumulus crown of condensed vapor hung.

Presumably this was condensed water vapor. All about it was a very thin, much diffused bluish haze of uncondensed fumes. By day the effect was disappointingly slight. Drifting clouds during forenoon and afternoon made seeing uncertain. Toward sundown, however, clear seeing was again afforded. Seen in sunset lighting, partly

by reflected, partly by transmitted light, the thin fume curtain—now chiefly a north and a south column—displayed a succession of color tints of distinctly fluorescent character, as follows; (a) just before sunset, with the sun on the mountain profile well south of the summit, the fumes showed a dirty saffron tint, seen largely by reflected light; (b) at about ten minutes after sunset this had gradually turned to a brown, in which a distinctly greenish cast was seen; it was still a muddy color, though seen largely by transmitted light; (c) about twenty minutes after sunset the tone had become a deep, translucent brown, still of somewhat muddy consistency.

Seeing in the evening was much interrupted by mist. Meteorological conditions at the summit were unquestionably less favorable for a spectacular display than on the evening of outbreak. Nevertheless it appeared certain that the active area had decreased, though there was no suggestion that the intensity of action was diminishing. There were two well-marked columns of rising fumes, the southern larger and better illuminated. Usually these were separated by a blank space of clear sky, but at times illuminated drifting fumes intervened.

On November 27, by day only brief glimpses of the top of the fume column were obtained. At night the scene was essentially unchanged, though somewhat more spectacular than on the previous evening.

On November 28, forenoon views were like those of the preceding days. Heavy rain set in about noon and there was no further seeing.

On November 29, no view was obtained till late afternoon and evening. The summit was seen to be covered with snow down to about 12,000 feet. There was no significant change in the action from that seen on Friday evening, November 27.

On November 30, at about ten a. m. the north fume column was seen to be very much lessened. At night in bright, hazy moonlight the display was brilliant and quite as spectacular as at any time except the first evening and night. Nevertheless the output of fumes was less than on the preceding

evenings. The south column of fumes was much the larger, and better illuminated. The dark space intervening between it and the north column was occasionally filled with drifting fumes well lighted.

On December 1, an overcast day with very high clouds, the fumes showed faint brown tints against the cloud background in early forenoon. A stratum of very thin, cerulean blue fumes, with a faint but distinctly defined limiting plane at the bottom, rested upon the mountain, above about 10,000 feet. In the afternoon only the south fume column was any longer visible. This rose, straight and slender, from 9000 to 10,000 feet above the summit, and there a ragged cumulus crown hung stationary in a streaked, wavy network of blue haze. In the evening the slender fume column was faintly illuminated and soon obscured by drifting clouds. While this would apparently indicate decreasing activity, such an opinion must be scanned cautiously—for the spectacle depends very greatly upon meteorological conditions at the summit.

On December 2, no view was obtained until evening. Then, at first the single south fume column appeared dimly lighted, almost invisible in the bright light of the full moon, but soon fumes appeared to be rising more copiously and more rapidly and the column became very brilliantly lighted, as much so as at any time except on the night of outbreak.

There can be no question that, so far, the most brilliant spectacle was afforded on the evening and night of the outbreak. Nevertheless it is conjectured that there has been no significant change in the intensity of the action in Mokuaweoweo, but it is practically sure that the area of action has decreased, and it is highly probable that there are fewer playing fountains. But there still is a magnificent scene to be observed at close hand in the great caldera.

Observations at Halemaumau

On November 25, the molten surface was approximately 25 feet below the floor of the pit. The relatively vigorous surface action so common of late was going on—both traveling fountains,

or better, migrating boiling places, were moving, and torn crusts were streaming, toward the northeast wall and the east cove. There was much activity in the south and east coves and around the site of "Old Faithful." The noise was like that of heavy surf. During a couple of hours the surface rose four or five feet.

On November 26, in the late forenoon the molten surface was about ten feet below the floor and exhibited rapid streaming of torn crusts around the bend, where the two arms of the lake join, toward the wall under the northeast. Boiling action was vigorous in many parts of the lake. The northwest pool was very active and the west cone was blowing very loudly.

On November 27, the conditions of surface activity were practically unchanged. The fumes rising near the east margin were exceptionally sharp. Wherever vigorous fountain action was going on, particularly under the cliff margin in the small arm of the lake near its southeast end, there was much splashing of molten spray with spinning of Pele's hair. Streaming in both arms was toward this place of fountaining. Subordinate strong fountain action was going on under the central part of the north margin of the main arm and there was subordinate streaming toward this place. The northwest pool was relatively sluggish. The molten surface was from ten to fifteen feet below the floor.

On November 28 a very heavy rain prevented observation.

On November 29, the molten surface had sunk to twenty-five or thirty feet below the floor. The encircling spatter margin, seen clearly for the first time recently, was built up surprisingly little. The configuration of the lake remained unchanged. The surface action was somewhat less vigorous than on the twenty-seventh. Slow streaming with slow tearing of the crusts was going on as then. Later this streaming became more rapid. At one time a spasmodic breakup of the entire crusted lake occurred, almost explosive in character, accompanied by a foot or two of sudden sinking and a dull, explosive splashing sound. A few minutes of exceptionally vigorous surface action ensued. Foun-

tain action with great spattering was most vigorous under the cliff margin of the smaller arm of the lake near its southeast end. At long, irregular intervals a harsh blast was blown by the westernmost of the high south cones. Blue flames were playing from the cones. The sound like that of heavy surf was continuous.

On November 30 no change worthy of description was observed.

On December 1 the streaming was frequently changing in direction, and was taking place in several directions simultaneously in different parts of both arms of the lake. Fountains were flinging spatter vigorously, particularly at the east margin of the east cove. The molten surface had risen slightly, being from fifteen to twenty-five feet below the floor.

On December 2 it was observed that two flows had occurred on the floor. One had burst out from under the cliff wall at the west end of the pit, beyond the west cones, and flowed along the west and north margins of the pit along the cliff wall as far as the talus heap below the north station. When seen it had crusted over, but was still issuing sluggishly from the source. The fresh lava shone through numerous cracks in the surface of the flow. This flow had gone partly into the open pool at the northwest. This was now more sluggish than usual. On the cliff side the pool seemed to be nearly level with the floor, but the walls toward the cen-

ter were from six to ten feet high. The north boiling pot had enlarged almost to a small pool. The second small flow, originating near the cliff margin somewhere near the east cove (the origin being continuously hidden by fumes), had also worked along the northeast margin of the pit as far as the talus heap under the north station. This talus heap was all that had prevented the meeting of the two flows. The molten surface of the lake was somewhat higher than on December 1, but no numerical estimate was made because there was always a veil of thin fumes. The general activity had slightly increased, and much spatter was being flung from the fountains, particularly that under the cliff wall in the east cove.

The sound of rock cracking from heat was heard at intervals, presumably from the fresh flows. Blue flames were flaring, even from one cone almost submerged by the western flow. There was the noise of heavy surf. On one occasion the fountain action under the northeast wall was so violent that a pronounced vibration of the rock was perceptible at the Old Rest House.

During the week there has been no opportunity for the making of an observation for the correction of time. In consequence of this and of unusual pressure of routine, no report from the Whitney Laboratory of Seismology can be included in this report.

H. O. WOOD, Associate.

TECHNOLOGY STATION, December 10.—During the past week the visible glow and fume column on Mauna Loa has ceased to appear, and Kilauea has increased its area of liquid lava and shows rise by survey on December 9. Kilauea is very active and a splendid spectacle, as was expected for this season of approach to the solstice. The depth of the lava surface is 446 feet below the rim.

From the observatory on December 3 in the evening Mauna Loa cleared under high clouds, showing a single smoke column more voluminous than on previous days and more spectacularly illuminated. December 4 and 5 there was rain, but a faint diffused illumination

of the cloud cap was seen at night. December 6, at half-past nine p. m., Mauna Loa cleared off, showing a single slender column of fume with orange light of about the same color as Halemaumau, rising rapidly in puffs discernible even at this great distance (twenty-two miles) to a height of about 6000 feet, and there spreading into a diffuse mushroom or balloon of thin vapor, illumined ruddy. The topmost detectable glow reached to at least 10,000 feet above the summit. The next morning, Monday, December 7, at eight a. m., Mauna Loa was revealed with a wide snow cap, and from its middle rose a very slender column of white vapor, diffused above into a bluish haze. On the next morn-

ing, December 8, the mountain was brilliantly clear and showed not the faintest trace of a fume column, and there was no night glow seen, though the mountain was clear at 4 a. m., December 10.

Halemaumau on December 4, from four forty-five to five forty-five p. m., was a remarkable spectacle from the northwest and west stations. There were the main lake, the east arm along the northeast wall, coves south and southeast, the outlying pond along the wall northwest, moving glowing flows from this region along the north wall at its base, glowing and hissing cones on the west floor and in the southwest talus, and at the wall end of the southeast cone a splashing pot had opened within the rock gash in the wall, which had been for so long the high east chimney. The lava in the pot appeared to be at the lake level. At first there was a crust separating the east arm from the main lake. About five twenty o'clock this broke up and great activity ensued with westward streaming, and the surface of the northwest pond was seen to be broken up also into vigorous surface action. The small flow in progress along the northeast margin of the pit exhibited glowing cracks. Shore bombardment with spatter was going on on the north side of the main lake, in the south cove and on the east side of the east arm. The inner portion of the northeast arm was crusted over more than of late, but otherwise the surface action was more intense. There were the usual surf noises, a steady, harsh blowing from the west cones, and one of the latter was an open pot with surging magma. There appeared to be further collapse of the floor north, away from the pit margin, leaving a gulf between the floor block and the wall strata, on the northeast and north sides. A broad blue flame banner was playing from the entrance to the east chimney pot.

