

DEPARTMENT OF THE INTERIOR

U.S. GEOLOGICAL SURVEY

United States Earthquakes, 1950

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and

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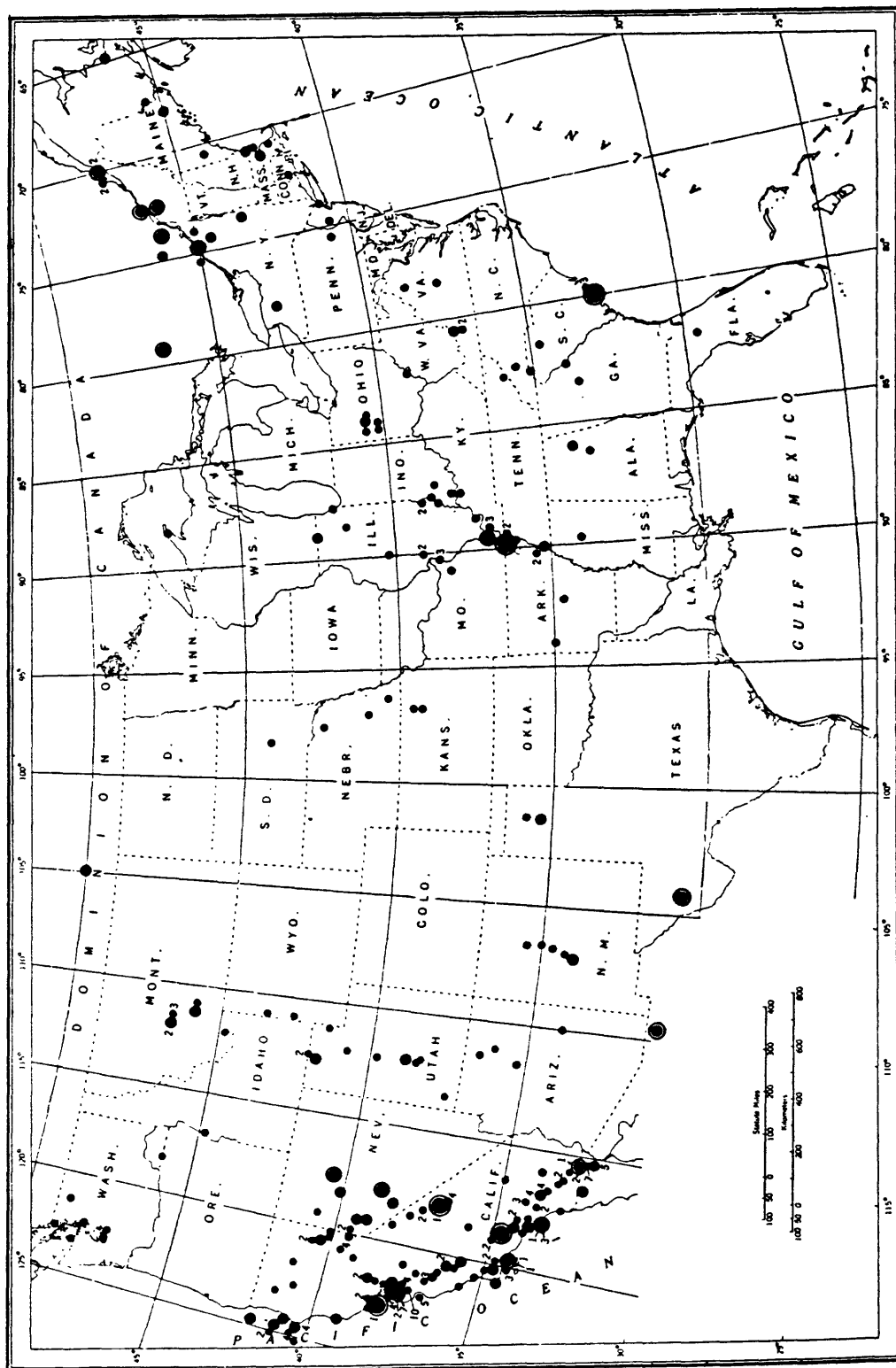


FIGURE 1.—Destructive and near destructive earthquakes in the United States through 1950.

UNITED STATES EARTHQUAKES, 1950

INTRODUCTION

This publication is a summary of earthquake activity in the United States and regions under its jurisdiction for the calendar year 1950. 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 1950:

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.—Dr. Ira S. Allison, Oregon State College, Corvallis.

Utah.—Prof. J. Stewart Williams, Utah State Agricultural College, Logan.

Washington.—Prof. Howard A. Coombs, University of Washington, Seattle.

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 north-eastern States.

Modified Mercalli Intensity Scale of 1931.—All intensities used by the Coast and Geodetic Survey refer to the Modified Mercalli Intensity Scale of 1931.¹ The abridged version of this scale is given here with equivalent intensities according to the Rossi-Forel scale.

MODIFIED MERCALLI INTENSITY SCALE OF 1931

(ABRIDGED)

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

Epicenter maps.—Figure 1 is designed to show the existence of destructive and near destructive earthquakes in the United States through 1950. 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 1950. In a few cases where instrumental control is not satisfactory or where results of investigations are inadequate, the plotted epicenters should be considered as showing the existence of the earthquake rather than the precise location.

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

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

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

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

Teleseismic results.—On page 31 is a list of Survey and cooperating teleseismic stations for which the Survey publishes results. An expansion of the communication facilities as announced in 1949 for transmission of earthquake readings permitted the locations of 154 epicenters to be announced promptly on *Preliminary Determination of Epicenter* cards and an additional 604 locations to be reported weekly on *Supplement* cards. Those desiring to receive these cards should request addition of their name to the *PDE* mailing list. All seismogram interpretations are published in the quarterly *Seismological Bulletin*, MSI series, available on mailing list *CGS-7* from the Director, U. S. Coast and Geodetic Survey, Washington 25, D. C. During the year 1951, MSI-126 for the second quarter of 1946 and MSI-138 for the second quarter of 1949 were issued.

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

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

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

The preliminary analyses of strong-motion records are published in the *Quarterly Engineering Seismology Bulletin* which is available upon request from the Director of the Coast and Geodetic Survey, Washington 25, D. C. The revised analyses are given in table 6.

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

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

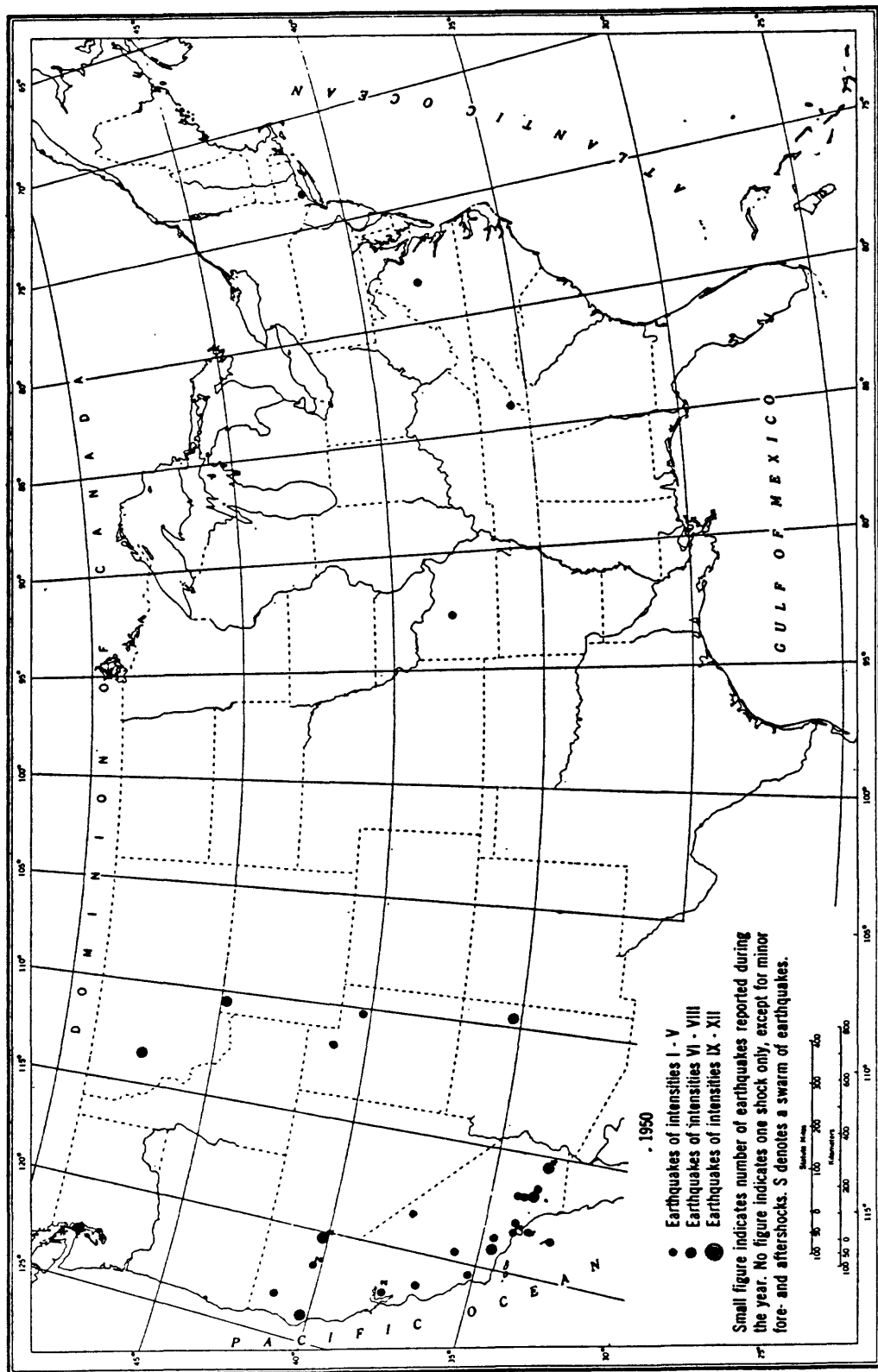


FIGURE 2.—Earthquake epicenters, 1950.

NONINSTRUMENTAL RESULTS

NOTE.—The following symbols are used to indicate authority for times or reported epicenters: P, reported by the Seismological Laboratory, California Institute of Technology, Pasadena; B, reported by the Seismographic Station, University of California, Berkeley; BC, reported by the Boulder City office of the United States Coast and Geodetic Survey; NESA, reported by the Northeastern Seismological Association, Weston, Mass.; JSA, reported by the Jesuit Seismological Association, St. Louis, Mo.; and W, reported by the Washington Office, United States 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*, MSA series, issued on mailing list CGS-3 by the United States Coast and Geodetic Survey, Washington 25, D. C.

EARTHQUAKE ACTIVITY IN THE VARIOUS STATES

NOTE.—The intensities of the earthquakes for which no ratings are given range from I to IV.

Arizona: January 16, VI.
California (intensity VI and above only): January 14, VI; February 25, VI; June 3, VI; July 27, VI; July 28; VI; July 29, VIII; August 1, VI; September 5, VI; November 16, VI; December 14, VII; and December 31, VI.
Colorado: January 17, V.
Connecticut: March 29.
Idaho: October 18, V.
Minnesota: February 15.
Missouri: February 8, V.
Montana: February 10, IV; April 30, III; June 27, VI; August 18, IV; August 19, VI; and December 4, IV.
Nevada: January 13, III; February 6, IV; March 21, IV; May 7, V; June 5, IV; July 3; July 4; July 6; July 11; July 13, IV; July 14, III; July 14 (2), IV; August 23, IV; October 12, IV; October 26; October 31; November 4; December 3; December 4, III; and December 13.
New Hampshire: February 24.
New York: March 29, August 4, and August 5.
North Carolina: June 18.
Tennessee: June 18 and September 16.
Texas: March 20.
Utah: January 2, IV; January 17; February 19; February 20, IV; May 5, IV; May 8; and July 21, IV.
Virginia: November 26.
Washington: March 7, IV; April 14, VI; May 16, III; June 25, IV; and December 2, VI.
Wyoming: January 23, IV; April 10, IV; June 27, IV; June 29, IV; and August 17, IV.

EARTHQUAKE ACTIVITY OUTSIDE THE UNITED STATES

Alaska: January 2, 3, 29; February 24; March 9; April 22 (7); May 23, 24 (3); August 7, 25 (2), 27; September 24; October 10, 13 (2); December 25.
Hawaiian Islands: January 25; February 12, 13; March 25; April 5; May 4 (3), 29, VI; June 19, 21, 26; July 24, 31; August 11, 19, 27; September 16; October 11; December 9 (2), 10, 18, 22, 26.
Panama Canal Zone: March 2, July 8, September 15, October 11.
Puerto Rico: January 1, 15; May 18.

NORTHEASTERN REGION

(75TH MERIDIAN OR EASTERN STANDARD TIME)

February 24: 08:04:15* NESA. New Hampshire. Slight earthquake felt in New Boston and Francestown.

March 29: 09:43:02* Epicenter 41°02'42" north, 73°36'25" west, NESA. Connecticut. Felt along the Long Island north shore and in southern Connecticut. Tremors and thudding sounds were heard in Stamford's city and rural areas and in Greenwich and Darien. Dishes rattled and doors were jarred. Many residents called newspaper and police offices, some in panic. The shock was also felt in Norwalk, Conn., and in Huntington, Long Island.

EASTERN REGION

(75TH MERIDIAN OR EASTERN STANDARD TIME)

August 4: 10:30. Massena, N. Y. Light shock rocked buildings and produced rumbling sounds. Another shock of comparable intensity the following day at about 19:00, and a third much weaker tremble occurred around midnight.

November 26: 02:45. Buckingham County, Va. Tremors felt by many residents of Dillwyn, Arvonnia, and New Canton. The west to east trembling and loud, thunderous sounds awakened many persons in Dillwyn. A few unstable objects such as candles were overturned in Arvonnia. Many New Canton residents called newspaper and police offices.

CENTRAL REGION

(90TH MERIDIAN OR CENTRAL STANDARD TIME)

February 8: 04:37:06.7* JSA. Near Lebanon, Laclede County, Mo. V. Greatest intensity reported from Lebanon where almost everyone in town was awakened, dishes rattled, and light fixtures swayed. The shock was distinctly perceptible to patients in Wallace Hospital. At Nebo, Oria, Brownfield, Drynob, Hazelgreen, Oakland, and Sleeper, residents reported the tremor as like an explosion of dynamite or like the rumble of thunder. Additional felt reports came from Stoutland, Montreal, Big Piney, Buffalo, Fairfield, Fortuna, and Mint Hill.

February 15: 04:05. Alexandria, Minn. Sharp shock accompanied by a muffled boom awakened residents and startled night workers. Two 136-foot wells at the Land O' Lakes creamery were damaged.

March 20: 07:23. Chico, Tex. One abrupt shock felt by several at the Centerville Powerhouse Camp. Flower pot moved and windows rattled.

May 1: 09:30. Gideon, Mo. Felt by a few.

June 18: 23:19. Alcoa, Tenn. Rapid trembling motion felt by many. Loose windows rattled. The tremor was felt in Knoxville, Marysville, and as far west as Tapoco, N. C. At the last-named places reporters stated jars and cans on shelves were displaced.

September 16: 23:48* Epicenter in Mississippi County, Ark., JSA. Felt at Driver, Edmondson, Luxora, Osceola, Riverdale, and Roseland, Ark.; and at Burlison, Covington, Fort Pillow, Fulton, Gold Dust, Memphis, and Tipton, Tenn. Recorded instrumentally at St. Louis and Florissant, Mo.

WESTERN MOUNTAIN REGION

(105TH MERIDIAN OR MOUNTAIN STANDARD TIME)

January 2: 12:53:04* Epicenter $41\frac{1}{2}^{\circ}$ north, 112° west, northern Utah, W. IV. Felt throughout area extending from Preston, Idaho, on the north to Salt Lake City on the south, with greatest intensity at Corinne. Felt by nearly everyone in Brigham City and Corinne where houses creaked and dishes rattled. Hanging objects swung in Brigham and Logan. Salt Lake City experienced only mild intensity.

January 13: 08:36:34* BC. Hoover Dam, Nev. III. Felt by several.

January 16: 17:53. Apache County, Ariz. VI. Felt by at least half the people questioned in Ganado. Several cracks one-half inch wide to 12 feet long, extending north-south, were found in the ground south of the Ganado Trading Post. Windows and dishes rattled. Moderate rumbling sounds were heard.

January 17: 18:55:31* Epicenter $40\frac{1}{2}^{\circ}$ north, $110\frac{1}{2}^{\circ}$ west, east of Wasatch Range, near Soldier Summit, Utah, W. V. Apparently strongest in Grand Junction, Colo., where it was felt in all parts from 3 miles east of town to about 12 miles west. Larger buildings shook slightly, floors vibrated, and a few plaster cracks were reported. Light objects on shelves or window sills moved slightly. At Greenriver, Utah, a quarter-inch crack appeared in a stucco-covered frame motel building.

INTENSITY IV IN COLORADO: Fruita.

INTENSITY IV IN UTAH: Duchesne, Moab, and Sego.

INTENSITY I TO III IN UTAH: Price.

Negative reports were received from 15 places in Colorado and from 15 places in Utah.

January 23: 21:20. Hamilton Dome, Wyo. IV. Press reported houses trembled and dishes rattled from an earthquake which began with a big rumble. Also felt in Thermopolis.

February 6: 11:33:43* BC. Lake Mead region, Nev. IV. Felt by many. Windows, doors, and dishes rattled; house creaked.

February 10: 19:10. Superior, Mont. IV. Walls of farmhouse creaked.

February 19: (early p. m.). Payson, Utah. Press reported shock felt.

February 20: 07:59. Payson, Utah. IV. Press reported 3 distinct earth shocks in quick succession rattled dishes. Most distinctly felt in area of 1-mile radius about a mile west of the Payson business district.

March 21: 23:44:40* BC. Lake Mead region, Nev. IV. Felt by many. Windows rattled.

April 10: 10:25. Painter, Wyo. IV. Felt by several. Buildings creaked, loose objects rattled, and lamps shook.

April 30: 09:48. Kenwood (suburb of Helena) Mont. III. Felt by observer in home.

May 5: 00:35. Piute County, Utah. IV. "A distinct earthquake accompanied by a loud rumble was reported by Junction residents. . . . Windows and dishes were rattled but no damage was reported." (BSSA, July 1950).

May 7: 01:36:26* BC. Boulder City, Nev. V. Felt by and awakened many. Windows rattled.

May 8: 12:40. Eureka, Utah. Press reported slight shock felt.

May 8: 15:35. Payson, Utah. V. Press reported some cracked plaster and some broken dishes. A slight shock was reported felt previously (14:00) the same day.

June 5: 12:02:50* BC. Boulder City and Hoover Dam, Nev. IV. Felt by many.

June 27: 00:20. Yellowstone National Park, Wyo. IV. Felt by observer at Old Faithful Ranger Station. Windows rattled and building creaked.

June 27: 21:31:04* Epicenter $44\frac{1}{4}^{\circ}$ north, $110\frac{1}{2}^{\circ}$ west, West Yellowstone, Mont., W. VI. Felt by many, many tourists ran from buildings. Small objects shifted, knickknacks fell, and some grocery stocks fell. Also felt by observer at the Mary Lake Patrol Cabin where windows and dishes rattled and frame building creaked. Other mild shocks occurred at 15:15, 15:20, 15:30, 21:15, 22:00, and 23:30.

June 29. 06:15. Yellowstone National Park, Wyo. IV. Felt by several at the Mary Lake Patrol Cabin. Windows rattled and walls creaked.

July 3: 19:51:49* BC. Boulder City, Nev. Felt by one person.

July 4: 08:04* BC. Boulder City, Nev. Felt by one person.

July 6: 23:00. Boulder City, Nev. Felt by one person.

July 11: 04:03:10* Boulder City, Nev. Felt by one person.

July 13: 04:42:08*, 04:42:39*, and 04:45:46* BC. Boulder City and Hoover Dam, Nev. IV and III. First two shocks felt by many, windows rattled; last shock felt by several.

July 14: 07:39:59* BC. Boulder City and Hoover Dam, Nev. IV. Felt by many. Windows and doors rattled.

July 14: 13:26:54* BC. Hoover Dam, Nev. III. Felt by several.

July 14: 20:53:45* BC. Boulder City and Hoover Dam, Nev. IV. Felt by several. Windows rattled.

July 21: 12:23. Logan, Utah. IV. Two shocks of brief duration felt by most people.

July 24: 20:14:50* BC. Boulder City, Nev. IV. Felt by many. Windows rattled.

August 17: 13:45. Lander, Wyo. IV. Felt by many in southeast section. Loose objects rattled, buildings creaked, disturbed objects observed by a few. Also reported felt by United States Forest Service in Shoshone Basin. Dickinson Park residents reported creaking buildings and rattling doors, dishes, and windows.

August 18: 00:22. Helena, Mont. IV. Felt by many. Buildings creaked and loose objects rattled. Moderately loud subterranean sounds heard by many during shock.

August 19: 18:44:55* Epicenter $47\frac{1}{4}^{\circ}$ north, $113\frac{1}{2}^{\circ}$ west, western Montana, W. Felt over an area of about 4,000 square miles. Maximum intensity VI.

INTENSITY VI:

Desert Mountain Lookout.—Swayed lookout tower, timbers creaked, and windows shook.

Mud Lake Lookout.—Caused minor rockslide.

Niarada.—"Two wells near here were disturbed and muddy after the earthquake. One had been a little muddy before but became so muddy after the earthquake it had to be cleaned out. The other one cleared up. The wells are about 2 miles apart." Intensity IV in city area.

Spotted Bear Ranger Station.—Shook lookout tower. Swayed suspension bridge over Flathead River.

INTENSITY V: Bungalow Lookout, Kah Mountain Lookout, Kalispell, Seeley Lake Ranger Station, and Seeley Lake (northeast of).

INTENSITY IV: Hungry Horse Dam, Johnson Lookout, Missoula, North Fork Cabin, Ovando (3 miles northwest of), Ovando, Somers, and Superior.

August 23: 09:48:16* and 09:48:17*. BC. Boulder City, Nev. IV. Felt by many. Second tremor caused building walls and frame to creak.

October 12: 20:48:34* BC. Boulder City, Nev. IV. Felt by one person. Windows rattled.

October 18: 02:30, 07:00, 10:30, and 15:30. Cascade, Idaho. V. Press reported slight damage from a series of minor shocks. Combing cracked on the roof of one dwelling and one plaster crack was reported in the Cascade school building. The old Cascade Hotel creaked and rattled.

October 26: 16:51:39* BC. Boulder City, Nev. Felt by one person.

October 31: 13:28:18* BC. Boulder Beach, Nev. Felt by one person.

November 4: (no times given). Austin, Nev. "Three small earthquakes shook the Kingston Canyon area during the previous week. The strongest shook dishes from shelves in a house near Kingston Canyon Mine."—BSSA, January 1951.)

December 3: 14:34:07* BC. Boulder City, Nev. Felt by one person.

December 4: 02:34:30* BC. Boulder City, Nev. III. Felt by several.

December 4: 08:00. Ruby Creek (near Cameron), Mont. IV. Felt by several. Windows, doors, and dishes rattled. A lighter shock was felt about 20 minutes later. The initial tremor was also felt by two persons at the Tale Mine about 26 miles south of Ennis.

December 13: 22:17:15* BC. Boulder City, Nev. Felt by one person.

CALIFORNIA AND WESTERN NEVADA

(120TH MERIDIAN OR PACIFIC STANDARD TIME)

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

January 1: 15:39:12* Epicenter 40.3° north, 121.4° west, B. IV. Slight shock of 2-seconds duration felt by many in building in Mineral. Windows and doors rattled.

January 7: 01:37:35* Epicenter 32.1° north, 116.6° west, Lower California, P. III. Felt by and awakened observer 5 miles east of Campo.

January 9: 05:24:57* Epicenter $34^{\circ}05'$ north, $116^{\circ}58'$ west, near Forest Home, P. V. Many awakened in Big Bear City, few awakened in Fawnskin. Windows, doors, and dishes rattled at the latter place and in Hemet. House creaked in Cabazon. Also felt in Banning, Mentone, and Redlands.

January 11: 13:41:35* Epicenter $33^{\circ}57'$ north, $118^{\circ}12'$ west, near South Gate, P. V. Strongest in west section of Los Angeles. One window cracked, light fixtures had sudden twisting motion, and loose objects rattled. Distinctly felt in downtown office buildings, City Hall windows rattled and furniture shuffled in sidewise, wrenching movement. Police switchboards were swamped with calls. Felt by and startled all in Maywood.

INTENSITY IV: Bellflower, Glendale, Huntington Park, Inglewood, Pasadena, and Walnut.

INTENSITY I TO III: Alhambra, Burbank, Compton, Long Beach, Montebello, Monterey Park, Riverside, San Bernardino, San Marino, and South Gate.

January 12: 21:07:19* Epicenter 34°01' north, 116°29' west, near Desert Hot Springs, P. V. Felt by all, awakened and frightened many in Desert Hot Springs. Disturbed unstable objects. Felt slightly in Palm Springs, and by one observer in Riverside.

January 13: 04:19:30* Epicenter 40.3° north, 124.4° west, off Cape Mendocino, B. V. Felt by observer at Cape Mendocino Light Station, awakened many Ferndale residents. Windows and doors rattled at both places. Felt by several and awakened a few in Scotia where walls creaked. Also felt in Eureka.

January 14: 11:52:30* Epicenter 40°13' north, 124°25' west, Humboldt County coast, B. VI. Strongest at Punta Gorda Light Station. Felt by all at station, 3 windows in light tower cracked, plaster cracked, and concrete floor cracked in one place.

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

INTENSITY IV: Briceland, Bridgeville (7 miles northeast of), Ettersburg, Fortuna, Petrolia, and Scotia.

INTENSITY I TO III: Arcata, Rockport, and Trinidad.

Negative reports were received from 5 places.

A light aftershock of intensity IV was felt in Ferndale and Scotia at 12:31. Windows rattled in Ferndale, walls creaked in Scotia.

January 16: 11:21:25* Epicenter 40°15' north, 121°23' west, near Mineral, B. V. Felt by many at Manzanita Lake where some plaster was cracked. Felt by several in Mineral.

January 19: 01:33:48* Epicenter 33°45' north, 118°26' west, near Point Vicente, P. V. San Pedro observer was awakened from sound sleep by rattling of windows and dishes, a few persons were awakened in Lomita. Press reported some residents awakened in El Segundo, Hermosa Beach, Manhattan Beach, and Palos Verdes; also felt in Hollywood.

January 20: 08:16:54* Epicenter 32°56' north, 115°48' west, west of Brawley, P. IV. Felt in Brawley and throughout the Northend.

January 20: 08:24:11* Epicenter 33°10' north, 115°25' west, near Calipatria, P. IV. Felt in Brawley and throughout the Northend.

January 24: 13:56:59* Epicenter 34°40' north, 118°50' west, south of Gorman, P. V. Very strong in Fillmore and Piru, felt by practically all residents in area although not felt in Santa Paula and Ventura. Workers prepared to leave Fillmore City Hall building, felt by oil workers in nearby fields. Many small objects and furnishings shifted in Piru.

February 9: 12:47:03* Epicenter 40°48' north, 122°03' west, B. IV. Felt by many at Shasta Dam power plant where doors rattled and coffee slopped in pot. Also felt in Toyon and vicinity.

February 10: 15:41:09* Epicenter 41.2° north, 124.3° west, B. V. Felt by many in Eureka, both indoors and outdoors. Buildings creaked and loose objects rattled. People leaning against buildings and light poles felt them sway.

February 19: 22:36:46* Epicenter 34°36' north, 118°00' west, east of Palmdale, P. Felt in Beverly Hills.

February 24: 20:47:19* Epicenter 33°40' north, 120°17' west, southwest of Santa Rosa Island, P. IV. Felt by many (some outdoors) in Lompoc.

