DEPARTMENT OF THE INTERIOR

U.S. GEOLOGICAL SURVEY

# United States Earthquakes, 1947

BY

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Open-File report 84-947

Prepared in cooperation with National Oceanic and Atmospheric Administration.

This report has not been reviewed for conformity with U.S. Geological Survey editorial standards.

1984

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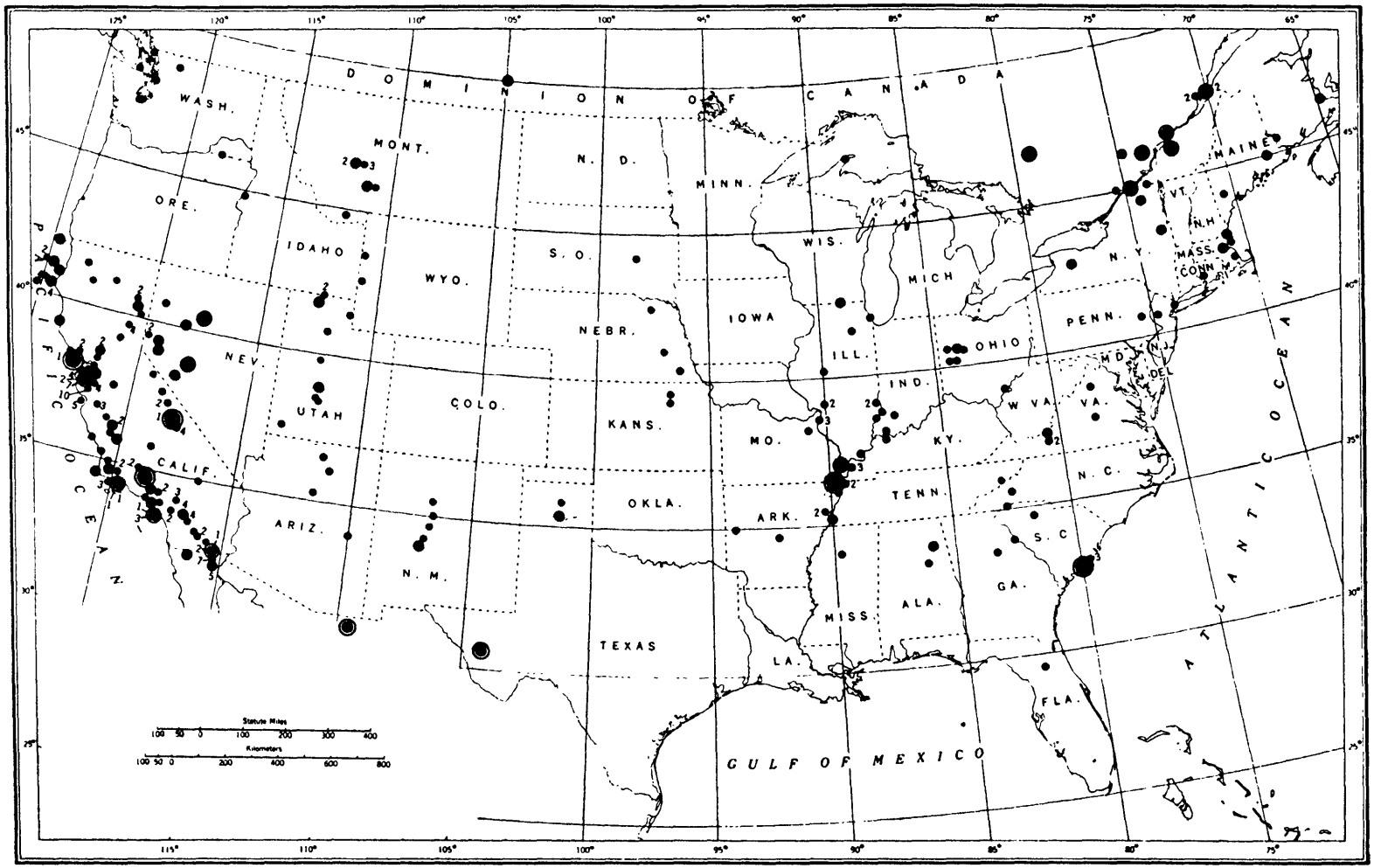


FIGURE 1.—*Destructive and near destructive earthquakes in the United States through 1947.*

# UNITED STATES EARTHQUAKES, 1947

## INTRODUCTION

This publication is a summary of earthquake activity in the United States and regions under its jurisdiction for the calendar year 1947. 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 31 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 1947:

*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, 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.

[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.

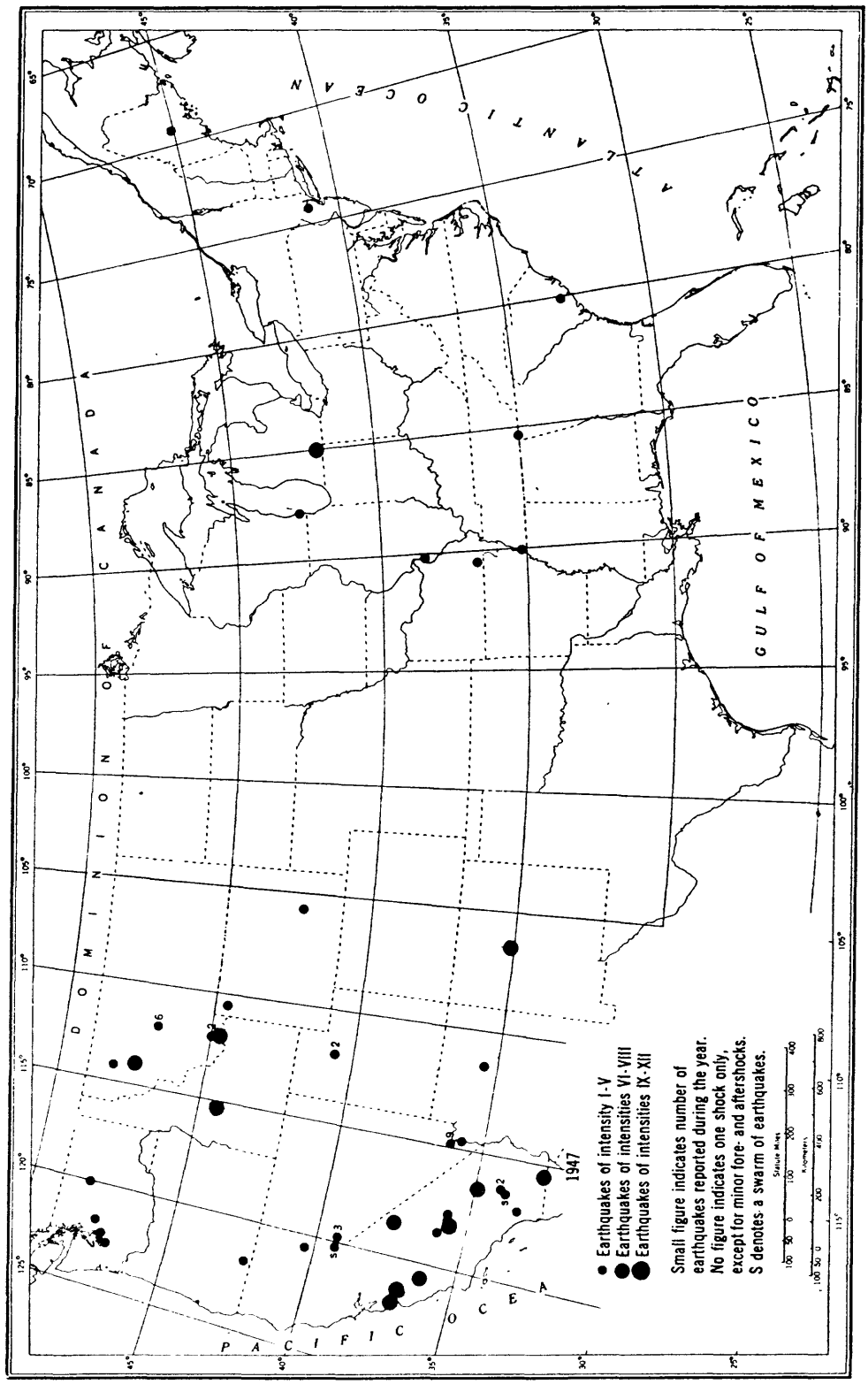


FIGURE 2.—*Earthquake epicenter, 1947.*

## 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 pipe lines 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 1947. 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 1947. 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 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.

*Teleseismic results.*—On page 31 is a list of Survey and cooperating teleseismic stations for which the Survey publishes results. Immediate epicenter determinations are made usually within three days through the cooperation of Science Service, the Jesuit Seismological Association, and many foreign and domestic stations. 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, D. C.

*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, D. C. The revised analyses are given in table 4.

*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 1941.

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, Vol. 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

**Arizona:** April 10, May 18, October 26.
**Arkansas:** December 15.
**California:** January 11, 12; February 4, 6; March 29; April 2, 10; May 27; June 22; July 6, 24; August 10; September 20, 23; October 12; November 18; and December 16 (2).
**Georgia:** December 27.
**Idaho:** September 24; November 23.
**Maine:** December 28.
**Michigan:** August 9.
**Mississippi:** December 15.
**Missouri:** June 29, December 1.
**Montana:** March 14, 15, 28; April 10, 25; May 30; July 5, 22; August 10; October 3, 31; November 1, 23; and December 12.
**Nevada:** March 11 (2); April 10; May 18 (2); June 6, 17, 19 (4); July 18 (2), 19, 26, 30; August 22, 23; September 7, 25 (2), 26, 29 (2), 30; and October 21.
**New Jersey:** April 1.
**New Mexico:** November 6, December 14.
**Oregon:** December 24.
**South Carolina:** November 1.
**Tennessee:** December 15 and 27.
**Utah:** March 7 and 28.
**Washington:** January 12, April 1, September 20, November 23, and December 22.
**Wisconsin:** May 6.
**Wyoming:** January 8, April 14, and November 23.

### EARTHQUAKE ACTIVITY OUTSIDE THE UNITED STATES

**Alaska:** January 2; February 3 (3); April 29; June 5, 28; July 27; August 4, 27; and October 16.
**Panama Canal Zone:** November 9.
**Hawaiian Islands:** February 26; March 13, 15, 19, 29; June 14, 19, 26; August 7, 18, 19; September 21, 30; October 17, 31; December 14, 17, 20, and 24.
**Puerto Rico:** July 10 and August 24.

### NORTHEASTERN REGION

(75TH MERIDIAN OR EASTERN STANDARD TIME)

**April 1:** 08:26.* Pompton Lakes, N. J. Mild earthquake rattled dishes. Recorded on the seismograph at Fordham University in New York City.

**December 28:** 14:58:20.* Epicenter 45.2° north, 69.2° west, by NESA. Dover-Foxcroft area, Maine. This shock was felt over an area of approximately 60,000 square miles. See map, page 5. Maximum intensity V from results of a questionnaire coverage by NESA. Dover-Foxcroft residents reported stoves and furniture moved slightly and light objects toppled from shelves. One housewife in Sebec reported the disturbance knocked a fruit jar off a shelf, and farmers reported rakes, hoes, and other implements were knocked from wall pegs in barns. The tremor was recorded on the seismograph at Boston College in

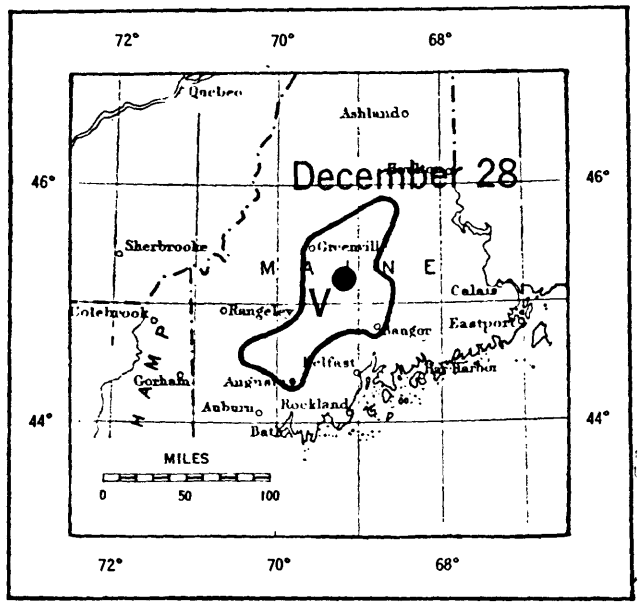


FIGURE 3.—*Area affected by the earthquake of December 28.*

Weston, Mass. At Charleston, small objects moved and windows, doors, and dishes rattled. In Harmony, picture frames moved, frame walls creaked, and windows, doors, and dishes rattled. A low rumble resembling thunder accompanied the quake.

INTENSITY IV:

Brownville, Corinna, Eastport, Farmington, Greenville, Guilford, Howland, Millinochet, Milo, Monson, and North Anson.

INTENSITY I TO III:

Augusta, Bangor, Dexter, East Cornith, Enfield, Hartland, La Grange, and Madison.

Negative reports were received from 77 places.

### EASTERN REGION

(75TH MERIDIAN OR EASTERN STANDARD TIME)

**November 1:** 23:30. Summerville, S. C. Light shock felt by many. Some awakened. No damage.

**December 27:** About 19:00. Tennessee and Georgia. Moderately strong shock felt in Missionary Ridge area. At Chattanooga, windows rattled, houses shook, and rumbling sounds were reported. Red Bank residents reported 2 tremors, windows and doors rattled, and venetian blinds were jarred. Houses also shook in Ooletewah, Collegedale, Cleveland, and Hixon. A resident in Sequatchie Valley reported 3 movements about one-half hour apart. Many inquiries were received by the Marion County sheriff. In Georgia, a concrete block house in Rossville was rocked for 1 minute, and at Fort Oglethorpe the disturbance was reported as distinct, lasting 2 or 3 seconds, and accompanied by a rumble like heavy thunder underground. Windows, doors, and a coal scuttle on a porch rattled. Toys fell to the floor.

### CENTRAL REGION

(90TH MERIDIAN OR CENTRAL STANDARD TIME)

**May 6:** 15:25. Southeastern Wisconsin. "A sharp earthquake at 3:25 p. m., C.S.T., was felt in a 3,000-square-mile area of southeastern Wisconsin, shaking buildings and rattling windows in most communi-

ties in the area. Some frightened Milwaukee residents ran into the streets in the belief there had been a serious explosion. The shock caused only minor damage and there were no reports of injuries to any residents of the area. There were a few reports of broken windows in Kenosha, and residents of other communities reported that dishes and glasses had fallen from shelves. The earthquake appeared to have centered just south of Milwaukee on the shore of Lake Michigan. It was felt in a 100-mile-wide strip from Sheboygan, Wis., to the Wisconsin-Illinois border, and extended from the lakeshore 25 miles inland to Waukesha." (SSA Bulletin, July 1947.)

**June 29:** 22:23:53.* Near St. Louis, Mo. Epicenter according to JSA, near 38.4° north, 90.2° west. Felt strongly in St. Louis. Reported felt 60 miles north and south, and 30 miles east and west of St. Louis. Several chimneys toppled and a sidewalk cracked.

**August 9:** 20:46.8.* South-central Michigan. Epicenter 42°00′ north, 85°00′ west, by University of Michigan. Intensity VI covered an area of 18-mile radius from the epicenter. See map, page 6. Special reference is made to the Greenville area which has an abnormal intensity of V+. It is assumed

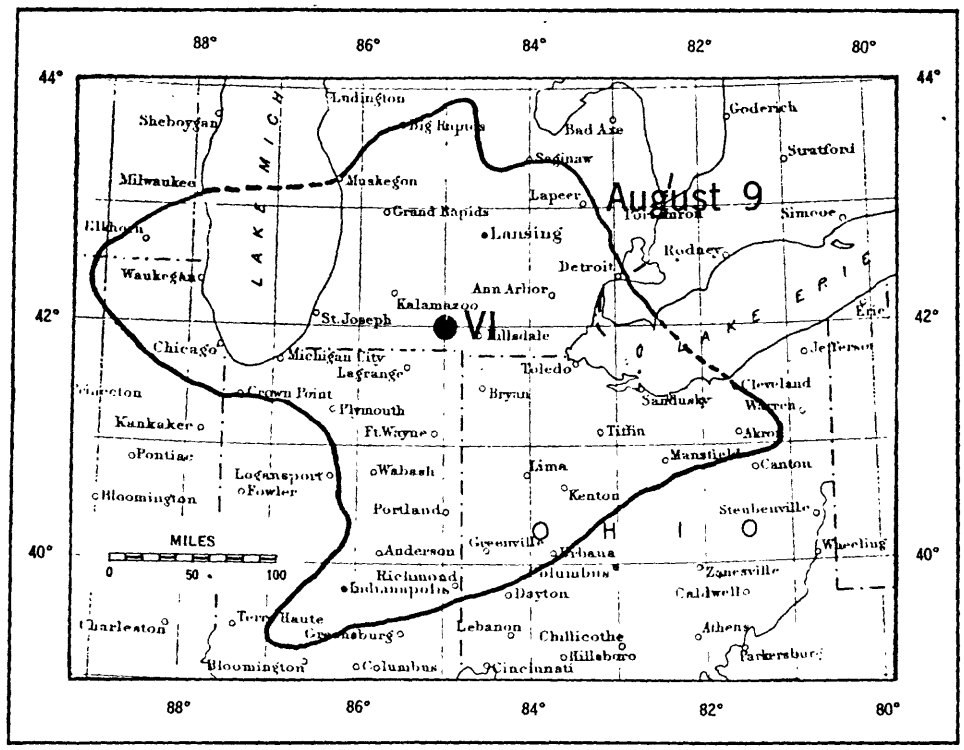


FIGURE 4.—*Area affected by the earthquake of August 9.*

that the surface structure in the region along the Flat River, elevation 0–500 feet, is very favorable for a greater response. The cities of Ionia, Owassa, and Portland, which also have high intensity ratings, are situated along rivers.

INTENSITY VI:

*Athens.*—In general, people ran outdoors. Merchandise was shaken from store shelves. Some chimney damage observed. Buildings swayed.

*Bronson.*—Some cracked plaster and broken windows. Merchandise thrown from store shelves. Many people ran outdoors; near panic at theater.

*Coldwater.*—One chimney twisted. Windows broke and plaster fell. Trees shaken slightly.

*Colon.*—Some slight chimney damage and cracked plaster. Buildings swayed. Some goods thrown off shelves. Most of the people ran outdoors.

*Matteson Lake.*—Many slightly damaged chimneys. Cracked plaster. One cracked cement foundation. Merchandise thrown from shelves in one store.

*Sherwood.*—Considerable plaster and some chimney damage.

*Union City.*—Some damaged plaster and chimneys. Loose bricks fell from cornices. Merchandise thrown from store shelves. Several street lights broken. Slump in a building excavation was noticed.

INTENSITY V:

Adrian, Albion, Greenville, Hillsdale, Marshall, Quincy, and Sturgis.

INTENSITY IV:

Allegan, Allen, Belding, East Lansing, Flint, Grand Ledge, Grand Rapids, Holland, Hudson, Ionia, Jackson, Jonesville, Kalamazoo, Lansing, Lowell, Mason, Owassa, Paw Paw, Pontiac, Portland, Reading, and Vicksburg.

INTENSITY IV IN INDIANA:

Angola, Auburn, Columbia City, Elkhart, Hartford City, Logansport, Plymouth, Portland, and Wabash.

INTENSITY IV IN OHIO:

Archbold, Bryan, Pioneer, Wauseon, and West Unity.

INTENSITY I TO III:

Alma, Ann Arbor, Battle Creek, Benton Harbor, Big Rapids, Charlotte, Clare, Corunna, Dowagiac, Detroit, Eaton Rapids, Flushing, Hastings, Howell, Monroe, Muskegon, Niles, Otsego, Saginaw, Sparta, Vassar, Ypsilanti, and Zeeland.

INTENSITY I TO III IN INDIANA:

Alexandria, Anderson, Bluffton, Bowling Green, Crown Point, Findlay, Fort Wayne, Gas City, Garrett, Goshen, Huntington, Kendallville, Knox, Kokomo, La Porte, Marion, Michigan City, Mishawaka, Muncie, Napanee, New Castle, North Manchester, Peru, Richmond, Rochester, Rushville, South Bend, Three Rivers, Tipton, Valparaiso, Warsaw, and Winchester.

INTENSITY I TO III IN OHIO:

Alliance, Bucyrus, Cleveland, Defiance, Delphos, Fremont, Lima, Mansfield, Mt. Gilead, Napoleon, Kenton, Oakwood, Shelby, Tiffin, Toledo, Vandalia, Van Wert, and Wapakoneta.

INTENSITY I TO III IN ILLINOIS:

Aurora, Belvedere, Chicago, Chicago Heights, Evanston, Joliet, Rockford, and Wilmette.

INTENSITY I TO III IN WISCONSIN:

Medford, Milwaukee, and Racine.

Negative reports were received from 16 places in Michigan, 16 in Indiana, 30 in Ohio, 15 in Illinois, 24 in Wisconsin, and 4 in Iowa.

**December 1:** 02:47:33.* Epicenter 36°43′ north, 90°38′ west, according to St. Louis University. Near Poplar Bluff and New Madrid, Mo. Light shock aroused many residents. The State Highway Patrol reported a rumbling sound several seconds before the "explosion" which "sounded like a truck ran into the side of a building."

**December 15:** 21:27. Near Memphis, Tenn. Slight shock felt in area extending from Lepanto, Ark., to Brownsville, Tenn., and Hernande, Miss., according to press reports. No felt reports were received from the area west of Memphis.

## WESTERN MOUNTAIN REGION

(105TH MERIDIAN OR MOUNTAIN STANDARD TIME)

**January 8:** 12:37. South-central section of Yellowstone National Park, Wyo. Building of Snake River Ranger Station trembled. Windows rattled and small objects were disturbed. Pictures swung on walls. Slight rumble heard inside house immediately after and during shock.

**March 7:** 07:14. Salt Lake City, Utah. Press reports rocking buildings sent scores of persons in the southeast section into the streets. Persons who reported the shock stated it felt as though their homes were suddenly sinking beneath them. There were indications it was a direct movement rather than a shake, possibly caused by a slip in the Wasatch Mountains east of the city. Coastal seismographs failed to record the tremor.

**March 11:** 12:30 and 13:45. Washoe Valley, Nev. "Residents of Washoe Valley near Reno reported having felt two distinct earthquakes . . ." (SSA Bulletin, April 1947.)

**March 14:** 11:00. Seeley Lake, Mont. Intensity VI shock felt only at Seeley Lake and Niarada. At the first place plaster cracked and fell, hanging objects swung, and buildings creaked and rattled. Five miles to the east persons in a log house thought a heavy gust of wind had caused the building to shake. Also felt by several people 2 miles south and 10 miles north of Niarada. Walls of buildings creaked. Negative reports were received from 80 places.

**March 15:** 10:29. Helena, Mont. Moderate shock lasting 2 to 3 seconds.

**March 28:** 04:02. Salt Lake City, Utah. Residents of the southeastern section of city reported intense shock and loud rumbling from a quake originating on Wasatch Fault, possibly slipping of a fracture in mountains west of Holladay. Residents of Murray and Holladay reported pronounced tremors, one claiming she heard a sound "like a blast of dynamite."

**April 10:** 08:58:04.* See section on California and Western Nevada for reports on this shock which centered in southern California.

**April 14:** 12:30. La Prele Creek, Wyo. (about 30 miles southwest of Douglas). Felt by all in ranch home, felt by some outdoors. Rattled windows, moved chairs and radio, buildings shook. Motion was very sharp through ground. Shock was accompanied by noise like a bump of heavy object and roar. Frightened one woman who ran from house.

**April 25:** 05:50. Somers, Mont. Light shock.

**May 18:** 21:42:34.* BC. Kingman, Ariz., and Boulder City, Nev. Light shock reported felt.
**May 18:** 22:09:04.* BC. Boulder City, Nev. Light shock reported felt.
**May 30:** 22:40. Helena, Mont. Intensity III shock reported felt.
**June 6:** 09:58:11.* BC. Boulder City, Nev. Light shock reported felt.
**June 17:** 07:28. Boulder City, Nev. Light shock reported felt.
**June 19:** 13:07:41*, 20:02:19*, 20:06:09*, and 20:16:21.* BC. Boulder City, Nev. Light shocks reported felt.
**July 5:** 04:00. Helena, Mont. Weak shock, lasted 2 seconds.
**July 18:** 18:15. Boulder City, Nev. Felt by several, frightened one. Rattled windows, doors, and dishes.
**July 18:** 21:35. Boulder City, Nev. Felt by several in home, outdoors by some. Rattled windows, doors, and dishes. Quite strong at Boulder Power Plant, felt by many, direction vertical.
**July 19:** 02:55. Boulder City, Nev. Felt by one person. Windows, doors, and dishes rattled.
**July 22:** 06:08. Helena, Mont. Weak shock, lasted 2 seconds. Felt by one resident in Kenwood (suburb). House creaked.
**July 26:** 22:21. Boulder City, Nev. Felt by several in home. Rattled windows, doors, and dishes; hanging objects swung.
**July 30:** 15:45. Boulder City, Nev. Generally felt by all persons in area, reportedly the strongest shock of the year. Rattled windows and dishes. Trees and bushes shaken moderately.
**August 10:** 09:21. Helena, Mont. Felt by many in Weather Bureau Office. Direction mostly vertical, building creaked.
**August 22:** 17:00:01.* BC. Boulder City, Nev. Light shock felt by a few.
**August 23:** 04:39:26.* BC. Boulder City, Nev. Light shock felt by several in home, awakened a few. Rattled windows and dishes; house creaked.
**September 24:** 18:34.5.* Epicenter 44°20′ north, 115°25′ west, about 60 miles northeast of Boise, Idaho, W. Mild tremor at Boise. Disturbed objects observed by several. Several large rents in brick building (well constructed), minor damage. Dishes rattled, flower pots were displaced, furniture moved. Hanging objects swung in Atlanta, and trees and bushes were shaken slightly. Felt by several in Emmett and by a few in Horse Shoe Bend.
Negative reports were received from 15 places.
**September 25:** 06:57:56.* BC. Boulder City, Nev. Light shock felt by several, awakened few.
**September 25:** 06:59:54.* BC. Boulder City, Nev. Light shock felt by several, awakened few.
**September 26:** 14:10. Boulder City, Nev. Felt by observer in home.
**September 29:** 20:05:23.* BC. Boulder City, Nev. Light shock felt by several.
**September 29:** 21:24:55.* BC. Boulder City, Nev. Light shock felt by several. Windows rattled and buildings creaked.
**September 30:** 14:58. Boulder City, Nev. Hard shock of local type, felt by all. Rattled windows and doors, pendulum clock stopped, buildings creaked.
**October 3:** 04:50. Helena, Mont. Weak shock reported felt in Weather Bureau Office.
**October 21:** 03:44:40.* BC. Boulder City, Nev. Light shock felt by many. Windows, doors, and dishes rattled. Many in community were awakened.
**October 26:** 21:15:40.* Epicenter 35½° north, 112° west, Coconino County, Ariz., W. Prolonged peals of thunder reported by a National Park Service observer at Flagstaff. Noticed suspended vase swing in E.-W. direction. Navajo Indians living in vicinity of Wupatki Headquarters heard the noise but did not feel any movement. At Sunset Crater National Monument, a ranger and wife noticed a tent located on cinder formation at base of Sunset Crater was shaking and dishes rattling. A Navajo Indian in vicinity of Gray Mountain Trading Post, 8 miles south of Cameron, stated his friends heard 3 peals of thunder and felt the ground shake.
**October 31:** 16:23. Southwestern Montana. Moderate shock felt at Grayling (Hebzen Dam), Francis, and Wickes. Felt by all at Dam. Rattled windows and dishes, pictures swayed. Small objects shifted. Also felt at Dean, Pony, West Yellowstone, and Wisdom.
Negative reports were received from 60 places.
**November 1:** 10:53. Wisdom, Mont. Light shock rattled windows. Walls creaked.
**November 6:** 09:50. San Antonito, N. Mex. Press reports slight tremors in the Sandia Mountain region. A school teacher reported classroom floor jarred and desks rattled. A survey covering 15 persons indicated the shock was felt in a 10-mile radius. One housewife reported dishes were jarred from shelves in her house. Professor Stuart A. Northrop, Collaborator in Seismology for New Mexico, stated the earthquake centered in the vicinity of the Tijeras Coal Basin, a graben-like block on the eastern dip slope of the Sandia Mountains fault block.

INTENSITY VI:

*Zamora.*—Felt by all in ranch home. Rattled windows, doors, and dishes. Cracked plaster and fireplace. Slight damage to fireplace and south wall of house.

INTENSITY V:

Cedar Crest (4 miles east of), San Antonito, and Sandia Park and vicinity.
**November 23:** 02:46:05.* Epicenter 44°47′ north, 112°02′ west, southwestern Montana, W. Felt over a wide area of approximately 150,000 square miles including the western two-thirds of Montana, northwest Wyoming, most of Idaho except the southwestern part, and a small part of eastern Washington. See map, page 9. Maximum intensity VIII in central region of Madison County in Virginia City and Alder areas. There was considerable damage to brick, masonry, and concrete. Large rocks rolled down mountainsides, creeks were made muddy, and new mud springs opened up, the mud forming cones or mounds.

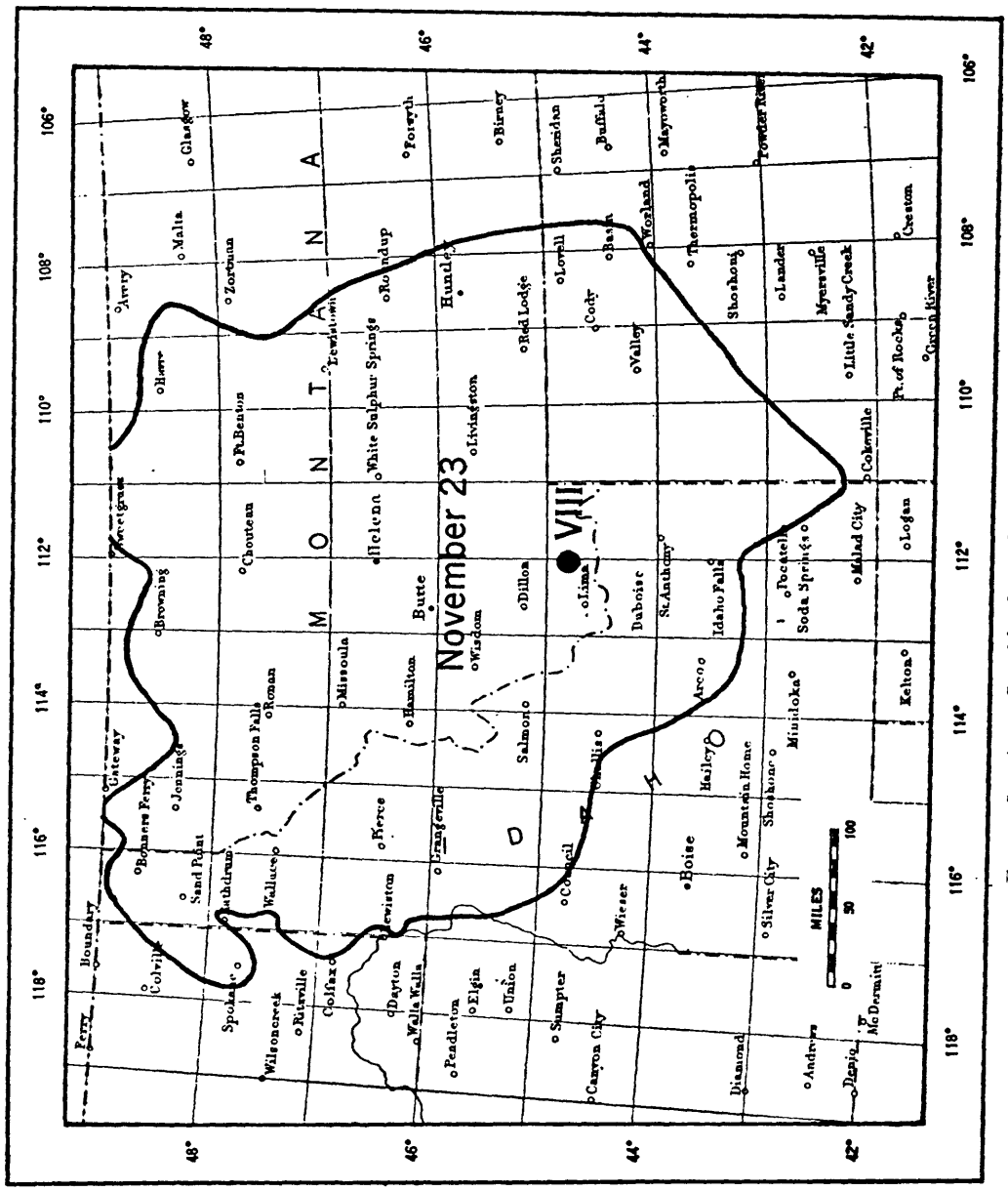


FIGURE 5.—*Area affected by the earthquake of November 23.*

INTENSITY VIII:

*Alder.*—Motion rapid, lasted several seconds. Chimneys fell, windows broke, walls and plaster cracked. Damage considerable to brick. Plaster cracked length of chimneys; books, pictures, and plaster fell; canned goods were knocked from store shelves; and a light globe was shaken from ceiling. Clock on south wall fell to floor. At Ruby Dam there seemed to be severe movement running from northeast to southwest for width of 1,000 feet. Boulders weighing several tons came down off cliff of rocks 300 feet high and landed close to river. Many weighing approximately 100 lbs. each blocked road leading to Dam. Many residents were awakened in Upper Ruby Valley where jars of fruit were broken, a small creek was made muddy, and horses became frightened and broke out of a corral.

*Cameron.*—Ranch house chimney fell off even with the house and cracked down about 6 feet on one side and 3 feet on the other. Dishes fell from cupboards; small objects fell from kitchen and medicine cabinets. Oil stoves were put out 3½ miles south of Cameron. Many big rocks were loosened and rolled down mountains. Pendulum clocks facing north stopped. Horse Creek in Hutchins Bridge region became milky. New mud springs opened up about 6 miles from Hutchins Bridge. Red slime could be seen from highway.

*Elk Lake Camp* (on Elk Lake).—Two-story house built of heavy studding with 6-inch packed sawdust walls was heaving. Mounted game heads fell off walls, a quarter of meat fell off table, numerous articles fell from shelves. Eight-inch thick ice on Elk Lake cracked in same direction as that taken by fallen objects. Springs feeding Elk Lake seemed to have gained. Spring in yard gained considerably.

*Ennis.*—Water in Wigwam Creek became clay white to extent that at 8 a. m. it was impossible to see the bottom; did not clear entirely until 1 p. m. There was a definite rise in flow of creek. At Cherry Creek, warm water began running into river. Several chimneys were shaken down, and a considerable amount of plaster was shaken loose and fell from ceilings. Twenty-five miles to the south, 2 stove pipes were shaken out in log cabin. Water 3 inches from rim of bucket was agitated sufficiently to slop over rim. A small spring-fed stream running through the Sam Collins Ranch ran muddy all the next day.

*Laurin.*—Part of one chimney fell northeast. Other chimneys twisted. Tremor was felt by all in dance hall, a few were frightened.