December 5, three to four p. m., the lake was about five feet below the floor, streaming westward around the bend from the east arm into the main lake. Jets of spray shot high in the south cove. The northwest pond was streaming eastward, with a five-foot wall overhanging it on the side toward the lake. The west cones and a cone fifty feet up the southwest talus were blowing

out spurts of liquid lava. The southwest cone made a loud blast with every spurt. The northwest pond was also spattering its bank.

December 6, at three-thirty p. m., lava had been rising through the west cones to such extent that a long new steel-colored flow flowed the whole southwest border of the floor from west to east, reaching to a point under the south station, where it surrounded the old south cone on the border of the floor. It was more than 500 feet long. The floor has receded from the east wall and in the crack or gully so formed the lake has undermined the wall and poured small festooned flows ten feet below the floor level. A torrent was pouring from the east arm into the main pool, and the streaming was westward and to places of bombardment north and south. The southeast cone was crusted over, but the east chimney pot at its end was spattering. The east arm was partially blanketed, and its walls appeared higher than those of the lake, which on this day were about ten feet high. There was a glowing cone on the floor at the west end of the lake, and smoke from cracks in the floor north and south, and within the new flow there were glowing cracks and the west cones were flaming. The northwest pond was streaming eastward. The lake was plashing and a sharp puffing noise came occasionally from the high southwest cone.

On the afternoon of December 7 the most significant change was further collapse of a marginal area of the floor north, making a trench between the east arm and the northwest pond, the floor block between this trench and the middle of the pit being upraised and tilted toward the lake. New glowing lava occupied part of this trench. The north pot was almost choked and the northwest pond sluggish and active by turns. The southwest cone was spurring a little regularly. There was heavy and steady fountain action near the east bend, near Old Faithful, in the middle of the lake, and in the south cone. The lake was about ten feet below its margin.

December 8, at 5 p. m., the lake had sunk so that the cliff around it was fully thirty feet high. This had nearly cut off the east arm from the main pool, revealing a promontory protruding from

the upturned central floor block into the east arm. A narrow cascade poured from the east arm into the lake. There were crusts on the pool which broke up from time to time. A lava curtain with a slot in it had formed before a grotto at the northwest end of the main lake. Old Faithful was spattering violently. The streaming changed direction so as to run in three directions from a middle point east of old Faithful. The noise was of plashing with puffs from the southwest cone.

December 9 I made a survey of the lake about three p. m. and obtained some unusual views of the floor from the southwest and west stations, owing to a southerly wind. The north side of the main lake was 446 feet below the southwest station; the high pinnacle of upturned floor north of it 388 feet down; the floor level at the west cones 434 feet; the east end of the northwest pond 441 feet; and the floor level above the west end of the lake 440 feet.

The most striking feature of these measurements, which also was obvious to the eye from these points of view, is the upturned rock pinnacle, now fifty-eight feet high above the lake, constructed of the northern half of the floor, which has been bodily upheaved on the pit margin side, leaving a trench between it and the wall, and a pro-

nounced slope towards the lake. This mass appears to be becoming a large island, and will do so if the lake rises fifteen feet higher.

There were new small flows trickling east from the west cones and from overflow of the northwest pond westward. The streaming in the lake was westward and the pool was only six feet below its rim. Rapid rising had taken place since the previous day. Smoke was rising from cracks in the tilted block of floor. The border talus is consumed and buried east, north and west; the southeast talus fumarole has dwindled, and dense white fume clouds are rising from talus fumaroles south and southwest. The 1912 sloping bench still persists 250 feet above the lake southwest, and a remnant of the sixty-foot bench clings to the wall under the south station. At the west and east end of the floor the walls of Halemaumau have steepened as the result of undermining by the lava, and the fresh raw rock shows some white bodies, more or less rectangular in section, which appear to be a different rock from the old lava flows, and possibly intrusive.

The length of the lake by measurement east-west is 435 feet, and of the floor 750 feet.

T. A. JAGGER JR., Director.

THE OUTBREAK OF MAUNA LOA.

The scientific staff of the Hawaiian Volcano Observatory has been awaiting an eruption of Mauna Loa since 1911. On October 21 of that year the writer recorded this expectation and the statistical data on which it was based, as follows:*

"It is fair to expect that Mauna Loa will renew activity with a lava pool at the Mokuaweoweo center, and without flows at first, before February 1, 1915. After lakings and fountains, with intervals of retirement of the lava, one outflow is expectable in the course of the five years following the outbreak (average duration since 1868).

"As the last flow in 1907 was to the south, the next by the law of

alternation, which has held since 1868, should be on the north side of the mountain. These north flows have not commonly been accompanied by strong earthquakes. As the flows on each side, north and south, have been progressively higher since 1868, and there is no sign of collapse like that which led to the 1868 crisis, the new flow on the north side may be expected at a higher level than the Dewey crater of 1899. Thus the flow may be looked for somewhere near the high crater of 1843 northeast, or near the vent of 1859 on the northwest slope."

In accordance with such precedent the great lava fountain appeared in the summit crater on Thanksgiving Eve, November 25, 1914, about three-forty-

*Report of the Hawaiian Volcano Observatory, January-March, 1912, Mass. Inst. Tech., Boston. Also Chamber of Commerce Annual, Honolulu, 1912.

five p. m., Hawaiian Standard Time. This date brings to a close an interval of repose which in length is within two months of equaling the maximum recorded interval of the last half century, namely, the eight years from 1888 to 1895 inclusive. At that time, as at present, the long repose period followed one of the southern outflows. The summit outbreak of April, 1896, inaugurated an active epoch which culminated in the northern outflow of July 4, 1899.

The four seismographs of the Whitney Laboratory of Seismology of the Massachusetts Institute of Technology, in charge of H. O. Wood, in the basement of the observatory, have abundantly recorded a seismic prelude to this eruption, fifty-six earthquakes, all but one local, being registered in the twenty-one days preceding the outbreak.

Moreover, throughout the year there have been strong recurrent seismic spasms, sometimes accompanied by strongly felt shocks, especially in the region of the Mauna Loa longitudinal axis. The seismic activity of the above mentioned twenty-one days was greater than any similar period of the last three years.

On November 25, in the early afternoon there were eight or more shocks, beginning shortly after noon with a continuous shaking, having several maxima, extending over several minutes. No shocks were registered after the midafternoon. These shocks attracted no attention except instrumentally, showing that the statements that the outbreaks of Mauna Loa are frequently unheralded by shocks of earthquake are loose assertions and refer only to earthquakes of perceptible magnitude. The action of the instruments about noon on November 25 was so peculiar that Mr. Wood called my attention to it and mentioned the probability that an outbreak of Mauna Loa was the cause.

Kilauea cannot be said to have shown the slightest instantaneous sympathy with the Mauna Loa revival. Throughout 1914 Kilauea has gradually increased in the activity of a rising lava column, following upon marked dormancy in 1913. As a whole the lava column of Kilauea rose gradually from 1906 to 1910, its revival taking place

just before the culminating outflow of Mauna Loa in 1907.

In the winters of 1910 and 1912 the Kilauea lava column rose to within sixty feet of the rim of the Halemau-mau cone, but did not overflow. Since 1912 the lava has gradually receded, and even now, while brilliant, is very low, 460 feet below the rim.

There were thus three years of rise, two years of high level and three years of subsidence in Kilauea, with minor semi-annual and monthly fluctuations. And this term of eight years checks closely with the repose period of Mauna Loa. If the lava of Kilauea disappears in 1915, and during the term of the active epoch of Mauna Loa remains dormant, we may well suspect a sympathy of alternation between the two volcanoes.

During the week of November 15, 1914, Mr. Conant of Kona, with Charles Ka as guide, went to the summit crater of Mauna Loa, Mokuaweoweo, and found conditions as usual, the 1907 cone on the floor of the crater just as it has been in the last eight years, with a few sulphurous cracks vaporing on the floor near the cone. Therefore in the week before the outbreak there was no significant visible change.

At the observatory notes have been kept for months past on the appearance of Mauna Loa, not a trace of vapor being seen above Mokuaweoweo. From time to time since 1912 high, thin, vapor columns have been recorded, rising several hundred feet above three old conellets on the northeast rift line of the mountain, the highest of many such cones which appear in profile from the observatory, and about in the position where the next flow might be expected. This locality exhibited five vapor jets on the evening of December 1, 1914, but it has not been especially active this year.

On the afternoon of November 25, 1914, Wednesday, shortly before four o'clock, the observatory was enveloped in a drizzling mist, but at Pahala, on the southern flank of Mauna Loa, the summit was clearly seen, and a column of white vapor suddenly rose from the north side of the summit; then four other columns rose in rapid succession beside it and next south of it, occupying apparently an arc of the mountain

top about equal to the diameter of the main Mokuaweoweo basin. There was no noise and no earthquake.

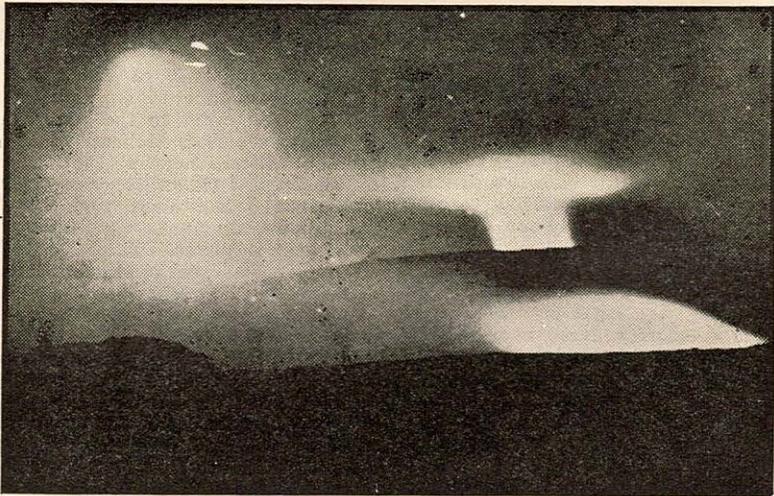
When darkness came the fume columns were brilliantly lighted from below, and then there was some good seeing from the observatory on Kilauea. The slender vapor stems over Mauna Loa reflected bright yellow light from what must have been immense fountains of lava below, and they made collectively a wide trunk for a spreading mushroom of vapor above.

