Hawaiian Volcano Observatory
1963 Quarterly Administrative reports

Introductory Note By Thomas L. Wright and Jennifer S. Nakata

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Summary 29
January, February, and March 1963
By Robert Y. Koyanagi, Arnold T. Okamura,
Harold L. Krivoy, and Akira Yamamoto

Summary 30
April, May, and June 1963
By Harold L. Krivoy, Willie T. Kinoshita,
Arnold T. Okamura, and Robert Y. Koyanagi

Summary 31
July, August, and September 1963
By Robert Y. Koyanagi, Arnold T. Okamura,
Willie T. Kinoshita, James G. Moore, and Howard A. Powers

Summary 32
October, November, and December 1963
By Arnold T. Okamura, Robert Y. Koyanagi, Willie T. Kinoshita,
James G. Moore, Dallas L. Peck, and Howard A. Powers

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INTRODUCTORY NOTE

The Hawaiian Volcano Observatory Summaries have been published in the current format since 1956. The Quarterly Summaries (1956 through 1973) and the Annual Summaries (1974 through 1985) were originally published as Administrative Reports. These reports have been compiled and published as U.S. Geological Survey Open-File Reports. The quarterly reports have been combined and published as one annual summary. All the summaries from 1956 to the present are now available as .pdf files at http://www.usgs.gov/pubprod.

The earthquake summary data are presented as a listing of origin time, depth, magnitude, and other location parameters. Network instrumentation, field station sites, and location algorithms are described. Tilt and other deformation data are included until Summary 77, January to December 1977. From 1978, the seismic and deformation data are published separately, due to differing schedules of data reduction.

There are eight quarters—from the fourth quarter of 1959 to the third quarter of 1961—that were never published. Two of these (4th quarter 1959, 1st quarter 1960) have now been published, using handwritten notes of Jerry Eaton (HVO seismologist at the time) and his colleagues. The seismic records for the remaining six summaries went back to California in 1961 with Jerry Eaton. Other responsibilities intervened, and the seismic summaries were never prepared.

Chronology

The following Kīlauea eruption chronology covers the two recent reports and the six missing quarters:

Location	Beginning Date	Ending Date	Comment
Kīlauea Iki crater (Kīlauea's summit)	11/14/1959	12/20/1959	19 eruptive episodes
Kapoho (lower east rift zone)	1/13/1960	2/18/1960	4 eruption stages
Halemaumau (Kīlauea's summit)	2/24/1961	2/24/1961	Intermittent activity during uninterrupted inflation following the 1960 eruption
Halemaumau (Kīlauea's summit)	3/22/1961	3/25/1961	Same as above.
Halemaumau (Kīlauea's summit)	7/10/1961	7/17/1961	Same as above.
Heiheiahulu (middle east rift zone)	9/22/1961	9/25/1961	First historical east rift eruption at this location

The 1959-1960 eruptions were among two of the most spectacular Kīlauea eruptions. The HVO staff was kept busy with acquisition of unusually high quantities of instrumental data and observations of the two sequences, which were separated by less than one month. Even with a year's interval before the beginning of the summit-east rift sequence in 1961, the staff never caught up, and the seismic records were set aside for later study.

A total of 1,672 earthquakes—1,106 for 1960 and 566 for 1961—are part of HVO's cataloged database. The annual listings have been appended to the 1st Quarter Report of 1960 and to the 4th Quarter Report for 1961. The number of earthquakes is probably low, biased toward the larger magnitudes. The entire HVO catalog, including 1960 and 1961, is accessible from the ANSS CATALOG SEARCH site at http://www.ncedc.org/anss/catalog-search.

Thomas L. Wright and Jennifer S. Nakata

UNITED STATES

DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

HAWAIIAN VOLCANO OBSERVATORY

SUMMARY 29

January, February, and March, 1963

By

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Harold L. Krivoy, and Akira Yamamoto

Issued September 1964

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Chronological summary

Following its small, sharp subsidence during the December 1962 Aloi eruption, the summit region of Kilauea promptly resumed the cycle of swelling that began in the summer of 1960. A moderate rate of inflation during the first quarter of 1963 is indicated by the average rate of outward tilting at the inner ring of tilt bases (Uwe, TM, Kea, and Kam), which was 11 microradians per month between December 18, 1962, and March 18, 1963. As was true throughout 1962, tilting at Kamokukolau was more rapid than at any other base during this interval.

The average daily count of shallow Kilauea caldera earthquakes diminished from 113 during the first half of January, to 62 during the second half, and to 50 during the first half of February. A moderate resurgence of these earthquakes during the second half of February sent the average daily count to 138. The level of this activity remained moderately high throughout March, with an average of 92 per day.

The frequency of earthquakes from the southwest rift zone of Kilauea and the nearby Kaoiki fault system rose from an average of 6 per day during January to 15 per day during February and March.

The number of earthquakes from the upper part of the east rift zone of Kilauea (near Aloi Crater) also increased during the quarter, from a total of 20 in January, to 49 in February, and to 92 in March. These quakes were particularly frequent late in March, when 83 occurred between the 19th and 27th.

Deep tremor was quite prominent during the quarter with totals of 82 minutes during January, 75 minutes during February, and 119 minutes during March.

Excluding January 8 and 9, the frequency of earthquakes from the source about 30 km beneath Halemaumau was about 5 per day during the entire quarter. A flurry of activity from this source on January 8 and 9, however, produced 154 earthquakes. Four of these were felt (table 4, p. 14 and 15).

The first of these earthquakes--which occurred on January 8, at $09^h39^m44.9^s$, magnitude 4.3, was the largest earthquake in Hawaii during January and was felt throughout Hawaii and on Maui and Oahu.

The lower part of Kilauea's east rift zone near Pahoa was the source of occasional earthquakes throughout the quarter and of a mild swarm of 55 earthquakes during the first week in March. Five earthquakes from this region were felt in Pahoa (table 4, p. 16, 17, and 18).

The largest earthquake in the Hawaiian region during February was not felt. It originated 83 km west of Keahole Point at 09^h08^m on the 17th and had a magnitude of 4.1.

During March, 6 earthquakes in the Hawaiian Islands had magnitudes of 3.5 or greater (table 4, p. 18 and 19).

The largest earthquake in March, with a magnitude of 4.5, originated 14 km southeast of Waikii at a depth of about 13 km at 22^h32^m on the 24th. It was felt over all of the island of Hawaii and on Maui.

A very interesting earthquake was felt throughout Maui at 07^h19^m on March 25. It had a magnitude of 3.9 and originated 35 km beneath Haleakala National Park headquarters. There were neither foreshocks nor aftershocks.

Other earthquakes felt during the quarter are listed in table 4.

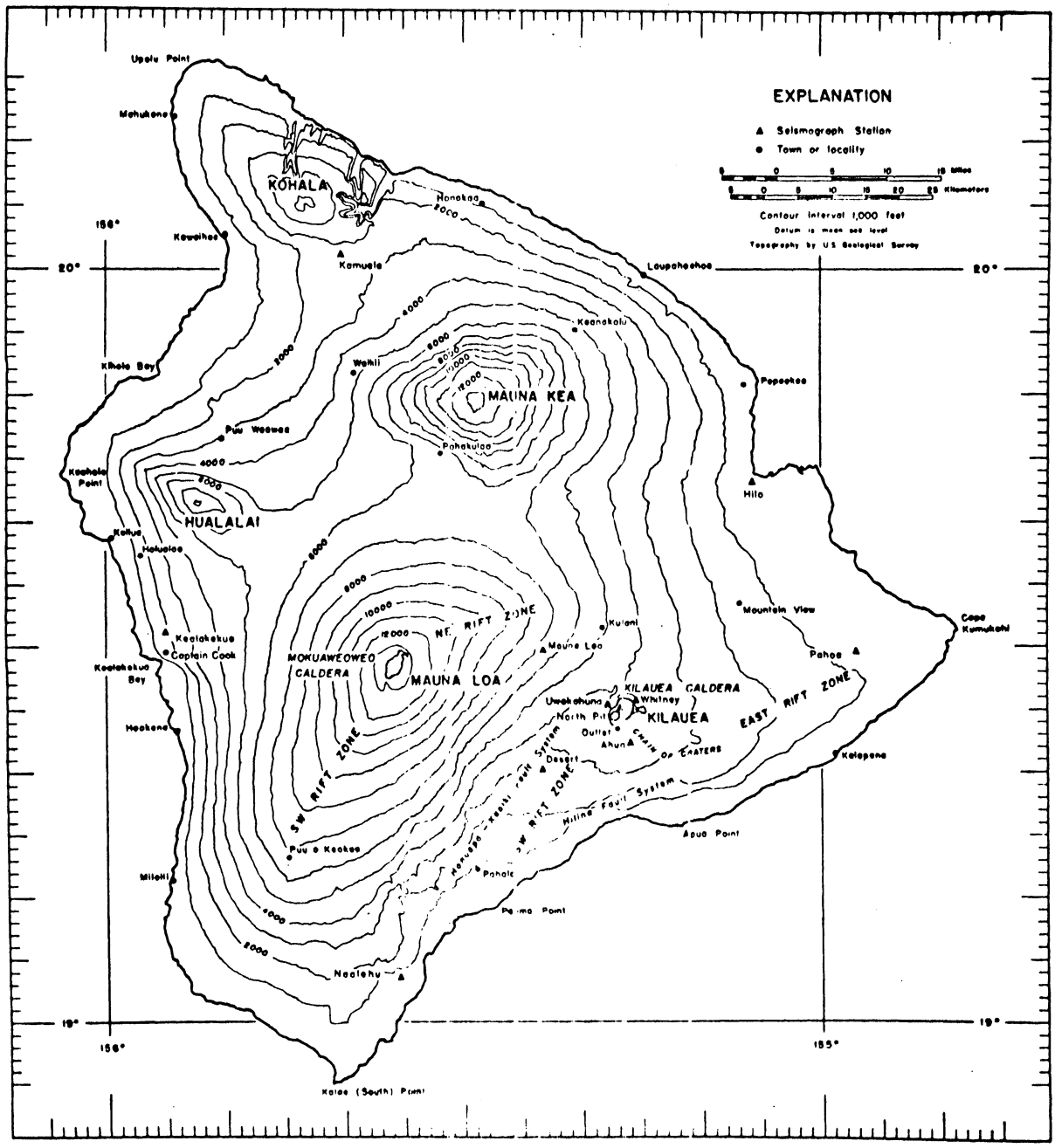

Figure 1.--Map of the island of Hawaii showing seismograph stations operated by the Geological Survey and localities mentioned in the text. Epicenters of local earthquakes are given in terms of geographic coordinates, which are indicated at the edges of the map.

Tilting of the ground around Kilauea caldera.--Tilting of the ground around the summit of Kilauea is monitored daily by a short-base water-tube tiltmeter in Uwekahuna Vault (table 1), and at irregular intervals it is measured on a regional scale by means of a network of field tilt bases and a portable water-tube tiltmeter (table 2). The attitude of the ground surface at each tilt base is reported in terms of north-south and east-west tilt coordinates. Both coordinates at each station were arbitrarily set equal to 500 when measurements at that station were begun. Increasing tilt coordinates correspond to northward and eastward tilting of the earth's surface, i.e., to a relative subsidence toward the north and east. A one-unit change in coordinate cooresponds to a tilting of 1 microradian (1 mm per km) in the direction indicated.

Table 1.--Tilt coordinates Uwekahuna Vault, January, February, and March, 1963

Date	N-S	E-W	Date	N-S	E-W
Jan. 6	460	492	Mar. 3	470	486
13	465	492	10	476	482
20	467	490	17	485	482
27	467	490	24	488	482
Feb. 3	467	490	31	489	483
10	468	491			
17	470	487			
24	469	488			

Table 2.--Tilt coordinates and changes at bases around Kilauea caldera, 1st Quarter, 1963 (see fig. 2)

Tilt base (location)	Date (1963)	Tilt coordinates		Rate (10^{-6} rad/mo) and direction of tilting since last reading		Date last reading (1962)
		N-S	E-W			
Uwekahuna (19°25.5' N., 155°17.4' W.)	Mar. 20	471.2	481.2	11.6	N. 28.5° W.	Dec. 10
Tree Molds (19°26.3' N., 155°17.3' W.)	Mar. 19	448.7	511.0	4.0	N. 6.9° W.	Dec. 12
Sand Spit (19°24.1' N., 155°16.8' W.)	Mar. 21	938.5	707.5	13.9	N. 6.0° E.	Dec. 12
Kalihipaa (19°21.4' N., 155°15.3' W.)	Mar. 18	568.5	428.3	2.6	S. 33.0° E.	Dec. 11
Keamoku (19°25.1' N., 155°19.0' W.)	Mar. 18	494.5	577.6	10.7	N. 54.1° W.	Dec. 11
Ahua Kamokukolau (19°22.7' N., 155°16.6' W.)	Mar. 19	599.3	539.3	18.5	S. 16.7° E.	Dec. 10
Kipuka Nene (19°19.4' W., 155°16.7' W.)	Mar. 15	507.1	496.7	1.1	S. 5° E.	Dec. 13
Hilina Pali (19°18.2' N., 155°18.6' W.)	Mar. 13	509.6	497.4	0.6	S. 27.6° E.	Oct. 24
Kapapala Ranch (19°20.5' N., 155°23.8' W.)	Mar. 14	497.4	505.0	0.1	S. 27° E.	Dec. 19

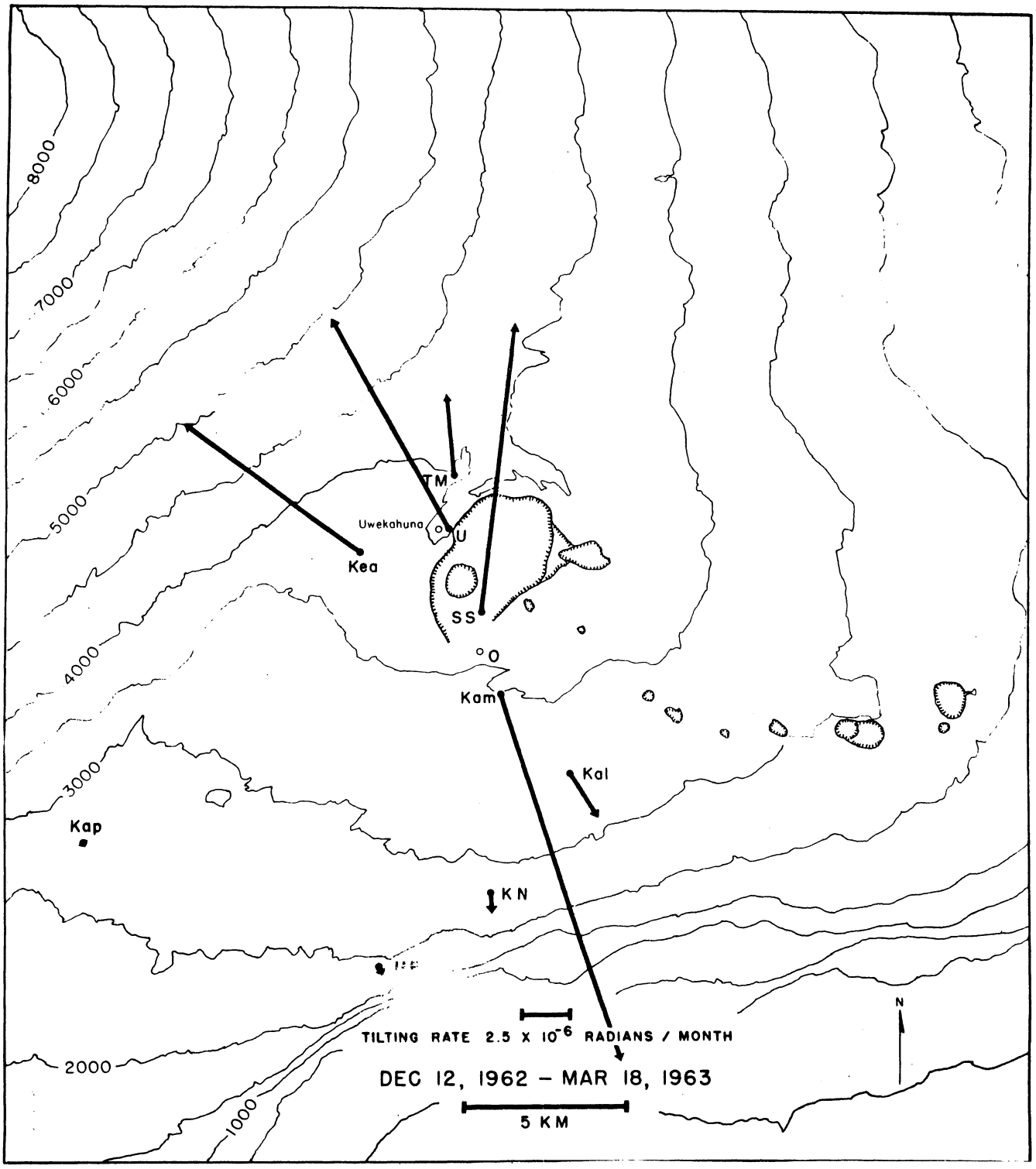

Figure 2.--Tilting of the ground around Kilauea caldera. The vector depicting tilting at a given base points in the direction of maximum relative subsidence and has a length proportional to the rate of tilting during the measurement interval.

Seismic summary.--Events recorded by the U.S. Geological Survey seismograph network in Hawaii fall into two categories: local earthquakes and tremor originating in the region of the Hawaiian Islands, usually within 100 km of at least one seismograph, and distant earthquakes originating more than 3,000 km from Hawaii. As an index of seismic activity at Hawaiian volcanoes, daily counts of earthquakes and minutes of tremor recorded by seismographs in Hawaii are listed in table 3. The earthquakes are separated into groups on the basis of region of origin as determined primarily by analysis of records obtained daily at the Observatory (U, M, A, D, N). Earthquakes of magnitude 2.5 or greater are generally sufficiently well recorded to be located with greater precision; they are listed individually in table 4. Data on identifiable phases from distant earthquakes are listed in table 5.

Locations of the seismograph stations are shown on figure 1. Essential data on the stations are given in table 6.

Table 3.--Numbers of earthquakes and minutes of tremor recorded on seismographs U, M, A, D, and N around Kilauea caldera

Tremor is separated into three categories: deep, intermediate, and shallow, on the basis of relative amplitudes on seismographs in the summit region. Unless otherwise stated, tremor is presumed to be associated with movement of magma within the central complex of Kilauea.

Earthquake categories are: Halemaumau rock slides, which are detected by the characteristic record they produce on the North Pit seismograph; shallow earthquakes in the Kilauea caldera region; shallow earthquakes along the SW. rift zone of Kilauea and the adjacent portion of the Kaoiki fault system; earthquakes along the eastern half of Kilauea's east rift zone (from the Pahoa seismograph); earthquakes from a source about 30 km beneath Halemaumau; earthquakes from the upper east rift zone and the adjacent fault systems on Kilauea's south flank, and earthquakes from other regions: Kona, Mauna Kea, etc.

Date (1963)	Tremor (in minutes)			Earthquakes						
	Deep	Inter-mediate	Shallow	Hale-maumau slides	Kilauea Caldera	SW. rift and Kaoiki	Eastern East rift	Hale-maumau 30 km	Kala-pana Trail	Others
Jan. 1	-----	-------	-------	------	105	9	------	2	3	1 South Point
2	27	-------	-------	------	110	12	------	1	1	----------
3	-----	-------	-------	------	115	3	------	3	------	----------
4	-----	-------	-------	------	110	3	------	2	------	1 South Point
5	-----	-------	-------	------	110	4	------	5	------	1 Mauna Kea
6	3	-------	-------	------	127	7	------	4	------	----------
7	-----	-------	7	------	75	3	------	6	------	----------
8	-----	-------	-------	------	82	6	------	112	2	1 Kona
9	-----	-------	-------	1	160	4	------	42	1	1 Mauna Kea
10	-----	-------	-------	------	115	5	------	5	------	----------
11	24	-------	-------	------	80	5	1	2	1	1 Kona
12	-----	-------	-------	------	110	8	------	5	1	1 Apua Pt.
13	-----	-------	-------	------	107	5	------	2	------	1 Kona
14	-----	-------	-------	------	170	5	------	4	10	----------

Table 3.--Numbers of earthquakes and minutes of tremor recorded on seismographs U, M, A, D, and N around Kilauea caldera--Continued

Date (1963)	Tremor (in minutes)			Earthquakes						
	Deep	Intermediate	Shallow	Halemaumau slides	Kilauea caldera	SW. rift and Kaoiki	Eastern East rift	Halemaumau 30 km	Kalapana Trail	Others
Jan. 15	-----	-------	------	1	89	5	------	2	------	----------
16	Instruments turned off--extreme weather									
17	-----	-------	------	-------	66	5	------	2	------	----------
18	-----	-------	------	-------	50	5	------	4	------	1 Kona 1 Kohala
19	-----	-------	------	-------	40	6	------	5	------	----------
20	-----	4	------	-------	61	6	------	5	------	2 Puako
21	-----	1	------	-------	50	5	------	4	------	1 Kona
22	10	-------	------	-------	75	14	------	2	------	----------
23	-----	-------	------	3	66	7	1	6	------	----------
24	-----	-------	------	1	52	7	------	3	------	----------
25	28	40	------	3	60	4	------	1	------	----------
26	-----	-------	------	2	90	10	------	5	------	----------
27	-----	-------	------	7	100	13	------	10	------	----------
28	-----	-------	------	1	47	9	------	4	------	1 Kona
29	-----	-------	------	2	49	6	------	3	------	----------
30	-----	-------	------	-------	45	7	------	7	1	1 Kona
31	Poor records--extreme weather									
Feb. 1	-----	-------	------	-------	30	15	------	3	------	----------
2	-----	-------	------	-------	58	17	------	6	------	3 Kona
3	-----	-------	------	-------	69	27	------	5	1	2 Kona
4	-----	-------	------	-------	26	31	------	6	------	1 Kohala
5	-----	-------	------	-------	40	23	------	3	------	1 Kona 1 Kohala
6	-----	4	------	-------	28	18	------	10	1	5 Kona
7	-----	-------	------	1	35	25	------	9	13	----------
8	-----	-------	------	-------	55	22	------	11	------	2 Kona
9	-----	-------	------	1	60	36	------	7	5	----------

Table 3.--Numbers of earthquakes and minutes of tremor recorded on seismographs U, M, A, D, and N around Kilauea caldera--Continued

Date (1963)	Tremor (in minutes)			Earthquakes						
	Deep	Inter-mediate	Shallow	Hale-maumau slides	Kilauea caldera	SW. rift and Kaoiki	Eastern East rift	Hale-maumau 30 km	Kala-pana Trail	Others
Feb. 10	-----	-------	-------	------	50	18	------	4	------	----------
11	4	-------	-------	------	53	13	------	2	------	3 Kona
12	-----	-------	-------	------	74	7	------	------	------	1 Kona
13	-----	-------	-------	------	34	7	------	2	------	1 Kona
14	-----	-------	-------	------	40	6	------	2	------	----------
15	29	-------	-------	1	80	10	1	3	------	----------
16	29	-------	-------	------	240	11	------	3	1	1 Maui
17	-----	-------	-------	------	350	10	------	3	------	1 Kona
18	-----	-------	-------	------	300	12	1	13	------	4 Kona
19	-----	-------	-------	------	60	15	------	12	------	1 Kona
20	13	-------	-------	------	100	16	------	7	1	1 Kona
21	-----	-------	-------	------	100	8	------	3	------	----------
22	-----	-------	-------	------	45	5	------	5	------	----------
23	-----	-------	3	------	70	15	------	7	1	----------
24	-----	-------	-------	------	120	20	------	5	------	----------
25	-----	4	-------	------	115	14	------	1	1	1 Kona
26	-----	-------	-------	------	150	15	1	2	------	----------
27	-----	-------	-------	------	80	15	------	3	18	1 Kohala
28	-----	-------	-------	------	65	17	1	1	7	1 Kona

Table 3.--Numbers of earthquakes and minutes of tremor recorded on seismographs U, M, A, D, and N around Kilauea caldera--Continued

Date (1963)	Tremor (in minutes)			Earthquakes						
	Deep	Intermediate	Shallow	Halemaumau slides	Kilauea caldera	SW. rift and Kaoiki	Eastern East rift	Halemaumau 30 km	Kalapana Trail	Others
Mar. 1	-----	------	------	------	50	12	------	2	------	----------
2	-----	------	------	------	70	17	2	2	------	----------
3	-----	------	------	------	65	11	9	-----	------	----------
4	-----	------	------	------	166	12	8	3	1	4 Kona
5	-----	------	------	------	100	13	12	3	------	1 Mauna Kea
6	-----	------	------	------	80	14	21	1	------	----------
7	-----	------	------	------	120	20	3	2	------	1 Maui
8	-----	------	------	------	100	7	------	------	------	----------
9	-----	------	3	------	70	16	------	2	------	1 Maui
10	-----	25	------	------	60	15	4	6	------	1 Kona
11	-----	------	2	------	80	30	------	2	3	1 Mauna Kea
12	-----	------	------	------	80	22	1	------	------	1 Kona 1 Mauna Kea
13	40	------	------	------	90	27	------	3	------	3 Kona 1 Mauna Kea
14	-----	------	------	------	75	6	------	9	------	----------
15	-----	------	------	------	100	17	1	3	1	----------
16	15	------	------	------	90	20	1	7	1	1 Kona
17	-----	------	------	1	75	20	------	1	------	2 Kona
18	59	------	------	------	79	32	------	6	1	3 Kona 2 Mauna Kea
19	-----	------	------	------	76	18	------	5	5	----------
20	-----	------	------	------	96	15	------	12	40	2 Kona
21	-----	------	------	------	90	15	------	10	1	1 Kona
22	-----	------	------	------	90	10	------	7	3	2 Kona 1 Mauna Loa

Table 3.--Numbers of earthquakes and minutes of tremor recorded on seismographs U, M, A, D, and N around Kilauea caldera--Continued

Date (1963)	Tremor (in minutes)			Earthquakes						
	Deep	Intermediate	Shallow	Halemaumau slides	Kilauea caldera	SW. rift and Kaoiki	Eastern East rift	Halemaumau 30 km	Kalapana Trail	Others
Mar. 23	------	-------	------	-------	80	16	------	10	------	----------
24	3	-------	------	-------	115	11	------	6	10	1 Pohakuloa 1 Maui
25	------	-------	------	-------	176	28	1	9	16	----------
26	------	19	------	-------	120	8	2	5	------	----------
27	12	-------	------	5	153	19	------	5	9	3 Kona 1 Mauna Kea
28	------	-------	------	-------	100	9	------	4	------	1 Mauna Kea
29	------	-------	------	-------	120	8	-------	1	1	----------
30	------	-------	------	2	100	7	------	------	------	----------
31	------	-------	------	-------	3	3	2	4	------	1 Mauna Kea

Table 4.--Local earthquakes recorded by seismographs of the U.S. Geological Survey, January, February, and March, 1963

[Except for smaller earthquakes of special interest, only earthquakes with magnitudes of 2.5 or greater are listed. Origin time is Hawaiian standard.

In the following list some origin times are followed only by "KM 30" and a statement of magnitude. These are all members of a continuing family of quakes noted also in other Summaries. The best mean focus for this group is beneath Halemaumau at a depth of 30 km (19°24.1' N., 155°17.1' W.).

Origin times of members of a second persistent sequence of earthquakes are followed by "KT" (Kalapana Trail). These earthquakes originate at very shallow depths in a remote region along the Kalapana Trail west of Kalapana, and they generally are not felt. Seismograms of these earthquakes are poorly recorded and difficult to interpret; so only an approximate epicenter, 19°20' N., 155°05' W., can be assigned to them.

The mean focus of the magnitude 6.1 Kaoiki fault system earthquake of June 27 and its aftershocks is 19°24' N., 155°25' W., at a depth of 3 to 8 km. This focus has been abbreviated "Kaoiki."

Since the flank eruption near Aloi Crater (Summary 28) numerous earthquakes have been recorded from the Aloi region and the Koae fault system southwest of Aloi. These are described as "upper east rift" earthquakes in this table]

Date (1963)	Time			Magnitude	Depth (km)	Epicenter			Felt Report
	h	m	s			Lat. N.	Long. W.	Description	
Jan. 2	03	41	54.4	2.5	8	19°11.2'	155°37.9'	15 km NNW of Naalehu-----	----------
2	08	03	00.4	2.9	3	19°13.8'	155°35.2'	19 km north of Naalehu---	----------
5	17	33	57.2	2.2	---	--------	---------	Kaoiki----------	----------
5	22	27	59.4	2.2	3	19°48.8'	155°20.2'	28 km WNW of Hilo--------	----------
8	07	56	00.6	2.5	---	--------	---------	KM 30----------	----------
8	09	39	44.9	4.3	---	--------	---------	KM 30----------	Felt island-wide, Maui and Oahu.
8	09	46	25.3	2.4	---	--------	---------	KM 30----------	----------
8	09	48	44.0	2.2	---	--------	---------	KM 30----------	----------
8	09	49	25.1	2.3	---	--------	---------	KM 30----------	----------
8	09	50	49.2	2.4	---	--------	---------	KM 30----------	----------
8	10	02	08.5	2.1	---	--------	---------	KM 30----------	----------

Table 4.--Local earthquakes recorded by seismographs of the U.S. Geological Survey, January, February, and March, 1963 --Continued

Date (1963)	Time h	Time m	Time s	Magnitude	Depth (km)	Epicenter Lat. N.	Epicenter Long. W.	Epicenter Description	Felt Report
Jan. 8	10	08	37.2	2.4	----	----------	----------	KM 30----------	----------
8	10	57	14.8	2.8	----	----------	----------	KM 30----------	----------
8	11	14	44.4	2.3	----	----------	----------	KM 30----------	----------
8	12	00	40.1	3.0	----	----------	----------	KM 30----------	----------
8	15	41	06.2	4.2	----	----------	----------	KM 30----------	Felt widely on Hawaii.
8	15	45	15.0	3.4	----	----------	----------	KM 30----------	----------
8	18	06	23.9	2.3	----	----------	----------	KM 30----------	----------
8	18	18	23.9	2.8	----	----------	----------	KM 30----------	----------
8	19	21	06.9	2.1	----	----------	----------	KM 30----------	----------
8	20	00	59.5	2.5	5	19°20.8'	155°04.8'	21 km SW of Pahoa--------	----------
9	00	39	48.0	2.2	----	----------	----------	Kaoiki----------	----------
9	04	36	12.7	2.6	----	----------	----------	KM 30----------	----------
9	04	36	24.0	3.2	----	----------	----------	KM 30----------	Felt on Hawaii
9	05	19	29.9	2.8	----	----------	----------	KM 30----------	----------
9	05	24	42.7	2.5	<3	19°21.5'	155°43.3'	28 km SE of Kealakekua	----------
9	06	45	21.5	2.3	----	----------	----------	KM 30----------	----------
9	08	57	45.4	2.4	----	----------	----------	KM 30----------	----------
9	09	23	08.9	3.1	----	----------	----------	KM 30----------	Felt from Naalehu to Kulani.
9	10	54	07.8	3.2	----	----------	----------	KM 30----------	----------
10	04	05	49.1	2.4	8	19°57.7'	155°21.5'	13 km WSW of Laupahoehoe	----------
10	07	37	28.4	2.2	----	----------	----------	KT----------	----------
10	15	31	35.0	2.1	----	----------	----------	KM 30----------	----------
11	01	52	42.0	2.7	----	----------	----------	KM 30----------	----------
11	14	06	44.3	2.7	----	----------	----------	KM 30----------	----------
12	01	49	58.3	2.4	8	18°56.0'	155°19.8'	32 km SE of Naalehu------	----------
12	23	44	01.4	3.5	----	----------	----------	KT----------	----------
13	20	54	55.0	3.1	8	19°32.2'	156°12.3'	32 km WNW of Kealakekua--	----------

Table 4.--Local earthquakes recorded by seismographs of the U.S Geological Survey, January, February, and March, 1963--Continued

Date (1963)	Time			Magnitude	Depth (km)	Epicenter			Felt Report
	h	m	s			Lat. N.	Long. W.	Description	
Jan. 14	13	50	21.0	2.5	3	19°21.9'	155°08.2'	14 km east of Ahua seismometer	----------
15	03	21	20.0	3.2	----	--------	---------	KM 30----------	----------
18	05	58	50.2	2.2	----	--------	---------	KM 30----------	----------
18	10	51	06.0	2.3	5	19°11.5'	155°37.5'	15 km NNW of Naalehu----------	----------
18	20	59	57.0	2.7	13	20°04.9'	155°48.9'	12 km WNW of Kamuela seismograph.	----------
20	10	26	35.0	3.1	13	20°13'	156°15'	40 km WSW of Upolu Point------	----------
20	17	42	32.8	2.2	----	--------	---------	KM 30----------	----------
23	06	12	41.0	2.8	8	19°27.0'	154°52.8'	10 km SE of Pahoa----------	Felt in Hilo and Pahoa.
26	22	12	04.4	2.2	3	19°24.8'	155°15.7'	SE edge of Kilauea Caldera----	----------
26	23	14	01.8	2.3	3	19°24.8'	155°15.7'	SE edge of Kilauea Caldera----	----------
26	23	29	59.3	2.2	----	--------	---------	Kaoiki----------	----------
27	13	58	05.5	3.4	----	--------	---------	KM 30----------	----------
28	02	08	18.7	2.5	8	19°11.2'	155°34.0'	14 km NNE of Naalehu----------	----------
29	12	53	19.0	2.3	----	--------	---------	KM 30----------	----------
29	14	08	02.9	3.2	----	--------	---------	Kaoiki----------	----------
30	23	08	10.8	2.2	5	19°13.3'	155°42.6'	23 km NW of Naalehu----------	----------
31	14	25	05.6	2.8	8	19°18.5'	155°09.5'	13 km SE of Ahua seismometer--	----------
Feb. 2	03	24	23.3	2.1	8	19°14.7'	155°02.0'	14 km SSW of Kalapana---------	----------
4	12	48	44.0	2.1	13	20°19'	155°30'	34 km NE of Kamuela seismograph.	----------
5	13	36	47.8	2.3	----	--------	---------	Kaoiki----------	----------
5	20	39	44.3	2.7	13	19°57.1'	155°44.8'	10 km SW of Kamuela seismograph.	----------
5	22	47	25.5	2.2	5	19°13.9'	155°38.2'	19 km NNW of Naalehu----------	----------
7	19	05	10.9	2.3	----	--------	---------	KT----------	----------
9	04	25	53.5	2.5	8	19°35.7'	156°00.8'	13 km NW of Kealakekua--------	----------
9	10	19	53.4	2.0	----	--------	---------	KT----------	----------
9	04	24	53.0	2.9	8	19°35.7'	156°00.8'	13 km NW of Kealakekua--------	----------
10	18	49	48.5	2.7	----	--------	---------	Kaoiki----------	----------
12	02	28	28.5	2.5	8	19°29.0'	155°58.2'	7 km WSW of Kealakekua--------	----------

Table 4.--Local earthquakes recorded by seismographs of the U.S. Geological Survey, January, February, and March, 1963--Continued

Date (1963)	Time			Magnitude	Depth (km)	Epicenter			Felt Report
	h	m	s			Lat. N.	Long. W.	Description	
Feb. 12	16	58	02.5	2.4	----	--------	---------	Kaoiki----------	----------
13	08	47	48.5	2.7	8	19°32.8'	155°55.7'	3 km NNW of Kealakekua---------	----------
14	09	17	30.0	3.1	8	19°05.0'	156°12.5'	35 km WSW of Milolii----------	----------
15	02	36	43.8	2.1	----	--------	---------	KM 30----------	----------
16	07	01	13.5	2.5	8	19°16.2'	155°04.2'	23 km ESE of Ahua seismometer--	----------
16	09	31	22.6	2.4	----	--------	---------	Upper east rift----------	----------
16	13	56	20.1	2.5	30	19°29.4'	155°09.5'	10 km SW of Mountain View------	----------
17	01	32	23.7	2.5	13	18°57.3'	155°08.1'	50 km ESE of Naalehu----------	----------
17	09	07	44.5	4.1	13	19°43'	156°52'	83 km west of Keahole Point----	----------
17	11	47	26.6	2.3	5	19°30.0'	155°41.8'	25 km east of Kealakekua-------	----------
17	23	10	35.7	2.3	10	19°19.5'	155°21.2'	6 km SW of Uwekahuna seismometer.	----------
19	01	52	43.3	2.3	----	--------	---------	KM 30----------	----------
19	04	00	13.4	2.4	8	19°30.1'	155°46.7'	15 km east of Kealakekua-------	----------
19	21	25	51.1	2.2	3	19°10.8'	155°35.0'	13 km north of Naalehu---------	----------
21	05	41	28.2	2.8	13	19°03'	156°16'	65 km SW of Kealakekua---------	----------
22	21	24	33.5	2.3	8	19°21.9'	155°56.6'	5 km SW of Hookena----------	----------
23	21	59	24.4	2.3	3	19°21.8'	155°05.6'	40 km south of Hilo----------	----------
24	19	24	26.5	3.1	13	21°30'	156°40'	38 km north of Halawa Cape, Molokai.	----------
25	11	38	28.5	2.4	3	19°20.9'	155°47.1'	13 km SE of Hookena----------	----------
25	13	11	21.9	2.8	5	19°30.7'	155°26.2'	5 km WNW of Mauna Loa seismometer.	----------
26	01	21	42.0	2.0	8	19°24.4'	154°52.2'	13 km SE of Pahoa----------	----------
27	15	44	28.5	2.9	13	20°08.4'	155°50.6'	18 km NW of Kamuela----------	Felt in Kamuela---
27	21	42	19.3	2.6	----	--------	---------	Upper east rift----------	----------
27	22	22	10.1	3.0	----	--------	---------	Upper east rift----------	----------
28	11	03	20.3	2.4	8	19°47.4'	155°31.4'	5 km north of Pohakuloa--------	----------
28	11	10	20.6	2.4	8	19°47.4'	155°31.4'	5 km north of Pohakuloa--------	----------
28	11	21	50.8	2.1	8	19°26.8'	155°00.1'	8 km SW of Pahoa----------	Felt in Pahoa-----

Table 4.--Local earthquakes recorded by seismographs of the U.S. Geological Survey, January, February, and March, 1963--Continued

Date (1963)	Time h	Time m	Time s	Magnitude	Depth (km)	Epicenter Lat. N.	Epicenter Long. W.	Epicenter Description	Felt Report
Mar. 1	01	48	26.6	3.2	3	19°19.8'	155°45.0'	17 km SE of Hookena----------	Felt along southwestern shore of Hawaii Island.
1	02	43	00.7	2.7	13	18°57.3'	155°38.3'	5 km NE of Kalae Point--------	----------
3	06	14	38.0	2.3	---	--------	---------	KM 30----------	----------
5	17	11	16.4	2.5	5	19°28.5'	154°54.9'	5 km SE of Pahoa----------	----------
5	20	04	19.8	2.4	5	19°28.5'	154°54.9'	5 km SE of Pahoa----------	----------
5	20	44	02.3	2.6	8	19°59.0'	155°24.1'	14 km SE of Honokaa----------	----------
6	02	23	55.1	2.8	5	19°28.5'	154°54.9'	5 km SE of Pahoa----------	Felt in Pahoa---
6	05	46	14.3	2.9	5	19°28.5'	154°54.9'	5 km SE of Pahoa----------	Felt in Pahoa---
7	16	08	34.7	2.4	8	19°30.8'	156°04.8'	18 km west of Kealakekua------	----------
8	14	25	23.3	2.3	8	19°17.9'	155°11.8'	11 km SE of Ahua seismometer--	----------
8	15	45	27.0	2.3	8	19°17.9'	155°11.8'	11 km SE of Ahua seismometer--	----------
8	17	22	17.8	2.7	8	19°53.0'	155°31.8'	23 km SE of Kamuela----------	----------
9	12	47	50.5	2.4	3	19°38.1'	156°04.2'	21 km NW of Kealakekua--------	----------
10	11	51	52.0	2.3	8	19°14.9'	155°04.1'	54 km south of Hilo----------	----------
11	10	06	25.0	2.6	8	19°57.0'	155°21.9'	15 km WSW of Laupahoehoe------	Felt in Hilo----
11	17	45	28.3	3.0	13	21°08'	156°07'	43 km NNE of Haleakala seismometer (Maui).	----------
11	21	33	22.6	2.4	8	19°05.5'	155°21.9'	39 km south of Hilo----------	----------
12	22	08	05.2	2.7	3	19°53.1'	155°22.8'	6 km SW of Keanakolu----------	----------
13	01	37	33.5	3.0	8	19°40.1'	155°50.4'	19 km NE of Kealakekua--------	----------
13	03	22	52.7	2.3	3	19°51.0'	155°23.3'	10 km SW of Keanakolu---------	----------
13	10	57	26.9	3.5	5	19°24.2'	155°30.0'	15 km SW of Mauna Loa seismometer.	Felt in Pahala, Hilo, and Kilauea Caldera area.
13	22	28	18.9	2.5	3	19°51.0'	155°23.3'	10 km SW of Keanakolu---------	----------
14	00	18	35.7	3.3	13	19°29'	157°14'	138 km west of Kealakekua-----	----------
14	01	23	26.0	2.1	---	--------	---------	KM 30----------	----------
14	08	23	20.5	3.0	8	20°12.7'	155°55.8'	31 km NW of Kamuela----------	----------
15	18	10	07.0	2.7	8	19°31.0'	155°03.3'	11 km NW of Pahoa----------	Felt in Pahoa---

Table 4.--Local earthquakes recorded by seismographs of the U.S. Geological Survey, January, February, and March, 1963--Continued

Date (1963)	Time			Magnitude	Depth (km)	Epicenter			Felt Report
	h	m	s			Lat. N.	Long. W.	Description	
Mar. 17	23	32	57.8	2.5	<3	19°29.0'	155°44.6'	20 km ESE of Kealakekua---------	----------
17	23	44	52.0	2.5	<3	19°29.0'	155°44.6'	20 km ESE of Kealakekua---------	----------
18	14	44	13.2	2.9	---	--------	---------	KM 30----------	----------
18	15	50	43.7	2.3	3	19°53.1'	155°46.0'	13 km WNW of Waikii----------	----------
18	22	02	36.9	2.4	8	19°49.2'	155°32.6'	8 km NNW of Pohakuloa----------	----------
19	02	35	01.5	2.4	5	19°24.2'	155°46.6'	20 km SE of Kealakekua----------	----------
19	17	56	36.6	2.7	8	19°41.9'	156°06.2'	5 km SW of Keahole Point--------	----------
20	14	17	03.0	2.2	8	19°18.6'	155°05.5'	45 km south of Hilo----------	----------
20	20	42	15.7	2.6	---	--------	---------	KM 30----------	----------
20	21	15	38.2	2.2	---	--------	---------	Upper east rift----------	----------
21	19	57	31.4	2.3	<3	19°26.8'	155°46.0'	18 km SE of Kealakekua----------	----------
22	10	59	40.5	3.8	13	19°32.6'	155°49.9'	10 km ENE of Kealakekua---------	Felt in Hilo, Kamuela, and Kealakekua.
22	17	38	16.3	3.0	3	19°53.8'	155°16.3'	28 km NW of Hilo----------	----------
22	18	01	16.9	2.8	8	19°44.3'	155°45.6'	30 km NE of Kealakekua----------	----------
22	20	59	43.0	2.4	---	--------	---------	Upper east rift----------	----------
22	21	07	56.0	2.7	---	--------	---------	Upper east rift----------	----------
22	21	09	02.3	2.6	---	--------	---------	Upper east rift----------	----------
22	21	11	16.5	2.8	8	19°48.5'	156°01.4'	35 km NNW of Kealakekua---------	----------
23	04	48	13.4	3.5	13	19°53.2'	155°20.8'	5 km SW of Keanakolu----------	----------
24	10	03	34.5	2.9	---	--------	---------	KM 30----------	----------
24	11	31	08.2	2.2	---	--------	---------	KM 30----------	----------
24	20	30	35.9	2.6	---	--------	---------	Kaoiki----------	----------
24	22	31	51.8	4.5	13	19°47.0'	155°33.8'	14 km SE of Waikii----------	Felt in Hawaii and Maui.
24	23	43	06.3	2.0	---	--------	---------	KM 30----------	----------
25	06	41	50.2	2.5	<3	19°20.2'	155°42.3'	22 km ESE of Hookena----------	----------
25	06	57	05.6	2.7	<3	19°28.7'	155°48.5'	13 km ESE of Kealakekua---------	Felt in Kealakekua
25	07	18	35.0	3.9	35	20°47'	156°14'	3 km NE of Haleakala seismometer (Maui).	Felt throughout Maui.

