DEPARTMENT OF THE INTERIOR

U.S. GEOLOGICAL SURVEY

United States Earthquakes, 1949

By

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and

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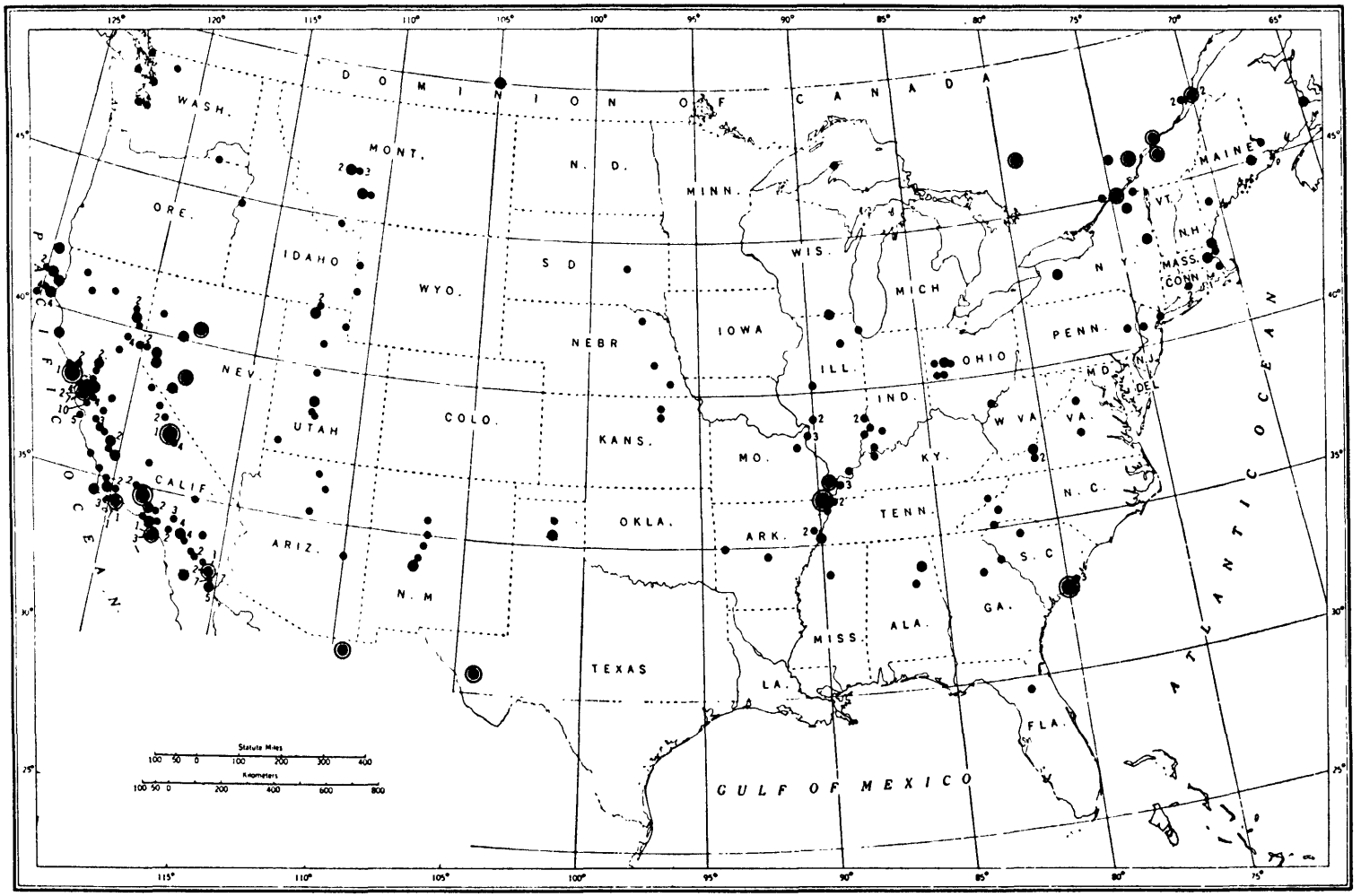

FIGURE 1.—*Destructive and near destructive earthquakes in the United States through 1949.*

UNITED STATES EARTHQUAKES, 1949

INTRODUCTION

This publication is a summary of earthquake activity in the United States and regions under its jurisdiction for the calendar year 1949. The sources of noninstrumental information used in the compilation include the United States Weather Bureau, whose observers prepare periodic reports on local seismic activity; telegraphic information collected by Science Service, Washington, D. C.; Bulletins of the Seismological Society of America; special reports of the Jesuit Seismological Association and the Northeastern Seismological Association; the Hawaiian Volcano Letter; newspaper clippings; and reports from interested individuals. Instrumental data used in locating earthquakes are obtained from the network of Coast and Geodetic Survey stations listed on page 41 and from other cooperating seismological stations in the United States and throughout the world.

The Coast and Geodetic Survey endeavors to coordinate efforts in collecting all types of earthquake information with the special object of correlating instrumental earthquake locations with noninstrumental reports received from the epicentral areas. This is done by local organizations making intensive regional investigations in California and elsewhere, and, when necessary, by the Coast and Geodetic Survey. This information serves to adequately map the seismic areas of the country and promote public safety through a better understanding of earthquake phenomena. Since the success of the general information service depends largely on the cooperation of local officials and citizens, all are urged to fill out and return earthquake questionnaires.

Earthquake information services.—The Coast and Geodetic Survey maintains a Seismological Field Survey in San Francisco to collect earthquake information and make field investigations of strong shocks in the Pacific Coast and Western Mountain States. Details concerning damage, destruction, and other effects are enumerated in the quarterly *Abstracts of Earthquake Reports for the Pacific Coast and the Western Mountain Region.* This report is available on request from the Director of the Coast and Geodetic Survey, Washington 25, D. C. Active cooperation in this work is received from the University of California Seismographic Station, Berkeley (Dr. Perry Byerly, in charge); and the Seismological Laboratory, Pasadena (Dr. Beno Gutenberg, Director); as well as State Collaborators in Seismology. The following Collaborators served as agents of the Coast and Geodetic Survey in their respective States in 1949:

Arizona.—Dr. Eldred D. Wilson, University of Arizona, Tucson.
Colorado.—Prof. C. A. Heiland, Heiland Research Corporation, Denver.
Idaho.—Prof. Vernon E. Scheid, University of Idaho, Moscow.
Montana.—Prof. Stephen W. Nile, Montana School of Mines, Butte.
Nevada.—Prof. Vincent P. Gianella, University of Nevada, Reno.
New Mexico.—Prof. Stuart A. Northrop, University of New Mexico, Albuquerque.
Oregon.—Dean E. L. Packard, Oregon State College, Corvallis.
Utah.—Prof. J. Stewart Williams, Utah State Agricultural College, Logan.
Washington.—Dr. Harold E. Culver, Washington State College, Pullman.
Wyoming.—Prof. Horace D. Thomas, University of Wyoming, Laramie.

Among the commercial agencies on the west coast rendering valuable services are telephone, power, oil, railroad, and especially insurance companies. Certain concerns interested in the manufacture of earthquake-resistant building materials are also active together with various organizations of structural engineers and architects.

In other parts of the country the Jesuit Seismological Association with central office at St. Louis University collects information in the central Mississippi Valley area (Rev. Dr. James B. Macelwane, S. J., Dean of the Institute of Technology). The Northeastern Seismological Association with headquarters at Weston College, Weston,

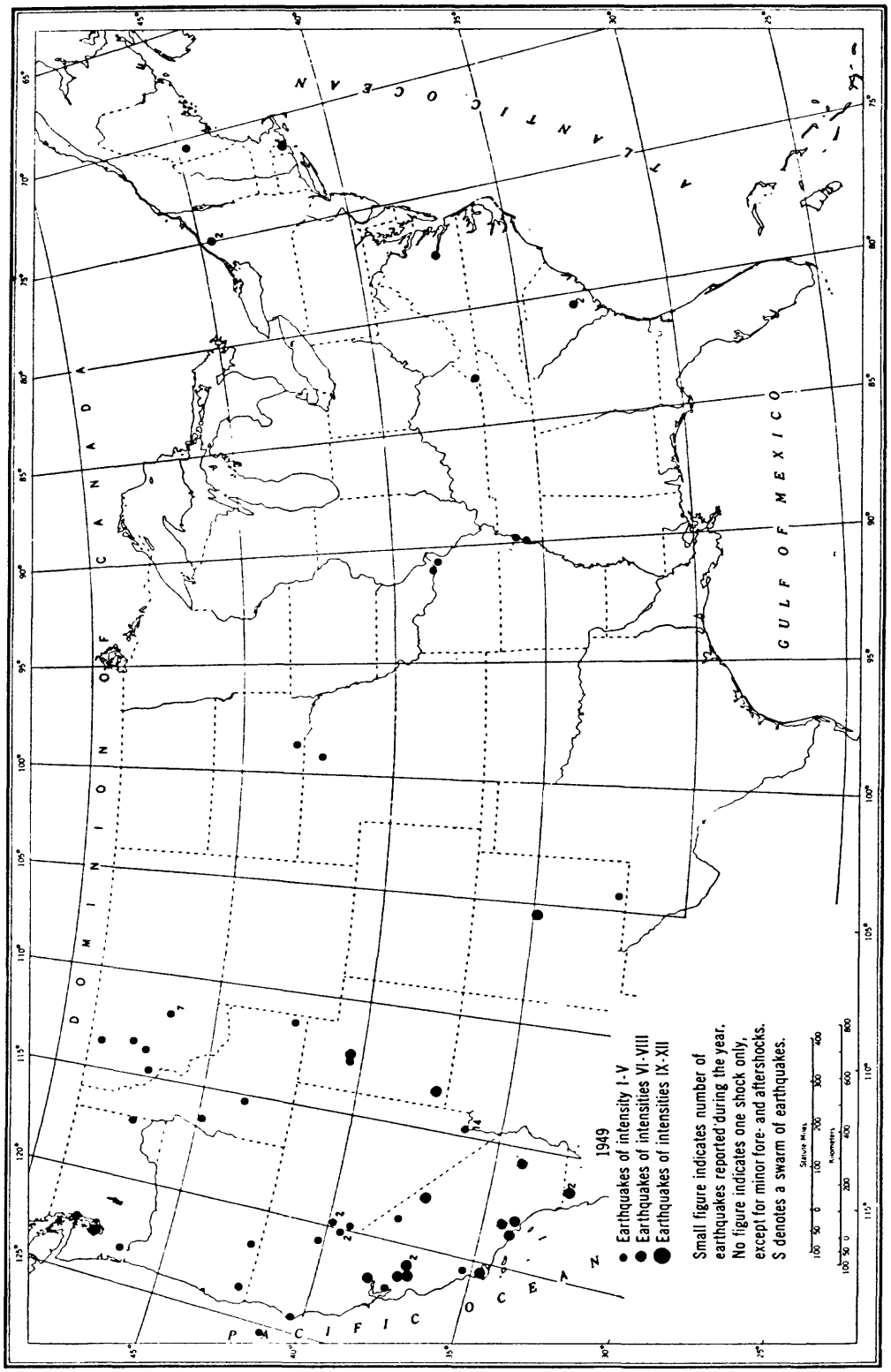

FIGURE 2.—*Earthquake epicenters, 1949.*

Mass. (Rev. Daniel J. Linehan, S. J., in charge) undertakes similar work in the northeastern States.

Modified Mercalli Intensity Scale of 1931.—All intensities used by the Coast and Geodetic Survey refer to the Modified Mercalli Intensity Scale of 1931.[1] The abridged version of this scale is given here with equivalent intensities according to the Rossi-Forel scale.

MODIFIED MERCALLI INTENSITY SCALE OF 1931

(ABRIDGED)

I. Not felt except by a very few under especially favorable circumstances. (I Rossi-Forel scale.)
II. Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing. (I to II Rossi-Forel scale.)
III. Felt quite noticeably indoors, especially on upper floors of buildings, but many people do not recognize it as an earthquake. Standing motorcars may rock slightly. Vibration like passing of truck. Duration estimated. (III Rossi-Forel scale.)
IV. During the day felt indoors by many, outdoors by few. At night some awakened. Dishes, windows, doors disturbed; walls make creaking sound. Sensation like heavy truck striking building. Standing motorcars rocked noticeably. (IV to V Rossi-Forel scale.)
V. Felt by nearly everyone, many awakened. Some dishes, windows, etc., broken; a few instances of cracked plaster; unstable objects overturned. Disturbance of trees, poles, and other tall objects sometimes noticed. Pendulum clocks may stop. (V to VI Rossi-Forel scale.)
VI. Felt by all, many frightened and run outdoors. Some heavy furniture moved; a few instances of fallen plaster or damaged chimneys. Damage slight. (VI to VII Rossi-Forel scale.)
VII. Everybody runs outdoors. Damage **negligible** in buildings of good design and construction; **slight** to moderate in well-built ordinary structures; **considerable** in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving motorcars. (VIII Rossi-Forel scale.)
VIII. Damage **slight** in specially designed structures; **considerable** in ordinary substantial buildings with partial collapse; **great** in poorly built structures. Panel walls thrown out of frame structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. Sand and mud ejected in small amounts. Changes in well water. Persons driving motorcars disturbed. (VIII+ to IX− Rossi-Forel scale.)
IX. Damage **considerable** in specially designed structures; well-designed frame structures thrown out of plumb; **great** in substantial buildings, with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Underground pipes broken. (IX+ Rossi-Forel scale.)
X. Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations; ground badly cracked. Rails bent. Landslides considerable from river banks and steep slopes. Shifted sand and mud. Water splashed (slopped) over banks. (X Rossi-Forel scale.)
XI. Few, if any, (masonry) structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipelines completely out of service. Earth slumps and land slips in soft ground. Rails bent greatly.
XII. Damage total. Waves seen on ground surfaces. Lines of sight and level distorted. Objects thrown upward into air.

Epicenter maps.—Figure 1 is designed to show the existence of destructive and near destructive earthquakes in the United States through 1949. The smallest dot indicates the shock was strong enough to overthrow chimneys or affect an area of more than 25,000 square miles (intensity VII to VIII); the largest solid dot may be associated with damage ranging from several thousand dollars to one hundred thousand dollars, or to shocks usually perceptible over more than 150,000 square miles (intensity VIII to IX); the smaller encircled dots represent damage ranging from approximately one hundred thousand to one million dollars, or an affected area greater than 500,000 square miles (intensity IX to X); the larger encircled dots represent damage of a million dollars or more, or an affected area usually greater than 1,000,000 square miles (intensity X to XII).

Figure 2 shows earthquake distribution in the United States during 1949. In a few cases where instrumental control is not satisfactory or where results of investigations are inadequate, the plotted epicenters should be considered as showing the existence of the earthquake rather than the precise location.

In figures 1 and 2, those earthquakes occurring in the California area are plotted when felt reports are received from several places. Earthquakes reported as feeble are not plotted on the epicenter map of the United States, nor are minor aftershocks plotted for heavy earthquakes in California or any other region. The number after a

[1] Modified Mercalli Intensity Scale of 1931. Harry O. Wood and Frank Neumann, Bulletin of the Seismological Society of America, Vol. 21, No. 4, December 1931.

dot indicates the number of shocks which have occurred at or near the location shown. Bulletins of the University of California Seismographic Station, Berkeley, and the Seismological Laboratory, Pasadena, should be consulted for further details regarding epicenters and often for data on additional shocks.

The selection of isoseismal or "felt area" maps (figs. 3–6) is governed largely by the size of the area affected, the minimum radius generally being of the order of 50 miles. In the case of sharp localized shocks this means that some earthquakes of intensity VI (mostly in California) will not be shown on such maps whereas others of intensity IV and V (largely in the eastern and central areas) will be shown.

Teleseismic results.—On page 41 is a list of Survey and cooperating teleseismic stations for which the Survey publishes results. An expansion of the epicenter program was completed during the year whereby communication facilities of the Military, the Division of Foreign Reporting Services of the Commerce Department in cooperation with the State Department, and the teletype circuit of the Public Buildings Administration are made available for transmission of earthquake messages. The seismograph stations in those regions of the world where the above services are not available initiated an airmail schedule for sending the interpretations to Washington. Through cooperation with Science Service and the Jesuit Seismological Association 119 epicenters were reported on Preliminary Determination of Epicenter cards which are distributed usually within 3 days after occurrence of an earthquake. In July a supplementary epicenter card service was inaugurated in which the locations of weaker earthquakes are summarized. These cards, which are distributed weekly, covered 260 earthquakes during the last 6 months of 1949. The results are furnished by mail to cooperators to assist in further analyses of their seismograms and to aid in seismological investigations. Teleseismic data and results are published in the quarterly *Seismological Bulletin* available from the Director of the Coast and Geodetic Survey, Washington 25, D. C.

Magnitude-intensity correlation.—Magnitude is given according to the Richter-Gutenberg scale used extensively as a measure of the energy of an earthquake. An explanation of this scale is given in the *Bulletin of the Seismological Society of America*, volume 32, No. 3, 1942. This scale, derived from an empirical formula based on instrumental results, should be distinguished from the intensity scale which is a measure of the effects on animate and inanimate objects, including damage to buildings. The following comparison is given between the magnitude and intensity designations for normal depth earthquakes in southern California.

Magnitude	2.2	3	4	5	6	7	8	8.5
M–M Intensity	1.5	2.8	4.5	6.2	7.8	9.5	11.2	12.0

Strong-motion results.—The maintenance of a network of strong-motion seismographs and analysis of the records of destructive earthquake motions thus obtained are functions of the Bureau in connection with a broad cooperative program of research being carried out on the Pacific Coast with a number of local organizations and institutions interested in the engineering aspects of the earthquake problem. The details of this program are described in S. P. 201, *Earthquake Investigations in California, 1934–35.*

The preliminary analyses of strong-motion records are published in the *Quarterly Engineering Seismology Bulletin*, formerly *Quarterly Progress Report on Strong-motion Earthquake Work*, which is available upon request from the Director of the Coast and Geodetic Survey, Washington 25, D. C. The revised analyses are given in table 5.

Earthquake history.—A history of the more important shocks of the country appears in Serial 609, *Earthquake History of the United States.* Part I covers continental United States and Alaska, exclusive of California and western Nevada; Part II covers the stronger earthquakes of California and western Nevada. The first part was revised in 1947 and the latter in 1951.

A history of minor activity is covered largely in a series of references listed in Serial 609, in recent reports of the Coast and Geodetic Survey, and in the *Bulletin of the Seismological Society of America*, volume 29, No. 1, January 1939. The last two references give detailed information for all California earthquakes. The last one contains all information appearing in early catalogs published by the Smithsonian Institution.

NONINSTRUMENTAL RESULTS

NOTE.—The following symbols are used to indicate authority for origin times, instrumental times, or reported epicenters.
P—reported by the Seismological Laboratory of the California Institute of Technology at Pasadena.
B—reported by the Seismographic Station of the University of California at Berkeley.
BC—reported by the Boulder City office of the Coast and Geodetic Survey.
W—reported by the Washington Office of the Coast and Geodetic Survey.
An asterisk (*) indicates instrumental origin time of the earthquake when coordinates of the epicenter are given. Otherwise, instrumental times shown with asterisks are those of first motions.
When more than one degree of intensity is reported from a town, the town is listed under the highest intensity reported. More details will be found in the quarterly *Abstracts of Earthquake Reports for the Pacific Coast and the Western Mountain Region.*

EARTHQUAKE ACTIVITY IN THE VARIOUS STATES

Arkansas: January 13.
California: (Intensity VI and above only) February 11; March 9, 13; May 2, 13; June 9; August 8, 26, 27; September 18; November 4 (2), and 17; and December 26.
Idaho: January 8, March 15, and October 3.
Maine: October 4.
Missouri: January 13, August 11, 13, and 26.
Montana: January 15, 28; February 27; April 3; May 22; June 5; August 21; September 9; October 23; and November 18.
Nebraska: May 12.
Nevada: January 1, 2, 6 (2), 7 (3), 10, 11, 19; February 4, 6, 11, 26; March 14; April 10, 13, 14; May 4, 10, 22, 24 (2); July 14, 19, 20 (4), 21 (2), 22 (2), 23, 29; August 2, 8, 11, 16, 17, 21 (2); October 7 (2); October 8; December 11 and 28.
New Mexico: February 2 and May 23.
New York: February 7 and October 16.
Oregon: March 24 and April 3 (2).
Rhode Island: April 16.
South Carolina: February 2 and June 27.
South Dakota: May 7, June 2, and December 13.
Tennessee: January 13.
Utah: March 6, 7; November 1, 18, and 19.
Virginia: March 8 and September 17.
Washington: February 6; April 13, 14, 19; August 21; September 26; October 20; and November 29.

EARTHQUAKE ACTIVITY OUTSIDE THE UNITED STATES

Alaska: February 23, 26; March 7; April 3, 7 (2), 10, 11; May 11; June 6, 19 (3); July 8; August 26, 31; September 1, 2, 15, and 27.
Hawaiian Islands: February 26 (2), 27; April 11; May 2 (2), 7, 21, 23, 28; July 29; August 21, 30, 31; September 1, 14, 16; October 22, 26 (2); November 4, 25; and December 11 (2).
Panama Canal Zone: March 30, July 15, and August 18.
Puerto Rico: March 23.

NORTHEASTERN REGION

(75TH MERIDIAN OR EASTERN STANDARD TIME)

February 7: 01:17. Massena, N. Y. Felt by many in area. The rumbling noise which accompanied the slight bump was heard distinctly by those who were up at the time and it also awakened a large number. Some women reported dishes rattled in their homes.

April 16: 19:15. Felt in region along western shores of Narragansett Bay, R. I. North Kingstown residents experienced the most pronounced shock, with other reports coming from East Greenwich, West Warwick, and southern and eastern sections of Warwick. Houses shook and dishes rattled throughout the area. Many persons reported noises such as a loud blast, many others thought boilers in basements might have exploded.

September 2: 00:48:10.* South Tamsworth, N. H. Slight shock felt by a few.

October 4: 21:33:47.5.* Epicenter 44.8° north, 70.5° west, by NESA. Southwestern Maine. Results of a questionnaire coverage by NESA indicate a felt area of approximately 135,000 square miles throughout central and southwestern Maine and across northern New Hampshire to St. Johnsbury, Vermont. See map. Maximum intensity V reported in southwestern Maine. Rangely residents reported small objects moved; windows, doors, and dishes rattled; and trees shaken slightly. Doors swung northeast, knickknacks fell, and dishes broke in Westbrook. In Mechanics Falls the shock was felt throughout the town, picture frames moved, and windows, doors, and dishes rattled. A noise resembling strong winds followed the earthquake.

INTENSITY IV: Athens, Auburn, Bangor, Bethel, Bridgton, Dufield, Gardiner, Hallowell, Kingfield, Livermore Falls, Madison, Mexico, New Castle, New Sharon, Norway, Peru, Ridlonville, Rumford, Skowhegan, Solan, Stratton, Waterville, and Welton.

INTENSITY I TO III: Augusta, Bath, Belfast, Brewer, Camden, Canton, Chrisholm, Dexter, East Belfast, Farmington, Guilford, Hampden Highlands, Hartland, Lewiston, New Port, New

(page 8 follows)

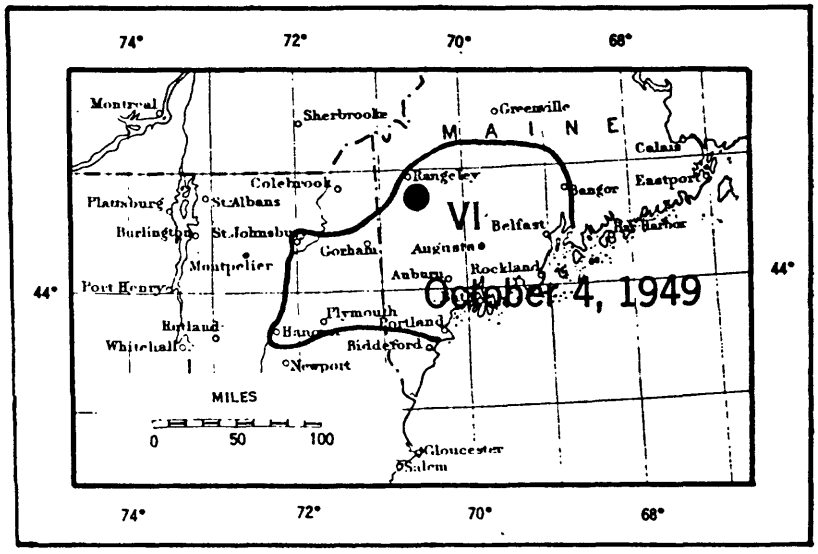

FIGURE 3.—*Area affected by the earthquake of October 4.*

Portland, North Anson, North Augusta, Portland, Readfield, Richmond, South Portland, Waterford, Wilton, Windham, and Winslow.

INTENSITY I TO III IN NEW HAMPSHIRE: Berlin, Hanover, Lincoln, and Plymouth.

INTENSITY I TO III IN VERMONT: St. Johnsbury.

Negative reports were received from 11 places.

October 16: 18:35. Massena, N. Y. Felt over an area of approximately 1,500 square miles, extending as far as Ottawa and Montreal. Light furniture was moved about and glasses were knocked off tables, but no extensive damage was reported. Windows shook and dishes rattled in the Potsdam area. The shock was also felt slightly in Canton.

EASTERN REGION

(75TH MERIDIAN OR EASTERN STANDARD TIME)

February 2: 05:52. Summerville, S. C. Light shock awakened sleepers. "One booming sound, gradual trembling."

May 8: 06:01. Richmond, Va. Felt throughout Powhatan, Richmond, Amelia, and Bremo Bluff vicinity. Many residents were awakened by a loud roar resembling a muffled explosion and shaking of their homes. Richmond was hardest hit with many persons reporting whole houses vibrated, a few plaster cracks, and many old plaster cracks opened wider.

June 27: 01:53. Summerville, S. C. Two abrupt shocks, one following immediately after the first. Bed shook.

September 17: 04:30. Lee County, Va. Brief shock, but very exciting to those who distinctly heard and felt the upheaval. Houses shook and windows rattled. The disturbance was reported as "greater than dynamite and lasted about 4 times longer." Pennington Gap, St. Charles, Station Creek, Stone Creek, and Duffield residents reported the tremors.

CENTRAL REGION

(90TH MERIDIAN OR CENTRAL STANDARD TIME)

January 13: 21:50. Tennessee, Arkansas, and Missouri. Houses shook and dishes rattled in western Tennessee, eastern Arkansas, and southern Missouri. In Memphis the shock was reported mainly in the Crosstown and southeast sections with some disturbances reported from the northeast section. The shock was not reported in the business district.

Tiptonville, Tenn., residents reported one hard shock followed by three pulsing, rolling waves of about 1 second each. Other reporting places included Union City, Huntingdon, Covington, and Newberry.

Missouri towns reporting tremors were Poplar Bluff, Kennett, Hayti, Caruthersville, Sikeston, New Madrid, Lilbourne, Portageville, Malden, and Chaffee.

Wynne, Blytheville, Luxora, and Osceola, Ark., reported only a slight tremor. Cairo, Ill., reportedly experienced a mild earthquake that was felt by a remarkably large number of people.

August 11: 10:32. Clayton, Mo. Very light shock reported felt in St. Louis suburbs of Clayton and University City.

August 13: 15:45. Caruthersville, Mo. Very light shock reported felt.

August 26: (before noon). Defiance, Mo. Very light shock reported felt.

September 9: 21:42. Helena, Mont. Light shock felt by few in northwest section. Slight rumble heard. Buildings creaked and loose objects rattled.

October 3: 14:00. Conda, Idaho. Light shock felt by several.

October 7: 22:34:31* and 23:47:13.* BC. Hoover Dam, Nev. Light shocks felt by several. Windows rattled. Another shock the following day at 00:28:46.*

October 23: 23:43:34.* Montana. Felt strongest at Polson where buildings creaked and pictures and dishes rattled. Cracking and rattling subterranean sounds were heard. Also felt in Niarada, Perma (4 miles northeast of), Kerr Dam, and Moiese. The tremor was recorded at the Butte seismograph station.

November 1: 19:30:05.* BC. Southwestern Utah. Felt over an area of approximately 700 square miles. Maximum intensity VI at Rockville and St. George. At Rockville hanging objects swung W–E, and in two homes pictures and vases slid from pianos. At St. George hanging objects swung, small objects were shifted, and knickknacks fell. Also felt quite strongly at Santa Clara, and with lesser degrees of intensity at Beryl, Cedar City, Enterprise, Gunlock, Hurricane, Kanarraville, Leeds, New Harmony, Springdale, Toquerville, and Washington. In Arizona, it was the first shock ever felt by most people in Tuweep, and it caused small landslides from cliffs on the eastern side of Tuweep Valley. Hanging objects swung, disturbed objects were observed by several.

November 18: 12:11. Salt Lake City, Utah. Jarring motion reported felt at airport Weather Bureau station. Windows rattled and building creaked.

November 18: 16:32. Helena, Mont. Light shock felt by several in Kenwood suburb.

November 19: 11:45. Ogden, Utah. Press reported mild earth tremor felt heaviest in the Roy and Hill Air Force areas, but felt as far away as the mouth of Ogden Canyon east of Ogden. Windows rattled at the Ogden arsenal; windows and doors shook at Hill, and at Roy windows and dishes rattled and a rumbling noise was heard.

December 11: 18:13:06.* BC. Boulder City, Nev. Very light tremor felt by one person.

December 13: 21:15. Gregory, S. Dak. Slight vibration lasting only a few seconds felt throughout community.

CALIFORNIA AND WESTERN NEVADA

(120TH MERIDIAN OR PACIFIC STANDARD TIME)

Note.—All places are in California unless otherwise stated. The *Bulletin of the Seismological Society of America* is referred to as the BSSA.

January 1: 03:22 (a. m. or p. m. not given). Long Valley, Nev. Light shock felt by two in home, frightened one. Windows rattled and hanging objects swung SE-NW.

January 1: 06:30 (about). Hollister, 7 miles south of. Weak shock felt by observer in home. Windows rattled and walls creaked.

January 2: 14:03.9.* Epicenter 38.7° north, 119.0° west, west of Walker Lake, Nev., P. Felt by several in Schurz, Nev., where house walls creaked.

January 3: 05:43:39.* Epicenter 34°57′ north, 116°30′ west, near Manix, P. Awakened household from sound sleep at Pisgah Substation, 15 miles west of Ludlow. Doors rattled and house creaked.

January 4: 01:35. Weldon. Light tremor awakened few. Windows, doors, and dishes rattled. House creaked.

January 4: 08:57:07.* Epicenter 35.7° north, 118.1° west, near Walker Pass, P. Felt by several in Weldon. Rattled windows, doors, and dishes; house creaked. Trees and bushes shaken moderately. Shifted small objects and furnishings.

January 5: 08:45. Weldon. Felt by several, outdoors by some. Windows, doors, and dishes rattled; house creaked. Hanging objects swung. Trees and bushes shaken slightly.

January 7: 19:39:21* and 19:56:24.* Epicenter 39°33′ north, 120°05′ west, B. Reno, Nevada, press reported the tremors shook windows and rattled doors in the Reno-Verdi area. Bottles rattled in Verdi stores but did not overturn or break. All reports generally noted a north-south movement. In Greenfield Acres the first quake was strong enough to bang leaves of a drop-leaf table against the table legs. Plumb Lane residents felt the shocks strongly. A rumble was heard in some sections. Also felt on top of Peavine Mountain, at Long Valley, and at Loyalton.

January 7: 14:18. Big Pine, 7 miles south of. Light shock felt by observer. Windows and doors rattled; house creaked. Direction NW. Also felt at Tinemaha Reservoir by several. Windows rattled. Noise like explosion heard at both places at time of shock.

January 9: 04:05. Loyalton. Weak shock felt by several.

January 10: 08:57. Reno, Nev. "Another in a series of minor earthquakes was felt in Reno . . . in nearby Verdi the shock was reported as very distinct."—(BSSA, April 1949).

January 11: 16:45. Verdi, Nev. Light shock felt by observer. Direction N-S. Windows rattled and walls creaked.

January 16: 01:30. "A resident of Happy Valley reported feeling a slight tremor . . ."—(BSSA, April 1949).

January 19: 23:59:23.* Epicenter 39°33′ north, 120°05′ west, B. Two distinct shocks felt by several, awakened few, in Baxter. Windows rattled. At Reno, Nev., downtown buildings shook noticeably. Also felt in the Truckee and Grass Valley area, Nev., and at Grizzly Flats and Quincy, Calif.

January 23: 16:10:32.* Epicenter 36°38′ north, 121°20′ west, B. Weak shock felt 7 miles south of Hollister. Windows and doors rattled, house creaked.

January 24: 20:29. Santa Maria and Orcutt. Light shock moved chair, four-legged table, and table lamps in first named place, and caused hanging objects to swing at the latter. Windows and dishes rattled.

January 30: 14:55, 15:45:36,* and 22:38. Epicenter 37°43′ north, 122°04′ west, B. "Three light earthquakes occurred in the Hayward area . . . They were reportedly felt in Castro Valley, Oakland, Ashland, San Lorenzo Village, and communities to the south. Residents of Watsonville felt the last shock."—(BSSA, April 1949).

February 11: 13:05:24.* Epicenter 37°05′ north, 117°45 west, east of Tinemaha, P. Felt over approximately 18,000 square miles in south-central California and into Nevada as far as Goldfield and Beatty. See map. Maximum intensity VI, slight damage reported.

INTENSITY VI:

Ash Mountain (Sequoia National Park).—Two shocks with few seconds' interval. Building damage included three small cracks in rock slab facing over concrete foundation, with vertical cracks in south facing wall. Disturbed objects observed by two, loose objects rattled, buildings creaked. Subterranean sounds like low rumble of thunder heard a few seconds before shock.

Bakersfield.—Some deepening cracks appeared in walls of City Hall. Elevator in County Courthouse banged from side to side against the walls, and operator was forced to stop the car. Persons in some of Bakersfield's taller buildings reported feeling a swaying motion. In private homes, chandeliers, swung, but no damage was reported.

Big Pine.—Felt generally. Some cracked plaster. Trees and bushes shaken moderately. Small objects shifted. At Power Plant, hanging objects swung N.

Corcoran (northwest section).—Felt by many. Visible swaying of buildings and trees. Cracked standpipes on 18-inch concrete water supply line. Lighting fixtures swung.

Fresno.—Downtown buildings swayed, windows rattled, chandeliers jiggled, and lights flickered. Residents of Kerman reported chandeliers shook and dishes rattled. On seventh floor of the San Joaquin Power Building, pictures swung back and forth and a desk moved slightly. Reportedly severe at Crane Valley and Edison Big Creek power plants, but no damage. Also felt at Friant Dam, one-fourth mile below dam, but no damage in that area.

Hanford.—Chandeliers swung. Some people reported a distinct jolt. Three power lines or telephone poles reportedly fell near the Plaza underpass.

Independence.—Felt by all, frightened few. Hanging objects swung NE. Trees and bushes shaken slightly. Small objects shifted.

Lone Pine.—Felt by several indoors, by some outdoors. Hanging objects swung north–south. Small objects and furnishings shifted, knickknacks fell. Stove and floor lamp rocked. Trees and bushes shaken moderately.

Olancha.—Felt by several. Walls cracked slightly. Damage slight to pumice brick. Hanging objects swung north-south; windows, doors, and dishes rattled.

INTENSITY V: Death Valley National Monument (Cow Creek), Laws, Mineralking, Owenyo, Pinehurst, and Porterville.

INTENSITY IV: Alabama Gates, Alpaugh, Benton, Bishop, Clovis, Cottonwood Gates, Cutler, Deep Springs, Ducor, Dunlap, Fowler, Friant, Haiwee Powerhouse and Camp (few miles north of Coso Junction), Keeler, Kingsburg, Le Grande, Lindsay, Madera, Mendota, Merced, Mojave, Orange Cove, Raisin, Riverdale, Snelling, South Dos Palos, Springville, Three Rivers, Visalia, Westend, Woodlake, and Yosemite National Park.

INTENSITY IV IN NEVADA: Goldfield (50 miles southwest of).

INTENSITY I TO III: Academy, Coalinga, Modesto, Oilfields, Onyx, South Haiwee Reservoir (about 8 miles north of Coso Junction), Stratford, Tinemaha Reservoir, Trona, Tupman, and Westhaven.

INTENSITY I TO III IN NEVADA: Beatty.

Negative reports were received from 51 places in California and from 3 places in Nevada.

February 11: 18:56:16.* Epicenter 37°37′ north, 121°57′ west, B. San Francisco press reported the Bay area was jolted by a moderate earthquake.

February 21: 05:42:25.* Epicenter 34°00′ north, 117°30′ west, near Mira Loma, P. Felt by several in Fontana, and by one observer in Riverside.

February 24: 18:28:02.* Epicenter 36.9° north, 120.7° west, B. Slight shock accompanied by rumbling sound reported felt in Los Banos.

February 24: 21:42. Pit River Powerhouse No. 3 (central Shasta County). Light shock felt by all at Powerhouse. Hanging objects swung.

February 25: 03:20. Pit River Powerhouse No. 3. Light shock felt by all at Powerhouse. Hanging objects swung.

February 26: 08:10. Reno, Nev. Press reported slight shock felt by several residents in Verdi and in the northwest section of Reno.

February 27: 16:17:18.* Epicenter 33°46′ north, 118°10′ west, near Long Beach, P. "No damage was reported as the result of a light earthquake which jarred Long Beach and vicinity. . . . Dishes rattled and chandeliers swayed throughout the Long Beach area."—(BSSA, April 1949).

March 2: 19:23 and 21:02. Strawberry Valley (Yuba County). Light shock felt by few, only those in poorly constructed buildings.

March 3: 02:30. Strawberry Valley. Felt by few, awakened observer. Felt by only those in poorly constructed buildings. Another shock felt the following day at 04:10.

March 8: 19:00 (about). Jenner (north section). Trembling motion felt by three.

March 9: 04:28:39.* Epicenter 37°01′ north, 121°29′ west, B. Felt over an area of approximately 20,000 square miles in western half of north-central California from Santa Rosa south to Paso Robles. See map. Maximum intensity VII at Hollister where considerable damage occurred. A much lighter shock occurred about a half hour later and apparently centered in the same region.

INTENSITY VII:

Hollister.—Structural damage consisted of fallen chimneys, cracked walls, broken plate-glass windows, and sprung elevator shafts and door frames. Considerable loss was caused by goods being thrown from store shelves and destroyed. Of three fallen chimneys investigated in Hollister, two had fallen east and the third north. Cracks appeared in north-south walls and also in east-west walls. Two chimneys were broken in the area immediately surrounding the city. In two instances buildings which had been in contact with each other separated by a visible amount. In one, the buildings fronted on a north-south street, and in the other on an east-west street. At least two of the larger stores in the city had plate-glass windows shattered. The south wall of the Council Chamber on the second floor of the City Hall was cracked at a point where the outside wall formed a right angle corner while the inside wall continued in the same direction. The crack occurred where the inside wall joined the outside wall. A brick wall separating two department stores split lengthwise. Many well-built business houses and homes suffered considerable damage. Objects fell in all directions. Chairs, beds, tables, and pictures were displaced; water spilled from open containers. Principal loss in homes was from broken dishes, vases, and windows; and cracked or fallen plaster. Many stores closed because of damaged goods on floor, many show windows broken or cracked. All pendulum clocks stopped.

Seven miles south of Hollister damage included cracked plaster, windows, walls, and chimneys. Books, knickknacks, pictures, and plaster fell. Hanging objects swung and pendulum clocks stopped.