The night was moonlit, and a photograph was made by the writer from the gravel flats east of Kilauea near Keanakakoi crater, looking westward

a glare made by the track of the moon.

Kilauea was very active and made a bright reddish glow on its fume cloud, but the Mauna Loa column appeared almost silvery in its whiteness by contrast. The writer would judge the color to have been the yellow resembling a coal-gas flame.

The Mauna Loa column was made up of from four to six thin, wavy strands, apparently separate fume jets above separate fountains, appearing almost stationary at the great distance of observation. One strand, to the right (north), maintained its distance from the others, so as to leave a dark belt



across Halemaumau at Mauna Loa. This was made with Zeiss Tessar F 6.3, Wratten panchromatic plate, exposed twenty-five minutes, beginning at midnight. It shows the Kilauea fume cloud below on the right, blown toward the left with the trade wind. Right over it is the great "pino" or pine tree of smoke rising above Mauna Loa, and the profile of both domes is shown in the volcanic glare.

The Mauna Loa column, twenty-two miles away, rises in still air from its high base (13,675 feet, 4168 meters), and spreads above into a diffuse table of fume. In the sky on the left is

of sky beyond between it and them, which shows even in the photograph.

This first night was unquestionably the most brilliant, and up to the present (December 10) represented the maximum fountain activity. On the night of November 27 the summit was clearly seen from Puu Lehua, on the northwest slope, by the writer, when the brightest column rose from the south side of the band and there was a secondary smoky strand on the north side with a dark zone in between, and the color was orange.

Fortunately, in view of the stormy weather which followed, an ascent was



The Crater Lake on Mauna Kea, (12,000 feet), Hawaii.

made by two good observers, Messrs. Leslie Forrest and L. C. Palmer, from Pahala on the evening of November 27, and they spent the night on the edge of Mokuaweoweo southeast near the Wilkes station. I am indebted to these gentlemen for the following description and the accompanying plan. They reached the rim in the early evening, watched the fountains off and on all night, and returned down the mountain next morning. The activity was confined to the main central basin of Mokuaweoweo, where an elongate area of new lava overspread the middle part of the floor in a northeast-southwest direction and seemed to overlap the northern lunate platform of the Alexander map. Mr. Palmer did not see the remnant of that platform at all. This new lava was an elongate fountaining pool at the south, and apparently overflows on the floor at the west and north.

There were eight main fountains, mostly playing continuously, the southernmost a tremendous sheet fountain, estimated 150 feet wide, apparently playing above a north-south crack which determined its elongate character. As seen from the east it varied in width (length) like a flickering flame on a ragged, flat lamp wick, but played continuously to heights estimated between 300 and 400 feet. The height was estimated by comparison with the west wall behind it.

The other fountains were lower, forty to fifty feet high, the southern ones having in part the character of shore jets working in grottoes. Several mounds had been built up by spatter, and some of the fountains were concealed behind these mounds, or possibly within them.

At F2 (see diagram) was a spasmodic fountain which erupted at varying intervals, sometimes ten minutes, sometimes an hour or more, resembling a fiery flower pot, and shooting up to heights estimated at 200 feet.

The new lava flows glowed from time to time, especially between two and four a. m. November 28, when there was general recondescence. There was white vapor on the south lunate platform and all around the northern end of the lava field. In the greater fountains the lava jets reached the curved

upper limits of their trajectories still red and blackened in their downward course.

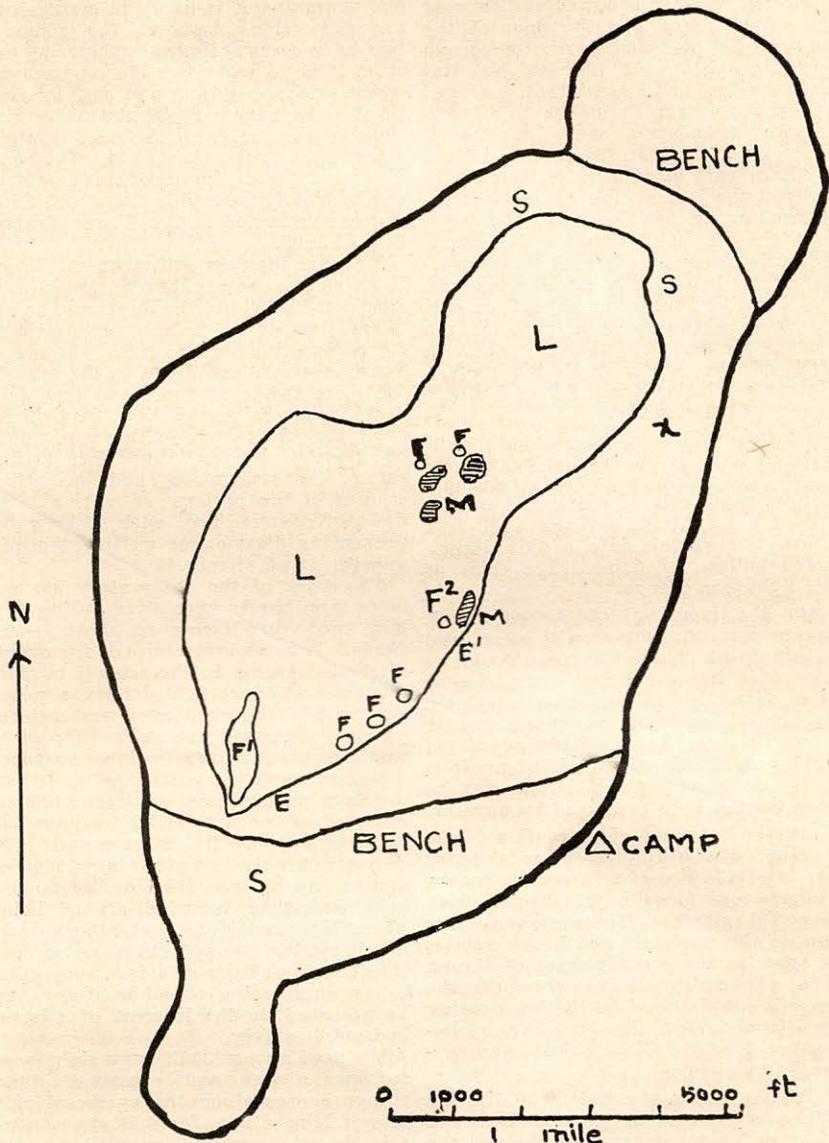
The following is the text of Mr. Palmer's description of the sketch-map:

"If the southern platform is 550 feet down (Alexander), the lake of lava must have been about 600 feet below the top of the mountain. Circles are fountains (F). 'M' are mounds with fountains back of them or else cones with fire coming through them. (Mr. Palmer identified no definite flames.) I could not tell at night, and by morning there did not seem to be any lava coming over them at all.

"F1 is a large fountain, varying in width, as it sometimes included a small fountain to the south; about 150 feet was the average width, but that is only a guess. The great fountain played continuously about half the height of the west wall of the crater, sometimes higher, particularly between two and four a. m., when it must have reached a height two-thirds or three-quarters that of the west cliff.

"F2 is a fountain which sent up a single column of lava at irregular intervals, not as high as F1. 'S' is steam or vapor. Most of the night there was black crust over most of the lava area, but towards morning, between two and four, it disappeared, particularly in the northern part, where the surface was all red for a while, but by daylight it looked black again. Between the lake and the east wall (x), the lava was the same level as the lake, but black, except that a little fire showed through at x."

The next night, November 28, the writer's party reached the summit area, but were driven back by a severe sleet storm. In camp, at a distance of about three miles from Mokuaweoweo west, distinct rumbling could be heard from the crater at intervals, resembling the rumbling heard at Kilauea during activity, a few feet back from the edge of Halemaumau. Messrs. Palmer and Forrest on the previous night described the noises of the fountains as heard at about one mile distant from the east rim as rumbling and splashing, but not very loud or different from the sounds usually heard at Kilauea.



X—Glowed a little.
 L—New lava, mostly flows.
 EE'—Edge of distinct pool.
 F'—Large fountain.

F—Fountains.
 S—Steam (white vapor).
 M—Mounds.
 F2—Irregular fountain.

Outline of Mokuaweoweo, November 27-28, 1914. Sketched by L. C. Palmer from the J. M. Alexander map of 1885.

Stormy weather followed and covered the summit area and the floor of the crater with ice and snow. A second party, consisting of Charles Ka, Hawaiian guide, and an assistant, was sent up by the writer December 3, 1914, to recover abandoned camp equipment. They reported four fountains in the southern part of the crater, the northernmost the largest, the whole four corresponding in position with the large fountain F1 of November 27. Such dwindling corresponds with the appearance from below. Ka saw the mounds, and identified the cone of 1907 as still in place in the western part of the crater. He described the entire eastern half of the crater and the eastern plateau as plastered with heavy ice. He saw very little smoke.

December 6, from the observatory at Kilauea at 10 p. m., the summit of Mauna Loa was clear, with only a single slender vapor column rising and spreading at a height of perhaps 7000 feet above the summit into a thin illuminated balloon of flame. The color of the light was orange.

On the morning of December 7, Mauna Loa was capped with snow, and a thin faint column of fume could be seen widening above into very tenuous blue films in the upper atmosphere. The smoke has the same quality as that from Kilauea, brown in transmitted light and blue in reflected light. It is undoubtedly sulphurous, but as yet its odor has not been perceived by any one.

On the morning of December 8 the weather was brilliantly clear and not the faintest trace of a fume column over Mokuaweoweo could be detected with powerful glasses. There was a snow cap on the mountain and heavy masses of snow on the summit cones of Mauna Kea. December 9 also revealed the summit of Mauna Loa in the morning free from fumes. In the nights of December 7 and 8 Mauna Loa was concealed by clouds.