*Virginia City.*—The following is a summary of a report by Professor Stephen W. Nile, Collaborator in Seismology, State of Montana. Glass panes of all windows, especially those to the north, in Court House showed holes through them and finer diagonal cracks aiming toward the northwest corner. Inside, cracks in wall which is the E.-W. plane, sloped down and to west. Plaster cracked all around court room where ceiling joins wall, worst on south side.

At the Episcopal Church, a very substantial stone building, large vertical cracks on outside separated junction of tower and rest of church. Other cracks separated east buttress from building proper. The tower which extends to the ground settled 3/16 inch as shown by difference in level of plaster strips between building stones. Vertical cracks appeared from ground level to be from 1 to 2 inches wide, tapering to the smaller size as they neared the ground.

Brick veneer fell from above the entrance to the City Hall exposing wood boards in the wall.

Plaster in school fell from a strip 18 inches by 8 feet on south wall of main floor. On second floor books were thrown from shelves along north and south walls but not from other two walls. North-south walls and the ceiling cracked. A 500 cubic centimeters graduated cylinder left full of liquid on a drainboard fell southward into sink and broke. A 5-foot radiator along the north wall swung out 6 inches southward at its free end, the steam pipe at the east end serving as axis of rotation. A vertical crack ¼ inch wide appeared between the Masonic Temple and Rank's drugstore. Goods along west wall in drugstore were thrown to floor. Three tombstones in cemetery were moved. One, 3½ feet high and 9¾ inches square at base and resting upon a larger stone, slid northwest and at the same time rotated so that side which had faced north moved eastward and side which had faced southward moved westward a distance of 2.75 inches.

In other parts of city plaster, windows, walls, and chimneys were cracked; knickknacks, books, and pictures fell; windows and dishes broke. A clock fell from a shelf. Damage was considerable to brick, masonry, and concrete.

INTENSITY VII:

*Cliff Lake.*—Motion rocking, lasted 40 seconds. Felt by all in community. One chimney fell and loose rocks on highway were moved. Windows, doors, and dishes rattled in most homes, some houses creaked.

*Dillon.*—Felt by and awakened all in home. Loud grinding noise heard. Ceiling fell in bunkhouse, house was frame building and plastered. Small objects overturned; knickknacks fell; a few chimney bricks fell; doors swung back and forth, and a bed moved in several directions. Quite a number of clocks were stopped; a pendulum clock (long pendulum) hanging on west wall stopped. Lower part of garment (ankles), hanging up to dry, swung N.-S. about 18 inches. One chimney fell in business district.

*Hedgeville.*—Motion slow, lasted 2 or 3 minutes. Felt by many in community. Twisting and fall of one chimney. Damage slight. Plaster and walls cracked in homes.

INTENSITY VI:

*Anaconda.*—Felt by all, frightened many in community. Slight damage. Small chains hanging from ceiling of fire department swayed N.-S. Roaring noise preceded quake.

*Avon* (Ophir Gulch above old Blackfoot City).—Rocked house E.-W. Broke dishes and cracked plaster. Ground badly faulted in Ophir.

*Avon* (8 miles northwest of). Bed and night stand moved in E.-W. direction, also curtains hanging on clothes hanger over window. Dishes rattled.

*Barber.*—Felt by all in community. Rattled dishes; houses creaked. Cracked plaster slightly.

*Basin.*—Felt by all in community, frightened few. Hanging objects swung. Windows, doors, and dishes rattled.

*Big Timber.*—Felt by many in community, awakened many, frightened few. Hanging objects swung. Pictures fell, plaster cracked. Four miles to the west in a house on island in Yellowstone River, rattling of a stove pipe awakened observer. Direction west, with an upthrust roll-like movement, short and jerky.

*Billings.*—Awakened many. Hanging objects swung; houses creaked. Some cracked plaster fell from longbeams at Montana Federal Building. Plaster cracked in homes.

*Boyd.*—Felt by many in home, awakened and frightened many in community. Hanging objects swung; windows, doors, and dishes rattled.

*Bozeman.*—Felt by all in community. Buildings seen to sway. Windows in store swayed in and out. Drawers came out of dresser and spilled contents. A pipe broke in the Joyce Theater and water ran into the theater. An ancient grandfathers clock wich had not run in months was started.

*Brady.*—Felt by few in community. Hanging objects swung and knickknacks fell.

*Butte.*—Observer was awakened by loud crash of minerals falling off top of a closet and noise of bottles falling over. Bed seemed to tip from E.-W. Brick oven in yard cracked. Pictures slightly askew on walls; two hanging flower baskets swayed for nearly 5 minutes in E.-W. direction. Tea cups in china closet were tipped over to east, also an ornamental china deer. Stove pipe fittings fell to floor from shelves; iron pipe fittings rolled out of stocked bins. Many residents reported standing picture frames and small objects toppled. Many reported sounds before the shock.

*Clancey.*—Felt by many, frightened few in community. Cracked plaster in one home. Damage slight. Windows, doors, and dishes rattled. Ground, rocky.

*Clarkston.*—Awakened all in community. Spilled water out of a full pail. Ground, gravel, level.

*Craig.*—Felt by many in community. Rattled windows, doors, and dishes. Shifted small objects; some small objects fell.

*Cushman.*—Awakened all in community. Trembled first time for about 10 seconds, then followed immediately by trembling for about 15 seconds, motion rapid. Hanging objects swung. Windows and dishes rattled; houses creaked.

*Darby.*—Felt by many in home and community, frightened many. Windows rattled, trees and bushes shaken slightly.

*Deer Lodge.*—Motion rapid and of long duration. Rattled windows and dishes very noticeably, house creaked. Hanging objects swung, pendulum clock stopped. Outside the city window panes broke in chicken house and chickens became so disturbed they flew out through the broken panes. Wheel chair in a home, standing against the north wall and facing south, continued to move back and forth for several seconds after the tremor ceased.

*Dell.*—Felt by many in community, frightened few. Hanging objects swung, small objects and furnishings shifted. Chimneys cracked. Windows, doors, and dishes rattled.

*Dutton.*—Felt by many in community, frightened few. Some canned goods on store shelves fell. Cupboards and shelves rattled.

*Emigrant.*—Felt by many in community, frightened few. Pendulum clock stopped. Windows, doors, and dishes rattled; some knickknacks fell.

*Forest Grove.*—Windows, doors, and dishes rattled. Dresser close to south wall pounded against wall. Chickens off roost in chicken house.

*Gallatin Gateway.*—Felt by all in community. Rattled windows and dishes. Pendulum clock stopped, knickknacks fell, hanging objects swung. Some plaster cracked.

*Grant.*—Felt by all. Few small cracks in plaster especially around a large chimney which has not quite enough foundation. One glass in a suspended cupboard was overturned. Windows and dishes rattled, house creaked.

*Grayling* (Hebzen Dam).—Felt by all in community. Direction SW.-NE. Rattled windows, doors, and dishes. Knickknacks and pictures fell. Pendulum clocks facing northeast stopped.

*Great Falls.*—Felt by many. Hanging objects swung. Numerous cracks in plaster especially in poorly constructed dwellings. Few mildly alarmed. Manikin toppled against a plate glass window in Strain Brothers Department store, breaking the glass. Pictures moved; table lamps, windows, and dishes rattled. Clocks stopped. A frame compo-board used to hold strip well logs was thrown down and broken. The board, about 5 feet high, was leaning against south wall, bottom slipped (north), and loaded upper part struck radiator and snapped off. Many reported sounds before quake.

*Hall.*—Felt by many in community. Shifted small objects and clocks, overturned vases. Knickknacks fell and hanging objects swung.

*Hamilton.*—Buildings and chandiliers swayed. Many reported odd noises. Officers investigating what was thought to be a prowler commotion found sections of ceiling and plaster on floor in Main Street Cafe.

*Havre.*—Felt all over community. Rattled windows in telephone building. Hanging objects swung, pendulum clocks facing west stopped. Card table moved, one door opened.

*Helena.*—Very definite preliminary shaking. Small statuettes were moved about on a table, one upset. Bookends moved. Window already cracked was observed to have cracked considerably more. Rock wall in yard cracked between 1 and 1½ inches in width. Canned goods fell from shelves in basement of home, a few articles were shaken down in pantry and attic. Some residents at Veterans Hospital reported the stone house bounced in an alarming manner and they got under an archway for safety.

*Jackson.*—Felt by and frightened all in community. Houses creaked.

*Jeffers.*—Felt by all in community. Shifted small objects and overturned vases. Knickknacks, books, and pictures fell.

*Jens.*—Felt by several in home. Windows, doors, and dishes rattled; hanging objects swung.

*Limestone.*—First part of shock not very strong, decreased to slight shaking, then increased again, and the last of it rolled observer in bed placed in E.-W. direction. Rattled windows, doors, and dishes.

*Livingston.*—Awakened all in community. Hanging objects swung, houses creaked, small objects moved, and vases overturned. Knickknacks and plaster fell.

*Logan.*—Felt by all in community, frightened many. Small objects and furnishings were shifted; knickknacks fell. Windows, doors, and dishes rattled.

*McLeod.*—Felt by many in home. Rattled windows, doors, and dishes; shifted small objects.

*Melstone.*—Felt by quite a few, some were awakened. Boxes of cereal were shaken from shelves in one store. Small crack noticed in one chimney, cracks in mortar on floor of frame building. Lights swung.

*Melville.*—Felt by many in community. Cracked plaster in several places. Shifted small objects. Stock and fowls ran from shelters.

*Milltown.*—Awakened all in community. Direction E.-W. Windows and dishes rattled.

*Miner.*—Felt by all in community. Houses creaked and hanging objects swung. Small objects and furnishings were shifted; knickknacks fell.

*Monida.*—Felt by all at ranch 19 miles to the east. Ice in creek was broken and fell in. One table shifted 8 inches. Terrific noise heard before things started to move, sounded like roar of an engine in basement. Three miles to the south plaster fell out of a log house. Hanging doors swung NE.

*Norris.*—Awakened and frightened all in community. Walls creaked, small objects were shifted, knickknacks fell.

*Philipsburg.*—Felt by and awakened many in community. Trees and bushes shaken moderately. Bottles shook so much that observer thought they would break. Rattled dishes, hanging objects swung.

*Plains.*—Felt by many in community, felt outdoors by some. Windows, doors, and dishes rattled; hanging objects swung.

*Pony.*—Awakened and frightened many in community. Rattled windows, doors, and dishes; houses creaked. Hanging objects swung.

*Ramsay.*—Felt by two people in home. Shifted small objects slightly; cracked plaster slightly. Windows and dishes rattled; house creaked.

*Reedpoint.*—Felt by several in home. House creaked, pendulum clock stopped. "At railway station train was passing through, and it felt and looked to the operator as though it would leave the rails."

*Ronan.*—Felt by few. Rattled windows, doors, and dishes. Hanging objects swung and knickknacks fell.

*Rothiemay.*—Awakened many in home. Rattled windows, doors, and dishes slightly; hanging objects swung NE.

*Sappington.*—Awakened all in community. Pendulum clock stopped, small objects and furnishings shifted, rockers and light fixtures moved N.-S.

*Shambo.*—Felt by several. Cracked plaster in one home. Ground soil, level.

*Shonkin.*—Awakened and frightened many in community. Rattled dishes, walls creaked, hanging objects swung.

*Silver Star.*—Motion rapid, lasted 45 seconds. Direction NE. Felt by all in community. Rattled windows, doors, and dishes. Small objects were shifted and canned goods thrown off store shelves.

*Sula.*—Seemed to be coming from all directions at once, trembling motion felt for nearly 5 minutes. Felt by many at ranch. Windows and doors rattled, house creaked. Many people in community got out of bed.

*Sun River.*—Felt by several. Beds vibrated E.-W. Chickens greatly excited at several farms. Windows in chicken houses broken, water and feed containers tipped over.

*Tampico.*—Felt by few in community. Plaster, windows, and wallpaper cracked; hanging objects swung; small objects were shifted. Well water was very discolored for about 5 days.

*Three Forks.*—Motion medium, wavelike, lasted 5 to 10 seconds. Felt by all in community, frightened few. Rattled windows, dishes, and doors; house creaked. Hanging objects swung SE.-NE.

*Toston.*—Awakened all in community. Walls creaked.

*Townsend.*—Awakened many in community, frightened few. Cracked plaster and walls, damage slight. Small objects were shifted; knickknacks moved; windows and dishes rattled.

*Twin Bridges.*—Felt by all in community. Rattled windows, doors, and dishes; house creaked. Hanging objects swung; small objects and furnishings were shifted.

*Twodot.*—Felt by several in home, outdoors by some. Small objects overturned; knickknacks fell; dishes broke.

*Ulm.*—Awakened and frightened all in community. House creaked; windows and dishes rattled; hanging objects swung.

*Warm Springs.*—Motion rapid, lasted 10 seconds. Felt by all in community. Trees and bushes shaken slightly; windows and dishes rattled.

*Washoe.*—Felt by many in community. Windows rattled.

*Waterloo.*—Awakened and frightened many in community. Trees and bushes shaken strongly. Windows and doors rattled, walls creaked.

*West Yellowstone.*—Two distinct shocks. Awakened and frightened all in community. Hanging objects swung; small objects and furnishings were shifted. Bed moved up and down.

*Whitehall.*—Felt by all in community. Rattled windows. Hanging objects swung.

*White Sulphur Springs.*—Felt by many in community. Rattled windows, doors, and dishes; house creaked. Hanging objects swung NE. A few chimneys were cracked.

*Whitlash.*—Motion slow, lasted about 1 minute. Felt by several. Hanging objects swung. Some plaster cracked. Moved linoleum under stove.

*Wickes.*—Felt by all in community. Rattled windows, doors, and dishes. "We were nearly shaken out of our beds."

*Willow Creek.*—Considerable noise increasing in intensity until shakes came. Clocks stopped, light pulls swayed. Cracks in plaster of the bedrooms upstairs and all seams in plasterboard had broken apart. Large cracks in walls of basement stairway.

*Wisdom.*—Motion slow and rolling, E.-W. lasted 30 seconds. Felt by many in community. Rattled windows and dishes; walls creaked; hanging objects swung; knickknacks fell.

*Wise River.*—Eleven miles southwest 2 shocks were felt. First shock awakened observer, second shock rocked cabin. Dishes and pans rattled. Plaster was shaken loose; pendulum clocks stopped. Small rockslides from high ledges.

*Wolf Creek.*—Felt by several, awakened few. Felt by all at Holter Dam plant. Windows, doors, and dishes rattled; house creaked.

INTENSITY V:

Alberton, Alpine, Armington, Augusta, Bearcreek, Beehive, Belfry, Belgrade, Bercail, Big Horn, Blackfoot, Bonner, Boulder, Cardwell, Chinook, Choteau, Clyde Park, Coffee Creek, Columbus (Mystic Lake Plant), Columbus, Conrad, Corvallis (and 4 miles north of), Corwin Springs, Dayton, Devon, Drummond, East Helena (Canyon Ferry), Eden, Edgar, Ferdig, Florence, Fort Benton, Francis, Frenchtown, Gardiner, Garrison, Glasgow, Gold Creek, Giltedge, Grantsdale, Grassrange, Harlem, Harlowton, Harrison, Helmville, Highwood, Hingham, Homestake, Hot Springs, Huson, Jardine, Jefferson City, Jefferson Island, Kalispell, Lima, Lodge Grass, Lolo, Lombard, Lonepine, Luther, McAllister, Manhattan, Martinsdale, Maudlow, Maxville, Mike Horse, Missoula, Moccasin, Molt, Nashua, Ovando, Paradise, Park City, Perma, Polaris, Polytechnic, Power, Radersburg, Ravalli, Red Lodge, Red Lodge (Dry Creek), Reichle (Glen), Rexford, Roscoe, Roundup, Ryegate, Seeley Lake, Seeley Lake Ranger Station, Shawmut, Sheridan, Silesia, Silverbrow, Simms, Springdale, Square Butte, Stark, Stevensville, Stockett, Straw, Superior, Tarkio, Trout Creek, Utica, Valier, Vaughn, Wilsall, and Winston.

INTENSITY IV:

Absarokee, Arlee, Armstead, Barratts, Bearmouth, Belt, Belton, Benchland, Big Snady, Box Elder, Bridge, Camas, Cascade, Charlo, Chester, Clinton, Conner, Creston, Dean, Deborgia, Denton, Divide, Dover, Eagleton, Eddy, Evaro, Fishtail, Forks (2 miles north of), Fromberg, Gold Stone, Greenough, Grey Cliff, Hobson, Huntley, Joliet, Judith Gap, Klein, Kolin, Larslan, Laurel, Lennep, Lewiston, Lloyd, Lozeau, McCabe (5 miles south of), Marysville, Moore, Moiese, Musselshell, Neihart, Niarada, Nimrod, Nye, Pablo, Pryor, Ringling, Rivulet, Rudyard, Saint Ignatius, Saint Regis, Sandcoulee, Shelby, Swan Lake, Thompson Falls, Troy, Waltham, Whitefish, and Windham.

INTENSITY I TO III:

Brooks, Fairfield, Floweree, Fort Peck, Hilger, Libby, Pompeys, Pillar, Somers, Sweetgrass, Ural, and Winifred.

Negative reports were received from 170 places in Montana.

STATE OF IDAHO:

This earthquake shook most of the intermountain country and was clearly distinguished in the Lost River Valley. Buildings swayed in Idaho Falls.

INTENSITY VI:

*Ashton.*—Felt by many in community. Windows and dishes rattled; some plaster cracked. Hanging objects swung and small objects were shifted.

*Coeur d'Alene.*—Awakened and frightened all in community. House creaked.

*Gibbonsville.*—Awakened and frightened many in community. Roaring noise heard. Windows rattled, walls creaked, window blinds shook. Trees and bushes shaken slightly.

*Grangeville.*—Felt by many. Sleepers awakened by rocking beds. Some reported house creaked and different objects therein rattled.

*Hamer.*—Awakened many in community. Small objects were shifted and vases overturned. Dishes broke. Loud roar heard.

*Kilgore.*—Awakened many in community. Rattled windows, doors, and dishes. Small objects were shifted and knickknacks fell. Chimneys cracked.

*Lewisville.*—Awakened few and frightened many in community. Windows rattled.

*Menan.*—Awakened many in community. Windows, doors, and dishes rattled, house creaked. Pendulum clocks facing north stopped. Trees and bushes shaken strongly. Some plaster cracked.

*Orogrande.*—Felt by many in community, lasted 20 seconds. Dishes rattled and hanging objects swung. Cracked wallpaper. Knickknacks fell.

*Pocatello.*—Felt by observer in hotel. Cracked plaster, rattled windows and doors.

*Roberts.*—Motion rapid and of long duration. Awakened all in community. Hanging objects swung, small objects were shifted. Damage slight. "The west part of town felt it harder and longer."

*Saint Anthony.*—Motion rapid, lasted 10 seconds. Awakened many in community. Rattled windows, doors, and dishes; house creaked. Hanging objects swung, small objects were shifted. Trees and bushes shaken slightly. Knickknacks fell.

*Shoup.*—Motion rapid and of long duration. Direction NE. Awakened many in community, frightened few. Rattled windows, doors, and dishes; house creaked. Damage slight.

*Troy.*—Felt by several in community, awakened few. Hanging objects swung, plaster cracked, and small objects were shifted. "I notice that my doors do not fit the way they should."

*Weiser.*—Distinct shaking of beds and creaking of walls reported by 3 occupants of Hotel Washington.

*Winsper.*—Felt by all in home, awakened many in community. Rattled windows, doors, and dishes; hanging objects swung; some plaster cracked.

INTENSITY V:

Arco, Baker, Boise, Cataldo, Challis, Chester, Clarkia, Cottonwood, Dent and vicinity, Dixie, Dubois, Elk City, Elk River, Enaville, Felt, Gifford (northeast of), Headquarters, Humphrey, Island Park, Kendrick (northeast of), Lane, Leadore, McCall, Mackay, Macks Inn, North Fork, Orofino, Patterson, Rigby, Rupert, Salmon, Samuels, Spencer, Sugar, Swan Valley, Tendoy, Terreton, Tetonia, Thornton, and Yellow Pine.

INTENSITY IV:

Avery, Bonners Ferry, Camas, Clearwater, Deary, Dover, Driggs, Drummond, Edgemore, Fenn, Forney, Gibbs, Golden, Greencreek, Greer, Harpster, Howe, Kamiah, Kingston, Kooskia, Laclede, Lorenzo, May, Medimont, Moore, Moscow, Mullen, Osburn, Pinehurst, Priest River, Rexburg, Riggins, Saint Maries and Santa, Sanders, Sweetwater, Ucon, and Woodland.

INTENSITY I TO III:

Blanchard, Lewiston, Kootenai, Peck, Ponderoy, Sagle, Santa, and Wallace.
Negative reports were received from 170 places.

STATE OF WASHINGTON:

Seismograph at Mount St. Michael's recorded the tremor; the needle of one of the instruments was thrown off the record.

INTENSITY VI:

*Colfax.*—Motion slow, lasted 1 minute. Awakened many. Rattled windows, doors, and dishes; hanging objects swung; small objects were shifted, and books fell. House creaked.

INTENSITY V:

*Spokane.*—Felt by many, 3 seconds duration. A woman in Browne's addition reported windows rattled and furniture shook. A man reported his bed moved and lightly bumped the wall, and another felt his chair tremble while reading. Ten miles to the northeast the motion was gentle and swaying. Disturbed objects were observed by several.

INTENSITY IV:

Chewelah and Farmington.

INTENSITY I TO III:

Ritzville.
Negative reports were received from 17 places.

STATE OF WYOMING:

INTENSITY VI:

*Wilson.*—Motion rapid, lasted 30 seconds. Felt by several in home and community; all who felt it were frightened. Preceded by noise like wind.

*Yellowstone Park.*—Motion rapid, lasted about 1 minute. Felt by all, awakened all, frightened many. Windows and dishes rattled, house creaked. Hanging objects swung and pendulum clocks facing north stopped. "Old time residents state this was the most severe shock ever felt in Yellowstone Park." Several were frightened at Snake River Ranger Station. Beds rattled. Two shocks were felt in northeast corner of Park. Buildings creaked and loose objects rattled. Gasoline lamps hanging on hooks from ceiling swung E.-W.

INTENSITY V:

Painter.

INTENSITY IV:

Basin, Greybull, Jackson, Jenny Lake, Moose, Moran, and Pitchfork.

INTENSITY I TO III:

Cody and Lovell.
Negative reports were received from 22 places.

**December 12:** 12:55. Helena, Mont. Light shock felt by observer in home.

**December 14:** 18:30. Chappel, N. Mex. Felt on railroad siding of Southern Pacific Railroad about 17 miles west of Afton in vicinity of old lava flow. Felt by train and engine crew of westbound freight. Disturbed objects observed, rattled engine car windows and doors.

**December 15:** 07:38. Helena, Mont. Slight shock felt by one in community.

**December 17:** 05:38:00.* Epicenter 46½° north, 112° west, Lewis and Clark County, Montana, W. Felt by several and awakened a few residents of Ovando. One large picture fell from wall.

INTENSITY V:

Benchland, Butte, Craig, Hamilton, Helena, Martinsdale, Sand Coulee, and Sappington.

INTENSITY IV:

Alder (12 miles south of), Anaconda, Bearmouth, Brady, Cardwell, Clancey, Deer Lodge, Drummond, Ennis, Frenchtown, Hall, Helmville, Jeffers, Radersburg, Sheridan, and Wickes.

**December 22:** 13:15. Helena, Mont. Weak shock.

**December 27:** 01:48. Helena, Mont. Weak shock.

## 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 SSA Bulletin.

**January 7:** 09:28:30.* Epicenter 37°10′ north, 118°07′ west, northeast of Tinemaha, P. Felt by several at Bigpine Power Plant; at Laws it was reported as just a jolt and very abrupt.

**January 8:** 18:20:35.* Epicenter 33°40′ north, 117°58′ west, Inglewood Fault, P. Felt by most everyone at Huntington Beach. Rattled windows and doors. Four miles north of town it was reported as 2 shocks about 3 minutes apart which were felt harder than at Huntington Beach. The ground is marshier at that location. A deep rumble was heard.

**January 8:** 18:22:57.* Epicenter 33°42′ north, 117°48′ west, south of Tustin, P. (This is probably the second shock referred to in the preceding.)

**January 9:** 05:24:44.* Epicenter 33°58′ north, 117°14′ west, east of Riverside, P. Felt by several in homes in Riverside, awakened observer.

**January 11:** 03:57:48.* Epicenter 37°36′ north, 118°26′ west, P. Felt strongest at Owens River Gorge north of Bishop. Intensity VI. Felt generally and awakened all or nearly all. Houses creaked, windows and dishes rattled. Bushes and trees shook moderately. Loosened rocks off Canyon walls. Felt with intensity V at Tinemaha Reservoir near Independence where inhabitants were awakened by brief, rapid motion that rattled windows and made houses creak. Intensity IV at Bigpine Power Camp, Bishop, and Woodlake.

**January 12:** 14:10. Emigrant Ranger Station (west section of Death Valley National Monument). Motion trembling with gradual onset. "Ranger Jones was outside the ranger station at Emigrant, elevation 2,000 feet, and his attention was drawn to a huge cloud of dust rising from the strata of rock which evidently slipped and caused the debris to slide from the face of the cliff. It was not a shelf breakoff but a parallel settlement of the mountainside. It had no effect on the station located 3 miles from the mountain."

**January 17:** 21:30:03.* Epicenter 35.7° north, 118.0° west, near Walker Pass, P. Felt at Sand Canyon Aqueduct Station. Motion rapid, lasted 1 second.

**January 19:** 11:32:0.* Epicenter 35.6 north, 120.3° west, P. Minor shock felt by many at Paso Robles.

**February 1:** 05:30:48.* Epicenter 35°12′ north, 118°21′ west, northeast of Tehachapi, P. Awakened observer at Jawbone Aqueduct Station. Rattled windows; house located on filled ground shook. Felt by several in Tehachapi. Buildings creaked and loose objects rattled.

**February 2:** 06:01:23.* Epicenter 35°42′ north, 117°24′ west, Searles Lake, P. Felt at Sand Canyon Aqueduct Station. Awakened all in home. Also felt by several in Bakersfield, Southern California Edison Co., Powerhouse No. 1. Bumping subterranean sounds were heard at time of shock.

**February 4:** 22:14:23.* Epicenter 36°13′ north, 120°37′ west, near Coalinga, P. Felt strongest, intensity VI, at Lonoak (Priest Valley). Many alarmed. Visible swaying of buildings, plaster cracked and fell, small objects fell to west. Beds moved and doors opened, pictures swung to the west. Intensity V at Idria where the shock was felt by many in camp. Buildings creaked, loose objects rattled, west windows rattled more than north windows. Inside, building and bed moved visibly. Observer reported quake as most violent of any felt by him in past 10 years at this location. At King City, cords of window blinds swayed and standing lamps tottered slightly north to south. Felt with lesser intensity at Big Sur, Coalinga, Huron, Parkfield, San Ardo, and Westhaven. Felt slightly at Kettleman Compressor station near Avenal.

**February 6:** 09:20:40.* Epicenter 35°40′ north, 118°04′ west, near Walker Pass, P. Weather Bureau office at Bakersfield reported the quake was apparently centered in Kern Canyon, quite abrupt at Edison Powerhouse No. 1 (15 miles east of Bakersfield). Strongest motion, intensity VI, occurred at the Jawbone Aqueduct Station where small objects overturned and knickknacks fell.

INTENSITY V:

Kernville (Post Office), Kern River Powerhouse No. 3, Lone Pine, Miramonte, Onyx, Sand Canyon Aqueduct Station, and Trona.

INTENSITY IV:

Borel Powerhouse (Bodfish), Brown, Cantil, Cottonwood Powerhouse (near Lone Pine), Cottonwood Gates, Johannesburg, Lindsay, Springville, and Three Rivers.

INTENSITY I TO III:

Tehachapi and Visalia.

Negative reports were received from 9 places.

**February 6:** 13:18:13.* Epicenter 35°40′ north, 118°04′ west, near Walker Pass, P. Felt at Jawbone Aqueduct Station.

**February 7:** 04:19:58.* Epicenter 35°28′ north, 118°43′ west, Kern River east of Bakersfield, P. Felt by several at Kern River Powerhouse No. 1, 15 miles east of Bakersfield. Buildings creaked and loose objects rattled.

**February 8:** 08:50. Felt by several at Kern River Powerhouse No. 1, 15 miles east of Bakersfield. Loose objects rattled. Bumping subterranean sounds were heard at time of shock. Ground rocky.

**February 10:** 01:24:01.* Epicenter 35°30′ north, 118°45′ west, east of Bakersfield, P. Bumping motion with abrupt onset at Kern River Powerhouse No. 1, 15 miles east of Bakersfield.

**February 12:** 05:32:59.* Epicenter 35°27′ north, 118°25′ west, east of Bakersfield, P. One observer reported bumping motion with abrupt onset at Kern River Powerhouse No. 1, 15 miles east of Bakersfield.

**February 16:** 05:56 and 13:56:43.* Epicenter 35°40′ north, 118°04′ west, near Walker Pass, P.

Felt by several in home and community of Onyx. Direction SE.-NW. Rattled windows, doors; walls creaked. Trees and bushes shaken slightly.

**February 16:** 18:21:48.* Epicenter 35.7° north, 118.0° west, near Walker Pass, P. Felt by several in community near Sand Canyon Aqueduct Station. Direction E.-W. Motion rapid, slight, lasted 1 second.

**February 17:** 07:14. Bumping motion with abrupt onset reported at Kern River Powerhouse No. 1, 15 miles east of Bakersfield.

**February 18:** 04:19. Bumping motion with abrupt inset reported at Kern River Powerhouse No. 1, 15 miles east of Bakersfield.

**February 20:** 11:44:58.* Epicenter 37.7° north, 119.2 west, east of Yosemite, P. Felt by 2 at Ellery Lake, Mono County. Motion rocking, W.-E., quite sharp with rapid onset. Buildings creaked. Moderately loud subterranean sounds heard by several at time of shock. Also felt by 2 at Gem Lake. Building creaked, loose objects rattled. Roaring sound heard.

**February 28:** 14:22. Strong shock at Weldon. More noticeable on Walker Pass. Buildings rocked.

**March 1:** 02:40:21.* Epicenter 35°40′ north, 118°04′ west, near Walker Pass, P. Felt by several and awakened few in community near Sand Canyon Aqueduct Station. Motion rapid, lasted 2 seconds. Rattled windows and doors. Very strong motion at Weldon where "continuation of intensity of shock would no doubt do damage . . . a noticeable amount of roaring and rumbling."

**March 1:** 02:55 and 04:32. Weldon. Light shocks. Roaring and rumbling heard.

**March 1:** 07:25. Weldon. Light shock, very little movement. Loud roaring.

**March 2:** 10:20. Felt by several at Southern California Edison Company Powerhouse in Kern Canyon, near Bakersfield. Motion bumping with abrupt onset. Bumping and roaring sounds heard at time of shock.

**March 9:** 13:10:44.* Epicenter 35°49′ north, 117°41′ west, northeast of Inyokern, P. Felt strongest at Nine Mile Aqueduct Station. Felt by several in home, outdoors by observer. Rattled windows, doors, and dishes. Trees and bushes shaken slightly. Also felt at Jawbone Aqueduct Station, Sand Canyon Aqueduct Station, Trona, and Weldon.

**March 11:** 12:30 and 13:45. Washoe Valley, Nev. Two distinct shocks felt.

**March 12:** 13:55. Weldon. Light shock with upward motion, like underground blast.

**March 12:** 15:54:10.* Epicenter 35.7° north, 118.0° west, near Walker Pass, P. Felt by several in Weldon. Motion rapid, lasted 2 seconds. Walls creaked.

**March 14:** 03:36.* Epicenter near Petrolia, B. Felt by several in Upper Mattole, awakened few. Direction SW. Trees and bushes shaken slightly.

**March 14:** 15:05:32* and 21:15. Epicenter 35°43′ north, 118°05′ west, near Walker Pass, P. Light shock felt at Weldon. Rumbling heard. Shock at 21:15 rattled windows.

**March 17:** 00:46.* Epicenter about 40 miles SW. of Ferndale, B. Felt in Ferndale and Petrolia.

**March 21:** 11:39:42.* Epicenter 33°00′ north, 115°31′ west, near Brawley, P. Felt by many in Brawley (NE. section). Disturbed objects observed by many, pictures and dishes on east wall moved south. General alarm.

**March 23:** 18:30. Brawley (NE. section). Motion rocking with gradual onset. Felt by all.

**March 27:** 01:16:46.* Epicenter 35.0° north, 121.0° west, off the coast, P. At Lompoc, motion was slow, lasted 20 seconds. Felt by and awakened all in home. Rattled windows and doors. Felt by a few in Los Alamos.

**March 28:** 22:05.* Imperfectly recorded, near Walker Pass, P. Felt by several at Sand Canyon Aqueduct Station. Direction E.-W. Rattled windows, doors, and dishes; walls creaked.

**March 29:** 23:44. Epicenter 15 miles west of Cape Mendocino, B. This earthquake was felt principally on the coast of southwestern Humboldt County over an area of about 2,000 square miles extending from Blue Lake southeast to Hayfork and southwest to Fort Bragg on the coast. Maximum intensity VI reported from Upper Mattole where many were frightened and all were awakened. Strong-motion earthquake records were obtained from instruments at Eureka and Ferndale.

INTENSITY V:

Bridgeville, Eureka, Fields Landing, Fortuna, Holmes, Honeydew, and Kneeland.

INTENSITY IV:

Arcata, Benbow, Blue Lake, Cape Mendocino Light Station, Carlotta, Dyerville, Fort Bragg, Petrolia, and Scotia.

INTENSITY I TO III:

Alderpoint and Hayfork.

Negative reports were received from 13 places.

**March 30:** 05:29.* Imperfectly recorded, near Walker Pass, P. Felt slightly at Weldon. Windows rattled.

**April 2:** 07:16. Southern Imperial County. This earthquake was felt over a small area near the California-Mexico border. Maximum intensity VI reported from Holtville where plaster was cracked, damage slight. A strong-motion earthquake record was obtained from the instrument at El Centro.

INTENSITY V:

Brawley, El Centro, and Imperial.

INTENSITY IV:

Heber, Mt. Laguna, and Niland.

Negative reports were received from 12 places.

**April 10:** 07:58:04.* Epicenter 34°58′ north, 116°32′ west, Manix Fault, P. This earthquake was strong, and was felt over an area of 75,000 square miles covering the greater portion of the southern half of California from the coast inland as far as Las Vegas, Nev., and Pheonix, Ariz. See map, page 17. Maximum intensity VII reported from the Newberry Springs area, 25 miles east of Barstow between the volcanic Ord and Cady Mountain ranges, where half the water in a large irrigation reservoir near the hamlet was sloshed over the sides by quake-produced waves. New veins opened in the Mojave River to raise its level from 12 to 14 inches. Magnitude of the shock as determined by Pasadena was 6.8. Over 100 aftershocks were recorded instrumentally but no damage or felt reports were received.

Strong-motion earthquake records were obtained from all instruments in southern California except those at Santa Barbara and El Centro. Strong-motion instruments in the San Francisco Southern Pacific Building were also operated.

The results of an investigation of this earthquake appear in the Bulletin of the Seismological Society of America, Vol. 37, No. 3, July 1947.

