

**UNITED STATES
EARTHQUAKES
1944**

SERIAL No. 682

**U. S. DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY - WASHINGTON**

U. S. DEPARTMENT OF COMMERCE

HENRY A. WALLACE, Secretary

COAST AND GEODETIC SURVEY

Leo Otis Colbert, Director

Serial No. 682

UNITED STATES EARTHQUAKES

1944

By

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UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1946

For sale by the Superintendent of Documents, U. S. Government Printing Office
Washington 25, D. C. - - - Price 25 cents

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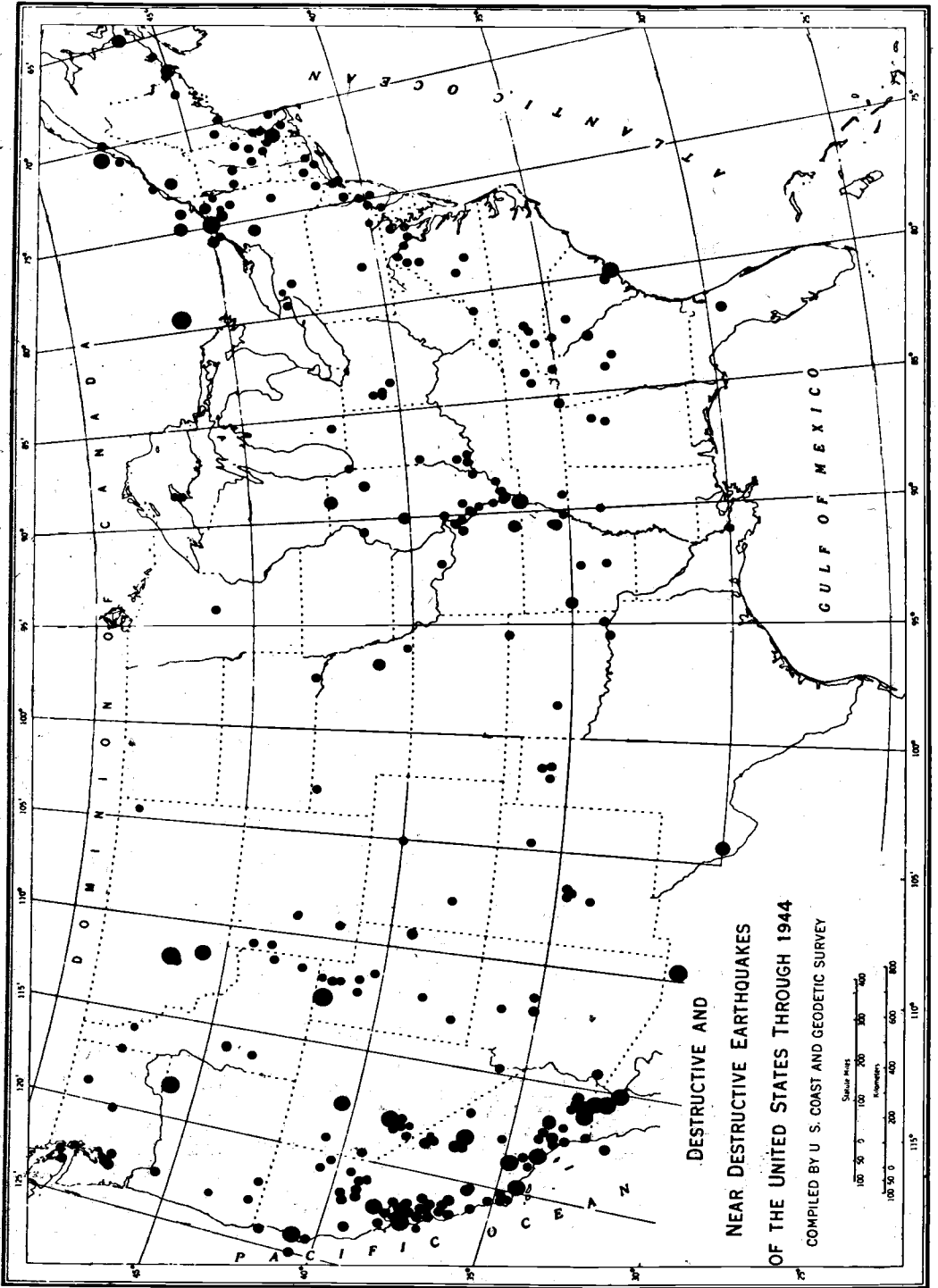


FIGURE 1.—Destructive and near destructive earthquakes in the United States through 1944.