INTENSITY VI:

Alameda.—Felt by all in home, awakened all. Rattled windows, doors, and dishes; house creaked.

Alviso.—Felt by and awakened all, frightened many. Windows, doors, and dishes rattled.

Aptos.—Felt by all and awakened many in home. Hanging objects swung; windows, doors, and dishes rattled. Small objects shifted. Plaster cracked.

Ben Lomond.—Felt by many, awakened all. Rattled windows, doors, and dishes; hanging objects swung.

Berkeley.—Felt by all and awakened all in home. Frame houses creaked. Shifted small objects, knickknacks fell.

Caruthers.—Felt by and awakened all in home. Windows rattled.

Castroville.—Awakened all, frightened many.

Chualar.—Felt by and awakened many, frightened few. Rattled windows, doors, and dishes; house creaked. Hanging objects swung. Trees and bushes shaken moderately. Small objects shifted, vases overturned, dishes broke.

Coyote.—Felt by and awakened all. Rattled windows, doors, and dishes; house creaked. Hanging objects swung. Rumbling noise accompanied shock.

Fairfax.—Felt by and awakened all in community. House creaked, loose objects rattled.

Felton.—Felt by and awakened all, frightened many. Windows, doors, and dishes rattled.

Forest Knolls.—Felt by, awakened, and frightened many. Direction east–west.

Gilroy.—Felt by and awakened all, frightened many. Windows, doors, and dishes rattled; house creaked. Pendulum clocks facing east stopped. Trees and bushes shaken strongly.

Half Moon Bay.—Awakened all. Windows and doors rattled, house creaked.

Hayward.—Felt by and awakened all in home, frightened many. Plaster cracked in City Hall and City Hall Annex.

La Honda.—Felt by, awakened, and frightened many. Dishes rattled, frame houses creaked. Trees and bushes shaken slightly. Small objects shifted, vases overturned, dishes broke.

Loma Mar.—Felt by and awakened all. Direction northeast.

Los Banos.—Felt outdoors by some, awakened many and frightened many. Direction north–south. Windows, doors, and dishes rattled; hanging objects swung northeast.

Madrone.—Felt by and awakened all, frightened many. Windows rattled; frame houses creaked, hanging objects swung northwest. Pendulum clocks facing southeast stopped. Small objects shifted, vases overturned, plaster cracked, dishes broke, and knickknacks fell. Water main reported broken in garage and floor flooded.

Montara.—One chimney cracked and one house rocked out of plumb so that doors would not open or close. Clocks were knocked off bureaus.

Morgan Hill.—Felt by many. Buildings creaked and loose objects rattled. One concrete block wall cracked. Damage slight to buildings. Some stocks fell from grocery shelves, cupboard doors in observer's home opened.

Mount Hermon.—Awakened all.

Moss Landing.—Felt by many. Windows rattled, hanging objects swung, some objects fell from shelves.

Newark.—Felt by and awakened all. Windows, doors, and dishes rattled; house creaked. Hanging objects swung and pendulum clocks stopped.

Niles.—Felt by and awakened all. Rattled windows, doors, and dishes; walls creaked.

Oakland.—Felt by many. Burglar siren on automobile was set off. Weather Bureau at Oakland airport reported the needles of the recording instruments were thrown off by the jolt. Buildings creaked and loose objects rattled. Faint rumbling at time of shock.

Palo Alto.—Felt by several in home, awakened all. Small objects shifted slightly, windows rattled. Direction almost due north–south. Moderately loud rumbling heard at time of shock.

Pescadero.—Momentary duration, awakened all.

Pinole.—Felt by and awakened all, frightened many.

Redwood City.—Felt by all in home, awakened many, frightened many. Rattled windows, doors, and dishes; house creaked. Hanging objects swung west–east.

Salinas.—Felt by all, awakened many, frightened few. Windows and doors, some dishes rattled. Pendulum clocks stopped.

San Anselmo.—Felt by many in home, awakened all. Windows, doors, and dishes rattled.

San Francisco.—Two shocks felt, second being scarcely felt. A low rumbling preceded the first jar, awakening thousands of Bay area residents. Twenty-nine burglar alarms were set off and calls from anxious householders flooded police and newspaper switchboards. One water pipe was broken, and rocks showered down on many Telegraph Hill residences. Visible sway of buildings and trees.

San Gregorio.—Frightened all. Rattled dishes.

San Jose.—Felt by all in area. One picture fell on second floor, chandeliers swayed north–south. One woman reported dishes fell from china closet and were broken, and that canned goods and packaged foods tumbled from shelves.

San Martin.—Awakened all and frightened many. Windows, doors, and dishes rattled; house creaked. Small objects and furnishings shifted, vases overturned, knickknacks fell, dishes broke.

San Ramon.—Awakened all in home.

Santa Cruz.—Felt by and awakened all in home. Rattled windows, doors, and dishes. Some heard low rumbling sounds immediately following the shock. Few people reported dishes and loose articles on tables shifted slightly.

Sausalito.—Felt by and awakened many. Windows, doors, and dishes rattled. Hanging objects swung. Trees and bushes shaken strongly. Small objects shifted, knickknacks fell.

Seaside.—Awakened all. Rattled windows, doors, and dishes.

Sharp Park.—Felt by and awakened all. Windows rattled.

Skyline Boulevard.—Sheriff's officers reported the highway weaved up and down and they had difficulty in staying on the road.

Soledad.—Awakened all. Rattled windows and doors; walls creaked.

Soquel.—Awakened all. Hanging objects swung. One tree reported to have fallen across road.

Spreckels.—Felt by and awakened many, frightened many. Windows and dishes rattled, house creaked. Hanging objects swung.

Sunnyvale.—Felt by and awakened all, frightened all. Direction east–west. Rattled windows and doors.

Tres Pinos.—Felt by all, awakened many, frightened many.

Walnut Creek.—Felt by many, awakened and frightened all in home. House creaked. Shock slight at first, then increased in intensity.

Watsonville.—Awakened many in commnuity. Direction northeast–southwest. Windows, doors, and dishes rattled. Hanging objects swung. Two shocks felt, first was much stronger than second.

INTENSITY V: Agua Caliente, Alamo, Altamont, Aromas, Big Sur, Bolinas, Boulder Creek, Burlingame, Carmel, Cupertino, Daly City, Davenport, Diablo, Dillon Beach, Gonzales, Holt, King City, Livermore, Lonoak, Los Gatos, Marina, Mendota, Merced, Milpitas, Mount Bullion and vicinity, Mount Eden, Newman, Pacific Grove, Paicines, Patterson, Petaluma, Pinnacles, Richmond, Robles del Rio, Saint Mary's College, San Bruno, San Carlos, San Juan Bautista, San Leandro, San Lucas, South Dos Palos, Stevinson, Stinson Beach, Stockton, Tracy, Vernalis, Volta, Warm Springs, and Westley.

INTENSITY IV: Alcatraz, Albany, Brentwood, Byron, Camanche, Chinese Camp, Collinsville, Concord, Creston, Crows Landing, El Nido, Fairfield, Fulton, Greenfield, Gustine, Helm, Idria, Inverness, Irvington, Isleton, Kentfield, Kerman and vicinity, Lafayette, Knights Ferry, Linden, Menlo Park, Modesto, Monticello, Napa, Oakdale, Oilfields, Planada, Pleasanton, San Ardo, Saint Helena, San Benito, San Miguel, San Rafael, Santa Rosa, Sebastapol (2 miles west of), Snelling, South San Francisco, Tranquillity, and Vallejo.

INTENSITY I TO III: Clayton, Firebaugh, Hopland, Manteca, Mill Valley, Paso Robles, and Santa Margarita.

Negative reports were received from 56 places.

March 13: Between 13:00 and 13:30. San Martin. Sharp jolt with loud sound felt by many. Direction west–east. House creaked.

March 13: 22:10:15.* Epicenter 37°01′north, 121°29′ west, B. Felt over the same general area as that of March 9 but was of much lesser force. Maximum intensity VI. See map.

INTENSITY VI:

Gilroy.—Felt by many, awakened all in home. Windows and doors rattled; pendulum clocks stopped.

Hollister.—Felt by all, awakened many. Dishes rattled, hanging doors swung. Small objects and furnishings shifted. Slight visible sway of buildings. Pictures and hanging fixtures swung. One or two plaster walls slightly cracked.

Morgan Hill.—Felt by and awakened all. Rattled windows.

INTENSITY V: Alviso, Aptos, Bolinas, Firebaugh, Madrone, Moss Beach, Redwood City, San Francisco, San Jose (6 miles northeast of), San Jose, San Martin, Santa Cruz, Saratoga, Sunnyvale, and Watsonville.

INTENSITY IV: Ben Lomond, Big Sur, Gonzales, Los Gatos, Modesto, Montara, Monterey, Moss Landing, Newman, Oakland, Palo Alto, Pescadero, Richmond, Salinas, San Bruno, San Miguel, San Rafael, and Vallejo.

INTENSITY I TO III: Almaden, Burlingame, Crows Landing, Greenfield, Hayward, Newark, Petaluma, Point Reyes, Robles del Rio, Saint Mary's College, San Ardo, San Carlos, Templeton, and Volta.

Negative reports were received from 27 places.

March 14: Morning. "A slight earthquake rocked Reno, Nevada, on the morning of March 14. No damage was reported. Some 400 earthquakes have been recorded in this area since the sharp one of December 29."—(BSSA, April 1949).

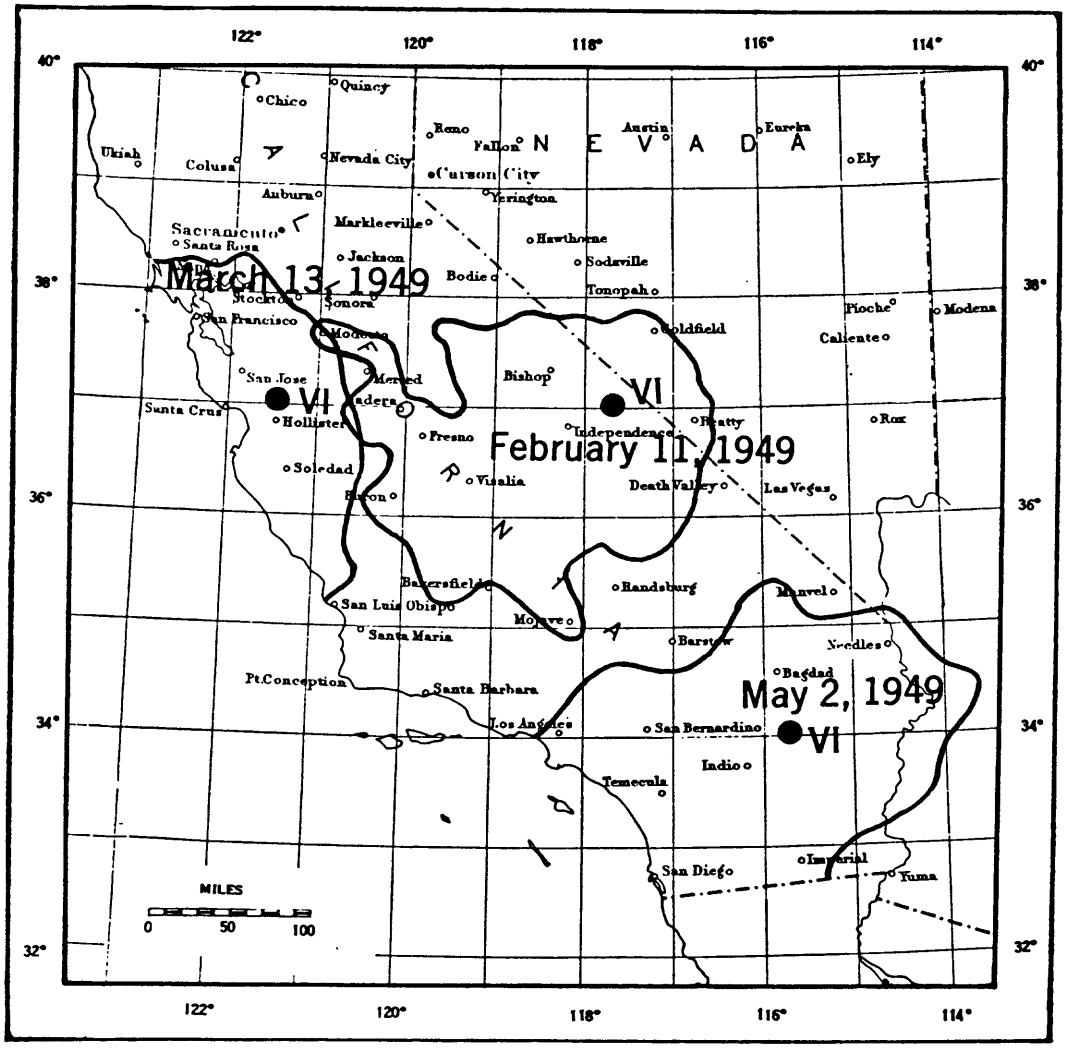

FIGURE 4.—*Areas affected by the earthquakes of February 11, March 13, and May 2.*

March 17: 08:06:29.* Epicenter 33°25′ north, 116°30′ west, northwest of Clark Lake, P. Felt in Borego Valley where buildings creaked and loose objects rattled. Very slight movement of light fixtures. Preceded by rumble.

March 20: 11:34:50.* Epicenter 35°08′ north, 117°15′ west, northwest of Barstow, P. Felt by several in Hinkley. Hanging objects swung.

March 22: 05:00. "A sharp earthquake jolted Ferndale at 5 a. m. There was no reported damage."—(BSSA, April 1949).

March 24: 10:03. San Martin. Light shock felt by several. Direction north–south. Hanging objects swung.

March 24: 16:00. San Francisco. Light shock felt by observer in office on 10th floor at 65 Market Street.

March 29: 13:40:19.* Epicenter 34°00′ north, 118°19′ west, southern Los Angeles, P. Felt by several and frightened few in Los Angeles. Direction south.

April 4: 20:36. Redding and Toyon. Felt by observer and jarred entire house at first named place; windows rattled and hanging objects swung at latter place.

April 8: 05:17:07.* Epicenter 34°36′ north, 120°21′ west, P. Los Alamos. Felt by several in home, awakened few. Windows rattled.

April 12: 23:53:36.* Epicenter 33°17′ north, 116°21′ west, P. Felt by many in Indio. Windows, doors, and dishes rattled; small objects shifted.

April 12: 23:58:25.* Epicenter 37.3° north, 118.6° west, B. Felt by several at Long Valley Dam and in Yosemite National Park. Windows and dishes rattled, hanging objects swung east–west. Trees and bushes shaken slightly and small objects and furnishings jolted at the latter place.

April 14: No time given. Reno, Nev. "Minor earthquake tremors were reported to be continuing every two or three days in the Reno area. They were thought to be a continuation of the series of aftershocks that jolted the area in late December and early January."—(BSSA, July 1949).

April 16: 02:55. Hollister (7 miles south of). Light shock felt by several, awakened few. Windows, doors, and dishes rattled; house creaked.

April 21: 19:48. Gualala (Fish Rock). Felt by many. Walls creaked, windows and doors rattled. Hanging objects swung.

April 28: 15:35:14.* Epicenter 36°56′ north, 121°48′ west, B. Felt by several in Watsonville, frightened few in Post Office. Windows rattled. At Moss Landing it was felt by several, trees and bushes were shaken slightly.

May 2: 03:24:58* and 03:25:47.* Epicenter 34°01′ north, 115°41′ west. in desert area southeast of Twentynine Palms, P. Main shock at 03:25:47* followed by 102 recorded aftershocks varying in magnitude from 2.9 upward to 4.7. Felt over approximately 16,000 square miles from Santa Monica inland to the San Gabriel Range, and as far east as El Centro, Blythe, San Bernardino, and Riverside, and in the extreme western portion of Arizona. See map. Maximum intensity VI.

INTENSITY VI:

Amboy.—Felt by and awakened many. Rattled windows, doors, and dishes; overturned vases and small objects.

Desert Center (5 miles northeast of).—Felt by all in home. Frame house creaked. Windows and dishes rattled; hanging objects swung. "Could see house shake with a slow roll for several seconds. There appeared to be a second lesser shock a few seconds later."

Desert Center (15 miles west of).—Awakened all. Windows and doors rattled; house creaked.

Desert Hot Springs.—Awakened all, frightened many. Windows, doors, and dishes rattled; house creaked.

Indio.—Felt by all. Most everyone awakened by rocking of beds. Windows, doors, and dishes rattled. Hanging objects swung. Vases and small objects overturned, knickknacks fell.

Pearblossom.—"In my home I noticed a clock had overturned in south direction (had been standing east-west)."

Rice.—Felt by and awakened all. Windows rattled and walls creaked. Loud subterranean sound.

INTENSITY V: Baker, Essex, Fallbrook, Hayfield Reservoir, Ludlow, Los Angeles (Post Office building and Weather Bureau airport station), Mecca, Midland, Newport Beach-Balboa area, Newport Beach, Palm Springs, Riverside, Twentynine Palms, and White Water.

INTENSITY V IN ARIZONA: Parker.

INTENSITY IV: Anza, Beaumont (southeast section), Big Bear City, Borego Valley, Calipatria, Campo, Del Mar, El Centro, Elsinore, Joshua Tree, Mount Laguna, Needles, Pisgah Substation (15 miles west of Ludlow), Potrero, Riverside, San Diego, Santa Ysabel, Wildomar, Warner Springs, Yucaipa, and Yucca Valley.

INTENSITY IV IN ARIZONA: Quartzsite, Reed Valley Flat, and Topock.

INTENSITY I TO III: Corona, Mount Wilson, Niland, and San Juan Capistrano.

Negative reports were received from 29 places in California and from 2 places in Arizona.

May 3: 06:30. Hayfield Reservoir. Light shock felt.

May 3: 17:34:03.* Epicenter 40.4° north, 124.3° west, B. Felt over an area of about 900 square miles in southwestern Humboldt County on the coast of northern California. Maximum intensity V.

INTENSITY V: Cape Mendocino Light Station, Ferndale, and Fields Landing.

INTENSITY IV: Alderpoint, Briceland, Fortuna, Honeydew, Holmes, Petrolia, Scotia, and Weott.

INTENSITY I TO III: Arcata, Carlotta, Eureka, Kneeland, and Piercy.

Negative reports were received from 21 places.

May 9: 22:20. Santa Maria. Light shock felt by many. Chandeliers swung. "We had another slight shock at 3 o'clock."

May 10: 03:34:56.* Epicenter 37°01′ north, 121°34′ west, B. San Martin. Awakened and frightened few in home. Windows and doors rattled: house creaked. Another shock reported at 04:29.

May 13: 02:18:31.* Epicenter 34°01′ north, 118°15′ west, P. Los Angeles. Press reported two shocks felt in southern part of Los Angeles proper. Communities north and south of the city limits, including Alhambra, Glendale, Burbank, Montrose, San Gabriel, Temple City, and San Dimas, reported sharper disturbances. Dishes rattled and chandeliers swayed in those areas. Telephone operators in the Los Angeles City Hall tower reported they felt the tower sway slightly. Disturbed objects were observed by several at the Weather Bureau airport station, and venetian blinds rattled and swung slightly from east-west at the Post Office building.

INTENSITY IV: Altadena, Glendale, Glendora, Huntington Park, Montebello, Ontario, Pasadena, San Marino, Sierra Madre, Walnut, and Wrightwood.

INTENSITY I TO III: Boron, Corona, and Hinkley.

Negative reports were received from 21 places.

May 17: 15:57:55.* Epicenter 35°38′ north, 121°09′ west, P. San Simeon. Brief shock felt by many. Doors rattled, frame house creaked.

May 17: 21:57:01.* Epicenter 35°52′ north, 118°30′ west, P. Felt by all at Kern River Powerhouse No. 3. Windows and doors rattled. Also felt by several at Kernville.

May 22: 00:27:15.* Epicenter 36.6° north, 121.5° west, P. Two distinct shocks felt by several at Lonoak. "Our house is built on the San Andreas Fault."

May 25: 20:43. Hollister (near). Light shock felt by several. Windows rattled and walls creaked.

May 26: 19:42:31.* Epicenter 34°06′ north, 117°00′ west. P. Felt by several at Mill Creek Powerhouse No. 2 (Mentone). Loose objects rattled, building creaked. Bumping subterranean sounds heard before shock.

June 3: 16:45. Hollister (7 miles south of). Very weak shock felt by several. Windows and doors rattled, house creaked.

June 6: 10:45. Borego Valley. Very light shock felt by very few. Rumbling subterranean sounds heard before shock. Observer states another jolt was felt after this one.

June 9: 19:06:39,* 19:13, and 21:04:36.* Epicenter 37°21′ north, 121°37′ west, about 10 miles east of San Jose, B. First shock was strongest of series and the one felt by most persons. Affected area

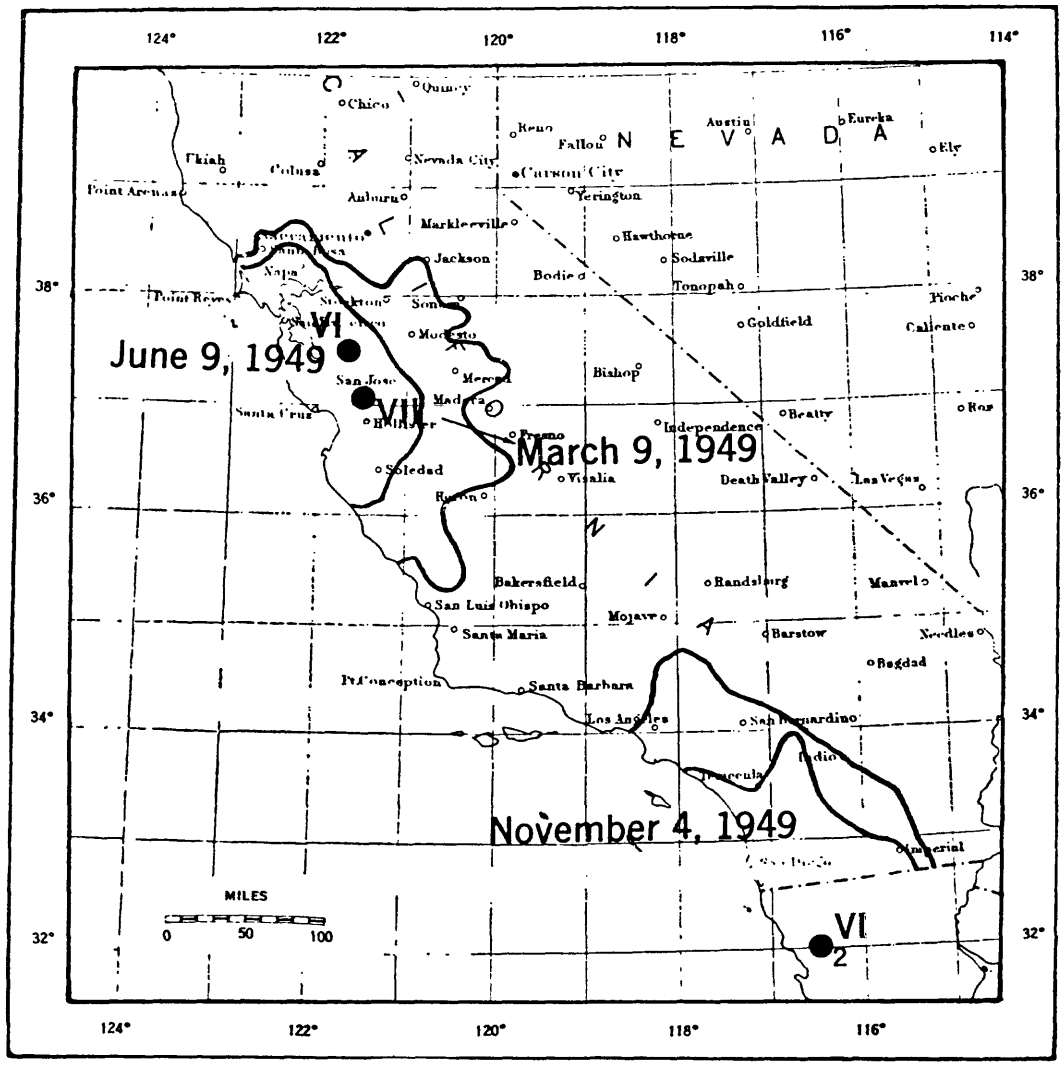

FIGURE 5.—*Areas affected by the earthquakes of March 9, June 9, and November 4.*

included approximately 8,000 square miles of west-central California. See map. Slight damage at San Jose. Maximum intensity VI.

INTENSITY VI:

San Jose.—Three shocks felt, first of which tumbled stocks from store shelves and shattered glass in east-side homes. Door in one home banged shut, breaking glass. Shock was of explosive nature, some thought water tanks had exploded, others, had sensation of floor dropping suddenly. Chandeliers swayed northwest–southeast, pictures were displaced on walls running NW–SE. "A 12-inch cast-iron main was split open, causing water to bubble up through cracks in street paving and around water meters."—(BSSA, October 1949)

San Jose (6 miles east of).—Felt by all. Dishes rattled, hanging objects swung. Knickknacks fell on second floor. Slight plaster cracks. First shock was in two parts; first, slow and easy, and second, quite severe.

Watsonville.—Felt by several. A number of persons called the Police Department, mostly those living on second floor level who found their water glasses spilling over.

INTENSITY V: Morgan Hill, Mount Hamilton, and San Francisco.

INTENSITY IV: Alameda, Ben Lomond, Burlingame, Castro Valley, Fairfax, Gilroy, Hillister (7 miles south of), Hollister, La Honda, Livermore, Los Gatos, Napa, Oakland, Petaluma, Pinnacles, Redwood City, San Rafael, Santa Cruz, and Sharp Park.

INTENSITY I TO III: Berkeley, Big Sur, Hayward, Holy City, Pescadero, and Saratoga.

Negative reports were received from 21 places.

June 15: 19:47:34.* Epicenter 36°45′ north, 121°40′ west, B. Generally felt by all in Hollister and San Juan Bautista. Felt stronger at Hollister where motion was described as twisting. Windows and doors rattled, house creaked. Slight aftershock 1 minute later.

June 17: 14:30. Fresno. "A mild earthquake . . . rattled dishes and windows, and caused pictures to sway in the northern and western suburban districts. . . . "—(BSSA, October 1949)

June 18: 21:31:53* and 22:32:54.* Epicenter 34°09′ north, 119°15′ west, near Oxnard, P. First shock reported as single sharp jolt; second "was accompanied by rumbling and was a 'longer back-and-forth roller.' Lamps swayed and dishes fell in some areas, but no sizable damage was reported. Los Angeles apparently felt the shock."—(BSSA, October 1949)

June 20: 10:35:29.* Epicenter 32°55′ north, 117°18′ west, P. Felt by several in San Diego and by one in Point Loma. Another shock felt following day in San Diego.

June 21: 11:39:34.* Epicenter 32°48′ north, 117°20′ west, near Ocean Beach, P. Felt by one person.

June 22: 10:08:46.* Epicenter 37°20′ north, 121°41′ west, at or near Mount Hamilton, B. Lightly felt in downtown San Francisco, San Mateo, and San Jose. This earthquake reportedly caused a break in a water pipe at Golden Gate Park in San Francisco, resulting in considerable damage, but from personal inquiries made during a field investigation in the general region of the park and because no reports were received from any other locality (except San Jose), it is doubtful that the earthquake was the direct cause of this damage. None of the workmen in the park were aware of the shock. Many persons were interviewed in this district and only a very few reported feeling the shock.

June 24: 18:13:18.* Epicenter 32°52′ north, 117°20′ west, west of La Jolla, P. "San Diego felt its third earthquake in a week. . . . No damage was reported."—(BSSA, October 1949)

June 27: 02:35:31.* Epicenter 35.8° north, 121.1° west, off coast near Cape Mendocino, B. Awakened many San Ardo and San Miguel residents. Houses creaked in San Ardo, hanging objects swung and windows rattled in San Miguel. Felt with lesser intensities in San Luis Obispo, San Luis Obispo (Tank Farm), Santa Margarita, and Paso Robles.

July 8: 03:00. Saint Mary's College (northeast section). Gentle movement, north–south, with gradual onset, felt by several. Doors creaked.

July 9: 20:26:01.* Epicenter 33°54′ north, 118°28′ west, off Manhattan Beach, P. Felt by hundreds of residents from West Los Angeles to North Long Beach. The tremor was described as of only a few seconds' duration and no damage was reported in any area. The southwest section of Los Angeles reported two sharp jolts, north to south. Buildings creaked, loose objects rattled, and tables shook. Visible swaying of buildings and trees. Faint bumping subterranean sounds were heard before shock. A single bump followed by a slight, rapid vibration similar to an explosion, was reported from Redondo Beach.

July 12: 11:17:26.* Epicenter 35°22′ north, 117°38′ west, near Garlock, P. Felt by many in Cantil (about ½ mile south of Garlock Fault). Direction southwest–northeast. Trees and bushes shaken slightly.

July 14: 20:50 (about). Fresno. Felt in northern and eastern sections. No damage.—(BSSA, October 1949)

July 20: 14:15: Camanche. Felt by several. Windows and doors rattled. "Vibrations and rumblings have been heard and felt in afternoon for several weeks."

July 21: 08:50 and 09:01 (a. m. or p. m. not given). Coalinga. Light shock shook windows and doors, dishes rattled slightly. Direction north by east.

July 24: 10:50:14* and 10:54:07.* Epicenter 32°21′ north, 117°48′ west, off the coast, P. One person in Mount Helix reported house moved and creaked.

July 27: 04:38:06.* Epicenter 37°10′ north, 121°53′ west, B. San Jose (6 miles east of). Felt by all in home. Direction northeast.

July 30: 13:09:39.* Epicenter 33°39′ north, 118°13′ west, off Long Beach, P. Long Beach residents in an area about 1½ miles long, from First Street and Alamitos Avenue diagonally northwest to 29th Street and Santa Fe Avenue, reported feeling a slight earthquake. Some stated it felt like an explosion. No damage was reported. Buildings creaked, loose objects rattled. Faint roaring subterranean sounds heard before and during shock.

August 8: 03:00:03.* Epicenter 37°57′ north, 122°19′ west, near Richmond, B. Felt over an area of about 300 square miles of Bay region. Maximum intensity VI. Slight damage reported.

INTENSITY VI:

Pinole.—Felt by and awakened all. Windows and doors rattled. Frightened few.

Richmond.—Felt by all, frightened many. Dishes fell from shelves, hanging objects swung, small objects shifted, windows broke, and knickknacks fell. Slight damage.

Vallejo.—Felt by many, felt outdoors by some. Trees and bushes shaken moderately. Plaster cracked, small objects and furnishings shifted, frame houses creaked. Windows, doors, and dishes rattled. Slight damage.

INTENSITY V: Berkeley and Lafayette.
INTENSITY IV: Alameda, Mill Valley, Oakland, San Francisco, and San Pablo.
INTENSITY I TO III: Bolinas, Martinez, and San Rafael.
Negative reports were received from 3 places.

August 15: 21:37:13.* Epicenter 36°47′ north, 121°22′ west, B. Hollister (7 miles south of). Felt by several in home. Windows and doors rattled, house creaked.

August 16: 21:14:19.* Epicenter 34°00′ north, 117°12′ west, east of Riverside, P. Felt by and awakened many in homes in Riverside. Movement was slight and wave-like. Also felt by a number of San Bernardino's north-end residents.

August 19: 02:57:51.* Epicenter 33°57′ north, 116°53′ west, near Banning, P. Felt by many in central section of Palm Springs. Buildings creaked and loose objects rattled.

August 21: 02:51:03,* 03:45:20,* and 12:48:16.* Epicenter for first two shocks, 40°17′ north, 121°10′ west; for third and main shock, 40°16′ north, 121°14′ west, B. Felt by all at Caribou (P. G. & E.). Roaring subterranean sounds like distant blasting heard at beginning of shocks. Last shock felt both indoors and outdoors, some persons frightened by being awakened so abruptly. Buildings creaked and loose objects rattled. Also felt at Lake Almanor, Butte Valley, and Las Plumas with similar effects. At Chester, first two shocks were felt by several, last shock was felt by many. Creaking of buildings and rattling of loose objects heard by few during first two shocks, by many during last shock. Moderately loud subterranean sounds heard by few during first two shocks, thunderous sounds heard by many during last shock. Disturbed objects observed by several during last shock, few reported leaves on trees disturbed. The last shock was also felt at Mineral.

August 21: 19:00. Kettleman Hills. "The fifth tremor in 2 weeks was reported shortly before 7 p. m. P. S. T. Some residents of the oil field said the jolt was accompanied by a loud noise, similar to a clap of thunder. No damage was reported. The four previous tremors toppled boulders and caused small slides on rocky canyon walls."—(BSSA, October 1949).

August 21: 21:03. Lafayette. Mild shock felt by observer in home.

August 26: 08:52:32.* Epicenter 34.5° north, 120.5° west, near Point Conception, P. Felt over an area of approximately 250 square miles on coast of San Luis Obispo and Santa Barbara counties. Maximum intensity VI.

INTENSITY VI:

Arlight.—Small shake, then a good hard shake. Entire house creaked, windows and dishes rattled. Hanging objects swung N. Trees and bushes shaken strongly. Everything shook, mirror and bed shaken back and forth. "Hardest felt here for a very long time."

Arlight (Point Arguello Lifeboat Station).—Two shocks felt by several. Buildings creaked and loose objects rattled. Station fire bell rang. Disturbed objects observed by several, charts on north-northeast wall swung northnorthwest to eastsoutheast. Visible swaying of buildings and trees.

Surf.—Awakened many. Windows and doors rattled, house creaked. Pendulum clocks facing N. stopped. Small objects shifted, light fixture fell.

INTENSITY IV: Guadalupe, Lompoc, and Los Alamos.
INTENSISY I TO III: Casmalia, Nipomo, San Luis Obispo, and Sudden.
Negative reports were received from eight places.

August 27: 06:15. Arlight. Slight shock felt.

August 27: 06:51:46.* Epicenter 34.5° north, 120.5° west, near Point Conception, P. Felt over an area of approximately 350 square miles in coastal region of San Luis Obispo and Santa Barbara counties. Maximum intensity VI.

Arlight.—Hard shock, seven shocks have been felt to 10 o'clock. Direction of all shocks from west to north. Dishes broke, one chimney knocked down. Things knocked off shelves in post office.

Lompoc.—Felt by all, awakened many. Shifted or overturned small objects, broke dishes, rattled windows and doors. Hanging objects swung. Trees and bushes shaken strongly. Hunters in hills between Lompoc and the ocean reported shock was strong enough to move large oak trees and spill coffee from cups.

Sudden.—Broke dishes. One chimney fell.

INTENSITY V: Casmalia, Los Alamos, Nipomo, Santa Barbara, and Surf.
INTENSITY IV: Buellton, Concepcion, Goleta, Los Prietos Ranger Station, Santa Ynez, and Summerland.
INTENSITY I TO III: Atascadero, Cayucos, Orcutt, and San Luis Obispo.
Negative reports were received from four places.

August 27: 13:10. Jenner area (about 4 miles east of Fort Ross and one-half mile north of San Andreas Fault line). Light shock felt by three persons. Two other shocks felt in a. m. of daylight hours.

August 29: 04:07:21.* Epicenter 36.2° north, 120.2° west, east of Coalinga, P. Kettleman City and Avenal. Light shock felt by several. A few residents reported broken dishes. Disturbed electrical equipment in oil field, timing devices stopped for a few minutes. Shale and small rocks were shaken from roadside cliffs. In canyons, pipeline walkers noted newly toppled boulders.

September 6: 03:20:20.* Eureka. Radio reported shock felt.

September 7: 19:30. Gilroy and San Juan. Residents reported a slight shock rattled windows.

September 17: 08:21:57.* Epicenter 35°48′ north, 118°30′ west, near Kernville, P. Felt by many, felt outdoors by some at Kern River Powerhouse No. 3. Windows and doors rattled. Also felt in Kernville with same effects. Reportedly felt strongly at Tobias Peak lookout station in Sequoia National Forest.

September 18: 21:08:13.* Epicenter 34°00′ north, 118°17′ west, near Huntington Park, P. Felt over an area of about 700 square miles in central Los Angeles County. Maximum intensity VI. Press reported dishes and windows were broken and cement driveways cracked in Los Angeles. Many

were frightened in Long Beach and San Gabriel. At the last named place residents reported two shocks, one immediately following the other, with direction from southeast to northwest.

INTENSITY V: Compton and Downey.

INTENSITY IV: Bell, Bellflower, Eagle Rock, Huntington Park, La Habra, Montebello, and Norwalk.

INTENSITY I TO III: Manhattan Beach and Pasadena.

Negative reports were received from 13 places.

September 19: 20:14:11.* Epicenter 34°53′ north, 116°40′ west, north of Newberry, P. Felt by all in Yermo. Windows and dishes rattled.

September 22: 13:30. Imperial. "Bump from west, felt like truck hitting building." Felt by several. Buildings creaked and loose objects rattled.

September 22: 20:35:35.* Epicenter 33°58′ north, 118°57′ west, off Point Dume, P. Felt at Cornell and Oxnard (13 miles southeast of). Houses creaked in Cornell, and a rumble like far off thunder was heard before shock. At latter place the shock was felt by all in homes, windows rattled.

September 23: 13:44:40.* Epicenter 34°00′ north, 116°40′ west, north of White Water, P. Felt by many in Palm Springs. Creaking of buildings and rattling of loose objects heard by many. Bumping noise heard at time of shock.

September 29: 02:53:58.* Epicenter 34°10′ north, 117°14′ west, near Arrowhead Springs, P. Press reported residents were awakened in the northwest section of San Bernardino. Some residents reported a loud noise accompanied the shock.

September 30: 20:23:05.* Epicenter 34°08′ north, 117°16′ west, near Patton, P. Press reported the earthquake as a single sudden jolt followed by a loud thud. Dishes rattled and chandeliers shook in San Bernardino. No damage.

October 2: 12:36. Oakland and San Leandro. Light shock felt. "Police stations reported having received many telephoned statements that a roaring noise was heard at the time of the shock . . ." (BSSA, January 1950).

October 3: 01:34. Berkeley-Oakland-San Leandro area. Light shock felt. Dishes rattled.

October 3: 18:47:06.* Epicenter 36°59′ north, 121°38′ west, B. Felt by seven persons in home near Morgan Hill in Eastman Canyon. One slight rapid jolt followed immediately by distant rumble. Windows rattled.

October 10: 14:15. Borego Valley. Mild shock reported felt by one person.

October 12: 20:12:20.* Epicenter 33°51′ north, 115°51′ west, Pinto Basin, P. Felt by many in Indio, felt by some outdoors. Rattled windows and dishes, shifted small objects.

October 13: 16:29:25.* Epicenter 33°11′ north, 116°23′ west, P. Felt quite strongly by many in Borego Valley and Dulzura (Barrett Dam). Buildings creaked and loose objects rattled at both places, lamps swayed at the latter place. A minor aftershock was reported in Borego Valley. Two miles southeast of town, reporters felt one heavy single jolt. Also felt at Grossmont (Mt. Helix, about 5 miles northeast of San Diego) where walls creaked, and also felt by several in San Diego.

October 16: 08:05:22.* Epicenter 37°40′ north, 118°40′ west, northern Owens Valley, P. Felt by several in homes near Long Valley Dam. Windows rattled and walls creaked.

October 17: 05:20:57* Epicenter 33°57′ north, 116°38′ west, northeast of White Water, P. Felt by several in White Water where buildings creaked and loose objects rattled. Faint subterranean sounds were heard before shock. Buildings swayed slightly. Sleepers in Palm Springs were awakened by the tremors.