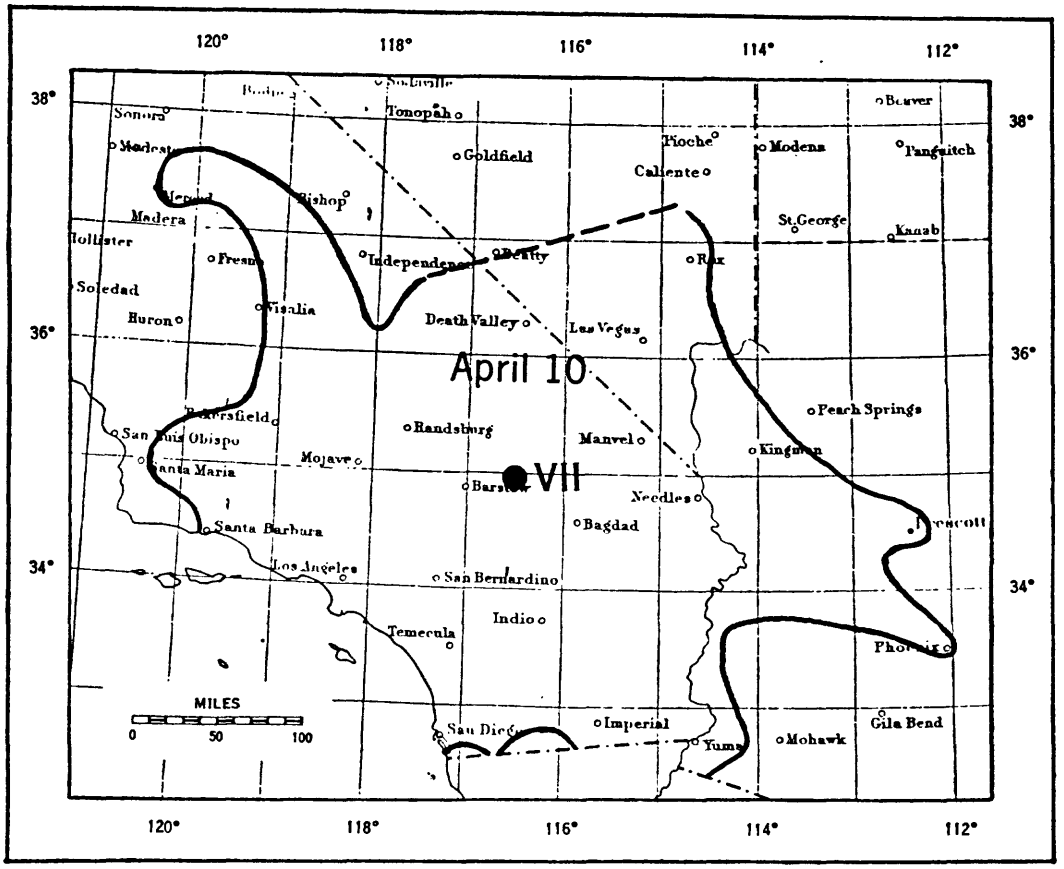


FIGURE 6.—*Area affected by the earthquake of April 10.*

INTENSITY VII:

*Afton Canyon.*—25 to 30 slides from steep cuts occurred on west side of railroad near Afton. Extensive fill and grade repairs were needed. One railroad trestle settled over a foot. A ranch home was reported flattened.

*Amboy.*—Four shocks felt by all in community. Shifted small objects and overturned vases. Rocks fell in mountains to the east causing a huge dust cloud to tower upward.

*Bob's Service Station* (about 5 miles west of epicenter).—Brick chimney collapsed from roof to room ceiling. A refrigerator and a gas stove were displaced several inches; lunch counter 19 feet long was displaced 1 foot against stools. Canned and bottled goods, dishes, etc. were thrown off shelves. Batteries of electric plant were shaken off shelves. Ground was traversed with many small cracks. Cement floor of building badly cracked. A stack of 3,000 cement building blocks was shaken down; cases of beer and soft drinks piled about 5 feet high were thrown down.

*Cronise.*—Plaster cracked in combination gas station and cafe of adobe construction. Washroom annex showed a few cracks between bricks, some bricks were displaced about 1 inch. Articles fell off well-filled shelves.

*Daggett.*—Pendulum clocks stopped, small objects overturned, knickknacks fell, hanging objects swung, windows, doors, and dishes rattled. Slight damage reported.

*Dorrance House.*—Many cracks reported in a one-story adobe structure. Two adobe chimneys cracked. Water sloshed out of reservoir. Many cans fell from shelves, many glass jars broken.

*Field Station.*—Many cracks on concrete building approximately 26 feet square. Some cracks 2 inches wide, especially in corners and over ends of windows and doors. Large ice box moved about 12 inches. Some glassware broken. Landslides and dust clouds reported in hills to south.

*Harvard Station.*—A big railroad water tank was moved 6 inches out of line.

*Hiatt House.*—Pipe connections in windmill broken. Top tank of two set one on top of the other tipped over southward. Bookcase and ice box overturned. Well became muddy.

*Johnson House.*—Adobe cracked around door and a few bricks were knocked off top of this adobe, half-underground structure. Gas stove moved one foot northward; an ice box outdoors overturned southward. A radio on a piano fell to the floor. Well became muddy. Water sloshed out of a tank.

*Lucerne Valley.*—Swimming pool was badly cracked and had to be drained for repairs. Sleepers were awakened. Cans fell from shelves.

*Manix Service Station.*—Piano moved south 3 feet in house of frame construction, stuccoed. Rafters under galvanized iron roof appeared to have moved vertically. Many cracks in concrete floor. Much dust was seen rising from hills to southeast. A loud roaring or explosive noise was heard. Earth fills slumped, lowering the highway a few inches at a bridge 1 mile east of Manix and at another north of Field.

*Midway.*—Roadway cracked at one end of a bridge 3 miles west of town and dropped 5 inches.

*Mojave River.*—Numerous cracks noticed on both sides of channel, largest about 3 inches wide. Water in the river rose 2 to 3 inches after the main shock.

*Newberry.*—Most severe shock felt in 72 years. Broke dishes, windows, and light furniture. Grocery stocks fell from shelves and other small articles were thrown to the floor. Felt over entire community.

*Newberry Springs.*—Schoolhouse had to be condemned. Three houses of adobe and brick construction were badly damaged. Several small farm tanks set up on frames toppled to the ground.

*Summit.*—A small reservoir near the city was reported badly cracked.

*Tankersley House.*—Parts of north and west wall of one-story adobe structure collapsed. All walls of annex were completely shaken down. Reservoir dug in ground did not spill water but a slightly raised tank did. A 2-inch waterline was torn from the water tank.

*Van Haute House.*—Many cracks in lime mortar in north section of house, a few cracks in cement mortar in south section. Reservoir 20 feet square and full at the time of the shock lost about 2 feet of water which spilled over the north and south walls. Dishes were thrown from an open cabinet.

*Victorville.*—Small objects shifted and vases overturned. A few cracked walls. Pictures fell.

*Wright Brothers Ranch.*—One wall badly cracked in house made of railroad ties set vertically and stuccoed inside and outside. A frame water tank tower showed many cracks in exterior stucco, west wall showed a large bulge. Water pipes developed leaks but no breaks. Cement bottom and sides of a swimming pool cracked.

*Yermo.*—Motion caused portable house trailer setting on valley fill to rock up and down at each end alternately. Trees and bushes shaken strongly. Air became dusty. Several stores reported foodstuffs fell from shelves. Some plaster and walls cracked; books, plaster, and knickknacks were knocked down; dishes were broken.

INTENSITY VI:

*Acton.*—Motion rapid, lasted 40 seconds. Direction E. Hanging objects swung east. Trees and bushes shaken slightly.

*Adelanto.*—Motion rapid, lasted several seconds. Hanging objects swung. Canned goods were thrown from shelves and filled cartons were knocked over in a grocery store. Two shocks were felt. Level, sandy ground.

*Aguanga.*—Motion slow to moderate, lasted 2 to 3 seconds. Direction NE. Hanging objects swung. Trees and bushes shaken slightly to moderately.

*Baker.*—Motion slow, even, lasted 8 seconds. Ground river bed, solid. Another shock 10 minutes later, rapid motion. Large number of cans, jars, and bottles shaken off shelves in grocery store. Hanging objects swung NE.

*Barstow.*—Telephone poles shook noticeably. Passengers were frightened as elevator cages rattled against their shafts. A man at work on twenty-seventh floor of City Hall said he had to brace himself to keep from falling as a result of the swaying motion of the tower.

*Claremont.*—Rocking movement set ceiling lamps hanging on 32-inch chains swinging with maximum estimated amplitude of 2 to 3 inches. A large oak tree was visibly shaken causing a few leaves to fall. Two distinct sets of waves about 5 to 10 seconds apart. Observer had impression that second set had stronger E.-W. component compared to first which had a definite N.-S. component. Dishes rattled. Parked automobiles were noticeably rocked.

*Compton.*—Motion slow, lasted 1 minute. Felt by many. Hanging doors swung. Trees and bushes shaken moderately.

*Chubbuck.*—Felt by many; ground rocky, sloping, steep. Hanging objects swung. Small objects and furnishings shifted. Trees and bushes shaken moderately.

*Cima.*—Motion rapid and of momentary duration, on filled ground. Hanging objects swung and knickknacks fell.

*El Monte.*—Motion slow, lasted 1 minute; ground level, sandy. Direction NE. Felt by many. Hanging objects swung. Trees and bushes shaken moderately.

*Fenner.*—Motion rapid, lasted a few seconds; ground level, compact. Felt by all in frame house, shifted small objects in pantry. Hanging objects swung NE. Trees and bushes shaken moderately.

*Forest Home.*—Motion slow, lasted 1 minute; ground sloping, loose. Direction N.-S. Trees and bushes shaken moderately.

*Glendale.*—Window shattered in Security First National Bank at Broadway and Grand Boulevard.

*Helendale.*—Motion rapid, lasted 1 minute; ground compact, level. Felt by all in community. Reported as strongest quake felt in locality in 35 years.

*Hinkley.*—Motion rapid, lasted about 1 minute. Reported as strongest quake ever felt in district. Rumbling sounds heard, direction of quake uncertain, seemed to be from several directions. Hanging objects swung and small objects were shifted.

*Hollywood.*—Plaster cracked in the Hollywood Division Jail.

*Huntington Park.*—Motion slow, lasted 20 seconds. Direction NE.-E. Hanging objects swung NE. Pendulum clocks stopped. A few instances of cracked plaster. One observer became slightly nauseated.

*Indio.*—Motion slow, lasted 30 seconds. Ground level and compact. Direction N.-S. Hanging objects swung N.-S. Trees and bushes shaken moderately. Small objects displaced.

*Jawbone Aqueduct Station.*—Motion rapid, lasted 3 seconds; Ground level, compact. Felt by many in community. Observer outdoors noticed trees shaking.

*Johnsondale.*—Motion slow, lasted about 2 minutes. Direction NE. Hanging objects swung and knickknacks fell. Trees and bushes shaken slightly.

*Johnstone House.*—A few cracks in interior plaster in house constructed of cement tiles. Large crack developed around outside between foundation and ground.

*Kelso.*—Motion rapid, lasted 30 seconds. Direction E. Felt by all in community. Trees and bushes shaken strongly. Small objects shifted and some overturned. A few windows were broken.

*Lake Arrowhead.*—Motion moderate, lasted 30 seconds. Ground sloping, compact. Circular motion felt by some. Hanging objects swung. Flower pots overturned. Small objects and pictures swayed and fell toward SE.

*Lancaster.*—Motion rapid, lasted several seconds. Trees and bushes shaken moderately.

*Long Beach.*—Felt by all above second floor in Federal Building. Hanging objects swung.

*Los Alamitos.*—Motion slow, lasted 35 to 40 seconds. Felt by many in community. Trees and bushes shaken moderately.

*Los Angeles.*—Motion rolling, SE.-NW., with gradual onset. Felt by many. Loose objects rattled, disturbed objects observed by many. Observer on twenty-seventh floor of City Hall reported swaying motion. Chandeliers, pictures E.-W., swinging or displaced. Dishes rattled.

*Ludlow.*—Motion rapid, lasted 15 seconds. Hanging objects swung NE. Trees and bushes shaken strongly. Knickknacks fell, dishes broke. Reported as severe as any felt in many years.

*Lynwood.*—Motion slow, lasted 1 minute; ground level, loose. Direction E.-W. Hanging objects swung. Trees and bushes shaken moderately. Some cracked plaster. Water in toilet bowls rocked for 2 minutes.

*Maiposa.*—Felt. Some cracked plaster.

*Mojave.*—Motion rapid, lasted 1 minute; ground level, compact. Hanging objects swung S.-N. Trees and bushes shaken strongly. Some cracked plaster.

*Monrovia.*—Motion rapid. Felt by many in region. Hanging objects swung. Trees and bushes shaken moderately.

*Moreno.*—Motion slow, lasted 1 minute. Hanging objects swung. Small objects and canned goods shifted. Some plaster cracked.

*Mount Wilson.*—Motion rapid, lasted 10 seconds. Trees and bushes shaken strongly; was not felt very strongly.

*Needles.*—Motion rapid, lasted 10 seconds. Four shocks, two hard and two slight. Hanging objects swung NE.

*Newport Beach.*—Motion rapid, lasted 5 to 10 seconds. Felt outdoors by some. Pendulum clocks stopped. A few knickknacks fell.

*North Hollywood.*—Felt by all in community. Hanging objects swung E.-W. Shifted small furnishings. Trees and bushes shaken strongly.

*Pasadena.*—Motion slow, lasted 30 seconds. Felt by all in downtown area. Direction SE. Hanging objects swung. Shifted small objects and overturned vases. A crack was reported in a new partition from floor to ceiling in the Union National Bank.

*Pine Valley.*—Motion slow, felt by several. Some windows broke.

*Rice.*—Motion slow, lasted a few seconds. Two shocks felt by 4 persons in Post Office. Some plaster fell.

*Riverside.*—Motion slow, lasted 45 seconds. Ground compact. Felt by and frightened many.

*San Bernardino.*—Motion slow, lasted 4 minutes. Hanging objects swung. Trees and bushes shaken moderately.

*San Jacinto.*—Motion slow, lasted about 1 minute. Direction E. Hanging objects swung. Trees and bushes shaken strongly. Some plaster cracked.

*South Pasadena.*—A 75-pound pot holding a fern was overturned.

*Stanton.*—Motion slow, lasted 10 seconds. Hanging objects swung. Small objects were shifted.

*Tecopa.*—Motion moderate, lasted about 1 minute. Felt by all in community. Shifted some small objects and overturned some vases. Trees and bushes shaken moderately.

*Thousand Palms.*—Motion slow and of momentary duration. Water in washtubs started going from side to side (N.-S.). Water was about 4 inches from top of tub and did not go quite over top.

*Valyermo.*—Motion slow, lasted 30 seconds. Hanging objects swung NW.

*Victorville.*—Motion slow, lasted 50 seconds. Hanging objects swung. Trees and bushes shaken moderately. Small objects shifted E.-W., also up and down. Overturned vases.

*Walnut.*—Motion rapid, lasted 10 seconds. Felt by several in Post Office. Hanging objects swung SE.-NW. Cracked plaster slightly. Small objects were shifted.

*Wrightwood.*—Motion slow, lasted 30 seconds. Trees and bushes shaken slightly. Roofs and tops of cabins seemed to shake worst.

*Yucaipa.*—Motion rapid, lasted 1 minute. Knickknacks fell. Trees and bushes shaken moderately.

INTENSITY V:

Alhambra, Alta Loma, Arroyo Seco Ranger Station, Artesia, Banning, Beaumont (1 mile east of), Big Pine Recreation Area (Wrightwood), Boron, Brea, Camp Baldy, Cantil, Castaic, Corona, Culver City, Death Valley, Downey, East Highlands, Elsinore, Etiwanda, Fall Brook, Fawnskin, Fullerton, Gardena, Hayfield, Hemet, Hollywood, Hynes, Idyllwild, Inglewood, Irvine, Ivanpah, Jacumba, Kernville, La Crescenta, Laguna Beach, La Habra, Lake Hughes, La Mirada, Maywood, Mecca, Montebello, Midway, Muroc, Niland, Oxnard, Palmdale, Palm Springs, Palos Verdes Estates, Pearblossom, Pomona, Ripley, Romoland, Rosamond, Sand Canyon Aqueduct Station, San Diego, San Dimas, San Fernando Power Plant, San Pedro, Santa Ana, Santa Barbara, Santa Fe Springs, Santa Monica, Santa Susana, Saugus, South Gate, Springville, Tehachapi, Temple City, Thermal, Trona, Twentynine Palms, Upland, Van Nuys, Ventura, Vidal, Westend, Wheeler Ridge, Whitewater, Wildomar, and Winterhaven.

INTENSITY IV:

Arcadia, Arvin, Beverly Hills, Blythe, Calimesa, Carpinteria, Coachella, Coronado, Coso Junction, Cuyama, Darwin, El Toro, Essex, Fillmore, Frazier Park, Garden Grove, Glendora, Gorman, Hobo Hot Springs, Huntington Beach, Indian Springs, Lakeside, Lancaster (Neenach), Little Lake Aqueduct Station (Little Lake), Lomita, Los Alamos, Midland, Miramonte, Nipton, Norwalk, Orange, Panamit Springs (east of Darwin), Palomar Mountain, Piru, Randburg, Sandberg, San Juan Capistrano, Seal Beach, Spadra, Torrance, Valley Wells, Westminster, Yorba Linda, Yosemite National Park, and Yucca Grove.

INTENSITY I TO III:

Anza, Bakersfield, Brawley, Caliente, Coulterville, Desert Center, Escondido, Grapevine, Holtville, Keeler, La Jolla, Mecca, Mesa Grande, Mount Bullion, Newhall, Paymaster Mine, Perris, Porterville, Silverado, and Sorrente.

Negative reports were received from 70 places.

INTENSITY VI IN NEVADA:

*Las Vegas.*—An observer in the Huntridge addition reported a coffeepot was knocked from a stove. Typewriters were found out of position on desks in the courthouse. Lights swayed and dishes fell from cupboards. A few doors jammed. One observer reported seeing water roll up in a toilet bowl. Pendulum clock in sheriff's office stopped, and a house doorbell rang. Patrons in gambling casinos were among the first to feel the disturbance. In the Weather Bureau office, 9 miles northeast of Las Vegas, 4 flourescent, 4-tube, 48-inch lamps hanging 30 inches from the ceiling were set in motion with a swing of about $\frac{3}{8}$ inch. Lamps are lengthwise NW.-SE. and were swung at right angles to their length. Observer on duty in control tower 55 feet high at McCarran Field reported the tower swayed quite a bit.

INTENSITY V IN NEVADA:

Beatty, Goodsprings, Nelson, and Pahrump.

INTENSITY IV IN NEVADA:

Carp, Henderson, Jean, Kyle Canyon, and Searchlight.

INTENSITY I TO III IN NEVADA:

Boulder City and Sloan.

Negative reports were received from 7 places.

INTENSITY VI IN ARIZONA:

*Phoenix.*—Felt slightly by people on upper floors of buildings; not felt by people on ground floors. Pictures on walls and venetian blinds swayed back and forth. Office occupants on top floors of Security Building and Hotel Westward Ho reported wall pictures were jarred out of level. Secretaries in the Security Building reported the sensation was that their chairs were moving. Chandeliers and wall pictures moved noticeably for a few seconds in ninth floor offices of the Central Arizona Light and Power Company. Workers jumped from their desks and ran excitedly into the hallways. A woman on the sixth floor said the floor seemed to roll like an escalator, hangers on the coat rack banged into each other.

*Yucca.*—Felt by all in community. Direction E.-W. Hanging objects swung. Windows, doors, and dishes rattled. Trees and bushes shaken moderately.

INTENSITY V:

Chloride, Hackberry, Kingman, Parker, and Wickenburg.

INTENSITY IV:

Swansea Mine, Topock, and Wellton.

INTENSITY I TO III:

Aguila, Bouse, Congress, Prescott, and Wittman.

Negative reports were received from 35 places.

**April 10:** 23:47. Aftershock of April 10 earthquake at 07:58:04.* P. Felt at Baker (10 miles north of), Trona, Needles, and Old Woman Springs.

**April 14:** 08:35:44.* Epicenter 36°31′ north, 121°35′ west, B. Felt with intensity IV at Carmel.

**May 7:** 04:56:36.* Epicenter 35°45′ north, 118°02′ west, near Walker Pass, P. Reported felt at Jawbone Aqueduct Station, Kernville, Sand Canyon Aqueduct Station, and Weldon.

**May 9:** 21:53. Reported intensity III at Kern River Powerhouse No. 1, Kern Canyon.

**May 10:** 00:10:42.* Epicenter about 2 miles east of Sierraville, 39.6° north, 120.3° west, B. Felt with intensity IV at Sierra City and Sierraville.

**May 10:** 21:06:20.* Epicenter 34°14′ north, 116°20′ west, northwest of Twentynine Palms, P. At Palm Springs chandeliers swayed and windows rattled during the few seconds of earthquake; there were no reports of damage or injuries. Also felt at Coachella, Mecca (3 miles SE. of), Twentynine Palms (35 miles to the northeast), and Yucaipa. An aftershock was reported felt at 5:15 on May 11.

**May 16:** 22:25. Sand Canyon Aqueduct Station. Slight shock felt. Followed by a loud rumble at 22:28 but no earth movement.

**May 18:** 21:28:12.* Epicenter 33°23′ north, 117°02′ west, near Pala, P. Felt at Oak Grove Ranger Station (Aguanga), Poway, Palomar Mountain, Rancho Lilac, and Escondido.

**May 19:** 18:54:52.* Epicenter 33°17′ north, 116°56′ west, near Palomar, P. Felt with intensity V at Oak Grove Ranger Station (Aguanga).

**May 20:** 21:17:15.* Epicenter 34°09′ north, 117°31′ west, near Etiwanda, P. Felt at Riverside.

**May 24:** 21:30. Sand Canyon Aqueduct Station. Slight shock felt.

**May 25:** 16:22:23.* Epicenter 35°47′ north, 118°02′ west, near Walker Pass, P. Felt slightly at Sand Canyon Aqueduct Station. Another shock was felt at 17:50.

**May 26:** 09:06:52.* Epicenter 35°45′ north, 118°02′ west, near Walker Pass, P. Felt slightly at Sand Canyon Aqueduct Station.

**May 27:** 11:35. Felt slightly at Upper Mattole.

**May 27:** 12:58:42.* Epicenter 40.4° north, 124.7° west, B. Felt over an area of about 2,400 square miles in Humboldt County with limits of affected area extending from Trinidad east to Hoopa, south through Bridgeville, Alderpoint, Garberville, and Fort Bragg on the coast. Maximum intensity VI. Strong-motion earthquake records were obtained from the instruments located in Eureka and Ferndale.

INTENSITY VI:

*Honeydew.*—Motion rapid. Hanging objects swung.

*Upper Mattole.*—Motion rapid, lasted 20 seconds. Felt by all in community. Hanging objects swung N.-NE. Trees and bushes shaken strongly. Some plaster cracked. Reported as an unusually sharp earthquake.

INTENSITY V:

Cape Mendocino Light Station, Eureka, Ferndale, Fort Bragg, Garberville, Petrolia, and Scotia.

INTENSITY IV:

Alderpoint, Arcata, Bridgeville (7 miles N. of), Carlotta, Fortuna, and Trinidad.

INTENSITY I TO III:

Hoopa.

Negative reports were received from 9 places.

**May 27:** 13:10. Light shock felt at Fairmont Ranch and Frazier Park.

**June 16:** 07:59:37.* Epicenter 33°57′ north, 118°21′ west, near Inglewood, P. Slight shock reported felt in Los Angeles area.

**June 22:** 15:29:33.* Epicenter 37°00′ north, 121°46′ west, B. Felt over an area of about 7,000 square miles in San Francisco Bay region. See map, page 22. Press reported windows broken at Santa Cruz, plaster chipped at Hollister, and boulders cracked and blocked highway near Chittenden Pass. One voluntary observer reported plaster cracked at Gilroy. Hecker Pass in Santa Clara County was reported closed by slides. Maximum intensity VI. Strong-motion earthquake records were obtained from San Francisco, Oakland, San Jose, and Hollister.

INTENSITY VI:

*Alma.*—Motion rapid; ground sloping, steep, compact. Severe shock felt by all. Direction N. Trees and bushes shaken strongly.

*Aptos.*—Motion slow, lasted 4 seconds. Hanging objects swung. Trees and bushes shaken slightly. Furnishings were shifted and small objects overturned.

*Benecia.*—Motion slow, lasted a few seconds; ground level, compact, soil. Felt by and frightened many in community.

*Ben Lomond.*—One short, heavy shock. Motion rapid. Trees and bushes shaken moderately.

*Corralitos.*—Chimneys damaged.

*Coyote.*—Motion rapid, sharp, lasted 30 seconds; ground level, compact. Motion vertical. Hanging objects swung. Trees and bushes shaken moderately, no wind blowing at the time. Power lines moved up and down as though poles were being hit.

*Felton.*—Motion slow, lasted 5 seconds. Trees and bushes shaken moderately. Shifted small objects; books fell from shelf.

*Freedom.*—Motion slow and of long duration. Hanging objects swung N.-NE.

*Gilroy.*—Motion rapid, felt by all at Gilroy Golf Club. Street-light posts swayed. Ceilings of some of the older buildings developed small cracks and showered floors with chips of plaster. Trees and bushes shaken moderately.

*Madrone.*—Motion moderate, seemed to be an up and down motion, then shifted to NW.-SE. Hanging objects swung NW. Trees and bushes shaken moderately. Knickknacks fell.

*Morgan Hill.*—Motion rapid, lasted 3 seconds. Felt by many in community. Books on N.-S. shelves toppled and a half dozen were thrown to floor in second story of a frame high school building.

*Moss Landing.*—Motion rapid and of long duration. Felt by all.

*Mountain View.*—Motion rapid, lasted 1 minute. Hanging objects swung N. Trees and bushes shaken moderately.

*Rockaway Beach.*—Motion rapid, lasted 2 minutes. Felt by and frightened many in community.

*San Carlos.*—Motion rapid, lasted 5 seconds. Direction N.-S. Hanging objects swung.

*San Francisco.*—Tall buildings swayed with such force that occupants on upper floors headed for the streets. Windows and dishes rattled. Burglar alarms were set off, a small section of pavement weakened by a leaking water main caved in.

*San Jose.*—Motion rapid, lasted 5 seconds; ground level, compact. Felt by all in community. Trees and bushes shaken moderately. Hanging objects swung.

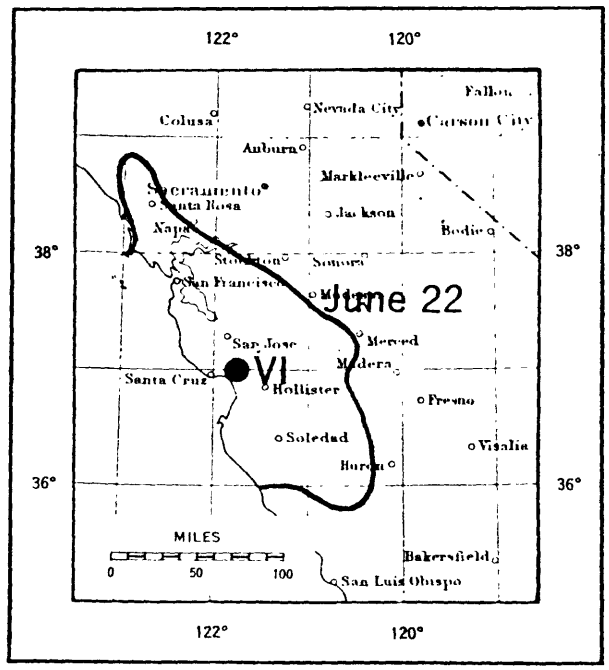


FIGURE 7.—*Area affected by the earthquake of June 22.*

*San Martin.*—Motion rapid, lasted 10 seconds. Hanging objects swung S. Trees and bushes shaken slightly. Small objects and vases overturned; knickknacks fell.

*Spreckels.*—Motion rapid, lasted 5 seconds. Hanging objects swung N. Trees and bushes shaken slightly. Small objects were shifted.

*Watsonville* (7 miles east of).—Motion rapid, lasted 3 seconds. Felt by many on highway. In town, hanging objects swung, trees and bushes shook moderately.

*Watsonville.*—"Plaster dislodged from ceiling, one chimney reported damaged, small articles were thrown down in homes, and window displays in downtown stores were knocked about." (SSA Bulletin, July 1947.)

INTENSITY V:

Alviso, Belmont, Bolinas, Alameda, Boulder Creek, Brisbane, Brookdale, Burlingame, Canyon, Chualar, Cotati, Fairfax, Greenfield, Hollister, Kentfield, Los Gatos, Mill Valley, Montara, Mount Eden, Mount Hamilton, Niles, Pedro Valley, Pleasanton, Robles Del Rio, Salinas, San Anselmo, San Ardo, San Bruno, San Gregorio, San Leandro, San Rafael, Santa Cruz, Saratoga, Sharp Park, Soquel, Stinson Beach, Sunnyvale, Tiburon, Tres Pinos, and Woodacre.

INTENSITY IV:

Agnew, Altamont, Antioch, Big Sur, Bitterwater (Lonoak), Campbell, Castroville, El Cerrito, Forestville, Fulton, Glenwood, Gonzales, Half Moon Bay, Lafayette, Los Altos, Martinez, Mission San Jose, Monterey, Moss Beach (6 miles southeast of), Newman, Newark, Palo Alto, Petaluma, Pinole, Redwood City, San Benito, San Juan Bautista, San Lorenzo, San Lucas, San Mateo, San Ramon, Santa Rosa, Sausalito, South San Francisco, Stevinson, Sunol, Saint Mary's College, and Tassajara Hot Springs.

INTENSITY I TO III:

Alamo, Byron, Corte Madera, Diablo, Hayward, Idria, King City, La Honda, Livermore, Loma Mar, Moraga, Mills College, Menlo Park, Novato, Pescadero, Patterson, Tracy, Vallejo, Vernalis, Volta, and Warm Springs.

Negative reports were received from 70 places.

**June 22:** 16:08. Slight shock at Watsonville, intensity III.

**June 25:** 10:39:53*, 10:41:21*, and 12:55:54.* Epicenter 34°15′ north, 119°30′ west, P. Three shocks felt near Carpinteria, 2 slightly, the last sharply.

**July 4:** 22:41. South Dos Palos. Motion rapid, lasted 2 or 3 seconds. Felt by several in home.

**July 6:** 20:40:30.* Epicenter 36°46′ north, 121°25′ west, B. Felt over a small area of the coastal region with limits of affected area extending from Sausalito northeast to Pinole, southeast to Hollister, south-southwest to Tassajara Hot Springs, and northwest to Monterey. Maximum intensity V at Hollister where windows and doors rattled and walls creaked. The strong-motion instrument in Hollister was operated.

INTENSITY IV:

Monterey, San Martin, South San Francisco, and Tassajara Hot Springs.

INTENSITY I TO III:

Aptos, Castroville, Chualar Canyon, Pinole, Salinas, and Sausalito.

Negative reports were received from 49 places.

**July 13:** 21:40:06.* Epicenter 35°55′ north, 119°55′ west, near Kettleman Hills, P. Felt by several in Kettleman City. Windows rattled and walls creaked. A rumbling sound was heard.

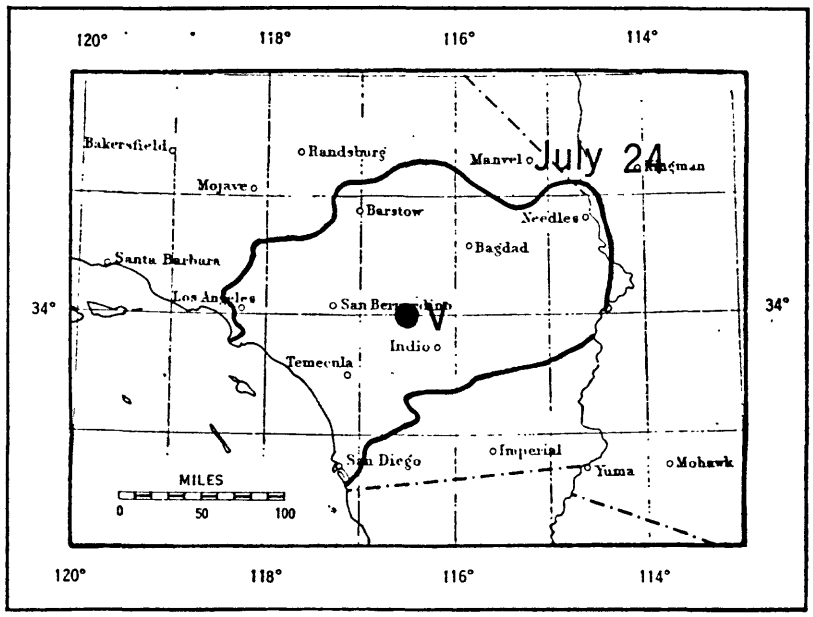


FIGURE 8.—*Area affected by the earthquake of July 24.*

**July 16:** 14:08. Sand Canyon Aqueduct Station. Intensity IV quake lasting 4 seconds, felt by several in home and outdoors by some. Windows rattled and walls creaked.

**July 24:** 00:45. Markleeville. Slight shock felt by several in community 5 miles from Markleeville.

**July 24:** 09:10. Wildomar. Motion rapid, lasted 2 to 3 seconds. Direction E.-W., ground compact. Felt by several in community.

**July 24:** 14:10:46.* Epicenter near 34°01′ north, 116°30′ west, Morongo Valley, P. Aftershocks at 14:54:26*, 16:46:31*, and 22:19:49.* Series felt over approximately 35,000 square miles. Maximum intensity V. See map, page 23. Strong-motion earthquake records were obtained from instruments in the Hollywood Storage Building and the Subway Terminal Building in Los Angeles.

Beaumont press reports indicate the shock was moderate and followed by a gentle, rocking motion, movement being in a N.-S. direction. In Los Angeles, more than 100 miles from the epicenter, the City Hall swayed gently. In San Diego, two of the shocks were felt by residents, the first being felt especially on upper floors of tall buildings in the downtown area. Dishes rattled and chandeliers swayed throughout the city. Heavy chandeliers swung in the Santa Ana courthouse.

INTENSITY V:

Aguanga, Big Bear City, Cabazon, Calimesa, Fawnskin, Forest Home, Fullerton, Highland, Indio, Los Angeles, Mountain Center, Mount Wilson, Palm Springs, and San Diego.

INTENSITY IV:

Acton, Alhambra, Anza, Beverly Hills, Claremont, Coachella, Covina, Hemet, Jacumba, Laguna Beach, La Habra, Ludlow, Montebello, Moreno, Oak Grove Ranger Station, Oceanside (10 miles northwest of), Orange, Palomar Mountain, Pasadena, Perris, Redlands, Riverside, San Bernardino, San Juan Capistrano, Spadra, Summit, Tustin, Twentynine Palms, Van Nuys, White Water, and Wrightwood.

INTENSITY I TO III:

Amboy, Avalon, Baker, Barstow, Beamont, Cadiz, Cedar Springs, Compton, Corono (Estelle Peak Lookout), Costa Mesa, Desert Center, Escondido, Fall Brook, Fillmore, Glendale, Glendora, Huntington Beach, Lake Arrowhead, Long Beach, Lucerne Valley, Mecca, Midland, Miramar, Needles, Newberry, Pomona, San Pedro (City Hall), Santa Fe Springs, Santa Monica, Santa Ysabel, Vidal, and Yorba Linda.

Negative reports were received from 60 places.

**July 25:** 07:30 and 08:15. White Water. Motion rapid, lasted a few seconds. Ground level, loose, gravel. Felt by several in community. Windows, doors and dishes rattled, doors creaked. Hanging objects swung.