Table 4.--Local earthquakes recorded by seismographs of the U.S. Geological Survey, January, February, and March, 1963--Continued

Date (1963)	Time			Magnitude	Depth (km)	Epicenter			Felt Report
	h	m	s			Lat. N.	Long. W.	Description	
Mar. 25	23	30	20.0	2.5	13	19°05.4'	155°25.2'	18 km ENE of Naalehu	----------
26	20	56	19.2	2.5	----	--------	---------	Kaoiki	----------
27	04	55	50.6	2.2	----	--------	---------	KM 30	----------
27	11	12	57.0	2.9	8	19°55.7'	155°32.1'	20 km SE of Kamuela	----------
27	17	24	25.9	2.4	8	19°21.4'	155°45.4'	16 km ESE of Hookena	----------
28	00	26	22.9	2.3	8	19°26.1'	155°36.8'	5 km SW of Mokuaweoweo Caldera	----------
28	02	37	45.2	2.1	-----	--------	---------	KM 30	----------
28	13	08	27.1	2.6	8	19°47.9'	155°34.6'	8 km NW of Pohakuloa	----------
28	19	47	02.5	2.8	----	--------	---------	Kaoiki	----------
29	08	50	08.8	2.1	----	--------	---------	Upper east rift	----------
30	20	49	01.9	2.8	35	19°09.5'	155°30.0'	14 km NE of Naalehu	----------
31	16	35	57.5	3.7	8	20°01.0'	155°52.9'	6 km SW of Kawaihae	Felt in Kamuela

Table 5.--Distant earthquakes

[Times are reported in Greenwich Civil Time which is 10 hours faster than Hawaiian Standard Time. A "c" following the time of P indicates compressional first motion; a "d" indicates dilatational first motion. Station symbols, locations, and instrumentation are presented in table 6. Magnitudes calculated from the Hawaii seismograms are followed by (HVO). Location of epicenter, origin times, and focal depths, and magnitudes reported by other institutions are taken from "Preliminary Determination of Epicenters" published by the U.S. Coast and Geodetic Survey]

Jan. 1, 1963

M	Z	iP	12:26:51.6 d
A	Z	eP	12:26:50.1 d
D	Z	iP	12:26:49.8 d
N	Z	eP	12:26:51.2 d
WP	Z	iP	12:26:51.1 d
Na	Z	iP	12:26:48.0
Pa	Z	iP	12:26:52.0 c
Hi	Z	eP	12:26:53.3 d
Ka	Z	eP	12:26:54.5 d

C&GS card 1-63:
12:17:38.6
6.8° S., 155.9° E.
Solomon Islands
h about 165 km.

Jan. 1

M	Z	eP	23:46:13.6 d
A	Z	eP	23:46:14.4 d
D	Z	iP	23:46:14.5 d
N	Z	eP	23:46:13.9 d
WP	Z	eP	23:46:13.9 d
U	Z	iP	23:46:13.7 d
Ha	Z	iP	23:46:03.4 c
		epP	23:46:19.7
Ka	Z	eP	23:46:08.6 d
Hi	Z	iP	23:46:11.4 d
Pa	Z	iP	23:46:13.5 d
Na	Z	iP	23:46:16.8 d
U	PEZ	iP	23:46:14 d
		iS	23:51:57
		iSS	23:55:03
U	PEE	isS	23:52:27
		eL	23:54:41
U	PEN	i	23:52:52
		i	23:56:16
M	Z	Tmax	00:24:45
A	Z	Tmax	00:24:48
D	Z	Tmax	00:24:40
N	Z	Tmax	00:24:48
WP	Z	Tmax	00:24:44
U	Z	Tmax	00:24:45
Ha	Z	Tmax	00:23:07
Ka	Z	Tmax	00:24:01
Hi	Z	Tmax	00:24:11

Jan. 1--Continued

Pa	Z	Tmax	00:24:43

C&GS card 1-63:
23:39:05.6
56.6° N., 157.7° W.
Alaska Peninsula
h about 50 km
Magnitude 6.5 (Pas)
5.75 (Pal)
6.5 (HVO)

Jan. 2

M	Z	iP	15:07:35.8 c
N	Z	eP	15:07:35.5 c

C&GS card 4-63:
14:56:05.4
4.1° S., 132.2° E.
Near south coast of western New Guinea.
h about 33 km.

Jan. 2

U	PEZ	eR	16:32:21

C&GS card 3-63:
15:55:47.9
52.9° S., 118.2° W.
South Pacific Ocean
h about 33 km.

Jan. 3

U	PEZ	eR	10:06:20

C&GS card 3-63:
09:39:46.8
5.3° S., 151.5° E.
New Britain
h about 74 km
Magnitude 5.3 (Pal).

Table 5.--Distant earthquakes--Continued

Jan. 4, 1963

U	PEZ	iS	12:33:51
U	PEZ	iR	12:41:46

C&GS card 2-63:
12:16:38.0
4.7° S., 154.0° E.
Solomon Islands region
h about 69 km.

Jan. 5

M	Z	iP	00:31:16.7 c
	Z	ipP	00:32:08.2 c
A	Z	eP	00:31:15.7 c
	Z	epP	00:32:07.3 c
D	Z	eP	00:31:15.6 c
	Z	epP	00:32:07.2 c

C&GS card 1-63:
00:20:11.6
3.2° N., 127.0° E.
Halmahera region
h about 33 km.

Jan. 5

M	Z	iP	13:29:19.1 d
A	Z	eP	13:29:18.5 d
D	Z	eP	13:29:18.1 d

C&GS card 2-63:
13:16:38.0
10.0° S., 124.0° E.
Timor
h about 33 km.

Jan. 7

M	Z	eP	12:00:27.6 d
WP	Z	eP	12:00:27.0 d
U	Z	eP	12:00:27.2 d
Ka	Z	eP	12:00:28.8 d
U	PEZ	eR	12:25:12

C&GS card 3-63:
11:48:22.7
0.6° N., 126.7° E.
Halmahera region
h about 42 km

Jan. 7--Continued

C&GS card--Continued
Magnitude 5.5-5.8 (Pal)
6.0 (HVO).

Jan. 9

Pa	Z	eP	03:22:47.9 c

C&GS card 4-63:
03:13:26.4
18.6° N., 145.4° E.
Mariana Islands
h about 192 km.

Jan. 15

M	Z	eP	02:42:23.2 d
A	Z	eP	02:42:23.7 d
N	Z	eP	02:42:23.7 d
WP	Z	eP	02:42:23.3 d

C&GS card 4-63:
02:32:39.9
13.4° N., 145.3° E.
Mariana Islands
h about 38 km.

Jan. 24

Na	Z	iP	12:16:32.5 c
Hi	Z	eP	12:16:40 d

C&GS card 9-63:
12:09:01.2
15.2° S., 173.6° W.
Tonga Islands region
Felt: Apia
h about 33 km.

Jan. 25

A	Z	eP	12:59:54.1 c

C&GS card 7-63:
12:49:42.0
21.8° N., 143.8° E.
Mariana Islands region
h about 190 km.

Table 5.--Distant earthquakes--Continued

Jan. 28, 1963

M	Z	eP	12:22:12.8 d
A	Z	eP	12:22:11.9 d
D	Z	eP	12:22:11.9 d
U	Z	eP	12:22:12.7 d
Na	Z	eP	12:22:11.5 c
Pa	Z	eP	12:22:13.7 c
Hi	Z	iP	12:22:16.2 c
Ha	Z	iP	12:22:16.5 c
U	PEE	iS	22:30:25
U	PEZ	eSS	22:34:10
		iR	22:38:37

C&GS card 10-63:
12:12:19.8
2.6° S., 149.9° E.
New Britain
h about 33 km
Magnitude 6.5 (Pas)
6.7 (HVO).

Jan. 28

M	Z	iP	13:07:44.8 d
A	Z	eP	13:07:45.7 d
D	Z	iP	13:07:45.9 d
		i	13:08:54.1 c
N	Z	eP	13:07:45.5 d
WP	Z	eP	13:07:45.4 d
U	Z	eP	13:07:45.6 d
		ePP	13:09:10.7 c
		iPcP	13:10:06.9 c
Ha	Z	eP	13:07:40.5 c
Hi	Z	eP	13:07:43.7 c
Pa	Z	eP	13:07:44.1 d
Na	Z	eP	13:07:49.1 c
U	PEZ	iS	13:13:21
		iR	13:16:49
M	Z	Tmax	13:45:33
A	Z	Tmax	13:45:28
D	Z	Tmax	13:45:30
N	Z	Tmax	13:45:11
WP	Z	Tmax	13:45:24
U	Z	Tmax	13:45:21
HA	Z	Tmax	13:43:33
Hi	Z	Tmax	13:44:55
Pa	Z	Tmax	13:45:08
Na	Z	Tmax	13:45:15

Jan. 28--Continued

C&GS card 7-63:
13:00:50.7
54.7° N., 161.6° E.
Alaska Peninsula
h about 33 km
Magnitude 6.0-6.5 (Pas)
6.7 (HVO).

Jan. 29

M	Z	iP	09:29:54.6 d
A	Z	eP	09:29:55.4 d
D	Z	eP	09:29:54.8 d
N	Z	eP	09:29:55.0 d
U	Z	eP	09:29:55.1 d
Ka	Z	iP	09:29:49.4 d
Hi	Z	iP	09:29:54.0 d
Pa	Z	iP	09:29:55.6 d
Na	Z	iP	09:29:56.7 d

C&GS card 8-63:
09:21:14.3
49.7° N., 154.9° E.
Kurile Islands
h about 126 km.

Jan. 30

M	Z	eP	10:29:10.9 c
U	PEN	eSKSP	10:41:26
		iSS	10:48:36
		iG	11:02:36

C&GS card 10-63:
10:10:04.1
55.6° S., 28.3° W.
Sandwich Islands region
h about 33 km
Magnitude 6.5 (Pas)
7.5 (HVO).

Jan. 31

Hi	Z	eP	05:18:03.6 d
Pa	Z	eP	05:18:04.3 d

C&GS card 9-63:
05:06:46.0
27.9° N., 126.3° E.

Table 5.--Distant earthquakes--Continued

Jan. 31, 1963--Continued

C&GS card--Continued
Ryukyu Islands
h about 33 km.

Feb. 4

M	Z	iP	23:29:50.5 d
A	Z	eP	23:29:51.5 d
D	Z	eP	23:29:51.0 d
N	Z	eP	23:29:51.3 c
WP	Z	eP	23:29:51.4 d
Hi	Z	iP	23:29:49.5 d
U	Z	eP	23:29:50.8 d
Pa	Z	iP	23:29:52.0 d

C&GS card 10-63:
23:21:09.0
48.5° N., 154.9° E.
Kurile Islands
h about 85 km.

Feb. 5

U	PEZ	eSS	21:10:35
		eR	21:22:35

C&GS card 10-63:
20:39:21.6
38.4° S., 73.2° W.
Near coast of central Chile
h about 41 km
Magnitude 6.3-6.5 (Pas)
6.0-6.3 (Brk)
5.8-6.0 (Pal)

Feb. 12

M	Z	iP	23:14:45.2 d
A	Z	iP	23:14:44.3 d
D	Z	iP	23:14:43.6 d
N	Z	iP	23:14:44.5 d
WP	Z	iP	23:14:44.3 d
U	Z	iP	23:14:44.4 d
Na	Z	iP	23:14:40.5 d
Pa	Z	eP	23:14:45.4 d
Hi	Z	iP	23:14:50.0 d
Ha	Z	iP	23:14:54.3 d

Feb. 12--Continued

C&GS card 13-63:
23:07:28.9
17.8° S., 178.6° W.
Fiji Islands
h about 583 km
Magnitude 5.5 (CGS)

Feb. 13

M	Z	eP	09:01:47.8 c
A	Z	iP	09:01:48.4 c
D	Z	iP	09:01:47.5 c
N	Z	iP	09:01:48.1 c
WP	Z	iP	09:01:48.0 c
U	Z	eP	09:01:48.3 c
Ha	Z	iP	09:01:46.3 c
Ka	Z	eP	09:01:44.2 c
Hi	Z	iP	09:01:48.7 c
Pa	Z	eP	09:01:49.4 c
Na	Z	iP	09:01:47.0 c
U	PEZ	iP	09:01:48.0 c
		eR	09:25:34
U	PEE	iS	09:11:32
		iSS	09:16:41
U	PEN	eSSS	09:19:46

C&GS card 13-63:
08:50:02.2
24.5° N., 121.8° E.
Northern Formosa
3 deaths and widespread damage
h about 33 km
Magnitude 7.3 (Pas)
7.3 (Brk)
7.0-7.3 (Pal)
7.5 (HVO)

Feb. 13

M	Z	iP	18:23:05.5 c
A	Z	iP	18:23:04.8 d
D	Z	iP	18:23:03.9 d
N	Z	iP	18:23:05.0 d
WP	Z	iP	18:23:04.9 d
Na	Z	iP	18:23:02.8 d
Pa	Z	iP	18:23:06.3 d

Feb. 13, 1963--Continued

Hi	Z	eP	18:23:07.5	d
Ka	Z	eP	18:23:06.8	c
Ha	Z	iP	18:23:05.8	c
U	PEZ	iP	18:23:06	c
		eR	18:37:34	
U	PEE	iS	18:30:42	
U	PEN	eG	18:35:00	

C&GS card 16-63:
18:13:55.1
9.9° S., 160.8° E.
Solomon Islands
h about 29 km
Magnitude 6.0-6.3 (Pal)
6.5 (Pas)
6.5 (Brk)
5.8 (CGS)
6.6 (HVO).

Feb. 14

M	Z	iP	07:16:32.8	c
D	Z	eP	07:16:31.3	c
N	Z	eP	07:16:32.3	c
WP	Z	eP	07:16:32.1	c
U	Z	iP	07:16:32.0	c
Na	Z	iP	07:16:30.4	c
Pa	Z	iP	07:16:33.9	d
Hi	Z	iP	07:16:34.6	c
Ka	Z	iP	07:16:34.0	c
Ha	Z	iP	07:16:34.2	c

C&GS card 15-63:
07:04:40.8
7.2° S., 128.2° E.
Banda Sea
h about 197 km
Magnitude 6.5 (Pas)
5.8 (CGS)
Felt: Darwin, Australia.

Feb. 14

M	Z	iP	22:18:22.3	c
D	Z	eP	22:18:21.5	d
N	Z	eP	22:18:21.8	d
U	Z	eP	22:18:21.8	d
Hi	Z	eP	22:18:24.3	c
U	PEN	eG	22:34:28	

Feb. 14--Continued

U	PEZ	iR	22:37:14

C&GS card 16-63:
22:07:54.3
5.0° S., 144.6° E.
Eastern New Guinea
h about 80 km
Magnitude 6.5 (Pas)
6.0 (Pal)
6.2 (HVO)
6.0 (CGS)

Feb. 21

M	Z	iP	02:43:22.7	c
A	Z	eP	02:43:23.6	c
D	Z	eP	02:43:23.0	c
WP	Z	iP	02:43:23.4	c
U	Z	eP	02:43:23.3	c
Ha	Z	eP	02:43:13.3	c
Na	Z	iP	02:43:22.3	c

C&GS card 14-63:
02:33:35.9
33.4° N., 139.2° E.
South of Honshu, Japan
h about 168 km
Magnitude 4.4 (CGS)

Feb. 21

Ha	Tmax	12:42:14

C&GS card 17-63:
12:01:19.4
40.4° N., 125.0° W.
Near coast of northern California
h about 33 km.

Feb. 21

M	Z	eP	13:24:14.6	d
A	Z	eP	13:24:14.0	d
N	Z	eP	13:24:14.5	d
WP	Z	iP	13:24:14.4	d
U	Z	eP	13:24:14.0	d
Hi	Z	iP	13:24:15.8	c
Ka	Z	eP	13:24:16.6	c
Ha	Z	eP	13:24:18.9	d

Feb. 21, 1963--Continued

C&GS card 15-63:
13:16:05.6
20.6° S., 175.1° W.
Tonga Islands region
h about 33 km
Magnitude 5.2 (CGS).

Feb. 22

M	Z	eP	08:06:14.2	c
A	Z	eP	08:06:13.5	c
N	Z	iP	08:06:14.1	c
WP	Z	iP	08:06:14.1	c
U	Z	eP	08:06:13.9	c
Na	Z	iP	08:06:10.7	c
Pa	Z	iP	08:06:15.8	c
Hi	Z	iP	08:06:16.8	c
Ka	Z	iP	08:06:17.1	c
Ha	Z	iP	08:06:19.8	c

C&GS card 16-63:
07:58:57.0
17.8° S., 178.8° W.
Fiji Islands region
h about 550 km
Magnitude 5.0 (CGS).

Feb. 24

M	Z	eP	13:44:18.2	d
A	Z	eP	13:44:17.4	d
D	Z	eP	13:44:17.9	d
N	Z	eP	13:44:17.5	d
WP	Z	eP	13:44:17.5	d
U	Z	eP	13:44:17.4	d
Hi	Z	iP	13:44:15.5	d
Pa	Z	iP	13:44:14.8	d
Ka	Z	eP	13:44:20.9	d

C&GS card 17-63:
13:34:15.7
14.6° N., 91.4° W.
Central Guatemala
h about 135 km
Magnitude 5.7 (CGS).

Feb. 26

M	Z	iP	20:24:22.2	d
A	Z	eP	20:24:20.7	d
U	Z	iP	20:24:22.0	d
Na	Z	iP	20:24:20.4	d
		isP	20:25:20.5	c
Pa	Z	iP	20:24:24.3	d
Hi	Z	iP	20:24:24.8	d
		ipP	20:25:03.0	d
Ka	Z	iP	20:24:25.6	d
Ha	Z	iP	20:24:26.5	d
		isP	20:25:17.9	c
U	PEZ	iP	20:24:22	d
		ipP	20:25:05	d
		isP	20:25:25	c
U	PEZ	ipPP	20:27:31	dn
		ipPPP	20:28:46	dn
		iPKKP	20:42:41	
U	PEE	iPP	20:26:47	
		iS	20:32:46	
		iScS	20:33:21	
		isS	20:34:00	
U	PEN	iG	20:40:05	
M	Z	Tmax	21:32:24	
A	Z	Tmax	21:32:16	
WP	Z	Tmax	21:32:16	
Ha	Z	Tmax	21:32:11	

C&GS card 16-63:
20:14:08.7
7.5° S., 146.2° E.
Eastern New Guinea
h about 171 km
Magnitude 7.3-7.5 (Pas)
7.0-7.3 (Brk)
6.8-7.0 (Pal)
7.1 (CGS)
7.0 (HVO).

Feb. 27

M	Z	eP	04:40:17	d
U	PEZ	eP	04:40:15	d
		iS	04:48:27	
		iSS	04:52:39	
		eR	04:57:55	
U	PEE	iG	04:55:15	

Feb. 27, 1963--Continued

C&GS card 19-63:
04:30:00.8
6.0° S., 149.4° E.
New Britain region
h about 52 km
Magnitude 6.5-6.8 (Pal)
5.2 (CGS)
6.8 (HVO).

Feb. 27

Ha	Tmax		28:00:18:56

C&GS card 16-63:
23:36:20.4
54.8° N., 161.6° W.
Alaska Peninsula
h about 33 km
Magnitude 5.3 (CGS).

Mar. 4

M	Z	eP	15:54:52.8	d
D	Z	eP	15:54:52.3	c
WP	Z	eP	15:54:52.0	d
U	Z	iP	15:54:52.2	d

C&GS card 19-63:
15:43:04.0
4.5° S., 81.6° W.
Off coast of northern Peru
h about 33 km
Magnitude 5.6 (CGS).

Mar. 5

M	Z	iP	07:16:51.7	d
A	Z	iP	07:16:50.7	d
D	Z	eP	07:16:51.0	d
N	Z	eP	07:16:50.8	d
WP	Z	iP	07:16:50.8	d
U	Z	iP	07:16:50.8	d
Pa	Z	iP	07:16:58.3	c
Hi	Z	eP	07:16:50.0	d
Ha	Z	iP	07:16:50.0	d

C&GS card 19-63:
07:05:01.7
4.5° S., 81.5° W.

Mar. 5--Continued

C&GS card--Continued
Off coast of northern Peru
h about 31 km
Magnitude 5.6 (CGS).

Mar. 7

M	Z	iP	05:32:18.0	c
A	Z	eP	05:32:17.4	c
D	Z	eP	05:32:17.7	c
N	Z	eP	05:32:17.8	c
WP	Z	eP	05:32:17.8	c
U	Z	eP	05:32:18.0	c
Pa	Z	eP	05:32:14.8	c
Hi	Z	iP	05:32:18.1	c
U	PEZ	iP	05:32:19	d
		iSS	05:44:39	
		eR	05:50:05	
U	PEE	iS	05:40:41	
		iG	05:47:43	
M	Z	Tmax	06:38:56	
A	Z	Tmax	06:38:49	
D	Z	Tmax	06:38:55	
N	Z	Tmax	06:38:57	
WP	Z	Tmax	06:38:56	
U	Z	Tmax	06:38:57	
Pa	Z	Tmax	06:38:49	
Na	Z	Tmax	06:38:41	

C&GS card 18-63:
05:22:01.1
27.0° S., 113.5° W.
500 km west of Easter Island
h about 33 km
Magnitude 6.8 (Pas)
6.8 (Brk)
5.6 (CGS)
6.8 (HVO).

Mar. 7

U	PEZ	ePS	12:42:35
		eSS	12:47:51
		eR	13:00:55

C&GS card 20-63:
12:16:28.5
44.3° S., 75.3° W.

Mar. 7, 1963--Continued

C&GS card--Continued
Near coast of southern Chile
h about 45 km
Magnitude 5.6 (CGS).

Mar. 8

U	PEZ	eR	03:08:07

C&GS card 22-63:
02:44:31.5
19.2° S., 169.7° E.
New Hebrides Islands
h about 33 km
Magnitude 5.3 (CGS).

Mar. 8

U	PEZ	eR	03:48:27

C&GS card 22-63:
03:24:57.2
19.2° S., 169.6° E.
New Hebrides Islands
h about 49 km
Magnitude 4.8 (CGS).

Mar. 10

M	Z	Tmax	02:12:18
A	Z	Tmax	02:12:26
D	Z	Tmax	02:12:08
N	Z	Tmax	02:12:20
WP	Z	Tmax	02:12:18
U	Z	Tmax	02:12:23
Pa	Z	Tmax	02:11:56
Hi	Z	Tmax	02:11:40
Ka	Z	Tmax	02:12:35
Ha	Z	Tmax	02:10:50

C&GS card 20-63:
01:26:04.1
56.2° N., 153.8° W.
Kodiak Island, Alaska
h about 33 km
Magnitude 5.1 (CGS).

Mar. 10

M	Z	Tmax	12:50:12
A	Z	Tmax	12:50:02
D	Z	Tmax	12:50:07
N	Z	Tmax	12:50:06
Na	Z	Tmax	12:50:06

C&GS card 20-63:

Mar. 10--Continued

C&GS card 20-63:
10:51:48.1
29.9° S., 71.2° W.
Near coast of central Chile
h about 70 km
Magnitude 6.0-6.3 (Pas)
5.5 (CGS).

Mar. 10

M	Z	iP	14:03:01.9
A	Z	eP	14:03:01.7
N	Z	eP	14:03:01.4
WP	Z	eP	14:03:01.3
U	Z	iP	14:03:01.4

C&GS card 20-63:
13:51:04.3
2.4° N., 126.6° E.
Celebes Sea
h about 41 km.

Mar. 15

M	Z	iP	00:27:41.0	c
		iPcP	00:27:54.1	d
A	Z	iP	00:27:42.7	c
		iPcP	00:27:54.4	d
D	Z	iP	00:27:41.7	c
		ePcP	00:27:54.8	d
N	Z	eP	00:27:42.2	c
		iPcP	00:27:55.0	d
WP	Z	iP	00:27:42.0	c
		ePcP	00:27:53.9	d
U	PEZ	iP	00:27:42.3	c
U	PEZ	iPcP	00:27:53.2	d

C&GS card 21-63:
00:16:01.3
8.4° N., 126.4° E.
Mindanao, Philippine Islands
h about 117 km
Magnitude 5.0 CGS).

Table 5.--Distant earthquakes--Continued

Mar. 16, 1963

M	Z	iP	08:53:36.1	c
A	Z	iP	08:53:37.0	c
D	Z	iP	08:53:36.7	c
N	Z	iP	08:53:36.5	c
U	Z	eP	08:53:36.4	c
Pa	Z	eP	08:53:37.0	d
Na	Z	iP	08:53:38.2	d
Hi	Z	iP	08:53:36.0	d
Ka	Z	iP	08:53:34.1	c
Ha	Z	iP	08:53:26.7	c
U	PEZ	iP	08:53:37.2	c
U	PEZ	i	08:53:57	d
		i	08:54:13	c
		iPP	08:55:45	d
		iS	09:00:39	
		iSS	09:04:14	
		eR	09:07:51	
U	PEE	iG	09:05:13	
Ha	Z	Tmax	09:45:44	

C&GS card 21-63:
08:44:48.3
46.5° N., 154.7° E.
Kurile Islands region
h about 26 km
Magnitude 7.0 (Pas)
7.8 (Brk)
6.8 (Pal)
6.2 (CGS)
7.3 (HVO).

Mar. 20

M	Z	eP	04:50:37.6	d
A	Z	eP	04:50:36.2	d
D	Z	eP	04:50:36.5	d
N	Z	iP	04:50:37.2	d
Pa	Z	iP	04:50:38.7	c
Hi	Z	eP	04:50:39.4	d
Ka	Z	iP	04:50:39.6	c
Ha	Z	iP	04:50:42.2	c

C&GS card 24-63:
04:43:13.5
19.9° S., 179.1° W.
Fiji Islands region
h about 680 km
Magnitude 5.2 (CGS).

Mar. 20

M	Z	eP	04:53:12.0	d
D	Z	eP	04:53:10.9	d
N	Z	eP	04:53:11.6	d
WP	Z	iP	04:53:11.6	d
U	Z	eP	04:53:11.8	c
Pa	Z	iP	04:53:13.0	c
Na	Z	iP	04:53:09.5	c
Hi	Z	eP	04:53:14.8	c
Ka	Z	iP	04:53:14.9	c
Ha	Z	iP	04:53:17.5	c

C&GS card 24-63:
04:45:49.5
19.6° S., 179.3° W.
Fiji Islands region
h about 680 km
Magnitude 5.2 (CGS).

Mar. 20

M	Z	iP	16:49:57.1	d

C&GS card 23-63:
16:38:55.8
2.4° S., 138.4° E.
Western New Guinea
Magnitude 5.5 (CGS)
h about 40 km.

Mar. 24

M	Z	iP	02:20:03.5	c
A	Z	iP	02:20:03.0	c
D	Z	eP	02:20:02.4	c
Na	Z	iP	02:20:01.9	c
Ha	Z	iP	02:20:08.6	c
U	PEN	iL	02:43:22	

C&GS card 26-63:
02:07:12.8
9.7° S., 120.4° E.
Sumba Island region
Magnitude 6.3 (Pas)
6.0 (Pal)
5.4 (CGS)
h about 57 km.

Table 5.--Distant earthquakes--Continued

Mar. 24, 1963

M	Z	iP	09:55:10.7 c
A	Z	iP	09:55:11.2 c
D	Z	iP	09:55:10.3 c
Pa	Z	iP	09:55:12.8 c

C&GS card 25-63:
09:43:20.2
9.0° N., 125.6° E.
Mindanao region,
Philippine Islands
Magnitude 5.2 (CGS)
h about 51 km.

Mar. 24

M	Z	iP	21:42:38.1 d
A	Z	eP	21:42:39.8 d
D	Z	iP	21:42:40.5 d
N	Z	eP	21:42:39.7 d
WP	Z	eP	21:42:39.7 d
U	Z	eP	21:42:40.0 c
Pa	Z	iP	21:42:40.1 c
Ha	Z	eP	21:42:28.8 c
U	PEZ	eR	21:52:03
M	Z	Tmax	22:21:23
D	Z	Tmax	22:22:05
N	Z	Tmax	22:21:34
WP	Z	Tmax	22:21:24
U	Z	Tmax	22:21:34
Pa	Z	Tmax	22:21:32
Ha	Z	Tmax	22:19:37

C&GS card 24-63:
21:35:24.4
51.8° N., 178.1° W.
Andreanof Islands,
Aleutian Islands
h about 57 km
Magnitude 6.0 (Pas)
5.0 (Pal)
5.5 (CGS)
5.4 (HVO).

Mar. 26

M	Z	iP	09:57:39.4 d
A	Z	iP	09:57:38.0 d
D	Z	iP	09:57:37.2 c
N	Z	eP	09:57:37.7 d
WP	Z	eP	09:57:37.6 d
U	Z	eP	09:57:37.3 d

Mar. 26--Continued

Pa	Z	iP	09:57:40.8 c
Na	Z	eP	09:57:34.7 d
Hi	Z	eP	09:57:41.5 d
Ka	Z	eP	09:57:43.6 c
Ha	Z	eP	09:57:46.4 c
U	PEZ	iP	09:57:38 c
		iS	10:05:15
		iSS	10:08:51
	PEE	iG	10:09:49
		iR	10:12:23

C&GS card 26-63:
09:48:19.7
29.7° S., 177.8° W.
Kermadec Islands
h about 45 km
Magnitude 6.8-7.0 (Pas)
7.0 (Brk)
7.0 (Pal)
7.1 (HVO).

Mar. 26

M	Z	iP	13:34:24.2 d
A	Z	iP	13:34:22.9 d
D	Z	eP	13:34:22.6 d
N	Z	eP	13:34:23.2 d
WP		eP	13:34:23.2 d
U	Z	eP	13:34:22.8 c
Pa	Z	eP	13:34:24.9 d
Na	Z	eP	13:34:21.4 d
Hi	Z	eP	13:34:26.4 d
Ka	Z	eP	13:34:28.2 d
Ha	Z	eP	13:34:31.5 c
U	PEZ	iP	13:34:23
		iSS	13:45:33
		iR	13:49:23
U	PEN	iS	13:41:55

C&GS card 27-63:
13:25:02.6
29.8° S., 177.9° W.
Kermadec Islands
h about 42 km
Magnitude 7.3 (Pas)
6.5 (Pal)
5.9 (CGS)
6.4 (HVO).

Table 5.--Distant earthquakes--Continued

Mar. 26, 1963

M	Z	iP	19:56:56.2 c
A	Z	eP	19:56:57.0 c
D	Z	iP	19:56:56.4 c
N	Z	iP	19:56:56.7 c
WP	Z	iP	19:56:56.6 c
U	Z	iP	19:56:56.5 c
Pa	Z	eP	19:56:57.2 c
Na	Z	eP	19:56:57.3 c

C&GS card 25-63:
19:47:46.0
44.4° N., 146.7° E.
Kurile Islands
h about 110 km
Magnitude 5.6 (CGS)

Mar. 26

M	Z	iP	21:45:00.9 d
A	Z	iP	21:45:01.7 d
D	Z	iP	21:45:01.1 d
N	Z	iP	21:45:01.4 d
WP	Z	iP	21:45:01.4 d
U	Z	iP	21:45:01.2 d
Pa	Z	iP	21:45:03.1 d
Na	Z	iP	21:45:01.4 d
Hi	Z	eP	21:45:00.5 c
Ha	Z	iP	21:44:52.3 d
U	PEZ	iP	21:45:01
		iG	22:03:05
U	PEE	iS	21:53:55
U	PEN	eSSS	22:00:31

C&GS card 24-63:
21:34:41.1
36.0° N., 135.7° E.
Near east coast of Honshu, Japan
Magnitude 6.0-6.3 (Pal)
6.5 (Pas)
6.5 (Brk)
5.9 (CGS)
6.5 (HVO)

Mar. 28

U	PEE	iS	00:39:31
		iL	00:52:23
U	PEN	iPS	00:40:36

Mar. 28--Continued

U	PEZ	iSS	00:45:33
		iSSS	00:49:15
		iR	00:56:59

C&GS card 27-63:
00:15:47.5
66.3° N., 19.6° W.
Iceland
Magnitude 7.0-7.3 (Pas)
6.5 (Bks)
6.5-6.8 (Pal)
7.0 (HVO)
h about 15 km.

Mar. 28

M	Z	eP	11:21:52.9 c
A	Z	eP	11:21:52.5 c
WP	Z	eP	11:21:52.3 c
Hi	Z	eP	11:21:55.2 c

C&GS card 27-63:
11:12:31.3
30.2° S., 177.8° W.
Kermadec Islands
h about 38 km.

Mar. 30

M	Z	iP	02:02:21.9 c
A	Z	eP	02:02:21.6 c
D	Z	eP	02:02:20.5 c
N	Z	eP	02:02:21.6 c
WP	Z	eP	02:02:21.6 c
U	Z	iP	02:02:21.4 c
Na	Z	eP	02:02:18.5 c
Hi	Z	iP	02:02:24.1 d
Ka	Z	eP	02:02:24.8 c
Ha	Z	iP	02:02:25.1 c

C&GS card 29-63:
01:53:28.8
19.1° S., 169.1° E.
New Hebrides Islands
Magnitude 6.1 (CGS).
h about 160 km.

Mar. 30

M	Z	iP	17:01:11.4 d

Table 5.--Distant earthquakes--Continued

Mar. 30, 1963--Continued

D	Z	iP	17:01:11.7 d
N	Z	eP	17:01:11.7 d
WP	Z	eP	17:01:11.9 d
U	Z	eP	17:01:11.6 c
Pa	Z	iP	17:01:13.6 d
Na	Z	eP	17:01:12.5 d
Hi	Z	iP	17:01:11.2 d

C&GS card 27-63:
16:51:56.6
44.2° N., 148.0° E.
Kurile Islands
h about 33 km
Magnitude 5.3-5.5 (Pal)
6.3 (CGS)

Mar. 30

M	Z	Tmax	22:20:44
A	Z	Tmax	22:20:33
D	Z	Tmax	22:20:32
N	Z	Tmax	22:20:30
U	Z	Tmax	22:20:31
Pa	Z	Tmax	22:20:01
Na	Z	Tmax	22:20:29

C&GS card 28-63:
21:13:54.1
8.7° S., 109.2° W.
About 2,000 km southwest of Galapagos Islands
h about 33 km
Magnitude 4.6 (CGS).

Mar. 31

M	Z	iP	05:40:05.6 d
A	Z	eP	05:40:02.2 d
N	Z	eP	05:40:02.7 d
U	Z	eP	05:40:03.4 d
Pa	Z	eP	05:40:07.3 c
U	PEN	iS	05:47:36
U	PEZ	eR	05:54:44

C&GS card 27-63:
05:30:49.3
29.9° S., 177.7° W.
Kermadec Islands
h about 48 km.

Mar. 31--Continued

C&GS card--Continued
Magnitude 6.3-6.5 (Pas)
6.5 (Bks)
6.0-6.3 (Pal)
5.7 (CGS)
6.3 (HVO)

Mar. 31

D	Z	iP	07:18:13.7 d
U	PEN	iG	07:32:48
U	PEE	eR	07:35:32

C&GS card 27-63:
07:07:36.3
6.1° S., 149.0° E., New Britain
Magnitude 6.3 (Pas)
6.0 (Pal)
5.7 (CGS).

Mar. 31

M	Z	iP	19:32:13.9 d
A	Z	eP	19:32:12.9 d
D	Z	eP	19:32:12.2 d
N	Z	iP	19:32:13.4 d
WP	Z	iP	19:32:13.4 d
U	Z	iP	19:32:13.4 d
Hi	Z	eP	19:32:14.9 d

C&GS card 27-63:
19:22:53.3
30.0° S., 178.0° W.
Kermadec Islands
h about 50 km
Magnitude 6.3-6.5 (Pas)
6.5 (Bks)
5.8 (CGS).

Table 6.--U.S. Geological Survey seismograph stations in Hawaii

Station	Symbol	Location		Altitude (M) above sea level	Equipment (Z, vertical; N, north-south; E, east-west)
		Latitude N.	Longitude W.		
Uwekahuna (Hawaiian Volcano Observatory).	U	19°25.4'	155°17.6'	1,240	Long-period Press-Ewing: N, E, Z. (Seismometer and galvanometer periods are 15 and 90 seconds, respectively.) Short-period Sprengnether: E, Z. HVO-1: Z[1]. Short-base liquid-level tiltmeter. April 9, 1963 to May 27, 1963 a Wood-Anderson (NS) replaced Sp-Z on an experimental, temporary basis. Operated by John Forbes, Akira Yamamoto and other HVO staff members.
Mauna Loa----------	M	19°29.8'	155°23.3'	2,010	Remote recording HVO-2: Z[2].
Ahua----------	A	19°22.4'	155°15.9'	1,070	Remote recording HVO-2: Z.
Desert----------	D	19°20.2'	155°23.3'	815	Do.
North Pit----------	N	19°24.9'	155°17.0'	1,115	Do.
West Pit----------	WP	19°24.7'	155°17.5'	1,110	Do. Installed October 31, 1962.
Whitney Vault--------	W	19°25.9'	155°15.7'	1,210	Bosch-Omori: N, E. (Seismometer period 9 seconds.) Discontinued February 1, 1963.

Table 6.--U.S. Geological Survey seismograph stations in Hawaii--Continued

Station	Symbol	Location		Altitude (M) above sea level	Equipment (Z, vertical; N, north-south; E, east-west)
		Latitude N.	Longitude W.		
Hilo----------	Hi	19°43.2'	155°05.3'	20	HVO-1: Z Wood-Anderson: N, E. Operated by Sister Thecla at St. Joseph's School.
Naalehu----------	Na	19°03.8'	155°35.2'	205	HVO-1: Z. Operated by Rev. H. Hanson till September 1, 1962, when new operator, Rev. D. Thompson, took over duties at Naalehu School. HVO-1, buried July 17, 1962.
Pahoa----------	Pa	19°29.7'	154°56.8'	205	HVO-1: Z. Operated by Mr. Kongo Kimura at Pahoa School.
Kamuela----------	Ka	20°01.9'	155°42.0'	740	HVO-1: Z. Operated by Mr. Edward Van Gorder, Preparatory Academy, Kamuela.
Konawaena----------	Ko	19°30.8'	155°55.1'	495	Not operated in 1963.
Haleakala, Maui----	Ha	20°46.0'	156°15.0'	2,090	HVO-1: Z. Wood-Anderson: N, E. Operated by the staff of Hawaii National Park at Haleakala, Maui.