UNITED STATES EARTHQUAKES, 1944

INTRODUCTION

THIS publication is a summary of earthquake activity in the United States and the regions under its jurisdiction for the calendar year 1944. A history of the more important shocks of the country appears in Serial 609 of the Survey, "Earthquake History of the United States: Part I.—Continental United States (Exclusive of California and Western Nevada) and Alaska," and "Part II.—Stronger Earthquakes of California and Western Nevada, Revised (1941) edition."

The history of minor activity is covered largely in a series of references listed in Serial 609, in recent reports of the United States Coast and Geodetic Survey, and in a bulletin of the Seismological Society of America.¹ The last two references give very detailed information for all California earthquakes. The last one contains all of the information appearing in the early catalogs published by the Smithsonian Institution.

Earthquakes of volcanic origin in the Hawaiian and Philippine Islands are not included, and only the stronger shocks are included in the case of the Philippine Islands. Complete reports are published by local seismological institutions. Earthquakes adjacent to the United States and felt within its borders are described only in a general way when detailed descriptions are published elsewhere.

Cooperation of investigators solicited.—In order that these publications may be as complete as possible in the more important details of earthquakes and in references, it is desired that investigators cooperate to the fullest extent, as such cooperation will be to the mutual advantage of everyone concerned. The Survey is willing to furnish investigators all information at its disposal, consisting principally of seismographic records and postcard questionnaires obtained in many instances through special canvassing of affected areas. In return it is requested that advance notices be furnished of results obtained so that abstracts and references may be inserted in these reports. An advance notice of a planned investigation might save considerable overlapping of effort and would give wider publicity to the work of the investigator.

Earthquake information services.—The Coast and Geodetic Survey maintains a field party in San Francisco, the Seismological Field Survey, which in addition to other duties collects earthquake information in the Pacific Coast and Western Mountain States. In this work the Seismological Station of the University of California, Berkeley (Dr. Perry Byerly in charge), and the Seismological Laboratory of the California Institute of Technology, at Pasadena, cooperate actively. 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.

Outside of California the following Collaborators in Seismology served as agents of the Coast and Geodetic Survey in collecting earthquake information in their respective States in 1944.

Arizona.—Dean G. M. Butler, University of Arizona, Tucson.

Colorado.—Prof. C. A. Heiland, Colorado School of Mines, Golden.

Idaho.—Prof. J. D. Forrester, University of Idaho, Moscow.

Montana.—Dr. Francis A. Thomson, 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.

¹ Descriptive Catalog of Earthquakes of the Pacific Coast of the United States, 1769 to 1928. S. D. Townley and M. W. Allen, Bulletin of the Seismological Society of America, vol. 29, No. 1, January 1939.