This morning, December 10, in the darkness of 4 a. m., Mauna Loa was clear, without any trace of glow on the summit.

There has been much talk about a lava flow. As shown in the first paragraph of this article, the lava flow of this period of activity of Mauna Loa may break out at any time in the next

five years and it is likely to emerge on the Hilo side. Because the summit fountains cease activity, as they may do soon, it is no sign that the eruption is ended. The eruption will not be finished until a flow floods the mountain slope and so relieves the accumulated gas and lava pressure within. The conditions of the beginning of this eruptive epoch closely resemble those of 1896, which culminated in the Dewey Crater flow of 1899.

Whether the flow will menace Hilo or Kona no one can say, but we Americans must not be behind the Japanese, as at Sakurajima, in our orderly preparations for engineering such a crisis. Governor Pinkham wrote as follows on the appeal for more funds of the Hawaiian Volcano Research Association, September 26, 1914: "I approve of this work, and of legislation providing for trails, refuge houses, maps and scientific studies in the regions of active lava flows of Mauna Loa, with a view to preventing disaster, as well as the advancement of science."

The work of the observatory has no more than barely kept alive during the last two years owing to shortage in funds. It is no great burden for every interested person in the Islands to join the association at five dollars a year, and with a thousand members instead of one hundred, the scientific work would be much more effective. Furthermore, we want the patronage, and that means a subscription of from \$100 to \$500, of every interested corporation and plantation. By "interested" is meant not only those having business houses, ranches and mills in the danger zone, and that includes all of Hilo, Funa, Kau and Kona, but all who are public-spirited enough to take an interest in the efforts of a few, supported by an engineering school in Boston, to be prepared, in the interest of science and public safety.

We need about \$3000 extra right now to open a way and construct stone refuge houses along the northeast rift line of Mauna Loa, for it is almost certain that the coming flow will burst out along that line. I have been trying to get this for years, knowing the difficulties that would confront us when the eruption came.

In the recent summit fountaining, all the marvelous exhibit was confined to

the first twenty-four hours; no one saw it. For two clear, brilliant nights it was impossible to get either horses or men who would make the ascent. On the third night the activity had probably dwindled, according to my photographic record from a distance and the report of Forrest and Palmer, to at least one-third of its first intensity. And when I finally got there by a long, circuitous route, I was baffled and defeated by bad weather.

If Hawaii wishes to maintain its record for scientific efficiency, in which it has been successful in the sugar industry (but pitifully unsuccessful in some other lines, such as road maintenance, infant hygiene and dairying), it has an opportunity now to do an epoch-making feat in science and engineering; to call back a topographic party of the United States Geological Survey, and complete rapidly a reconnaissance map of the north slope of Mauna Loa; to appoint a commission of engineers to co-operate with the observatory in preparation for

the lava flow, making an exhaustive study and report upon probable paths of flow, orifices of exit, past experience and critical divides where deflection might be accomplished artificially in case valuable property were menaced; and to appropriate money for trails and refuge houses so that these studies may be made from proper camps where supplies may be stored and both animals and men protected from inclement weather.

Whether property is eventually endangered or not, the record of complete preparation will redound to the credit of the Territory or of whoever accomplishes the work as one of the romances of science, like the story of the British engineers in India in preparation for the bursting of the Gohna dam in 1896.

The time is now.

The place is here.

The opportunity will not come again for ten years. And scientific men, however willing, cannot do the work without assistance and money.

The following report is submitted from the Whitney Laboratory of Seismology:

Nov. 4, from 10:35:46 p. m. to 10:36:12 p. m. H. S. T. Intensity, low II Cancani scale; about 35% of the minimum perceptible unit. Origin distant about 16.8 miles.

Nov. 5, from 9:00:29 p. m. to 9:02:27 p. m. H. S. T. Intensity, low II Cancani scale; about 38% of the minimum perceptible unit. Origin distant about 13.7 miles.

Nov. 5, from 9:04:52 p. m. to 9:06:54 p. m. H. S. T. Intensity, I-II Cancani scale; about 26% of the minimum perceptible unit. Origin distant about 15.5 miles.

Nov. 6, from 3:06:33 p. m. to 3:07:55 p. m. H. S. T. Intensity, low I Cancani scale; about 8% of the minimum perceptible unit. Origin distant about 13.7 miles.

Nov. 6, from 7:24:00 p. m. to 7:24:19 p. m. H. S. T. Intensity, IV Cancani scale, but not felt; about of perceptible magnitude. Origin distant about 11.8 miles.

Nov. 7, from 6:42:59 a. m. to 6:44:26 a. m. H. S. T. Intensity, high I Cancani scale; about 22.5% of the minimum

perceptible unit. Origin distant about 32.4 miles.

Nov. 7, from 10:29:52 a. m. to 10:31:00 a. m. H. S. T. Intensity, medium I Cancani scale; about 16% of the minimum perceptible unit. Origin distant about 29.2 miles.

Nov. 7, from 11:36:25 a. m. to 11:37:41 a. m. H. S. T. Intensity, low II Cancani scale; about 30% of the minimum perceptible unit. Origin distant about 20 miles.

Nov. 7, from 8:33:25 p. m. to 8:35:06 p. m. H. S. T. Intensity, high III Cancani scale; about 80% of the minimum perceptible unit. Origin distant about 13 miles.

Nov. 8, from 3:01:27 a. m. to 3:01:48 a. m. H. S. T. Intensity, low I Cancani scale; about 7% of the minimum perceptible unit. Origin distance indeterminate.

Nov. 8, from 5:29:20 a. m. to 5:29:50 a. m. H. S. T. Intensity, medium I Cancani scale; about 12% of the minimum perceptible unit. Origin distant about 13 miles.

Nov. 8, from 7:10:24 a. m. to 7:11:10 a. m. H. S. T. Intensity, low I Cancani scale; about 6.5% of the minimum perceptible unit. Origin distant about 29.2 miles.

Nov. 10, from 10:41:02 a. m. to 10:42:21 a. m. H. S. T. Intensity, low I Cancani scale; about 9.5% of the minimum perceptible unit. Origin distant about 14.3 miles.

Nov. 10, from 6:42:33 p. m. to 6:43:— p. m. H. S. T. Intensity, low I Cancani scale; about 10% of the minimum perceptible unit. Origin distant about 19.3 miles.

Nov. 10, from 6:43:13 p. m. to 6:44:46 p. m. H. S. T. Intensity, low II Cancani scale; about 30% of the minimum perceptible unit. Origin distant about 20 miles.

Nov. 10, from 11:38:43 p. m. to 11:40:33 p. m. H. S. T. Intensity, low III Cancani scale; about 60% of the minimum perceptible unit. Origin close at hand, but distance indeterminate. A felt shock.

Nov. 11, from 8:25:00 a. m. to 8:25:39 a. m. H. S. T. Intensity, medium II Cancani scale; about 37% of the minimum perceptible unit. Origin distant about 13 miles.

Nov. 13, from 1:34:42 p. m. to 1:36:10 p. m. H. S. T. Intensity, high I Cancani scale; about 24% of the minimum perceptible unit. Origin distant 10.6 miles.

Nov. 13, from 7:57:36 p. m. to 7:59:46 p. m. H. S. T. Intensity, low IV Cancani scale, but not reported as felt. From 120% to 160% of the minimum perceptible unit. Origin distant about 15.5 miles.

Nov. 13, from 11:20:33 p. m. to 11:21:35 p. m. H. S. T. Intensity, III-IV Cancani scale; about the minimum perceptible unit, but not reported as felt. Origin distance indeterminate.

Nov. 15, from 12:50:39 p. m. (noon) to 12:53:29 p. m. H. S. T. Intensity, low IV Cancani scale; felt gently. About 220% of the minimum perceptible unit. Origin distant about 11.7 miles.

Nov. 16, from 1:23:01 p. m. to 1:24:39 p. m. H. S. T. Intensity, low III Cancani scale; about 55% of the minimum perceptible unit. Origin distant about 20 miles.

Nov. 17, from 3:12:29 a. m. to 3:13:15 a. m. H. S. T. Intensity, low IV Cancani scale; about 110% of the minimum perceptible unit, but not reported as felt. Origin distance indeterminate.

Nov. 17, from 7:29:00 a. m. to 7:29:15 a. m. H. S. T. Intensity, low II Cancani scale; about 35% of the minimum

perceptible unit. Origin distant about 13 miles.

Nov. 17, from 5:44:44 p. m. to 5:46:15 p. m. H. S. T. Intensity, high II Cancani scale; about 42% of the minimum perceptible unit. Origin distant about 14.3 miles.

Nov. 17, from 8:30:15 p. m. to 8:30:46 p. m. H. S. T. Intensity, medium I Cancani scale; about 12% of the minimum perceptible unit. Origin distance indeterminate.

Nov. 18, from 9:40:25 a. m. to 9:41:17 a. m. H. S. T. Intensity, medium I Cancani scale; about 16% of the minimum perceptible unit. Origin distant about 15.5 miles.

Nov. 18, from 11:15:36 a. m. to 11:17:07 a. m. H. S. T. Intensity, low II Cancani scale; about 30% of the minimum perceptible unit. Origin distant about 20.3 miles.

Nov. 18, from 1:43:08 p. m. to 1:44:10 p. m. H. S. T. Intensity, I-II Cancani scale; about 25% of the minimum perceptible unit. Origin distant about 13 miles.

Nov. 18, from 4:37:30 p. m. to 4:38:55 p. m. H. S. T. Intensity, medium I Cancani scale; about 19% of the minimum perceptible unit. Origin distant about 16.2 miles.

Nov. 19, from 2:31:45 a. m. to 2:32:34 a. m. H. S. T. Intensity, medium I Cancani scale; about 19% of the minimum perceptible unit. Origin distant about 10.5 miles.

