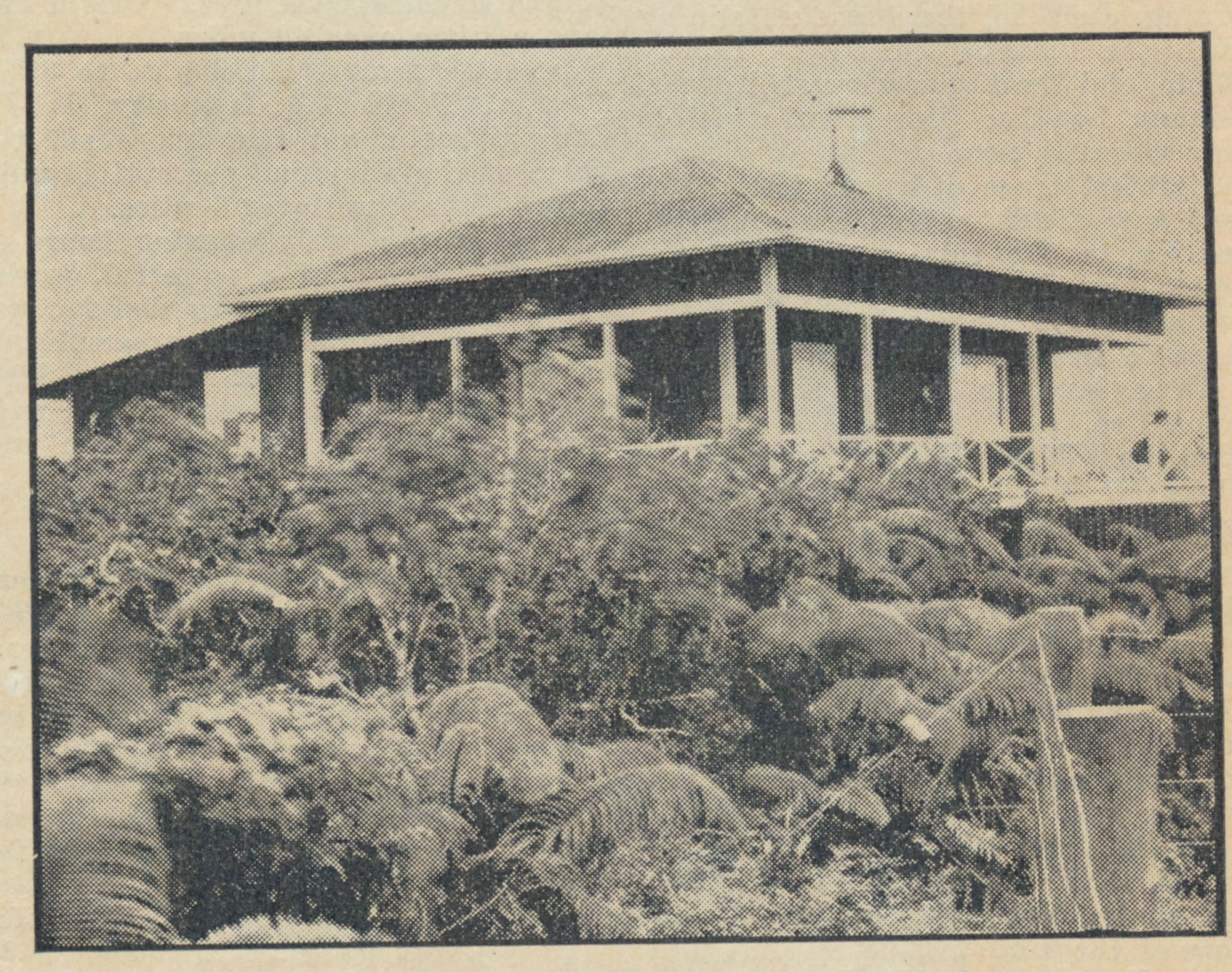
BULLETJN OF THE TECHNOLOGY STATION, KILAUEA, HAWAII,
JUNE 28, 1913

Kilauea Rumbles an dRoars, but Lava Does Not Rise; Activity Now Expected to Begin July 3.



Hawaiian Volcano Observatory. The observatory is largely supported by the Hawaiian Volcanic Association, made up of leading citizens of the Territory. Photos by T. A. Jaggar, Jr.

DISTANT QUAKE AND 16 LOCAL SHOCKS RECORDED.

TECHNOLOGY STATION, Kilauea, June 28, 1913.—The time of the summer solstice, which reached its culmination June 22, has shown its usual terrestrial effects in the recently reported earthquakes in Martinique and Bulgaria, with loss of life in the last place, and in volcanic eruptions of Asama in Japan and of one or more volcanoes in the upper Alaskan Peninsula. Also, as shown in Mr. Wood's report below, a strong distant earthquake was recorded on our seismographs the evening of June 25, and sixteen local shocks have been noted in the last two weeks. As yet the crater of Kilauea has not responded to the tidal strain.

Halemaumau Dormant.

Halemaumau remains dormant. The glow reported last week died away. On June 22 the fumes appeared thin and there was some faint blowing noise with an interval of forty seconds like Old Faithful playing in cavities beneath the floor over 600 feet down. There were occasional avalanches: a heavy one was reported in the early morning of June 20. On June 24 the fumes had become heavier, there was no noise, and weak talus slides were heard. This morning, June 26, there was no sliding heard, the blowing noise was faintly audible, and the fumes were still dense.

Mauna Loa has been clearly visible today morning, noon and night without the faintest trace of vapor jets. Mr. Wood has calculated that a second culmination in the tidal stresses of the solstice period is reached July 3. It remains to be seen whether any response to this stress will be evidenced by rising lava in either Kilauea or Mauna Loa.

For the Whitney Laboratory of Siesmology Mr. W. O. Wood makes the following report:

Seven Shocks Recorded.

During the past week seven earthquakes have been registered, six small local shocks and one feeble teleseism.

June 19, from 2:17:02 a.m. to 2:18 a.m. H. S. T. Intensity, high II Cancani scale; about 0.4 the minimum perceptible unit. Origin distant about 15

June 19, from 3:38:32 a.m. to 3:40:15 a.m. H. S. T. Intensity, III-IV Cancani scale: not felt, but about the value of the minimum perceptible unit. Origin distant about 20 miles.

June 19, from 4:27:25 a.m. to 4:29 a.m. H. S. T. Intensity, III-IV Cancani scale; not felt, but about the value of the minimum perceptible unit. Origin distant about 15 miles.

June 21, from 10:38:27 a.m. to 10:40:47 a. m. H. S. T. Intensity, III-IV Cancani scale; just below the minimum perceptible unit. Origin distant about 14 miles.

June 22, teleseismic chief-phase waves from 3:31:5 a.m. to 3:27:5 a.m. H. S. T. Earlier phases were not registered. Distance of origin unknown. This shock manifested only moderate power at its source.

June 22, from 5:46:46 p.m. to 5:48:5 p. m. H. S. T. Intensity, medium I Cancani scale; about one-tenth the minimum perceptible unit. Origin distant a little over 40 miles.

June 25, from 8:20:19 a.m. to 8:20:36 a.m., H. S. T. Intensity, III-IV Cancani scale; not felt, but about the value of the minimum perceptible unit. Origin distant not over 6 miles.

Also, in the early evening hours of June 25, motion of a powerful, world-shaking teleseism was recorded for several hours, motion of large amplitude being recorded for over an hour. This record has not yet been measured with care. Approximately, the origin was distant a little over 3000 miles.

T. A. JAGGAR, Jr., Director.

Cancani Scale.

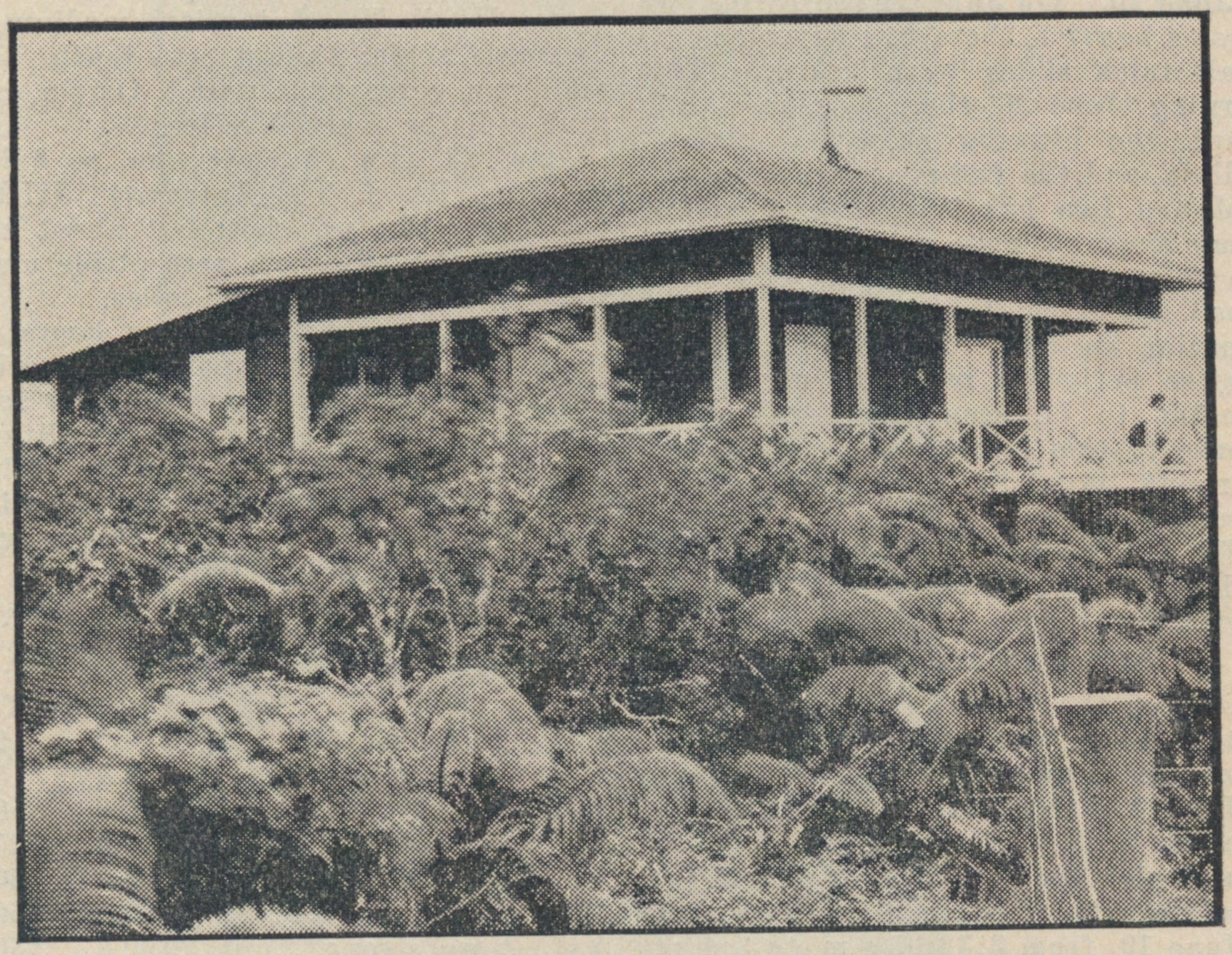
Those in charge of the Observatory at the Volcano have prepared a table explaining the Cancani dynamical scale by which seismic intensity is measured. The scale is based on millimeters per second. The intensity of acceleration from one given point to another in the scale enables the observers to state definitely the system of the shock, as follows:

		From	To
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	25.0	50.0
VII.	Very strong 100.0		250.0
VIII.	Ruinous 250.0		500.0

Inner cone and pit at Halemaumau, as seen from the concrete pier on the observatory porch. Daily photographs are taken of this scene to show changes in fumes, clouds and atmospheric conditions.

WEEKLY REPORT OF HAWAIIAN VOLCANO OBSERVATORY

From the Pacific Commercial Advertiser, June 30, 1913.



Hawaiian Volcano Observatory. The observatory is largely supported by the Hawaiian Volcano Research Associa tion, made up of leading citizens of the Territory. Photos by T. A. Jaggar, Jr.

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T. A. JAGGAR, Jr., Director.

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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.

Inner cone and pit at Halemaumau, as seen from the concrete pier on the observatory porch. Daily photographs are taken of this scene to show changes in fumes, clouds and atmospheric conditions.

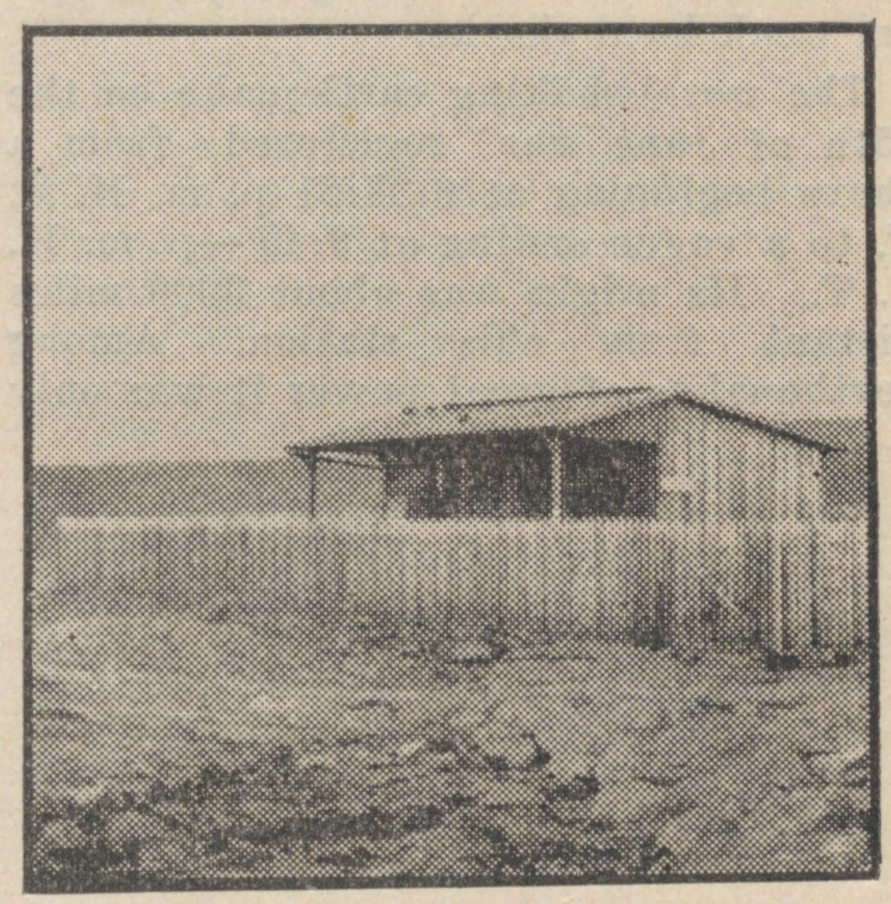
WEEKLY REPORT OF HAWAIIAN VOLCANO OBSERVATORY

From the Pacific Commercial Advertiser, July 7, 1913.

TECHNOLOGY STATION, Kilauea, July 3.—The reported activity of Vesuvius, June 29, adds another to the list of eruptions following the solstice. At Kilauea, June 27, between 11:30 a. m. and 2:30 p. m., the blowing noises had ceased to be audible, and subsidence of the lava was indicated by heavy avalanches and small slides from the N.E. side of the bottom of the pit. The fumes appeared heavier and were irrespirable on the east and south edges of the pit. June 29 the avalanching had diminished and a faint blowing was heard again.

June 30, at 11 a. m., a prolonged hissing occurred at intervals of about 50 seconds, each hissing lasting from 20 to 30 seconds. It appeared to come from about the middle of the bottom area, and was heard best on the north or windward edge. Rare light sliding of rocks was heard and one avalanche at 11:40 a. m. Below the north station the wall far down could be seen flaring inward, the talus has slipped far below where it was in March last, and there is a sulphurous patch high under the west station. The N. bench 60 feet down is all gone except a clinging remnant 3 to 4 feet wide under the N sta-

INSTRUMENT SHELTER,
Built on the north edge of Halemaumau.



TECHNOLOGY STATION,
The building on the lava near the edge of the fire pit.

tion. The Postal Rift at 2 p. m., June 30, 1913, had a temperature of 316 Cent., a fall of only 7 C. since April 1.

July 1, between 10:30 a. m. and noon, two long slides and a number of small slides were heard and some hissing could be heard from time to time lasting from 10 to 15 seconds.

The first reports of work done at this station by Mr. Perret in 1911 have been published in the American Journal of Science monthly February to June, 1913.

Some Activity.

Up to the time of writing no response of the magma column to the culumination of stress on this date, mentioned in the last report, has been noted other than this—that the sounds of eruption, chiefly hoarse breathing noises, which had become inaudible on June 27, have again increased in energy. In view of the general low stage of eruption at present, more than this could scarcely be looked for with confidence. Large talus-avalanches, usually considered to indicate sinking magma, have been heard several times in the past week.

Seismic Records.

The routine report of the Whitney Laboratory of Seismology follows:

Up to June 30 six shocks have been recorded, the first being the strong teleseism mentioned last week, the others weak local shocks.

The world-shaking earthquake on the 25th of June was registered from a sharp beginning at 6:33:51 p. m. H. S. T. to a vague ending at 8:45 —p. m. H. S. T. Its origin was about 3000 miles distant from this station. Among earthquakes of great power it was only a moderate shock.

June 28, from 5:58:27 p. m. to 6:02 p. m. H. S. T. Intensity, III-IV Cancani scale; not felt, but about the value of the minimum perceptible unit. Origin distant about 30 miles.

June 29, from 11:32:03 a. m. to 11:32:15 a. m. H. S. T. Intensity, low III Cancani scale; about 0.6 the minimum perceptible unit. Distance of origin indeterminate.

June 29, from 11:32:20 a. m. to 11:32:27 a. m. H. S. T. Intensity, III-IV Cancani scale; not felt, but about the value of the minimum perceptible unit. Distance of origin indeterminate.

June 29, from 11:34:10 a. m. to 11:34:31 a. m. H. S. T. Intensity, medium III Cancani scale; about 0.7 to 0.8 the minimum perceptible unit. Distance of origin indeterminate.

June 30, from 11:12:27 a. m. to 11:13:5 a. m. H. S. T. Intensity, low I Cancani scale; about 0.1 the minimum perceptible unit. Origin distant about 25 miles.

Also in July two local shocks have been registered.

July 1, from 9:27:00 a. m. to 9:29:54 a. m. H. S. T. Intensity, medium III Cancani scale; about 0.8 the minimum perceptible unit. The registration of this shock was witnessed and it definitely was not perceptible to the senses. Origin distant about 30 miles.

July 1, from 2:21:06 p. m. to 2:21:36 p. m. H. S. T. Intensity, medium I Cancani scale; about 0.2 the minimum perceptible unit. Distance of origin indeterminate. Very respectfully,

T. A. JAGGAR, JR., Director.

WEEKLY REPORT OF HAWAIIAN VOLCANO OBSERVATORY

From the Pacific Commercial Advertiser, July 14, 1913.

TECHNOLOGY STATION, Kilauea, July 10.—Earthquakes have been reported in Italy with some damage to buildings; this brings the number of districts in the world where seismic and volcanic disturbances of an unusual sort have been reported up to six, without counting those places which have not attracted newspaper notice. All of these happenings have come at a time when the earth was under nutation strain by reason of the sun's northing. The observers at the Hawaiian Volcano Observatory expected some change of activity at Kilauea at this season, because of the record of the volcano since the return of the lava in the autumn of 1907, the record showing rise winter and summer and subsidence spring and autumn, as follows:

Winter 1907-1908, rising lava.
Spring 1908, moderate.
Summer 1908, increase.
Autumn 1908, collapse.
Winter 1908-1909, high.
Spring 1909, lower.
Summer 1909, higher.
Autumn 1909, subsidence.
Autumn and winter 1909, high.
Spring 1910, low.
April and June 1910, high.
Summer and autumn 1910, lower.
Winter 1910-1911, moderate.
Spring 1911, no measure.
Summer 1911, high.
Autumn 1911, low.
Winter 1911-1912, highest.
Spring, 1912, lower.
Summer 1912, high.
Autumn 1912, low.
Winter 1912-1913, higher.
Spring 1913, very low.

It will be seen that this has been fairly systematic, the exceptions being the two cases capitalized. The beginning of this period of activity followed within nine months the cessation of activity on Mauna Loa.

Kilauea during the past week shows no change. July 4, 1913, two avalanches were heard about four o'clock in the afternoon, and an occasional very deep booming from the lava in the depths. On the afternoon of July 7 one avalanche at the W. was heard at three o'clock, and rare faint blowing sounds. On July 9 the blowing was more distinct. At some time during June, 1913, a large portion of the S.E. high rim of Halemaumau has fallen, removing a formerly protruding crag.

Seven Earthquakes Recorded.

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

Seven earthquakes have been registered here during the interval covered; two of these were very feeble teleseismic movements, the others weak local shocks.

July 4, from 8:22:40 a.m. to 8:23:32 a.m. H. S. T. Intensity, III-IV Cancani scale; not felt but about the value of the minimum perceptible unit. Origin distant about 21 miles.

July 6, from 2:59:23 p.m. to 2:59:58 p.m. H. S. T. Intensity, III-IV Cancani scale; not felt but about the value of the minimum perceptible unit. Origin distant about 16 miles.

July 7, from 7.15:26 a.m. to 8.33 a.m. H. S. T. Intensity, locally very slight, probably of only moderate energy at its origin, for a strong shock. Origin distant not less than 2200 miles nor more than 3900 miles phases ill-defined so that more precise determination is impossible.

July 8, from 1:55:38 p.m. to 2:35 p.m. H. S. T. This shock had only moderate energy, for a strong shock, at its origin; very feebly registered here.

Distance of origin cannot be determined.

July 9, from 2:24:00 a.m. to 2:25:03 a.m. H. S. T. Intensity, medium III Cancani scale; about 0.75 the minimum perceptible unit. Origin distant about 26 miles.

July 9, from 5:08:59 a.m. to 5.10:35 a.m. H. S. T. Intensity, I-II Cancani scale; about 0.25 the minimum perceptible unit. Origin distant about 22 miles.

July 9, from 6.35:44 a.m. to 6:37:11 a.m. H. S. T. Intensity, I-II Cancani scale; about 0.25 the minimum perceptible unit. Origin distant about 25 miles.

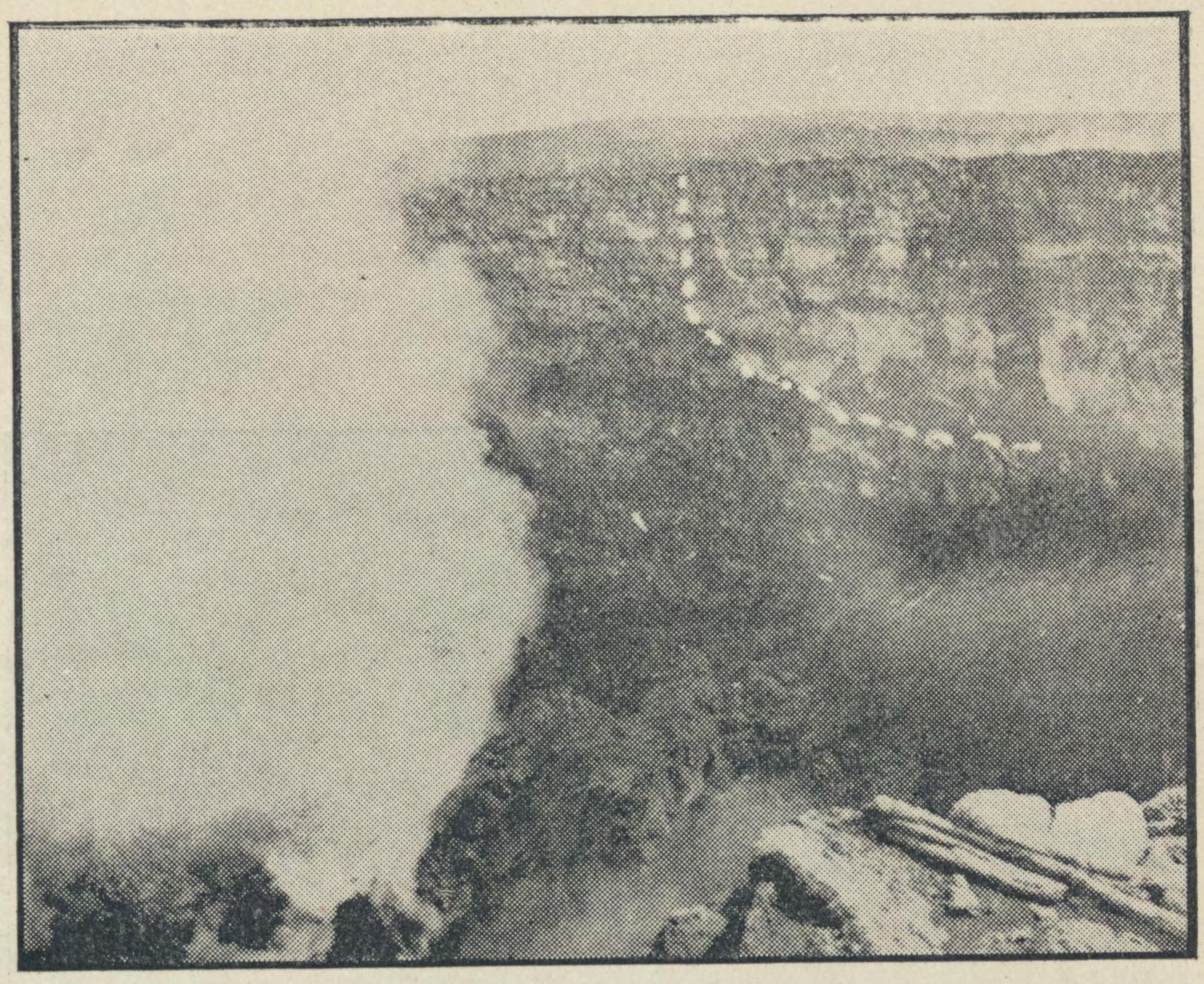
T. A. JAGGAR, Jr.,
Director.

VIEWS SHOWING ACTIVITY IN PIT OF KILAUEA.

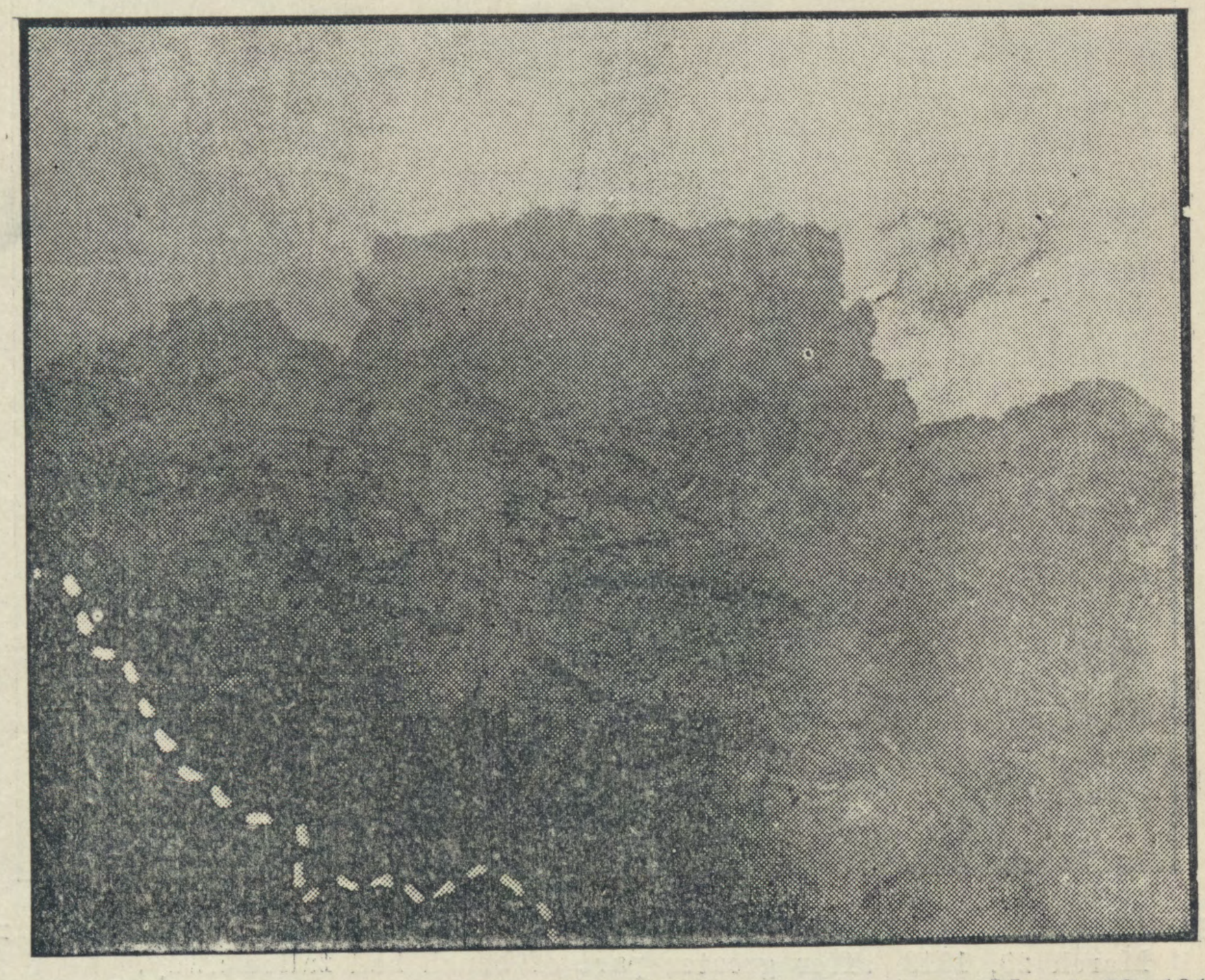
(Photographs by Prof. T. A. Jaggar, Jr.)

First Stage: S. Bench of 1912; lookin g down from S. Station 11 a. m., Jan. 14, 1913. White line shows what fell away in second stage.

Second Stage: S. Bench of 1912; looking down from S. Station 11 a. m., March 29, 1913, after greater part of bench had fallen away.



S. part Halemaumau pit Dec. 3, 1912. From S. W. Station. Portion marked by white line has fallen during June, 1913.



Looking eastward and down from Old Rest-house 6:10 p. m., March 23, 1913. Entire bench beyond white line fell during week following.

WEEKLY BULLETIN OF HAWAIIAN VOLCANO OBSERVATORY

From the Pacific Commercial Advertiser, Honolulu, July 21, 1913.

TECHNOLOGY STATION, July 17. —The only noteworthy change in the behavior of Halemaumau during the past week has happened during the last twenty-four hours, when the blowing noises became louder. Since the last report the crater has remained smoky, the fumes acrid and unbreathable, the noise a faint rhythmic blowing, and rock slides few.

It may be of interest to state here briefly the present condition of the 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.

Source of Support.

There are twenty-six subscribers in Hawaii and Massachusetts, both 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 will publish the quarterly reports.

From now on 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. L. A. Thurston is chairman of the active committee of the subscribers and C. H. Cooke 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 by every legitimate means the establishment of volcano observatories all over the world.

Fourteen Earthquakes.

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

During the interval covered by this report fourteen earthquakes have been registered at the observatory; all were of local origin and four wrote records of considerable amplitude.

July 9, from 4:55:10 p. m. to 4:56:54 p. m. H. S T. Intensity, medium I Cancani scale; about 0.15 the value of the minimum perceptible unit. Origin distant about 12 miles.

July 10, from 3:07:03 p. m. to 3:07:12 p. m. H. S. T. Intensity, I-II Cancani scale; about 0.25 the minimum perceptible unit. Origin distant about seven miles.