February 25: 16:06:22* Epicenter 34°37' north, 119°05' west, Sespe Hot Springs, P. VI. Felt over approximately 2,500 square miles extending from Wheeler Ridge as far as Lompoc and Casmalia and through Cuyama to Wheeler Ridge. Damage was limited to cracked and fallen plaster, a few broken windows, and merchandise thrown from shelves. Part of one old chimney fell.

INTENSITY VI:

Montalvo.—Felt by and frightened all. House creaked. Trees and bushes shaken slightly.

Oxnard.—Felt by all. Slight plaster cracks, buildings creaked, chandeliers swung southeast-northwest. Store merchandise thrown to floor. Slight breakage of glassware.

Santa Paula.—Felt by many. Cracked plaster. Some merchandise knocked off shelves.

Saticoy.—Frightened few. Knickknacks and pictures fell. Goods knocked off shelves. Overturned vases and small objects.

Ventura.—Frightened few. Cracked plaster and one window, one old chimney collapsed. Tumbled canned goods to floor. Knickknacks and plaster fell.

INTENSITY V: Goleta, Ojai, Rincon Point, Santa Barbara, Somis, Summerland, and Wheeler Springs.

INTENSITY IV: Agoura, Camarillo, Carpinteria, Fillmore, Gaviota, Lompoc, Newbury Park, Palmdale, Piru, Port Hueneme, Sandberg, and Wheeler Ridge.

INTENSITY I TO III: Chatsworth, Casmalia, Cuyama, Lebec, Los Alamos, Moorpark, Newhall, Santa Susana, Simi, Van Nuys, and Ventucopa.

Negative reports were received from 8 places adjacent to the felt area and from 27 other places.

February 25: 22:45:40* Epicenter 39°51' north, 120°39' west, B. IV. Felt by many and awakened some in Sierra City. Buildings creaked, subterranean sound heard before shock.

March 6: 21:19:04* Epicenter 34°20' north, 118°05' west, north of Mount Wilson, P. IV. Felt sharply in Montrose.

March 7: 19:23:57* Epicenter 37°46' north, 122°10' west, B. V. Strongest in Oakland where plaster was cracked in one home, and in Moraga where a large pendulum clock for school bells at St. Mary's College was stopped. Rumbling subterranean sounds were reported from both places and also from Orinda. Felt by several in Alamo. Felt by many in Berkeley and Lafayette, houses

creaked; felt by many in San Francisco, buildings creaked and loose objects rattled; felt by two persons in Bollinger Canyon, houses creaked.

March 9: 15:43:19* Epicenter 36°21' north, 121°13' west, B. V. Two shocks felt by few in Robles del Rio. Cup fell from hook, a butane tank moved slightly.

March 20: 07:22:17* Epicenter 40°27' north, 121°28' west, near Lassen Peak, B. V. Felt over approximately 4,000 square miles which extended from Hat Creek to Susanville, Sacramento, and Shasta Dam. Scattered reports were received from Reno and Yerington, Nevada, with many negative reports from places between these points and the main area. "Aftershocks were recorded at Berkeley at 11:03, 15:33, 17:01, and 22:33."—(BSSA, April 1950.)

INTENSITY V: Chester, Chico, Gridley, Lake Almanor, Magalia, Mill Creek, Manzanita Lake, Mineral, and Susanville.

INTENSITY IV: Belden, Caribou, Fall River Mills (1 mile west of), Hat Creek, Las Plumas, Sacramento, and Stirling City.

INTENSITY I TO III: Adin, Emigrant Gap, Oregon House (6 miles north of), Paynes Creek, Quincy, Red Bluff, and Richvale.

INTENSITY I TO III IN NEVADA: Reno and Yerington.

Negative reports were received from 18 places adjacent to the felt area and from 35 other places in California and 8 places in Nevada.

March 21: 21:06:04* Epicenter 34°11' north, 117°37' west, near Cucamonga Peak, P. IV. Felt in area east of Los Angeles to Riverside. A few people were frightened at the last named place.

March 27: 11:09:29* Epicenter 40°16' north, 123°59' west, B. IV. Two bumps with second heavier than first felt 9 miles north of Garberville. Building creaked, loose objects rattled, electric wires swung.

March 29: 04:43:20* Epicenter 35°58' north, 120°53' west, near San Ardo, P. V. Awakened many in Lonoak.

March 30: 03:21:53* Epicenter 34°53' north, 117°50' west, south of Muroc, P. IV. Awakened few in Muroc.

April 1: 15:48:15* Epicenter 36°10' north, 117°53' west, near Haiwee, P. IV. Felt at Haiwee Powerhouse. House creaked; windows, doors, and dishes rattled.

April 15: 03:56:32* Epicenter 35°45' north, 119°37' west, northeast of Lost Hills, P. V. Strongest near Ash Mountain in Sequoia National Park where a landslide was reported on the highway 2 miles above the checking station. Floor lamps swayed and pictures were shaken on walls. Many were awakened in Shafter and Kernville. A second earth shock was reported from Shafter 15 minutes later.

INTENSITY IV: Buttonwillow, Jawbone Aqueduct Station, Lost Hills, Three Rivers, and Visalia.

INTENSITY I TO III: Bakersfield, Fresno, Reedley, and Tulare.

April 16: 10:47:32* Epicenter 37°56' north, 122°16' west, northeast of El Cerrito, B. V. Two windows reported broken in Albany. Many phone calls received by police from Berkeley-Richmond areas. Also felt in San Francisco and as far south as San Jose.

April 17: 04:15:32* Epicenter 35°42' north, 118°00' west, near Walker Pass, P. IV. Houses creaked and windows rattled in Weldon.

April 18: 21:10* III. Felt by several at Kern River Powerhouse No. 3 near Kernville. Recorded instrumentally at China Lake and Haiwee.

April 19: 18:47:54* Epicenter 33°34' north, 118°08' west, southwest of Huntington Beach, P. Reported felt in the Long Beach harbor district.

April 21: 05:17:29* Epicenter 34°23' north, 119°35' west, west of Carpinteria, P. IV. Press reported some Santa Barbara residents awakened.

April 25: 23:23:29* Epicenter 35°12' north, 120°36' west, south of San Luis Obispo, P. V. Strongest in southeast section of Santa Maria. Felt by many, buildings creaked, hanging objects swayed slightly, and very slight visible swaying of buildings and trees. Also felt in Orcutt. Another earth shock was reported from Santa Maria 15 minutes later.

April 30: 07:59:04* Epicenter 36°05' north, 117°58' west, south of Haiwee, P. IV. Creaked houses and rattled loose objects at Haiwee Powerhouse and South Haiwee Reservoir, both near Coso Junction.

May 11 and 13: "Three slight earthquakes were recorded in the Imperial Valley in May. IV. The first occurred on May 11 at 10:35 p. m.; 2 days later, at 3:15 a. m. and at 7:25 a. m., P. D. T., 2 more tremors were felt."—(BSSA, October 1950.)

May 13: 06:43:25* Epicenter 33°53' north, 118°31' west, west of Manhattan Beach, P. Press reported slight tremor felt in the southwest section of Los Angeles near the International Airport.

May 28: 05:08:56* Epicenter 33°59' north, 118°21' west, near Inglewood, P. IV. Felt by many in west-southwest sections of Los Angeles. Buildings creaked, loose objects rattled, and a few pictures swayed. A series of tremors was felt lightly in El Segundo and Hawthorne.

May 29: 05:06:36* Epicenter 34°02' north, 118°18' west, north of Inglewood, P. IV. Felt at Los Angeles airport.

June 2: 09:25. Watsonville. "A light earthquake was reported felt in the Chittenden Pass area . . . no reports of damage were received."—(BSSA, October 1950.)

June 2: 21:39:16* Epicenter 40.8° north, 124.4° west, B. IV. Press reported a sharp tremor felt in Eureka.

June 3: Between 02:00 and 03:00. Southwestern Siskiyou County. VI. Awakened all residents in the Salmon River area, also felt in Oro Fino some 30 miles to the northeast, and in Yreka and Blue Lake.

June 5: 11:37:28* Epicenter 34°12' north, 119°14' west, southeast of Ventura, P. Felt in Ventura.

June 7: 21:09:10* Epicenter 34°16' north, 119°17' west, southeast of Ventura, P. III. Very slight shock felt by a few in Fillmore and Ventura.

June 8: 01:28:13* Epicenter 34°15' north, 119°15' west, southeast of Ventura, P. IV. Awakened a few in Fillmore, Rincon Point, and Ventura. Windows and doors rattled, houses creaked.

June 13: 00:11:37* Epicenter 38°42' north, 120°05' west, northeast tip of Amador County, B. II. Felt by observer at Salt Springs Powerhouse near Jackson.

June 23: 07:38. V. "An earthquake was felt in East Oakland . . . the only damage reported was a cracked kitchen wall."—(BSSA, October 1950.)

July 6: 20:38:35* Epicenter 33°57' north, 117°49' west, north of Olinda, P. Felt in Anaheim.

July 13: 07:01:47* Epicenter 34°20' north, 119°30' west, off Carpinteria, P. V. Press reported some Montecito residents scurried into streets. At Santa Barbara and other nearby areas two gently rolling tremors in quick succession were felt.

July 17: 02:16:56* Epicenter 33°37' north, 118°04' west, off Huntington Beach, P. Felt in Los Angeles.

July 21: 09:30. Brentwood. "A small earthquake, centered in the Brentwood area, occurred at 10:30 a. m. P. D. T. It was reported felt in Port Chicago."—(BSSA, October 1950.)

July 21: 22:37. Chico. IV. "Dishes were rattled and walls shaken by an earthquake lasting about 15 seconds. . . . The shock was also felt in Willows."—(BSSA, October 1950.)

July 23: 01:45:09* Epicenter 37°48' north, 122°02' west, B. IV. Felt by several in south-east Oakland, awakened observer at San Ramon and residents in San Leandro. Buildings creaked and loose objects rattled in Oakland. Loud rumbling subterranean sounds were heard at time of shock.

July 26: 22:19:30* Epicenter 33°59' north, 117°14' west, east of Riverside, P. V. "A mild earthquake shook Riverside and Arlington . . . windows rattled and glasses were shaken from shelves."—(BSSA, October 1950.)

July 27: 03:29:26* Epicenter 33°07' north, 115°34' west, near Calipatria, P. VI. This was the first of a series of destructive shocks which occurred in the Imperial Valley from July 27 to 29. Brawley was hardest hit with fall of knickknacks, books, pictures, and cracked plaster. Some windows and dishes were broken. Many were awakened in Niland and Seeley where windows, doors, and dishes rattled. Slight damage occurred in Niland.

INTENSITY V: El Centro and Holtville.

INTENSITY V IN ARIZONA: Yuma.

INTENSITY IV: Rice.

INTENSITY I TO III: Boulevard, Desert Center, and Mount Laguna.

Negative reports were received from 52 places in California and from 6 places in Arizona.

An aftershock at 04:02* awakened many in El Centro and set hanging objects swinging; another at 19:25* sent many theater patrons into the streets in Brawley and set off a burglar alarm; and a third at 20:00* was reported as fairly heavy in Calexico.

July 28: 00:24* Epicenter 33°07' north, 115°34' west, near Calipatria, P. II. Felt by very few in Winterhaven and felt slightly at Gadsden and Yuma, Arizona. An aftershock of intensity III was felt by several in San Diego at 09:27.*

July 28: 09:50:48* Epicenter 33°07' north, 115°34' west, near Calipatria, P. VI. This was a stronger and more widely felt shock than that at 03:29:26* on the previous day.

INTENSITY VI:

Brawley.—Felt by all. Cracked plaster in walls and ceilings of business houses was common in all parts of town. Water was splashed from ponds and merchandise was shaken from shelves in several stores. Books and pictures fell, dishes broke.

Calipatria.—Press reported merchandise fell from shelves.

Niland.—Felt by all. Plaster cracked, merchandise fell from shelves.

North End Dam.—Press reported cooking vessels were knocked off stoves.

Seeley.—Felt by all. Plaster cracked. Windows, doors, and dishes rattled. Trees and bushes shaken moderately.

Westmorland.—Plate-glass windows of the Westmorland Post Office were shaken loose. Cracks in the City Hall sent occupants fleeing from the building. A pharmacy reported \$1,000 damage to drug goods.

INTENSITY V: Boulevard and Plaster City.

INTENSITY IV: Dulzura, El Centro, Escondido, Heber, Lakeside, Mecca (3 miles southeast of), Mecca, Mesa Grande, Parker Dam, Ripley, San Diego, and Thermal.

INTENSITY IV IN ARIZONA: Parker.

INTENSITY I TO III: Campo, Desert Center, Midland, Mount Laguna, Palm Springs, Poway, Romona, San Ysidro, and Winterhaven.

INTENSITY I TO III IN ARIZONA: Wellton and Yuma.

Negative reports were received from 39 places in California and from 9 places in Arizona.

Aftershocks at 11:49* and 16:17* were felt in El Centro.

July 29: 06:36:32* Epicenter 33°07' north, 115°34' west, near Calipatria, P. This was the main shock of the series, the affected area covering approximately 18,500 square miles and extending from the Mexican border to Banning, Calif., and Parker, Ariz., and from San Diego, Calif., to Yuma, Ariz. See map. Maximum intensity was VIII in the Calipatria area where damage estimates ranged upward of \$50,000. Numerous sand boils were formed, irrigation ditch banks sloughed, and ground settled and cracked 1 to 2 miles southwest of Calipatria. Several concrete stand-pipes broke and a small railroad bridge shifted 6 to 8 inches. At North End Dam, old sheet piling broke as the levee settled.

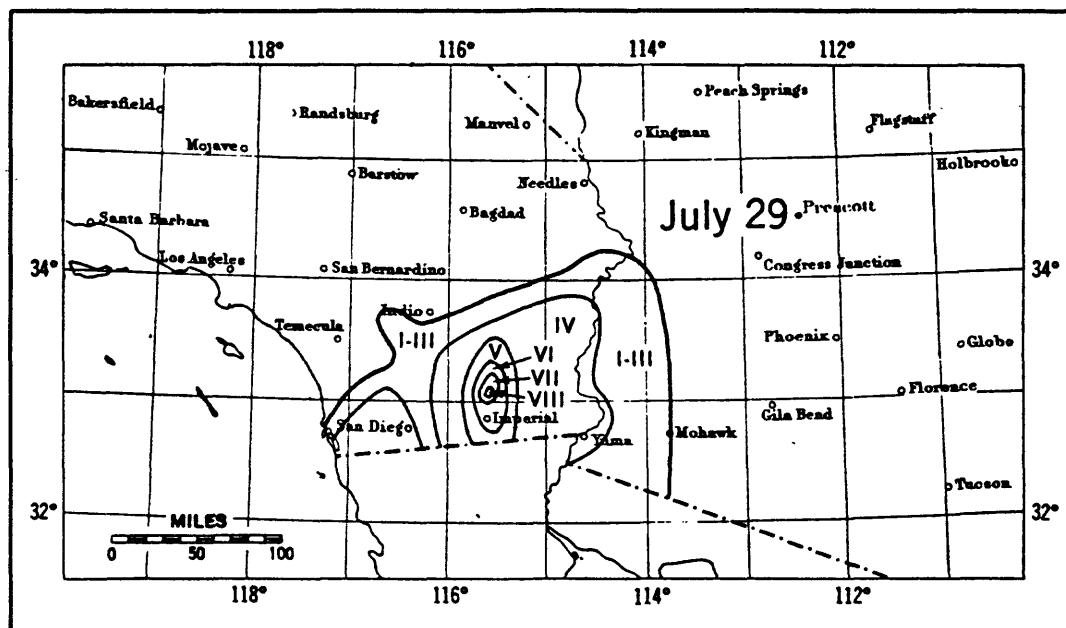


FIGURE 3.—Area affected by the earthquake of July 29.

INTENSITY VII:

Calipatria.—Felt by and awakened all. Damage considerable to older buildings and plaster cracked in newer buildings in business district. Outside business district several chimneys were broken, stacks of brick and baled hay tumbled, tie rods on a 50,000 gallon elevated water tank were loosened, a few water pipes were broken causing leaks, and much chinaware and glassware was broken in homes.

Niland.—Felt by and awakened all. Supplies knocked from shelves, a few walls cracked, considerable plaster fell.

Westmorland.—Frightened all. Reinforced concrete walls of post office building cracked slightly in several places, plaster fell, and windows broke. At the City Hall, an adobe building, considerable plaster fell. Walls were cracked at the Office of the Imperial Irrigation District; windows were broken, plaster knocked loose, and arcade cracked in the Food Center Building.

INTENSITY VI:

Brawley.—Awakened all. Several windows broken, some plaster cracked. Overturned and shifted furnishings.

Kane Springs.—Supplies knocked from shelves.

Heber.—Frightened many. Slight plaster cracks. Small objects and furnishings shifted.

Seeley.—Awakened all. Hanging objects swung. Trees and bushes shaken moderately.

INTENSITY V: El Centro, Holtville, Plaster City, and Ripley.

INTENSITY V IN ARIZONA: Somerton.

INTENSITY IV: Banning, Blythe, Campo, Desert Center (5 miles northeast of), Mecca (3 miles southeast of), Midland, Palo Verde, Parker Dam, Ramona, and Santa Ysabel.

INTENSITY IV IN ARIZONA: Parker, Tacna, and Yuma.

INTENSITY I TO III: Anza, Borego Valley, Hemet, Mecca, Mount Laguna, Poway, San Diego, and Winterhaven.

INTENSITY I TO III IN ARIZONA: Gadsden and Wellton.

Negative reports were received from 43 places in California and from 7 places in Arizona.

Aftershocks at 07:09*, 08:35, and 10:34, intensity IV, were felt by many in El Centro; two more at 09:05* and 12:49*, intensity V, were felt by all in Boulevard; another at 09:30, intensity V, was felt by all in Yuma, Ariz.; and several about 09:43*, intensity IV, were felt by two persons in Thousand Palms.

July 29: 08:00 (a. m. or p. m. not given). Idyllwild. III. Felt by several.

July 29: (p. m.) Mesa Grande. IV. Slight rattling of windows, doors, and dishes; house cracked.

August 1: 00:37:20*. Epicenter 33°07' north, 115°34' west, near Calipatria, P. VI. A few bricks fell and ground fissures opened wider in the vicinity of North End Dam and Vail Canal. A small portion of a wall collapsed. Additional earth boils were started in the areas previously affected, mostly at the dam site and along the levees of the Vail Canal.

INTENSITY V: El Centro.

INTENSITY IV: Campo, Seeley, and Westmorland.

INTENSITY IV IN ARIZONA: Somerton.

INTENSITY I TO III: Dulzura, Midland, San Diego, and Thousand Palms.

- August 1: 12:25:51*** Epicenter 36°51' north, 121°40' west, B. IV. Felt by many 7 miles south of Hollister and in Watsonville. Windows, doors, and dishes rattled. Also felt in Gilroy.
- August 2: 05:28:30*** Epicenter 36.7° north, 121.4° west, B. IV. Felt by several 7 miles south of Hollister. Windows rattled and walls creaked.
- August 2: 19:00.** Niland. IV. Felt by many (some outdoors) and awakened few.
- August 5: 05:32.** Wildomar. IV. Felt by and awakened few. Rattled loose objects and shifted small objects slightly.
- August 11: 18:17:17*** Epicenter 34°19' north, 116°48' west, near Baldwin Lake, P. IV. Felt by several in Big Bear, Highland, Mentone, Riverside, and San Bernardino. Dishes rattled and walls creaked.
- August 21: 03:45.** Alpine. IV. Felt by observer in bed.
- August 21: 17:58*** Epicenter 33°07' north, 115°34' west, near Calipatria, P. V. Felt by all in Calipatria where houses creaked and trees and bushes were shaken moderately. Felt by many (some outdoors) in Niland.
- August 22: 14:47:58*** Epicenter 34°09' north, 119°21' west, near Ventura, P. This was the strongest of a series felt in Ventura County. Other shocks occurred about 17:40 and 20:00 and the following day at 08:00. Nine shocks were reported overnight in the Santa Ana Valley west of Ojai.
- August 23: 01:10.** Rincon Point. IV. Windows rattled, a few people were awakened. Felt by one person in Carpinteria.
- August 24: 21:17:24*.** Epicenter 34°02' north, 117°01' west, near Yucaipa, P. III. Slight shock, preceded by rumble, felt by observer in Moreno.
- August 28: 10:15, 10:18, 10:19, and 10:22.** Chester. III. Felt by one observer. Potted plant stems swayed north-south, fishing pole standing upright vibrated considerably.
- August 28: 11:45:26*** Epicenter, 34°18' north, 116°47' west, north of Baldwin Lake, P. IV. Strongest at Big Bear Village where windows and dishes rattled. Also felt in Fawnskin.
- September 2: 01:02:58*** Epicenter 37°44' north, 122°33' west, B. IV. Light shock felt in the Ingleside, Taraval, Richmond, and Sunset districts of San Francisco. A few pictures were reported shaken from walls.
- September 3: 09:20.** Barrett Dam (Dulzura). IV. Felt by several. Buildings creaked and loose objects rattled. Subterranean sounds preceded the tremor.
- September 5: 11:19:56*** Epicenter 33°39' north, 116°45' west, northwest of Anza, P. Felt over an approximate area of 10,000 square miles extending from San Diego northeast to Twentynine

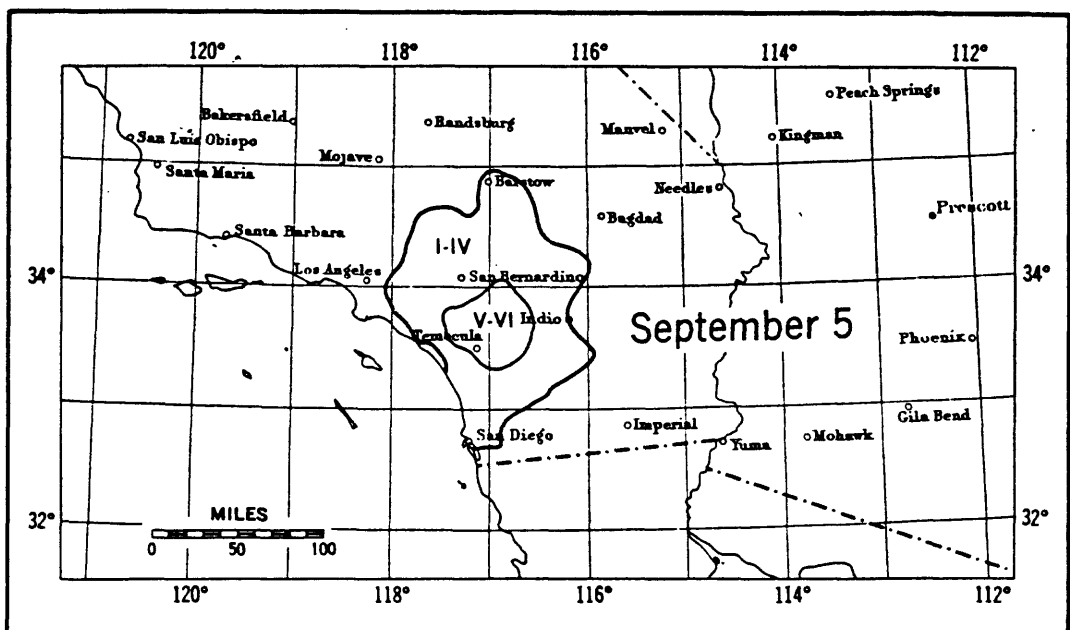


FIGURE 4.—Area affected by the earthquake of September 5.

Palms, north to Hinkley, southwest to Laguna Beach, and along the coast to San Diego. See map. Maximum intensity VI. Slight damage.

INTENSITY VI:

Banning.—Canned goods and bottles jolted from shelves.

Beaumont and vicinity.—Felt by all. Barely noticeable for a few seconds, then built up to a sharp jolt which rolled the floors and ground. Glasses jiggled on shelves and objects were knocked from tables.

Elsinore.—Canned goods and bottles jolted from shelves.

Idyllwild.—Felt by all. Pictures displaced on walls, dishes broken, clock thrown in southerly direction from shelf. Seventy-foot radio pole swayed.

San Jacinto.—Felt by nearly all. Some dishes broken and plaster cracked. Few things knocked off shelves running north and south in stores. Hanging lights swung.

Wildomar.—Felt by several. Knickknacks, books, and pictures fell. Furnishings shifted, table left floor about one-half inch, tables and chairs moved up and down 3 or 4 inches. Hanging objects swung in all directions.

INTENSITY V: Aguanga, Alberhill, Anza, Anza (4 miles northwest of), Coahuila, Fawnskin, Hemet, Lakeside, San Bernardino, and Tahquitz Peak Lookout (one-half mile east of Idyllwild).

INTENSITY IV: Adelanto, Barstow, Calimesa, Coachella, Del Mar, Escondido (2½ miles northwest of), Fullerton, Jacumba, Laguna Beach, Mesa Grande, Moreno, Mountain Center, Newberry, Ocean-side, Ranchita, Riverside, San Marcos, Spadra, Thousand Palms, Vista, Walnut, and White Water.

INTENSITY I TO III: Alta Loma, Bellflower, Corona, Dulzura, Fall Brook, Glendora, Indio, Lake Arrowhead, Los Angeles, Niland, Redlands, Santa Ana, San Diego, Twentynine Palms, Valyermo, and Warner Springs.

Negative reports were received from 30 places.

September 8: 11:15 (a. m. or p. m. not given). Laguna Beach. III. Trembling motion felt by several in southeast section.

September 17: 11:43:30* Epicenter 32°10' north, 116°25' west, Lower California, P. IV. Buildings creaked and loose objects rattled at Barrett Dam; felt by many in San Diego and Loma Mesa, hanging objects swung at the San Diego Gas and Electric Plant, Station B. Also felt in Campo and Jacumba.

September 17: 20:41:38* Epicenter 34°10' north, 117°16' west, near Arrowhead Springs, P. III. Felt in Riverside and San Bernardino. A slight aftershock was felt in Riverside at 21:25.

September 21: 12:22:57* Epicenter 37°23' north, 122°15' west, B. Slightly felt in Mountain View.

September 21: 14:45. "A slight earthquake was reported felt in San Bernardino. . . ."—(BSSA, January 1951.)

September 22: 17:58:49* Epicenter 33°50' north, 118°23' west, near Redondo, P. IV. Strongest in Inglewood district where windows and dishes rattled. Felt slightly at Los Angeles airport.

September 23: 20:45. Arlight. III. Felt by several in home.

September 28: 03:03:22* Epicenter 37°29' north, 118°35' west, northwest of Bishop, P. V. Felt by and awakened many residents in Bishop, Owens Gorge, and Laws. Windows and dishes rattled at first 2 places. Three miles east of Bishop whistling sounds like an abrupt strong wind were heard at time of shock. Disturbed objects were observed by several.

October 3: 03:38:00* Epicenter 39°24' north, 123°51' west, B. III. Felt by several in Fort Bragg.

October 6: 06:52:00* Epicenter 36°01' north, 117°45' west, near Coso Hot Springs, P. IV. Felt near Coso Junction. Windows and doors rattled, house creaked.

October 6: 21:47. Project City. IV. Felt by many. Windows and doors rattled, house creaked. Phonograph arm skidded across record.

October 15: 12:40:11* and 16:48:45* Epicenter 33.0° north, 115.4° west, near Brawley, P. Press reported slight shocks were felt in Brawley.

October 26: 03:18:08* Epicenter 39°37' north, 119°42' west, B. V. Strongest in southern section of Reno, Nev., where many residents were awakened. Windows and dishes rattled. Also felt in Verdi, Nev.

October 29: 12:34:02* Epicenter 33°16' north, 116°45' west, near Lake Henshaw, P. III. Slight trembling at Santa Ysabel (Lake Henshaw) felt by several.