Nov. 19, from 2:44:03 a. m. to 2:44:52 a. m. H. S. T. Intensity, high II Cancani scale; about 40% of the minimum perceptible unit. Origin distant about 10.6 miles.

Nov. 19, from 4:46:17 p. m. to 4:46:45 p. m. H. S. T. Intensity, medium IV Cancani scale, but neither felt nor perceptible owing to the smallness of the amplitude. Acceleration measures 280% of the value of the ordinary minimum perceptible unit. Origin distant 5.3 miles.

Nov. 19, from 7:17:27 p. m. to 7:19:01 p. m. H. S. T. Intensity, medium I Cancani scale; about 17.5% of the minimum perceptible unit. Origin distant 13 miles.

Nov. 19, from 8:06:36 p. m. to 8:08:03 p. m. H. S. T. Intensity, low III Cancani scale; about 70% of the minimum perceptible unit. Origin distant about 10 miles.

Nov. 19, from 8:09:08 p. m. to 8:09:52 p. m. H. S. T. Intensity, low III Cancani scale; about 70% of the minimum perceptible unit. Origin distance indeterminate.

Nov. 20, from 3:09:41 a. m. to 3:10:40 a. m. H. S. T. Intensity, low I Cancani scale; about 6.5% of the minimum perceptible unit. Origin distance indeterminate.

Nov. 20, from 3:13:14 a. m. to 3:14:13 a. m. H. S. T. Intensity, low I Cancani scale; about 5% of the minimum perceptible unit. Origin distance indeterminate.

Nov. 20, from 3:44:17 a. m. to 3:45:23 a. m. H. S. T. Intensity, low I Cancani scale; about 4% of the minimum perceptible unit. Origin distance indeterminate.

Nov. 20, from 3:54:44 a. m. to 3:55:57 a. m. H. S. T. Intensity, medium I Cancani scale; about 18% of the minimum perceptible unit. Origin distant about 20 miles.

Nov. 20, from 6:11:02 a. m. to 6:12:36 a. m. H. S. T. Intensity, I-II Cancani scale; about 27% of the minimum perceptible unit. Origin distant about 4.8 miles.

Nov. 20, from 6:15:13 a. m. to 6:16:15 a. m. H. S. T. Intensity, low I Cancani scale; about 6.5% of the minimum perceptible unit. Origin distance indeterminate.

Nov. 20, from 10:27:13 a. m. to 10:27:55 a. m. H. S. T. Intensity, low I Cancani scale; about 6.5% of the minimum perceptible unit. Origin distant about 18.3 miles.

Nov. 20, from 11:46:08 a. m. to 11:46:31 a. m. H. S. T. Intensity, I-II Cancani scale; about 30% of the minimum perceptible unit. Origin distance indeterminate.

Nov. 20, from 1:48:41 p. m. to 1:49:16 p. m. H. S. T. Intensity, high II Cancani scale; about 45% of the minimum perceptible unit. Origin distant about 18.6 miles.

Nov. 20, from 5:39:01 p. m. to 5:39:42 p. m. H. S. T. Intensity, II-III Cancani scale; about half the minimum perceptible unit. Origin distant about 12.4 miles.

Nov. 21, from 4:00:17 p. m. to 4:01:37 p. m. H. S. T. Intensity, III-IV Cancani scale, but not felt; about the minimum perceptible unit. Origin distant about 14.3 miles.

Nov. 21, from 6:03:25 p. m. to 6:05:27

p. m. H. S. T. Intensity, high III Cancani scale; about 90% of the minimum perceptible unit. Origin distant about 13 miles.

Nov. 22, from 3:56:40 a. m. to 3:57:30 a. m. H. S. T. Intensity, low I Cancani scale; about 7% of the minimum perceptible unit. Origin distance indeterminate.

Nov. 22, from 11:55:56 p. m. to 11:56:10 p. m. H. S. T. Intensity, high II Cancani scale; about 45% of the minimum perceptible unit. Origin distance indeterminate.

Nov. 23, from 6:23:29 a. m. to 6:24:58 a. m. H. S. T. Intensity, high I Cancani scale; about 20% of the minimum perceptible unit. Origin distant about 32 miles.

Nov. 23, from 10:11:07 p. m. to 10:11:20 p. m. H. S. T. Intensity, I-II Cancani scale; about 25% of the minimum perceptible unit. Origin distance indeterminate.

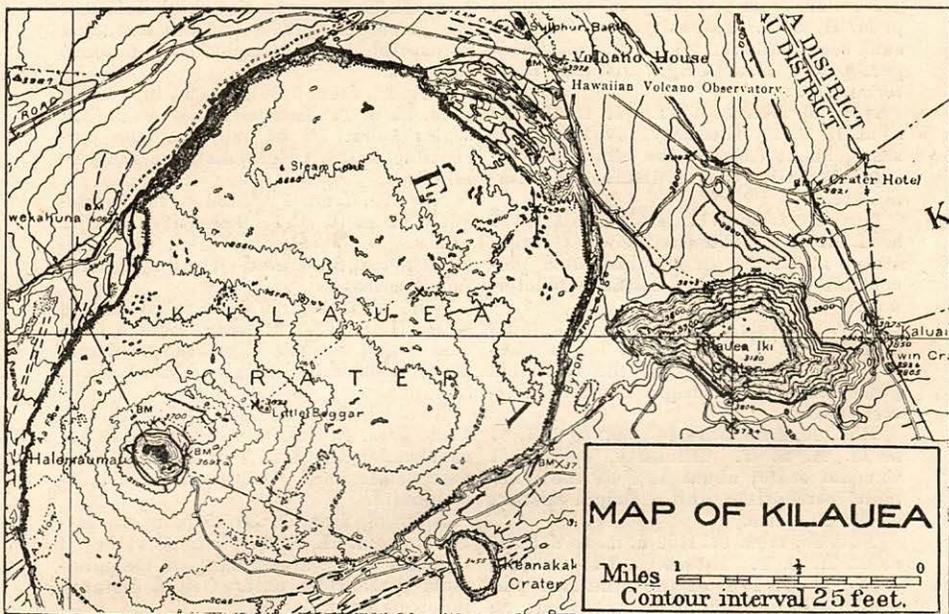
Nov. 23, from 11:30:05 p. m. to 11:30:50 p. m. H. S. T. Intensity, low I Cancani scale; about 6.5% of the minimum perceptible unit. Origin distance indeterminate.

Nov. 24, from 1:32:51 a. m. to 2:23: plus a. m. H. S. T. A teleseism of moderate energy, probably, at its origin a weak shock of the strong class. The technical phase-times follow—eP 1:32:51 a. m., eS 1:37:31 a. m., iLM 1:40:47 a. m., M 1:47:37 a. m., C 1:43: plus, F 2:23: plus. All these are given here in Hawaiian Standard Time. To reduce to Greenwich Time add 10 hours and 30 minutes. Owing to strong microseismic waves it was difficult and uncertain work fixing upon the times of beginning of the fore-phases. Consequently the distance of the origin is in some doubt. The best approximation makes it a little over 1800 miles. The record of the chief phase was sharply written, but with a small amplitude, indicating only moderate energy, for a shock of the strong class, at the origin.

Nov. 24, from 9:53:47 a. m. to 9:55:05 a. m. H. S. T. Intensity, high III Cancani scale; about 83% of the minimum perceptible unit. Origin distant about 10 miles.

Nov. 24, from 9:57:38 a. m. to 9:58:02 a. m. H. S. T. Intensity, low I Cancani scale; about 6.5% of the minimum perceptible unit. Origin distance indeterminate.

H. O. WOOD, Associate.



HAWAIIAN VOLCANO RESEARCH ASSOCIATION.

This society is a voluntary one, made up of subscribers to scientific work which is being executed by the Massachusetts Institute of Technology.

In 1913 there were 26 subscribers in Hawaii and Massachusetts, firms and individuals. A group of firms and persons in Hilo built the main observatory building in the spring of 1912. Publications to date have been weekly reports since the summer of 1911, a memoir by Daly in the Proceedings of American Academy of Arts and Sciences in 1911, articles by the director in the Technology Review 1911 and the Honolulu Chamber of Commerce Annual 1912, articles by H. O. Wood in the Bulletin of the Seismological Society of America, and articles by Perret in the American Journal of Science. The Massachusetts Institute of Technology will publish semi-annual reports.

This weekly bulletin as it appears in the Advertiser will be reprinted as a leaflet and sent to regular annual subscribers to the work of the association. C. H. Cooke is president of the Board of Directors of the association and R. W. Shingle is treasurer. New subscribers who are interested in our volcanoes will be welcomed in the association. The association aims: (1) To record volcanic activity and earthquakes in Hawaii; (2) to attract scientific men hither for special studies; (3) to promote the establishment of volcano observatories all over the world.

WHITNEY LABORATORY OF SEISMOLOGY.

The Whitney Laboratory of Seismology is equipped with two Bosch-Omori 100 kg tromo-

meters registering N-S and E-W motion, a heavy Omori tromometer registering E-W motion and an Omori "ordinary Seismograph" designed for registering strong earthquakes in all three components of motion. These are seated on concrete piers in a closed basement room having practically constant temperature, beneath the chief Observatory building near the hotel. Time is referred to a rated chronometer, checked at intervals by solar observations with a transit. Both instruments are loaned by the College of Hawaii. At the substation by the edge of the active pit an Omori two-component tromometer with light steady masses is mounted on a concrete pier placed directly on the fresh lava surface. Hawaiian standard time (H. S. T.) is 10 hrs. 30 m. slower than Greenwich time.