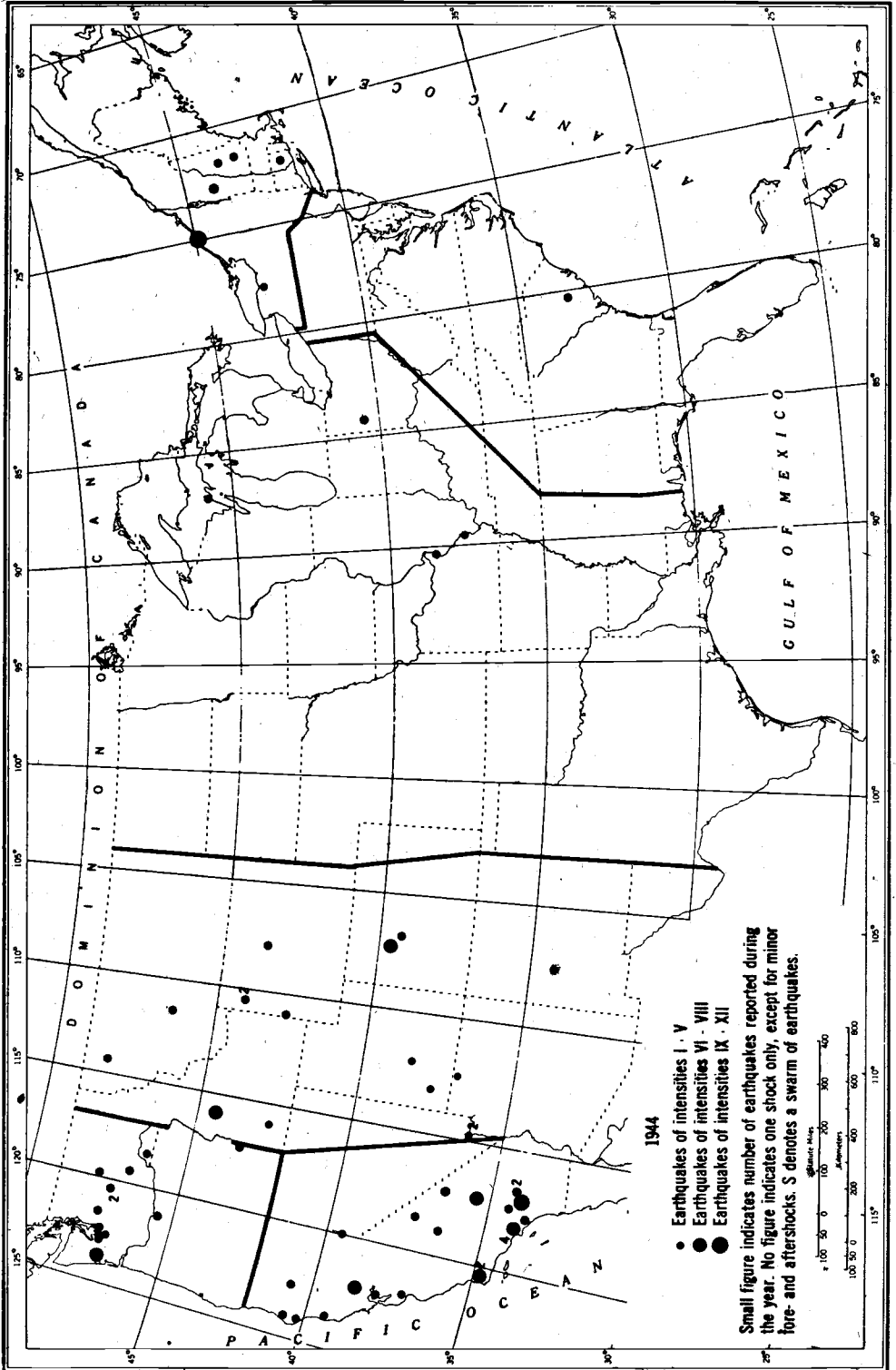


Figure 2.—Earthquake epicenters, 1944.

Oregon.—Dean E. L. Packard, Oregon State Agricultural College, Corvallis.
Utah.—Prof. J. Stewart Williams, University of Utah, Salt Lake City.
Washington.—Dr. Harold E. Culver, Washington State College, Pullman.
Wyoming.—Prof. Horace D. Thomas, University of Wyoming, Laramie.

In other parts of the country the Jesuit Seismological Association was active in cooperative projects. The central office of the association at St. Louis University (Rev. Dr. J. B. Macelwane, S. J., in charge) collected information in the central Mississippi River valley area, and the Seismological Station at Weston College, Massachusetts (Rev. Daniel Linehan, S. J., in charge) undertook similar work in the Northeastern States under the auspices of the Northeastern Seismological Association and in close collaboration with the Harvard Seismological Observatory.

Other sources of information used in compiling this report included: (1) The United States Weather Bureau, whose observers prepare periodic reports on local seismic activity; (2) telegraphic information collected by Science Service, Washington; (3) bulletins of the Seismological Society of America; (4) bulletins of the Northeastern Seismological Association; (5) special bulletins of the Jesuit Seismological Association; (6) Earthquake Notes; (7) reports of the Hawaiian Volcano Observatory; and (8) reports from many interested individuals.

Notes on the regional earthquake lists.—The destructive features of all shocks are enumerated in the abstracts, but otherwise the descriptive matter is reduced to a minimum. The original reports are open for inspection by anyone interested in unpublished details. More detailed descriptions of earthquakes on the west coast will be found in the mimeographed reports available at the office of the Supervisor, Western District, in San Francisco.