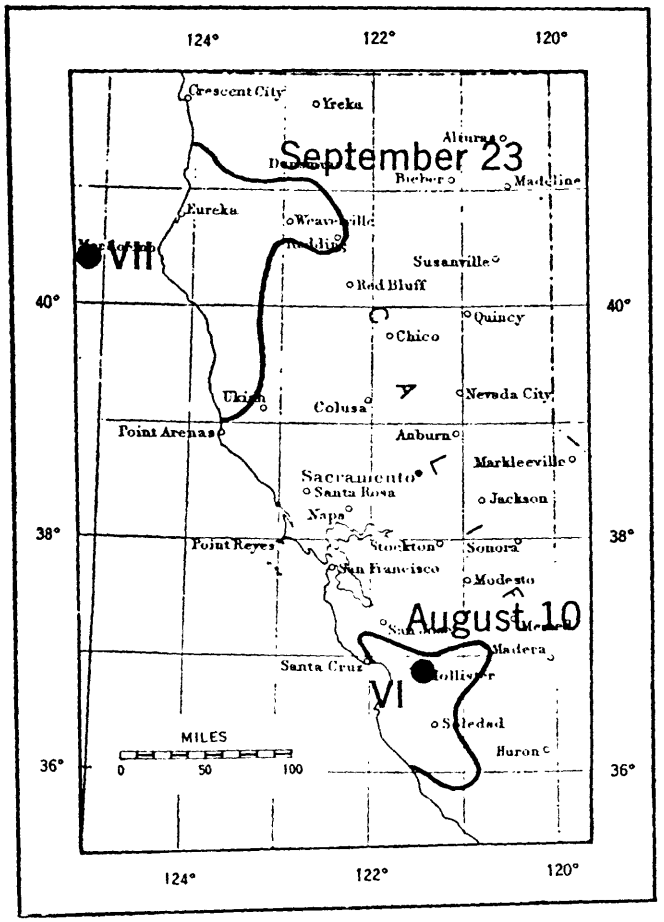


FIGURE 9.—*Areas affected by the earthquakes of August 10 and September 23.*

**July 25:** 23:55. Upper Mattole. Motion rapid, lasted 6 seconds. Ground compact. Rattled windows, doors, and dishes slightly. Trees and bushes shaken slightly. Also felt at Scotia where motion was rapid, abrupt, direction W.-E. Doors and windows rattled; house creaked.

**July 27:** Sequoia National Forest, Calif. "Observers at the Forest Service lookout station atop Tobias Peak in the Sequoia National Forest reported that a sharp earthquake shook their station on July 27. It sent boulders plunging down the mountains, blocking the trail to the station." (SSA Bulletin, October 1947.)

**July 29:** 20:50:18.* Epicenter 34°00′ north, 117°20′ west, near Riverside, P. Felt in Hemet and the San Jacinto Valley.

**July 31:** 11:12. Los Angeles. Motion slow, lasted 3 seconds. Felt by observer in office in Hall of Records.

**August 1:** 07:42:30.* Epicenter 35°00′ north, 117°00′ west, north of Barstow, P. Felt in community of Barstow. Direction E.-W. Some noise heard at time of shock.

**August 10:** 13:58:24.* Epicenter 36°53′ north, 121°25′ west, B. Felt over approximately 3500 square miles in area extending from Glenwood southeast to Los Banos Creek, south to San Ardo, and northwest to Big Sur on the coast. Maximum intensity VI. Hardest hit was the Hollister area where two plate-glass windows in a furniture store were cracked, an ornamental stone pillar on a house on Monterey Street was split, and cans and bottles fell from a number of grocery and drugstore shelves. A stationery store reported broken porcelain figurines and a broken mirror. One water main leading to a residence was broken. Patrons of a local theater were startled by the quake which rocked the building, and a few persons who had started for the exits when the shock began, returned to their seats when it ended. Moderately loud subterranean sounds were heard by many before the shock. Slight settlement was noticed toward an adjacent excavation on the west side of the City Hall. Trouble was experienced after the shock with the west door of the fire station located in the building. The door jammed at the floor. Two vertical cracks on the west side of the building were widened. The pendulum clock on the east wall of the Public Library was stopped. Seven miles south of Hollister a large tree located on valley fill was observed to sway heavily in the north-south direction. A small slide occurred from a sidehill cut on a private ranch roadway. Nine miles south of Hollister plaster cracks were reported; at a winery building differential settlement occurred at the junction of old and new portions, the older section having settled with respect to the newer. A transverse crack was noticed extending all the way across a concrete platform about 4 feet wide.

INTENSITY V:

Glenwood, Los Banos Creek, Pinnacles, Soledad, and Tres Pinos.

INTENSITY IV:

Chualar (8 miles east of), Monterey, and Salinas.

INTENSITY I TO III:

Big Sur, Gilroy, San Ardo, and San Juan Bautista.

Negative reports were received from 12 places.

**August 13:** 12:08:59.* Epicenter 35°00′ north, 117°00′ west, north of Barstow, P. Felt by many in Post Office in Barstow. Direction E.-W. Rattled windows, doors, and dishes.

**August 19:** 05:31:56.* Epicenter 36°35′ north, 121°34′ west, B. Felt by many on ranch in hills near Chaular Canyon. Rattled windows. Felt slightly in a home 7 miles south of Hollister.

**August 22:** 06:54. Sand Canyon. Motion rapid, lasted 3 seconds. House creaked, trees and bushes shaken moderately.

**September 4:** 01:38. Kern Canyon Powerhouse No. 1. Motion bumping, with abrupt onset. Felt by several.

**September 7:** 00:25:55.* Epicenter 33°48′ north, 117°08′ west, near Lakeview, P. Felt by several in Perris. Rattled windows, doors, and dishes. House creaked. Some residents reported hearing grinding noises the night of the 6th attributable to an earthquake.

**September 7:** 21:45, 21:52*, 22:20, 22:30*, and 23:13.* Epicenter 39.3° north, 120.2° west, B. Felt strongest by persons along rim of Washoe Lake basin in southern Washoe County, Nevada. Plaster cracked from ceiling and mortar was loosened in stone walls of a ranch home on the Mt. Rose highway about 16 miles from Reno. The rancher reported the second shock was severe and the last one very severe. At Carson, 4 quakes were reported, the heaviest one at 21:55. Foundation of a house under construction near the high school football field was cracked. At both Carson and in the Washoe Valley some persons reported hearing a rumble just before the quakes. At Marlette Lake, Minden, and Reno, loose objects rattled and buildings creaked.

**September 20:** 10:01:52.* Epicenter 36°52′ north, 121°52′ west, B. Watsonville. Felt more on the east and north sides of Watsonville, much stronger in country than in town. Windows and dishes rattled. Trees and bushes shaken strongly. At Moss Landing, dishes rattled and chandeliers swayed. Workers reported buildings swayed in Watsonville Junction.

**September 23:** 05:52:55.* Epicenter 40.4° north, 125.2° west, B. Felt over an area of about 4,000 square miles in area extending from Orick to Redding to Elk. Isolated reports were received from San Francisco, Occidental, and 3 miles north of Big Bend. Maximum intensity VII. Strong-motion earthquake records were obtained from instruments in Eureka and Ferndale.

INTENSITY VII:

*Punta Gorda Light Station.*—Awakened and frightened all at light station. Rattled windows and dishes. Hanging objects swung N. Knickknacks and books fell, plaster cracked. Heavy vibrations were felt at sea, 40°51′ north, 124°45′ west.

INTENSITY VI:

*Bridgeville.*—Motion slow and of long duration. Rattled windows. Hanging objects swung. Trees and bushes shaken moderately. Also felt 7 miles northeast, 3 shocks with swaying motion. Ground rocky, mountainous terrain.

*Eureka.*—Motion rapid, lasted 10 seconds. Felt by many in home and community. Level, compact soil. Hanging objects swung.

*Ferndale.*—Motion rapid, gradual, lasted 30 seconds. Rattled windows and doors, walls creaked.

*Fields Landing.*—Motion slow. Felt by, awakened, and frightened many in community. Rattled windows, doors, and dishes. Trees and bushes shaken moderately. Ground level, marshy.

*Kneeland.*—Motion between rapid and slow. "This shock was different than any we have ever experienced. It began light, got strong, then became light, and house almost stopped quivering when it started in again as before."

*Upper Mattole.*—Motion rapid, lasted 7 seconds. Direction SW. Rattled windows and doors. "Lulled in middle, then came harder."

INTENSITY V:

Arcata, Bell Springs, Benbow, Blocksburg, Blue Lake, Comptche, Denny, Ettersburg, Fort Bragg, Garberville, Holmes, Honeydew, Island Mountain, Korbel, Petrolia, Rockport, Scotia, and Westport.

INTENSITY IV:

Alderpoint, Big Bend, Burnt Ranch, Carlotta, Elk, Harris, Hoopa, Mendocino, Miranda (4 miles south of), Occidental, Orick, Piercy, Redding, San Francisco, Trinidad, Trinity Center, and Willits.

INTENSITY I TO III:

Dos Rios, Laytonville, Spyrock, and Weaverville.

Negative reports were received from 50 places.

**September 25:** 04:27:51.* Epicenter 36°52′ north, 122°11′ west, B. Santa Cruz and Soquel. This earthquake caused no damage but was the most severe felt in Santa Cruz for a long time. Residents reported the quake was preceded by a noise like a blast. Felt by several in Soquel where windows rattled.

**September 26:** 23:30. Epicenter 40.3° north, 120.6° west, B. Flanigan, Nev. Motion bumping, rapid onset. Creaking of buildings and rattling of loose objects heard by several. Ground sandy.

**September 30:** 05:00. Brawley. Three light shocks rattled dishes.

**October 1:** 04:11. Redding. Motion rapid, felt by several. Rattled windows, doors, and dishes; awakened sleepers. Direction SE. Ground rock, compact, level.

**October 1:** 18:53. Upper Mattole. Motion rapid, lasted 3 seconds. Felt by all in community. Trees and bushes shaken slightly. At Ferndale and Scotia, houses creaked, hanging objects swung; windows, doors, and dishes rattled.

**October 8:** 16:25:49.* Epicenter 37°42′ north, 122°11′ west, B. Abrupt shock with sharp onset. Felt by several at St. Mary's College in Contra Costa County. Rattling of loose objects and creaking of buildings heard by observer. Also reported felt in San Leandro.

**October 12:** 01:36:29.* Epicenter 33°58′ north, 117°17′ west, east of Riverside, P. Motion rapid, quite sharp, wavelike, lasted 1 or 2 seconds. Felt by several in Riverside. Direction from E. Shook entire house. Ground compact, level.

**October 12:** 16:35. Sand Canyon Aqueduct Station. Motion mild, lasted 1 second. Felt in home and community.

**October 12:** 21:40. Bridgeville (7 miles northeast of). Two shocks with trembling motion and gradual onset. Slight creaking of building heard by observer.

**October 12:** 23:25:07.* Epicenter 33°51′ north, 118°43′ west, Santa Monica Bay, P. Felt sharply in a 5-mile radius in Malibu region. A telephone was knocked from a desk in the sheriff's office in Pasadena. Felt by several as a severe jolt in Latigo Canyon. Hanging objects swung south; windows, doors, and dishes rattled. Small objects and furnishings were shifted. Santa Monica reported "just one severe shock of short duration but was a stiff jolt." A single sharp jolt was reported from Van Nuys and North Hollywood.

**October 13:** 01:15. Los Angeles. Motion slow, abrupt, lasted 15 seconds. Felt by observer. Direction from N. Ground soil, level.

**October 13:** 06:06:48.* Epicenter 33°56′ north, 116°42′ west, near White Water, P. Awakened many in Palm Springs. Felt by some outdoors. Motion bumping, from north, with abrupt onset. Faint subterranean sounds were heard before shock.

**October 20:** 18:45:58.* Epicenter 37°20′ north, 121°38′ west, B. Felt 6 miles east of San Jose. Motion slow, lasted a few seconds. Direction NE. Ground soil, compact, sloping.

**November 3:** 00:15. San Leandro. Slight shock awakened residents.

**November 3:** 00:44. Kernville. Deep rumbling sound heard increasing in volume and ending in a loud report. Very little discernible movement or shock. Felt by observer in home. Ground rock, sloping.

**November 3:** Between 12:15 and 12:16. San Leandro. Slight shock awakened residents. Recorded at the University of California seismograph station.

**November 3:** 16:20. San Francisco. Felt by observer in home. "Shock was so slight that I was not sure it was an earthquake until I noted mention of it in paper."

**November 6:** 22:50. Paradise. Slight shock felt by several residents.

**November 7:** 08:50. Los Angeles. Slight shock reported by several on 12th floor of Hall of Records.

**November 7:** 19:02:03.* Epicenter 33°51′ north, 117°17′ west, north of Perris, P. Felt by a few in Riverside. "Some noise, slight shock."

**November 9:** 18:22:55.* Epicenter 34°24′ north, 116°25′ west, east of Old Woman Springs, P. Reported from Pisgah Substation near Ludlow where rattling of windows, doors, and dishes was just audible.

**November 9:** 22:49:21.* Epicenter 39.8° north, 122.7° west, B. Felt by few in Paradise. Trees and bushes shaken slightly. At Chrome, 3 short crosswise jigs were felt. Direction NW.-SE. Awakened many in home and community. House creaked.

**November 12:** 00:20. Soda Springs, north section. Two shocks felt by several. Loose objects rattled and buildings creaked. Moderately loud rumble preceded first shock. Second shock was less severe, of shorter duration, and disturbed objects only slightly.

**November 12:** 05:22:35.* Epicenter 37°17′ north, 121°51′ west, B. Shock rocked homes throughout the Alum Rock district and was accompanied by a loud noise. Six miles east of San Jose the shock rattled windows and doors. Houses creaked.

**November 15:** 14:29:36.* Epicenter 36°47′ north, 122°07′ west, B. Felt by few in northeast section of Santa Cruz. Loose objects rattled, buildings creaked. Rumbling sound like distant thunder heard

by one person during shock. Felt by several in Pfeiffer Big Sur State Park. Loose objects rattled, buildings creaked. Chandelier swung, dishes and pans rattled slightly. Ground rocky.

**November 18:** 13:59:05.* Epicenter 33°16′ north, 119°27′ west, north of San Nicolas Island, P. Press reports indicated this shock was moderately severe, felt along the northern seacoast of southern California at Santa Barbara, Redondo Beach, and Hermosa Beach. It was unnoticed in San Bernardino, Santa Ana, and Long Beach. Downtown Los Angeles buildings including the towering City Hall swayed noticeably. Also felt in Wilmington and San Pedro, and in Hollywood it was reported as moderately heavy.

INTENSITY VI:

*San Nicolas Island, central section.*—Two shocks, one at 1:57 and another at 1:59. Rocks fell but there were no serious landslides. Unusually large breakers noticed at beach for a short period and ground was observed to roll as waves on the sea. Rattling of loose objects and creaking of buildings heard by all. Thunderous subterranean sounds which decreased rapidly heard at time of shocks. General shaking and rocking of buildings. Objects fell toward NE., doors swung toward NE. Pen arm on microbarograph jolted about an inch upward.

INTENSITY V:

Los Angeles (Post Office, and Weather Bureau), and Ventura.

INTENSITY IV:

Lomita and Redondo Beach.

INTENSITY I TO III:

Agoura, Huntington Beach, and San Pedro (City Hall).

Negative reports were received from 17 places.

**November 25:** 09:09:14.* Epicenter 34°01′ north, 116°38′ west, near Morongo Valley, P. Felt in central section of Palm Springs. Rattling of loose objects and creaking of buildings heard by several. Faint subterranean sounds heard by several at time of shock. Also felt slightly at White Water by people outdoors. Doors rattled.

**November 25:** 10:09:02.* Epicenter 39.3° north, 119.8° west, B. Carson City, Nev. (central section). Single light shock felt by several. Motion bumping with abrupt onset.

**December 14:** 05:43. Upper Mattole. Motion rapid, lasted 4 seconds. Direction E. Rattled windows, doors, and dishes; house creaked. Trees and bushes shaken slightly. Also felt by several in Ferndale.

**December 16:** 01:02:49. Epicenter 34°00′ north, 118°19′ west, P. Los Angeles (southwest section). Two tremors with 5-second interval felt in the Leimert Park and West Adams districts. Dishes and windows rattled but no damage was reported. Numerous telephone calls were received at the City Hall switchboard from alarmed residents.

**December 16:** 01:21:03.* Epicenter 36.3° north, 120.7° west, west of Coalinga, P. Felt by many in San Lucas, awakened a few. Windows and dishes rattled.

**December 17:** 08:30. Sand Canyon Aqueduct Station. Motion rapid, lasted 1 second. Felt by several in home. Direction E.-W. Windows rattled and walls creaked.

**December 17:** 19-21. Twentynine Palms. Rapid vibrating motion, lasted 6 seconds. Felt by observer and two others in home. Ground compact, level.

**December 18:** 03:19:33.* Epicenter 37°04′ north, 121°41′ west, B. Morgan Hill. Felt by and awakened many in home and community. Direction E.-W. Ground soil, compact, valley floor.

**December 18:** 11:30:06.* Epicenter 36°07′ north, 120°54′ west, near San Lucas, P. Parkfield. Motion sharp, lasted 1 second. Felt by several in Post Office. Windows, doors, and dishes rattled; walls creaked. Ground soil, level.

**December 22:** 18:02:03.* Epicenter 37°49′ north, 121°51′ west, B. San Ramon. Motion rapid and brief. Felt in home. Rattled windows, doors, and dishes. Other shocks reported felt at 01:00, 08:00, 09:00, and 20:00.

**December 24:** 22:05 and 22:20. Cambria. Motion rapid, lasted 3 seconds each shock. Felt by many in community. Direction S.-N. Windows and doors rattled; knickknacks fell.

**December 30:** 11:18:14.* Epicenter 34°58′ north, 116°56′ west, near Barstow, P. Motion rapid, very short. Felt in Post Office in Barstow. Direction N. Rattled windows and doors. Ground compact.

## WASHINGTON AND OREGON

(120TH MERIDIAN OR PACIFIC STANDARD TIME)

**January 12:** 01:40. Strongest at Bothell and Snoqualmie Falls, Wash. Felt by several in lodge hall in Fall City and in homes in Monroe and North Bend.

**April 1:** 16:58. Olympia, Wash. Press reports shock of low intensity felt strongest in downtown district of Olympia and in Quilcene. A Boston Harbor resident reported a short, rocking motion which lasted about 1 second. A woman in Seattle felt a piano stool rock. Professor H. A. Coombs of the University of Washington stated the quake originated within 40 miles of Seattle and was "just barely felt."

**September 20:** 02:30. Puyallup, Wash. Light shock felt by two persons in home. Dishes rattled and small objects were shifted. Rather loud noise at time of shock. Hanging objects swung NE. in Cove; and Eatonville residents reported windows, doors, and dishes rattled, a few were awakened.

**November 23:** 01:46:05.* See section on Western Mountain region for reports from Washington on this shock which centered in southwestern Montana.

**December 22:** 02:30. North-central Washington. Shock of intensity IV awakened several in Entiat neighborhood, and few in Lucerne, Orondo, and Tonasket (12 miles east of). Windows rattled in Entiat,

and in Orondo windows, doors, and dishes rattled; houses creaked. One person at the latter place reported a rumbling, rattling sound.

**December 24:** 12:02. Klamath Falls, Oreg. Felt by several in central section of town, motion trembling, swaying. Loose objects rattled and buildings creaked. Pictures on walls and suspended lighting fixtures swayed. Few were alarmed. Faint bumping sounds heard.

### ALASKA

(150TH MERIDIAN OR ALASKA STANDARD TIME)

**January 2:** 09:13. McGrath. Slight shock felt, 30 seconds duration. Some cribbing was knocked from under river steamer but no other damage was reported.

**February 3:** 09:30, 11:00, and 13:30. Ketchikan. Light shocks felt.

**April 29:** 18:52.5. Juneau (airport). Light shock of 30 seconds duration felt by several.

**June 5:** 14:04. Anchorage. Light shock felt by many in eastern section of town. Disturbed objects observed by several. Rocking motion swung lights suspended from ceiling in frame building.

**June 28:** 23:59. Juneau. Three light shocks felt in north section of town. Floor lamps and similar objects rattled for 2 or 3 seconds. Only a few recognized it.

**July 27:** 17:50. Fairbanks. Slight shock felt by many in central part of town. Rocking motion, lasted about 30 seconds. Pendant light fixtures swayed.

**August 4:** 21:30. Anchorage. Light shock with swaying motion noticed by majority of populace.

**August 27:** 15:54. Fairbanks. Moderate shock felt.

**October 16:** 16:09:45.* Epicenter 64.5° north, 148.8° west, about 40 miles southwest of Fairbanks, Alaska. Intensity VIII reported at Fairbanks and Nenana. This swarm of earthquakes consisted of over 200 fore- and aftershocks, intense activity on 16th and severe aftershock on 20th. The center of disturbance was southeast of Nenana at the Salcha River Fault.

Cracks were found from Shaw Creek on Richardson Highway to headwaters of the Kantishna and Tolavana Rivers, in river mud as well as ice. Fifteen miles below Chena Bluffs on the Tanana River, cracks were 22 inches wide, between 6 and 12 inches deep, and in many cases several hundred feet long. A few instances of bulging (pressure ridges) were noted where large frozen blocks came together. Surface layer movement was in excess of 3 feet.

Surface effects of shock waves extended west from Nenana into the Cosno Hills and south into the middle reaches of the Kantishna River leaving shatter cracks some ¾ mile long and 10 feet wide. Average cracks in the Kantishna were possibly 10 to 20 percent larger than those in Tanana River Valley. Cracks were quite extensive and were plainly seen from an airplane at 2,000 feet. Landslides occurred on Richardson Hill and Shaw Creek Hill on Richardson Highway. Rockslides occurred about halfway between Nenana and Fairbanks on the Tanana River. The Alaska Railroad reported rails bent between Julius, Nenana, and Browne, and some changes in elevation of the road bed.

Reports from the following listed places are condensed from an article by Pierre St. Amand entitled "The Central Alaska Earthquake Swarm of October 1947" published in the Transactions of the American Geophysical Union, Vol. 29, No. 5, October 1948. Beaver, Browne, Central, Chicken, Clear, Ester Creek, Ferry, Gulkana, Healy Forks, McKinley Park Station, Rampart, and Tetlin.

INTENSITY VIII:

*Fairbanks.*—Many residents fled to streets. Heavy damage to drug, grocery, and liquor supplies as stocks rolled from shelves. Flower pots and numerous windows broke. A heavy cabinet tipped over on third floor of Federal Building, clocks were stopped. Plaster fell from walls in District Court. Telephone wires jiggled; powerline near University of Alaska short-circuited. Furniture moved about and carbon dioxide bottles overturned at Pepsi-Cola plant. People in moving automobiles felt the tremors. A number of well-water increases were reported.

*Nenana.*—Town in general was shaken hard. Small fissures opened in ground near airport. One chimney cracked sufficiently to put hand in, furniture moved about, and cups were shaken off cup hooks. Several long cracks appeared in ground, streets were upheaved in several places. One resident reported water gushed from well pump; a well at the Experimental Farm which had been practically dry during previous year renewed flow of water and filled a 10,000 gallon tank in a short while. The 300 foot tower of radio station KFAR reportedly did a veritable dance. Water splashed from tank 10 feet in diameter, 8 feet high, mounted on concrete foundation and filled to within 6 inches of top.

INTENSITY VII:

*Beaver.*—Noise heard before quake struck. First motion from south. Several minor cases of dizziness. Suspended objects moved. Open leads reported in river; course of water changed in one right limit slough of Yukon. High willow trees swung round and round.

*Berg.*—Felt by men in railway car. Pile of ties fell over. Train crew a short distance away was inclined to stop train to investigate shaking. Canned goods fell from shelves in log cabins, cupboard doors swung open, and water splashed from teakettle.

*Clear.*—Felt by everyone, including man driving caterpillar tractor. Some found it difficult to stand without support. Standing automobiles not in gear or with brakes on moved back and forth several feet. Heavy objects fell over and suspended bags in Barracks swung through 2 foot arc. Many prefabricated buildings were thrown out of line, one wall pulled out 2 inches.

*McKinley Park Station.*—Panels in very well-built station house pulled about one-half inch from walls. Unstable objects overturned, furniture moved slightly. A number of objects fell from shelves.

INTENSITY VI:

*Central.*—People left buildings. Cars standing in 7 inches of snow moved 2 inches. Trees and radio poles swayed violently.

*Ester Creek.*—All frightened. Many articles shaken from shelves, some rolled across floor. Clouds of dust rose from slides on hill. A number of dishes broke.

*Ferry.*—Everyone ran outdoors. Station house moved violently. Water splashed from pail filled to within 4 inches of top; furniture moved about, unstable objects fell over. Doors stuck. Many strong aftershocks reported felt.

*Healy Forks.*—Mine timbers cracked and loud noises heard in Suntrana Coal Mine, 4 miles distant. Boulders were shaken from hillsides, banks are very steep.

INTENSITY V:

Blair Lake, McGrath, Rampart, and Tetlin.

INTENSITY IV:

Anchorage, Big Delta, Chicken, Ladd Field, and Tanacross.

INTENSITY I TO III:

Beaver (7 miles north of), Cordova, Gulkana, Harding Lake, Koyukuk, Northway, and Wiseman.

### HAWAIIAN ISLANDS

(HAWAIIAN STANDARD TIME)

**February 26:** 18:54. Slight shock. Felt generally in eastern Hawaii.

**March 13:** 03:52. Slight shock. Felt at Hawaiian Volcano Observatory.

**March 15:** 16:14. Slight shock. Felt at Hawaiian Volcano Observatory.

**Match 19:** 23:06. Moderate shock. Widely felt on Island of Hawaii. Mauna Loa seismographs were dismantled.

**March 29:** 20:11. Slight shock. Felt at Hawaiian Volcano Observatory and at Hilo.

**June 14:** 23:00. Moderate shock. Felt at Hawaiian Volcano Observatory and as far as Papaikou. Mauna Loa instrument was dismantled.

**June 19:** 05:24. Moderate shock. Felt at Hawaiian Volcano Observatory. E.-W. seismograph was dismantled.

**June 26:** 14:23. Slight shock. Felt at Hawaiian Volcano Observatory, Naalehu, and Hilo.

**August 7:** 20:36. Slight shock. Felt at Hawaiian Volcano Observatory, Naalehu, and Hilo.

**August 18:** 09:52. Moderate shock. Felt at Hawaiian Volcano Observatory and Naalehu. E.-W. seismograph was dismantled at Observatory.

**August 19:** 06:44. Slight shock. Felt at Hawaiian Volcano Observatory, Naalehu, and Mauna Loa.

**September 21:** 05:50. Slight shock. Felt widely on Hawaii and by a few at Maui.

**September 30:** 04:04. Moderate shock. Generally felt from South Kona to Hilo. Instruments were dismantled at Hawaiian Volcano Observatory.

**October 17:** 00:27. Slight shock. Generally felt on eastern part of Hawaii near Kapapala.

**October 31:** 02:13. Moderate shock. Widely felt in eastern half of Hawaii. Clocks stopped in South Kona. E.-W. seismograph was dismantled at Hawaiian Volcano Observatory.

**December 14:** 10:10. Moderate shock. Felt at Hawaiian Volcano Observatory and Hilo. E.-W. seismograph was dismantled.

**December 17:** 00:01. Slight shock. Felt at Kapapala.

**December 20:** 05:18. Slight shock. Felt in eastern half of Hawaii.

**December 24:** 06:38. Slight shock. Felt at Hawaiian Volcano Observatory, Hilo, and Naalehu.

### PANAMA CANAL ZONE

(SIXTIETH MERIDIAN TIME)

**November 9:** 06:08. Light shock felt by many throughout the Canal Zone. Some were awakened from sleep.

### PUERTO RICO

(SIXTIETH MERIDIAN TIME)

**July 10:** 04:45:49.* Caguas. Light shock reported felt.

**August 24:** 24:05:20.* Light shock reported felt in eastern Puerto Rico and Virgin Islands.

## MISCELLANEOUS ACTIVITIES

### GEODETIC WORK OF SEISMOLOGICAL INTEREST

During the calendar year 1947, detailed triangulation in California was completed from Santa Cruz northward to Point Reyes. Repeat triangulation observations were made over a number of stations previously established in connection with seismological studies. It is evident from observations made over a period of years since 1885 that horizontal movement is occurring to the westward of the San Andreas Fault line in California, in some localities amounting to over 10 ft. Data concerning such movement are of value to seismologists as an indication of the possibility of a definite fracture occurring when the resulting strain is so great that it must be relieved. It is planned to repeat these triangulation observations at periodic intervals of from 5 to 10 years.

In Southern California detailed triangulation, traverse, and leveling were accomplished at the earthquake fault line near Palmdale, Calif. It is planned to repeat these observations periodically to determine the extent of suspected earth movements.

At the request of the Bureau of Reclamation accurate elevations were determined for bench marks established at 1-mile intervals along two lines of leveling extending from Bakersfield to Red Bluff, Calif., totaling 1,000 miles. One line follows the east and one line follows the west side of the valley. Cross ties were run between these two lines at about 30-mile intervals.

A similar project for the determination of accurate elevations was undertaken in the vicinity of Delano, Calif. There is evidence of subsidence in the Central Valley of California and in the vicinity of Delano, and it is planned to run periodic leveling to lines already established to determine the extent and characteristics thereof. These earth movements will be of interest to seismologists to determine the possible relationship to earthquake movements.

### TIDAL DISTURBANCES OF SEISMIC ORIGIN

No tidal disturbances of seismic origin were noted during the year.

## SEISMOLOGICAL OBSERVATORY RESULTS

The Coast and Geodetic Survey publishes the results of its teleseismic stations and cooperating stations in the quarterly Seismological Bulletin. In these reports 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. The last Bulletin to be issued to date covers the fourth quarter of 1945.

Instrumental results are published for the following observatories:

Balboa Heights, Canal Zone.
(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 United States Weather Bureau).
College, Alaska.
(University of Alaska).
Columbia, S. C.
(University of South Carolina).
Grand Coulee, Wash.
Honolulu, T. H.
Huancayo, Peru.
(Peruvian Government).
Hungry Horse, Mont.
Lincoln, Nebr.
(Nebraska Wesleyan University).
Logan, Utah.
(Utah State Agricultural College).
Montezuma, Chile.
(Smithsonian Institution).
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).

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

Boulder City, Grand Coulee, 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, College, Columbia, Lincoln, Rapid City, and Salt Lake City are cooperating University stations.

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

All readings were made or revised at the Washington Office except those for Balboa Heights. The provisional epicenter results for 1945 are listed in table 1. Epicenters of the stronger shocks of 1947 are listed in table 2.

Instruments at the University of Hawaii in Honolulu were transferred to the site of the new magnetic and seismological observatory on October 17, 1946. The Huancayo, Peru, station was transferred by the Carnegie Institution of Washington to jurisdiction of the Peruvian Government, Instituto Geofisico de Huancayo, on July 1, 1947. A new station of the Bureau of Reclamation chain began operating at Hungry Horse Dam, Columbia Falls, Mont., in November 1947.