See footnotes at end of table, p. 35.

Table 6.--U.S. Geological Survey seismograph stations in Hawaii--Continued

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1/ HVO-1 is a moving-coil, hinged, vertical-component seismograph with seismometer and galvanometer periods of 0.5 second. Over-damping of both seismometer and galvanometer is used to control the strong galvanometer reaction. This seismograph has a peak magnification of about 20,000 at a period of 0.25 second. Recording is optical, on photographic paper.

2/ HVO-2 is a moving-coil, vertical-component seismograph with a seismometer period of 0.8 second. Its signal is transmitted over telephone wires to the Hawaiian Volcano Observatory, where it is recorded on smoked paper. The response of this seismograph is similar to that of HVO-1. Records from these seismographs at the M, A, and D stations are recorded on a 3-component drum to permit an accurate comparison of arrival times at these stations.

The following persons or agencies reported "felt" earthquakes during the first quarter, 1963. Their assistance is gratefully acknowledged.

North Hawaii

Honokaa School
Mrs. Hunter
Mr. Van Gorder
Mrs. Lindsey
Miss Tulley
Mrs. Thwine
Mrs. Richards, Jr.
Mrs. Christensen
Mrs. Walker
Hawaii Preparatory Academy
Mr. McCabe
Mrs. Weight
Mrs. Eklund
Miss Wallace
Mr. Stewart

Kilauea summit region

Mrs. Loucks
Keakelani School
Mrs. Hansen
National Park Headquarters
Volcano House Hotel
Mrs. Mist
Mr. Koyanagi
Shipman Ranch (Keaau)
Mrs. Wentworth
Mrs. Duncan
Kilauea Military Camp
Miss English
Mrs. Fraser
Mrs. Yamamoto

Kona coast

Mr. Johnson, Jr.
Mr. Sutherland
Miss Greenwell
Mr. Paris
Mrs. Mitchell
Mr. S. Greenwell
Mrs. Rice
Mr. Sleightholm
Mr. Yeoman
Mrs. Higashihara
Mrs. Cherry
Mrs. Miyatake
Mrs. Hayashi
Mrs. Yamasaki
Mrs. Korenaga

Puna

Mr. Edwards
Mr. Hay
Miss Takemoto
Mrs. Isbell
Mr. Warner
Mrs. Walker

Hilo region

Mr. Sadamoto
Mr. McMurray
Mr. Pierce
Miss Perriera
Mrs. Schaeffer
Mrs. Duncan
Mr. Elliot
Mrs. Ingledue
Mr. Okamura
Mr. Warner
Mrs. Baldwin
Mr. Ho
Mr. Onuma
Mrs. Veriato
Mrs. Breyton

Kau region

Mr. Godfrey
Mrs. Schattauer
Mrs. Billings
Mrs. Yamamoto
Kau Police Dept.
Mr. Manierre
Mr. Edwards

Central Hawaii

Kulani Honor Camp
Lt. Carvalho
Mr. Kamiko
Puu Anahulu School

Maui Island

Mrs. Boyum
Mr. Griffiths
Mr. Ching
Dr. Leekrick
Ulupalakua Ranch
Hana-Maui Hotel
Haleakala National Park
Mr. Hupp
Mrs. Lindsay
Kahului Airport

Oahu Island

Mr. Johnson

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

HAWAIIAN VOLCANO OBSERVATORY

SUMMARY 30

April, May, and June 1963

By

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Issued March 1965

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Chronological summary

Slight inflation of Kilauea volcano during early April was indicated by northwestward tilting at Uwekahuna. Very heavy rainfall (26 inches in one week) was followed by moderate but persistent southward tilting between April 17-30. Part of the apparent collapse may have been caused by cooling and shrinking of near-surface lava storage, but most of it is best attributed to rainfall-induced deformation in the immediate vicinity of Uwekahuna Vault.

April was not an unusual month seismically: shallow caldera quakes were slightly more numerous but activity elsewhere was similar to that during March (table 3). Three earthquakes were felt in Hawaii during the month (table 4).

Strong northward tilting at Uwekahuna characterized the first 8 days of May. Except for slightly increased activity along the Kaoiki fault, including a magnitude 3.4 "felt" earthquake on March 4, the statistics of shallow and deep seismic activity continued unchanged from April.

At 21^h50^m on May 9, an episode of unusual seismic activity consisting of frequent earthquakes in a background of continuous harmonic tremor began. Early in this crisis, which lasted 4 days, about a dozen earthquakes were felt lightly in the Kilauea summit region. Only two of these could be identified individually (table 4). Otherwise, earthquakes were not felt, although they occurred at rates as high as five per minute. The appearance of harmonic tremor on instruments of the Kilauea summit network suggested that lava was moving at a shallow depth beneath the summit region. Earthquakes that could be read through the tremor background originated along the Koae fault system in the vicinity of Puu Koae on Kilauea's southwest flank (fig. 2). Fresh cracks up to 2 feet in width were eventually found in this region in a zone several miles long. The cracks were all tensional. The tilt diagram for March 18 to May 12 (fig 2) very clearly shows tumescence of an elongate zone along the southwest rift zone. Movement of lava into this region from the summit reservoir is believed to have caused the seismic activity and extensive cracking.

While the southwest rift zone was swelling and cracking, a remarkable collapse of the Kilauea summit region was recorded by the short-base tiltmeter at Uwekahuna. Although the summit collapse is shown in a gross manner (7-day averages) in table 1, a more detailed record of this event is provided by the unaveraged tilt coordinates at Uwekahuna Vault derived from a stepped-up reading schedule during the collapse (table A). On May 12 summit collapse ceased and rapid reinflation began, as indicated by rapid northwestward tilting at Uwekahuna. A remarkably similar episode of summit collapse accompanied by earthquakes and ground cracking south of the caldera occurred in December 1950 (Volcano Letter 510).

The frequency of earthquakes in and near Kilauea caldera decreased sharply after the May 9-12 crisis. Three additional earthquakes were felt on Hawaii during the rest of the month.

During June, seismic activity in the vicinity of Kilauea caldera and along the upper part of Kilauea's east rift zone increased slightly. Tilting at Uwekahuna declined about the end of May and showed little change during June.

Four earthquakes were felt on Hawaii during June. The largest was of magnitude 4.2 and occurred beneath the south flank of Mauna Loa on June 6.

Note on instrumentation.--Early in April an HVO-2 seismometer was installed at Makaopuhi Crater. Its signal is transmitted over a telephone line to the Observatory, where recording of data from the new station (MP) was begun on April 18.

Table A.--Tilt coordinates and cumulative changes at Uwekahuna Vault during the May 9-12 summit collapse

Date	Time	Tilt coordinates and cumulative changes			
		N-S	S(N-S) urad	E-W	S(E-W) urad
May 8	08^h30^m	505	0	482	0
9	08^h30^m	505	0	482	0
10	00^h15^m	509	+4	494	+12
10	03^h15^m	503	-2	499	+17
10	06^h30^m	496	-9	505	+23
10	08^h30^m	493	-12	506	+24
10	11^h30^m	494	-11	505	+23
10	14^h30^m	493	-12	508	+26
10	18^h30^m	490	-15	508	+26
11	08^h00^m	491	-14	505	+23
12	09^h30^m	484	-21	510	+28
12	12^h30^m	489	-16	508	+26
13	08^h30^m	486	-19	510	+28

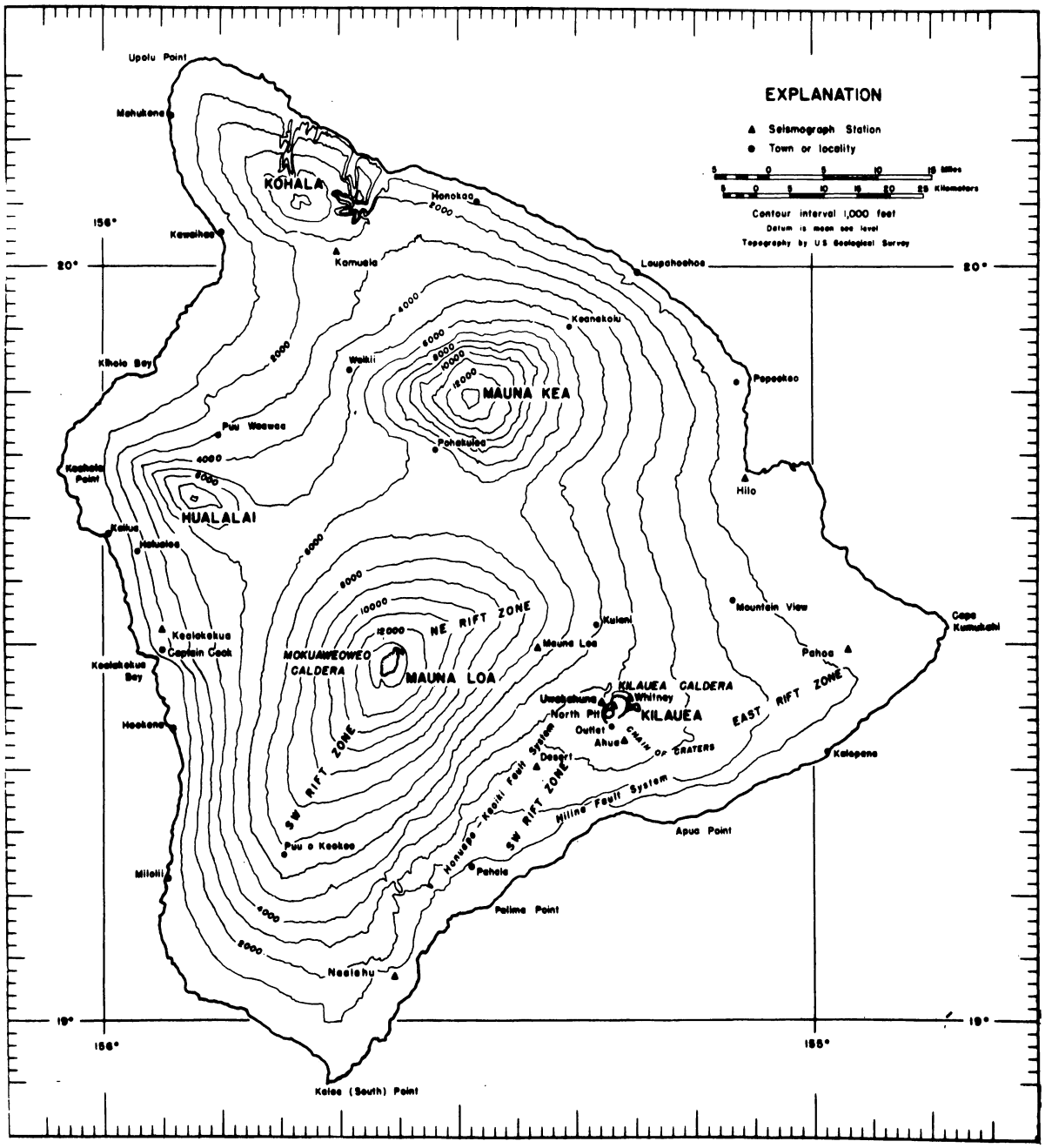

Figure 1.--Map of the island of Hawaii showing seismograph stations operated by the Geological Survey and localities mentioned in the text. Epicenters of earthquakes are given in terms of geographic coordinates, which are indicated at the edges of the map.

Tilting of the ground around Kilauea caldera.--Tilting of the ground around the summit of Kilauea is monitored daily by a short-base water-tube tiltmeter in Uwekahuna Vault, and at irregular intervals it is measured on a regional scale by means of a network of field tilt-bases and a portable water-tube tiltmeter. The attitude of the ground surface at each tilt base is reported in terms of north-south and east-west tilt coordinates. Both coordinates at each station were arbitrarily set equal to 500 when measurements at that station were begun. Increasing tilt coordinates correspond to northward and eastward tilting of the earth's surface; i.e., to a relative subsidence toward the north and east. A one-unit change in coordinate corresponds to a tilting of 1 microradian (1 mm per km) in the direction indicated.

Table 1.--Tilt coordinates at Uwekahuna Vault, April, May, and June 1963

Date	N-S	E-W	Date	N-S	E-W
April 7	495	482	June 2	504	496
14	496	481	9	507	494
21	490	483	16	507	493
28	491	483	23	507	493
May 5	501	483	30	505	497
12	491	504			
19	494	502			
26	501	497			

Table 2.--Tilt coordinates and changes at bases around Kilauea caldera (see fig. 2)

Tilt Base (location)	Date (1963)	Tilt coordinates		Rate (10^{-6} rad/mo) and direction of tilting since last reading		Date of last reading (1963)
		N-S	E-W			
Uwekahuna (19°25.5' N., 155°17.4' W.)	May 10	471.6	494.6	8.0	East	March 20
Tree Molds (19°26.3' N., 155°17.3' W.)	14	453.6	512.4	2.8	N. 15.9° E.	19
Sand Spit (19°24.1' N., 155°16.8' W.)	14	829.9	709.9	4.2	S. 15.4° E.	21
Kalihipaa (19°21.4' N., 155°15.3' W.)	11	559.5	451.0	13.8	S. 68.5° E.	18
Keamoku (19°25.1' N., 155°19.0' W.)	10	519.1	564.1	15.9	N. 28.9° W.	18
Ahua Kamokukolau (19°22.7' N., 155°16.6' W.)	10	607.9	583.2	26.0	N. 79.0° E.	19
Kipuka Nene (19°19.4' N., 155°16.7' W.)	13	497.9	507.7	7.4	S. 51.1° E.	15
Hilina Pali (19°18.2' N., 155°18.6' W.)	13	501.4	501.9	4.7	S. 28.8° E.	13
Kapapala Ranch (19°20.5' N., 155°23.8' W.	11	497.8	503.1	1.0	N. 78° W.	14

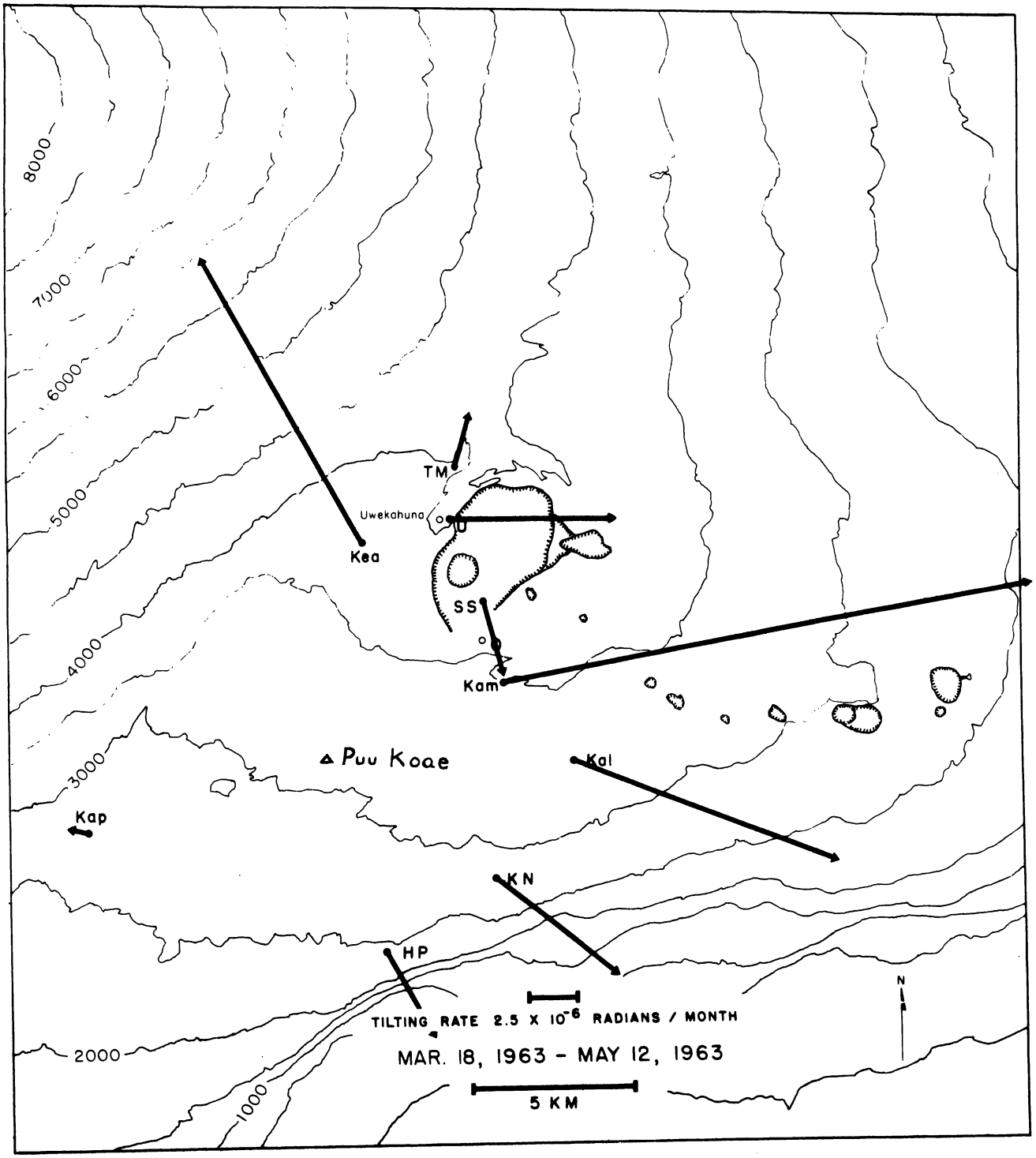

Figure 2.--Tilting of the ground around Kilauea caldera, March 18 to May 12, 1963. The vector depicting tilting at a given tilt-base points in the direction of maximum relative subsidence and has a length proportional to the rate of tilting during the measurement interval. Closed circles represent field tilt-bases; open circles, short-base water-tube tiltmeters.

Seismic summary.--Events recorded by the U.S. Geological Survey seismograph network in Hawaii fall into two categories: local earthquakes and tremor originating in the region of the Hawaiian Islands, usually within 100 km of at least one seismograph, and distant earthquakes originating more than 3,000 km from Hawaii. As an index of seismic activity at Hawaiian volcanoes, daily counts of earthquakes and minutes of tremor recorded by seismographs in Hawaii are listed in table 3. The earthquakes are separated into groups on the basis of region of origin as determined by analysis of records obtained daily at the Observatory (U, M, A, D, N, MP). Earthquakes of magnitude 2.5 or greater are generally sufficiently well recorded to be located with greater precision; they are listed individually in table 4. Data on identifiable phases from distant earthquakes are listed in table 5.

Locations of the seismograph stations are shown on figure 1, and essential data on the stations were given in Summary 29.

Table 3.--Number of earthquakes and minutes of tremor recorded on seismographs U, M, A, D, N, and MP around Kilauea caldera

Tremor is separated into three categories: deep, intermediate, and shallow, on the basis of relative amplitudes on seismographs in the summit region. Unless otherwise stated, tremor is presumed to be associated with movement of magma within the central complex of Kilauea.

Earthquake categories are: Halemaumau rock slides, which are detected by the characteristic record they produce on the North Pit seismograph; shallow earthquakes in the Kilauea caldera region; shallow earthquakes along the SW. rift zone of Kilauea and the adjacent portion of the Kaoiki fault system; earthquakes along the eastern half of Kilauea's east rift zone (from the Pahoa seismograph); earthquakes from a source about 30 km beneath Halemaumau; earthquakes from the upper east rift zone and the adjacent fault systems of Kilauea's south flank, and earthquakes from other regions: Kona, Mauna Kea, etc. ?=Obscured by the swarm of earthquakes near Puu Koae.

Date (1963)	Tremor (in minutes)			Earthquakes						
	Deep	Inter-mediate	Shallow	Hale-maumau slides	Kilauea caldera	SW. rift and Kaoiki	Eastern East rift	Hale-maumau 30 km	Upper East rift	Others
April 1	3	8	------	2	170	11	------	4	13	----------
2	11	------	------	------	90	5	------	5	10	----------
3	34	------	------	------	90	13	------	4	2	----------
4	------	------	------	------	137	11	------	2	------	----------
5	------	------	------	------	150	15	------	3	------	----------
6	------	3	------	------	130	10	------	1	------	----------
7	------	------	------	2	160	13	------	3	6	----------
8	------	------	------	------	197	25	------	5	1	1 offshore Kona
9	------	------	6	------	195	10	1	------	5	----------
10	------	------	------	------	179	10	------	6	3	----------
11	------	------	------	------	196	18	------	2	6	1 Naalehu region
12	------	------	------	------	150	16	------	2	------	----------
13	32	------	2	1	115	5	------	2	2	2 Hilina Pali
14	------	------	------	------	102	27	------	4	6	1 offshore Kona
15	------	------	------	------	70	29	1	3	------	----------
16	------	------	6	2	100	12	------	2	------	----------

Table 3.--Number of earthquakes and minutes of tremor recorded on seismographs U, M, A, D, N, and MP around Kilauea caldera--Continued

Date (1963)	Tremor (in minutes)			Earthquakes						
	Deep	Inter-mediate	Shallow	Hale-maumau slides	Kilauea caldera	SW. rift and Kaoiki	Eastern East rift	Hale-maumau 30 km	Upper East rift	Others
Apr. 17	-----	------	5	------	100	7	------	2	9	----------
18	-----	------	-------	------	55	7	------	5	2	----------
19	-----	------	-------	1	90	9	------	6	-------	----------
20	5	------	-------	------	80	9	------	1	-------	----------
21	-----	------	-------	------	59	20	------	3	-------	----------
22	-----	------	-------	------	70	12	------	3	-------	----------
23	-----	------	-------	------	120	6	------	6	3	1 offshore Kona
24	-----	5	-------	------	110	5	------	3	10	----------
25	-----	------	-------	1	110	11	------	5	-------	----------
26	-----	------	-------	------	100	9	------	5	15	----------
27	18	------	-------	------	110	12	------	4	10	1 Kulani
28	-----	------	-------	------	130	20	3	------	6	1 Kona
29	-----	------	-------	------	113	5	------	1	-------	1 Pohakuloa
30	2	------	-------	------	120	12	------	7	2	1 Pohakuloa
May 1	-----	------	-------	------	100	16	------	2	-------	----------
2	-----	------	-------	------	95	12	------	4	2	----------
3	4	------	-------	------	120	7	------	4	-------	----------
4	-----	------	-------	------	160	27	------	9	1	1 offshore Puna 1 Pahala
5	-----	------	-------	------	130	16	------	2	2	----------
6	-----	------	-------	------	75	8	------	1	1	----------
7	-----	------	-------	------	80	20	------	1	-------	----------
8	-----	------	3	------	100	17	------	1	-------	----------
9	?	?	190	?	?	?	?	?	?	ca 600 } about 5 km SSW of Halemauma near Puu Koae.
10	?	?	1440	?	?	?	?	?	?	ca 2000
11	?	?	960	?	?	?	?	?	?	ca 400
12	?	?	-------	?	?	?	?	?	?	ca 250
13	-----	------	5	-------	69	?	------	3	------	ca 50

Table 3.--Number of earthquakes and minutes of tremor recorded on seismographs U, M, A, D, N, and MP around Kilauea caldera--Continued

Date (1963)	Tremor (in minutes)			Earthquakes						
	Deep	Inter-mediate	Shallow	Hale-maumau slides	Kilauea caldera	SW. rift and Kaoiki	Eastern East rift	Hale-maumau 30 km	Upper East rift	Others
May 14	----	45	------	------	43	12	------	4	-----	1 Kona
15	----	-----	------	------	40	6	------	3	1	----------
16	----	-----	------	------	36	15	------	3	2	1 Pohakuloa
17	----	-----	------	------	33	9	------	1	2	1 offshore Kona
18	----	-----	------	------	36	18	------	6	3	----------
19	12	-----	------	------	80	14	------	-----	3	2 Pahala 1 Kona
20	----	-----	------	------	70	25	------	1	1	1 Pahala
21	----	-----	------	------	45	7	------	2	3	1 Honokaa 1 offshore Kona
22	----	-----	------	------	25	10	------	5	1	1 Waikii
23	10	-----	------	------	16	8	------	2	-----	----------
24	15	-----	------	------	40	36	------	3	2	----------
25	----	-----	------	------	37	26	------	1	-----	----------
26	----	-----	5	------	42	16	1	4	2	----------
27	----	-----	------	------	61	12	------	2	3	1 offshore Hilina-Pali.
28	----	5	------	------	43	10	------	3	1	1 offshore Hilina-Pali.
29	----	-----	------	1	47	15	------	3	1	----------
30	----	-----	------	------	52	8	------	2	1	1 Kamuela
31	----	-----	------	------	30	20	------	5	------	----------
June 1	----	-----	------	------	37	16	1	11	3	1 Kona----------
2	----	-----	------	------	35	10	1	3	2	1 Kona
3	----	-----	------	------	29	8	------	-----	4	----------
4	----	-----	------	------	42	9	------	-----	3	1 Naalehu
5	----	-----	------	------	47	12	------	8	7	----------
6	----	-----	------	------	45	18	------	3	6	1 Naalehu

Table 3.--Number of earthquakes and minutes of tremor recorded on seismographs U, M, A, D, N, and MP around Kilauea caldera--Continued

Date (1963)	Tremor (in minutes)			Earthquakes						
	Deep	Inter-mediate	Shallow	Hale-maumau slides	Kilauea caldera	SW. rift and Kaoiki	Eastern East rift	Hale-maumau 30 km	Upper East rift	Others
June 7	----	10	-----	-----	60	12	------	9	5	----------
8	----	4	-----	-----	65	13	------	3	10	----------
9	----	------	-----	-----	65	10	1	3	10	1 Kona----------
10	----	------	-----	-----	75	21	1	3	15	----------
11	----	4	-----	-----	51	8	------	2	21	----------
12	3	2	-----	-----	65	15	------	12	20	1 Kona----------
13	----	------	-----	-----	68	18	------	8	27	----------
14	6	11	-----	-----	48	12	------	20	17	----------
15	6	------	-----	-----	66	15	3	2	18	----------
16	----	5	-----	-----	68	10	------	7	11	1 Kona----------
17	----	------	-----	-----	40	10	------	5	15	1 Kona----------
18	----	------	-----	-----	31	8	------	3	8	----------
19	43	------	-----	-----	42	3	------	1	18	----------
20	----	------	-----	-----	35	7	------	2	11	----------
21	----	------	-----	-----	34	8	------	6	9	1 Mauna Kea----------
22	----	------	-----	-----	43	8	------	8	7	----------
23	3	------	-----	-----	48	11	------	15	6	1 Maui----------
24	----	------	-----	-----	60	14	------	7	6	----------
25	----	------	-----	-----	46	9	------	6	9	----------
26	----	------	-----	-----	43	10	------	4	25	----------
27	----	------	-----	-----	26	3	------	2	2	----------
28	----	------	-----	-----	52	6	------	1	-----	1 Kamuela----------
										1 Molokai----------
29	----	------	-----	-----	87	8	------	3	45	1 Kona----------
30	10	------	-----	-----	77	8	------	3	21	1 Kamuela----------

Table 4.--Local earthquakes recorded by seismographs of the U.S. Geological Survey,

April, May, and June 1963

[Entries for a given quake are: date, origin time (Hawaiian Standard Time), magnitude, depth, epicenter, and felt reports. All earthquakes of magnitude 2.5 and larger, as well as many favorably located smaller ones, occurring on or near the island of Hawaii are included in the list.

In the following list, some origin times are followed only by "KM 30" and a statement of magnitude. These are all members of a continuing family of quakes noted also in other Summaries. The best mean focus for this group is beneath Halemaumau at a depth of 30 kilometers (19°24.1' N., 155°17.1' W.).

In Summary 29, a persistent earthquake sequence was codified by the initials KT which referred to a "poor" location along the Kalapana Trail. This designation is retained for the purposes of this Summary but will be discontinued in the future unless Kalapana Trail quakes resume. The approximate epicenter for these quakes is 19°20' N., and 155°05' W., and shallow depth is assumed.

In Summary 24, "Kaoiki" was introduced as a symbol for listing any of a family of quakes with mean focus 19°24' N., 155°25' W., h=3 to 8 km. This symbol is used in the following list]

Date (1963)	Time			Magnitude	Depth (km)	Epicenter			Felt Report
	h	m	s			Lat. N.	Long. W.	Description	
Apr. 2	09	12	06.0	3.1	-----	--------	---------	KT----------	----------
2	10	00	11.7	2.5	-----	--------	---------	KT----------	----------
2	15	37	14.2	2.8	-----	--------	---------	KM 30----------	----------
3	06	10	09.5	2.0	3	19°17.8'	155°12.7'	12 km southeast of Ahua seismometer.	----------
7	06	00	55.7	2.0	8	19°26.2'	155°25.0'	7 km south-southwest of Mauna Loa seismometer.	----------
7	07	38	39.8	2.1	3	19°27.9'	155°23.2'	2 km south of Mauna Loa seismometer.	----------
7	08	24	14.8	3.3	-----	--------	--------	Kaoiki----------	Felt in Hilo and Pahala.
7	23	04	47.7	2.2	10	19°21.1'	155°16.5'	5 km south-southwest of Ahua seismometer.	----------

Table 4.--Local earthquakes recorded by seismographs of the U.S. Geological Survey, April, May, and June 1963--Continued

Date (1963)	Time			Magnitude	Depth (km)	Epicenter			Felt Report
	h	m	s			Lat. N.	Long. W.	Description	
Apr. 8	09	02	51.5	3.2	8	19°26.5'	155°27.4'	10 km southwest of Mauna Loa seismometer.	----------
8	19	58	21.3	3.7	13	19°13'	156°27'	60 km southwest of Kealakekua.	----------
10	21	28	13.2	2.2	-----	--------	---------	KM 30----------	----------
11	07	11	30.9	2.0	-----	--------	---------	KM 30----------	----------
11	07	31	23.5	2.5	8	19°11.7'	155°39.8'	16 km north-northwest of Naalehu.	----------
11	13	01	40.5	2.7	-----	--------	---------	Kaoiki----------	----------
11	22	01	19.8	2.0	15	19°19.3'	155°12.1'	9 km southeast of Ahua seismometer.	----------
12	00	19	06.0	2.6	25	19°23.7'	155°20.4'	6 km southwest of Uwekahuna seismometer.	----------
13	19	19	02.9	2.5	5	19°14.3'	155°14.6'	6 km west-southwest of Apua Point.	----------
13	19	20	11.5	2.2	3	19°15.3'	155°13.3'	3 km west-southwest of Apua Point.	----------
13	22	52	16.0	3.2	-----	--------	---------	Kaoiki----------	----------
14	05	22	18.8	3.3	13	19°29'	156°17'	37 km west of Kealakekua	----------
17	17	23	40.1	2.3	-----	--------	---------	KM 30----------	----------
18	07	12	40.6	2.0	10	19°20.1'	155°16.1'	4 km south of Ahua seismometer.	----------
19	07	19	14.7	2.2	10	19°19.5'	155°16.1'	5 km south of Ahua seismometer.	----------
19	17	24	10.8	2.1	35	19°21.4'	155°10.5'	2 km south of Makaopuhi seismometer.	----------
20	03	12	29.2	2.0	-----	--------	---------	KM 30----------	----------
22	04	01	29.2	3.2	-----	--------	---------	KM 30----------	Felt in Kilauea summit area.

Table 4.--Local earthquakes recorded by seismographs of the U.S. Geological Survey, April, May, and June 1963--Continued

Date (1963)	Time			Magnitude	Depth (km)	Epicenter			Felt Report
	h	m	s			Lat. N.	Long. W.	Description	
Apr. 23	03	44	35.6	3.0	13	19°41'	156°17'	25 km WSW of Keahole Point	----------
25	07	18	33.3	2.9	8	19°21.8'	155°14.9'	2 km SE of Ahua seismometer	----------
26	23	46	33.2	2.3	----	--------	---------	KM 30----------	----------
27	01	49	38.4	3.4	15	19°32.8'	155°14.8'	15 km NNE of Uwekahuna seismometer.	Felt-in-Kilauea summit area, Hilo, Glenwood, and Pahoa.
27	01	53	43.0	2.6	3	19°26.8'	155°41.3'	27 km ESE of Kealakekua	----------
28	20	20	46.9	2.0	< 3	19°21.2'	155°16.0'	3 km S of Ahua seismometer	----------
28	13	43	56.4	3.0	----	--------	---------	Kaoiki----------	----------
29	02	43	03.7	2.7	10	19°20.9'	155°24.2'	2 km NW of Desert seismometer.	----------
29	02	52	47.1	2.2	----	--------	---------	Kaoiki----------	----------
29	19	15	40.0	2.7	5	19°51.2'	155°30.2'	12 km NNW of Pohakuloa	----------
30	01	25	29.0	2.7	8	19°47.5'	155°35.8'	10 km ENE of Pohakuloa	----------
May 1	17	30	40.7	2.9	----	--------	---------	Kaoiki----------	----------
4	15	22	55.0	2.2	38	19°19.6'	155°05.5	43 km S of Hilo----------	----------
4	16	11	25.0	3.4	----	--------	---------	Kaoiki----------	Felt in Kilauea summit area, Hilo, Kapapala, Pahala, and Honaunau.
4	18	22	59.0	3.0	8	19°10.3'	155°30.6'	5 km SW of Pahala--------	----------
9	20	51	43.5	2.9	3	19°22.3'	155°17.4'	Koae fault system near Puu Koae.	Felt Volcano----
9	20	54	07.1	3.1	3	19°22.9'	155°19.0'	----do----------	Felt Volcano----
9	20	54	51.1	2.7	< 3	19°21.9'	155°18.9'	----do----------	----------
9	20	56	02.7	2.7	< 3	19°21.3'	155°19.1'	----do----------	----------
9	20	58	50.1	2.5	< 3	19°22.0'	155°19.5'	----do----------	----------
9	21	00	42.6	2.0	< 3	19°22.3'	155°18.4'	----do----------	----------

Table 4.--Local earthquakes recorded by seismographs of the U.S. Geological Survey, April, May, and June 1963--Continued

Date (1963)	Time			Magnitude	Depth (km)	Epicenter			Felt Report
	h	m	s			Lat. N.	Long. W.	Description	
May 9	21	02	17.0	2.8	< 3	19°20.5'	155°19.8'	Koae fault system near Puu Koae	----------
9	21	04	38.3	2.5	< 3	19°20.5'	155°19.8'	----do----------	----------
9	21	08	06.1	2.3	< 3	19°22.3'	155°18.6'	----do----------	----------
9	21	38	01.6	2.4	< 3	19°21.1'	155°19.2'	----do----------	----------
9	22	48	37.4	2.3	< 3	19°22.0'	155°20.2'	----do----------	----------
9	22	56	13.6	2.4	< 3	19°20.6'	155°18.2'	----do----------	----------
10	00	16	50.2	2.4	< 3	19°22.5'	155°16.8'	----do----------	----------
10	00	42	42.0	2.1	< 3	19°21.2'	155°17.8'	----do----------	----------
10	03	59	24.7	2.1	< 3	19°20.9'	155°19.3'	----do----------	----------
10	04	05	43.1	2.0	< 3	19°22.0'	155°19.1'	----do----------	----------
10	04	31	11.9	2.2	< 3	19°21.1'	155°19.3'	----do----------	----------
10	04	57	00.9	2.5	< 3	19°20.5'	155°16.0'	----do----------	----------
10	05	22	13.7	2.0	< 3	19°21.5'	155°18.9'	----do----------	----------
10	07	01	17.9	2.1	< 3	19°21.5'	155°19.0'	----do----------	----------
10	07	28	29.3	2.5	< 3	19°21.6'	155°18.9'	----do----------	----------
10	08	12	54.4	2.3	< 3	19°19.8'	155°21.2'	----do----------	----------
10	09	05	04.9	2.3	< 3	19°20.7'	155°19.1'	----do----------	----------
10	09	30	55.3	2.4	< 3	19°20.9'	155°18.4'	----do----------	----------
10	14	14	36.1	2.5	< 3	19°20.6'	155°19.6'	----do----------	----------
10	14	20	30.9	2.2	< 3	19°21.8'	155°18.6'	----do----------	----------
10	19	10	41.0	2.9	10	19°16.5'	155°14.6'	5 km WNW of Apua Point---------	----------
11	06	15	42.1	2.1	< 3	19°22.2'	155°19.0'	Koae fault system near Puu Koae	----------
12	09	01	07.7	2.2	< 3	19°20.3'	155°19.2'	----do----------	----------
14	06	48	27.0	2.6	8	19°31.2'	155°55.0'	1 km N of Kealakekua----------	----------
14	09	31	45.8	2.0	8	19°23.9'	155°17.2'	3 km SSE of Uwekahuna seismometer.	----------
14	16	20	19.2	2.7	-----	--------	---------	KM 30----------	----------
16	08	37	21.2	2.1	8	19°19.0'	155°15.0'	6 km SSE of Ahua seismometer---	----------
16	15	24	42.3	2.1	8	19°21.2'	155°17.2'	3 km SW of Ahua seismometer ---	----------

Table 4.--Local earthquakes recorded by seismographs of the U.S. Geological Survey, April, May, and June 1963--Continued

Date (1963)	Time			Magnitude	Depth (km)	Epicenter			Felt Report
	h	m	s			Lat. N.	Long. W.	Description	
May 16	21	22	41.5	2.1	5	19°46.5'	155°36.6'	10 km WNW of Pohakuloa	----------
17	01	31	19.0	2.8	8	19°36'	156°26'	57 km WNW of Kealakekua	----------
17	09	19	07.0	2.5	20	19°23.5'	155°17.5'	3 km NW of Ahua seismometer	----------
17	04	54	16.9	2.2	25	19°12.3'	155°32.2'	4 km west of Pahala	----------
19	01	54	59.4	3.4	5	19°12.4'	155°21.3'	14 km east of Pahala	----------
19	02	21	25.5	3.9	8	19°14.7'	155°31.1'	6 km NW of Pahala	Felt in Kilauea summit area, Hilo, Pahala, and Waiohinu.
19	03	01	37.7	2.2	----	--------	--------	Kaoiki	----------
19	17	20	08.6	3.3	----	--------	--------	Kaoiki	----------
19	19	37	36.2	2.0	----	--------	--------	Kaoiki	----------
19	19	56	10.1	2.9	----	--------	--------	Kaoiki	----------
19	22	06	23.9	2.4	8	19°41'	156°08'	10 km SW of Keahole Point	----------
20	03	09	52.1	2.2	----	--------	--------	Kaoiki	----------
20	04	11	16.0	2.8	8	19°14.3'	155°31.6'	7 km NW of Pahala	Felt in Pahala
20	10	31	27.3	3.1	----	--------	--------	Kaoiki	----------
20	10	31	54.6	3.9	----	--------	--------	Kaoiki	----------
20	10	39	28.7	2.1	----	--------	--------	Kaoiki	----------
20	12	15	01.0	2.8	----	--------	--------	Kaoiki	----------
21	06	19	26.4	2.4	3	19°17.2'	155°06.1'	12 km SE of Makacpuhi seismometer.	----------
21	09	25	59.2	2.0	----	--------	--------	Kaoiki	----------
21	14	26	55.3	2.6	8	19°54.2'	155°29.0'	18 km S of Honokaa	----------
21	19	27	09.7	2.3	3	19°08.0'	155°16.8'	16 km SE of Desert seismometer.	----------
21	20	15	19.1	2.5	13	19°39'	156°27'	42 km WSW of Keahole Point	----------
22	06	07	57.7	2.8	45	19°16.9'	155°01.5'	25 km SW of Pahoa	----------
22	23	01	20.5	2.6	3	19°52.8'	155°40.6'	3 km NW of Waikii	----------
23	10	34	32.5	2.5	5	19°14.2'	155°22.1'	12 km SSE of Desert seismometer.	----------

Table 4.--Local earthquakes recorded by seismographs of the U.S. Geological Survey, April, May, and June 1963--Continued

Date (1963)	Time			Magnitude	Depth (km)	Epicenter			Felt Report
	h	m	s			Lat. N.	Long. W.	Description	
May 25	01	49	00.2	2.8	----	--------	---------	Kaoiki----------	----------
25	04	32	56.0	2.4	10	19°17.1'	155°13.1'	10 km SW of Makaopuhi seismometer.	----------
27	02	23	09.8	2.6	----	--------	---------	Kaoiki----------	----------
27	16	19	52.5	2.6	13	18°56.2'	155°14.9'	50 km S of Ahua seismometer	----------
28	09	52	05.0	2.1	3	19°15.6'	155°18.1'	18 km S of Uwekahuna seismometer.	----------
28	23	56	53.2	2.2	13	18°56.9'	155°16.0'	48 km S of Ahua seismometer	----------
30	18	54	47.1	2.2	10	19°31.0'	155°03.4'	23 km SSE of Hilo----------	----------
30	19	55	04.8	2.3	----	--------	---------	KM 30----------	----------
30	23	32	14.5	2.9	8	19°58.5'	155°37.8'	10 km SE of Kamuela--------	----------
31	00	09	40.2	3.3	8	19°26.5'	155°26.5'	9 km SW of Mauna Loa seismometer.	Felt in Kilauea summit area and Pahala.
31	22	19	05.7	2.0	8	19°21.8'	155°14.9'	3 km SE of Ahua seismometer	----------
June 1	02	45	04.8	2.7	3	19°33.6'	155°55.7'	5 km N of Kealakekua-------	Felt in Kealakekua.
1	12	07	12.2	2.3	----	--------	--------	KM 30----------	----------
2	01	30	44.5	2.4	3	19°37.6'	156°03.4'	20 km NW of Kealakekua-----	----------
3	03	53	48.6	3.0	----	--------	--------	Kaoiki----------	----------
3	09	18	49.8	2.3	6	19°23.8'	155°17.3'	4 km SSE of Uwekahuna seismometer.	----------
4	07	28	42.4	2.7	8	19°13.9'	155°38.1'	20 km NNW of Naalehu-------	----------
4	19	59	20.7	2.3	10	19°18.3'	155°14.1'	9 km SSE of Ahua seismometer.	----------
6	09	01	23.3	2.4	----	--------	---------	Kaoiki----------	----------
6	19	19	40.8	2.8	----	--------	---------	Kaoiki----------	Felt on north rim of Kilauea caldera.
6	22	25	38.8	4.2	3	19°11.9'	155°33.1'	15 km NNE of Naalehu-------	Felt in Hilo, Pahala, Naalehu Waiohinu, and

Table 4.--Local earthquakes recorded by seismographs of the U.S. Geological Survey, April, May, and June 1963--Continued

Date (1963)	Time			Magnitude	Depth (km)	Epicenter			Felt Report
	h	m	s			Lat. N.	Long. W.	Description	
June 7	12	52	25.6	2.4	15	19°23.4'	155°59.5'	13 km SW of Pahoa	----------
7	22	04	05.7	2.2	40	19°18.8'	155°08.4'	7 km SW of Makaopuhi seismometer.	----------
8	03	49	06.1	2.9	----	--------	--------	Kaciki	----------
9	05	03	28.7	2.6	< 3	19°25.3'	155°45.5'	15 km ENE of Hookena	----------
10	20	49	51.8	2.4	8	19°22.8'	155°15.1'	1 km NE of Ahua seismometer	----------
10	21	00	15.5	2.6	8	19°22.6'	155°14.5'	3 km ENE of Ahua seismometer.	----------
12	03	50	01.7	2.2	8	19°20.1'	155°09.0'	4 km SE of Makaopuhi seismometer.	----------
12	07	58	32.0	2.4	<3	19°28.7'	155°46.8'	15 km ESE of Kealakekua	----------
12	11	49	56.6	2.0	8	19°20.4'	155°08.3'	5 km SE of Makaopuhi seismometer.	----------
13	07	28	15.7	2.4	----	--------	--------	KM 30	----------
13	07	32	50.3	2.4	----	--------	--------	KM 30	----------
14	11	17	57.0	3.7	30	19°26.2'	155°16.7'	2 km NE of Uwekahuna seismometer.	Felt in Kilauea summit area, Kulani, and north Kona.
14	11	43	57.8	2.4	25	19°26.1'	155°17.3'	1 km NE of Uwekahuna seismometer.	----------
14	11	45	37.0	2.3	25	19°26.1'	155°17.1'	1 km NE of Uwekahuna seismometer.	----------
14	12	46	38.4	2.4	25	19°25.9'	155°16.4'	2 km NE of Uwekahuna seismometer.	----------
16	06	31	35.6	2.2	3	19°20.5'	155°49.3'	10 km SE of Hookena	----------
17	04	14	35.2	2.4	< 3	19°34.2'	155°53.3'	7 km NNE of Kealakekua	----------
17	04	36	19.0	2.4	13	19°21.7'	155°06.2'	9 km E of Makaopuhi seismometer.	----------
17	14	48	42.9	2.0	5	19°18.6'	155°14.4'	8 km SSE of Ahua seismometer.	----------

Table 4.--Local earthquakes recorded by seismographs of the U.S. Geological Survey, April, May, and June 1963--Continued

Date (1963)	Time			Magnitude	Depth (km)	Epicenter			Felt Report
	h	m	s			Lat. N.	Long. W.	Description	
June 17	22	42	42.9	2.7	5	19°22.0'	155°14.8'	3 km SE of Ahua seismometer	----------
20	21	30	16.4	2.6	----	-------	---------	KM 30----------	----------
21	17	54	33.9	2.6	3	19°50.7'	155°22.1'	8 km SW of Keanakolu-------	----------
23	03	35	11.6	3.2	13	20°48'	155°58'	30 km ENE of Haleakala seismometer.	----------
24	04	39	25.3	2.1	-----	--------	---------	KM 30----------	----------
24	08	36	33.8	2.3	-----	--------	---------	KM 30----------	----------
24	13	20	42.8	2.2	-----	--------	---------	KM 30----------	----------
26	11	42	05.3	2.2	40	19°15.8'	155°08.8'	12 km SSE of Makaopuhi seismometer.	----------
28	00	13	04.3	2.8	40	19°13.1'	155°06.8'	19 km SSE of Makaopuhi seismometer.	----------
28	03	56	30.3	2.3	3	19°53.2'	155°44.8'	16 km SSE of Kamuela	----------
28	22	50	50.1	3.4	13	21°20'	157°05'	19 km NW of Kalaupapa, Molokai.	----------
29	05	14	47.7	2.5	3	19°24.3'	155°52.5'	5 km NE of Hookena	----------
29	18	43	26.5	2.1	8	19°22.0'	155°14.7'	3 km SE of Ahua seismometer.	----------
30	04	59	59.6	2.1	10	19°22.0'	155°15.0'	3 km SE of Ahua seismometer.	----------
30	11	13	22.7	3.1	8	19°51.2'	155°42.1'	20 km S of Kamuela	----------

Table 5.--Distant earthquakes

[Times are reported in Greenwich Civil Time which is 10 hours faster than Hawaiian Standard Time. A "c" following the time of P indicates compressional first motion; a "d" indicates dilatational first motion. Station symbols, locations, and instrumentation were presented in summary 29. Magnitudes calculated from the Hawaii seismograms are followed by (HVO). Location of epicenters, origin times, focal depths, and magnitudes reported by other institutions are taken from "Preliminary Determination of Epicenters" published by the U.S. Coast and Geodetic Survey]

April 2, 1963

M	Z	iP	16:25:43.5 d
A	Z	iP	44.5 d
U	Z	iP	43.8 d
Ha	Z	iP	31.1 c
Ka	Z	iP	35.8 d
Hi	Z	iP	42.7 d
Na	Z	iP	46.7 c

C&GS card 25-63:
16:18:55.6
53.2° N., 171.7° W.
Andreanof Islands, Aleutian Islands
h about 142 km
Magnitude 6.25-6.5 (Pas)
5.5 (Brk)
5.7 (CGS).