October 18: 23:00. Santa Rosa. Two persons awakened by light shock. "House creaked very noticeably."

October 19: 19:26:35.* Epicenter 37°40′ north, 118°40′ west, northern Owens Valley, P. Felt by several near Long Valley Dam. Slow shaking motion with gradual onset, preceded by rumble.

October 22: 13:45:21.* Epicenter 36.6° north, 121.2° west, B. Felt throughout most of central coastal area. Felt by all in restaurant in Hollister. Moderate rattling of windows, doors, and dishes; hanging objects swung, and small objects were shifted. Felt by several 7 miles south of Hollister. "Walnut pickers and shed workers could see the motion in walls and boxes on the ground." Also felt by many in Big Sur and by several in homes south of Morgan Hill.

October 23: 13:50. San Francisco. Felt by observer lying down in home. Not felt by others in motion.

October 27: 18:29:16.* Epicenter 40.9° north, 121.2° west, B. Felt by many in Eureka. Very faint surface sounds heard. Disturbed objects observed by several, floor lamp rocked east–west for about 8 seconds after shock. Two very slight tremors about 5 seconds before main shock.

October 30: 18:46. San Diego. Very light shock felt.

November 1: 03:05. Hollister (7 miles south of). Felt by observer already awake. Windows rattled very slightly, frame house creaked slightly.

November 2: 21:00. Santa Rosa. Felt by two in home. Walls creaked.

November 4: 06:45 and 06:50. Santa Rosa. Felt by observer lying down. Direction north. Walls creaked during latter shock.

November 4: 12:42:38.* Epicenter 32° north, 116½° west, Baja California, W. Felt over an area of about 9,000 square miles extending from Palmdale southeast to Niland, south to El Centro, west to San Diego, and northwest along the coast of Van Nuys and Palmdale. Maximum intensity VI. At Guadalupe, about 13 miles northeast of Ensenada, cracks up to 1½ inches wide were noted in six soft adobe brick houses (one story); half the end of an abandoned building fell out, and a few small landslides were noted.

INTENSITY VI:

Alpine.—Felt by all, frightened many. Direction circular. Windows, doors, and dishes rattled; house creaked.

Balboa Park.—"It was thought for a time that the 196-foot California Tower might topple, it was shaken so intensely."

Borego Valley.—Several shocks, first was of long duration, then short interval, followed by several short jolts. Felt by most people. Disturbed objects observed by several, buildings creaked. A few cement floors cracked. Chandeliers swung in circular motion, casement windows were unlocked.

Campo.—Felt by all. Direction east. Windows, doors, and dishes rattled; hanging objects swung E. Shifted small furnishings, overturned vases, cracked plaster, and broke dishes.

Coronado.—City Hall shook violently, palm trees outside swayed as though pushed by a heavy wind. Cracks in auditorium of Coronado High School brought cancellation of a scheduled assembly. Chandeliers in the building moved ¼ inch.

Del Mar.—Felt by all. Hanging objects swung, small objects shifted. Plaster cracked. Windows and doors rattled.

National City.—Felt by many, felt outdoors by some. Decided vertical motion at start, then northeast. Windows, doors, and dishes rattled; houses creaked. Hanging objects swung.

Potrero.—Felt by all in entire area, frightened many. Rattled windows, doors, and dishes; hanging objects swung. Considerable roaring noise.

San Diego (Lindbergh Field).—Motion vertical, then north–south, then circular. Felt by majority. Disturbed objects observed by many, definite visible swaying of buildings and poles (appeared to vibrate in a circular motion). Few slight plaster cracks Large steel cabinets swayed north–south, lighter objects bounced as a result of initial upward thrust.

San Diego.—Noontime lunch crowds in downtown area ran for doors. Swayed such tall structures as the El Cortez Hotel, the Bank of America building, and the tower of the Civic Center. Throughout the city, wall cracks were reported, hanging objects swung, plaster cracked slightly in the Dana Junior High School, and a potted palm was shaken moderately. At the Harbor Department Building a ¼-inch crack opened from ceiling to floor in the corner of one office.

Santa Ysabel.—Felt by all in area, frightened many. Buildings creaked, loose objects rattled, hanging objects swung. Bumping subterranean sounds heard at time of shock.

Santee.—Felt by many. Rattled windows, doors, and dishes severely; house creaked severely. Hanging objects swung, pictures shifted on wall. Stucco cracked.

San Ysidro.—Felt by all in public garage. Hanging objects swung, plaster cracked.

Spring Valley.—A porch was reported loosened in the Casa de Oro area.

INTENSITY V: Brawley, Dulzura (Barrett Dam), Dulzura, Jamul, and Ocean Beach.

INTENSITY IV: El Cajon, El Centro, Encinitas, Heber, Hipass, Huntington Beach, Jacumba, Lakeside (El Capitan Dam), Laguna Beach (northeast section), Laguna Beach, Leucadia, Mount Laguna, Niland, Oceanside, Plaster City, Thousand Palms, Valley Center, Walnut, and Wildomar.

INTENSITY I TO III: Anza, Balboa-Newport Beach area, Cabazon, Long Beach (Belmont shore), Los Angeles, Palmdale, Perris, Riverside, San Bernardino, Thermal, and Van Nuys.

Negative reports were received from 28 places.

November 4: 13:48. Indio. Felt by several in home. Windows, doors, and dishes rattled slightly.

November 4: 20:35:24.* Aftershock of 12:42:38.* Maximum intensity VI. See map. No serious damage.

INTENSITY VI:

Campo (6 miles E. of).—Felt by all, frightened few. Hanging objects swung east, small objects shifted, vases overturned. Trees and bushes shaken slightly.

Grossmont High School.—Felt by all in school, frightened many in community. Windows and doors rattled, hanging objects swung northeast. Plaster cracked in northwest corner of library. Desks shook.

La Jolla.—Press reported an inner wall cracked in one residence and a door jammed between two rooms in another residence.

National City.—Felt by many. Windows, doors, dishes, and lamps rattled. Hanging objects swung north–south. Terrific roar accompanied shock.

San Diego.—Felt by nearly all. Small cracks in one or two walls. Lamps, doors, and other suspended objects swung. Trees and bushes shaken strongly. Considerable rumbling.

INTENSITY V: Jamul, Mount Laguna, Santa Ysabel, and Wildomar.

INTENSITY IV: Borego Valley, Dulzura (Barrett Dam), El Centro, Hipass, Jacumba, Lake Henshaw, and Valley Center.

INTENSITY I TO III: Balboa, Encinitas, Lakeside (El Capitan Dam), Ocean Beach, and White Water.

November 5: 00:00. Bratton Valley (10 miles east of Jamul). Felt only in this vicinity.

November 5: 12:02:07.* After shock of November 4 at 12:42:38.* Felt by several in Post Office in Jamul, felt by some outdoors. Direction east–west. Windows rattled. Very slight swaying motion felt by a few at Lindbergh Field in San Diego.

November 6: 15:05:10.* Aftershock of November 4 at 12:42:38.* Felt at Campo, Dulzura (Barrett Dam), and Hipass. Mild at Campo and Hipass; at Barrett Dam, buildings creaked and loose objects rattled. Faint rumbling subterranean sounds were heard during shock.

November 6: 23:53. Watsonville (San Miguel Canyon Road). Very light shock felt by several, awakened few.

November 9: 21:16:35.* Epicenter 36°38′ north, 121°08′ west, B. Felt in Hollister and 7 miles to south. Windows rattled and houses creaked.

November 11: 05:54:00.* Aftershock of November 4 at 12:42:38.* Intensity IV at Campo (4 miles east of), Coronado, San Diego, and Jacumba. Loose objects rattled at first three places; at last named, observer in railroad coach was awakened by loud rumbling noise and shaking of coach.

November 16: 21:06:1* Epicenter 34.8° north, 120.7° west, P. Felt by many in east section of Santa Maria. Buildings creaked and loose objects rattled. Lights, pictures, and couch jarred slightly; disturbed objects observed by many.

November 17: 17:19:52.* Epicenter 33°45′ north, 118°15′ west, on Terminal Island, P. Very local earthquake moderately perceptible at surface. Damage estimated by engineers to exceed 9 million dollars occurred at 1,800-foot level below the surface where nearly 200 oil wells were damaged. Most persons feeling the shock were on upper floors of buildings in Long Beach. Ink wells were reportedly thrown off desks at the Jergins Trust Building on Ocean Boulevard, disturbed objects were observed by many. Also felt lightly by several persons in San Pedro.

November 19: 23:11:32.* San Diego. Felt by several in home. Dishes rattled and chandeliers swayed.

November 22: 01:40:54.* Epicenter 33°53′ north, 118°21′ west, west of Gardena, P. Two shocks felt in southwest section of Los Angeles. Buildings creaked and loose objects rattled. Disturbed objects observed by several. Tinned and carton foods in cupboard were knocked over.

November 23: 05:20:01.* Epicenter 35°51′ north, 117°48′ west, northwest of China Lake, P. Felt by two in trailer at Nine Mile Aqueduct Station.

November 28: 22:51:38.* Epicenter 37°21′ north, 121°42′ west, B. Felt by all in home in San Jose. Windows rattled.

November 29: 23:10. Hollister (7 miles south of). Felt by several in home. Windows and doors rattled, house creaked.

November 30: 00:31:54.* Epicenter 38°37′ north, 122°08′ west, B. Windows rattled strongly in Fairfield (Gordon Valley). In Sacramento a bed lurched and a chandelier swung.

December 6: (afternoon). Arbuckle. "An earthquake was felt in Arbuckle on the afternoon of December 6."—(BSSA, January 1950).

December 7: 10:44:40.* Epicenter 39.1° north, 119.9° west, B. Felt by majority in Carson City, Nevada; some people ran out of older State buildings. Hanging light fixtures swung. Moderately loud booming subterranean sounds heard before and at time of shock.

December 9: 04:39:02.* Epicenter 37°28′ north, 118°22′ west, north of Bishop, P. A foreshock occurred at 00:41:18.* Reported felt in towns of Bishop, Laws, June Lake, and Yosemite National Park. Felt by observer at Big Pine Power Plant and awakened many in community.

December 10: 07:46:53.* Epicenter 34°03′ north, 118°30′ west, near Santa Monica, P. Press reported the shock was felt in Santa Monica.

December 12: 21:05:18.* Epicenter 38.6° north, 119.7° west. B. Felt by several in Markleeville. Windows rattled slightly and walls creaked. Another slight tremor followed in 10 minutes.

December 12: 21:25:05.* Epicenter 34°04′ north, 118°29′ west, near Santa Monica, P. Short, sharp jolt reported felt in Santa Monica. Culver City and West Los Angeles reported feeling a mild shock. Wilshire Division police station reported receiving a number of calls from persons who noticed the tremor in that area.

December 15: 16:05. Imperial. Very light shock felt by several.

December 21: 15:08:41.* Epicenter 40.4° north, 124.2° west, B. Felt by several seven miles northeast of Bridgeville. Building creaked slightly. Faint cracking subterranean sounds heard. Felt by many in Ferndale and Scotia. Hanging objects swung in Ferndale.

December 26: 06:27:40.* Epicenter 34°00′ north, 118° 20′ west, near Inglewood, P. Felt principally in southwestern Los Angeles County. Maximum intensity VI. Short, jolting motion jarred Westchester and Inglewood areas, breaking dishes and causing chandeliers to swing. Pictures were knocked from walls and a few windows were cracked. One gas pipe reportedly broke. Police at Inglewood and beach towns reported their switchboards were swamped with calls. People ran from buildings at the Los Angeles International Airport. Felt quite strongly at Hawthorne, El Segundo, Manhattan Beach, Torrance, South Gate, and in parts of Hollywood. Also felt at Lynwood and Venice.

Negative reports were received from 13 places.

December 26: 08:37. "San Mateo experienced a mild earthquake . . . which rattled windows."—(BSSA, April 1950).

December 28: 08:46. Carson City, Nev. Light shock felt by several. Hanging light fixtures swung. Faint rumble was heard by several at time of shock.

December 29: 03:35:38.* Epicenter 34°02′ north, 118°25′ west, near Culver City, P. Very light shock felt by a few persons in Inglewood.

December 30: 03:13:48.* Epicenter 32°12′ north, 116°48′ west, Baja California, P. Felt by observer in home 4 miles east of Campo.

WASHINGTON AND OREGON

(120TH MERIDIAN OR PACIFIC STANDARD TIME)

February 6: 11:00. Wapato, Wash. One sharp jolt or thud felt and heard by observer.

March 24: 12:56:56.* Epicenter 41.3° north, 126.0° west, B. Very short shock reported at Grants Pass, Oreg. "Vase and silver chest on refrigerator shook and rattled. Chair made slight movement from side to side. Bed shook." Windows rattled in Phoenix.

April 3: 13:30. Grants Pass, Oreg. Light shock felt by several in home.

April 3: 17:20. Klamath Falls, Oreg. Light shock felt by many. Windows, doors, and dishes rattled. House creaked and some small objects shifted.

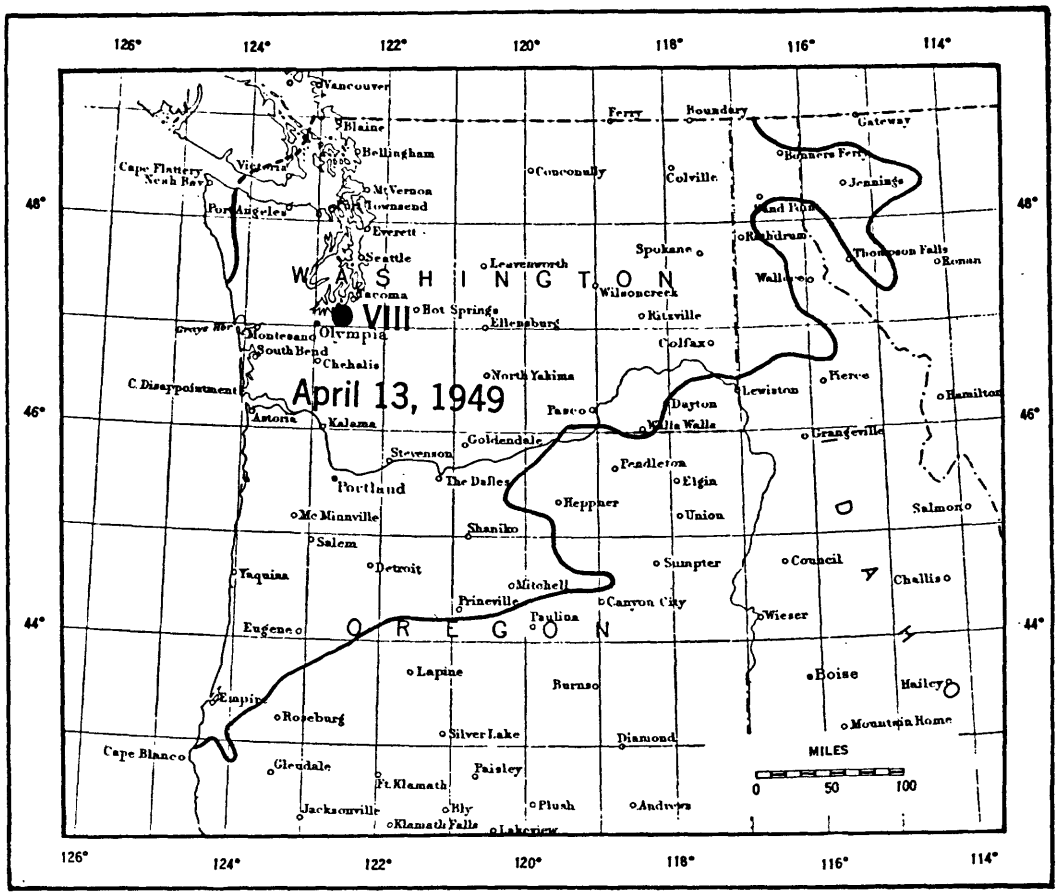

FIGURE 6.—*Area affected by the earthquake of April 13.*

April 13: 11:55:41.* Epicenter 47.1° north, 122.7° west, between Olympia and Tacoma, Wash. W. Felt over an area of 150,000 square miles in the United States. See map. Magnitude was 7.1 for a depth slightly greater than normal. Maximum intensity VIII was reported for an unusually large distance, about 85 miles, and mainly on soft ground with a high water table. Eight deaths were caused either directly or indirectly, many were injured, and damage was estimated at upwards of 25 million dollars. A school, church, and library were condemned and widely separated schools were seriously damaged. In Olympia eight capitol buildings were damaged with a loss of 2 million dollars. Elsewhere heavy property damage was caused by falling parapet walls, toppled chimneys, and cracked walls.

Public utilities suffered seriously when water and gas mains were broken and electric and telegraph services were interrupted. Railroad service into Olympia was suspended for several days, and railroad bridges south of Tacoma were thrown out of line, delaying traffic for several hours.

A large portion of a sandy spit jutting into Puget Sound north of Olympia disappeared during the earthquake. Near Tacoma a tremendous rockslide involving a half-mile section of a 300-foot cliff toppled into Puget Sound. One 23-ton cable saddle was thrown from the top of the Tacoma Narrows bridge tower, causing considerable damage.

INTENSITY VIII IN WASHINGTON:

Aberdeen.—One death. Several brick and concrete buildings cracked, brickwork fell. Scores of chimneys tumbled at roof levels. Water main cracked. Many cracked walls and chimneys; many broken dishes and windows.

Adna.—Chimneys cracked or twisted. Knickknacks, books, and pictures fell; many dishes broke. Furniture and small objects overturned. Considerable damage to brick. Trees and bushes shaken strongly.

Ashford.—Cracked windows, walls, and chimneys; many chimneys twisted or fell. Considerable damage.

Auburn.—One person injured. Four blocks of downtown district severely damaged. Parapet walls and many chimneys fell. Junior High School condemned. Many wall and plaster cracks; many broken dishes.

Buckley.—Part of high school building fell. Most chimneys in town toppled at roof line. Cracked plaster, chimneys, and ground. Books, plaster, and walls fell. Large trees shaken like small bushes. Several brick buildings damaged considerably.

Castle Rock.—One death, several persons injured. One school damaged severely with brick and masonry falling on children. Upper wall over entrance fell. Many cracks up to 6 inches wide in fields and on river dikes. Landslides. Many twisted or fallen chimneys and fireplaces, most falling north and south. Trees and power lines swayed. Plaster, windows, walls, and chimneys cracked; many dishes broken.

Cathlamet.—Chimneys fell, plaster cracked. Knickknacks, books, pictures, and plaster fell. Pendulum clocks facing north stopped. Trees and bushes swayed violently.

Centralia.—One death, 10 persons hospitalized. Very heavy damage. Collapse of building walls and many chimneys. Two city schools permanently closed; 1 church condemned, continued settling of ground caused extensive damage. Water mains broken, and 5,000 feet of concrete pipe in city intake water supply damaged. Water and sand spouted from ground. Violent swaying of buildings and trees. Most chimneys either damaged or fallen. Many walls cracked, worst damage to north walls. Most walls fell to north or south, some to west, very few to east; chimneys twisted clockwise. Telephone lines twisted together for many miles. Many objects moved, including pianos. Objects moved from shelves on all walls. Large amounts of plaster knocked down. Pendulums swinging east–west stopped. Many persons panic-stricken. Four miles southwest of town, water spouted 18 inches high in middle of field, leaving a very fine sand formation for a considerable space around each hole, the holes varying from 1 to 3 inches in diameter. Water spouted from inch-wide crack 8 or 10 feet long. Caretaker on Newaukum River intake noticed gas or air boiling up through water in the river.

Chehalis.—Several persons severely injured. Great damage to downtown buildings, schools, and churches. Water mains damaged, 1,351 chimneys damaged. City Library condemned. Twisting or fall of chimneys, columns, and monuments. Most damage to brick and masonry. "It didn't seem to make any difference in new or old construction as far as chimneys were concerned; certain paths took them all and other places not any." Many broken windows and dishes; knickknacks, pictures, books, and plaster fell. Shifted heavy furnishings if on castors, overturned floor lamp.

Cinebar.—Cracked plaster, windows, walls, chimneys, and ground. Many chimneys twisted or fallen. Some trees twisted and uprooted. Books, pictures, and plaster fell. Damage considerable.

Forest.—At the Niels Paulsen farm, two springs appeared; the first came in the 1946 temblor and another appeared close by during this shock.

Granite Falls.—Twisting and fall of a few chimneys, many chimneys twisted. Considerable damage to brick and masonry. Plaster cracked and fell. Trees and bushes shaken strongly.

Hoquiam.—At least a dozen water mains and pipes broken. Several cracked sidewalks. Considerable damage to brick and masonry. Many cracked windows and walls, many plaster cracks.

Index.—Three 6-inch water mains broken. Considerable damage to chimneys, twisted or fallen, and considerable damage to brick. Many cracked walls and chimneys. Books, pictures, and plaster fell.

Kelso.—Two persons injured. Extensive property damage in business and industrial districts. Stocks in stores knocked from shelves. Three-foot section of theater corner wall fell. Many plaster, window, wall, chimney, and ground cracks. Twisting and fall of chimneys.

Kosmos.—Cracked plaster, walls, windows, chimneys, and ground. Knickknacks, pictures, and plaster fell; dishes broke. Twisting and fall of chimneys. Considerable damage to brick and masonry. Bells rung. Visible swaying of buildings and trees. Many light fixtures torn off. Objects fell west–east.

La Grande.—Damage considerable to brick and masonry. Walls cracked south–north, objects fell north–south. Chimneys fell. Plaster, windows, and walls cracked. Visible swaying of buildings and trees. Ground cracks on steep side hills 1 inch wide to 25–30 feet long. Landslides. Pictures, books, and dishes fell.

Lakebay.—Twisting and fall of many brick chimneys. Cracked plaster and chimneys. Trees and bushes shaken strongly. Small objects and furnishings shifted; many dishes broken.

Littlerock.—Many chimneys broken off and fallen to ground, very few left standing. Trees and bushes shaken strongly. Plaster, windows, and walls cracked; knickknacks, books, pictures, and plaster fell. Trees and bushes shaken strongly.

Longview.—Two minor injuries. Thousands of dollars damage in Cowlitz County. Gable of community church fell; water main at high school broke, beams cracked in cafeteria. Damage extensive, but scattered, to business buildings, industrial properties, and residences. Upheaval action broke a concrete basement floor, pushing up as much as 7 inches. Water came through cracks in sizable quantity for about 3 hours after the shock, stopped entirely about 12 hours after the shock. Water and sand spouted from ground. Ground cracks in yards and road over dikes. Landslides on cuts along highway. Objects fell in all directions, one piano on glass cups rolled about 8 inches in easterly direction. One fireplace mantle moved 1½ inches from wall at one end but not at all at other end; glass figurine resting on end of mantle that moved was thrown a distance of 12 feet, similar figurine at other end of mantle did not even tip over.

Nisqually.—Damage considerable to brick, masonry, and concrete. Many toppled chimneys. Plaster, walls, chimneys, and ground cracked; pictures, books, knickknacks, and plaster fell. Trees and bushes shaken strongly.

Oakville.—One minor injury. Only damage to chimneys which twisted or fell. Twenty-five percent of chimneys damaged. Walls in high school cracked, top of one entrance column broke. Many broken dishes and windows. Wells and creeks were very muddy after shock. Goats raced around.

942770°—51——4

Olympia.—Two deaths, many persons injured. Eight capitol buildings damaged. Nearly all large buildings were damaged through cracked or fallen walls and plaster. Two large smokestacks and many chimneys fell. Streets were damaged extensively; water and gas mains were broken. A large portion of a sandy spit jutting into Puget Sound north of Olympia disappeared during the earthquake.

Olympia (4 miles south of).—Fifty percent of chimneys down or severely damaged; plaster and masonry walls cracked in every direction. Top 50 feet of a 250-foot plant stack fell. Only one major water main broken and that was on filled waterfront ground. Objects on southwest–northeast shelves fell; objects on northwest–southeast shelves were little disturbed. Eight cubic-foot refrigerator moved about 1½ inches in southeast direction, full bureau moved 6 inches from north wall. Pendulum clock with 16-inch pendulum stopped. One man at airport claimed he observed waves in ground similar to waves on water.

Onalaska.—Damage considerable to brick; many chimneys twisted, fallen, or badly cracked. Milk bottles overturned, many dishes broken. Trees and bushes shaken strongly.

Orting.—Cracks on several dirt roads, small landslide on road to powerhouse. Very loud roaring and whistling subterranean sound heard. Visible swaying of buildings and trees. Several chimneys damaged. Puyallup River turned quite muddy soon after the shock. Mt. Rainier was observed and quite a mist had formed due to falling snow; through glasses new cracks could be seen. Right after shock air was filled with small flies and gnats that disappeared in about two hours. Deer seemed badly frightened.

Puyallup.—Many injured. High school building severely damaged with collapse of stage in auditorium. Nearly every house chimney toppled at roof line. Hundreds of walls cracked, several houses were jarred off their foundations. Roads were blocked by landslides for several hours. Water mains broken. Multiple story brick buildings most severely damaged, walls facing east and west most severely damaged. Narrow dimensional buildings facing east and west not so badly damaged. Some basement floors raised several feet, driving supports through floor above. Everything loose crashed. Plaster badly damaged. Geysers erupted in fields bringing up much sand.

Randle.—Twisting and fall of chimneys, about one-fourth of all chimneys fell. Damage considerable. Water spilled from containers and tanks. Plaster and walls fell, dishes and windows broke. Lights went out.

Richmond Beach.—Damage considerable. Twisted and fallen chimneys, cracked plaster, windows and walls. Dishes and windows broken. Trees and bushes shaken strongly.

Seattle.—One death indirectly, many persons seriously injured with scores reporting shock, bruises, and minor cuts. Many houses on filled ground demolished; many old buildings on soft ground damaged considerably. Collapse of top of one radio tower and one wooden water tank with damage to many tanks on weak buildings. Many chimneys toppled. Heavy damage to docks and stocks awaiting shipment. Several bridges damaged, many water mains in soft ground broken and many basements flooded. Telephone and power service temporarily interrupted. Large cracks in filled ground, some cracking of pavement. Water spouted 6 feet or more from many ground cracks.

At the Federal Office building, bookcases and stands against east walls were thrown face down. North, west, and south wall furniture not displaced. East wall cabinets had drawers pulled out about halfway toward west, none disturbed in other directions. Plaster badly cracked and broken on north-south walls, bulged in great masses with pieces 1 to 3 feet square thrown from walls. Pictures on north-south walls were canted, those on east-west wall showed little cant. Some doors did not fit door casings after shock. In this central section, chimneys, cornices, and parts of sidewalls were thrown down, but not on modern buildings. Many old brick buildings were partially destroyed.

Seattle (south section).—Many old brick buildings damaged, largely on south and east walls. Objects fell mostly north or south, some twisted 30° but left standing. North-south water mains broken. Plaster cracked, broken, and thrown down. Water observed spouting 6 feet or more from many ground faults. Blue silt forced up through minor cracks in basement floors. Many basements completely filled with silt, with floors forced upwards until failure resulted. Loaded tanker reported moving about 1 inch vertically at about 3 cycles per second; tanker was tied to dock in Puget Sound with keel north-south. Visible swaying of buildings and trees.

Shelton.—Most damage to business buildings with some houses damaged. School chimney collapsed. Twisting and fall of chimneys and columns. Severe visible swaying of buildings and trees. Few masonry walls cracked, brickwork damaged in a few buildings. Objects swayed violently, chairs and tables moved, pictures displaced, dishes and other glassware broken. Considerable damage to stocks in stores.

South Bend.—Cracked windows and chimneys, some chimneys fell. Many broken dishes and windows. Books, pictures, and plaster fell; damage considerable to brick.

Steilacoom.—Considerable damage to State Hospital, consisting of collapsed walls and other interior damage. Four chimneys fell. Some cracking of plaster, windows, and walls. Knickknacks and books fell. Merchandise spilled from shelves.

Tacoma.—One death, at least a dozen injured. Many buildings damaged and parts fell. Many chimneys damaged and toppled. Several houses slid into Puget Sound. One smokestack fell. One 23-ton cable saddle was thrown from the top of tower of Tacoma Narrows Bridge, causing considerable loss. Railroad bridges south of Tacoma were thrown out of line. Tremendous rockslide followed earthquake when a half-mile section of a 300-foot cliff slid into Puget Sound. Considerable damage to brick; plaster, windows, walls, and ground cracked.

Tenino.—City Hall and every business house and dwelling suffered some damage. Stores and stocks damaged severely. Damage considerable to brick. Windows, plaster, and chimneys cracked.

Tumwater.—Twisting and fall of chimneys and monuments. Damage considerable to brick and masonry. Plaster, windows, walls, chimneys, and ground cracked. Knickknacks, books, pictures, plaster, and walls fell. Pendulum clocks facing south stopped.

Vader.—Twisting and fall of chimneys, damage to three-fourths of all chimneys. Windows and dishes broken. Damage considerable to wood, brick, and masonry. Shifted everything, overturned vases, small objects, and furniture.

Wilkeson.—Twisting and fall of many brick chimneys, damage considerable to brick. Several houses moved a few inches off their foundations. Plaster, windows, and chimneys cracked. Books and pictures fell. Dishes and windows broke.

INTENSITY VIII IN OREGON:

Clatskanie.—Twisting and fall of chimneys. Damage considerable to brick and masonry. Overturned vases and small objects; plaster cracked and fell. Knickknacks, books, and pictures fell. Hanging objects swung, pendulum clocks stopped.

Rainier.—Building shook with great violence. Knickknacks, books, pictures, plaster, and walls fell. Twisting and fall of chimneys. Damage considerable.

INTENSITY VII:

Arlington.—Cracked chimneys. Knickknacks fell. Hanging objects swung north by northeast. Trees and bushes shaken strongly, small objects overturned.

Black Diamond.—Cracked walls, chimneys, and wallpaper. Pictures fell. Twisting of chimneys. Slight damage to brick.

Bothell.—Cracked plaster and chimneys, broke dishes and windows. Slightly damaged buildings, plastered walls, and chimneys. Frightened people into streets. In central section of town several chimneys fell to west. Light fixtures, pictures, and doors swung.

Bremerton.—One death. Cracked plaster and walls, bricks cracked where steel rested on brick. Set off sprinkler system in National Bank of Commerce. Pulled elevator counterweights out of guides and put several out of service in Navy Yard. Visible swaying of buildings and trees.

Camas.—Twisting and fall of chimneys, slight damage. Small furnishings shifted, hanging objects swung northeast.

Concrete.—Severe trembling. Visible swaying of buildings and trees. One cement floor in new building cracked.

Cosmopolis.—One death caused by heart attack.

Cove.—All buildings creaked. Visible swaying of old frame building. Few old brick chimneys fell. Few small plaster cracks. People ran out of stores and homes.

Des Moines.—One chimney cracked, many dishes broken. Slight damage. Hanging objects swung, trees and bushes shaken strongly.

Doty.—Twisting and fall of chimneys, several cracked chimneys. Small objects and furnishings shifted, vases overturned. Pictures and knickknacks fell. Trees and bushes shaken strongly.

Eatonville.—In east half of town more than half the chimneys were toppled, not so much damage in west half of town. Plaster fell in large pieces in schoolhouse. Extensive damage to dishes. Difficult to maintain balance. Some water pipe connections were loosened, causing leaks.

Elbe.—Cracked chimneys, broke dishes, shifted small objects. Knickknacks fell. Twisting and fall of few chimneys. Trees and bushes shaken strongly.

Enumclaw.—Few chimneys damaged, plaster cracked. Damage slight. Trees and bushes shaken strongly.

Everett.—Loaded coal car broke loose from its blocking and rolled down grade. Considerable minor damage to store stocks thrown from shelves. Pictures thrown from walls. Water tanks splashed over. Slight cracking of plaster, some things fell out of bookcase.

Fall City.—Several chimneys fell. Hanging objects swung north. Trees and bushes shaken strongly.

Frances.—Twisting and fall of chimneys. Plaster and chimney cracks. Hanging objects swung, small furnishings shifted, books and pictures fell.

Grapeview.—Cracked plaster and chimneys. Slight damage. Knickknacks, books, pictures, and plaster fell; small objects and furnishings shifted; vases overturned. Electric lights and telephone wires swayed violently and long after shock stopped.

Grayland.—Some chimneys cracked and some dishes broken. Overturned vases and small objects, shifted small objects. Hanging objects swung.

Hobart.—Cracked plaster and chimneys. Knickknacks fell, vases overturned. Trees and bushes shaken strongly.

Issaquah.—Chimneys cracked, pictures fell, small objects overturned. Hanging objects swung north. Trees and bushes shaken strongly.

Kirkland.—Cracked plaster, walls, and chimneys. Some store windows broken. Knickknacks, books, pictures, and plaster fell.

Lacey.—Rattled windows, house shook violently. Knickknacks fell. Twisting and fall of some chimneys.

La Conner.—Hanging objects swung, pendulum clocks stopped. Trees and bushes shaken strongly. Cracked a few chimneys, broke a few dishes. Damage slight.

Landsburg (one-half mile east of).—Trees and buildings swayed violently. Several chimneys collapsed, some plaster walls cracked in easterly direction. Several poorly constructed buildings with old brick chimneys were damaged. Wires, parked cars, and water tanks swung west–east. Most objects fell in easterly direction.

Langley.—Cracked plaster and chimneys, broke dishes. Shifted all small objects and furnishings, overturned all vases. Knickknacks, books, pictures, and plaster fell. Pendulum clocks facing northeast stopped.

Leavenworth.—Cracked plaster and walls, fall of plaster. Damage slight. Shifted small objects and furnishings. Hanging objects swung.

Longbranch.—Damage slight to wood and brick. Shook small buildings hard. Plaster, windows, walls, and chimneys cracked; knickknacks, books, pictures, and plaster fell. Trees and bushes shaken strongly.

Longmire.—Chimneys cracked, knickknacks fell. Damage slight. Shifted or overturned small objects. Hanging objects swung. Several rockslides on Rampart Ridge, Eagle Peak, and Mt. Rainier; some snow avalanches occurred. Dishes fell eastward, walls cracked slightly in only one building.

Morton.—Plaster, windows, walls, and chimneys cracked; knickknacks, books, and pictures fell. Dishes and windows broke, twisting and fall of few chimneys. Trees and bushes shaken strongly.

North Bend Ranger Station.—Cracked plaster and chimneys. Knicknacks fell. Some slight damage. Cars and trucks shifted.

Olalla.—Twisting and fall of chimneys. Many plaster, window, and wall cracks. Windows and dishes broke. Trees and bushes shaken strongly.

Orchards.—Cracked plaster and chimeys, fall of chimney brick. Damage slight to brick and concrete. Overturned furniture. Trees and bushes shaken strongly.

Packwood.—Hanging objects swung, furnishings shifted. Chimneys cracked, knickknacks and books fell. Dishes broke. Trees and bushes shaken strongly.

Packwood (north section).—Several landslides. Bells rung. Visible swaying of buildings and trees. Pendulum clocks stopped. Electric wires swung violently. One chimney broken off at roof, plaster on chimney broke at District Guard's house. Books fell out of bookcase.

Preston.—Trees and bushes shaken strongly. Fires in oil stoves extinguished. Chimneys cracked, vases overturned, small objects shifted. Damage slight.

Roy.—Plaster, windows, chimneys, and ground cracked. Several chimneys fell, windows broke. Hanging objects swung east to west.

Satsop.—Cracked ground. Broke dishes. Hanging objects swung, pendulum clocks stopped. Trees and bushes shaken strongly. Furnishings shifted.

Satsop (west section).—Visible swaying of buildings and trees. Cupboard doors swung open, pendulum clock stopped. Thunderous subterranean sound heard before shock, rattling heard after shock.

Seahurst.—Plaster and ground cracked. Knickknacks, books, pictures, and plaster fell. Hanging objects swung, small objects and furnishings shifted.

Snoqualmie.—All damage confined to brick chimneys, dishes, and plaster. Overturned vases and floor lamps. Shook coffee out of cups. Rockslides on Mt. Si. Trees and bushes shaken strongly.

Startup.—Chimneys slightly damaged. Some vases, small objects, and furniture overturned.

Stevenson.—Plaster on ceiling of several store buildings cracked. Heavy light fixtures swayed with arc of about 8 inches. Groceries in stores fell from shelves. Landslide occurred at Table Mountain, with dust visible for 10 miles. About eight shocks were felt.

Sultan.—Cracked plaster, walls, and chimneys. Books fell and dishes broke. Small objects shifted or overturned, hanging objects swung north. Pendulum clocks facing northeast stopped.

Toutle.—Log house creaked. Trees and bushes shaken strongly. Twisting and fall of chimneys.

Vancouver.—Cracked oil tank. Pendulum clock facing north stopped. Trees and bushes shaken moderately. Hanging objects swung east-west. Visible swaying of buildings and trees. Dishes and stand lamps fell. Some plaster cracked east-west.

Vashon.—Cracked plaster and chimneys. Two chimneys fell.

Winlock.—One injured. Damage extensive. Store windows shattered, store merchandise damaged. Bricks fell from buildings, general damage to residences.

INTENSITY VII IN OREGON:

Astoria.—Several injured. Several chimneys fell, considerable fallen plaster, mostly north–south walls. Wall of courthouse shifted one inch and glass dome was badly broken. Several water mains broke and flooded basements. Lamps fell, chandeliers swung, water from fish bowl spilled on table, water below rim about 1¼ inches, spilled mostly to east. Whistling subterranean sounds heard at time of shock.

Astoria (16 miles east of).—Man working in garden saw ground move back and forth about 3 inches in east–west direction. Slight rumble heard.

Hebo.—Shifted small objects from shelves, overturned vases and small objects. Walls and chimneys cracked, knickknacks fell. Hanging objects swung.

Hillsboro.—Shifted furnishings, overturned some vases and small objects. Some plaster cracks, windows and walls cracked. Twisting and fall of some chimneys. Some people made ill from motion and nervousness.

Jewell.—Cracked and twisted chimneys, some chimneys fell. Small objects overturned. Hangings objects swung. Trees and bushes shaken strongly.

North Portland.—Heavy swaying motion. Cans fell off shelves, cupboard doors opened. Rocking chairs rocked. Top bricks fell from chimneys and light fixtures swayed very strongly. Trees and bushes shaken strongly.

Oregon City.—Plaster and chimneys fell. Considerable merchandise fell from shelves. House rocked back and forth, lights swung southwest–northeast. Chandelier and flowerpot swung for 20 minutes after shock.

Oswego.—Hanging objects and doors swung. Shifted furnishings, overturned vases and small objects. Columns twisted. Loud subterranean roar at time of shock.

Oswego (1 mile south of).—Shifted small objects and furnishings about 1½ inches.

Portland.—Three minor injuries. Started rockslides and bent rails on the Spokane-Portland-Seattle railway. Cracks opened in several buildings; walls and roofs were damaged, chimneys fell, window panes cracked, merchandise knocked from shelves, and bric-a-bric broken in many homes. Tops of tall buildings swayed considerably. Pictures and mirrors on all four walls tilted. Plaster cracked in many areas in Weather Bureau building. At Weather Bureau airport station, automobiles parked in north-south direction rolled back and forth.

Pratum.—Hanging objects swung. Concrete floor cracked in 8 or 10 places as much as ⅛ inch. Floor badly damaged.

Quincy.—Cracked plaster, windows, walls, chimneys, and ground. Pictures and plaster fell. Some damage to columns and monuments. Trees and bushes shaken moderately.

Rockaway.—Cracked plaster and chimneys, three chimneys twisted and fell. Shifted small objects and furnishings, pendulum clocks stopped, dishes broke.

Sandy.—Cracked walls and chimneys, cracked concrete wall in garage. Canned fruit fell. Trees and bushes shaken strongly.