## Table 1.—*Summary of instrumental epicenters for 1945*

NOTE.—The provisional epicenters in this table are primarily intended to cover earthquakes recorded in the United States. Some of them have been determined by the Coast and Geodetic Survey, and some have been taken from the reports of other organizations and stations. An asterisk (*) indicates probable error of one-tenth minute. In the case of the Pasadena epicenters the time is given in one-tenth minute. The epicenters reported by nearby stations are usually given preference. More detailed information will be found in the Seismological Bulletins of the Coast and Geodetic Survey and in the bulletins of other organizations and stations.

| 1945 | Origin time G. C. T. | Region, focal depth, and remarks | Coordinates of provisional epicenter | |
|---|---|---|---|---|
| | | | Latitude | Longitude |
| | h m s | | ° ′ | ° ′ |
| Jan. 1 | 01 20 43 | Baffin Bay. Mag. 7 | 73 N. | 69½ W. |
| 2 | 02 36 10 | Owens, Lake, Calif. Mag. 3.5 | 36 24 N. | 117 55 W. |
| 5 | 05 18 23* | Galapagos Islands, about 1200 mi. west of | 2 S. | 107 W. |
| 5 | 06 36 16 | South of San Clemente Island, Calif. Mag. 3.6 | 32 36 N. | 118 14 W. |
| 6 | 09 36 25* | Easter Island, about 1000 mi. north of | 12 S. | 110 W. |
| 7 | 22 25 32 | California, near northwest coast. Minor damage in San Benito County. Mag. 5.1 | 36.5 N. | 111.8 W. |
| 9 | 12 17 41* | Haiti, near north coast | 19½ N. | 73 W. |
| 11 | 11 56.0* | Lincoln County, Nev. Mag. 3.8 | 37.4 N. | 114.9 W. |
| 11 | 21 08 40* | Jamaica, off east coast. Felt throughout Island | 18½ N. | 76½ W. |
| 12 | 18 38 27 | Honshu, Japan, near southern coast. Slight damage reported on Honshu. Mag. 6.9. | 34½ N. | 138 E. |
| 12 | 21 59 35 | Mexico, near southern coast. Felt in Chiapas. Depth about 150 km. | 16.0 N. | 93.0 W. |
| 16 | 13 36 42* | Honshu, Japan, near southern coast | 35 N. | 137½ E. |
| 17 | 03 59 18* | Chile, near coast. Felt. Slightly deeper than normal | 35½ S. | 72 W. |
| 18 | 03 12 56* | Atlantic Ocean, southeast of Greenland | 57 N. | 34 W. |
| 18 | 03 45 23* | ----do---- | 57 N. | 34 W. |
| 18 | 18 06 21* | Isthmus of Tehuantepec, near north coast. Felt in Coatzacoalcos. | 18 N. | 94 W. |
| 19 | 05 10 44.6 | Inglewood Fault, Calif. Felt. Mag. 3.5 | 33 56.5 N. | 118 19.5 W. |
| 22 | 07 47 51* | Dominican Republic, near north coast. Felt in Ciudad Trujillo. | 20 N. | 70 W. |
| 23 | 21 34 11 | Near Anza, Calif. Mag. 3.5 | 33 28 N. | 116 42 W. |
| 25 | 00 31 55* | Arctic Circle, off northeast coast of Siberia | 66 N. | 173 W. |
| 25 | 06 00 23* | Bonin Islands region. Depth about 100 km | 27 N. | 140 E. |
| 26 | 04 23 56 | Near Lake Arrowhead, Calif. Felt. Mag. 3.5 | 34 12 N. | 117 09 W. |
| 31 | 09 35 32* | Chile, near coast | 29 S. | 71½ W. |
| Feb. 1 | 10 35 47* | Loyalty Islands region | 22 S. | 169 E. |
| 1 | 12 13 37* | ----do---- | 22 S. | 169 E. |
| 2 | 02 02 30* | Southern Alaska | 60½ N. | 146 W. |
| 2 | 21 37 48* | Ecuador, off coast | ½ S. | 81 W. |
| 2 | 23 27 50* | ----do---- | ½ S. | 81 W. |
| 5 | 08 02 38* | Colombia. Felt in Valle del Cauca | 6 N. | 77 W. |
| 6 | 22 56 11 | Near Inglewood Fault, Calif. Felt. Mag. 3.5 | 33 57 N. | 118 21 W. |
| 10 | 04 57 50 | Honshu, Japan, off northeast coast. Felt in northern Honshu. Slightly deeper than normal. Mag. 7.3. | 41½ N. | 142 E. |
| 12 | 16 24 40* | Chile, near northwest coast. Felt | 32 S. | 72 W. |
| 13 | 11 27 13* | Atlantic Ocean, southwest of Azores | 34 N. | 39 W. |
| 14 | 03 01 15 | Idaho. Felt in Mont., Wash., and Oreg. Mag. 6 | 44.7 N. | 115.4 W. |
| 16 | 08 15 09 | Near Lake Arrowhead, Calif. Mag. 3.0 | 34 12 N. | 117 09 W. |
| 18 | 06 46 25 | Panama, off coast | 7 N. | 82 W. |
| 18 | 10 08 05 | Hokkaido, Japan, off southeast coast. Slightly deeper than normal. Mag. 7.0. | 42 N. | 144 E. |
| 20 | 09 35.8* | Baja California. Mag. 4.0 | 32 N. | 115½ W. |
| 26 | 22 14 24 | Bonin Islands region. Mag. 7.1 | 26 N. | 143 E. |
| 27 | 07 16 23* | Mexico, Bay of Tehuantepec | 15 N. | 95 W. |
| 27 | 09 06 53 | Baja California. Mag. 3.8 | 32.0 N. | 115.5 W. |
| Mar. 1 | 11 19 58 | Baja California, west of Sierra Juarez. Mag. 4.4 | 32 03 N. | 116 09 W. |
| 2 | 10 39 25 | Turkey, near northern coast | 42 N. | 36 E. |
| 2 | 19 42 30* | Bonin Islands region. Depth about 500 km | 25 N. | 143 E. |
| 3 | 14 13 10 | Near Borego Valley, Calif. Mag. 3.4 | 32 58 N. | 116 00 W. |
| 5 | 12 17 05* | Tonga Islands region. Depth about 100 km | 19 S. | 172 W. |
| 11 | 00 01 31 | Little San Bernardino Mountains, Calif. Mag. 3.2 | 34 00 N. | 116 13 W. |
| 11 | 00 20 03 | Little San Bernardino Mountains, Calif. Mag. 3.8 | 33 52 N. | 116 12 W. |
| 11 | 21 37 49 | Honshu, Japan, off east coast. Slightly deeper than normal. Mag. 7.2. | 37½ N. | 142½ E. |
| 12 | 11 03 13 | Northwest of Barstow, Calif. Mag. 3.2 | 35 11 N. | 117 24 W. |
| 17 | 23 57 53 | Colombia, off coast. Felt in Panama Canal Zone. Mag. 6¾. | 6.7 N. | 78.1 W. |
| 18 | 00 21 16* | Kermadec Islands region | 33 S. | 179 W. |
| 18 | 18 54 42* | Alaska Peninsula, south of | 55 N. | 157 W. |
| 18 | 23 18 09 | Azores region. Felt | 38½ N. | 29 W. |
| 19 | 13 19 20* | Chile, off northwestern coast | 23 S. | 72 W. |
| 20 | 07 58 53 | South-central Turkey. Fourteen killed and hundreds injured in series of earthquakes. | 36½ N. | 34 E. |
| 20 | 21 55 07 | Mojave Desert, northwest of Twentynine Palms, Calif. Mag. 5.0. | 34 15 N. | 116 10 W. |
| 22 | 04 23 43* | North-central Chile. Possibly slightly deeper than normal. | 25 S. | 69 W. |
| 23 | 08 13 25* | ----do---- | 26 S. | 69 W. |
| 23 | 23 14 15* | New Zealand, about 1100 mi. southwest of. Mag. 7.1 | 61 S. | 155½ E. |
| 28 | 13 03 06* | New Guinea, off east coast. Possibly slightly deeper than normal. | 5 S. | 146 E. |
| 29 | 04 04 17 | Northwest of Twentynine Palms, Calif. Mag. 4.2 | 34 17 N. | 116 11 W. |
| 29 | 17 53 14 | Northwest of Twentynine Palms, Calif. Mag. 3.7 | 34 17 N. | 116 11 W. |
| 31 | 18 50 45 | Gulf of California. Mag. 5 | 31 N. | 114 W. |
| 31 | 19 27 37 | ----do---- | 31 N. | 114 W. |
| Apr. 1 | 09 02 12* | Tonga Islands. Slightly deeper than normal | 19 S. | 175 W. |
| 1 | 10 43.8 | Gulf of California. Mag. 4.6 | 30.7 N. | 113.9 W. |

**Table 1.—*Summary of instrumental epicenters for 1945*—Continued**

| 1945 | Origin time G. C. T. | Region, focal depth, and remarks | Coordinates of provisional epicenter | |
|---|---|---|---|---|
| | | | Latitude | Longitude |
| | *h m s* | | ° ′ | ° ′ |
| Apr. 1 | 22 20 06* | Salta Province, Argentina | 24 S. | 66 W. |
| 1 | 23 43 42 | Santa Rosa Island, Calif. Felt over most of Santa Barbara and Ventura Counties. Mag. 5.4 | 34 00 N. | 120 01 W. |
| 5 | 08 33.5 | South of Laguna Salada, Calif. Mag. 3.8 | 32 N. | 115 W. |
| 6 | 15 46 45 | San Andreas Fault, near Cabazon, Calif. Felt at Idyllwild. Mag. 3.6. | 34 00 N. | 116 46 W. |
| 6 | 18 30 52 | Northwestern Venezuela. Felt at Cucuta, Colombia | 8¼ N. | 71¾ W. |
| 7 | 10 25 41* | Colombia, near west coast | 5½ N. | 77 W. |
| 7 | 10 31 56 | Near Lucerne Valley, Calif. Mag. 2.9 | 34 33 N. | 116 47 W. |
| 7 | 21 29 30* | Aleutian Islands | 53 N. | 177 W. |
| 10 | 01 22 08* | Hokkaido, Japan. Slightly deeper than normal | 42½ N. | 143 E. |
| 11 | 11 22 27* | Oregon, off coast | 42 N. | 126 W. |
| 11 | 15 18 52* | Kermadec Islands. Slightly deeper than normal | 26 S. | 117 W. |
| 12 | 00 21 10* | Ecuador, off coast | 2 N. | 80 W. |
| 14 | 06 57 38* | Near northwest coast of Chile | 19½ S. | 70 W. |
| 15 | 02 35 29* | Kamchatka, off east coast. Depth about 130 km | 57½ N. | 165 E. |
| 15 | 03 41 32* | Kamchatka. Aftershock | 57½ N. | 165 E. |
| 15 | 19 50 40* | Mexico, off west coast | 22 N. | 107 W. |
| 18 | 04 58 02 | Lucerne Valley, Calif. Felt at Fawnskin and San Bernardino. Mag. 4.3. | 34 26 N. | 116 59 W. |
| 19 | 13 03 55* | Loyalty Islands | 21 S. | 170 E. |
| 20 | 22 32.1 | Baja California. Mag. 4.3 | 31.6 N. | 115.6 W. |
| 20 | 22 34 20* | Tonga Islands, southwest of | 24 S. | 178 W. |
| 21 | 17 14 24 | Mexico, Michoacan Province. Depth about 130 km | 18 N. | 101 W. |
| 22 | 09 45 48 | Gulf of California. Mag. 5.3 | 31.5 N. | 114.0 W. |
| 26 | 13 41 03* | Tonga Islands. Depth about 450 km | 20 S. | 178 W. |
| 28 | 11 09 13 | Near Brawley, Calif. Mag. 3.3 | 33 06 N. | 115 32 W. |
| 28 | 15 44 05* | Panama, off west coast | 5 N. | 83 W. |
| 29 | 20 16 17 | Washington, 10 mi. southeast of North Bend. Felt over whole State. | 47.4 N. | 121.7 W. |
| 30 | 17 27 22* | Tonga Islands. Depth about 500 km | 20 S. | 178½ W. |
| May 1 | 05 57 31* | Northern Chile. Depth about 120 km | 21 S. | 69 W. |
| 1 | 16 34 55* | Western Argentina. Depth about 100 km | 32 S. | 69 W. |
| 2 | 19 47.9 | California. Intensity VI in Trinity and Siskiyou Counties. Felt. Mag. 5.3. | 41.3 N. | 122.5 W. |
| 8 | 18 08 46 | Northern Owens Valley, Calif. Felt. Mag. 4.4 | 37 30 N. | 118 34 W. |
| 9 | 03 31 15* | Banda Sea region. Depth about 550 km | 7 S. | 125 E. |
| 10 | 01 57 35* | Chile, near coast. Depth about 250 km | 18½ S. | 70 W. |
| 10 | 17 53 15* | Peru, off coast. Felt at Lima. Slightly deeper than normal. | 15 S. | 77 W. |
| 12 | 07 33.0 | Baja California, Sierra Juarez. Mag. 5.2 | 31.6 N. | 115.6 W. |
| 13 | 20 27 35* | Mexico, off west coast | 24 N. | 109 W. |
| 15 | 18 28 16 | California, south end of Death Valley. Mag. 3.1 | 35 45 N. | 116 34 W. |
| 17 | 11 17 23 | California, near Twentynine Palms. Mag. 3.2 | 34 14 N. | 116 09 W. |
| 17 | 15 06 47* | California. Minor damage at Hollister. Mag. 4.5 | 37 N. | 121½ W. |
| 18 | 09 44 40 | Kern River Fault, west of Haiwee, Calif. Mag. 4.0 | 36 12 N. | 118 23 W. |
| 18 | 23 35 38* | Hokkaido, Japan, off northeast coast | 44½ N. | 149½ E. |
| 19 | 07 55 46* | Mexico, off southern coast | 16 N. | 98½ W. |
| 19 | 15 07 02 | California, off Cape Mendocino. Felt along northern coast. | 40.6 N. | 126.4 W. |
| 21 | 21 21 14* | Peru, near coast | 14½ S. | 77 W. |
| 28 | 09 39 25* | Fiji Islands. Foreshock | 20½ S. | 174½ E. |
| 28 | 10 08 31* | Southwest of Fiji Islands | 20½ S. | 174½ E. |
| June 1 | 15 13 29* | Aleutian Islands. Depth about 70 km | 52 N. | 170 W. |
| 1 | 15 43 39* | do | 52 N. | 170 W. |
| 1 | 16 54 50 | Montana. Felt at Helena | 46 6 N. | 112.0 W. |
| 1 | 21 20 14 | Near Borego Valley, Calif. Mag. 3.5 | 33 07 N. | 116 01 W. |
| 1 | 22 24 07* | Atlantic Ocean, southwest of Cape Verde Islands | 6½ N. | 34 W. |
| 2 | 06 10 13 | California, northeast of Barstow. Mag. 3.9 | 35 07 N. | 117 14 W. |
| 3 | 13 05 36 | Panama. Felt in Province of Chiriqui. Minor damage at David and Puerto Armuelles. Mag. 7. | 8.6 N. | 82.6 W. |
| 4 | 12 08 55* | Northern India. Slightly deeper than normal. Mag. 7 | 30 N. | 80 E. |
| 4 | 15 53 29* | Panama. Aftershock of June 3 quake | 8.6 N. | 82.6 W. |
| 6 | 07 00 08* | North Atlantic Ocean, approximately 250 mi. southwest of Iceland. | 61 N. | 28½ W. |
| 14 | 03 31 13 | North of Death Valley, Calif. Mag. 5.0 | 37 05 N. | 117 30 W. |
| 15 | 04 18.2* | Aleutian Islands. Slightly deeper than normal | 51 N. | 170 W. |
| 15 | 22 24 21* | Washington, near Georgia Strait. Felt | 48 N. | 123 W. |
| 16 | 19 54 50* | North Atlantic Ocean | 50 N. | 29 W. |
| 17 | 09 03 18 | San Andreas Fault, near Yucaipa, Calif. Mag. 3.4 | 34 05 N. | 117 02 W. |
| 20 | 01 23 45 | Kurile Islands. Foreshock | 46¼ N. | 153 E. |
| 20 | 17 35 07 | Kurile Islands | 46¼ N. | 153 E. |
| 22 | 09 18 36* | Hokkaido, Japan, off northeast coast. Depth about 100 km. Mag. 7. | 44 N. | 146 E. |
| 22 | 18 00 48* | India, Kashmir Province | 32½ N. | 76½ E. |
| 23 | 20 26 00* | South Atlantic Ocean, Sandwich Islands Group | 56½ S. | 25 W. |
| 24 | 19 57 56* | Chile, approximately 100 mi. south of Santiago. Depth about 100 km. | 35 S. | 71 W. |
| 26 | 01 57 00* | Peru, off coast | 17 S. | 76 W. |
| 26 | 21 25 23* | Pacific Ocean, approximately 250 mi. off coast of Panama | 5 N. | 83 W. |
| 27 | 13 08 18 | Gulf of California. Felt at Santa Rosalia, Baja California. Mag. 7. | 26.7 N. | 111.3 W. |
| 27 | 18 08 05* | Gulf of California. Aftershock | 26.7 N. | 111.3 W. |
| 28 | 09 08 22 | Near Borego Valley, Calif. Mag. 3.1 | 32 58 N. | 116 00 W. |
| 29 | 02 36 44 | do | 32 58 N. | 116 00 W. |
| 30 | 05 31 16* | Pacific Ocean, approximately 800 mi. off west coast of Mexico. Mag. 6¾. | 16½ N. | 116 W. |
| 30 | 18 18 25* | Northern Colombia. Slightly deeper than normal | 9½ N. | 75 W. |

**Table 1.—*Summary of instrumental epicenters for 1945*—Continued**

| 1945 | Origin time G. C. T. | | | Region, focal depth, and remarks | Coordinates of provisional epicenter | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Latitude | | | Longitude | | |
| | *h* | *m* | *s* | | ° | ′ | | ° | ′ | |
| July 2 | 08 | 31 | 00* | Mexico, off west coast. Depth about 100 km | 19 | 1/2 N. | | 110 | | W. |
| 3 | 04 | 10 | 30* | Gulf of California | 27 | | N. | 111 | | W. |
| 3 | 04 | 55 | 03* | ....do | 27 | | N. | 111 | | W. |
| 3 | 05 | 10 | 05* | ....do | 27 | | N. | 111 | | W. |
| 3 | 21 | 58 | 40* | Kurile Islands | 47 | | N. | 154 | | E. |
| 5 | 12 | 02 | 30* | Panama. Felt | 9 | | N. | 81 | | W. |
| 6 | 02 | 20 | 09* | Ecuador, off coast | 2 | | N. | 84 | 1/2 | W. |
| 9 | 11 | 56 | 44* | Gulf of Panama | 7 | | N. | 79 | | W. |
| 9 | 16 | 42 | 10* | Southwestern Colombia. Felt in western Colombia from Pasto to San Marcos. Depth about 150 km. Mag. 6 1/2. | 2 | | N. | 76 | 1/2 | W. |
| 11 | 00 | 30 | 39* | Alaska, near southern coast. Depth about 100 km | 59 | | N. | 153 | | W. |
| 12 | 09 | 12 | 08* | Peru. Felt in central Peru. Depth about 150 km | 8 | 1/2 S. | | 74 | 1/2 | W. |
| 13 | 20 | 29 | 25* | Leeward Islands | 19 | | N. | 64 | | W. |
| 15 | 05 | 35 | 07* | Marianas Islands. Depth about 100 km. Mag. 7.1 | 17 | 1/2 N. | | 146 | | E. |
| 16 | 12 | 33 | 30* | Ecuador, off coast | 1 | | S. | 82 | | W. |
| 17 | 06 | 47 | 36* | Guatemala, near coast | 15 | 1/2 N. | | 92 | 1/2 | W. |
| 17 | 10 | 56 | 01* | Central Alaska | 62 | | N. | 148 | | W. |
| 21 | 21 | 57 | 57* | Kermadec Islands region | 29 | | N. | 176 | | W. |
| 23 | 03 | 55 | 18* | Nicobar Islands, Bay of Bengal | 9 | | N. | 93 | | E. |
| 23 | 04 | 26 | 28 | Near Old Woman Springs, Calif. Mag. 3.5 | 34 | 21 N. | | 116 | 40 | W. |
| 26 | 10 | 32 | 17 | Near Columbia, S. C. Felt over an area of 25,000 sq. mi. | 34.3 | | N. | 81.4 | | W. |
| 30 | 06 | 06 | 10 | Near Tinemaha, Calif. Mag. 4.1 | 37 | 10 N. | | 118 | 04 | W. |
| Aug. 1 | 11 | 47 | 27* | Eastern Peru. Depth about 650 km | 11 | | S. | 71 | | W. |
| 1 | 22 | 23 | 16* | Formosa region | 24 | | N. | 122 | | E. |
| 2 | 17 | 52 | 19* | ....do | 24 | | N. | 122 | | E. |
| 2 | 20 | 44 | 43* | Queen Charlotte Islands, off British Columbia. Depth possibly slightly greater than normal. | 54 | | N. | 133 | | W. |
| 3 | 04 | 11 | 31* | Panama, south of | 6 | | N. | 82 | 1/2 | W. |
| 3 | 06 | 34 | 41* | ....do | 6 | | N. | 82 | 1/2 | W. |
| 3 | 06 | 43 | 55* | Panama. Aftershock | 6 | | N. | 82 | 1/2 | W. |
| 3 | 06 | 58 | 27* | ....do | 6 | | N. | 82 | 1/2 | W. |
| 3 | 09 | 54 | 22* | ....do | 6 | | N. | 82 | 1/2 | W. |
| 3 | 10 | 49 | 33* | ....do | 6 | | N. | 82 | 1/2 | W. |
| 4 | 06 | 11 | 45* | ....do | 6 | | N. | 82 | 1/2 | W. |
| 4 | 14 | 48 | 16* | Mediterranean Sea, near Sicily | 36 | 1/2 N. | | 16 | 1/2 | E. |
| 6 | 23 | 02 | 10* | Peru, near Moyobamba. Felt in northwestern Peru. Depth about 100 km. | 6 | | S. | 76 | 1/2 | W. |
| 7 | 22 | 07 | 39* | North of Bonin Islands | 31 | | N. | 142 | | E. |
| 8 | 09 | 53 | 40* | Andaman Islands | 12 | | N. | 92 | | E. |
| 9 | 03 | 13 | 32* | Peru. Aftershock of Aug. 6 quake | 6 | | S. | 76 | 1/2 | W. |
| 10 | 11 | 20 | 16* | Guatemala. Considerable property damage in Quirigua. Felt in Zacapa, Chiquimula, and Izabel | 15 | 1/2 N. | | 89 | | W. |
| 10 | 14 | 09 | 05* | Guatemala. Aftershock | 15 | 1/2 N. | | 89 | | W. |
| 11 | 00 | 33 | 50* | Panama, south of | 7 | | N. | 82 | | W. |
| 11 | 11 | 14 | 59 | Southeast of Lida, Nev. Mag. 3.3 | 37 | 25 N. | | 117 | 20 | W. |
| 12 | 08 | 33 | 00* | Bonin Islands region | 28 | | N. | 142 | | E. |
| 13 | 03 | 24 | 03* | Central Alaska | 63 | | N. | 147 | | W. |
| 14 | 02 | 08 | 4 | Southeast of Laguna Salada, Calif. | 32 | | N. | 115 | | W. |
| 14 | 02 | 20 | 2 | Southeast of Laguna Salada, Calif. Mag. 4.4 | 32 | | N. | 115 | | W. |
| 14 | 12 | 10 | 50* | South of Kyushu, Japan | 27 | | N. | 130 | | E. |
| 15 | 14 | 15 | 54* | Bonin Islands region | 29 | | N. | 142 | | E. |
| 15 | 17 | 56 | 24 | San Jacinto Fault, near Borego Valley, Calif. Felt widely. Mag. 5.7. | 33 | 13 N. | | 116 | 08 | W. |
| 15 | 18 | 43 | 55 | San Jacinto Fault. Aftershock | 33 | 13 N. | | 116 | 08 | W. |
| 17 | 19 | 05 | 35* | Southern Alaska | 61 | | N. | 149 | | W. |
| 17 | 20 | 21 | 14 | West of Bishop, Calif. Mag. 4.2 | 37 | 25 N. | | 118 | 35 | W. |
| 19 | 05 | 30 | 26* | Northern Peru | 11 | | S. | 76 | | W. |
| 19 | 07 | 16 | 21 | Elsinore Fault, southeast of Cuyamaca, Calif. Mag. 3.4 | 32 | 55 N. | | 116 | 25 | W. |
| 19 | 07 | 31 | 58* | Panama, off southern coast | 5 | 1/2 N. | | 82 | 1/2 | W. |
| 21 | 10 | 07 | 12* | Near Vladivostock, U. S. S. R. Depth about 600 km | 43 | | N. | 131 | | E. |
| 21 | 16 | 29 | 37* | Central Peru. Felt in west-central Peru. Depth about 100 km. | 10 | 1/2 S. | | 75 | 1/2 | W. |
| 21 | 20 | 02 | 40* | New Hebrides Islands | 17 | 1/2 S. | | 168 | | E. |
| 22 | 05 | 03 | 35* | New Hebrides Islands. Aftershock | 17 | 1/2 S. | | 168 | | E. |
| 22 | 05 | 14 | 09* | ....do | 17 | 1/2 S. | | 168 | | E. |
| 22 | 08 | 39 | 40* | ....do | 17 | 1/2 S. | | 168 | | E. |
| 25 | 21 | 27 | 57 | South of Banning, Calif. Mag. 3.4 | 33 | 53 S. | | 116 | 53 | W. |
| 27 | 07 | 34 | 42* | Bonin Islands. Depth about 100 km | 23 | | N. | 143 | 1/2 | E. |
| 27 | 09 | 13 | 05* | West-central California. Felt over 13,000 sq. mi. Mag. 5. | 37 | 23 N. | | 121 | 43 | W. |
| 27 | 11 | 25 | 20 | San Jacinto Fault, southeast of Baily Wells, Calif. Mag. 4.0. | 33 | 02 N. | | 115 | 53 | W. |
| 28 | 12 | 49 | 52* | New Hebrides Islands. Foreshock | 14 | | S. | 167 | | E. |
| 28 | 19 | 20 | 22* | Honshu, Japan. Foreshock | 33 | | N. | 139 | | E. |
| 28 | 19 | 21 | 11* | Honshu, Japan, off southeast coast | 33 | | N. | 139 | | E. |
| 29 | 10 | 22 | 35* | New Hebrides Islands. Mag. 7.2 | 14 | | S. | 167 | | E. |
| 29 | 10 | 35 | 50* | New Hebrides Islands. Aftershock | 14 | | S. | 167 | | E. |
| 29 | 12 | 40 | 33* | Amsterdam Island, Indian Ocean. Foreshock | 37 | | S. | 80 | | E. |
| 29 | 13 | 38 | 32* | Northern Peru | 1 | 1/2 S. | | 78 | 1/2 | W. |
| 29 | 15 | 03 | 02* | Near Amsterdam Island, Indian Ocean | 37 | | S. | 80 | | E. |
| 30 | 23 | 30 | 04* | Tonga Islands region | 19 | | S. | 175 | 1/2 | W. |
| 31 | 11 | 11 | 40 | Elsinore Fault, east of Cuyamaca Lake, Calif. Mag. 3.3 | 32 | 59 N. | | 116 | 30 | W. |
| 31 | 15 | 48 | 51* | Central Alaska. Depth about 100 km | 63 | 1/2 N. | | 146 | | W. |

**Table 1.—*Summary of instrumental epicenters for 1945*—Continued**

| 1945 | Origin time G. C. T. | | | Region, focal depth, and remarks | Coordinates of provisional epicenter | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Latitude | | | Longitude | | |
| | *h* | *m* | *s* | | ° | ′ | | ° | ′ | |
| Sept. 1 | 22 | 44 | 07* | New Zealand, near southern coast. Mag. 7.2 | 47 | | S. | 166 | | E. |
| 2 | 11 | 54 | 01 | Eastern Mediterranean Sea. Depth about 100 km | 34½ | | N. | 28¾ | | E. |
| 3 | 12 | 59 | 20* | Mid-Atlantic Ocean | 1 | | S. | 20 | | W. |
| 3 | 19 | 30 | 36* | Chile, near west-central coast. Felt. Depth about 60 km. | 33 | | S. | 71½ | | W. |
| 4 | 11 | 13 | 56 | Near Tinemaha, Calif. Mag. 4.2 | 37 | 20 | N. | 118 | 07 | W. |
| 5 | 21 | 48 | 40* | New Britain. Mag. 7.1 | 5 | | S. | 152 | | E. |
| 6 | 01 | 26 | 19* | New Britain. Aftershock | 5 | | S. | 152 | | E. |
| 7 | 14 | 45 | 16 | Baja California, Sierra Juarez. Mag. 4.4 | 31 | 26 | N. | 115 | 24 | W. |
| 7 | 15 | 34 | 24 | San Andreas Fault, north of Cabazon, Calif. Felt. Mag. 4.3. | 33 | 58 | N. | 116 | 48 | W. |
| 7 | 15 | 48 | 23* | Romania. Depth about 100 km | 46 | | N. | 26½ | | E. |
| 9 | 04 | 02 | 54 | New Hebrides region | 17 | | S. | 168 | | E. |
| 9 | 12 | 56 | 20* | Peru, near coast. Felt strongest at Ica and Pisco | 14½ | | S. | 76 | | W. |
| 11 | 02 | 01 | 08 | Northern Panamint Range, Calif. Mag. 3.4 | 36 | 32 | N. | 117 | 10 | W. |
| 11 | 19 | 11 | 17* | Tonga Islands region. Depth about 550 km | 24½ | | S. | 179 | | W. |
| 13 | 11 | 17 | 08 | Chile, about 60 mi. south of Santiago. Four reported killed, 35 injured. Severest property damage in Curico, Talca, Rancagua, and Rengo. Depth about 100 km. Mag. 7.1. | 34.2 | | S. | 70.8 | | W. |
| 14 | 02 | 02 | 24* | Mid-Atlantic Ocean | 7½ | | N. | 38 | | W. |
| 19 | 12 | 28 | 02* | Hokkaido, Japan, off southeast coast. Depth about 100 km. | 43 | | N. | 144 | | E. |
| 22 | 09 | 05 | 40 | Northwest of Anza, Calif. Mag. 3.8 | 33 | 33 | N. | 116 | 50 | W. |
| 22 | 09 | 09 | 54* | New Guinea, off northeast coast | 3½ | | S. | 148 | | E. |
| 23 | 09 | 57 | 47 | Montana. Felt over an area of 36,000 sq. mi. Slight damage. | 48 | | N. | 114¼ | | W. |
| 23 | 15 | 34 | 19* | Yellow Sea, Gulf of Chihli. Felt in Peiping | 39½ | | N. | 118½ | | E. |
| 23 | 17 | 20 | 45* | Mexico, near west coast | 18½ | | N. | 105 | | W. |
| 26 | 03 | 36 | 50* | Aleutian Islands region | 53 | | N. | 170 | | W. |
| 26 | 14 | 27 | 00* | Puerto Rico, off northeast coast | 19 | | N. | 65 | | W. |
| 27 | 23 | 09 | 00* | Samoa Island region. Felt in Apia | 15 | | S. | 173 | | W. |
| 28 | 22 | 24 | 05 | California, off northern coast. Mag. 6 | 41.7 | | N. | 126.9 | | W. |
| 29 | 04 | 27 | 46 | North-central Peru | 6 | | S. | 77 | | W. |
| Oct. 1 | 05 | 16 | 40* | Near Afghanistan-India border | 29 | | N. | 67 | | E. |
| 2 | 00 | 37 | 16* | Yellow Sea | 38½ | | N. | 122 | | E. |
| 2 | 22 | 40 | 32* | Southern Peru. Depth about 200 km | 15 | | S. | 71 | | W. |
| 3 | 04 | 26 | 57 | Northwest end of San Bernardino Mts., Calif. Mag. 3.1 | 33 | 59 | N. | 116 | 21 | W. |
| 3 | 06 | 19 | 25* | Off coast of El Salvador | 12 | | N. | 91 | | W. |
| 5 | 03 | 09 | 40* | Bonin Islands region | 23 | | N. | 143 | | E. |
| 5 | 23 | 17 | 28* | Off coast of Nicaragua. Depth about 100 km | 13 | | N. | 87 | | W. |
| 6 | 09 | 12 | 31* | Northern New Guinea | 3 | | S. | 138 | | E. |
| 7 | 13 | 23 | 25 | Off coast of El Salvador | 13 | | N. | 89 | | W. |
| 9 | 14 | 36 | 33* | Off coast of Hokkaido, Japan. Depth about 100 km. Mag. 7.0. | 44 | | N. | 147½ | | E. |
| 11 | 16 | 52 | 52 | Oaxaca, Mexico. Depth about 100 km. Mag. about 7½ | 18 | | N. | 97¾ | | W. |
| 14 | 04 | 07 | 14* | Samoa Islands region. Depth about 100 km | 16 | | S. | 172½ | | W. |
| 15 | 02 | 56 | 26 | Northeast of Bailey's Wells, Calif. Mag. 3.8 | 33 | 12 | N. | 115 | 56 | W. |
| 15 | 15 | 58 | 21* | Pacific Ocean, south of Panama | 4 | | N. | 83 | | W. |
| 15 | 21 | 51 | 51* | do | 4 | | N. | 83 | | W. |
| 16 | 18 | 02 | 20* | Juneau, Alaska, about 100 miles west of. Felt | 58 | | N. | 137 | | W. |
| 17 | 22 | 19 | 05* | do | 58 | | N. | 137 | | W. |
| 18 | 01 | 07 | 41* | South-central Utah. Felt in Servier County | 38 | | N. | 112 | | W. |
| 19 | 04 | 35.3 | | Baja California, Sierra Juarez | 32 | | N. | 116 | | W. |
| 20 | 06 | 27 | 55* | Eastern Turkey | 39 | | N. | 43 | | E. |
| 20 | 18 | 07 | 09* | Southern Mexico, near coast | 16 | | N. | 98 | | W. |
| 22 | 15 | 19 | 21* | Dominican Republic, near northern coast | 19½ | | N. | 70 | | W. |
| 25 | 19 | 12 | 46* | Gulf of California | 31 | | N. | 115 | | W. |
| 26 | 01 | 03 | 58* | Near Peru-Bolivia border. Depth about 700 km | 11 | | S. | 69 | | W. |
| 26 | 05 | 13 | 10* | Southwest of Tonga Islands. Depth about 600 km. Mag. 7.0. | 21 | | S. | 180 | | |
| 27 | 11 | 54 | 03* | New Guinea, off northwest coast | 1½ | | S. | 149 | | E. |
| 27 | 12 | 23 | 16* | do | 1½ | | S. | 149 | | E. |
| 27 | 21 | 57 | 00* | Arabian Sea, off southeast coast of Iran. Strong tidal wave. Destructive at Ormara, Baluchistan, and Karachi, India. Mag. 8¼. | 25 | | N. | 60½ | | E. |
| 28 | 07 | 37 | 15* | Ecuador, off west coast | 2 | | S. | 80 | | W. |
| 29 | 12 | 02 | 54* | Black Sea, off coast of northern Turkey | 42 | | N. | 38 | | E. |
| 30 | 11 | 09 | 25* | Celebes Sea | 5 | | N. | 125 | | E. |
| Nov. 2 | 17 | 43 | 41* | Mexico, off southern coast | 15 | | N. | 97 | | W. |
| 2 | 18 | 57 | 55* | Banda Sea | 4½ | | S. | 127 | | E. |
| 3 | 22 | 09 | 00* | Alaska, off southern coast | 59 | | N. | 151 | | W. |
| 8 | 09 | 05 | 26* | Greenland, near northeast coast | 81 | | N. | 18 | | W. |
| 8 | 10 | 02 | 40* | do | 81 | | N. | 18 | | W. |
| 8 | 10 | 05 | 32* | do | 81 | | N. | 18 | | W. |
| 8 | 23 | 51 | 58* | Dominican Republic, off northeast coast | 19 | | N. | 68 | | W. |
| 9 | 23 | 58 | 52* | Peru, near southwest coast | 15 | | S. | 76½ | | W. |
| 11 | 09 | 22 | 11* | New Britain region | 6 | | S. | 152 | | E. |
| 13 | 02 | 46 | 38* | Peru, near west-central coast. Slightly deeper than normal. | 8½ | | S. | 79½ | | W. |
| 14 | 14 | 43 | 30* | East of Bakersfield, Calif. Felt at Bakersfield and in Kern Canyon. Mag. 3.7. | 35 | 24 | N. | 118 | 55 | W. |
| 15 | 08 | 01 | 23* | Southern Alaska. Felt in Sitka | 59 | | N. | 138 | | W. |
| 15 | 18 | 24 | 40* | Northeast of Jan Mayen Island | 73 | | N. | 4 | | E. |
| 16 | 16 | 03 | 03* | Molucca Passage. Depth about 100 km | 1 | | N. | 126 | | E. |
| 19 | 16 | 57.7 | | Arizona-California border | 34 | | N. | 114 | | W. |

**Table 1.—*Summary of instrumental epicenters for 1945*—Continued**

| 1945 | Origin time G. C. T. | Region, focal depth, and remarks | Coordinates of provisional epicenter | |
|---|---|---|---|---|
| | | | Latitude | Longitude |
| | *h* *m* *s* | | ° ′ | ° ′ |
| Nov. 20 | 00 32 43* | Vancouver, British Columbia, off west coast | 49½ N. | 130 W. |
| 21 | 03 21 03* | Formosa, near east coast | 24 N. | 122 E. |
| 24 | 05 15 23* | Honshu, Japan, near east coast | 36 N. | 140 E. |
| 25 | 14 58 42* | Kamchatka, off east coast | 57 N. | 165 E. |
| 26 | 13 56 40* | Northern Turkey | 41½ N. | 33½ E. |
| 27 | 11 24 28* | Central Guatemala. Depth about 100 km | 15½ N. | 91 W. |
| 29 | 06 41 21* | Northwestern Yukon, Canada | 70 N. | 139 W. |
| 29 | 10 54 15* | Northwest of Vancouver, British Columbia | 51½ N. | 131½ W. |
| 31 | 20 41 52 | Northeast of Lake Arrowhead, Calif. Felt in Fawnskin. Mag. 3.7. | 34 20 N. | 117 07 W. |
| Dec. 1 | 05 49 18* | Tonga Islands region. Depth about 400 km | 21 S. | 176 W. |
| 8 | 01 04 03* | South of New Britain Island. Mag. 7.1 | 6½ S. | 151 E. |
| 8 | 21 55 53 | Near Candelaria, Nev. Mag. 3.8 | 38 09 N. | 118 03 W. |
| 9 | 06 08 42* | Romania. Depth about 100 km | 45¾ N. | 27 E. |
| 9 | 20 45 47* | Guatemala, near coast | 14 N. | 92 W. |
| 14 | 17 26 46* | Southern Ecuador. Depth about 100 km | 2½ S. | 76½ W. |
| 20 | 03 59 12* | Mindanao, near east coast | 8 N. | 127 E. |
| 23 | 08 10 02* | Venezuela, near northeast coast. Depth about 100 km | 10 N. | 62 W. |
| 25 | 01 25 55* | Bering Sea | 54 N. | 174 E. |
| 25 | 17 24 00* | Central Chile. Felt | 29 S. | 70 W. |
| 27 | 04 41 05* | New Britain region | 6 S. | 151½ E. |
| 28 | 17 48 49* | South of New Britain. Mag. 7.8 | 6½ S. | 151 E. |
| 29 | 09 50 39* | New Britain region. Aftershock | 6½ S. | 151 E. |
| 29 | 12 26 52* | ....do | 6½ S. | 151 E. |
| 30 | 00 48 40* | ....do | 6½ S. | 151 E. |
| 31 | 17 26 00* | ....do | 6½ S. | 151 E. |

**Table 2.—*Principal earthquakes of the world from January through December 1947***

NOTE.—This table lists (1) the strongest shock 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.

| 1947 | Origin time G. C. T. | Region | Coordinates of provisional epicenter | | Remarks |
|---|---|---|---|---|---|
| | | | Latitude | Longitude | |
| | *h* *m* *s* | | ° ′ | ° ′ | |
| Jan. 3 | 02 17 06* | Hokkaido, Japan, off east coast | 45 N. | 148½ E. | Mag. 7. |
| 21 | 20 06 40* | Northern Chile | 25 S. | 70 W. | Mag. 7. |
| 26 | 10 06 45* | Nicaragua, west coast | 12 N. | 86¼ W. | Depth 170 km. Mag. 7.2. |
| Mar. 2 | 19 09 21* | New Guinea, near east coast | 5½ S. | 144 E. | Mag. 7. |
| 17 | 08 19 31* | Sikang Province, China | 33½ N. | 99½ E. | Mag. 7.6. |
| 25 | 20 32 15* | New Zealand, off east coast of North Island. | 39 S. | 178 E. | Felt with intensity IV along east coast of North Island. Mag. 7. |
| Apr. 2 | 05 39 10* | New Guinea, near north coast | 1½ S. | 138 E. | Mag. 7.4. |
| 10 | 15 58 04 | South of Manix and Field, Mojave Desert, Calif. | 34 58 N. | 116 32 W. | By Pasadena. Felt over 70,000 sq. mi. in southern California. Intensity VII. Mag. 6½. |
| 24 | 19 35 08* | Brazil, off northeast coast | 7½ N. | 38 W. | Mag. 7. |
| May 6 | 20 30 32* | New Britain region | 7 S. | 149 E. | Mag. 7.6. |
| 11 | 06 32 39* | Italy, off southern coast | 38½ N. | 17½ E. | Destructive in Calabre. Damage in Ischia, Iona, Badolato, and Santa Catorina. |
| 27 | 05 58 54* | New Guinea, off northern coast | 2 S. | 136 E. | Mag. 7¼. |
| June 12 | 09 02 23* | Molucca Islands | 1 N. | 126 E. | Mag. 7.2. |
| 13 | 20 24 56* | South of Bonin Islands | 21 N. | 146½ E. | Depth about 60 km. Mag. 7.2. |
| July 29 | 13 43 19* | Southern Tibet | 28½ N. | 93 E. | Mag. 7.5. |
| Aug. 5 | 14 24 10* | Near coast of Baluchistan | 25 N. | 64 E. | Mag. 7.1. |
| 6 | 09 36 40* | Algeria, coast of Alzeana east of Philippeville. | 37 N. | 8 E. | Destructive in Oved Haminine. Intensity VIII–IX, 3 deaths, several injuries. |
| Sept. 23 | 12 28 08* | Eastern Iran | 33½ N. | 58½ E. | Destructive in Khurasan Province at Daulatabad, near Birjand and Ghaen, 412 deaths, 142 injured. |
| 26 | 16 01 54* | Formosa, off eastern coast | 24½ N. | 123½ E. | Depth 100 km. Felt in Islands of Ishigaki and Miyako. Mag. 7.4. |
| Oct. 6 | 19 55 31* | Southern Greece | 37 N. | 22 E. | Felt with intensity VIII–IX at Corone. Mag. 7. |
| 16 | 02 09 45 | Alaska, about 40 mi. southwest of Fairbanks. | 64.5 N. | 148.8 W. | Damage in vicinity of Fairbanks. Mag. 7. |
| Nov. 1 | 14 58 51* | Central Peru | 11 S. | 75 W. | 233 reported killed. Considerable porperty damage around Satipo. Mag. 7.3. |
| Dec. 15 | 19 20 26* | South Pacific Ocean, 1600 mi. southeast of New Zealand. | 59 S. | 160 W. | Mag. 7. |

## 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. None of the 1947 records was of large enough amplitude to justify analysis by integration.