April 3

U	PEZ	eR	15:23:49
Pa	Z	Tmax	16:32:32

C&GS card 35-63:
14:47:55.5
55.4° S., 128.2° W.
South Pacific Ocean
h about 33 km
Magnitude 5.8 (CGS).

April 6

M	Z	iP	07:10:24.9 d
A	Z	iP	24.3 d
D	Z	eP	23.2 d
U	Z	iP	24.7 d
Pa	Z	iP	25.3 c
Hi	Z	iP	26.7 c
Ka	Z	iP	27.2 c
Ha	Z	iP	29.5 d

April 6--Continued

C&GS card 30-63:
07:03:06.5
17.5° S., 178.9° W.
Fiji Islands region
h about 526 km
Magnitude 5.1 (CGS).

April 6

M	Z	iP	11:27:28.7 d
A	Z	iP	29.0 d
D	Z	iP	29.3 d
U	Z	eP	28.5 c

C&GS card 27-63:
11:19:23.3
63.4° N., 149.5° W.
Central Alaska
h about 39 km
Magnitude 5.5 (CGS).

April 9

M	Z	iP	02:09:43.3 d
A	Z	eP	42.8 d
U	Z	iP	43.0 d
Na	Z	iP	39.0 c
Pa	Z	eP	43.3 c
Hi	Z	iP	44.1 c
Ha	Z	iP	47.8 c

C&GS card 30-63:
02:02:25.1
17.7° S., 178.7° W.
Fiji Islands region
h about 538 km
Magnitude 4.9 (CGS).

April 10, 1963

M	Z	iP	08:02:57.6 c
A	Z	iP	57.4 d
D	Z	eP	56.1 c
U	Z	iP	57.3 d
Na	Z	eP	55.4 c
Ha	Z	iP	08:03:00.6 c

C&GS card 31-63:
07:50:30.2
9.2° S., 125.0° E.
Timor
h about 33 km
Magnitude 5.2 (CGS).

April 13

M	Z	eP	02:33:04.3 d
A	Z	iP	03.7 d
A	Z	ipP	33.9 c
D	Z	eP	03.9 d
U	Z	eP	03.8 d
U	Z	epP	33.9 c
Na	Z	eP	04.6 d
Pa	Z	eP	02.1 d
Hi	Z	iP	03.2 d
Ka	Z	eP	05.9 d
Ha	Z	iP	10.8 c
U	PEZ	iP	04 d
U	PEZ	ipP	36 c
U	PEZ	iPS	02:44:26
U	PEN	iS	02:43:08
		iSS	02:48:40
		iG	02:54:54

C&GS card 31-63:
02:20:57.5
6.2° S., 76.5° W.
Central Peru
h about 125 km
Magnitude 6.75-7 (Pas),
6.3 (CGS).

April 13

M	Z	iP	14:42:43.0 d
A	Z	iP	43.2 d
D	Z	eP	42.1 d
U	Z	eP	42.9 d
Na	Z	iP	40.8 d
Pa	Z	eP	45.0 d

April 13--Continued

Hi	Z	iP	45.0 d

C&GS card 30-63:
14:31:21.0
3.4° S., 135.4° E.
Near north coast of New Guinea
h about 31 km
Magnitude 5.6 (CGS).

April 16

M	Z	eP	01:41:19.5 d
A	Z	iP	18.7 d
D	Z	iP	18.0 d
U	Z	iP	19.4 c
Pa	Z	eP	20.6 d
Ha	Z	eP	23.4 d
U	PEZ	iP	19 d
U	PEZ	iSS	01:56:15
U	PEZ	iR	02:04:51
U	PEE	iS	01:51:17
U	PEE	iPPS	01:52:00
U	PEN	iSSS	01:59:24
		iG	02:01:21

C&GS card 31-63:
01:29:19.4
0.8° S., 128.0° E.
Halmahera region
h about 33 km
Magnitude 7 (Pas), 6.1 (CGS),
7.5 (HVO).

April 16

M	Z	iP	01:48:55.2 c
A	Z	iP	54.6 c
D	Z	iP	53.5 c
Pa	Z	eP	56.1 d
Ha	Z	eP	59.1 c
U	PEZ	iS	01:59:01
U	PEZ	iR	02:12:29
U	PEN	iSS	02:04:17

C&GS card 31-63:
01:36:59.4
1.2° S., 128.4° E.
Halmahera region
h about 33 km
Magnitude 6.3 (CGS), 7.5 (HVO).

April 16, 1963

A	Z	iP	02:07:13.9 c
D	Z	eP	12.6 c
U	Z	iP	14.3 c
Ha	Z	eP	18.0 c
U	PEE	iSS	02:22:01
U	PEN	iSSS	02:25:28
U	PEN	iG	02:27:11
U	PEZ	iR	02:31:04

C&GS card 31-63:
01:55:10.9
0.7° S., 128.0° E.
Halmahera region
h about 32 km
Magnitude 6.0 (CGS),
7.25 (HVO).

April 16

M	Z	iP	02:17:51.0 c
A	Z	eP	50.3 c
D	Z	eP	49.3 c
U	Z	eP	51.1 c

C&GS card 31-63:
02:05:42
1.3° S., 126.9° E.
Halmahera region
Magnitude 5.8 (CGS).

April 17

Pa	Z	iP	02:19:58.0 d
A	Z	iP	57.0 d
N	Z	iP	57.5 d
U	PEZ	iS	02:26:43
U	PEZ	iR	02:32:53
U	PEN	iG	02:30:27

C&GS card 31-63:
02:11:26.1
19.6° S., 178.6° E.
Fiji Islands
h about 33 km
Magnitude 6.5-6.75 (Pas),
6.0 (Brk),
5.9 (CGS),
5.9 (HVO).

April 19

U	PEN	iS	07:59:22
U	PEN	iG	08:14:16
U	PEZ	iPS	08:00:53
U	PEZ	iSS	08:05:44
U	PEZ	iL	08:13:16
U	PEZ	iR	08:18:06

C&GS card 32-63:
07:35:23.7
35.8° N., 96.9° E.
Tsinghai Province, China
h about 33 km
Magnitude 7 (Pas), 6.75-7 (Brk),
6.1 (CGS), 7 (HVO).

April 24

M	Z	iP	21:50:23.7 c
A	Z	eP	23.1 c
N	Z	iP	23.2 c
MP	Z	iP	23.0 c
Ha	Z	iP	28.3 c

C&GS card 33-63:
21:42:49.0
20.8° S., 179.1° W.
Fiji Islands region
h about 603 km
Magnitude 5.1 (CGS).

April 25

M	Z	iP	08:24:14.1 d
A	Z	iP	14.3 d
D	Z	iP	13.6 d
MP	Z	iP	14.5 d
U	Z	iP	13.9 d
Ha	Z	iP	09.3 d

C&GS card 33-63:
08:12:57.2
4.7° N., 122.4° E.
Celebes Sea
h about 610 km
Magnitude 5.5 (CGS).

Table 5.--Distant earthquakes--Continued

April 25, 1963

M	Z	eP	16:47:52.4

C&GS card 34-63:
16:35:56.2
1.3° S., 128.7° E.
Halmahera region
h about 33 km.

April 29

Hi	Z	eP	21:51:43.0 d
U	PEN	iS	21:57:25
U	PEZ	iR	22:01:25
Ha	Z	Tmax	22:29:33

C&GS card 34-63:
21:44:17.1
51.4° N., 178.6° E.
Andreanof Islands,
Aleutian Islands
h about 60 km.

April 30

M	Z	iP	01:10:17.4 c
Hi	Z	eP	23.6 c
U	PEE	iS	01:20:41
U	PEN	iG	01:29:59
U	PEZ	iR	01:33:13

C&GS card 36-63:
00:58:18.3
0.7° S., 129.0° E.
Halmahera region
h about 33 km
Magnitude 6.75 (Pas),
6.5 (Pal), 5.6 (CGS),
7.0 (HVO).

May 1

M	Z	iP	10:12:15.8 d
A	Z	iP	15.7 d
D	Z	eP	14.6 d
MP	Z	eP	15.8 d
U	Z	eP	15.9 d
Na	Z	iP	13.1 c
Pa	Z	eP	17.2 c
Hi	Z	iP	18.0 d

May 1--Continued

Ka	Z	iP	19.0	d
Ha	Z	iP	20.3	c
U	PEZ	iP	16	c
U	PEZ	i ?	10:13:05	d
U	PEZ	isS	10:20:10	
U	PEE	iS	10:19:25	
U	PEN	i ?	10:20:29	
U	PEN	iG	10:24:06	

C&GS card 36-63:
10:03:20.0
19.0° S., 169.0° E.
New Hebrides Islands
h about 140 km
Felt.
Magnitude 7 (Pas), 6.75-7 (Brk),
6.2 (CGS).

May 4

M	Z	eP	06:02:58.7 d
A	Z	iP	06:03:01.0 d
U	Z	iP	59.2 d
Hi	Z	eP	57.9 c

C&GS card 35-63:
05:56:04.1
51.8° N., 175.4° W.
Andreanof Islands, Aleutian
Islands
h about 69 km
Magnitude 5.5 (CGS).

May 5

Na	Z	Tmax	17:14:18

C&GS card 37-63:
15:17:01.9
24.7° S., 69.5° W.
Northern Chile
Felt: Antafagasta
h about 50 km
Magnitude 5.1 (CGS).

May 8, 1963

M	Z	iP	08:57:48.6 c
M	Z	iPP	08:59:16.2 c
A	Z	iP	08:57:49.4 c
A	Z	ePP	08:59:17.5 c
D	Z	iP	08:57:50.4 c
D	Z	iPP	08:59:17.2 c
MP	Z	iP	08:57:49.7 c
MP	Z	ePP	08:59:17.8 d
U	Z	iP	08:57:49.1 c
U	Z	iPP	08:59:16.7 c
Hi	Z	iP	08:57:47.5 c
Hi	Z	iPP	08:59:13.8 c
Pa	Z	iP	08:57:49.0 c
Pa	Z	ePP	08:59:16.0 c
Ha	Z	iPP	08:58:56.0 d
M	Z	Tmax	09:35:41
A	Z	Tmax	33
D	Z	Tmax	28
MP	Z	Tmax	26
U	Z	Tmax	24
Pa	Z	Tmax	28
Ka	Z	Tmax	09:34:36
Ha	Z	Tmax	09:33:46

C&GS card 35-63:
08:50:56.0
54.9° N., 163.9° W.
Unimak Island,
Aleutian Islands region
h about 89 km
Magnitude 5.6 (CGS).

May 8

M	Z	eP	10:31:54.6 c
U	PEE	iS	10:40:00
U	PEE	iG	10:46:34
U	PEZ	eR	10:49:20

C&GS card 35-63:
10:22:11.2
36.6° N., 141.0° E.
Honshu, Japan
h about 53 km
Magnitude 6.1 (CGS).

May 8

M	Z	iP	15:35:55.4 d
A	Z	iP	55.5 d
N	Z	iP	55.6 d

C&GS card 40-63:
15:24:00.3
5.3° N., 125.7° E.
Off coast of Mindanao,
Philippine Islands
h about 70 km
Magnitude 5.6 (CGS).

May 12

A	Z	iP	20:15:53.5 d
D	Z	iP	53.7 d
MP	Z	iP	53.7 d
U	Z	iP	53.4 d
Ha	Z	iP	47.6 d
Hi	Z	iP	51.2 d
Na	Z	iP	57.1 c
U	PEZ	iP	54 d
U	PEZ	eS	20:21:43
U	PEZ	iR	20:25:52
Ha	Z	Tmax	20:53:44

C&GS card 37-63:
20:08:43.0
57.4° N., 153.9° W.
Kodiak Island, Alaska
h about 80 km
Magnitude 5.9 (CGS),
5.8 (HVO).

May 14

M	Z	iP	15:20:13.2 c
A	Z	eP	13.0 c
N	Z	eP	13.1 c
MP	Z	iP	13.5 c

C&GS card 42-63:
15:08:46.1
5.6° S., 127.8° E.
Banda Sea
h about 405 km
Magnitude 5.3 (CGS).

May 17, 1963

M	Z	iP	07:42:18.2 c
A	Z	iP	18.0 c
D	Z	eP	17.0 c
MP	Z	eP	17.6 c
U	Z	iP	18.1 c
Ka	Z	eP	20.8 c

C&GS card 40-63:
07:33:17.5
31.0° S., 179.8° W.
Kermadec Islands region
h about 358 km
Magnitude 4.7 (CGS).

May 17

M	Z	iP	22:48:46.3 c
A	Z	eP	45.7 c
D	Z	eP	44.8 c
U	Z	iP	45.9 c
Hi	Z	iP	47.3 c
Ka	Z	iP	48.8 c
Ha	Z	iP	51.8 c

C&GS card 41-63:
22:40:06.7
24.4° S., 177.2° W.
Tonga Islands region
h about 70 km
Magnitude 5.9 (CGS).

May 19

U	PEZ	ePP	01:20:37
U	PEZ	iSS	01:35:01
U	PEZ	iR	01:47:57
U	PEE	iPS	01:29:31
U	PEE	iPPS	01:30:07
U	PEN	iS	01:27:26
U	PEN	eL	01:42:29
U	PEN	eG	01:43:30
M	Z	Tmax	03:04:35
A	Z	Tmax	31
D	Z	Tmax	33
MP	Z	Tmax	26
U	Z	Tmax	34
Pa	Z	Tmax	15
Na	Z	Tmax	23
Hi	Z	Tmax	27

May 19--Continued

C&GS card 39-63:
01:03:04.1
46.5° S., 75.1° W.
Coast of southern Chile
h about 33 km
Magnitude 6.75 (Pas), 6.5 (CGS), 7 (HVO).

May 20

M	Z	iP	11:47:27.8 d
A	Z	iP	27.4 d
MP	Z	iP	27.3 d
U	Z	iP	27.5 d
Na	Z	eP	24.7 d
Pa	Z	iP	28.7 d
Hi	Z	eP	29.4 d
Ka	Z	iP	30.2 d
Ha	Z	iP	33.8 d
U	PEZ	iP	27.6 c
U	PEZ	iS	11:55:09
U	PEZ	iSS	11:58:48
U	PEZ	iR	12:02:41
U	PEE	iG	12:00:21

C&GS card 40-63:
11:38:00.9
30.7° S., 178.3° W.
Kermadec Islands region
h about 34 km
Magnitude 6.75-7 (Pas), 6.5 (Brk), 6.2 (CGS), 6.5 (HVO).

May 21

U	PEZ	eR	01:34:22

C&GS card 45-63:
00:58:07.4
56.0° S., 123.9° W.
South Pacific Ocean
h about 33 km.

May 21

U	PEZ	iS	17:46:48
U	PEZ	iR	17:53:22
U	PEN	iL	17:50:58

May 21--Continued

C&GS card 45-63:
17:30:15.4
11.1° S., 163.3° E.
Solomon Islands region
h about 33 km
Magnitude 5.75-6 (Pal),
5.4 (CGS).

May 22

M	Z	eP	14:05:31.6 c
A	Z	eP	32.8 c
MP	Z	eP	32.6 c
U	Z	eP	32.1 c
Ka	Z	eP	28.4 c
Hi	Z	iP	31.3 c
Na	Z	iP	35.3 c
U	PEE	iS	14:12:40
U	PEZ	iSS	14:16:04
U	PEZ	iR	14:18:56
Ha	Z	Tmax	14:56:51

C&GS card 39-63:
13:56:43.0
48.6° N., 154.7° E.
Kurile Islands region
h about 22 km
Magnitude 6.5 (Pas),
6 (Brk),
6.3 (CGS), 6.3 (HVO).

May 22

M	Z	eP	15:54:33.6 c
A	Z	eP	34.1 c
N	Z	iP	33.9 c
MP	Z	eP	34.3 c

C&GS card 42-63:
15:42:48.6
4.3° N., 127.9° E.
Molucca Passage
h about 58 km
Magnitude 5.0 (CGS).

May 22

M	Z	iP	16:32:15.1 c

May 22--Continued

C&GS card 39-63:
16:25:36.8
52.2° N., 165.3° W.
Fox Islands, Aleutian Islands
h about 33 km
Magnitude 4.2 (CGS).

May 22

M	Z	iP	22:06:09.3 c

C&GS card 41-63:
21:53:02.5
8.2° S., 115.7° E.
Java Sea
h about 33 km
Magnitude 5.6 (CGS).

May 23

M	Z	eP	01:03:40.7 d

C&GS card 42-63:
00:51:40.3
1.6° N., 126.4° E.
h about 33 km
Molucca Passage
Magnitude 4.8 (CGS).

May 23

M	Z	iP	03:40:30.6 c
MP	Z	eP	29.9 c
U	Z	eP	30.1 c
Na	Z	iP	27.9 d
Hi	Z	iP	31.6 d
Ka	Z	eP	32.1 d
Ha	Z	iP	35.3 d

C&GS card 40-63:
03:33:19.1
15.0° S., 176.7° W.
Fiji Islands region
h about 279 km
Magnitude 5.4 (CGS).

May 23

U	PEZ	iS	03:52:06
U	PEZ	iR	03:58:32

May 23, 1963--Continued

C&GS card 48-63:
03:35:34.7
10.9° S., 163.3° E.
Solomon Islands region
h about 33 km
Magnitude 5.5 (CGS).

May 23

M	Z	iP	15:23:53.7 c
A	Z	eP	54.0 c
MP	Z	iP	54.7 c
U	Z	eP	53.9 c

C&GS card 43-63:
15:12:05.7
6.0° N., 126.1° E.
Near east coast of Mindanao, Philippine Islands.
h about 88 km
Magnitude 5.5 (CGS).

May 26

M	Z	iP	23:15:38.4 c
A	Z	eP	40.1 c
N	Z	iP	39.0 c
Pa	Z	eP	40.0 c
U	PEZ	iR	23:29:15

C&GS card 41-63:
23:06:55.0
55.2° N., 159.9° E.
Near east coast of Kamchatka
h about 47 km
Magnitude 4.25 (Pal), 5.3 (CGS).

May 27

M	Z	iP	04:07:30.0 d
D	Z	iP	30.7 c
Pa	Z	eP	32.1 d
U	PEE	iG	04:19:17
U	PEZ	iR	04:21:07

C&GS card 42-63:
03:58:47.9
55.3° N., 160.1° E.

May 27--Continued

C&GS card--Continued
Near east coast of Kamchatka
h about 54 km
Magnitude 5.25 (Pal), 5.7 (CGS).

May 29

M	Z	Tmax	19:39:44
A	Z	Tmax	50
MP	Z	Tmax	25
Pa	Z	Tmax	20
Na	Z	Tmax	34

C&GS card 46-63:
18:27:19.1
22.6° S., 114.4° W.
Easter Island region
h about 33 km
Magnitude 4.7 (CGS).

May 29

M	Z	Tmax	19:42:57
A	Z	Tmax	52
D	Z	Tmax	51
MP	Z	Tmax	44

C&GS card 49-63:
18:30:25
24.4° S., 114.7° W.
Easter Island region
h about 33 km
Magnitude 4.5 (CGS).

May 30

U	PEZ	iR	07:37:56

C&GS card 46-63:
06:56:09.3
54.2° S., 143.7° E.
South of Australia
h about 33 km
Magnitude 5.25-5.5 (Pal).

June 2, 1963

U	PEZ	eR	22:05:29

C&GS card 46-63:
21:04:24.2
58.5° S., 15.6° W.
Sandwich Islands region
h about 50 km
Magnitude 6-6.25 (Pal),
5.9 (CGS).

June 3

M	Z	eP	07:45:56.6 c
U	PEZ	eR	08:03:01

C&GS card 44-63:
07:35:54.3
34.2° N., 138.7° E.
Honshu, Japan
h about 43 km
Magnitude 5.3 (CGS).

June 4

M	Z	iP	21:16:45.5 d
A	Z	eP	45.6 d
MP	Z	iP	45.8 d
U	Z	eP	45.7 c
Hi	Z	eP	46.3 c
U	PEN	eL	21:37:02
U	PEZ	eR	21:41:10

C&GS card 46-63:
21:04:42.3
1.2° S., 127.3° E.
Halmahera region
h about 31 km
Magnitude 5.2 (CGS).

June 6

M	Z	iP	05:30:56.9 d
A	Z	eP	56.0 d
D	Z	eP	56.1 d

C&GS card 46-63:
05:18:55.1
19.9° N., 120.2° E.
Off north coast of Luzon,
Philippine Islands.
h about 33 km

June 6--Continued

C&GS card--Continued
Magnitude 5.8 (CGS).

June 7

U	PEZ	iS	19:47:15
U	PEZ	eR	19:53:53

C&GS card 49-63:
19:30:35.6
8.5° N., 103.1° W.
Clipperton Island region
h about 33 km
Magnitude 5.5-5.75 (Brk),
5.25-5.5 (Pal),
4.9 (CGS).

June 7

U	PEE	iL	22:53:31

C&GS card 51-63:
22:37:30.0
15.3° S., 173.2° W.
Samoa Islands region
h about 33 km
Magnitude 5.0 (CGS).

June 10

M	Z	iP	04:29:34.4 d
A	Z	iP	32.4 d
D	Z	eP	32.3 c
U	Z	eP	33.2 d
U	PEE	eG	04:53:58
U	PEZ	iR	04:58:14

C&GS card 47-63:
04:16:37.7
55.4° S., 146.4° E.
800 km west of Macquarie Islands
h about 33 km
Magnitude 6.25 (Pas), 5.75-6 (Pal),
6.1 (CGS), 6.7 (HVO).

June 10, 1963

M	Z	iP	06:52:06.5 d
A	Z	iP	04.9 d
U	Z	eP	05.3 d
U	PEN	eSS	07:08:54
U	PEN	eG	07:16:32
U	PEZ	iR	07:20:21

C&GS card 48-63:
06:39:04.0
55.3° S., 146.1° E.
800 km west of Macquarie Islands
h about 18 km
Magnitude 6.25-6.5 (Pas),
6.25-6.5 (Pal),
6.0 (CGS),
6.6 (HVO).

June 16

M	Z	Tmax	10:05:34
A	Z	Tmax	10:06:02
D	Z	Tmax	10:05:58
MP	Z	Tmax	10:05:48
U	Z	Tmax	10:05:55
Pa	Z	Tmax	10:05:51
Hi	Z	Tmax	10:05:23
Ha	Z	Tmax	10:04:58

C&GS card 49-63:
09:19:54.8
50.8° N., 129.5° W.
Vancouver Island region
h about 33 km
Magnitude 4.4 (CGS).

June 17

M	Z	iP	18:40:05.7 c
D	Z	iP	06.8 c
MP	Z	eP	08.2 c
U	Z	eP	06.2 c
Hi	Z	eP	04.5 c
Ha	Z	iP	18:39:58.7 c
U	PEE	eL	18:49:57
U	PEZ	eR	18:51:53

C&GS card 49-63:
18:32:14.5
60.4° N., 140.8° W.

June 17--Continued

C&GS card--Continued

Southwestern Yukon
h about 33 km
Magnitude 5.25-5.5 (Pal)
5.1 (CGS).

June 19

M	Z	iP	09:20:53.9 d
A	Z	iP	55.3 d
U	Z	eP	54.2 d
U	PEZ	eR	09:44:06

C&GS card 49-63:
09:09:04.0
4.7° N., 126.5° E.
Talaud Islands region
h about 83 km
Magnitude 5.25-5.5 (Pal),
6.2 (CGS),
6.0 (HVO).

June 19

Ha	Z	iP	18:31:19.4 d
Na	Z	iP	15.4 c
Hi	Z	eP	17.4 d

C&GS card 49-63:
18:22:09.6
3.5° S., 153.4° E.
New Ireland region
Felt: Rabaul
Magnitude 5.1 (CGS).
h about 279 km.

June 24, 1963

M	Z	iP	04:34:12.0	d
A	Z	iP	13.5	d
D	Z	iP	13.8	d
MP	Z	eP	13.6	d
U	Z	iP	13.1	d
Pa	Z	eP	10.0	c
Na	Z	iP	16.8	c
Hi	Z	iP	11.1	c
Ha	Z	iP	01.6	d
U	PEZ	iP	13	d
U	PEZ	iPP	04:35:41	d
U	PEZ	iPPP	04:36:25	d
U	PEZ	iR	04:44:54	
U	PEE	iS	04:40:20	
U	PEE	iL	04:43:04	
Ha	Z	Tmax	05:12:41	

C&GS card 46-63:
04:26:37.9
59.5° N., 151.7° W.
Cook Inlet
h about 52 km
Magnitude 6.75 (Pas),
5.7 (CGS),
6.5 (HVO).

June 24

M	Z	Tmax	11:04:19
A	Z	Tmax	10
D	Z	Tmax	30
MP	Z	Tmax	17
U	Z	Tmax	12
Pa	Z	Tmax	12
Hi	Z	Tmax	11:03:53
Ha	Z	Tmax	11:03:23

C&GS card 52-63:
10:17:02.5
52.8° N., 131.9° W.
Queen Charlotte Islands region
h about 38 km
Magnitude 3.9 (CGS).

June 24

M	Z	iP	15:08:51.9	d
A	Z	iP	51.7	d
N	Z	iP	52.1	c
MP	Z	eP	51.0	c
Na	Z	iP	47.8	d
Hi	Z	iP	53.9	c
Ha	Z	iP	56.7	c

C&GS card 53-63:
15:01:44.2
15.5° S., 177.5° W.
Fiji Islands region
h about 412 km
Magnitude 5.0 (CGS).

June 24

M	Z	iP	16:24:08.4	d
M	Z	iPP	16:25:21.0	d
A	Z	eP	16:24:08.7	d
U	Z	ePP	22.7	d
U	PEZ	iS	16:29:39	
U	PEZ	iR	16:33:13	
Ha	Z	Tmax	16:59:36	

C&GS card 49-63:
16:17:15.4
52.3° N., 171.2° W.
Fox Islands region
Aleutian Islands
h about 33 km
Magnitude 5.4 (CGS), 5.5 (HVO).

June 25

Ha	Z	Tmax	09:06:41

C&GS card 52-63:
08:26:21.9
44.3° N., 129.1° W.
off coast of Oregon
h about 31 km
Magnitude 4.5 (CGS).

June 25, 1963

Ha	Z	Tmax	10:19:36

C&GS card 50-63:
09:39:28.4
44.3° N., 129.1° W.
off coast of Oregon
h about 32 km
Magnitude 4.5 (CGS).

June 26

A	Z	eP	17:54:03.2	c
D	Z	eP	02.2	c
U	Z	iP	03.7	d
Pa	Z	eP	05.9	d
U	PEN	iS	18:03:27	
U	PEN	iG	18:12:45	
U	PEZ	iR	18:15:39	

C&GS card 50-63:
17:42:40.6
7.1° N., 82.3° W.
near south coast of Panama
h about 20 km
Magnitude 6.25-6.5 (Pas),
5.5-5.75 (Pal),
6.0 (CGS), 6.2 (HVO).

June 27

U	PEZ	eR	07:28:08
Ha	Z	Tmax	07:59:00

C&GS card 50-63:
07:08:01.7
60.5° N., 140.7° W.
Yukon territory
h about 29 km
Magnitude 4.6 (CGS).

June 28

U	Z	eP	22:04:22.6	c
Pa	Z	iP	22.6	c
Hi	Z	iP	22.7	c
Ha	Z	eP	21.3	c
U	PEZ	iP	23	d
U	PEZ	iPPP	22:06:44	
U	PEZ	iSSS	22:17:56	
U	PEE	iS	22:11:44	
U	PEE	isSS	22:16:16	

June 28--Continued

C&GS card 50-63:
21:55:38.8
46.5° N., 153.2° E.
Kurile Islands region
h about 33 km
Magnitude 6.75 (Pas),
6.1 (CGS),
7.0 (HVO).

June 29

M	Z	iP	12:53:54.5	d
U	Z	eP	54.6	c
Pa	Z	iP	56.7	d

C&GS card 54-63:
12:43:47.5
11.6° N., 142.7° E.
Mariana Islands region
h about 30 km
Magnitude 5.2 (CGS).

The following persons or agencies reported "felt" earthquakes during the second quarter, 1963. Their assistance is gratefully acknowledged.

North Hawaii

Mrs. Eklund
Mrs. Lindsey
Puuanahulu School
Miss Wallace

Kilauea summit region

Mrs. Hansen
Mrs. Mist
Mrs. Wentworth
Mrs. Cuskelly
KMC residents
Mr. Ryall
Mrs. Yong
Mrs. Hirano
Miss English

Kona coast

Mr. B. Berman
Mr. Ladd

Puna

Mr. Edwards

Central Hawaii

Kulani Honor Camp

Hilo region

Mrs. Shoemaker
Mr. S. Ho
Mr. Baldwin
Miss Patten
Mrs. Carter

Kau region

Mr. Mizuba
Kau Police station
Kahuku Ranch
Lt. C. Araujo
Mr. Godfrey
Kapapala Ranch residents
Mrs. Billings
Mrs. Walters
Mr. Meinecke
Mrs. Schattauer

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

HAWAIIAN VOLCANO OBSERVATORY

SUMMARY 31

July, August, and September, 1963

By

Robert Y. Koyanagi, Arnold T. Okamura,

Willie T. Kinoshita, J. G. Moore, and Howard A. Powers

Issued December 1964

Observatory Staff

Geology

J. G. Moore (Scientist-in-charge)
D. L. Peck, geologist, arrived 7-5-63
C. K. Wentworth

Geophysics:

W. T. Kinoshita, geophysicist, arrived 6-17-63
G. Kojima
R. Y. Koyanagi
H. L. Krivoy
A. T. Okamura
A. S. Ryall
N. Sherrill

Geochemistry:

R. T. Okamura

Support:

E. T. Endo
J. G. Forbes
W. H. Francis
B. J. Loucks
A. Yamamoto

Visiting Japanese scientists

(Arrived 6-29-63 for 6 months' cooperative program)

T. Minakami (Group leader), D. Shimozuru, S. Aramaki, T. Miyazaki, C. Kurihara, and S. Hiraga

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U.S.-Japan cooperative study of Kilauea Volcano

For 6 months, beginning in the summer of 1963, a team of Japanese scientists lived and worked at Kilauea Volcano in close cooperation with the staff of the Volcano Observatory. This study was part of a program of scientific cooperation between the United States and Japan; the program originated in talks between President Kennedy and Prime Minister Ikeda in June 1961. The United States' participation is financed by the National Science Foundation and Japan's participation by the Japanese Ministry of Education.

The main group of Japanese scientists which arrived in Hawaii June 29, included Takeshi Minakami, Professor of Geophysics, University of Tokyo, leader; Daisuke Shimozuru, Assistant Professor of Geophysics, University of Kyushu; and Shigeo Aramaki, Assistant in Geology, University of Tokyo. Kosuke Kamo, Geophysicist, University of Kyoto, joined the team later. Several technicians accompanied the group.

The principal program of the Japanese scientists was the monitoring of seismic activity in the Kilauea summit area. To do this, a net of about 16 short-period seismometers (mainly vertical instruments) was placed in and near Kilauea caldera in the summit region of the volcano (fig. A). The instruments telerecorded at the Observatory. Six instruments recorded continuously on smoked paper drums and the others recorded a few hours per day (or longer during periods of exceptional activity) on photographic paper.

While the team was in Hawaii, seismic recordings were made of several noteworthy events: earthquakes and tremors associated with the eruptions of August and October; the collapses of July and August; several other large earthquakes and earthquake swarms; and explosions set off as part of the Geological Survey's program of refraction seismology.

The Observatory staff joined with the Japanese team in an offshore investigation of the south flank of Kilauea Volcano. The Kagoshima Maru, a 1,000-ton fisheries research vessel from Kagoshima University, which was on a training voyage in Hawaiian waters, was utilized in a 4-day echo-sounding program in August. The ship made about 400 km of depth-profiling traverses over a submarine part of Kilauea Volcano directly south of the summit region. Observatory members sailed on the ship and aided in the operation of the echo-sounder, and members of the Japanese team joined the Observatory staff in fixing the position of the ship from three transit stations on land.

The first data-gathering stage of the U.S.-Japan cooperative program was completed in early 1964 when the Japanese team left Hawaii. The second stage--analysis of the data--will continue for 2 years. Results will be compared and data integrated at future meetings, terminating in the fall of 1965.

J. G. M.

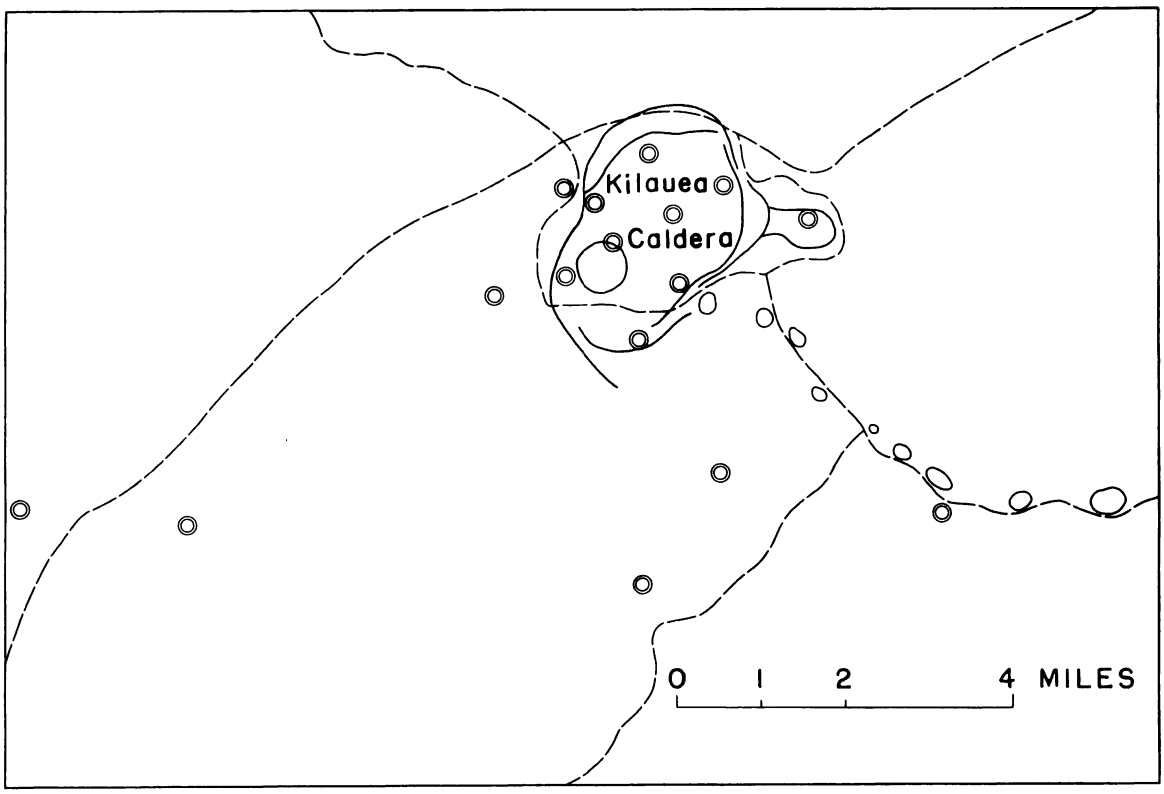

Figure A.--Map of the Kilauea caldera region at the summit of Kilauea Volcano. Locations of seismometers operated by visiting Japanese team are shown by double circles.