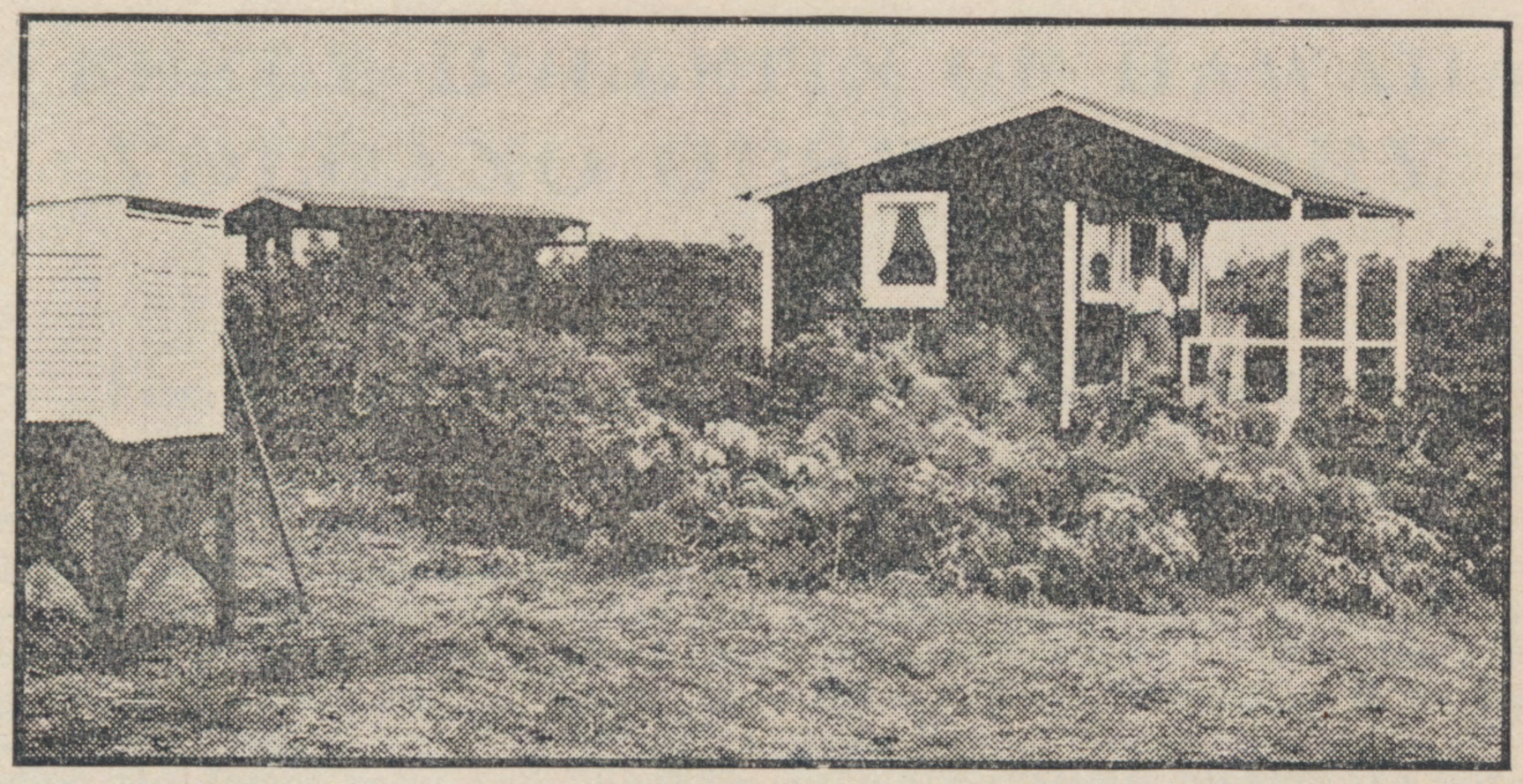
July 10 from 4:54:51 p. m. to 4:56:03 p. m. H. S. T. Intensity, low I Cancani scale; about 0.07 the minimum perceptible unit. Origin distant about 30 miles.

July 11, from 4:06:34 p. m. to 4:07:39 p. m. H. S. T. Intensity, high I Cancani scale; about 0.2 the minimum perceptible unit. Origin distant about 13 miles.

July 11, from 10:19:24 p. m. to 10:20:45 p. m. H. S. T. Intensity, medium I Cancani scale; about 0.1 the minimum perceptible unit. Origin distant about 13 miles.

July 12, from 1:31:30 a. m. to 1:33:03 a. m. H. S. T. Intensity, medium I

CLIFF-WALL UNDER THE OBSERVATORY.



COTTAGE AND INSTRUMENT SHELTER OF HAWAIIAN VOLCANO OBSERVATORY.

Cancani scale; about 0.1 the minimum perceptible unit. Origin distance is indeterminate.

July 12, from 2:29:42 a. m. to 2:30:31 a. m. H. S. T. Intensity, low I Cancani scale; about 0.06 the minimum perceptible unit. Origin distance is indeterminate.

July 12, from 3:39:32 a. m. to 4:02:17 a. m. H. S. T. Intensity, III-IV Cancani scale; not felt here, but about the value of the minimum perceptible unit. Felt at Kapapala. Origin distant about 30 miles.

July 12, from 4:37:03 a. m. to 4:38:48 a. m. H. S. T. Intensity, low I Cancani scale; about 0.06 the minimum perceptible unit. Origin distant about 10 miles.

July 13, from 8:06:57 a. m. to 8:08:49 a. m. H. S. T. Intensity, II Cancani scale; about 0.4 the minimum perceptible unit. Origin distant about 30 miles.

July 13, from 11:50:03 a. m. to 11:50:55 a. m. H. S. T. Intensity, low I Cancani scale; about 0.1 the minimum perceptible unit. Origin distance is indeterminate.

July 18, from 5:14:43 p. m. to 5:15:28 p. m. H. S. T. Intensity, low I Cancani scale; about 0.06 the minimum perceptible unit. Origin distance is indeterminate.

July 14, from 9:59:56 p. m. to 10:00:45 p. m. H. S. T. Intensity, medium I Cancani scale; about 0.1 the minimum perceptible unit. Origin distance indeterminate.

July 15, from 1:28:50 p. m. to 1:30:39 p. m. H. S. T. Intensity, III-IV Cancani scale; about the value of the minimum perceptible unit, though not felt here. For one value of the amplitude the acceleration rises far about the value of the minimum perceptible unit, but this probably was caused by a superposition of thrusts in succession, for such a value, if real, would have been felt generally. Origin distant about 14 miles.

Very respectfully,

T. A. JAGGAR JR., Director.

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Expressed by accelerations measured in millimeters per second.

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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.

The Whitney Laboratory of Seismology is equipped with two Bosch-Onori 100ky tromometers registering N-S and E-W motion, a heavy Onori tromometer registering E-W motion and an Onori "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 Onori two-component tromometer with light steady masses is mounted on a concrete pier placed directly on the fresh lava surface.

WEEKLY BULLETIN OF HAWAIIAN VOLCANO OBSERVATORY

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

TECHNOLOGY STATION, July 24. —The week at Kilauea began without marked change, the pit smoky and the glow of the lava or burning gases invisible beneath a mantle of crust and rock tumble, as in the weeks past. An important change took place July 23, and the visible fire returned. About June 19, 1913, glow and flames in cavities were last seen during a short-lived rise, which came to an end within a few days. The active lava pool of the past winter subsided and crusted over early in April, and since that time has been hissing and rumbling at a depth of over 600 feet below the 3700-foot contour, the level of the north rim of Halemaumau.

The slight increase of blowing noise reported last week for Thursday, July 17, did not develop any great intensity. July 18 blowing could be heard by listening intently near the Old Resthouse on the north rim, the puffs lasting from 8 to 13 seconds. About 11:30 a.m. and 11.45 a.m., two rock-slides were heard, lasting each about four minutes. July 20 the noises were a little stronger but there was very little sliding. July 22 the blowing noise was very faint, and could not be heard at all from the east side of the pit. Throughout the period from July 17 to July 22 the fumes rose in dense clouds of hard outline.

Signs of a Rise.

On the morning of July 23 the fume cloud as seen from the Observatory appeared less dense, smaller and of softer outline. The wind-eddy opened from time to time the southeast half of the pit, so that the walls, the low-lying talus at their foot and the inner ring of fuming holes could be clearly seen. At 11 a.m. from the S. and SE. stations strong hissing noises from the bottom area could be heard every 60 to 70 seconds and lasting from 5 to 10 seconds. The fumes as seen from the edge appeared much thinner and their odor was much less acrid and more breathable, than of late. These changes have all been observed in the past to be the characteristic of rising lava.

At 4:30 p.m. July 23 the hissing was still louder accompanied by an occasional deep rumbling note like subterranean lava in a cavern. The blowing had become almost continuous with a rhythmic puff-puff like a freight engine on a steep grade interrupted every now and then by a long hiss. The short puffs were at intervals of about two-fifths of a second. The recurrent deep grumble was timed and found to have no regularity, the intervals being 20, 30, 35, 90 seconds, etc. Occasional light rock slides were heard, principally NE, W and N.

The Postal Card Rift at 6 p.m. had a temperature of 313 degrees C., a fall of 3 degrees sine June 30, 1913.

After dark at 8 p.m., July 23, a glowing and probably flaming chimney was seen in the northeast part of the bottom area of the pit during temporary clearings of the fume-cloud. It appeared to be in the location whence the blowing noises proceeded and about where the Old Faithful fountain was last seen. It was seen from the E, SE, S and SW stations.

For the Whitney Laboratory of Seismology Mr. H. O. Wood reports the somewhat unusual condition that there have been no earthquakes registered during the past week. Very respectfully, T. A. JAGGAR, Jr., Director.

THE LAVA POOL WHEN LAST SEEN.

Feb. 24, 1913 at 8 p. m., from the East. Two great torrents of melt were pouring around an island from West to East.

Cancani Scale of Seismic Intensity.

Expressed by accelerations measured in millimeters per second.

I.	Instrumental . .	0.0	2.5
II.	Very slight	2.5	5.0
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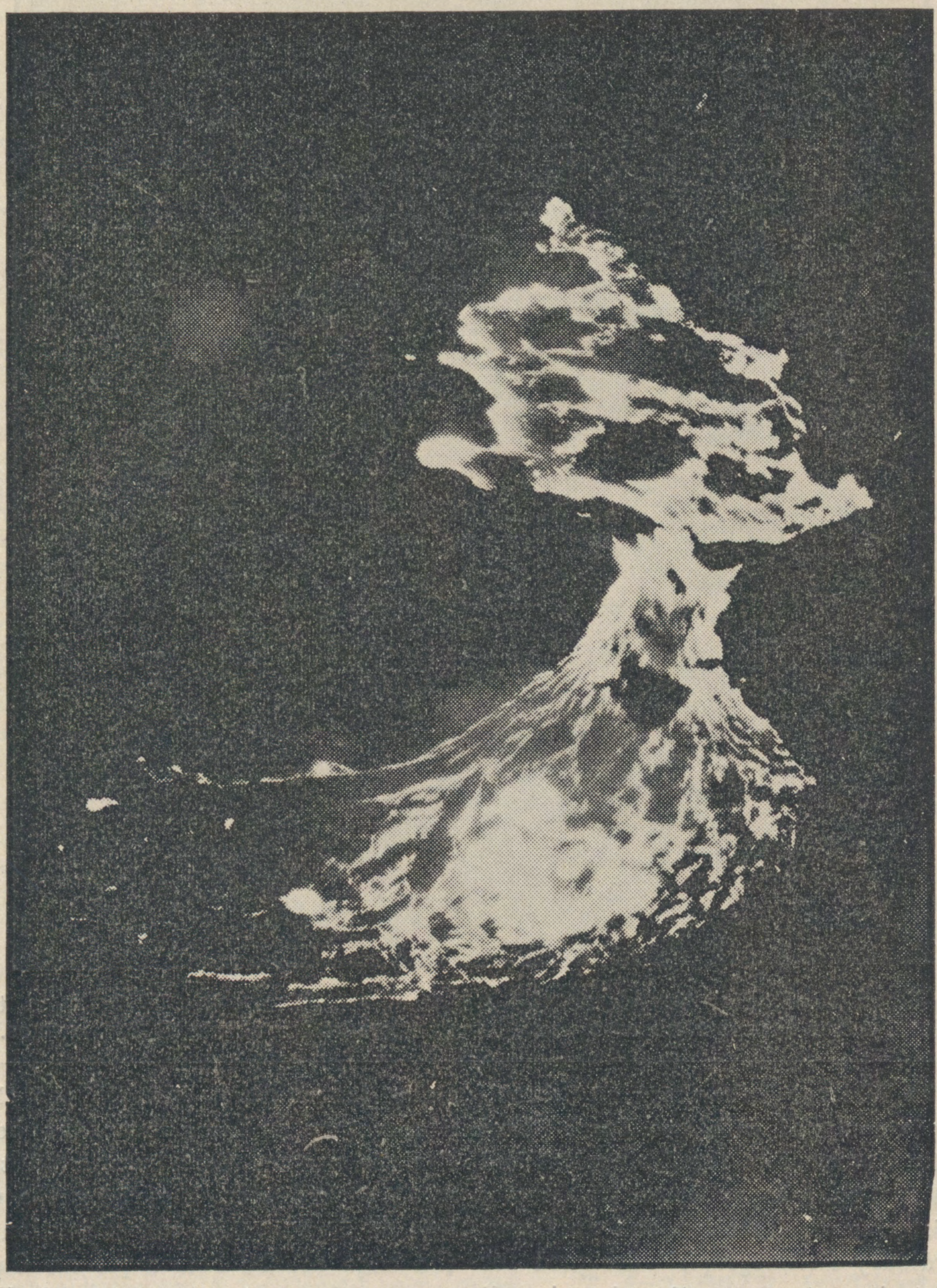

The Lava Pool at 9 a. m., Feb. 26, 1913, from the East. The island has become a peninsula, on the left.

The Lava Pool after temporary rise at 9 a. m., March 10, 1913, from the East. After this it sank away and became gradually obscured by fumes.

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WEEKLY BULLETIN OF HAWAIIAN VOLCANO OBSERVATORY

From the Pacific Commercial Advertiser, Honolulu, August 4, 1913.

TECHNOLOGY STATION, Kilauea, July 31.—The glowing chimney in Halemaumau seen last week was short-lived. On the morning of Thursday, July 24, from ten o'clock to noon noises of hissing, rumbling and pulsating exhausts were audible as on the previous day. Heavier and more continuous avalanches of rock took place, sometimes continuing for five minutes or longer, especially on the west side of the pit. In the morning the fumes appeared as before, relatively thin, but in the afternoon they appeared denser, with hard edges to the rising billows. These signs were all indicative of subsiding lava beneath. In the evening continued avalanches were reported and no glow was seen.

Heavy Avalanches Witnessed.

On July 25, from ten o'clock to noon, the fumes rose straight up with little wind, overriding the edges first east, then west. Further confirmation of subsidence after the rise of two days before was presented by the acridity of the fumes to any one breathing them, the sulphuric acid being very strong, whereas on July 23 the smoke had been respirable. About eleven a.m. by a rare chance of the eddying fumes the whole bottom tract of Halemaumau was seen clearly. It was an immense flat funnel of slide-rock with the inner talus continually sliding. There was no hole in the middle, but the fumes rose from orifices in the rock tumble about the periphery of the slide-rock area.

One fumarole high on the west wall is cemented with plastered lava, moulded in talus which has now slipped away to a lower position. The bare, steep rock walls extend down from two to four hundred feet almost sheer, and in places with some overhang. By good fortune the writer saw one very heavy avalanche of talus when the entire funnel ring slid inward with a tremendous roar which could be heard at a considerable distance away from the pit, and clouds of brown dust were thrown up in the center. The effect was as though the lava floor under the talus were withdrawing its support by subsidence. The slide lasted a full minute.

On this date a grumbling noise like pounding lava deep down was heard the sound becoming almost continuou after eleven a.m. At ten-thirty in the morning from the East an occasional faint blowing was heard. After eleven o'clock the fumes closed in and the pit was obscured.

Uwekahuna Moving.

At nine-fifteen in the morning July 25 a landslide was seen from the observatory on the west wall of Kilauea south of Uwekahuna Bluff. At the foot of this cliff on the lava floor there are two talus cones, and the slide augmented the southern and lighter colored one. The source of the slide at the top of the cliff was seen to be one of the Uwekahuna cracks, suggesting that those cracks are perhaps "working," that is, the great rock spalls on the side of the subsiding lava of the pit may be tending to slip down a little. There is a series of such spalls under Uwekahuna Bluff making terraced steps in the wall of Kilauea Crater. Light brown dust rose from the slide, and similar dust clouds marking slides at the same place arose repeatedly during the day and the following four

days. At eleven forty-five a.m. July 27, there was a strong slide there.

Saturday, July 26, at 8:30 a.m. sliding rocks in Halemaumau could be heard occasionally, the fumes were strong, and partial views of the bottom area from the southeast and south stations showed nothing new. From the north a very faint and rare breathing noise was heard, but the dominant noise was sliding stones. The Postal Rift at ten-thirty a.m. had a temperature of 313 degrees C., temperature of the air 20 degrees C.

On July 29, at three-twenty p.m., the temperature of the Postal Rift remained the same, 313 degrees C. On this date there was a slight rumble from the pit, having tendency to the Old Faithful period (40 seconds). The new Uwekahuna slide was examined and photographed; it was found that a chasm at the top of the cliff is extending itself northward in the direction of the many parallel cracks.

Six Shocks Recorded.

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

Since the last report six local earthquakes have been registered here, none of which was strong enough to attract the notice of any person. In all cases the amplitude of movement was small, but in two cases it was unusually rapid, denoting a relatively high acceleration.

July 25, from 11:29:57 p. m. to 11:31:22 p. m. H. S. T. Intensity, very low I Cancani scale; less than 0.1 the minimum perceptible unit. Origin distant about 47 miles.

July 27, from 9:16:40 a. m. to 9:18:25 a. m. H. S. T. Intensity, medium I Cancani scale; less than 0.2 the minimum perceptible unit. Origin distant about 50 miles.

July 28, from 10:03:08 p. m. to 10:03:44 p. m. H. S. T. Intensity, doubtful—acceleration measures twice the minimum perceptible unit, but the amplitude was very small and the shock was not felt—the motion was exceedingly rapid. Origin distant about 12.5 miles.

July 29, from 12:44:08 (midnight) to 12:44:51 a. m. H. S. T. Intensity, doubtful—higher acceleration than that of the minimum perceptible unit, but not felt—motion very rapid. Origin distant about 13 miles.

July 29, from 6:07:48 a. m. to 6:09:15 a. m. H. S. T. Intensity, medium III Cancani scale; about 0.5 the minimum perceptible unit. Origin distant about 12.5 miles.

July 29, from 6:37:20 a. m. to 6:38:35 H. S. T. Intensity, medium III Cancani scale; about 0.8 the minimum perceptible unit. Origin distant about 18.6 miles.

Besides these feeble earthquakes there has been a noteworthy registration of the motion due to volcanic vibration. At this station this motion is seldom or never absent completely from the seismogram. There are, however, sporadic waxings in amplitude which give rise to conspicuous groups of waves which may run for a few seconds up to several minutes, rarely longer. Fundamentally these do not differ from weak local earthquakes, except perhaps in point of causation; but on the seismogram they differ from typical earthquake records because they increase in amplitude gradually from minimum to maximum and then decrease gradually again. Thus they do not present the well-marked phases commonly distinguishable even with very feeble nearby shocks.

Since July 18 there have been registered between 125 and 150 distinct groups of these vibrations. This is at least twice as many groups as for any corresponding interval, probably three times as many. Also the energy of these groups has been far greater than usual. In one instance the acceleration measures nearly twice the minimum perceptible unit, but as in the cases of the shocks discussed above this is due to exceedingly rapid motion, not to moderately large amplitude, and consequently such motion was not actually perceptible. No interpretation of the meaning of this marked augmentation in volcanic vibration can be hazarded.

Very respectfully,

T. A. JAGGAR JR., Director.

VIEWS TAKEN AT KILAUEA.

Upper—Blister lava. An extraordinary flow which solidified in a hollow shell in the northeast part of the Kilauea lava field.—Lower—Sulphur crystals in cavities at the Sulphur banks, Volcano House.

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WEEKLY BULLETIN OF HAWAIIAN VOLCANO OBSERVATORY

From the Pacific Commercial Advertiser, Honolulu, August 11, 1913.

TECHNOLOGY STATION, KILAUEA, August 7.—No important changes have taken place at Halemaumau. On Thursday, July 31, there was some blowing noise in the pit and a few rock slides. On August 1 there was a rumbling noise from the depths resembling thunder, more or less continuous. On both days the fumes were dense.

On the evening of August 1, at about six o'clock, there was a rock fall at the new slide from the wall of Kilauea Crater south of Uwekahuna Bluff. Sharp tilting of the ground northward was recorded by the seismographs during the night. In the early morning of August 2 two more rock slides were reported at this place.

August 3 at the pit no noise at all was audible in the afternoon, and there was very little talus sliding. On Monday, August 4, there was blowing and rumbling. August 5, from one to three p. m., the blowing noise was almost continuous as heard from the north rest-house. The fumes appeared thinner from a distance, but were not easily respirable on the edge. A thunderous reverberation accompanied the puffing. The latter had no rhythmic quality, but seemed to wax and wane with the thundering of lava in caverns. The puffing was in general of the "freight engine" kind.

August 5, at four p. m., the temperature of the Postal Rift was 313 degrees C.

August 6. at three p. m., the noise had diminished. There was thudding and rumbling and a rare breathing noise. It could be heard only on the windward edge, and occasionally augmented. There were no avalanches and the fumes were irrespirable and dense. There was no good seeing. The rumbling was nearly continuous, but not loud. At five p. m. the fumarole high on the western wall was seen to be smoking strongly, with sulphur stain. At four-thirty p. m. the intervals between the beginnings of the rumbling sounds were timed and found to vary from twenty to fifty seconds, and the duration of each rumble varied from five to fifteen seconds.

The fuming vents on the high northeastern slope of Mauna Loa were plainly visible from the Observatory at sundown on the evenings of August 5 and 6.

Large Lava Tube Explored.

A notable happening of the week was an exploration on the morning of August 2, by a party headed by L. A. Thurston, of a large lava tube or cavern leading northeast from the bottom of Kaluaiki Crater, the northern of the twin craters. This cave opens from the wall twenty-five feet above the ground and extends 1914 feet about N. 55° E. It is some twelve feet in diameter at the entrance, of nearly circular section, with a flat floor like a masonry water conduit.

Chambers within the tube are thirty feet wide and eighteen feet high. The floor is encumbered in two or three places with tumble from the roof, one of these opening a shallow shaft to daylight, but otherwise for a third of a mile a man may walk erect through the tunnel. Stalagmites in groups of spires dot the floor in places, one to two feet high and four to six inches across at the base, and corresponding stalactites are suspended from the roof. These accretions are of the water-made variety. The tunnel ends abruptly in a wide chamber with roof sloping down to the floor.

No Local Shocks Recorded.

For the Whitney Laboratory of Seismology, H. O. Wood submits the following report:

During the past week no local earthquakes have been recorded and there

has been nothing noteworthy about the registration of the local volcanic vibration. Sharp earth-tilt has been recorded, but not more notably than on former occasions.

During the week three teleseismic records have been written. In all three cases the energy transmitted to this station was slight, so that the earlier phases were not well delineated; consequently no accurate measure of origin distance is possible in any of the cases. It is sure that these shocks were not of unusual power in the vicinity of their origins, though of course they were strong shocks. They were registered as follows:

THE LAVA POOL WHEN LAST SEEN.

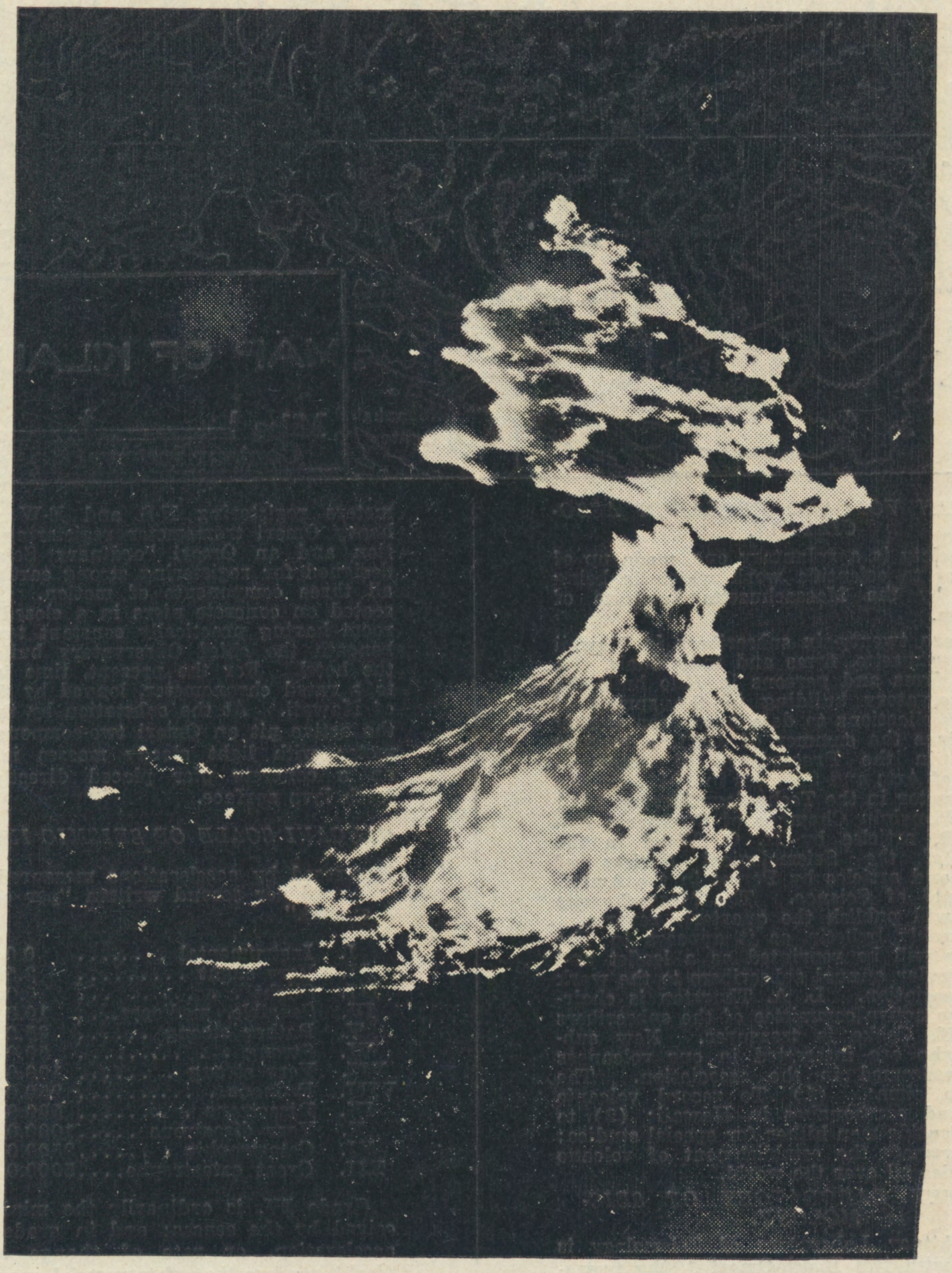
Feb. 24, 1913 at 8 p. m., from the East. Two great torrents of melt were pouring around an island from west to east.

July 31, from 5:32:37 a. m. to 5:45 approx. a. m. H. S. T. Only the chief-phase action was registered.

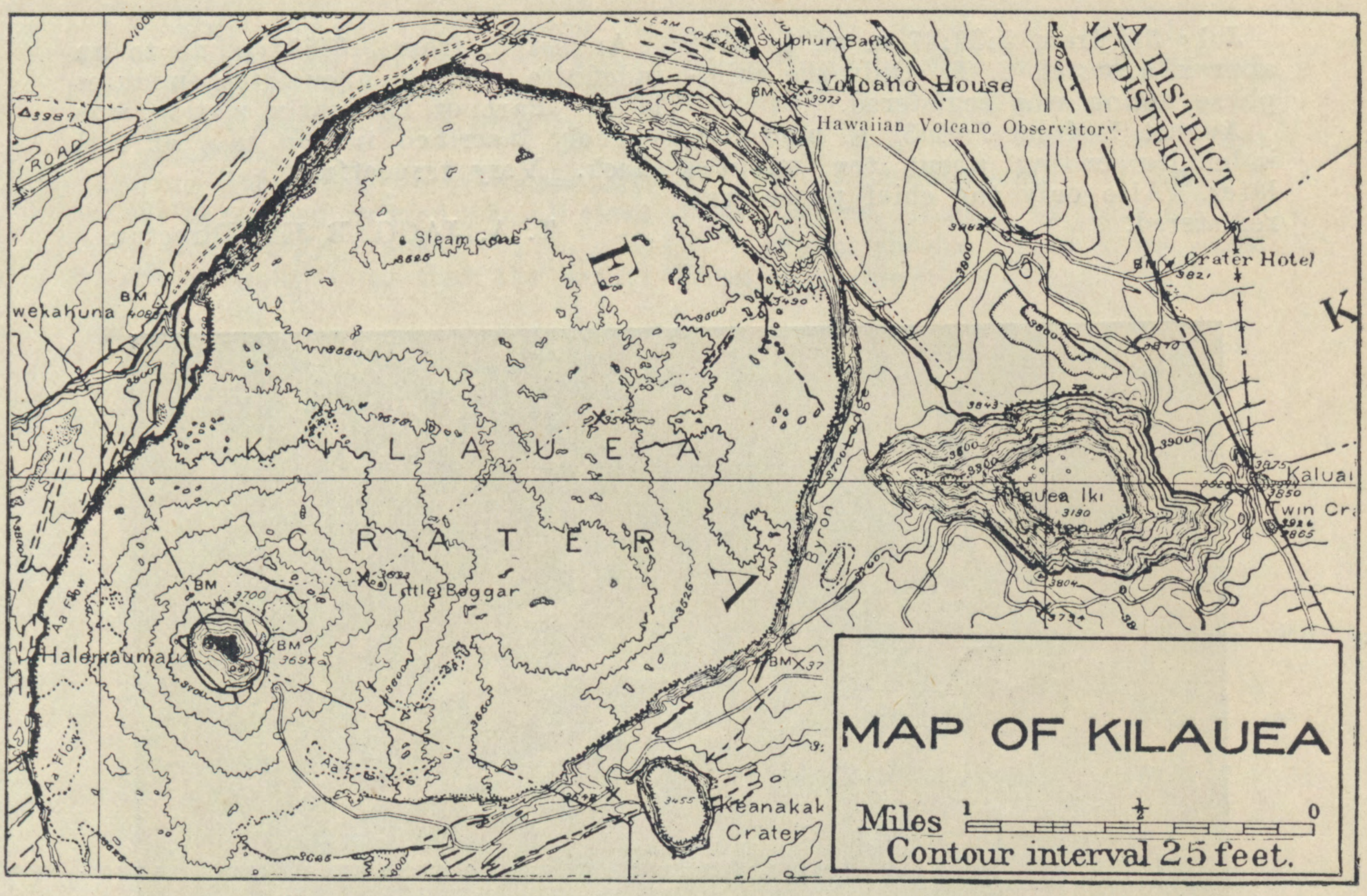
August 1, from 7:01:37 a. m. to an indefinite ending about ten minutes later. Also only the chief phase was registered.

August 5, from 3:31:32 p. m. to an indefinite ending about ten minutes later. Part of the early motion was vaguely inscribed in the case of this shock. Very respectfully,

T. A. JAGGAR JR., Director.



The Lava Pool at 9 p. m., Feb. 26, 1913, from the east. The island has become a peninsula, on the left.



HAWAIIAN VOLCANO RESEARCH ASSOCIATION.