CANANI SCALE OF SEISMIC INTENSITY

Expressed by accelerations measured in millimeters per second per second.

| | | |
|---------------------------------|--------|---------|
| I. Instrumental | 0.0 | 2.5 |
| II. Very slight | 2.5 | 5.0 |
| III. Slight | 5.0 | 10.0 |
| IV. Sensible, mediocre. | 10.0 | 25.0 |
| V. Rather strong | 25.0 | 50.0 |
| VI. Strong | 50.0 | 100.0 |
| VII. Very strong | 100.0 | 250.0 |
| VIII. Ruinous | 250.0 | 500.0 |
| IX. Disastrous | 500.0 | 1000.0 |
| X. Very disastrous | 1000.0 | 2500.0 |
| XI. Catastrophic | 2500.0 | 5000.0 |
| XII. Great catastrophe. | 5000.0 | 10000.0 |

Grade IV. is ordinarily the minimum perceived by the senses; and in grade XII. the acceleration, or rate of change of motion (jerk) reaches that of terrestrial gravitation.

WEEKLY BULLETIN
OF THE
Hawaiian Volcano Observatory

Vol. II.

HONOLULU, HAWAII, DECEMBER 31, 1914.

No. 32.

TECHNOLOGY STATION, December 17.—The week at Kilauea has been marked by the high activity, with overflow of the floor area at the bottom of Halemaumau, expected at this season. We have also succeeded this week in reaching Mokuawewewo and taking photographs and notes of the fountaining activity which continues there.

There have now been five parties which reached the summit area, and only one of these, the first, Messrs. Forrest and Palmer, on November 27, succeeded in spending the night there. Owing to high winds and snow the December parties have had to content themselves with daylight views. The parties named were Forrest and Palmer, November 27; Jaggar, November 28; Charles Ka, December 3; Baker and Bowdish, December 11; Volcano Observatory expedition, December 15.

Three of the expeditions attempted to camp at the summit and failed, owing to weather conditions. The expense, in the case of the observatory's trips, has been enormously out of proportion to the small results achieved, owing wholly to the lack of any shelter in the summit area. The lessons learned in this respect, however, have been of great value. The Mauna Loa summit region cannot be a place of good scientific observation and survey until a shelter hut and stable have been erected there.

The expedition of this week left Volcano House Monday, December 14, at 9 a. m., by motor car for the upper cattle pen of Kapapala ranch, below the Halfway House. At 10:30 the pack train was loaded and it reached the water tank and camp ground in the forest reservation, at an elevation of about 8000 feet, at 4 p. m. and camp was made for the night. There were eight men, with riding animals and five pack animals. The party was H. O.

Wood, D. Lycurgus, Mr. Withers, Mr. Hannon, Alex Lancaster, Joe de Mello and H. Kaukine, besides the writer.

December 15 start was made for the summit with the packs at 7:30 a. m., and before noon, in the snow-covered summit region, a gale of wind from the southwest sprang up. This was bitterly cold and the animals could barely make progress against it. The weather was cloudy but without snowfall or rain.

The snow of the summit plateau was deep and crusted over, so that it generally supported horses without their plunging through the crust, but one or two of the animals went through. There was perhaps the equivalent of a foot of snow on the level, drifted into the hollows, and revealing points of rocks.

As there was no diminution of wind on the summit plateau, which was reached at 12:30 p. m., I sent the pack animals back to the lower camp and all but the two packers proceeded to the crater. It was quite impracticable to make camp in such a gale, and in deep snow, with every prospect of a possible storm.

There are no ridges to offer protection, only a waste of pahoehoe and a-a blanketed with snow and occasional concealed crevasses. This plateau extends about four miles from the edge of the crater on the east side, but the west or Kona side is the actual summit of Mauna Loa and slopes off rapidly westward.

We reached the east margin of Mokuawewewo at one-fifteen p. m. above the east end of the south lunate platform as mapped by Alexander in 1885. We looked across the south half of the main crater circle, which in general is much like the greater crater of Kilauea, and saw a large red fountain playing continuously in the southwest part of the crater. The fountain rose from the

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northwest corner of an oval pool of crusted pumiceous lava, and back of the fountain was a huge half-cone of its own building. All of this was a mile away, as though one looked from the Volcano House at Kilauea at a fountain playing near the foot of Uwekahuna bluff, the great west cliff of Kilauea crater.

The fountain played steadily to a height of about a hundred feet, and its horizontal diameter was about the same. Above this it sent up jets fifty feet higher, which parted into many fragments, cooling through shades of cherry red to claret color and black, and these black ejeeta, instead of falling heavily, floated away and fell slowly like burnt paper, showing that the lava was of a very light, pumice-like quality.

The falling spatter from the fountain was to the west and north, and here on the edge of the pool was a black mound, probably crescent-shaped in plan, and steep or overhanging on the side of the fountain like the oven ramparts that build over grottoes around the borders of the Kilauea lake.

This spatter heap was at least seventy-five feet high and made part of the background of the great fountain. Lower ramparts engirdled the oval lake, which stood relatively high above a region of black pools and flows south of it and from it. The west side of the lake exhibited other lower fountains, one of them building a small mound, and mostly in the line of the big fountain and along the shore of the pool. Other fountains broke through the crust of the pool from

place to place and time to time, seemingly indicating that the black crust was foamy or light and easily punctured. The fountains were indescribably different from the relatively heavy domes like old Faithful in Halemau-mau.

They appeared to me much redder in daylight and more like flames than a heavy liquid. The suggestion was rather as of an exceedingly light and gas-charged liquid, which cooled and changed color even more quickly than the fluid of Kilauea, and which boiled to much greater heights because of its aeriform consistency.

In the high wind which was blowing very little smoke showed. Above the fountains, however, a blue fume developed in volutes and rose. Between the large fountain and the fume above it appeared a semi-transparent space with strong uprushing heat-movement lines, which gave me the impression of being a bluish flame which in darkness would have shown as such. The only smoking area was in the vicinity of the heated pool and the flows below it to the south.

The rest of the crater appeared much as in 1912 and 1913, except that new detail of small mounds appeared along a fissure line northward from the large fountain and beyond the great mound or cone of 1907. Mr. Palmer's map, reprinted from my report of last week, will serve to illustrate the line of this fissure, and no doubt there are new flows from this fissure over the middle region of the crater. The larger central mounds, however, shown on his map are not new, but are the old cones of 1907, somewhat modified by the new eruption. The detail of these changes, and perhaps some dimensions, I hope to work out from the photograph studied in comparison with earlier ones.

No changes were seen in the walls of Mokuaweoweo nor in the north or south pits, though we could not see into the latter. The southern lunate bench and parts of the crater floor were covered with snow, but not the central, southern and north central parts of the main crater, implying, perhaps, that all of that region is warm. Remnants of the north lunate bench

still persist and show no change since last year. The north gateway to the crater formed a frame for a striking view of Mauna Kea, with its snow-covered upper cones.

The party left the summit at two p. m. and reached the lower camp at five. One of the animals was quite exhausted and was unable to hold out through the return trip next day. On December 16 we left the camp at eight-forty-five a. m. and reached the high road soon after noon.

Halemaumau.

At three-thirty p. m., December 9, 1914, a curious meteorological phenomenon was seen over the northwest part of Kilauea crater. It was drizzling and the wind was southerly, and great volumes of visible steam were rising from the cracks of the floor, partly ionized by the smoke from Halemaumau. The low rain cloud effected a junction with this steam in the shape of a long vertical filament of cloud with a central hollow or pipe which showed lighter than the main whirl, the whole thing looking like a waterspout. At the crater floor it threw the steam into a whirl. The spout migrated slowly northwestward, and once or twice broke in two, and then rejoined. Finally it broke away and was sucked up into the cloud above.

December 10, at noon, the lake in Halemaumau was about 5 feet below the rim. Streaming was from the east arm westward and into the southeast and south coves. The southwest cone, high above the floor, was spouting and blowing out lava spurts. The northwest pond was streaming eastward and the activity was strong.

December 11, at three-fifteen p. m. the temperature of the air was 16 degrees C., (61 degrees F.) and of the Postal Rift 307 degrees C., (585 degrees F.)

Halemaumau was about the same but with very intense fountaining occasioned by opposed currents meeting. The places of meeting were first the narrow entrance to the east arm, then

near Old Faithful; then there was tremendous continued bombardment of the southwest bank, then the west bank of the south cove. The pool was about five feet below the banks. The streaming changed, first radial from the middle, then westward. When the bombardment became transferred to the north shore, great spatter blocks of the rampart fell into the flood. Later there was some sinking.

December 12 and 13 new flows poured along the walls along the border of the floor south and north from the west cones. The general tilt to the old floor had now made the edge of the lake much higher at the east end than the west. The west end was only about three feet above the lake and the east end five feet. There was heavy fountaining, various streaming, and conflicting currents. The northwest pond appeared to have migrated out from the wall, with broad flows back of it. For the first time this year overflow took place from the edge of the lake, two such flows pouring southward from the main pool.

December 16, at six-thirty p. m. conditions were much the same, with very high activity, new flows, glowing cracks, and the southwest cone gone along with the lower talus of that wall. There was now a rock chimney southwest. The four west cones were flaming and blowing, flames were rising from the west grotto of the main pool, and from the east vents. The heat of the lake could be strongly felt on the edge of Halemaumau. Very bright boiling pots lay alongside of the northwest pond. The lake was about ten feet below its banks and the streaming was various and tumultuous.

A correction concerning the outbreak of Mauna Loa, November 25, is to the effect that herders of Kapapala ranch saw the smoke between noon and one p. m., just when the seismographs registered prolonged motion. There was evening glow on Mauna Loa, December 10 and 13, and thereafter and occasional fumes seen by day.

T. A. JAGGAR, JR., Director.

TECHNOLOGY STATION, Kilauea, December 24, 1914.—The summit glow and fume column on Mauna Loa during the past week have been visible in clear weather over Mokuaweoweo without marked change.

The level of the lake in Halemauau has been as follows:

Dec. 17, below NW. station.....409 ft.
Dec. 19, below SE. station.....414 ft.
Dec. 23, below E. station.....405 ft.

The level of the floor around the lake has been:

Dec. 17, below E. station, about..407 ft.
Dec. 19, below E. station, about..411 ft.
Dec. 23, below E. station, about..390 ft.