November 1: 12:21:22* Epicenter 32°07' north, 116°28' west, Lower California, P. IV. Felt by several in Campo Post Office. Windows and doors rattled slightly.

November 1: 21:07:22* Epicenter 39°37' north, 119°55' west, B. V. Distinct boom almost like an explosion felt by many. Strongest in southwest section of Reno, Nev., and felt as far east as Sparks. Lights swung, one report of a cracked ceiling.

November 6: 12:55:46* Epicenter 32°43' north, 117°50' west, northwest of Los Coronados, P. IV. Strongest in San Diego where buildings in downtown area creaked, loose objects rattled, and suspended light fixtures swayed. Windows and doors rattled in Avalon. Felt by several and preceded by roaring subterranean sounds in La Mesa.

November 7: 07:02:35* Epicenter 33°38' north, 118°01' west, off Huntington Beach, P. IV. Felt by many in Huntington Beach. Windows and doors rattled.

November 10: 09:28:15* Epicenter 39°38' north, 119°41' west, B. Felt in Reno, Nev., with possible center in the Dog Valley area northwest of the city.

November 11: 21:05:33* Epicenter 33°57' north, 118°26' west, near Culver City, P. IV. Felt by many in western section of Los Angeles with center apparently near Santa Monica. "It was reported felt in West Los Angeles, Culver City, Beverly Hills, Santa Monica, Inglewood, and the beach area. . . ."—(BSSA, January 1951.)

November 12: 00:26:26* Epicenter 40.7° north, 124.9° west, B. V. Felt by and awakened many in Ferndale. Walls creaked. "It was felt along the coast as far south as Petrolia."—(BSSA, July 1951.)

November 13: 18:04:40* and 18:35:50* Epicenter 40½° north, 121¼° west, W. V. Series of shocks felt in the Mt. Lassen area, 16 being definitely felt in Mineral which is about 15 miles from the epicenter. Three shocks were felt in Chester where chairs moved and floor lamps swayed. Lake

Almanor was rough and rocks rolled down the canyon in Butte Valley. Also felt at Canyon Dam, roaring subterranean sounds being heard before and after the shock. Felt by several in Las Plumas where windows and doors rattled.

November 14: 13:55:53* Epicenter 40°29' north, 121°30' west, B. One of the Mt. Lassen area series, felt lightly at Caribou Powerhouse near Belden.

November 15: 05:20. Santa Maria. V. Felt by many residents. Building creaked, loose objects rattled; one slight plaster crack.

November 15: 17:59:19* Epicenter 33°57' north, 118°24' west, P. IV. Strongest in southwest section of Los Angeles where buildings creaked and loose objects rattled. Barely noticed in other areas of city. Also felt in Culver City, Maywood, and Van Nuys.

November 16: 19:46:42* and 19:46:51* Epicenter 33°55' north, 118°19' west, near Hawthorne, P. VI. Felt over an area extending from Van Nuys in the San Fernando Valley to Pasadena and North Glendale, west to Malibu, south to Long Beach, and including the entire beach area. There were scattered reports of cracked plaster and broken dishes in the southwest section of Los Angeles. Buildings and trees swayed visibly in the south section of Los Angeles. Intensity IV in Culver City, North Hollywood, and Torrance where buildings creaked and loose objects rattled.

November 19: 13:22. Palm City (San Diego). One person reported feeling an earthquake.

November 19: 23:55. Saratoga. "Residents of Saratoga and the Cupertino-Monte Vista area reported they felt an earthquake. . . . It was thought to be centered about 10 miles south or southeast of San Jose."—(BSSA, January 1951.)

November 20: 20:30. Santa Maria. "A news report from Santa Maria states that an earthquake was felt in that area. . . ."—(BSSA, January 1951.)

November 23: 05:58:24* Epicenter 36°49' north, 121°31' west, B. IV. Felt by several 7 miles south of Hollister where windows rattled and walls creaked. Also felt by many in the Watsonville area where buildings creaked and loose objects rattled. Very slight movement felt in San Francisco.

December 4: 17:38, 19:40, 19:52, 20:03, and 20:20. Near Bakersfield. III. Felt by several at Kern River Powerhouse No. 1.

December 6: 19:51:09* Epicenter 36°23' north, 118°14' west, near Cottonwood Lakes, P. IV. Felt by few in home in Cottonwood Gates. Windows and doors rattled, house creaked.

December 6: 23:14:30* Epicenter 35°29' north, 118°49' west, northeast of Bakersfield P. IV. One heavy bump felt at Kern River Powerhouse No. 1. At least 10 shocks were felt during daylight hours, 4 were severe and 6 were medium to light. No times or details known.

December 7: 04:55. IV. "Reno and its vicinity were jolted by a sharp earthquake. . . . No damage was reported."—(BSSA, January 1951.)

December 7: 20:18:19* Epicenter 35°31' north, 118°49' west, northeast of Bakersfield, P. V. Felt by 4 people at Kern River Powerhouse No. 1. A few rocks rolled from mountainside on west side of river. The plant annunciator was set off. Several light shocks followed.

December 9: 01:15, 01:20, and 01:35. Near Bakersfield. III. Trembling and bumping felt by several at Kern River Powerhouse No. 1. Other shocks felt between 19:00 on the 8th and 02:00 on the 9th, seeming to occur in series of 3 or 4 with 30-second intervals every half hour.

December 10: 22:12:09* Epicenter 35°30' north, 118°49' west, P. IV. One sharp bump felt at Kern River Powerhouse No. 1. There were also several small bumps between 18:00 on the 10th and 19:00 on the 11th. No times or details known.

December 11: 14:30 and 23:00. Doyle. IV. Felt by several. Buildings creaked, loose objects rattled, and cups in china closet swung.

December 12: 02:00 and 02:30. Near Bakersfield. IV. Two sharp bumps with trembles felt at Kern River Powerhouse No. 1. Similar disturbances were felt at 17:15, 17:35, and 17:45.

December 12: 04:00, 04:15, 05:00, and 10:50. Doyle. IV. Felt by several. Buildings creaked and loose objects rattled.

December 14: 00:59:34* Epicenter 40.1° north, 120.2° west, near Honey Lake, W. Felt in Wendel. Aftershock at 01:29:54* felt in Vinton. Also reported at 04:00, intensity V, as severely felt by men at Wendel roundhouse. Near roundhouse pictures fell, glass was broken, and coffee spilled from cups.

December 14: 02:00. Sierraville. Weak shock felt.

December 14: 05:24:21* Epicenter 40.1° north, 120.2° west, near Herlong, W. This was the main shock of a series, the felt area including about 20,000 square miles extending from Sacramento to Mineral, to Alturas, and as far east as Lovelock, Nev. See map. Maximum intensity VII at Herlong where considerable damage occurred. Shocks of varying degrees of intensity were felt for 2 days previous to and following the main shock.

INTENSITY VII:

Herlong.—Several buildings shifted on foundation; numerous cracks in structures, the cracks ranging in width from less than $\frac{1}{8}$ inch to a little over $\frac{1}{4}$ inch and in length to 80 feet; plaster cracked and fell. Some underground pipe damage. Tile and bricks broken in several buildings, many chimneys broken. Trusses and roof rafters badly shaken up and split. Windows and dishes broken in all sections of town. A great many heavy objects were displaced.

INTENSITY VI:

Beckworth.—Awakened all. Windows, doors, and dishes rattled; house creaked.

Doyle.—Awakened all. Damage considerable to brick. Knickknacks, books, and pictures fell; dishes broke.

Litchfield.—Felt by and frightened all. Pendulum clock facing south stopped. Bed rocked.

Portola.—Awakened all. Windows, doors, and dishes rattled.

Wendel.—Felt by and awakened many. Pendulum clock stopped, pictures fell. Heavy bed shaken.

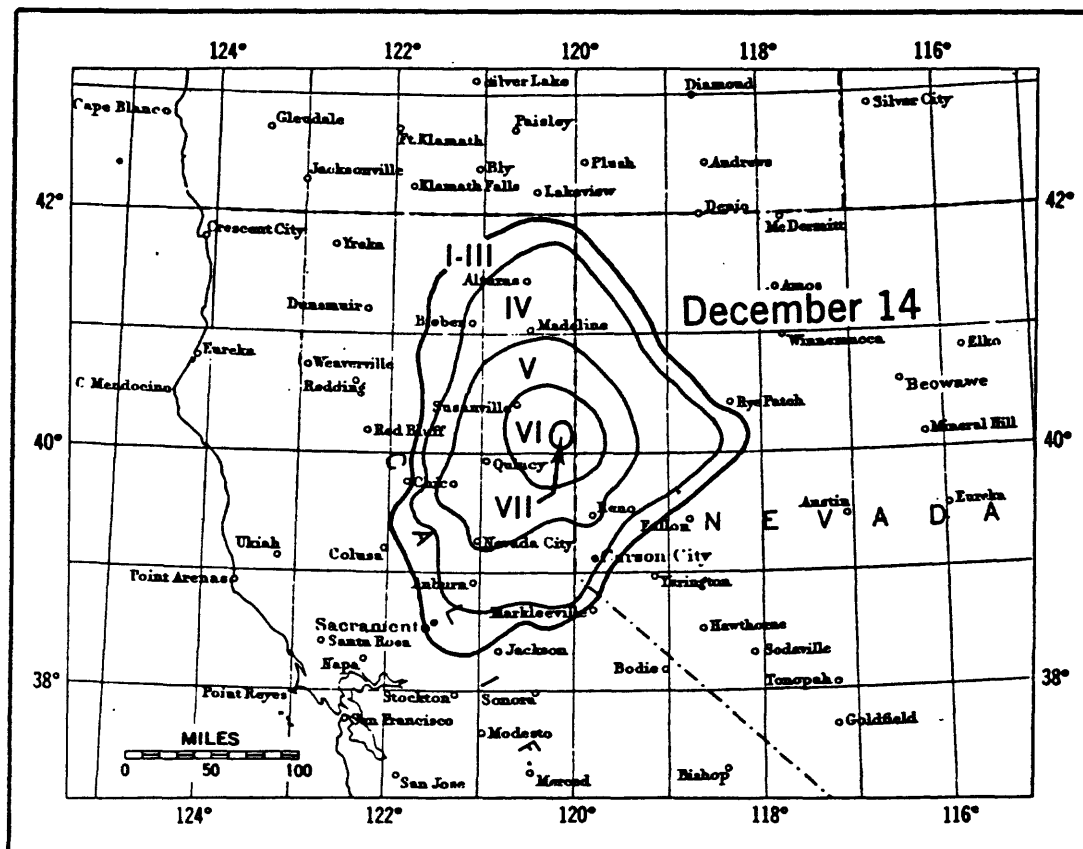


FIGURE 5.—Area affected by the earthquake of December 14.

INTENSITY VI IN NEVADA:

Flanigan.—Felt by and awakened many. Plaster cracked, merchandise on shelves in store fell. Small objects shifted or overturned.

INTENSITY V: Alleghany, Emigrant Gap, Nevada City, Oroville, Quincy, Ravendale, Sierra City, Sierraville, Sloat, Storrie, Strawberry Valley, Susanville, Termo, Twain, and Westwood.

INTENSITY V IN NEVADA: Lovelock and Reno.

INTENSITY IV: Alturas, Bijou, Canby, Caribou, Chester, Floriston, Foresthill, Grass Valley, Gridley, Isleton, Lake Spaulding, Las Plumas, Likely, Madeline, Oregon House, Phillips, Sheridan, Soda Springs, Stirling City, and Vinton.

INTENSITY IV IN NEVADA: Gerlach, Hazen, Nixon, Pyramid, Verdi, Winnemucca, and Yerington.

INTENSITY I TO III: Canyon Dam, Cedarville, Courtland, Marysville, Michigan Bluff, Mineral, Pit River Powerhouse No. 1 near Fall River Mills, Pit River Powerhouse No. 3 near Burney, Sacramento, Tahoe City, Wilton, Whitehorse, and Yuba City.

INTENSITY III IN NEVADA: Genoa and Glenbrook.

Negative reports were received from 23 places in California and 9 places in Nevada.

December 14: 05:56:23* Epicenter 35°03' north, 119°10' west, near Wheeler Ridge, P. IV. Two shocks felt by several on San Emedio Ranch, 12 miles east of Wheeler Ridge. Windows rattled, trees and bushes shaken slightly.

December 15: 10:01:16* III. Herlong aftershock, felt by several in Wendell.

December 15: 13:30. Flanigan, Nev. IV. Severe shock felt in schoolroom, building creaked.

December 16: (a. m.) Felt in Janesville.

December 18: (no time given). Flanigan, Nev. IV. Wavelike tremor felt in home. Walls creaked.

December 21: 18:05:36* Epicenter 33°25' north, 116°34' west, northeast of Santa Rosa Mountains, P. IV. Felt mostly in northeastern San Diego County. Creaking houses, rattling of loose objects, and rumbling sounds reported generally from Campo, Hemet, Mesa Grande, Valley Center (3 miles northeast of), and Warner Springs. Also felt slightly in the Martinez Canyon, Palomar, and Santa Ysabel (Lake Henshaw).

December 26: 03:30. Flanigan, Nev. IV. Slight tremor. Walls creaked.

December 26: 04:05:49* Epicenter 33°57' north, 117°35' west, north of Arlington, P. IV. Awakened a few Riverside residents. Slight rumble preceded shock. A control tower operator at the Long Beach airport reported a slight earthquake at 05:32.

December 27: 21:22:11* Epicenter 33°12' north, 116°07' west, southeast of Borego Valley, P. Felt 3 miles northeast of Valley Center.

December 29: 19:48:09* Epicenter 33°57' north, 116°30' west, near Desert Hot Springs, P. IV. Rattled dishes in White Water, felt slightly 3 miles northeast of Valley Center.

December 30: 08:08:52* Epicenter 36°26' north, 118°13' west near Cottonwood Lakes, P. IV. Felt by several in Cottonwood. Loose objects rattled, buildings creaked, and windows shook.

December 31: 02:00 (about). Doyle. VI. Press reported an earth fracture in Long Valley about 1½ miles east of Doyle, extending at least 4 miles to the north and possibly to the south. Width of the fracture varied from a crack to about 6 inches and the down drop was from 1 or 2 inches to 10 inches. Professor Gianella of the University of Nevada stated the fracture was in all probability produced by the earthquake. The tremor was recorded on the University's seismograph in Reno.

WASHINGTON AND OREGON

(120TH MERIDIAN OR PACIFIC STANDARD TIME)

March 7: 22:25. Entiat, Wash. IV. Sharp, blast-like shock felt by two persons.

April 14: 03:03:48*. Epicenter 48° north, 122½° west, about 8 miles southwest of Langley, Wash., W. Felt over an area of about 7,000 square miles in northwestern Washington from Bellingham southeast to Rockport, southwest to North Bend and Eatonville, northwest to Quilcene and Port Angeles, Eastsound, and Bellingham. See map. Press reported the shock was also felt in Vancouver, British Columbia. Maximum intensity in the United States was VI.

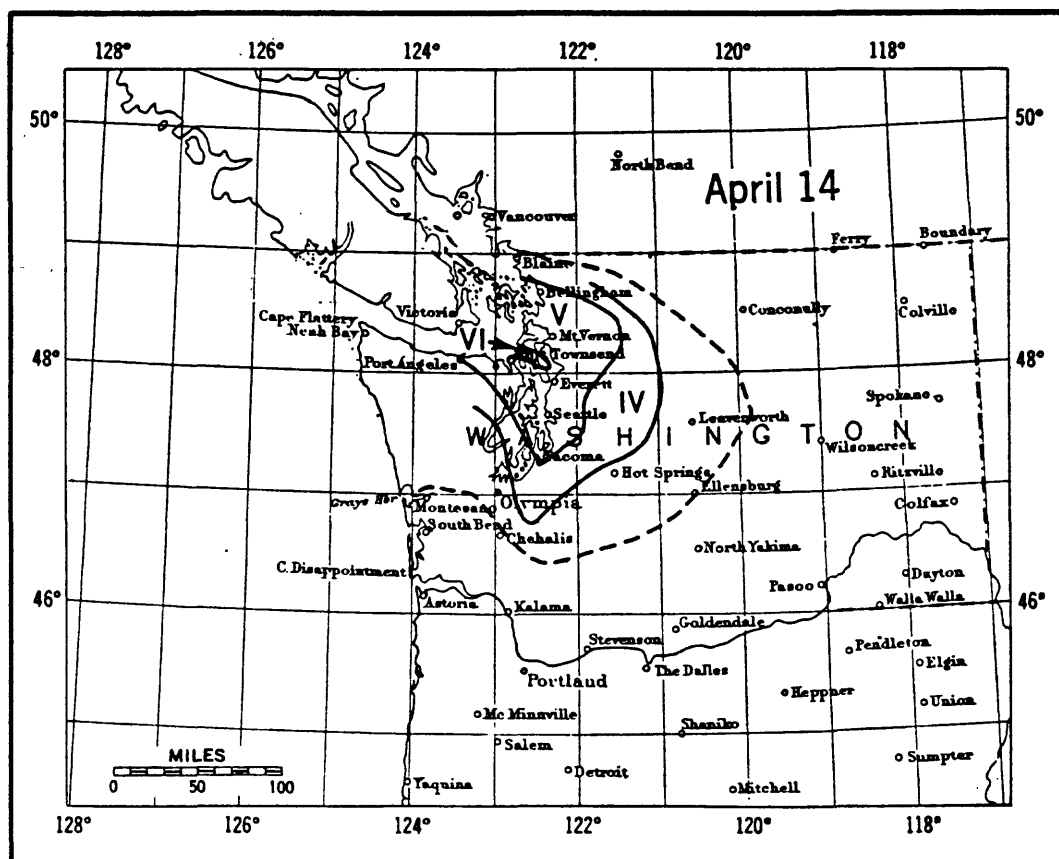


FIGURE 6.—Area affected by the earthquake of April 14.

INTENSITY VI:

Coupeville.—Felt by, awakened, and frightened all in home. Sounded like distant, heavy explosion. Everything shook.

Langley.—Awakened many in community. Slight roaring sound. Plaster cracked and fell, hanging objects swung, small objects shifted and overturned. Trees and bushes shaken strongly.

Port Townsend.—Felt by, awakened, and frightened all. A few plaster cracks. Pendulum clocks stopped, windows and doors rattled.

INTENSITY V: Bellingham, Concrete, Darrington, Eastsound, Everett, Monroe, North Bend Ranger Station, Port Angeles, Port Gamble, Possession, Sedro-Woolley, and Tacoma.

INTENSITY IV: Ariel, Buckley, Carbonado, Cle Elum, Eatonville, near Landsburg, Puyallup, Quilcene (2 miles south of), Rockport, and Seattle.

INTENSITY III: Tillicum.

Negative reports were received from 5 places adjacent to the felt area and from 7 other places.

May 16: 23:36. Whatcom and Skagit Counties, Wash. III. Slight shock felt by several. No particular locality given.

June 25: 15:45. Cheney, Wash. IV. "A small earthquake was felt in Cheney. . . . The shock was said to have been quite sharp and followed by noticeable swaying."—(BSSA, October, 1950.)

December 2: Mukilteo, Wash. V. "Residents of this Puget Sound town felt sharp earth tremors from 5:57 to 6:05 p. m., P. S. T. Stovepipes were shaken loose and dishes were broken."—(BSSA, January, 1951.)

ALASKA

(150TH MERIDIAN OR ALASKA STANDARD TIME)

January 2: 01:35. Fairbanks. Felt by many in southwest section. Motion swaying, direction indeterminate.

January 3: 07:15. Juneau. Two shocks felt by only a few persons. Chandeliers swayed north-south.

January 29: 16:49:49* Epicenter $61\frac{1}{2}^{\circ}$ north, 150° west, W. Anchorage. One strong and two light tremblings, east to west. Disturbed objects were observed by a few persons.

February 24: 11:27. Cordova. Rocking motion felt by many persons. Fluorescent lights swung.

March 9: 07:38:02* Epicenter 61° north, 151° west, W. Anchorage. Several slight tremors with northeast-southwest motion felt by many persons. Lighting fixtures swung. One abrupt shock followed by rippling motion reported from Spenard. Electric light poles and wires swayed.

April 22: 08:50 to 10:05. Fairbanks. Seven very small shocks centered within 10 miles of city, possibly in vicinity of Ladd Air Force Base. Felt by many residents, many particularly noticed disturbed objects.

May 23: 10:58. Anchorage. One shock felt by many. East-west motion. Doors rattled.

May 24: 14:48:49* W. Anchorage. Trembling and bumping motion felt by several. Suspended wall map in Weather Bureau office swung east-west. Lighting fixtures in one home swung.

May 24: 22:34:32* Epicenter $65\frac{1}{2}^{\circ}$ north, $151\frac{1}{2}^{\circ}$ west, W. Northeast of Tanana and about 100 miles northwest of Fairbanks. Felt at College.

May 24: 22:37. McGrath. Swaying east-west motion felt by two people. Only reported disturbance was swinging light fixtures.

August 7: 23:25. Anchorage. One shock reported felt by several in southwest section of town. Lamp on wall moved and pans in cupboard rattled.

August 25: 17:39:27* Epicenter 65° north, 162° west, W. On Seward Peninsula about 100 miles east of Nome. One abrupt shock felt by proportion of populus in Kotzebue. Buildings swayed slightly. Water in fishbowl $5\frac{1}{2}'' \times 6''$ surged up 1'' on northeast side. The earthquake was also felt in Wales where loose objects rattled and chandeliers swung. Also felt by several in Shishmaref. A foreshock occurred at 14:39:27* and was reported as two shocks felt by all at Hangar No. 1, Marks Air Force Base, Nome.

August 27: 05:33:32* Nome. One abrupt trembling felt by most persons awake at Hangar No. 1, Marks Air Force Base.

September 24: 10:13:28* Epicenter 64° north, 156° west, W. Felt in College.

October 10: 22:35:19* Epicenter 63° north, 160° west, W. Anchorage. Felt by many. Motion east-west. Loose objects rattled, chandeliers swayed, and buildings shook back and forth.

October 13: 11:31. Anchorage. Two shocks felt by several in central section of town. Doors and windows rattled.

December 25: 14:53. Stony River. Swaying motion felt by one person in bed inside log building. Not felt by another person sitting at desk in same building.

HAWAIIAN ISLANDS

(HAWAIIAN STANDARD TIME)

NOTE.—Data on the following local disturbances were determined from seismograph stations operated on the Island of Hawaii by the Hawaiian Volcano Observatory of the United States Geological Survey. "Felt locally" appearing in the summary means in the vicinity of the Observatory. For additional information see *The Volcano Letter*, Nos. 507-510.

- January 25: 16:26. Feeble. Felt at 29 Miles and Hilo.
 February 12: 06:09. Slight. Felt locally and at Naalehu. Origin near Makaopuhi.
 February 13: 11:59. Slight. Felt locally and at Hilo. Origin 8 miles deep under east slope of Mauna Loa.
 March 25: 05:43. Widely felt on Island of Hawaii. Seismographs dismantled. Origin 15-20 miles deep under 5,000-foot contour, east slope of Mauna Loa.
 April 5: 04:50. Feeble. Felt locally. Kilauea quake.
 May 4: 05:51, 05:54, and 06:02. Felt at Kapapala. First earth shock was slight, last two were very feeble.
 May 29: 15:17. VI. Strong. Origin at upper southwest rift of Mauna Loa. Hilo residents reported chinaware broken and pictures and light fixtures swayed. At Kona canned goods in several stores toppled to the floors. Three trucks rocked in a field at Opaikou. Small sections of stone around the rim of Halemaumau were shaken loose and hurtled to the bottom of the crater. Seismographs were dismantled at the Hawaiian Volcano Observatory and broken at the Konawaena station.
 June 19: 09:22. Very feeble. Felt locally. Origin near Ohaieka.
 June 21: 07:06. Moderate. Felt locally. Kilauea quake.
 June 26: 19:56. Feeble. Felt at Naalehu.
 July 24: 15:42. Feeble. Felt locally. Origin at north end of Kilauea Caldera.
 July 31: 04:29. Slight. Felt locally. Origin at north end of Kilauea Caldera.
 August 11: 10:58. Feeble. Felt at Naalehu.
 August 19: 05:12. Very feeble. Felt locally. Kilauea quake.
 August 27: 12:18. Feeble. Felt locally and at Hilo. Origin on north slope of Mauna Loa.
 September 16: 21:51. Feeble. Felt locally and at Hilo. Origin on northeast rift of Mauna Loa.
 October 11: 20:06. Slight. Felt over most of Hawaii. Origin 20-25 miles deep under east slope of Mauna Loa.
 December 9: 05:43. Moderate. Widely felt. Origin east of Mauna Iki, 4-5 miles deep.
 December 9: 20:45. Widely felt. Instruments dismantled at Hawaiian Volcano Observatory. Origin near Kamakaia Hills.
 December 10: 21:25. Strong. Widely felt. Instruments dismantled at Hawaiian Volcano Observatory. Origin near Kamakaia Hills.
 December 18: 05:54. Very feeble. Felt plainly at Naalehu. Origin above South Point.
 December 22: 03:07. Slight. Felt locally. Origin Mauna Loa.
 December 26: 02:55. Moderate. Widely felt. Origin 8 miles deep south of Kilauea Iki.

PANAMA CANAL ZONE

(60TH MERIDIAN TIME)

- March 2: 08:07:17* Epicenter off coast of Colombia, S. A., W. Felt by a few persons throughout Canal Zone, most noticeably on the upper floors of buildings. Also felt in Santiago, Republic of Panama.
 July 8: 00:27:45* Felt with intensity III in Canal Zone.
 September 15: 05:47:58* Generally felt with intensity IV in Canal Zone.
 October 11: 14:56:38* Felt by a few in Canal Zone.

PUERTO RICO

(60TH MERIDIAN TIME)

- January 1: 20:42:26* Epicenter 19° north, 67½° west, off west coast of Puerto Rico, W. Felt at Mayaguez.
 January 15: 13:32. Felt at Caguas.
 May 18: 03:28. Santa Isabel. Rapid east-west movement lasting not more than 2 or 3 seconds. windows, glassware, and bottles rattled. Similar reports came from Caguas and vicinity and from Ciales.

MISCELLANEOUS ACTIVITIES**GEODETIC WORK OF SEISMOLOGICAL INTEREST**

During the calendar year triangulation to be used in the study of earth movements was observed at Moreno and Whitewater areas, Riverside County, Calif. It is planned to reobserve this work in about 10 years. Triangulation originally observed in 1932 in the vicinity of Indio, Calif., was reobserved. No movement was disclosed by this work. Repeat surveys of the Long Beach, Calif., subsidence areas disclosed continued horizontal movement towards the center of greatest subsidence.

Leveling for a study of vertical changes in the earth's surface was accomplished in the calendar year. Lake Mead area, Nevada, was leveled to determine subsidence since the last previous survey in 1940, and also since the original 1935 survey which was made before the reservoir was filled. The results of these surveys show that a gradual measurable settlement is continuing at Lake Mead. Prints of a sketch showing the divergencies between the three leveling surveys are available. Releveling from Galveston to Port Isabel, Tex., to determine the extent of subsidence noted in that area was underway.

TIDAL DISTURBANCES OF SEISMIC ORIGIN

The tide station at Puerto Armuelles, Panama, was destroyed by an earthquake on October 5. The gage at Puntarenas, Costa Rica, was shaken and soon thereafter it recorded a seiche or possible seismic sea wave. Small oscillations that may have resulted from this earthquake were also recorded on tide gages at San Juan del Sur, Nicaragua, and La Union, El Salvador.

The existence of a large seismic sea wave in the Moluccas, Indonesia, on October 8 (reported by the press to have a height of 200 meters) could not be verified from tide records.

Following an earthquake near Guatemala, the gage at San Jose, Guatemala, recorded a wave of somewhat less than 1 foot. At La Union, El Salvador, it was barely noticeable on the tide record. It was not recorded by other tide gages in Mexico and Central America.