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There are twenty-six 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 will publish the quarterly 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. L. A. Thurston is chairman of the active committee of the subscribers and C. H. Cooke 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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II.	Very slight	2.5	5.0
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WEEKLY BULLETIN OF HAWAIIAN VOLCANO OBSERVATORY

From the Pacific Commercial Advertiser, Honolulu, August 18, 1913.

TECHNOLOGY STATION, August 14.—The inner lava pit of Kilauea, Halemaumau, continues in a state of repose, the only mark of activity of the lava beneath being clouds of whitish fume which either fill the pit, diffused by the strong tradewind, or eddy over the edge at one or more places so as to leave one side open to view. The most common point of view under the northeast trade is from the south or southeast, and here one looks down into an enormous caldron, with vertical walls extending down two to four hundred feet, beyond which slide-rock continues down funnelwise to where the fumes are seen rising through the tumble of talus. Beyond all is concealed by the fume-fog.

During the last three months the only marks of activity which have fluctuated have been noises of blowing and rumbling, greater or less suffocating quality to the fumes when breathed, and very rare glimpses of flame seen two or three times at night. The sliding of talus blocks, either heard or seen, increases when the bottom is sinking.

Unusually Quiet Conditions.

The past week has been unusually quiet, corresponding with a marked cessation of local earthquakes for three weeks past. On August 10, at eleven forty-five a.m. there was no noise except a weak working of the W talus. At ten a.m., August 11, there was not even any sliding heard. On August 12 at four p.m. one or two blocks of rock were heard slipping, but otherwise all was quiet. The fumes seemed a little more breathable. Today, August 14, at eleven a.m., four fumaroles around the bottom area could be seen S. SE and E, the southeastern one emitting white fume very vigorously.

The talus was sliding a little W, the fumes were very irrespirable, and there was no blowing or rumbling.

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

Local seismic action continues to be of slight energy. During the interval covered by this report no local earthquakes have been registered and no noteworthy tilting or volcanic-vibration groups have been recorded. During the past three days microscopic waves have been strong, but not of unusual energy.

Peruvian Earthquake Recorded.

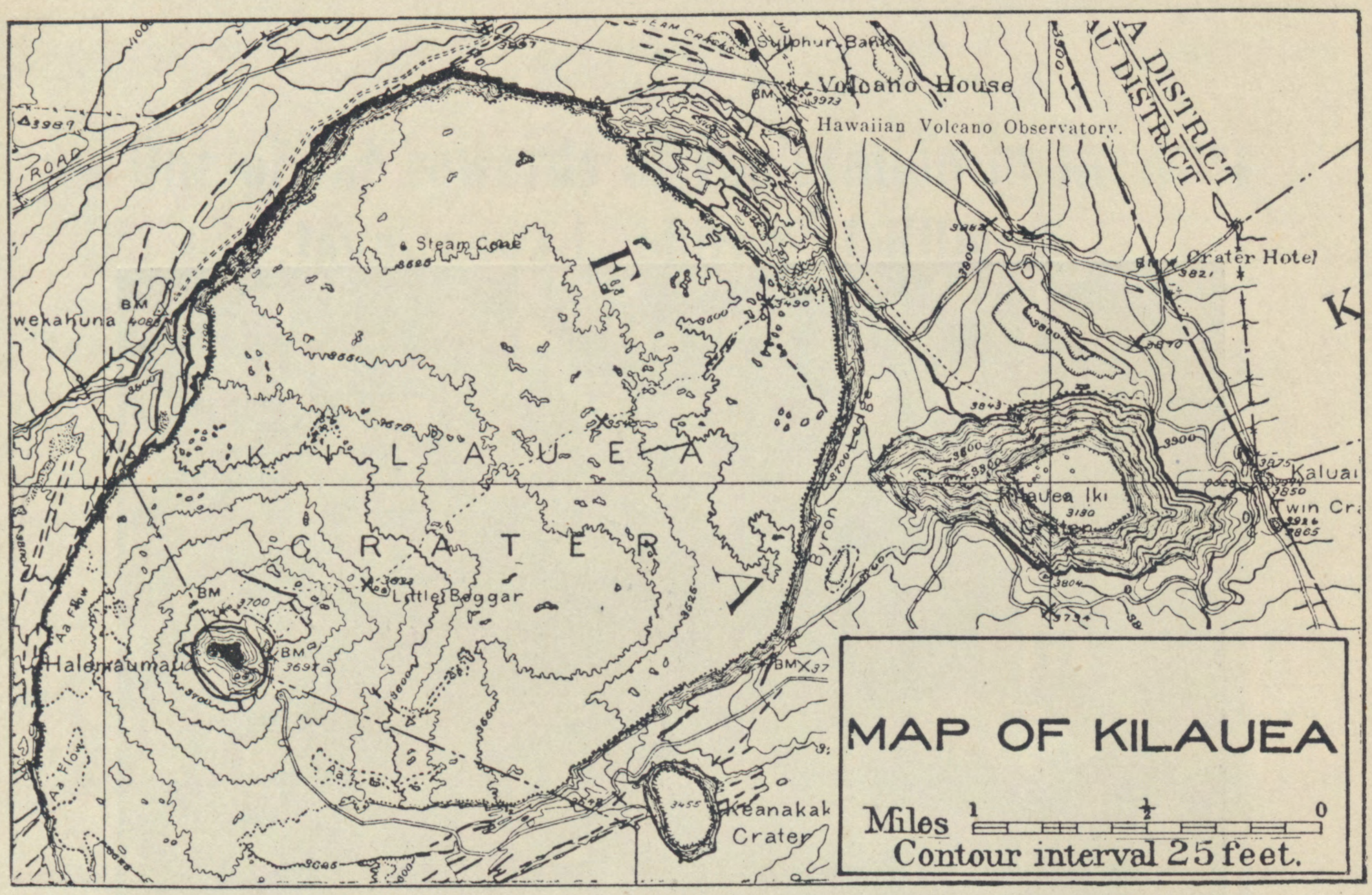
The strong earthquake of August 6, reported from Caraveli in West-central Peru, was registered here. It wrote a peculiar record. The first phase, beginning sharply at 12:06:17 (noon) H. S. T., was unusually vigorous and of unusually large amplitude, but it died away quickly and became lost to view completely, among moderate microscopic waves, except in the north-south component. No indication of the registration of the second phase can be discerned on any of the seismograms. The chief phase began vaguely, but surely, at about 12:23:20 p.m. H. S. T.; except in the north-south component in which its beginning was very vague. This interpretation of the record is justified by the periods of waves measured, as well as by the fact that the time interval between the beginning of the first and chief phases, thus interpreted, denotes a distance for the origin of somewhat over 4000 miles—a close approximation to the actual value. In appearance, however, the record more closely resembles a record of the chief phase of two weak distant shocks with a short time interval intervening, so strong relatively is the motion of the first phase. A reasonable interpretation of this record would point to a very short, sharp shock of moderate destructive energy at the source, so that the energy of the chief phase, and especially of the second phase, would be relatively slight. Motion of this shock was not registered later than 1:35 p.m. Very respectfully;

T. A. JAGGAR, Jr.
Director.

One of the rewards of exploration in the vast lava-crusted caldron of Kilauea.

Looking out through the entrance of Keanakakina (Thurston's Cavern).

Looking into en trance of Keanakakina



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WEEKLY BULLETIN HAWAIIAN VOLCANO OBSERVATORY.

Technology Station, August 21, 1913.

At Kilauea the past week has been uneventful. There has been no marked change in the activity of Halemaumau, there have been no earthquakes, and nothing unusual or noteworthy has been observed in the registration of microseismic motion, or of volcanic vibrations.

In the early forenoon of Friday, August 15, a strong south to southwest wind set in which blew, with diminishing energy, until late Sunday evening, August 17. During the first day of its duration, this wind brought heavy rain, the precipitation amounting to more than two inches in twenty-four hours. Associated with this storm there was immediate, sharp southward tilting of the rock surface at the Observatory, of unusually large amount, with less marked but still considerable westward tilting. This response is considered to be due to sudden and unusual loading with rainfall of the adjacent south and southwest region.

At Halemaumau at 2 p.m. on Saturday, August 16, the wind was south, sweeping dense fumes over the 1894 shelf at the northwest. Fumes were rising at the southeast, south, southwest and west. Here they were sharp and irrespirable. At the west one rumble and some slipping of talus was heard. One long continuous blast was heard, due either to a general talus slide or to a puff.

Partial views from the old rest house showed that there were not many fumaroles working on the north side. At this point the fumes were perhaps a little more respirable.

At about 10 a.m. on Sunday, August 17, there was a light south wind and drizzling rain at the edge of the pit, and at the old rest house there

was heard from time to time a sharp crackling -- or single snaping sounds -- at first thought to be due to single rocks falling. However, with a favorable wind change the fumes cleared from the whole pit of Halemaumau affording a splendid view of the entire bottom. There were six marked fumarole places, one at the west being most active, and largest. From this place came the snapping noise -- now thought to be due to rocks cracking under great heat, like the cracking of a lamp chimney. Two talus slides were heard, one at the northwest and one at the west.

Under the west station and just above the talus there are two rock caverns revealed by the breaking away of the lower walls, which are new. The southernmost of these is a cave in the wall, opening downwards at about forty-five degrees. The other is a craterlet with a vertical tube about ten feet in diameter, extending downwards. These are in the same general region with Perret's cavern and the one under the west station, but much lower down.

In the bottom of the pit two of the fumaroles yield fumes much more fluish than the others. The bottom area appears even flatter than when last seen previously, and no lower. It is the sliding away of the lowermost talus which has revealed the west caves.

On the north wall at its bottom the vertical cliff gives place to an insloping rock face of much flatter angle. At the joint between the two is an active fumarole at a fissure in the wall. This is where active fuming undermined the north shelf earlier in the year, but now the source of the fumes is seen to be from the wall itself, all the talus having slipped lower. Amongst the talus material still farther down on the side there are one or two ledges which suggest an inner rock wall. Occasional rumbling noises and rare breathing sounds were heard. With the resumption of the trade wind, nothing could be seen or heard on Monday or Tuesday, August 18 and 19.

WEEKLY BULLETIN OF HAWAIIAN VOLCANO OBSERVATORY

From the Pacific Commercial Advertiser, Honolulu, September 1, 1913.

TECHNOLOGY STATION, August 28.—Conditions at Kilauea remain without change. uring the past week northeast trade winds have blown steadily, so maintaining almost continually a swirl of fumes in the Halemaumau pit. No view into the depths has been afforded to the writer and, so far as can be learned, only one party of visitors has been more fortunate. This party reported that the caves leading into the west wall were visible but that no view of the very bottom was obtained. No sounds of eruption have been heard by any.

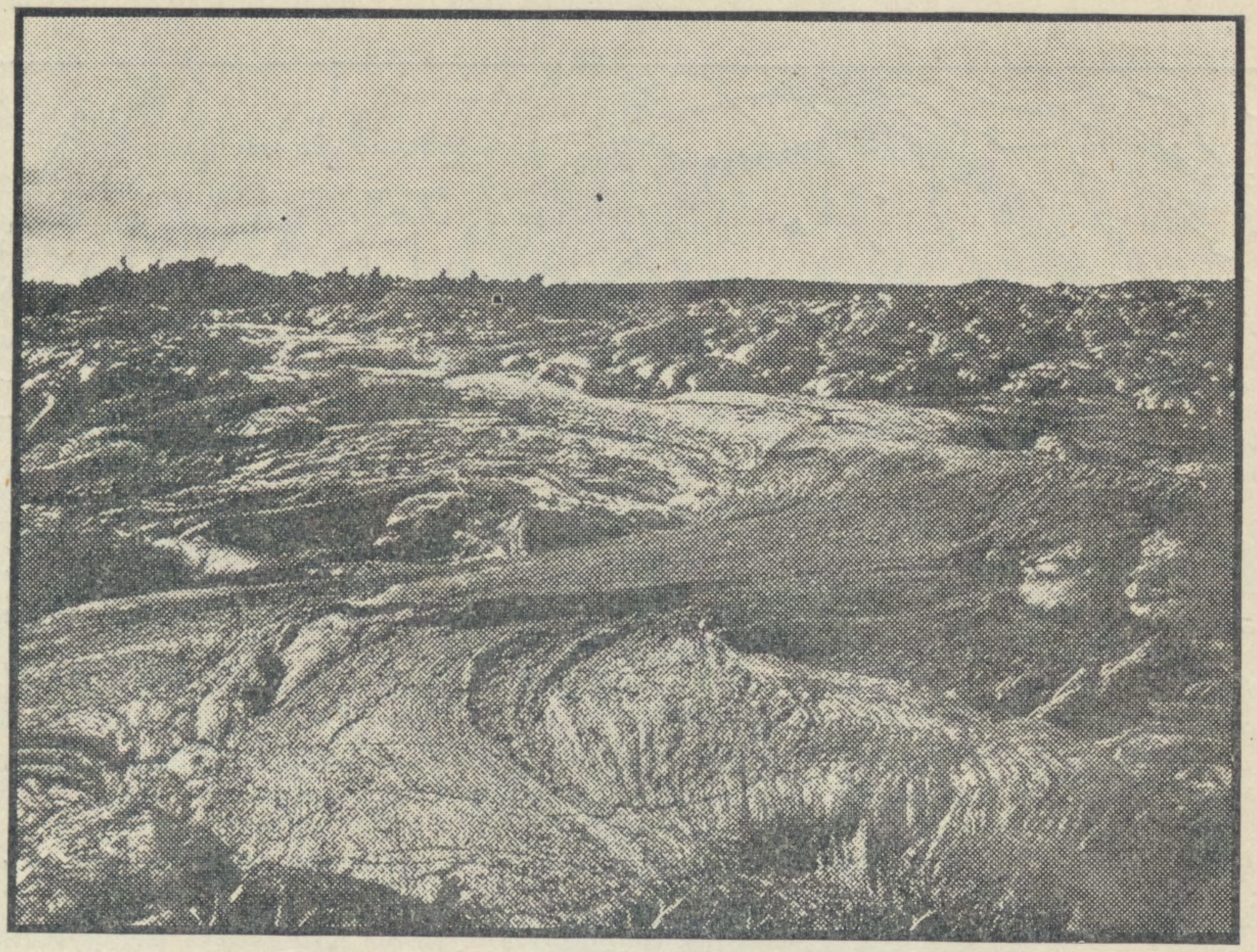
One sharp local earthquake has been recorded but it was not felt by any one in the vicinity of the cald-ra. As has been the case several times recently its rate of vibration was very rapid and in consequence of this its acceleration value was considerably above that fixed as the minimum perceptible unit, but on the other hand its maximal amplitudes were small so that the motion did not become perceptible to the senses. For, in reality, the perceptibility of seismic motion depends upon both acceleration and amplitude, though the former is the more important factor. This shock was registered as follows

August 21, from 9:04:48 a. m. to 9:07 a. m. H. S. T. Intensity, III-IV Cancani scale; in the neighborhood of the value of the minimum perceptible unit. Origin distant about 14.3 miles.

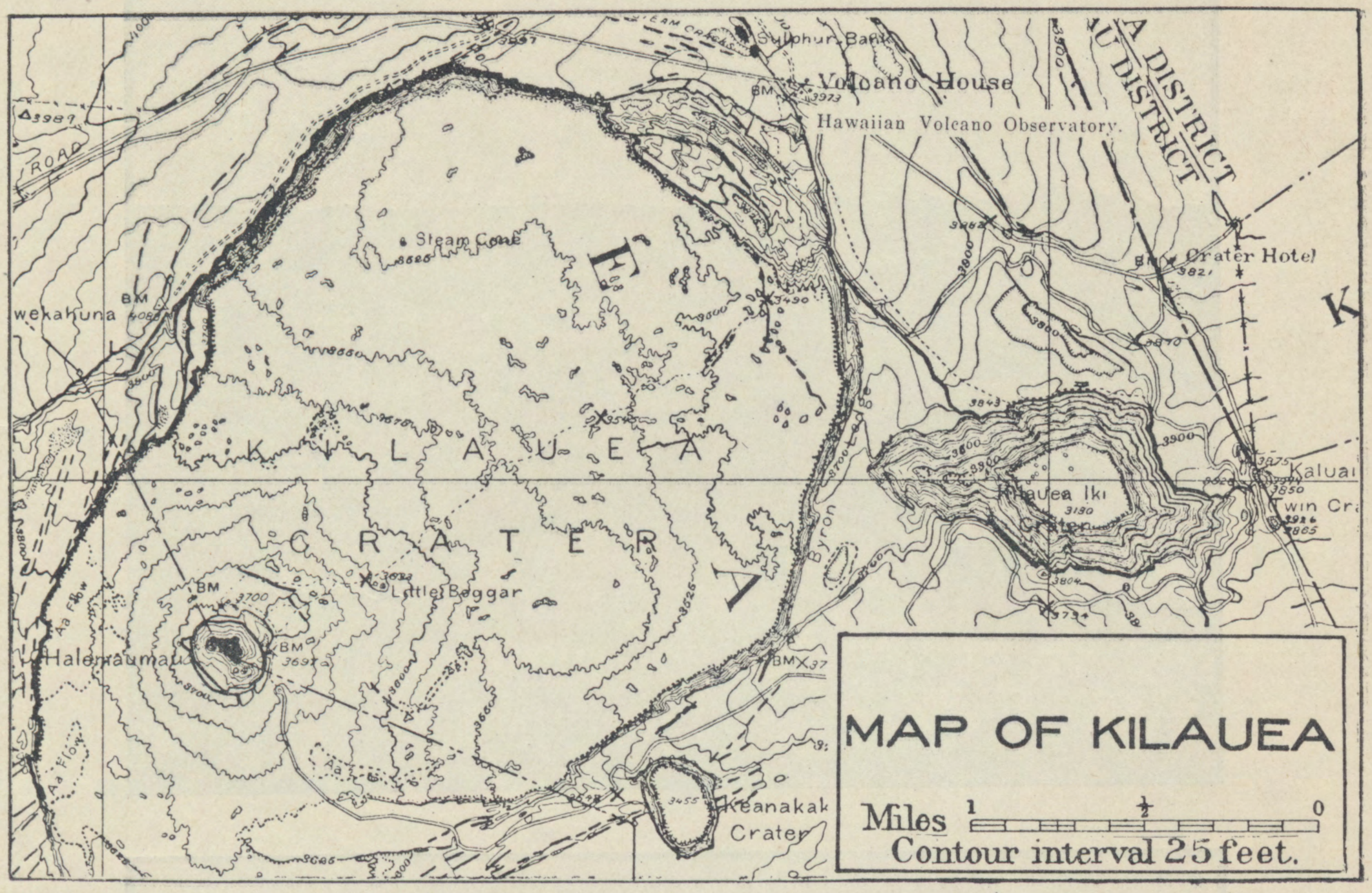
There has been nothing noteworthy in the registration of other earth motions during the past week Very respectfully,

H. O. WOOD, Associate.

Evidence of Former Activity at Kilauea



A meandering, distributing lava flow (top) from near the old margin of the former "New Lake," and (lower) doming, with fracture of ropy-festooned lava surface, from the eastern margin of the main crater.



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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
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VI.	Strong	50.0	100.0
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WEEKLY BULLETIN OF HAWAIIAN VOLCANO OBSERVATORY

From the Pacific Commercial Advertiser, Honolulu, September 8, 1913.

TECHNOLOGY STATION, September 4.—The week has produced a slight increase of activity in Halemaumau, marked by the return of blowing noise from the bottom. From August 28 to August 31, 1913, conditions remained quiet. On September 1 marked blowing noise was heard from the southeast, the wind being southerly. On September 2, at eleven-thirty in the morning, the wind was from the south and a fair view was obtained of the north half of the interior of the caldron of Halemaumau. No pronounced change in the condition of the interior of the pit was observed, except that the western fumaroles appeared more extensive. A strong periodic blowing noise, with the Old Faithful period of about forty-five seconds, was audible from the northern brink. There was very little talus sliding.

A heavy thunderstorm gathered over the Mauna Loa slopes during the morning of September 2, and broke as a torrential rain over Kilauea in the early afternoon, nearly two inches of rain falling, with heavy thunder claps and much lightning.

Today, September 4, at ten in the morning, the blowing noises continue at Halemaumau and the northeast trade wind has brought cooler weather.

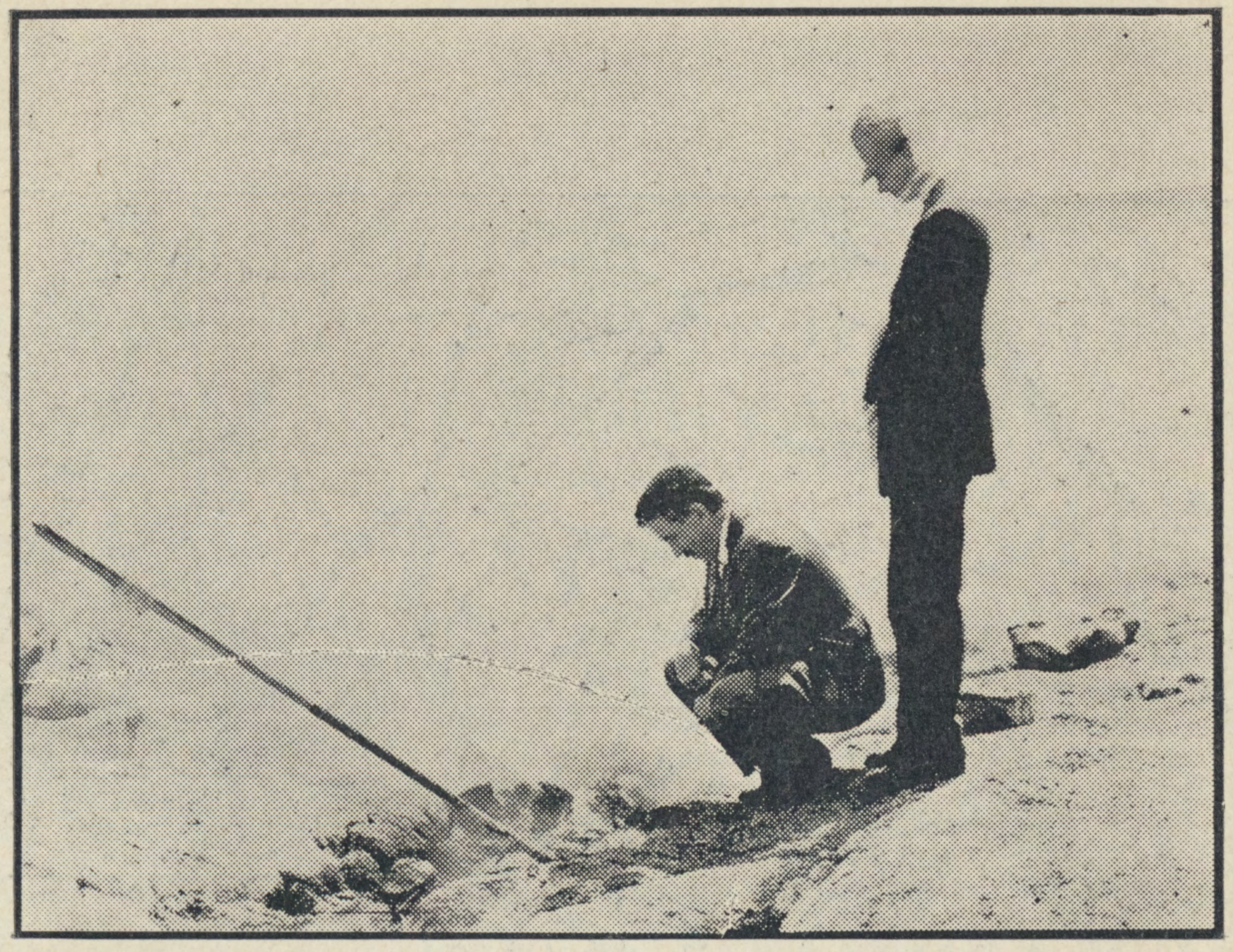
J. W. Green, magnetic observer of the United States Coast and Geodetic Survey, has arrived at the Observatory, detailed by the chief of the survey to make special magnetic observations for some weeks at Kilauea. These observations are made at the request of the Hawaiian Volcano Research Association, and have in view both the occupancy of certain magnetic stations to determine local changes in magnetism throughout periods of years, and also to experiment on fluctuations in magnetic declination in relation to the observed changes of activity in Halemaumau.

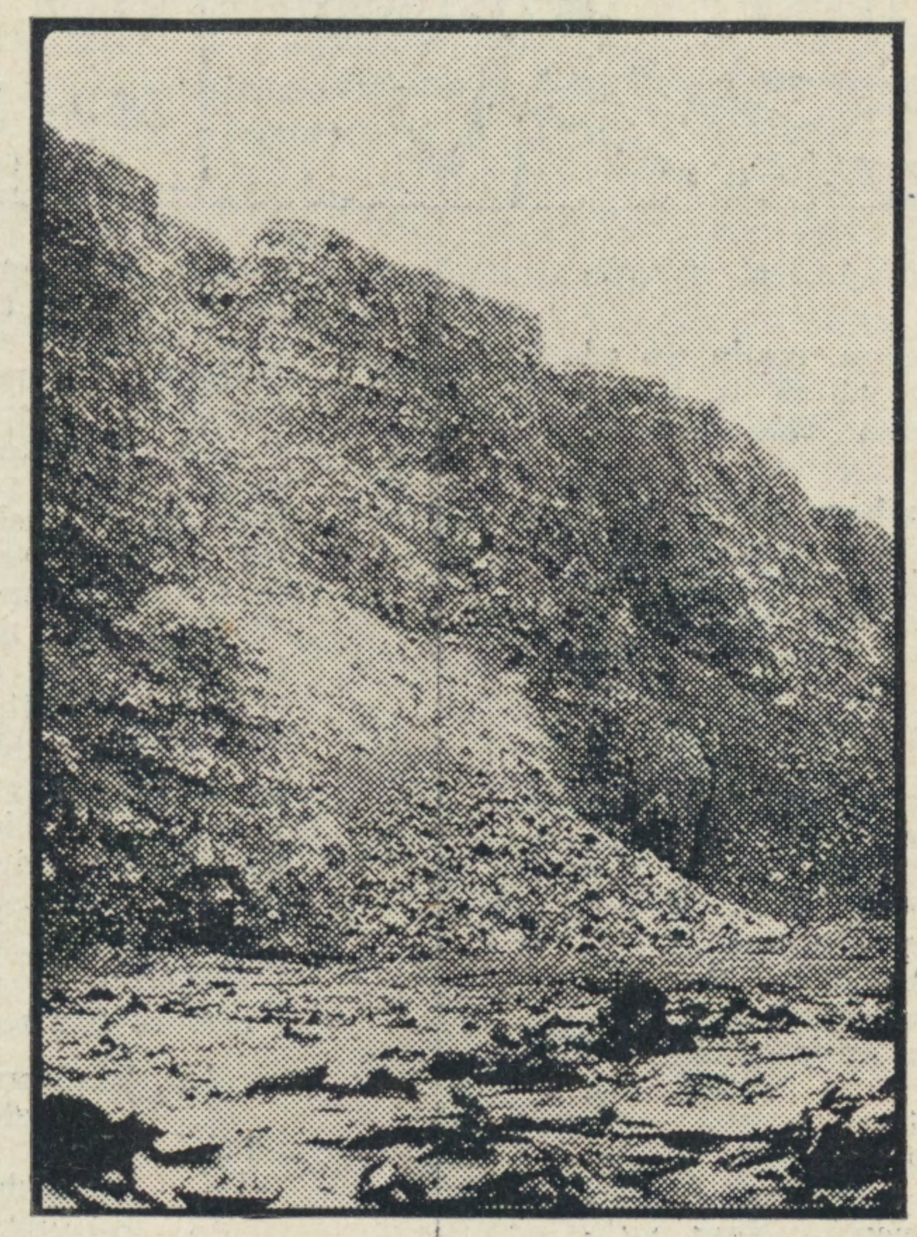
H. O. Wood reports as follows for the Whitney Laboratory of Seismology:

A single very small earthquake of local origin was recorded between eleven and twelve a. m. on September 2. The exact times of phases and the dimensions of this shock will be given in a later report.

The heavy rain September 2 to September 3 produced notable northward tilt deviation. There has not been any further noteworthy seismic registration. Very respectfully,

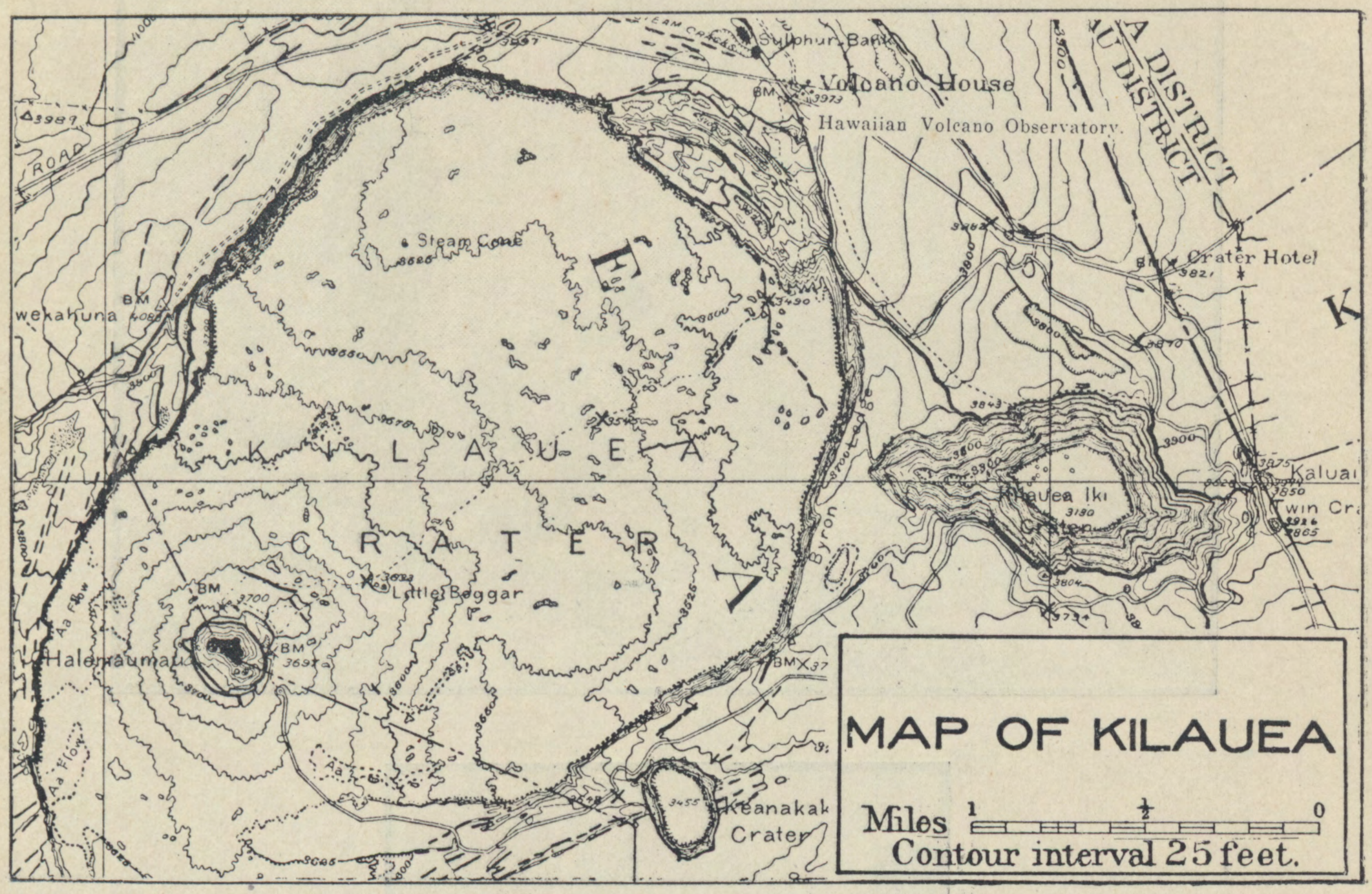
T. A. JAGGAR JR., Director.