Full discussion of the overflows and floor movements of the past week will have to be deferred, as they have been remarkable. Just at the solstice, as expected, a rise occurred which continued for five days, December 18 to 22 inclusive. Instead of progressing by overflow from the lake, the overflow was from the west cones and northwest pond, with great flows along the walls which encircled and poured into the lake.

The lake itself remained relatively stationary, but a block of floor lava involving the accumulations of the early part of this year tilted and rotated about a horizontal east-west axis, so as to lift a crag on the north and sink beneath new flows on the south side of the lake.

The basin of the lake itself, hollowed into this older block, has shifted slightly. The new flows built up the floor about twenty-one feet in actual elevation, but probably more in thickness of filling on the south. The top of the tilted crag, by measurement December 23, was only 347 feet below the east station, or fifty-eight feet above the lake.

December 17 no marked change in general configuration was seen, the lake was two feet below the banks, the streaming was westward, and the new filling of south flows sloped towards the lake markedly. The suggestion is strong that the heavy southern talus is subsiding and pushing the floor block with it. From cracks in the floor and crag much smoke arose.

On December 18 at three p. m. tremendous flows poured from the northwest pond, north and south, reaching the east arm and the main lake southwest, with inflooding torrents, the lake

preserving its outline and the north-east crag and west cones rising as islands in the hot flood.

The heat was very strong on the rim and the noise was a high, steady roar and hiss. The rapid current at the source was estimated to flow from half a mile to one mile per hour. The flowing diminished at four-thirty, revived at five p. m., ceased before eight p. m., revived about ten-forty p. m., was still in action at one a. m., and the next morning at ten-thirty a. m. had quieted. At this time (December 19) the streaming in the lake was to the west, north and south from the east arm, the old south cone in the talus was buried under new flows, the crag appeared as high as ever; the southwest cone was now reforming on the floor and wide flow lava appeared between the east arm and the northeast wall.

December 20, at five-fifteen p. m. and at ten p. m., flooding from the west was again in progress with all the features of December 18, one of the sources of the great southern flow being the larger west cone on the floor as well as the northwest pond. The flow was cascading into the lake southwest and puddling in an immense circle on the floor south. There were many flames and the lake was tumultuous.

December 21. at three p. m. flooding was still in progress in the same fashion. On the southern floor two holes were receiving from the flow steady cascades near the site of the southwest cone and another south of the south cone. These cascades poured thus into voids for an hour and were still pouring when the writer departed. The lake in its temporary rises would meet the fall pouring into it sometimes at a brimming level, so that the surface currents and the inflowing torrent met in conflict at a common plane.

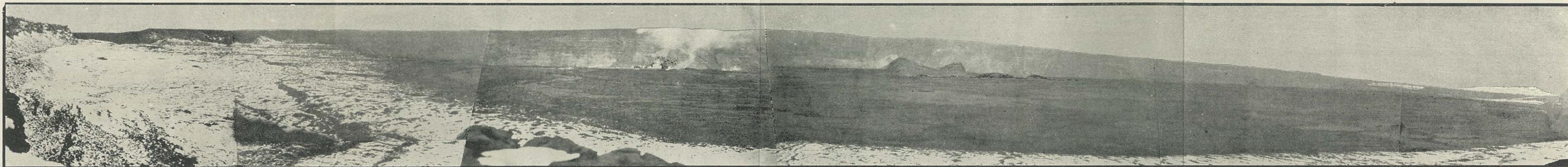
December 22 flowing continued in diminished volume during the day, the lake subsided from two to six feet below its banks, and increased fumes, snapping sounds, puffing, and in the afternoon a few rock slides from the crag and from the northeast wall gave evidence of the beginning of general sinking.

December 23 the lake and northwest pond were fifteen feet down, there was a little rock sliding and harsh blasts at thirty-second intervals southwest.

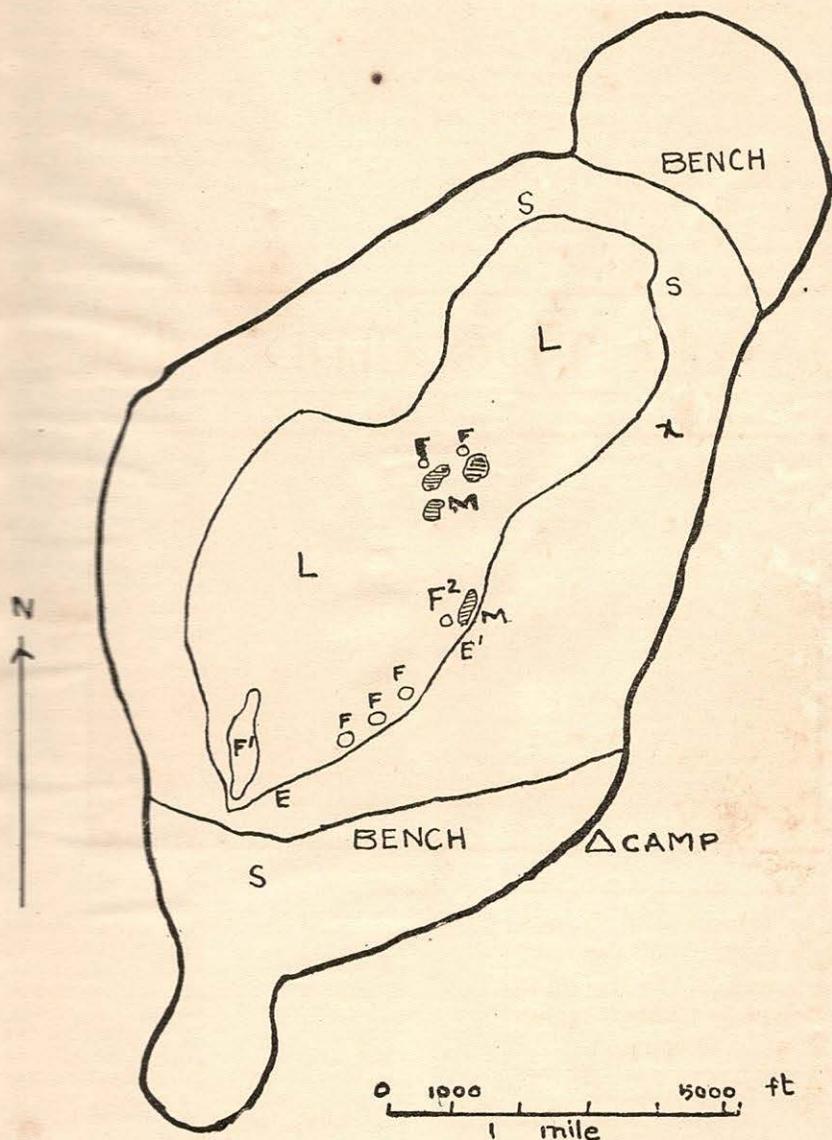
T. A. JAGGAR, JR., Director.



First Photographs of 1914 Activity In Mokuaweoweo Sent To Honolulu, Taken December 15



THE PANORAMA of the active crater of Mokuaweoweo, shown in the upper reproduction, is the first photograph of the recent activity to be taken. The various plates from which this panorama is made up, were exposed by Professor Jaggar for The Advertiser on December 15, and show the south lunate platform on the left; next, the fire fountains as they appeared that day; next, to the right, the cone of 1903-7 in the middle and the new mound, formed in the present activity. On the right is Maunakea and the north bay of the crater. The group photograph reproduced is that of the Observatory party at the summit, with the exception of Professor Jaggar, who took the picture. The photograph gives a splendid idea of the bleak surroundings of the crater and the severe cold with which the scientists had to contend.



X—Glowed a little.
 L—New lava, mostly flows.
 EE'—Edge of distinct pool.
 F'—Large fountain.

F—Fountains.
 S—Steam (white vapor).
 M—Mounds.
 F2—Irregular fountain.

Outline of Mokuaweoweo, November 27-28, 1914. Sketched by L. C. Palmer from the J. M. Alexander map of 1885.

TECHNOLOGY STATION, December 31.—The fume column on Mauna Loa has been very clearly visible this week owing to exceptionally transparent air. It makes a visible gauge of wind direction on the summit, often quite different from the wind below.

December 26, the slender single fume column was glowing in the evening. December 27, from 7 to 9 a. m., with light northeast wind at Volcano House, the fume column on Mauna Loa rose high, bent eastward and thinned out over Puna to a bluish iridescent fume cirrus, quite unlike any rain cloud in color and luster. It showed a slight transverse ripple-marking in the middle part of its course. There was possibly a slight increase in volume of fumes, which has continued through the week, but owing to varying conditions of wind and of clear atmosphere, with frequently no seeing at all, it is impossible to judge slight changes accurately.

An increase of fumes is to be looked for, by analogy with the habit of Kilauea, if the fountains in Mokuaweoweo are still diminishing. The glow at night continued through the week. December 28, in the morning, small volutes of fume were rising; December 29, a straight column in still air; December 30, the same, bending in a counter current eastward in the upper atmosphere, while the wind was northeast below.

At 1 p. m. the high column was bending southward, the puffs showing brownish below and blue above. This morning, December 31, with northeast wind continuing below, the fume puffs of Mokuaweoweo are blowing away westward, implying that the wind below and above is now one and the same, and that the trade-wind stratum has in the last few days thickened to above 14,000 feet.

Halemaumau suffered a temporary subsidence December 22 to 24 inclusive, but since that time has risen vigorously so that the lake of basalt is twenty-five feet higher than on December 23, the present level (measurement of December 28) being 380 feet below the rim.

General conditions remain the same, with overflowing both from the lake and from the western pots and pond. The island-like crag continues to rise with the elevation of the floor, being on December 28 about 333 feet below the southeast rim, 47 feet above the lake.