Seaside.—Cracked plaster, windows, and chimneys. Knickknacks and plaster fell. Twisting and fall of chimneys. Books, pictures, and canned goods fell. Pendulum clocks stopped, hanging objects swung. Felt by people in parked cars, but not by people driving. Accompanied by a heavy roaring and rumbling sound.

Shedd.—Pendulum clocks facing east stopped. Small objects shifted. Several chimneys twisted and fell. Plaster and chimneys cracked.

INTENSITY VI:

Anacortes.—Felt by all. Hanging objects swung north, pendulum clocks stopped. Few chimney cracks.

Ariel.—Very loud rattling of windows, doors, and dishes. Hanging objects swung. Books fell, few cracked chimneys.

Bay Center.—Small objects shifted, books fell. "Too excited to do much observing."

Belfair.—Shifted small objects and furnishings, broke two dishes. Car bounced up and down.

Bellingham.—Hanging objects swung southeast–northwest. Visible swaying of buildings and trees. Pendulum clock stopped.

Bryn Mawr.—Hanging objects swung. Trees and bushes swayed.

Bumping Lake Ranger Station.—Visible swaying of buildings and trees, slight damage to buildings. Few chimney and plaster cracks. Objects swung north–south.

Carrolls.—Trees and bushes shaken strongly. Slight damage to brick and concrete. Hanging objects swung west–east.

Cedar Falls.—Cracked plaster in one place. Knickknacks fell, small objects overturned.

Chelan.—Slight damage and falling bricks in one old two-story wooden frame house. Hanging objects swung east–west, pendulum clocks stopped.

Chelan Falls.—Felt by and frightened many.

Chimacum.—Rattled windows, doors, and dishes. Hanging objects swung. Small objects and furnishings shifted. Trees and bushes shaken strongly.

Chimacum Ranger Station.—Visible swaying of buildings and trees. Few walls cracked around doors and windows. Two concrete-block buildings partially damaged. Pictures displaced on north–south walls. Electric clock stopped.

Clallam Bay.—Felt by and frightened all. Windows, doors, and dishes rattled. Hanging objects swung northeast. Trees and bushes shaken moderately.

Cle Elum.—Pendulum clocks stopped. Small objects and furnishings shifted. Trees and bushes shaken moderately.

Clinton.—Hanging objects swung north. Trees and bushes shaken strongly. Damage slight to brick and masonry.

Coupeville (south of).—Disturbed objects observed by many. Visible swaying of buildings and trees. Walls cracked. Pictures on walls and dishes swung, chandeliers swayed, water moved north–south. Pendulum clocks stopped.

Coupeville.—Houses creaked, hanging objects swung. Water in containers both indoors and outdoors spilled out in south–north direction. Pendulum clocks stopped.

Darrington.—Strong motion up and down at first, then east–west. Telephone wires shook severely. Hanging basket swung for about 20 minutes. Plaster cracked. Cans fell off shelves at store. Snow and rock avalanches in mountains. Thunderous subterranean sounds heard in mountains.

Gig Harbor.—Slight damage to few chimneys.

Greenbank.—Windows, doors, and dishes rattled; house creaked. Hanging objects swung, small objects and furnishings shifted. Vases overturned.

Greenwater.—Buildings creaked, loose objects rattled. Trees swayed for 5 minutes after shock. Objects fell northwest–southeast, lamp chimneys swayed northwest–southeast. Pendulum clock stopped. Moderately loud subterranean sounds heard before shock.

Hartford.—Rattled windows, doors, and dishes. Small objects shifted and pictures fell.

Hoodsport.—Houses creaked, windows and dishes rattled. Plaster cracked, knickknacks, pictures, and plaster fell. Shifted small objects and furnishings.

Hyak.—Rattled windows, doors, and dishes. Trees and bushes shaken strongly. Small objects and furnishings shifted, Power station D. C. voltmeter made line on chart 1½ inches long.

Laurier.—Windows rattled, hanging objects swung northwest. Pendulum clocks stopped. Trees and bushes shaken slightly. Few plaster cracks.

Lucerne.—Rattled windows, doors, and dishes. Hanging objects swung, small objects shifted. Trees and bushes shaken slightly.

Marietta.—Hanging objects swung north, pendulum clocks stopped. Knickknacks and books fell.

Mercer Island.—Slight damage. Trees and bushes shaken strongly. Small objects and furnishings shifted.

Monroe.—Hanging objects swung. Slight cracking of plaster.

Montesano.—Hanging objects swung, pendulum clocks stopped. Plaster cracked, knickknacks fell.

Mount Adams Ranger Station.—Visible swaying of buildings. Lanterns swung north–south. Saws and chains thrown to floor. Pendulum clock stopped.

Naselle Junction.—Hanging objects swung, some knickknacks fell. Motion shook loaded truck, trees, and buildings.

Omak.—Hanging objects swung. Few plaster cracks. Damage slight. Ceiling lights and rocking chairs swayed.

Orting.—Hanging objects swung. Trees and bushes shaken strongly.

Pacific Beach.—Hanging doors swung northwest. Knickknacks and pictures fell. Slight damage.

Palmer.—Hanging objects swung. Some plaster cracked. Trees and bushes shaken strongly.

Parkway.—Hanging objects swung north. Trees and bushes shaken strongly. Shock preceded by loud crack-like blast.

Port Townsend.—Pendulum clocks facing northeast stopped. Hanging objects swung northwest–southeast. Slight damage. Subterranean sounds heard during shock.

Potlatch.—Rocked building, pendulum clocks facing east stopped. Knickknacks, books, and pictures fell.

Prevost.—Ten fruit jars fell from shelf. Slight damage.

Prosser.—Pendulum clocks stopped. Plaster cracked. Knickknacks fell. Damage slight.

Quilcene.—Visible swaying of buildings and trees. Pictures fell from wall.

Quinault.—Visible swaying of electric wires. Slight damage to buildings, few chimneys cracked.

Ridgefield (4 miles southeast of).—Water in cistern sloshed back and forth almost directly west–east. Seemed to go up and down about 8 inches.

Rockport.—Hanging objects swung northeast. Trees and bushes shaken.

Scienic.—Hanging objects swung north. Trees and bushes shaken strongly. Books fell.

Sequim.—Hanging objects swung east–west. Plaster cracked. Slight damage to masonry.

Silverdale.—Cracked plaster very little. Pictures fell. Trees and bushes shaken moderately.

Skykomish.—Hanging objects swung, vases overturned. Plaster, chimneys, and walls cracked. Dishes and windows broke. Damage slight.

Skykomish Ranger Station.—Slight damage to plaster and chimneys. Flower pot fell off sill, dry battery thrown off pile toward east. Pendulum clock stopped.

Snohomish.—Cracked plaster, one old chimney toppled. Merchandise shaken from shelves in stores. Trees and bushes shaken strongly.

Spanaway.—Hanging objects swung north–south. Pendulum clocks facing east stopped. Shifted stove pipe, overturned vases and small objects. Knickknacks fell. Lake was choppy.

Washougal.—Hanging objects swung north–south and east–west. Cracked plaster, some cracks in brick and masonry walls were enlarged.

Washougal (about 8 miles from highway in the Columbia Gorge, near Cape Horn).—House swayed back and forth, loose objects bounced around. Wires connected to house whipped up and down. Tree tops, cables, and ropes swayed strongly. Arm of telephone pole broke off.

White Salmon.—Visible swaying of buildings and trees. Dressing table moved 6 inches south–north.

Willapa Harbor Station.—Visible swaying of buildings and trees. Many chimneys shaken down in Raymond and South Bend. Objects fell west–east. Pendulum clock stopped. Roaring subterranean sounds at time of shock.

Winton.—Cracked plaster. Damage slight. Trees and bushes shaken strongly.

INTENSITY VI IN OREGON:

Antelope.—Hanging objects swung. Plaster cracked. Damage slight.

Baker.—Light fixtures swung, small objects and furnishings shifted. Some clocks stopped. Knickknacks and books fell.

Bay City.—Hanging objects swung north–south, pendulum clocks facing south stopped. Cracked plaster and windows. Damage slight. Broke wallpaper in a few homes, some plaster on brick flues cracked. Some canned goods knocked off shelves, broke jam and catsup jars.

Beaverton.—Hanging objects swung. Trees and bushes shaken noticeably. Damage slight. Large easel picture toppled.

Burton and vicinity.—Water heard sloshing in well. Trees, electric poles, and 30-gallon hot-water tank swayed. Boards on ground moved as if on water. Merchandise fell from shelves in grocery store. Old post office building swayed violently.

Corvallis.—Cracked plaster in high school, damage slight to concrete. Elevator swayed, pictures shifted, pendulum clocks stopped, rocked swivel chair.

Cutler.—Knickknacks and pictures fell. Damage slight. Pendulum clocks stopped, hanging objects swung northeast.

Dallas.—Hanging objects swung east. Knickknacks fell. Damage slight.

Dallas (5 miles west of).—Couch moved. Electric light cord swayed east–west. Dishes rattled.

Delake.—Piano jiggled. Bushes and power poles shaken, wires swung. Glassware in cabinet shifted.

Depoe Bay.—Hanging objects swung. Knickknacks fell, vases overturned.

Dundee.—Rattled windows, doors, and shingles on roof. Telephone wires swayed. Stove pipes jarred. Made observer and others ill.

Eagle Creek.—Water in pan swayed north–south. Hanging objects swung south. House and drain pipes creaked.

Florence.—Cracked plaster. Damage slight. Hanging lights swung.

Forest Grove.—Cracked plaster. Hanging objects swung. Trees and bushes shaken strongly. Damage slight. Made some dizzy.

Glenwood.—Hanging objects swung northeast. Electric clocks stopped. Trees and bushes shaken strongly. People rushed outdoors.

Gable.—One can of coffee fell. Hanging objects swung. Trees and bushes shaken moderately.

Gable (2 miles west of).—Swung hinged panel of radio cabinet open. Water tumblers thrown off shelves and broken.

Gresham.—Hanging objects swung, small objects shifted and overturned. Knickknacks fell. Slight damage.

Hubbard.—Pendulum clocks facing northeast stopped. Plaster cracked, knickknacks fell. Very slight damage.

Keasey.—Strongly felt. Cracked plaster and broke dishes. Knickknacks and plaster fell.

Lacomb.—Trees and bushes shaken strongly.

Lacomb (3 miles northeast of).—House shaken strongly, occupants ran outside. Saw woodshed bouncing back and forth, east–west. Shook light wires strongly. Clock stopped.

Lake Grove.—Rattled articles. Pendulum clocks stopped, vases overturned. Plaster cracked and knickknacks fell. Slight damage to masonry.

Lebanon.—Cracked plaster and windows. Hanging objects swung.

McMinnville.—Cracked plaster, broke dishes. Hanging objects swung north–northeast, knickknacks fell. Few ground cracks.

Manhattan Beach.—Trees and bushes shaken strongly.

Manning.—Plaster cracked, knickknacks fell. Slight damage to concrete.

Maplewood.—Shifted small objects and furnishings. Slight damage.

Marion Forks.—Light cords and pictures on wall swung. Trees and bushes shaken strongly.

Marshland.—Hanging objects swung, pendulum clocks stopped. Plaster cracked. Slight damage.

Molalla.—Hanging objects swung, small objects and furnishings shifted.

Monmouth.—Hanging objects swung north–south, pendulum clocks facing west stopped. Plaster cracked and fell. Slight damage.

Mount Angel.—Hanging objects swung east, pendulum clocks facing east stopped. Small objects shifted and knickknacks fell.

Mount Hood.—Plaster cracked and fell. Slight damage. Hanging objects swung.

Nelscott.—Pendulum clocks facing west stopped, hanging objects swung north–south. Cracked plaster and chimneys. Cans fell in grocery store. Slight damage to brick, masonry, and concrete.

Newberg.—Hanging objects swung north. Plaster and chimneys cracked. Slight damage.

Newberg (6 miles northwest of).—House swayed so strongly observer thought it would leave foundation.

Newport.—Cracked walls and chimneys. Knickknacks fell. Slight damage.

Oak Grove.—Cracked plaster. Slight damage.

Oceanlake.—Cracked plaster, walls, and chimneys. Overturned small objects.

Oceanside.—Hanging objects swung. Made everyone dizzy.

Odell.—Hanging objects swung east–west, pendulum clocks stopped. Cars moved.

Orenco.—Hanging objects swung, pendulum clocks stopped. Trees and bushes shaken strongly. Chimneys cracked; knickknacks and dishes fell. Slight damage to brick.

Parkdale.—Hanging objects swung, small objects shifted and overturned. Trees and bushes shaken strongly.

Philomath.—Bars in post-office windows rattled. Hanging objects swung north. Well caved in.

Prineville.—Hanging objects swung, pendulum clocks stopped, knickknacks fell. People felt seasick.

Redmond.—Pendulum clocks facing north stopped. Knickknacks fell.

Roy.—Cracked plaster and walls, some plaster fell. Motion like small boat on choppy water.

Salem.—Chandeliers, hanging plants, and bird cages swung north–south. Small objects and furnishings shifted. Plaster cracked. Slight damage.

Salem (Weather Bureau Office at airport).—Radio tower swayed, slight damage to buildings, few walls cracked north to northeast.

Sandlake.—Car shaken strongly. Hanging objects swung.

Sauvies Island.—Felt by all on picnic field. Trees and bushes shaken moderately.

Scappoose.—Felt by and frightened all. Windows, doors, and dishes rattled.

Scio.—Small objects and furnishings shifted. Slight damage.

Sheridan.—Hanging objects swung, pendulum clocks stopped. Plaster cracked and knickknacks fell.

Sherwood.—Hanging objects swung north–south, pendulum clocks facing south stopped. Trees and bushes shaken strongly. Plaster cracked. Slight damage.

Siletz.—Cracked a few chimneys. Slight damage in a few old brick buildings.

Silverton.—Hanging objects swung. Nearly all people felt seasick.

Spray.—Knickknacks fell.

Tigard.—Large trees and all telephone poles weaved.

Tillamook.—Plaster cracked, knickknacks fell. Slight damage to masonry. Objects fell from shelves. Most people felt nauseated and dizzy.

Toledo.—Hanging objects swung, small objects shifted, vases overturned. Slight damage. Some cracked plaster and walls. Knickknacks and plaster fell.

Troutdale.—Cracked plaster, walls, and chimneys. Knickknacks, books, and pictures fell. Slight damage to masonry. Wires swung.

Troutdale (airport).—Large mirror on north wall fell and was broken. Car (not in gear) rolled in east–west direction about 3–4 feet.

Tualatin.—Shifted dishes, overturned small objects. Plaster and chimneys cracked, books and knickknacks fell. Parked cars rolled back and forth (east–west, about 8 inches). Light wires swung.

Twin Rocks.—Cracked plaster and ground. Knickknacks and books fell.

Valsetz.—Hanging objects swung northwest. Trees and bushes shaken strongly. Small objects and furnishings shifted; knickknacks, books, and pictures fell.

Vernonia.—Hanging objects swung north–south. Cracked plaster, walls, and chimneys. Knickknacks and plaster fell, dishes broke. Slight damage.

Waldport.—Shifted cars.

Waldport (Ranger Station).—Five-ton chain hoist suspended free about 20 inches from ceiling swung east–west for 5 minutes.

Williamette.—Felt like bed moved 6 inches east–west. Electric stove moved back and forth. Hanging objects swung.

Wilsonville.—Railroad trestle swayed and cross members rattled.

Woodburn.—Plaster cracked, few knickknacks fell. Damage slight.

INTENSITY V: Almira, Bangor, Bellevue, Brookfield, Camano Island, Colfax, Colville, Cougar, Deer Park, Diablo Dam, Eastsound, Ellensburg, Entiat, Ferndale, Gifford, Glacier, Hemlock Ranger Station (Carson), Illwaco, Malott, Marblemount, Marysville, Moclips, Mulikteo, Naches, Neah Bay, Nooksack, Ocean Park, Oroville (3½ miles northwest of), Oso, Oysterville, Point Roberts, Pomeroy, Port Angeles, Port Gamble, Possession, Sedro-Woolley, Sekiu, Spokane, Stampede Pass, Stehekin, Valley, Walla Walla, Wenatchee, White Swan, Willard, and Yakima.

INTENSITY V IN OREGON: Agate Beach, Albany, Blachly, Cherry Grove, Cottage Grove, Gresham (2 miles east of), Halsey, Harriman (12 miles northwest of), Harrisburg, Hood River, Jefferson, Junction City, Kernville, Lafayette, La Grande, McCoy, McKenzie Bridge, Mill City, Milwaukee, Monroe, Neskowin, North Bend, Pacific City, Springbrook, Sisters, The Dalles, and Wamic.

INTENSITY V IN IDAHO: Fairfield and Juliaetta.

INTENSITY IV: Blaine, Cascade, Chesaw, Chewelah, Clearbrook, Clearwater, Connell, Cook, Coulee Dam, Custer, Edmonds, Ephrata, Forks (1¼ miles east of), Garfield, Hunters, Irby, Klickitat, Lake Cle Elum, Lake Crescent, Laurel, Leavenworth, Lyle, Metaline Falls, Monroe, Monse, Newport, North Bend, Okanogan, Oakesdale, Olga, Palomas, Pateros, Riverside, Thorp, Trinidad, Vantage, Wapato, Washtucna, Waterville, Wauconda, Winona, and Winthrop.

INTENSITY IV IN OREGON: Alsea, Dayville, Dilley, Eugene, Eugene (9 miles south of), Fairview, Fossil, Grand Ronde, Hoskins, Idanda, Kings Valley, Kinzua, Lonerock, North Powder, Olex, Otter Rock, Otis, Perrydale, Riverton, Stanfield, Tidewater, Timberline, Tygh Valley, Veneta, Vida, and Wasco.

INTENSITY IV IN IDAHO: Deary, Harvard, Paul Jones Beach, Saint Maries, and Sandpoint.

INTENSITY I TO III: Beverly, Bickelton, Cheney, Dallesport, Lind, Loomis, Othello, Paterson, Pullman, Quincy, Ritzville (¾ mile southwest of), Rosalia, Spangle, Tonasket, and Twisp.

INTENSITY I TO III IN OREGON: Dufur, Eastside, Falls City, Flora, John Day, Marion, Powers, Rose Lodge, Rufus, Scottsburg, Siltcoos, Springfield, and Thurston.

INTENSITY I TO III IN IDAHO: Bonners Ferry, Coeur d'Alene, Dudley, Headquarters, Hope, Kotenai, Moscow, Potlatch, Spirit Lake, Tensed, and Viola.

INTENSITY I TO III IN MONTANA: Kalispell, Libby, and Plains.

Negative reports were received from 15 places in Washington, 73 places in Oregon, 51 places in Idaho, and 22 places in Montana.

April 14: No time given. Pullman, Wash. Slight earthquake reportedly stronger than previous day's earthquake. Windows rattled and mirrors shook.

April 19: 22:45. Toutle, Wash. Light shock rattled windows, doors, and dishes. Also felt in Eatonville.

August 21: 20:01:12.* Epicenter 54° north, 133° west, Queen Charlotte Islands region, west. Small power lines and water mains broke in Seattle, and boats broke loose from their moorings. Tidal rise observed in Seattle lakes such as Lake Union and Lake Washington. Water sloshed from a swimming pool in Tacoma. Strong wave action reported in Bea Lake north of Nelport and from Clear Lake northwest of Cheney, pulling boats loose from docks and leaving many fish on beaches. Light fixtures swung in Sedro-Woolley; observer in fishing boat on Commencement Bay, Tacoma, noted swell in bay. Also felt at Clearbrook, Eatonville, and Lake Whatcom.

Negative reports were received from 20 places.

September 26: 17:45. Wenatchee, Wash. Brief, rapid jolt felt by three in home.

October 20: 08:00. Lost River, Wash. Light shock rattled windows, doors, and dishes, and caused hanging objects to swing. Sounded like blast.

November 29: 05:03. Seattle, Wash. Abrupt, bumping noise in buildings; loose objects rattled. Felt by more persons in Bremerton but there was no damage.

ALASKA

(150TH MERIDIAN OR ALASKA STANDARD TIME)

February 23: 10:05. Anchorage. Swaying motion felt by many. Chandeliers and hanging plants swayed east–west. Map and mirror on wall were displaced.

February 26: 13:19. Anchorage. Slight shock felt by two persons in southwest section of town.

March 7: 01:42. Northway. Light shock felt by few (people awake). Light fixtures swayed gently north to south.

March 12: 09:28. Anchorage. Light shock felt by several. Chandeliers swayed northeast–southwest.

April 3: 03:05. Anchorage. Trembling motion, southwest to northeast, felt by many in east section of town. Disturbed objects observed by several.

April 7: 09:20. Anchorage. Numerous small shocks felt by many. Windows rattled slightly, mirrors and other wall hangings disturbed slightly.

April 7: 20:52. Anchorage. Numerous mild shocks felt by several. Table lamp shade rattled.

April 10: 20:14. Fairbanks. Four to six small shocks accompanied a few seconds later by sounds like faint explosions.

April 11: 19:05. Fairbanks. Many small shocks lasting in all about 15 seconds. Felt by several.

April 11: 21:28. Fairbanks. Several slight shocks felt by many.

May 11: 21:31. Fairbanks. Slight shock felt by several in southwest section of town.

June 6: 18:37. Anchorage. Slight shock felt by several in central section of town.

June 19: (no time given). Near Chickaloon, on shore of small lake. Large stones (large as a person's hand) were noticed in road at several places, the rocks coming from man-made slides (banks). Rumbling sound heard at time of shock.

June 19: 12:06. Anchorage. Several small shocks felt by several persons. Accompanied by sounds like thunder. Trees shook, dishes rattled, and pictures and chandeliers swayed.

June 19: 22:30. Fairbanks. Slight shock felt by several.

July 8: 19:10. Anchorage. Numerous small shocks felt by several. Chandeliers observed swaying southeast to northwest. Noted by many persons in theater.

August 26: 23:45. Anchorage. Several small shocks felt by many. Disturbed objects observed by several.

August 31: 03:48. Anchorage. Two small shocks felt by a few persons.

September 1: 21:35. Annette. Felt by several in Tamgas Harbor section of Annette Island. Slight sway of houses.

September 2: 17:07. Anchorage. Slight tremor in northeast to southwest direction felt by several persons. Light fixtures in ceiling and map on wall swayed.

September 15: 09:40. Anchorage. Very light shock felt by several.

September 27: 05:31. Anchorage. Numerous small shocks. Sleepers were awakened. Hanging objects swung. One pendulum clock stopped, dishes and windows rattled. Felt by many persons in Weather Bureau office in Cordova where fluorescent lights, clipboards, and filing cabinets swayed or were displaced.

HAWAIIAN ISLANDS

(HAWAIIAN STANDARD TIME)

(Note.—Data on the following local disturbances were determined from seismograph stations operated on the Island of Hawaii by the Hawaiian Volcano Observatory of the U. S. Geological Survey. For additional seismicity of the region, see Hawaiian Volcano Observatory Letters Nos. 503, 504, 505, and 506.)

February 26: 13:20. Very feeble. Felt at Kapapala.

February 26: 13:54. Strong. Felt strongly from Hilo to Naalehu. Instruments dismantled. Origin shallow focus, northeast rift of Mauna Loa at 7,000 feet.

February 27: 13:45. Feeble. Felt at Pahala.

April 11: 18:40. Moderate. Felt at Naalehu. Both components dismantled at Mauna Loa. Origin at Kaoiki Fault.

May 2: 05:02. Strong. Felt in Hilo, strongly at Puu Ulaula, and generally from Holualoa to Naalehu. Kona seismograph broken. Many sleepers wakened, some rushed outdoors. Some objects thrown from shelves in area from Honaunau to Kealakekua. Origin at west slope of Mauna Loa.

May 2: 12:55. Feeble. Felt at Kapapala. Origin at Mauna Loa.

May 7: 23:26. Strong. Felt at Holualoa, Kealakekua, and Naalehu. Both components dismantled at Mauna Loa. Origin about 12 miles beneath Mokuaweoweo.

May 21: 01:06. Feeble. Felt at Holualoa. Origin at west slope of Mauna Loa.

May 23: 10:24. Felt at Kilauea and Hookena, strongly at Pahala. Both components dismantled at Mauna Loa. Origin at south slope of Mauna Loa near Kapapala.

May 28: 17:30. Feeble. Felt at Holualoa. Origin at west slope of Mauna Loa.

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July 29: 20:52. Moderate. Felt strongly at Kapapala, weakly from Hawaii National Park to Hilo. Both components of Mauna Loa instrument dismantled. Origin about 6 miles deep, approximately 3 miles ENE of Mokuaweoweo.

August 21: 18:49. Feeble. Felt by a few persons in the Volcano district. Origin offshore southeast of Kilauea caldera.

August 30: 14:27. Slight. Felt in Volcano district. Origin about 8 miles SSE of Apua Point, 20 to 25 miles deep.

August 31: 19:23. Very feeble. Felt at Holualoa. Origin under southwest rift of Mauna Loa, about 30 miles deep.

September 1: 12:53. Moderate. Felt strongly from Kapapula to Naalehu, weakly from Volcano district to Hilo and in Kona from Pahoehoe to Holualoa. Both components of Mauna Loa instrument dismantled. Origin on Kaoiki Fault, about 3 to 4 miles northeast of Kapapala Ranch headquarters.

September 14: 16:47. Feeble. Felt in Hilo. Origin about 6 miles deep on Kaoiki Fault, approximately 3 miles west of Uwekakuna.

September 16: 14:08. Very feeble. Felt in South Kona. Origin near coast, about 5 miles south of Hookena.

October 22: 07:55. Very feeble. Felt at Pahala. Origin at south end of Mokuaweoweo.

October 26: 17:58. Feeble. Felt at Kapapala.

October 26: 18:12. Very feeble. Felt at Kapapala.

November 4: 12:12. Feeble. Felt by a few at 10,000 foot level on Mauna Kea. Origin at a depth of 20 miles under summit of Mauna Kea.

November 25: 07:58. Moderate. Felt locally and from North Kona to Hilo. Instruments dismantled. Origin 20 miles under east slope of Mauna Loa near Mokuaweoweo.

December 11: 03:06. Feeble. Felt locally. Origin deep under Kilauea.

December 11: 15:08. Slight. Felt locally and accompanied by roar. Origin under north end of Hilauea caldera.

PANAMA CANAL ZONE

(60TH MERIDIAN TIME)

March 30: 02:00:48.* Felt by several in Balboa Heights school building.

July 15: 19:45:53.* Felt by a few people in Balboa Heights.

August 18: 09:34:16.* Felt by a few Canal Zone residents. Epicenter in Chiriqui Province, Panama.

PUERTO RICO

(60TH MERIDIAN TIME)

March 23: 05:30. Very light shock felt at Caguas.

MISCELLANEOUS ACTIVITIES

GEODETIC WORK OF SEISMOLOGICAL INTEREST

During the calendar year triangulation to be used in the study of earth movements was observed at Cajon Pass and Brea, California. A reobservation of the 1938 work at Maricopa showed no significant change. Reobservations of the 1938 triangulation at Gorman showed some indication of the same creeping as noted before. That is, points south and west of the fault moved northwesterly.

Leveling for a study of vertical changes in the earth's surface was accomplished in the following areas in the calendar year 1949: Lines of levels across the fault line were releveled at Cajon Pass, Moreno, and Whitewater, California. The Long Beach subsidence area was releveled. A basic net of first-order lines in the Central Valley of California was completed.

TIDAL DISTURBANCES OF SEISMIC ORIGIN

At Sitka, Alaska, there appeared to be a very small wave (about 3 inches) following the earthquake of August 22 in the Queen Charlotte Islands. While there is no evidence of a wave from the earthquake of September 27, near Seward, Alaska, the Seward tide record indicated that the gage was shaken by this quake.

Two gages recorded a wave from the shock of October 19 near the Solomon Islands. At Rabaul, New Britain, an extreme range of about 2.0 feet between highest crest and lowest trough of seismic sea waves was recorded, though the time element was obscured by an inopportune failure of the motor clock. A very small wave of about 0.1 foot was recorded at Dreger Harbor, New Guinea.

Table 1.—*Earthquake fluctuations in wells—Jan. 1, 1944, to Dec. 31, 1949*

Well No.	Date	Time (E. S. T.)	Depth to water in feet**				Amplitude of fluctuation in feet
			Before disturbance	After disturbance	At highest point of fluctuation	At lowest point of fluctuation	
SOUTHERN FLORIDA							
F-210	[1] 10- 7-45	08:00	1.64	1.64	1.655	1.625	0.03
G-218	10- 7-45	08:00	5.35	5.35	5.36	5.34	0.02
S-19	10- 7-45	08:30	1.225	1.225	1.26	1.19	0.07
S-68	10- 7-45	08:20	0.265	0.265	0.28	0.25	0.03
F-210	[1] 10-27-45	06:00	1.895	1.895	1.905	1.885	0.02
G-218	10-27-45	06:15	5.80	5.80	5.82	5.78	0.04
S-19	10-27-45	06:00	2.15	2.15	2.16	2.14	0.02
S-68	10-27-45	06:15	0.93	0.93	0.94	0.92	0.02
F-210	[1] 11-27-45	18:15	1.665	1.665	1.695	1.635	0.06
G-218	11-27-45	18:00	5.82	5.82	5.83	5.81	0.02
S-18	11-27-45	18:00	2.19	2.19	2.195	2.185	0.01
S-68	11-27-45	18:00	1.075	1.075	1.085	----------	0.02
F-210	[1] 12-23-45	03:15	1.205	1.205	1.210	1.200	0.01
S-68	12-23-45	03:40	0.92	0.92	0.923	0.917	0.006
F-210	[1] 12-28-45	14:30	1.58	1.58	1.595	1.565	0.03
S-19	12-28-45	14:00	1.325	1.325	1.34	1.31	0.03
F-210	[1] 1-12-46	16:00	1.15	1.15	1.155	1.140	0.015
S-68	1-12-46	16:00	0.09	0.09	0.097	0.083	0.014
F-210	[1] 4-10-46	21:00	0.905	0.905	0.918	0.893	0.025
S-19	4-10-46	21:00	1.30	1.30	1.308	1.292	0.016
S-68	4-10-46	20:00	0.28	0.28	0.29	0.27	0.02
F-210	5-15-46	16:45	0.73	0.73	0.735	0.725	0.01
S-19	5-15-46	17:00	0.955	0.955	0.96	0.95	0.01
F-210	[1] 6- 6-46	22:00	1.20	1.20	1.22	1.18	0.04
G-218	6- 6-46	21:45	4.46	4.46	4.52	4.40	0.12
S-19	6- 6-46	22:00	2.15	2.15	2.175	2.125	0.05
S-68	6- 6-46	22:30	1.45	1.45	1.42	1.39	0.09
S-539	6- 6-46	22:30	0.80	0.80	0.81	0.79	0.02
F-210	[1] 6-10-46	12:50	1.275	1.275	1.28	1.27	0.01
S-19	6-10-46	13:00	1.865	1.865	1.868	1.862	0.006
S-68	6-10-46	12:45	1.36	1.36	1.37	1.35	0.02
F-210	[1] 6-23-46	13:00	1.06	1.06	1.13	0.985	0.145
G-218	6-23-46	12:15	3.99	3.99	4.02	3.96	0.06
S-18	6-23-46	12:40	1.805	1.805	1.812	1.798	0.014
S-19	6-23-46	12:45	0.89	0.89	0.94	0.84	0.10
S-68	6-23-46	12:30	0.02	0.02	0.01	0.05	0.06
F-179	[1] 8- 4-46	12:45	2.34	2.34	----------	----------	+1.06
F-210	8- 4-46	12:45	1.78	1.78	----------	----------	+4.50
F-358	8- 4-46	12:45	4.31	4.31	4.43	4.17	0.26
F-378	8- 4-46	12:30	3.66	3.66	3.70	3.47	0.23
G-3	8- 4-46	13:00	0.795	0.795	0.803	0.787	0.016
G-72	8- 4-46	13:00	5.11	5.11	5.27	4.93	0.34
G-218	8- 4-46	13:00	5.30	5.30	6.85	3.75	3.10
G-350	8- 4-46	12:45	3.85	3.85	+4.19	----------	+0.68
L-418	8- 4-46	13:00	17.32	17.32	17.67	16.93	0.74
S-18	8- 4-46	12:45	2.55	2.55	2.80	2.33	0.47
S-19	8- 4-46	12:45	1.89	1.89	----------	----------	+1.30
S-68	8- 4-46	12:20	0.51	0.51	----------	----------	+1.08
S-182	8- 4-46	13:15	5.50	5.50	5.54	5.46	0.08
S-329	8- 4-46	12:30	5.59	5.59	+6.39	−4.87	+1.23
S-539	8- 4-46	13:00	0.69	0.69	0.82	0.45	0.27
F-210	[1] 8- 8-46	08:00	1.61	1.61	2.07	1.15	0.92
F-358	8- 8-46	07:45	4.06	4.06	4.07	4.05	0.02
F-378	8- 8-46	08:15	3.43	3.43	3.432	3.428	0.004
F-72	8- 8-46	08:00	5.005	5.005	5.025	4.985	0.04
G-418	8- 8-46	08:30	17.54	17.54	17.58	17.49	0.09
S-68	8- 8-46	08:30	0.94	0.94	1.17	0.71	0.26
S-182	8- 8-46	08:40	5.315	5.315	5.325	5.305	0.02
S-329	8- 8-46	07:45	5.20	5.20	5.42	4.98	0.44
S-539	8- 8-46	08:15	0.87	0.87	0.89	0.85	0.04
G-218	[1] 8- 8-46	10:00	5.12	5.12	5.44	4.81	0.63
S-182	8- 8-46	09:30	5.31	5.31	5.32	5.30	0.02
F-210	8- 8-46	13:00	1.59	1.59	1.605	1.575	0.03
S-68	8- 8-46	12:30	0.86	0.86	0.87	0.85	0.02
F-210	8-20-46	04:30	1.275	1.275	1.28	1.27	0.01
S-68	8-20-46	04:45	0.52	0.52	0.53	0.51	0.02
F-179	[1] 8-21-46	15:00	1.88	1.88	1.895	1.865	0.03
F-210	8-21-46	15:00	1.20	1.20	1.235	1.165	0.07
G-218	8-21-46	15:00	5.36	5.36	5.40	5.32	0.08
S-19	8-21-46	14:50	1.08	1.08	1.14	1.01	0.13
S-68	8-21-46	14:45	0.24	0.24	0.28	0.20	0.08
S-329	8-21-46	14:45	4.95	4.95	4.96	4.94	0.02

See footnotes at end of table.

Table 1.—*Earthquake fluctuations in wells—Jan. 1, 1944, to Dec. 31, 1949*—Continued

Well No.	Date	Time (E. S. T.)	Depth to water in feet**				Amplitude of fluctuation in feet
			Before disturbance	After disturbance	At highest point of fluctuation	At lowest point of fluctuation	
SOUTHERN FLORIDA—continued							
F-210	[1] 9-12-46	10:45	1.845	1.845	1.853	1.837	0.16
S-329	9-12-46	11:15	5.37	5.37	5.38	5.36	0.02
F-210	[1] 9-12-46	12:30	1.85	1.85	1.87	1.83	0.04
G-218	9-12-46	13:15	5.72	5.72	5.74	5.70	0.04
S-19	9-12-46	13:00	2.02	2.02	2.05	1.99	0.06
S-68	9-12-46	12:30	1.02	1.02	1.04	1.00	0.04
S-329	9-12-46	13:00	5.38	5.38	5.40	5.86	0.04
F-210	[1] 9-25-46	04:00	1.81	1.81	1.82	1.80	0.02
S-19	9-25-46	04:30	2.27	2.27	2.28	2.26	0.02
S-68	9-25-46	04:30	1.40	1.40	1.41	1.39	0.02
S-329	9-25-46	05:00	5.50	5.50	5.51	5.49	0.02
F-210	[1] 10- 4-46	09:45	2.09	2.09	2.105	2.075	0.03
G-218	10- 4-46	09:30	5.77	5.77	5.79	5.75	0.04
S-68	10- 4-46	09:45	1.94	1.94	1.97	1.91	0.06
S-329	10- 4-46	10:15	5.58	5.58	5.60	5.56	0.04
F-210	[1] 11- 1-46	06:00	1.895	1.895	1.90	1.89	0.01
G-218	11- 1-46	06:15	5.66	5.66	5.68	5.64	0.04
F-210	[1] 11-10-46	13:15	2.00	2.00	2.01	1.99	0.02
S-19	11-10-46	12:40	2.20	2.20	2.205	2.195	0.01
S-68	11-10-46	13:00	1.14	1.14	1.15	1.13	0.02
F-210	[1] 12-20-46	15:30	1.87	1.87	1.925	1.81	0.115
F-262	12-20-46	15:15	*8.61	*8.61	*8.58	*8.64	0.06
G-218	12-20-46	15:00	5.48	5.48	5.50	5.46	0.04
G-221	12-20-46	15:40	3.86	3.86	3.995	3.765	0.19
S-18	12-20-46	15:45	2.22	2.22	2.23	2.21	0.02
S-19	12-20-46	15:30	1.71	1.71	1.755	1.675	0.08
S-68	12-20-46	15:30	0.96	0.96	0.99	0.93	0.06
S-329	12-20-46	15:15	4.41	4.41	4.45	4.37	0.08
F-210	[1] 1-24-47	23:30	0.88	0.88	0.885	0.875	0.01
S-68	1-24-47	23:15	−0.73	−0.73	−0.725	−0.735	0.01
S-329	1-24-47	23:00	3.175	3.175	3.18	3.17	0.01
F-179	1-26-47	05:15	1.41	1.41	1.415	1.405	0.01
F-210	1-26-47	05:20	0.89	0.89	0.93	0.84	0.09
G-72	1-26-47	05:15	4.615	4.615	4.635	4.595	0.04
G-218	1-26-47	05:30	4.74	4.74	4.78	4.69	0.09
L-418	1-26-47	05:40	15.89	15.89	15.90	15.88	0.02
S-18	1-26-47	06:00	1.38	1.38	1.39	1.37	0.02
S-19	1-26-47	05:30	0.48	0.48	0.53	0.43	0.10
S-68	1-26-47	05:10	−0.75	−0.75	−0.71	−0.80	0.09
S-329	1-26-47	05:10	3.15	3.15	3.19	3.11	0.08
F-210	[1] 3- 2-47	07:00	1.13	1.13	1.14	1.12	0.02
F-358	3- 2-47	07:00	1.685	1.685	1.69	1.68	0.01
F-378	3- 2-47	06:45	1.31	1.31	1.32	1.30	0.02
S-19	3- 2-47	07:15	0.86	0.86	0.88	0.84	0.04
S-68	3- 2-47	07:15	0.17	0.17	0.18	0.16	0.02
F-210	[1] 4-10-47	11:55	0.66	0.66	0.67	0.65	0.02
G-218	4-10-47	12:10	3.33	3.33	3.335	3.325	0.01
S-19	4-10-47	11:40	0.91	0.91	0.925	0.89	0.035
S-68	4-10-47	11:30	0.13	0.13	0.14	0.12	0.02
S-329	4-10-47	11:45	2.42	2.42	2.43	2.41	0.02
G-72	[1] 7- 8-47	13:15	6.02	6.02	6.03	6.01	0.02
S-19	7- 8-47	13:00	1.82	1.82			0.01
S-68	7- 8-47	13:00	1.03	1.03	1.05	1.01	0.04
G-72	[1] 7- 9-47	11:45	6.055	6.055	6.06	6.05	0.01
S-68	7- 9-47	11:15	1.08	1.08	1.09	1.07	0.02
F-210	7-28-47	05:40	2.94	2.94	2.95	2.93	0.02
S-68	7-28-47	06:00	2.34	2.34	2.35	2.33	0.02
F-179	[1] 8- 6-47	20:00	2.41	2.41	2.46	2.36	0.10
F-210	8- 6-47	20:00	2.29	2.29	2.40	2.18	0.18
F-358	8- 6-47	19:45	4.08	4.08	4.09	4.07	0.02
F-378	8- 6-47	19:30	3.34	3.34	3.35	3.33	0.02
G-72	8- 6-47	20:15	6.97	6.97	7.03	6.91	0.12
G-218	8- 6-47	20:00	6.21	6.21	6.30	6.15	0.15
G-476	8- 6-47	19:50	5.375	5.375	5.42	5.33	0.09
G-553	8- 6-47	19:30	8.015	8.015	8.06	7.97	0.09
S-18	8- 6-47	19:45	3.38	3.38	3.39	3.37	0.02
S-19	8- 6-47	19:45	2.21	2.21	2.30	2.12	0.18
S-68	8- 6-47	20:00	1.80	1.80	1.91	1.70	0.21
S-329	8- 6-47	19:45	7.40	7.40	7.54	7.28	0.26
S-539	8- 6-47	20:00	1.21	1.21	1.24	1.18	0.06
F-210	[1] 11- 1-47	11:10	4.21	4.21	4.22	4.20	0.02
S-19	11- 1-47	10:30	6.34	6.34	6.345	6.335	0.01
S-68	11- 1-47	10:00	5.41	5.41	5.42	5.40	0.02
G-221	[1] 1- 6-48	13:15	4.67	4.67	4.69	4.65	0.04
S-329	1- 6-48	13:00	5.44	5.44	5.45	5.42	0.03
F-210	[1] 1-24-48	14:15	1.76	1.76	1.78	1.74	0.04
G-72	1-24-48	14:00	6.39	6.39			0.005
G-221	1-24-48	14:00	4.55	4.55	4.57	4.53	0.04
G-553	1-24-48	13:45	6.50	6.50	6.51	6.49	0.02
S-19	1-24-48	13:50	2.71	2.71	2.73	2.69	0.04
S-68	1-24-48	13:45	2.045	2.045	2.06	2.03	0.03

See footnotes at end of table.