SCENES AT KILAUEA.

Taking temperature of the Postal Rift (upper), and view of recent landslide on west wall of Kilauea crater.



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WEEKLY BULLETIN OF HAWAIIAN VOLCANO OBSERVATORY

From the Pacific Commercial Advertiser, Honolulu, September 16, 1913.

TECHNOLOGY STATION, September 11.—The week at Kilauea has been marked by first a diminution and then an increase of the blowing noises in Halemaumau, and by an earthquake about 11:38 a.m., September 8, perceptible at the Volcano House and sharply felt at Hilo.

On Friday, September 5, 1913, the blowing noise was inaudible from the east station in the morning but was heard faintly in the afternoon. One rock slide was heard in the morning. On September 7 there was some blowing. At 9 a. m., September 8, the blowing was moderate and rhythmtic with the usual 40-second interval. It was heard from the north. A few stones were heard moving on the W. slides. There was some thudding noise and faint rumble. The fumes were acrid but moderate in volume, and under the NE. trade obscured all view east or north.

On September 10 strong blasts were reported, one lasting 20 seconds.

Seismology Report.

From the Whitney Observatory of Seismology the following report is submitted by H. O. Wood:

Since the last systematic report the following six earthquakes have been registered here:

August 30, from 7:45:40 p. m. to 7:48:50 p. m. H. S. T. Intensity, medium I Cancani scale; about 0.1 the minimum perceptible unit. Origin distant about 25 miles.

August 30, from 8:12:36 p. m. to 8:13:32 p. m. H. S. T. Intensity, medium I cancani scale; less than 0.1 the minimum perceptible unit. Origin distant about 12.5 miles.

September 2, from 11:37:49 a. m. to 11:39:21 a. m. H. S. T. Intensity, medium I Cancani scale; more than 0.1 the minimum perceptible unit. Origin distant about 27.5 miles.

September 3, from 10:39:02 a. m. to 11:16:3 a. m. H. S. T. An ill-registered teleseismic disturbance, probably of relatively small energy at its origin. The phases are indeterminate, hence its origin-distance is unknown.

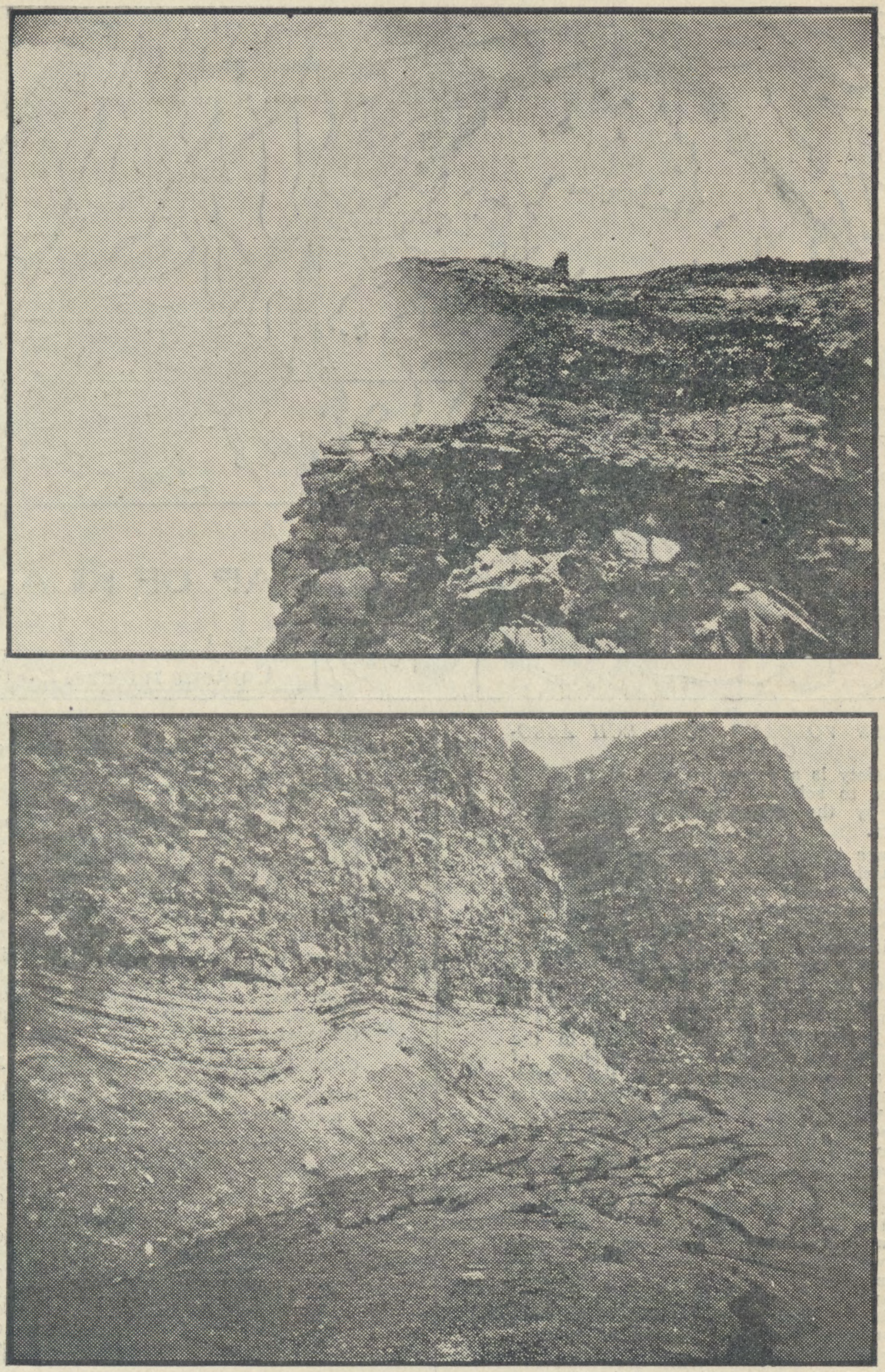
September 8, at 11:37:56 a.m. H. S. T. A local shock felt at the margin of Kilauea; felt sharply in Hilo. Intensity estimated at IV F-R scale, at VI Cancani scale. All pens of the more sensitive tromometers swept off recording cylinders instantly. Origin-distance approximated at 14 miles. Data uncertain on account of the mutilation of the record.

September 8, from 4:38:45 p. m. to 4:39:49 p. m. H. S. T. Intensity, medium I Cancani scale; about 0.1 the minimum perceptible unit. Origin distant about 16 miles.

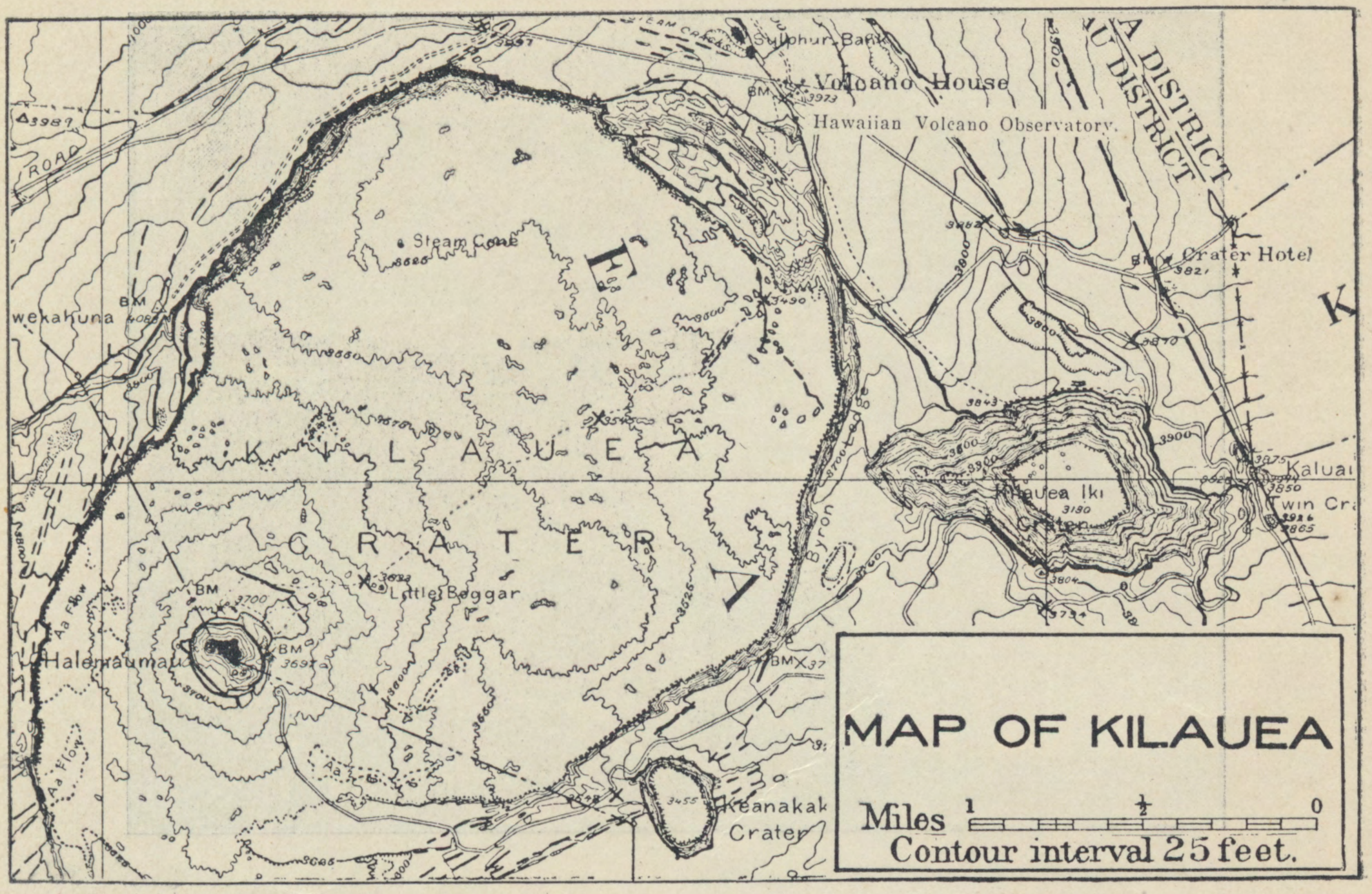
Very respectfully,

T. A. JAGGAR, Jr.,

Director.



Upper photo shows north edge of Halemaumau, taken from northeast station; lower shows ash beds under lava of Uwekahuna Bluff on the west wall of Kilauea: both taken on July 29, 1913.



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WEEKLY BULLETIN OF HAWAIIAN VOLCANO OBSERVATORY

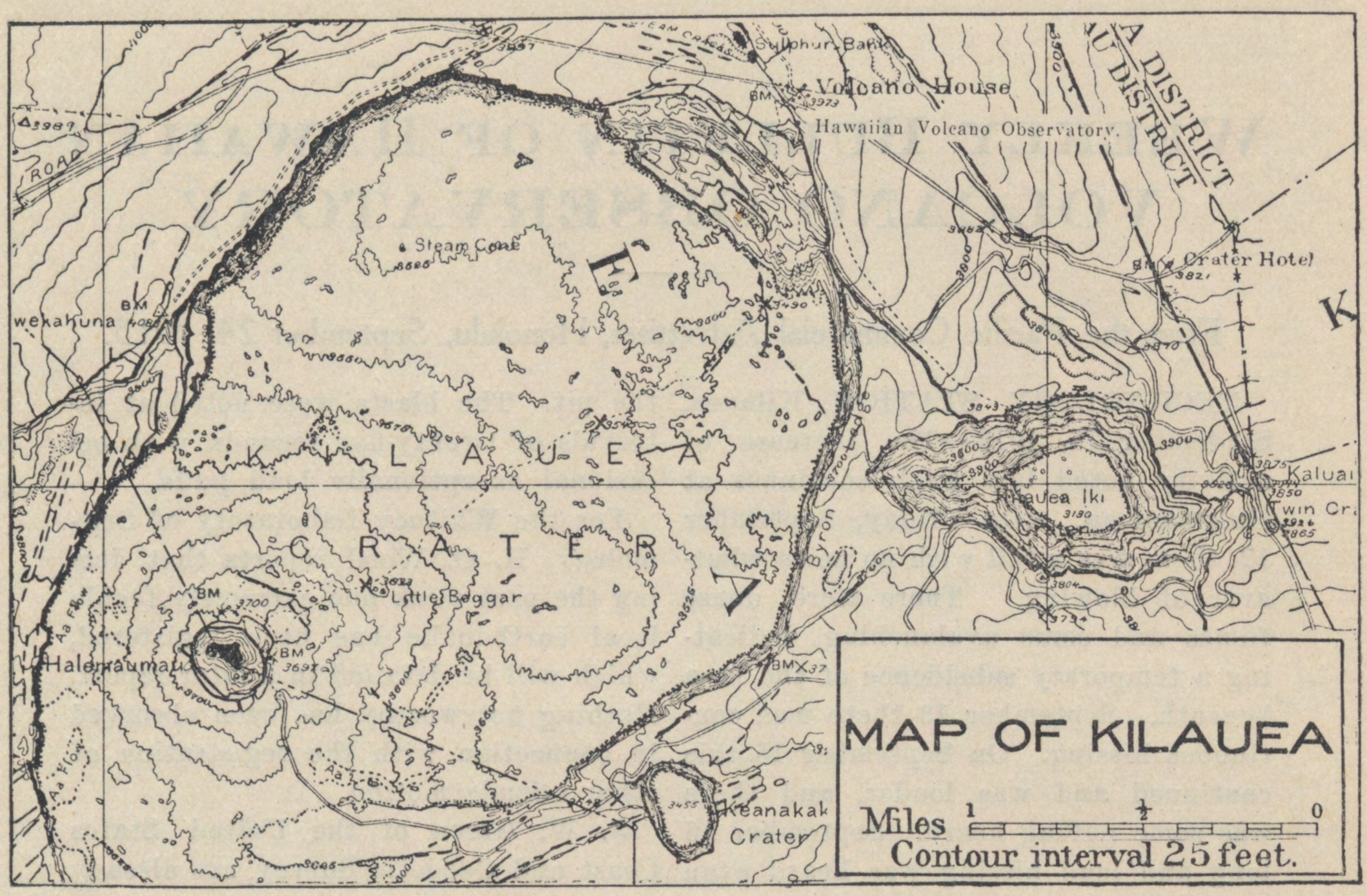
From the Pacific Commercial Advertiser, Honolulu, September 24, 1913.

TECHNOLOGY STATION, Kilauea, September 18, 1913.—The increase of activity noted last week continues at Halemaumau. On Friday, September 12, there was a lull with no noise whatever of blowing. There were dense fumes and some avalanching, indicating a temporary subsidence of the lava beneath. September 13 there was continuous hissing. On September 15 this continued and was louder, and there was some puffing heard. September 16 long and loud hissing was heard even at the east station, where the noise is generally drowned by the wind. September 17 the hissing was moderate and periodic, but today (the eighteenth) the blowing has become harsh and very loud, so that it can be heard at some distance back from the edge of the pit. The blasts were noted at intervals of twenty-five seconds, with occasional exceptionally loud puffs.

For the Whitney Laboratory of Seismology, H. O. Wood reports that during the past week one extremely feeble local earthquake has been registered, which will be detailed in a later report. Nothing noteworthy has been observed in connection with the registration of other seismic motion.

J. W. Green of the United States Coast and Geodetic Survey has already obtained very striking results in magnetic measurement at stations near the edge of Halemaumau, his observations showing very unusual fluctuations in dip and declination within short distances. Very respectfully,

T. A. JAGGAR JR., Director.



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

TECHNOLOGY STATION, September 25,—The activity of the inner crater Halemaumau continued to increase to the time of the equinox (September 22) and beyond, with stronger blasting of hot gas through the bottom talus, until at length a glowing lava conelet has appeared about the locality of strong blowing, and the blasting noise has become continuous and loud. The last time a glow was seen was on July 23, 1913, when in the evening, after greatly increased puffing for several days, a glowing spot could be seen faintly through the fumes for a short time, but its nature could not be determined. It was probably a glowing cone, as at present. Accompanying the present increase of activity is a distinct rise of temperature of the Postal Rift fumes, a few hundred feet north of the Halemaumau edge.

On Friday, September 19, increasingly loud blasts were heard from the bottom, lasting each for twenty seconds, followed by lighter puffing for from twenty to twenty-five seconds, when a new blast would begin. September 20, in the evening, the noise was louder, resembling somewhat the roar of a breaking surf. September 21 the blowing noise continued.

September 22, Monday, a record was kept from 10 a. m. until 4 p. m., omitting the hour 12 to 1, to show the average duration of the long puffs and the quieter intervals for a five-minute period at the beginning of every ten minutes. Once an hour throughout this time the temperature of the Postal Rift was read, for six hours. During the same day Mr. J. W. Green made minute to minute observations of magnetic declination at a station northeast of and near Halemaumau. The long puffs averaged about thirty seconds, followed by ten or fifteen seconds usually of diminished hissing, but sometimes the strong hiss would be continuous for from forty to fifty seconds, and then would be augmented in violence by the beginning of a new puff. The Postal Rift remained at a constant temperature, namely, 323 degrees Cent., and the magnetic declination exhibited no unusual phenomena.

The high temperature of the Postal Rift is noticeable, 323 degrees being the same temperature recorded March 25, 1913, when the lava pool was on its final decline before the crusted period of the past summer. The fall in temperature of the Postal Rift appears to have coincided with the subsidence of the lava, and if causally so the present rise in temperature may imply a rise in the lava commensurate with the stand of the end of March last. The following list shows temperatures of Postal Rift:

March 25, 1913, 323 degrees Cent.
March 28, 1913, 318 degrees Cent.
March 29, 1913, 317 degrees Cent.
Lava lake reported "stagnant, low and approaching a stationary condition."
June 30, 1913, 316 degrees Cent.
July 23, 1913, 313 degrees Cent.
July 26, 1913, 313 degrees Cent.
July 29, 1913, 313 degrees Cent.
August 5, 1913, 313 degrees Cent.
September 22, 1913, 323 degrees Cent.

At 1:45 p. m. of this date (September 22) an eddy from the light and variable east wind opened the west and northwest sides of the pit to view, showing the bottom with its active fumaroles west and north, the cavern and craterlet at the foot of the west wall, and glimpses were had of the tumble of rocks on the bottom in the

center, where now and then a whitish jet seemed to correspond with the noise of blowing. A very hot-looking beehive cone had developed around the north fumarole. A visit to the S. station on the edge of Halemaumau revealed the fact that the western part of the south high bench has lately fallen away. Rock slides were heard occasionally.

Tuesday, September 23, hissing of the same character was in progress, but less loud. At 4:30 p. m. September 24, however, a fine view of the bottom from the north instrument house was obtained, and a glowing conelet was seen in the midst of the funnel of talus. This cone lay to the south of the north fumarole, about the middle of the bottom, not far from the Old Faithful position. Whether the glow in the fissures of the cone was lava or burning gas it was not possible to determine in the short time of vision before the fumes again closed in. The border fumaroles were purling very actively, but the vapors were white and quickly dissipated, and the fumes breathed at the edge were less strong than usual. The hissing was continuous and very loud, and the glowing cone appeared to be the source of the hissing, but no vapor could be seen rising from it. There was some appearance of lava splash around the cone.

Today, September 25, at 4 p. m. continuous hissing could be heard from the old resthouse, but much less loud. There was some faint crackling, rumbling and rock sliding. Little could be seen. The hissing stopped for an instant at one time, only to be immediately resumed. Apparently the volcano is marking time, and the lava falling very slightly since yesterday. In general this period represents the highest activity since early in April.

Seismology Report.

For the Whitney Laboratory of Seismology, the following report is submitted by H. O. Wood:

Since the last systematic report the following earthquakes, all of local origin, have been registered:

Sept. 13, from 10:06:01 a. m. to 10:07:08 a. m. H. S. T. Intensity, low I Cancani scale; about 0.06 the minimum perceptible unit Origin distant about 12.4 miles

Sept. 14, from 7:59:00 a. m. to 8:00:28 a. m. H. S. T. Intensity, low I Cancani scale; about 0.9 the minimum perceptible unit. Origin distant about 12.4 miles.

Sept. 20, from 8:14:29 a. m. to 8:16:49 a. m. H. S. T. Intensity, III-IV Cancani scale; not sensibly felt, but measures above the minimum perceptible unit. Origin distant 12.4 miles.

Sept. 20, from 8:20:22 a. m. to 8:20:40 a. m. H. S. T. An exceedingly feeble shock, leaving the phases, magnitudes and origin distance practically indeterminable.

Sept. 20, from 8:22:25 a. m. to 8:24:22 a. m. H. S. T. Intensity, medium I Cancani scale; about 0.15 the minimum perceptible unit. Origin distant about 31 miles.

Sept. 24, from 1:10:49 a. m. to 1:12:07 a. m. H. S. T. Intensity, low I Cancani scale; about 0.08 the minimum perceptible unit. Origin distant about 12.5 miles.

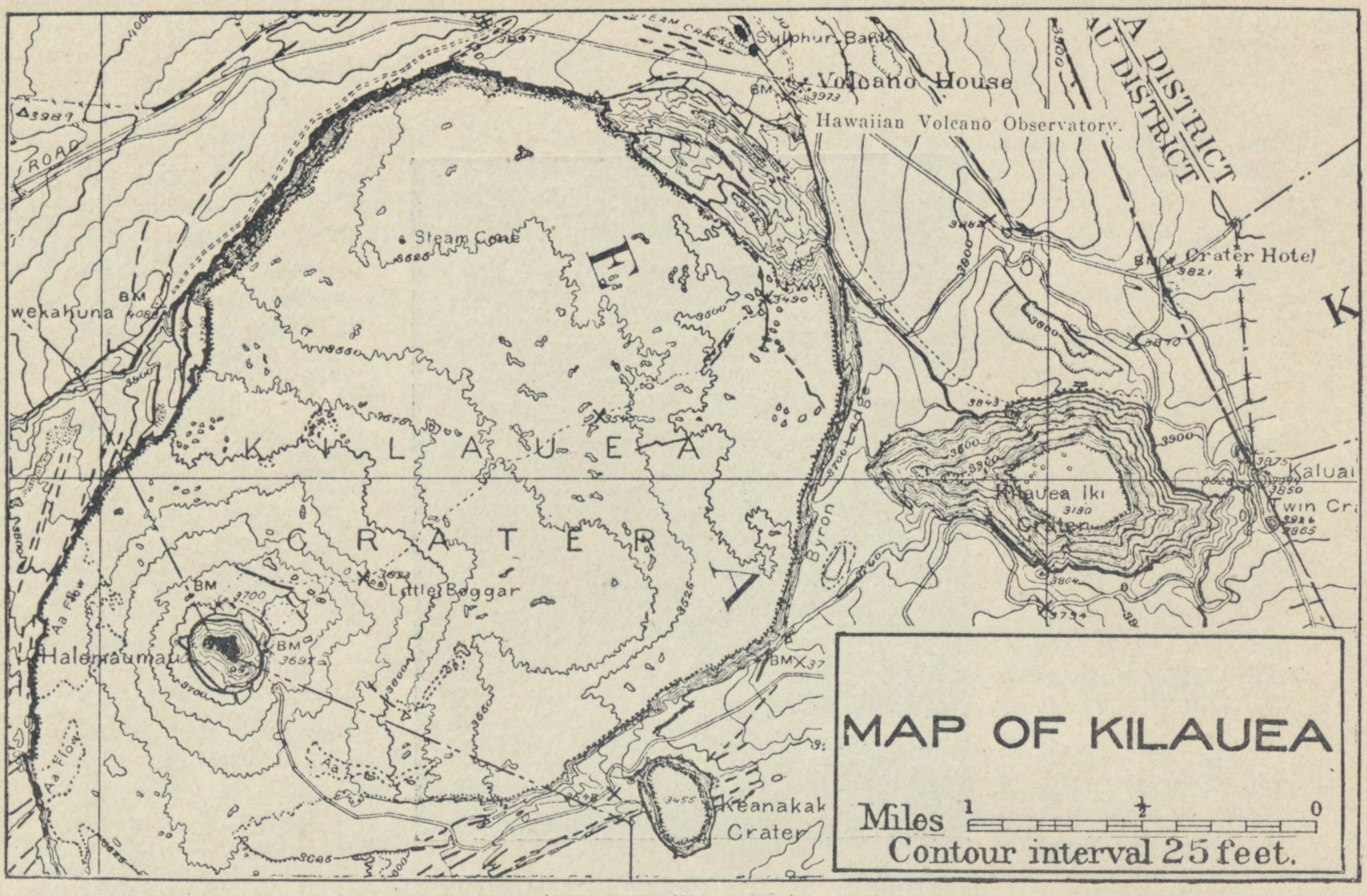
Besides these shocks a considerable number of groups of volcanic vibrations have been recorded in the past fortnight, and particularly during the past week. These have, for the most part, been of small amplitude and, except for the unusual quiet of the preceding weeks, they would not be regarded as worthy of note in this routine report. Rapid tilting has been registered during the past week, but it has not been of unusual character.

Very respectfully,

T. A. JAGGAR JR.,
Director.

Northeast Rim, Halemaumau, Photographed in July.

Northwest Rim, Halemaumau, Photographed in July.



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WEEKLY BULLETIN OF HAWAIIAN VOLCANO OBSERVATORY

From the Pacific Commercial Advertiser, Honolulu, October 5, 1913.

TECHNOLOGY STATION, October 2 —The increased activity noted last week has continued at the inner pit of Kilauea, a spouting, puffing and rumbling lava cone is growing in its bottom, and new Pele's hair is being distributed over the lava to leeward.

At 5 p. m. Friday, September 26, a light continuous hissing could be heard, but nothing could be seen through the fume cloud. At 4:30 p. m., September 27, only the louder hisses could be heard from the east station, and from the old resthouse on the north the hissing was fainter than the previous day and fluctuating. No rock slides were heard. The intervals between the louder puffs were about 70 seconds long. At 5:10 p. m. the temperature of the Postal Rift was 320 degrees Cent. a fall of 3 degrees since September 22.

At 4 p. m., September 29, the noise had changed to a distinct puffing at intervals of from one to two seconds, louder at the end of every minute. For about forty seconds the puffing would be loud and then die away during the last twenty seconds. There was no longer any continuous hiss and at times the puffing was fairly loud. This puffing noise continued, growing more strident and irregular the next two days and finally, at 8 p. m. October 1, flaring at night on the fume cloud over Halemaumau was detected from the Volcano House. At the pit the wind was W.N.W., and from the S.E. station strong glow could be seen. The fumes occasionally overran the edge but they were tolerable to breathe.

Nothing could be seen from the northern stations. The glow would flare up accompanied by loud snorts from the lava cone below, the snorting being clogged and accompanied by a thudding sound, and the loudness was very irregular with intervals of complete silence for a few seconds. Sometimes the blowing was very loud with a noise like a rocket.

Lava Splashing.

During slight clearing from the S.E. at 11 p. m., October 1, a glowing crack apparently eight or ten feet long, was seen, presumably the apex of the lava cone, in the same position as the cone seen September 24. This fissure was the source of the muffled blasts which came with a roar every thirty to forty seconds. With the blasts the crack sputtered sparks and lava splash. It slowly changed to the shape of an oven open northward and ejecting lava sidewise in that direction. Flames were observed playing about the opening. The depth to the lava cone was estimated to be between 500 and 600 feet, and it will be measured when there is sufficient seeing to permit. Only glimpses have been obtained as yet.

KATMAI VOLCANO, ALASKAN PENINSULA, IN AUGUST, 1913.

Pele's Hair Blown Out.

Today, October 2, the wind has been from the SW., and the humidity high, making the fume cloud dense and obstructive to seeing. Strong puffing continued at 3 p. m., when the crater was visited by the writer, the puffs lasting from five to fifteen seconds, followed by intervals of nearly complete quiet averaging about thirty seconds. There were a few light rock slides. The fumes were respirable. Fresh Pele's hair was found scattered to leeward in small tufts, partly coarse hairs of spun glass, but largely a fine whitish down. The roar of the gas blasts at the lava cone in the pit could be plainly heard at the fumarole zone of the Postal Rift to leeward. At 4 p. m. the temperature of the Postal Rift was 320 degrees Cent. At 4:30 the same sputtering noise as last night, like gas explosions clogged with liquid lava, was heard from the lava cone.

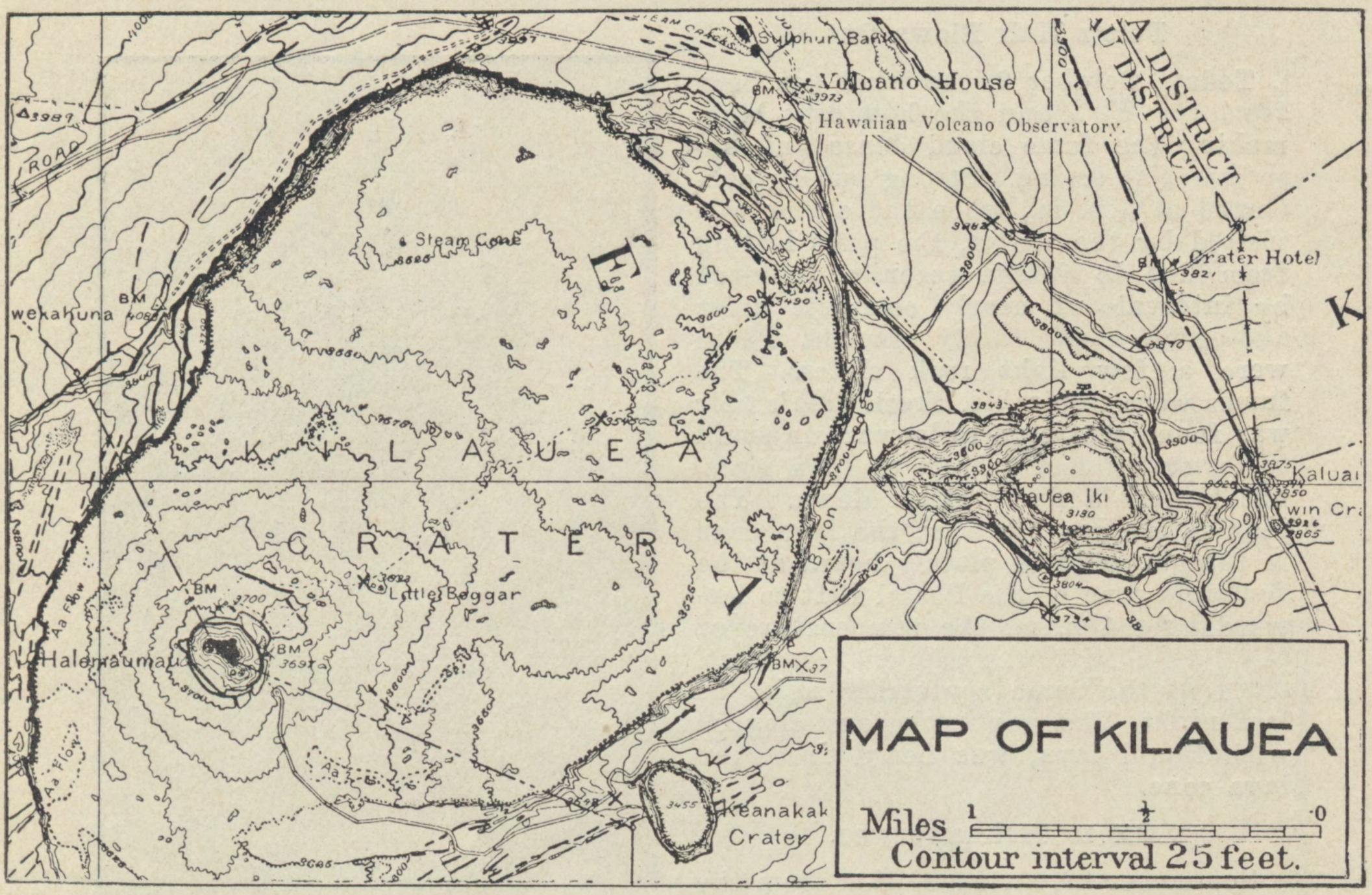
Off to Mokuaweoweo.