In the notes following table 3, listing the strong-motion records obtained during 1947, the maximum values of acceleration and displacement are given for each station. Accelerations shown may have been recorded by any one of the three components. The maximum recorded acceleration in table 4 is not necessarily associated with the same ground period as the maximum computed displacement.

In June 1947, a program of substituting unifilar suspensions in all accelerometers in place of the pivoted spindle type was begun. The new type of suspension insures more stable zero positions of the pendulums and more precise determination of displacements associated with the recorded accelerations. An outline of the double integration process required to accomplish this 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.

*Units and instrumental constants.*—Quantitative results are expressed in c. g. s. units; centimeters or millimeters for displacement; and centimeters per second 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 1.8 to 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 3.—*List of shocks recorded and records obtained on strong-motion seismographs in 1947***

| Date, epicenter, and recording station | Records | | |
|---|---|---|---|
| | Accelerograph | Displacement meter | Weed strong-motion seismograph |
| Mar. 29: Off Cape Mendocino: Eureka | 1 | | |
| Ferndale | 1 | 1 | |
| Apr. 2: Southern California: El Centro | 1 | | |
| Apr. 10: Southern California: Bishop | 1 | | |
| Colton | 1 | 1 | |
| Hollywood Storage Bldg | 14 | | |
| Long Beach | 1 | | |
| Los Angeles Chamber of Commerce Bldg | 2 | | |
| Los Angeles Subway Terminal | 4 | 2 | |
| Pasadena | 1 | 1 | 1 |
| San Bernardino | | | 1 |
| San Diego | 1 | | |
| San Francisco Southern Pacific Bldg | 2 | 1 | |
| Santa Ana | | | 1 |
| Vernon | 1 | | |
| Westwood | 1 | | |
| May 27: Northern California: Eureka | 1 | | |
| Ferndale | 1 | 1 | |
| June 5: Near coast of El Savador: | | | |
| Guatemala City | 1 | | |
| June 22: Northern California: Hollister | 1 | | |
| Oakland City Hall | 2 | | |
| San Francisco Alexander Bldg | 3 | | |
| San Francisco Shell Bldg | | | 3 |
| San Francisco Sutter Bldg | | | 1 |
| San Francisco Southern Pacific Bldg | 2 | 1 | |
| San Jose | 4 | | |
| July 6: Northern California: Hollsiter | 1 | | |
| July 24: Southern California: | | | |
| Holywood Storage Bldg | 3 | | |
| Los Angeles Subway Terminal | 2 | 1 | |
| Aug. 10: Northern California: Hollister | 1 | | |
| Monterey | 1 | | |
| San Francisco Southern Pacific Bldg | 2 | 1 | |
| Sept. 23: Northern California: Eureka | 1 | | |
| Ferndale | 1 | 1 | |
| Nov. 1: Northeast of Lima, Peru: Lima | 1 | | |
| Nov. 18: Off coast of southern California: | | | |
| Westwood | 1 | | |
| Nov. 25: Southwestern Montana: Bozeman | 1 | | |
| Butte | 1 | | |
| Great Falls | 1 | | |
| Helena | 1 | | |
| Dec. 29: Near coast of Costa Rica: San Jose | 1 | | |
| Total | 66 | 11 | 7 |

### EARTHQUAKE OF MARCH 29 OFF CAPE MENDOCINO

Epicenter from local instrumental data, 15 miles west of Cape Mendocino. Maximum intensity VI reported from Upper Mattole.

*Eureka.*—Station 40 miles NE. 45° of epicenter. Intensity V reported at Eureka. Maximum acceleration 3 cm/sec.$^2$ and computed maximum displacement 0.005 cm.

*Ferndale.*—Figure 10. Station 25 miles NE. 60° of epicenter. Maximum acceleration 6 cm/sec.$^2$ and computed maximum displacement 0.025 cm. Maximum displacement 0.06 cm. recorded on displacement meter and computed maximum acceleration 5 cm/sec.$^2$

### SOUTHERN CALIFORNIA EARTHQUAKE OF APRIL 2

Epicenter in southern part of Imperial County. Maximum intensity VI reported from Holtville.

*El Centro.*—Figure 10. Intensity V in El Centro. Maximum acceleration 14 cm/sec.$^2$ and computed maximum displacement 0.028 cm.

### SOUTHERN CALIFORNIA EARTHQUAKE OF APRIL 10

Epicenter from local instrumental data 34°58′ north, 116°32′ west, Manix Fault vicinity. Maximum intensity VII, possibly VIII, reported from epicenter region.

*Bishop.*—Station 193 miles NW. 328° of epicenter. Not felt in Bishop. Maximum acceleration 14 cm/sec.$^2$ and computed maximum displacement 0.001 cm.

*Colton.*—Figure 10. Station 77 miles SW. 215° of epicenter. Maximum acceleration 9 cm/sec.$^2$ and computed maximum displacement 0.015 cm. Maximum displacement 0.40 cm. recorded on displacement meter and computed maximum acceleration 3 cm/sec.$^2$

*Hollywood Storage Building.*—Station 118 miles SW. 240° of epicenter. Intensity V in Hollywood. Maximum acceleration 100 cm/sec.$^2$ and computed maximum displacement 0.854 cm. in Penthouse. Maximum acceleration 14 cm/sec.$^2$ and computed maximum displacement 0.045 cm. in basement. Maximum acceleration 10 cm/sec.$^2$ and computed maximum displacement 0.047 cm. at P. E. lot.

*Long Beach.*—Station 124 miles SW. 229° of epicenter. Intensity VI reported in Long Beach. Maximum acceleration 1.0 cm/sec.$^2$ and computed maximum displacement 0.018 cm.

*Los Angeles Chamber of Commerce.*—Figure 11. Station 115 miles SW. 237° of epicenter. Intensity VI reported in Los Angeles. Maximum acceleration 31 cm/sec.$^2$ and computed maximum displacement 1.147 cm. on 11th floor. Maximum acceleration 5.0 cm/sec.$^2$ and computed maximum displacement 0.032 cm. in basement.

*Los Angeles Subway Terminal.*—Station 115 miles SW. 237° of epicenter. Intensity VI reported in Los Angeles. Maximum acceleration 21 cm/sec.$^2$ and computed maximum displacement 0.243 cm. on 13th floor. Maximum acceleration 8.0 cm/sec.$^2$ and computed maximum displacement 0.017 cm. in subbasement. Maximum displacement 0.45 cm. recorded on displacement meter and computed maximum acceleration 1.0 cm/sec.$^2$ in subbasement.

*Pasadena.*—Station 105 miles SW. 237° of epicenter. Intensity VI reported in Pasadena. Maximum acceleration 1.0 cm/sec.$^2$ and computed maximum displacement 0.014 cm. Maximum displacement 0.82 cm. recorded on displacement meter and computed maximum acceleration 3 cm/sec.$^2$ Maximum acceleration 2 cm/sec.$^2$ and computed maximum displacement 0.001 cm. recorded on Weed seismograph.

*San Bernardino.*—Station 82 miles SW. 216° of epicenter. Intensity VI reported in San Bernardino. Maximum acceleration 1 cm/sec.$^2$ and computed maximum displacement 0.002 cm. recorded on Weed seismograph.

*San Diego.*—Station 158 miles SW. 193° of epicenter. Intensity V reported in San Diego. Maximum acceleration 2 cm/sec.$^2$ and computed maximum displacement 0.014 cm.

*San Francisco Southern Pacific Building.*—Station 375 miles NW. 298° of epicenter. Maximum acceleration 3 cm/sec.$^2$ and computed maximum displacement 0.001 cm. on 14th floor. Maximum displacement 0.01 cm. recorded on displacement meter and computed maximum acceleration 1 cm sec.$^2$ in basement.

*Santa Ana.*—Station 112 miles SW. 222° of epicenter. Maximum intensity V reported in Santa Ana. Maximum acceleration 1 cm sec.$^2$ and computed maximum displacement 0.007 cm. recorded on Weed seismograph.

*Vernon.*—Figure 11. Station 114 miles SW. 234° of epicenter. Intensity VI reported in Los Angeles. Maximum acceleration 10 cm/sec.$^2$ and computed maximum displacement 0.054 cm.

*Westwood.*—Figure 11. Station 116 miles SW. 239° of epicenter. Intensity VI reported in Los Angeles. Maximum acceleration 4 cm/sec.$^2$ and computed maximum displacement 0.048 cm.

### AFTERSHOCKS OF SOUTHERN CALIFORNIA EARTHQUAKE OF APRIL 10

*Hollywood Storage Building.*—Station 118 miles SW. 240° of epicenter. Results of two aftershocks. Maximum acceleration 1 cm sec.$^2$ and computed maximum displacement 0.037 cm., and maximum acceleration 1 cm/sec.$^2$ and computed maximum displacement 0.037 cm. in Penthouse. Maximum acceleration 1 cm sec.$^2$ and computed maximum displacement 0.002 cm., and maximum acceleration 1 cm sec.$^2$ and computed maximum displacement 0.001 cm. in basement. Maximum acceleration 1 cm/sec.$^2$ and computed maximum displacement 0.002 cm., and maximum acceleration 1 cm sec.$^2$ and computed maximum displacement 0.006 cm. in P. E. lot.

*Los Angeles Subway Terminal.*—Station 115 miles SW. 237° of epicenter. Results of one aftershock. Maximum acceleration 1 cm/sec.$^2$ and computed maximum displacement 0.008 cm. in 13th floor. This aftershock was not recorded by the subbasement displacement meter.

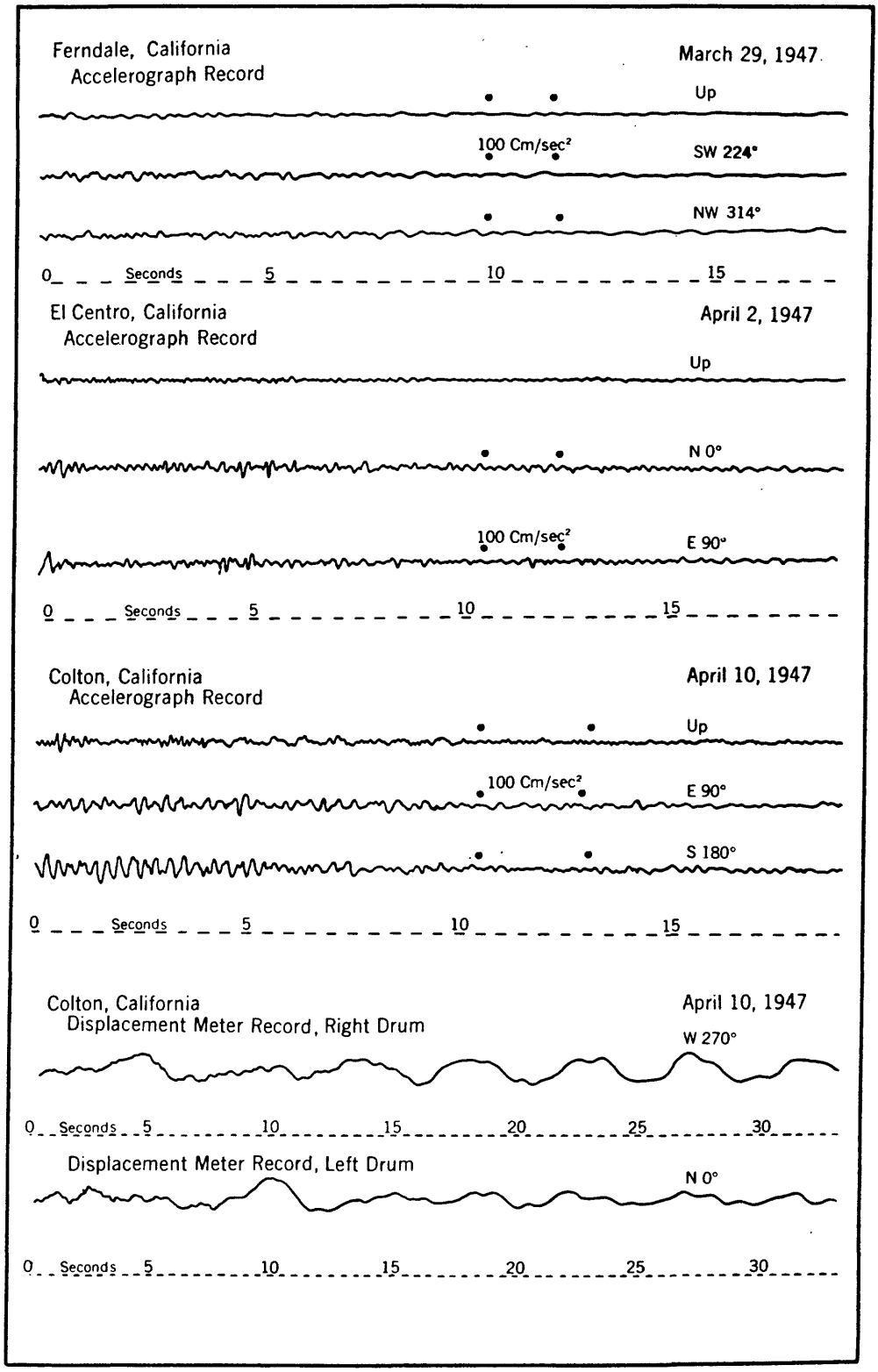


FIGURE 10.—*Tracings of accelerograph records obtained at Ferndale on March 29, El Centro on April 2, and tracing of accelerograph record and displacement-meter records obtained at Colton on April 10.*

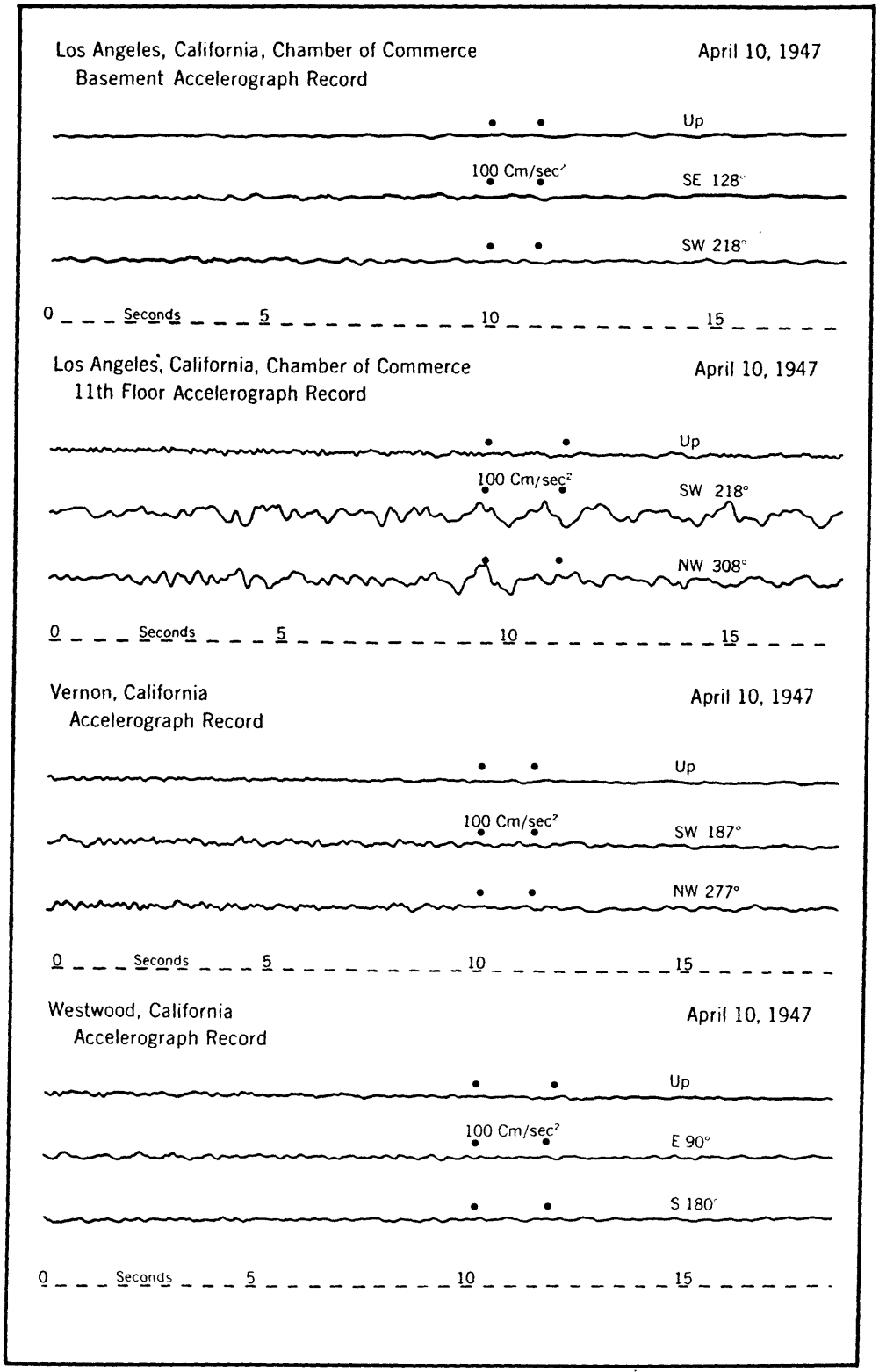


FIGURE 11.—*Tracings of accelerograph records obtained at Los Angeles Chamber of Commerce, Vernon, and Westwood on April 10.*

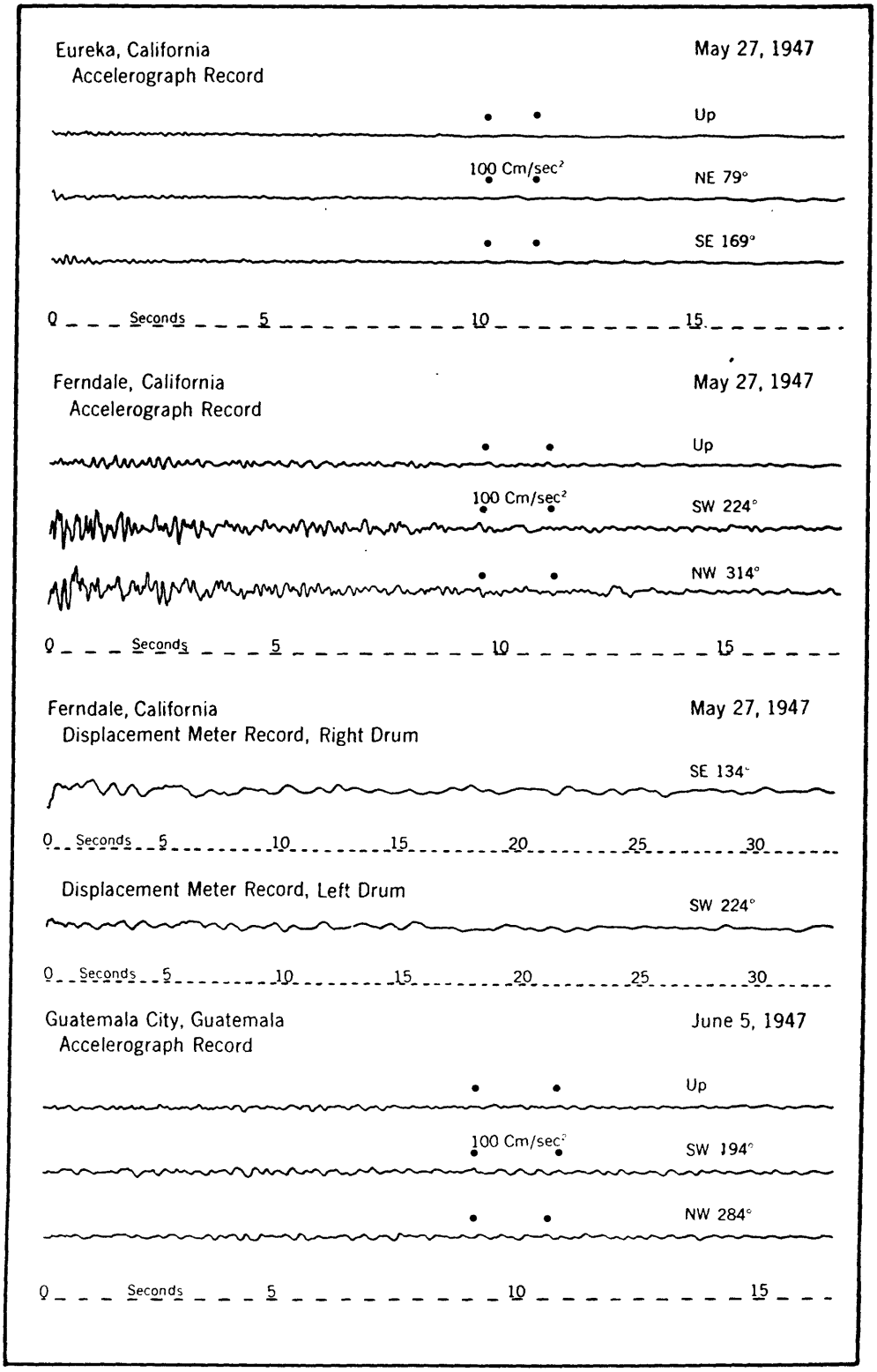


FIGURE 12.—*Tracings of accelerograph records obtained at Eureka and Ferndale on May 27, and at Guatemala City on June 5, and tracings of displacement-meter records obtained at Ferndale on May 27.*

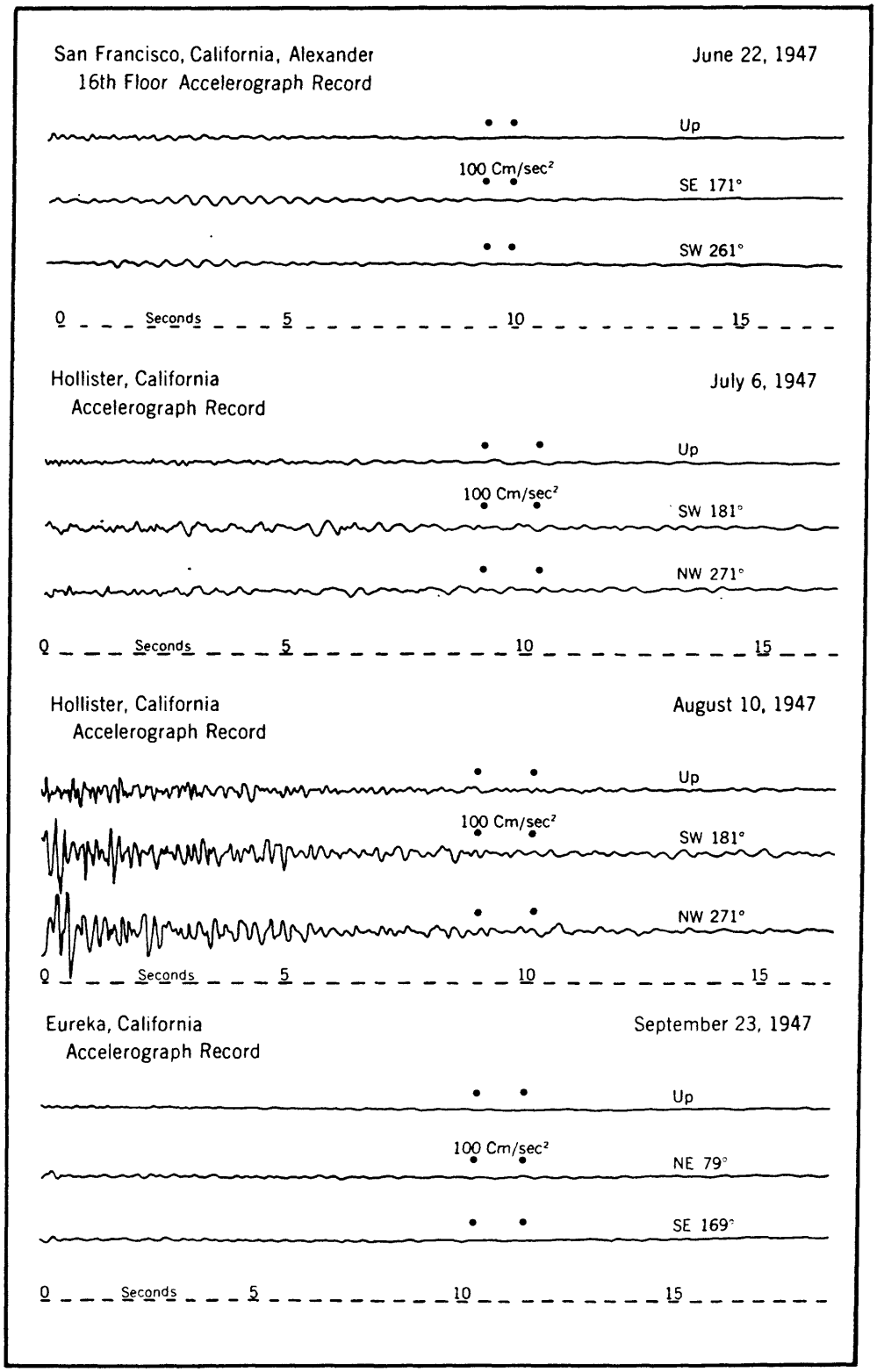


FIGURE 13.—*Tracings of accelerograph records obtained at Hollister, Oakland City Hall, and San Francisco Alexander Building basement on June 22.*

### NORTHERN CALIFORNIA EARTHQUAKE OF MAY 27

Epicenter from local instrumental data 40.4° north, 124.7° west, in Humboldt County off Cape Mendocino. Intensity VI reported from Honeydew and Upper Mattole.

*Eureka.*—Figure 12. Station 40 miles NE. 45° of epicenter. Intensity V reported in Eureka. Maximum acceleration 7 cm/sec.$^2$ and computed maximum displacement 0.006 cm.

*Ferndale.*—Figure 12. Station 25 miles NE. 60° of epicenter. Intensity V reported in Ferndale. Maximum acceleration 34 cm/sec.$^2$ and computed maximum displacement 0.048 cm. Maximum displacement 0.19 cm. recorded on displacement meter and computed maximum acceleration 45 cm/sec.$^2$

### EARTHQUAKE OF JUNE 5 NEAR COAST OF EL SALVADOR

Epicenter from instrumental data 14° north, 90° west, near coast of El Salvador. Maximum intensity unknown.

*Guatemala City.*—Figure 12. Station 45 miles NW. 330° of epicenter. Maximum acceleration 4 cm/sec.$^2$ and computed maximum displacement 0.009 cm.

### NORTHERN CALIFORNIA EARTHQUAKE OF JUNE 22

Epicenter from local instrumental data 37°00′ north, 121°46′ west, north of Watsonville. Intensity ranged from I to a maximum of VI over an area of 7,000 square miles.

*Hollister.*—Figure 13. Station 23 miles SE. 116° of epicenter. Maximum intensity V reported in Hollister. Maximum acceleration 21 cm/sec.$^2$ and computed maximum displacement 0.114 cm.

*Oakland City Hall.*—Figure 13. Station 62 miles NW. 334° of epicenter. Maximum intensity V reported in Oakland. Maximum acceleration 11 cm/sec.$^2$ and computed maximum displacement 0.126 cm. on 16th floor. Maximum acceleration 3 cm/sec.$^2$ and computed maximum displacement 0.003 cm. in basement.

*San Francisco Alexander Building.*—Figures 13 and 14. Station 65 miles NW. 325° of epicenter. Maximum intensity VI reported in San Francisco. Maximum acceleration 2 cm/sec.$^2$ and computed maximum displacement 0.009 cm. on 16th floor. Maximum acceleration 1 cm/sec.$^2$ and computed maximum displacement 0.002 cm. on 11th floor. Maximum acceleration 2 cm/sec.$^2$ and computed maximum displacement 0.003 cm. in basement.

*San Francisco Shell Building.*—Station 65 miles NW. 325° of epicenter. Maximum intensity VI reported in San Francisco. Maximum acceleration 1 cm/sec.$^2$ and computed maximum displacement 0.013 cm. on 29th floor. Maximum acceleration 1 cm/sec.$^2$ and computed maximum displacement 0.020 cm. on 21st floor. Maximum acceleration 1 cm/sec.$^2$ and computed maximum displacement 0.001 cm. recorded on Weed seismograph in basement.

*San Francisco Southern Pacific Buidling.*—Station 65 miles NW. 325° of epicenter. Maximum intensity VI reported in San Francisco. Maximum acceleration 27 cm/sec.$^2$ and computed maximum displacement 0.002 cm. on 14th floor. Maximum acceleration 14 cm/sec.$^2$ and computed maximum displacement 0.060 cm. in basement. Maximum displacement 0.07 cm. recorded on displacement meter and computed maximum acceleration 7 cm/sec.$^2$ in basement.

*San Francisco Sutter Building.*—Station 65 miles NW. 325° of epicenter. Maximum intensity VI reported in San Francisco. Maximum acceleration 1 cm/sec.$^2$ and computed maximum displacement 0.006 cm. recorded on Weed seismograph on 29th floor.

*San Jose Bank of America Building.*—Station 24 miles NW. 346° of epicenter. Maximum intensity VI reported in San Jose. Maximum acceleration 5 cm/sec.$^2$ and computed maximum displacement 0.013 cm. on 13th floor. Maximum acceleration 1 cm/sec.$^2$ and computed maximum displacement 0.002 cm. in basement.

### NORTHERN CALIFORNIA EARTHQUAKE OF JULY 6

Epicenter from local instrumental data 36°46′ north, 121°25′ west, coastal region of west-central California. Maximum intensity V reported in Hollister.

*Hollister.*—Figure 14. Station 6 miles NE. 5° of epicenter. Maximum intensity V reported in Hollister. Maximum acceleration 13 cm/sec.$^2$ and computed maximum displacement 0.040 cm.

### SOUTHERN CALIFORNIA EARTHQUAKE OF JULY 24

Epicenter from local instrumental data 34°01′ north, 116°30′ west, near Morongo Valley. Maximum intensity V reported over a considerable area.

*Hollywood Storage Building.*—Station 105 miles NW. 272° of epicenter. Maximum intensity V reported in Los Angeles and intensity IV reported in Pasadena. Maximum acceleration 1 cm/sec.$^2$ and computed maximum displacement 0.032 cm. in Penthouse. The record of the basement accelerograph was too weak to interpret. Maximum acceleration 1 cm/sec.$^2$ and computed maximum displacement 0.015 cm. in P. E. lot.

*Los Angeles Subway Terminal.*—Station 100 miles NW. 271° of epicenter. Maximum intensity V reported in Los Angeles. Maximum acceleration 9 cm sec.$^2$ and computed maximum displacement 0.036 cm. on 13th floor. Maximum acceleration 1 cm sec.$^2$ and computed maximum displacement 0.07 cm. in subbasement.