Chronological summary

The month preceding the opening of this quarter was exceedingly quiet in terms of any kind of seismic activity, and no clear trend of tilting was indicated by the short-base tiltmeter. However, during this quarter there were two episodes of summit collapse, two swarms of Kaoiki quakes, and two surface eruptions of lava (if we include the first week of October in the period of generalization).

A sharp spasm of seismic activity that began at 9:50 p.m. July 1, 1963, included a great many felt earthquakes, a countless swarm of small quakes, and probably intermittent tremor. Rapid collapse tilting began at Uwekahuna shortly before midnight, and at about the same time cracks opened and pavement buckled in the road at Devil's Throat (fig. B). This structural crisis was over by July 5 and no lava had appeared at the surface. However, the Kilauea summit showed about the same amount of tilt collapse as it had shown during the December 1962 eruption along the upper Puna rift. Also upward swelling in part of this rift, as determined by precise leveling of the bench marks along the Chain of Craters road, was as much as 3 feet in the center of the disturbed zone. From these observations it is inferred that strong structural disturbance along the Puna rift and its junction with the Koae fault system permitted the movement of perhaps 10 million cubic yards of magma from under the summit region into the Puna rift system.

During the rest of July, tilting at Uwekahuna was moderately strong westerly, a direction associated with tumescence, but there was no noteworthy seismic activity.

On August 3, shallow tremor began at 9:25 p.m. and continued, accompanied by a swarm of shallow earthquakes centered near Aloi that began 15 minutes later. The quakes were felt only feebly in the Kilauea summit area 6 miles northwest, but their intensity caused concern at Ainahou Ranch 2 miles south of Aloi. The seismic crisis lasted only about 2 hours, but several new cracks intersected the Chain of Craters road, and leveling revealed surface subsidence of a 2-mile section of the road, greatest (.4 ft) in the zone of cracking. A swarm of 30-km-deep quakes under the Kilauea summit followed the surface crisis by a few hours (fig. C).

There was comparative inactivity, both seismically and tiltwise, until August 21. On that day lava appeared, at about 6:00 p.m., from fissures across the floor and up the northeast wall of Alae Crater. The eruption lasted about 38 hours and formed a lake in the crater bottom containing almost a million cubic yards of tholeiitic basalt. Careful study of this lava lake was started immediately for the purpose of observing all aspects of the cooling history of the lava.

On August 26 at 8:49 a.m., an earthquake of magnitude 4.9 took place in the Kaoiki fault zone. The shock was felt strongly throughout the island of Hawaii. Aftershocks numbered about 50 per day for several weeks to follow. Two of the earliest of these were felt in the Kilauea summit area: one of magnitude 3.1 at 09:48, August 26, and one of magnitude 3.3 at 21:35, August 26.

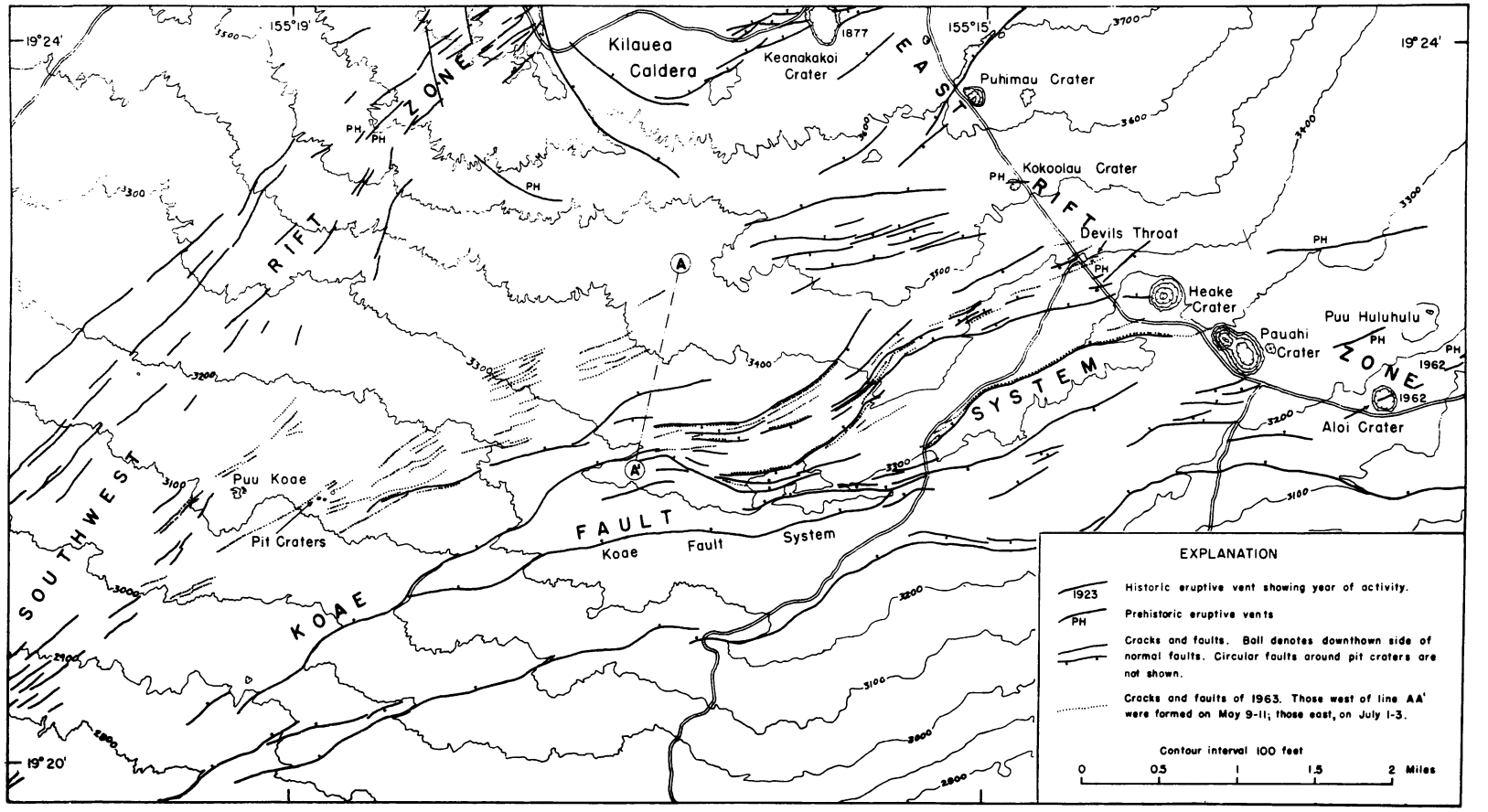

Figure B.--1963 faults and cracks along the Koae fault system on Kilauea's south flank mapped by James G. Moore (see also Summary 30).

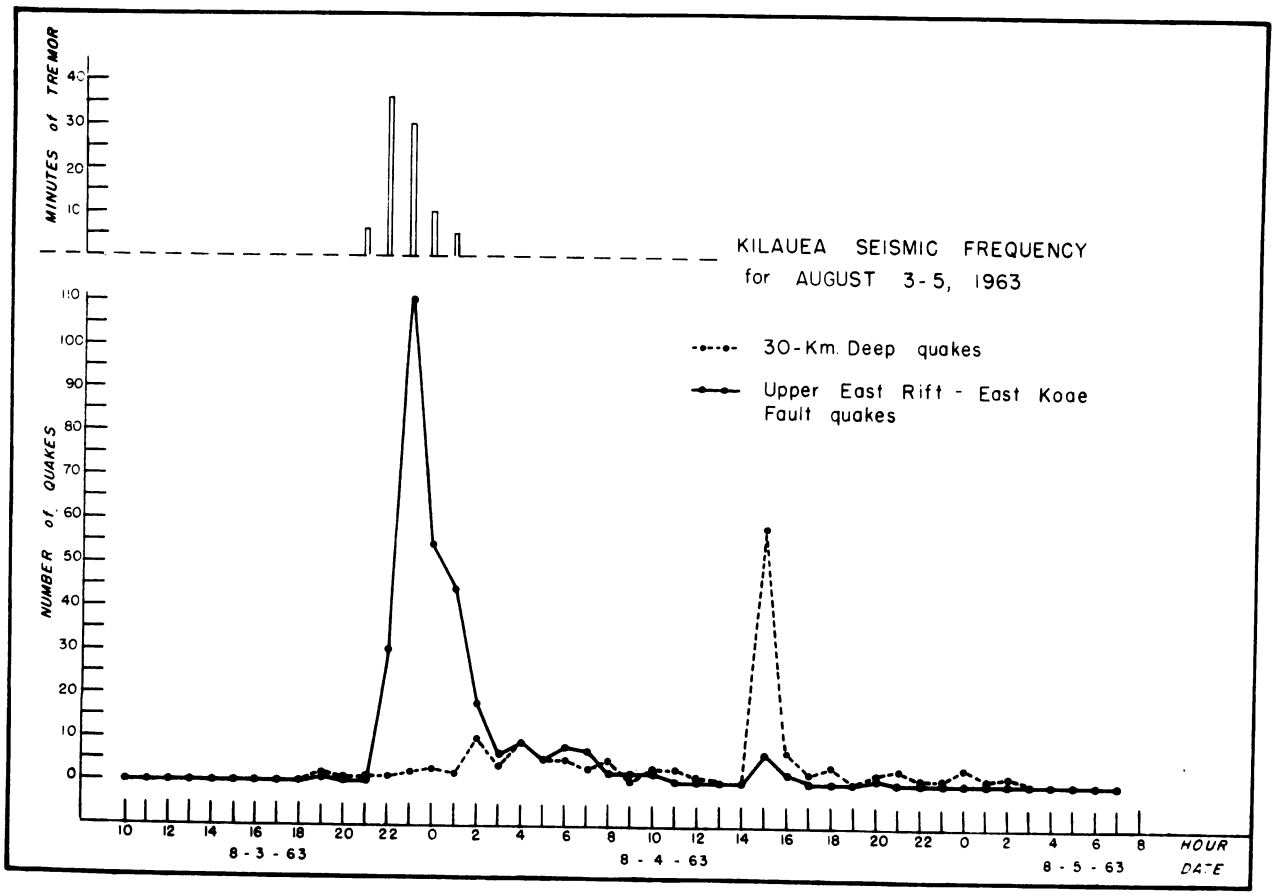

Figure C.--Hourly frequency plot of Kilauea seismic events during August 3-5, 1963.

A second swarm of Kaoiki quakes was initiated by an earthquake of magnitude 4.8 that took place at 6:24 a.m. on September 21. This quake also was felt throughout the island. Two of the many aftershocks were felt throughout the southern half of the island: one of magnitude 3.5 at 06:26, Sept. 22, and a second of the same magnitude one minute later at 06:27.

Large numbers of small quakes centered under Kilauea summit accompanied the numerous aftershocks from the Kaoiki fault zone until the end of the quarter, in fact until the beginning of a flank eruption at Napau Crater on October 4, which will be reported in the next quarterly summary.

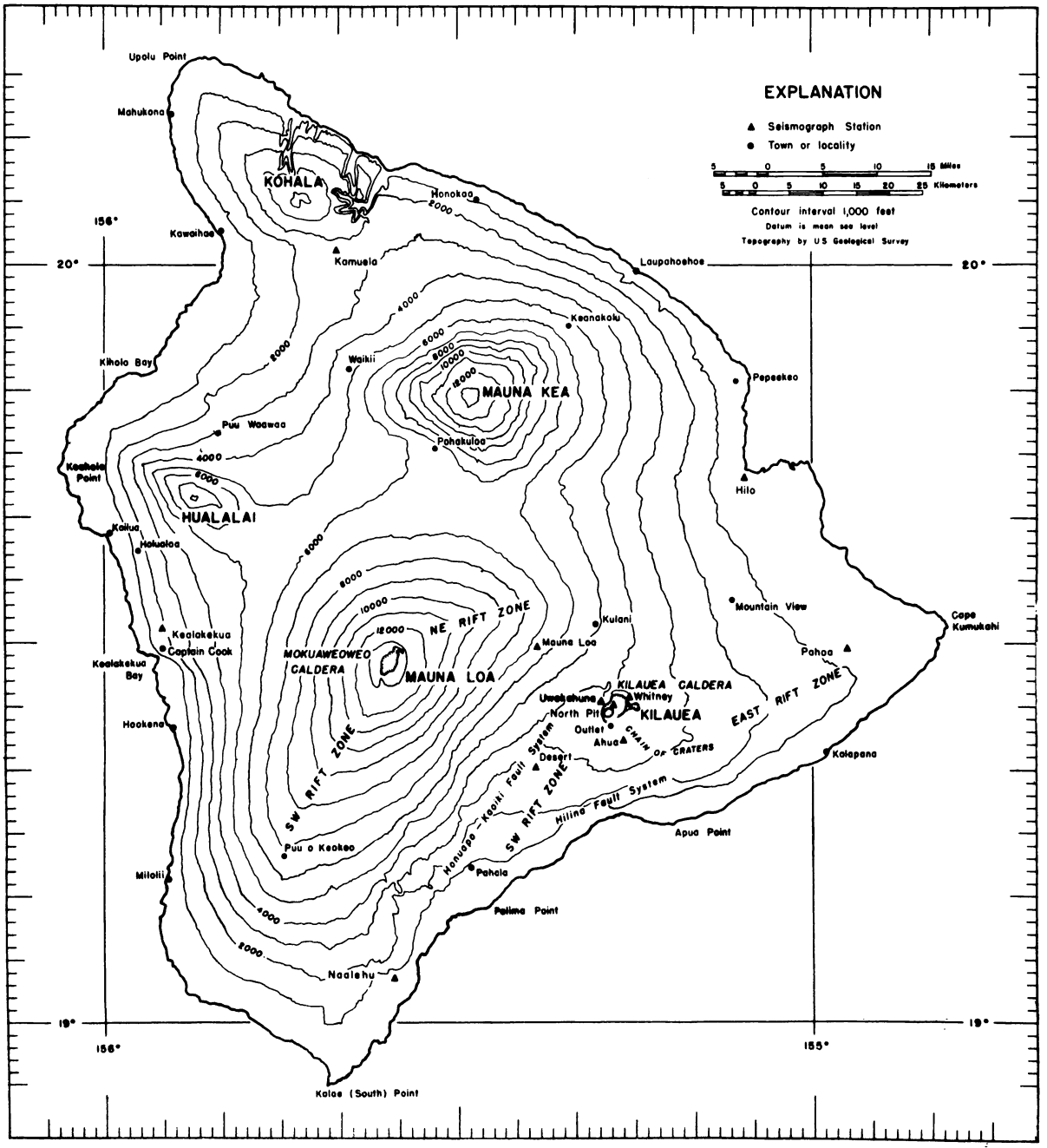

Figure 1.--Map of the island of Hawaii showing seismograph stations operated by the Geological Survey and localities mentioned in the text. Epicenters of local earthquakes are given in terms of geographic coordinates, which are indicated at the edges of the map.

Tilting of the ground around Kilauea caldera.--Tilting of the ground around the summit of Kilauea is monitored daily by a short-base water-tube tiltmeter in Uwekahuna Vault, and at irregular intervals it is measured on a regional scale by means of a network of field tilt bases and a portable water-tube tiltmeter. The attitude of the ground surface at each tilt base is reported in terms of north-south and east-west tilt coordinates. Both coordinates at each station were arbitrarily set equal to 500 when measurements at that station were begun. Increasing tilt coordinates correspond to northward and eastward tilting of the earth's surface, i.e., to a relative subsidence toward the north and east. A one-unit change in coordinate corresponds to a tilting of 1 microradian (1 mm per km) in the direction indicated.

Table 1.--Tilt coordinates at Uwekahuna Vault, July, August, and September, 1963

Date	N-S	E-W	Date	N-S	E-W
June 30	505	497	Sept. 1	503	491
July 7	498	504	8	504	494
14	499	504	15	505	490
21	502	499	22	505	482
28	502	495	29	505	476
Aug. 4	502	492			
11	501	492			
18	503	488			
25	501	494			

Table 2a.--Tilt coordinates and changes at bases around Kilauea caldera (see fig. 2a)

Tilt base (location)	Date (1963)	Tilt coordinates		Rate (10^{-6} rad/mo) and direction of tilting since last reading		Date of last reading (1963)
		N-S	E-W			
Uwekahuna (19°25.5' N., 155°17.4' W.)	July 6	478.6	488.2	5.0	N. 42.5° W.	May 10
Tree Molds (19°26.3' N., 155°17.3' W.)	4	452.6	512.9	0.67	S. 24.3° E.	14
Sand Spit (19°24.1' N., 155°16.8' W.)	6	824.3	725.5	9.6	S. 70.2° E.	14
Kalihipaa (19°21.4' N., 155°15.3' W.)	3	349.2	387.5	127.8	S. 18.3° W.	11
Keamoku (19°25.1' N., 155°19.0' W.)	4	531.2	552.4	9.5	N. 44.9° W.	10
Ahua Kamokukolau (19°22.7' N., 155°16.6' W.)	3	521.1	548.3	52.9	N. 22.1° W.	10
Kipuka Nene (19°19.4' N., 155°16.7' W.)	5	486.8	510.3	6.5	S. 16.0° E.	13
Hilina Pali (19°18.2' N., 155°18.6' W.	not occupied this epoch					
Kapapala Ranch (19°20.5' N., 155°23.8' W.	not occupied this epoch					

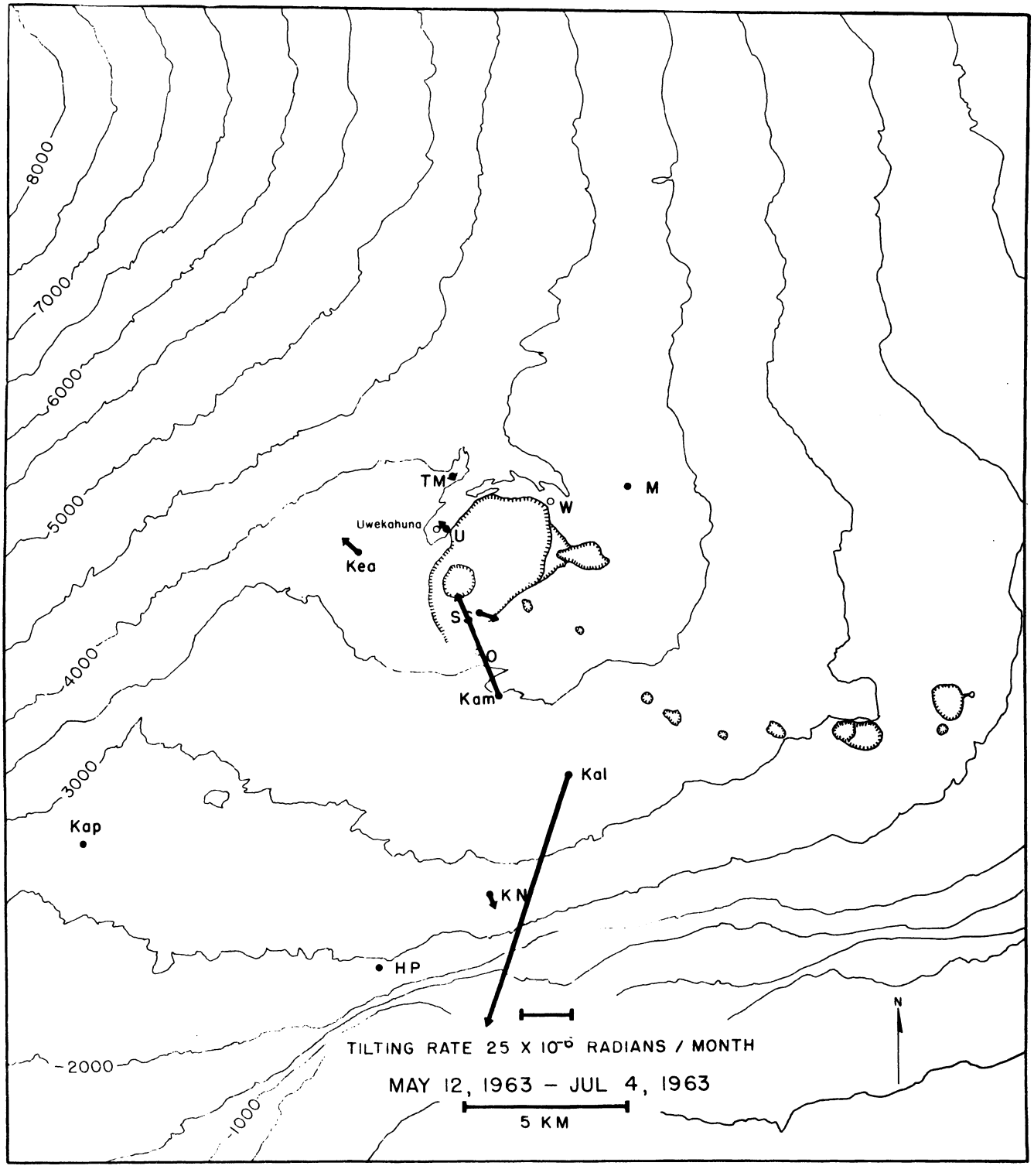

Figure 2a.--Tilting of the ground around Kilauea caldera, May 12 to July 4, 1963. The vector depicting tilting at a given tilt base points in the direction of maximum relative subsidence and has a length proportional to the rate of tilting during the measurement interval. Closed circles represent field tilt bases; open circles, short-base water-tube tiltmeters.

Table 2b.--Tilt coordinates and changes at bases around Kilauea caldera (see fig. 2b)

Tilt Base (location)	Date (1963)	Tilt coordinates		Rate (10^{-6} rad/mo) and direction of tilting since last reading		Date of last reading (1963)
		N-S	E-W			
Uwekahuna (19°25.5' N., 155°17.4' W.)	Aug. 6	486.8	480.5	11.3	N. 43° W.	July 6
Tree Molds (19°26.3' N., 155°17.3' W.)	6	457.0	515.8	4.8	N. 33° W.	4
Sand Spit (19°24.1' N., 155°16.8' W.)	12	821.4	727.0	2.6	S. 26° E.	6
Kalihipaa (19°21.4' N., 155°15.3' W.)	5	336.1	377.8	14.8	S. 37° W.	3
Keamoku (19°25.1' N., 155°19.0' W.)	12	536.9	544.7	6.8	N. 54° W.	4
Ahua Kamokukolau (19°22.7' N., 155°16.6' W.)	5	528.1	555.7	9.3	N. 47° E.	3
Kipuka Nene (19°19.4' N., 155°16.7' W.)	9	484.8	510.1	1.7	S. 06° W.	5
Hilina Pali (19°18.2' N., 155°18.6' W.)	8	497.5	500.7	1.4	S. 17° W.	May 13
Kapapala Ranch (19°20.5' N., 155°23.8' W.)	8	496.9	503.5	0.3	S. 24° E.	11

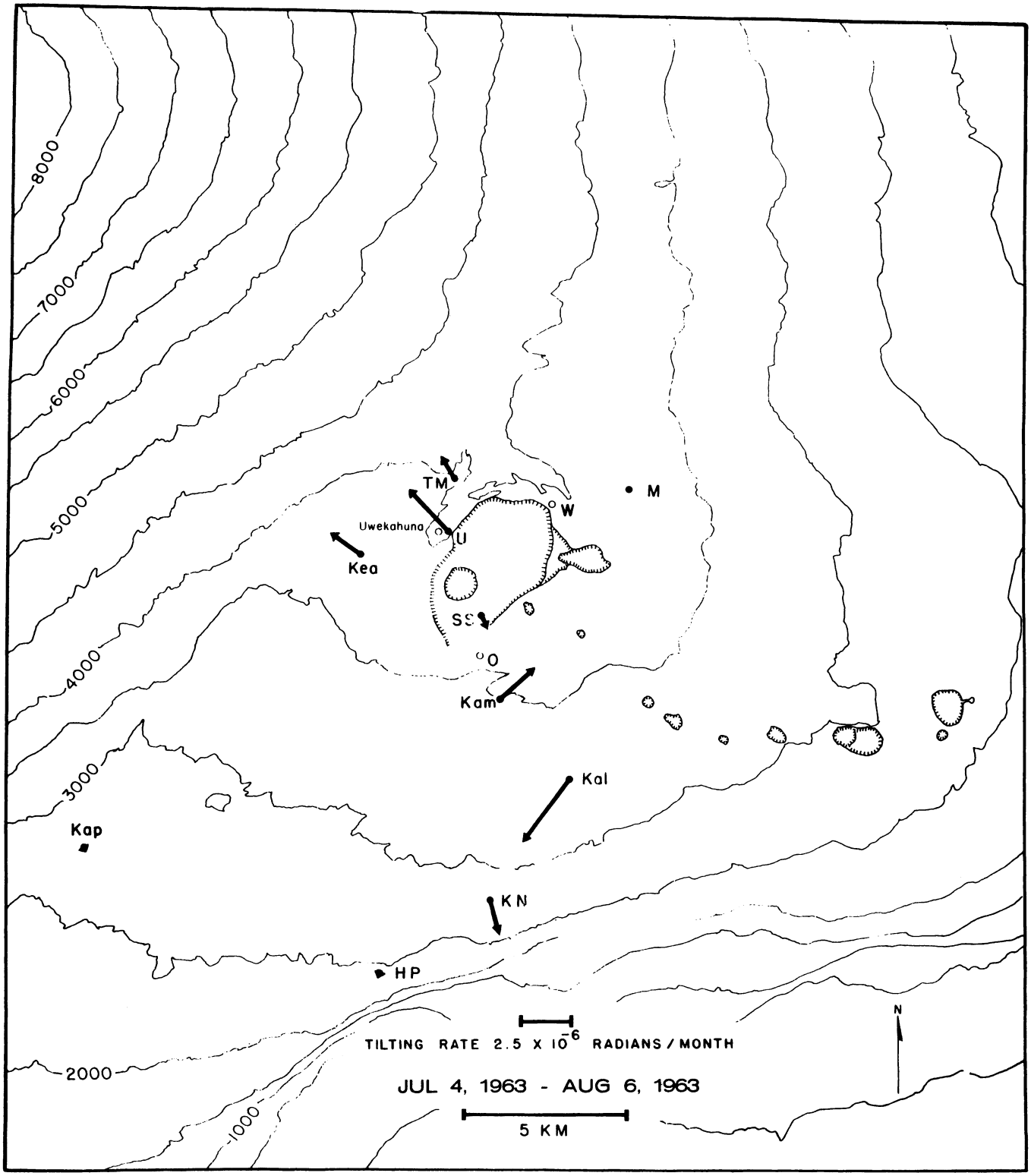

Figure 2b.--Tilting of the ground around Kilauea caldera, July 4 to August 6, 1963. The vector depicting tilting at a given tilt base points in the direction of maximum relative subsidence and has a length proportional to the rate of tilting during the measurement interval. Closed circles represent field tilt bases; open circles, short-base water-tube tiltmeters.

Seismic summary.--Events recorded by the U.S. Geological Survey seismograph network in Hawaii fall into two categories: local earthquakes and tremor originating in the region of the Hawaiian Islands, usually within 100 km of at least one seismograph, and distant earthquakes originating more than 3,000 km from Hawaii. As an index of seismic activity at Hawaiian volcanoes, daily counts of earthquakes and minutes of tremor recorded by seismographs in Hawaii are listed in table 3. The earthquakes are separated into groups on the basis of region of origin as determined by analysis of records obtained daily at the Observatory (U, M, A, D, N, MP). Earthquakes of magnitude 2.5 or greater are generally sufficiently well recorded to be located with greater precision: they are listed individually in table 4. Data on identifiable phases from distant earthquakes are listed in table 5.

Locations of the seismograph stations are shown on figure 1, and essential data on the stations were given in Summaries 25 and 30.

Table 3.--Numbers of earthquakes and minutes of tremor recorded on seismographs U, M, A, D, N, and MP around Kilauea caldera

Tremor is separated into three categories: deep, intermediate, and shallow, on the basis of relative amplitudes on seismographs in the summit region. Unless otherwise stated, tremor is presumed to be associated with movement of magma within the central complex of Kilauea.

Earthquake categories are: Halemaumau rock slides, which are detected by the characteristic record they produce on the North Pit seismograph; shallow earthquakes in the Kilauea caldera region; shallow earthquakes along the SW. rift zone of Kilauea and the adjacent portion of the Kaoiki fault system: earthquakes along the eastern half of Kilauea's east rift zone--detected largely on the Pahoa short-period vertical; earthquakes from a source about 30 km beneath Halemaumau; earthquakes from the upper east rift zone and the adjacent fault systems of Kilauea's south flank (these are usually first arrivals at Ahua or Makaopuhi); and earthquakes from other regions: Kona, Mauna Kea, etc.

"Kalapana Trail" quakes formerly listed as column 9, have essentially ceased and are thus no longer listed.

A question mark (?) in the column indicates questionable interpretation of the records due to high concentration of seismic activity or an instrumental problem.

Date (1963)	Tremor (in minutes)			Earthquakes						
	Deep	Intermediate	Shallow	Halemaumau slides	Kilauea caldera	SW. rift and Kaoiki	Eastern East rift	Halemaumau 30 km	Upper East rift	Others
July 1	----	------	------	-----	25	10	-----	6	?	----------
2	?	?	?	?	?	?	-----	1	900+	----------
3	?	?	?	?	?	?	-----	------	600+	1 S. Pali
4	----	------	------	-----	34	?	-----	5	275+	2 Kona
5	----	------	------	-----	30	------	1	2	65+	----------
6	----	------	------	-----	29	------	1	1	38	1 Offshore
7	----	------	------	-----	31	8	-----	1	33	----------
8	----	------	------	1	32	11	-----	1	12	----------
9	----	------	------	3	49	19	-----	6	13	----------
10	----	------	------	-----	35	3	-----	14	16	1 Mauna Kea
11	----	------	------	-----	23	20	-----	6	10	----------
12	----	------	------	-----	32	5	-----	3	5	----------
13	12	------	------	-----	30	9	-----	11	2	----------
14	----	------	------	-----	60	11	2	6	8	----------
15	----	------	------	-----	80	8	-----	11	-----	----------
16	----	------	------	-----	37	30	-----	2	1	----------

Table 3.--Numbers of earthquakes and minutes of tremor recorded on seismographs U, M, A, D, N, and EE around Kilauea caldera--Continued

Date (1963)	Tremor (in minutes)			Earthquakes						
	Deep	Inter-mediate	Shallow	Hale-maumau slides	Kilauea caldera	SW. rift and Kaoiki	Eastern East rift	Hale-maumau 30 km	Upper East rift	Other
July 17	42	-----	-----	-----	60	3	-----	1	3	----------
18	----	-----	-----	-----	50	10	-----	5	7	1 Kona
19	----	-----	-----	-----	50	17	-----	21	3	----------
20	----	-----	-----	-----	45	5	-----	3	3	1 Kohala 1 Mauna Loa
21	----	-----	-----	-----	60	10	-----	3	10	1 Honokaa
22	----	-----	-----	1	41	11	-----	5	8	----------
23	----	-----	-----	-----	46	21	-----	3	3	1 Offshore 1 Mauna Kea
24	----	-----	-----	1	70	5	-----	2	6	2 Offshore
25	----	-----	-----	-----	46	11	-----	2	3	----------
26	----	-----	-----	-----	45	6	1	7	4	----------
27	----	-----	-----	-----	50	8	-----	4	3	----------
28	----	-----	-----	-----	64	16	-----	8	1	1 Mauna Kea
29	----	-----	-----	-----	90	30	-----	2	----	----------
30	----	-----	-----	-----	60	18	-----	5	----	1 Mauna Loa
31	----	-----	-----	-----	100	25	-----	11	----	----------
Aug. 1	----	-----	8	-----	65	9	-----	9	1	----------
2	----	37	-----	-----	70	8	1	9	----	----------
3	----	50+	-----	2	50	13	-----	53	200+	1 Offshore
4	----	-----	?	-----	37	12	-----	71	3	1 S. Pali 1 Mauna Kea
5	13	-----	-----	-----	48	12	-----	9	5	----------
6	----	-----	-----	-----	44	14	-----	4	2	----------
7	46	-----	-----	-----	94	18	-----	8	7	1 Hualalai
8	3	-----	-----	-----	40	9	-----	21	1	----------

Table 3.--Numbers of earthquakes and minutes of tremor recorded on seismographs U, M, A, D, N, and EE around Kilauea caldera--Continued

Date (1963)	Tremor (in minutes)			Earthquakes						
	Deep	Inter-mediate	Shallow	Hale-maumau slides	Kilauea caldera	SW. rift and Kaoiki	Eastern East rift	Hale-maumau 30 km	Upper East rift	Others
Aug. 9	----	-----	------	-----	50	7	----	2	4	----------
10	----	-----	------	-----	75	5	----	2	4	----------
11	----	-----	------	-----	60	11	----	3	7	----------
12	----	-----	3	-----	81	11	----	5	5	----------
13	----	-----	------	-----	73	7	----	1	17	----------
14	----	-----	------	-----	85	5	----	1	-----	1 Oahu
15	----	-----	------	-----	80	6	----	2	6	1 Offshore
16	----	-----	------	1	80	6	----	1	4	----------
17	----	-----	------	-----	88	6	----	4	-----	----------
18	----	-----	------	-----	91	6	----	4	6	----------
19	2	-----	------	-----	96	6	----	2	8	----------
20	3	-----	------	-----	105	8	----	1	7	----------
21	Eruption starts at 18:00,				50+	13+	----	----	675+	----------
22	continuous tremor. Eruption				12+	5+	----	?	?	----------
23	ends 08:10.				30+	2+	1	3	?	----------
24	----	-----	------	-----	35	5	----	2	4	1 Hualalai
25	----	-----	------	-----	42	14	----	5	3	1 Kawaihae 1 Offshore Maui
26	----	-----	------	1	70	375+	----	1	-----	----------
27	38	-----	------	4	63	85	----	5	2	1 Mauna Loa
28	----	-----	------	1	92	83	----	4	-----	1 Kona 1 Offshore
29	----	-----	------	-----	60	23	----	8	-----	----------
30	4	-----	------	-----	50	31	----	5	1	----------
31	----	-----	------	-----	75	32	2	15	-----	1 Kona

Table 3.--Numbers of earthquakes and minutes of tremor recorded on seismographs U, M, A, D, N, and EE around Kilauea caldera--Continued

Date (1963)	Tremor (in minutes)			Earthquakes						
	Deep	Inter-mediate	Shallow	Hale-maumau slides	Kilauea caldera	SW. rift and Kaoiki	Eastern East rift	Hale-maumau 30 km	Upper East rift	Others
Sept. 1	14	-----	-----	-----	70	35	1	9	1	1 Mauna Loa 1 S. Pali
2	----	-----	-----	-----	80	35	----	5	8	----------
3	----	-----	-----	-----	102	77	----	3	2	----------
4	----	-----	-----	-----	53	20	----	9	----	----------
5	----	-----	-----	-----	65	30	----	2	1	----------
6	----	-----	-----	1	50	30	----	2	2	2 S. Pali 3 Kona
7	----	-----	-----	1	60	30	----	7	2	1 Offshore Maui
8	----	-----	-----	-----	60	42	----	1	3	2 Kona 1 Mauna Loa
9	----	-----	9	-----	69	35	----	7	2	1 S. Pali
10	15	-----	-----	-----	120	24	1	19	-----	----------
11	----	-----	-----	-----	71	22	----	4	-----	----------
12	4	-----	-----	1	60	24	----	2	5	----------
13	30	-----	-----	-----	85	8	----	1	5	1 S. Pali
14	----	-----	-----	-----	110	28	----	2	1	----------
15	----	-----	-----	-----	75	27	----	7	2	1 S. Pali
16	----	-----	-----	-----	120	32	-----	4	2	1 S. Pali 1 Offshore
17	32	-----	-----	1	150	33	----	7	6	1 Offshore
18	----	-----	-----	-----	115	44	1	5	4	2 Mauna Kea
19	----	-----	-----	1	170	48	-----	7	5	1 Kona
20	----	-----	-----	-----	85+	75	1	2	-----	----------
21	26	-----	-----	2	155+	1960	3	----	2	1 Offshore 1 Mauna Kea
22	----	-----	-----	2	120	1300	2	1	2	----------

Table 3.--Numbers of earthquakes and minutes of tremor recorded on seismographs U, M, A, D, N, and EE around Kilauea caldera --Continued

Date (1963)	Tremor (in minutes)			Earthquakes						
	Deep	Inter-mediate	Shallow	Hale-maumau slides	Kilauea caldera	SW. rift and Kaoiki	Eastern East rift	Hale-maumau 30 km	Upper East rift	Others
Sept. 23	----	-----	-----	1	130	740	5	4	4	----------
24	----	-----	-----	-----	190	580	7	8	12	1 Kona 1 Mauna Kea
25	----	-----	-----	-----	200	305	----	1	9	1 Offshore
26	----	-----	-----	-----	200	160	7	3	10	----------
27	20	-----	-----	-----	170	120	7	4	11	----------
28	----	-----	-----	-----	160	135	4	-----	----	----------
29	72	-----	-----	1	185	130	----	-----	5	1 Offshore
30	----	-----	-----	-----	185	95	----	2	9	----------

Table 4.--Local earthquakes recorded by seismographs of the U.S. Geological Survey July, August, and September, 1963

Entries for a given quake are: date, origin time (Hawaiian Standard Time), epicenter, depth, magnitude and felt report. Except for smaller earthquakes of special interest, only earthquakes with magnitudes of 2.5 or greater are included in the list.

In the following list, some origin times are followed only by "KM 30" and a statement of magnitude. These are all members of a continuing family of quakes noted also in other Summaries. The best mean focus for this group is beneath Halemaumau at a depth of 30 kilometers (19°24.1' N., 155°17.1' W.).

In the following list a number of quakes are described as "Upper east rift" (see Summary 28). Further statistical study of this group which occurs in the swarm periods during July 1 to 6 and August 3 to 4 gives a mean epicenter 19°21.5' N., 155°14' W., about 2 km south of Aloi Crater at near-surface depth.

In Summary 24, "Kaoiki" was introduced as a symbol for listing any of a family of quakes with mean focus 19°24' N., 155°25' W., h=3 to 8 km. This symbol is used in the following list.