September 29, an expedition from the observatory departed for Mokuaweoweo the summit crater of Mauna Loa, by the Ainapo route, over the trail recently buillt by Mr. Julian Monsarrat, The party consisted of Mr. H. O. Wood, of the observatory staff, seismologist and geologist, and Mr. J. W Green, magnetician of the Coast Survey. They plan to stay four days at the summit and carry on magnetic and geological investigations. They were accompanied by men from Kapapala Ranch and by Alex. Lancaster.

The complete report of the Whitney Laboratory of Seismology for the week will be made after Mr. Wood's return. Seismically nothing of importance happened until September 30 to October 1, when a remarkable tilt towards the north immediately preceded the increased activity of the crater October 1; this was followed by a number of small local earthquakes, including one felt at the Volcano House about 7:30 a. m. October 2. Very respectfully,

T. A. JAGGAR, JR.,
Director.

These remarkable pictures were taken by M. Hohner, during the past summer, and sent to Professor Jaggar, at the Kilauea observatory, by A. H. Bradford, a graduate of Technology. Katmai, the volcano pictured on the preceding page, was in violent eruption in the summer of 1912, and strewed ashes over much of Alaska. The crater was quite inaccessible for many months, and these are among the first pictures taken near it. The picture on this page is that of a great rock, hurled a mile and a half by Katmai.



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WEEKLY BULLETIN OF HAWAIIAN VOLCANO OBSERVATORY

From the Pacific Commercial Advertiser, Honolulu, October 13, 1913.

TECHNOLOGY Station, October 9.—The Mauna Loa expedition returned in good health after a successful four days at the summit. The party, consisting of Mr. Wood, Mr. Green and Alex. Lancaster left the Volcano House by automobile September 29, at eight a. m., reached the bull-pen of Kapapala (near the Halfway House) at eight thirty a. m., left there on horseback with two Hawaiian kamaainas and a pack train of four animals at nine twenty a. m., and arrived at the watertank above Ainapo at twelve forty five a. m, where camp was made. This point is about the lower terminus of the new trail.

At Crater Four Days.

The next morning camp was broken at six fifteen a. m., and the crater reached at ten ten a. m., where the four-day camp was made some distance south of the old Wilkes campground on the east side of Mokuaweoweo. The packers here left the party and returned below with the animals. Perfect weather and nearly cloudless skies characterized the whole week. At night at the summit the mercury registered below freezing. The expedition slept in cone tents of oiled silk, pegged down with bowlders, cooking was done with alcohol stove, and water was found in abundance in the ice-lined cracks near the edge of the crater.

During the next three days from October 1 to October 3, Mr. Wood explored the region and Mr. Green set up magnetic stations and made readings for dip and intensity, and secured one determination of approximate declination, though he had only dip-circle with compass attachment. No unusual activity of the volcano was observed, the fuming cracks on the floor being about as they were in 1912. Mr. Wood made the entire circuit of Mokuaweoweo on foot, and descended to the floor and explored it. Both observers obtained photographs. A remarkable feature noted by Mr. Wood is the row of large cones extending northeastward from the north end of the crater. These are continuous with the line of many craters down the northeast slope of Mauna Loa, which have been the source of nineteenth century flows, and this slope ought to be provided with an alpine hut as a substation of the Hawaiian Volcano Observatory, for there is in that vicinity a vast field for exploration and observation.

The packers returned to the summit with the animals at eight-thirty a. m. Saturday, October 4, the return start down the mountain was made at nine fifteen a. m., Ainapo was reached at two forty five p. m., and the rendezvous on the highroad at four twenty p. m., where the motor car was in waiting.

Simple Route Now Open.

A plain trail has been built from the water tank to the crater, although much of the way is a-a lava.

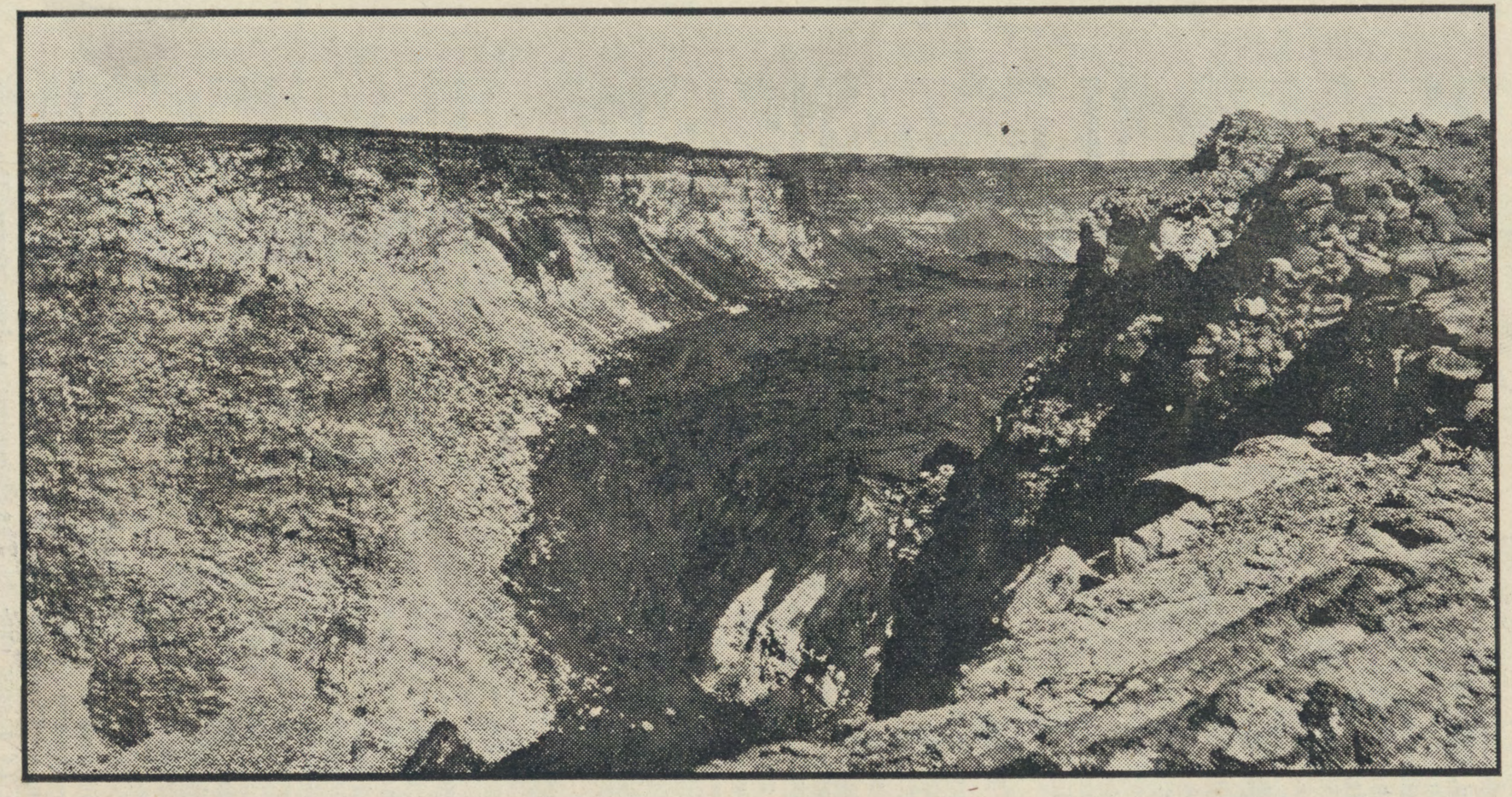
The Observatory is very grateful to Messrs. Julian Monsarrat and C. E. Wright of the Volcano Stables Company, for courtesies in the accomplishment of this trip, and the public should now be able to make closer acquaintance with Mauna Loa through this simple route to the summit. The Observatory party suffered from no mountain sickness, and had no serious difficulties of any kind, but they learned that military folding cots would be desirable, as the ground is very rough for a bed, and good sleep is essential to good work at that altitude. With good sleep and good warm food, very few people would be at all seriously troubled by the altitude of Mokuaweoweo, after a day's acclimatization.

Quiet Week at Halemaumau.

After the revival recorded last week at Halemaumau another week of quiet follows. Some faint glow was seen on the evenings of October 3 and 4. Saturday, October 4, the blowing noise at the bottom of the crater was continuous.

On the morning of October 5 at ten o'clock the SE amphitheater cleared from time to time, and showed the usual fumaroles through the talus at the bottom, a continuous slope of slide-rock leading down into the funnel SE, S and SW, and the whole west half of the high S bench was seen to be gone, only the east remnant of that bench clinging to the wall sixty feet below the S station.

The blowing noises from the lava cone could be heard from the Old Rest-house and from the SE. These noises had changed in quality. They were now short sudden coughs like the noise from the exhaust-pipe of a gasoline en-



gine. There was occasional longer hissing, and much of the coughing noise sounded like explosions coming through pasty lava. The bottom could not be seen.

Glow Not Visible.

Tuesday, October 7, occasional strong hissing puffs could be heard in the morning from the eastern stations, but by five p. m. the noise had diminished remarkably, so that even from the Old Resthouse on the north, where under a projecting ledge the best hearing is obtained with northeast winds, the only sounds were very faint and distant rhythmic puffs like a far-away freight engine, sometimes dying away altogether, and at times interrupted by short coughs. At five p. m. a good view was obtained from the southeast nearly to the middle of the bottom area, but no glow was seen nor could the detail of the lava cone region be made out. The fumes on this day were more acrid. At about four p. m. the writer heard a distinct deep rumble while in the cavern known as Pele's "drawing room," just back of the Technology station.

In a preliminary report for the week for the Whitney Laboratory of seismology, H. O. Wood reports earthquakes as follows:

A short sharp felt shock October 3, 1913, a little before 6 p. m.

Very feeble shock Monday October 6 a few minutes after 9 a. m.

Very feeble shock Tuesday, October 7, shortly before 3 a. m.

Very slight shock Tuesday, October 7, shortly before 3 p. m.

Very respectfully,

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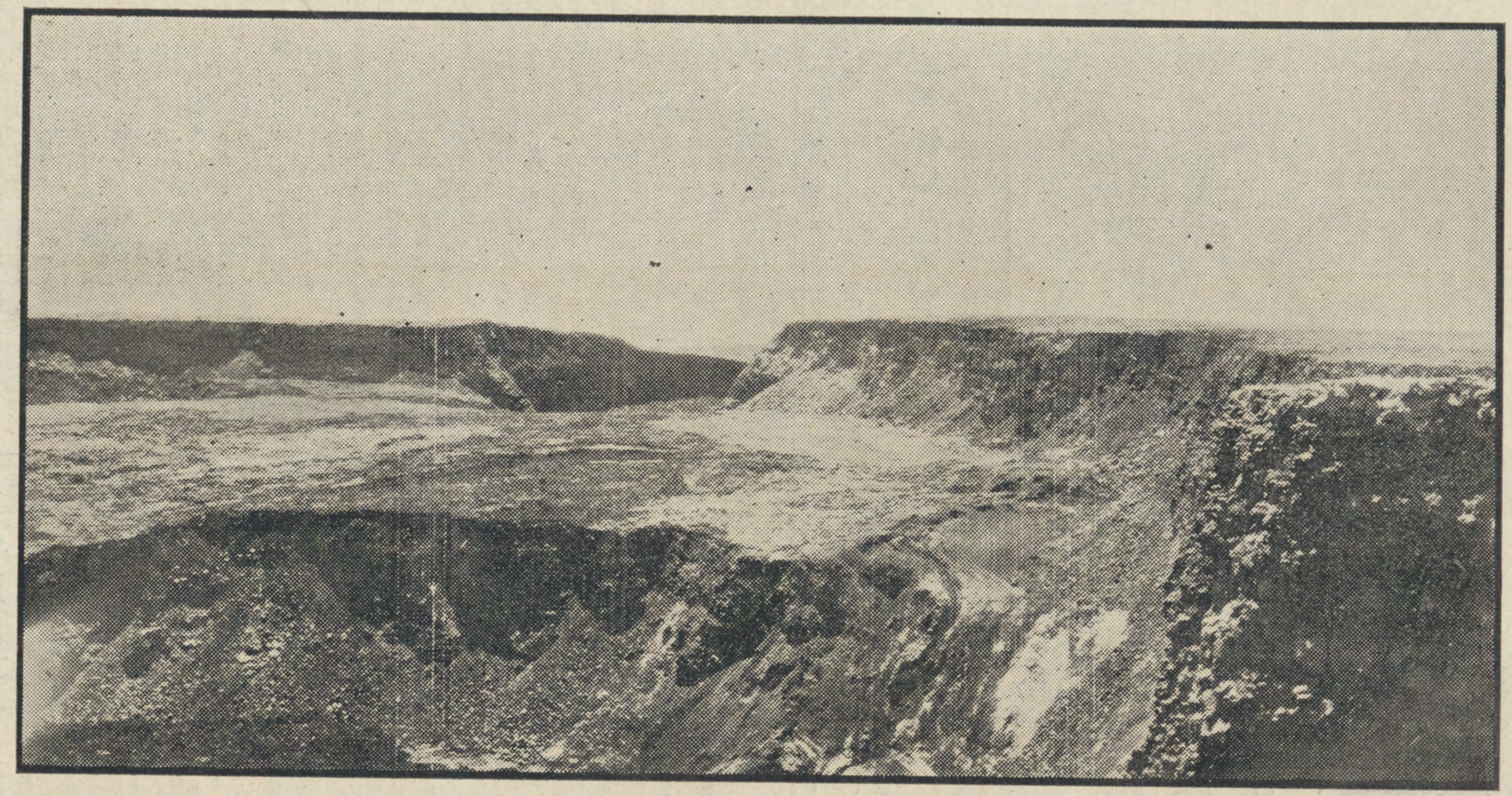
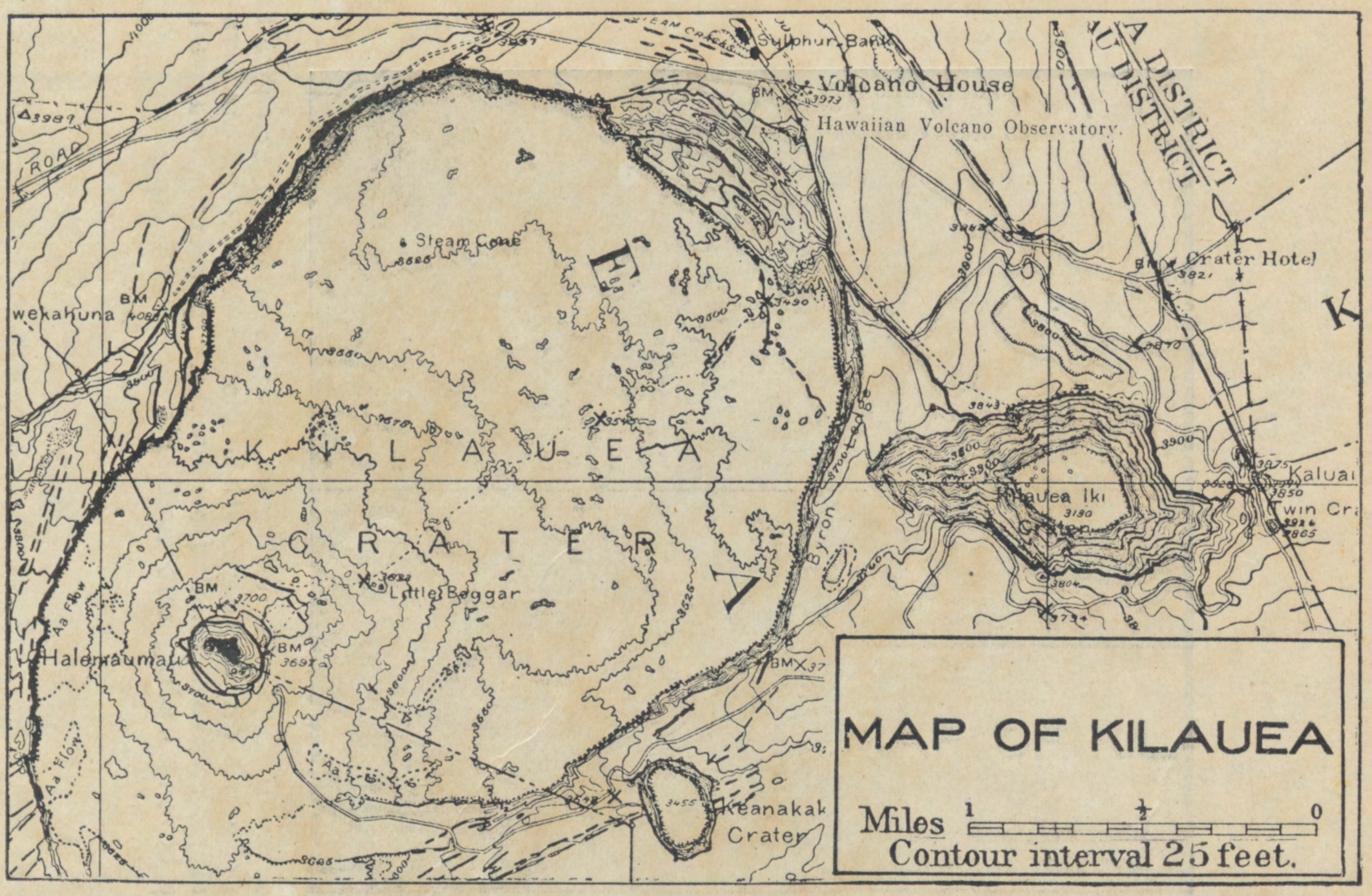
Director.



Mokuaweoweo, October 1, 1913, from photographs taken by H. O. Wood, during exploration of crater at summit of Mauna Loa. Preceding view is taken from the southeast side of south pit, looking north by northwest; fresh, thin lava cascade from south platform into south pit. This view looking south-southeast from southern promontory on west wall; south lunate platform, fresh flow on the right, and gap beyond leading into south pit.



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From the Pacific Commercial Advertiser, Honolulu, October 20, 1913.

TECHNOLOGY STATION, October 16.—The volcano continues in minor eruptive phase. Frequent irregular explosive noises have been heard throughout the past week, varying from puffing sounds to sharp explosions accompanied by rumbling like deep distant thunder, waxing and waning but, on the whole, increasing in volume and energy. Intervals between noises have varied from twenty seconds to over a minute, and these have been distributed without order.

Sliding of talus on a small scale has been heard during the week, but it is thought to denote readjustments among the blocks rather than pronounced movement of the magma column.

Great volumes of fumes continue to be given off. To measure these is next to impossible but the writer considers their volume now much greater than some weeks ago — and increasing. Views into the pit, particularly to its very bottom, are consequently rare and fortuitous. The gases appear to be rushing from the bottom fumaroles on the north and west as though under considerable pressure. This was especially noted Wednesday, October 15.

Lava Visible at Bottom.

Late in the afternoon on Friday, October 10, J. W. Green obtained a good view of the bottom of the pit when, for about twenty minutes, the bottom region was kept free of fumes. A small area of incandescent lava was visible and at irregular intervals when especially hard blowing took place a jet of molten spray was shot out of this orifice to a height of a few feet, at a slight angle from the vertical.

The ordinary activity described above continued, with fluctuations, until just before noon, Wednesday, October 15, when it was noticed that the explosive noises were becoming distinctly sharper. At about 2:30 p. m., an unusually loud and energetic explosive sound was heard, after which these sounds were accompanied by a swashing noise like that of a much disturbed heavy fluid. After hard blasts the patter of falling lumps, presumably from lava jets, was heard. Mr. Green mentions also a sound resembling that of rock snapping from heat. After nightfall at long intervals brilliant flarings were seen from the Volcano House, despite a bright moonlight illumination of the fume cloud.

Earthquakes Recorded.

Since the last systematic report from the Whitney Laboratory the following shocks have been recorded:

September 25, from 1:58:09 a.m. to 1:58:52 a.m. H. S. T. Intensity, I Cancani scale; about 0.15 the minimum perceptible unit. Origin distant about 12 miles.

October 2, from 7:29:02 a.m. to 7:31:02 a.m. H. S. T. Intensity, II-III Cancani scale; felt but measures only about 0.8 the minimum perceptible unit. Origin distant about twenty-eight miles.

October 3, from 5:58:14 p.m. to 6:00:12 p.m. H. S. T. Intensity, V-VI Cancani scale; about 5 to 8 times the minimum perceptible unit. Distinctly felt. Origin-distance in doubt.

October 6, from 9:20:31 a.m. to 9:21:23 a.m. H. S. T. Intensity, low I Cancani scale; less than 0.1 the minimum perceptible unit. Origin distant a little over six miles.

October 7, from 2:54:31 a.m. to 2:54::56 a.m. H.S.T. Intensity, high I Cancani scale; over 0.2 the minimum perceptible unit. Origin distant about 10.5 miles.

October 7, from 2:41:00 p.m. to 2:42 p.m. H. S. T. Intensity, II-III Cancani scale; not felt, from 0.4 to 1.0 the minimum perceptible unit. Origin distant about six miles.

October 10, from 3:32 p.m. to 3:47 p.m. H. S. T. Feeble registered waves of a very distant earthquake, chief phase only. Hence not a shock of very great power. Origin distance indeterminate.

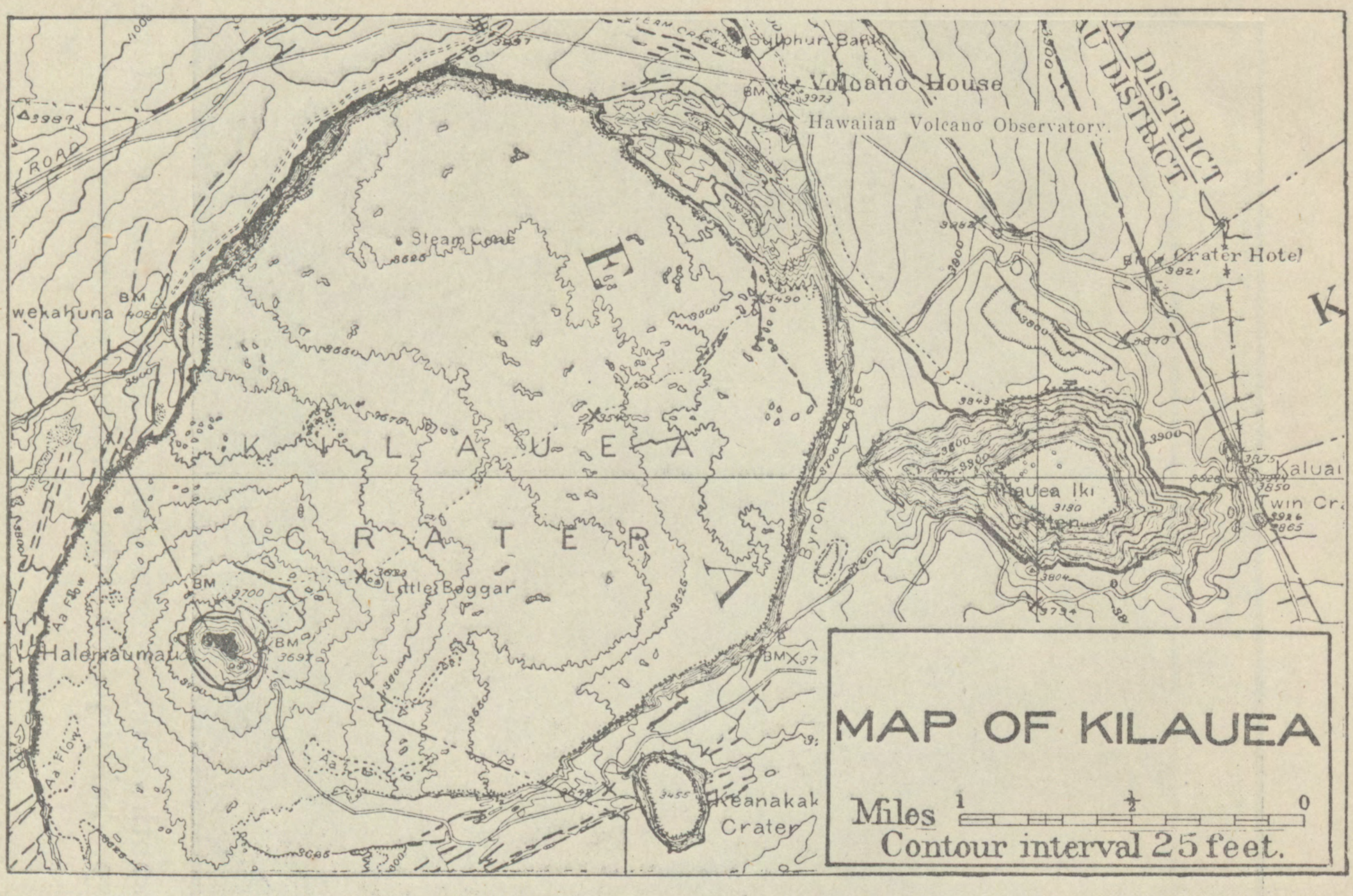
October 10, from 6:05 p.m. to 6:27 p.m. H. S. T. Waves of a very distant earthquake, registration beginning with the chief phase. This was not a shock of very great power. Its origin distance is indeterminate.

October 13, from 9:47:34 p.m. to 11:08 p.m. H. S. T. A distant earthquake of only ordinarily great power, originating at a distance of about 2300 miles from this Observatory. Very respectfully,

H. O. WOOD, Associate.

From the north part of the west rim, looking southward. This shows a block of the original summit area, partly engulfed and tremendously fissured.

From the central part of the east rim, looking southward. Shows the southeast "Lunate platform," an old pahoehoe surface, weathered and fissured, probably part of the original surface.



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From the Pacific Commercial Advertiser, Honolulu, October 27, 1913.

TECHNOLOGY STATION, October 23.—The activity of Kilauea in October, 1913, has been similar to that of October, 1912, in that the month started with a revival, followed by sluggish phases and occasional withdrawals of the lava, as though a contest were in progress between a rising lava column and a subsiding tumble of debris which tends to choke and chill the hot fluid beneath. The past week has been an illustration of this, in that the fumes have been dense, the glow repressed, and the noises less, everything pointing to a suppression of the rising column by the great quantity of talus fragments which must needs be taken into solution by the magma before its seemingly limited supply of hot gases can sufficiently assert their power to make a vigorous lava lake.

Lakes of Lava Active.

Throughout the week there have been sounds as of the swashing of a heavy liquid. This noise had a tendency to increase and decrease every few seconds, accompanied at short intervals by spattering sounds, such as are made by the falling of lumps of molten lava.

At longer and quite irregular intervals, a minute, more or less, sharp blowing noises have been heard, followed usually by much of the spatter sound.

Glow on the Clouds.

In the evenings of October 18, 19, and 20, Saturday, Sunday and Monday, particularly the 19th, there was visible from the Observatory (and the Volcano House) a dim but steady glow on the fume cloud with brilliant flaring at considerable irregular intervals.

On the morning of October 20, D. Lycurgus reported a view of the bottom which disclosed a well-marked cone with an orifice at the apex some ten feet in diameter, out of which lava jets spurted at fairly long intervals.

Today, October 23, at 4 p. m., the weather was rainy and foggy and little could be seen. A puff, not at all loud, could be heard from the east and north stations about once a minute, sometimes repeated two or three times at intervals of ten seconds, with some sound of splash. The fumes were strong and disagreeable to breathe.

Magnetic Work Continues.

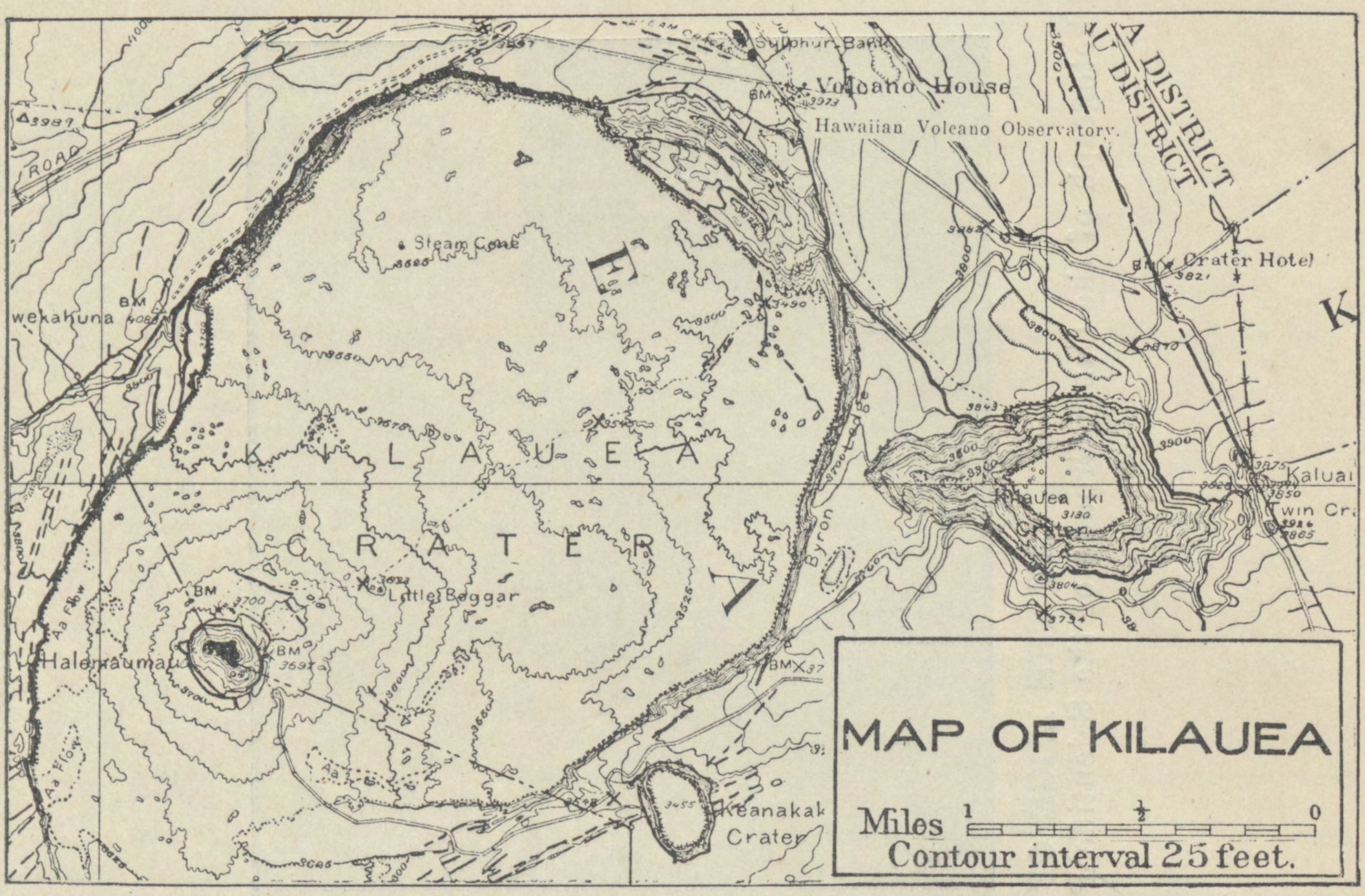
J. W. Green continues his magnetic work and is now engaged in establishing magnetic stations on the rim of the greater crater of Kilauea. He has found that owing to its content of magnetic minerals the Kilauea basalt is itself variously magnetic in small specimens, a fact which promises to greatly complicate the use of the magnetic needle in this region.