Beginning with the 1931 number of this series, Serial 553, the Coast and Geodetic Survey has used and will continue to use the modified Mercalli intensity scale of 1931, in place of the Rossi-Forel scale, to designate the intensity of earthquake activity. All intensity numbers therefore refer to the modified Mercalli scale unless otherwise designated. The reasons for this change are set forth in an article entitled "Modified Mercalli Intensity Scale of 1931," by Harry O. Wood and Frank Neumann, in the December 1931 number of the Bulletin of the Seismological Society of America, Vol. 21, No. 4. This article contains the original unabridged scale and also an abridged scale. The latter is given here, together 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 motor cars 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 motor cars 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 motor cars. (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. Disturbs persons driving motor cars. (VIII+ to IX- Rossi-Forel scale.)
- IX. Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb; great in substantial buildings, with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Underground pipes broken. (IX+ Rossi-Forel scale.)
- X. Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations; ground badly cracked. Rails bent. Landslides considerable from river banks and steep slopes. Shifted sand and mud. Water splashed (slopped) over banks. (X Rossi-Forel scale.)
- XI. Few, if any (masonry), structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipe lines completely out of service. Earth slumps and land slips in soft ground. Rails bent greatly.
- XII. Damage total. Waves seen on ground surfaces. Lines of sight and level distorted. Objects thrown upward into air.

In the case of California, earthquakes reported as feeble are not plotted on the epicenter map of the United States, nor are minor after-shocks plotted for heavy earthquakes in California or any other region. The reader should bear in mind that the information service in California has been developed to a point not approached in any other section of the country. When the coordinates of epicenters are given, the sources of information are stated when the epicenters are determined by other organizations such as the Seismological Station of the University of California or the Seismological Laboratory of the California Institute of Technology. The bulletins of these institutions should be consulted for further details and often for data on additional shocks.

Within the United States the same regional arrangement has been followed as in Serial 609 previously mentioned.

Special quarterly report.—Attention is invited to a special quarterly report issued by the Seismological Field Survey, with headquarters at San Francisco, entitled "Abstracts of Earthquake Reports for the Pacific Coast and the Western Mountain Region." The reports are in mimeographed form and tabulate in unabbreviated style all information of value contained in noninstrumental reports collected in the region indicated.

Epicenter maps.—Figures 1 and 2 are designed to show earthquake distribution in the United States at a glance but the reader is cautioned in accepting all epicenter locations as correct. In a few cases, especially offshore epicenters and others in uninhabited areas, where instrumental control is not satisfactory or where results of investigations are overdue, the plotted epicenters may be in error. The maps must therefore be accepted as showing, in some cases, the existence of epicenters rather than their precise locations. The text of the publication should be consulted to appraise any individual case. This same condition prevails also, to some extent, in the case of isoseismal maps. In figure 2 the relative intensity of a shock is indicated by the size of the dot.

Teleseismic results.—On page 27 is a list of Survey and cooperating teleseismic stations for which the Survey publishes results. Immediate epicenter determinations are frequently made through the cooperation of Science Service, the Jesuit Seismological Association, the Coast and Geodetic Survey, and individual stations. The results are furnished by mail to cooperators.

Strong-motion results.—The introductory remarks in the chapter on this subject explain in detail the purpose of the work, which is primarily to furnish engineers exact information concerning ground movements in the central regions of strong earthquakes. The instrumental equipment is essentially different in type from teleseismic equipment although the principles involved are the same. Strong-motion instruments are installed mostly in the urban areas of California, and operate only when actuated by the movements of a strong earthquake.

The interpretation of strong-motion results is one of the duties assigned to the Survey in connection with a broad cooperative program of seismological research being carried out on the Pacific coast between the Survey and a number of

local organizations and institutions interested in the engineering aspects of the earthquake problem. The details of this program are fully described in the Survey's Special Publication No. 201, "Earthquake Investigations in California, 1934-35," which is obtainable from the Superintendent of Documents, Washington 25, D. C., for 35 cents.

Preliminary reports on strong-motion results are issued in quarterly mimeographed bulletins and sometimes in special mimeographed reports. They appear in revised form in this publication.

NONINSTRUMENTAL RESULTS

NOTE.—The following symbols are used to indicate authority for the data shown.

P —epicenter reported by the Seismological Laboratory of the California Institute of Technology at Pasadena.

B —epicenter reported by the Seismological Station of the University of California at Berkeley.

BC —epicenter reported by the Boulder City office of the Lake Mead Seismological Survey.

W —epicenter reported by the Washington Office of the U. S. Coast and Geodetic Survey.

An asterisk (*) indicates instrumental time. Time is indicated as continuous from 0 to 24 hours, beginning and ending at midnight.

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 which may be obtained from the Washington Office of the U. S. Coast and Geodetic Survey.

EARTHQUAKE ACTIVITY IN THE VARIOUS STATES

Arizona: January 30.