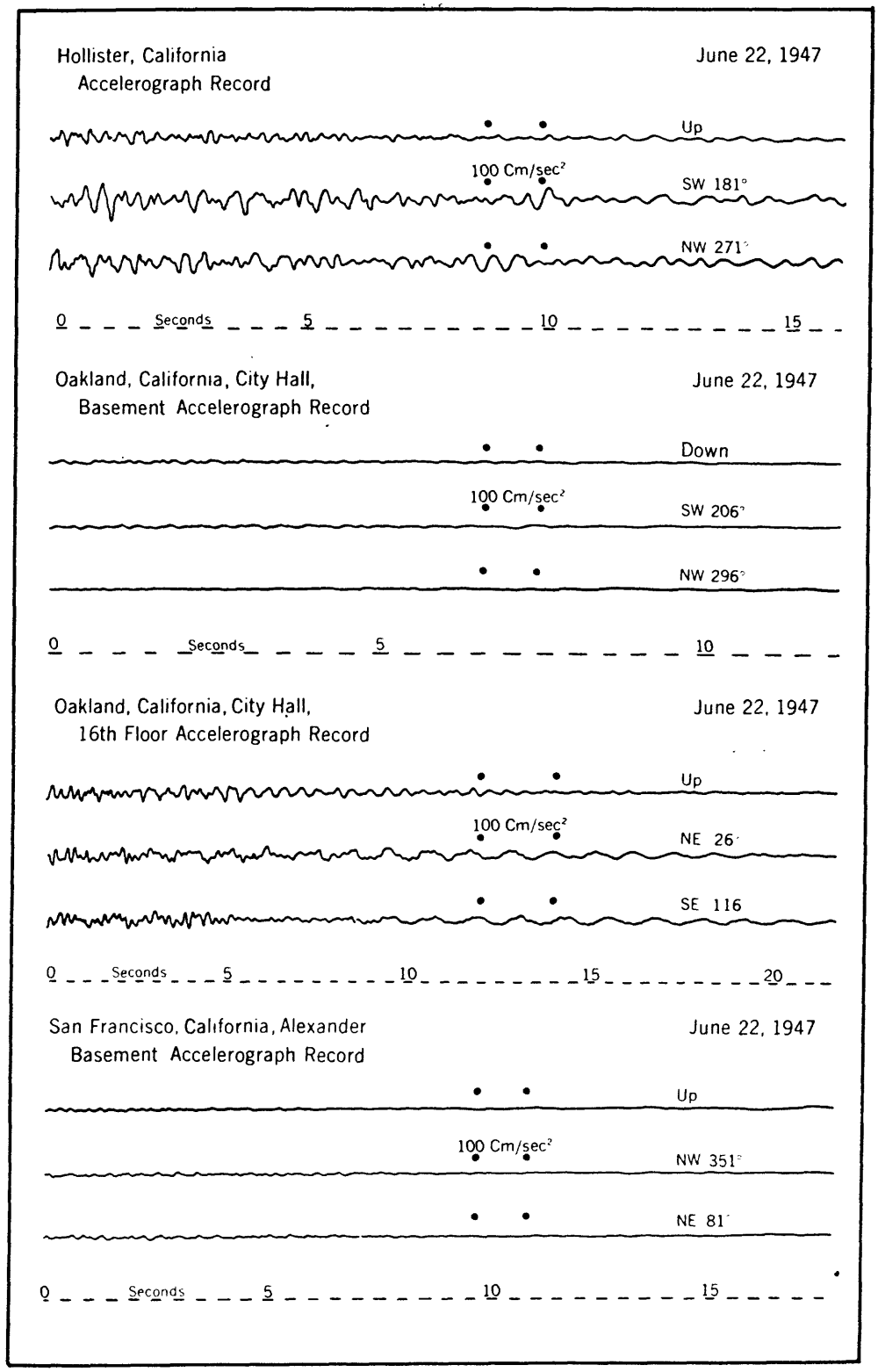


FIGURE 14.—*Tracings of accelerograph records obtained at San Francisco Alexander Building 16th floor on June 22, Hollister on July 6 and August 10, and Eureka on September 23.*

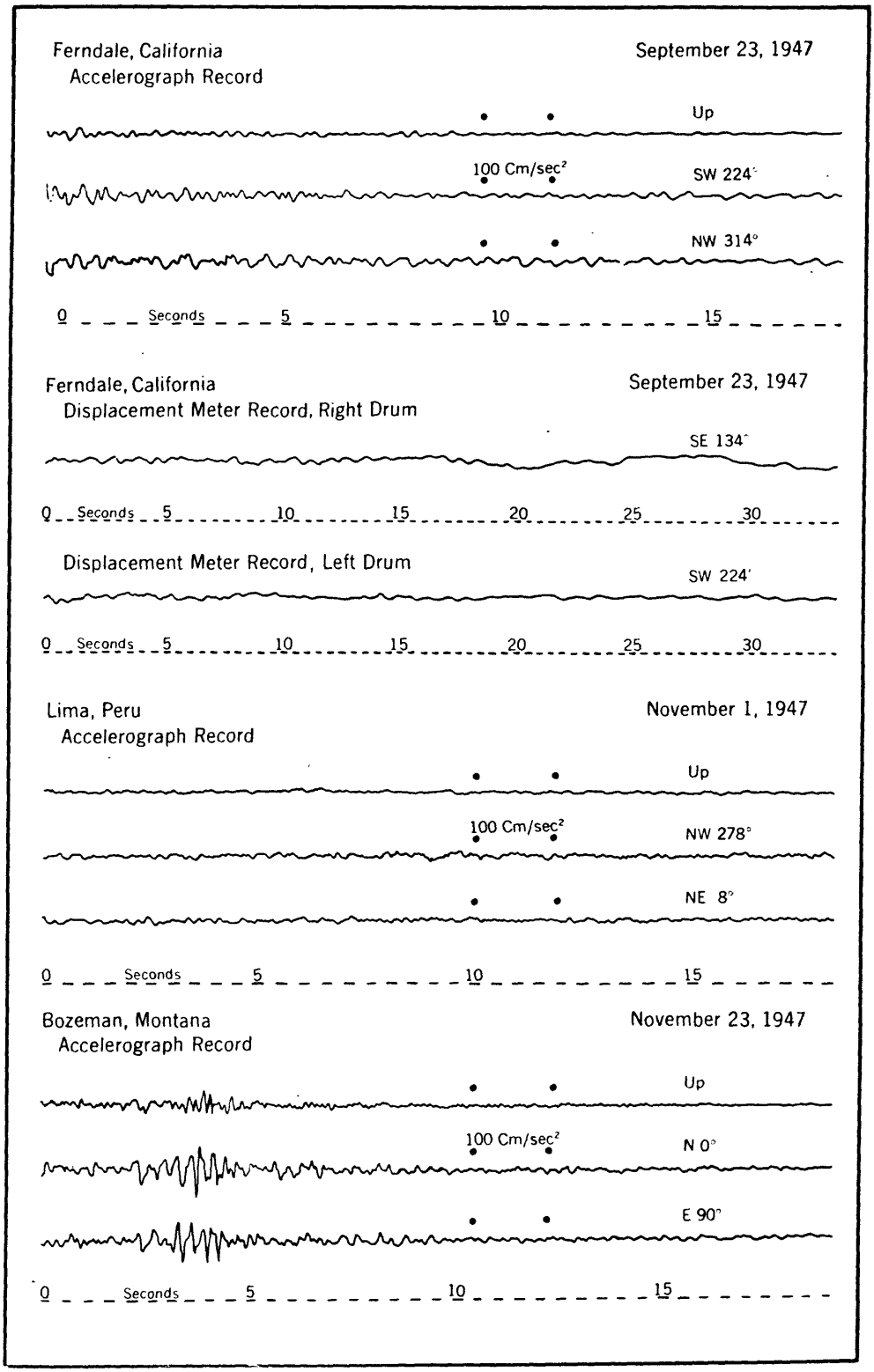


FIGURE 15.—*Tracings of accelerograph record and displacement-meter records obtained at Ferndale on September 23, and tracings of accelerograph records obtained at Lima on November 1, and at Bozeman on November 23.*

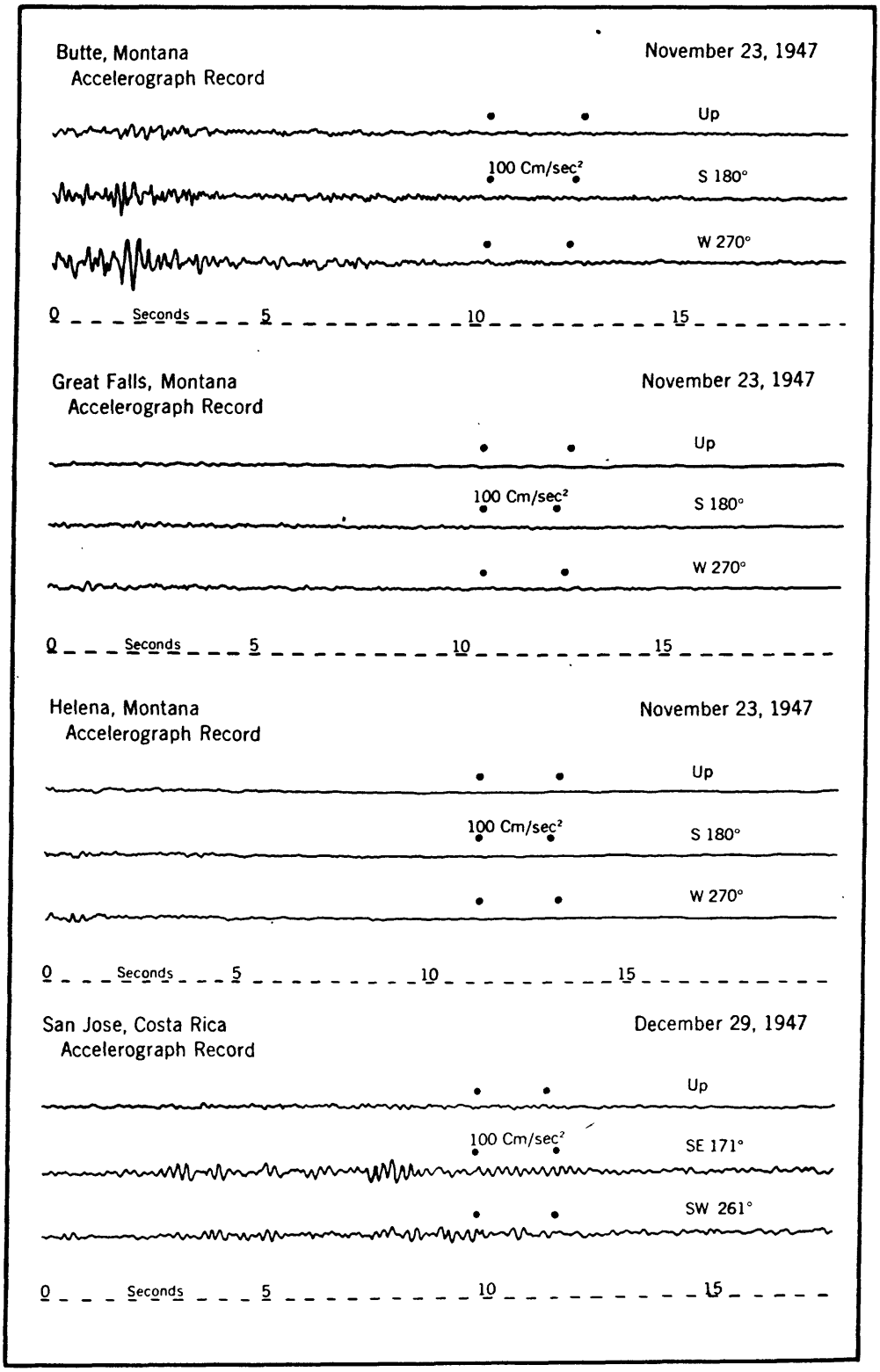


FIGURE 16.—*Tracings of accelerograph records obtained at Butte, Great Falls, and Helena on November 23, and at San Jose on December 29.*

### NORTHERN CALIFORNIA EARTHQUAKE OF AUGUST 10

Epicenter from local instrumental data 36°53′ north, 121°25′ west, near Hollister. Maximum intensity VI reported in Hollister.

*Hollister.*—Figure 14. Station 3 miles SE. 160° of epicenter. Maximum intensity VI in Hollister. Maximum acceleration 15 cm/sec.$^2$ and computed maximum displacement 0.010 cm.

*Monterey.*—Station 33 miles SE. 232° of epicenter. Maximum intensity IV reported in Monterey. Maximum acceleration 1 cm/sec.$^2$ and computed maximum displacement 0.001 cm.

*San Francisco Southern Pacific Building.*—Station 82 miles NW. 319° of epicenter. Maximum acceleration 1 cm/sec.$^2$ and computed maximum displacement 0.052 cm. on 14th floor. The record of the basement accelerograph was too weak to interpret. Maximum displacement of 0.01 cm. recorded on displacement meter and computed maximum acceleration 1 cm/sec.$^2$ in basement.

### NORTHERN CALIFORNIA EARTHQUAKE OF SEPTEMBER 23

Epicenter from local instrumental data 40.4° north, 125.2° west, northwestern California. Maximum intensity VII reported from Punta Gorda Light Station.

*Eureka.*—Figure 14. Station 60 miles NE. 65° of epicenter. Maximum intensity VI reported in Eureka. Maximum acceleration 10 cm/sec.$^2$ and computed maximum displacement 0.012 cm.

*Ferndale.*—Figure 15. Station 50 miles NE. 75° of epicenter. Maximum intensity VI reported in Ferndale. Maximum acceleration 15 cm/sec.$^2$ and computed maximum displacement 0.069 cm. Maximum displacement 0.10 cm. recorded on displacement meter and computed maximum acceleration 1 cm/sec.$^2$

### EARTHQUAKE OF NOVEMBER 1 NORTHEAST OF LIMA, PERU

Epicenter from instrumental data 11° south 75° west, about 150 miles northeast of Lima. No report of intensity, but 53 were reported dead and considerable property was damaged.

*Lima.*—Figure 15. Station 160 miles SW. 240° of epicenter. Maximum acceleration 6 cm/sec.$^2$ and computed maximum displacement 0.007 cm.

### EARTHQUAKE OF NOVEMBER 18 OFF COAST OF SOUTHERN CALIFORNIA

Epicenter from local instrumental data 33°16′ north, 119°27′ west, northwest of San Nicolas Island. Maximum intensity VI reported at San Nicolas Island.

*Westwood.*—Station 87 miles NE. 50° of epicenter. Maximum intensity V reported in Los Angeles. Maximum acceleration 2 cm/sec.$^2$ and computed maximum displacement 0.006 cm.

### SOUTHWESTERN MONTANA EARTHQUAKE OF NOVEMBER 23

Epicenter from instrumental data 44°47′ north, 112°02′ west, southwestern Montana. Maximum intensity VIII reported in several places in epicentral region.

*Bozeman.*—Figure 15. Station 80 miles NE. 40° of epicenter. Intensity VI reported in Bozeman. Maximum acceleration 30 cm/sec.$^2$ and computed maximum displacement 0.036 cm.

*Butte.*—Figure 16. Station 85 miles NW. 345° of epicenter. Maximum intensity VI reported at Butte. Maximum acceleration 23 cm sec.$^2$ and computed maximum displacement 0.039 cm.

*Great Falls.*—Figure 16. Station 190 miles NE. 10° of epicenter. Maximum intensity VI reported in Great Falls. Maximum acceleration 5 cm/sec.$^2$ and computed maximum displacement 0.010 cm.

*Helena.*—Figure 16. Station 125 miles N. 0° of epicenter. Maximum intensity VI reported in Helena. Maximum acceleration 6 cm/sec.$^2$ and computed maximum displacement 0.006 cm.

### EARTHQUAKE OF DECEMBER 29 NEAR COAST OF COSTA RICA

Epicenter from instrumental data 9.5° north, 84.5° west, near coast of Costa Rica. Maximum intensity unknown.

*San Jose.*—Figure 16. Station 60 miles NE. 45° of epicenter. Maximum acceleration 12 cm/sec.$^2$ and computed maximum displacement 0.009 cm.

**Table 4.—*Summary of strong-motion seismograph data for the year 1947***

(See the text preceding this table for additional details. Simple harmonic motion is assumed when computing displacement from an accelerogram and when computing acceleration from a displacement-meter record.)

| Station and component* | Earthquake wave period | Maximum acceleration | Maximum displacement | Remarks |
|---|---|---|---|---|
| | *Sec.* | *Cm/Sec.²* | *Cm.* | |
| **EARTHQUAKE OF MARCH 29 OFF CAPE MENDOCINO** | | | | |
| Eureka accelerograph: | | | | |
| Vertical, up | 0.23 | 1 | 0.001 | Weak record. |
| NE. 79° | .24 | 3 | .004 | Possibly preceded by stronger motion. |
| | .31 | 2 | .005 | |
| SE. 169° | .22 | 2 | .002 | |
| | .26 | 2 | .003 | |
| Ferndale accelerograph: | | | | |
| Vertical, up | .22 | 3 | .004 | Complex wave. |
| | .24 | 2 | .003 | |
| | .26 | 1 | .002 | |
| SW. 224° | .13 | 6 | .003 | Two short-period waves superposed on a 0.37 second wave. |
| | .33 | 6 | .017 | |
| | .32 | 3 | .008 | |
| NW. 314° | .15 | 2 | .001 | Several short-period waves superposed on a 0.52 second wave. |
| | .22 | 5 | .006 | |
| | .50 | 4 | .025 | Irregular long-period waves. |
| Right displacement meter: | | | | |
| SE. 134° | .80 | 2 | .03 | Weak record. |
| | .70 | 5 | .06 | |
| SW. 224° | .71 | 5 | .06 | |
| | .70 | 3 | .04 | |
| **SOUTHERN CALIFORNIA EARTHQUAKE OF APRIL 2** | | | | |
| El Centro accelerograph: | | | | |
| Vertical, up | 0.15 | 3 | 0.002 | Irregular motion. |
| | .11 | 3 | .001 | |
| | .26 | 1 | .002 | Short-period waves superposed. |
| N. 0° | .23 | 11 | .014 | Regular wave. |
| | .20 | 9 | .009 | |
| | .24 | 4 | .006 | Irregular waves. |
| | .32 | 2 | .005 | |
| E. 90° | .29 | 14 | .028 | Possibly preceded by stronger motion. |
| | .16 | 8 | .005 | |
| | .15 | 6 | .003 | Regular waves. |
| | .20 | 3 | .003 | |
| **SOUTHERN CALIFORNIA EARTHQUAKE OF APRIL 10** | | | | |
| Bishop accelerograph: | | | | |
| Vertical, up | | | | Motion very rapid and difficult to interpret. |
| E. 90° | 0.02 | 14 | 0.001 | Strong sharp phases. |
| | .03 | 9 | .001 | |
| | .02 | 6 | .001 | |
| S. 180° | .02 | 5 | .001 | Strong sharp phases. |
| | .02 | 8 | .001 | Difficult to separate waves. |
| Colton accelerograph: | | | | |
| Vertical, up | .15 | 9 | .005 | Regular wave. |
| | .15 | 4 | .002 | |
| | .44 | 3 | .015 | Short-period waves superposed. |
| E. 90° | .15 | 7 | .004 | Regular waves. |
| | .24 | 9 | .013 | Do. |
| S. 180° | .25 | 8 | .013 | |
| | .29 | 5 | .011 | Irregular long-period waves. |
| Left displacement meter: | | | | |
| N. 0° | 2.40 | 3 | .40 | Long-period waves. |
| | 2.62 | 1 | .12 | |
| Right displacement meter: | | | | |
| W. 270° | 3.37 | 1 | .27 | Irregular long-period waves. |
| | 3.15 | 1 | .36 | |
| Holywood Storage Bldg., penthouse accelerograph: | | | | |
| Vertical, up | .10 | 1 | .001 | Short-period waves superposed on 0.32 sec. waves. |
| | .24 | 11 | .015 | |
| | .45 | 11 | .056 | Irregular long-period waves. |
| S. 180° | .45 | 6 | .031 | |
| | .31 | 15 | .036 | Irregular waves. |
| | .55 | 30 | .230 | Strong wave. |
| | 1.24 | 13 | .494 | |
| W. 270° | .50 | 14 | .088 | |
| | .58 | 100 | .854 | Strong surface waves |
| | .58 | 28 | .238 | |
| | .59 | 12 | .106 | Sinusoidal waves. |

See footnote at end of table.

**Table 4.—*Summary of strong-motion seismograph data for the year 1947*—Continued**

SOUTHERN CALIFORNIA EARTHQUAKE OF APRIL 10—continued

| Station and component* | Earth-wave period | Maximum acceleration | Maximum displacement | Remarks |
|---|---|---|---|---|
| | *Sec.* | *Cm Sec.²* | *Cm.* | |
| AFTERSHOCK: | | | | |
| Vertical, up | 0.15 | 1 | 0.001 | Very weak. |
| S. 180° | .22 | 1 | .001 | |
| W. 270° | .55 | 1 | .008 | Weak long-period waves. |
| AFTERSHOCK: | .54 | 1 | .037 | Irregular long-period waves. |
| Vertical, up | .45 | 1 | .005 | Weak. |
| S. 180° | | | | |
| W. 270° | | | | Very weak. |
| Hollywood Storage Bldg., basement accelerograph: | 1.20 | 1 | .037 | Weak long-period waves. |
| Vertical, up | .45 | 1 | .005 | |
| E. 90° | .22 | 1 | .001 | |
| S. 180° | .21 | 5 | .005 | Weak long-period waves at beginning. |
| | .51 | 2 | .013 | |
| | .22 | 2 | .002 | Weak beginning. |
| | .30 | 10 | .022 | Sinusoidal waves. |
| | .42 | 11 | .045 | |
| | .17 | 2 | .001 | Weak beginning. |
| | .24 | 14 | .020 | |
| AFTERSHOCK: | .29 | 10 | .021 | Regular waves. |
| Vertical, up | .44 | 1 | .005 | |
| E. 90° | | | | |
| S. 180° | | | | Very weak. |
| AFTERSHOCK: | .28 | 1 | .022 | Weak. |
| Vertical, up | .29 | 1 | .002 | |
| E. 90° | | | | |
| S. 180° | | | | Very weak. |
| Hollywood Storage Bldg., P. E. lot accelerograph: | .05 | 1 | .001 | |
| Vertical, up | .03 | 1 | .001 | |
| E. 90° | .25 | 1 | .002 | Weak beginning. |
| | .37 | 3 | .010 | Irregular waves. |
| | .24 | 2 | .003 | Do. |
| S. 180° | .29 | 10 | .021 | |
| | .61 | 5 | .047 | Irregular long-period waves. |
| | .37 | 5 | .017 | Irregular motion. |
| AFTERSHOCK: | .19 | 10 | .009 | |
| Vertical, up | .37 | 3 | .010 | |
| E. 90° | | | | |
| S. 180° | | | | Very weak; |
| AFTERSHOCK: | .26 | 1 | .002 | Do. |
| Vertical, up | .26 | 1 | .002 | |
| E. 90° | .31 | 1 | .002 | |
| S. 180° | | | | Very weak. |
| Long Beach accelerograph: | .30 | 1 | .002 | |
| Vertical, up | .49 | 1 | .006 | |
| N. 0° | | | | |
| E. 90° | .49 | 1 | .006 | Weak motion. |
| Los Angeles Chamber of Commerce, 11th floor accelerograph: | .58 | 1 | .009 | |
| Vertical, up | .85 | 1 | .018 | Irregular motion. |
| SW. 218° | .16 | 3 | .002 | Regular waves. |
| | .37 | 1 | .003 | Short-period waves superposed. |
| NW. 308° | .90 | 10 | .206 | Irregular long-period waves. |
| | 1.35 | 13 | .566 | |
| | 1.25 | 2 | .077 | |
| | .28 | 9 | .018 | |
| Los Angeles Chamber of Commerce, basement accelerograph: | 1.23 | 31 | 1.147 | Irregular long-period waves. |
| Vertical, up | 1.09 | 9 | .276 | |
| SE. 128° | .39 | 2 | .008 | Weak motion. |
| SW. 218° | .45 | 5 | .026 | Irregular. |
| | .59 | 1 | .009 | |
| Los Angeles Subway Terminal, 13th floor accelerograph: | .50 | 5 | .032 | Irregular. |
| Vertical, up | .53 | 2 | .014 | |
| SW. 219° | .13 | 3 | .001 | Regular waves. |
| | .30 | 5 | .011 | |
| NW. 309° | .36 | 3 | .010 | |
| | .83 | 8 | .140 | Short-period waves superposed. |
| | .20 | 21 | .021 | Strong phase. |
| | .71 | 19 | .243 | |
| | .48 | 4 | .023 | |
| AFTERSHOCK: | .32 | 16 | .042 | Strong phase. |
| Vertical, up | .65 | 16 | .171 | Irregular waves. |
| SW. 219° | .22 | 1 | .001 | Very weak. |
| NW. 309° | .37 | 1 | .008 | Short-period waves superposed. |
| | .39 | 1 | .004 | Do. |

See footnote at end of table.

**Table 4.—*Summary of strong-motion seismograph data for the year 1947*—Continued**

SOUTHERN CALIFORNIA EARTHQUAKE OF APRIL 10—continued

| Station and component* | Earth-wave period | Maximum acceleration | Maximum displacement | Remarks |
|---|---|---|---|---|
| | *Sec.* | *Cm/Sec.²* | *Cm.* | |
| Los Angeles Subway Terminal, subbasement accelerograph: | | | | |
| Vertical, up | 0.14 | 1 | 0.001 | Weak. |
| | .29 | 3 | .006 | Irregular waves. |
| SE. 129° | .10 | 1 | .001 | |
| | .29 | 8 | .017 | Irregular waves. |
| SW. 219° | .29 | 7 | .015 | |
| | .07 | 1 | .001 | Weak. |
| | .25 | 7 | .011 | Irregular waves. |
| | .29 | 7 | .015 | |
| AFTERSHOCK: | | | | |
| Vertical, up | ---------- | ---------- | ---------- | Very weak. |
| SE. 129° | ---------- | ---------- | ---------- | Do. |
| SW. 219° | ---------- | ---------- | ---------- | Do. |
| Los Angeles Subway Terminal, subbasement displacement meter: | | | | |
| NE. 39° | 4.16 | 1 | .12 | Irregular waves superposed. |
| | 3.36 | 1 | .30 | |
| SE. 129° | 5.60 | 1 | .45 | Very long long-period wave. |
| | 5.36 | 1 | .42 | |
| Pasadena accelerograph: | | | | |
| Vertical, up | .09 | 1 | .001 | Weak beginning. |
| | .22 | 1 | .001 | |
| | .73 | 1 | .014 | |
| S. 180° | .22 | 1 | .001 | Weak beginning. |
| | .58 | 1 | .009 | Short-periods superposed. |
| | .52 | 1 | .007 | |
| W. 270° | .40 | 1 | .004 | Irregular motion. |
| | .58 | 1 | .009 | |
| Right displacement meter: | | | | |
| N. 0° | 6.60 | 1 | .82 | Large waves superposed. |
| | 1.73 | 1 | .07 | |
| Left displacement meter: | | | | |
| E. 90° | 5.92 | 1 | .63 | Irregular waves superposed. |
| | 2.02 | 3 | .35 | |
| | 3.60 | 1 | .28 | |
| Weed seismograph: | | | | |
| N. 0° | .31 | 1 | .001 | Very irregular trace. |
| | .65 | 1 | .001 | |
| E. 90° | ---------- | 2 | ---------- | Sharp phase. |
| | .15 | 1 | .001 | |
| San Bernardino Weed seismograph: | | | | |
| SE. 135° | .14 | 1 | .001 | Very weak. |
| | .24 | 1 | .002 | Impulsive motion. |
| | .24 | 1 | .002 | Do. |
| | 1.00 | 1 | .001 | |
| NE. 45° | .14 | 1 | .001 | |
| | .24 | 1 | .001 | Impulsive motion. |
| | .29 | 1 | .001 | |
| San Diego accelerograph: | | | | |
| Vertical, up | .32 | 1 | .003 | Weak record. |
| | .23 | 1 | .001 | |
| E. 90° | .43 | 2 | .009 | Irregular motion. |
| | .75 | 1 | .014 | |
| S. 180° | .46 | 2 | .011 | Irregular motion. |
| | .66 | 1 | .011 | |
| San Francisco Southern Pacific, 14th floor accelerograph: | | | | |
| Vertical, up | ---------- | ---------- | ---------- | Very weak. |
| SW. 225° | .10 | 3 | .001 | Weak long-period waves. |
| NW. 315° | .09 | 1 | .001 | Do. |
| San Francisco Southern Pacific, basement accelerograph: | | | | |
| Vertical, up | ---------- | ---------- | ---------- | Very weak. |
| NW. 319° | ---------- | ---------- | ---------- | Do. |
| NE. 49° | ---------- | ---------- | ---------- | Do. |
| Right displacement meter: | | | | |
| NW. 319° | ---------- | ---------- | ---------- | Do. |
| Left displacement meter: | | | | |
| NE. 49° | .29 | 1 | .01 | Weak long-period wave. |
| Santa Ana Weed seismograph: | | | | |
| NE. 45° | .48 | 1 | .001 | Irregular motion. |
| | .72 | 1 | .002 | |
| | 1.80 | 1 | .007 | |
| SE. 135° | .38 | 1 | .001 | Superposed on 0.45 sec. waves. |
| | .62 | 1 | .006 | |
| | 1.52 | 1 | .005 | Weak long-period waves. |

See footnote at end of table.

**Table 4.—*Summary of strong-motion seismograph data for the year 1947*—Continued**

SOUTHERN CALIFORNIA EARTHQUAKE OF APRIL 10—continued

| Station and component* | Earth-wave period | Maximum accelera-tion | Maximum displace-ment | Remarks |
|---|---|---|---|---|
| | *Sec.* | *Cm/Sec.²* | *Cm.* | |
| Vernon accelerograph: | | | | |
| Vertical, up | 0.12 | 3 | 0.001 | Possibly preceded by stronger motion. |
| | .76 | 1 | .015 | |
| SW. 187° | .34 | 10 | .003 | Irregular motion. |
| | .31 | 8 | .019 | |
| | .36 | 2 | .007 | |
| NW. 277° | .23 | 9 | .012 | Possibly preceded by stronger motion. |
| | .55 | 7 | .054 | |
| | .62 | 2 | .020 | |
| Westwood accelerograph: | | | | |
| Vertical, up | .30 | 3 | .001 | Irregular motoin. |
| | .64 | 1 | .010 | Short-period waves superposed. |
| E. 90° | .69 | 4 | .048 | Irregular motion. |
| | .35 | 3 | .009 | |
| S. 180° | .41 | 4 | .017 | Irregular motion. |
| | .51 | 3 | .020 | |

NORTHERN CALIFORNIA EARTHQUAKE OF MAY 27

| | | | | |
|---|---|---|---|---|
| Eureka accelerograph: | | | | |
| Vertical, up | 0.15 | 2 | 0.001 | Weak record. |
| | .14 | 1 | .001 | |
| NE. 79° | .18 | 7 | .006 | Possibly preceded by stronger motion. |
| | .17 | 4 | .003 | |
| | .20 | 1 | .001 | |
| SE. 169° | .14 | 7 | .004 | Sinusoidal waves. |
| | .14 | 2 | .001 | |
| | .17 | 1 | .001 | Weak motion. |
| Ferndale accelerograph: | | | | |
| Vertical, up | .15 | 9 | .005 | Irregular waves. |
| | .10 | 13 | .003 | |
| | .22 | 10 | .012 | Sinusoidal waves. |
| | .31 | 2 | .005 | |
| SW. 224° | .10 | 34 | .007 | Strong phases. |
| | .18 | 26 | .002 | Do. |
| | .16 | 16 | .010 | |
| | .56 | 6 | .048 | Short-period waves superposed. |
| NW. 314° | .14 | 26 | .013 | Strong phases. |
| | .09 | 22 | .004 | |
| | .15 | 22 | .011 | Strong phases. |
| | .19 | 6 | .005 | |
| | .61 | 2 | .019 | Weak long-period waves. |
| Right displacement meter: | | | | |
| SE. 134° | .41 | 45 | .19 | Possibly preceded by stronger motion. |
| | .56 | 13 | .10 | Regular waves. |
| | .48 | 5 | .03 | |
| Left displacement meter: | | | | |
| SW. 224° | .18 | 14 | .11 | Possibly preceded by stronger motion. |
| | .42 | 25 | .11 | |

EARTHQUAKE OF JUNE 5 NEAR COAST OF EL SALVADOR

| | | | | |
|---|---|---|---|---|
| Guatemala accelerograph: | | | | |
| Vertical, up | 0.25 | 2 | 0.003 | Weak. |
| | .26 | 3 | .005 | Irregular motion. |
| | .25 | 2 | .003 | |
| SW. 194° | .21 | 4 | .004 | Irregular motion. |
| | .34 | 3 | .009 | |
| | .27 | 1 | .002 | Weak motion. |
| NW. 284° | .23 | 3 | .004 | |
| | .15 | 3 | .002 | Irregular motion. |
| | .36 | 1 | .003 | |

See footnote at end of table.

**Table 4.—*Summary of strong-motion seismograph data for the year 1947*—Continued**

NORTHERN CALIFORNIA EARTHQUAKE OF JUNE 22

| Station and component* | Earth-wave period | Maximum acceleration | Maximum displacement | Remarks |
|---|---|---|---|---|
| | *Sec.* | *Cm/Sec.²* | *Cm.* | |
| Hollister accelerograph: | | | | |
| Vertical, up | 0.20 | 12 | 0.012 | Single sinusoidal wave. |
| | .21 | 10 | .011 | Do. |
| | .26 | 11 | .019 | One short-period wave superposed. |
| | .38 | 4 | .015 | Weak long-period wave. |
| S. 181° | .33 | 21 | .058 | Strongest phase on record. |
| | .34 | 20 | .059 | Irregular wave motion. |
| | .43 | 19 | .089 | Regular sinusoidal wave. |
| | .81 | 6 | .100 | Do. |
| W. 271° | .26 | 21 | .036 | Possibly preceded by stronger motion. |
| | .52 | 21 | .144 | Short-period waves superposed. |
| | .46 | 14 | .075 | Regular sinusoidal waves. |
| | .50 | 10 | .064 | |
| Oakland City Hall, 16th floor accelerograph: | | | | |
| Vertical, up | .19 | 9 | .008 | Possibly preceded by stronger motion. |
| | .17 | 9 | .006 | Sinusoidal wave. |
| | .39 | 6 | .023 | Irregular waves. |
| NE. 26° | .21 | 8 | .009 | Possibly preceded by stronger motion. |
| | .18 | 9 | .007 | Strong phases superposed on weak long-period waves. |
| | .19 | 11 | .010 | Do. |
| | .93 | 5 | .109 | Short-period waves superposed. |
| SE. 116° | .18 | 8 | .007 | Waves superposed on long-period waves. |
| | .19 | 10 | .009 | Do. |
| | .91 | 6 | .126 | Irregular long-period waves. |
| Oakland City Hall, basement accelerograph: | | | | |
| Vertical, down | .16 | 1 | .001 | Very weak record. |
| SW. 206° | .20 | 3 | .003 | Weak long-period waves. |
| | .20 | 1 | .001 | |
| NW. 296° | .14 | 1 | .001 | Weak long-period waves. |
| | .20 | 1 | .001 | |
| San Francisco Alexander Bldg., 16th floor accelerograph: | | | | |
| Vertical, up | .19 | 2 | .002 | Weak sinusoidal waves. |
| | .41 | 1 | .004 | Irregular long-period waves. |
| SE. 171° | .27 | 1 | .002 | Weak irregular waves at beginning. |
| | .41 | 2 | .009 | Regular waves. |
| SW. 261° | .19 | 1 | .001 | Weak at beginning. |
| | .31 | 2 | .005 | |
| San Francisco Alexander Bldg., 11th floor accelerograph: | | | | |
| Vertical, up | .19 | 1 | .001 | Weak regular waves. |
| NE. 81° | .23 | 1 | .001 | Do. |
| | .31 | 1 | .002 | |
| SE. 171° | .23 | 1 | .001 | |
| | .28 | 1 | .002 | Weak long-period waves. |
| San Francisco Alexander Bldg., basement accelerograph: | | | | |
| Vertical, up | .14 | 1 | .001 | Very weak. |
| NW. 351° | .20 | 2 | .002 | Irregular waves. |
| | .22 | 1 | .001 | |
| NE. 81° | .20 | 1 | .001 | Irregular waves. |
| | .33 | 1 | .003 | |
| San Francisco Shell Bldg., 29th floor Weed seismograph: | | | | |
| SW. 261° | .36 | 1 | .003 | |
| | .24 | 1 | .001 | |
| | .72 | 1 | .013 | Sinusoidal waves. |
| SE. 171° | .60 | 1 | .009 | Very sharp phase. |
| | .08 | 1 | .001 | |
| | .36 | 1 | .003 | |
| San Francisco Shell Bldg., 21st floor Weed seismograph: | | | | |
| NE. 81° | .36 | 1 | .003 | Regular waves. |
| | .52 | 1 | .007 | |
| NW. 351° | .32 | 1 | .003 | Regular waves. |
| | .88 | 1 | .020 | Sinusoidal waves. |
| San Francisco Shell Bldg., basement Weed seismograph: | | | | |
| E. 90° | .07 | | | Very weak. |
| N. 0° | .16 | 1 | .001 | Weak sinusoidal wave. |
| San Francisco Southern Pacific Bldg., 14th floor accelerograph: | | | | |
| Vertical, up | .16 | 8 | .005 | Regular waves. |
| | .47 | 10 | .056 | |
| SW. 225° | .41 | 3 | .013 | |
| | .52 | 24 | .166 | Long-period waves. |
| | 1.20 | 3 | .110 | |
| NW. 315° | .41 | 3 | .013 | Short-period waves superposed. |
| | .47 | 27 | .151 | Regular sinusoidal waves. |
| | 1.02 | 9 | .243 | |

See footnote at end of table.