An earthquake near the south coast of Mexico on December 14 created a series of waves that were recorded on the gage at Acapulco, Mexico. The largest wave had a height of 2 feet. Other gages in Mexico and Central America did not record the waves.

FLUCTUATIONS IN WELL WATER LEVELS

INTRODUCTION

The following data are tabulated for the purpose of possibly associating fluctuations in well water levels with earthquakes. Complete information on earthquakes may be obtained from the *Preliminary Determination of Epicenter* and *Supplement* cards issued by the United States Coast and Geodetic Survey or from registers of seismographic stations nearest the locality. The data are made available by the Ground Water Branch of the United States Geological Survey.

Similar data for 1943 were published by the United States Coast and Geodetic Survey in Serial 672, *United States Earthquakes, 1943*, and those for subsequent years through 1949 appeared in Serial 748, *United States Earthquakes, 1949*. Descriptions of wells given here include only those that have not appeared in either of the previous mentioned editions.

WELL DESCRIPTIONS

CALIFORNIA

Well No. 7/1E-6C3, nonartesian, sec. 6, T. 7 N., R. 1 E. Owner, J. L. Kilkenny. Depth, 67.8'; diameter, 6"; finish, gravel packed. Aquifer, gravel, cobbles, and coarse sand.

Well No. 8/1E-28K1, artesian, sec. 28, T. 8 N., R. 1 E. Owner, A. Felner. Depth, 350'; diameter, 12". Aquifer, valley fill.

Well No. 8/1E-20G3, nonartesian, sec. 20, T. 8 N., R. 1 E. Owner, Murray Bros. Depth, 68'; diameter, 6". Aquifer, gravel, cobbles, and coarse sand.

Well No. 8/1W-25D1, nonartesian, sec. 25, T. 8 N., R. 1 W. Owner, Davis Ranches. Depth, 61'; diameter, 12". Aquifer, valley fill.

Well No. 8/1W-20R2, semiartesian, sec. 20, T. 8 N., R. 1 E. Owner, A. L. Martin. Depth, 100'; diameter, 12". Aquifer, sand, and gravel.

Well No. 8/1W-22D5, semiartesian, sec. 22, T. 8 N., R. 1 W. Owner, U. S. Geological Survey on R. Lopez property. Depth 96'; diameter 6". Aquifer, coarse gravel and sand.

Well No. 8/1W-28R3, nonartesian, sec. 28, T. 8 N., R. 1 W. Owner, R. E. Campbell. Diameter, 8". Aquifer, sand, gravel, and alluvial fill.

ILLINOIS

Well No. ANL-9, artesian. Owner, Argonne National Laboratory. Depth, 140'; diameter, 4" for 90'; finish, open. Aquifer, limestone.

Well No. ANL-10, artesian. Owner, Argonne National Laboratory. Depth, 186'; diameter, 4"; finish, open. Aquifer, limestone.

Well No. ANL-11, artesian. Owner, Argonne National Laboratory. Depth, unknown; diameter, 4"; finish, open. Aquifer, limestone.

Well No. ANL-13, artesian. Owner, Argonne National Laboratory. Depth, 141'; diameter, 4" for 86'; finish, open. Aquifer, limestone.

IOWA

Well No. 83-7-21K1, artesian, NW¼SE¼ sec. 21, T. 83 N., R. 7 W. Owner, Wapsi Valley Creamery. Depth, 156'; diameter, 8" to 6½"; cased from +1.7' to 28.3' with 8" casing, and from 21.3' to 105' with 6½" casing; finish, open hole from 105' to 156'. Aquifer, Silurian dolomite.

LOUISIANA

Well No. Cu-22, artesian, SE¼SE¼ sec. 8, T. 10 S., R. 9 W. Owner, Magnolia Petroleum Co. Depth, 560'; diameter, 13¾" to 7"; finish, 47' 10" of 7" screen. Aquifer, sand, and gravel.

Well No. Ac-40, artesian, NE¼ sec. 1, T. 9 S., R. 1 W. Owner, H. A. Kerr. Depth, 303'; diameter, 8". Aquifer, sand.

Well No. Cn-28, S½ sec. 31, T. 15 S., R. 10 W. Owner, A. M. Barb. Depth, 282'; diameter, 4"; finish, 52' of 4" screen. Aquifer, sand.

Well No. Cu-445, artesian, SW corner of SE¼ sec. 18, T. 10 S., R. 9 W. Owner, Cities Service Refinery, Lake Charles. Depth, 500'; diameter, 18" to 10"; finish, 80' of 10" screen. Aquifer, sand.

Well No. Cu-446, artesian, SW corner of SE¼ sec. 18, T. 10 S., R. 9 W. Owner, Cities Service Refinery, Lake Charles. Depth, 738'; diameter, 18" to 10¾"; finish, 80' of 10¾" screen. Aquifer, sand.

Well No. EB-20, artesian, Baton Rouge. Owner, Esso Standard Oil Co. Depth, 665'; diameter, 10". Aquifer, sand.

Well No. EB-293, artesian, sec. 37, T. 6 S., R. 1 W. Baton Rouge. Owner, Consolidated Chemical Corp. Depth, 606'; finish, 60' screen. Aquifer, sand.

Well No. Ev-200, artesian, SW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 18, T. 4 S., R. 1 W. Owner, Continental Oil Co. Depth, 240'; diameter, 4". Aquifer, sand.

Well No. Ev-229, artesian, SE $\frac{1}{4}$ sec. 25, T. 4 S., R. 1 W. Owner, Cheatley Fontenot. Depth, 135'; diameter, 18". Aquifer, sand.

Well No. JD-43, artesian, NE $\frac{1}{4}$ sec. 24, T. 8 S., R. 6 W. Owner, Lucius Vidrine. Depth, 277'. Aquifer, sand.

Well No. JD-224, artesian, sec. 10, T. 8 S., R. 4 W. Owner, T. J. Heinen. Depth, 760'; diameter, 2 $\frac{1}{2}$ "; finish, 20' of 2 $\frac{1}{2}$ " screen set from 581 to 601'. Aquifer, sand.

Well No. Mo-9, artesian, sec. 24, T. 21 N., R. 5 E. Owner, Southern Kraft Corp. Depth, 890'; diameter, 26" to 10". Aquifer, sand.

Well No. Ou-100, artesian, NE $\frac{1}{4}$ sec. 67, T. 18 N., R. 4 E. Owner, City of Monroe. Depth, 869'; diameter, 3"; finish, 3" screen for 20'. Aquifer, sand.

Well No. Ve-120, artesian, SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 35, T. 12 S., R. 4 E. Owner, Erath Sugar Co. Depth, 285'; diameter, 10". Aquifer, sand.

Well No. Ve-460, artesian, NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 5, T. 13 S., R. 2 E. Owner, Acadia Vermilion Rice Irrigating Co. Depth, unknown; diameter, 9 $\frac{1}{2}$ ". Aquifer, sand.

Well No. EB-128, artesian, 135 South Fifteenth Street, Baton Rouge. Owner, Ice Service Co. Depth, 412'; diameter, 8". Aquifer, sand.

MICHIGAN

Well No. Ea-GL-1, artesian, Grand Ledge, 365' west of Perry Street, 310' north of Jefferson Street. Owner, Layne-Northern Co. Depth, 376'; diameter, 12"; finish, open hole. Aquifer, sandstone.

Well No. IgDh12, artesian, NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 8, T. 3 N., R. 2 W. Owner, F. H. Kraus. Depth, 73.8'; diameter, 3"; finish, open hole. Aquifer, sandstone.

Well No. IgLs265, artesian, NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 24, T. 4 N., R. 2 W. Owner, Frank Clever. Depth, 455'; diameter, 10"; finish, open hole. Aquifer, sandstone.

Well No. IcWr1, artesian, NE $\frac{1}{4}$ sec. 7, T. 23 N., R. 7 E. Owner, United States Forest Service. Depth, 341'; diameter, 6"; finish, screen. Aquifer, drift ?

Well No. WaYk22, artesian, SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 10, T. 4 S., R. 6 E. Owner, Ypsilanti State Hospital. Depth, 173.1'; diameter, 6"; finish, screen. Aquifer, grave.

NEW JERSEY

Well No. 26.21.5.4.6, nonartesian, 40°41'03" N., 74°17'26" W., near Kenilworth. Owner, Union County Park Commission. Depth 290'; diameter, 6". Aquifer, Brunswick shale (Triassic).

Well No. 25.15.7.5.4, semiarartesian, 40°44'43" N., 74°21'20" W., near Summit. Owner, Commonwealth Water Co. Depth, 130'; diameter, 10". Aquifer, glacial drift (Wisconsin).

Well No. 28.5.4.8.1, nonartesian, 40°24'32" N., 74°21'08" W., Old Bridge. Owner, Guhernal Water System. Depth, 67'; diameter, 6". Aquifer, No. 3 Old Bridge sand.

Well No. 28.5.1.5.3, artesian, 40°27'12" N., 74°20'47" W., near Parlin. Owner, Duhernal Water System. Depth, 150'. Aquifer, Farrington sand.

Well No. 31.1.6.4.8, artesian, 39°57'00" N., 75°07'30" W., Camden. Owner, Esterbrook Pen Co. Depth, 185'. Aquifer, Magothy-Raritan sands.

NEW MEXICO

Berrendo, artesian, SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 9, T. 10 S., R. 24 E. Depth, 258'; diameter, 10". Aquifer, San Andres limestone.

Berrendo-Smith, artesian, NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 21, T. 10 S., R. 24 E. Depth, 324'; diameter, 10". Aquifer, San Andres limestone.

Mountain View, artesian, SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 29, T. 11 S., R. 29 E. Depth, 553'; diameter, 10 $\frac{1}{4}$ ". Aquifer, San Andres limestone.

Greenfield, artesian, NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 27, T. 13 S., R. 27 E. Depth, 880'; diameter, 10". Aquifer, San Andres limestone.

Artesia, artesian, SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 5, T. 18 S., R. 26 E. Depth, 1,056'; diameter, 8". Aquifer, San Andres limestone.

Carlsbad GS-4, artesian, sec. 17, T. 23 S., R. 29 E. Depth, 286'; diameter, 6 $\frac{1}{2}$ ". Aquifer, base of Rustler formation.

Carlsbad GS-3, artesian, NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 8, T. 24 S., R. 29 E. Depth, 405'; diameter, 6 $\frac{1}{2}$ ". Aquifer, base of Rustler formation.

Hot Springs 6, thermal artesian, sec. 4, T. 14 S., R. 4 W. Depth, 105'; diameter, 6 $\frac{1}{2}$ ". Aquifer, Magdalena limestone.

NEW YORK

Well No. Sa 529, artesian. Owner, city of Saratoga Springs. Depth, unknown; diameter, 6"; casing assumed to be seated in bedrock. Aquifer believed to be Little Falls dolomite.

Well No. S 6409, artesian, 40°52'30" N., 72°52'30" W. Owner, Brookhaven National Laboratory, Upton. Depth, 1,431'; diameter, 8"; finish, steel casing 25' screen. Aquifer, Lloyd sand member of Raritan formation.

Well No. S 6410, nonartesian, 45°55'20" N., 72°54'10" W. Owner, Brookhaven National Laboratory, Ridge. Depth, 88'; diameter, 4"; finish, casing bottom 5' slotted. Aquifer, glacial till.

Well No. S 6413, nonartesian, 40°53'15" N., 72°55'20" W. Owner, Brookhaven National Laboratory, Middle Island. Depth, 110'; diameter, 4". Aquifer, glacial till.

Well No. S 6419, nonartesian, 40°48'45" N., 72°52'30" W. Owner, Brookhaven National Laboratory, Upton. Depth, 89'; diameter, 4"; finish, casing lower 5' slotted. Aquifer, glacial till.

Well No. S 6434, artesian, 40°52'00" N., 72°52'30" W. Owner, Brookhaven National Laboratory. Depth, 1,397'; diameter, 10"; finish, steel casing 80' 6" Layne shutter screen in gravel pack. Aquifer, Lloyd sand member of Raritan formation.

Well No. S 6455, artesian, 40°52'30" N., 72°52'30" W. Owner, Brookhaven National Laboratory. Depth, 962'; diameter, 4"; finish, steel casing 10' 4" in Layne shutter screen. Aquifer, bottom part of so-called Magothy formation.

Well No. Wn 29, artesian, 43°08'14" N., 77°11'19" W. Owner, town of Marion, near 55 Mill Street. Depth, 107'; diameter, 8"; finish, casing 25'. Aquifer, Lockport dolomite.

Well No. S 5517, nonartesian, 40°51'46" N., 72°53'20" W. Owner, Brookhaven National Laboratory. Depth, 91'; diameter, 4"; finish, casing to 6' screen. Aquifer, glacial till.

OHIO

Well No. Cl-1, Clark County, 39°59' N., 83°43' W. Owner, E. L. Shuey. Depth, 57'; diameter, 6". Aquifer, gravel.

Well No. Cl-2, Clark County, 39°55' N., 83°51' W. Owner, city of Springfield. Depth, 74'; diameter, 6". Aquifer, gravel.

Well No. Dl-3, Delaware County, 40°21' N., 83°04' W. Owner, United States Army Engineers. Depth, 135'; diameter, 12". Aquifer, limestone.

Well No. Fa-1, Fayette County, 39°32' N., 83°31' W. Owner, Martha Slagle. Depth, 78'; diameter, 5". Aquifer, limestone.

Well No. Fn-1, Fulton County, 41°35' N., 84°00' W. Owner, city of Delta. Depth, 130'; diameter, 8". Aquifer, gravel.

Well No. Fn-2, Fulton County, 41°31' N., 84°06' W. Owner, Wauseon Water Works. Depth, 50'; diameter, 8". Aquifer, gravel.

Well No. Fr-11, Franklin County, 39°58' N., 82°56' W. Owner, city of Columbus Parks. Depth, 85'; diameter, 6". Aquifer, gravel.

Well No. Fr-12, Franklin County, 39°58' N., 83°57' W. Owner, city of Columbus Parks. Depth, 79'; diameter, 6". Aquifer, gravel.

Well No. Ge-2, Geauga County, 41°25' N., 81°11' W. Owner, D. L. Cameron. Depth, 61'; diameter, 6". Aquifer, gravel.

Well No. Hy-1, Henry County, 41°14' N., 83°54' W. Owner, Mrs. H. Fasnow. Depth, 81'; diameter, 4". Aquifer, limestone.

Well No. M-1, Madison County, 39°43' N., 83°15' W. Owner, M. Chenoweth. Depth, 60'; diameter, 4". Aquifer, gravel.

Well No. Mi-1, Miami County, 40°02' N., 84°13' W. Owner, Troy Sunshade Co. Depth, 49'; diameter, 8". Aquifer, gravel.

Well No. Mn-1, Marion County, 40°34' N., 83°23' W. Owner, village of LaRue. Depth, 100'; diameter, 4". Aquifer, gravel.

Well No. Mr-1, Mercer County, 40°39' N., 84°38' W. Owner, S. O. Sells. Depth, 130'; diameter, 4". Aquifer, limestone.

Well No. Mu-2, Muskingum County, 39°57' N., 82°01' W. Owner, city of Zanesville. Depth, 54'; diameter, 6". Aquifer, gravel.

Well No. Po-2, Portage County, 41°08' N., 81°22' W. Owner, city of Kent Water Works. Depth, 65'; diameter, 10". Aquifer, gravel.

Well No. Po-3, Portage County, 41°11' N., 81°02' W. Owner, United States Army Engineers. Depth, 172'; diameter, 12". Aquifer, sandstone.

Well No. R-2, Richland County, 40°40' N., 82°34' W. Owner, Lexington Water Works. Depth, 129'; diameter, 6". Aquifer, sandstone.

Well No. Sh-1, Shelby County, 40°26' N., 84°12' W. Owner, John Wanger. Depth, 120'; diameter, 4". Aquifer, limestone.

Well No. St-1, Stark County, 40°47' N., 81°31' W. Owner, Republic Steel Co. Depth, 48'; diameter, 6". Aquifer, gravel.

Well No. St-5a, Stark County, 40°50' N., 81°21' W. Owner, Canton Water Works. Depth, 132'; diameter, 12". Aquifer, gravel.

Well No. St-10, Stark County, 40°48' N., 81°27' W. Owner, city of Canton. Depth, 188'; diameter, 12". Aquifer, gravel.

Well No. T-2, Trumbull County, 41°16' N., 80°50' W. Owner, Copperweld Steel Corp. Depth, 124'; diameter, 10". Aquifer, sandstone.

Well No. Tu-1, Tuscarawas County, 40°37' N., 81°32' W. Owner, Everett Waltz. Depth, 23'; diameter, 4". Aquifer, gravel.

Well No. W-2, Warren County, 39°26' N., 84°13' W. Owner, Lebanon Water Works. Depth, 100'; diameter, 6". Aquifer, gravel.

RHODE ISLAND

Well No. P-48, semiartesian, on bank of Mashapaug Pond, 2.2 miles southwest of Providence. Depth, 121'; diameter, 8"; finish, 8' of 8" screen. Aquifer, sand (Pleistocene drift).

SOUTHERN FLORIDA

Well No. L 414, NE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 21, T. 44 S., R. 26 E. Owner, city of Fort Myers. Depth, 93.5'; diameter, 8"; finish, open hole. Aquifer, shelly and sandy limestone.

Well No. G-10, artesian, NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 4, T. 54 S., R. 40 E. Owner, United States Geological Survey. Depth, 5.5'; diameter, 8"; finish, open hole. Aquifer, oolitic limestone.

TENNESSEE

Well No. 79:8-73, artesian, 35°07'27" N., 89°55'56" W. Owner, Memphis Light Co., Gas and Water Division. Depth, 499'; diameter, 8"; finish, screen in Claiborne sands.

Well No. 79:1-2, artesian, 35°13'25" N., 89°53'57" W. Owner, Memphis Light Co., Gas and Water Division. Depth, 344'; diameter, 6"; finish, screen in Claiborne sands.

Well No. 79:5-193, artesian, 35°07'36" N., 89°59'32" W. Owner, Memphis Light Co., Gas and Water Division. Depth, 490'; diameter, 12"; finish, screen in Claiborne sands.

Well No. 79:7-26, artesian, 35°09'11" N., 90°01'49" W. Owner, Memphis Light Co., Gas and Water Division. Depth, 1,387'; diameter, 8"; finish, screen in Wilcox sands.

Well No. 79:9-115, artesian, 35°05'10" N., 90°01'08" W. Owner, Memphis Light Co., Gas and Water Division. Depth, 310'; diameter, 4"; finish, screen in Claiborne sands.

Well No. 79:9-131, artesian, 35°04'47" N., 90°01'47" W. Owner, Memphis Light Co., Gas and Water Division. Depth, 312'; diameter, 4"; finish, screen in Claiborne sands.

Well No. 79:148-1D, artesian, 35°21'10" N., 99°57'02" W. Owner, The Hamilton Co., Inc. Depth, 1,558'; diameter, 24" to 16"; finish, screen in Wilcox sands.

Well No. 7:1-6, artesian, 36°34'25" N., 84°07'30" W. Owner, Jellico Water Works. Depth, 620'; diameter, 12"; in Briceville formation.

Well No. 6:200-1, artesian, 35°09'05" N., 84°51'00" W. Owner, Griffin Cason. Depth, 430'; diameter, 6"; in Knox dolomite.

Well No. 6:155-1, artesian, 37°10'53" N., 84°51'06" W. Owner, Cleveland Water Works. Depth, 200'; diameter, 8"; in Knox dolomite.

TEXAS

Well No. 436, artesian, Beverly Lodges Well, 4.5 miles northeast of courthouse in San Antonio, 29°27' N., 98°27' W. Owner, Ed Stevens & Sons. Depth, 756'; diameter, 12 $\frac{1}{2}$ "; finish, open end. Aquifer, Edwards limestone.

Well No. J-1-6, artesian, old Castroville well, in Castroville, 29°21' N., 98°52' W. Owner, city of Castroville. Depth, 695'; diameter, 6"; finish, open end. Aquifer, Edwards limestone.

Well No. 224, artesian, Acme Road well, on east side of Acme Road, 0.4 mile north of United States Highway 90, 29°25' N., 98°32' W. Owner, city of San Antonio. Depth, 965'; diameter, 24" and 12"; finish, open end. Aquifer, Edwards limestone.

Well No. 790, artesian, Galveston production well No. 14, 2.5 miles northwest of Alta Loma, 20 miles northwest of Galveston, 29°23' N., 95°06' W. Owner, city of Galveston. Depth, 775'; diameter, 18" and 10"; finish, screen at 661' to 775'. Aquifer, sand (Alta Loma).

WISCONSIN

Well No. Fl-20, artesian, SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 3, T. 14 N., R. 17 E. Owner, city of Fond du Lac. Depth, 700'; diameter, 6" for 158'; finish, open. Aquifer, sandstone and limestone.

Well No. Ml-36, artesian, NE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 12, T. 7 N., R. 21 E. Owner, A. D. Smith Corp. Depth, 1,091'; diameter, 13 $\frac{3}{8}$ " for 774'; finish, open. Aquifer, sandstone.

Well No. Ml-148, nonartesian, NE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 32, T. 6 N., R. 21 E. Owner, Milwaukee County. Depth, 179'; diameter, 5"; finish, open. Aquifer, limestone.

Well No. Ml-153, artesian, NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 11, T. 18 N., R. 21 E. Owner, Lakeside Laboratory. Depth, 1,502'; diameter, 10" from 0' to 250' and 519' to 762'; finish, open. Aquifer, sandstone and limestone.

Well No. Mo-17, artesian, NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 29, T. 18 N., R. 2 W. Owner, United States Army, Camp McCoy. Depth, 192'; diameter, 9"; finish, open. Aquifer, sandstone.

Well No. Mt-5, artesian, SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 19, T. 30 N., R. 23 E. Owner, city of Peshtigo. Depth, 700'; diameter, 5"; finish, open. Aquifer, sandstone and limestone (probable).

Well No. Wk-31, artesian, NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 2, T. 5 N., R. 19 E. Owner, Fulton Farms. Depth, 600'; diameter, 6" for 429'; finish, open. Aquifer, limestone.

Table 1.—Fluctuations in well-water levels, Jan. 1 through Dec. 31, 1950

NOTE.—Complete information on earthquakes possibly associated with the following tabulations may be obtained from the *Preliminary Determinations of Epicenter and Supplement* cards issued by the U. S. Coast and Geodetic Survey, or from registers of seismographic stations nearest the locality.

CALIFORNIA

Well No.	Date	Time (G. C. T.)	Depth to water below land surface datum				Amplitude of fluctuation
			Before disturbance	After disturbance	At highest point of fluctuation	At lowest point of fluctuation	
71E-6C3.....	2-10-50	17:00	ft. 33.82	ft. 33.82	ft. 33.79	ft. 33.83	ft. 0.04
81E-28K1.....	5- 3-50	11:30	41.15	41.15	41.13	41.18	0.05
81W-25D1.....	7-29-50	23:00	52.36	52.36	52.34	52.38	0.04
81E-20G3.....	8-15-50	14:30	38.94	38.93	38.91	38.96	0.05
81W-20R2.....	8-15-50	15:15	55.50	55.50	55.47	55.54	0.07
81W-22D5.....	8-15-50	14:45	45.36	45.36	45.34	45.39	0.05
81W-28R3.....	8-15-50	15:00	53.05	53.05	52.98	53.15	0.17
81E-20G3.....	10- 5-50	15:15	38.98	38.98	38.97	38.99	0.02
81W-28R3.....	12-14-50	13:00	39.21	39.21	39.17	39.25	0.08

ILLINOIS

ANL-13.....	7- 9-50	02:40	102.13	101.94	101.745	101.792	0.045
ANL-13.....	7- 9-50	05:45	101.770	101.770	101.745	101.792	0.047
ANL-9.....	8- 7-50	18:40	90.715	90.715	90.714	90.717	0.003
ANL-9.....	8-15-50	15:15	90.682	90.686	90.598	90.828	0.230
ANL-10.....	8-15-50	16:00	65.06	65.25	64.987	65.45	0.47
ANL-11.....	8-15-50	15:15	70.605	70.605	70.516	70.752	0.236
ANL-9.....	9-29-50	06:45	91.237	91.232	91.206	91.260	0.054
ANL-9.....	10- 5-50	16:00	91.255	91.241	91.161	91.326	0.165
ANL-10.....	10- 5-50	16:15	65.95	66.10	65.93	66.18	0.25
ANL-11.....	10- 5-50	16:15	72.000	72.01	71.952	72.060	0.108
ANL-9.....	10-23-50	16:15	91.451	91.452	91.422	91.469	0.047
ANL-11.....	10-23-50	16:15	72.805	72.815	72.800	72.820	0.020
ANL-9.....	12- 9-50	21:30	91.765	91.766	91.749	91.781	0.032
AN-10.....	12- 9-50	21:45	68.92	68.92	68.90	68.98	0.08
ANL-11.....	12- 9-50	20:30	74.17	74.162	74.162	74.178	0.016
ANL-9.....	12-14-50	14:15	91.873	91.879	91.868	91.889	0.021
ANL-10.....	12-14-50	14:15	68.97	68.97	68.92	68.99	0.07

IOWA

83-7-21K1.....	16- 5-50	15:30	65.34	65.35	64.99	65.69	0.70
83-7-21K1.....	10-23-50	16:00	64.89	64.91	64.82	64.97	0.14
83-7-21K1.....	12- 2-50	20:45	64.75	64.77	64.72	64.78	0.06

LOUISIANA

Cu-22.....	7-18-50	18:00	49.827	49.832	49.822	49.850	0.032
Ac-40.....	8-15-50	15:15	58.05	58.12	57.94	58.25	0.31
Cn-28.....	8-15-50	15:00	10.96	10.94	10.84	11.15	0.31
Cu-22.....	8-15-50	15:00	53.624	53.622	53.627	53.617	0.01
Cu-445.....	8-15-50	15:00	69.93	69.96	69.82	70.05	0.23
Cu-446.....	8-15-50	15:00	57.504	57.504	57.44	57.63	0.19
EB-20.....	8-15-50	15:50	178.35	178.37	178.34	178.39	0.05
EB-293.....	8-15-50	15:15	142.80	142.83	142.72	142.87	0.15
Ev-200.....	8-15-50	15:40	41.235	41.245	41.145	41.340	0.195
Ev-229.....	8-15-50	15:00	66.365	66.372	66.360	66.379	0.019
JD-43.....	8-15-50	15:00	51.69	51.77	51.47	51.96	0.49
JD-224.....	8-15-50	15:00	65.20	65.20	65.15	65.26	0.11
Mo-9.....	8-15-50	15:15	182.24	182.24	182.23	182.22	0.01
Ou-100.....	8-15-50	15:00	106.84	106.80	106.79	106.89	0.10
Ve-120.....	8-15-50	15:00	9.707	9.708	9.697	9.724	0.027
Ve-460.....	8-15-50	15:00	10.59	10.60	10.515	10.717	0.202
Ac-40.....	9-29-50	18:45	48.4	48.4	48.37	48.41	0.04
Ve-460.....	9-29-50	18:30	11.357	11.357	11.353	11.363	0.01
EB-128.....	10- 5-50	16:00	102.54	102.59	102.52	102.69	0.17
Cu-446.....	10- 5-50	16:00	58.02	58.00	57.94	58.07	0.13
Cu-445.....	10- 5-50	16:15	69.10	69.10	69.02	69.20	0.18
Ev-200.....	10- 5-50	16:00	35.28	35.26	35.20	35.32	0.12
Ev-229.....	10- 5-50	16:00	58.395	58.385	58.385	58.398	0.013
JD-43.....	10- 5-50	17:00	45.18	45.17	45.13	45.24	0.11
Ac-40.....	10- 5-50	16:15	47.42	47.40	47.34	47.49	0.15
JD-224.....	10- 5-50	16:00	57.1	57.1	57.05	57.13	0.08
Ou-100.....	10- 5-50	16:15	107.6	107.6	107.54	107.66	0.12
Mo-9.....	10- 5-50	16:00	181.74	181.74	181.71	181.77	0.06
Cn-28.....	10- 5-50	16:30	10.87	10.92	10.84	10.96	0.12
Ve-460.....	10- 5-50	16:00	11.34	11.34	11.275	11.410	0.135
EB-293.....	10- 5-50	16:00	158.64	158.63	158.53	158.73	0.20
Ve-120.....	10- 5-50	16:15	9.445	9.450	9.440	9.460	0.02