There has been almost nothing to report this week for the Whitney Laboratory of Seismology. What few feeble movements have been recorded will be embodied in a later report by Mr. H. O. Wood. Very respectfully,

T. A. JAGGAR, JR.,
Director.

AT THE EDGE OF MOKUAWEOWEO.

Photograph of the Camp Ground of the Scientific Party which ascended Mauna Loa. Taken October 4.



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.

There are twenty-six 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 will publish the quarterly 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. L. A. Thurston is chairman of the active committee of the subscribers and C. H. Cooke 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 100kg tromometers 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. 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 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.

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 HAWAIIAN VOLCANO OBSERVATORY

From the Pacific Commercial Advertiser, Honolulu, November 2 and 3, 1913.

TECHNOLOGY STATION, October 30, 1913.

A Notable Week.

"The week at Kilauea has been a notable one, characterized by a rising lava column in Halemaumau with finally overflow of the cone in the bottom, and by an earthquake strong enough to dismantle the more sensitive seismographs of the station — the strongest experienced here since the station was established in January, 1912.

"Mr. J. W. Green today finishes his magnetic work, and the Volcano Research Association has reason to be grateful to him and to the U. S. Coast and Geodetic Survey for this excellent addition to our knowledge of the physical peculiarities of Kilauea. It is to be hoped that this preliminary magnetic reconnaissance of a region which shows extraordinary magnetic variations, will lead eventually to a complete magnetic survey of this island.

"At Halemaumau from the SW station at 8:45 a. m. October 24, moderately loud puffs could be heard every fifty seconds. The weather was calm. There were occasional intermediate puffs, and sometimes a rocket-like noise, but no sound of splashing. At 9:05 a. m., a faint rhythmic 'freight engine' puffing was heard. At 9:25 and 9:35 a. m. respectively, small rock slides were heard W and S. At night from 10 to 12 p. m., steady glow on the fume-cloud could be seen from the Volcano House with occasional flaring, showing that the lava cone was spouting.

The Earthquake.

"After midnight, during the first hour of October 25, the fume products of the pit settled northeastward over the Volcano House, making breathing very disagreeable. The night was very still. About 1 a. m. the earthquake occurred, the stronger portion lasting five or six seconds and shaking the buildings vigorously so that some objects fell, pictures swayed and were left awry, everyone was awakened, and numerous rock slides were started in Kilauea and Kilauea-iki, which could be heard roaring and rumbling through the mist of fumes. These slides left numerous brown fresh scars especially on the north walls of the two craters. Two of the tromometers of the seismograph cellar were broken, and a crack was made in the concrete wall, on the north side. A record of the earthquake was written by the Omori ordinary seismograph. The first rock falls were heard in the direction of Kilauea-iki, suggesting that the movement was from the eastward. Mr. Green reported hearing the rumble of the earthquake receding toward the southwest before the noise of the rock falls began.

A Quick Inspection.

"An inspection of Halemaumau from two to four a. m. revealed an illumined fume cloud, with light NE wind, and fog hanging over the region of the Twin Craters. In four places rocks had fallen from the banks into the Crater Road. Looking down into the pit from the Old Resthouse on the north side, a cavity on the bottom was seen to be spouting lava at intervals of forty to fifty seconds, with chiefly a splashing noise, and occasionally large sputterings would fall on the rock floor with thuds. The opening was in the top of a cone or dome, roughly rectangular, continuously open, and showing a seething pool within. Cracks extended from the four corners, as though the aperture had been made at the intersection of two main fissures. Its estimated length was from ten to twelve feet, width five to six feet, with walls three or four feet thick. The spurting was oblique northward. The pool appeared about in the Old Faithful position, as compared with last spring. The flaring on the fume-cloud was made by the spurts, but the fumes were continuously illumined.

"The earthquake had wrought no

conspicuous change in the eastern or northern rim of Halemauman. There was little rock-sliding. At the volcano station a stadia rod had fallen into the middle of the room from the southern frame timbers, and a bottle had fallen over on the table. The rocks of the east wall of the Old Resthouse had tumbled southward at the entrance. At about 2:30 a. m. the talus was still sliding in Kilauea Iki.

Crater Walls Shaken.

"At 10 a. m. an inspection of the craters by daylight showed:

"In Kilauea Iki, at least four falls from the north wall and two from the east; the eastern falls are from the southern sides of two pronounced scars high up on the precipitous cliff, which are themselves the product of some earthquake of the nineteenth century, perhaps 1868.

"In Kilauea, fresh fallen material at the northern end of Uwokehuna cliff, and a number of breaks along the cliffs under the Volcano House. Near the northern end of Byron's ledge one fresh brown scar is seen.

New Earth Cracks.

"Four small crevices had opened in the hard brown earth of the path up the hill back of the Volcano House, near the water tanks and in the line of the large steam crack. The maximum gaping was one-half inch. All the crevices are side by side in a distance of fifteen feet, and they extend in the line of the cliff and the steam cracks, implying some slight movement on the large steam crack. No other fresh cracks were found, although they were looked for along the stable paths and from the Sulphur Banks southward.

"October 26, 1913, at 3:40 p. m., the fumes cleared away and the detail of the bottom of Halemauman was clearly seen by daylight. The cone of black fresh masalt was spurting lava at about fifty-second intervals. The cavity in the top had changed its form and become roundish, perhaps five feet in diameter, and the liquid splashed out often in heavy masses. Approximately the cone was twenty feet wide and fifteen feet high. From it extended black flows some hundred feet to the northwest, and among them was another black cavity, which appeared to have been recently active. The active cone was ejecting its liquid in an easterly direction.

"The fumaroles toward the west were very active, very hot and crackling, sulphur stained and emitting rapidly bluish fumes. These fumaroles west and north are at least one hundred feet above the active cone, and emerge from the top of the talus slopes that surround the active area. On the north side of the ring of talus is a bright salmon-colored bank of red rock, with blue fumes rising from rock cracks back (N.) of it. The axis of the active area in the bottom, cone and flows, lies about in the line between the SE. and NW. stations on the rim.

"During the next three days activity of the same sort continued, and moderate glow was seen on the fume-cloud at night.

Lava Splashing.

"Today, October 30, at 10:30 a. m., with moderate NE. wind, the lava cone could be heard spouting vigorously every fifteen to forty seconds, and the splash of the falling lava spray could be heard some distance back from the edge; at 10:45 a new noise was heard, which was at first mistaken for continuous rock-sliding low down, and a rumble as of lava in a cavern. At 11:10 a. m. a view of the cone was obtained, and the sliding and rumbling were explained: a splendid lava flow was pouring westward from the top of the cone, in three streams, bubbling out continuously like an artesian well, with floods added to it by the spasmodic vomitings of the fountain in the cone. The lava-filled area was much larger than it had been when last seen, L-shaped, with its new extension to the west. The flows poured on with distributary branchings.

"At 11:20 a. m. the temperature of the air was 23 degrees Cent., and of the Postal Rift 310 degrees.

"At 11:30 a. m., from the hot fumaroles on the SW. side, came a noise of snapping of hot rocks, like musketry, superimposed on the continuous noise of the streaming lava.

"All of this indicates that the lava column at the moment is rising rapidly, but there is still a vast amount of talus for it to dissolve, and while lava may rise into the hot and crackling SW. fumaroles and pour thence in cataracts, more periods of stagnation are to be expected before the bottom of the pit is clear for the formation of a large pool. At present the lava torrent is a magnificent spectacle, but it may become choked and invisible within twenty-four hours.

Much importance is attached to the shocks of October 25, 1913, by Professor Jaggar and his associates at the observatory. They are anxious to secure data on the distribution of earthquake intensity. This will be valuable in determining a distribution for simple observation instruments which the scientists will place at different points on Hawaii and the other Islands. There is little doubt but the shock was felt all over the Island of Hawaii and possibly on others of the Islands.

Want People to Aid.

Professor Jaggar has called upon the newspapers to aid in securing this data. What is wanted is a report from every person on the Islands as to whether or not they experienced the earthquake on the morning of October 25. To aid in making the work more thorough, reports are asked from persons who did not feel the shock as well as those who did. A full list of questions has been prepared. Residents of the Islands are asked to fill these out and send them to Professor T. A. Jaggar at the Volcano House, Kilauea, Hawaii. Following are the questions:

List of Questions.

Earthquake of October 25, 1913; Information Blank.

What is your name, occupation, and P. O. address?

Did you feel the earthquake October 25, 1913, about 1 a. m.?

How many shocks did you feel?

At what locality were you? Describe place as exactly as possible.

Were you indoors or outdoors, and if indoors, on what floor of house?

Were you walking, riding, standing, sitting or lying down?

At what time did the shock or shocks occur, as nearly as you know?

How long, in your judgment, did the shock or shocks last?

At your locality.

(1) Was the earthquake felt by few or many persons?

(2) Did doors and windows rattle, or buildings creak?

(3) Did hanging objects, like pictures swing?

(4) Did plaster crack?

(5) Was furniture moved about?

(6) Did bottles, vases, etc., fall?

(7) Did church bells ring?

(8) Were people generally awakened?

(9) Were pendulum clocks stopped?

(10) If so, in what direction did the pendulum swing? (answer north-south, east-west, etc.)

(11) Were many people frightened?

(12) Were many people made dizzy or sick?

(13) Did trees, doors, etc., swing slowly, or did they quiver?

(14) Was water in tanks observed to swing slowly, or splash quickly?

(15) Did chimneys fall?

(16) Did brick masonry crack?

(17) Did window glass break?

(18) If so, what directions did most of the broken windows face?

(19) Did concrete masonry crack?

(20) Were any buildings destroyed?

(21) Was there any damage to wooden buildings?

(22) Were there any landslips, cracks in the earth or new springs formed?

(23) What noise did you hear, if any, before, during or after the earthquake?

(24) Was there general evidence that objects shook or fell in one direction, or one line of direction, as north-south, east-west, etc.?

(25) Were animals or fowls restless, noisy or unusually quiet before the earthquake?

(26) Were there any other noteworthy happenings?

(27) Persons of scientific training who receive this are invited to write here a complete brief description of phenomena observed.

Since the last systematic report from the Whitney Laboratory of Seismology, Mr. H. O. Wood reports that earthquakes have been registered as follows:

Oct. 15, from 5:37:19 a.m. to 5:38:06 a.m. H. S. T.

Intensity, medium II Cancani scale; about 0.3 the minimum perceptible unit. Origin distance about 16 miles.

Oct. 18, from 3:12:11 p.m. to 3:13:7 p.m. H. S. T. Intensity, medium I Cancani scale; about 4.15 the minimum perceptible unit. Origin distance unknown.

Oct. 19, from 5:31:38 a.m. to 5:32:23 a.m. H. S. T. Intensity, medium I Cancani scale; about 0.15 the minimum perceptible unit. Origin distant about 18.7 miles.

"October 25, beginning at 12:57:37 (mdt.) a.m. a shock sufficiently energetic to disable all the delicate, continuously recording seismometers, and

to stop the pendulum time-marking clock, at 12:57:39 a.m., whose pendulum swung in a north-south direction, very closely in the true meridian. There was no further continuous registration for some hours.

"While this was a strong shock instrumentally, from the geological point of view it was only a strong weak-shock here at Kilauea—the phenomena in this vicinity corresponding unusually well with those which define Grade VI of the Rossi-Forel scale, or Grade V-VI of the Mercalli scale.

"The silk-fibre suspensions of both the Bosch-Omori tromometers were snapped off, and the Cardan lamella of the N-S component was broken. The delicate Omori tromometer had its subpendulum dislodged and slightly bent by its fall, and some pivots in the universal joints of the magnifying lever system were sprung from their sockets and injured.

"The Omori ordinary seismograph recorded motion for two or three minutes. One or two seconds elapsed before the motion it recorded became large enough to be limited by the safety stops of the instrument, indicating very vaguely an origin from ten to twenty kilometers distant. The origin probably lay in the Hilo direction. The strong part of the motion began one or two seconds after the first movement and lasted from four to six seconds.

"Here at Kilauea the perceptible duration of the shock was from sixteen to eighteen seconds, according to an approximate second-count by Mr. J. W. Green and an estimate by Mr. H. O. Wood. These were independent determinations.

"In this vicinity all persons were wakened, but no one was alarmed. A few unstable objects, a mirror, two or three bottles, etc., were tipped over.

"Small but noisy falls of loosened rock blocks occurred along the northwest pali of the main crater, on the Byron's ledge section of the crater wall, and also from the high, steep pali on the northeast in Kilauea-iki.

"Minute cracks were opened in earth in a filled-in place along the course of an old steam crack.

"A single crack was opened from top to bottom of the concrete wall on the north of the seismograph cellar. In view of the loose-block character of the rock foundation here at the very edge of the pali, this is not surprising or significant of high energy, but formally such an effect cannot be correlated with other phenomena here since ordinarily it would denote very strong motion.

The motion was preceded and accompanied by an earth sound, a roaring noise heard before the roar of the rock falls, which appeared to move progressively southwestward.

"Vague information indicates that the shock was little, if any, stronger at Hilo than here, but at intermediate places it seems to have been stronger —tending to confirm the probability of the intermediate location of the origin.

"Between 12 o'clock noon and 12 o'clock midnight on October 25 five very feeble shocks were recorded. One of these was of the usual magnitude of local small shocks, the others were exceedingly feeble. These were recorded only by the Bosch-Omori east-west component and, owing to settling movements following readjustments necessitated by the strong shock, the traces of the seismograph are confused by overscoring so that the times and dimensions of these shocks cannot be measured precisely."

Oct. 26, from 10:31:39 a.m. to 10:32:00 a. m. H. S. T. Intensity, high I Cancani scale; about 0.22 the minimum perceptible unit. Origin distance about 13 miles.

Between about 2 p.m. of Oct. 26 and 6 a.m. of October 27 there were registered several, from 6 to 10, very feeble shocks whose times and dimensions cannot be measured precisely.

Oct. 27, from 9:44:26 a.m. to 9:45:21 a.m. H. S. T. Intensity, low II Cancani scale; about 0.3 the minimum perceptible unit. Origin distant about 13 miles.

Oct. 28, from 5:05:57 a.m. to 5:06:29 a.m. H. S. T. Intensity, low II Cancani scale; about 0.35 the minimum perceptible unit. Origin distant about 14.3 miles.

Oct. 28, from 8:45:10 a.m. to 8:47:08 a.m. H. S. T. Intensity, high III Cancani scale; a little less than the minimum perceptible unit; not felt perceptibly. Origin distant 13 miles.

Oct. 28, from 1:00:18 p.m. to 1:01:22 p.m. H. S. T. Intensity, low I Cancani scale; about 0.08 the minimum perceptible unit. Origin distance unknown.

Oct. 29, from 5:49:29 a.m. to 5:49:48 a.m. H. S. T. Intensity, high I Cancani scale; about 0.2 the minimum perceptible unit. Origin distant about 13.7 miles.

Very respectfully,

T. A. JAGGAR, JR.,
Director.

WEEKLY BULLETIN HAWAIIAN VOLCANO OBSERVATORY.

Technology Station, November 6, 1913.

A crusted lava pool has continued to sputter idly in the bottom of Halemaumau during the past week. The week has been uneventful Seismically and accordingly no report of the Whitney Laboratory of Seismology is here included.

At 9:10 p.m. Oct. 30, 1913, the flows which had been seen earlier in the day had so filled up the the bottom area as to nearly drown the cone, and the effect was as of a pool of crusted lava, cherry red, elongate east and west, with considerable sputter over the buried cone. Every now and then the crust would crack open with a sharp report and a wide band of liquid lava would well up the crack. The rim of the pool showed bright glow lines. Glows was also seen in the SE and SW fumaroles. When the crust was rent asunder and the liquid welled up, a bright flare was made on the fume cloud above, which was seen from a distance. The noisy crackling which was made by the splitting of the crust in all directions probably is identical with the noise heard in the morning, supposed to be the snapping of hot rocks in the SW fumarole.

Nov. 1 at 11:30 a.m. a light NE wind was blowing, the SE station was fumy, but there was occasional seeing from the north stations. A sluggish belching noise came from the E end of the pool, as of vicious lava confined. At very irregular periods came rocket blasts, and there was some rumbling as of thudding lava under a crust. At noon from the Old Resthouse intervals between the blasts were respectively 42, 100, 35, 25, and 10 seconds. A glimpse showed the pool black and crusted, the puffing coming from the E end, where the cone had been. The fumaroles were mostly emitting thin fumes sluggishly, except the low SW one which was very active. A faint very light crackling noise could be heard. At night the fumes obscured the view, though there was glow on the cloud.

Nov, 2 in the evening a bright flare was seen once or twice from the Observatory, otherwise the fume cloud appeared nearly dark.

Monday and Tuesday, Nov. 3 and 4, there was a mild puffing and no seeing, the noise being louder at 9:30 a.m. Nov, 4 than on the previous afternoon. At 6: p.m. on Nov. 4, a glimpse was had of two spouting cracks at the east and west ends of the pool, and occasionally there were extra loud rocket blasts, but very little sound of splashing or falling lava. The glow on the cloud after dark was slight.

In the evening of November 5 the fume cloud in the moonlight appeared almost without glow from beneath. Today Nov. 6 at 10:45 a.m. the wind was light from the NE, and the fumes appeared thin. From the old Resthouse the noise was found to have changed in character during the last two days; there was the spatter of heavy falls of lava on a rocky floor, the continuous sliding noise of a running lava-flow, a grumble from the W and a blowing noise mixed with splash from east. The suggestion was that there is an open pot toward the position of the former eastern cone from which a flow is pouring.

New slides about Kilauea, generated by the earthquake of Oct. 25, 1913, have been discovered near the base of Waldron's ledge, where a single large block has fallen out near the trail, and from the low cliff west of the foot of the trail leading from the Volcano House to the crater. This last place is a broad fresh notch, marking the scar of a landslip of considerable magnitude, as shown by the talus heaps beneath.

WEEKLY BULLETIN OF HAWAIIAN VOLCANO OBSERVATORY

From the Pacific Commercial Advertiser, Honolulu, November 17, 1913

TECHNOLOGY, STATION, November 13.—The volcano has remained quiet throughout the heavy rainstorm of the week. The rain began on Saturday, November 8, and since that time to today, November 13, eleven inches of rain have fallen at the observatory, with nearly four and one-half inches in one day, between Tuesday and Wednesday, November 11 and 12.

November 7, in the evening, visitors were able to see the floor of Halemaumau, where at two points lava was spurting. November 8, at 11:30 a. m., the floor could be seen from the old resthouse, and the festoons of the new lava flows appeared light brownish, as though powdered with the dust of avalanches. Strong blowing could be heard from two fissures which were splashing lava at the east end of the floor.

The crackling noise of a lava flow could be heard but its source was not evident through the fumes. The crusted pool appeared to have increased in size. Around the edges were some glowing cracks. The humidity of the air on this day was extraordinarily low and the fumes appeared thin. The blowing noises were incessant, with some variations in loudness.

November 9 and 10 there was no seeing, but at midnight of the 10th, a view of the pit by moonlight from the observatory revealed no glow or flaring on the fume-cloud. November 11 all was enveloped in rain and mist.

Veiled in Steamy Fumes.

November 12 at 3 p. m., a partial view through steamy fumes from the northwest showed all conditions to be similar to November 8, one glowing crack at the east end of the floor was faintly seen, and stones were heard sliding from the west and north walls. The noises of blowing had decreased and once in three or four minutes a louder blast came from the region of Old Faithful.

Today, November 13, at noon, the noises were the same with some rock-sliding, but nothing could be seen. Excessive volumes of fumes continue to be given off from fumaroles all around the talus ring within the pit, and the talus is slowly sliding inward and retarding the progress of the rising lava column. It is still impossible to get any observations of depth with instruments, owing to the incessant veil of fumes.

In the earthquake report which follows, and in these reports since August 27, 1913, time has been referred as heretofore, to a rated chronometer, but it has been possible to check the rate with solar observations. These were first kindly furnished by Mr. J. W. Green, in connection with his magnetic work, and later the solar observing has been done by Mr. Wood, with aid of a transit with solar attachment loaned to the observatory by the College of Hawaii.

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

Earthquake Report.

Since the last systematic report the following earthquakes have been registered here.

October 29, from 2:08:24 p.m. to 2:09:03 p.m., H.S.T. Intensity, medium III Cancani scale; more than 0.5 the minimum perceptible unit. Origin distant about fourteen miles.

November 1, in late afternoon or early evening; overscoring makes it im-

possible to determine the precise time limits. Intensity, high I Cancani scale; about 0.2 the minimum perceptible unit. Origin distant between twelve and fourteen miles.

November 3, in the late evening (or possibly in the early morning of the fourth). Precise time limits are indeterminate owing to overscoring. Intensity, low II Cancani scale; about 0.25 the minimum perceptible unit. Origin distant about 12.5 miles.

November 6, from 2:54:30 p.m. to 2:55:19 p.m., H.S.T. Intensity, medium I Cancani scale; about 0.1 the minimum perceptible unit. Origin distant about thirteen miles.

November 7, from 10:07:41 a.m. to 10:08:38 a.m. H. S. T. Intensity, low I Cancani scale, about 0.5 the minimum perceptible unit. Origin distant about forty-eight miles.

November 7, from 12:35:41 p.m. (noon) to 12:37:18 p.m. H.S.T. Intensity III-IV Cancani scale; about the minimum perceptible unit. Felt in Hilo, but not felt in the vicinity of the crater. Origin distant about 13.3 miles.

November 7, from 7:01:50 p.m. to 7:02:05 p.m. H.S.T. Intensity, medium II Cancani scale; about 0.3 the minimum perceptible unit. Origin distant about ten miles.

November 8, from 4:27:45 a.m. to 4:28:01 a.m. H. S. T. Intensity, high II Cancani scale; about 0.4 the minimum perceptible unit. Origin distant about twelve miles.

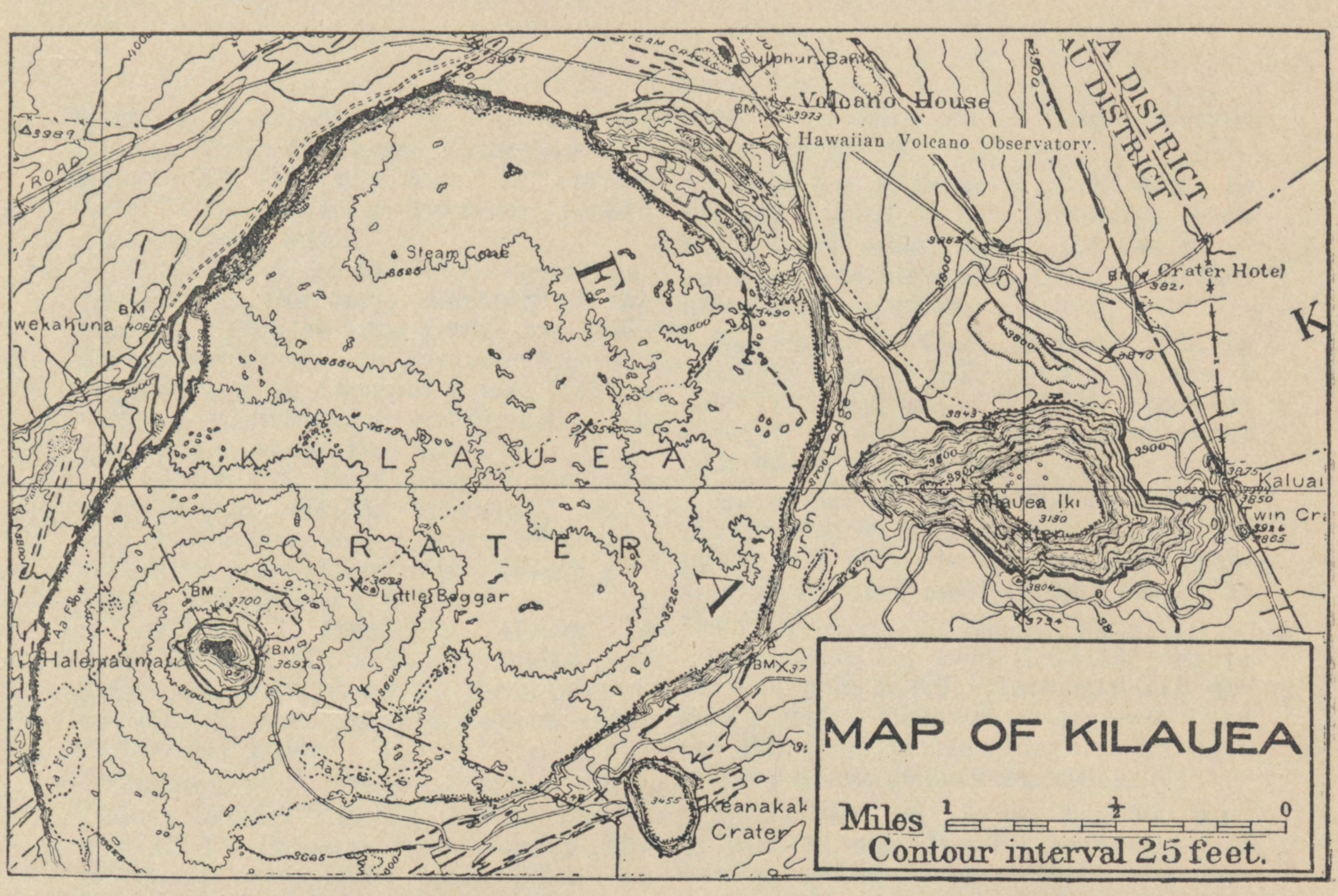
November 9, from 10:27:38 p.m. to 10:28:39 p.m. H.S.T. Intensity, low I Cancani scale; about 0.05 the minimum perceptible unit. Origin distant about 20.3 miles.

November 10, from 11:04 to 11:30 approximately H.S.T. Waves of the chief phase of a very distant teleseism, probably of only ordinarily strong energy at the origin.

November 10, from 1:13:33 p.m. to 1:13:58 p.m. H.S.T. Intensity III, approximately, Cancani scale; less than the minimum perceptible unit. Origin distant about twenty-six miles.

November 12, from 9:23:08 a.m. to 9:23:33 a.m. H.S.T. Intensity, II Cancani scale; about 0.35 the minimum perceptible unit. Origin distant indeterminate. Very respectfully,

T. A. JAGGAR, Jr.,
Director.



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WEEKLY BULLETIN OF HAWAIIAN VOLCANO OBSERVATORY

From the Pacific Commercial Advertiser, Honolulu, November 23, 1913.

TECHNOLOGY STATION, November 20.—A quiet period in the present state of activity at Kilauea accompanied continued heavy rain from the time of the preceding report, November 13, to the afternoon and evening of Tuesday, November 18. Heavy winds from the northeast brought much fog and mist with frequent heavy showers, many of which were of prolonged duration, thus setting up conditions of swirling fumes and steam under which it is practically impossible to see the lower portion of the Halemaumau pit, even in brief glimpses.

During this stormy interval no views were obtained. However, throughout this time the fume cloud was not perceptibly illuminated, not even by flaring. It was conspicuously dark on Monday evening, November 17.

On Tuesday afternoon, November 18, one instantaneous glimpse of a small area at the bottom of the pit showed spots of glowing lava. The blowing noise of escaping gas was moderately loud and practically continuous, though the usual irregular variations in the volume of sound, supposed to follow the irregular action of Old Faithful, were heard. Also at intervals was heard the spatter sound made by the falling of lumps of molten lava after vigorous fountain action.

Throughout the evening and night of November 18-19 the fume cloud was continuously illuminated by the molten lava rising and flowing in the bottom of the pit, with frequent brilliant flarings at the usual irregular intervals of Old Faithful. However, the wind and rain made seeing impossible from all sides of the pit.

Activity Increases.

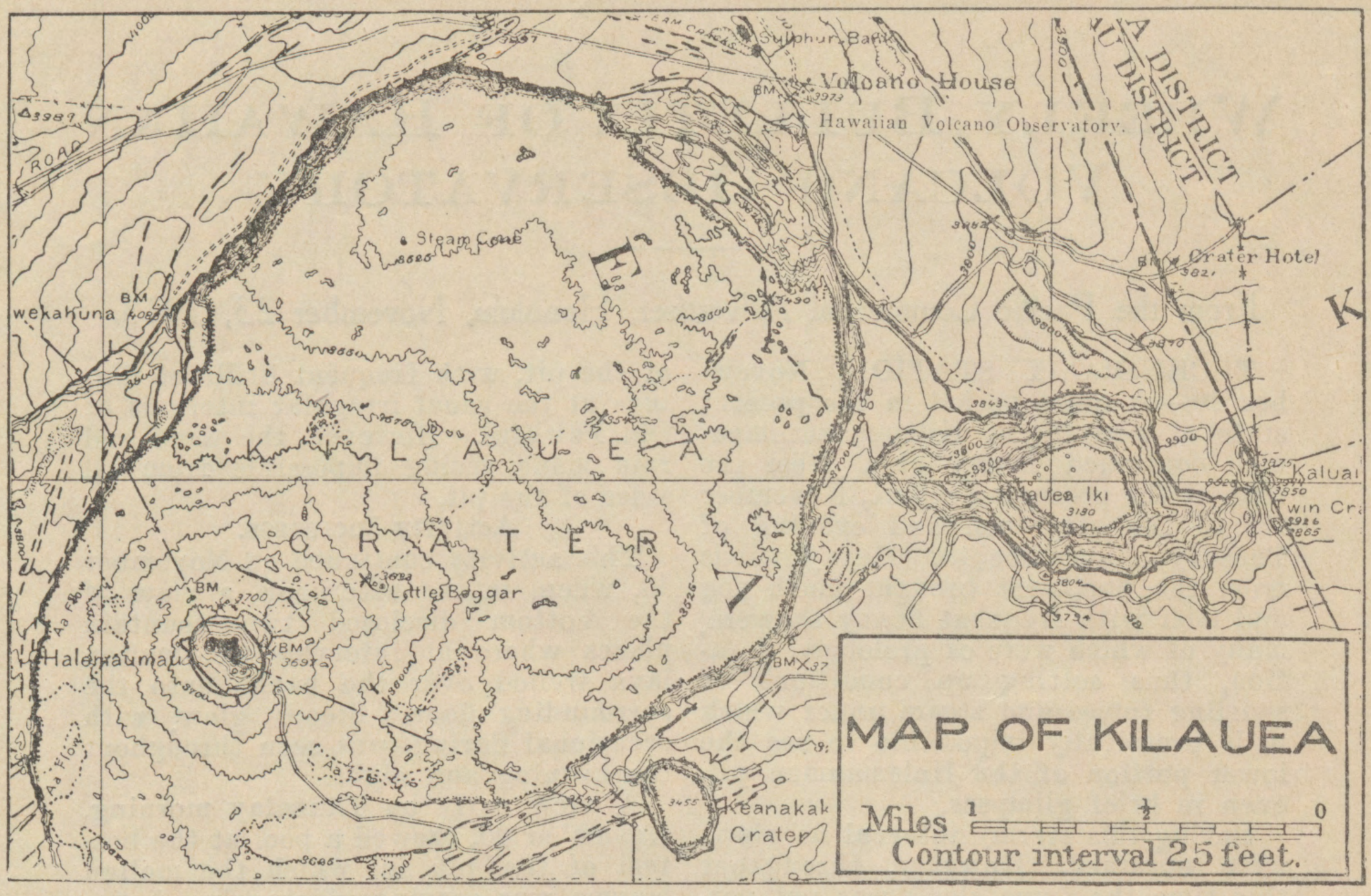
This activity continued on November 19, when, in the afternoon, a view of the bottom disclosed two fountain places where at intervals the molten lava welled over the banks onto the surrounding floor. Steady glow, with occasional flaring, was seen throughout the evening and night.

A view early on Thursday morning, November 20, showed a pool at the bottom of the pit in which the molten magma was surging vigorously. Later in the forenoon the lake crust was breaking up, particularly along the edges, and the bottom of the pit was filling at a comparatively rapid rate. The noise of escaping gas was much louder than on Tuesday.