Date (1963)	Time			Magnitude	Depth (km)	Epicenter			Felt Report
	h	m	s			Lat. N.	Long. W.	Description	
July 1	08	39	20.7	2.4	---	--------	---------	Upper east rift-------	----------
1	08	40	54.4	2.6	---	--------	---------	----do----------	Felt at Volcano
2	06	06	54.1	3.0	---	--------	---------	----do----------	----------
2	06	18	22.9	2.9	---	--------	---------	----do----------	----------
2	06	41	05.7	3.0	---	--------	---------	----do----------	----------
2	06	47	43.4	3.2	---	--------	---------	----do----------	----------
2	07	15	23.4	2.7	---	--------	---------	----do----------	----------
2	07	37	30.1	2.9	---	--------	---------	----do----------	----------
2	07	41	23.4	2.8	---	--------	---------	----do----------	----------
2	07	54	07.5	2.9	---	--------	---------	----do----------	----------
2	08	08	28.9	2.7	---	--------	---------	----do----------	----------
2	08	22	09.4	2.7	---	--------	---------	----do----------	----------
2	08	45	30.6	2.5	---	--------	---------	----do----------	----------
2	09	37	37.1	3.1	---	--------	---------	----do----------	----------

Table 4.--Local earthquakes recorded by seismographs of the U.S. Geological Survey, July, August, and September, 1963--Continued

Date (1963)	Time			Magnitude	Depth (km)	Epicenter			Felt Report
	h	m	s			Lat. N.	Long. W.	Description	
July 2	09	46	11.0	3.3	---	--------	---------	Upper east rift---------	----------
2	10	00	25.3	3.5	---	--------	---------	---do----------	----------
2	10	17	10.4	3.0	---	--------	---------	---do----------	----------
2	11	18	38.8	2.0	---	--------	---------	---do----------	----------
2	11	23	55.8	2.4	---	--------	---------	---do----------	----------
2	11	36	01.8	2.0	---	--------	---------	---do----------	----------
2	11	49	51.7	2.8	---	--------	---------	---do----------	----------
2	11	55	51.1	2.0	---	--------	---------	---do----------	----------
2	13	16	24.3	3.0	---	--------	---------	---do----------	----------
2	13	19	17.8	2.9	---	--------	---------	---do----------	----------
2	13	23	51.7	2.7	---	--------	---------	---do----------	----------
2	14	29	42.3	3.1	---	--------	---------	---do----------	----------
2	15	36	55.7	2.8	---	--------	---------	---do----------	----------
2	15	49	32.2	2.8	---	--------	---------	---do----------	----------
2	15	52	32.9	2.6	---	--------	---------	---do----------	----------
2	15	57	12.8	2.3	---	--------	---------	---do----------	----------
2	16	24	11.4	2.3	---	--------	---------	---do----------	----------
2	17	51	13.4	2.1	5	19°19.0'	155°09'	8 km NE of Apua Point---	----------
2	18	16	00.8	2.1	---	--------	---------	Upper east rift---------	----------
2	18	35	34.7	2.4	---	--------	---------	---do----------	----------
2	18	59	18.6	3.0	---	--------	---------	---do----------	----------
2	19	38	45.7	3.1	---	--------	---------	---do----------	----------
2	19	45	39.7	2.4	---	--------	---------	---do----------	----------
2	21	55	17.1	2.8	---	--------	---------	---do----------	----------
3	00	04	25.7	2.3	---	--------	---------	---do----------	----------
3	01	06	44.8	2.2	---	--------	---------	---do----------	----------
3	02	56	19.4	2.7	---	--------	---------	---do----------	----------
3	03	58	23.2	2.1	---	--------	---------	---do----------	----------
3	04	54	55.1	2.0	---	--------	---------	---do----------	----------
3	05	41	28.3	2.6	---	--------	---------	---do----------	----------
3	06	16	27.2	2.7	---	--------	---------	---do----------	----------

Table 4.--Local earthquakes recorded by seismographs of the U.S. Geological Survey, July, August, and September, 1963--Continued

Date (1963)	Time			Magnitude	Depth (km)	Epicenter			Felt Report
	h	m	s			Lat. N.	Long. W.	Description	
July 3	06	30	15.7	3.1	---	--------	---------	Upper east rift----------	Felt at Volcano
3	06	37	31.7	2.0	---	--------	---------	---do----------	----------
3	10	11	36.4	2.3	---	--------	---------	---do----------	----------
3	16	01	08.4	2.7	---	--------	---------	---do----------	----------
3	16	28	53.4	2.0	---	--------	---------	---do----------	----------
3	19	30	34.8	2.6	---	--------	---------	---do----------	----------
3	20	31	51.5	2.5	---	--------	---------	---do----------	----------
4	00	12	50.9	3.3	---	--------	---------	---do----------	Felt at Volcano
4	05	03	40.4	2.3	---	--------	---------	---do----------	----------
4	06	45	18.0	2.8	13	19°22.3'	155°55.6'	16 km SSW of Kealakekua	----------
4	07	38	31.4	2.9	13	19°25.3'	155°59.0'	13 km SW of Kealakekua---	----------
4	08	04	11.1	2.9	---	--------	---------	Upper east rift----------	Felt at Volcano
4	08	39	09.9	2.6	---	--------	---------	---do----------	----------
4	10	52	12.7	2.4	---	--------	---------	---do----------	----------
4	12	05	04.4	2.8	---	--------	---------	---do----------	----------
4	17	01	02.7	2.6	---	--------	---------	---do----------	----------
4	17	55	57.4	2.8	---	--------	---------	---do----------	----------
4	17	58	13.9	2.5	---	--------	---------	---do----------	----------
4	20	06	26.7	2.0	---	--------	---------	---do----------	----------
4	20	07	13.0	3.0	---	--------	---------	---do----------	Felt at Volcano
5	03	19	27.2	2.5	---	--------	---------	KM 30----------	----------
5	15	14	34.5	2.5	---	--------	---------	Upper east rift----------	----------
6	16	34	43.2	2.2	---	--------	---------	---do----------	----------
6	17	12	01.1	2.4	3	19°16.8'	155°04.0'	13 km SW of Kalapana-----	----------
7	01	42	19.0	2.8	---	--------	---------	KM 30----------	Felt at Volcano
10	16	32	44.0	3.4	13	19°55.5'	155°28.8'	18 km SSW of Honokaa-----	Felt at Kamuela
11	01	39	26.0	3.3	8	19°16.5'	155°16.2'	12 km S of Ahua seismometer.	Felt at Volcano
11	02	43	57.5	3.8	3	19°15.2'	155°10.1'	3 km ESE of Apua Point---	Felt at Volcano to Hilo.
11	03	10	14.7	3.5	---	-------	--------	Upper east rift----------	Felt at Volcano to Hilo.
11	11	29	19.8	2.5	---	-------	--------	KM 30----------	----------
12	21	36	11.5	2.2	---	-------	--------	Upper east rift----------	----------

Table 4.--Local earthquakes recorded by seismographs of the U.S. Geological Survey, July, August, and September, 1963--Continued

Date (1963)	Time			Magnitude	Depth (km)	Epicenter			Felt Report
	h	m	s			Lat. N.	Long. W.	Description	
July 14	08	10	16.0	2.6	---	--------	--------	Kaoiki----------	----------
14	22	54	54.7	2.6	---	--------	--------	---do----------	----------
15	22	44	10.3	2.6	---	--------	--------	Upper east rift----------	----------
17	18	43	36.0	2.3	---	--------	--------	KM 30----------	----------
18	11	27	46.0	3.3	8	19°22.0'	155°52.3'	18 km SSE of Kealakekua	Felt at Honaunau.
18	16	28	51.7	2.4	---	--------	--------	KM 30----------	----------
19	20	12	36.5	2.5	---	--------	--------	Upper east rift----------	----------
20	00	03	21.2	2.7	13	20°04.0'	155°37.2'	10 km ENE of Kamuela seismograph station.	----------
20	11	26	43.5	2.3	---	--------	--------	Kaoiki----------	----------
20	12	31	31.5	3.2	13	19°10.8'	155°36.9'	12 km NNW of Naalehu------	----------
21	17	24	02.0	3.2	13	19°59.0'	155°24.2'	13 km SE of Honokaa-------	----------
23	01	37	01.0	2.8	3	18°59.0'	155°13.5'	32 km SSW of Apua Point---	----------
23	03	52	10.8	3.2	---	--------	--------	KM 30----------	----------
23	07	38	12.6	2.7	13	19°50.9'	155°32.1'	13 km ESE of Waikii-------	----------
24	19	18	03.5	2.7	3	19°36.9'	155°25.8'	14 km NNW of Mauna Loa seismometer.	----------
25	16	18	15.5	2.8	13	18°57.5'	154°58.2'	41 km SSE of Apua Point	----------
25	18	19	36.1	2.7	13	19°45.0'	155°58.9'	27 km NNW of Kealakekua	----------
26	03	21	19.7	2.3	---	--------	--------	Kaoiki----------	----------
28	03	32	10.5	2.4	13	19°51.5'	155°38.2'	2 km ESE of Waikii--------	----------
29	08	39	12.5	2.7	---	--------	--------	Kaoiki----------	----------
30	04	32	54.0	2.4	8	19°47.5'	155°26.5'	34 km NNW of Mauna Loa seismometer.	----------
Aug. 1	01	10	52.4	2.9	---	--------	--------	KM 30----------	Felt at Glenwood and Volcano.
2	10	06	29.3	2.1	---	--------	--------	KM 30----------	----------
2	14	53	03.1	2.8	---	--------	--------	KM 30----------	----------
2	17	55	00.4	2.0	---	--------	--------	Upper east rift----------	----------

Table 4.--Local earthquakes recorded by seismographs of the U.S. Geological Survey, July, August, and September, 1963--Continued

Date (1963)	Time			Magnitude	Depth (km)	Epicenter			Felt Report
	h	m	s			Lat. N.	Long. W.	Description	
Aug. 3	06	41	22.0	2.6	8	18°44'	154°57'	64 km SSE of Apua Point	----------
3	23	21	02.5	2.0	---	--------	--------	Upper east rift--------	----------
3	23	47	35.0	2.0	---	--------	--------	----do----------	----------
4	00	10	49.5	2.7	---	--------	--------	----do----------	----------
4	00	54	11.7	2.3	---	--------	--------	----do----------	----------
4	01	13	48.1	2.3	---	--------	--------	**KM 30**----------	----------
4	01	39	54.9	2.0	---	--------	--------	Upper east rift--------	----------
4	02	57	06.5	2.0	---	--------	--------	----do----------	----------
4	03	45	53.0	2.3	3	19°18.8'	155°0.5'	14 km WSW of Kalapana	----------
4	07	17	40.5	2.0	---	--------	--------	Upper east rift--------	----------
4	07	54	58.6	2.3	---	--------	--------	KM 30----------	----------
4	08	53	35.3	3.4	13	20°02.3'	155°18.8'	9 km NW of Laupahoehoe	Felt at Kamuela
5	08	15	22.1	2.5	---	--------	--------	Upper east rift--------	----------
7	07	54	23.0	2.9	13	19°45.9'	156°00.8'	7 km NE of Keahole Point	----------
8	16	13	55.2	2.2	---	--------	--------	KM 30----------	----------
8	16	14	20.0	3.3	---	--------	--------	KM 30----------	Felt at Volcano
8	22	04	14.1	2.1	---	--------	--------	Upper east rift--------	----------
9	18	41	43.0	2.4	---	--------	--------	Kaoiki----------	----------
10	04	10	08.0	2.5	---	--------	--------	KM 30----------	----------
12	11	09	42.6	2.2	---	--------	--------	Upper east rift--------	----------
14	05	25	38.1	3.5	30	21°28'	158°06'	Waianae Mountains near Kolekole Pass, Oahu.	Felt in Oahu
15	10	31	38.4	3.4	**shallow**	19°35.7'	155°58.8'	11 km NW of Kealakekua	----------
15	11	01	19.0	2.3	---	--------	--------	Upper east rift--------	----------
18	16	40	41.3	2.2	---	--------	--------	----do----------	----------
19	02	03	00.1	2.8	---	--------	--------	KM 30----------	----------
24	03	02	20.5	2.9	13	19°40.2'	156°02.9'	8 km SSE of Keahole Point.	----------
25	06	55	05.0	2.3	13	20°00.7'	155°49.8'	**4 km SSE of Kawaihae**---	----------
25	22	41	43.0	3.1	13	21°23'	156°29'	**74 km NNW of Haleakala, Maui.**	----------
25	23	35	45.0	2.3	---	--------	--------	**KM 30**----------	----------
26	08	49	17.6	4.9	---	--------	--------	**Kaoiki**----------	Felt island-wide.

Table 4.--Local earthquakes recorded by seismographs of the U.S. Geological Survey, July, August, and September, 1963--Continued

Date (1963)	Time			Magnitude	Depth (km)	Epicenter			Felt Report
	h	m	s			Lat. N.	Long. W.	Description	
Aug. 26	09	48	23.3	3.1	----	--------	---------	Kaoiki----------	Felt in Kapapala and Kilauea summit area.
26	15	24	38.2	2.2	----	--------	---------	Kaoiki----------	----------
26	18	17	05.9	2.0	----	--------	---------	----do----------	----------
26	18	42	15.4	2.0	----	--------	---------	----do----------	----------
26	19	28	24.5	2.0	----	--------	---------	----do----------	----------
26	19	34	12.7	2.0	----	--------	---------	----do----------	----------
26	19	44	19.7	2.6	----	--------	---------	----do----------	----------
26	21	35	00.0	3.3	----	--------	---------	----do----------	Felt in Kapapala and Naalehu.
26	22	17	31.4	2.0	----	--------	---------	----do----------	----------
27	02	20	04.2	2.2	----	--------	---------	----do----------	----------
27	13	13	37.5	2.9	----	--------	---------	----do----------	----------
27	14	10	27.7	2.3	----	--------	---------	----do----------	----------
27	19	07	30.6	2.9	8	19°23.4'	155°36.4'	24 km west-northwest of Desert seismometer.	----------
28	05	14	03.8	2.7	<3	19°29.8'	155°56.0'	3 km southwest of Kealakekua.	Felt in Kealakekua.
28	05	51	59.8	3.6	13	18°59.7'	155°18.2'	31 km east-southeast of Naalehu.	----------
29	01	06	43.4	2.9	----	--------	--------	KM 30----------	----------
29	21	10	40.4	2.7	----	--------	--------	KM 30----------	----------
30	10	58	48.6	2.0	10	19°19.2'	155°12.8'	6 km southwest of Makaopuhi seismometer.	----------
31	20	24	05.5	2.5	8	19°35.1'	155°53.9'	8 km north-northwest of Kealakekua	----------
Sept. 1	01	24	17.7	2.3	----	--------	--------	KM 30----------	----------
1	11	31	15.1	3.3	3	19°11.9'	155°39.3'	17 km NW of Naalehu----	Felt in Pahala
1	21	43	59.3	2.6	30	19°14.3'	155°21.8'	11 km south-southeast of Desert seismometer.	----------
2	10	05	38.4	2.2	----	--------	--------	Upper east rift--------	----------

Table 4.--Local earthquakes recorded by seismographs of the U.S. Geological Survey, July, August, and September, 1963--Continued

Date (1963)	Time			Magnitude	Depth (km)	Epicenter			Felt Report
	h	m	s			Lat. N.	Long. W.	Description	
Sept. 3	12	54	30.6	3.6	---	--------	---------	Kaoiki----------	Felt in Kapapala.
3	13	51	57.2	3.0	---	--------	---------	---do----------	----Do----------
3	17	17	39.7	2.1	---	--------	---------	---do----------	----------
3	18	25	04.5	2.9	---	--------	---------	---do----------	Felt in Kapapala
4	21	58	37.4	3.1	---	--------	---------	KM 30----------	Felt in Kilauea summit area.
6	00	54	45.4	2.5	8	19°29.0'	155°53.5'	5 km SE of Kealakekua---	----------
6	02	41	37.6	2.3	10	19°16.0'	155°13.2'	13 km SSE of Ahua seismometer.	----------
6	03	30	01.6	3.6	3	19°29.1'	156°02.9'	15 km WSW of Kealakekua	Felt in Kealakekua and Captain Cook.
6	09	10	48.8	2.1	8	19°17.4'	155°14.3'	10 km SW of Ahua seismometer.	----------
6	22	47	53.0	2.6	5	19°28.3'	155°52.2'	8 km SE of Kealakekua	----------
7	05	07	40.0	2.2	---	--------	--------	Kaoiki----------	----------
7	05	32	11.2	2.1	10	19°19.8'	155°11.8'	5 km SW of Makaopuhi seismometer.	----------
7	12	01	18.6	2.9	13	20°48'	155°12'	100 km NE of Kamuela----	----------
7	18	04	17.4	2.1	---	---------	--------	Upper east rift---------	----------
8	04	48	04.9	2.4	8	19°40.2'	156°05.8'	11 km west of Kailua---	----------
8	12	09	36.8	3.0	3	19°12.3'	155°34.8'	16 km north of Naalehu-	----------
8	12	43	43.9	3.0	3	19°22.6'	155°54.1'	1 km south of Hookena--	----------
8	23	37	06.0	2.3	---	---------	---------	Kaoiki----------	----------
9	01	33	43.4	2.3	10	19°17.1'	155°09.3'	9 km SSE of Ahua seismometer.	----------

Table 4.--Local earthquakes recorded by seismographs of the U.S. Geological Survey, July, August, and September, 1963--Continued

Date (1963)	Time			Magnitude	Depth (km)	Epicenter			Felt Report
	h	m	s			Lat. N.	Long. W.	Description	
Sept. 10	00	21	23.8	2.0	10	19°20.7'	155°17.0'	4 km SW of Ahua seismometer	----------
11	08	00	39.5	3.2	----	--------	---------	KM 30----------	Felt in Kapapala
13	23	58	09.5	2.3	8	19°16.1'	155°13.7'	5 km WNW of Apua Point-----	----------
15	02	22	58.3	2.9	5	19°16.5'	155°12.6'	3 km NW of Apua Point------	Felt in Kilauea summit area.
15	02	50	48.6	2.7	----	--------	---------	KM 30----------	----------
15	02	53	56.0	2.3	----	--------	---------	KM 30----------	----------
16	00	24	07.9	2.0	8	19°14.8'	155°21.4'	11 km SSW of Desert seismometer.	----------
16	20	34	11.5	3.8	13	18°48'	156°39'	100 km SW of Hookena-------	----------
17	13	25	25.8	2.8	5	19°21.3'	155°17.2'	3 km SW of Ahua seismometer	----------
17	14	12	17.4	2.8	13	19°21'	156°34'	73 km WSW of Kealakekua----	----------
18	07	54	43.5	2.1	< 3	19°48.2'	155°31.7'	6 km north of Pohakuloa----	----------
18	08	07	57.5	3.5	13	19°50.9'	155°32.2'	11 km north of Pohakuloa---	Felt in Pohakuloa
18	21	31	45.2	2.6	----	--------	--------	Kaoiki----------	----------
18	21	33	44.7	2.3	----	--------	--------	---do----------	----------
18	21	50	33.2	2.2	----	--------	--------	----do----------	----------
19	06	23	23.7	3.4	3	19°28.3'	155°54.5'	5 km SSE of Kealakekua----	Felt in Kealakekua, Captain Cook, and Hilo.
21	00	17	48.0	3.1	13	20°27'	156°25'	40 km SW of Heleakala seismometer.	----------
21	00	19	05.7	2.5	13	19°53.1'	155°24.0'	8 km SW of Keanakolu	----------
21	06	24	26.5	4.8	----	--------	---------	Kaoiki----------	Felt island-wide

Table 4.--Local earthquakes recorded by seismographs of the U.S. Geological Survey, July, August, and September, 1963--Continued

Date (1963)	Time			Magnitude	Depth (km)	Epicenter			Felt Report
	h	m	s			Lat. N.,	Long. W.	Description	
Sept. 21	06	33	24.0	2.3	----	--------	--------	Kaoiki----------	----------
21	06	49	59.4	2.8	----	--------	--------	---do----------	----------
21	07	04	28.8	2.4	----	--------	--------	---do----------	----------
21	07	40	27.4	2.2	----	--------	--------	---do----------	----------
21	08	38	23.3	2.3	----	--------	--------	---do----------	----------
21	08	46	16.5	2.4	----	--------	--------	---do----------	----------
21	10	02	59.1	2.2	----	--------	--------	---do----------	----------
21	18	49	43.7	2.3	----	--------	--------	---do----------	----------
21	20	18	15.0	2.2	----	--------	--------	---do----------	----------
21	23	19	11.0	2.3	----	--------	--------	---do----------	----------
22	06	26	17.4	3.5	----	--------	--------	---do----------	Felt in Hilo, Kapapala, and Kilauea summit area.
22	06	27	24.4	3.5	---	--------	--------	Kaoiki----------	Felt in Hilo, Kapapala, and Kilauea summit area.
22	07	33	23.2	2.3	----	--------	--------	Kaoiki----------	----------
22	17	16	33.4	2.2	----	--------	--------	---do----------	----------
22	19	23	34.3	2.3	----	--------	--------	---do----------	----------
23	21	44	11.4	2.6	----	--------	--------	---do----------	----------
24	01	48	04.9	3.4	5	19°26.6'	154°57.1'	6 km south-southwest of Pahoa.	Felt in Pahoa and Kapoho.
24	05	58	22.3	2.7	5	19°36.0'	155°21.3'	4 km northwest of Keanakolu.	----------
24	08	18	02.2	3.3	8	19°16.5'	155°53.3'	13 km south-southeast of Hookena.	----------
24	09	36	16.0	2.1	25	19°30.1'	155°05.3'	24 km south of Hilo	----------
24	23	54	58.0	2.3	13	19°09.9'	154°59.1'	37 km south-southwest of Pahoa.	----------
25	20	02	11.5	2.6	35	18°58.7'	155°25.1'	21 km southeast of Naalehu.	----------
26	05	01	27.6	2.1	8	19°26.8'	154°57.0'	5 km south of Pahoa-------	----------

Table 4.--Local earthquakes recorded by seismographs of the U.S. Geological Survey, July, August, and September, 1963--Continued

Date (1963)	Time			Magnitude	Depth (km)	Epicenter			Felt Report
	h	m	s			Lat. N.	Long. W.	Description	
Sept. 27	17	09	24.7	2.9	3	19°25.8'	154°57.3'	7 km south-southwest of Pahoa.	Felt in Pahoa
27	20	04	20.0	2.3	---	--------	---------	Kaoiki----------	----------
28	02	45	33.9	3.0	3	19°26.8'	154°56.1'	6 km south of Pahoa---	Felt in Kapoho---
29	10	18	10.6	2.4	8	18°58.2'	155°18.0'	51 km south of Uwekahuna seismometer.	----------
30	08	28	10.0	2.4	5	19°26.9'	154°54.6'	7 km southeast of Pahoa	----------

Table 5.--Distant earthquakes

[Times are reported in Greenwich Civil Time which is 10 hours faster than Hawaiian Standard Time. A "c" following the time of P indicates compressional first motion; a "d" indicates dilatational first motion. Station symbols, locations, and instrumentation are presented in Summary 28. Magnitudes calculated from the Hawaii seismograms are followed by (HVO). Location of epicenter, origin times, and focal depths, and magnitudes reported by other institutions are taken from "Preliminary Determination of Epicenters" published by the U.S. Coast and Geodetic Survey]

July 4, 1963

M	Z	eP	11:06:56.7 d
A	Z	eP	56.4 d
D	Z	eP	55.4 d
MP	Z	eP	56.4 d
U	Z	iP	56.6 d
Pa	Z	iP	58.1 d
Na	Z	iP	53.3 d
Ka	Z	iP	59.1 d
Hi	Z	iP	59.1 d
Ha	Z	iP	11:07:03.1 d
U	PEZ	iP	11:06:56 d
U	PEN	iS	11:13:59

C&GS card 54-63:
10:58:13.2
26.3° S., 177.7° W.
Tonga Islands region
h about 158 km
Magnitude 6.75 (Pas)
6.75 to 7 (Brk)
6.5 (CGS).

July 9

U	PEZ	eR	09:57:02

C&GS card 55-63:
09:24:33.3
8.5° N., 83.0° W.
Costa Rica
Panama Border
h about 31 km
Magnitude 5.1 (CGS).

July 10

M	Z	iP	05:31:49.4 d
N	Z	eP	50.2 d
Pa	Z	eP	49.7 d

July 10--Continued

U	PEZ	iP	49 d
U	PEZ	iR	05:45:31
U	PEE	iS	05:39:02
U	PEN	iL	05:43:26

C&GS card 55-63:
05:22:57.1
46.3° N., 152.9° E.
Kurile Islands region
h about 33 km
Magnitude 5.6 (CGS)
6.1 (HVO).

July 14

M	Z	iP	17:16:58.6 d
A	Z	iP	58.1 d
D	Z	iP	57.3 d
MP	Z	iP	58.1 d
U	Z	iP	58.3 d

C&GS card 57-63:
17:06:38.6
39.4° S., 174.9° E.
North Island, New Zealand
h about 189 km
Magnitude 6.0 (CGS).

July 15

Ha	Z	Tmax	07:11:51

C&GS card 57-63:
06:28:21.7
51.8° N., 176.8° W.
Andreanof Islands, Aleutian Islands
h about 33 km
Magnitude 4.6 (CGS).

Table 5.--Distant earthquakes--Continued

July 15

M	Z	iP	08:49:43.3 d
A	Z	eP	45.0 d
D	Z	iP	44.3 d
U	Z	eP	44.1 d
Pa	Z	iP	44.3 d
Ha	Z	Tmax	09:39:39

C&GS card 56-63:
08:41:07.5
55.6° N., 162.0° E.
Kamchatka
h about 60 km
Magnitude 5.2 (CGS).

July 16

U	PEN	eS	18:56:45
U	PEN	eL	19:16:33
U	PEZ	eR	19:22:11

C&GS card 57-63:
18:27:18.4
43.1° N., 41.5° E.
Georgia S.S.R.
h about 33 km
Magnitude 5.8 (CGS).

July 18

Ha	Z	Tmax	00:48:23
Pa	Z	Tmax	00:49:02

C&GS card 57-63:
00:04:05.3
49.1° N., 128.9° W.
Vancouver Islands region
h about 33 km
Magnitude 4.8 (CGS).

July 19

M	Z	Tmax	13:28:16
A	Z	Tmax	13:28:00
D	Z	Tmax	13:28:18
MP	Z	Tmax	13:27:59
Ha	Z	Tmax	13:28:05

No coast and Geodetic Survey preliminary listing.

July 24

U	PEZ	eR	12:07:51

C&GS card 59-63:
11:32:17.7
24.6° N., 122.0° E.
Near east coast of Formosa

July 24--Continued

h about 33 km
Magnitude 5.3 (CGS).

July 29

U	PEZ	iP	20:23:30 d
U	PEZ	iR	20:38:20
U	PEE	iS	20:31:00
U	PEN	iG	20:35:56

C&GS card 61-63:
20:14:07.3
30.2° S., 177.3° W.
Kermadec Islands
h about 39 km
Magnitude 6.5 -6.75 (Bks)
5.7 (CGS)
6.5 (HVO).

July 30

M	Z	iP	05:55:16.0 d
A	Z	iP	15.5 d
D	Z	eP	14.9 d
U	PEZ	iP	16 d
U	PEZ	iR	06:10:28
U	PEN	iS	06:02:52
U	PEN	eG	06:07:40

C&GS card 59-63:
05:45:53.3
29.6° S., 177.3° W.
Kermadec Islands region
h about 33 km
Magnitude 5.3 (CGS)
6.1 (HVO).

Aug. 2

M	Z	iP	19:38:19.5 d

C&GS card 62-63:
19:26:26.0
6.0° N., 125.1° E.
Mindanao, Philippine Islands
h about 118 km
Magnitude 5.0 (CGS).

August 3

Pa	Z	Tmax	02:17:26

C&GS card 67-63:
01:09:56
8.8° S., 108.3° W.
Southwest of Galapagos Islands
h about 33 km
Magnitude 4.4 (CGS).

August 3

U	PEZ	ePP	10:41:26
U	PEZ	iSS	10:56:45
U	PEE	iPS	10:50:53
U	PEE	iL	11:07:53

C&GS card 61-63:
10:21:36.6
7.7° N., 35.8° W.
Mid-Atlantic Ocean
h about 33 km
Magnitude 6.1 (CGS)
6.3 (HVO).

August 3

M	Z	iP	20:35:30.5 d
A	Z	eP	30.3 d
D	Z	eP	29.0 d
Hi	Z	eP	33.1 d

C&GS card 62-63:
20:26:04.1
30.7° S., 178.3° W.
Kermadec Islands
h about 37 km
Magnitude 5.2 (CGS).

August 4-5

M	Z	iP	00:01:33.9 c
A	Z	iP	33.8 c
D	Z	eP	33.6 c
MP	Z	iP	33.8 c

August 4-5--Continued

U	Z	iP	33.7 c
Pa	Z	eP	34.8 d
Na	Z	iP	30.5 c
Ka	Z	iP	36.0 c
Hi	Z	iP	35.4 d
Ha	Z	iP	38.5 d

C&GS card 62-63:
23:54:14.0
17.5° S., 179.1° W.
Fiji Islands region
h about 515 km
Magnitude 5.2 (CGS).

August 8

M	Z	eP	02:23:04.6 c
D	Z	iP	05.2 c
U	Z	iP	05.0 c
Pa	Z	iP	06.0 c
Hi	Z	eP	03.7 c
U	PEN	eS	02:29:40
U	PEE	eL	02:33:04
U	PEZ	iR	02:35:11

C&GS card 63-63:
02:14:54.4
54.2° N., 168.1° E.
Fox Islands, Aleutian Islands
h about 33 km
Magnitude 5.5 (CGS)
5.8 (HVO).

August 8

M	Z	eP	11:26:04.9 d
A	Z	eP	05.0 d
D	Z	iP	04.4 d
U	Z	eP	05.0 c
Na	Z	eP	02.1 c
Hi	Z	iP	07.0 c
Ha	Z	iP	08.1 d
U	PEZ	eP	05 c
U	PEZ	iR	11:43:04
U	PEE	eS	11:34:09
U	PEN	eL	11:40:04

August 8, 1963--Continued

C&GS card 65-63:
11:16:11.2
5.8° S., 151.0° E.,
New Britain
h about 48 km
Felt: Palmalmal, Pomio
Magnitude 5 (Bks)
5.6 (CGS)
6.0 (HVO).

Aug. 9

U	PEZ	eP	14:44:14	c
U	PEZ	iS	14:50:34	
U	PEZ	iR	14:54:39	
U	PEE	iL	14:52:56	

C&GS card 64-63:
14:36:45.9
15.3° S., 175.7° W.
Fiji Islands region
h about 33 km
Magnitude 5.5 (CGS)
5.7 (HVO).

Aug. 14

M	Z	iP	18:55:18.8	d
A	Z	iP	18.0	d
Hi	Z	eP	19.6	c

C&GS card 64-63:
18:43:55.5
3.4° S., 135.4° E.
West Iran
h about 33 km
Magnitude 6.4 (CGS).

Aug. 15

M	Z	eP	06:21:17.2	c
A	Z	eP	20.0	d
D	Z	eP	17.5	c
Pa	Z	eP	19.3	c
Hi	Z	iP	18.3	c
Ha	Z	eP	15.0	d
U	PEZ	iP	18	d
U	PEZ	iR	06:37:54	
U	PEE	iS	06:29:15	

August 15--Continued

C&GS card 64-63:
06:11:34.6
37.9° N., 141.6° E.
Near east coast of Honshu, Japan
h about 59 km
Magnitude 6.6 (HVO).

Aug. 15

A	Z	iP	17:37:14.5	d
D	Z	eP	14.9	d
N	Z	iP	15.0	d
Pa	Z	eP	12.9	c
Hi	Z	eP	14.9	c
U	PEZ	eP	15	d
U	PEZ	ipP	17:39:21	d
U	PEZ	iPP	17:41:12	
U	PEZ	ipPP	17:43:00	
U	PEZ	iPPP	17:43:27	
U	PEZ	iSKS	17:47:04	
U	PEZ	iS	17:47:44	
U	PEZ	iSP	17:48:38	
U	PEZ	i	17:52:37	
U	PEZ	iSS	17:54:04	
U	PEZ	isSS	17:57:02	
U	PEZ	i	18:08:26	
U	PEN	isP	17:39:53	
U	PEN	esS	17:50:59	
U	PEN	e	18:00:27	
U	PEN	iG	18:02:57	
U	PEN	i	18:14:28	

C&GS card 65-63:
17:25:05.9
13.8° S., 69.3° W.
Peru-Bolivia border
h about 543 km
Magnitude 7.75 (Pas)
8 (Bks).

Aug. 17

M	Z	eP	11:23:20.9	d
A	Z	eP	21.8	c
D	Z	eP	21.5	c
Pa	Z	eP	23.3	c
Hi	Z	eP	21.0	d
U	PEZ	iP	21	d
U	PEZ	iR	11:42:33	

August 17, 1963--Continued

U	PEE	iS	11:32:17
U	PEN	iG	11:39:49

C&GS card 66-63:
11:12:41.2
30.6° N., 130.9° E.
Ryukyu Islands region
h about 33 km
Magnitude 5.6 (CGS)
6.5 (HVO).

Aug. 17

M	Z	iP	11:43:48.3 c
A	Z	iP	47.4 c
D	Z	iP	48.3 c
U	Z	iP	47.8 c
Pa	Z	iP	44.8 c

C&GS card 67-63:
11:34:23.4
17.7° N., 94.3° W.
Veracruz, Mexico
h about 163 km
Magnitude 4.9 (CGS).

Aug. 18

M	Z	eP	18:50:10.2 c
A	Z	iP	12.2 c
U	Z	eP	11.3 c
Hi	Z	iP	10.4 c
U	PEE	eL	18:58:00
U	PEZ	eR	18:59:33

C&GS card 65-63:
18:43:16.1
50.3° N., 176.9° W.
Andreanof Islands, Aleutian Islands
h about 33 km
Magnitude 5.5 (CGS).

Aug. 20

U	PEZ	eR	16:13:59

Aug. 20--Continued

C&GS card 65-63:
15:48:12.2
41.2° N., 142.7° E.
Off east coast of Honshu, Japan
h about 50 km
Magnitude 4.5 (CGS).

Aug. 22

Ha	Z	Tmax	10:09:25

C&GS card 68-63:
09:27:09.3
42.0° N., 126.2° W.
Off coast of Oregon
h about 33 km
Magnitude 5.6 (CGS).

Aug. 22

M	Z	iP	20:01:47.4 c
D	Z	iP	46.9 c
U	Z	eP	47.2 c
Pa	Z	eP	50.2 c
Na	Z	eP	45.1 c
Hi	Z	iP	50.5 c
Ha	Z	eP	51.1 c
U	PEZ	eP	50 d
U	PEZ	iR	20:16:46
U	PEE	iS	20:09:26

C&GS card 69-63:
19:52:25.0
9.4° S., 158.0° E.
Solomon Islands
Felt
h about 33 km
Magnitude 6.75-7 (Pas)
6.1 (CGS)
6.6 (HVO)
6-6.25 (Brk).

Table 5.--Distant earthquakes--Continued

August 25, 1963

M	Z	eP	12:25:27.3	c
A	Z	eP	27.0	c
D	Z	eP	25.8	c
MP	Z	eP	27.7	c
U	Z	eP	27.3	c
Pa	Z	eP	29.1	c
Hi	Z	iP	29.7	c
Ka	Z	iP	31.0	c
Ha	Z	iP	32.3	c
U	PEZ	iP	27	c
U	PEZ	ipP	12:27:06	
U	PEZ	iPP	12:27:18	
U	PEZ	iSS	12:35:52	
U	PEE	isP	12:28:10	
U	PEE	iS	12:31:18	
U	PEE	isS	12:34:32	

C&GS card 67-63:
12:18:12.5
17.5° S., 178.8° W.
Fiji Islands region
h about 565 km
Magnitude 6.5 (Pas)
6-6.25 (Brk)
6.1 (CGS)
6.5 (HVO).

Aug. 29

M	Z	iP	15:42:27.3	d
A	Z	eP	26.7	d
D	Z	eP	26.7	d
U	Z	iP	26.8	d
Pa	Z	iP	25.1	d
Na	Z	iP	23.8	d
Hi	Z	eP	27.7	c
Ha	Z	eP	33.5	d
U	PEZ	iP	27	d
U	PEZ	iS	15:52:58	
U	PEZ	iSSS	16:02:50	
U	PEZ	iG	16:06:02	

C&GS card 68-63:
15:30:31.4
7.1° S., 81.6° W.
Off coast of Peru
h about 23 km
Magnitude 6.5 (Pas)
6.1 (CGS)
6.8 (HVO).

September 4

M	Z	iP	13:43:19.0	c
A	Z	iP	19.3	c
D	Z	iP	19.6	c
MP	Z	eP	20.1	c
U	Z	eP	19.0	c
Hi	Z	eP	16.6	c
U	PEZ	eSS	13:57:40	
U	PEZ	iR	14:04:54	
U	PEN	eL	14:01:00	
U	PEE	eG	14:01:52	

C&GS card 71-63:
13:32:12.3
71.4° N., 73.3° W.
Near east coast of Baffin Island. Felt: Clyde River.
h about 33 km
Magnitude 6.25-6.5 (Pas)
6 (Bks)
5.9 (CGS)
6.2 (HVO).

Sept. 6

M	Z	eP	21:03:51.9	d
M	Z	Tmax	21:41:02	
MP	Z	Tmax	14	
U	Z	Tmax	12	
Pa	Z	Tmax	21:41:15	
Hi	Z	Tmax	21:40:53	
Ha	Z	Tmax	21:39:27	

C&GS card 72-63:
20:56:59.9
53.9° N., 165.6° W.
Fox Islands, Aleutian Islands
h about 33 km
Magnitude 5.0 (CGS).

Sept. 8

M	Z	eP	19:58:28.5	c
A	Z	eP	28.2	c
MP	Z	eP	28.3	c
U	Z	iP	28.3	c
Pa	Z	iP	29.9	c
Ka	Z	iP	31.9	c
Hi	Z	iP	31.1	c
Ha	Z	iP	33.9	c

September 8, 1963--Continued

C&GS card 72-63:
19:50:29.8
23.6° S., 179.8° E.
Fiji Islands region
h about 550 km
Magnitude 5.7 (CGS).

Sept. 9

M	Z	eP	02:55:29.1	c
Hi	Z	eP	29.3	c
Ha	Z	eP	31.2	c
U	PEZ	iP	28	c
U	PEZ	eG	03:03:34	
U	PEZ	eR	03:11:52	
U	PEE	eS	03:03:17	
M	Z	Tmax	03:55:51	
A	Z	Tmax	38	
D	Z	Tmax	48	
U	Z	Tmax	48	
Ka	Z	Tmax	03:56:02	
Ha	Z	Tmax	03:56:27	

C&GS card 72-63:
02:45:45.5
4.4° S., 152.7° E.
New Britain;
felt, Rabaul
h about 3 km
Magnitude 5.6 (CGS)
6.3 (HVO).

Sept. 11

M	Z	eP	09:11:23.4	c

C&GS card 75-63:
08:59:37.6
3.5° S., 131.2° E.
Ceram
h about 33 km
Magnitude 5.7 (CGS).

Sept. 13

M	Z	eP	17:07:25.4	c
A	Z	eP	24.8	c
D	Z	eP	26.3	c

Sept. 13--Continued

MP	Z	eP	24.3	c
U	Z	eP	25.1	c
Pa	Z	eP	22.4	c
Na	Z	eP	29.6	d
Hi	Z	eP	21.9	c
Ha	Z	eP	24.2	d

No C&GS preliminary listing.

Sept. 14

M	Z	iP	04:01:53.8	d
A	Z	eP	53.3	d
MP	Z	eP	52.9	d
U	PEZ	iR	04:17:16	

C&GS card 77-63:
03:52:16.9
31.4° S., 179.0° W.
Kermadec Islands
h about 33 km
Magnitude 4.9 (CGS)
5.9 (HVO).

Sept. 15

M	Z	iP	00:55:35.5	d
A	Z	iP	35.4	d
D	Z	iP	34.4	d
U	Z	iP	35.3	d
Pa	Z	iP	37.3	d
Na	Z	iP	31.5	d
Ka	Z	eP	39.6	d
Hi	Z	iP	38.4	d
Ha	Z	iP	40.8	
U	PEZ	iP	35	d
U	PEZ	iS	01:02:42	
U	PEZ	iR	01:08:57	
U	PEN	iG	01:06:28	
M	Z	Tmax	01:47:23	
A	Z	Tmax	19	
D	Z	Tmax	22	
U	Z	Tmax	21	
Ha	Z	Tmax	01:47:51	

C&GS card 75-63:
00:46:54.1
10.3° S., 165.6° E.
Santa Cruz Islands. Felt, Vanikoro.
h about 33 km
Magnitude 7.25-7.5 (Pas)
6.3 (CGS)
6.75-7 (Pal)
7.5 (HVO).

September 16, 1963

U	PEZ	eR	20:28:10

C&GS card 76-63:
20:05:21.9
13.4° S., 166.5° E.
Santa Cruz Islands
h about 28 km
Magnitude 5.0 (CGS).

Sept. 17

D	Z	eP	06:07:08.0	c
Pa	Z	eP	08.5	c
U	PEZ	eP	06:31:52	
M	Z	Tmax	07:36:04	
A	Z	Tmax	34	
D	Z	Tmax	36	
MP	Z	Tmax	16	
U	z	Tmax	22	
Pa	Z	Tmax	07:35:43	
Na	Z	Tmax	07:36:23	

C&GS card 75-63:
05:54:33.7
10.6° S., 78.2° W.
Central Peru
h about 61 km
Magnitude 6.75 (Pas)
5.5 (CGS)
6.0 (HVO).

Sept. 17

M	Z	iP	19:28:54.2	d
A	Z	eP	53.4	d
D	Z	eP	53.1	d
U	Z	iP	54.0	d
Pa	Z	iP	54.6	c
Na	Z	iP	51.5	d
Hi	Z	iP	54.9	c
Ha	Z	iP	56.5	c
U	PEZ	iP	54	d
U	PEZ	iS	19:36:00	
U	PEZ	iR	19:42:09	
U	PEN	iG	19:39:47	
M	Z	Tmax	20:20:44	
U	Z	Tmax	23	

Sept. 17--Continued

C&GS card 76-63:
19:20:08.2
10.1° S., 165.3° E.
Santa Cruz Islands
Felt: Eastern Solomon Islands
h about 17 km
Magnitude 7.25 (Pas)
7.5 (Brk)
7 (Pal)
6.1 (CGS)
7.5 (HVO).

Sept. 22

M	Z	iP	02:55:57.4	c
N	Z	eP	58.0	c

C&GS card 76-63:
02:49:03.4
52.5° N., 174.9° W.
Andreanof Islands, Aleutian Islands.
h about 105 km
Magnitude 4.8 (CGS).

Sept. 22

M	Z	eP	03:05:01.7	d
A	Z	eP	00.6	d
D	Z	eP	00.4	d
Pa	Z	eP	02.7	d
Hi	Z	eP	03.3	d
Ha	Z	eP	05.3	c
U	PEZ	iP	01	d
U	PEZ	eR	03:18:10	
U	PEN	iS	03:12:12	

C&GS card 82-63:
02:56:24.3
19.3° S., 175.9° E.
Fiji Islands region
h about 28 km
Magnitude 5.8 (CGS).

Sept. 22

M	Z	iP	19:30:33.7	c
A	Z	iP	33.4	c
N	Z	iP	33.6	c

September 22, 1963--Continued

MP	Z	iP	33.3 c
Pa	Z	eP	34.6 d
Na	Z	eP	30.1 d
Ka	Z	eP	35.9 c
Hi	Z	eP	37.3 c

C&GS card 76-63:
19:21:57.1
19.2° S., 175.9° E.
Tonga Islands region
h about 24 km.

Sept. 23

M	Z	eP	17:09:51.0 c

C&GS card 76-63:
17:02:36.6
51.3° N., 179.2° W.
Andreanof Islands, Aleutian Islands.
h about 33 km
Magnitude 5.2 (CGS).

Sept. 24

M	Z	iP	16:42:28.8 c
A	Z	iP	28.2 c
D	Z	iP	28.3 c
N	Z	iP	28.3 c
MP	Z	iP	27.4 c
Pa	Z	iP	29.0 c
Na	Z	iP	29.5 c
Ka	Z	iP	31.6 c
Ha	Z	iP	32.5 c
U	PEZ	iP	28 c
U	PEZ	ipP	16:43:04
U	PEZ	iPP	16:45:42
U	PEZ	ePS	16:53:37
U	PEZ	eSS	16:58:13
U	PEZ	eR	17:07:28
U	PEN	iS	16:52:38
U	PEN	eSSS	17:01:52
U	PEN	iG	17:04:20
U	PEE	esS	16:53:18
U	PEE	isPS/ sSP	16:54:09

Sept. 24--Continued

C&GS card 76-63:
16:30:16.0
10.6° S., 78.0° W.
Near coast of Peru
h about 80 km
Magnitude 7 (Pas)
6.5 (Brk)
6.0 (CGS)
6.6 (HVO).