Table 1.—Fluctuations in well-water levels, Jan. 1 through Dec. 31, 1950—Continued

LOUISIANA—continued							
Well No.	Date	Time (G. C. T.)	Depth to water below land surface datum				Ampli- tude of fluctua- tion
			Before disturb- ance	After disturb- ance	At highest point of fluctua- tion	At lowest point of fluctua- tion	
Ve-460.....	10-23-50	16:00	ft. 11.570	ft. 11.575	ft. 11.562	ft. 11.585	ft. 0.021
Ac-40.....	10-23-50	15:00	45.44	45.44			0.02
Ev-200.....	10-23-50	16:00	33.91	33.91	33.90	33.91	0.01
Cu-445.....	12-9-50	22:30	51.65	51.64	51.63	51.67	0.04
Ac-440.....	12-14-50	19:30	41.56	41.55	41.54	41.57	0.03
MICHIGAN							
IgLS255.....	8-1-50	10:05	48.07	48.07	48.05	48.08	0.015
IgDhl2.....	8-15-50	16:10	13.08	13.08	13.07	13.09	0.01
IgLS265.....	8-15-50	16:10	49.99	50.00	49.98	50.11	0.115
WaYk22.....	8-15-50	16:10	73.09	73.10	72.95	73.19	0.12
IcWrl.....	8-15-50	16:15	27.20	27.20	27.10	27.29	0.095
EaGL-1.....	9-9-50	13:15	23.40	23.40	23.37	23.46	0.045
NEW JERSEY							
26.21.5.4.6 ¹	8-15-50	14:15	+62.33	+62.32	+62.34	+62.30	0.05
25.15.7.5.4 ¹	8-15-50	14:15	+122.17	+122.17	+122.25	+121.85	0.40
28.5.4.8.1 ¹	8-15-50	14:20	+4.81	+4.815			0.005
28.5.1.5.3 ¹	8-15-50	14:00	14.94	14.95	14.93	14.96	0.03
31.1.6.4.8 ¹	8-15-50	14:45	16.40	16.42	16.30	16.50	0.20
28.5.4.8.1 ¹	9-31-50	07:15	+4.955	+4.995	+5.00	+4.99	0.01
31.1.6.4.8 ¹	10-5-50	16:45	8.44	8.44	8.25	8.61	0.36
28.5.1.5.3 ¹	10-5-50	16:00	15.50	15.52	15.48	15.55	0.07
26.21.5.4.6 ¹	10-5-50	16:00	+62.08	+62.08	+62.10	+62.05	0.04
28.5.4.8.1 ¹	10-5-50	16:40	+4.69	+4.69			0.05
31.1.6.4.8 ¹	10-23-50	16:30	15.765	15.76			0.01
31.1.6.4.8 ¹	12-9-50	21:40	7.37	7.37			0.10
26.21.5.4.6 ¹	12-9-50	21:40	+63.24	+63.24	+63.25	+63.235	0.015
NEW MEXICO							
Greenfield.....	8-5-50	09:20	26.60	26.74	26.57	26.68	0.11
Carlsbad GS-3.....	8-5-50	09:30	38.51	38.52	38.50	38.52	0.02
Berrendo.....	8-14-50	23:00	28.10	28.12	28.12	27.93	0.19
Carlsbad GS-4.....	8-15-50	14:20	28.49	28.45	28.30	28.52	0.22
Carlsbad GS-3.....	8-15-50	14:15	38.58	38.61	37.97	39.17	1.20
Hot Springs.....	8-15-50	14:15	0.03	0.05	0.18	0.30	0.48
Artesia.....	8-15-50	14:45	68.23	68.47	68.20	68.37	0.17
Greenfield.....	8-15-50	14:30	60.23	61.80	60.37	61.77	1.40
Mt. View.....	8-15-50	15:00	74.02	74.08	73.99	74.07	0.08
Berrendo-Smith.....	8-15-50	14:45	24.82	25.12	24.69	25.23	0.54
Berrendo.....	8-15-50	14:45	27.50	27.60	27.47	27.63	0.16
Berrendo.....	9-29-50	06:40	23.48	23.47	23.46	23.49	0.04
Berrendo-Smith.....	9-29-50	06:35	18.72	18.74	18.69	18.73	0.04
Greenfield.....	9-29-50	06:40	11.65	11.66	11.63	11.71	0.08
Artesia.....	9-29-50	06:35	40.41	40.42	40.40	40.43	0.03
Carlsbad GS-3.....	9-29-50	06:45	37.94	37.95	37.83	38.11	0.26
Hot Springs.....	9-29-50	06:45	0.01	0.01	0.23	0.21	0.44
Berrendo.....	10-5-50	16:20	22.54	22.53	22.51	22.56	0.05
Berrendo-Smith.....	10-5-50	16:30	17.43	17.42	17.36	17.50	0.14
Greenfield.....	10-5-50	16:30	5.08	5.17	4.36	5.38	1.02
Artesia.....	10-5-50	16:30	36.36	36.38	33.33	36.42	0.09
Carlsbad GS-3.....	10-5-50	16:30	37.87	37.85	36.58	38.16	0.58
Hot Springs.....	10-5-50	16:30	0.19	0.24	0.05	0.38	0.33
Greenfield.....	10-23-50	16:20	3.28	3.28	3.24	3.37	0.13
Carlsbad GS-3.....	10-23-50	18:00	38.15	38.16	38.12	38.22	0.10
Hot Springs.....	10-23-50	16:20	0.32	0.36	0.23	0.43	0.20
Carlsbad GS-3.....	11-7-50	15:15	38.63	38.65	38.61	38.67	0.06
Greenfield.....	12-2-50	20:20	+1.68	+1.70	+1.78	+1.64	0.14
Carlsbad GS-3.....	12-2-50	20:30	38.88	38.87	38.84	38.91	0.07
Berrendo-Smith.....	12-9-50	09:45	15.85	15.87	15.84	15.88	0.04
Greenfield.....	12-9-50	21:45	+0.40	+0.37	+0.46	+0.28	0.18
Carlsbad GS-3.....	12-9-50	09:45	38.65	38.65	38.62	38.68	0.06
Greenfield.....	12-14-50	02:15	1.04	1.03	0.99	1.06	0.07
Carlsbad GS-3.....	12-14-50	00:30	38.21	38.23	38.20	38.25	0.05
Berrendo-Smith.....	12-14-50	14:45	15.45	15.48	15.34	15.56	0.22
Mt. View.....	12-14-50	14:30	63.73	64.74	64.69	64.75	0.06
Greenfield.....	12-14-50	14:30	0.98	1.07	0.84	1.24	0.40
Artesia.....	12-14-50	14:30	26.77	26.79	26.71	26.88	0.17
Carlsbad GS-3.....	12-14-50	12:30	38.28	38.30	37.57	39.01	1.44
Hot Springs.....	12-14-50	14:30	0.10	0.21	0.40	0.60	1.00

See footnotes at end of table.

Table 1.—*Fluctuations in well-water levels, Jan. 1 through Dec. 31, 1950—Continued*

NEW YORK							
Well No.	Date	Time (G. C. T.)	Depth to water below land surface datum				Ampli- tude of fluctua- tion
			Before disturb- ance	After disturb- ance	At highest point of fluctua- tion	At lowest point of fluctua- tion	
Mt-1.....	7-23-50	22:30	ft. 8.14	ft. 8.24	ft. 8.225	ft. 8.24	ft. 0.015
Mt-1.....	7-25-50	23:40	8.29	8.29	8.28	8.31	0.03
Sa 529.....	8-15-50	15:20	55.84	55.70	55.44	55.92	0.48
Wn 29.....	9-28-50	04:30	20.485	20.49	20.435	20.61	0.18
Wn 29.....	9-30-50	11:30	20.53	20.53	20.50	20.53	0.03
S-6409.....	10- 5-50	16:30	32.310	32.312	32.213	32.196	0.017
S-6410.....	10- 5-50	16:30	43.930	43.929	43.936	43.927	0.009
S-6413.....	10- 5-50	16:30	47.190	47.185	47.200	47.169	0.031
S-6419.....	10- 5-50	16:30	16.180	16.179	16.187	16.170	0.017
S-6434.....	10- 5-50	16:30	31.387	31.390	31.417	31.360	0.057
S-6435.....	10- 5-50	16:30	36.643	36.649	36.680	36.614	0.066
Mt-1.....	10- 5-50	13:15	7.80	7.81	7.78	7.82	0.04
Sa 529.....	10- 5-50	17:50	51.73	51.76	52.56	52.96	0.40
Sn 29.....	10- 5-50	13:00	20.67	20.67	20.66	20.68	0.02
Sn 128.....	10- 7-50	12:51	31.46	31.47	31.30	31.61	0.31
S-5517.....	10-23-50	08:30	40.734	40.736	40.742	40.730	0.012
Sa 529.....	10-23-50	17:20	51.08	51.09	51.04	51.12	0.08
Mt-1.....	10-31-50	00:40	7.69	7.70	7.69	7.70	0.01
Bm 121.....	11-23-50	00:30	28.53	28.51	28.48	28.54	0.06
Sa 529.....	12- 1-50	17:30	49.43	49.43	49.41	49.45	0.04
Sa 529.....	12- 2-50	23:00	49.565	49.56	49.54	49.58	0.04
S 6409.....	12- 9-50	20:00	32.200	32.200	32.213	32.196	0.017
S 6434.....	12- 9-50	20:00	31.250	31.248	31.264	31.240	0.024
NORTHERN FLORIDA							
E-60.....	4- 2-50	17:00	8.17	8.17	8.16	8.18	0.02
C-9.....	8-15-50	15:00	89.97	90.00	89.95	90.01	0.06
E-46.....	8-15-50	15:15	69.98	69.99	69.97	70.01	0.04
G-30.....	8-15-50	14:30	25.30	25.36	25.28	25.40	0.12
H-13.....	8-15-50	15:00	7.37	7.40	7.24	7.41	0.17
L-7.....	8-15-50	15:45	163.57	163.54	163.10	163.97	0.87
L-28.....	8-15-50	15:15	138.60	138.62	138.59	138.63	0.04
M-92.....	8-15-50	15:00	39.53	39.58	39.28	40.15	0.87
O-47.....	8-15-50	14:15	7.17	7.20	6.94	7.45	0.51
P-13.....	8-15-50	15:00	8.40	8.33	8.18	8.52	0.34
P-77.....	8-15-50	14:50	64.98	64.91	64.91	64.99	0.08
P-246.....	8-15-50	15:15	25.80	25.67	25.53	25.99	0.46
P-269.....	8-15-50	14:30	10.72	10.94	10.58	11.06	0.48
P-561.....	8-15-50	14:00	2.08	2.13	2.02	2.21	0.19
P-44.....	8-15-50	14:50	2.59	2.61	2.45	2.74	0.29
P-51.....	8-15-50	15:00	7.16	7.13	6.86	7.47	0.61
T-35.....	8-15-50	15:15	3.92	3.93	2.70	5.14	2.44
T-36.....	8-15-50	14:00	10.55	10.56	10.32	10.81	0.49
W-2.....	8-15-50	15:15	2.88	2.92	2.87	2.94	0.07
D-206.....	9-29-50	06:45	6.48	6.47	6.43	6.50	0.07
T-35.....	9-29-50	06:30	4.48	4.47	4.44	4.50	0.06
H-13.....	10- 3-50	13:05	7.04	7.04	6.98	7.06	0.08
B-7.....	10- 5-50	16:30	50.90	50.98	50.88	51.03	0.15
D-206.....	10- 5-50	15:45	6.13	6.12	5.77	6.54	0.77
E-46.....	10- 5-50	17:00	70.22	70.23	70.20	70.24	0.04
H-13.....	10- 5-50	16:15	7.02	7.01	6.85	7.13	0.28
H-30.....	10- 5-50	16:00	+12.19	+12.16	+11.55	+12.84	1.29
L-7.....	10- 5-50	17:45	164.49	164.48	164.05	164.87	0.82
M-92.....	10- 5-50	15:45	39.44	39.42	38.64	40.22	1.58
N-64.....	10- 5-50	17:00	24.90	24.89	24.80	24.94	0.14
P-13.....	10- 5-50	15:15	1.69	1.69	1.42	1.97	0.55
P-44.....	10- 5-50	15:20	1.69	1.68	1.43	1.97	0.54
P-77.....	10- 5-50	16:15	64.24	64.26	64.22	64.33	0.11
P-246.....	10- 5-50	15:30	25.22	25.28	24.94	25.54	0.60
P-561.....	10- 5-50	14:45	1.71	1.68	1.59	1.83	0.24
P-45.....	10- 5-50	16:00	67.00	67.00	66.41	67.58	1.17
P-51.....	10- 5-50	15:45	6.60	6.54	6.22	6.88	0.66
S-6.....	10- 5-50	15:45	5.88	5.87	5.73	5.98	0.25
S-9.....	10- 5-50	16:15	0.72	0.71	0.46	0.97	0.51
T-35.....	10- 5-50	16:00	4.62	4.57	2.68	6.52	3.84
T-36.....	10- 5-50	16:00	11.62	11.62	11.32	11.97	0.65
V-24.....	10- 5-50	16:50	7.18	6.82	7.80	0.98
D-206.....	10- 8-50	04:15	6.23	6.22	6.19	6.24	0.05
D-206.....	10-23-50	16:00	5.76	5.76	5.67	5.84	0.17
H-13.....	10-23-50	16:45	6.95	6.98	6.93	7.00	0.07
H-30.....	10-23-50	16:15	+11.96	+11.90	+12.08	+11.71	0.37
J-23.....	10-23-50	16:00	40.11	40.11	40.03	40.18	0.15
L-7.....	10-23-50	15:40	165.11	165.11	165.09	165.13	0.04
M-92.....	10-23-50	16:20	39.09	39.10	38.86	39.32	0.46
P-13.....	10-23-50	16:45	8.72	8.75	8.67	8.82	0.15
P-246.....	10-23-50	14:50	24.99	25.02	24.90	25.10	0.20
P-269.....	10-23-50	16:15	8.65	8.78	8.60	8.84	0.24

See footnotes at end of table.

Table 1.—Fluctuations in well-water levels, Jan. 1 through Dec. 31, 1950—Continued

NORTHERN FLORIDA—continued

Well No.	Date	Time (G. C. T.)	Depth to water below land surface datum				Ampli- tude of fluctua- tion
			Before disturb- ance	After disturb- ance	At highest point of fluctua- tion	At lowest point of fluctua- tion	
			ft.	ft.	ft.	ft.	ft.
P-561.....	10-23-50	16:15	1.64	1.65	1.62	1.69	0.07
P-44.....	10-23-50	17:00	0.89	0.70	0.62	0.81	0.19
P-45.....	10-23-50	15:30	66.06	66.09	65.93	66.19	0.26
P-51.....	10-23-50	15:50	5.96	5.94	5.86	6.04	0.18
S-5.....	10-23-50	16:45	5.71	5.71	5.65	5.75	0.10
S-9.....	10-23-50	16:00	0.67	0.71	0.62	0.77	0.15
T-35.....	10-23-50	16:10	3.88	3.84	3.02	4.69	1.67
T-36.....	10-23-50	16:10	11.74	11.74	11.64	11.84	0.20
V-31.....	10-23-50	16:30	4.18	4.19	4.16	4.23	0.07
T-35.....	10-23-50	17:55	3.84	3.83	3.78	3.90	0.12
T-35.....	11- 7-50	03:15	4.28	4.28	4.26	4.31	0.05
T-35.....	11-26-50	16:45	4.80	4.80	4.77	4.82	0.05
D-206.....	12- 1-50	14:50	5.73	5.73	5.70	5.76	0.06
T-35.....	12- 1-50	15:00	4.97	4.97	4.95	5.00	0.05
D-206.....	12- 2-50	20:10	5.68	5.69	5.66	5.71	0.05
T-35.....	12- 2-50	20:50	4.97	4.98	4.96	4.99	0.03
L-7.....	12- 2-50	00:10	166.19	166.18	166.17	166.20	0.03
T-35.....	12- 3-50	20:10	4.87	4.89	4.83	4.90	0.07
D-206.....	12- 9-50	21:30	5.53	5.52	5.42	5.61	0.19
H-13.....	12- 9-50	23:00	7.52	7.51	7.52	7.49	0.03
H-30.....	12- 9-50	21:30	+11.57	+11.60	+11.63	+11.55	0.08
L-7.....	12- 9-50	22:00	166.42	166.42	166.38	166.47	0.09
O-47.....	12- 9-50	21:00	+2.16	+2.17	+2.10	+2.20	0.10
M-92.....	12- 9-50	21:50	40.39	40.37	40.33	40.42	0.09
P-246.....	12- 9-50	21:30	25.87	25.84	25.82	25.88	0.06
P-269.....	12- 9-50	22:00	8.17	8.14	8.13	8.18	0.05
P-561.....	12- 9-50	21:40	2.46	2.43	2.42	2.46	0.04
P-44.....	12- 9-50	21:30	1.37	1.37	1.34	1.38	0.04
S-5.....	12- 9-50	22:00	6.84	6.83	6.82	6.85	0.03
T-35.....	12- 9-50	21:30	4.45	4.45	4.32	4.56	0.24
T-35.....	12-14-50	03:00	4.53	4.53	4.50	4.55	0.05
D-206.....	12-14-50	14:30	5.72	5.71	5.68	5.72	0.04
H-30.....	12-14-50	13:20	+11.64	+11.69	+11.70	+11.63	0.07
M-92.....	12-14-50	14:15	40.30	40.29	40.23	40.38	0.15
P-13.....	12-14-50	14:50	9.74	9.77	9.73	9.78	0.05
P-246.....	12-14-50	14:00	24.89	25.92	25.87	25.93	0.06
P-269.....	12-14-50	14:35	7.35	7.45	7.34	7.46	0.12
P-44.....	12-14-50	14:00	1.57	1.57	1.53	1.61	0.08
S-5.....	12-14-50	13:50	6.81	6.80	6.78	6.82	0.04
T-35.....	12-14-50	15:00	4.54	4.51	4.33	4.71	0.38
T-36.....	12-14-50	13:55	12.39	12.39	12.37	12.42	0.05

OHIO

Cl-1.....	8-15-50	14:45	3.79	3.80	3.70	3.90	0.20
Cl-2.....	8-15-50	14:45	6.87	6.89	6.64	7.12	0.48
DI-3.....	8-15-50	13:00	36.50	36.48	36.68	36.59	0.21
Fa-1.....	8-15-50	15:00	7.16	7.15	7.14	7.17	0.03
Fn-1.....	8-15-50	15:00	63.81	63.80	63.79	63.82	0.03
Fn-2.....	8-15-50	14:45	58.31	58.31	58.29	58.33	0.04
Fr-11.....	8-15-50	15:00	10.98	11.00	10.90	11.09	0.19
Fr-12.....	8-15-50	15:00	16.77	16.80	16.69	16.90	0.21
Ge-2.....	8-15-50	15:00	14.47	14.47	14.43	14.51	0.08
Hy-1.....	8-15-50	15:00	21.20	21.22	21.13	21.29	0.16
M-1.....	8-15-50	-----	26.09	26.10	26.08	26.10	0.02
Mi-1.....	8-15-50	16:00	11.45	11.50	11.44	11.52	0.08
Mn-1.....	8-15-50	15:00	11.30	11.40	11.24	11.45	0.21
Mr-1.....	8-15-50	15:00	10.08	10.09	10.03	10.16	0.13
Mu-2.....	8-15-50	15:00	7.9	7.91	7.82	7.97	0.15
Po-2.....	8-15-50	15:30	19.79	19.80	19.77	19.82	0.05
Po-3.....	8-15-50	15:30	32.82	32.80	32.79	32.82	0.03
R-2.....	8-15-50	14:45	27.25	27.25	27.21	27.29	0.08
Sh-1.....	8-15-50	15:00	-----	13.42	13.39	13.46	0.07
St-1.....	8-15-50	16:00	48.55	48.56	48.53	48.57	0.04
St-5a.....	8-15-50	16:00	31.15	31.18	31.08	31.26	0.18
St-10.....	8-15-50	16:00	0.78	0.78	0.65	0.90	0.25
T-2.....	8-15-50	16:00	41.77	41.79	41.72	41.82	0.10
Tu-1.....	8-15-50	16:00	13.39	13.43	13.35	13.49	0.14
W-2.....	8-15-50	-----	-----	19.16	19.10	-----	0.12

RHODE ISLAND

P-48.....	8-22-50	18:15	7.091	7.088	7.056	7.115	0.050
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See footnotes at end of table.

Table 1.—Fluctuations in well-water levels, Jan. 1 through Dec. 31, 1950—Continued

SOUTHERN FLORIDA ¹

Well No.	Date	Time (G. C. T.)	Depth to water below land surface datum				Ampli- tude of fluctua- tion
			Before disturb- ance	After disturb- ance	At highest point of fluctua- tion	At lowest point of fluctua- tion	
F-210	3-29-50	13:55	ft. 0.69	ft. 0.69	ft. 0.70	ft. 0.68	ft. 0.02
G-221	3-29-50	13:00	0.94	0.94	0.95	0.93	0.02
F-210	4-26-50	20:30	1.01	1.01	1.05	0.97	0.08
S-18	4-26-50	20:30	1.63	1.63	1.64	1.52	0.02
S-68	4-26-50	20:40	0.195	0.19	0.19	0.20	0.01
F-319	8-6-50	17:50	1.56	1.56	1.64	1.47	0.17
G-580	8-6-50	18:00	1.53	1.53	1.55	1.51	0.04
F-210	8-15-50	15:25	2.18	2.18	2.58	1.78	0.80
F-291	8-15-50	15:20	1.92	1.92	2.19	1.63	0.56
F-358	8-15-50	15:20	2.75	2.75	2.76	2.74	0.02
G-72	8-15-50	15:20	4.79	4.79	4.85	4.72	0.13
G-218	8-15-50	15:20	4.63	4.63	4.79	4.44	0.35
G-221	8-15-50	15:20	2.45	2.45	3.00	1.90	1.10
G-476	8-15-50	15:30	3.50	3.50	3.62	3.37	0.25
G-518	8-15-50	15:20	1.57	1.57	1.86	1.30	0.56
G-551	8-15-50	15:20	4.79	4.79	4.80	4.78	0.02
G-553	8-15-50	15:20	3.35	3.35	3.59	3.11	0.48
G-561	8-15-50	15:30	2.065	2.065	2.075	2.05	0.025
G-580	8-15-50	15:30	2.02	2.02	2.44	1.57	0.87
G-594	8-15-50	15:15	5.16	5.16	5.27	5.04	0.23
G-595	8-15-50	16:00	3.36	3.36	3.374	3.349	0.025
G-612	8-15-50	15:30	1.38	1.38	1.55	1.20	0.35
G-613	8-15-50	15:30	2.40	2.40	2.43	2.38	0.05
G-614	8-15-50	15:20	3.875	3.875	3.88	3.87	0.01
M-125 ²	8-15-50	15:30	18.28	18.28	18.18	18.36	0.18
S-18	8-15-50	15:30	2.19	2.19	2.36	2.03	0.33
S-19	8-15-50	15:20	1.23	1.23	1.64	0.80	0.84
S-68	8-15-50	15:20	0.72	0.72	1.02	0.44	0.58
S-329	8-15-50	15:30	3.36	3.36	3.66	3.06	0.60
S-539	8-15-50	15:15	0.76	0.76	0.81	0.71	0.10
S-19	9-29-50	06:20	1.18	1.18	1.19	1.17	0.02
S-68	9-29-50	06:30	1.82	1.82	1.84	1.80	0.04
F-179	10-5-50	14:30	2.51	2.51	2.57	2.42	0.15
F-210	10-5-50	16:00	2.25	2.25	2.74	1.77	0.97
F-291	10-5-50	15:00	2.54	2.54	3.09	1.97	1.12
F-358	10-5-50	14:30	4.70	4.70	4.71	4.69	0.02
G-72	10-5-50	16:00	5.19	5.19	5.23	5.14	0.09
G-218	10-5-50	16:30	4.76	4.76	4.94	4.59	0.35
G-221	10-5-50	14:00	4.34	4.34	4.67	4.09	0.58
G-476	10-5-50	16:30	3.59	3.59	3.85	3.33	0.52
G-518	10-5-50	14:00	3.60	3.61	3.85	3.38	0.50
G-551	10-5-50	16:30	5.80	5.80	5.81	5.79	0.02
G-553	10-5-50	15:30	4.70	4.70	4.85	4.58	0.27
G-561	10-5-50	15:00	2.77	2.77	2.78	2.77	0.01
G-580	10-5-50	15:15	2.75	2.75	3.20	2.32	0.88
G-594	10-5-50	16:45	6.05	6.05	6.13	5.99	0.14
G-595	10-5-50	14:30	4.51	4.51	4.52	4.50	0.02
G-612	10-5-50	16:00	2.80	2.80	2.93	2.69	0.24
L-414	10-5-50	17:00	17.48	17.48	17.56	17.40	0.16
M-125	10-5-50	16:00	2.73	2.73	2.78	2.67	0.09
S-18	10-5-50	15:30	2.50	2.50	2.62	2.40	0.22
S-19 ²	10-5-50	15:30	1.22	1.22	1.70	0.70	1.00
S-68	10-5-50	14:30	0.50	0.50	0.70	0.30	0.40
S-329	10-5-50	16:00	5.44	5.44	5.62	5.24	0.38
S-539	10-5-50	16:00	1.02	1.02	1.04	1.00	0.04
F-291	10-23-50	16:30	3.76	3.76	3.82	3.62	0.20
F-358	10-23-50	16:30	5.08	5.08	5.08	5.07	0.01
G-10	10-23-50	17:30	4.74	4.74	4.75	4.72	0.03
G-72	10-23-50	16:30	5.83	5.83	5.86	5.80	0.06
G-218	10-23-50	17:00	5.60	5.60	5.61	5.60	0.01
G-221	10-23-50	16:30	5.78	5.78	5.94	5.62	0.32
G-476	10-23-50	16:45	4.87	4.87	4.91	4.84	0.07
G-518	10-23-50	16:00	3.60	3.60	3.67	3.52	0.15
G-553	10-23-50	15:00	7.49	7.49	7.53	7.45	0.08
G-580	10-23-50	15:30	5.82	5.82	5.97	5.68	0.29
G-612	10-23-50	17:00	2.40	2.40	2.45	2.38	0.07
G-614	10-23-50	15:30	6.96	6.96	6.97	6.96	0.01
L-414	10-23-50	12:00	18.05	18.05	18.06	18.03	0.03
S-18	10-23-50	17:00	3.35	3.35	3.37	3.33	0.04
S-19	10-23-50	16:30	2.54	2.54	2.69	2.41	0.28
S-68	10-23-50	15:00	1.94	1.94	2.00	1.86	0.14
S-329	10-23-50	16:00	6.47	6.47	6.54	6.40	0.14
S-539	10-23-50	15:30	1.69	1.69	1.70	1.68	0.02
F-210	12-9-50	21:45	1.46	1.46	1.48	1.44	0.04
F-291	12-9-50	21:30	2.67	2.67	2.68	2.66	0.02
G-72	12-9-50	21:00	5.86	5.86	5.87	5.86	0.01
G-221	12-9-50	21:30	3.71	3.71	3.76	3.66	0.10
G-476	12-9-50	22:00	3.04	3.04	3.05	3.03	0.02
G-518	12-9-50	21:30	2.34	2.34	2.35	2.33	0.02
G-553	12-9-50	21:30	4.73	4.73	4.75	4.72	0.03
G-580	12-9-50	21:30	2.67	2.67	2.69	2.66	0.03

See footnotes at end of table.