Table 1.—*Earthquake fluctuations in wells—Jan. 1, 1944, to Dec. 31, 1949*—Continued

Well No.	Date	Time (E. S. T.)	Depth to water in feet**				Amplitude of fluctuation in feet
			Before disturbance	After disturbance	At highest point of fluctuation	At lowest point of fluctuation	
SOUTHERN FLORIDA—continued							
F-210	4-21-48	15:45	1.47	1.47		0.92	1.10
F-291	4-21-48	16:15	1.54	1.54	2.48	0.57	1.91
F-358	4-21-48	15:30	1.16	1.16	1.18	1.14	0.04
F-378	4-21-48	15:10	1.07	1.07	1.16	0.98	0.18
G-72	4-21-48	15:45	4.12	4.12	4.19	4.05	0.14
G-218	4-21-48	15:45	4.08	4.08	4.43	3.72	0.71
G-221	4-21-48	16:00	2.52	2.52	3.14	1.90	1.24
G-476	4-21-48	15:45	3.54	3.54	3.64	3.44	0.20
G-551	4-21-48	15:30	4.14	4.14	4.16	4.12	0.04
G-553	4-21-48	15:30	3.17	3.17	3.38	2.97	0.41
L-246	4-21-48	15:15	14.45	14.45	14.47	14.43	0.04
L-418	4-21-48	15:50	15.90	15.90	15.98	15.82	0.16
S-18	4-21-48	15:45	1.565	1.565	1.63	1.50	0.13
S-19	4-21-48	16:00	0.51	0.51	+1.01	+0.01	+1.00
S-68	4-21-48	15:15	−0.15	−0.15	−0.15	−0.48	0.63
S-182	4-21-48	15:30	2.72	2.72	2.73	2.71	0.02
S-329	4-21-48	16:00	2.41	2.41	2.64	2.19	0.45
F-291	4-21-48	20:15	1.54	1.54	1.61	1.45	0.16
G-72	4-21-48	20:00	4.10	4.10	4.105	4.095	0.01
G-218	4-21-48	20:00	4.06	4.06	4.10	4.02	0.08
G-221	4-21-48	20:00	2.52	2.52	2.56	2.48	0.08
G-553	4-21-48	19:30	3.16	3.16	3.18	3.14	0.04
S-18	4-21-48	20:15	1.565	1.565	1.57	1.56	0.01
S-19	4-21-48	20:00	0.51	0.51	0.60	0.43	0.17
S-68	4-21-48	19:30	−0.10	−0.10	−0.06	−0.13	0.07
S-329	4-21-48	20:15	2.38	2.38	2.40	2.36	0.04
F-291	4-22-48	08:30	1.55	1.55	1.56	1.54	0.02
G-218	4-22-48	08:45	4.04	4.04	4.045	4.035	0.01
G-221	4-22-48	08:15	2.52	2.52	2.525	2.515	0.01
S-19	4-22-48	08:30	0.525	0.525	0.53	0.52	0.01
F-291	4-23-48	06:40	1.55	1.55	1.60	1.50	0.10
G-218	4-23-48	07:15	3.95	3.95	3.97	3.93	0.04
G-221	4-23-48	06:45	2.03	2.03	2.05	2.01	0.04
G-553	4-23-48	07:00	3.14	3.14	3.15	3.13	0.02
S-19	4-23-48	06:50	0.60	0.60	0.65	0.55	0.10
S-68	4-23-48	06:45	−0.14	−0.14	−0.12	−0.16	0.04
F-210	5-14-48	18:20	1.865	1.865	1.87	1.86	0.01
G-221	5-14-48	18:15	3.35	3.35	3.36	3.34	0.02
S-19	5-14-48	18:30	1.205	1.205	1.21	1.20	0.01
S-68	5-14-48	18:15	0.56	0.56	0.57	0.55	0.02
F-210	6-27-48	08:00	1.24	1.24	1.25	1.23	0.02
F-291	6-27-48	08:00	1.17	1.17	1.19	1.15	0.04
G-221	6-27-48	07:45	2.02	2.02	2.03	2.01	0.02
S-19	6-27-48	08:00	0.39	0.39	0.40	0.38	0.02
S-68	6-27-48	07:40	−0.08	−0.08	−0.07	−0.09	0.02
F-210	12- 3-48	19:53	1.83	1.83	1.85	1.81	0.04
F-291	12- 3-48	20:10	3.02	3.02	3.03	3.01	0.02
G-218	12- 3-48	20:15	6.55	6.55	6.555	6.545	0.01
G-221	12- 3-48	20:00	4.29	4.29	4.30	4.28	0.02
S-19	12- 3-48	19:30	2.54	2.54	2.56	2.52	0.04
S-68	12- 3-48	20:00	1.52	1.52	1.54	1.50	0.04
F-210	4-13-49	15:00	1.06	1.06	1.08	1.04	0.04
F-291	4-13-49	15:00	0.76	0.76	0.77	0.75	0.02
G-221	4-13-49	14:55	1.07	1.07	1.08	1.06	0.02
S-19	4-13-49	15:00	0.77	0.77	0.78	0.76	0.02
S-68	4-13-49	15:15	0.09	0.09	0.10	0.08	0.02
S-329	4-13-49	15:00	2.11	2.11	2.10	2.12	0.02
F-210	7-10-49	00:20	1.45	1.45	1.47	1.43	0.04
F-291	7-10-49	00:30	1.50	1.50	1.51	1.49	0.02
G-221	7- 9-49	23:50	3.07	3.07	3.10	3.04	0.06
S-18	7-10-49	00:10	1.645	1.645	1.65	1.64	0.01
S-19	7- 9-49	23:45	0.535	0.535	0.55	0.52	0.03
S-68	7- 9-49	23:50	−0.04	−0.04	−0.02	−0.06	0.04
S-329	7- 9-49	23:50	4.05	4.05	4.07	4.03	0.04
F-179	8-21-49	23:40	1.89	1.89	2.08	1.73	0.35
F-210	8-21-49	23:37	1.56	1.56	2.10	1.00	1.10
F-291	8-21-49	23:50	1.48	1.48	1.97	1.01	0.96
F-358	8-21-49	23:50	3.54	3.54	3.56	3.52	0.04
F-378	8-21-49	23:00	3.10	3.10	3.12	3.08	0.04
G-72	8-21-49	23:30	5.70	5.70	5.78	5.62	0.16
G-218	8-21-49	23:00	5.45	5.45	5.77	5.13	0.64
G-221	8-21-49	23:00	3.90	3.90	4.48	3.42	1.06
G-350	8-21-49	23:30	2.59	2.59	2.60	2.58	0.02
G-476	8-21-49	23:45	3.34	3.34	3.44	3.25	0.19
G-518	8-21-49	23:30	2.03	2.03	2.49	1.63	0.86
G-551	8-21-49	23:50	5.69	5.69	5.72	5.66	0.06
G-553	8-21-49	23:45	5.59	5.59	5.79	5.37	0.43
G-561	8-21-49	23:50	1.665	1.665	1.67	1.66	0.01
G-580	8-21-49	23:20	2.60	2.60	3.15	2.05	1.10
G-594	8-21-49	23:10	7.64	7.64	7.76	7.51	0.25
G-595	8-21-49	23:20	4.555	4.555	4.56	4.55	0.01

See footnotes at end of table.

Table 1.—*Earthquake fluctuations in wells—Jan. 1, 1944, to Dec. 31, 1949*—Continued

Well No.	Date	Time (E. S. T.)	Depth to water in feet**				Amplitude of fluctuation in feet
			Before disturbance	After disturbance	At highest point of fluctuation	At lowest point of fluctuation	
SOUTHERN FLORIDA—continued							
L-246	8-21-49	23:50	18.735	18.735	18.75	18.72	0.03
L-414	8-21-49	23:40	19.22	19.22	19.31	19.13	0.18
M-125	8-21-49	23:00	2.34	2.34	2.41	2.28	0.13
S-18	8-21-49	23:30	1.59	1.59	1.70	1.48	0.22
S-19	8-21-49	23:30	0.56	0.56	+1.06	−0.06	+1.00
S-68	8-21-49	23:30	−0.11	−0.11	0.25	−0.49	0.71
S-182	8-21-49	23:45	−5.095	−5.095	−5.10	5.09	0.01
S-329	8-21-49	22:45	4.86	4.86	----------	4.53	0.66ca
S-539	8-21-49	23:50	0.56	0.56	0.60	0.52	0.08
F-210	9- 8-49	12:10	2.24	2.24	2.255	2.225	0.03
G-221	9- 8-49	11:30	3.99	3.99	4.02	3.96	0.06
S-19	9- 8-49	11:50	1.77	1.77	1.78	1.76	0.02
S-68	9- 8-49	11:15	−0.02	−0.02	−0.01	−0.03	0.02
S-329	9- 8-49	10:30	4.42	4.42	4.44	4.40	0.04
F-291	9-27-49	11:15	2.45	2.45	2.48	2.42	0.06
G-72	9-27-49	11:00	6.06	6.06	----------	----------	0.005
G-221	9-27-49	11:10	3.70	3.70	3.78	3.62	0.16
G-518	9-27-49	11:20	2.23	2.23	2.24	2.22	0.02
G-555	9-27-49	11:00	5.40	5.40	5.41	5.39	0.02
G-580	9-27-49	11:00	2.94	2.94	2.97	2.90	0.07
S-18	9-27-49	11:00	1.965	1.965	1.97	1.96	0.01
S-19	9-27-49	11:10	1.18	1.18	1.22	1.14	0.08
S-68	9-27-49	11:10	0.40	0.40	0.42	0.38	0.04
S-329	9-27-49	10:45	5.005	5.005	5.03	4.98	0.05
F-210	10-20-49	02:37	1.90	1.90	1.88	1.92	0.04
F-291	11-20-49	02:15	2.83	2.83	2.82	2.84	0.02
G-221	11-20-49	02:00	3.73	3.73	3.76	3.70	0.06
G-580	11-20-49	02:00	3.52	3.52	3.54	3.52	0.02
S-19	11-20-49	02:20	1.94	1.94	1.97	1.91	0.06
S-68	11-20-49	02:45	1.01	1.01	1.03	0.99	0.04
S-329	11-20-49	02:00	4.76	4.76	4.77	4.75	0.02
G-221	12-17-49	02:30	2.70	2.70	2.72	2.68	0.04
G-580	12-17-49	02:40	2.41	2.41	2.42	2.40	0.02
S-68	12-17-49	02:45	0.28	0.28	0.29	0.27	0.02
F-210	12-17-49	10:55	1.02	1.02	1.05	1.00	0.05
F-291	12-17-49	10:50	1.545	1.545	1.56	1.53	0.03
G-72	12-17-49	11:00	6.07	6.07	----------	----------	0.005
G-221	12-17-49	11:00	2.53	2.53	2.55	2.51	0.04
G-553	12-17-49	11:15	4.955	4.955	4.96	4.95	0.01
G-580	12-17-49	11:15	2.41	2.41	2.43	2.49	0.04
S-19	12-17-49	11:00	0.74	0.74	0.75	0.73	0.02
S-68	12-17-49	11:15	0.375	0.375	0.39	0.36	0.03
F-210	12-22-49	04:45	1.03	1.03	1.04	1.02	0.02
F-291	12-22-49	04:30	1.49	1.49	1.50	1.48	0.02
G-72	12-22-49	05:00	5.98	5.98	5.99	5.97	0.02
G-218	12-22-49	05:00	5.54	5.54	5.55	5.53	0.02
G-221	12-22-49	05:15	2.30	2.30	2.31	2.29	0.02
G-518	12-22-49	04:45	1.75	1.75	1.76	1.74	0.02
G-553	12-22-49	04:50	4.755	4.755	4.76	4.75	0.01
G-580	12-22-49	04:45	2.37	2.37	2.38	2.36	0.02
S-68	12-22-49	04:45	0.00	0.00	0.04	−0.04	0.08
S-329	12-22-49	04:30	3.32	3.32	3.34	3.30	0.04
NORTHERN FLORIDA							
S-9	2- 1-44	00:01	−2.25	−2.25	−2.23	−2.26	0.03
S-9	5-25-44	09:00	−1.25	−1.26	−1.24	−1.27	0.03
O-47	6-25-44	10:20	−6.73	−6.74	−6.71	−6.77	0.06
N-64	6-28-44	04:00	−21.452	−21.455	−21.402	−21.512	0.110
S-9	6-28-44	03:50	−1.12	−1.12	−1.08	−1.17	0.09
S-5	12- 7-44	02:00	−5.57	−5.55	−5.54	−5.59	0.05
S-9	12- 7-44	02:00	−2.32	−2.31	−2.28	−2.35	0.07
O-47	12- 7-44	13:20	−2.78	−2.77	−2.74	−2.82	0.02
M-92	11-27-45	17:45	−37.70	−37.74	−37.64	−37.82	0.18
N-64	11-27-45	17:30	−19.91	−19.92	−19.88	−19.95	0.13
O-47	11-27-45	18:30	−1.64	−1.66	−1.63	−1.69	0.06
P-272	11-27-45	16:30	−25.83	−25.79	−25.75	−25.88	0.13
S-9	11-27-45	17:00	−2.15	−2.20	−2.14	−2.21	0.07
L-7	11-28-45	01:00	−165.43	−165.42	−165.38	−165.52	0.14
S-9	12-22-45	20:00	−1.62	−1.62	−1.60	−1.63	0.03
M-92	12-28-45	15:15	−37.55	−37.53	−37.50	−37.56	0.06
O-47	12-28-45	15:30	−2.24	−2.22	−2.20	−2.26	0.06
P-272	12-28-45	11:45	−25.36	−25.32	−25.31	−25.37	0.06
S-5	2-17-46	14:20	−5.76	−5.75	−5.73	−5.78	0.05
E-60	3- 7-46	15:45	−11.57	−11.57	−11.56	−11.58	0.01
H-4	4-10-46	17:00	−16.35	−16.36	−16.33	−16.41	0.08
O-47	6- 6-46	23:30	−4.08	−4.08	−4.06	−4.10	0.04
M-92	6- 6-46	22:45	−38.66	−38.65	−38.64	−38.67	0.03
L-7	6- 6-46	23:30	−157.70	−157.69	−157.65	−157.74	0.09

See footnotes at end of table.

Table 1.—*Earthquake fluctuations in wells—Jan. 1, 1944, to Dec. 31, 1949*—Continued

Well No.	Date	Time (E. S. T.)	Depth to water in feet**				Amplitude of fluctuation in feet
			Before disturbance	After disturbance	At highest point of fluctuation	At lowest point of fluctuation	
NORTHERN FLORIDA—continued							
H-4	6- 7-46	00:45	−17.76	−17.74	−17.70	−17.80	0.10
H-4	6-23-46	12:45	−17.88	−17.86	−17.75	−17.98	0.23
L-7	6-23-46	11:55	−158.10	−158.09	−158.00	−158.18	0.18
O-47	6-23-46	12:00	−3.63	−3.64	−3.62	−3.65	0.03
T-35	7-10-46	23:45	−3.18	−3.18	−3.17	−3.19	0.02
H-4	7-18-46	01:20	−16.83	−16.83	−16.82	−16.84	0.02
T-35	7-18-46	01:45	−3.37	−3.37	−3.36	−3.39	0.03
T-35	7-18-46	02:55	−3.37	−3.37	−3.36	−3.38	0.02
L-7	8- 4-46	12:50					
M-92	8- 4-46	13:00	−37.59	−37.57	−36.03	−38.17	1.14
O-47	8- 4-46	13:00	+1.62	+1.59	+1.66	+1.39	0.27
P-246	8- 4-46	12:45	−25.06	−24.97	−24.66	−25.40	0.74
P-272	8- 4-46	12:00	−24.74	−24.71	−24.25	−25.15	0.90
S-5	8- 4-46	13:00	−5.00	−4.97	−4.76	−5.22	0.46
S-9	8- 4-46	13:00	−0.07	+0.02	+0.37	−0.49	0.86
L-7	8- 8-46	08:15	−158.71	−158.75	−158.52	−158.91	0.39
M-92	8- 8-46	07:45	−37.49	−37.51	−37.41	−37.59	0.18
O-47	8- 8-46	09:15	−0.69	−0.70	−0.67	−0.74	0.07
P-246	8- 8-46	14:15	−24.75	−24.79	−24.71	−24.83	0.11
P-272	8- 8-46	08:15	−24.78	−24.77	−24.67	−24.85	0.18
S-5	8- 8-46	09:00	−4.71	−4.79	−4.75	−4.81	0.06
S-9	8- 8-46	07:45	+0.44	+0.43	+0.49	+0.37	0.12
T-35	8- 8-46	08:30	−0.92	−0.95	−0.63	−1.32	0.69
T-35	8- 8-46	13:55	−1.60	−1.60	−1.58	−1.62	0.04
H-4	8-21-46	15:00	−15.73	−15.73	−15.67	−15.78	0.11
H-4	9-12-46	12:50	−15.49	−15.49	−15.46	−15.52	0.06
M-92	9-12-46	11:10	−37.53	−37.55	−37.50	−37.56	0.05
T-35	9-12-46	11:10	−1.56	−1.58	−1.50	−1.67	0.17
H-4	9-25-46	06:50	−15.37	−15.36	−15.35	−15.38	0.03
H-4	9-29-46	00:30	−15.34	−15.34	−15.33	−15.36	0.03
M-92	9-28-46	22:15	−36.32	−36.34	−36.31	−36.34	0.03
T-35	9-28-46	22:50	−0.76	−0.77	−0.73	−0.80	0.07
L-7	9-29-46	06:30	−157.39	−157.37	−157.34	−157.41	0.07
H-4	10- 4-46	11:40	−15.39	−15.39	−15.37	−15.43	0.06
H-4	11- 1-46	06:15	−15.80	−15.80	−15.78	−15.81	0.03
L-7	11- 1-46	09:50	−158.09	−158.11	−158.07	−158.13	0.06
M-92	11- 1-46	06:40	−36.63	−36.63	−36.62	−36.64	0.02
T-35	11- 1-46	14:30	−2.05	−2.05	−1.97	−2.12	0.15
H-4	11- 2-46	13:45	−15.66	−15.67	−15.63	−15.68	0.05
M-92	11- 2-46	14:00	−36.47	−36.47	−36.46	−36.48	0.02
T-35	11- 2-46	14:20	−2.01	−2.03	−1.93	−2.11	0.18
H-4	11- 4-46	17:20	−15.83	−15.84	−15.82	−15.85	0.03
M-92	11- 4-46	17:55	−36.74	−36.76	−36.73	−36.77	0.04
T-35	11- 4-46	17:55	−2.16	−2.18	−2.15	−2.19	0.04
H-4	11-10-46	12:50	−15.93	−15.92	−15.90	−15.95	0.05
M-92	11-10-46	13:00	−36.91	−36.89	−36.88	−36.91	0.03
T-35	11-10-46	12:55	−2.30	−2.29	−2.24	−2.35	0.11
M-92	11-12-46	11:00	−36.93	−36.93	−36.92	−36.95	0.03
H-4	12-20-46	15:00	−16.65	−16.66	−16.47	−16.84	0.37
H-13	12-20-46	14:00	−8.14	−8.14	−8.13	−8.16	0.03
N-64	12-20-46	15:00	−19.67	−19.66	−19.62	−19.69	0.07
O-47	12-20-46	15:00	−3.63	−3.64	−3.61	−3.65	0.04
P-246	12-20-46	15:00	−25.85	−25.86	−25.82	−25.91	0.09
P-272	12-20-46	15:30	−25.87	−25.93	−25.82	−25.93	0.11
P-44	12-20-46	15:30	−2.67	−2.68	−2.64	−2.70	0.06
T-35	12-20-46	15:00	−3.21	−3.22	−2.97	−3.45	0.48
H-4	12-21-46	06:40	−16.68	−16.69	−16.67	−16.69	0.02
T-35	12-21-46	06:05	−2.95	−2.94	−2.92	−2.98	0.06
H-13	1-15-47	15:50	−8.69	−8.70	−8.66	−8.73	0.07
T-35	1-21-47	11:25	−3.44	−3.43	−3.42	−3.46	0.04
H-4	1-24-47	22:45	−17.39	−17.39	−17.39	−17.42	0.03
H-4	1-26-47	04:50	−17.36	−17.35	−17.27	−17.44	0.17
H-13	1-26-47	06:20	−8.61	−8.61	−8.60	−8.62	0.02
L-7	1-26-47	05:10	−161.74	−161.75	−161.71	−161.79	0.08
M-92	1-26-47	05:30	−38.23	−38.22	−38.19	−38.27	0.08
N-64	1-26-47	05:15	−20.21	−20.21	−20.20	−20.22	0.02
P-246	1-26-47	05:15	−25.63	−25.64	−25.62	−25.67	0.05
P-272	1-26-47	05:00	−25.73	−25.75	−25.72	−25.77	0.05
P-44	1-26-47	04:45	−3.06	−3.05	−3.03	−3.07	0.04
S-9	1-26-47	04:45	−1.66	−1.65	−1.63	−1.68	0.05
T-35	1-26-47	05:10	−3.53	−3.51	−3.44	−3.60	0.16
T-35	2-24-47	12:40	−2.69	−2.69	−2.68	−2.70	0.02
T-35	3-17-47	03:55	−1.95	−1.96	−1.89	−2.00	0.11
P-44	4-10-47	12:45	−5.55	−5.56	−5.54	−5.56	0.02
T-35	4-24-47	15:35	−2.43	−2.43	−2.40	−2.44	0.04
T-35	5-27-47	02:50	−3.33	−3.33	−3.31	−3.35	0.04
T-35	6-13-47	18:00	−3.42	−3.44	−3.41	−3.46	0.05
L-7	7-29-47	08:50	−156.77	−156.76	−156.74	−156.78	0.04
T-35	7-29-47	10:20	−2.60	−2.60	−2.57	−2.63	0.06
L-7	8- 6-47	18:50	−156.96	−156.98	−156.88	−157.06	0.18
M-92	8- 6-47	19:30	−37.20	−37.20	−37.17	−37.23	0.06

See footnotes at end of table.

Table 1.—*Earthquake fluctuations in wells—Jan. 1, 1944, to Dec. 31, 1949*—Continued

Well No.	Date	Time (E. S. T.)	Depth to water in feet**				Amplitude of fluctuation in feet
			Before disturbance	After disturbance	At highest point of fluctuation	At lowest point of fluctuation	
NORTHERN FLORIDA—continued							
N-64	8- 6-47	19:45	−20.76	−20.76	−20.75	−20.77	0.02
P-246	8- 6-47	19:45	−25.29	−25.31	−25.26	−25.33	0.07
P-44	8- 6-47	19:45	−1.67	−1.68	−1.62	−1.73	0.11
P-44	8-15-47	20:45	−1.18	−1.20	−1.15	−1.27	0.12
L-7	8-27-47	13:50	−157.02	−157.01	−156.97	−157.04	0.07
L-7	10-16-47	01:45	−158.59	−158.61	−158.50	−158.69	0.19
M-92	10-15-47	21:50	−36.75	−36.77	−36.72	−36.79	0.07
P-13	10-15-47	20:45	−8.38	−8.34	−8.29	−8.38	0.09
P-246	10-15-47	21:30	−24.50	−24.47	−24.46	−24.52	0.06
T-35	10-15-47	21:45	−1.47	−1.42	−1.30	−1.60	0.30
L-7	11- 1-47	11:50	−159.07	−159.04	−159.03	−159.11	0.08
M-92	11- 1-47	10:30	−36.92	−36.92	−36.90	−36.93	0.03
T-35	11- 1-47	10:10	−1.86	−1.86	−1.81	−1.91	0.10
T-35	1- 6-48	12:40	−1.40	−1.39	−1.37	−1.41	0.04
L-7	1-24-48	13:45	−155.46	−155.41	−155.37	−155.52	0.15
M-92	1-24-48	14:00	−36.89	−36.88	−36.82	−36.94	0.12
P-44	1-24-48	13:15	−0.82	−0.81	−0.79	−0.83	0.04
T-35	1-24-48	13:40	−1.63	−1.64	−1.56	−1.71	0.15
L-7	4-17-48	13:20	−149.04	−149.03	−149.02	−149.05	0.03
G-30	4-21-48	14:00	−17.62	−17.64	−17.57	−17.68	0.11
L-7	4-21-48	18:00	−148.91	−148.89	−148.62	−149.18	0.56
M-92	4-21-48	16:25	−37.75	−37.72	−37.58	−37.91	0.33
P-13	4-21-48	14:45	−9.10	−9.25	−9.04	−9.32	0.28
P-77	4-21-48	15:00	−64.73	−64.76	−64.73	−64.76	0.03
P-246	4-21-48	15:30	−25.72	−25.75	−25.62	−25.85	0.23
P-269	4-21-48	15:00	−10.62	−10.64	−10.37	−10.89	0.52
P-272	4-21-48	15:15	−26.35	−26.39	−26.18	−26.53	0.35
P-337	4-21-48	15:00	−43.56	−43.54	−43.58	−43.51	0.07
P-561	4-21-48	15:00	−2.50	−2.57	−2.50	−2.59	0.09
P-44	4-21-48	16:00	−1.93	−1.92	−1.71	−2.13	0.42
T-36	4-21-48	15:30	−4.36	−4.38	−4.30	−4.47	0.17
L-7	4-21-48	22:20	−157.89	−157.91	−157.84	−157.96	0.12
P-269	4-21-48	21:30	−10.26	−20.27	−10.25	−10.28	0.03
P-44	4-21-48	20:00	−1.93	−1.94	−1.92	−1.96	0.04
L-7	4-23-48	09:20	−148.97	−149.00	−148.96	−149.02	0.06
P-44	4-23-48	07:30	−1.97	−1.98	−1.97	−1.99	0.02
P-77	5- 5-48	10:15	−64.59	−64.55	−64.51	−64.68	0.17
P-272	5-12-48	07:00	−26.03	−26.01	−25.76	−26.18	0.42
L-7	5-15-48	20:00	−149.73	−149.75	−149.69	−149.78	0.09
P-45	5-14-48	17:30	−64.36	−64.38	−64.33	−64.40	0.07
T-35	5-14-48	18:15	−1.61	−1.63	−1.54	−1.70	0.16
P-246	5-17-48	13:45	−25.81	−25.82	−25.73	−26.04	0.31
P-269	5-17-48	14:00	−10.35	−10.47	−10.19	−10.56	0.37
P-272	5-17-48	13:30	−26.50	−26.50	−26.45	−26.57	0.12
L-7	5-25-48	04:15	−150.37	−150.37	−150.35	−150.38	0.03
M-92	5-25-48	03:05	−37.66	−37.66	−37.65	−37.67	0.02
P-561	5-25-48	07:15	−2.13	−2.11	−2.06	−2.18	0.12
T-35	5-25-48	03:40	−2.23	−2.22	−2.17	−2.27	0.10
P-13	5-29-48	09:30	−9.03	−9.04	−8.99	−9.07	0.08
E-60	6-15-48	20:10	−11.33	−11.33	−11.31	−11.37	0.06
T-35	6-28-48	03:40	−2.56	−2.57	−2.55	−2.58	0.03
P-13	6-29-48	22:45	−9.13	−9.18	−9.13	−9.19	0.06
L-7	8-11-48	06:45	−149.59	−149.61	−149.58	−149.63	0.05
P-77	8-23-48	19:30	−64.77	−64.87	−64.50	−65.88	1.38
D-206	9- 8-48	10:30	−3.92	−3.95	−3.91	−3.98	0.07
L-7	9- 8-48	11:30	−149.50	−149.48	−149.44	−149.53	0.09
M-92	9- 8-48	11:00	−37.33	−37.33	−37.32	−37.36	0.04
L-7	10- 5-48	16:15	−150.15	−150.13	−150.12	−150.19	0.07
T-35	10- 5-48	15:55	+0.24	+0.24	+0.26	+0.24	0.02
E-60	11- 5-48	18:50	−8.37	−8.37	−8.36	−8.38	0.02
L-7	11-18-48	21:05	−152.08	−152.08	−152.06	−152.09	0,03
T-35	11-18-48	20:20	−1.62	−1.64	−1.61	−1.66	0.05
L-7	12- 3-48	21:35	−152.75	−152.76	−152.74	−152.77	0.03
T-35	12- 3-48	20:05	−1.31	−1.33	−1.30	−1.34	0.04
T-35	12- 4-48	17:35	−1.34	−1.35	−1.33	−1.37	0.04
L-7	12- 4-48	22:35	−152.77	−152.77	−152.75	−152.78	0.03
L-7	12-30-48	18:50	−152.06	−152.07	−152.05	−152.08	0.03
T-35	3- 4-49	05:00	−1.03	−1.03	−1.00	−1.05	0.05
T-35	3-22-49	11:20	−1.13	−1.13	−1.12	−1.15	0.03
D-206	4-13-49	11:40	−2.31	−2.29	−2.26	−2.33	0.07
M-92	4-13-49	14:30	−40.63	−40.62	−40.58	−40.65	0.07
P-45	4-13-49	15:00	−65.55	−65.53	−65.49	−65.59	0.10
T-35	4-13-49	15:15	−0.29	−0.28	−0.25	−0.32	0.07
T-35	4-25-49	09:30	−1.13	−1.13	−1.12	−1.14	0.02
L-7	7-10-49	00:20	−156.86	−156.86	−156.80	−156.95	0.15
M-92	7- 9-49	23:30	−39.58	−39.58	−39.56	−39.61	0.05
P-45	7- 9-49	23:00	−63.62	−63.62	−63.58	−63.67	0.09
P-44	7- 9-49	23:45	−2.31	−2.31	−2.30	−2.32	0.02
P-246	7-10-49	00:15	−26.03	−26.02	−25.99	−26.04	0.05
T-35	7- 9-49	23:40	−2.03	−2.02	−1.91	−2.15	0.24
P-13	7-16-49	13:45	−8.95	−8.90	−8.88	−8.95	0.07

See footnotes at end of table.

Table 1.—*Earthquake fluctuations in wells—Jan. 1, 1944, to Dec. 31, 1949*—Continued

Well No.	Date	Time (E. S. T.)	Depth to water in feet**				Amplitude of fluctuation in feet
			Before disturbance	After disturbance	At highest point of fluctuation	At lowest point of fluctuation	
NORTHERN FLORIDA—continued							
C-9	8-21-49	22:33	−86.03	−86.07	−86.02	−86.08	0.06
D-206	8-21-49	22:20	−3.51	−3.46	−3.18	−3.88	0.70
E-46	8-21-49	22:15	−57.49	−57.51	−57.40	−57.56	0.16
G-30	8-21-49	23:15	−19.96	−20.05	−19.88	−20.17	0.29
L-7	8-21-49	22:45	−154.24	−154.22	−153.21	−155.19	1.98
M-92	8-21-49	22:45	−38.35	−38.33	−37.80	−38.93	1.13
O-47	8-21-49	22:30	−5.26	−5.24	−5.04	−5.46	0.42
P-13	8-21-49	23:30	−7.55	−7.50	−7.22	−7.85	0.63
P-77	8-21-49	24:00	−63.87	−63.83	−63.79	−63.88	0.09
P-337	8-21-49	22:00	−42.71	−42.72	−42.62	−42.88	0.26
P-561	8-21-49	23:15	−1.62	−1.66	−1.56	−1.74	0.18
P-44	8-21-49	22:30	−2.11	−2.07	−1.75	−2.47	0.72
P-45	8-21-49	22:00	−63.57	−63.56		−63.94	
S-5	8-22-49	01:15	−5.25	−5.25	−5.11	−5.35	0.24
S-9	8-21-49	22:45	−0.20	−0.13	+0.04	−0.43	0.47
T-36	8-21-49	22:45	−7.30	−7.25	−6.91	−8.70	0.79
V-24	8-21-49	23:00	−6.58	−6.70	−5.84	−7.50	1.66
V-25	8-21-49	22:45	+2.15	+2.17	+2.19	+2.14	0.05
V-27	8-22-49	07:00	+1.69	+1.72	+2.64	+0.75	1.89
L-7	8-23-49	17:20	−154.43	−154.43	−154.42	−154.44	0.02
M-92	8-25-49	06:00	−38.33	−38.33	−38.32	−38.35	0.03
M-92	8-26-49	23:00	−38.04	−38.02	−38.00	−38.04	0.04
M-92	9- 1-49	05:00	−38.07	−38.10	−38.07	−38.11	0.04
M-92	8- 1-49	18:45	−38.01	−38.03	−38.00	−38.04	0.04
M-92	9-15-49	21:00	−37.79	−37.80	−37.78	−37.81	0.03
M-92	9-21-49	18:00	−37.75	−37.72	−37.73	−37.78	0.05
L-7	9-27-49	12:30	−155.87	−155.89	−155.78	−155.99	0.21
M-92	9-27-49	10:30	−37.69	−37.68	−37.64	−37.72	0.08
P-246	9-27-49	10:30	−25.08	−25.07	−25.06	−25.11	0.05
T-35	9-27-49	11:00	−2.01	−2.01	−1.73	−2.28	0.55
T-35	10-19-49	18:00	−2.64	−2.66	−2.63	−2.67	0.04
P-44	11-20-49	02:00	−1.57	−1.56	−1.53	−1.58	0.05
T-35	11-20-49	02:35	−2.96	−2.94	−2.86	−3.04	0.48
L-7	11-20-49	03:30	−138.09	−158.08	−158.02	−158.15	0.13
E-60	11-27-49	16:20	−7.52	−7.51	−7.49	−7.55	0.06
L-7	12-16-49	07:30	−159.27	−159.26	−159.22	−159.30	0.08
L-7	12-16-49	15:30	−159.34	−159.47	−159.32	−159.56	0.24
M-92	12-17-49	02:50	−37.75	−37.74	−37.73	−37.76	0.03
P-45	12-17-49	02:00	−63.33	−63.32	−63.30	−63.33	0.03
T-35	12-17-49	02:20	−3.09	−3.07	−3.00	−3.15	0.15
D-206	12-17-49	10:15	−2.60	−2.79	−2.76	−2.84	0.08
M-92	12-17-49	10:45	−38.80	−38.80	−38.77	−38.84	0.07
O-47	12-17-49	14:30	−3.92	−3.92	−3.91	−3.93	0.02
P-246	12-17-49	07:45	−26.05	−26.02	−26.01	−26.06	0.05
P-45	12-17-49	09:45	−63.37	−63.37	−63.31	−63.42	0.11
T-35	12-17-49	10:40	−3.13	3.11	−3.04	−3.22	0.18
L-7	[1] 12-22-49	08:30	−159.40	−159.39	−159.37	−159.42	0.05
T-35	[1] 12-22-49	04:40	−3.26	−3.25	−3.21	−3.28	0.07
NEW YORK							
Sn-128	6-27-46	06:30	31.60	31.60	31.59	31.60	0.01
Bm-49	8- 4-46	12:50	11.17	11.17	11.13	11.21	0.08
Sn-128	9- 5-46	13:45	31.28	31.28	31.26	31.28	0.02
Sy-9	10- 6-46	02:00	6.895	6.895	6.890	6.891	[2]
Sy-9	10- 7-46	04:15	6.97	6.97	6.965	6.975	0.01
Sn-128	10- 8-46	08:00	30.82	30.81	30.80	30.84	0.04
Sy-9	10-22-46	00:45	4.545	4.545	4.53	4.56	0.03
Sy-9	10-28-46	08:30	3.925	3.93	3.92	3.94	0.02
Sy-9	11- 8-46	05:30	6.165	6.17	6.16	6.18	0.02
Sy-9	11-11-46	03:30	6.91	6.915	6.91	6.92	0.01
Sy-9	11-22-46	03:30	7.735	7.73	7.725	7.74	0.015
Sy-9	12- 4-46	16:00	8.22	8.22	8.20	8.255	0.055
Sy-9	12-17-46	12:30	7.79	7.79	7.78	7.82	0.04
Sn-128	1- 3-47	02:45	32.87	32.87	32.86	32.88	0.02
Sy-9	4- 5-47	18:00	2.49	2.44	2.41	2.48	0.07
St-1	4-11-47	13:00	4.10	4.10	4.075	4.13	0.055
St-1	5-16-47	14:00	4.64	4.64	4.63	4.65	0.02
Bm-49	6- 5-47	07:20	9.75	9.75	9.65	10.08	0.43
Bm-49	6- 5-47	10:40	9.75	9.75	9.71	9.77	0.06
Sn-128	7- 5-47	17:00	30.96	30.93	30.70	31.38	0.68
Bm-49	7-23-47	14:50	11.03	11.03	11.01	11.04	0.03
Sy-9	8- 9-47	23:15	8.48	8.475	8.47	8.495	0.025
Mt-1	8-20-47	12:30	8.40	8.405	8.39	8.42	0.03
Sy-9	8-22-47	15:45	6.105	6.10	6.08	6.12	0.04
Mt-1	9-22-47	18:00	8.92	8.92	8.91	8.93	0.02
Mt-1	9-22-47	10:15	8.945	8.95	8.94	8.95	0.01
Mt-1	10- 7-47	05:45	9.10	9.105	9.10	9.12	0.02
Mt-1	10- 8-47	14:20	9.12	9.125	9.12	9.135	0.015

Table 1.—*Earthquake fluctuations in wells—Jan. 1, 1944, to Dec. 31, 1949*—Continued

Well No.	Date	Time (E. S. T.)	Depth to water in feet**				Amplitude fluctuation in feet
			Before disturbance	After disturbance	At highest point of fluctuation	At lowest point of fluctuation	
NEW YORK—continued							
Bm-49	10-16-47	17:15	13.435	13.435	13.43	13.44	0.01
Mt-1	10-25-47	17:00	9.37	9.37	9.365	9.372	(2)
Sy-9	10-26-47	16:00	9.01	9.01	9.01	9.02	0.01
Mt-1	10-28-47	08:45	9.395	9.395	9.395	9.40	(2)
Mt-1	11-10-47	05:45	8.56	8.555	8.525	8.585	0.06
Mt-1	11-16-47	10:30	7.88	7.88	7.875	7.885	0.01
Mt-1	11-17-47	14:30	7.14	7.135	7.135	7.14	(2)
Bm-49	12-11-47	10:25	13.195	13.195	13.18	13.21	0.03
Sy-9	1- 6-48	21:00	8.31	8.31	8.305	8.325	0.02
Wn-29	1- 7-48	09:30	18.78	18.78	18.78	18.795	0.015
Bm-49	1-15-48	11:50	13.83	13.83	13.81	13.86	0.05
Bm-49	1-15-48	12:10	13.83	13.83	13.82	13.845	0.025
Bm-49	1-20-48	10:10	13.875	13.875	13.85	13.90	0.05
Wn-29	1-21-48	20:45	18.735	18.73	18.725	18.75	0.025
Mt-1	2-17-48	17:15	7.135	7.13	7.13	7.14	0.01
Mt-1	2-17-48	20:30	7.125	7.11	7.085	7.16	0.075
Mt-1	2-18-48	17:00	6.79	6.78	6.76	6.80	0.04
Mt-1	2-19-48	18:15	6.395	6.395	6.375	6.42	0.045
Mt-1	2-19-48	23:00	6.35	6.345	6.32	6.38	0.06
Mt-1	3-22-48	12:05	4.495	4.49	4.48	4.52	0.04
Mt-1	4- 1-48	01:45	5.44	5.44	5.43	5.45	0.02
Bm-49	4-23-48	16:00	9.74	9.74	9.72	9.76	0.04
Bm-105	5- 6-48	14:30	20.245	20.25	20.245	20.255	0.01
Bm-49	5- 7-48	09:20	10.215	10.215	10.19	10.23	0.04
Sy-9	5-11-48	13:45	7.40	7.40	7.385	7.42	0.035
Bm-49	5-19-48	22:00	9.92	9.92	9.88	9.94	0.06
Wn-29	5-24-48	14:00	18.14	18.14	18.125	18.155	0.03
Wn-29	7-12-48	05:00	20.25	20.25	20.245	20.255	0.01
St-1	9-30-48	12:15	14.86	14.865	14.86	14.87	0.01
St-1	10-16-48	15:15	15.95	15.95	15.95	15.96	0.01
St-1	10-21-48	11:30	16.21	16.21	16.17	16.23	0.06
Sy-9	10-27-48	23:30	8.725	8.725	8.72	8.73	0.01
St-1	10-29-48	16:20	16.49	16.49	16.46	16.515	0.055
Bm-49	11- 6-48	09:40	17.82	17.82	17.80	17.84	0.04
Sy-9	12- 1-48	02:45	3.69	3.69	3.685	3.695	0.01
Sy-9	12-21-48	03:30	6.135	6.135	6.13	6.14	0.01
Sy-9	2-12-49	08:00	7.28	7.275	7.245	7.30	0.055
Mt-1	4- 4-49	14:00	6.29	6.29	6.27	6.31	0.04
Mt-1	4-12-49	12:15	6.005	6.005	5.99	6.02	0.03
Bm-49	5- 2-49	14:40	14.33	14.33	14.32	14.345	0.025
Bm-49	5- 8-49	18:30	14.605	14.605	14.60	14.61	0.01
Mt-1	5-27-49	07:30	6.92	6.92	6.91	6.93	0.02
Bm-49	6-25-49	10:20	16.17	16.17	16.16	16.175	0.015
Bm-49	7-26-49	07:20	17.385	17.385	17.375	17.39	0.015
Bm-49	7-26-49	07:50	17.385	17.39	17.275	18.01	0.735
Bm-49	7-26-49	08:15	17.39	17.39	17.35	18.04	0.69
Bm-49	7-29-49	23:25	17.38	17.38	17.375	17.385	0.01
Bm-49	8- 1-49	22:20	17.15	17.15	17.14	17.16	0.02
Bm-105	8-22-49	12:30	19.67	19.67	19.65	19.70	0.05
Mt-1	8-30-49	05:30	9.38	9.37	9.36	9.39	0.03
Mt-1	10-11-49	10:00	8.28	8.275	8.265	8.29	0.025
Sy-9	10-30-49	23:15	8.93	8.92	8.915	8.925	0.01
Sy-9	11- 9-49	04:30	8.86	8.865	8.85	8.88	0.03

*Depth to water below measuring point.
**Referred to mean sea level in southern Florida and land surface datum in northern Florida and New York State.
[1]Date corresponds with that for which Coast and Geodetic Survey reported an earthquake.
[2]Less than 0.01.