**Table 4.—*Summary of strong-motion seismograph data for the year 1947*—Continued**

NORTHERN CALIFORNIA EARTHQUAKE OF JUNE 22—continued

| Station and component* | Earth-wave period | Maximum accelera-tion | Maximum displace-ment | Remarks |
|---|---|---|---|---|
| | *Sec.* | *Cm/Sec.²* | *Cm.* | |
| San Francisco Southern Pacific Bldg., basement accelerograph: | | | | |
| Vertical, up | 0.09 | 1 | 0.001 | Very weak. |
| | .43 | 4 | .019 | |
| NW. 319° | .41 | 14 | .060 | Long-period waves. |
| NE. 49° | .36 | 13 | .042 | Irregular long-period waves. |
| | .38 | 1 | .004 | |
| Right displacement meter: | | | | |
| NW. 319° | .78 | 3 | .04 | Irregular waves. |
| | .81 | 2 | .03 | |
| Left displacement meter: | | | | |
| NE. 49° | .64 | 7 | .07 | Irregular waves. |
| San Francisco Sutter Bldg., 29th floor Weed seismograph: | | | | |
| E. 90° | .97 | 2 | .06 | |
| | .02 | 1 | .001 | Very sharp phase. |
| | .45 | 1 | .005 | |
| N. 0° | .02 | 1 | .001 | Very sharp phase. |
| | .50 | 1 | .006 | Sinusoidal waves. |
| San Jose Bank of America, 13th floor accelerograph: | | | | |
| Vertical, up | .18 | 5 | .004 | Very short-period waves superposed. |
| NE. 60° | .38 | 3 | .011 | |
| | 1.73 | 2 | | Very weak. |
| SE. 150° | .28 | 3 | .006 | Weak. |
| | .51 | 2 | .013 | |
| San Jose Bank of America, basement accelerograph: | | | | |
| Vertical, up | .16 | 1 | .001 | Very weak. |
| NE. 60° | .14 | 1 | .001 | Irregular waves. |
| | .30 | 1 | .002 | |
| SE. 150° | .15 | 1 | .001 | Irregular waves. |
| | .14 | 1 | .001 | |

NORTHERN CALIFORNIA EARTHQUAKE OF JULY 6

| | | | | |
|---|---|---|---|---|
| Hollister accelerograph: | | | | |
| Vertical, up | 0.10 | 5 | 0.001 | Sinusoidal waves. |
| | .29 | 4 | .009 | Short-period waves superposed. |
| | .46 | 4 | .021 | |
| SW. 181° | .35 | 9 | .028 | Possibly preceded by stronger motion. |
| | .35 | 13 | .040 | Largest waves. |
| | .37 | 4 | .014 | |
| NW. 271° | .10 | 7 | .002 | Very irregular motion at beginning. |
| | .14 | 13 | .007 | |
| | .50 | 6 | .038 | Short-period waves superposed. |

SOUTHERN CALIFORNIA EARTHQUAKE OF JULY 24

| | | | | |
|---|---|---|---|---|
| Hollywood Storage Bldg., penthouse accelerograph: | | | | |
| Vertical, up | | | | Too weak to interpret. |
| S. 180° | 1.12 | 1 | 0.032 | Very weak long-period waves. |
| W. 270° | .81 | 1 | .017 | Very weak waves. |
| Holywood Storage Bldg., basement accelerograph: | | | | |
| Vertical, up | | | | Too weak ot interpret. |
| E. 90° | | | | Do. |
| S. 180° | | | | Do. |
| Holywood Storage Bldg., P. E. lot accelerograph: | | | | |
| Vertical, up | | | | Do. |
| E. 90° | | | | Very weak long-period waves. |
| S. 180° | .78 | 1 | .015 | Do. |
| Los Angeles Subway Terminal, 13th floor accelerograph: | | | | |
| Vertical, up | .13 | 2 | .001 | |
| | .30 | 1 | .002 | Short-period waves superposed. |
| | .24 | 1 | .001 | |
| SW. 219° | .33 | 9 | .025 | Possibly preceded by stronger motion. |
| | .69 | 3 | .036 | Short-period waves superposed. |
| | .44 | 3 | .015 | |
| NW. 309° | .43 | 3 | .014 | Possibly preceded by stronger motion. |
| | .31 | 3 | .007 | |
| | .44 | 1 | .005 | Very weak. |
| Los Angeles Subway Terminal, subbasement accelerograph: | | | | |
| Vertical, up | .21 | 1 | .001 | Do. |
| | .34 | 1 | .003 | |
| SE. 129° | .32 | 1 | .003 | Possibly preceded by stronger motion. |
| | .28 | 1 | .002 | |
| SW. 219° | .33 | 1 | .003 | Very weak. |
| | .34 | 1 | .003 | Do. |

See footnote at end of table.

**Table 4.—*Summary of strong-motion seismograph data for the year 1947*—Continued**

SOUTHERN CALIFORNIA EARTHQUAKE OF JULY 24—continued

| Station and component* | Earth-wave period | Maximum acceleration | Maximum displacement | Remarks |
|---|---|---|---|---|
| | *Sec.* | *Cm/Sec.²* | *Cm.* | |
| Right displacement meter: | | | | |
| NE. 39° | 3.04 | 1 | .05 | |
| | 3.35 | 1 | .01 | |
| Left displacement meter: | | | | |
| SE. 129° | 2.52 | 1 | .05 | |
| | 3.35 | 1 | .07 | |

NORTHERN CALIFORNIA EARTHQUAKE OF AUGUST 10

| | | | | |
|---|---|---|---|---|
| Hollister accelerograph: | | | | |
| Vertical, up | 0.06 | 2 | 0.001 | Sharp phase. |
| | .07 | 2 | .001 | |
| | .18 | 2 | .002 | |
| | .22 | 2 | .002 | Regular wave. |
| | .36 | 2 | .007 | Short-period waves superposed. |
| S. 181° | .16 | 6 | .004 | Very sharp phase. |
| | .16 | 5 | .003 | Do. |
| | .13 | 2 | .001 | Regular wave. |
| | .22 | 1 | .001 | |
| | .64 | 1 | .010 | Short-period waves superposed. |
| W. 271° | .11 | 15 | .005 | Very sharp phase. |
| | .17 | 8 | .006 | |
| | .17 | 2 | .001 | Irregular wave. |
| | .41 | 1 | .004 | |
| | .49 | 1 | .006 | Short-period waves superposed. |
| Monterey accelerograph: | | | | |
| Vertical, up | .11 | 1 | .001 | Very weak. |
| NE. 10° | .11 | 1 | .001 | Do. |
| | .18 | 1 | .001 | |
| SE. 100° | .11 | 1 | .001 | Very weak. |
| | .20 | 1 | .001 | |
| San Francisco Southern Pacific Bldg., 14th floor accelerograph: | | | | |
| Vertical, up | 1.43 | 1 | .052 | Very weak. |
| SW. 225° | .50 | 1 | .006 | |
| NW. 315° | .88 | 1 | .020 | |
| San Francisco Southern Pacific Bldg., basement accelerograph: | | | | |
| Vertical, up | | | | Too weak to interpret. |
| NW. 319° | | | | Do. |
| NE. 49° | | | | Do. |
| Right displacement meter: | | | | |
| NW. 315° | 76 | 1 | .01 | Very weak. |
| Left displacement meter: | | | | |
| NE. 45° | .92 | 1 | .01 | Do. |

NORTHERN CALIFORNIA EARTHQUAKE OF SEPTEMBER 23

| | | | | |
|---|---|---|---|---|
| Eureka accelerograph: | | | | |
| Vertical, up | 0.14 | 2 | 0.001 | Small motion. |
| | .38 | 1 | .004 | |
| NE. 79° | .21 | 10 | .011 | Possibly preceded by stronger motion. |
| | .34 | 2 | .005 | |
| | .27 | 2 | .003 | |
| SE. 169° | .28 | 6 | .012 | Possibly preceded by stronger motion. |
| | .32 | 2 | .005 | Small motion. |
| Ferndale accelerograph: | | | | |
| Vertical, up | .36 | 7 | .023 | Large irregular wave. |
| | .25 | 4 | .006 | Sinusoidal wave. |
| | .28 | 4 | .008 | |
| | .34 | 1 | .003 | |
| SW. 224° | .54 | 15 | .111 | Possibly preceded by stronger motion. Short-period waves superposed. |
| | .35 | 9 | .028 | Irregular motion. |
| | .37 | 5 | .017 | |
| NW. 314° | .28 | 11 | .022 | Possibly preceded by stronger motion. |
| | .52 | 10 | .069 | Short-period waves superposed. |
| | 41 | 7 | .030 | Regular sinusoidal waves. |
| Right displacement meter: | | | | |
| SE. 134° | .07 | 1 | .10 | Small motion. |
| | .07 | 1 | .09 | Some ten-second waves with very little amplitude. |
| Left displacement meter: | | | | |
| SW. 224° | .08 | 1 | .07 | Small motion. |
| | 11 | 1 | .04 | |
| | .14 | 1 | .05 | |

See footnote at end of table.

**Table 4.—*Summary of strong-motion seismograph data for the year 1947*—Continued**

EARTHQUAKE OF NOVEMBER 1 NORTHEAST OF LIMA, PERU

| Station and component* | Earth-wave period | Maximum acceleration | Maximum displacement | Remarks |
|---|---|---|---|---|
| | *Sec.* | *Cm/Sec.²* | *Cm.* | |
| Lima, Peru, accelerograph: | | | | |
| Vertical, up | 0.30 | 3 | 0.007 | Irregular motion with superposed short-period waves. |
| | .29 | 2 | .004 | |
| NW. 278° | .23 | 3 | .004 | Irregular motion with superposed short-period waves. |
| | .23 | 4 | .005 | |
| NE. 8° | .24 | 5 | .007 | Irregular waves. |
| | .19 | 6 | .005 | |
| | .25 | 4 | .006 | |

EARTHQUAKE OF NOVEMBER 18 OFF COAST OF SOUTHERN CALIFORNIA

| | | | | |
|---|---|---|---|---|
| Westwood accelerograph: | | | | |
| Vertical, up | 0.16 | 1 | 0.001 | Very weak. |
| S. 180° | .33 | 1 | .003 | Weak sinusoidal wave. |
| | .29 | 1 | .002 | |
| W. 270° | .34 | 2 | .006 | Weak sinusoidal wave. |
| | .31 | 1 | .002 | |

SOUTHWESTERN MONTANA EARTHQUAKE OF NOVEMBER 23

| | | | | |
|---|---|---|---|---|
| Bozeman accelerograph: | | | | |
| Vertical, up | 0.17 | 4 | 0.003 | |
| | .15 | 9 | .005 | Sinusoidal surface waves. |
| | .19 | 11 | .010 | Do. |
| N. 0° | .20 | 9 | .009 | Possibly preceded by stronger motion. |
| | .28 | 18 | .036 | Large surface waves. |
| | .20 | 30 | .030 | Do. |
| | .17 | 8 | .006 | |
| E. 90° | .22 | 3 | .004 | |
| | .16 | 11 | .007 | |
| | .20 | 24 | .024 | Large surface waves. |
| Butte accelerograph: | | | | |
| Vertical, up | .06 | 4 | .001 | Possibly preceded by stronger motion. |
| | .16 | 7 | .005 | |
| | .40 | 3 | .012 | Several short-period waves superposed. |
| S. 180° | .19 | 9 | .008 | Possibly preceded by stronger motion. |
| | .16 | 15 | .009 | Sinusoidal surface waves. |
| | .12 | 7 | .003 | |
| | .47 | 4 | .022 | Several short-period waves superposed. |
| W. 270° | .13 | 8 | .003 | |
| | .26 | 23 | .039 | Sinusoidal surface waves. |
| | .19 | 9 | .008 | |
| | .25 | 5 | .008 | Irregular motion. |
| Great Falls accelerograph: | | | | |
| Vertical, up | .47 | 1 | .006 | Very weak. |
| S. 180° | .16 | 3 | .002 | Sinusoidal wave. |
| | .47 | 1 | .006 | |
| W. 270° | .20 | 5 | .005 | |
| | .44 | 2 | .010 | Irregular waves. |
| Helena accelerograph; | | | | |
| Vertical, up | .26 | 2 | .003 | Irregular motion. |
| | .29 | 1 | .002 | |
| S. 180° | .15 | 4 | .002 | Irregular motion. |
| | .34 | 2 | .006 | Short-period waves superposed. |
| W. 270° | .15 | 5 | 003 | Possibly preceded by stronger motion. |

EARTHQUAKE OF DECEMBER 29 NEAR COAST OF COSTA RICA

| | | | | |
|---|---|---|---|---|
| San Jose accelerograph: | | | | |
| Vertical, up | 0.05 | 4 | 0.001 | Sharp phase superposed on long-period waves. |
| | .18 | 3 | .003 | |
| | .23 | 3 | .004 | Long irregular waves. |
| SE. 171° | .48 | 9 | .007 | Sinusoidal wave groups. |
| | .17 | 12 | .009 | Strong sinusoidal waves superposed on 0.6-second waves. |
| | .37 | 2 | .007 | Very irregular long-period waves. |
| SW. 261° | .19 | 7 | .006 | Regular sinusoidal waves. |
| | .21 | 7 | .008 | Do. |
| | .29 | 1 | .002 | Very irregular long-period waves. |

* The quadrant is given first, then the pendulum direction corresponding to upward motion of the trace, the direction being measured in degrees from north around by east.

**Table 5.—*Instrumental constants of strong-motion seismographs in 1947***

| Station and instrument | Orientation of instrument [1] | Pendulum period | Static magnification | Sensitivity [2] | Damping ratio | Instrument number |
|---|---|---|---|---|---|---|
| **EARTHQUAKE OF MARCH 29 OFF CAPE MENDOCINO** | | | | | | |
| | | *Sec.* | | *Cm.* | | |
| Eureka accelerograph No. 30 | Up | 0.070 | 101 | 1.25 | 9 | V-29 |
| | NE. 79° | .069 | 106 | 1.27 | 10 | L-13 |
| | SE. 169° | .068 | 108 | 1.26 | 7 | T-8 |
| Ferndale accelerograph No. 28 | Up | .098 | 70 | 1.70 | 9 | V-126 |
| | SW. 224° | .099 | 71 | 1.76 | 11 | L-124 |
| | NW. 314° | .100 | 74 | 1.87 | 9 | T-125 |
| Displacement meter No. 13 | SE. 134° | 10.0 | 1 | | 5 | |
| | SW. 224° | 9.9 | 1 | | 5 | |
| **SOUTHERN CALIFORNIA EARTHQUAKE OF APRIL 2** | | | | | | |
| El Centro accelerograph No. 52 | Up | 0.102 | 78 | 2.04 | 8 | V-172 |
| | N. 0° | .102 | 74 | 1.95 | 13 | L-171 |
| | E. 90° | .102 | 77 | 2.02 | 11 | T-170 |
| **SOUTHERN CALIFORNIA EARTHQUAKE OF APRIL 10** | | | | | | |
| Bishop accelerograph No. 6 | Up | 0.100 | 107 | 2.72 | 10 | V-23 |
| | E. 90° | .100 | 106 | 2.67 | 10 | L-36 |
| | S. 180° | .097 | 106 | 2.53 | 10 | T-19 |
| Colton accelerograph No. 38 | Up | .100 | 115 | 2.90 | 9 | V-111 |
| | E. 90° | .098 | 109 | 2.65 | 10 | L-91 |
| | S. 180° | .100 | 112 | 2.85 | 9 | T-101 |
| Displacement meter No. 16 | N. 0° | 10.02 | 1 | | 10 | |
| | W. 270° | 10.01 | 1 | | 8 | |
| Hollywood Storage Bldg.: [3] | | | | | | |
| Penthouse accelerograph No. 40 | Up | .102 | 80 | 2.10 | 9 | V-11 |
| | S. 180° | .099 | 84 | 2.08 | 9 | L-93 |
| | W. 270° | .101 | 79 | 2.03 | 9 | T-103 |
| Basement accelerograph No. 22 | Up | .069 | 104 | 1.25 | 9 | V-25 |
| | E. 90° | .069 | 111 | 1.33 | 10 | L-3 |
| | S. 180° | .070 | 110 | 1.36 | 8 | T-18 |
| P. E. lot accelerograph No. 1 | Up | .070 | 108 | 1.33 | 10 | V-66 |
| | E. 90° | .070 | 108 | 1.34 | 8 | L-64 |
| | S. 180° | .070 | 111 | 1.38 | 9 | T-65 |
| Long Beach accelerograph No. 24 | Up | .070 | 112 | 1.39 | 12 | V-30 |
| | N. 0° | .070 | 110 | 1.37 | 9 | L-5 |
| | E. 90° | .071 | 109 | 1.40 | 13 | T-34 |
| Los Angeles Chamber of Commerce: [3] | | | | | | |
| 11th floor accelerograph No. 42 | Up | .100 | 80 | 2.02 | 9–10 | V-115 |
| | SW. 220° | .098 | 82 | 2.00 | 9 | L-95 |
| | NW. 310° | .098 | 79 | 1.92 | 9 | T-105 |
| Basement accelerograph No. 21 | Up | .069 | 107 | 1.29 | 12 | V-28 |
| | SE. 120° | .068 | 109 | 1.27 | 8 | L-9 |
| | SW. 218° | .068 | 110 | 1.29 | 11 | T-26 |
| Los Angeles Subway Terminal: [3] | | | | | | |
| 13th floor accelerograph No. 39 | Up | .101 | 81 | 2.10 | 12 | V-112 |
| | SW. 219° | .100 | 81 | 2.04 | 9 | L-92 |
| | NW. 309° | .100 | 80 | 2.03 | 12 | T-102 |
| Subbasement accelerograph No. 3 | Up | .069 | 116 | 1.40 | 9 | V-58 |
| | SE. 129° | .068 | 118 | 1.38 | 12 | L-59 |
| | SW. 219° | .070 | 119 | 1.48 | 9 | T-60 |
| Subbasement displacement meter No. 13 | NE. 39° | 9.94 | 1 | | 9 | |
| | SE. 129° | 10.32 | 1 | | 9 | |
| Pasadena accelerograph No. 7 | Up | .102 | 76 | 2.00 | 10 | V-114 |
| | S. 180° | .101 | 78 | 2.02 | 10 | L-94 |
| | W. 270° | .100 | 71 | 1.81 | 11 | T-104 |
| Displacement meter No. 17 | N. 0° | 9.80 | 1 | | 8 | |
| | E. 90° | 9.88 | 1 | | 9 | |
| Weed seismograph No. 7 | N. 0° | .19 | 6.8 | .73 | 2.1 | |
| | E. 90° | .19 | 7.0 | .74 | 1.7 | |
| San Bernardino Weed seismograph No. 10 | SE. 135° | .19 | 6.4 | .56 | 2.2 | |
| | NE. 45° | .19 | 6.3 | .57 | 2.2 | |
| San Diego accelerograph No. 5 | Up | .098 | 105 | 2.56 | 13 | V-70 |
| | E. 90° | .100 | 107 | 2.71 | 9 | L-71 |
| | S. 180° | .099 | 111 | .275 | 10 | T-72 |
| San Francisco Southern Pacific Bldg.: [3] | | | | | | |
| 14th floor accelerograph No. 34 | Up | .047 | 119 | .67 | 7 | V-184 |
| | SW. 225° | .047 | 122 | .68 | 11 | L-183 |
| | NW. 314° | .046 | 126 | .68 | 12 | T-182 |
| Basement accelerograph No. 27 | Up | .064 | 121 | 1.26 | 9 | V-196 |
| | NW. 319° | .065 | 119 | 1.27 | 9 | L-195 |
| | NE. 49° | .066 | 120 | 1.33 | 9 | T-194 |
| Basement displacement meter No. 18 | NW. 319° | 9.9 | 1 | | 11 | |
| | NE. 49° | 9.8 | 1 | | 12 | |

See footnotes at end of table.

**Table 5.—*Instrumental constants of strong-motion seismographs in 1947*—Continued**

SOUTHERN CALIFORNIA EARTHQUAKE OF APRIL 10—continued

| Station and instrument | Orientation of instrument [1] | Pendulum period | Static magnification | Sensitivity [2] | Damping ratio | Instrument number |
|---|---|---|---|---|---|---|
| | | *Sec.* | | *Cm.* | | |
| Santa Ana Weed seismograph No. 12 | NE. 45° | 0.19 | 7.3 | 0.67 | 2.6 | |
| | SE. 135° | .19 | 7.6 | .69 | 2.6 | |
| Vernon accelerograph No. 41 | Up | .070 | 109 | 1.35 | 9 | V-47 |
| | SW. 187° | .069 | 114 | 1.38 | 9 | L-37 |
| | NW. 277° | .068 | 115 | 1.35 | 10 | T-48 |
| Westwood accelerograph No. 20 | Up | .103 | 75 | 2.00 | 9 | V-78 |
| | E. 90° | .100 | 75 | 1.90 | 10 | L-76 |
| | S. 180° | .100 | 73 | 1.84 | 10 | T-77 |
| NORTHERN CALIFORNIA EARTHQUAKE OF MAY 27 | | | | | | |
| Eureka accelerograph No. 30 | Up | 0.070 | 102 | 1.26 | 9 | V-29 |
| | NE. 79° | .069 | 105 | 1.27 | 9 | L-13 |
| | SE. 169° | .068 | 109 | 1.27 | 7 | T- 8 |
| Ferndale accelerograph No. 28 | Up | .098 | 70 | 1.70 | 9 | V-126 |
| | SW. 224° | .099 | 71 | 1.76 | 10 | L-124 |
| | NW. 314° | .100 | 74 | 1.87 | 9 | T-125 |
| Displacement meter No. 13 | SE. 134° | 10.0 | 1 | | 10 | |
| | SW. 224° | 9.9 | 1 | | 12 | |
| EARTHQUAKE OF JUNE 5 NEAR COAST OF EL SALVADOR | | | | | | |
| Guatemala accelerograph No. 49 | Up | 0.100 | 80 | 2.02 | 10 | V-138 |
| | SW. 194° | .101 | 81 | 2.10 | 8 | L-136 |
| | NW. 284° | .096 | 80 | 1.86 | 7 | T-137 |
| NORTHERN CALIFORNIA EARTHQUAKE OF JUNE 22 | | | | | | |
| Hollister accelerograph No. 23 | Up | 0.069 | 116 | 1.40 | 3 | V-20 |
| | SW. 181° | .069 | 114 | 1.38 | 4 | L-21 |
| | NW. 271° | 071 | 114 | 1.46 | 4 | T-32 |
| Oakland City Hall: [3] | | | | | | |
| 16th floor accelerograph No. 37 | Up | .102 | 75 | 1.96 | 7 | V-109 |
| | NE. 26° | .101 | 76 | 1.97 | 10 | L-99 |
| | SE. 116° | .101 | 74 | 1.91 | 7 | T-89 |
| Basement accelerograph No. 33 | Down | 069 | 112 | 1.35 | 8 | V-16 |
| | SW. 206° | .069 | 116 | 1.40 | 9 | L-33 |
| | NW. 296° | .068 | 117 | 1.36 | 9 | T-12 |
| San Francisco Alexander Bldg.: [4] | | | | | | |
| 16th floor accelerograph No. 36 | Up | .047 | 114 | .63 | 14 | V-181 |
| | SE. 171° | .047 | 121 | .68 | 7 | L-180 |
| | SW. 261° | 046 | 124 | .66 | 7 | T-179 |
| 11th floor accelerograph No. 43 | Up | 045 | 120 | .62 | 8 | V-178 |
| | NE. 81° | .046 | 127 | .68 | 6 | L-177 |
| | SE. 171° | .047 | 120 | .67 | 7 | T-176 |
| Basement accelerograph No. 10 | Up | .065 | 120 | 1.28 | 6 | V-199 |
| | NW. 351° | 065 | 120 | 1.29 | 11 | L-198 |
| | NE. 81° | 065 | 121 | 1.30 | 6 | T-197 |
| San Francisco Shell Bldg.: [3] | | | | | | |
| 29th floor Weed seismograph No. 2 | SW. 261 | .20 | 7 3 | .74 | 3 | |
| | SE. 171 | 21 | 7.4 | .83 | 3 | |
| 21st floor Weed seismograph No. 3 | E. 90° | 20 | 6 2 | .63 | 4 | |
| | N. 0° | .20 | 6.1 | .62 | 4 | |
| Basement Weed seismograph No. 4 | NE. 81° | 18 | 7.7 | .69 | 3 | |
| | NW. 351 | .19 | 7.7 | .62 | 3 | |
| San Francisco Southern Pacific Bldg.: | | | | | | |
| 14th floor accelerograph No. 34 | Up | .047 | 119 | .67 | 6 | V 184 |
| | SW. 225° | .047 | 122 | .68 | 8 | L-183 |
| | NW. 315 | .046 | 126 | .68 | 9 | T 182 |
| Basement accelerogtaph No. 27 | Up | 064 | 121 | 1.26 | 9 | V 196 |
| | NW. 319 | .064 | 119 | 1.23 | 9 | L-195 |
| | NE. 49° | .065 | 120 | 1.29 | 8 | T-194 |
| Basement displacement meter No. 18 | NW. 319 | 9 9 | 1 | | 11 | |
| | NE. 49° | 9 8 | 1 | | 12 | |
| San Jose Bank of America: [3, 4] | | | | | | |
| 13th floor accelerograph No. 35 | Up | 046 | 117 | .63 | 7 | V 175 |
| | NE. 60 | 046 | 120 | .64 | 8 | L-174 |
| | SE. 150° | 047 | 118 | .66 | 7 | T 173 |
| Basement accelerograph No. 8 | Up | 065 | 125 | 1.34 | 7 | V 202 |
| | NE. 60° | 063 | 120 | 1.24 | 8 | L-201 |
| | SE. 150 | 065 | 124 | 1.32 | 9 | T 200 |

See footnotes at end of table.

**Table 5.—*Instrumental constants of strong-motion seismographs in 1947*—Continued**

| Station and instrument | Orientation of instrument [1] | Pendulum period | Static magnification | Sensitivity [2] | Damping ratio | Instrument number |
|---|---|---|---|---|---|---|
| | | *Sec.* | | *Cm.* | | |
| **NORTHERN CALIFORNIA EARTHQUAKE OF JULY 6** | | | | | | |
| Hollister accelerograph No. 23 | Up | 0.069 | 116 | 1.40 | 3 | V-20 |
| | SW. 181° | .069 | 114 | 1.37 | 4 | L-21 |
| | NW. 271° | .070 | 115 | 1.42 | 4 | T-32 |
| **SOUTHERN CALIFORNIA EARTHQUAKE OF JULY 24** | | | | | | |
| Hollywood Storage Bldg.: [3] | | | | | | |
| Penthouse accelerograph No. 193 | Up | 0.046 | 123 | 0.66 | 5 | V-193 |
| | S. 180° | .046 | 125 | .67 | 10 | L-192 |
| | W. 270° | .045 | 132 | .68 | 17 | T-191 |
| Basement accelerograph No. 22 | Up | .068 | 104 | 1.22 | 8 | V-25 |
| | E. 90° | .068 | 111 | 1.30 | 9 | L-3 |
| | S. 180° | .070 | 110 | 1.37 | 7 | T-18 |
| P. E. lot accelerograph No. 1 | Up | .070 | 108 | 1.34 | 9 | V-66 |
| | E. 90° | .070 | 108 | 1.34 | 7 | L-64 |
| | S. 180° | .070 | 111 | 1.38 | 8 | T-65 |
| Los Angeles Subway Terminal: [3] | | | | | | |
| 13th floor accelerograph No. 39 | Up | .102 | 83 | 2.18 | 10 | V-112 |
| | SW. 219° | .100 | 80 | 2.02 | 8 | L-92 |
| | NW. 309° | .100 | 79 | 2.00 | 10 | T-102 |
| Subbasement accelerograph No. 3 | Up | .069 | 116 | 1.40 | 8 | V-58 |
| | SE. 129° | .068 | 121 | 1.36 | 10 | L-59 |
| | SW. 219° | .070 | 119 | 1.44 | 9 | T-60 |
| Subbasement displacement meter No. 13 | NE. 39° | 9.91 | 1 | | 9 | |
| | SE. 129° | 10.35 | 1 | | 8 | |
| **NORTHERN CALIFORNIA EARTHQUAKE OF AUGUST 10** | | | | | | |
| Hollister accelerograph No. 23 | Up | 0.069 | 116 | 1.40 | 3 | V-20 |
| | SW. 181° | .069 | 114 | 1.37 | 4 | L-21 |
| | NW. 271° | .070 | 115 | 1.42 | 4 | T-32 |
| Monterey accelerogrgh No. 2 | Up | .068 | 117 | 1.37 | 10 | V-63 |
| | NE. 10° | .067 | 116 | 1.32 | 9 | L-61 |
| | SE. 100° | .068 | 115 | 1.34 | 12 | T-62 |
| San Francisco Southern Pacific Bldg.: [3] | | | | | | |
| 14th floor accelerograph No. 34 | Up | .047 | 116 | .65 | 7 | V-184 |
| | SW. 225° | .047 | 122 | .68 | 8 | L-183 |
| | NW. 315° | .047 | 126 | .70 | 9 | T-182 |
| Basement accelerograph No. 4 | Up | .066 | 118 | 1.30 | 8 | V-196 |
| | NW. 319° | .066 | 118 | 1.30 | 8 | L-195 |
| | NE. 49° | .066 | 119 | 1.32 | 8 | T-194 |
| Basement displacement meter No. 18 | NW. 319° | 10.0 | 1 | | 11 | |
| | NE. 49° | 9.6 | 1 | | 13 | |
| **NORTHERN CALIFORNIA EARTHQUAKE OF SEPTEMBER 23** | | | | | | |
| Eureka accelerograph No. 30 | Up | 0.070 | 101 | 1.25 | 9 | V-29 |
| | NE. 79° | .068 | 105 | 1.23 | 11 | L-13 |
| | SE. 169° | .068 | 108 | 1.26 | 11 | T-8 |
| Ferndale accelerograph No. 28 | Up | .098 | 70 | 1.70 | 9 | V-126 |
| | SW. 224° | .099 | 72 | 1.79 | 11 | L-124 |
| | NW. 314° | .100 | 74 | 1.86 | 9 | T-125 |
| Displacement meter No. 13 | SE. 134° | 10.0 | 1 | | 10 | |
| | SW. 224° | 9.9 | 1 | | 12 | |
| **EARTHQUAKE OF NOVEMBER 1 NORTHEAST OF LIMA, PERU** | | | | | | |
| Lima accelerograph No. 44 | Up | 0.100 | 84 | 2.07 | 9.0 | V-7 |
| | NW. 278 | .098 | 85 | 2.03 | 5.9 | L-2 |
| | NE. 8 | .096 | 77 | 2.16 | 6.4 | T-17 |
| **EARTHQUAKE OF NOVEMBER 18 OFF COAST OF SOUTHERN CALIFORNIA** | | | | | | |
| Westwood accelerograph No. 20 | Up | 0.101 | 81 | 2.09 | 10 | V-78 |
| | S. 180° | .099 | 82 | 2.01 | 10 | L-76 |
| | W. 270 | .098 | 77 | 1.87 | 10 | T-77 |

See footnotes at end of table.

**Table 5.—*Instrumental constants of strong-motion seismographs in 1947*—Continued**

SOUTHWESTERN MONTANA EARTHQUAKE OF NOVEMBER 23

| Station and instrument | Orientation of instrument [1] | Pendulum period | Static magnification | Sensitivity [2] | Damping ratio | Instrument number |
|---|---|---|---|---|---|---|
| | | *Sec.* | | *Cm.* | | |
| Bozeman accelerograph No. 56 | Up | 0.102 | 78 | 2.06 | 11 | V-173 |
| | N. 0° | .100 | 78 | 1.97 | 10 | L-175 |
| | E. 90° | .100 | 76 | 1.92 | 8 | T-174 |
| Butte accelerograph No. 53 | Up | .103 | 91 | 2.44 | 8 | V-165 |
| | S. 180° | .104 | 81 | 2.22 | 9 | L-164 |
| | W. 270° | .102 | 82 | 2.17 | 9 | T-166 |
| Great Falls accelerograph No. 55 | Up | .106 | 80 | 2.26 | 11 | V-160 |
| | S. 180° | .095 | 75 | 1.91 | 10 | L-158 |
| | W. 270° | .101 | 82 | 2.11 | 11 | T-159 |
| Helena accelerograph No. 54 | Up | .102 | 77 | 2.04 | 10 | V-169 |
| | S. 180° | .101 | 71 | 1.85 | 9 | L-168 |
| | W. 270° | .104 | 76 | 2.08 | 10 | T-167 |

EARTHQUAKE OF DECEMBER 29 NEAR COAST OF COSTA RICA

| | | | | | | |
|---|---|---|---|---|---|---|
| San Jose accelerograph No. 48 | Up | 0.099 | 78 | 1.78 | 12 | V-135 |
| | SE. 171° | .099 | 82 | 2.04 | 10 | L-133 |
| | SW. 261° | .099 | 83 | 2.09 | 9 | T-134 |

[1] 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.

[2] The sensitivity is the number of centimeters on the seismogram that corresponds to 100 cm sec.$^{-2}$ of acceleration. The deflection corresponding to 1/10 gravity may be obtained by multiplying the sensitivity tabulated by 0.98.

[3] Instruments at this station are wired to start simultaneously.

[4] Instruments at this station are equipped with unifilar suspensions.

## 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.

## CORRECTIONS TO PREVIOUS PUBLICATIONS

1945: Serial 682. In Table 1, pp. 20–24, all instrumental epicenters are for the year 1944.

1946: Serial 714. In the Western Mountain Region, pp. 7–8, times given for Boulder City reports should be two hours later—January 7: 16:00 corrected to 18:00; January 8: 04:13 corrected to 06:13, etc.

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