California: Intensity VI shocks, February 16, June 12, 13, 18 (2), July 2; Intensity V shocks, January 12, March 15, April 12, June 10, 11, 19, November 16; Intensity IV shocks, January 12, 14, 15, June 11, July 26 (2) September 21, October 23, November 16, December 23. A number of sharp shocks of smaller intensity occurred on March 13, May 2, June 1, 7, July 8, 29, August 15, 25, September 3, 17, October 9, 19, 28, November 7, 10, 19, 30, December 5 (2), 13. Other minor shocks are not listed here.

Colorado: September 3 (intensity VI), October 5.

Connecticut: December 13, intensity IV, also felt lightly in New York state.

Delaware: January 8.

Idaho: May 9, July 12 (intensity VII, also felt in Montana, Oregon, and Washington), July 24, 26.

Michigan: November 16.

Missouri: January 7, September 25.

Montana: June 6, 21, July 16, 18, September 5, 12, November 29.

Nevada: June 14, August 6. A series of 46 weak shocks confirmed by instrumental records were reported.

New Hampshire: March 6, April 11.

New York: January 16, February 26, September 5 (intensity VII, strongest shock of the year, also felt in Connecticut, Delaware, Illinois, Indiana, Maryland, Massachusetts, Maine, Michigan, New Hampshire, New Jersey, Ohio, Pennsylvania, Rhode Island, West Virginia, Wisconsin, Vermont, and Virginia), October 31.

Ohio: November 13.

Oregon: March 5, September 19.

South Carolina: January 28.

Utah: May 3, June 5, 13.

Vermont: June 3.

Washington: January 9, 28, March 30, 31, 31 (intensity V), May 9, September 1, 7, 18, October 7, 31 (intensity V), December 6, 25.

Wyoming: October 2, 8, 11, 25.

Alaska: January 26, 28, February 25, 26, 28, July 18, 30, October 20.

Hawaii: November 12, December 27.

NORTHEASTERN REGION

(60TH MERIDIAN OR EASTERN WAR TIME)

January 16: About 06:00. Rochester, New York. The U. S. Weather Bureau Meteorologist at Rochester reported: "On Sunday morning a slight tremor lasting approximately 30 seconds was observed by a resident. This was later verified by another person outside of the city. The Rochester observer, an engineer by profession and former resident of California, had had previous experience with earthquakes."

February 26: 16:58.3*. A very local shock was recorded on the seismograph at Canisius College, Buffalo, New York.

March 6: 01:46 to 08:15. Concord, New Hampshire. A series of slight shocks was felt by several.

April 11: 16:25. Woodstock, New Hampshire. Felt by many. Thirty seconds duration. began with trembling and increased until house swayed.

June 3: 22:15. Barre, Graniteville, Montpelier, Northfield, and Waterbury, Vermont. Light shock apparently strongest at Northfield where it was felt by most of the population.

September 5: 00:39. Provisional epicenter 44°58' north, 74°48' west, according to Dominion Observatory, Ottawa, Canada. This position may be slightly revised on completion of a special study now under way. In the United States the shock was felt over an area of approximately 175,000 square miles. A field investigation of the epicentral area was made by seismologists of the Dominion Observatory. It revealed a true center about midway between Cornwall, Ontario, and Massena, New York, with a total damage estimate of \$2,000,000.