Table 1.—Fluctuations in well-water levels, Jan. 1 through Dec. 31, 1950—Continued

SOUTHERN FLORIDA—continued

Well No.	Date	Time (G. C. T.)	Depth to water below land surface datum				Ampli- tude of fluctua- tion
			Before disturb- ance	After disturb- ance	At highest point of fluctua- tion	At lowest point of fluctua- tion	
S-18	12-9-50	22:00	ft. 2.44	ft. 2.44	ft. 2.45	ft. 2.43	ft. 0.02
S-19	12-9-50	22:00	0.88	0.88	0.90	0.87	0.03
S-68	12-9-50	21:00	0.16	0.16	0.19	0.13	0.06
S-329	12-9-50	22:00	4.10	4.10	4.12	4.08	0.04
F-210	12-14-50	14:30	1.38	1.38	1.50	1.25	0.25
F-291	12-14-50	14:30	2.46	2.46	2.51	2.39	0.12
F-358	12-14-50	14:00	2.70	2.70	2.70	2.69	0.01
G-72	12-14-50	14:30	5.82	5.82	5.85	5.80	0.05
G-218	12-14-50	14:00	5.50	5.50	5.52	5.46	0.06
G-221	12-14-50	14:00	3.55	3.55	3.79	3.31	0.48
G-476	12-14-50	15:00	3.04	3.04	3.05	3.02	0.03
G-518	12-14-50	13:00	2.05	2.05	2.12	1.98	0.14
G-553	12-14-50	14:00	4.55	4.55	4.59	4.51	0.08
G-580	12-14-50	15:00	2.61	2.61	2.76	2.46	0.30
G-612	12-14-50	15:00	1.20	1.20	1.24	1.18	0.06
M-125	12-14-50	14:30	3.13	3.13	3.15	3.12	0.03
S-18	12-14-50	15:00	2.27	2.27	2.28	2.25	0.03
S-19	12-14-50	15:00	0.95	0.95	1.09	0.86	0.23
S-68	12-14-50	15:00	0.08	0.08	0.15	0.01	0.14
S-329	12-14-50	15:30	3.88	3.88	3.98	3.77	0.21

TENNESSEE

6:155-1	5-25-50	20:00	5.24		5.215	5.279	0.064
6:155-1	8-15-50	15:00	8.36				1
79:1-2	8-15-50	15:00	77.265	77.265	77.24	77.295	0.055
79:8-73	8-16-50	15:00	124.38	124.38	124.37	124.42	0.05
79:9-110	8-16-50	15:30	55.03	55.04	55.01	55.05	0.04
79:9-115	8-16-50	14:00	60.48	60.49	60.42	60.56	0.14
79:148-1D	8-16-50	14:50	45.62	45.62	45.58	45.66	0.08
6:200-1	8-16-50	15:00	137.80	137.87	137.680	137.940	0.280
7:1-6	8-16-50	15:00	78.58	78.60	78.415	78.750	0.335
79:9-115	8-24-50	15:30	61.40	61.41	61.25	61.71	0.46
7:1-6	9-4-50	17:00	78.46	78.46	78.446	78.483	0.037
7:1-6	9-29-50	07:00	79.025	79.025	79.020	79.030	0.010
6:155-1	9-29-50	06:00	5.59		5.508	5.671	0.163
6:155-1	10-5-50	11:00	5.85				1
6:200-1	10-5-50	16:00	132.60	132.63	132.462	132.697	0.235
7:1-6	10-5-50	17:15	79.10	79.10	78.983	79.235	0.252
79:148-1D	10-5-50	17:15	45.70	45.70	45.675	45.71	0.035
79:9-131	10-5-50	16:00	80.24	80.24	80.20	80.28	0.08
79:9-115	10-5-50	17:00	57.65	57.65	57.63	57.68	0.05
79:7-26	10-5-50	16:15	74.10	74.10	74.05	74.14	0.09
79:5-193	10-5-50	16:00	101.88	101.88	101.87	101.89	0.02
79:1-2	10-5-50	16:15	77.155	77.155	77.14	77.17	0.03
6:155-1	10-23-50	16:00	5.59		5.314	5.834	0.520
6:200-1	10-23-50	16:30	134.12	134.12	134.08	134.16	0.08
7:1-6	10-23-50	16:45	79.56	79.56	79.523	79.609	0.086
6:155-1	10-31-50	20:00	5.75		5.738	5.759	0.021
6:155-1	11-8-50	03:00	5.69		5.668	5.723	0.055
6:155-1	12-1-50	16:30	5.50		5.465	5.525	0.060
6:155-1	12-9-50	22:00	4.20		4.105	4.227	0.122
6:200-1	12-9-50	22:30	128.15	128.12	128.077	128.182	0.105
7:1-6	12-9-50	22:30	78.65	78.65	78.630	78.665	0.025

TEXAS

436	9-15-50	15:40	66.75	66.98	65.81	68.02	2.21
J-1-6	9-15-50	15:50	79.77	79.77	79.42	80.14	0.72
224	9-15-50	15:20	66.45	66.52	66.14	66.82	0.68
790	9-15-50	15:40	116.20	116.20	116.12	116.27	0.15

WISCONSIN

M1-153	7-13-50	04:45	36.923	36.926	36.920	36.934	0.014
FL-20	8-15-50	14:45	81.40	81.37	81.32	81.45	0.13
M1-36	8-15-50	14:45	182.992	182.962	182.897	183.012	0.133
M1-148	8-15-50	14:45	31.134	31.190	30.044	31.300	0.256
M1-153	8-15-50	14:45	36.688	36.730	36.524	36.917	0.393
Mo-17	8-15-50	14:45	4.85	4.85	4.83	4.87	0.04
Mt-5	8-15-50	14:00	25.14	25.14	25.07	25.27	0.20
WK-31	8-15-50	14:45	134.473	134.458	134.404	134.485	0.081

See footnotes at end of table.

Table 1.—*Fluctuations in well-water levels, Jan. 1 through Dec. 31, 1950—Continued*

WISCONSIN—continued

Well No.	Date	Time (G. C. T.)	Depth to water below land surface datum				Ampli- tude of fluctua- tion
			Before disturb- ance	After disturb- ance	At highest point of fluctua- tion	At lowest point of fluctua- tion	
			<i>ft.</i>	<i>ft.</i>	<i>ft.</i>	<i>ft.</i>	<i>ft.</i>
M1-36.....	8-22-50	06:15	183.560	183.563	183.556	183.569	0.013
WK-31.....	9- 2-50	04:50	134.492	134.501	134.490	134.505	0.050
M1-36.....	10- 5-50	16:15	182.525	182.515	182.490	182.544	0.054
M1-148.....	10- 5-50	16:00	31.654	31.650	31.589	31.700	0.111
M1-153.....	10- 5-50	16:15	36.918	36.892	36.834	36.989	0.155
M1-36.....	10-23-50	16:15	182.257	182.259	182.251	182.268	0.017
M1-148.....	10-23-50	16:15	32.065	32.063	32.047	32.085	0.038
M1-153.....	10-23-50	16:15	36.955	36.955	36.935	36.980	0.005
M1-36.....	12- 9-50	21:30	178.439	178.440	178.421	178.452	0.031
M1-148.....	12- 9-50	22:00	32.755	32.756	32.717	32.787	0.070
M1-153.....	12- 9-50	21:00	35.672	35.677	35.620	35.720	0.100
M1-153.....	12-14-50	02:45	35.636	35.635	35.631	35.642	0.011
M1-36.....	12-14-50	14:15	178.055	178.051	178.047	178.057	0.010
M1-148.....	12-14-50	14:15	32.802	32.805	32.800	32.814	0.014
M1-153.....	12-14-50	14:15	35.677	35.665	35.645	35.681	0.036

+ Water surface above mean sea level or land surface datum.

¹ Values refer to mean sea level datum.

² Values refer to arbitrary measuring point.

³ Indicates minimum value; chart rotated more than once.

⁴ Estimated value.

SEISMOLOGICAL OBSERVATORY RESULTS

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

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

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

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

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

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

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

In November 1950, a short-period vertical Benioff seismograph with photographic recording was installed at San Juan, P. R.

For detailed instrumental data regarding these stations, including instrumentation, constants, and other information, see *Seismological Bulletin*, MSI-137, for the first quarter of 1949. Those desiring to receive this publication as issued should request addition of their name to the CGS-7 mailing list. All requests should be made to the Director, United States Coast and Geodetic Survey, Washington 25, D. C.

Table 2.—Summary of instrumental epicenters for 1949

1949	Origin time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter	
			Latitude	Longitude
	h m s		° ' "	° ' "
July 1.....	03 26 53*	Near Bolivia-Chile border. Depth about 100 km.	22 S.	68 W.
1.....	04 16 36*	South of Fiji Islands. Depth about 600 km.	25 S.	177 E.
1.....	22 19 10*	Mediterranean Sea, near north coast of Crete.	35 N.	24 E.
2.....	00 43 05**	New Hebrides Islands region.		
2.....	11 27 48*	About 350 miles southwest of New Zealand.	50½ S.	162 E.
2.....	19 57 16*	Mariana Islands region. Depth about 60 km. Mag. 7.2	16 N.	147½ E.
3.....	04 13 50**	Mariana Islands region.		
3.....	07 35 53**	New Britain region. Depth about 150 km.		
3.....	21 45 59*	Central Peru.	13 S.	76 W.
4.....	01 46 06**	Ryukyu Islands regions. Depth about 60 km.		
4.....	03 40 40*	Persian Gulf.	27½ N.	56 E.
4.....	04 22 40**	Persian Gulf aftershock.		
4.....	13 47 58*	Loyalty Islands region. Depth about 100 km.	21 S.	174 E.
5.....	02 30 01**	Persian Gulf aftershock.		
6.....	19 45 06*	Solomon Islands.	10 S.	162 E.
7.....	04 32 13*	North Atlantic Ocean.	35 N.	36 W.
7.....	12 21 06*	Off southwest coast of Turkey.	36 N.	27½ E.
8.....	08 02 10**	Eastern Turkistan foreshock.		
8.....	12 46 47*	Near coast of Guatemala. Depth about 100 km. Mag. 6.	14 N.	91½ W.
8.....	18 18 06*	Arctic Ocean, about 200 miles east of Jan Mayen Island.	72 N.	0 W.
9.....	00 36 51*	Sandwich Islands.	58 S.	24 W.
9.....	18 44 44*	Atlantic Ocean.	32½ N.	70½ W.
10.....	03 53 35*	Eastern Turkistan. Mag. 7.7.	39½ N.	70½ E.
10.....	04 26 01	Off Manhattan Beach, Calif. Felt. Mag. 3.2.	33 54 N.	118 28 W.
10.....	10 57 32**	Eastern Turkistan aftershock.		
10.....	11 57 50*	do.	39 N.	71 E.
10.....	14 13 19**	do.		
10.....	15 18 58*	do.	39½ N.	71 E.
10.....	15 49 13**	do.		
10.....	16 23 59**	do.		
10.....	23 08 55**	do.		
11.....	00 14 58**	Off south coast of Panama.		
11.....	01 12 25**	Eastern Turkistan aftershock.		
11.....	03 55 34**	do.		
11.....	09 30 28**	Fiji Islands region.		
11.....	16 10 50*	Near south coast of Honshu, Japan. Two killed and minor property damage in Kure City. Depth about 50 km.	34 N.	132 E.
11.....	16 28 11*	Moluccas. Depth about 150 km.	1 S.	127 E.
12.....	08 01 51**	Northern Chile. Felt. Depth about 100 km.		
12.....	19 17 26	West of Cuddeback Lake, Calif. Felt in Cantil. Mag. 3.4.	35 22 N.	117 38 W.
13.....	09 07 18**	Near coast of Vera Cruz, Mexico.		
13.....	09 59 17*	Near coast of Ecuador. Felt in Guayaquil.	3 S.	80 W.
13.....	10 14 00**	Eastern Turkistan aftershock.		
13.....	18 28 23**	do.		
14.....	03 01 30**	Gulf of Fonseca, Nicaragua.		
14.....	03 35 33**	Eastern Turkistan aftershock.		
14.....	11 09 52**	Yugoslavia.	43½ N.	20½ E.
14.....	19 20 12**	Andreanof Islands, Aleutian Islands.		
14.....	19 40 11**	Kermadec Islands region. Depth about 60 km.		
14.....	23 21 10*	Bonin Islands region. Depth about 450 km.	30 N.	139 E.
15.....	09 15 32*	New Britain region.	6 S.	154 E.
15.....	10 59 58*	Northwestern Burma.	25 N.	95 E.
15.....	23 45 23*	Off coast of northern Panama. Felt.	9½ N.	78 W.
16.....	09 57 20*	Off coast of Guatemala.	13½ N.	92½ W.
18.....	00 33 19**	Celebes region. Depth about 200 km.		
18.....	04 42 04*	Off south coast of Mindanao, Philippine Islands. Depth about 150 km.	5½ N.	127 E.
18.....	07 35 00**	Fiji Islands region. Depth about 300 km.		
18.....	08 27 21*	Santa Cruz Islands region.	11½ S.	171 E.
18.....	09 53 02*	Off south coast of Hokkaido, Japan.	41½ N.	143 E.
19.....	09 43 00**	Near coast of Oaxaca, Mexico. Depth about 100 km.		
19.....	14 58 37**	Banda Sea.		
19.....	17 42 10*	Eastern Turkistan.	39½ N.	71 E.
20.....	22 20 05*	Off south coast of Sumatra.	11 S.	102 E.
21.....	08 01 39*	Near coast of southern Peru. Depth about 150 km. Mag. 6½.	15½ S.	73 W.
21.....	17 07 54*	Kamchatka. Depth about 200 km.	54 N.	158 E.
23.....	10 26 44*	New Hebrides. Depth about 150 km. Mag. 7.2.	19 S.	169½ E.
23.....	15 03 30*	Near west coast of Turkey. Destructive in Izmir and Karaburum. 1 killed, several injured. Heavy property damage in Kardamyla, northern part of Island of Chios, where 4 died and several hundred houses collapsed. Mag. 6¾.	38½ N.	26½ E.
23.....	17 42 05**	Eastern Turkistan.		
24.....	14 51 25**	Off coast of Guatemala.		
24.....	18 50 14	Off coast of San Diego, Calif. Felt in Mt. Helix. Mag. 3.6.	32 21 N.	117 48 W.
25.....	03 50 30*	Mariana Islands region. Mag. 6¼.	19 N.	148 E.
25.....	11 24 33*	Easter Island region. Mag. 6¼.	33 S.	112 W.
25.....	20 02 01	Northeast of Whitewater, Calif. Mag. 3.1.	33 58 N.	116 37 W.
26.....	08 24 24	Pinto Basin, Calif. Mag. 3.3.	34 01 N.	115 41 W.
27.....	11 01 29**	Banda Sea, north of Timor.		
27.....	15 11 40*	Kermadec Islands region. Mag. 7.1.	27½ S.	177 W.
28.....	03 36 36*	Near coast of southern Peru. Depth about 60 km.	15½ S.	76 W.
28.....	16 06 00	Southeast of Perris, Calif. Mag. 2.3.	33 43 N.	117 08 W.
29.....	11 08 15*	Off coast of Vancouver Island, British Columbia.	50 N.	129 W.
29.....	20 48 05**	Gulf of California. Mag. 2.3.		

See footnotes at end of table.

Table 2.—Summary of instrumental epicenters for 1949—Continued

1949	Origin time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter	
			Latitude	Longitude
	<i>h m s</i>		<i>° ' "</i>	<i>° ' "</i>
July 29	21 47 06**	Gulf of California		
29	21 59 25**	do.		
30	06 29 34*	Kurile Islands region	45 N.	149 E.
30	15 25 20*	Off south coast of Panama	8 N.	83 W.
30	16 22 35**	Ryukyu Islands region		
30	17 47 06*	Off west coast of Turkey. Depth about 60 km	39 N.	26 E.
30	23 55 59**	Off coast of Guerrero, Mexico		
31	04 14 04*	Near coast of central Chile	32 S.	72½ W.
31	06 55 33**	Solomon Islands region		
Aug. 1	04 47 00**	Samoa Islands region		
1	07 39 45	Northern India	35½ N.	74½ E.
1	08 03 47*	Off east coast of Mexico	19½ N.	96 W.
1	15 27 50*	Eastern Mediterranean Sea, near Crete. Depth about 200 km	35 N.	21 E.
1	22 42 22*	Off west coast of Turkey	39 N.	26 E.
2	23 02 40**	Pacific Ocean, about 300 miles southwest of Easter Island		
3	03 47 17**	Formosa Strait, about 150 miles northeast of Formosa		
3	20 23 45**	South Atlantic Ocean, about 300 miles south of Capetown, South Africa		
4	07 51 40**	New Britain Island region		
4	10 47 50**	Fiji Islands region. Depth about 600 km		
5	07 49 29*	Northern Peru. Depth about 100 km	6½ S.	77 W.
5	14 42 43	East of Morongo Valley, Calif. Mag. 2.8	34 04 N.	116 24 W.
5	19 02 56*	Central Ecuador foreshock	1 S.	78 W.
5	19 08 48*	Central Ecuador. Destructive in Ambato, Guano, Pelileo, Patate, and Pillaro. 4,000-6,000 killed, \$7½ million property damage. Depth about 60 km. Mag. 6¼	1 S.	78 W.
6	00 35 33*	Tonga Islands region. Felt in Nukualofa. Depth about 70 km. Mag. 7.6	18½ S.	175 W.
6	11 56 03**	Kermadec Islands		
6	15 51 03*	Tonga Islands region	19 S.	175 W.
6	18 53 36*	Near coast of Vera Cruz, Mexico	19½ N.	96 W.
7	08 15 20*	Off coast of British Columbia	50½ N.	130 W.
7	10 44 42*	British Columbia aftershock	50½ N.	130 W.
7	23 53 52*	Southern Peru	15 S.	71½ W.
8	07 09 05*	Indian Ocean, about 1,100 miles east of Madagascar	19 S.	65½ E.
8	11 00 03	Felt in Pinole, Richmond, and Martinez, Calif. Mag. 3.3	37 57 N.	122 19 W.
8	13 11 42**	Tonga Islands region		
8	14 10 32*	Near coast of Chiapas, Mexico. Depth about 100 km	14 N.	93½ W.
8	17 12 32**	Kermadec Islands		
8	19 07 24*	Off coast of southern Peru. Depth about 100 km	16 S.	76 W.
9	00 39 27	West of Calistoga, Calif. Mag. 3.6	38 35 N.	122 40 W.
9	10 58 00**	Fiji Islands. Depth about 600 km		
9	21 31 51**	Eastern Turkistan		
10	03 17 38**	Mediterranean Sea, off south coast of Turkey		
10	09 37 08	Near Cottonwood Springs, Calif. Mag. 3.4	33 45 N.	115 50 W.
10	13 45 15*	North Polar region foreshock	86½ N.	67 E.
10	20 33 47*	North Polar region	86½ N.	67 E.
11	00 09 30	Pinto Basin, Calif. Mag. 3.4	33 50 N.	115 53 W.
11	03 13 10**	Central Ecuador aftershock		
11	13 49 55*	Chiapas, Mexico, aftershock	14 N.	93½ W.
11	14 40 36*	North Atlantic Ocean, about 400 miles north of Azores	45 N.	29 W.
11	15 00 43*	Samoa Islands. Felt in Apia. Depth about 60 km	15 S.	173½ W.
12	07 38 33**	Turkistan		
12	23 15 49*	New Hebrides Islands	14½ S.	167 E.
13	18 24 51*	Admiralty Islands region. Mag. 6½	0	146½ E.
16	05 33 30	Pinto Basin, Calif. Mag. 3.0	33 57 N.	115 57 W.
16	09 03 27	Thousand Palms, Calif. Mag. 2.5	33 51 N.	116 16 W.
16	10 58 02	Northeast of Manix, Calif. Mag. 2.9	35 00 N.	116 29 W.
16	11 48 53**	Southern Baluchistan		
16	20 51 40**	Northern Peru		
17	05 14 19	East of Riverside, Calif. Felt. Mag. 3.4	34 00 N.	117 12 W.
17	18 34 09*	Near east coast of Hokkaido, Japan. Depth about 100 km. Mag. 6½	43 N.	146 E.
17	18 43 13*	Eastern Turkey. 320 killed. Destructive in Bingol, Cat, Tercan, Karliova, and Kigi. Mag. 6¼	39 N.	40½ E.
17	20 45 22*	Eastern Turkey aftershock	39 N.	40½ E.
18	09 58 12**	Bonin Islands. Depth about 400 km		
18	13 33 25*	Off south coast of Panama. Mag. 6¼	8½ N.	83 W.
18	14 25 16	East of Walker Lake, Nev. Mag. 3.7	38.8 N.	118.6 W.
18	20 31 16*	Andreanof Islands, Aleutian Islands	52 N.	175½ W.
19	08 25 31*	Tonga Islands. Depth about 60 km	18 S.	175½ W.
20	01 56 09**	Kurile Islands region		
21	03 46 25**	do.		
21	05 38 23	Death Valley, Calif. Mag. 3.8	37 04 N.	117 31 W.
21	08 45 52**	Tonga Islands region		
21	11 45 20	Lake Almanor, Calif. Mag. 3.9	40 17 N.	121 10 W.
21	20 33 31*	Near north coast of Venezuela. Depth about 100 km	10½ N.	62½ W.
21	20 48 16	Near Lake Almanor, Calif. Felt. Mag. 4.5	40 16 N.	121 14 W.
22	01 51 56	Pinto Basin, Calif. Mag. 3.0	33 56 N.	116 00 W.
22	02 41 38	do.	33 57 N.	115 55 W.
22	03 16 33**	New Britain region		
22	04 01 12*	Queen Charlotte Islands. Felt from Portland, Oreg., to southern Alaska. 2-foot tidal wave at Ketchikan, Alaska. Mag. 8.1	54 N.	133 W.

See footnotes at end of table.

Table 2.—Summary of instrumental epicenters for 1949—Continued

1949	Origin time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter	
			Latitude	Longitude
	<i>h m s</i>		<i>° ' "</i>	<i>° ' "</i>
Aug. 22.	07 11 40**	Southern Peru. Depth about 100 km.		
22.	08 51 18*	South Atlantic Ocean, near Tristan da Cunha.	37 S.	18 W.
22.	09 15 20**	Queen Charlotte Islands aftershock.		
22.	11 41 23**	Bonin Islands region.		
22.	12 22 05**	Queen Charlotte Islands aftershock.		
22.	13 40 20**	do.		
22.	20 26 08*	South Atlantic Ocean, about 375 miles south of Ascension Island.	14 S.	14 W.
23.	02 59 02**	Queen Charlotte Islands aftershock.		
23.	15 13 44*	Southern Peru. Depth about 150 km.	16 S.	73 W.
23.	19 37 30**	Queen Charlotte Islands aftershock.		
23.	19 43 35**	do.		
23.	20 24 32*	Queen Charlotte Islands aftershock. Felt. Mag. 6½.	53 N.	132 W.
23.	22 03 50*	Eastern Turkistan.	39 N.	71 E.
24.	02 37 21**	Queen Charlotte Islands aftershock.		
24.	06 07 14*	Off coast of Oregon.	43½ N.	127 W.
24.	06 25 45*	Tonga Islands region. Depth about 100 km.	21½ S.	177 W.
24.	09 20 00**	Queen Charlotte Islands aftershock.		
24.	09 22 02*	Pacific Ocean, 1,200 miles north of Easter Island.	9 S.	109 W.
24.	12 42 39**	Queen Charlotte Islands aftershock.		
24.	12 52 05**	Tonga Islands region.		
24.	21 51 41**	Queen Charlotte Islands aftershock.		
24.	22 37 03**	do.		
25.	04 14 28*	Andreanof Islands, Aleutian Islands. Mag. 6½.	51½ N.	179 W.
25.	05 50 22**	About 500 miles east of Azores.		
25.	11 27 38	Pinto Basin, Calif. Mag. 3.2.	34 03 N.	115 52 W.
25.	11 42 44**	Off east coast of Honshu, Japan.		
25.	18 33 16**	Near coast of northern Chile. Depth about 100 km.		
25.	23 25 57*	Banda Sea. Depth about 200 km.	7 S.	129 E.
26.	05 25 58*	Off coast of southeastern Alaska.	56 N.	135 W.
26.	16 52 32	San Luis Obispo foreshock. Felt. Mag. 4.2.		
26.	22 39 40**	Queen Charlotte Islands aftershock.		
27.	14 51 46	Near Point Conception, Calif. Felt from San Luis Obispo to Point Arguello. Mag. 4.9.	34.5 N.	120.5 W.
27.	15 35 42	Southwest of Santa Rosa Island, Calif. Mag. 3.7.	33 48 N.	120 17 W.
27.	15 54 28	Southwest of Santa Rosa Island, Calif. Mag. 4.0.	33 51 N.	120 18 W.
27.	21 30 40**	Queen Charlotte Islands aftershock.		
28.	09 45 02**	Fox Islands, Aleutian Islands.		
28.	19 28 54*	North Atlantic Ocean.	54 N.	34 W.
29.	00 19 11**	Eastern Turkey aftershock.		
29.	01 56 01	East of Salinas, Calif. Mag. 4.0.	37 41 N.	121 32 W.
29.	12 07 20	North of Avenal, Calif. Felt in Avenal and Kettleman. Mag. 3.0.	36.0 N.	120.1 W.
30.	16 50 21*	Near coast of Crimea.	44½ N.	34 E.
31.	00 08 10**	Mariana Islands. Depth about 100 km.		
31.	13 47 11*	Southern Alaska. Felt in Anchorage.	62 N.	153 W.
Sept. 1.	13 58 14*	Pacific Ocean, southeast of Easter Island.	36 S.	97 W.
1.	16 59 15**	Mariana Islands.		
1.	18 26 50*	Galapagos Islands region.	2½ N.	90 W.
2.	01 31 18**	Queen Charlotte Islands aftershock.		
3.	03 06 47*	Southern Alaska. Depth about 100 km.	62 N.	148 W.
3.	07 38 05**	Western Wyoming.		
4.	14 55 20**	Samoa Islands region.		
5.	02 54 14*	Northern Luzon, Philippine Islands. Felt in Manila. Depth about 100 km.	19 N.	122 E.
5.	03 18 10*	Luzon, Philippine Islands. Felt in Manila.	17 N.	121½ E.
5.	06 54 15*	Queen Charlotte Islands.	53½ N.	132 W.
6.	11 20 30	Off coast of Cape Mendocino, Calif. Felt in Eureka. Mag. 4.1.	40 23 N.	124 42 W.
7.	07 02 04	Southwest of Santa Rosa, Calif. Mag. 3.5.	33 47 N.	120 38 W.
7.	07 26 57*	Galapagos Islands.	2 S.	93 W.
7.	13 33 55**	Fiji Islands region.		
8.	02 46 52*	Kurile Islands.	47½ N.	154 E.
8.	16 02 02*	Near south coast of Peru. Depth about 150 km.	15½ S.	75½ W.
9.	11 26 50	South of Point Mugu, Calif. Mag. 3.4.	33 53 N.	119 05 W.
9.	20 26 21*	Samoa Islands region.	16½ S.	172½ W.
11.	13 38 47*	Near east coast of Kamchatka. Depth about 100 km.	57½ N.	164½ E.
11.	21 44 40**	Off east coast of Honshu, Japan.		
12.	08 36 12*	Queen Charlotte Islands region.	56 N.	132 W.
12.	09 17 04*	Loyalty Islands region.	22 S.	170 E.
12.	10 43 25*	New Britain region. Depth about 100 km.	5 S.	150½ E.
12.	10 54 02*	Fiji Islands region. Depth about 500 km.	24 S.	179 E.
12.	14 37 52**	Queen Charlotte Islands aftershock.		
12.	22 24 05**	Near Adak, Aleutian Islands.		
13.	06 54 09**	Samoa Islands region.		
13.	16 10 35**	Off south coast of Panama.		
14.	05 27 40*	Off coast of Cape Mendocino, Calif. Mag. 4½.	40½ N.	126 W.
14.	16 38 45**	Molucca Passage foreshock.		
14.	19 50 16*	Molucca Passage. Mag. 7.2.	1 N.	126 E.
14.	20 49 50	Lower California. Mag. 4.4.	30.7 N.	114.9 W.
16.	15 45 10*	Lower California. Mag. 4.8.	31½ N.	116 W.
16.	19 11 07*	Molucca Passage aftershock.	1 N.	126 E.
16.	20 44 45*	Lower California. Mag. 5.1.	32 N.	116 W.
17.	02 31 35*	Off west coast of Vancouver Island, British Columbia.	50 N.	129 W.
17.	08 59 05**	Southern Greece foreshock.		
17.	11 30 06*	Southern Greece.	37 N.	22½ E.