Sept. 25

M	Z	eP	14:59:06.3 d

C&GS card 77-63:
14:50:18.2
10.1° S., 164.5° E.
Solomon Islands region
h about 33 km
Magnitude 5.1 (CGS).

Sept. 26

Pa	Z	Tmax	05:06:18
Ha	Z	Tmax	05:05:01

C&GS card 77-63:
04:20:21.5
56.5° N., 153.4° W.
Kodiak Island region
h about 33 km
Magnitude 4.8 (CGS).

Sept. 26

M	Z	eP	05:35:00.4 c
U	PEZ	eS	05:40:42
U	PEZ	eR	05:44:14
U	PEE	eL	05:42:28

C&GS card 76-63:
05:28:07.3
50.4° N., 176.9° W.
Andreanof Islands, Aleutian Islands.
h about 33 km
Magnitude 5.3 (CGS).

September 26, 1963

M	Z	Tmax	07:26:51
A	Z	Tmax	07:27:16
D	Z	Tmax	07:27:20
MP	Z	Tmax	07:27:20
U	Z	Tmax	07:27:09
Pa	Z	Tmax	07:27:04
Ha	Z	Tmax	07:25:31

C&GS card 77-63:
06:40:43.5
56.6° N., 153.2° W.
Kodiak Island region
h about 33 km
Magnitude 4.8 (CGS).

Sept. 27

U	PEN	eS	11:41:24
U	PEN	eG	11:44:49
U	PEZ	eR	11:46:53

C&GS card 79-63:
11:25:53.6
17.2° S., 174.7° E.
Fiji Islands region
h about 33 km
Magnitude 5.0 (CGS).

Sept. 28

M	Z	iP	07:07:09.4 d
A	Z	iP	08.9 d
D	Z	iP	08.0 d
MP	Z	iP	08.9 d
U	Z	iP	09.2 d
Hi	Z	eP	10.4 d
Na	Z	eP	06.1 d
Ka	Z	iP	11.6 d

C&GS card 79-63:
06:58:12.7
31.5° S., 179.6° E.
Kermadec Islands
h about 457 km
Magnitude 5.0 (CGS).

During the quarter "felt reports" were either phoned or mailed in by the following people to whom we wish to express our gratitude for these and other instances of cooperation.

North Hawaii

Mrs. Lindsey
Mrs. Ecklund
Mrs. Van Gorder
Dr. Heather
Mr. Hea
Mrs. Calles

Kau

Mrs. Billings
Mrs. Paiva
Mr. Meinecke

Hilo region

Mrs. Shoemaker
Mrs. Ingledue
Mrs. Shaffer
Mr. Baldwin
Mrs. Baldwin
Mr. Donahoe
Mr. Ho
Mr. Wessel
Mr. Potlock
Mr. Usagawa
Mr. Kumuhaki
Mr. Reeves
Mr. Guerimo

Puna

Mrs. Isbell
Mrs. Kimura
Miss Takemoto

Kona coast

Mr. Johnston
Mr. Glass
Mrs. Fujino
Mr. Sutherland
Miss Greenwell
Miss Wallace
Mr. Apple
Mrs. Apple
Mr. Ladd

Kilauea summit area

Mrs. Mist
Mr. Koyanagi
Mrs. Forbes
Dr. Wentworth
Dr. Moore
Mr. Francis
Mr. Young
Mr. Yamamoto
Miss English
Mr. Shipman
Mr. Correa
Mr. Cuskelly
Mrs. Hansen

Central Hawaii

Kulani Honor Camp

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

HAWAIIAN VOLCANO OBSERVATORY

SUMMARY 32

October, November, and December 1963

By

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Chronological summary

A flank eruption lasting less than 30 hours occurred on the central part of the east rift zone of Kilauea Volcano (fig. A) on October 5 and 6, 1963, just 43 days after the last previous eruption in Alae Crater.

The eruption was preceded by a marked deflation of the summit of Kilauea, which began at 03^h06^m October 5, as indicated by a deflection of the long-period seismographs at Uwekahuna. Ten minutes later seismographs at the summit and upper east rift zone began to record strong harmonic tremor and local shallow earthquakes. Harmonic tremor increased markedly after 05^h25^m, which may have marked the beginning of the eruption in Napau Crater.

A pilot who flew over Napau Crater at 06^h05^m on a flight to Naalehu observed lava fountaining from a fissure extending across the floor of the crater. When an Observatory party arrived at Makaopuhi Crater at 06^h08^m they observed a billowing fume cloud and heard a faint roar to the northeast. At 08^h50^m when they reached the southwest rim of Napau Crater an active line of lava fountains up to 50 feet high extended across the floor of the pit crater slightly north of the 1840 spatter ridge, and 80 percent of the floor of the crater was flooded with 20 feet of lava. Spatter and a small pad of lava across the trail northwest of Napau was still fuming when first seen at 09^h05^m.

Beginning at 09^h30^m regular aerial observation of the eruption was begun. At that time a line of vents extended from the west side of Napau Crater 4 miles to the northeast along the rift zone. At about 14^h00^m a quarter-mile line of 150-foot-high fountains broke out farther down the rift zone near Kalalua Crater. These fed two lava flows that were moving side by side down the rift zone. By 20^h30^m the flows had reached slightly more than a mile from the source fountains and were moving at less than 1/4 mile per hour; by 04^h00^m the next morning the glow of fountains had ceased and the flows, now 1 1/2 miles long, had stopped. The final outbreak of the eruption occurred at 09^h40^m on a fissure about 3 miles northeast of Napau Crater. Lava fountained briefly to heights of 25 feet, but by 09^h50^m the vent spattered weakly and presumably it soon died.

The site of the eruption, an inaccessible area of rain forest, severely hampered observations both during and after the eruption. However, the upper half of the area was examined on foot in October and December, and the lower part was sampled and mapped by helicopter in January. These studies, together with aerial photographs of the area taken by the Navy in November, show that an almost continuous line of active vents extended 7-3/4 miles northeastward along the rift zone from a point 1/3 mile west of Napau Crater. The vents are on the extreme north side of the rift zone, and are arranged in a right offset en echelon pattern. In addition to the small areas of spatter the eruption produced a shallow lava lake in Napau Crater and two major flows: a mile-long flow 2 to 3 miles northeast of Napau, and a double flow

($2\frac{1}{2}$ miles long and as much as $\frac{1}{2}$ mile wide) north of Kalalua Crater. The flows contain from less than 1 percent to 15 percent olivine, probably cover about 1-1/3 square miles, and contain about 10 million cubic yards of lava. Occupation of the network of long-base tilt stations around the summit of Kilauea showed a marked deflation of the summit area between August 6 and October 10, and the short-base tilt instruments at Uwekahuna indicated that the detumescence associated with the October eruption was equivalent to the removal of approximately 30 million cubic yards of magma from the summit reservoir.

J. G. M. and D. L. P.

During the eruption, readings of the short-base tiltmeter (table 1) showed strong collapse along the direction E. 28° S., and for a week following the eruption showed moderate collapse to the south. For about a month, from October 15 to November 15, the tilt indicated slow tumescence along the direction W. 28° N. This was accompanied by a sporadic, moderate increase in the daily number of local caldera quakes. From mid-November to the year-end, tilt recovered slightly in a due west direction. Total recovery of tilt from the end of the eruption to the end of the year was less than 1/2 to the west and 1/5 to the north of that lost in the collapse. The daily number of small local quakes again showed sporadic and moderate increase during the last six weeks, and there was a slight peak of 30 deep small quakes on December 26.

Mid-October to early November was a period of high earthquake activity along the Kaoiki fault system. On October 23 a Kaoiki quake of magnitude 5.3 occurred and was followed by several hundred smaller shocks. Several of these were felt.

Two distant earthquakes originating in the Kurile Islands were large enough to alert coastal residents of Hawaii of possible sea wave activity. These occurred on October 12 and 20 (H.S.T.) with magnitudes of 8.1 and 7.6, respectively. No damaging sea wave occurred in Hawaii.

H. A. P.

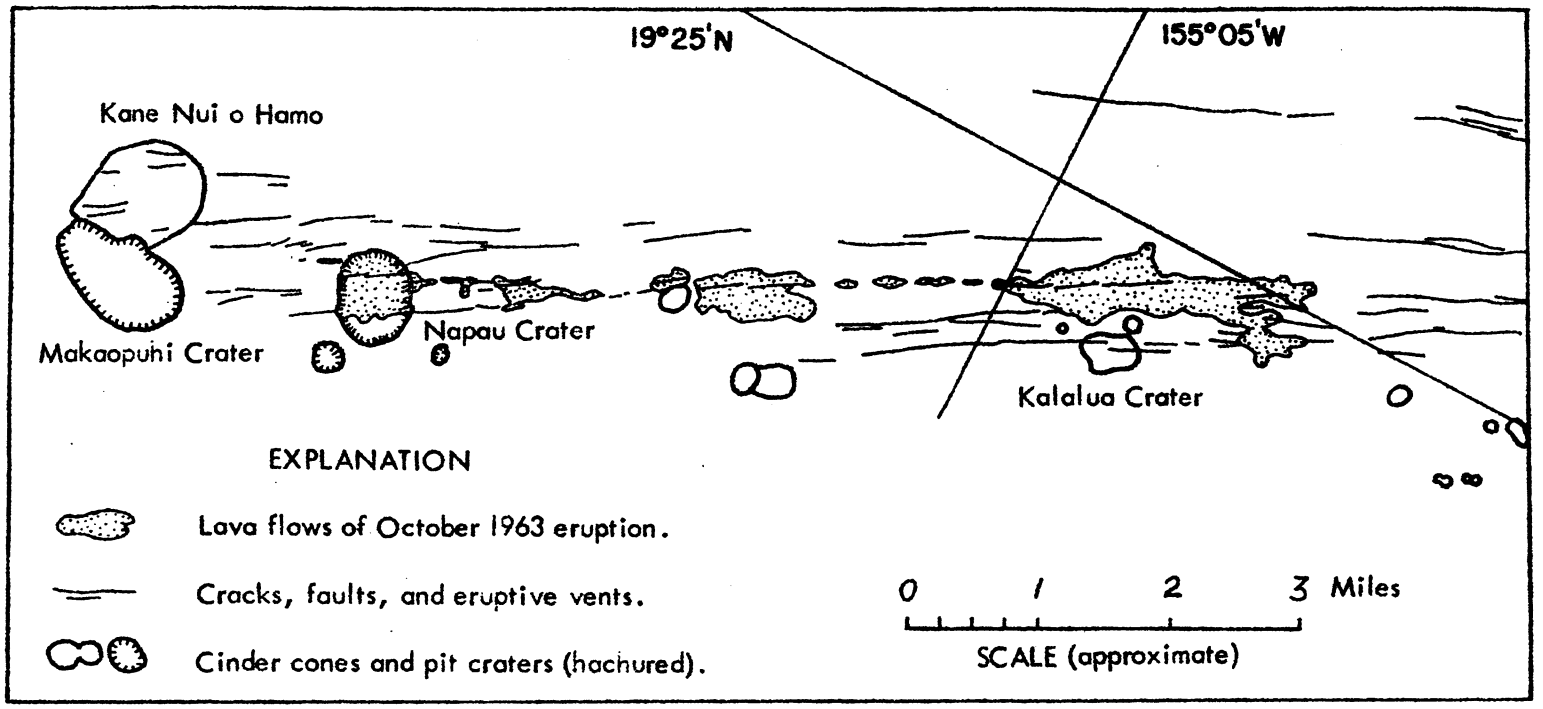

Figure A. Preliminary map showing area of lava erupted October 5-6, 1963.

(East Rift Zone)

26.

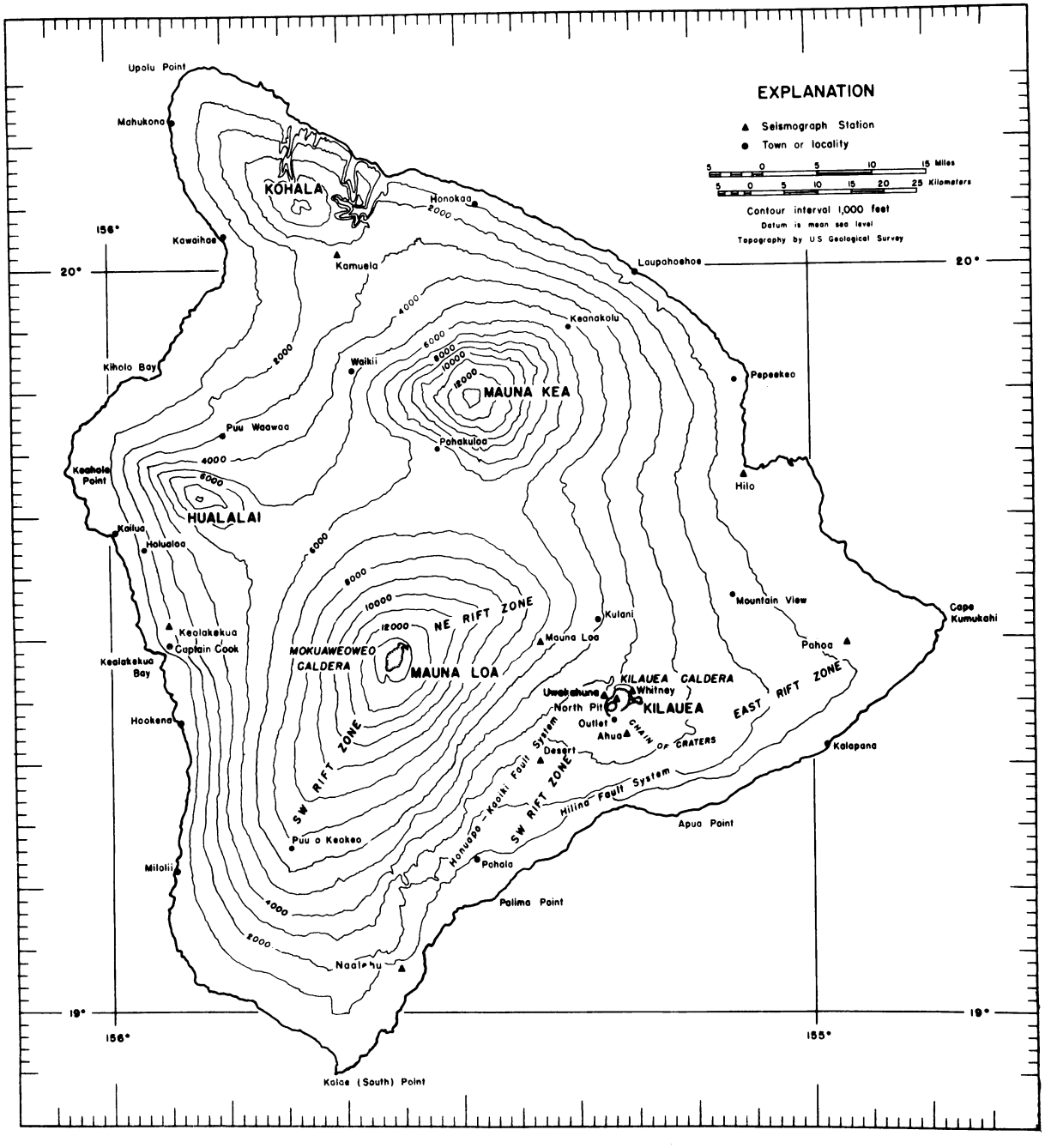

Figure 1.--Map of the island of Hawaii showing seismograph stations operated by the Geological Survey and localities mentioned in the text. Epicenters of local earthquakes are given in terms of geographic coordinates, which are indicated at the edges of the map.

Tilting of the ground around Kilauea caldera.--Tilting of the ground around the summit of Kilauea is monitored daily by a short-base water-tube tiltmeter in Uwekahuna Vault, and at irregular intervals it is measured on a regional scale by means of a network of field tilt-bases and a portable water-tube tiltmeter. The attitude of the ground surface at each tilt base is reported in terms of north-south and east-west tilt coordinates. Both coordinates at each station were arbitrarily set equal to 500 when measurements at that station were begun. Increasing tilt coordinates correspond to northward and eastward tilting of the earth's surface, i.e., to a relative subsidence toward the north and east. A one unit-change in coordinate corresponds to a tilting of 1 microradian (1 mm per km) in the direction indicated.

Table 1.--Tilt coordinates at Uwekahuna Vault, October, November, and December, 1963

Date	N-S	E-W	Date	N-S	E-W
Oct. 6	480	516	Dec. 1	467	511
13	461	538	8	467	510
20	461	535	15	467	510
27	462	530	22	467	506
Nov. 3	465	522	29	468	505
10	466	519			
17	467	514			
24	467	513			

Table 2.--Tilt coordinates and changes at bases around Kilauea caldera (see fig. 2)

Tilt base (location)	Date (1963)	Tilt coordinates		Rate (10^{-6} rad/mo) and direction of tilting since last reading		Date of last reading (1963)
		N-S	E-W			
Uwekahuna (19°25.5' N., 155°17.4' W.)	Oct. 10	420.8	527.5	37.3	S. 36° E.	Aug. 6
Tree Molds (19°26.3' N., 155°17.3' W.)	9	422.7	527.3	17.0	S. 19° E.	6
Sand Spit (19°24.1' N., 155°16.8' W.)	11	860.2	797.9	40.4	N. 61° E.	12
Kalihipaa (19°21.4' N., 155°15.3' W.)	7	363.8	351.8	18.1	N. 43° W.	5
Keamoku (19°25.1' N., 155°19.0' W.)	7	501.6	605.9	34.2	S. 57° E.	12
Ahua Kamokukolau (19°22.7' N., 155°16.6' W.)	10	628.2	529.8	47.0	N. 14° W.	5
Kipuka Nene (19°19.4' N., 155°16.7' W.)	14	486.2	510.8	0.7	N. 27° E.	9
Hilina Pali (19°18.2' N., 155°18.6' W.)	14	497.4	501.5	0.3	S. 83° E.	6
Kapapala Ranch (19°20.5' N., 155°23.8' W°)	11	495.5	501.4	1.2	S. 56° W.	8

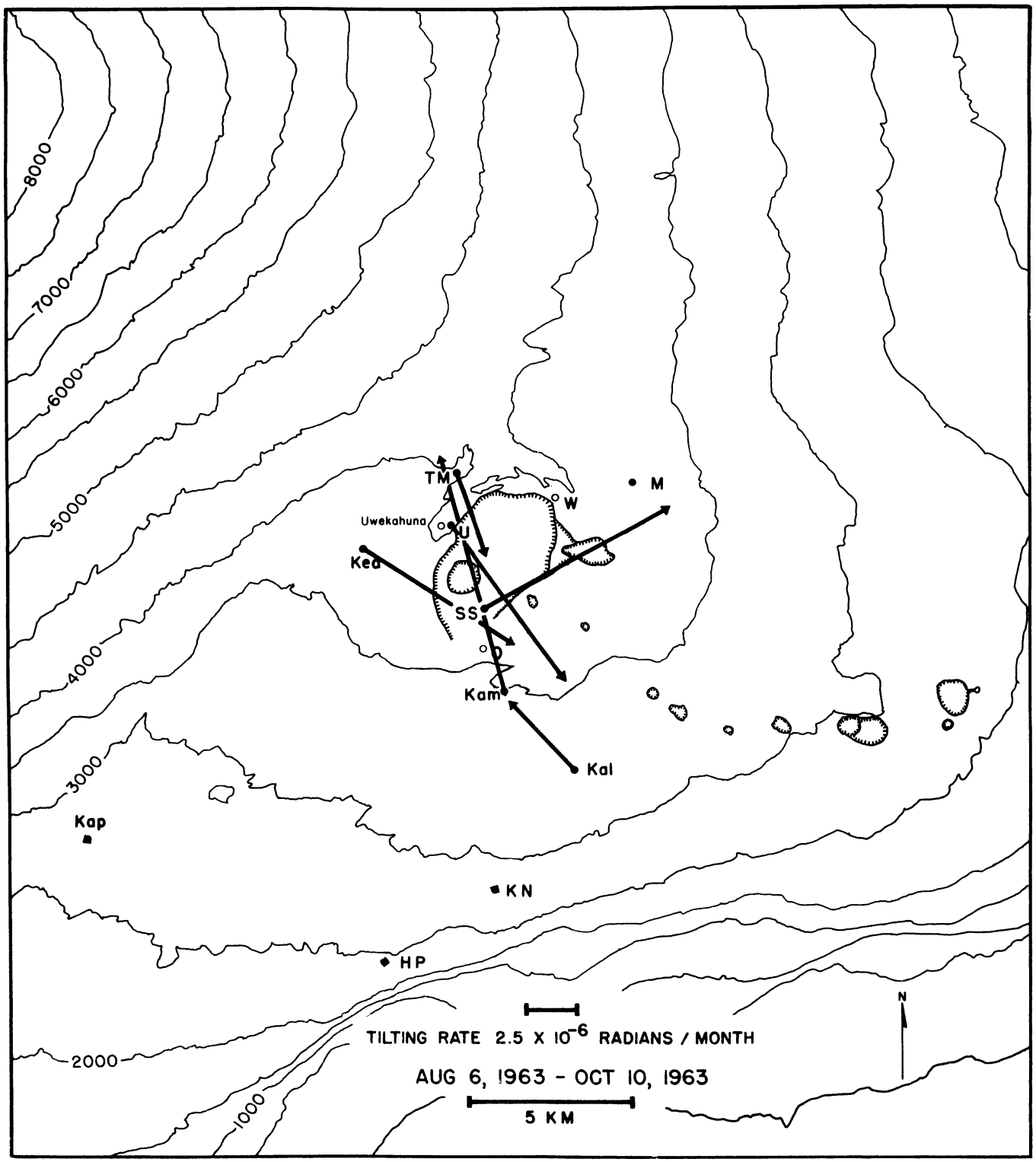

Figure 2.--Tilting of the ground around Kilauea caldera, August 6 to October 10, 1963. The vector depicting tilting at a given tilt base points in the direction of maximum relative subsidence and has a length proportional to the rate of tilting during the measurement interval. Closed circles represent field tilt bases; open circles, short-base water-tube tiltmeters.

GPO 846-800

Seismic summary.--Events recorded by the U.S. Geological Survey seismograph network in Hawaii fall into two categories: Local earthquakes and tremor originating in the region of the Hawaiian Islands, usually within 100 km of at least one seismograph, and distant earthquakes originating more than 3,000 km from Hawaii. As an index of seismic activity at Hawaiian volcanoes, daily counts of earthquakes and minutes of tremor recorded by seismographs in Hawaii are listed in table 3. The earthquakes are separated into groups on the basis of region of origin as determined by analysis of records obtained daily at the Observatory (U, M, A, D, N, MP). Earthquakes of magnitude 2.5 or greater are generally sufficiently well recorded to be located with greater precision; they are listed individually in table 4. Data on identifiable phases from distant earthquakes are listed in table 5.

Locations of the seismograph stations are shown in Figure 1, and essential data on the stations were given in Summaries 25 and 29.

Table 3.--Numbers of earthquakes and minutes of tremor recorded on seismographs U, M, A, D, N, WP, and MP around Kilauea caldera

Tremor is separated into three categories: deep, intermediate, and shallow, on the basis of relative amplitudes on seismographs in the summit region. Unless otherwise stated, tremor is presumed to be associated with movement of magma within the central complex of Kilauea.

Earthquake categories are: Halemaumau rock slides, which are detected by the characteristic record they produce on the North Pit seismograph; shallow earthquakes in the Kilauea caldera region; shallow earthquakes along the SW. rift zone of Kilauea and the adjacent portion of the Kaoiki fault system; earthquakes along the eastern half of Kilauea's east rift zone--detected largely on the Pahoa short-period vertical; earthquakes from a source about 30 km beneath Halemaumau; earthquakes from the upper east rift zone ahd the adjacent fault systems of Kilauea's south flank (these are usually first arrivals at the Ahua meter or at the new experimental geophone near Makaopuhi Crater (MP)); and earthquakes from other regions: Kona, Mauna Kea, etc.

Date (1963)	Tremor (in minutes)			Earthquakes						
	Deep	Inter-mediate	Shallow	Hale-maumau slides	Kilauea caldera	SW. rift and Kaoiki	Eastern East rift	Hale-maumau 30 km	Upper East rift	Others
Oct. 1	----	------	------	------	145	65	2	5	6	----------
2	3	------	------	------	140	59	6	2	5	----------
3	----	------	------	------	115	57	5	4	8	----------
4		Although many hundreds of earthquakes were recorded during this								
5		period (eruption), their arrival times were obscured by strong								
6		continuous harmonic tremor; therefore, few epicenters were located.								
7	----	------	------	------	20+	14+	2	5	200+	3 Offshore
8	----	------	------	------	40+	34+	-----	3+	165+	----------
9	----	------	------	------	40+	20	-----	10	50+	2 Offshore
10	----	------	------	1	40+	29	1	3	25	1 Offshore 1 Mauna Loa
11	----	------	------	------	40+	11	-----	7	30	4 Offshore 1 Offshore-Maui

Table 3.--Numbers of earthquakes and minutes of tremor recorded on seismographs U, M, A, D, N, WP, and MP around Kilauea caldera--Continued

Date (1963)	Tremor (in minutes)			Earthquakes						
	Deep	Inter-mediate	Shallow	Hale-maumau slides	Kilauea caldera	SW. rift and Kaoiki	Eastern East rift	Hale-maumau 30 km	Upper East rift	Others
Oct. 12	----	6	------	-----	25+	85+	-----	3	10	1 Offshore
13	----	-----	------	-----	30+	40	-----	-----	9	1 Kona 1 Offshore
14	----	-----	------	1	40	21	1	-----	8	1 Offshore 1 Kona
15	----	-----	2	1	15	14	1	3	7	----------
16	----	-----	5	-----	30+	23	1	1	-----	----------
17	----	-----	------	1	20	21	-----	2	17	----------
18	----	-----	------	-----	17	10	-----	5	5	1 S. Pali
19	----	5	5	-----	25	19	-----	------	4	1 Offshore
20	----	-----	3	1	25+	12	-----	------	17	2 Offshore
21	----	2	------	-----	50+	14	-----	------	10	----------
22	----	-----	------	1	30	17	-----	------	5	1 Offshore-Maui 1 Kona
23	----	-----	------	-----	43	425+	-----	------	4	----------
24	----	-----	------	-----	40	76	-----	------	5	----------
25	----	-----	------	3	60	115	-----	------	8	----------
26	----	-----	------	1	35	73	-----	------	8	1 Mauna Loa
27	----	-----	------	1	70	64	-----	------	4	1 Mauna Loa
28	----	-----	3	-----	90	40	-----	------	4	1 Mauna Loa
29	----	-----	------	-----	70	34	-----	------	5	----------
30	----	-----	------	-----	80	98	-----	8	40	1 Offshore-Maui 1 Offshore
31	----	-----	------	-----	80	70	-----	6	26	----------

Table 3.--Numbers of earthquakes and minutes of tremor recorded on seismographs U, M, A, D, N, WP, and MP around Kilauea caldera--Continued

Date (1963)	Tremor (in minutes)			Earthquakes						
	Deep	Inter-mediate	Shallow	Hale-maumau slides	Kilauea caldera	SW. rift and Kaoiki	Eastern East rift	Hale-maumau 30 km	Upper East rift	Others
Nov. 1	----	-----	-----	------	80	70	----	8	23	----------
2	----	3	-----	------	70	80	----	-----	11	1 Mauna Loa
3	----	-----	-----	------	90	123	----	6	7	1 Mauna Loa 1 Mauna Kea
4	----	-----	-----	------	60	54	----	2	6	1 Mauna Kea
5	12	-----	-----	------	40	27	----	1	14	----------
6	----	-----	-----	------	20	18	2	-----	12	1 Offshore
7	----	-----	-----	------	40	26	----	-----	8	----------
8	----	-----	-----	1	50	16	----	-----	2	----------
9	----	-----	-----	------	100	88	----	-----	9	----------
10	----	3	-----	------	60	50	----	-----	10	----------
11	----	-----	-----	------	100	49	----	-----	12	----------
12	----	-----	-----	------	70	58	----	4	13	1 Kohala
13	----	-----	-----	------	35	41	----	-----	17	----------
14	33	-----	-----	------	55	15	----	6	15	1 Offshore 1 Mauna Kea
15	----	-----	-----	------	50	25	----	17	2	1 Offshore
16	----	-----	-----	------	51	34	----	10	8	----------
17	----	-----	-----	------	45	42	----	-----	13	1 Offshore
18	----	-----	-----	------	45	28	----	5	28	----------
19	----	-----	-----	------	40	42	----	4	13	----------
20	----	-----	-----	------	20+	25	----	4	18	----------
21	----	-----	-----	------	26+	25	----	-----	6	----------
22	----	-----	-----	------	47	49	----	-----	17	----------
23	----	-----	-----	------	34	17	----	8	7	1 Offshore
24	----	-----	-----	------	41	19	----	3	6	----------

Table 3.--Numbers of earthquakes and minutes of tremor recorded on seismographs U, M, A, D, N, WP, and MP around Kilauea caldera--Continued

Date (1963)	Tremor (in minutes)			Earthquakes						
	Deep	Inter-mediate	Shallow	Hale-maumau slides	Kilauea caldera	SW. rift and Kaoiki	Eastern East rift	Hale-maumau 30 km	Upper East rift	Others
Nov. 25	7	-----	------	1	26	19	----	4	10	----------
26	----	-----	------	------	33	8	----	1	15	----------
27	----	12	------	------	35	13	----	8	8	----------
28	----	4	------	------	35	13	----	-----	5	----------
29	----	-----	------	------	50	30	----	18	6	1 Mauna Kea
30	----	-----	------	------	60	31	----	-----	9	----------
Dec. 1	----	-----	------	------	78+	15+	----	3+	7	----------
2	----	-----	------	------	50	11	----	2	9	----------
3	----	-----	------	------	57	12	----	4	15	----------
4	----	-----	------	------	60	14	----	11	7	1 S. Pali
5	----	-----	------	------	52	31	----	11	9	----------
6	----	-----	------	------	95	36	----	7	6	----------
7	----	-----	------	------	100	31	----	8	6	----------
8	----	-----	3	------	90+	35+	----	1	6	1 Kona 1 Mauna Loa
9	----	-----	------	------	105+	43	----	7	11	1 Mauna Kea
10	36	2	------	------	120+	10	----	2+	10	----------
11	4	-----	------	------	115	40	----	3	13	----------
12	64	-----	------	------	55	14	----	2	13	----------
13	31	-----	------	------	65	36	----	6	7	----------
14	----	-----	------	------	65	25	----	6	15	1 Mauna Loa 1 Kawaihae
15	----	-----	------	------	78	12	----	----	6	----------
16	----	-----	------	------	75	10	2	6	7	1 Mauna Loa
17	----	-----	------	2	83	18	----	2	3	----------
18	----	------	------	------	85	25	----	14	2	----------

Table 3.--Numbers of earthquakes and minutes of tremor recorded on seismographs U, M, A, D, N, WP, and MP around Kilauea caldera--Continued

Date (1963)	Tremor (in minutes)			Earthquakes						
	Deep	Inter-mediate	Shallow	Hale-maumau slides	Kilauea caldera	SW. rift and Kaoiki	Eastern East rift	Hale-maumau 30 km	Upper East rift	Others
Dec. 19	----	------	------	------	85+	14	-----	2	6	1 Mauna Kea
20	----	------	------	------	80	18	-----	7	8	----------
21	----	------	------	------	160	40	-----	9	20	----------
22	----	------	------	------	180+	34	-----	6	13	----------
23	----	------	------	------	39	7	-----	2	3	1 Offshore
24	----	------	------	------	90	30	-----	6	4	----------
25	----	------	------	------	190	30	-----	15	6	----------
26	----	------	------	------	170	18	-----	30	10	----------
27	----	------	------	------	150	25	-----	5	7	1 Kawaihae
28	----	------	------	------	170+	28	-----	10	10	----------
29	----	------	------	------	180+	35	-----	1	12	----------
30	----	------	4	------	175+	18	-----	12	9	----------
31	----	3	------	------	60+	16	-----	4	6	1 Offshore

Table 4.--Local earthquakes recorded by seismographs of the U.S. Geological Survey, October, November, and December, 1963

[Entries for a given quake are: date, origin time (Hawaiian Standard Time), magnitude, depth, epicenter, and felt report. All earthquakes of magnitude 2.5 and larger, as well as many favorably located smaller ones, occurring on or near the island of Hawaii are included in the list.

In the following list, some origin times are followed only by "KM 30" and a statement of magnitude. These are all members of a continuing family of quakes noted also in other Summaries. The best mean focus for this group is beneath Halemaumau at a depth of 30 km (19°24.1' N., 155°17.1' W.).

In the following list a number of quakes are described as "Upper east rift" (see Summary 28). Further statistical study of this group which occurred in the swarm periods during July 1 to 6 and August 3 to 4 gives a mean epicenter 19°21.5' N., 155°14' W. about 2 km south of Aloi Crater at near-surface depth.

In Summary 24, "Kaoiki" was introduced as a symbol for listing any of a family of quakes with mean focus 19°24' N., 155°24' W., h=3 to 8 km. This symbol is used in the following list]

Date (1963)	Time			Magnitude	Depth (km)	Epicenter			Felt Report
	h	m	s			Lat. N.	Long. W.	Description	
Oct. 1	00	06	04.2	2.4	30	19°08.5'	155°26.6'	7 km SE of Pahala---------	----------
1	11	04	04.3	2.2	10	19°17.1'	155°05.4'	48 km S. of Hilo----------	----------
4	06	39	04.1	2.0	----	--------	---------	KM 30----------	----------
4	07	04	33.3	2.0	----	--------	---------	KM 30----------	----------
5	Shallow harmonic tremor and earthquakes start at 03:16. Although hundreds of earthquakes were recorded during the eruption, their wave arrivals were obscured by strong harmonic tremor and few epicenters could be located precisely. These shocks originated mainly along or south of the upper and middle sections of the east rift of Kilauea.								
5	03	32	23.0	3.1	3	19°22.6'	155°08.1'	5 km ENE of Makaopuhi seismometer.	----------
5	03	40	17.0	3.4	3	19°22.6'	155°09.1'	4 km NE of Makaopuhi seismometer.	----------

Table 4.--Local earthquakes recorded by seismographs of the U.S. Geological Survey, October, November, and December, 1963--Continued

Date (1963)	Time			Magnitude	Depth (km)	Epicenter			Felt Report
	h	m	s			Lat. N.	Long. W.	Description	
Oct. 5	03	56	14.5	2.9	3	19°22.0'	155°08.0'	5 km E of Makaopuhi seismometer.	----------
5	03	58	08.6	3.1	3	19°22.6'	155°08.9'	4 km ENE of Makaopuhi seismometer.	----------
5	04	14	04.2	3.3	3	19°22.2'	155°09.0'	3 km ENE of Makaopuhi seismometer.	----------
5	04	20	41.4	2.6	3	19°22.6'	155°08.9'	4 km ENE of Makaopuhi seismometer.	----------
5	04	24	59.5	3.5	3	19°22.0'	155°08.0'	5 km E of Makaopuhi seismometer.	----------
5	04	51	07.5	2.7	3	19°22.8'	155°08.5'	4 km ENE of Makaopuhi seismometer.	----------
5	05	44	41.7	2.6	3	19°22.8'	155°06.2'	8 km ENE of Makaopuhi seismometer.	----------
5	10	25	57.9	3.0	3	19°20.7'	155°15.0'	4 km SE. of Ahua seismometer.	----------
5	10	41	22.5	3.1	<3	19°20.4'	155°17.5'	5 km SW. of Ahua seismometer.	----------

Table 4.--Local earthquakes recorded by seismographs of the U.S. Geological Survey, October, November, and December, 1963--Continued

Date (1963)	Time			Magnitude	Depth (km)	Epicenter			Felt Report
	h	m	s			Lat. N.	Long. W.	Description	
Oct. 5	18	10	14.5	2.7	5	19°21.7'	155°15.6'	1 km SE. of Ahua seismometer.	----------
5	19	26	51.9	3.1	<3	19°20.9'	155°16.5'	3 km SSW. of Ahua seismometer.	----------
5	20	42	35.7	2.8	3	19°20.3'	155°15.2'	4 km SSE. of Ahua seismometer.	----------
5	20	54	00.2	3.4	3	19°20.6'	155°14.8'	5 km SE. of Ahua seismometer.	----------
5	21	39	53.6	2.9	5	19°21.9'	155°16.7'	1 km SW. of Ahua seismometer.	----------
5	21	45	25.2	2.4	5	19°21.5'	155°15.8'	1 km S. of Ahua seismometer.	----------
6	00	38	28.2	2.6	8	19°17.9'	155°02.6'	17 km SE. of Makaopuhi seismometer.	----------
6	04	05	43.0	2.5	10	19°21.1'	155°05.8'	10 km E. of Makaopuhi seismometer.	----------
6	06	19	21.9	3.0	13	19°22.8'	155°07.5'	6 km ENE. of Makaopuhi seismometer.	----------
6	08	09	49.6	2.5	10	19°20.2'	155°01.0'	5 km WSW. of Kalapana	----------
6	09	28	48.4	2.4	10	19°24.2'	155°05.9'	11 km NE. of Makaopuhi seismometer.	----------
6	10	07	26.9	2.7	8	19°17.1'	155°00.6'	8 km SW. of Kalapana	----------
6	12	26	28.8	3.4	10	19°21.8'	155°09.5'	3 km E. of Makaopuhi seismometer.	Felt in Hilo, Kapapala, and Kilauea district.
6	21	04	41.5	2.6	10	19°16.8'	155°03.1'	49 km SSE. of Hilo	----------
7	04	08	07.9	2.7	13	19°20.2'	155°06.7'	8 km ESE. of Makaopuhi seismometer.	----------
7	06	34	11.0	3.0	10	19°12.1'	155°07.5'	10 km SE. of Apua Point.	----------

Table 4.--Local earthquakes recorded by seismographs of the U.S. Geological Survey, October, November, and December, 1963--Continued

Date (1963	Time			Magnitude	Depth (km)	Epicenter			Felt Report
	h	m	s			Lat. N.	Long. W.	Description	
Oct. 7	17	05	15.3	2.5	8	19°19.8'	155°03.7'	45 km SSE. of Hilo	----------
7	20	14	48.8	2.5	10	19°18.8'	155°05.8'	45 km S. of Hilo	----------
7	21	40	28.4	2.6	5	19°12.4'	155°10.8'	7 km SSE. of Apua Point	----------
7	22	20	33.7	3.7	5	19°12.5'	155°10.5'	7 km SSE. of Apua Point	Felt in Kilaua district.
8	06	10	52.0	2.0	---	-------	--------	KM 30----------	----------
8	11	44	35.3	3.3	8	19°18.6'	155°05.1'	45 km S. of Hilo-------	Felt in Kilauea district.
9	03	15	04.1	2.6	10	19°17.9'	155°13.3'	5 km NW. of Apua Point	----------
9	18	45	24.0	2.0	3	19°06.0'	155°08.2'	18 km SE. of Apua Point	----------
9	19	05	27.0	2.2	3	19°06.0'	155°08.2'	18 km SE. of Apua Point	----------
10	00	07	05.6	2.5	8	19°15.7'	155°01.2'	5 km SW. of Kalapana	----------
10	21	34	29.6	2.8	8	19°08.1'	155°44.0	18 km NW. of Naalehu---	----------
10	20	02	18.2	2.3	35	19°11.2'	155°28.1'	2 km SE. of Pahala-----	Felt in Pahala----
11	11	04	35.7	2.0	8	19°05.8'	155°23.7'	21 km ENE. of Naalehu--	----------
11	13	40	11.2	2.4	3	19°15.4'	155°20.1'	11 km SE. of Desert seismometer.	----------
11	13	40	48.9	2.6	3	19°15.4'	155°20.1'	11 km SE. of Desert seismometer.	Felt in Kapapala
11	16	52	47.8	3.8	8	19°08.3'	155°05.0'	64 km S. of Hilo	Felt in Kilauea district.
11	17	37	34.4	2.2	8	19°08.3'	155°05.0'	64 km S. of Hilo	----------
11	17	38	16.3	2.3	10	19°14.8'	155°07.7'	7 km ESE. of Apua Point.	----------
11	22	44	22.4	2.2	8	19°12.0	155°21.1'	16 km SSE. of Desert seismometer.	----------
11	23	46	01.3	3.2	13	21°10'	155°20'	106 km NE. of Haleakala seismometer.	----------
12	16	39	39.2	2.8	8	19°06.6'	155°06.4'	67 km S. of Hilo-------	----------
12	18	14	25.6	2.8	8	19°14.5'	155°22.0	11 km S. of Desert seismometer.	----------
12	21	16	30.3	3.3	8	19°14.5'	155°22.3'	11 km S. of Desert seismometer.	----------

Table 4.--Local earthquakes recorded by seismographs of the U.S. Geological Survey, October, November, and December, 1963--Continued

Date (1963)	Time h	Time m	Time s	Magnitude	Depth (km)	Epicenter Lat. N.	Epicenter Long. W.	Epicenter Description	Felt Report
Oct. 13	01	45	04.2	2.2	----	-------	--------	Kaoiki----------	----------
13	06	37	08.0	2.8	3	19°25.3'	155°46.1'	20 km SE. of Kealakekua	----------
13	09	59	16.2	2.0	8	19°09.9'	155°11.5'	10 km S. of Apua Point	----------
13	12	06	13.3	2.6	5	19°17.8'	155°27.2'	9 km SW. of Desert seismometer.	----------
14	07	58	35.9	2.4	3	19°05.0'	155°15.0'	20 km SSW. of Apua Point	----------
14	23	36	03.1	2.7	<3	19°29.0'	155°53.0'	6 km SE. of Kealakekua	----------
15	13	57	01.2	2.8	---	--------	---------	KM 30----------	Felt in Kapapala
17	04	26	10.6	2.5	8	19°17.1'	155°14.9'	11 km SSE. of Ahua seismometer.	----------
17	09	27	56.4	2.0	8	19°18.0'	155°21.5'	5 km SE. of Desert seismometer.	----------
18	14	19	51.0	2.9	8	19°12.5'	155°20.9'	13 km E. of Pahala	Felt in Pahala
18	17	53	42.7	2.6	10	19°17.2'	155°08.7'	9 km SE. of Makaopuhi seismometer.	----------
19	16	34	34.9	2.9	3	19°03.1'	155°17.8'	31 km E. of Naalehu	----------
20	02	31	42.8	2.7	8	19°08.5'	155°15.8'	15 km SW. of Apua Point	----------
20	18	29	55.5	2.4	8	19°05.5'	155°16.3'	35 km E. of Naalehu	----------
20	11	20	36.2	2.4	---	--------	---------	Kaoiki----------	----------
21	14	49	17.2	2.0	13	19°18.2'	155°14.7'	8 km SSE. of Ahua seismometer.	----------
22	03	16	41.6	2.1	8	19°15.0'	155°13.7'	5 km WSW. of Apua Point	----------
22	03	54	23.6	2.0	10	19°19.5'	155°13.1'	6 km SW. of Makaopuhi seismometer.	----------
22	07	35	45.2	3.3	13	20°23'	156°14'	40 km S. of Haleakala seismometer.	----------
22	19	08	11.7	3.2	---	--------	--------	Kaoiki----------	Felt in Kilauea district.
22	21	01	19.0	2.7	3	19°28.0'	155°43.3'	21 km ESE. of Kealakekua	----------
23	10	24	06.4	5.3	---	--------	--------	Kaoiki----------	Felt island-wide
23	10	35	58.5	2.7	---	--------	--------	Kaoiki----------	----------
23	10	48	00.7	2.6	---	--------	--------	Kaoiki----------	----------
23	11	24	47.0	3.8	---	--------	--------	Kaoiki----------	Felt in Hilo, Pahala, and Kapapala.