Rainy weather has obscured the sun at noon for a considerable time past, preventing observations for time to check the rates of the chronometer and clock. On this account the systematic report from the Whitney Laboratory will be given at a later time. However, only one earthquake, instrumentally only a moderately small shock, has been registered since the last report. It occurred early in the afternoon of November 18.

Very respectfully,

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.

WHITNEY LABORATORY OF SEISMOLOGY.

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

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
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WEEKLY BULLETIN HAWAIIAN VOLCANO OBSERVATORY

Technology Station, November 27, 1913

At the time of writing the last report a marked increase of activity was just beginning in Halemaumau. This increase continued throughout Thursday afternoon and evening, November 20. In the evening of this day quiet air made it possible to observe the surface action from the station at the Old Rest House for comparatively long intervals. Elsewhere swirling fumes interfered. The steady action in the Old Faithful pool resembled that of a boiling spring--the magma rising steadily and flowing rapidly away under the crust in several varying directions, occasionally overflowing onto the neighboring crust for a few minutes. During this time the lava was rising steadily, lifting and at times cracking the thin black crust which covered most of the lava lake. Now and then a miniature flow would well out through one of these cracks. In a general way this system of cracks was permanently maintained and the glowing lava could be seen through them all along their course.

Even on Thursday, Nov. 20, conditions were not favorable for the routine work which is carried on when the fumes will permit. Consequently the depth to the lake surface and its dimensions were not measured; but the bottom area has definitely risen above recent previous marks by a considerable amount; and the lake area was of moderate size, probably not less than 100 feet in the E-W direction by 60 feet in the N-S direction.

At frequent intervals fountain action disturbed the steady flowing in the Old Faithful pool, sending spasmodic momentary flows and down the small, low, south and east slopes of the spatter cone which enclosed the figuration. Throughout the evening and night of November 20 the fume cloud was brilliantly lighted and brilliant flares were seen frequently.

This was the crisis of this eruptive stage. On Friday, Nov. 21, no view could be obtained on account of the wind. In the evening and night the illumination of the fumes was steady, but low, and flaring was less conspicuous.

Since then strong winds have made seeing altogether out of the question. But diminished illumination of the fume cloud--sometimes almost to the vanishing point--has indicated clearly a cessation of the marked rising and overflowing.

Hissing and swashing sounds, with the sounds of falling spatter, have been heard whenever the pit has been visited, but they have not been so loud as previously.

Nothing of interest in the registration of seismic motion has occurred during this week.

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WEEKLY BULLETIN OF HAWAIIAN VOLCANO OBSERVATORY

From the Pacific Commercial Advertiser, Honolulu, December 7, 1913

TECHNOLOGY STATION, December 4.—The quiet stage in the activity in Halemaumau has continued without observed change, since the last writing. At the bottom of the pit there is a level area of black lava—the thickly frozen surface of the magna lake—probably somewhat larger in dimensions than the values given last week. However, it has not enlarged in the meantime, merely better views have been obtained of it, enabling better judged estimates to be made. It is judged to be in the neighborhood of 200 feet long, east and west, and about 150 feet wide, north and south. It is wider near the east end than near the west, an irregular polygon with curving sides. Several jagged peaks of low altitude rise around the place of Old Faithful, the remnants of its collapsed cone.

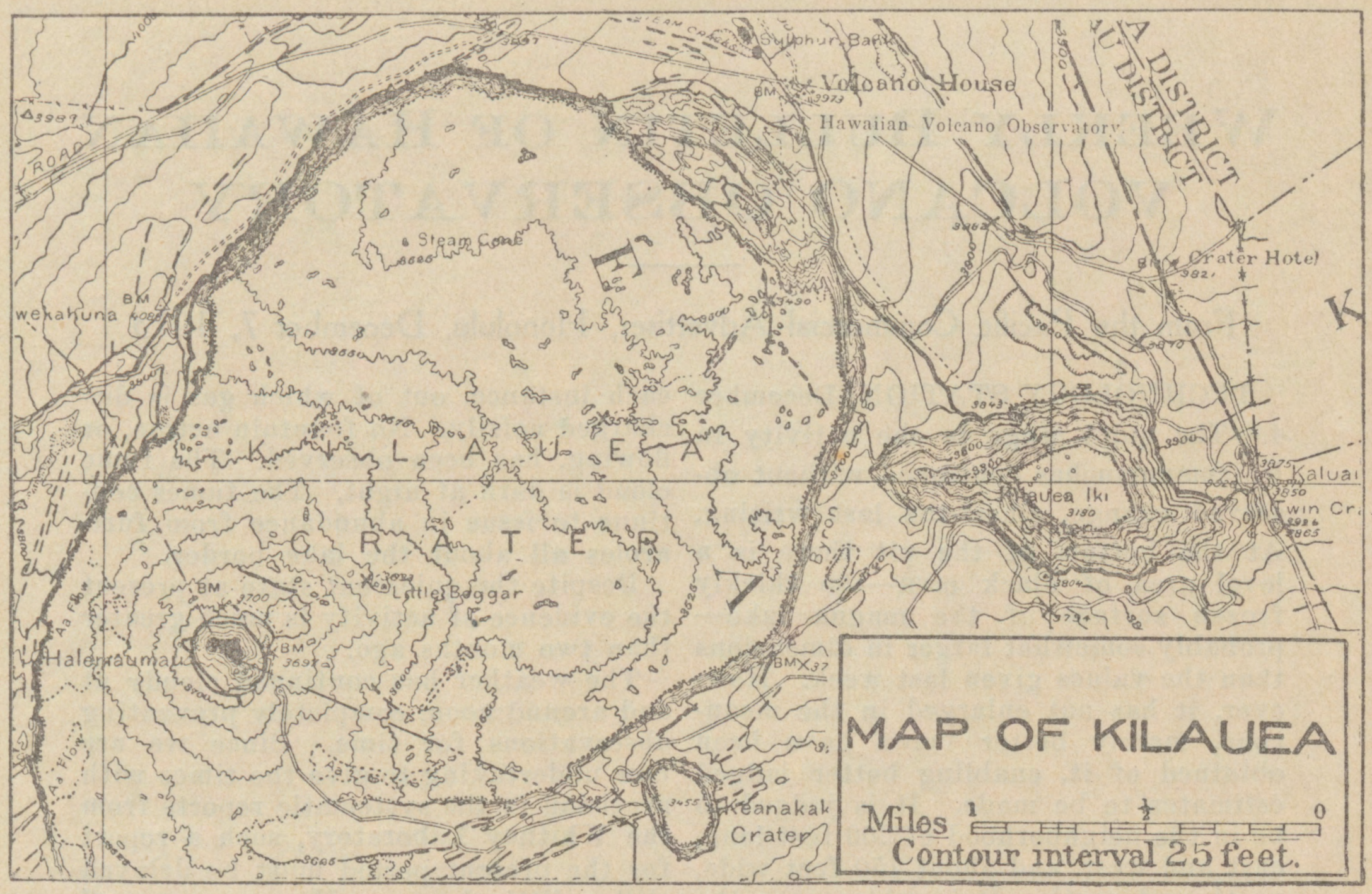
At the Old Faithful place, and at a point on the south shore of the lake area near its west end, are groups of small glowing orifices, two or three in each instance, out of which gas is discharged noisily. No fountain action, or flowing, has been observed. The fume cloud is dark at night. The fumes continue to issue in abundance from fumaroles all about the lake border.

Despite the quiescent state at present the evidence of activity is much greater than two months ago.

The weather has continued cloudy at and around noon, completely preventing observations for time. Since we are now undertaking to give the times with precision in the systematic reports from the Whitney Laboratory, such a report for the present period must be delayed still a little longer. However, several light, local earthquakes have occurred since the last writing.

Also in the afternoon and evening of December 3, the registration of volcanic vibrations was very pronounced, and individual groups of these waves were of comparatively long duration, from five to ten minutes. Very respectfully,

H. O. WOOD, Associate.



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WEEKLY BULLETIN HAWAIIAN VOLCANO OBSERVATORY

Technology Station, December 11, 1913

Kilauea still remains in a semi-dormant stage. In general the conditions described in the previous report persist. Good views, for brief intervals, were obtained on both Thursday and Friday, Dec. 4 and 5, but nothing noteworthy was then observed.

On Saturday afternoon, Dec. 6, during several intervals of from ten seconds to two or three minutes duration, large parts of the bottom area were visible from the north and northwest parts of the rim of Halemaumau. Glowing spots were seen at the Old Faithful place and on the south margin of the lake area near its western extremity. At this time there was no visible boiling, flowing, or spouting of molten lava. The fumaroles in the talus at the southwest were unusually productive, yielding copious quantities of both snow-white and thin, blue fumes. At this time a fumarole was discovered almost directly under the N station, less than 200 feet below the rim, the fumes issuing directly out of the precipitous rock wall, nearly 300 feet above the next highest fuming place. This fumarole had been noticed, but not reported, about a week earlier than this by the old guide, Alex Lancaster. As yet only a small amount of vapor, blue in color, is coming from this place. In the evening and night intermittent illumination of the fume cloud could be observed though there was bright moonlight. One or two of the flarings were very brilliant.

At sundown on Saturday, Dec. 6, the steam jets on the northeast slope of Mauna Loa were visible for more than half an hour -- being conspicuous for the first time in many weeks. The amount of vapor visibly issuing from them was as great as, probably greater than, has been observed hitherto.

Good views into the pit were obtained on Sunday, Dec. 7, but no new manifestations were observed. Save for one or two isolated flarings, which could barely be seen, there was no illumination of the fume at night.

On Dec. 6, no view of the bottom could be obtained but there was no sound of falling spatter from the molten lumps after fountain discharges. The noise of the eruption appeared slightly increased.

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On Dec. 9, there was no seeing, owing to a strong and gusty northeast wind.

On Dec. 10, a swerving southwest breeze made it impossible to see into the pit, but noises of swashing and of the falling of lumps of molten lava were heard, chiefly in the vicinity of the Old Faithful place.

On the morning of Dec. 11 brief but clear glimpses of portions of the bottom disclosed nothing new, except that the Old Faithful place was surrounded by fresh spatter lumps; and that a blowing cone under the south station near the edge of the lake area was also surrounded by fresh spatter fragments. Gas was rushing noisily from this orifice, from that at the southwest and from Old Faithful.

It is still necessary to withhold any systematic report from the Whitney Laboratory on account of uncertainty in regard to time correction factors. There was extreme tilting during the run of 8-9 December, and a feeble local shock was registered in the early afternoon of the 9th.

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Special Bulletin of Hawaiian Volcano Observatory.

AN ADDRESS DELIVERED AT A MEETING OF THE HAWAIIAN VOLCANO RESEARCH ASSOCIATION, IN HONOLULU, DEC. 11, 1913.

By T. A. JAGGAR, JR.

HAWAIIAN GAZETTE CO., LTD
1913

SCIENTIFIC WORK ON HAWAIIAN VOLCANOES.

After two years of recording activity and earthquakes at the observatory at Kilauea, with much coöperation and independent investigation by other institutions, the Director of the Hawaiian Volcano Observatory makes this report, not so much to set forth the accomplishment of the Observatory, which is published otherwise, as to review the development of the motives which underlie the work so as to make some forecast for future growth. The efficiency of an institution which is essentially educational and not commercial, productive of ideas rather than dollars, must be measured by its effect on productive men of learning in stimulating them to production; that is, to new discovery, experiment, investigation and publication. The founding of the Volcano Observatory and the formation of the group of subscribers here called the "Research Association," were themselves evolved productions of the inspiring work of early investigators, as well as of the natural intellectual stimulus created in man by the unexplained Kilauea lake of boiling nebulous flux.

The Three Great Pioneers.

Three names stand out above all others as recorders of the work of the Fire Goddess in Hawaii in the middle decades of the nineteenth century: Titus Coan, James Dwight Dana, and William Lowthian Green. Coan the missionary, earnest seeker after truth, for more than a third of the century watched every detail of the evolution of the volcanoes, pondered their meaning, and moreover made truthful record in scores of letters which were promptly published. This genius for *recording* is rare among men, and is an all-important requirement in science; many men are good observers, but millions of valuable observations are forever lost, because of a lack of appreciation of the value of a *jotting down*—day, hour, minute, event, stages, appearances. All science is no more than a categoric jotting-down, and the grouping of facts into new categories, until some of these reach the dignity of "theory." Coan without apparatus or endowment was an institution, a first Hawaiian volcano observatory, and in actual output he was a better observer and recorder than some institutions which have been elaborately equipped.

Professor Dana of Yale, foremost American geologist, was with the Wilkes Expedition at Kilauea in 1840, revisited Hawaii later, and wrote in 1891 a book, "Characteristics of Volcanoes," which stands preëminent among volcano memoirs. It was inspired by Kilauea and Mauna Loa, but is broad and sane, and presents a most painstaking and thoughtful summary of the progress of Hawaiian volcanic events, and their bearing on geology. Dana published in New Haven Coan's letters, and it was doubtless Dana who stimulated much of Coan's recording.

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 the 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.

These three men, Coan and Green resident here, Dana from an eastern university, typify the reason for the creation of an Hawaiian Volcano Observatory, and their portraits should forever hang in honored place upon its walls. Coan, the systematic observer, showed the value of record and system; Green, the

merchant, fascinated by the spell of Pelé and inspired by the problems of position of this mid-Pacific pinnacle, Hawaii, rising 37,000 feet above the ocean deep, adopted volcanology for avocation, and left monumental work to inspire specialist and layman alike. While Dana the scholar, coming from a distant seat of learning, hospitably entertained in the islands by Coan, Green, Bishop, Brigham, Alexander and a host of kind friends, rewarded their kindness by making famous to the whole world the achievements of his Hawaiian scientific colleagues, himself adding new volcano lore, and illustrating what production may come from scientific hospitality. So may we make from their example a text to guide Hawaiian volcano study: *Keep and publish careful records, invite the whole world of science to co-operate, and interest the business man.*

These subjects, keeping records, inviting scientific coöperation and interesting the laymen, will be treated separately in this essay.

KEEPING AND PUBLISHING RECORDS.

Volcano House Record-Book.

The maintenance of a record book at the Kilauea Volcano House wherein the impressions of visitors have been written, including many careful descriptions with diagrams and dates, has been an invaluable aid to the compilation of facts concerning the evolution of Kilauea and Mauna Loa. Here, and elsewhere in published letters from the missionary journals, in scientific periodicals, in magazines, and in the newspapers and annuals, much may be gleaned of information concerning the livelier times of volcanic activity, but the detail of the repose periods is largely without a recorder. Those who kept the record were mostly resident folk like Coan and Green, missionaries, physicians, engineers, teachers, artists, jurists and men of affairs. Conspicuous among them for repeated note-taking were W. D. and J. M. Alexander, Sereno Bishop, E. P. Baker, W. T. Brigham, W. R. Castle, E. D. Baldwin, F. S. Dodge, J. S. Emerson, Charles Furneaux, D. H. Hitchcock, and L. A. Thurston. Most of the early missionary names are among the sometime recorders of the fire-play, such as Bingham, Ellis, Judd, Gulick and Lyman. It would be impossible to name all those who contributed notes which have been used by the later compilers, but among them, to suggest what diverse interests in the community have been in sympathy in their common wonderment at the surging of the hot lavas, may be found the names Bush, Bonine, Bryan, Dole, Frear, Fuller, Gartley, Haskell, Hall, Hillebrand, Holmes, Hosmer, C. H. Htchcock, Hoogs, Jones, Judd, Ingalls, Kinney, Kennedy, Kopke, Kluegel, Lindsay, Lycurgus, Lydgate, Lyons, Merritt, Monsarrat, Moses, Mott-Smith, Nordhoff, Paxton, Pope, Ridgeway, Riggs, Rock, Severance, Schaefer, Stacker, Scott, Swezey, Thrum, Weld, Westervelt, Whitney and Wood. In addition the photographers Williams, Moses, Bonine, Perkins, Vaniman, Henshaw, Warren, Gurrey, Baker, Chock Chong and others have preserved im-- portant pictorial memoranda of the craters and flows, and many amateur photographs have been made which would be of great value if they could be collected and marked with appropriate dates.

Travelers' Books.

Such were the record-keepers, who, like Coan, took interest in the interest of posterity. They were persons who appreciated the value of a "jotting-down." There is another group, like Dana, who came from afar, gleaned all available information, visited craters, climbed mountains, conducted surveys or investigated specialties, and then went away and wrote books dealing in whole or in part with Hawaii. Such were Wilkes, Miss Bird, Guppy, the two brothers Friedlaender; Wm. Pickering, the selenographer, who made comparisons between Hawaii and the moon's face; Preston, who investigated gravity; and C. E. Dutton, accompanied by the great artist-geologist W. H. Holmes, who together made a reconnaissance of the islands for the U. S. Geological Survey. Dutton traveled with pack-train, camped among the high mountains, and Holmes drew some of his wonderful line sketches of the craters. Dutton became a famous geologic theorist, author of the doctrine of isostasy

to the effect that continents and ocean bottoms are in equilibrium gravitatively over a mobile fluid beneath, and he afterwards arrived at distinctive views concerning the shallowness of the source of volcanic lavas and the peculiarities of earthquakes. Holmes is now at the head of the Division of Anthropology of the U. S. National Museum.

Compilations.

Two naturalists now resident here, both of whom came from New England, have performed a lasting service to science and to the public welfare by preparing each a book which deals with Hawaiian volcanoes and compiles all that was available in the records and in the libraries to 1909: William T. Brigham, Director of the Bishop Museum in Honolulu, and Charles H. Hitchcock, Professor Emeritus of Geology in Dartmouth College. Dr. Brigham's book is a scientific memoir excellently illustrated, and is a scrupulously selected digest of the facts of activity of Mauna Loa and Kilauea. Dr. Hitchcock's work is a popular book of over three hundred pages copiously illustrated, dealing with the physical geography and geology of all the islands, the history of exploration of the volcanoes and the philosophy of their outbreaks, with notes on earthquakes, chemistry, and biography of the early observers. These two books were timely and have been of great service to the workers at the Hawaiian Volcano Observatory, which was first planned in 1909.

The Observatory Records.

The keeping of records at Kilauea from 1909 to 1913 inclusive has been coördinate with the growth of the observatory idea. In 1909 and 1910 and part of 1911 the Volcano House book still served, and unfortunately for this record, a misapprehension on the part of the public, who thought scientific recording already initiated, produced very meagre accounts for many months of these years. It should be pointed out that even now, with the observatory staff limited and overworked, the crater records are incomplete, and the clear description by visitors of what they saw, with a sketch, the date and the hour, would be of value to science and more dignified than the unworthy jests and references to inferno which now infest the pages of the record book *ad nauseam*. The Volcano Research Association would do valuable service if by placard or otherwise it could induce reform in this respect. Halemaumau is not continuously under the eye of an Observatory assistant, and many casual visitors see important changes taking place, which ought to be "jotted down."

Beginnings of Hawaiian Volcano Research Association.

The first half-yearly report of the Observatory, now in press in Boston, reviews these years exhaustively, following Dr. Brigham's plan. The growth of the Observatory resulted from a lecture by Professor Jaggar in Honolulu in the spring of 1909, when a group of citizens suggested that the proposed seismological observatory of the Massachusetts Institute of Technology be placed at Kilauea instead of in Boston. Money was pledged to this end in Hawaii, through the Honolulu Chamber of Commerce, but the plan lay dormant for two years. Technology then arranged an expedition headed by Mr. Perret, which arrived at Kilauea in June, 1911. Dr. Shepherd of the Carnegie Geophysical Laboratory of Washington came with Perret as high-temperature expert. Cables were erected and the temperature of the liquid lava measured, and Mr. Perret published his record of the crater doings in the Advertiser. October 5, 1911, at a well-attended meeting in the University Club, Honolulu, an informal organization of the Research Association was adopted and placed in the hands of a committee consisting of Messrs. Thurston, Kennedy, Gilmore, Cooke and Judd. Most of the subscribers of 1907 resubscribed, including firms and individuals. Mr. Jaggar arrived to start an observatory, on land subleased from the Volcano House Co., on a five-year basis January 1st, 1912, the Institute of Technology subscribing to the work and undertaking the scientific management of it. From 1912 on the Observatory and the Research Association have both grown. The Committee of the Association contracted with Technology July 1, 1912, to bring Mr. Jaggar to Kilauea for five years from that date and to pay his salary. The funds of Technology are now paid into the treasury of the Research Association as in the case of any other subscriber.

The weekly reports started by Perret have been continued since, and are now reprinted in the form of a weekly circu-

iar. On the back of these bulletins is a map, and a statement concerning the Hawaiian Volcano Research Association, which aims (1) to record volcanic activity and earthquakes in Hawaii; (2) to attract scientific specialists, and (3) to promote the establishment of other volcano observatories. The Whitney Laboratory of Seismology is a branch of the work specially fostered through an endowment fund presented to the Institute of Technology in 1909 by the Whitney Estate of Boston. As the weekly bulletins are of some interest as reports of progress to persons familiar with Kilauea, and are occasionally illustrated with half-tones, it is planned to send them to all subscribers as soon as the research association is more definitely constituted. Members will also receive the more elaborate semi-annual reports.

Need of Organization.

The present meetings have in view the formation of an active and interested membership, the determination of conditions of membership and of subscription, the election of a new committee, and provision for future meetings. It is to be hoped that meetings more often than heretofore may be addressed by distinguished visitors who come to study the volcanoes, and occasionally by the resident staff when there is an interesting story of activity to tell to the Association.

THE RESULTS OF INVITING SCIENTIFIC CO-OPERATION.

I can assume that the present subscribers and habitual visitors to Kilauea know more or less of the regular work of the Observatory, as it has been described in the newspapers. You are less familiar, however, with what our scientific guests have accomplished since 1909, and their splendid work should be better known, hence I venture to recount it here. Eleven investigators of note have been at Kilauea in the last five years, have produced four important memoirs, many smaller papers, and a topographic map; a large realistic model of Kilauea is in preparation for the Agassiz Museum of Harvard University; and chemical analyses have been completed in Washington. The workers have come from Germany, Switzerland, Italy, England and America, and represent the University of Zurich, the York Museum, the Sorbonne, the Springfield Volcano Research Association, the Massachusetts Institute of Technology, Harvard University, the U. S. Geological Survey, the Carnegie Institution, and the U. S. Coast and Geodetic Survey.

The Fire Mechanism.

Dr. R. A. Daly, Sturgis-Hooper Professor of Geology in Harvard University, and formerly of Technology, has published as result of his studies here in 1909 an important memoir entitled "The Nature of Volcanic Action" and a shorter paper on the chemical composition of Hawaiian lavas. (Proc. Amer. Acad. Arts. Sci. XLVII, No. 3, June, 1911.) He concludes that the earth is crusted with shells of a density increasing with depth. As we go down we meet outer sediments, then a siliceous shell, and beneath that an eruptible basalt or lava substratum capable of being locally ejected through the upper layers, largely through the agency of gases. Eruption is a heat problem, and with the rise of the fluid, by changes of pressure and temperature, dissolved compounds of instable character become dissociated, with evolution of heat and bubbles, and make of the volcanic vent a true furnace as the flames testify. A two-phase circulation by convection is set up, gaseous matter rising and liquid descending. Gas-fluxing is the prime agent for inducing liquidity, and the flow is not purely hydrostatic, but in large measure a froth mechanism. The local thickness of the crust, the heat and nature of the gases, and the composition of the lava, determine whether we shall have an explosive volcano or a fluent one like Kilauea. Mauna Kea was highly explosive before it became extinct. Daly's work is supported by data chemical and geological, and makes an excellent basis for proof or disproof for future observation at many volcano observatories.

An Anderson Memorial Observatory.

In 1909 the late Dr. Tempest Anderson of York, England, was in Hawaii, made many photographs, and he has since presented our observatory with one of his ingenious cameras and a battery of three

fine lenses. He published notes on the Samoa eruption with some comments on Kilauea. He met death by typhoid last August while on his way hither from the Philippines, during a voyage around the world studying volcanoes. His death is a sad and serious loss to science. It is hoped that British friends will honor his memory by the establishment on St. Vincent, in the Caribbee Islands, of a permanent observatory and laboratory, for the study of the Caribbean volcanoes. This was his field of specially distinguished work in 1902 and thereafter, the time of the Martinique disaster.

International Volcanologic Institute.

Mr. Immanuel Friedlaender of Naples, a German business man who became volcanologist, visited Hawaii about 1909, and this was not his first visit. Mr. Friedlaender proposed, at the International Geologic Congress in Stockholm in 1910, to establish at Naples an International Volcanologic Institute, toward which he offered $20,000 down, and $2000 per annum. He suggested that this take the form of a society, voting members to pay at least $2000 down and $200 per annum. Subscribers of less amounts would only receive the publications. He invited subscriptions, on the understanding that they would be collected only when the total offering for construction fund amounted to $300,000, and for annual income at least $10,000. The scheme received the approval of distinguished men of science, but it has not yet received the finances required. Mr. Friedlaender proposed that the office be in Naples, regulated under the laws of Italy, and that therefore the organization be essentially Italian, despite its name of "International." The functions of the Institute were to compile reports of volcanic activity all over the earth, to collect books, photographs, maps, etc., dealing with volcanoes, to have a museum of volcanology and laboratories of all kinds, to have main and subordinate seismograph stations, to build a second observatory on Vesuvius, and finally to maintain subordinate stations on the other volcanoes of Italy.

Friedlaender's plan is a most commendable vision of what might be done, but practically is wholly impossible with the funds stated; and the funds are not to be obtained from foreigners for such a scheme by subscription, where the administration is controlled locally. An annual income of $10,000 would barely support the central station in Naples for purposes of compilation alone, and would pay for very little publication; to say nothing of museum, laboratories, seismographs and observatories. Mr. Friedlaender seems to me to have greatly underestimated the cost of running expenses and salaries. In round numbers the Hawaiian Volcano Observatory, with its simple wooden buildings, staff of two geologists and a janitor, costs $10,000 per annum for operating expenses and salaries, exclusive of construction, instruments and larger publications. What is needed with money such as Mr. Friedlaender offers is the foundation of new volcano stations to record activity at places remote from Italy.

The Water of Volcanoes.

Professor A. Brun of Geneva and Paris, a chemist specially interested in volcanic gases, and experienced in collecting them, as well as in experimental work dealing with fusion of minerals, visited Kilauea in the summer of 1910. He made experiments dealing with humidity of the vapor cloud from Halemaumau, collected gases, took many photographs, and made observations concerning probable temperatures of the melt. He afterwards published in Paris a large memoir on the gases of volcanoes, which has attracted much attention because of his revolutionary statement that water vapor plays no essential part in volcanic activity. As applied to Kilauea, this idea was not new, because both Dr. Brigham and Wm. Lowthian Green had believed that water vapor is there a subordinate product largely due to rainfall. But Brun claimed that the deep gases of all volcanoes contain no water despite the old idea of the geologists that a volcano is a steam engine. Dr. Daly is disposed to agree with him, and writes, "Steam pressure can no more be regarded as the cause of vulcanism than is the boiling of a kettle the cause of the heat in the stove."

Volcanologic Instruments.

Frank A. Perret, who studied Kilauea from a little hut on the brink of Halemaumau all through the summer of 1911, has published, in addition to his weekly "Reports of the Technology Station," six articles (in the American Journal of Science in 1913) on the islands, fountains, circulatory system and subsidence phenomena of the lava lake, and on the

ejected products of the crater and some peculiar formations. These articles are illustrated by his wonderful instantaneous and telescopic photographs, and mark a brilliant advance in the standard of observational studies of volcanoes. Mr. Perret collected samples of the liquid lava directly from the lake with a cable system. Perret is a physicist and an inventor, who believes in applying laboratory methods to the field, and in correcting and amplifying our field observations with instruments devised for quantitative and qualitative use in recording all motions, sights, sounds and odors distinctive of an active volcano. He is also greatly interested in seismology and in the humane and engineering aspects of volcano and earthquake disaster.

Temperature of Lava.

Dr. E. S. Shepherd, chemist and specialist in high temperature measurement, prepared at our request special thermo-electric thermometers for direct contact with the lava pool. Mr. Perret erected for his use a steel cableway across the pit and after two failures, owing to the violence of the lava fountains, which broke and sucked down the instruments, the experiments were finally rewarded with one reading of temperature, 1000 degrees centigrade two feet below the surface of the middle of the lake, July 30, 1911. On lowering the instrument a second time a fountain burst under it, the hot lava was thrown over the cable and snapped it, and the thermometer was swallowed in the pool. The negative results of these expensive experiments were valuable, for we learned that no direct-contact pyrometer can withstand the pounding of liquid lava, and consequently Dr. Shepherd the following year brought with him an optical pyrometer which measures temperature by direct comparison of the color of an incandescent filament with that of the lava fountains. The instrument is calibrated specially for fused lava of the Hawaiian type.

Volcanic Gases.

Dr. Arthur L. Day, Director of the Carnegie Geophysical Laboratory, came out to Kilauea with Dr. Shepherd the following summer, 1912, made many photographs, collected gases directly from the hot vents by the lava lake, continued the temperature measurements with the Holborn-Kurlbaum optical pyrometer above mentioned, and collected the solid and crystalline matter in the smoke-cloud and accumulated on the sponge-like banks of Pele's hair to leeward. In his annual report of 1912, Dr. Day writes: "The lava temperature is not constant, but varies within considerable limits from day to day, and the changes appear to be governed entirely by the quantity of gas which is set free." When gas increases, there is a rise in temperature corresponding to it. He writes further: "In view of the fact that several recent writers have sought to prove that water has no part in volcanic activity, it may be mentioned that out of the gases which we collected directly from the boiling lava, something like a half pint of water condensed in the tubes on cooling." Mr. Thurston tells me that Dr. Day now has in press the results of the analyses of the gases, that the different samples collected at different times showed totally different proportions of the several gases present, and some of the gases identified must react with each other to produce heat, accounting for at least a part of the heat of the lava lake, and that argon, an element of the atmosphere, is wholly wanting, suggesting that the volcano vapor is not from atmospheric waters or gases, but entirely from a deep source in the earth's interior.

Photographs.

Dr. Arnold Heim, of the University of Zurich, son of the famous mountain geologist of Switzerland, visited Kilauea in January, 1912, and published a quarto album of remarkable photographs of the active crater and the lava fields in the series of "Geologische Charakterbilder" issued in Berlin by Dr. Stille of the University of Leipzig. His pictures reproduced in the wonderfully perfect photogravure process plates of the publisher Borntraeger are the most perfect illustrations of Kilauea yet made public. The text is descriptive.

Topography.

Claude H. Birdseye, United States topographer, mapped fifty-nine square miles around Kilauea, the proposed National Park area, in the spring of 1912. This is a contour map published on a scale 2 inches to the mile. By levelling from the Hilo Breakwater tide-gauge the elevation of the Volcano House pier was found to be 3973 feet above mean sea-level. Mr. Birdseye has written a short

article for the second report of our observatory on the topography of Kilauea, from which I extract the following notes: Kilauea-Iki is 713 feet deep, Devil's Throat 250 feet, Makaopuhi Crater 850 feet below the end of the trail and over 1000 feet below the highest point of the north rim. One of the pit craters near Puu Koae, in the desert south of Kilauea, is 275 feet deep. A large group of upright lava trees stands in a clearing east of Makaopuhi crater, covering an area of 30 acres, the monoliths standing six to ten feet in height. A lava tube west of the Keauhou road was traced southward for a thousand feet, and in it a human skeleton was found on a ledge. Mr. Birdseye makes constructive suggestions about trails and roads. "A good trail to Napau Crater," at the extreme east end of park area, "and the group of lava trees to the northward would open up this very interesting section and probably result in many discoveries of scientific interest." It may be added that nothing could benefit the Kilauea district more than a legislative appropriation for new trails. A trail up the northeast slope of Mauna Loa, with one or two rest-houses, and a trail across Puna along the line of craters between Makaopuhi and the Kapoho district, would open up excursions of surpassing interest.