See footnotes at end of table.

Table 2.—Summary of instrumental epicenters for 1949—Continued

1949	Origin time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter	
			Latitude	Longitude
	<i>h m s</i>		<i>° ' N</i>	<i>° ' E</i>
Sept. 17	13 48 46*	Eastern Mediterranean Sea	35	25
17	15 22 11*	Solomon Islands region	6	154
17	22 46 25*	South Pacific Ocean	35	154
18	11 59 00**	Queen Charlotte Islands aftershock		
18	12 45 57*	Northern Chile-Bolivia border. Depth about 200 km.	18	69
19	13 08 51**	Mona Passage		
19	21 42 21*	South Atlantic Ocean	53½	2½
20	02 26 42*	Off north coast of Honshu, Japan	39	138
20	04 14 11	North of Newberry, Calif. Felt in Yermo. Mag. 4.1	34 53 N.	116 40 W.
20	11 55 29*	Kermadec Islands. Depth about 80 km. Mag. 6.9	30	178
20	12 18 20**	Off coast of British Columbia		
21	12 55 11*	Oaxaca, Mexico. Depth about 100 km.	17	94½
21	18 19 40**	Samoa Islands region		
22	00 37 50*	Aleutian Islands	52	175
22	15 38 15*	Near south coast of Hokkaido, Japan	42	142
24	04 17 38*	Solomon Islands region. Mag. 7	6	153½
24	07 22 43*	Central Sumatra. Felt in Painan	1	102½
25	15 15 00*	Solomon Islands region. Mag. 6½	6	154½
25	15 57 32*	Solomon Islands region aftershock	6	154½
26	03 05 11*	do	6	154½
26	08 04 13*	do	6	154½
26	10 00 50**	Northwestern Argentina		
26	22 32 00**	Solomon Islands aftershock		
27	11 54 12**	Moluccas		
27	15 30 43*	Near south coast of Alaska. Felt in Anchorage. Depth about 50 km. Mag. 7	60	149
27	17 54 17**	Fiji Islands region. Depth about 550 km.		
27	18 21 54*	Alaska aftershock	60	149
27	19 23 10**	Fiji Islands region		
27	20 53 14**	Mindanao, Philippine Islands		
28	15 07 21*	Kermadec Islands region	31	177
30	03 58 48*	Tonga Islands region. Mag. 6½	24	175½
30	04 09 44**	Tonga Islands region aftershock		
30	08 50 06*	Solomon Islands	11	163
30	09 03 29	Northeast of Barstow, Calif. Mag. 2.9	35 03 N.	116 54 W.
30	15 16 07*	Loyalty Islands region. Depth about 100 km.	22	170
30	18 19 35*	Tonga Islands region	23	176
30	22 06 55*	do	23	176
Oct. 1	07 03 10**	Pacific Ocean, 150 miles south of Bonin Islands. Depth about 200 km.		
1	18 00 42*	Tanganyika, South Africa	8	31½
2	02 29 25*	North Atlantic Ocean	17	49
2	11 46 38*	Andreanof Islands, Aleutian Islands	51	177
3	02 23 43*	do	52	175
3	09 15 38*	Sandwich Islands	56	27
3	12 44 27**	Off east coast of New Guinea		
3	23 51 52*	Alaska Peninsula	55	157
4	04 28 30**	Samoa Islands		
4	09 58 24*	Northern Chile. Felt	30	70
4	10 20 23*	Atlantic Ocean. Mag. 6¼	1	21
4	17 13 04	North of Banning, Calif. Mag. 2.6	33 59 N.	116 51 W.
5	02 33 47.5	West-central Maine. Felt in Maine, New Hampshire, and Vermont.	44.8	70.5
5	16 20 35*	Near east coast of Greece. Felt in Agrinion	39	22½
5	19 07 00**	New Britain region		
5	21 04 34**	Ryukyu Islands region		
5	21 55 47**	Bonin Islands region		
6	04 12 20	Pinto Basin, Calif. Mag. 3.4	33 54 N.	115 48 W.
6	08 59 53**	Tonga Islands		
7	12 02 19*	Indian Ocean. Depth about 60 km. Mag. 6¼	33	56½
7	22 36 00**	Indian Ocean aftershock		
8	03 08 46*	Off south coast of Sicily. Felt in Catania and Acreale	36	16
8	20 34 19**	Off east coast of Formosa		
9	03 51 12**	Fiji Islands region. Depth about 600 km		
9	13 44 30**	Samoa Islands region		
10	21 23 55**	Kamchatka		
10	23 44 14**	Hokkaido, Japan		
11	00 25 55	Northeast of Seven Palms Well, Calif. Mag. 3.0	34 00 N.	116 26 W.
11	03 35 30**	Fox Islands, Aleutian Islands		
11	09 05 27*	Near east coast of Hokkaido, Japan. Felt. Depth about 100 km.	43	144
11	11 36 54*	Kermadec Islands region	33½	178½
13	03 35 44*	Fiji Islands region. Depth about 200 km.	16	176
13	04 20 40	Pinto Basin, Calif. Felt in Indio. Mag. 4.0	33 51 N.	115 51 W.
13	12 47 20*	Near coast of Guerrero, Mexico	17½	100
14	00 29 25	Near Borego, Calif. Felt in Borego Valley, Dulzura, and Mount Helix. Mag. 4.1	33 11 N.	116 23 W.
14	00 46 36	Borego Valley aftershock. Mag. 3.2	33 11 N.	116 23 W.
14	01 02 36	Borego Valley aftershock. Mag. 3.1	33 11 N.	116 23 W.
15	23 15 01	Northeast of Barstow, Calif. Mag. 2.8	34 58 N.	116 57 W.
16	16 05 22	Northern Owens Valley, Calif. Felt at Long Valley Dam. Mag. 3.1	37 40 N.	118 40 W.
16	16 22 00**	Southern Alaska		
16	23 33 44.8	Canada, near Alexandria, Ontario Province. Felt	40.4	74.8

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Table 2.—Summary of instrumental epicenters for 1949—Continued

1949	Origin time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter	
			Latitude	Longitude
	<i>h m s</i>		<i>° ' "</i>	<i>° ' "</i>
Oct. 17.....	02 41 45	East of Gilroy, Calif. Mag. 3.8.....	37 00 N.	121 13 W.
17.....	03 44 15*	Tonga Islands region. Depth about 200 km.....	19 S.	174 W.
17.....	13 20 57	Northeast of Whitewater, Calif. Felt in Palm Springs and Snow Creek Canyon. Mag. 3.5.....	33 57 N.	116 58 W.
19.....	06 53 37**	Fox Islands, Aleutian Islands.....		
19.....	21 00 17*	Solomon Islands. Depth about 60 km. 2-foot tidal wave re- corded at Rabaul, New Britain. Mag. 7¼.....	6 S.	154½ E.
20.....	03 26 35	Northern Owens Valley, Calif. Felt at Long Valley Dam. Mag. 3.5.....	37 40 N.	118 40 W.
20.....	11 41 58*	New Britain.....	5 S.	151 E.
20.....	12 44 54*	Solomon Islands aftershock. Mag. 6¼.....	5½ S.	154 E.
20.....	18 12 48*	Fiji Islands. Depth about 500 km.....	19 S.	178½ W.
21.....	03 32 15**	Fox Islands, Aleutian Islands.....		
21.....	06 09 01*	Off south coast of Formosa.....	21½ N.	121 E.
21.....	21 34 33*	Solomon Islands foreshock. Depth about 100 km.....	5½ S.	153½ E.
22.....	03 42 32*	Off coast of Cape Mendocino, Calif. Mag. 4.4.....	40.5 N.	126.6 W.
22.....	21 45 21*	Near coast of California. Felt in Hollister, Big Sur, and Mor- gan Hill. Mag. 4.7.....	36½ N.	121½ W.
23.....	05 12 44*	Near north coast of New Guinea. Depth about 150 km.....	4 S.	144 E.
24.....	02 22 33	Southeast of Benton, Calif. Mag. 4.1.....	37 40 N.	118 18 W.
25.....	03 05 08	North of Walker Pass, Calif. Mag. 2.7.....	35 44 N.	118 05 W.
25.....	03 56 30**	Fox Islands, Aleutian Islands.....		
25.....	04 18 52	Off coast of Cape Mendocino, Calif. Mag. 3.9.....	40.6 N.	125.2 W.
25.....	13 07 38*	Honshu, Japan. Felt. Depth about 100 km.....	36 N.	140 E.
26.....	00 02 31*	North Atlantic Ocean.....	10½ N.	41 W.
26.....	09 13 11*	Solomon Islands.....	6 S.	153 E.
27.....	04 37 55**	Arizona-Mexico border.....		
27.....	08 24 15*	Gulf of California. Mag. 5.....	30 N.	112 W.
27.....	10 05 37**	Gulf of California aftershock.....		
27.....	10 02 22*	South of Fiji Islands.....	24½ S.	180
27.....	18 35 58*	Kurile Islands.....	49 N.	155 E.
27.....	21 23 45**	Cape Mendocino foreshock.....		
28.....	00 12 08*	Off east coast of Honshu, Japan.....	34 N.	142 E.
28.....	02 29 15*	Off coast of Cape Mendocino, Calif. Mag. 4.5.....	41 N.	124 W.
28.....	13 22 33	Pinto Basin, Calif. Mag. 3.2.....	34 03 N.	115 48 W.
28.....	16 26 12*	New Britain region.....	6 S.	153 E.
28.....	18 48 01*	Fiji Islands region. Depth about 450 km.....	20 S.	179 W.
28.....	22 18 08**	Banda Sea.....		
29.....	00 06 20	Near Modesto, Calif. Mag. 3.4.....	37.5 N.	121.0 W.
29.....	00 21 43*	Samoa Islands region.....	17 S.	174 W.
29.....	06 31 46*	Solomon Islands.....	10 S.	160 E.
29.....	14 12 57**	Fiji Islands region. Depth about 500 km.....		
29.....	22 27 40	Northeast of Pinto Basin, Calif. Mag. 2.9.....	34 01 N.	115 59 W.
30.....	05 33 20*	New Hebrides Islands.....	19 S.	169 E.
30.....	05 34 13*	Fox Islands, Aleutian Islands.....	52½ N.	168 W.
30.....	23 54 05*	Kermadec Islands region. Depth about 60 km.....	33 S.	180
31.....	00 02 27**	Tonga Islands region.....		
31.....	01 39 32*	Near coast of southeastern Alaska. Felt in Sitka. Mag. 6¼.....	56 N.	135 W.
31.....	02 32 11*	Southeastern Alaska aftershock.....	56 N.	135 W.
31.....	02 50 37**	New Hebrides Islands region.....		
31.....	07 44 01*	Kurile Islands.....	49 N.	156 E.
31.....	17 55 39*	Solomon Islands region. Depth about 100 km. Mag. 6¼.....	5½ S.	154 E.
Nov. 1.....	07 32 49*	New Britain region. Depth about 100 km.....	5 S.	153½ E.
1.....	10 58 34	Pinto Basin, Calif. Mag. 3.2.....	33 59 N.	115 45 W.
1.....	11 55 50*	Off coast of Cape Mendocino, Calif. Mag. 4.7.....	40½ N.	127 W.
1.....	12 04 24**	About 100 miles off east coast of Mindanao, Philippine Islands.....		
1.....	13 04 25*	Mongolia.....	48 N.	93 E.
1.....	19 09 58*	Northwestern Mexico.....	31½ N.	112 W.
2.....	02 07 15**	Near south coast of Dominican Republic.....		
2.....	02 29 36*	Northwestern Arizona. Felt in Arizona and Utah. Mag. 4.7.....	36½ N.	113 W.
2.....	02 32 32*	Northwestern New Guinea.....	3 S.	135 E.
2.....	03 27 43**	New Britain region.....		
2.....	23 08 21	Southwest of Santa Rosa Island. Mag. 3.6.....	33 46 N.	120 29 W.
3.....	01 12 37*	Kurile Islands. Depth about 200 km. Mag. 6.9.....	48½ N.	154 E.
4.....	06 17 27**	East China Sea. About 100 miles northeast of Formosa.....		
4.....	20 42 40	Near Guadalupe, Lower California. Felt from southern Cali- fornia to Guadalupe, Mexico. Mag. 5.7.....	32.2 N.	116.6 W.
5.....	04 35 24	Lower California aftershock. Felt in San Diego. Mag. 5.1.....	32 12 N.	116 33 W.
5.....	15 05 38*	Northern Iran.....	37 N.	55 E.
5.....	20 02 07	Lower California aftershock. Felt in San Diego and Jamul. Mag. 4.0.....	32 12 N.	116 33 W.
6.....	01 11 25**	About 150 miles off south coast of Guatemala.....		
6.....	12 12 36**	Central Mexico. Depth about 100 km.....		
6.....	23 05 10	Northern Mexico. Felt in Dulzura, Hipass, and Campo. Mag. 4.0.....	32 12 N.	116 33 W.
7.....	04 31 17**	Near coast of Vera Cruz, Mexico.....		
7.....	05 59 41*	New Hebrides Islands. Depth about 60 km. Mag. 6¼.....	14 S.	167 E.
7.....	14 34 37**	Samoa Islands region. Felt in Apia.....		
9.....	23 03 29**	Pacific Ocean, about 1,100 miles north of Easter Island.....		
10.....	05 16 35	Near Pinnacles, Calif. Mag. 3.9.....	36 38 N.	121 08 W.
11.....	10 57 36*	Pacific Ocean, west of Galapagos Islands.....	9 S.	119 W.
11.....	13 54 00	Lower California aftershock. Felt in Carrizo Gorge, Coronado, San Diego, and Campo. Mag. 4.2.....	32 12 N.	116 38 W.
11.....	14 34 21	North of Walker Pass, Calif. Mag. 3.2.....	35 45 N.	118 06 W.

See footnotes at end of table.

Table 2.—Summary of instrumental epicenters for 1949—Continued

1949	Origin time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter	
			Latitude	Longitude
	<i>h m s</i>		<i>° ' N. S.</i>	<i>° ' E. W.</i>
Nov. 11	15 44 18*	Formosa	23 $\frac{1}{2}$ N.	121 E.
11	16 59 28*	Off coast of northern Guatemala	15 $\frac{1}{2}$ N.	93 W.
11	17 57 28**	Fiji Islands region. Depth about 500 km.		
12	19 28 27	Western Nevada. Mag. 3.2	39.8 N.	119.0 W.
12	20 42 34	Western Nevada. Mag. 3.1	39.8 N.	119.0 W.
13	04 42 40*	Southwestern Nicaragua. Depth about 60 km.	11 N.	85 $\frac{1}{2}$ W.
13	16 58 05	Pinto Mountains, Calif. Mag. 3.4	34 06 N.	115 46 W.
13	20 43 20*	New Hebrides Islands	15 S.	168 $\frac{1}{2}$ E.
13	21 28 33**	Kurile Islands region		
14	00 21 26	East of Yermo, Calif. Mag. 3.7	34 55 N.	116 46 W.
14	02 10 10*	Near coast of Ecuador	2 S.	80 W.
14	02 48 18**	Samoa Islands region		
14	10 41 59	Western Nevada. Mag. 3.5	39 23 N.	119 43 W.
14	13 31 23*	Near Honshu, Japan	39 N.	145 E.
14	17 12 43	North of Bishop, Calif. Mag. 3.8	37 29 N.	118 25 W.
15	13 19 54*	Fiji Islands. Depth about 400 km.	17 S.	177 $\frac{1}{2}$ E.
16	08 04 20	Near Mount Lassen, Calif. Mag. 3.2	40 32 N.	121 35 W.
17	05 08 25**	Eastern Turkistan		
17	19 20 35**	Burma-Assam border region		
17	22 28 58**	Near Shikoku, Japan. Felt. Depth about 400 km.		
18	01 19 52	Terminal Island, Calif. \$9 million damage to oil wells. Also felt in Long Beach and San Pedro, Mag. 3.7.	32 45 N.	118 15 W.
18	07 58 09*	New Hebrides Islands	14 S.	167 E.
19	07 25 34**	Tonga Islands region. Depth about 60 km.		
20	00 53 50**	Samoa Islands region		
20	04 43 56*	Central Peru	11 S.	75 W.
21	07 09 47*	Gulf of California. Felt in Sonora, Mexico. Mag. 6 $\frac{3}{4}$ -7	28 N.	112 W.
22	00 51 48*	Kermadec Islands. Depth about 150 km. Mag. 7.4	28 $\frac{1}{2}$ S.	178 $\frac{1}{2}$ W.
22	03 33 44**	Central Peru-Brazil border. Depth about 200 km.		
22	15 21 12*	Near south coast of Iran	28 N.	56 E.
23	06 14 40*	Near south coast of Cuba	19 $\frac{1}{2}$ N.	78 $\frac{1}{2}$ W.
23	16 51 00*	Aegean Sea	39 N.	26 E.
25	05 44 22*	Fiji Islands. Depth about 400 km.	19 S.	178 W.
25	17 35 17**	Off east coast of Honshu, Japan		
26	01 10 25**	Fiji Islands. Depth about 550 km.		
26	04 24 30*	Off south coast of Mexico	15 N.	94 $\frac{1}{2}$ W.
26	06 24 09*	Off south coast of Panama	7 N.	83 W.
26	07 43 35**	Pacific Ocean, 400 miles off coast of Colombia		
26	21 52 46*	Kurile Islands. Depth about 150 km.	48 N.	133 E.
27	08 42 20*	Tonga Islands region. Depth about 60 km. Felt in Nukualofa and Apia. Mag. 7.2.	18 $\frac{1}{2}$ S.	173 W.
28	16 27 49**	Kurile Islands		
28	16 53 21*	Off south coast of Panama	5 N.	83 W.
28	18 47 10**	Near north coast of Turkey		
29	09 18 57**	Tonga Islands region		
30	08 31 45*	Off coast of northern California. Mag. 4.4	38 N.	124 W.
Dec. 2	02 43 45*	Loyalty Islands region	22 $\frac{1}{2}$ S.	172 E.
2	19 42 30**	Samoa Islands region		
2	22 30 34*	Off northeast coast of Vancouver, British Columbia	50 $\frac{1}{2}$ N.	129 $\frac{1}{2}$ W.
3	12 01 54*	Chile-Peru border. Felt in Chile	18 S.	70 W.
4	22 38 54	Near Cape Mendocino, Calif. Felt in Ferndale and Petrolia. Mag. 3.8.	40.3 N.	124.3 W.
5	11 21 34**	Pacific Ocean foreshock		
5	12 42 13*	Pacific Ocean, south of Panama	6 N.	84 $\frac{1}{2}$ W.
5	14 51 50**	Off northeast coast of Honshu, Japan. Felt		
5	17 36 47**	Kurile Islands region		
5	23 48 40**	Northern Chile. Felt		
6	13 32 58**	New Hebrides Islands		
6	14 27 40**	Tonga Islands region		
6	16 13 20**	Northern Chile. Felt		
6	22 07 04*	Western Nevada	39 N.	118 $\frac{1}{2}$ W.
6	22 24 42**	About 150 miles south of Bonin Islands. Depth about 300 km.		
7	16 13 35*	Off south coast of Crete	35 N.	24 $\frac{1}{2}$ E.
7	16 44 16**	Pacific Ocean, about 150 miles south of Panama		
7	18 44 40	Western Nevada. Felt in Carson City. Mag. 3.8	39.0 N.	119.8 W.
7	23 54 18**	Northern Chile. Depth about 100 km.		
8	20 44 41	North of Death Valley, Calif. Mag. 3.3	36 55 N.	117 15 W.
9	04 31 49	Near Coso Hot Springs, Calif. Mag. 3.1	36 04 N.	117 40 W.
9	05 02 35**	Central Chile. Felt		
9	08 41 18	Bishop, Calif., foreshock. Mag. 4.1	37 28 N.	118 22 W.
9	11 04 57**	Tonga Islands region		
9	12 39 02	North of Bishop, Calif. Felt in Bishop, Big Pine, and June Lake. Mag. 4.6	37 28 N.	118 22 W.
10	14 50 15	Northeast of Palm Springs, Calif. Mag. 3.2	33 58 N.	116 29 W.
10	15 46 53	Near Santa Monica, Calif. Felt. Mag. 3.2	34 03 N.	118 30 W.
10	17 19 54**	Samoa Islands. Felt in Apia. Depth about 60 km.		
10	19 16 04*	Pacific Ocean. Depth about 150 km.	4 $\frac{1}{2}$ N.	128 $\frac{1}{2}$ W.
10	19 37 05**	Eastern India		
11	11 33 49*	Loyalty Islands	21 S.	169 E.
12	03 32 33	Eagle Mountain, Calif. Mag. 3.1	33 53 N.	115 35 W.
12	03 36 53	Southeast of Twentynine Palms, Calif. Mag. 3.1	34 03 N.	115 53 W.
12	05 18 04	Twentynine Palms, Calif., aftershock. Mag. 3.0	34 03 N.	115 53 W.
13	05 05 16	Near Markleeville, Calif. Felt. Mag. 3.4	38 40 N.	119 50 W.
13	14 32 56	Southwest of Manix, Calif. Mag. 2.9	34 53 N.	116 38 W.

See footnotes at end of table.

Table 2.—Summary of instrumental epicenters for 1949—Continued

1949	Origin time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter	
			Latitude	Longitude
	A m s		° ' "	° ' "
Dec. 14.....	14 40 00**	Off coast of Colima, Mexico.....		
14.....	17 32 21	Kawich Valley area, Nev. Mag. 3.9.....	37 52 N.	116 20 W.
15.....	03 32 20**	Off coast of Colima, Mexico.....		
15.....	09 48 52	Lucerne Valley, Calif. Mag. 3.0.....	34 25 N.	116 55 W.
15.....	10 27 22**	Kermadec Islands.....		
15.....	10 52 00**	do.....		
15.....	14 30 45**	Near coast of northern Chile. Felt.....		
16.....	02 01 39**	Off coast of Vancouver Island, British Columbia.....	50 N.	129 W.
16.....	14 06 38*	Kermadec Islands region.....	27 S.	177½ W.
17.....	06 53 23*	Southern Magallanes Province, Chile. Destructive in Punta Arenas. 1 killed. Mag. 7¼.....	54½ S.	70 W.
17.....	12 55 43*	Southern Chile aftershock. Felt.....	54½ S.	70 W.
17.....	15 07 48*	Southern Magallanes Province, Chile. Felt. Mag. 7¼.....	54½ S.	70 W.
18.....	01 46 00**	Southern Chile aftershock.....		
18.....	05 38 59*	Kermadec Islands region. Felt from Opotiki to Wellington, New Zealand. Depth about 150 km. Mag. 6¼.....	34 S.	179½ E.
18.....	19 12 40	Northeast of Barstow, Calif. Mag. 3.4.....	35 02 N.	116 53 W.
19.....	07 24 00**	Fiji Islands region. Depth about 500 km.....		
19.....	09 39 32**	Eastern New Guinea.....		
19.....	11 55 27**	Solomon Islands.....		
20.....	04 16 39*	Fiji Islands region. Depth about 650 km.....	21 S.	179 E.
21.....	04 30 37**	New Hebrides.....		
21.....	12 31 19*	Near coast of Puerto Rico. Felt in San Juan. Depth about 100 km.....	18½ N.	67 W.
21.....	13 18 06*	New Hebrides.....	18½ S.	168 E.
21.....	17 45 31**	Fiji Islands.....		
21.....	19 33 00*	Southern Bolivia. Felt in Chile. Depth about 600 km. Mag. 6¼-7.....	20 S.	64 W.
22.....	09 09 27**	New Britain region.....		
22.....	09 30 47*	Chiapas, Mexico. Felt. Depth about 100 km. Mag. 6¼.....	16 N.	93 W.
22.....	11 28 48**	Near north coast of Vancouver Island, British Columbia.....		
22.....	21 29 18*	San Juan Province, Argentina. Felt in Chile. Depth about 100 km.....	31½ S.	69½ W.
23.....	14 32 46*	East of Greenland.....	76 N.	6 E.
23.....	21 33 30**	100 miles south of Formosa.....		
24.....	22 01 49**	New Hebrides Islands.....		
25.....	01 52 16**	North Atlantic Ocean, 600 miles north of Azores.....		
25.....	06 07 04**	About 150 miles south of Fiji Islands.....		
25.....	22 40 45*	Colima, Mexico. Felt in Manzanillo. Mag. 6.....	19½ N.	104 W.
25.....	23 17 28**	Honshu, Japan, foreshock. Felt.....		
25.....	23 24 52*	Honshu, Japan. 8 killed, 163 injured, several thousand houses damaged. Mag. 6¼.....	36 N.	139 E.
26.....	05 32 09**	Fiji Islands region.....		
26.....	06 24 00*	Fiji Islands region. Depth about 100 km. Mag. 6.9.....	16 S.	180
26.....	14 27 40	Near Inglewood and southwestern Los Angeles. Felt. Mag. 2.8.....	34 00 N.	118 20 W.
27.....	02 42 59**	Honshu, Japan.....		
27.....	08 56 06**	Honshu, Japan. Felt.....		
27.....	10 52 28**	Andreanof Islands, Aleutian Islands.....		
27.....	16 41 55**	Honshu, Japan.....		
27.....	21 03 50**	Tonga Islands. Felt in Apia. Depth about 100 km.....	59½ S.	21 W.
27.....	23 57 13*	Sandwich Islands. Mag. 7.2.....		
28.....	03 50 59**	Azores region foreshock.....	41 N.	29 W.
28.....	06 25 25*	Azores region.....	39.4 N.	118.0 W.
28.....	11 58 39	Western Nevada. Mag. 2.9.....	51½ N.	176 W.
28.....	13 41 32*	Andreanof Islands, Aleutian Islands. Felt in Adak. Depth about 60 km.....		
29.....	03 03 50*	Northern Luzon, Philippine Islands. Heavy property damage along northwest coast of Isabella Province, minor damage in Manila. 1 killed by sea wave near Mercedes. Mag. 7.2.....	17½ N.	121½ E.
29.....	06 22 54**	Northern Luzon aftershock.....		
29.....	10 17 33**	do.....		
29.....	16 42 56*	Kermadec Islands region. Depth about 200 km. Mag. 6¼.....	27 S.	176½ W.
29.....	22 05 34**	Java Sea.....		
30.....	01 41 06**	Fiji Islands region.....		
30.....	10 41 01**	Kermadec Islands region.....		
31.....	04 08 10**	do.....		
31.....	08 41 42**	Fiji Islands region.....		