Table 2.—*Descriptions of wells*

Well No.	Location	Owner	Depth (*feet*)	Casing diameter (*inches*)	Finish and formation*
		SOUTHERN FLORIDA			
F-210	SW¼NE¼ sec. 13, T. 53 S., R. 41 E., northwest section of Miami, Dade County.	City of Miami	77.1	6	Calcareous sandstone or sandy limestone.
F-291	NW¼NW¼ sec. 22, T. 51 S., R. 42 E., Hollywood, Broward County.	City of Hollywood	107.0	6	Do.
F-319	SE¼SE¼ sec. 25, T. 54 S., R. 40 E., South Miami, Dade County.	City of South Miami	13.9	6	Perforated casing in rectangular shaped dug well, upper part concreted; lower part open hole, nonartesian. Sandy limestone.
F-358	NE¼NE¼ sec. 13, T. 57 S., R. 38 E., Homestead, Dade County.	City of Homestead	53.5	6	Sandy limestone.
G-72	NW¼NE¼ sec. 3, T. 52 S., R. 39 E., Dade County.	U. S. Geological Survey	4.6	8	Do.
G-218	NW¼NW¼ sec. 18, T. 53 S., R. 40 E., Dade County.	do	71.2	6	Calcareous sandstone.
G-221	NW¼NW¼ sec. 18, T. 50 S., R. 42 E., Fort Lauderdale, Broward County.	do	145	6	Do.
G-476	NW¼NE¼ sec. 35, T. 55 S., R. 40 E., Dade County.	do	34.5	6	Sandy limestone.
G-518	NE¼NW¼ sec. 30, T. 56 S., R. 40 E., Dade County.	do	75.0	4	Shelly limestone.
G-551	NW¼SW¼ sec. 36, T. 54 S., R. 39 E., Dade County.	City of Miami	80.0	(1)	18-inch slotted casing from 29 to 71 feet, open hole 27–80 feet, nonartesian. Sandy limestone with some sand.
G-553	NE¼SE¼ sec. 16, T. 55 S., R. 40 E., Dade County.	do	91.0	24	18-inch slotted casing 36 to 79 feet, 12-inch open hole 80 to 91 feet, nonartesian. Sandy limestone with some sand.
G-561	SE¼SE¼ sec. 15, T. 50 S., R. 42 E., Fort Lauderdale, Broward County.	U. S. Geological Survey	20.3	6	Sandy limestone.
G-580	SE¼NE¼ sec. 11, T. 55 S., R. 40 E., South Miami, Dade County.	do	99.5	2½	Do.
G-594	NE¼NE¼ sec. 32, T. 52 S., R. 38 E., Dade-Broward levee, Dade County.	do	20.0	6	Do.
G-595	NW¼NW¼ sec. 34, T. 54 S., R. 40 E., South Miami, Dade County.	do	14.4	6	Do.
G-612	SW¼NW¼ sec. 23, T. 57 S., R. 39 E., Dade County.	do	19.2	6	Do.
G-613	NW¼SW¼ sec. 3, T. 58 S., R. 38 E., Dade County.	do	20.5	6	Do.
G-614	NW¼NW¼ sec. 21, T. 56 S., R. 39 E., Dade County.	do	20.0	6	Do.
M-125	SW¼SE¼ sec. 12, T. 40 S., R. 42 E., Jupiter State Park, Martin County.	Florida Park Service	90	12–6	25-foot screen, nonartesian. Sandstone and sandy shell marl.
S-18	NW¼NW¼ sec. 15, T. 52 S., R. 41 E., Dade County.	Model Dairy	51.6	8	Sandy limestone.
S-19	NW¼NE¼ sec. 25, T. 53 S., R. 40 E., Miami Springs, Dade County.	City of Miami	94.8	6	Do.
S-68	SW¼NW¼ sec. 19, T. 53 S., R. 41 E., Miami Springs, Dade County.	do	60.7	6	Do.
S-329	SW¼NE¼ sec. 12, T. 50 S., R. 41 E., Fort Lauderdale, Broward County.	City of Fort Lauderdale	67.9	4	Sandy limestone or calcareous sandstone.
S-539	NW¼NE¼ sec. 24, T. 55 S., R. 40 E., Dade County.	Department of Agriculture	28.6	8	Sandy limestone.
F-179	SE¼NW¼ sec. 16, T. 54 S., R. 41 E., Miami, Dade County.	City of Miami	77.1	6	Do.
F-262	SE¼SE¼ sec. 18, T. 53 S., R. 41 E., Hialeah, Dade County.	City of Hialeah	53.6	6	Do.
F-378	SE¼SE¼ sec. 24, T. 57 S., R. 38 E., Florida City, Dade County.	Florida City	24.1	4	Sandy limestone or calcareous sandstone.
G-3	NE¼SE¼ sec. 13, T. 53 S., R. 40 E., Miami Springs, Dade County.	U. S. Geological Survey	8.5	6	Oolitic limestone.
G-350	NE¼NW¼ sec. 14, T. 54 S., R. 40 E., Coral Gables, Dade County.	do	14.7	4	Do.
L-246	SE¼NE¼ sec. 20, T. 44 S., R. 25 E., Lee County.	do	27.7		Shell marl.
L-418	NE¼SE¼ sec. 16, T. 44 S., R. 26 E., Buckingham Army Air Field, Lee County.	City of Fort Myers and Lee County.	92.6	8	Shelly, sandy limestone.
S-182	NW¼NW¼ sec. 5, T. 56 S., R. 40 E., Dade County.	International Fruit Corp.	50.7	6	Sandy limestone.

See footnotes at end of table.

Table 2.—*Descriptions of wells*—Continued

Well No.	Location	Owner	Depth (*feet*)	Casing diameter (*inches*)	Finish and formation*
		NORTHERN FLORIDA			
B-7	SW¼NE¼ sec. 1, T. 3 S., R. 15 W.	City of Panama City	356	3	Limestone.
C-9	Sec. 5, T. 4 S., R. 17 E.	City of Lake City	836	12	Do.
D-206	Sec. 12, T. 3 S., R. 25 E.	John Harrell	1,700	10	Do.
E-46	0.4 mile east of Ensley	U. S. Geological Survey	239	4	
E-60	Pensacola	do	178	4	
E-61	do	do	154	4	
G-30	NE¼NW¼ sec. 1, T. 7 S., R. 11 W.	Apalachicola Northern Railroad.	563	6	Do.
H-4	NW¼NW¼ sec. 15, T. 36 S., R. 25 E.	J. A. Ratliff		8	Do.
H-13	SE¼SE¼ sec. 21, T. 27 S., R. 18 E.	City of St. Petersburg	300		Do.
H-30	Sec. 31, T. 31 S., R. 19 E.	C. L. Councilman	500	6	Do.
J-23	NE¼NW¼ sec. 36, T. 4 N., R. 7 W.	Florida State Hospital	475	12	Do.
L-7	NE¼NE¼ sec. 36, T. 1 N., R. 1 W.	City of Tallahassee	211	6	Do.
L-28	NE¼NE¼ sec. 15, T. 2 N., R. 1 W.	John S. Phipps	200	4	Do.
M-92	SE¼SE¼ sec. 9, T. 35 S., R. 20 E.	Ray E. Anderson	600	5	Do.
N-64	SW¼SE¼ sec. 8, T. 3 N., R. 24 E.	Mrs. D. C. Henderson	648	8	Do.
O-47	NE¼NE¼ sec. 26, T. 22 S., R. 28 E.	Orange County	350	8–6	Do.
P-13	SE¼NE¼ sec. 13, T. 27 S., R. 15 E.	U. S. Geological Survey	141	6	Do.
P-77	NW¼NE¼ sec. 12, T. 28 S., R. 15 E.	R. Duguid	100	10	Do.
P-272	NW¼NW¼ sec. 15, T. 29 S., R. 15 E.	City of Clearwater	165	10	Do.
P-337	NW¼NE¼ sec. 7, T. 29 S., R. 16 E.	Coachman Packing Company	428	12	Do.
P-246	NE¼NE¼ sec. 15, T. 29 S., R. 15 E.	City of Clearwater	100	10	Do.
P-269	NE¼NE¼ sec. 15, T. 29 S., R. 15 E.	do	192	10	Do.
P-561	NW¼NE¼ sec. 26, T. 30 S., R. 16 E.	City of St. Petersburg	300	14	Do.
P-44	SW¼NE¼ sec. 28, T. 26 S., R. 27 E.	P. E. Williams		10	Do.
P-45	3.6 miles south of Lakeland	Claude Hardin	768	12–18	Do.
P-51	Frostproof	William Falls		6	Do.
S-5	SE¼NE¼ sec. 19, T. 36 S., R. 20 E.	R. M. Canty	720	8	Do.
S-9	SW¼SE¼ sec. 20, T. 36 S., R. 19 E.	Palmer Corp	730	6	Do.
T-35	NE¼ sec. 10, T. 5 S., R. 8 E.	Brooks-Scanlon Corp	245	12–17	Do.
T-36	NW¼NE¼ sec. 9, T. 5 S., R. 8 E.	do		6	Do.
V-24	About 2 miles southwest of New Smyrna.	City of New Smyrna		6	Do.
V-25	Daytona Beach	City of Daytona Beach		6	Do.
V-31	SE¼NW¼ sec. 11, T. 18 S., R. 32 E.	Florida State Road Department.	121	6	Do.
W-2	St. Marks	O. P. Shields	103	4	Do.
		NEW YORK			
Sn-128	42°49′26″ N., 73°59′22″ W.	City of Schenectady	40.1	47	Semiartesian. Gravel.
St-1	44°51′52″ N., 74°46′53″ W.	Benjamin Compeau	21	34	Nonartesian. Sand and gravel.
Sy-9	42°16′40″ N., 76°39′41″ W.	Soil Conservation Service	15.6	39	Nonartesian. Probably glacial till.
Bm-49	42°07′11″ N., 75°57′24″ W.	Johnson City	64.2	18	Artesian. Sand and gravel.
Bm-105	42°06′43″ N., 75°54′39″ W.	U. S. Geological Survey	143.2	6	Do.
Bm-121	42°06′57″ N., 75°58′35″ W.	U. S. Geological Survey and town of Union.	51	6	Do.
Mt-1	43°01′43″ N., 74°42′38″ W.	Floyd B. Groff	12.3	24	Nonartesian. Glacial till.
Wn-29	43°08′14″ N., 77°11′19″ W.	Town of Marion, near 55 Mill Street.	107	8	Artesian. Lockport dolomite.

*All wells in southern Florida are open hole, nonartesian; those in northern Florida are open hole, artesian, except in cases listed otherwise.

[1] 24 inches to 29 feet.

SEISMOLOGICAL OBSERVATORY RESULTS

The United States Coast and Geodetic Survey publishes the results of its teleseismic stations and cooperating stations in the quarterly *Seismological Bulletin*. All seismogram interpretations are tabulated together with epicenters based on the published data and instrumental results received from seismological stations in all parts of the world. Instrumental results are published for the following stations:

Balboa Heights, C. Z.
(The Panama Canal.)
Bermuda
(Meteorological Station and International Union Geodesy and Geophysics.)
Boulder City, Nev.
Bozeman, Mont.
(Montana State College.)
Burlington, Vt.
(University of Vermont.)
Butte, Mont.
(Montana School of Mines.)
Chicago, Ill.
(University of Chicago and U. S. Weather Bureau.)
College, Alaska
Columbia, S. C.
(University of South Carolina.)
Honolulu, T. H.
Huancayo, Peru
(Geophysical Institute of Huancayo.)
Hungry Horse, Mont.
Lincoln, Nebr.
(Nebraska Wesleyan University.)
Logan, Utah
(Utah State Agricultural College.)
New Kensington, Pa.
(Private station.)
Overton, Nev.
Philadelphia, Pa.
(The Franklin Institute.)
Pierce Ferry, Ariz.
Rapid City, S. Dak.
(South Dakota State School of Mines and Technology.)
Salt Lake City, Utah
(University of Utah.)
San Juan, P. R.
Seattle, Wash.
(University of Washington.)
Shasta, Calif.
Sitka, Alaska
Tucson, Ariz.
Ukiah, Calif.
(International Latitude Observatory.)

College, Honolulu, San Juan, Sitka, Tucson, and Ukiah are United States Coast and Geodetic Survey magnetic and seismological observatory stations.

Boulder City, Hungry Horse, Overton, Pierce Ferry, and Shasta are cooperating stations of the Bureau of Reclamation. Overton and Pierce Ferry are operated by the National Park Service personnel.

Bermuda, Bozeman, Butte, Chicago, Columbia, Lincoln, Rapid City, and Salt Lake City are cooperating university stations.

Balboa Heights, Burlington, Huancayo, Logan, New Kensington, Philadelphia, and Seattle are independent stations.

All readings were made or revised at the Washington Office except those for Balboa Heights.

In January 1949 three short-period Benioff seismographs were installed at College, Alaska. A second short-period vertical seismometer was installed at an outpost station with remote recording in the College seismograph vault. The Seattle, Wash., station was improved by installing a vertical Sprengnether short-period seismometer and two horizontal long- and short-period Sprengnether instruments.

SUMMARY OF INSTRUMENTAL EPICENTERS FOR 1946

In order to make available the more recent data, instrumental epicenters included in this publication are for the first half of 1949. *Seismological Bulletin*, *MSI–137*, issued June 30, 1951, was the first complete issue since MSI–124 covering the fourth quarter of 1945.

The summaries of instrumental epicenters for 1946–48 are not complete at this time. For this period the teleseismic interpretations without epicenter determinations are being published as time permits, and Bulletins subsequent to MSI–137 will be issued until the backlog is completed.

Table 3.—*Summary of instrumental epicenters for 1949*

1949	Origin time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter	
			Latitude	Longitude
	h m s		° ′	° ′
Jan. 1	01 17 54	Near Santa Cruz, Calif. Felt from San Francisco to King City. Mag. 4.5	36 54 N.	121 37 W.
1	09 05 32	Near Desert Hot Springs, Calif. Mag. 3.3	33 58 N.	116 20 W.
1	13 30 42*	Northern California	40½ N.	121½ W.
1	14 30 42	Near Santa Cruz, Calif. Mag. 3.0	36 54 N.	121 42 W.
1	15 11 27	Near Desert Hot Springs, Calif. Mag. 3.6	33 53 N.	116 20 W.
1	23 06 49*	Central Peru	12 S.	73 W.
2	00 11 34*	Samoa Islands region	14 S.	173½ W.
2	04 43 40*	Off west coast of Sumatra. Depth about 100 km	4 N.	94 E.
2	08 49 38*	North of Guam. Depth about 200 km	22 N.	143½ E.
2	12 50 22*	Near coast of Baluchistan	26 N.	61½ E.
2	18 01 44*	East of Crete	36 N.	27½ E.
2	22 03.9	Western Nevada. Felt at Schurz. Mag. 4.5	38.7 N.	119.0 W.
3	13 43 39	Region of Manix, Mojave Desert, Calif. Felt at Pisgah. Mag. 4.8	34 57 N.	116 30 W.
3	18 11 13**	Eastern Turkistan		
4	02 21 16*	East China Sea	26 N.	125 E.
4	07 27 47**	New Hebrides Islands region		
4	19 46 55*	Off southeast coast of Crete	35 N.	26 E.
5	08 56 26*	Loyalty Islands region	21 S.	170 E.
6	11 42 17*	Off central coast of Peru	11 S.	79 W.
7	09 47 33**	Tonga Islands region		
7	15 14 27**	Near coast of Ecuador. Depth about 100 km		
7	20 00 11*	Off northeast coast of Honshu Japan	40 N.	145 E.
8	03 39 21	Northern California. Mag. 4.3	39 33 N.	120 05 W.
9	07 48 06*	Off coast of southern Panama	5 N.	83 W.
9	10 34 35*	Northern Argentina. Depth about 200 km	24½ S.	67 W.
9	16 35 30**	Ryukyu Islands region		
13	08 47 34*	Fiji Islands region. Depth 680 km	25½ S.	178 E.
13	09 00 21*	do	25½ S.	178 E.
14	01 03 28*	Solomon Islands region	15½ S.	155 E.
14	02 17 45*	Yellow Sea. Felt at Nanking and in Lower Yangtze Valley	33 N.	121 E.
14	12 16 55*	Aleutian Islands. Depth about 100 km	52 N.	179 W.
14	15 53 50*	Aegean Sea region	39 N.	26 E.
14	21 00 15*	Aleutian Islands. Depth about 100 km	51 N.	179 W.
15	01 50 40**	Fiji Islands region		
16	00 07 42**	Off east coast of Kamchatka		
18	04 43 18*	South Pacific Ocean	44½ S.	90½ W.
19	14 59 59*	Off east coast of Formosa	24 N.	122½ E.
20	07 59 23	Northern California. Felt in Reno, Nevada. Mag. 4.8	39 33 N.	120 05 W.
20	13 24 55*	Southern Honshu, Japan	35½ N.	134½ E.
21	15 21 01**	Solomon Islands region		
21	17 43 22**	Samoa Islands region		
21	18 23 22**	do		
22	01 48 23**	Fiji Islands region. Depth about 250 km		
22	03 49 43**	Afghanistan-Baluchistan border		
22	05 33 50**	New Hebrides Islands region		
22	09 38 03**	Off north coast of Panama		
22	11 49 33*	Solomon Islands	9 S.	160 E.
23	01 08 31*	Off east coast of Greenland	72 N.	14 W.
23	06 31 13*	Indian Ocean. Depth 100 km. Mag. 7-7¼	9½ S.	94½ E.
23	16 43 00**	Off east coast of Kamchatka		
24	05 04 34*	Off coast of southern Peru	19 S.	73½ W.
24	09 15 42*	Tonga Islands region. Felt at Nukualofa. Depth about 100 km. Mag. 7.1	23 S.	176 W.
25	04 11 10**	Tonga Islands region. Depth about 200 km		
25	07 53 02*	Near coast of Nicaragua	11 N.	86 W.
26	23 38 58*	Off coast of southern Peru	18½ S.	73½ W.
27	02 40 59**	New Britain foreshock		
27	03 31 01**	do		
27	07 18 06*	New Britain region. Mag. 6½	4 S.	151 E.
27	11 00 00*	Off east coast of Kamchatka	55 N.	163½ E.
27	14 58 29*	New Britain region. Mag. 6	4 S.	151 E.
28	07 40 01*	Off east coast of Kamchatka	55 N.	163½ E.
28	08 18 03*	Mid-Atlantic Ocean. Mag. 6	24½ N.	43½ W.
28	23 26 54*	Off east coast of Korea	39 N.	129 E.
29	05 31 32**	Sandwich Islands region		
30	01 50 58*	Azores region	38 N.	27 W.
31	14 53 16**	Southern Bolivia. Depth about 250 km	21 S.	65 W.
31	23 31 10*	Samoa Islands region. Felt at Apia	15 S.	174 W.
Feb. 1	09 49 25	Near Desert Hot Springs, Calif. Mag. 2.9	33 25 N.	116 25 W.
1	11 59 19	Near Peralta, Calif. Mag. 2.8	33 51 N.	117 45 W.
1	13 30 42*	Northern California	40½ N.	121½ W.
1	14 15 56**	Atlantic Ocean. 600 miles southwest of Azores		
1	18 15 53*	Northern New Guinea	4 S.	135½ E.
2	17 41 31*	Aleutian Islands region. Depth about 200 km. Mag. about 7	53½ N.	172½ W.
3	16 29 21*	Tonga Islands region. Depth about 100 km	19 S.	173 W.
5	00 28 16*	Western Turkey	39 N.	29 E.
5	00 46 30*	Fiji Islands region. Depth about 500 km	16½ S.	180
5	15 24 13*	Greece	38 N.	22 E.
5	20 18 22*	Dominican Republic. Felt	19 N.	70½ W.
6	09 16 22*	Mariana Islands region. Depth 170 km	18 N.	145 E.
6	16 33 34**	Tonga Islands region		
7	10 53 16**	Off southern coast of Mexico. Depth about 100 km		
8	04 31 34*	Off southeast coast of Dominican Republic. Depth about 100 km	18 N.	68½ W.
10	21 56 39*	Samoa Islands region. Mag. 6¾	16 S.	173 W.
11	03 51 29*	North Atlantic Ocean	34 N.	39 W.

See footnotes at end of table.

Table 3.—*Summary of instrumental epicenters for 1949*—Continued

1949	Origin time G. C. T.			Region, focal depth, and remarks	Coordinates of provisional epicenter	
					Latitude	Longitude
	h	*m*	*s*		° ′	° ′
Feb. 11	07	23	48*	Pacific Ocean, 500 miles south of Easter Island	35 S.	108 W
11	09	57	25	Near Ensenada, Calif. Mag. 4.0	32 00 N.	117 00 W.
11	21	05	24	East of Tinemaha, Calif. Felt in Nevada and central California. Mag. 5.6	37 05 N.	117 45 W.
12	05	25	56	East of Tinemaha, Calif. Felt in Owens Valley and southern Joaquin Valley. Mag. 3.8	37 05 N.	117 45 W.
13	18	24	23*	Kermadec Islands region. Depth about 60 km. Mag. 7.4	33½ N.	178 W.
13	20	43	09*	Northern Chile. Felt. Depth about 100 km	21½ S.	69 W.
14	16	24	19*	New Hebrides Islands	15 S.	166½ E.
14	18	07	31*	Off coast of Colima, Mexico. Mag. 6½	18 N.	106 W.
14	18	42	04*	Near southern coast of Luzon, Philippine Islands	14 N.	121 E.
14	19	24	49*	Colima, Mexico, aftershock	18 N.	106 W.
14	20	41	48**	do		
14	22	29	17*	North Atlantic Ocean	50½ N.	29 W.
15	03	52	12*	Colima, Mexico, aftershock	18 N.	106 W.
15	06	42	55*	Near coast of southern Mexico	16 N.	96 W.
15	07	38	00*	do	16 N.	96 W.
15	14	09	00*	Near northern coast of Dominican Republic	19 N.	70 W.
16	10	39	16*	Jan Mayen Island region	72 N.	1 E.
16	11	02	47	East of Riverside, Calif. Mag. 2.7	34 00 N.	116 56 W.
16	11	37	13*	New Hebrides Islands	14½ S.	167 E.
16	17	36	07**	Northwestern Argentina		
17	03	36	38*	Samoa Islands region	13 S.	173 W.
17	08	43	07**	New Hebrides region		
17	20	24	33*	Tonga Islands region	20½ S.	175 W.
17	21	00	46*	Northern Algeria. Destructive in Constantine	36 N.	5½ E.
18	03	34	05	Near Borego Valley, Calif. Mag. 3.0	33 13 N.	116 09 W.
18	05	11	38**	Off coast of Colima, Mexico		
18	09	01	35*	Near northern coast of Dominican Republic	19½ N.	70 W.
18	12	56	40**	Off northern coast of Puerto Rico		
18	21	59	52	North of Cabazon, Calif. Mag. 3.1	34 03 N.	116 45 W.
19	00	55	39*	Santa Cruz Island	11 S.	166 E.
19	02	26	25**	Samoa Islands region. Depth slightly greater than normal		
19	20	22	41*	Off coast of northern Colombia	12 N.	74 W.
20	05	11	24	Near Big Bear Lake, Calif. Mag. 2.6	34 15 N.	117 03 W.
20	10	11	47*	Near east coast of Kamchatka. Depth about 80 km	55 N.	161 E.
21	11	39	35*	Mid-Atlantic Ocean	8½ N.	40 W.
22	11	48	25	Near Desert Hot Spring, Calif. Mag. 2.8	33 55 N.	116 25 W.
23	09	05	19*	Northwestern Alaska	66 N.	155 W.
23	15	28	28*	Off southeast coast of Crete	34½ N.	25½ E.
23	16	08	07*	Sinkiang Province, China. Mag. 7.3	41 N.	84 E.
23	16	49	25**	Sinkiang Province, China, aftershock		
23	20	05	22*	Southern Alaska. Felt at Anchorage. Depth about 100 km	62 N.	154 W.
23	21	40	48	Near Desert Hot Springs, Calif. Mag. 2.8	33 53 N.	116 20 W.
24	02	50	30*	Aleutian Islands region	51 N.	169 W.
24	04	03	16**	Sinkiang Province, China, aftershock		
24	05	27	59*	do	42 N.	84 E.
24	10	26	20**	Near coast of northern Peru. Depth about 60 km		
24	11	35	01*	Central Peru	12½ S.	75 W.
24	11	49	30*	Off Cape Mendocino, Calif.	41 N.	126 W.
24	23	02	18*	Northeastern Baluchistan	30 N.	69 E.
25	02	28	05*	Central California. Mag. 4½	36½ N.	120½ W.
25	04	09	45**	Philippine Islands region		
25	06	25	45**	Aleutian Islands region		
26	04	01	40**	Off east coast of Honshu, Japan	35 N.	142½ E.
26	08	30	06	West of Bishop, Calif. Mag. 3.5	37 20 N.	118 35 W.
26	15	45	45**	Ryukyu Islands region		
26	18	06	02*	Central Alaska	66 N.	154 W.
27	09	55	57*	North Atlantic Ocean	20 N.	44½ W.
27	10	35	25*	do	20 N.	44½ W.
27	13	35	48*	Off Cape Mendocino, Calif. Mag. 5.0	41½ N.	125 W.
28	00	12	59*	Sandwich Islands region. Mag. about 7	57½ S.	30 W.
28	04	00	08*	Samoa Islands region. Depth about 250 km	15 S.	175 W.
28	11	12	57**	Sandwich Islands aftershock		
Mar. 1	14	17	34**	Central Argentina		
2	06	54	31*	Jan Mayen Island region	72½ N.	2 W.
2	19	08	47**	Off southern coast of Guatemala		
3	04	38	18**	Off coast of southern Korea		
3	05	59	34*	Gulf of California. Mag. 4.5	31 N.	113 W.
4	01	17	03*	Near coast of southern Sumatra. Depth about 100 km	3½ S.	102½ E.
4	08	19	06**	New Hebrides region		
4	10	19	25*	Hindu Kush Range, Afghanistan. Destructive in West Punjab. Depth 230 km. Mag. 7.5	37 N.	70 E.
5	01	39	11*	Bonin Islands region	30 N.	140 E.
6	11	27	55**	Western Sinkiang Province, China		
6	16	36	21*	South-central Iran	30 N.	54½ E.
7	11	42	30**	About 125 miles east of Fairbanks, Alaska. Felt at Northway		
7	13	33	56**	Eastern Dominican Republic		
7	14	36	59**	Santa Cruz Islands region. Depth about 100 km		
9	04	21	01*	Eastern Turkistan	42 N.	72 E.
9	12	28	39	Central California. Felt. Mag. 3.5	37.1 N.	121.3 W.
9	14	55	29*	Samoa Islands region. Felt in Apia. Depth 150 km	16 S.	174 W.
12	19	27	57*	Southern Alaska. Felt in Anchorage	61 N.	147 W.
13	04	41	10**	Western Peru		
13	12	21	50**	Bonin Islands region		

See footnotes at end of table.

Table 3.—*Summary of instrumental epicenters for 1949*—Continued

1949	Origin time G. C. T.			Region, focal depth, and remarks	Coordinates of provisional epicenter	
					Latitude	Longitude
	h	m	s		° ′	° ′
Mar. 13	15	55	18	Near Manix, Calif. Mag. 3.8	34 58 N.	116 33 W.
13	17	56	02	North of Barstow, Calif. Mag. 2.9	35 05 N.	117 00 W.
13	18	43	00*	Northwestern Argentina. Depth 120 km	21½ S.	68 W.
14	00	39	20**	Off western Alaska Peninsula		
14	03	06	36*	Aleutian Islands region	52½ N.	167 W.
14	06	10	15	San Benito County, Calif. Mag. 4.7	37 01 N.	121 29 W.
14	18	54	10**	Samoa Islands region		
15	20	53	11*	Western Idaho. Felt in Council	45½ N.	117 W.
16	11	57	47	Near Manix, Calif. Mag. 2.9	34 56 N.	116 31 W.
16	18	00	27	West of Salton Sea, Calif. Mag. 4.0	33 17 N.	116 02 W.
16	22	15	08*	New Britain. Depth about 60 km. Mag. 7.1	6 S.	151½ E.
17	05	49	06*	Bolivia-Peru border	15½ S.	69½ W.
17	16	06	29	Clark Lake, Calif. Felt in Borego Valley. Mag. 3.7	33 25 N.	116 30 W.
17	21	05	06*	New Britain. Depth about 60 km. Mag. 7.0	6 S.	151½ E.
18	01	55	12	Near Manix, Calif. Mag. 3.3	34 56 N.	116 31 W.
18	03	24	22*	Kurile Islands region	43½ N.	147 E.
18	05	02	28	Near Newberry, Calif. Mag. 3.0	34 52 N.	116 39 W.
18	08	37	45	Near Thermal, Calif. Mag. 3.4	33 38 N.	116 02 W.
19	14	50	15*	Tonga Islands region	18 S.	173 W.
19	18	19	22*	Off southwest coast of Kyushu, Japan. Depth about 150 km	30½ N.	130 E.
20	19	34	50	Northwest of Barstow, Calif. Felt in Hinckley. Mag. 4.4	35 08 N.	117 15 W.
21	05	49	24	Near Twentynine Palms, Calif. Mag. 2.9	34 12 N.	116 07 W.
21	11	20	59**	Off west coast of Vancouver Island, British Columbia		
21	15	17	29**	Off coast of northern Chile		
22	18	55	39*	Easter Island region	24 S.	113½ W.
23	06	36	32*	Off north coast of New Guinea	3 S.	143½ E.
23	09	30	06*	Near east coast of Dominican Republic. Felt at Caguas, Puerto Rico. Depth about 60 km	19 N.	68½ W.
24	17	09	55*	Montana-Wyoming-Idaho border	44½ N.	111 W.
24	20	56	59*	Off Cape Mendocino, Calif. Felt. Mag. 6–6¼	41½ N.	125½ W.
25	00	35	18**	Cape Mendocino, Calif. aftershock		
25	02	06	42**	....do		
26	02	28	05*	Gulf of California	25 N.	109½ W.
26	05	04	27**	Gulf of California aftershock		
26	16	24	31**	Pacific Ocean, off southern coast of Mexico		
26	19	13	47	Near Walker Pass, Calif. Mag. 3.1	35 40 N.	118 20 W.
27	06	33	55*	Molucca Passage. Mag. 7.0	3 N.	128½ E.
27	11	45	29**	New Britain region. Depth about 100 km		
28	12	50	31**	Near west coast of Mindoro, Philippine Islands		
28	16	20	53**	Cape Mendocino, Calif. foreshock		
28	16	26	05**	....do		
28	18	29	39**	....do		
28	19	05	08**	....do		
28	19	39	06**	....do		
28	19	43	16*	Off coast of Cape Mendocino, Calif.	42 N.	126 W.
28	19	54	23**	Cape Mendocino, California, aftershock		
30	05	30	28**	Off coast of southern Mexico		
30	09	00	04**	New Hebrides region		
30	14	47	46*	Fiji Islands region. Mag. 6¼	16 S.	178 W.
30	20	28	28*	Off coast of Vancouver Island, British Columbia	49 N.	127½ W.
31	21	40	05**	New Britain region. Depth about 60 km	5½ S.	151 E.
Apr. 1	07	01	57*	Tonga Islands region. Depth about 600 km	23 S.	178 W.
1	08	40	52*	Gulf of California	29 N.	113 W.
1	16	45	45*	Off coast of Oregon	43½ N.	126 W.
2	09	14	37**	Queen Charlotte Islands		
2	19	03	02*	Tonga Islands region. Felt in Apia. Depth about 150 km	17 S.	174½ W.
2	23	46	40*	Near south coast of Peru	16½ S.	75 W.
4	13	14	02*	Near northwest coast of Colombia	11 N.	76 W.
5	09	27	00*	Near Vladivostok, U. S. S. R. Felt. Depth about 550 km. Mag. 6¾–7	42 N.	131½ E.
6	03	36	16**	Gulf of California		
6	06	49	17	Near Cuyamaca, Calif. Mag. 3.3	33 00 N.	116 21 W.
6	15	23	14**	700 miles northeast of Mindanao, Philippine Islands. Depth about 100 km		
6	23	45	50**	About 250 miles off northeast coast of North Island, New Zealand		
7	06	12	48**	Northwestern Colombia		
8	06	10	30*	Samoa Islands region	13 S.	172½ W.
8	08	18	28*	Mid-Atlantic Ocean, southwest of Cape Verde Islands	8 N.	38 W.
9	04	20	11*	Off south coast of Panama	5½ N.	83 W.
10	23	48	16**	300 miles north of Kermadec Islands. Mag. 6¼–6½		
10	04	53	00*	Off south coast of Alaska. Depth 80 km	55½ N.	149 W.
12	05	05	08*	Western Alaska	66½ N.	153 W.
12	07	22	41*	....do	66½ N.	153 W.
13	07	58	26	North of Bishop, Calif. Felt at Long Valley Dam and in Yosemite Valley. Mag. 4.5	37 40 N.	118 23 W.
13	15	12	56*	Atlantic Ocean, off northeast coast of South America	11 N.	41½ W.
13	18	55	10**	Eastern New Guinea		
13	19	55	41	Western Washington. Approximately 25 million dollars property damage in Seattle, Tacoma, and Olympia area. 8 killed and many injured. Depth slightly greater than normal. Mag. 7.1	47.1 N.	122.7 W.
14	15	46	22**	Samoa Islands region		
14	17	02	56**	....do		
14	23	28	40*	Jan Mayen Island region	72 N.	1 W.
15	00	34	00**	New Hebrides Islands		
15	14	07	21*	Flores Sea. Felt on Buton Island	5 S.	124 E.
16	00	38	01*	Off south coast of Alaska	56 N.	152 W.
17	00	41	50**	West-central Argentina. Depth about 100 km		

See footnotes at end of table.