George Carroll Curtis of Boston, a geographical sculptor of note who has modeled great cities, coral islands and volcanoes in many parts of the world, was assigned by the Harvard University Museum through a gift from Robert Sayles, Curator of Goelogy, to the task of making an exact naturalistic relief model of the craters Kilauea, Kilauea-Iki and Keanakakoi in the spring of 1913. Mr. Curtis gave three months to a photographic survey of the region, establishing a network of flag stations and photographing from them all. He writes that this was "probably the most comprehensive survey of its kind yet made for the reproduction of a land-form type." It is hoped that a copy of his model will be exhibited in the Hawaiian Building of the Panama-Pacific Exposition. Mr. Curtis has suggested to F. W. Haworth of Pittsburgh, expert in photography from kites, that he come to Kilauea and make a series of aerial photographs.

Magnetism.

Mr. J. W. Green, magnetician of the United States Coast and Geodetic Survey, was authorized by his chief, Dr. O. W. Tittman, on request of the Hawaiian Volcano Observatory, to spend three months at Kilauea, August to October, 1913, making reconnaissance surveys of magnetic declination, dip and intensity around and in the craters Kilauea and Mokuaweoweo. The lava was found to be magnetic in small specimens, including even the glassy Pele's hair. Among the stations occupied, encircling Halemaumau, on the Kilauea floor elsewhere, around the high rim of Kilauea, and on the east edge of Mokuaweoweo on Mauna Loa, great diversity was found in the attitude of the magnetic needle. The deflections, both vertical and horizontal, vary through many degrees in distances of a few hundred feet, but appear to be variations of place. No unusual variations in time were observed, though on one occasion the magnetometer was watched all day at the same station from minute to minute, near the edge of Halemaumau, while at the same time notes were made on the periodic gas-blowing in the bottom of the crater and the temperature of the hot Postal Rift. No correspondences were observed, and the magnet was steady, except for the normal diurnal fluctuation which would happen anywhere. The flag stations around Halemaumau used for surveying the lava lake were found to have differences of magnetic declination varying *from zero to sixteen degrees* in a distance of about a thousand feet. This extraordinary variation indicates that a complete magnetic survey of Hawaii ought to be made and would show isogonic lines of very unusual character, related perhaps in some way to the active volcanoes.

Volcanic Tides and Classification of Volcanoes.

In addition to these scientific visitors, Mr. H. O. Wood and Mr. Jaggar have been engaged in special studies apart from the routine work of the Observatory. Mr. Wood is at work on the 1868 earthquake, studying it in comparison with the great tectonic earthquakes like that of San Francisco in 1906, which in some respects it resembles, instead of being purely volcanic. Mr. Wood is also engaged in the construction of curves showing for the current years the nutation strains of the earth under the influence of sun and

moon, with a view to checking with the astronomically significant dates the days of marked change in the rise and fall of the lava and occurrence of local earthquakes, tilts and tremors. There is good reason for suspecting a tidal movement in the volcanoes. Mr. Jaggar, who has visited six volcanic regions of the earth in the last ten years, is engaged in the study of the classification of volcanoes and a comparative investigation of craters.

Methods of Helping Visiting Scientists.

The accommodations and apparatus which can be of service to visiting men of science at the observatory are still inadequate, but their use of such things as buildings, water, rope-ladders, dark-room, cases of drawers and motor-car has steadily increased as our facilities which could serve them have grown, not to mention books and records. Before 1911 there was no material plant except the stored seismographs; from 1911 on things began to accumulate which could assist the visiting specialists.

In 1911 the cableway was constructed by the Lidgerwood Co. by order of the Institute of Technology and erected by Mr. Perret for Dr. Shepherd's use in lowering his thermometers. Mr. Perret built the first hut east of Halemaumau. This has since been moved to the north side and rebuilt.

In 1912 Mr. Birdseye placed government bench-marks on two of our concrete tables at the pit, one of them in the hut. Messrs. Day and Shepherd made use of the Observatory building and dark-room and the crater hut, and Dr. Shepherd built a cottage for himself in the observatory grounds which is now the dwelling-place of Mr. Wood. Our men, with ropes and rope-ladders, were able to be of some assistance to the Carnegie visitors in their descents into the crater for collecting gases. We profited greatly by their advice in matters of laboratory practice and photography. Dr. Shepherd remained seven months.

Mr. Curtis and Mr. Green in 1913 used the Observatory, the dark-room and the camp at the pit and were assisted by men from the observatory. The motor runabout, which was bought in the summer of this year, was of great assistance in moving back and forth Mr. Green's magnetic instruments. The Observatory bore three-quarters of the expense of the 1913 expedition with Mr. Green to Mokuaweoweo. We were able to coöperate directly with Mr. Green in a part of his observations at Halemaumau, by making parallel observations of eruptivity. He furnished us valuable data for compass surveying and he gave Mr. Wood advice in solar work with transit. Mr. Green's magnetic results will be published in due course by the U. S. Coast and Geodetic Survey and should stimulate that bureau, or some other, to a more complete magnetic survey of our volcanoes.

Needs.

In general the kind of independent cooperation which we accomplished in this case was a model of what should be done in the future, the Observatory profiting by advice from each specialist in its own routine and in its equipment wherewith to aid others. We need an additional laboratory for guests costing $800, a more modern motor car costing by exchange $850, and furniture costing $300. In the line of coöperation also, at an expense of $600, we could place a dozen small Japanese seismographs all around the Island of Hawaii, devised to write their records in ink and be wound weekly, to be operated by voluntary observers. This would give the Observatory at Kilauea data as to the source of the local earthquakes which are frequently indicated on our sensitive instruments, and within a few years would yield most important data as to the distribution of small shocks about the volcanoes. Other needs appear on the last page and on pages 13 and 14.

WINNING THE INTEREST OF THE BUSINESS MAN.

I have now reviewed the general progress of the Hawaiian Volcano Observatory, its method of keeping records and of inviting scientific coöperation from experts in many lines. I believe enough has been done to show how to guide wisely the future policy of the establishment, and the key lies in strengthening the Hawaiian interest and Hawaiian support, so that the eclectic element

in our work, which keeps us hospitable to outsiders of all scientific creeds, may be made the strongest part of it. This also will make the Observatory more widely of service to the Territory, through advertisement.

Commercial Argument for Volcano Research—Earthquake Construction.

Let me put to rest the spectre which occasionally makes nightmare for the business promoter, that earthquake and volcano talk depreciates property and checks immigration. One might as well expect the insurance companies to hush up talk of new fine engines, for fear people would stop building, or advise against going to church, because sometimes hell is mentioned there. Earthquakes occur everywhere, tidal waves may engulf any flat coast, just as heavy rains may flood any river basin, and the supreme opportunity of a seismic land and its people is to show the world that suitable construction will resist anything. This was shown by the government buildings in San Francisco. Japan has no fear of earthquakes because construction there is adequate. Jamaica since 1907 has an effective earthquake building law, and the new Kingston is an earthquake-proof city. British engineers met the Gohna flood, produced by landslide damming in India, with such foresight that not a life was lost and very little property destroyed. Hilo engineers may some day have a chance to meet a Mauna Loa lava flow in the same spirit, and certainly American Hawaii cannot afford to let the British colonies and Japan get ahead of her in economic seismology.

Economic Geology.

It is not necessary in Hawaii to defend science, for the commerce of the islands has advanced mightily through scientific agriculture, chemistry, engineering, entomology, meteorology, hydrography, forestry, and even anthropology. The *natural* history of the archipelago is volcanic, and from volcanoes sprang waters, soils, road metal, vegetation, harbors, slopes, pastures and materials of construction. Iron, coal, copper and gold we import in Hawaii. But the philosophy of ore-deposits in Colorado, Mesabi or Calumet is based on volcanic process, and geologists acknowledge themselves ignorant of volcanic process. The Geological Society of America passed resolutions a few years ago, based on this ignorance, urging governments and private enterprise to establish volcano observatories. You in Hawaii are among the first to follow this advice, advice from all the leading geologists in the United States, men such as Van Hise, Chamberlin, Walcott and Lindgren. I was called in consultation last spring on the underpinning of the Pearl Harbor drydock, in default of the presence here of any Territorial economic geologist.. The underground water of Hilo, Olaa, Puna, Pahala, Waiohinu, and Kona is a mystery which only more knowledge of the active volcanoes will solve. Scientific men are explorers, and explorers open trails, caverns, pits, curiosities, beautiful glades and strange volcanic rifts and hot places, which become permanent landmarks of interest to travelers and nature-lovers. And finally, the advertisement of the country by scholars and persons of education, who are keenly interested in the scientific work when they visit Hawaii, brings finer people here and is more subtly far-reaching than ordinary advertisement for promotion and publicity.

Life and Property.

But apart from these considerations, there is an argument for volcano research that goes to the very heart of the present scarcity of capital and high cost of life. Mr. Frank A. Vanderlip, president of the National City Bank of New York, mentions first war, volcanoes, earthquakes and floods as among the causes of great waste of money. Japan has lost more lives by earthquakes and earthquake-waves than she ever lost in war, and realizing it she established a committee to study safeguards from earthquake twenty-three years ago. That committee is now locating volcano observatories, realizing the close dependence of earthquakes upon volcanic centers. The aims are to learn probable places and times, nature of the earth movement and its effects, as a guide to engineers, and to study safe location and safe construction. The terrible disasters of Messina, Kingston, Charleston, San Francisco, Galveston, Valparaiso, and St. Pierre might in loss of property and life have been minimized if science could only have dominated our laws of construction and location. Science is trying to learn, Honolulu is a unique Pacific centre for such learning, a centre of earthquake and volcanic belts

which encircle the greatest ocean, hence the Massachusetts Institute of Technology earnestly urged the maintenance here of a volcano research laboratory, of which our little wooden Observatory is the beginning.

The layman was awakened to the compelling interest of volcano science by the Mont Pelée disaster in Martinique, the 1906 eruption of Vesuvius and the destruction of 150,000 people in Messina, near Mount Etna, in 1908. Engineers realized their responsibility. Business has spread into the volcano lands. Taal Observatory in the Philippines, the temporary Pelée Observatory, the Asama Observatory in Japan were all motived more or less by disaster. Mr. Perret in his beneficent volcano work in Italy is financed by business men of Springfield, Massachusetts. Our Observatory has the distinction of having been founded soberly, under the stimulus of no disaster, by the Chamber of Commerce of Honolulu in 1909. Firms and individuals subscribed money.

Accounts of the Observatory 1912-13.

Receipts.

The subscriptions from all sources of 1912, amounted to $15,159.84, divided as follows among 26 subscribers:

From the Massachusetts Institute	$ 6,049.84
From one subscriber	1,600.00
From nine subscribers ($500) each	4,500.00
From Hilo Observatory fund.	1,785.00
From thirteen subscribers (mostly $100.00 each)	1,225.00
	$15,159.84

The subscriptions expectable in 1913 were $9,735.00.

To September 30, 1913, there had been paid	$4,616.81
Leaving uncollected	5,118.19

There are other doubtful subscriptions yet to be heard from amounting to $1,200.00.

In 1914, subscriptions of $3,300 are doubtful, dependent on renewal, and $6.175 is reasonably sure of collection.

Expenses.

The expenditures of 1912, including construction and salaries were $14,843.03.

This, in round numbers, was divided as follows:

Services	$6,764.00
Lodging	1,720.00
Travel	1,351.00
Freight	267.00
Purchases	2,075.00
Buildings	2,666.00
Total	$14,843.00

The average expense of the Observatory monthly, January to June, 1912, including construction, was $1,219.35
July to December, 1912..... 923.28
January to June, 1913..... 746.71
making a monthly reduction of $176.57 in 1913, over the last half of 1912.

Method of Raising Money.

In 1909 subscriptions were started by personal interview through the agency of Mr. Thurston and volunteer solicitors, after a lecture on volcanoes by Professor Jaggar, delivered at the University Club of Honolulu. The Chamber of Commerce appointed a committee to seek subscriptions in June, 1909. The meeting of October, 1911, put the money-raising in the hands of the committee of five, and the estate of C. M. Cooke, Ltd. became guarantor of a fund of $5,000 annually, the actual subscriptions in Hawaii at first amounting to some three-quarters of that sum. Mr. Jaggar by personal interviews raised $2,800 additional in 1912, assisted by a new subscription blank approved July 10, 1912, by the Honolulu Chamber of Commerce. In January of that year he had raised $1,785 in Hilo through the energetic assistance of Mr. Demosthenes Lycurgus, with the approval of the Hilo Board of Trade, this money being for the Observatory building. A few small gifts have been made for special purposes such as the motor-car and certain specimens destined for the Bishop Museum. The subscriptions are partly for five years, but many are renewable from year to year and the collection of these becomes increasingly difficult, owing to the present business stringency.

Ways and Means.

Accounts have been kept by C. H. Cooke, treasurer of the committee of five, and quarterly statements rendered to that committee. The Director of the Observatory has sent the treasurer a monthly statement of disbursements, which have been paid by cheque on

C. M. Cooke, Ltd. The account was $2,316.81 to the good December 31, 1912, and we have no reason to expect any deficit in 1913. But for the three years 1914 to 1917, the last three of the five years, the treasury of the Association will need considerable recruiting in annual subscriptions. The largest item of expense is salaries, and the next miscellaneous supplies and labor, such as photographic material, stationery, printing, shopwork, instrumental accessories, lumber, house sundries, drawing materials, hardware, paint, cerpentering, furniture and camping equipment. Instruments have been kindly furnished by the Massachusetts Institute of Technology, the College of Hawaii, U. S. Geological Survey, Weather Bureau, the Carnegie Geophysical Laboratory, and Dr. Tempest Anderson. The Bishop Museum most courteously placed a room at the Director's disposal for use in Honolulu, and gave him the use of the Museum library.

Endowment and permanency are the ends to be striven for in founding an observatory, for the phenomena to be studied are endless, and the field will never be exhausted by the specialists, as with discovery science is forever adopting new points of view. An endowment of $25,000.00 is already at hand in the Whitney Fund of the Masschusetts Institute of Technology, hence we have named the earthquake division of the observatory the Whitney Laboratory of Seismology. The instruments there were all purchased with the income of the Whitney Fund.

SUMMARY OF RESULTS AND PLANS.

Summing up, I have tried to gather here the facts and motives of scientific discovery and present-day recording at Hawaiian volcanoes. The Carnegie investigators expect to come again to drill and study underground temperatures; I hope the Weather Bureau will some day send us a man to study rainfall and clouds; and that the Geological Survey will send an expedition to make a thorough geological study of Mauna Loa and the petrography of its lava flows. I would like to get Professor Omori here, from Tokio, when we succeed in raising the money for the twelve small seismographs distributed over Hawaii. It would be intensely interesting to start, with the aid of a geodetic expert, a series of observations by leveling, to determine whether the inner dome of Halemaumau swells up and sinks down in the course of months or years.

The last five years have been prolific; Daly and Brun have opened vigorous controversies; Friedlaender and Perret have stirred up the world to a recognition of the need for volcano recording and compiling; at the Institute of Technology we have agitated, experimented and explored with a view to sound earthquake engineering and construction; and Birdseye, Day, Shepherd, Green and Curtis have visited us at the Hawaiian Volcano Observatory and produced maps, models, analyses, instruments and new knowledge of gases, temperatures, dimensions, quantities, magnetic variations and reactions, the results of which promise important discovery and are slowly built into the fabric of science. The Observatory itself is profiting by all this to improve a system of daily recording of volcanic processes, and of earth tilt, tremor and quake.

The Immediate Crisis.

I have been asked by interested persons in Hawaii, "Just how much money do you need at present?" and "Why is not this work done by the government, or some research institution?" In answer to the first question, we need more than anything assurance of a continuance of support for the five years, without the worry and uncertainty which has put an unduly heavy burden on the C. M. Cooke Estate, Ltd., has made it necessary to retrench and consider abandonment of important divisions of the work, and forced the Director to leave his post again and again in order to beg money, to keep alive the interest, to revive drooping subscribers and in general to think up advertising schemes instead of devoting his whole time to research. I have

tried to show here that the work is ultimately of practical value in protection of life and property, in mining, geology, water-supply, the tourist trade, and in the far-reaching ramifications of science and publicity. But scientific discovery is not to be done in a day, and commercial returns are not the first aim of our work, so that we strongly need for the bare support of it, apart from its infinite possibilities of growth, an organization of public spirited men who are willing to guarantee in some measure the stability of their interest, and to recognize in the Observatory and its motives a definite benefit to the Territory. We need an assured $10,000 per annum merely to do what we are doing now; if the Research Association is to be enlarged, and to meet every three months; if the subscribers are to receive all the publications; if the weekly reports are to be improved and sent to distant subscribers; if we are to promote to an adequate salary the gentleman who is uncomplainingly carrying the load of seismological work, and are to increase correspondence and affiliations with visiting scientists; and if we are to bring our plant up to high efficiency, especially in photographic equipment, we need two or three thousand dollars per annum more. An additional assistant, part stenographer and part observer, at $1200 per annum, would fill our greatest need at the present moment.

Advantage of Local Association.

In answer to the second question, "Why not some mainland institution?" the answer lies in our experience with visiting scientists. I have myself slowly changed my point of view in this respect. We had to begin by feeling our way, and the proposal of 1909 had in view putting all the administration in the hands of the Massachusetts Institute of Technology. This, the event has proved, would have narrowed the work, other institutions would have been slow to send their representatives to Kilauea, and questions of delicacy, scientific controversy, prior claim to the field, etc., would surely have arisen, however vigorously combatted, because certain men and their theories become identified with certain institutions. By keeping the laboratory, camps, trails, men and equipment of the Observatory maintained by a strong Territorial Association, with the routine work carried on by a prominent engineering school in the east, itself a member of the association, we can be hospitable to all scientific specialists from all schools of learning, and however polemic the controversy, we can be sure that both sides are fairly represented and that the hospitality is in no way forced but extended to all alike. Mr. Thurston very wisely insisted on this attitude in 1912, and on the desirability therefore of keeping the Research Association in control, and he was right. Accordingly, finances being the nutriment and life-blood of science as of other things, the question that is squarely before us now is—shall the Hawaiian Volcano Observatory at this critical time be given substantial and assured support in Hawaii, or is it to be allowed to dwindle and disappear?

The Future of Volcano Research.

If I were asked what is my vision of the future growth of the Hawaiian Volcano Research Association, I would hark back to Coan, Bingham, Dana, Bishop and Green. Mission men of the nineteenth century were the beginners of this work, men sent on a mission. To Martinique and to Messina in the first decade of this century went men of science, healers, army and navy commissaries, and a host of others gathered hastily in warships—missionaries, myself among them, not calling ourselves such, but mission men none the less. We learned of scientific *missions* from the Royal Society and the French Academy. The growth of this research association in Hawaii, the immediate generous response in friendliness and in money, the keen-eyed interest of the business men when again and again they came to visit the Hawaiian fiery pit, have all proved to me that the world is nearly ready for volcano research. What Honolulu and Boston have done for Hawaii, Batavia and Rotterdam can do for Java, or Kingstown and London for St. Vincent. The tariff change which has afflicted Hawaii has filled Martinique and St. Vincent with new hope. My vision of the future of our association is an organization strong enough to send missions out to found new volcano research associations and thereby win support for new volcano observatories. I want to see ten more strong volcano observa-

tories founded, keeping perpetual record, and then I shall feel that our science is launched. You here in Hawaii are laying the keel.

The real need in volcanology is for observing stations as in astronomy and meteorology. No matter how quiet an active volcano may be, there are always changing movements of the ground, temperatures of hot gases or waters to measure, and notes to be kept about their composition, and also about erosion and weather. The slow changes in the quiet periods are of the utmost importance as bearing on prediction of eruption. It will be time enough to establish a compiling centre, such as Mr. Friedlaender suggests, when there is something to compile. At present the effective volcano laboratories of the world may be numbered on the fingers on one hand. Here in Hawaii we could compile in a very short time, by writing to men of science and consular agents, all of what little information exists of the current activity of the 417 active terrestrial volcanoes. This we plan to do, especially for the great Pacific circle. But unfortunately there are almost no records being kept. Director Mercalli of the Royal Vesuvian Observatory, Mr. Perret and Mr. Friedlaender in Naples, Platania and Ricco in Sicily, are overworking the Italian field of volcanology, in view of the sparsity of observers in the Canaries, Cape Verde Islands, Mascarenes, Caribbees, South America, Iceland, Mexico, Central America, Alaska, Polynesia and the far east.

We need in science self-sacrificing missionaries. If only the salary of a devoted young geologist were paid, another *Titus Coan*, he to live continuously in one of these places and print a weekly report of volcanic activity, his tools being his head and his pen, the contribution to volcanology would be more stimulating than anything a central bureau could do. What are needed are facts, with photographic illustrations, recorded on the spot by competent men, and accumulated for years to come. The money for the planting of such men, as nuclei of future observatories, is the supreme need of volcanology. If the man is of the right type, his service and example will build for him an observatory with local funds. His published accounts of the place, its accessibility, its activity, and the growth of his work will draw scientific men to his field, equipped with money and resources, and national scientific bureaus will aid him. If he needs a motive, let him study the reason why 230,000 people were killed in Messina, San Francisco, Valparaiso, St. Pierre, Krakatoa and at Taal Volcano; why hundreds of millions in property were destroyed, disasters in large measure due to our ignorance. We prefer comfort, a stationary telescope, dainty manipulation, and the well-appointed city laboratory; but the warrior surgeons and the bridge-builders get along without these things; they hear the "everlasting whisper" of something better, like Kipling's explorer,

"Something hidden. Go and find it.
Go and look behind the Ranges—
"Something lost behind the Ranges.
Lost and waiting for you. Go!"

If a young man is fired with zeal for real exploration and discovery, or an older one with an earnest desire to contribute money for scientific and humane progress, there is no field which will yield more completely new results, as well as fame and growth, than the systematic recording of the activity of one or more of the now unknown active volcanoes of the globe.

T. A. JAGGAR, Jr.

HAWAIIAN VOLCANO RESEARCH ASSOCIATION, 1912-1913.

Subscribers in Hawaii.

Inter-Island Steam Navigation Co.
Hilo Railroad Co.
T. Clive Davies
B. P. Bishop Museum
C. M. Cooke, Ltd.
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G. N. Wilcox
Cecil Brown
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Alexander & Baldwin
H. Hackfeld & Co.
Kilauea Volcano House Co.
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A. Gartley
E. A. Mott-Smith
W. G. Irwin
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Subscribers in Boston, Massachusetts.

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Godfrey L. Cabot
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Mrs. W. S. Pitkin

Committee in Charge, 1912-13.

L. A. Thurston, Chairman
J. A. Kennedy
C. H. Cooke, Treasurer
A. F. Judd
J. W. Gilmore

Observatory Staff, 1912-13.

T. A. Jaggar, Director
F. B. Dodge, Asst. (Jan.-Aug., 1912)
H. O. Wood, Research Associate in Seismology
Miss E. Farley (Honolulu Secretary, September, 1912-April, 1913)
Alex. Lancaster, Janitor

Subscribers to Hilo Observatory Fund, 1912.

H. Hackfeld & Co.
Kilauea Volcano House Co.
T. H. Davies & Co.
John A. Scott
Matson Navigation Co.
First Bank of Hilo, Ltd.
J. S. Canario
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Hilo Emporium
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Hilo Mercantile Co.
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Volcano Stables Co.
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Hilo Electric Light Co.
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Hilo Drug Co.
Wall, Nichols Co.
E. H. Moses
P. C. Beamer
Osorio's Store
John D. Kennedy
W. H. Shipman
Hilo-Hawaii Telephone Co.
Hilo Board of Trade
Charles Furneaux

Needs of Hawaiian Volcano Observatory.

Assured additional subscriptions of $7,000 per annum for four years from Jan. 1, 1914. Other specific needs are:

An extra assistant and stenographer; $1,200 per annum.

A fellowship of $1,500 per annum to be awarded to a graduate student of any institution of learning, for special work at the Observatory.

A machinist at the Observatory; $1,800 per annum.

$5,000 worth of apparatus.

A new laboratory and appurtenances exclusively for visiting scientists, $1,100.

WEEKLY BULLETIN OF HAWAIIAN VOLCANO OBSERVATORY

From the Pacific Commercial Advertiser, Honolulu, December 22, 1913.

Weather conditions during the past week have been such that it has been diffcult to observe conditions at Halemaumau. However Madame Pele has not given much evidence of renewed activity according to reports from the observatory. The only marked feature has been in slides in the talus of the roaring and blowing sounds showing that active forces are continuing at work. Under date of December 18, Observer H. O. Wood, writing from the technology station at Kilauea makes the following report:

"Conditions at Halemaumau remain practically without change. The weather during the past week has not been favorable for observing; owing to steady winds only quick glimpses of the bottom region have been obtained.

"On Friday, December 12, a brief glimpse was obtained in the afternoon. Glowing spots were observable in the places heretofore noted. At irregular intervals slides were occurring in the talus. One of these was seen to run down into a deep, smoking hole about 100 feet above the bottom of the pit at a point a little to the south of the west end of the pit. No illumination of the smoke cloud was observed during the evening or night.

"On Saturday, December 13, nothing was noted except the continued visibility of the glowing blow-holes and snorting sounds of eruption. No illumination was observed at night.

"On Sunday, December 14, the deep, smoking hole seen on Friday was choked with talus. The bottom could not be seen. The usual sounds of eruption were heard. At intervals slight sliding took place in the talus. At night a faint illumination of the fume cloud could be seen, before moonrise, with occasional flaring.

"On Monday, December 15, nothing was observed except a continued, faint illumination before moon-rise.

"On Tuesday, December 16, at about 10:30 a. m. a considerable slide took place under the west station lasting for some sixty seconds. Numerous smaller slides were noted during the day. The sounds of blowing, rumbling, and snorting continued undiminished. By day the bottom could not be seen. At night the glowing spots were visible and the fume cloud was faintly illumined.

"Wednesday, December 17, a moderately high wind prevailed and no visit was made to the pit. The faint illumination at night continued.

"Below is submitted a systematic report from the Whitney Laboratory of Seismology covering to date the interval not hitherto reported upon.

"November 18, from 1:30:53 p. m. to 1:33:02 p. m. H. S. T. Intensity, about III Cancani scale; something less than the minimum perceptible unit. Origin distant about 20 miles.

"November 23, from 12:58 p. m. to 12:59:37 p. m. H. S. T. Intensity, low I Cancani scale; about 0.05 the minimum perceptible unit. Origin distance indeterminate.

"November 27, from 1:27:39 p. m. to 1:29:59 p. m. H. S. T. Intensity, III Cancani scale; about 0.8 the minimum perceptible unit. Origin distant about 46 miles.

"November 29, from 6:50:35 a. m. to 6:51:07 a. m. H. S. T. Intensity, low I Cancani scale; less than 0.1 the minimum perceptible unit. Origin distant about 12.4 miles.

"November 29, from 8:11:35 a. m. to 8:12:29 a. m. H. S. T. Intensity, about III Cancani scale; probably less than the minimum perceptible unit. Origin distant about 13 miles.

"November 29, from 6:21:25 p. m. to 6:22:55 p. m. H. S. T. Intensity, I-II Cancani scale; more than 0.2 the minimum perceptible unit. Origin distant about 12.4 miles.

"December 1, from 11:16:29 a. m. to 11:16:50 a. m. H. S. T. Intensity, II Cancani scale; about 0.5 the minimum perceptible unit. Origin distant about 13 miles.

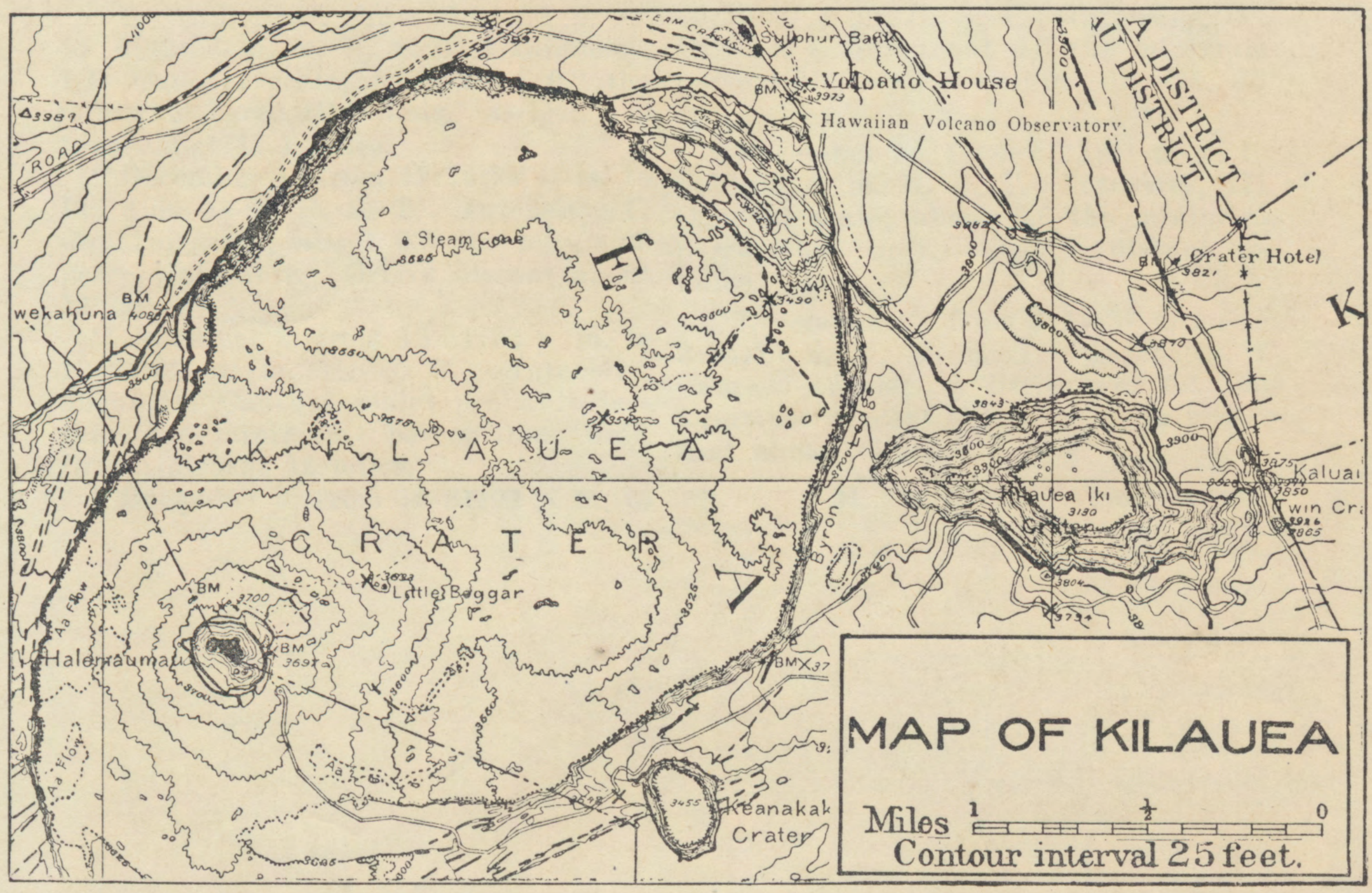
"December 3, from 12:51:22 p. m. to 12:53:21 p. m. H. S. T. Intensity, about III Cancani scale; probably less than the minimum perceptible unit. Origin distant 13 miles.

"December 9, from 10:51:02 p. m. to 10:51:59 p. m. H. S. T. Intensity, III Cancani scale; about 0.5 the minimum perceptible unit. Origin distant 13 miles.

"December 14, from 5:33:04 a. m. to 5:36:05 a. m. H. S. T. Intensity, III Cancani scale; about 0.6 the minimum perceptible unit. Origin distant 68 miles.

"December 15, from 3:33:37 a. m. to 3:35:15 a. m. H. S. T. Intensity, I Cancani scale; a little over 0.1 the minimum perceptible unit. Origin distant about 20 miles.

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 100kg tromometers 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. 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 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.

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.