Table 4.--Local earthquakes recorded by seismographs of the U.S. Geological Survey, October, November, and December, 1963--Continued

Date (1963)	Time			Magnitude	Depth (km)	Epicenter			Felt Report
	h	m	s			Lat. N.	Long. W.	Description	
Oct. 23	11	33	31.4	2.1	---	--------	-------	Kaoiki----------	----------
23	12	36	16.9	2.9	---	--------	-------	Kaoiki----------	Felt in Kapapala
23	12	53	56.0	2.0	---	--------	-------	Kaoiki----------	----------
23	13	02	48.8	2.0	---	--------	-------	Kaoiki----------	----------
23	13	28	10.1	2.7	---	--------	-------	Kaoiki----------	Felt in Kapapala and Kilauea district.
23	13	37	07.0	2.2	---	--------	-------	Kaoiki----------	Kaoiki
23	17	31	08.3	2.2	---	--------	-------	Kaoiki----------	----------
23	18	25	28.6	3.5	---	--------	-------	Kaoiki----------	Felt in Kapapala, Pahala, and Kilauea district.
23	20	52	57.6	2.8	---	--------	-------	Kaoiki----------	Felt in Kapapala
24	08	53	57.8	2.3	---	--------	-------	Kaoiki----------	----------
24	16	07	53.7	2.7	---	--------	-------	Kaoiki----------	Felt at Kapapala
25	15	29	34.0	3.8	---	--------	-------	Kaoiki----------	Felt in Kapapala, Pahala, and Kilauea district.
26	00	03	54.7	3.5	---	-------	-------	Kaoiki----------	Felt in Kilauea district.
26	02	29	04.8	3.3	---	-------	-------	Kaoiki----------	Felt in Kilauea district.
26	06	57	53.9	3.2	---	-------	-------	Kaoiki----------	Felt in Kilauea district.
26	13	09	28.4	2.4	8	19°11.3'	155°38.8'	15 km NW. of Naalehu	----------
26	22	46	40.6	2.2	---	-------	-------	Kaoiki----------	----------
27	00	46	59.0	2.1	8	19°14.2'	155°32.3'	8 km NW. of Pahala--------	----------
28	01	08	56.9	2.2	---	-------	-------	Kaoiki----------	----------
28	04	45	33.7	2.1	8	19°17.8'	155°32.6'	13 km NW. of Pahala-------	----------
29	13	01	45.3	3.3	30	19°17.5'	155°23.3'	6 km S. of Desert seismometer.	Felt in Kapapala

Table 4.--Local earthquakes recorded by seismographs of the U.S. Geological Survey, October, November, and December, 1963--Continued

Date (1963)	Time			Magnitude	Depth (km)	Epicenter			Felt Report
	h	m	s			Lat. N.	Long. W.	Description	
Oct. 29	23	53	42.5	2.3	25	19°14.7'	155°13.9'	5 km WSW. of Apua Point	----------
30	02	08	46.2	2.2	13	20°31'	155°53'	46 km SE. of Haleakala seismometer.	----------
30	05	40	29.0	2.0	---	--------	--------	Kaoiki----------	----------
30	07	15	19.9	2.4	---	--------	--------	Kaoiki----------	----------
30	07	20	26.2	2.2	---	--------	--------	Kaoiki----------	----------
30	12	57	04.2	2.7	---	--------	--------	KM 30----------	Felt in Kapapala
30	14	02	22.7	3.0	35	18°56.8'	155°22.8'	26 km SE. of Naalehu-----	Felt in Pahala
Nov. 1	13	48	05.2	2.7	---	--------	--------	KM 30----------	----------
2	12	46	04.5	2.6	---	--------	--------	Kaoiki----------	----------
2	22	09	42.6	2.7	---	--------	--------	Kaoiki----------	----------
2	03	22	32.9	2.7	8	19°12.4'	155°34.5'	17 km NNE. of Naalehu----	----------
3	10	35	56.4	3.4	5	19°12.1'	155°34.9'	15 km N. of Naalehu------	----------
3	21	23	25.4	3.7	13	20°09.3'	155°27.0'	8 km NNE. of Honokaa-----	Felt 1/2 of island
4	00	25	45.3	2.3	13	19°52.1'	155°29.6'	13 km NNE. of Pohakuloa	----------
5	06	45	27.0	3.4	---	--------	---------	Kaoiki----------	Felt Kapapala and Volcano.
5	22	01	02.5	3.1	5	19°12.2'	155°31.3'	5 km WNW. of Pahala------	----------
6	02	38	15.5	2.3	13	19°13.4'	154°58.2'	15 km S. of Kalapana-----	----------
7	08	43	03.7	2.2	---	--------	---------	Kaoiki----------	----------
8	22	18	32.5	3.1	---	--------	---------	Kaoiki----------	----------
8	22	36	51.6	2.5	---	--------	---------	Kaoiki----------	----------
12	01	50	15.0	2.6	8	19°16.4'	155°10.2'	3 km NE. of Apua Point--	----------
12	18	48	15.5	2.3	8	19°13.2'	155°07.1'	10 km SE. of Apua Point--	----------
12	23	12	27.0	2.0	13	20°11.9'	155°38.2'	21 km NNE. of Kamuela seismometer.	----------
13	02	42	15.3	2.1	---	-------	---------	KM 30----------	----------
14	01	37	12.0	3.2	---	-------	---------	Kaoiki----------	Felt Kapapala and Volcano.
14	09	33	31.5	2.6	---	-------	---------	Kaoiki----------	Felt at Kapapala
14	21	50	16.0	2.9	13	19°46'	157°01'	120 km WNW. of Kealakekua	----------

Table 4.--Local earthquakes recorded by seismographs of the U.S. Geological Survey, October, November, and December, 1963--Continued

Date (1963)	Time			Magnitude	Depth (km)	Epicenter			Felt Report
	h	m	s			Lat. N.	Long. W.	Description	
Nov. 14	23	38	50.5	2.6	3	19°54.0'	155°32.5'	23 km SE. of Kamuela seismometer.	----------
15	04	02	09.0	3.5	13	19°26'	156°09'	25 km WSW. of Kealakekua.	----------
15	07	18	34.0	2.1	----	-------	--------	Kaoiki----------	----------
15	09	01	26.5	3.8	----	-------	--------	KM 30----------	Felt in half of island.
15	10	11	33.2	2.2	----	-------	--------	KM 30----------	----------
16	06	55	51.5	2.3	----	-------	--------	KM 30----------	----------
16	12	26	39.1	2.9	----	-------	--------	KM 30----------	----------
16	16	07	00.2	2.1	----	-------	--------	KM 30----------	----------
17	08	23	27.0	2.4	13	18°56'	155°09'	37 km SSE. of Apua Point	----------
17	11	16	14.0	2.5	----	-------	--------	Kaoiki----------	Felt at Kapapala
17	17	07	47.5	2.3	----	-------	--------	Kaoiki----------	----------
18	19	51	25.7	2.4	----	-------	--------	Kaoiki----------	----------
20	14	16	58.7	2.2	----	-------	--------	KM 30----------	----------
23	02	29	41.3	2.7	13	19°38'	156°35'	52 km WSW. of Keahole Point.	----------
26	00	13	18.5	2.4	----	-------	---------	Kaoiki----------	----------
26	11	21	18.5	3.3	3	19°21.8'	155°07.1'	13 km NE of Apua Point--	----------
27	02	14	52.5	2.0	----	-------	---------	Kaoiki----------	----------
29	18	02	58.0	3.6	8	19°20.1'	155°07.8'	12 km NE. of Apua Point	Felt in Volcano, Puna, and Kulani.
29	19	51	25.3	2.2	13	19°56.2'	155°21.5'	13 km SW. of Laupahoehoe	----------
Dec. 2	03	11	22.6	2.3	----	--------	---------	KM 30----------	----------
3	09	51	26.5	2.9	8	19°16.2'	155°13.0'	3 km WNW. of Apua Point	----------
4	14	02	05.7	2.5	8	19°14.8'	155°15.8'	15 km S. of Ahua seismometer.	----------
8	01	34	07.0	2.2	8	19°33.8'	155°54.8'	6 km N. of Kealakekua	----------
8	20	49	50.8	2.0	8	19°12.2'	155°41.4'	18 km NW. of Naalehu	----------

Table 4.--Local earthquakes recorded by seismographs of the U.S. Geological Survey, October, November, and December, 1963--Continued

Date (1963)	Time			Magnitude	Depth (km)	Epicenter			Felt Report
	h	m	s			Lat. N.	Long. W.	Description	
Dec. 9	18	47	55.5	3.4	8	19°53.1'	155°31.3'	26 km SE. of Kamuela---	Felt in half of island.
9	18	50	07.0	2.5	8	19°56.7'	155°30.6'	23 km ESE. of Kamuela--	----------
11	22	22	24.0	2.6	----	--------	---------	Kaoiki----------	----------
12	17	29	19.0	2.3	8	19°18.8'	155°10.4'	8 km NNE. of Apua Point	----------
13	21	19	24.0	2.4	8	19°17.8'	155°17.5'	12 km ESE. of Desert seismometer.	----------
14	03	32	34.0	2.2	---	-------	--------	KM 30----------	----------
14	22	16	04.7	2.2	8	19°14.1'	155°36.7'	19 km NNW. of Naalehu---	----------
14	23	59	22.1	2.3	13	19°59.2'	155°59.2'	18 km WSW. of Kawaihae--	----------
16	10	57	39.8	2.6	8	19°13.1'	155°34.8'	17 km N. of Naalehu-----	----------
19	21	17	30.0	2.3	13	19°57.0'	155°22.2'	15 km WSW. of Laupahoehoe	----------
21	00	30	58.4	2.1	----	--------	---------	KM 30----------	----------
21	06	06	11.1	2.8	----	--------	---------	KM 30----------	----------
23	16	49	19.4	2.2	----	--------	---------	Kaoiki----------	----------
23	17	44	55.5	2.6	8	19°19.2'	155°12.7'	10 km SE. of Ahua seismometer.	----------
24	04	33	37.0	2.0	3	19°18.1'	155°05.8'	12 km ENE. of Apua Point	----------
24	20	04	55.5	2.3	8	19°14.9'	155°11.3'	2 km SSE. of Apua Point	----------
25	04	20	04.0	2.3	8	19°14.5'	155°25.9'	12 km SSW. of Desert seismometer.	----------
26	12	11	21.0	2.7	----	-------	--------	Kaoiki----------	----------
27	15	39	31.1	2.7	13	20°01.2'	155°53.0'	7 km WSW. of Kawaihae---	----------
27	02	12	30.6	2.0	----	-------	--------	KM 30----------	----------
27	03	03	23.3	2.0	----	-------	---------	KM 30----------	----------
27	17	33	15.0	2.4	----	-------	--------	KM 30----------	----------
28	11	14	55.5	2.4	----	-------	--------	Kaoiki----------	----------
29	04	02	02.1	2.4	25	19°19.8'	155°12.8'	8 km SE. of Ahua seismometer.	----------

Table 4.--Local earthquakes recorded by seismographs of the U.S. Geological Survey, October, November, and December, 1963--Continued

Date (1963)	Time			Magnitude	Depth (km)	Epicenter			Felt Report
	h	m	s			Lat. N.	Long. W.	Description	
Dec. 29	16	22	19.0	2.4	----	---------	---------	Kaoiki----------	----------
29	22	14	50.3	2.7	----	---------	---------	Kaoiki----------	----------
31	03	18	07.0	2.3	10	19°12.7'	155°11.0'	6 km SSE. of Apua Point.	----------
31	09	24	56.3	3.1	----	---------	---------	KM 30----------	----------

Table 5.--Distant earthquakes

[Times are reported in Greenwich Civil Time which is 10 hours faster than Hawaiian Standard Time. A "c" following the time of P indicates compressional first motion; a "d" indicates dilatational first motion. Station symbols, locations, and instrumentation are presented in summary 29. Magnitudes calculated from the Hawaii seismograms are followed by (HVO). Location of epicenter, origin times, and focal depths, and magnitudes reported by other institutions are taken from "Preliminary Determination of Epicenters" published by the U.S. Coast and Geodetic Survey]

Oct. 2, 1963

M	Z	eP	05:55:15.6 d
U	PEE	eS	06:02:14
U	PEE	eSS	06:05:35
U	PEE	eL	06:06:43
U	PEZ	eR	06:08:53

C&GS card 83-63:
05:47:05.5
20.8° S., 174.1° W.
Tonga Islands
h about 33 km
Magnitude 5.3 (CGS)
5.7 (HVO).

Oct. 3

U	PEZ	eR	16:48:07

C&GS card 80-63:
15:48:17.2
58.5° S., 25.1° W.
Sandwich Islands
h about 54 km.

Oct. 3

M	Z	eP	23:35:19.9 c
U	PEZ	iP	21 c
U	PEZ	eR	23:54:49
U	PEE	iS	23:44:09

C&GS card 80-63:
23:24:34.7
32.2° N., 131.6° E.
Kyushu, Japan
h about 33 km
Magnitude 6.5 (Pas)
6 (Pal)
5.7 (CGS).

Oct. 7

M	Z	iP	13:22:24.9 d
A	Z	iP	24.4 d
D	Z	iP	23.1 d
N	Z	iP	24.4 d
MP	Z	iP	24.7 d
Na	Z	iP	20.9 d
Ka	Z	iP	27.6 c
Hi	Z	iP	27.3 d
Ha	Z	iP	29.1 c

C&GS card 81-63:
13:14:24.6
23.6° S., 179.9° E.
Fiji Islands region
h about 550 km
Magnitude 5.7 (CGS).

Oct. 8

M	Z	iP	00:24:25.3 c
A	Z	iP	23.9 c
D	Z	iP	23.2 c
N	Z	iP	24.8 c
MP	Z	iP	25.2 c
Na	Z	iP	21.0 c
Hi	Z	iP	27.6 c
Ha	Z	iP	31.1 c

C&GS card 81-63:
00:17:01.1
15.1° S., 173.2° W.
Samoa Islands region
h about 33 km
Magnitude 6 (Pas)
5.75 (Bks)
5.7 (CGS).

Oct. 12, 1963

M	Z	iP	11:36:09.4	c
D	Z	iP	10.1	c
N	Z	eP	10.3	c
Pa	Z	eP	10.6	d
Na	Z	eP	14.7	d
Ka	Z	eP	05.2	c
Hi	Z	eP	10.0	c
Ha	Z	eP	11:35:57.5	c
U	PEZ	iP	11:36:10	d
U	PEZ	iS	11:43:31	
U	PEZ	iR	11:50:30	

C&GS card 85-63:
11:26:57.9
44.8° N., 149.0° E.
Kurile Islands
h about 40 km
Magnitude 6.75-7 (Pas)
7 (Bks)
6.75-7 (Pal)
7.5 (HVO).

Oct. 13

M	Z	iP	05:27:03.6	d
A	Z	eP	04.7	d
D	Z	eP	04.2	d
U	Z	eP	03.9	d
Na	Z	iP	06.0	c
Hi	Z	eP	01.3	d
Ha	Z	eP	05:26:52.7	d
U	PEZ	iP	05:27:04	d
U	PEZ	iS	05:34:26	
Ha	Z	Tmax	06:21:20	

C&GS card 84-63:
05:17:57.1
44.8° N., 149.5° E.
Kurile Islands
h about 60 km
Felt: Hokkaido and Honshu, Japan. Seismic sea waves: 4.0 ft. Hokkaido; 2.5 ft. Oahu, Hawaii; 2.2 ft. Crescent City, California; 1.5 ft. Attu, Aleutians.
Magnitude 8.25 (Pas)
7.75-8 (Pal)
8.1 (HVO)
Small tsunami in Hilo Bay.

Oct. 13

M	Z	iP	13:07:24.9	d
A	Z	iP	26.1	d
D	Z	iP	25.1	d
E	Z	iP	26.2	d
U	Z	iP	25.2	d
Hi	Z	iP	24.8	d

C&GS card 84-63:
12:58:21.6
45.0° N., 150.1° E.
Kurile Islands
h about 50 km
Magnitude 5.4 (CGS).

Oct. 13

M	Z	iP	16:08:56.7	c
WP	Z	iP	57.2	c
MP	Z	iP	57.9	c
Hi	Z	eP	56.3	c
U	PEN	iS	16:16:24	
U	PEE	iL	16:21:14	
U	PEZ	iR	16:23:22	

C&GS card 84-63:
15:59:52.9
45.6° N., 150.5° E.
Kurile Islands
h about 35 km
Magnitude 6.1 (CGS).

Oct. 13 (14)

U	PEZ	eR	00:17:50

C&GS card 84-63:
23:52:22.8
44.5° N., 150.1° E.
Kurile Islands
h about 50 km
Magnitude 5.5 (CGS).

Oct. 14

D	Z	eP	04:20:15.5	d
U	PEZ	eR	04:35:06	

Oct. 14, 1963--Continued

C&GS card 84-63:
04:11:14.0
44.7° N., 150.6° E.
Kurile Islands
h about 45 km
Magnitude 5.3 (CGS)
6.0 (HVO).

Oct. 14

M	Z	iP	13:30:41.7 d
A	Z	eP	43.0 d
D	Z	iP	42.7 d
MP	Z	eP	43.7 d
U	Z	iP	42.8 d
Pa	Z	iP	44.1 d
Na	Z	iP	43.0 d
Hi	Z	iP	42.2 d
Ha	Z	iP	31.3 d
U	PEN	iG	13:42:51
U	PEZ	eR	13:44:51

C&GS card 84-63:
13:21:45.2
44.8° N., 151.0° E.
Kurile Islands
h about 60 km
Magnitude 5.75 (Bks)
5.9 (CGS)
6.0 (HVO).

Oct. 15

U	PEZ	eR	07:13:23

C&GS card 90-63:
06:49:37.8
42.2° N., 152.3° E.
Kurile Islands
h about 40 km
Magnitude 4.2 (CGS)
5.8 (HVO).

Oct. 17

M	Z	iP	23:33:57.8 d
A	Z	iP	59.4 d
D	Z	iP	58.7 d
Pa	Z	eP	23:34:00.8 d
U	PEN	iS	23:41:17

Oct. 17--Continued

U	PEN	iG	23:46:09
U	PEZ	iR	23:48:23

C&GS card 84-63:
23:24:34.4
44.6° N., 149.0° E.
Kurile Islands
h about 45 km
Magnitude 5.4 (CGS)
6.6 (HVO).

Oct. 20

M	Z	iP	01:02:20.6 d
A	Z	eP	22.0 d
D	Z	iP	21.3 d
Ha	Z	eP	14.4 c
Na	Z	eP	22.8 c
Hi	Z	eP	20.3 d
U	PEZ	iP	22 d
U	PEZ	iS	01:09:36
U	PEZ	iR	01:16:10
U	PEN	iG	01:14:00

C&GS card 85-63:
00:53:07.2
44.7° N., 150.7° E.
Kurile Islands
h about 25 km
Seismic sea waves: 1.0 ft. LaJolla, California; 0.5 ft. Oahu, Hawaii.
Magnitude 6.75-7 (Pas)
7.25-7.5 (Pal)
7.6 (HVO).

Oct. 20

M	Z	iP	09:19:48.7 c
A	Z	iP	49.7 c
D	Z	iP	49.3 c
MP	Z	iP	50.1 c
U	Z	iP	49.3 c
Pa	Z	iP	50.5 c
Na	Z	iP	49.4 c
Hi	Z	iP	48.9 c

C&GS card 87-63:
09:10:43.9
44.4° N., 150.0° E.

Oct. 20, 1963--Continued

C&GS card--Continued:
Kurile Islands
h about 40 km
Magnitude 5.5 (CGS).

Oct. 20

U	PEZ	eR	12:16:01

C&GS card 87-63:
11:52:20.7
44.7° N., 150.2° E.
Kurile Islands
h about 45 km
Magnitude 4.2 (CGS)

Oct. 22

Pa	Z	Tmax	05:16:20
Ha	Z	Tmax	05:14:14

C&GS card 85-63:
04:29:11.7
51.0° N., 179.4° E.
h about 55 km
Rat Islands, Aleutian Islands
Magnitude 4.9 (CGS)

Oct. 22

U	PEZ	eR	03:49:26

C&GS card 87-63:
03:25:38.8
43.9° N., 150.3° E.
Kurile Islands
h about 50 km
Magnitude 4.9 (CGS).

Oct. 25

M	Z	iP	20:09:05.2	c
A	Z	iP	05.4	c
D	Z	iP	04.8	c
MP	Z	eP	06.9	c
U	Z	iP	05.2	c
Ha	Z	eP	20:08:59.1	c

Oct. 25--Continued

C&GS card 89-63:
19:58:58.3
12.3° N., 144.5° E.
Mariana Islands
h about 29 km
Magnitude 5.4 (CGS).

Oct. 29

Ha	Z	Tmax	07:43:07

C&GS card 88-63:
07:01:42.7
40.4° N., 124.7° W.
Near coast of Humbolt County, California
h about 38 km
Magnitude 4.7 (CGS)

Oct. 31

M	Z	eP	03:26:00.6	c
A	Z	eP	03:25:58.0	c
MP	Z	eP	57.2	c
U	Z	eP	58.1	c
Pa	Z	eP	59.7	c
Na	Z	eP	56.7	d
Ka	Z	eP	03:26:03.1	c
Ke	Z	eP	00.1	C
Hi	Z	eP	02.1	c
U	PEE	eS	03:32:41	
U	PEE	eG	03:36:00	

C&GS card 89-63:
03:17:42.0
21.8° S., 175.0° W.
Tonga Islands
h about 33 km
Magnitude 6.25 (Pas)
5.5 (Bks)
6.25-6.5 (Pal)
5.2 (CGS)
5.9 (HVO).

Oct. 31, 1963

M	Z	iP	08:58:53.2 d
D	Z	eP	52.0 d
U	Z	iP	52.1 d
Pa	Z	iP	54.1 d
Ka	Z	iP	56.7 c
Ke	Z	iP	52.7 c
Hi	Z	iP	55.3 c
Ha	Z	iP	57.9 c

C&GS card 89-63:
08:51:42
17.9° S., 178.8° W.
Fiji Islands region
h about 637 km
Magnitude 4.3 (CGS).

Nov. 3

M	Z	iP	03:22:20.9 d
A	Z	iP	19.8 d
D	Z	iP	20.0 d
MP	Z	iP	19.5 d
U	Z	iP	20.2 d
Pa	Z	iP	18.8 d
Na	Z	iP	20.1 d
Ka	Z	iP	22.4 d
Ke	Z	iP	21.7 d
Hi	Z	iP	20.5 d
Ha	Z	iP	25.0 d
U	PEN	iS	03:32:32
U	PEN	iG	03:42:56
U	PEZ	iR	03:46:10

C&GS card 90-63:
03:10:12.7
3.5° S., 77.8° W.
Peru-Ecuador border
h about 33 km
Magnitude 6.75 (Pas)
6-6.25 (Bks)
6.0 (Pal)
6.0 (CGS).
6.3 (HVO).

Nov. 4

M	Z	iP	01:23:14.1 c
Pa	Z	eP	15.4 c
Na	Z	iP	11.9 c
Ke	Z	iP	12.7 c

Nov. 4--Continued

Ha	Z	iP	19.8 c

C&GS card 91-63:
01:14:32.8
15.1° S., 167.3° E.
New Hebrides Islands
h about 154 km
Magnitude 6.75-7 (Pas)
5.8 (CGS).

Nov. 4

M	Z	eP	01:29:03.6 d
A	Z	eP	04.9 d
D	Z	iP	03.6 d
MP	Z	eP	04.5 d
U	Z	iP	04.8 d
Pa	Z	iP	06.4 d
Na	Z	iP	02.0 d
Ke	Z	iP	01.6 d
Hi	Z	eP	06.7 d
U	PEZ	iP	01:29:05 c
U	PEZ	iPcP	01:29:17
U	PEZ	ipP	01:29:34
U	PEZ	isP	01:29:50
U	PEZ	i	01:32:42
U	PEZ	i	01:35:00
U	PEE	iS	01:38:53
U	PEE	iSS	01:44:05
U	PEN	iSSS	01:47:42
U	PEN	iG	01:49:51

C&GS card 91-63:
01:17:08.9
6.8° S., 129.6° E.
Banda Sea
h about 80 km
Felt throughout Australia, northern Tasmania and Papua
Magnitude 7.5 (HVO).

Nov. 6, 1963

M	Z	iP	02:24:25.1 c
U	Z	eP	24.5 c
U	PEE	iS	02:33:19
U	PEN	eL	02:40:35
U	PEZ	iR	02:44:43

C&GS card 93-63:
02:13:16.8
138.4° E., 2.6° S.
Western New Guinea
h about 33 km
Magnitude 6.3 (HVO).

Nov. 8

M	Z	iP	16:25:05.6 d
MP	Z	iP	06.0 d

C&GS card 91-63:
16:13:36.2
128.4° E., 2.7° N.
Molucca Passage
h about 216 km
Magnitude 5.7 (CGS).

Nov. 9

M	Z	eP	21:27:17.4 c
A	Z	eP	16.5 c
MP	Z	eP	15.9 c
Pa	Z	eP	15.0 c
Ka	Z	eP	18.1 c
Hi	Z	eP	15.9 c
Ha	Z	iP	21.8 c
U	PEZ	iP	17 c
U	PEZ	ipP	21:29:25
U	PEZ	esP	21:30:31
U	PEZ	iPP	21:31:09
U	PEZ	ipPP	21:32:55
U	PEZ	iPPP	21:33:43
U	PEZ	i	21:39:35
U	PEE	iSKS	21:36:51
U	PEE	iSP	21:38:19
U	PEE	isP	21:41:01
U	PEN	iS	21:37:15
U	PEN	i	21:42:19
U	PEN	iSS	21:43:31
U	PEN	iSSS	21:46:47
U	PEN	i	21:49:55
U	PEN	eG	21:52:13

Nov. 9--Continued

C&GS card 93-63:
21:15:30.4
9.0° S., 71.5° W.
Western Brazil
h about 600 km
Magnitude 6.75-7 (Pas)
6.75-7 (Bks)
5.9 (CGS)
7 (HVO).

Nov. 10

M	Z	eP	01:12:26.8 c
A	Z	eP	26.3 c
MP	Z	eP	25.8 c
Pa	Z	iP	25.0 c
Hi	Z	iP	25.8 c
Ha	Z	eP	32.0 c
U	PEE	iS	01:22:19
U	PEE	iSP	01:23:34
U	PEE	i	01:26:58

C&GS card 93-63:
01:00:38.8
9.2° S., 71.5° W.
Western Brazil
h about 600 km
Magnitude 6.5-6.75 (Pas)
6.25 (BKS)
5.6 (CGS).

Nov. 10

M	Z	eP	17:27:05.0 c
D	Z	eP	05.5 c
U	Z	eP	05.2 c
U	PEN	iS	17:34:45
U	PEN	eL	17:39:19
U	PEZ	iR	17:41:43

C&GS card 93-63:
17:17:42.7
44.4° N., 149.0° E.
Kurile Islands
h about 40 km
Magnitude 5.5 (CGS)
6.4 (HVO).

Nov. 15

M	Z	eP	21:15:40.6 c
A	Z	eP	42.7 c
D	Z	iP	42.6 c

Nov. 15, 1963--Continued

MP	Z	eP	43.3	c
U	Z	iP	42.0	c
Pa	Z	iP	44.3	c
Na	Z	eP	44.3	c
Hi	Z	iP	21:15:43.0	c
U	PEZ	iP	42.4	c
U	PEZ	iR	21:30:40	
U	PEN	iS	21:23:02	
U	PEN	iG	21:27:40	

C&GS card 93-63:
21:06:34.0
44.3° N., 149.0° E.
Kurile Islands
h about 50 km
Magnitude 6.0 (Bks)
6.25-6.5 (Pal)
6.0 (CGS)
6.5 (HVO).

Nov. 18

M	Z	iP	14:45:58.7	d
A	Z	eP	58.3	d
D	Z	eP	59.3	d
MP	Z	iP	57.9	d
U	Z	iP	58.1	d
Pa	Z	iP	56.8	c
Na	Z	iP	14:46:03.1	c
Hi	Z	eP	14:45:56	d
Ke	Z	iP	14:46:02.7	c
Ha	Z	eP	14:46:02.7	c
U	PEZ	iS	14:51:56	
U	PEZ	iR	14:56:06	
U	Z	Tmax	15:25:50	
Pa	Z	Tmax	41	
Ha	Z	Tmax	15:26:15	

C&GS card 93-63:
14:38:28.9
29.9° N., 113.6° W.
Gulf of California
h about 14 km
Magnitude 6.5 (Pas)
6.5-6.75 (Pal)
5.7 (CGS)
6.5 (HVO).

Nov. 23

M	Z	iP	07:58:08.6	c
U	Z	eP	08.2	c
U	PEZ	eR	08:08:04	
M	Z	Tmax	08:37:41	
U	Z	Tmax	49	

C&GS card 96-63:
07:50:46.3
30.1° N., 114.0° W.
Gulf of California
h about 14 km
Magnitude 6 (Pas)
6 (Bks)
5.1 (CGS)
6.0 (HVO).

Nov. 23

M	Z	Tmax	09:19:16
U	Z	Tmax	12
Ha	Z	Tmax	15

C&GS card 102-63:
08:32.31
29.9° N., 114.0° W.
Gulf of California
h about 14 km
Magnitude 5.3 (CGS).

Nov. 28

Ha	Z	Tmax	16:02:06

C&GS card 96-63:
15:13:11.0
52.2° N., 174.2° E.
Near Islands,
Aleutian Islands
h about 33 km
Magnitude 5.4 (CGS).

Nov. 30

M	Z	iP	09:59:46.9	d
A	Z	eP	47.0	d
D	Z	eP	46.2	d
U	Z	iP	47.0	d

C&GS card 96-63:
09:47:59.0
1.6° N., 128.4° E.

Table 5.--Distant earthquakes--Continued

Nov. 30, 1963--Continued

C&GS card--Continued
Halmahera region
h about 61 km
Magnitude 5.5 (CGS).

Dec. 2

M	Z	Tmax	07:40:15
A	Z	Tmax	20
MP	Z	Tmax	22
U	Z	Tmax	21
Pa	Z	Tmax	17
Hi	Z	Tmax	02
Ha	Z	Tmax	07:39:24

C&GS card 97-63:
06:52:20
54.1° N., 134.2° W.
Queen Charlotte Islands
h about 33 km
Magnitude 3.9 (CGS).

Dec. 3 (4)

M	Z	Tmax	01:00:14
A	Z	Tmax	02
D	Z	Tmax	11
U	Z	Tmax	07
Pa	Z	Tmax	00:59:43
Ha	Z	Tmax	01:02:48

C&GS card 97-63:
23:03:41.6
22.4° S., 69.3° W.
Northern Chile
h about 18 km
Magnitude 6.25 (Pas)
6.1 (CGS).

Dec. 4

Ha	Z	Tmax	02:43:11

C&GS card 103-63:
01:35:24.5
45.3° N., 153.4° E.
Kurile Islands
h about 60 km
Magnitude 4.1 (CGS).

Dec. 7

M	Z	iP	04:15:40.9	c
A	Z	iP	40.1	d
U	Z	iP	40.4	c
Pa	Z	iP	41.9	d
Hi	Z	eP	42.8	d
Ke	Z	iP	38.6	d

C&GS card 99-63:
04:07:52.8
22.1° S., 179.4° W.
Fiji Islands region
h about 546 km
Magnitude 5.5 (CGS).

Dec. 7

M	Z	iP	04:55:36.0	d
A	Z	iP	36.2	c
U	Z	eP	36.0	c
Pa	Z	iP	38.0	d
Hi	Z	eP	38.4	d

C&GS card 102-63:
04:46:52.2
18.8° S., 169.2° E.
New Hebrides Islands
h about 227 km
Magnitude 4.7 (CGS).

Dec. 9

M	Z	Tmax	06:22:49
A	Z	Tmax	47
D	Z	Tmax	43
MP	Z	Tmax	47
U	Z	Tmax	43
Pa	Z	Tmax	48
Hi	Z	Tmax	19

C&GS card 99-63:
05:38:29.5
54.9° N., 159.4° W.
Alaska Peninsula
h about 45 km
Magnitude 5.1 (CGS).

Dec. 10, 1963

M	Z	iP	03:42:52.6 c
A	Z	iP	52.3 c
MP	Z	iP	52.6 c

C&GS card 100-63:
03:31:21.1
6.2° S., 128.1° E.
Banda Sea
Felt: Darwin
h about 366 km
Magnitude 5.6 (CGS).

Dec. 11

A	Z	eP	00:55:10.3 d
Na	Z	iP	09.7 d
Hi	Z	eP	15.9 c
Ke	Z	eP	11.2 c
U	PEZ	eR	01:05:17

C&GS card 101-63:
00:47:48.3
15.1° S., 173.6° W.
Tonga Islands region
Magnitude 5.6 (CGS).
h about 33 km.

Dec. 11

M	Z	iP	02:38:37.4 c
A	Z	eP	36.4 c
D	Z	iP	35.8 c
MP	Z	iP	36.4 c
U	Z	iP	36.8 c
Na	Z	iP	33.7 c
Ka	Z	iP	39.9 c
Ke	Z	iP	35.5 c
Hi	Z	iP	39.3 c
Ha	Z	iP	41.7 c

C&GS card 103-63:
02:31:19.4
17.8° S., 178.6° W.
Fiji Islands
h about 537 km
Magnitude 4.9 (CGS).

Dec. 12

M	Z	iP	23:33:35.0 d
D	Z	iP	35.4 d

Dec. 12--Continued

C&GS card 99-63:
23:24:36.6
46.3° N., 150.5° E.
Kurile Islands
h about 90 km
Magnitude 5.2 (CGS).

Dec. 14

M	Z	iP	07:59:19.8 c
A	Z	iP	20.4 c
D	Z	iP	20.7 c
MP	Z	iP	20.5 c
Ke	Z	iP	19.4 c

C&GS card 101-63:
07:51:07.9
62.7° N., 149.5° W.
Central Alaska
h about 95 km
Magnitude 5.1 (CGS).

Dec. 15

M	Z	Tmax	16:30:12
A	Z	Tmax	14
D	Z	Tmax	15
MP	Z	Tmax	07
U	Z	Tmax	12
Pa	Z	Tmax	18
Hi	Z	Tmax	00
Ha	Z	Tmax	16:29:31

C&GS card 102-63:
15:44:22.3
51.0° N., 128.8° W.
Vancouver Island region
h about 33 km
Magnitude 4.0 (CGS).

Dec. 15

M	Z	eP	19:47:17.5 d
A	Z	eP	17.9 d
U	PEZ	iS	19:57:58

C&GS card 103-63:
19:34:45.5
4.8° S., 108.0° E.
Java Sea

Dec. 15, 1963--Continued

C&GS card--Continued
h about 650 km
Felt: Djakarta
Magnitude 6.4 (CGS).

Dec. 18

M	Z	iP	00:38:43.4	d
Pa	Z	iP	44.7	c
Na	Z	iP	40.5	c
Ka	Z	eP	47.8	d
Hi	Z	eP	45.7	d
Ha	Z	iP	50.1	c
U	PEZ	iP	43	d
U	PEZ	iR	00:52:12	
U	PEE	iS	00:45:47	
U	PEE	iSS	00:49:22	
U	PEN	iG	00:50:00	

C&GS card 107-63:
00:30:02.6
24.8° S., 176.6° W.
Tonga Islands
Felt: Tonga, Fiji & Kermadec Islands.
h about 46 km
Magnitude 6.5 (CGS).

Dec. 20

M	Z	iP	09:09:12.4	c
MP	Z	eP	13.1	c
Hi	Z	eP	14.0	c

C&GS card 103-63:
08:57:17.8
7.0° S., 129.3° E.
Banda Sea
h about 103 km
Magnitude 5.5 (CGS).

Dec. 21

M	Z	eP	12:42:49	d
Na	Z	iP	47.9	d
Hi	Z	eP	53	d

C&GS card 104-63:
12:34:22.7

Dec. 21--Continued

C&GS card--Continued:
21.2° S., 175.8° W.
Tonga Islands
h about 90 km
Magnitude 5.1 (CGS).

Dec. 21

M	Z	iP	13:21:18.4	c
A	Z	eP	19.1	c
D	Z	iP	18.4	c
MP	Z	iP	19.7	c
U	Z	eP	18.9	c
Pa	Z	iP	20.4	c
Na	Z	iP	17.8	c
Ka	Z	eP	17.8	c
Hi	Z	iP	20.0	c

C&GS card 105-63:
13:09:09.6
16.1° N., 119.7° E.
Near west coast of Luzon, P.I.
h about 49 km
Felt: Manila
Magnitude 5.6 (CGS).

Dec. 24

M	Z	eP	11:27:17.6	c
U	Z	iP	17.2	c

C&GS card 105-63:
11:18:15.2
13.1° S., 166.7° E.
Santa Cruz Islands region
h about 61 km
Magnitude 5.5 (CGS).

Dec. 28, 1963

M	**Z**	eP	05:54:53.0 c
D	Z	eP	51.9 c
Na	Z	iP	50.4 d
Hi	Z	iP	55.7 c
Ha	Z	eP	57.8 c

C&GS card 105-63:
05:45:20.2
5.1° S., 153.5° E.
New Ireland region
h about 70 km
Magnitude 5.5 (CGS).

Dec. 28

M	Z	iP	09:13:35.0 c
A	Z	iP	34.3 c
D	Z	iP	33.6 c
MP	Z	iP	34.6 c
U	Z	iP	34.5 c
Pa	Z	iP	35.7 c
Na	Z	iP	31.2 c
Ka	Z	iP	37.4 c
Hi	Z	iP	37.3 c

C&GS card 106-63:
09:03:52.9
32.7° S., 178.9° W.
Kermadec Islands
h about 33 km
Magnitude 5.5-5.75 (Pal)
5.8 (CGS).

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North Kona

Mr. Ready
Dr. Heather
Mr. Sherwood
Dr. Tabrah
Mrs. Tabrah
Mrs. Christensen
Mrs. Van Gorder

Hilo region

Mrs. Shaffer
Mr. Isherwood
Mrs. Lewis
Mrs. Chiquita
Sister Thecla
Mr. Okamura
Mrs. Okamura
Mrs. Potlock
Mr. Shoemaker
Mr. Baldwin
Mr. Blackwood

Kau region

Mrs. Paiva
Mrs. Ashton
Mr. Meinecke
Mrs. Billing
Miss Yamamoto
Mrs. Walters

Puna

Mr. Warner
Mr. Williamson
Miss Takemoto

Kilauea summit region

Mr. Smith
Mr. Bush
Mr. Forbes
Mrs. Yong
Mr. Yong
Mrs. Mist
Mrs. Wentworth
Mrs. Yamamoto
Miss English
Mrs. Hansen
Mrs. Duncan

Kona coast

Mrs. Glass
Mrs. Higashihara
Mr. Ladd
Miss Greenwell
Mr. Johnston
Mr. Apple
Mr. Yeaman
Mr. Wallace
Mr. Sutherland
Mr. Sleightholm
Mrs. Gray

Central Hawaii

Mrs. Vredenburg
Mrs. Lindsey

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