Table 3.—*Summary of instrumental epicenters for 1949*—Continued

1949	Origin time G. C. T.			Region, focal depth, and remarks	Coordinates of provisional epicenter	
					Latitude	Longitude
	h	*m*	*s*		° ′	° ′
Apr. 17	02	25	35*	Western Bolivia. Depth about 200 km	16 S.	69 W.
17	15	24	03*	Andreanof Islands, Aleutians	52 N.	175 W.
17	15	27	35*	....do	52 N.	175 W.
17	17	32	33**	Fiji Islands region		
18	21	34	49*	Samoa Islands region. Felt. Depth about 100 km. Mag. about 7	15½ S.	173½ W.
19	15	19	11*	Kurile Islands region. Depth slightly greater than normal. Mag. 6½	48 N.	154 E.
19	17	02	03*	Near west coast of Hokkaido, Japan. Felt	43½ N.	142 E.
19	17	59	53*	Solomon Islands. Depth slightly greater than normal	6 S.	154½ E.
20	03	29	01*	Central Chile. Destructive in Angol and Traiguen. 57 killed and extensive property damage. Depth 70 km. Mag. 7.4	38½ S.	72½ W.
22	01	02	36**	Easter Island region foreshock		
22	17	17	09*	South Pacific Ocean, 550 miles southeast of Easter Island	35 S.	113 W.
23	00	30	14*	Peru-Brazil border region	9 S.	73 W.
23	11	15	30*	Flores Sea. Mag. 7.1	7 S.	121 E.
24	04	22	14*	Persian Gulf near south coast of Iran. Depth about 100 km	27 N.	56 E.
25	05	03	00**	Prince Edward Island region		
25	13	54	56*	Northern Chile. Destructive. Depth about 100 km. Mag. 7.5	20½ S.	69½ W.
25	23	09	14*	Central Turkey	38 N.	18 E.
26	10	11	38*	Santa Cruz Island region. Depth about 60 km	11 S.	166 E.
27	04	17	26**	Western Venezuela		
28	01	30	07**	Off south coast of Sumatra		
28	23	35	14	West-central California. Felt. Depth about 10 km. Mag. 3.3	36 56 N.	121 48 W.
30	01	23	32*	Near south coast of Mindanao, Philippine Islands. Depth 130 km. Mag. 7.3	6 N.	125½ E.
30	03	08	21*	North Atlantic Ocean	27 N.	47 W.
May 2	00	26	08	Gulf of California. Mag. 4.1	31.8 N.	115.0 W.
2	11	24	58	Pinto Basin, California, foreshock. Mag. 4.0	34 01 N.	115 46 W.
2	11	25	47	Pinto Basin, Calif. Felt. Mag. 5.9	34 01 N.	115 41 W.
2	13	27	05	Pinto Basin, California, aftershock. Mag. 3.8	34 01 N.	115 41 W.
2	14	35	21	Pinto Basin, California, aftershock. Mag. 4.2	34 01 N.	115 41 W.
2	18	41	03	....do	34 01 N.	115 41 W.
3	05	56	44*	Kurile Islands region. Depth about 150 km. Mag. 7	49 N.	153½ E.
3	10	54	26**	Off east coast of Kamchatka. Depth slightly greater than normal		
3	14	51	31*	Kermadec Islands region	35 S.	179 W.
4	01	34	03	Cape Mendocino, Calif. Felt in Humboldt County. Mag. 4.1	40.4 N.	124.3 W.
4	05	59	01*	Atlantic Ocean, northeast of Brazil	9 N.	40 W.
6	08	31	00**	Near west coast of Hokkaido, Japan. Felt		
6	12	45	59*	Santa Cruz Islands. Depth about 100 km	11 S.	166 E.
6	14	30	12*	Lake Baikal region, U. S. S. R	54 N.	109½ E.
7	00	59	19**	Mariana Islands region. Depth about 100 km		
7	12	31	19**	Fiji Islands. Depth about 500 km		
7	13	01	52*	Northwestern Argentina. Felt in northern Chile. Depth about 200 km	23½ S.	66 W.
7	14	54	10*	Central South Dakota	44 N.	100 W.
8	21	24	21*	Northern Chile. Felt. Depth about 100 km. Mag. 6–¾	21½ S.	69 W.
9	08	35	11*	Sinkiang Province, China	41 N.	84 E.
9	13	36	17*	Northwest coast of Sumatra. Mag. 6–¾	4½ N.	95½ E.
10	00	24	38*	Off coast of Colima, Mexico. Mag. 6¼	19 N.	106 W.
10	03	12	30**	Colima, Mexico, aftershock		
10	04	06	33	Pinto Basin, California, aftershock. Mag. 4.7	34 01 N.	115 41 W.
10	14	11	11**	Fiji Islands region. Depth about 100 km		
10	21	18	40**	Pacific Ocean, south of Panama		
10	22	23	32*	Off coast of Vancouver Island, British Columbia	49½ N.	129 W
12	07	16	20**	Fox Islands, Aleutians		
12	10	18	40**	Sumatra aftershock		
13	02	19	34	Off Cape Mendocino, Calif. Mag. 4.3	40.7 N.	124.7 W.
13	07	15	48*	Off coast of eastern Greenland	69½ N.	16 W
13	10	18	31	Los Angeles, Calif. Felt. Mag. 3.7	34 00 N.	118 16 W.
13	20	14	03*	Northern Turkey. Felt	41 N.	32 E.
14	23	38	29*	Queen Charlotte Islands	53 N.	133 W.
15	06	27	27*	Solomon Islands	9 S.	160 E.
15	11	14	10**	New Britain region		
16	04	32	18**	Timor Sea		
17	02	29	53*	Kurile Islands region	48 N.	155 E.
17	04	02	10*	Western Argentina	34 S.	68 W.
17	06	24	33**	Near west coast of Peru. Felt		
17	22	37	45*	Loyalty Islands region	23 S.	172 E.
17	23	57	55	San Simeon, Calif. Felt. Mag. 4.1	35 38 N.	121 09 W.
20	08	12	40*	Fiji Islands region. Depth about 200 km	17 S.	177 W.
20	22	35	31	Off coast of southern California. Mag. 4.8	33 N.	126 W.
21	05	43	51*	Near coast of Peru	14½ S.	76½ W.
21	07	43	03*	Pacific Ocean, 550 miles northwest of Easter Island	23 S.	117 W.
21	21	40	03*	Off east coast of Honshu, Japan. Felt. Mag. 6¼	37 N.	142 E.
22	15	25	35*	Off coast of Peru	7 S.	81½ W.
22	23	21	27	Pinto Basin, California, aftershock. Mag. 4.0	34 01 N.	115 41 W.
23	01	47	30	Pinto Basin, California, aftershock. Mag. 3.9	34 01 N.	115 41 W.
23	04	17	36*	Kermadec Islands. Felt. Depth 70 km. Mag. 6½	30 S.	178 W.
23	05	24	10*	New Britain region. Depth about 50 km	6 S.	154 E.
23	11	33	00*	Off coast of Vera Cruz, Mexico. Depth about 100 km	19 N.	95 W.
24	11	51	52*	Easter Island region	21½ S.	112½ W.
24	13	49	41**	Colima, Mexico, foreshock		
24	16	20	17*	Off coast of Colima, Mexico. Depth about 100 km. Mag. 6½	18 N.	105½ W.
24	18	59	16*	Honshu, Japan, aftershock. Felt	37 N.	142 E.
25	00	34	48*	Off coast of eastern Greenland	69 N.	19 W.
25	08	23	48*	Sinkiang Province, China	42 N.	83 E.
25	17	31	46	Pinto Basin, California, aftershock. Mag. 4.5	34 01 N.	115 41 W.

See footnotes at end of table.

Table 3.—*Summary of instrumental epicenters for 1949*—Continued

1949	Origin time G. C. T.			Region, focal depth, and remarks	Coordinates of provisional epicenter					
					Latitude			Longitude		
	h	*m*	*s*		°	′		°	′	
May 26	05	10	00*	Off coast of Chile	29½		S.	72½		W.
26	06	23	20*	Azores region	37		N.	33		W.
26	09	37	54*	Samoa Islands region	12		S.	171½		W.
26	15	43	39	Pinto Basin, California, aftershock. Mag. 3.9	34	01	N.	115	41	W.
27	10	59	22*	Samoa Islands region. Depth about 60 km	16		S.	172		W.
28	16	01	17*	Santa Cruz Islands	11		S.	165		E.
30	00	01	13*	Near coast of Ecuador	2		N.	79½		W.
30	01	32	44*	Tarapaca Province, Chile. Depth about 100 km. Mag. 7	22		S.	69		W.
June 1	08	23	15*	Off coast of Washington	47½		N.	124½		W.
3	03	06	45**	Western South Dakota. Felt in Nebraska and South Dakota						
4	00	55	00**	Fiji Islands region. Depth about 600 km						
4	03	51	40**	About 400 miles north of Guam						
4	23	26	30*	Off north coast of Puerto Rico	19½		N.	67		W.
5	19	26	40**	Off southeast coast of Honshu, Japan. Depth about 200 km						
6	06	59	04**	Tonga Islands region. Depth slightly greater than normal						
6	12	22	43	Near Desert Hot Springs, Calif. Mag. 3.5	33	57	N.	116	30	W.
6	13	52	16**	New Hebrides region						
7	04	35	45**	Near south coast of Alaska						
7	05	24	20*	Off northeast coast of Kamchatka	57		N.	165		E.
8	05	00	54*	Central Alaska	63		N.	151		W.
9	09	33	22*	Western Wyoming	42½		N.	110		W.
9	10	49	10*	Off coast of Guatemala. Depth about 100 km	14½		N.	91		W.
9	21	18	47*	Samoa Islands region. Felt in Apia. Depth about 200 km	14½		S.	174		W.
10	19	06	39	West-central California. Felt in San Francisco and Hollister. Mag. 4.6	37	21	N.	121	37	W.
11	07	34	55*	Near west coast of Nicaragua. Depth about 100 km	12½		N.	87		W.
12	04	31	36*	Near east coast of Dominican Republic	19		N.	69		W.
12	17	52	26*	Northern Argentina. Depth about 650 km. Mag. 6.9	28		S.	63½		W.
12	17	55	53*	do	28		S.	63½		W.
13	01	58	58*	Northern Argentina aftershock. Depth about 650 km	28		S.	63½		W.
13	06	42	21**	Kurile Islands region						
14	00	21	14*	Bay of Bengal	12		N.	95½		E.
14	05	49	00*	Aleutian Islands region	52		N.	160		W.
15	01	47	25*	Aleutian Islands region. Depth about 100 km	51		N.	179		W.
15	07	10	31	Pinto Basin, California, aftershock. Mag. 3.9	34	01	N.	115	41	W.
16	03	47	34	Near Hollister, Calif. Felt. Mag. 3.9	36	45	N.	121	40	W.
16	06	24	28	Death Valley, Calif. Mag. 3.7	36	20	N.	116	50	W.
16	17	57	58**	Gulf of Aden, off south coast of Arabia						
17	01	34	50*	Atlantic Ocean, about 400 miles north of Ascension Island	3		S.	12½		W.
17	04	24	55*	Mediterranean Sea, about 100 miles east of Crete	34		N.	28		E.
19	12	24	14*	North Atlantic Ocean	23½		N.	45		W.
19	22	04	28*	Southern Alaska. Depth about 100 km	61		N.	150		W.
20	09	17	56**	About 300 miles west of Samoa Islands. Depth about 200 km						
22	13	04	45*	Near east coast of Dominican Republic	19		N.	69		W.
22	18	08	46	West-central California. Felt in San Jose, San Francisco, and San Mateo. Mag. 4.1	37	20	N.	121	41	W.
23	18	47	09**	Kurile Islands region						
23	22	27	15*	New Hebrides. Depth about 200 km. Mag. 5½–6¾	16½		S.	168		E.
24	16	03	03*	Samoa Islands. Felt at Apia	12½		S.	171½		W.
24	22	38	48*	Java Sea. Depth about 60 km. Mag. 7	5		S.	106½		E.
25	19	17	10**	Tonga Islands region						
26	01	35.4		Gulf of California. Mag. 4.3	32.1		N.	113.9		W.
26	05	42	24*	Northwestern Greece	40		N.	21		E.
26	08	41	16*	Celebes Island region. Mag. 6½	0			125		E.
26	14	07	10**	Off east coast of Kamchatka						
26	20	59	28**	do						
26	22	50	23**	do						
27	10	35	31	Central California. Felt in San Ardo and San Miguel. Mag. 5.3	35.8		N.	121.1		W.
28	20	08	29*	North Atlantic Ocean	24		N.	45		W.
30	02	37	46*	Tonga Islands region	18½		S.	173		W.
30	17	18	57*	Samoa Islands region. Felt	14½		S.	172½		W.

*Indicates probable error of $\frac{1}{10}$ minute.
**Indicates probable error of $\frac{1}{4}$ minute.

Table 4.—*Principal earthquakes of the world from January through December 1949*

[NOTE.—This table lists (1) the strongest shocks of the period as revealed by seismographic records, particularly those of the Western Hemisphere stations; (2) important destructive and near destructive earthquakes; (3) earthquakes of unusual interest outside the two preceding categories; and (4) magnitudes as determined by Pasadena.]

1949	Origin time G. C. T.			Region	Coordinates of provisional epicenter				Remarks
					Latitude		Longitude		
	h	*m*	*s*		° ′		° ′		
Jan. 13	08	47	34*	Fiji Islands region	25½	S.	178	E.	Depth 680 km.
23	06	31	13*	Indian Ocean	9½	S.	94½	E.	Depth about 100 km. Mag. 7–7¼.
Feb. 13	18	24	23*	Kermadec Islands region	33½	S.	178	W.	Depth about 60 km. Mag. 7.4.
23	16	08	07*	Sinkiang Province, China	41	N.	84	E.	Mag. 7.3.
Mar. 4	10	19	25*	Hindu Kush Range, Afghanistan	37	N.	70	E.	Destructive in West Punjab. Depth 230 km. Mag. 7.5.
16	22	15	08*	New Britain	6	S.	151½	E.	Depth about 60 km. Mag. 7.1.
Apr. 5	09	27	00*	Near Vladivostok, U. S. S. R	42	N.	131½	E.	Felt. Depth about 550 km. Mag. 6¾–7.
13	19	55	41	Near Olympia, Wash	47.1	N.	122.7	W.	Approximately 25 million dollars property damage in Seattle, Tacoma, and Olympia area. 8 killed and many injured. Depth slightly greater than normal. Mag. 7.1.
20	03	29	01*	Central Chile	38½	S.	72½	W.	Destructive at Angol and Traiguen. 57 killed. Depth 70 km. Mag. 7.4.
23	11	15	30*	Flores Sea	7	S.	121	E.	Mag. 7.1.
25	13	54	56*	Northern Chile	20½	S.	69½	W.	Damage at Iquique, Chile. Depth about 100 km. Mag. 7.5.
May 3	05	56	44*	Kurile Islands	49	N.	153½	E.	Depth about 150 km. Mag. 7.
30	01	32	44*	Tarapaca Province, Chile	22	S.	69	W.	Depth about 100 km. Mag. 7.
June 12	17	52	26*	Northern Argentina	28	S.	63½	W.	Depth 650 km. Mag. 6.9.
12	17	55	53*	do	28	S.	63½	W.	Do.
24	22	38	48*	Java Sea	5	S.	106½	E.	Depth about 60 km. Mg. 7.
July 10	03	53	35*	Eastern Turkistan	39½	N.	70½	E.	Mag. 7.7.
23	10	26	44*	New Hebrides Islands	19	S.	169½	E.	Depth about 150 km. Mag. 7.2.
23	15	03	30*	Near west coast of Turkey	38½	N.	26½	E.	Destructive in Izmer and Karaburun. 1 killed, several injured. Heavy roperty damage in Marmara an Kardamyea, northern part of Island of Chios, where 4 died and several hundred houses collapsed. Mag. 6¾.
Aug. 5	19	08	55*	Central Ecuador	1	S.	78	W.	Destructive at Ambato, Guano, Pelileo, Pa-l tate, and Pillaro. 4,000 to 6,000 killed. Approximately $7,500,000 proporty damage. Mag. 7.
6	00	35	33*	Tonga Islands region	18½	S.	175	W.	Depth about 60 km. Mag. 7.6.
17	18	44	13*	Eastern Turkey	39½	N.	40½	E.	Aga Kevy destroyed. Also destructive in Erzurum, Karilova, and Bingel. 320 killed. Mag. 6¾.
22	04	01	12*	Queen Charlotte Islands	54	N.	133	W.	Felt from Portland, Oreg., to southern Alaska. 2-foot tidal wave at Ketchikan, Alaska. Mag. 8.1.
Sept. 14	19	50	16*	Celebes Island region	1	N.	126	E.	Mag. 7.2.
20	11	55	29*	Kermadec Islands	30	S.	178	W.	Depth about 100 km. Mag. 6.9.
24	04	17	38*	Solomon Islands region	6	S.	153½	E.	Mag. 7.
27	15	30	43*	Near south coast of Alaska	60	N.	149	W.	Depth about 50 km. Felt at Anchorage. Mag. 7.
Oct. 7	12	02	19*	Indian Ocean, 700 miles southeast of Madagascar.	33	S.	56½	E.	Mag. 7.
19	21	00	17*	Solomon Islands	6	S.	154½	E.	Depth about 60 km. Sea wave of 2 feet recorded at Rabaul, New Britain. Mag. 7¼.
Nov. 17	01	19	52	Terminal Island, San Pedro Bay, California.	33 45	N.	118 15	W.	Damage exceeding $9,000,000 at 1,800-ft. level below surface where nearly 200 oil wells were damaged. Felt in Long Beach and San Pedro.
22	00	51	48*	Kermadec Islands region	28½	S.	178½	W.	Depth about 150 km. Mag. 7.4.
27	08	42	20*	Tonga Islands region	18½	S.	173	W.	Depth about 60 km. Mag. 7.2.
Dec. 10	19	16	04*	Pacific Ocean	4½	N.	128½	W.	Depth about 150 km. Mag. about 6.
17	06	53	23*	Southern Magellanes Province, 50 miles south of Punta Arenas.	51½	S.	70	W.	Destructive at Punta Arenas. 1 killed. Mag. 7¾.
17	15	07	48*	do	51½	S.	70	W.	Mag. 7¾.
25	23	24	52*	Honshu, Japan	36	N.	139	E.	Destructive in Honshu, Japan. 8 killed, 163 injured. Mag. 6¾.
27	23	57	13*	Sandwich Islands	59½	S.	21	W.	Mag. 7.2.
29	03	03	50*	Northern Luzon, Philippine Islands	17½	N.	121½	E.	Heavy property damage along northwest coast of Isabela Province and inor damage in Manila. 1 death from sea wave near Mercedes. Mag. 7.2.

*Indicates probable error of ½0 minute.

STRONG-MOTION SEISMOGRAPH RESULTS

INTRODUCTION

During 1932, the Coast and Geodetic Survey inaugurated a program of recording strong ground movements in the seismically active regions of the country to obtain basic data needed in the design of earthquake-resistant structures. Notes pertinent to this program will be found in the preceding issues of the *United States Earthquakes* series and in S. P. 201, *Earthquake Investigations in California, 1934–35.* The latter is much broader in scope than the former, and contains data on structural and ground vibrations with detailed descriptions of the various activities which comprise the seismological program as a whole. Additional descriptive material on strong-motion instruments and vibration meters will be found in S. P. 206, *Selection, Installation, and Operation of Seismographs.*

Interpretation of records.—The following analyses are based on the assumption of simple harmonic motion. This refers especially to the computation of displacement from accelerograph records. As most accelerograph records are of irregular character, and the character of the longer period waves is often obscured by the superposition of shorter period waves of relatively large amplitude, the estimates of displacement must be considered only rough approximations.

For the more important records, those involving destructive ground motions, the use of integration methods in computing velocity and displacement curves has become established practice. The accelerograms of the destructive Puget Sound earthquake of April 13, 1949, are of sufficient amplitude for analysis by integration. This project is nearing completion. An outline of the double integration process is published in the *Bulletin of the Seismological Society of America*, vol. 33, No. 1, January 1943, subsequently reprinted by the Coast and Geodetic Survey as S. P. 250, *The Determination of True Ground Motion From Seismograph Records.*

Following the listing of strong-motion records obtained during 1949 is table 6 which gives the earthquake locations, the distance and azimuth to the epicenter, and the maximum values of acceleration and displacement for each station. All displacement meter readings should be assumed as recorded maximum displacement and computed maximum acceleration.

Table 7 is a composite of strong-motion seismogram interpretations. In 1949 there were several records of weaker shocks and those recorded at distant stations on which the traces were too indefinite or on which there were no discernible motions. These records have been omitted from the table. The instruments at the Hollywood Storage Company, Los Angeles Chamber of Commerce, San Francisco Southern Pacific Building, and San Jose Bank of America are wired to start simultaneously.

In June 1948, a program of substituting unifilar suspensions in all accelerometers in place of the pivoted spindle type was completed for all instruments operating in the United States.

Units and instrumental constants.—Quantitative results are expressed in c. g. s. units; centimeters or millimeters for displacement; and centimeters per second for acceleration. It is sometimes desirable to express acceleration in terms of the acceleration of gravity, indicated by "g" which is equal to 980 cm/sec.^{2} For practical purposes it is only necessary to point off three decimal places to convert cm/sec.^{2} to "g."

Most of the instruments have been adjusted so that each will register the maximum acceleration to be expected on the particular type of geological formation beneath the instrument. The following expectable earthquake accelerations were used in determining the accelerograph sensitivities: (*a*) rock foundation, 25 percent of gravity, (*b*) conglomerate foundations, 40 percent of gravity, (*c*) alluvium, 70 percent of gravity, and (*d*) top floors of tall buildings, 100 to 200 percent of gravity. The four sensitivities may be roughly listed as 26, 19.5, 13, and 6.5 mm. per 0.1 g, respectively.

Sensitivity of the seismographs is expressed as the deflection of the trace, or light spot, in centimeters, for a constant acceleration of 100 cm/sec.^{2} This means that the seismometer pendulum is tilted sideways until the effective component of the earth's gravitational field is equal to 100 cm/sec.^{2} or practically 0.1 g.

The following are constants which may be used in converting c. g. s. units to the customary English units:

1 cm.=0.3937 in.=0.03281 ft.
1 cm/sec. =0.03281 ft/sec.
1 cm/sec.^{2} =0.03281 ft/sec.^{2}
1 cm. =10 mm.
0.1 g. =98 cm/sec.^{2}=3.215 ft/sec.^{2}
1 (statute) mile =1.609 km.

Damping ratio of the pendulum is the ratio between successive amplitudes when the pendulum oscillates under the influence of the damping force alone.

Seismogram illustrations.—Reproductions of records in this publication are tracings of the original records and must not be accepted as genuine copies. The tabulated instrumental constants refer to the original records. The tracings are reduced approximately in the ratio of 1.6:1, so that the same scales do not apply. They are intended to show the nature of the data rather than furnish a means through which the reader can make his own measurements. Those who desire true copies for critical study should make request to the Director of the Coast and Geodetic Survey, Washington 25, D. C.

Acceleration scales are indicated on the tracings of acceleration curves by two dots, the distance between them representing the equivalent of 100 cm/sec.^{2} when applied to the curves over which they appear. These dots provide a quick means for making auxiliary scales in cases where an investigator desires to make rough measurements on the published curves. The measurements of periods on records of this nature is dependent largely on the judgment of the person reading them and considerable latitude must be allowed in appraising their accuracy. The aim of such analyses is primarily to give a fair picture of the magnitudes of the various elements involved, and the figures tabulated should therefore not be used for important studies without first referring to the illustrations for some idea of the nature of the original records.

Table 5.—*List of shocks recorded and records obtained on strong-motion seismographs in 1949*

Date	Region and recording station	Records		
		Accelerograph	Displacement meter	Weed
Feb. 11	Southern California. Bishop	1		
	San Francisco Southern Pacific Building	2	1	
Mar. 4	Peru. Lima	1		
6	Peru. Lima	1		
9	Northern California. Hollister	1		
	Oakland City Hall	2		
	San Francisco Southern Pacific Building	2	1	
	San Francisco Sutter Building			2
	San Jose Bank of America	2		
13	Northern California. Hollister	1		
	San Francisco Southern Pacific Building	2	1	
Apr. 13	Puget Sound Basin. Olympia	1		
	Seattle	1		
May 2	Southern California. Colton	1	1	
	Hollywood Storage Company	3		
	Los Angeles Chamber of Commerce	2		
	Los Angeles Edison Building	1		
	Los Angeles Subway Terminal	2	1	
	Pasadena	1	1	
	San Bernardino			1
	Vernon	1		
	Westwood	1		
3	Northern California. Ferndale	1	1	
17	Peru. Lima	1		
June 9	Near San Jose. San Francisco Southern Pacific Building	2	1	
	San Jose Bank of America	2		
15	Near Hollister. Hollister	1		
Aug. 5	Central Ecuador. Quito	1		
Sept. 21	Southern Mexico. Guatemala City	1		
Oct. 22	Near Hollister. Hollister	1		
	San Francisco Southern Pacific Building	2	1	
Nov. 4	Lower California. El Centro	1		
	San Diego	1		
17	Terminal Island. Hollywood Storage Building	3		
	Los Angeles Subway Terminal	2	1	
Dec. 9	Southern California. Bishop	1		
22	Southern Mexico. Guatemala City	1		
	Total	50	10	3

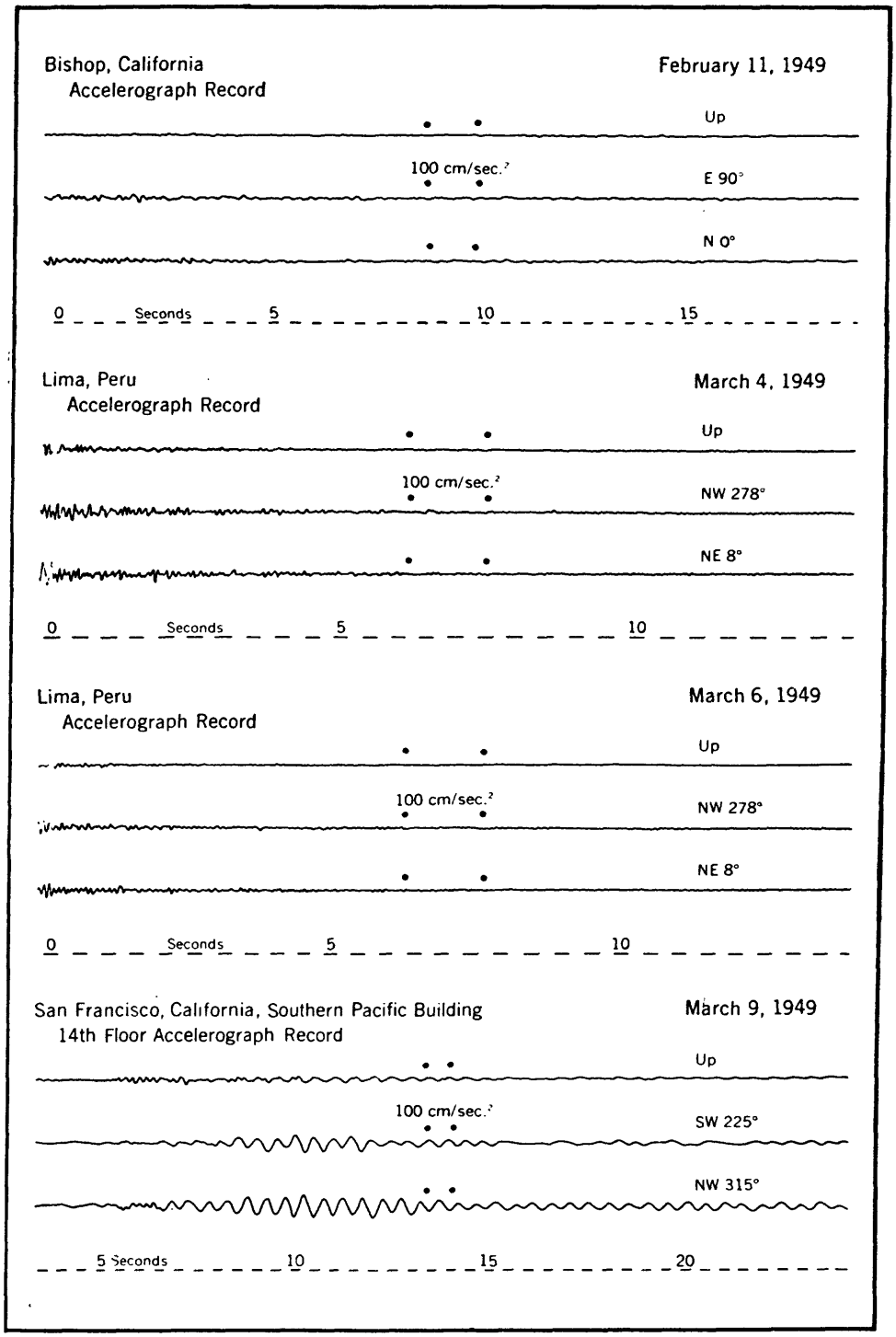

FIGURE 7.—*Tracings of accelerograph records obtained at Bishop on February 11, Lima on March 4 and 6, and San Francisco Southern Pacific Building 14th floor on March 9.*

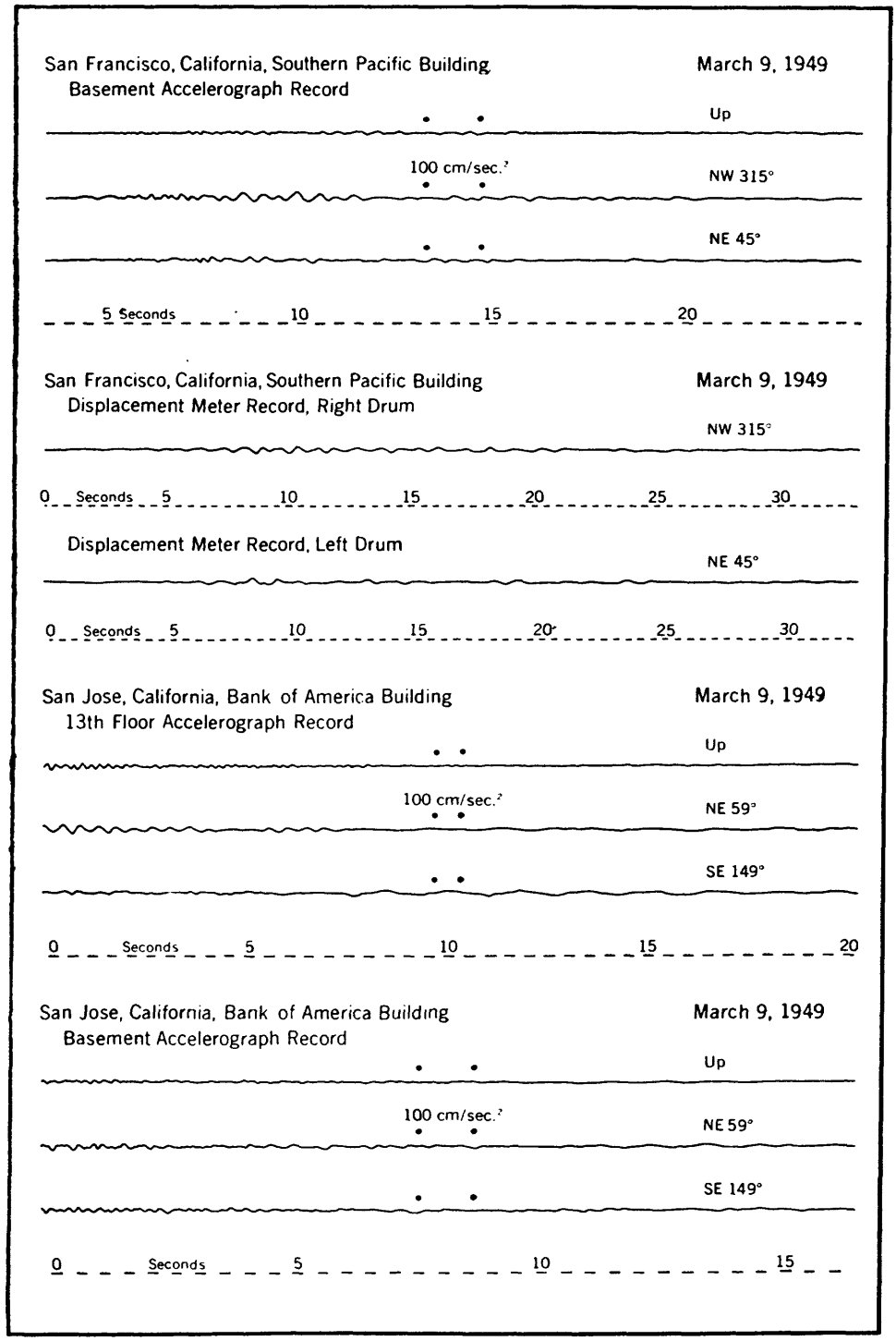

FIGURE 8.—*Tracings of accelerograph and displacement meter records obtained at San Francisco Southern Pacific Building basement, and accelerograph records obtained at San Jose Bank of America 13th floor and basement on March 9.*

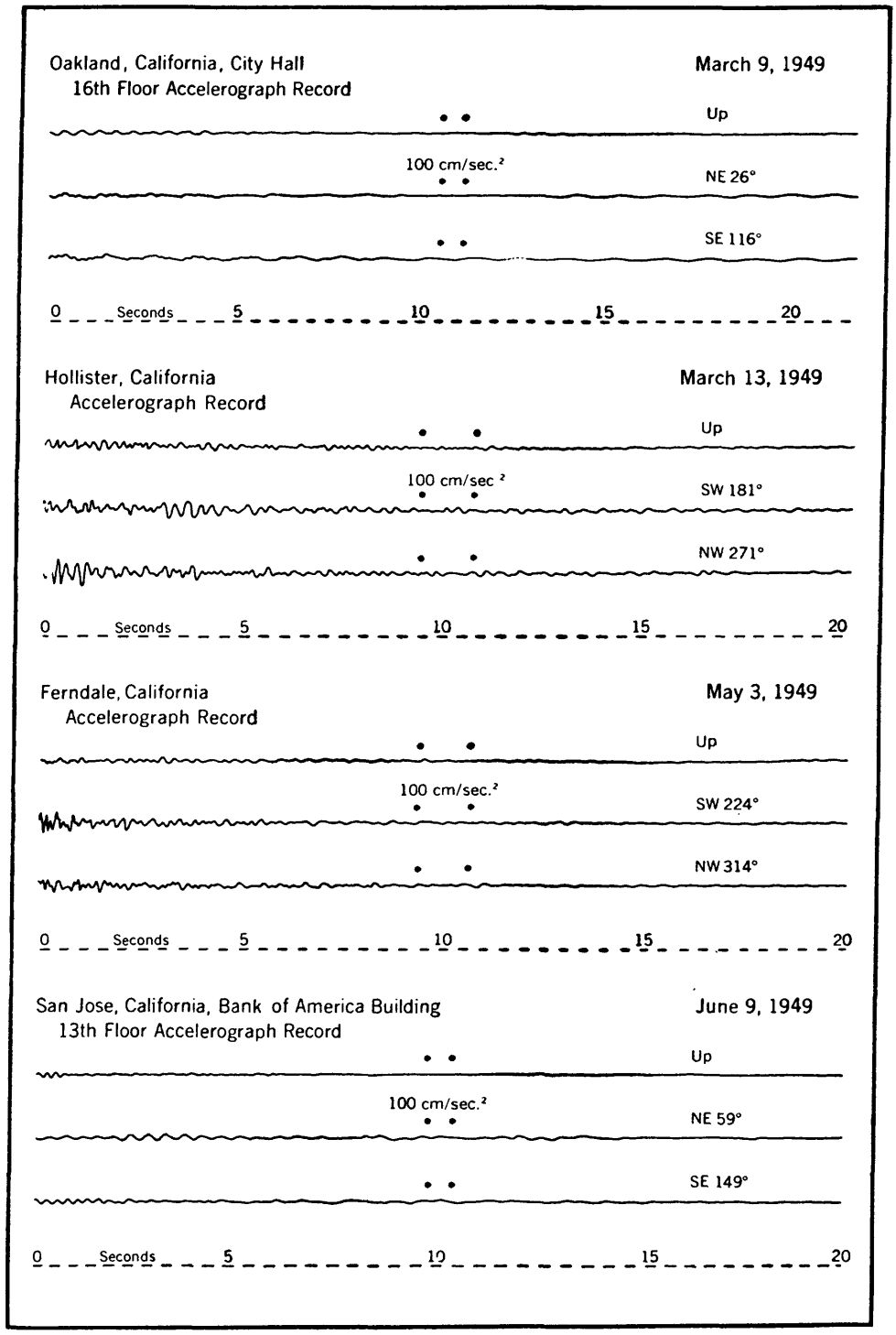

FIGURE 9.— *Tracings of accelerograph records obtained at Oakland City Hall on March 9, Hollister on March 13, Ferndale on May 3, and San Jose Bank of America 13th floor on June 9.*

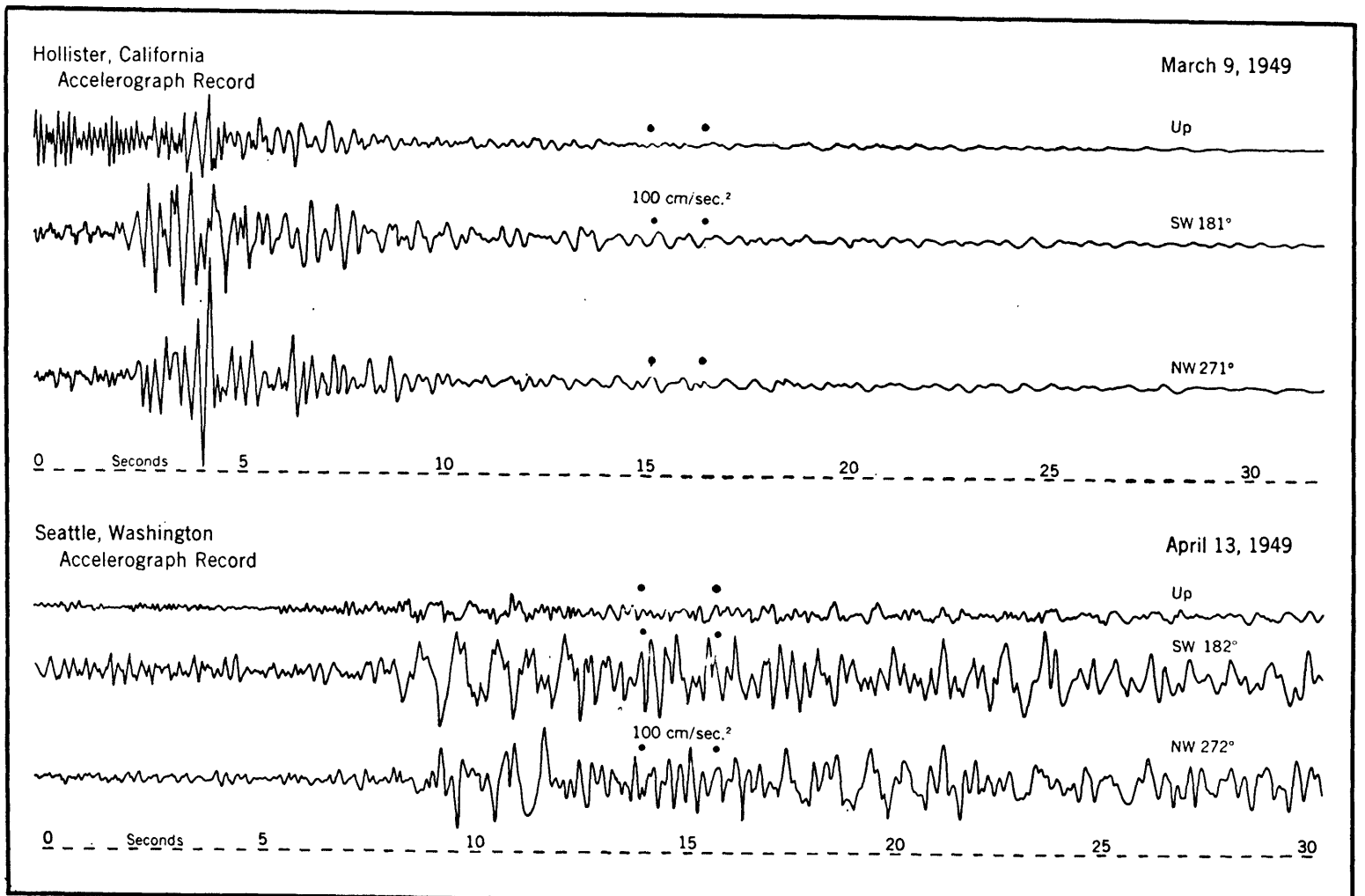

FIGURE 10.—*Tracings of accelerograph records obtained at Hollister on March 9 and Seattle on April 13.*