December 24, in the evening, there were no flows. December 25 was stormy. December 26, at 10 a. m., fresh hot flows were on the floor, violent fountaining across the lake near Old Faithful was occasioned by meeting currents, and the lake was almost brimming. Streaming was westward from the east arm, from under an arch of crust formed over the strait at the entrance to the arm. The northwest pond was active, and there were splashing pots in the floor southwest and off the end of the southeast cove. In the afternoon and evening flows from the west renewed their cascading into the southwest pot.

December 27, 8 to 10 p. m., the floor was covered with fresh glowing flows and from the north rest house an oven was seen in the southwest part of the floor, opening from the north side of an eruptive cone. Into this oven a lava stream from one of the western flows was pouring, and every minute or so a belch from within hurled out a great splash of lava, repelling the inflow. There was a pot of lava within at nearly the same level as the flow. With every belch tremendous spurts shot upward from the hole in the top of the cone, ejecting incandescent blobs at least fifty feet upward and sidewise. The west cones were submerged under splashing pools and a small flow poured southward from one of them. From time to time the skins on the northwest pond and the east arm broke up, and both the lake and the northwest pond were brimming full. There was hissing from an eastern cone.

December 28, 3 p. m., flows were pouring north and south from a west cone on the floor. On the southwest floor was an open grotto or cavern opening southeastward and into it cascades of glowing lava from a flow were dripping. Against the wall, southwest, a pot was boiling, and here the remnant of the 200-foot bench of 1912 was being undermined. The lake was brimming; at the southeast cove it was welling over in splashes and building a spatter cone; there was crust over the strait leading to the east arm; the streaming was from the east arm, southeast, south and west, meeting with tumult as eastward current about Old Faithful, while west of there the westward streaming was resumed.

The crag was still high, and a few blocks of freshly fallen talus appeared on the south floor.

From two boiling pots at the site of the west cones flows poured south and east, the latter following the edge of the floor to the east arm; the east arm brimmed over and made small flows toward the northeast wall. At 3:15 p. m. a heavy festooning flow overwelled the whole length of the east arm, filled up the space between it and the wall, and there poured into an open old lava tube or cavern in the northeast wall of Halemaumau, which has been a landmark for some months past. The torrent rushing into the cavern made a loud, crackling noise like the burning of a wood fire, probably due to the sudden contact of the hot fluid and the cold rock in the cave; it continued to pour in for an hour and probably longer when concealed under its crust.

This intrusion in old caverns is probably the process which makes the whitish intrusive bodies seen in the Kilauea and Halemaumau cliffs. At 4 p. m. the lake overflowed from the south side of the southeast cove, making a broad flood over the southeast part of the floor. At 4:30 the eastward flow from the west cone, which started with a bifurcation uniting under the north wall, was cascading into the northwest pond on its north side, as well as flowing along the wall beyond to the east arm. The east arm appeared obliterated under flows, with the one spitting hole. An oval area of collapse formed eastward from the cascade grotto southwest, and a crack south of it was spurting. There was a small blowing cone near the east wall. The dominant

streaming in the lake was westward as usual.

December 29, at 8 a. m., from the observatory, with low humidity, the fumes over Halemaumau appeared thinner than ever before during this year. The southwest wall of Kilauea crater could be seen through them plainly. At 11 a. m., from the southeast station it was evident that active rising had continued with much overflow. Two great sheets of overflow from the lake east and west of the south cove covered the whole southeastern floor, and new flows from the west covered the southwest floor. The southwest cone under the wall had increased in height and a fountain was playing continuously on its summit, with rills of lava flowing down its flanks. One of these was cascading continuously for two hours and longer into a hole at the site of the cascade grotto of the previous day.

December 30, at 5:30 p. m., streaming in the lake was westward as usual, there were new fresh flows glowing, three pots were boiling on the western floor, the northwest pond was stagnant, an active flow was pouring along the southwest wall, the east cone was hissing and fresh flows were glowing along the north wall. A large spatter lump protruded into the northeast side of the east arm. The southeast cove and the east arm crusted over and broke up from time to time. The lake was about three feet below its banks and was rumbling in the grottoes. A crack spurted occasionally on the southwest floor.

T. A. JAGGAR, JR., Director.

The following systematic report is submitted from the Whitney Laboratory of Seismology:

Nov. 25, from 12:17:49 p. m. to 12:19:30 p. m. H. S. T. Intensity, low I Cancani scale; about 9.6% of the minimum perceptible unit. Origin distance estimated at from 20 to 25 miles.

Nov. 25, from 12:23:43 p. m. to an indefinite moment, H. S. T. Recording pen swept from cylinder. Intensity, IV plus, Cancani scale; more than the minimum perceptible unit, but for all this *definitely not felt*. Origin distant 21-22 miles.

Nov. 25, from 12:25:50 (?) p. m. to 12:27:14 p. m., H. S. T. Intensity, low II Cancani scale; about 30% of the minimum perceptible unit. Origin estimated from 20 to 25 miles distant.

Nov. 25, from 12:27:50 p. m. to 12:29:26 p. m., H. S. T. Intensity, high I Cancani scale; about 21% of the minimum perceptible unit. Origin estimated from 20 to 25 miles distant.

Nov. 25, from 12:30:02 p. m. to 12:30:50 p. m., H. S. T. Intensity, medium I Cancani scale; about 16.5% of the minimum perceptible unit. Origin estimated from 20 to 25 miles distant.

Nov. 25, from 12:53:26 to 12:54:47 p. m., H. S. T. Intensity, low II Cancani scale; about 32% of the minimum perceptible unit. Origin estimated from 20 to 25 miles distant.

Nov. 25, from 12:57:24 p. m. to 12:59:09 p. m., H. S. T. Intensity, low I Cancani scale; about 6.5% of the minimum perceptible unit. Origin estimated from 20 to 25 miles distant.

Nov. 25, from 1:17:18 p. m. to 1:18:36 p. m., H. S. T. Intensity, low I Cancani scale; about 6.5% of the minimum perceptible unit. Origin estimated from 20 to 25 miles distant.

Nov. 25, from 1:26:57 p. m. to 1:28:44 p. m., H. S. T. Intensity, medium I Cancani scale; about 18% of the minimum perceptible unit. Origin distant 24 miles.

Nov. 25, from 12:53:26 p. m. to 12:54:47 p. m., H. S. T. Intensity, low II Cancani scale; about 32% of the minimum perceptible unit. Origin estimated from 20 to 25 miles distant.

Nov. 25, from 1:49:01 p. m. to 1:50:07 p. m., H. S. T. Intensity, low I Cancani scale; about 5% of the minimum perceptible unit. Origin estimated from 20 to 25 miles distant.

Nov. 25, from 2:13:10 p. m. to 2:17:48 p. m., H. S. T. Intensity, about IV Cancani scale, but definitely not felt. Origin distant about 23 miles. This shock was the last of the group which ushered in the outbreak of eruption.

Nov. 26, from 11:16:08 p. m. to 11:17:29 p. m., H. S. T. Intensity, low I Cancani scale; about 11% of the minimum perceptible unit. Origin distant about 23 miles.

Nov. 27, from 6:48:05 p. m. to 6:49:05 p. m., H. S. T. Intensity, low II Cancani scale; about 32% of the minimum perceptible unit. Origin distant about 25 miles.

Dec. 9, from 10:55:01 a. m. to 10:55:55 a. m., H. S. T. Intensity, low I Cancani scale; about 11% of the minimum perceptible unit. Origin distant 32 miles.

Dec. 10, from 8:21:36 a. m. to 8:22:20 a. m., H. S. T. Intensity, low I Cancani scale; about 11% of the minimum perceptible unit. Origin distant about 20 miles.

Dec. 13, from 7:40:13 p. m. to 7:41:33 p. m., H. S. T. Intensity, about IV Cancani scale; about the minimum per-

ceptible unit. Shock not felt. Origin distant about 20 miles.

Dec. 17, from 7:05:51 p. m. to 7:06:53 p. m., H. S. T. Intensity, IV plus Cancani scale; more than the minimum perceptible unit, but not perceived here. Origin distant 12.4 miles, approximately.

Dec. 18, from 7:52:40 a. m. to 7:54:13 a. m., H. S. T. Intensity, low I Cancani scale; about 7% of the minimum perceptible unit. Origin distance indeterminate.

Dec. 19, from 4:42:38 p. m. to 4:44:12 p. m., H. S. T. Intensity, low II Cancani scale; about 27% of the minimum perceptible unit. Origin distant about 20 miles.

Dec. 19, from 9:05:58 p. m. to 9:06:58 p. m., H. S. T. Intensity, low I Cancani scale; about 8% of the minimum perceptible unit. Origin distance indeterminate.

Dec. 22, from 8:37:45 p. m. to 8:38:04 p. m., H. S. T. Intensity, high III Cancani scale; about 90% of the minimum perceptible unit. Origin distant about 10.5 miles.

Dec. 22, from 11:03:01 p. m. to 11:03:58 p. m., H. S. T. Intensity, medium I Cancani scale; about 17.5% of the minimum perceptible unit. Origin distant about 29 miles.

Dec. 23, from 3:47:32 p. m. to 3:48:43 p. m., H. S. T. Intensity, medium I Cancani scale; about 13.5% of the minimum perceptible unit. Origin distant about 18 miles.

Dec. 27, from 8:47:47 a. m. to 8:49:12 a. m., H. S. T. Intensity, high I Cancani scale; about 22% of the minimum perceptible unit. Origin distant about 29 miles.

Dec. 28, from 00:49:07 a. m. to 00:50:12 a. m., H. S. T. Intensity, medium I Cancani scale; about 11% of the minimum perceptible unit. Origin distant about 29 miles.

Dec. 28, from 5:09:13 a. m. to 5:09:43 a. m., H. S. T. Intensity, III Cancani scale; about 70% of the minimum perceptible unit. Origin distance indeterminate.

No additional shocks during the remainder of December, 1914.

HARRY O. WOOD,
Associate.

(End of Volume II.)