*Indicates probable error of ½ minute. **Indicates probable error of ¼ minute.

Table 3.—Principal earthquakes of the world from January through December 1950

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

1950	Origin time G. C. T.	Region	Coordinates of provisional epicenter		Remarks
			Latitude	Longitude	
Jan. 12..	^h 12 ^m 06 ^s 07*	Fiji Islands region.....	18° S.	178° W.	Depth about 550 km. Mag. 7.0.
19..	17 27 18*	Near south coast of Iran.....	27½° N.	53° E.	20 killed and several injured in Bushire.
Feb. 4..		Eastern Turkey.....			20 killed, 100 houses destroyed.
28..	10 20 58*	Off north coast of Hokkaido, Japan..	46° N.	143½° E.	Depth about 350 km. Mag. 7.8.
Mar. 7..	02 07 54*	Panay Island, Philippine Islands..	11° N.	122½° E.	Felt at Iloilo. Depth about 60 km. Mag. 6¼.
May 21..	18 37 41*	Central Peru.....	14° S.	72° W.	Destructive in Cuzco and San Sebastian. 83 killed, 200 injured. Mag. 6.
26..	01 17 24*	New Hebrides Islands.....	19° S.	169° E.	Mag. 7.1.
June 7..	16 52 34*	Northern Peru.....	4° S.	76½° W.	Depth about 100 km. Mag. 7.0.
8..	16 07 33*	Atlantic Ocean south of Tristan da Cunha.	44½° S.	14½° W.	Mag. 7.1.
19..	12 36 51*	Near northeast coast of Java.....	6° S.	113° E.	Destructive in Surabaya, Grisee, and Sedajoe. 16 killed, 50 injured, and 50 houses destroyed. Mag. 6½.
24..	22 25 29*	New Hebrides Islands region.....	20° S.	168½° E.	Mag. 7.2.
July 9..	02 35 30*	Northern Colombia.....	8° N.	73° W.	Destructive in Arboleta, Cucutilla, Salazar de las Palmas, Toledo, Cucuta, and Mutiscua, Colombia; and in San Cristobal, Venezuela. 211 killed, 500 injured. Damage estimated at \$5 million.
9..	04 40 03*	Western Brazil.....	8° S.	71° W.	Depth about 650 km. Mag. 7.
29..	14 36 32	Near Calipatria, Calif.....	33° 07' N.	115° 34' W.	Estimated \$50,000 property damage in Calipatria, Niland, and Westmorland. Mag. 5.5.
29..	23 48 58*	Solomon Islands.....	6° S.	155° E.	Mag. 7.1.
Aug. 3..	22 18 18*	Northwestern Venezuela.....	10° N.	69½° W.	Destructive at Tocoyo. 100 killed. Mag. 6¼.
14..	22 51 26*	Northern Argentina.....	27° S.	63° W.	Depth about 650 km. Mag. 7¼.
15..	14 09 30*	Assam.....	28½° N.	97° E.	574 killed. Damage estimated at \$20 million. Mag. 8.6.
31..	07 05 36*	Near south coast of Mindanao, Philippine Islands.	6° N.	126° E.	Mag. 7.
Sept. 10..	15 16 04*	New Hebrides Islands region.....	15½° S.	168½° E.	Depth about 100 km. Mag. 7.1.
22..	23 53 29*	Fiji Islands region.....	18° S.	177° W.	Depth about 450 km. Mag. 7.
Oct. 5..	16 09 25*	Near coast of Costa Rica.....	10½° N.	85½° W.	Minor damage at Puntarenas and San Jose. Several injured. Mag. 7.7.
8..	03 23 07*	Banda Sea.....	4° S.	128° E.	Mag. 7.6.
23..	16 12 18*	Near coast of Guatemala.....	14½° N.	92° W.	Felt in Chiapas, Mexico. Mag. 7.3.
Nov. 2..	15 27 53*	Banda Sea.....	6½° S.	129° E.	Felt in Darwin, Australia. Depth about 60 km. Mag. 7.5.
8..	02 18 10*	Solomon Islands region.....	9½° S.	159° E.	Mag. 7¼.
Dec. 1..	14 50 58*	Atlantic Ocean.....	14½° N.	47° W.	Depth about 60 km. Mag. 7.
2..	19 51 48*	New Hebrides Islands.....	18° S.	167° E.	Depth about 60 km. Mag. 7¼.
4..	16 28 01*	New Britain region.....	5° S.	153½° E.	Depth about 100 km. Mag. 7.2.
9..	21 38 44*	Northern Argentina-Chile border.	24° S.	67° W.	1 killed and several injured in Calama, Chile. Depth about 100 km. Mag. 8.0.
10..	02 50 40*	Near coast of southern Peru.....	14½° S.	76½° W.	1 killed and 4 injured in Ica. Felt at Lima, Arequipa, and Tacna. Mag. 6¼.
10..	13 23 10*	Kermadec Islands region.....	28½° S.	179° W.	Depth about 300 km. Mag. 7¾.
14..	01 52 46*	Tonga Islands region.....	19½° S.	176° W.	Depth about 200 km. Mag. 7.7.
14..	14 15 48*	Oaxaca, Mexico.....	17° N.	98° W.	Felt. Mag. 7.3.

*Indicates probable error of ¼ minute.

STRONG-MOTION SEISMOGRAPH RESULTS

INTRODUCTION

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

Interpretation of records.—The analyses appearing in Tables 5 and 6 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. These analyses are essentially condensations of material appearing in the *Quarterly Engineering Seismology Bulletin* available through mailing list CGS-5 from the Director, United States Coast and Geodetic Survey, Washington 25, D. C.

For the more important records, those involving destructive ground motions, the use of integration methods in computing velocity and displacement curves has become established practice. The accelerograms from Seattle and Olympia for the destructive Puget Sound earthquake of April 13, 1949, have been thus analysed, and a preliminary report prepared. The latter is now available for very limited distribution and will appear in final form in the *Bulletin of the Seismological Society of America*. An outline of the double integration process is contained in S. P. 250, *The Determinations 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 for acceleration. It is sometimes desirable to express acceleration in terms of the acceleration of gravity, indicated by "g" which is equal to 980 cm/sec.² For practical purposes it is only necessary to point off three decimal places to convert cm/sec.² to "g."

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

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

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

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

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

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

Acceleration scales are indicated on the tracings of acceleration curves by two dots, the distance between them representing the equivalent of 100 cm/sec.² when applied to the curves over which they appear. These dots provide a quick means for making auxiliary scales in cases where an investigator desires to make rough measurements on the published curves. The measurements of periods on records of this nature are 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 4.—List of shocks recorded and records obtained on strong-motion seismographs in 1950

Date	Region and recording station	Records		
		Accelerograph	Displacement meter	Weed
Jan. 11	Southern California. Los Angeles Subway Terminal.....	2	1	-----
Jan. 14	Northern California:			
	Ferndale.....	1	1	-----
Feb. 10	Eureka.....	1		
Mar. 7	Chabot.....			1
Mar. 20	Sacramento.....			1
July 28	Imperial Valley:			
	El Centro.....	1		
July 29	El Centro.....	1		
Aug. 21	Calipatria (special).....	1		
Oct. 5	Costa Rica. San Jose.....	1		
Oct. 23	Guatemala. Guatemala City.....	1		
Nov. 16	Southern California. Hollywood Storage Co.....	2		
	Total.....	11	2	2

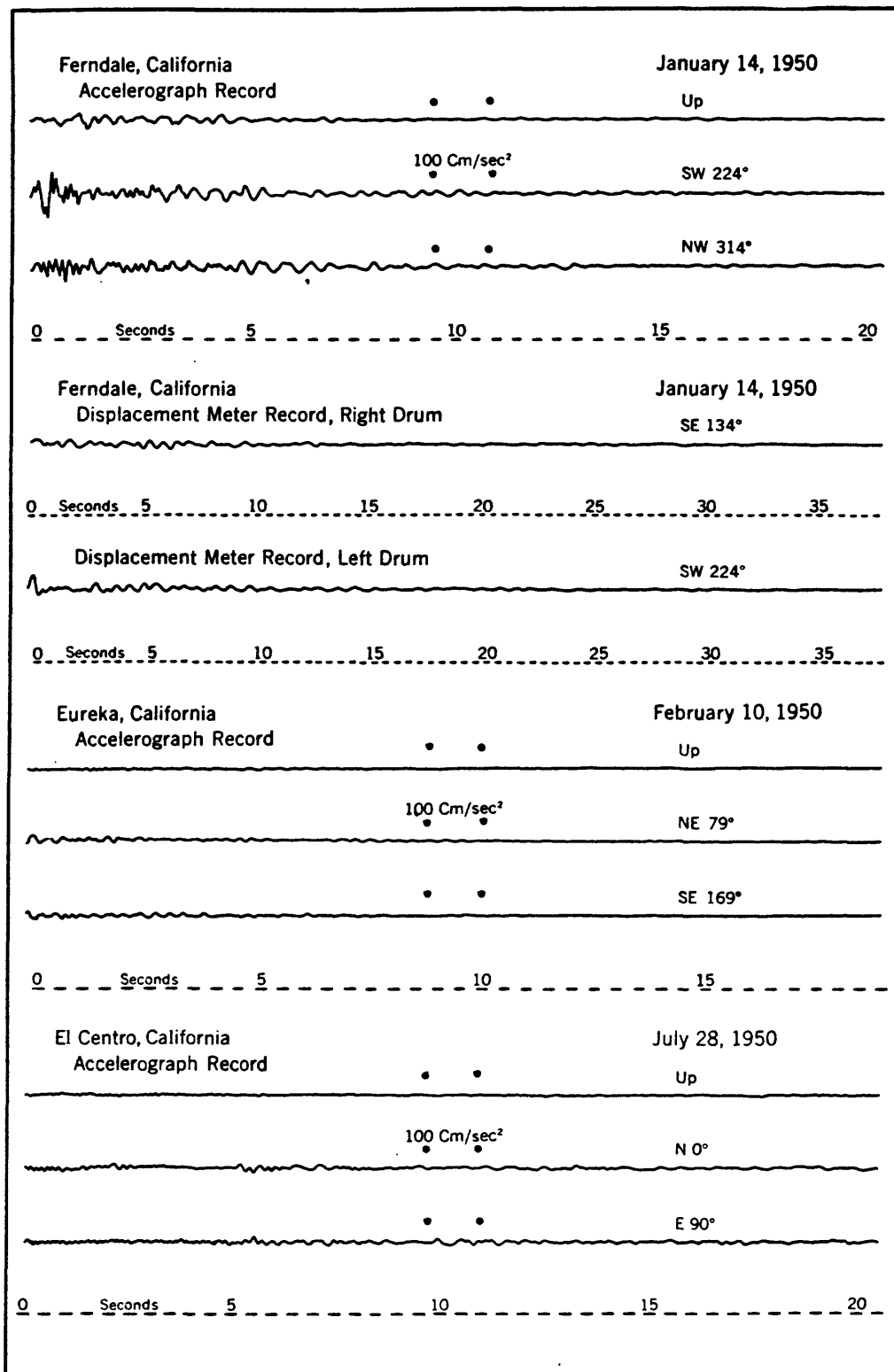


FIGURE 7.—Tracings of accelerograph and displacement meter records obtained at Ferndale on January 14, and of accelerograph records obtained at Eureka on February 10 and El Centro on July 28.

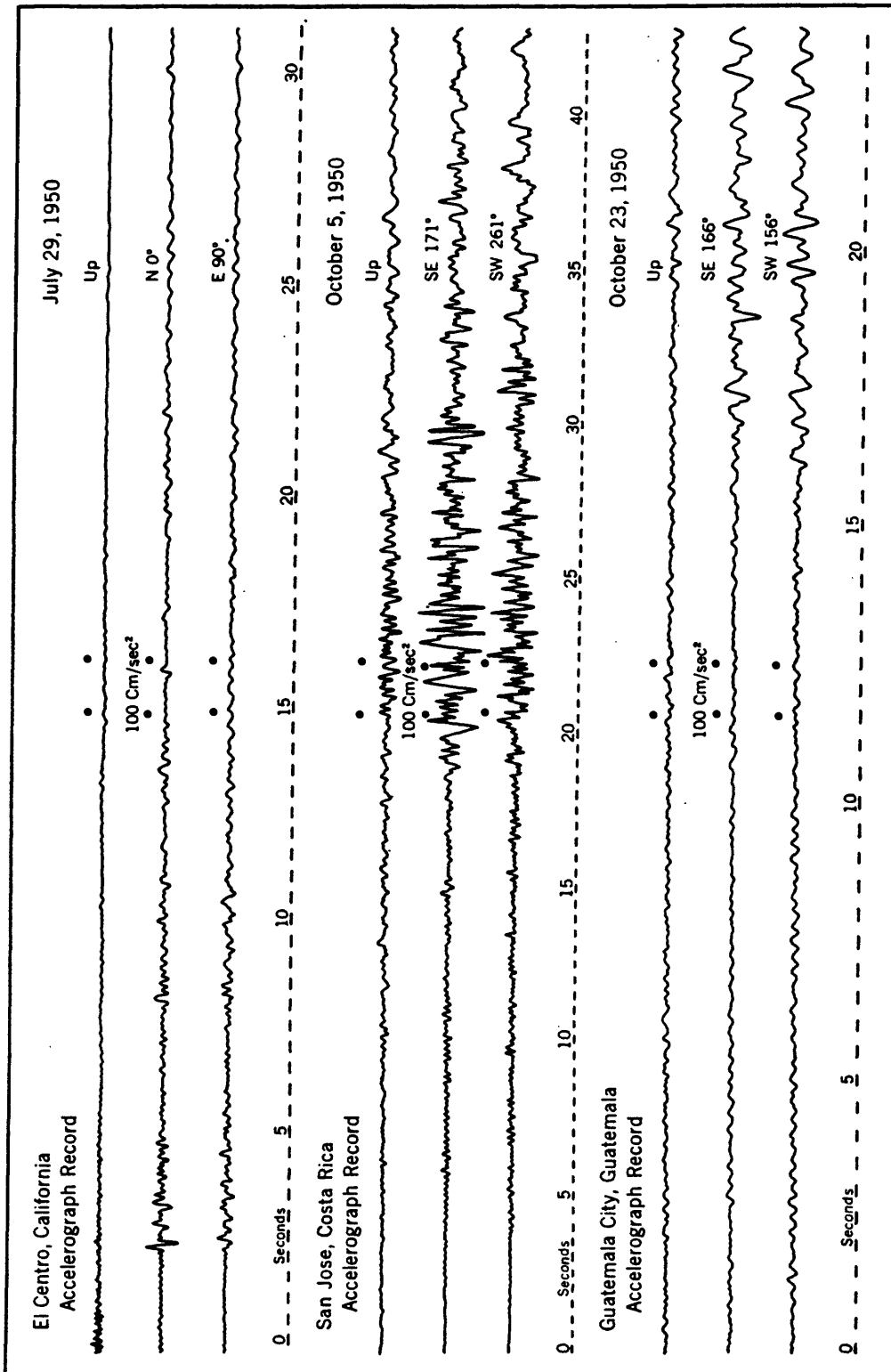


FIGURE 8.—Tracings of accelerograph records obtained at El Centro on July 29, San Jose on October 5, and Guatemala City on October 23.

Table 5.—Summary of outstanding instrumental and noninstrumental data for 1950

Epicenter	Recording station and position ¹	Location of instrument	Intensity ²	Maximum acceleration	Computed maximum displacement
SOUTHERN CALIFORNIA OF EARTHQUAKE OF JAN. 11					
33°57' N., 118°12' W., near South Gate, V*.	Los Angeles Subway Terminal, 55 miles NW. 83°.	Basement..... DM ³ 13th floor.....	V	cm/sec. ³ 6 ----- 12	cm. 0.001 ----- 0.014
NORTHERN CALIFORNIA EARTHQUAKE OF JAN. 14					
40°13' N., 124°25' W., Humboldt County, VI*.	Ferndale, 25 miles NW. 15°.....	1st floor..... DM ⁴	V	35 42	0.140 0.38
NORTHERN CALIFORNIA EARTHQUAKE OF FEB. 10					
41.2° N., 124.3° W., Humboldt County, V*.	Eureka, 64 miles SE. 172°.....	Basement.....	V	8	0.021
NORTHERN CALIFORNIA EARTHQUAKE OF MAR. 7					
37°46' N., 122°10' W., Alameda County, V*.	Chabot Observatory, Oakland, 2 miles S. 180°.	Weed, 1st floor....	IV	3	0.004
NORTHERN CALIFORNIA EARTHQUAKE OF MAR. 20					
40½° N., 121½° W., near Lassen Peak, V*.	Sacramento, 133 miles SE. 179°.....	Weed, basement...	IV	2	0.011
IMPERIAL VALLEY EARTHQUAKE OF JULY 28					
	El Centro.....	Sub-basement.....		7	0.044
IMPERIAL VALLEY EARTHQUAKE OF JULY 29					
33°02' N., 115°36' W., near Calipatria, VIII*.	El Centro, 17 miles SE. 172°.....	Sub-basement.....	V	17	0.061
IMPERIAL VALLEY EARTHQUAKE OF AUG. 21					
33°07' N., 115°34' W., near Calipatria, VI*.	Calipatria (special).....	1st floor.....	VI	3	0.003
COSTA RICA EARTHQUAKE OF OCT. 5					
10½° N., 85° W., northwestern Costa Rica.	San Jose, 155 miles SE. 125°.....	1st floor.....		55	1.321
GUATEMALA EARTHQUAKE OF OCT. 23					
14½° N., 92° W., near coast of Guatemala.	Guatemala City, 196 miles NE. 86°...	Basement.....		36	0.230
SOUTHERN CALIFORNIA EARTHQUAKE OF NOV. 16					
33°55' N., 118°19' W., near Hawthorne, V*.	Hollywood Storage Company, 12 miles NE. 1°.	Penthouse..... Basement.....	IV	6 2	0.036 0.001

¹ Position of station in respect to epicenter.² Reported intensity of earthquake at recording station.³ All displacement meter readings should be assumed as recorded maximum displacement and computed maximum acceleration.⁴ Following intensity designation indicates maximum reported intensity of earthquake.

TABLE 6.—Composite of strong-motion instrumental data for 1950

SOUTHERN CALIFORNIA EARTHQUAKE OF JAN. 11

Station and component ¹	Instru- ment No.	T ₀	V	Sensitiv- ity ²	•	Earth- wave period	Maxi- mum accelera- tion	Maxi- mum displace- ment	Remarks
Los Angeles Subway Terminal Sub-base- ment:		<i>sec.</i>		<i>cm.</i>		<i>sec.</i>	<i>cm/sec.²</i>	<i>cm.</i>	
Vertical-up.....	V-211.....	0.065	125	1.35	8	0.04	6	0.001	Weak record.
SE. 128°.....	L-210.....	0.065	126	1.35	8	0.09	2	0.001	
						0.14	1	0.001	
SW. 218°.....	T-209.....	0.065	127	1.35	8	0.10	2	0.001	
Right displacement me- ter:									
NE. 38°.....	R-15.....	10.0	-----	-----	11	-----	-----	-----	Very weak record.
Left displacement me- ter:									
SE. 128°.....	L-15.....	10.5	-----	-----	12	-----	-----	-----	Do.
Thirteenth floor:									
Vertical-up.....	V-190.....	0.046	123	0.66	9	0.10	7	0.002	Sinusoidal motion.
						0.13	2	0.001	
SW. 218°.....	L-189.....	0.046	126	0.68	11	0.19	7	0.006	
						0.74	1	0.014	Weak long-period waves.
NW. 308°.....	T-188.....	-----	129	-----	11	0.09	12	0.002	
						0.33	1	0.003	

NORTHERN CALIFORNIA EARTHQUAKE OF JAN. 14

Ferndale:									
Vertical-up.....	V-247.....	0.066	122	1.35	13	0.33	12	0.033	Irregular motion.
						0.60	7	0.063	
						0.36	7	0.023	
SW. 224°.....	L-248.....	0.066	129	1.42	10	0.40	35	0.140	Sinusoidal waves. Very irregular mo- tion.
						0.49	10	0.061	
									Several short-pe- riod waves su- perposed.
NW. 314°.....	T-249.....	0.064	114	1.26	11	0.11	14	0.004	Do.
						0.15	19	0.001	
						0.20	9	0.009	
						0.59	13	0.113	
Right displacement me- ter:									
SE. 134°.....	R-13.....	9.9	-----	-----	10	0.9	5	0.10	Irregular motion.
						0.55	12	0.09	
Left displacement me- ter:									
SW. 224°.....	L-13.....	9.9	-----	-----	14	0.6	42	0.38	
						0.55	14	0.11	

NORTHERN CALIFORNIA EARTHQUAKE OF FEB. 10

Eureka:									
Vertical-up.....	V-250.....	0.066	114	1.26	9	0.10	2	0.001	Weak record.
						0.31	2	0.005	
NE. 79°.....	L-251.....	0.067	119	1.34	10	0.32	8	0.021	Possibly preceded by stronger mo- tion at begin- ning.
						0.24	5	0.007	
SE. 169°.....	T-252.....	0.067	119	1.35	11	0.32	3	0.008	Sinusoidal waves. Irregular motion.
						0.30	5	0.011	
						0.34	4	0.012	

NORTHERN CALIFORNIA EARTHQUAKE OF MAR. 7

Chabot Observatory, Oakland. Weed:									
SW. 236°.....	R-8.....	0.207	7.5	0.81	2.4	0.25	3	0.004	Very weak record. Interpretation doubtful.
SE. 146°.....	L-8.....	0.209	7.5	0.83	2.7	0.15	2	0.001	
						0.30	1	0.002	
Sacramento. Weed:									
SE. 108°.....	R-5.....	0.184	6.6	0.57	3	0.50	2	0.011	Very weak record.
SW. 198°.....	L-5.....	0.184	6.6	0.57	3	-----	-----	-----	

See footnotes at end of table.

TABLE 6.—Composite of strong-motion instrumental data for 1950—Continued

IMPERIAL VALLEY EARTHQUAKE OF JULY 28									
Station and component ¹	Instrument No.	T _e	V	Sensitivity ²	ϵ	Earth-wave period	Maximum acceleration	Maximum displacement	Remarks
El Centro:		sec.		cm.		sec.	cm/sec. ²	cm.	
Vertical-up.....	V-208.....	0.064	121	1.27	7	0.14	1	0.001	Irregular waves.
N. 0°.....	V-206.....	0.065	123	1.30	6	0.12	2	0.001	
						0.19	2	0.001	
						0.64	1	0.008	
						0.19	3	0.003	
E. 90°.....	T-207.....	0.065	122	1.33	4	0.48	7	0.042	
						0.71	2	0.019	
						0.12	3	0.001	
						0.57	5	0.044	
						0.78	1	0.017	
IMPERIAL VALLEY EARTHQUAKE OF JULY 29									
El Centro:									
Vertical-up.....	V-208.....	0.064	121	1.27	7	0.08	8	0.002	Irregular waves.
N. 0°.....	L-206.....	0.065	123	1.30	6	0.53	2	0.011	
						0.21	17	0.019	
						0.38	10	0.036	
						0.75	4	0.060	
E. 90°.....	T-207.....	0.065	122	1.33	4	0.17	8	0.006	
						0.47	11	0.061	
IMPERIAL VALLEY EARTHQUAKE OF AUG. 21									
Calipatria (special):									
Vertical-up.....	V-268.....	0.067	119	1.33	9	-----	-----	-----	Weak and short record.
S. 180°.....	L-269.....	0.067	120	1.35	6	0.22	3	0.003	
W. 270°.....	T-270.....	0.067	119	1.35	7	0.21	2	0.002	
COSTA RICA EARTHQUAKE OF OCT. 5									
San Jose:									
Vertical-up.....	V-280.....	0.059	122	1.33	8	0.22	5	0.006	Irregular waves.
						0.42	6	0.027	
						0.33	20	0.055	
						1.05	15	0.419	
SE. 171°.....	L-281.....	0.064	121	1.27	8	1.28	2	0.083	Irregular waves.
						0.25	8	0.013	
						0.58	55	0.468	
						0.39	47	0.181	
SW. 261°.....	T-282.....	0.063	122	1.31	7	2.17	7	0.835	Irregular waves.
						0.21	8	0.009	
						0.77	23	0.345	
						0.20	27	0.027	
						1.54	22	1.321	
GUATEMALA EARTHQUAKE OF OCT. 23									
Guatemala City:									
Vertical-up.....	V-277.....	0.067	118	1.29	9	0.50	12	0.076	Irregular waves.
						0.25	12	0.019	
						0.78	4	0.062	
SE. 166°.....	L-278.....	0.066	120	1.33	10	0.25	8	0.013	Irregular waves.
						0.32	16	0.046	
						0.54	28	0.206	
SW. 256°.....	T-279.....	0.065	117	1.25	9	0.85	6	0.110	Irregular waves.
						0.27	8	0.015	
						0.38	36	0.132	
						0.57	28	0.230	

See footnotes at end of table.

TABLE 6.—Composite of strong-motion instrumental data for 1950—Continued

SOUTHERN CALIFORNIA EARTHQUAKE OF NOV. 16

Station and component ¹	Instru- ment No.	T _e	V	Sensitiv- ity ²	•	Earth- wave period	Maxi- mum accelera- tion	Maxi- mum displace- ment	Remarks
Hollywood Storage Co. Penthouse: ³		sec.		cm.		sec.	cm/sec. ³	cm.	
Vertical-up.....	V-193.....	0.046	118	0.63	7	0.13	3	0.001	Weak record.
S. 180°.....	L-192.....	0.046	123	0.66	10	0.19	3	0.003	Do.
W. 270°.....	T-191.....	0.045	127	0.65	5	0.49	6	0.036	Do.
						0.14	3	0.001	
Basement:									
Vertical-up.....	V-217.....	0.065	124	1.33	10	0.13	1	0.001	Weak record.
E. 90°.....	L-216.....	0.066	121	1.33	7	0.12	2	0.001	Do.
S. 180°.....	T-215.....	0.063	121	1.22	10	0.17	2	0.001	Do.

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 All instruments at this station are wired to start simultaneously.

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.

ADDITIONS AND CORRECTIONS TO PREVIOUS EDITIONS

Additions: Serial 748, Table 1, northern Florida, p. 35. Insert in 8 columns, left to right, H-4, 8-4-46, 12:00, —18.55, —18.57, —16.88, —20.29, 3.41; H-4, 8-4-46, 15:20, —18.57, —18.59, —18.55, —18.62, 0.07; H-4, 8-8-46, 08:00, —18.56, —18.57, —18.57, —18.20, —18.93, 0.73; and H-4, 8-8-46, 11:55, —18.56, —18.55, —18.57, —18.54, 0.03.

Corrections: Serial 748, Table 1, p. 34. Times in column 3 for the first nine entries for northern Florida should read one hour earlier. In addition, time listed for Well No. E-60 should read one hour earlier throughout. Time listed for Well No. H-4, 4-10-46, should read 18:00; 9-25-46 should read 05:50; and 9-29-46 should read 9-28-46 and time should read 22:45. Time listed for Well No. E-46, 8-21-49, should read 23:15. Column 8, p. 34, northern Florida, Well No. E-60, should read 0.02.

Table 1, pages 31-38, inclusive, the one asterisk footnote should follow the box heading of *Depth to water in feet* and should be changed to read as a footnote as follows: Depth to water below land surface datum.

PUBLICATION NOTICES

To make immediately available the results of its various activities to those interested, the Coast and Geodetic Survey maintains mailing lists of persons and firms desiring to receive notices of the issuance of charts, Coast Pilots, maps, and other publications. Should you desire to receive such notices, use the form given below.

For a list of seismological publications of the Coast and Geodetic Survey, request Leaflet M-2013-4 (2), revised January 1952 edition.

DIRECTOR, U. S. COAST AND GEODETIC SURVEY,
Washington 25, D. C.

(Date)-----

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