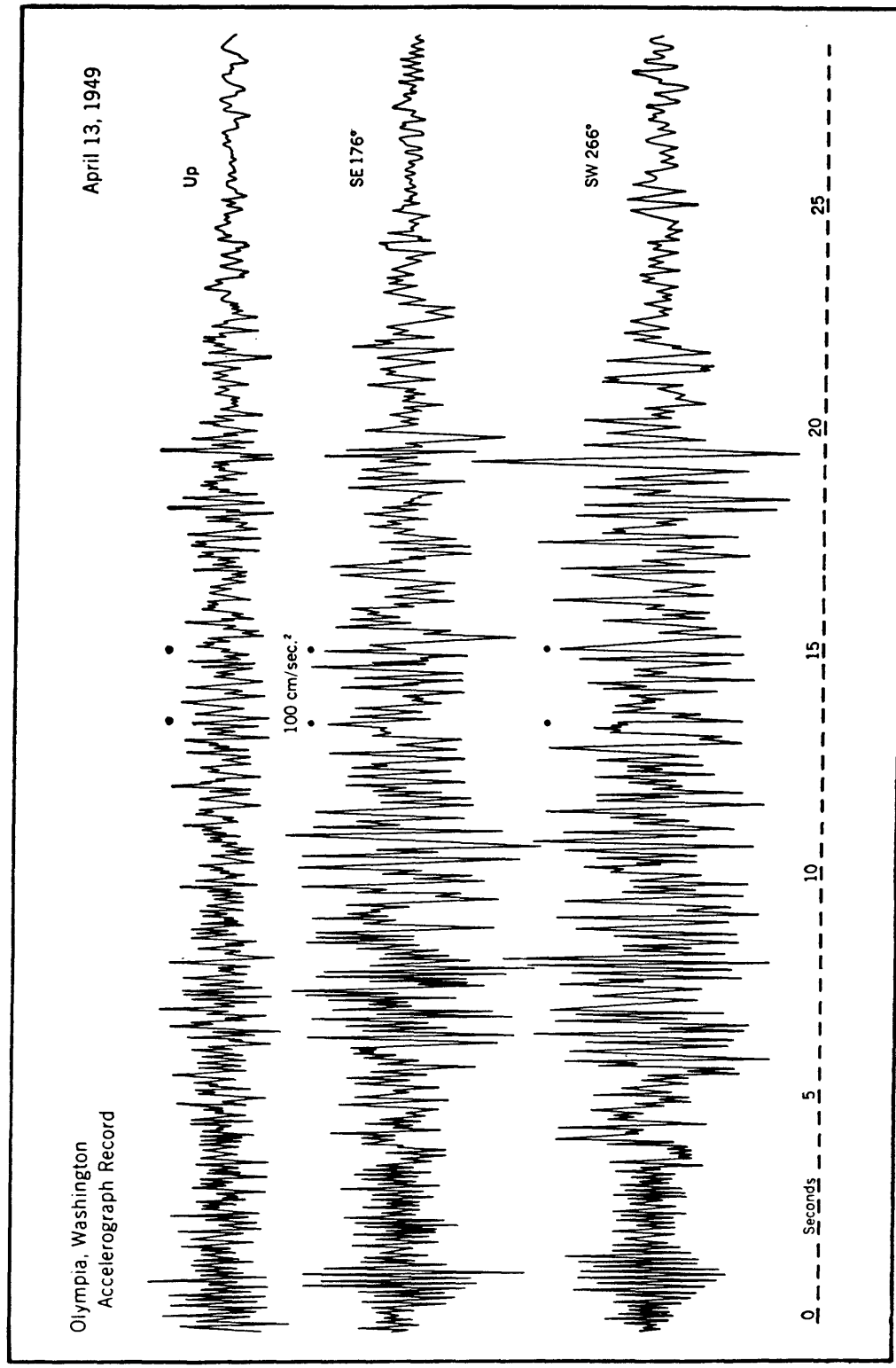

FIGURE 11.—*Tracings of accelerograph records obtained at Olympia on April 13.*

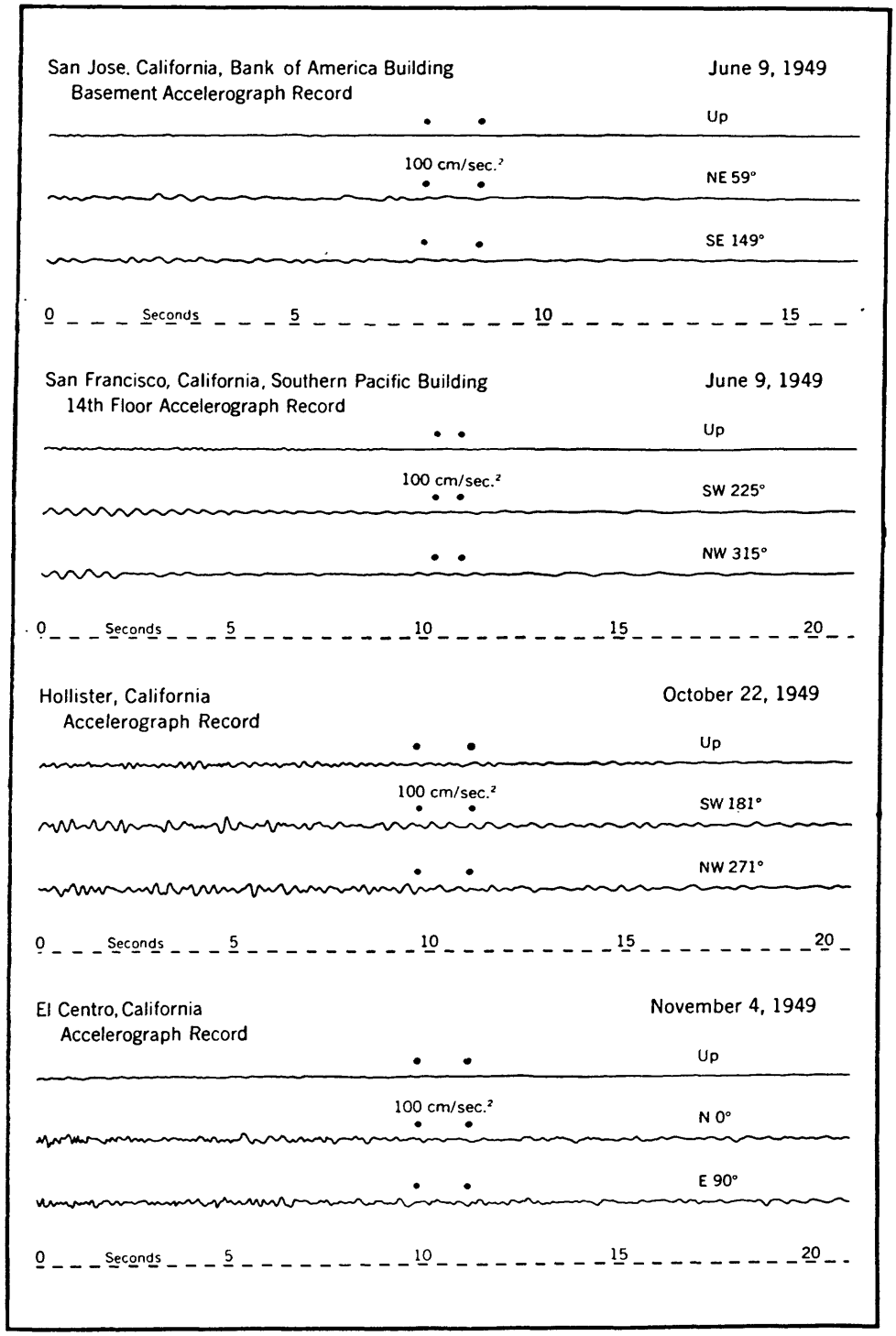

FIGURE 12.—*Tracings of accelerograph records obtained at San Jose Bank of America basement and San Francisco Southern Pacific Building 14th floor on June 9, Hollister on October 22, and El Centro on November 4.*

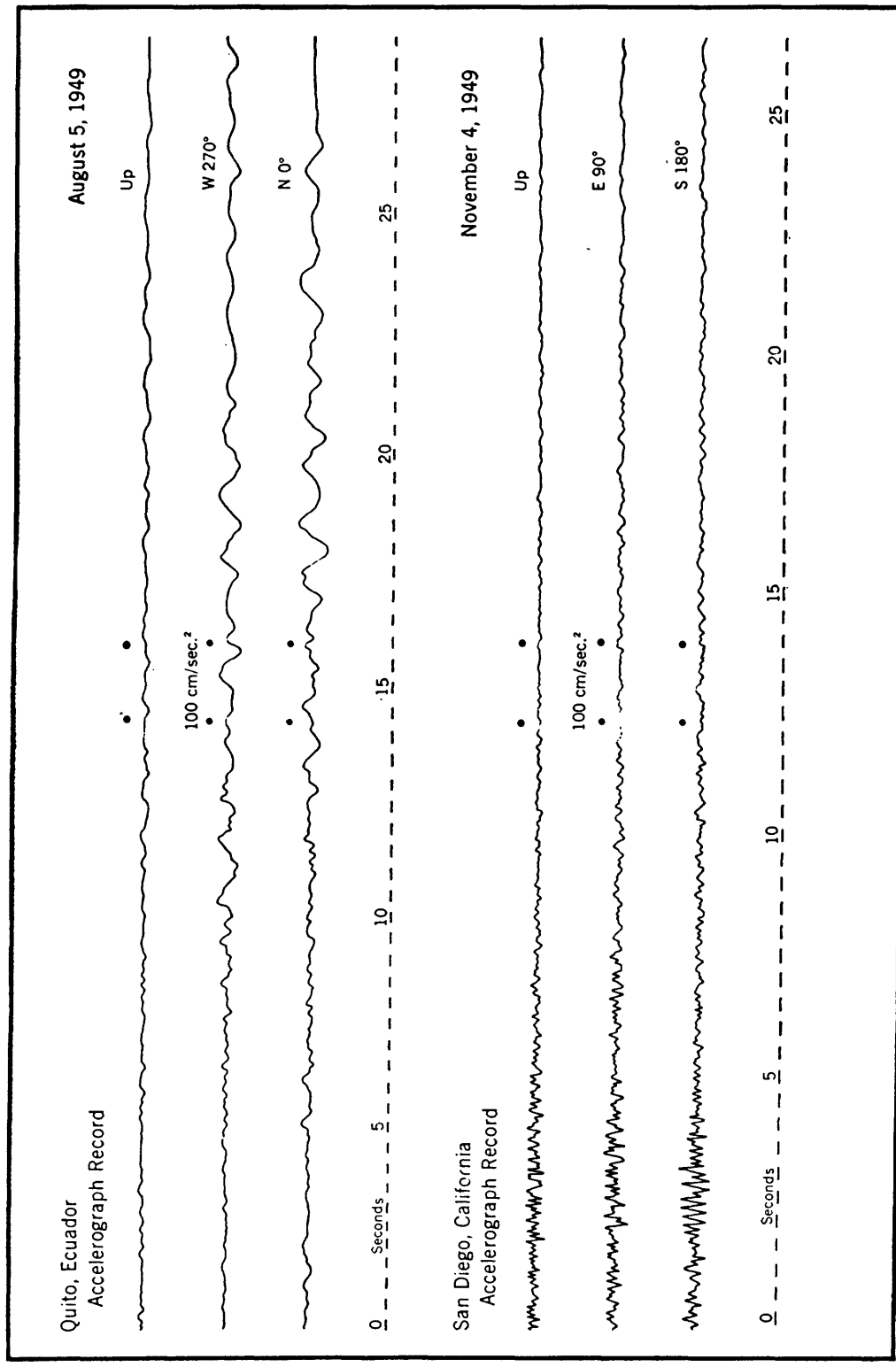

FIGURE 13.—*Tracings of accelerograph records obtained at Quito on August 5 and San Diego on November 4.*

Table 6.—*Summary of outstanding instrumental and noninstrumental data for 1949*

[All instruments are accelerographs unless otherwise noted]

Epicenter	Recording station and position [1]	Location of instrument	Intensity [2]	Maximum acceleration	Computed maximum displacement
				cm./sec.²	*cm.*
SOUTHERN CALIFORNIA EARTHQUAKE OF FEBRUARY 11					
37°05′ N., 117°45′ W., E. of Tinemaha, VI.*	Bishop, 40 miles NW. 297° (fig. 7)	1st floor	IV	8	0.007
	San Francisco, So. Pac. Bldg., 297 miles NW. 282°	14th floor		1	.033
PERUVIAN EARTHQUAKE OF MARCH 4					
	Lima (fig. 7)	1st floor		14	0.002
PERUVIAN EARTHQUAKE OF MARCH 6					
	Lima (fig. 7)	1st floor		7	0.001
NORTHERN CALIFORNIA EARTHQUAKE OF MARCH 9					
37°01′ N., 121°29′ W., VII*.	Hollister, 13 miles SE. 70° (fig. 10)	Basement	VII	191	0.408
	Oakland City Hall, 73 miles NW. 318° (fig. 9)	16th floor	VI	8	.246
		Basement		1	.001
	San Francisco, So. Pac. Bldg., 73 miles NW. 314° (figs. 7, 8).	14th floor	VI	41	.230
		Basement		8	.028
		DM [3]		12	.09
	San Francisco, Sutter Bldg., 73 miles NW. 314°	29th floor	VI	3	.050
	San Jose, Bank of America, 30 miles NW. 311° (fig. 8)	13th floor	VI	9	.514
		Basement		4	.009
NORTHERN CALIFORNIA EARTHQUAKE OF MARCH 13					
37°01′ N., 121°29′ W., VI*.	Hollister, 13 miles SE. 70° (fig. 9)	Basement	VI	21	0.026
	San Francisco, So. Pac. Bldg., 73 miles NW. 314°	14th floor	V	1	.004
		Basement		1	.004
PUGET SOUND BASIN EARTHQUAKE OF APRIL 13					
47.1° N., 122.7° W., between Olympia and Tacoma, VIII*.	Olympia, 10 miles SW. 247° (fig. 11)	1st floor	VIII	321	0.941
	Seattle, 38 miles NE. 26° (fig. 10)	do	VIII	75	.246
SOUTHERN CALIFORNIA EARTHQUAKE OF MAY 2					
34°01′ N., 115° 46′ W., Pinto Basin region, VI*.	Colton, 89 miles NW. 272°	1st floor		1	0.006
	Hollywood Storage Co., 148 miles NW., 272°	Penthouse		8	.047
		Basement		1	.017
		P. E. lot		1	.008
	Los Angeles C. of C., 143 miles NW. 271°	11th floor		10	.220
		Basement		1	.008
	Los Angeles Edison Bldg., 143 miles NW., 271°	do		1	.015
	Los Angeles Sub. Term., 143 miles NW., 271°	13th floor		7	.075
		Subbasement		1	.010
		DM [3]		7	.27
	Pasadena, 136 miles NW., 274°	Basement		1	.010
		DM [3]		8	.34
	Vernon, 139 miles SW., 268°	Basement		2	.016
	Westwood, 145 miles NW., 272°	do		1	.006
NORTHERN CALIFORNIA EARTHQUAKE OF MAY 3					
40.4° N., 124.3° W., V*.	Ferndale, 13 miles SW. 192° (fig. 9)	1st floor	V	18	0.013
		DM [3]		3	.01

See footnotes at end of table.

Table 6.—*Summary of outstanding instrumental and noninstrumental data for 1949*—Con.

Epicenter	Recording station and position [1]	Location of instrument	Intensity [2]	Maximum acceleration	Computed maximum displacement
PERUVIAN EARTHQUAKE OF MAY 17					
Near west coast of Peru, IV*.	Lima	1st floor	IV	15	0.024
SAN JOSE REGION EARTHQUAKE OF JUNE 9					
37°21′ N., 121°37′ W., E. of San Jose, VI*.	San Francisco, So. Pac. Bldg., 56 miles NW. 309° (fig. 12).	14th floor		19	0.098
		Basement		2	.005
		DM [3]		4	.09
	San Jose, Bank of America, 16 miles NW. 290° (figs. 9, 12).	13th floor	VI	14	.063
		Basement		6	.022
HOLLISTER EARTHQUAKE OF JUNE 15					
36°45′ N., 121°40′ W., IV*	Hollister, 17 miles NE. 64°	Basement		5	0.013
CENTRAL ECUADOR EARTHQUAKE OF AUGUST 5					
1° S., 78° W	Quito, 65 miles NW. 333° (fig. 13)	Basement		14	0.515
SOUTHERN MEXICO EARTHQUAKE OF SEPTEMBER 21					
17° N., 94½° W	Guatemala, 310 miles SE. 122°	Basement		1	0.014
HOLLISTER EARTHQUAKE OF OCTOBER 22					
36.6° N., 121.2° W., V*	Hollister, 21 miles NW. 327° (fig. 12)	Basement	V	16	0.056
	San Francisco, So. Pac. Bldg., 105 miles NW. 320°	14th floor		5	.112
		DM [3]		1	.02
LOWER CALIFORNIA EARTHQUAKE OF NOVEMBER 4					
32° N., 116½° W., VI*	El Centro, 78 miles NE. 44° (fig. 12)	1st floor	IV	9	0.035
	San Diego, 63 miles NW. 320° (fig. 13)	Basement	VI	17	.032
TERMINAL ISLAND EARTHQUAKE OF NOVEMBER 17					
33°45′ N., 118°15′ W., V* Terminal Island, San Pedro Bay.	Hollywood Storage Co., 24 miles NW. 346°	Penthouse		7	0.064
	Los Angeles Sub. Term., 21 miles NW. 359°	13th floor		4	.053
		DM [3]		1	.03
SOUTHERN CALIFORNIA EARTHQUAKE OF DECEMBER 9					
37°28′ N., 118°22′ W., V* North of Bishop.	Bishop, 9 miles NE. 9°	1st floor	V	6	0.004
SOUTHERN MEXICO EARTHQUAKE OF DECEMBER 22					
16° N., 93° W., Chiapas, Mexico.	Guatemala, 192 miles SE. 121°	Basement		2	0.021

*Following intensity designation indicates maximum reported intensity of earthquake.
[1] Position of station in respect to epicenter.
[2] Reported intensity of earthquake at recording station.
[3] All displacement meter readings should be assumed as recorded maximum displacement and computed maximum acceleration.

Table 7. *Composite of strong-motion instrumental data for 1949*

[See the text preceding this table for additional details]

SOUTHERN CALIFORNIA EARTHQUAKE OF FEBRUARY 11

Station and component*	Instr. No.	T_o	V	Sensitivity	ϵ	Earth-wave period	Max. Accel.	Max. Displ.	Remarks
		sec.		*cm.*		*sec.*	*cm/sec.*†	*cm.*	
Bishop, 1st floor:									
Vertical-up	V-241	0.066	119	1.31	7	0.14	2	0.001	Irregular waves at beginning.
						.25	1	.002	
E. 90°	L-242	.066	119	1.30	6	.16	8	.005	Sinusoidal wave.
						.24	3	.004	
						.38	2	.007	Long-period wave.
N. 0°	T-243	.065	118	1.24	6	.14	8	.004	(1).
						.16	5	.003	Irregular waves.
						.23	2	.003	
SF So. Pac. Bldg. 14th floor:									
Vertical-up	V-184	.047	116	.64	10	----	----	----	Very weak record.
SW. 225°	L-183	.046	122	.66	10	1.00	1	.025	Sinuosidal long-period waves.
NW. 315°	T-182	.046	126	.67	9	1.15	1	.033	Do.

PERU EARTHQUAKE OF MARCH 4

Lima: 1st floor:									
Vertical-up	V-7	0.097	84	2.03	12	0.07	8	0.001	(1).
						.07	5	.001	
						.14	1	.001	Sinusoidal waves.
NW. 278°	L-2	.096	84	1.98	7	.08	11	.002	Irregular waves.
						.08	3	.001	
						.05	4	.001	
NE. 8°	T-17	.099	81	2.00	4	.08	15	.002	(1).
						.08	8	.001	
						.07	3	.001	

PERU EARTHQUAKE OF MARCH 6

Lima, 1st floor:									
Vertical-up	V-7	0.097	84	2.03	12	0.08	3	0.001	Sinusoidal waves.
						.06	2	.001	
NW. 278°	L-2	.096	84	1.98	7	.08	7	.001	(1).
						.06	3	.001	
NE. 8°	T-17	.099	81	2.00	4	.09	7	.001	Sinusoidal waves.
						.08	5	.001	
						.07	1	.001	

NORTHERN CALIFORNIA EARTHQUAKE OF MARCH 9

Hollister basement									
Vertical-up	V-238	0.068	117	1.37	4	0.15	46	0.026	Sinusoidal waves.[1]
						.15	49	.028	
						.22	75	.090	
						.26	38	.065	Irregular waves.
						.84	6	.108	Short-period waves superposed.
SW. 181°	L-239	.066	122	1.34	5	.13	11	.005	(1).
						.29	98	.209	Strong wave.
						.32	120	.312	Do.
						.38	60	.220	
						.83	8	.140	Irregular waves.
W. 271°	T-240	.066	123	1.35	6	.18	17	.014	Short-period wave superposed.
						.26	71	.122	
						.29	191	.408	Very strong wave.
						.27	74	.137	Sinusoidal wave.
						.40	7	.028	
Oakland City Hall 16th floor.									
Vertical-up	V-226	.046	116	.61	9	.45	8	.041	Irregular waves.
						.41	5	.021	
NE. 26°	L-227	.047	110	.60	15	.74	5	.070	Short-period waves superposed.
SE. 116°	T-228	.047	111	.62	8	1.10	8	.246	Do.
						1.21	3	.111	
Basement:									
Vertical-down	V-235	.066	129	1.42	11	.03	1	.001	Weak record.
SW. 206°	L-236	.066	123	1.35	17	----	----	----	
NW. 296°	T-237	.067	118	1.35	15	.04	1	.001	
SF So. Pac. Bldg., 14th floor:									
Vertical-up	V-184	.047	116	.64	10	.19	8	.007	Regular waves.
						.40	9	.037	Short-period waves superposed.
SW. 225°	L-183	046	122	.66	10	.48	23	.135	Sinusoidal waves.
						.46	14	.075	
NW. 315°	T-182	.046	126	.67	9	.47	41	.230	Do.
						.47	12	.067	

See footnotes at end of table.

Table 7.—*Composite of strong-motion instrumental data for 1949*—Continued

NORTHERN CALIFORNIA EARTHQUAKE OF MARCH 9—continued

Station and component*	Instr. No.	T_o	V	Sensitivity	ε	Earth-wave period	Max. Accel.	Max. Displ.	Remarks
		sec.		*cm.*		*sec.*	*cm/sec.²*	*cm.*	
Basement:									
Vertical-up	V-196	0.068	122	1.42	9	0.16	1	0.001	Weak record.
						.36	1	.003	
NW. 315°	L-195	.067	120	1.36	6	.37	8	.028	Irregular waves.
						.65	1	.011	
NE. 45°	T-194	.067	121	1.38	8	.39	4	.015	Do.
						.46	2	.011	
RDM NW. 315°	R-18	9.9	1		11	.56	12	.09	
LDM NE. 45°	L-18	9.5	1		19	.86	1	.02	Weak record.
SF Sutter Bldg. 29th floor Weed:									
NE. 81°	R-1	.189	7.79	.704	11	.32	3	.008	
						1.40	1	.050	
NW. 351°	L-1	.189	7.90	.716	8				Very weak irregular motion.
San Jose Bank of America, 13th floor:									
Vertical-up	V-175	.046	117	.64	8	.17	9	.007	Regular wave.
						.17	6	.004	
NE. 59°	L-174	.046	120	.63	9	.42	6	.027	Do.
						1.55	4	.244	
SE. 149°	T-173	.047	118	.64	7	1.50	9	.514	Long-period waves.
Basement:									
Vertical-up	V-202	.067	124	1.42	9	.17	2	.002	Irregular waves.
						.15	1	.001	
NE. 59°	L-201	.066	122	1.36	11	.17	4	.003	Do.
						.28	1	.002	
SE. 149°	T-200	.067	122	1.38	10	.22	3	.004	Do.
						.41	2	.009	

NORTHERN CALIFORNIA EARTHQUAKE OF MARCH 13

Hollister Basement:									
Vertical-up	V-238	0.068	117	1.38	4	0.22	10	0.012	Irregular wave.
						.26	5	.009	
SW. 181°	L-239	.066	121	1.34	5	.28	13	.026	Sinusoidal waves.
						.32	8	.021	
NW. 271°	T-240	.066	123	1.36	7	.28	5	.010	
						.20	21	.021	(1).
						.22	13	.016	
						.29	5	.011	
SF So. Pac. Bldg. 14th floor:									
Vertical-up	V-184	.047	116	.64	10	.29	1	.002	Weak record.
SW. 225°	L-183	.046	122	.66	10	.36	1	.003	Do.
NW. 315°	T-182	.046	126	.67	9	.42	1	.004	Sinusoidal waves.
Basement:									
Vertical-up	V-196	.068	122	1.42	9				Very weak record.
NW. 315°	L-195	.067	120	1.36	6	.41	1	.004	
NE. 45°	T-194	.067	121	1.38	8				Do.
RDM NW. 315°	R-18	9.9	1		11				Do.
LDM NE. 45°	L-18	9.5	1		19				Do.

PUGET SOUND BASIN EARTHQUAKE OF APRIL 13

Olympia 1st floor:									
Vertical-up	V-307	0.079	114	1.83	10	0.10	107	0.027	Very strong sinusoidal waves.
						.15	72	.041	Short-period waves superposed.
						.19	55	.050	
						.11	94	.028	
						.28	43	.086	
SE. 176°	L-308	.077	123	1.87	9	.13	119	.051	Sinusoidal waves.
						.18	131	.107	
						.41	171	.720	Maximum trace amplitude.
						.30	145	.332	
						.14	103	.051	
SW. 266°	T-309	.080	118	1.91	9	.14	98	.049	
						.24	98	.145	Short-period waves superposed.
						.17	201	.147	Second largest trace amplitude.
						.13	145	.069	
						.28	120	.240	Irregular waves.
						.34	321	.941	Maximum trace amplitude.
						.27	42	.078	
Seattle, 1st floor:									
Vertical-up	V-304	.080	115	1.87	7	.11	6	.002	Sinusoidal waves.
						.10	8	.002	
						.63	13	.130	Transverse wave with short-period waves superposed.
						.27	14	.026	
SW. 182°	L-305	.081	113	1.89	9	.20	17	.017	
						.88	59	.116	Transverse waves.
						.21	46	.051	
						.31	40	.098	

See footnotes at end of table.

Table 7.—*Composite of strong-motion instrumental data for 1949*—Continued

PUGET SOUND BASIN EARTHQUAKE OF APRIL 13—continued

Station and component*	Instr. No.	T_o	V	Sensitivity	ϵ	Earth-wave period	Max. Accel.	Max. Displ.	Remarks
		sec.		*cm.*		*sec.*	*cm/sec.²*	*cm.*	
Seattle, 1st floor:									
NW. 272°	T-306	0.082	116	1.92	8	0.09	2	0.001	Weak initial motion.
						.21	7	.008	
						.36	75	.246	Irregular transverse wave.
						.27	43	.080	
						.29	64	.139	Irregular wave.
SOUTHERN CALIFORNIA EARTHQUAKE OF MAY 2									
Colton, 1st floor:									
Vertical-up	V-253	0.064	111	1.14	10	0.48	1	0.006	Weak 0.15 sec. waves superposed
E. 90°	L-254	.065	126	1.33	10	.42	1	.005	Weak irregular waves.
S. 180°	T-255	.064	126	1.30	8	.26	1	.002	
						.36	1	.003	
Holly. Stor. Co. Penthouse:									
Vertical-up	V-193	.046	122	.65	8				Very weak record.
S. 180°	L-192	.047	126	.70	11	.66	4	.044	Long-period waves.
W. 270°	T-191	.046	131	.69	24	.48	8	.047	Do.
Basement:									
Vertical-up	V-217	.065	126	1.36	7				Very weak record.
E. 90°	L-216	.067	120	1.35	7	.55	1	.008	
S. 180°	T-215	.064	125	1.31	10	.82	1	.017	
P. E. Lot:									
Vertical-up	V-214	.065	123	1.32	10				Do.
E. 90°	L-213	.066	123	1.34	9	.56	1	.008	
S. 180°	T-212	.066	126	1.39	11	.51	1	.007	
LA C of C, 11th floor:									
Vertical-up	V-187	.046	117	.63	13				Do.
SW. 218°	L-186	.045	122	.64	15	.93	10	.220	
NW. 308°	T-185	.046	126	.66	9	1.00	8	.203	
Basement:									
Vertical-up	V-205	.064	112	1.15	13				Do.
NE. 36°	L-204	.064	128	1.34	14	.55	1	.008	
SE. 126°	T-203	.065	128	1.39	12	.44	1	.005	
LA Edison Bldg. basement:									
Vertical-up	V-268	.066	118	1.31	9				Do.
SW 218°	L-269	.067	120	1.35	8				Do.
NW. 308°	T-270	.067	120	1.36	7	.76	1	.015	
LA Sub. Term. 13th floor:									
Vertical-up	V-190	.046	123	.66	10				
SW. 218°	L-189	.046	126	.67	12	.65	7	.075	Long-period waves.
NW. 308°	T-188	.046	129	.68	11	.68	4	.047	Do.
Sub-basement:									
Vertical-up	V-211	.065	124	1.34	9				Do.
SE. 128°	L-210	.064	125	1.31	8	.64	1	.010	Do.
SW. 218°	T-209	.065	127	1.34	10	.64	1	.010	
RDM NE. 38°	R-15	9.93	1		10	1.27	7	.27	
LDM SE. 128°	L-15	10.34	1		10	1.20	7	.27	
Pasadena:									
Vertical-up	V-325	.082	121	2.05	9	.64	1	.010	
S. 180°	L-326	.079	120	1.91	7	.41	1	.004	
W. 270°	T-327	.081	121	2.00	5	.53	1	.007	
RDM N. 0°	R-7	9.71	1		9	1.30	8	.34	
LDM E. 90°	L-7	9.67	1		8	1.05	7	.18	
Vernon:									
Vertical-up	V-256	.065	124	1.34	7	.52	1	.007	
SW. 187°	L-257	.065	128	1.36	6	.57	2	.016	Weak irregular motion.
NW. 277°	T-258	.065	129	1.38	7	.26	2	.003	Do.
						.42	2	.009	
Westwood:									
Vertical-up	V-262	.065	120	1.27	6				Very weak record.
S. 180°	L-263	.065	122	1.29	10				Do.
W. 270°	T-264	.065	118	1.26	10	.50	1	.006	Do.
NORTHERN CALIFORNIA EQRTHQUAKE OF MAY 3									
Ferndale:									
Vertical-up	V-247	0.063	121	1.32	12	0.15	5	0.003	
						.21	7	.008	
SW. 224°	L-248	.066	130	1.44	10	.15	18	.010	(1).
						.19	10	.005	
						.34	2	.006	
NW. 314°	T-249	.064	119	1.25	11	.11	9	.003	(1).
						.25	8	.013	
						.32	3	.008	
RDM SE. 134°	R-13	9.9	1		10	.51	1	.01	Irregular waves.
						.40	3	.01	
LDM SW. 224°	L-13	9.9	1		12	.57	1	.01	Do.
						.72	1	.01	

See *footnotes at end of table.*

Table 7.—*Composite of strong-motion instrumental data for 1949*—Continued

Station and component*	Instr. No.	T_o	V	Sensitivity	ϵ	Earth-wave period	Max. Accel.	Max. Displ.	Remarks
		sec.		*cm.*		*sec.*	*cm/sec.²*	*cm.*	
PERU EARTHQUAKE OF MAY 17									
Lima:									
Vertical-up	V-7	0.097	84	2.03	12	0.06	6	0.005	Small wave.
NW. 278°	L-2	.096	84	1.98	7	.08	15	.024	Sinusoidal waves.
NE. 8°	T-17	.099	81+	2.0+	4	.08	8	.013	Irregular waves.
SAN JOSE REGION EARTHQUAKE OF JUNE 9									
SF So. Pac. Bldg. 14th floor:									
Vertical-up	V-184	0.047	116	.64	10	0.16	2	0.001	
SW. 225°	L-183	.047	122	.66	9	.43	19	.089	Sinusoidal waves.
						.88	4	.079	
NW. 315°	T-182	.046	126	.68	9	.47	14	.078	Do.
						.88	5	.098	
Basement:									
Vertical-up	V-196	.068	122	1.42	8	.18	1	.001	Weak record.
NW. 315°	L-195	.067	120	1.35	6	.21	1	.001	
NE. 45°	T-194	.067	121	1.38	9	.33	2	.005	Irregular waves.
						.20	1	.001	
RDM NW. 315°	R-18	9.9	1		11	1.04	4	.09	
LDM NE. 45°	L-18	9.7	1		18	1.04	4	.09	
San Jose Bank of America, 13th floor:									
Vertical-up	V-175	.046	117	.64	8	.17	10	.007	
NE. 59°	L-174	.046	120	.64	8	.42	14	.063	Sinusoidal waves.
						.41	5	.021	
SE. 149°	T-173	.047	118	.65	7	.24	6	.009	Do.
						.61	2	.019	
Basement:									
Vertical-up	V-202	.068	124	1.43	9	.22	1	.001	Weak irregular waves.
NE. 59°	L-201	.066	122	1.36	10	.38	6	.022	
						.38	1	.004	
SE. 149°	T-200	.067	122	1.40	10	.25	4	.006	(1).
						.33	3	.008	
						.51	1	.007	Irregular long-period waves.
HOLLISTER EARTHQUAKE OF JUNE 15									
Hollister:									
Vertical-up	V-238	0.068	117	1.36	8	0.21	1	0.001	Irregular waves.
SW. 181°	L-239	.066	123	1.34	6	.32	5	.013	Do.
						.32	1	.003	
NW. 271°	T-240	.066	123	1.35	11	.25	2	.003	
						.47	2	.011	
CENTRAL ECUADOR EARTHQUAKE OF AUGUST 5									
Quito:									
Vertical-up	V-132	0.097	81	1.9	7	0.22	3	0.004	(1).
						.52	3	.019	Irregular long-period waves.
						.73	5	.068	
W. 270°	L-127	.098	82	2.0	11	.51	3	.020	Short-period waves superposed.
						1.25	13	.515	
						.83	6	.105	
N. 0°	T-128	.098	84	2.0	7	.38	4	.015	Very irrregular waves at beginning.
						.35	7	.022	
						.85	10	.184	
						1.00	14	.356	
SOUTHERN MEXICO EARTHQUAKE OF SEPTEMBER 21									
Guatemala City:									
Vertical-up	V-138	0.100	80	2.04	10	0.75	1	0.014	Weak record.
SW. 194°	L-136	.101	81	2.11	7	.60	1	.009	
NW. 284°	T-137	.097	80	1.89	7	.70	1	.012	
HOLLISTER EARTHQUAKE OF OCTOBER 22									
Hollister:									
Vertical-up	V-238	0.068	117	1.38	8	0.17	6	0.004	Sinusoidal waves.
						.41	3	.013	
SW. 181°	L-239	.066	123	1.34	7	.25	10	.016	(1).
						.37	16	.056	Single sinusoidal wave.
						.40	3	.012	
NW. 271°	T-240	.066	123	1.35	12	.25	11	.018	
						.30	13	.030	Sinusoidal waves.
						.55	6	.046	Weak long-period waves.

See footnotes at end of table.

Table. 7—*Composite of strong-motion instrumental data for 1949*—Continued

HOLLISTER EARTHQUAKE OF OCTOBER 22—Continued

Station and component*	Instr. No.	T_o	V	Sensitivity	ϵ	Earth-wave period	Max. Accel.	Max. Displ.	Remarks
		sec.		*cm.*		*sec.*	*cm/sec.²*†	*cm.*	
SF So. Pac. Bldg., 14th floor:									
Vertical-up	V-184	0.047	116	0.64	10				Very weak record.
SW. 225°	L-183	.047	122	.66	9	.48	5	.029	
NW. 315°	T-182	.046	126	.68	9	.52	4	.027	
						1.05	4	.112	
RDM NW. 315°	R-18	9.9	1		11	.75	1	.02	
LDM NE. 45°	L-18	9.7	1		18	.98	1	.02	
LOWER CALIFORNIA EARTHQUAKE OF NOVEMBER 4									
El Centro:									
Vertical-up	V-208	0.064	121	1.27	8	0.19	3	0.003	Weak record.
						.52	3	.020	
N. 0°	L-206	.064	123	1.28	8	.12	8	.003	Irregular wave.
						.27	6	.010	
						.48	6	.035	
E. 90°	T-207	.065	122	1.30	5	.11	8	.002	(1).
						.28	9	.018	
						.44	3	.015	Irregular long-period waves.
San Diego:									
Vertical-up	V-322	.081	124	2.05	7	.06	6	.001	(1).
						.11	12	.004	
						.26	4	.007	Irregular long-period waves.
E. 90°	L-323	.080	123	1.98	7	.09	13	.003	Very irregular motion.
						.34	11	.032	
						.40	4	.016	
S. 180°	T-324	.080	122	1.98	8	.15	9	.005	(1).
						.12	17	.006	Sinusoidal group of waves.
						.11	11	.003	
						.36	4	.013	Irregular long-period waves.
TERMINAL ISLAND EARTHQUAKE OF NOVEMBER 17									
Holly. Stor. Bldg. Penthouse:									
Vertical-up	V-193	0.046	122	0.65	8				Very weak record.
S. 180°	L-192	.047	126	.70	11	0.60	7	0.064	Long-period waves.
W. 270°	T-191	.046	131	.69	24	.48	6	.035	Do.
LA Sub. Term. 13th floor:									
Vertical-up	V-190	.046	123	.66	9				Very weak record.
SW. 218°	L-189	.046	126	.68	11	.72	4	.053	Long-period waves.
NW. 308°	T-188		129		11	.50	3	.019	Do.
RDM NE. 38°	R-15	10.0	1		11	1.65	1	.02	
LDM SE. 128°	L-15	10.5	1		12	1.80	1	.03	
SOUTHERN CALIFORNIA EARTHQUAKE OF DECEMBER 9									
Bishop:									
Vertical-up	V-241	0.066	119	1.31	7	0.21	2	0.002	Weak irregular waves.
E. 90°	L-242	.066	119	1.30	6	.14	4	.002	Do.
						.20	4	.004	
						.10	6	.001	
S. 180°	T-243	.065	118	1.24	6	.20	3	.003	(1).
						.13	5	.002	
						.14	5	.002	
SOUTHERN MEXICO EARTHQUAKE OF DECEMBER 22									
Guatemala:									
Vertical-up	V-138	0.101	80	2.07	10	0.68	1	0.012	Long-period waves.
SW. 194°	L-136	.102	81	2.15	7	.34	2	.006	
						.64	2	.021	Do.
NW. 284°	T-137	.097	80	1.91	7	.26	1	.002	
						.49	2	.012	Do.

*The directions given indicate the direction of pendulum displacement relative to instrument pier, which will displace the trace upward on the original seismogram. Directions for the horizontal components are given first by quadrant followed by specific directions expressed in degrees measured from north around by east.

†Assumed values.

‡ Possibly preceded by stronger motion at beginning.

TILT OBSERVATIONS

Two tiltmeters at Berkeley and one at Long Beach were continued in operation in cooperation with the University of California and the Long Beach Engineering Department, respectively.

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