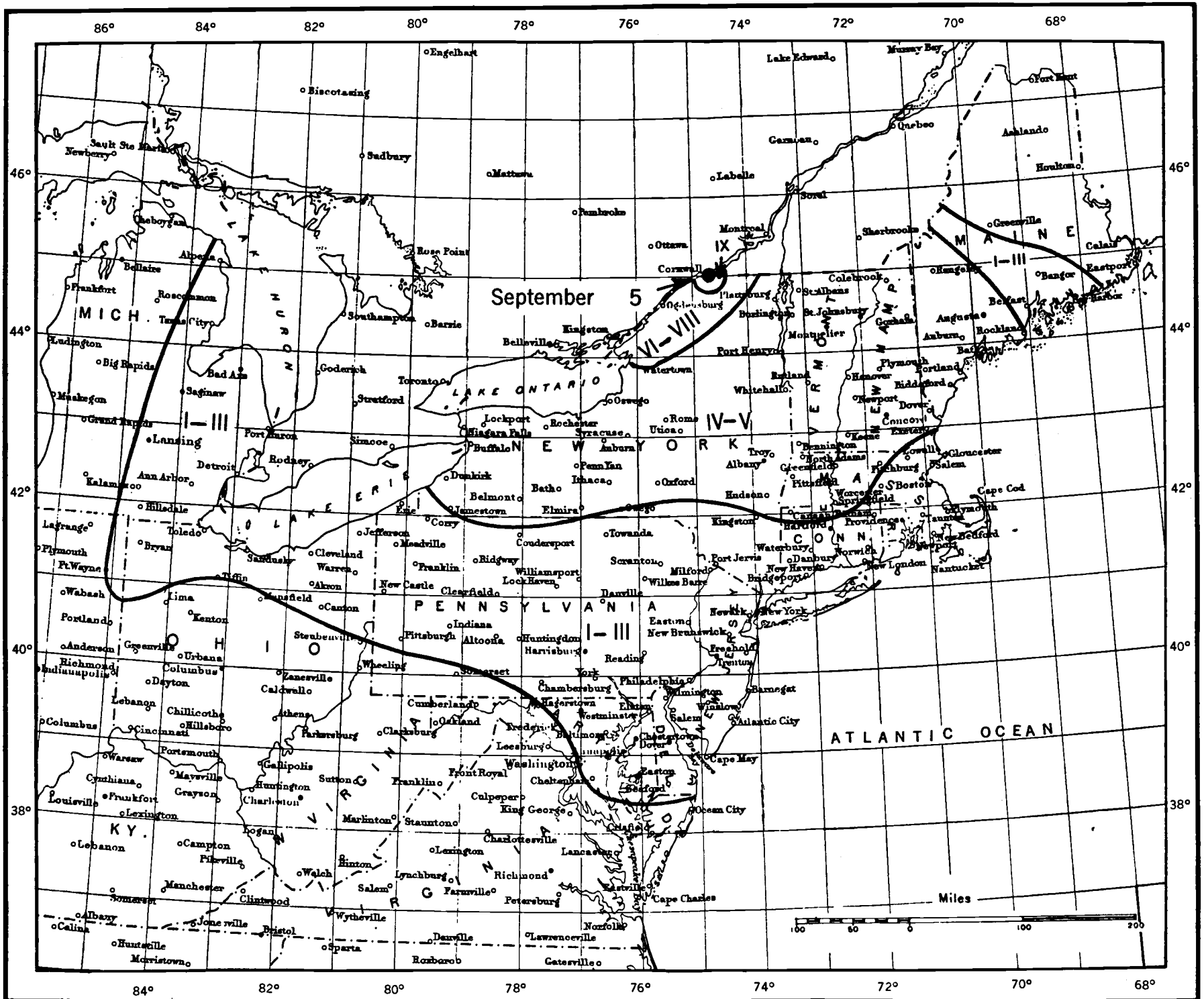


FIGURE 3.—Area affected by the Massena, New York-Cornwall, Ontario, earthquake of September 5, 1944.

A large number of chimneys required rebuilding and many structures were rendered unsafe for occupancy until repaired. Press reports indicated a large number of wells in St. Lawrence County, New York, went dry causing acute hardship. Effects of the shock were noted on the records of a number of stream gaging stations in northern New York, Long Island, and in Westchester County. The water level in several wells on Long Island was changed slightly as indicated by records of the water level recorders of the U. S. Geological Survey. Tabulated results were furnished for publication in this report. See tables, page —. Fourteen aftershocks were noted by November 1. The strongest nearly equaled the intensity of the first and occurred on September 9 at 19:25.

INTENSITY VIII:

Massena.—All frightened. Destroyed or damaged ninety percent of the chimneys. Damaged masonry, plumbing, and house foundations. Broke windows. Estimated damage \$1,000,000.
Hogansburg.—Trees shaken strongly. Damaged brick masonry and concrete structures. Cracked ground.

INTENSITY VII:

Fort Covington.—Some chimneys fell. Broke windows. Cracked plaster, walls, and ground.
Keeseville.—Some chimneys fell. Broke windows. Cracked plaster. Awakened all.
Malone.—Chimneys cracked and fell. Walls cracked. Awakened all.
Norfolk.—Chimneys fell. Trees shaken strongly. Broke windows, dishes, and plaster. Pictures and knickknacks fell.
Ogdensburg.—Chimneys cracked or fell. Broke windows and dishes. Awakened all and frightened many.
Waddington.—Chimneys fell. Broke dishes and windows. Plaster fell. Awakened all.

INTENSITY VI:

Au Sable Forks.—Cracked chimneys. Awakened all.
Carthage.—Broke dishes. Cracked plaster. Overturned vases and small objects.
Chateaugay.—Awakened all. Frightened many.
Clayton.—Broke windows. Cracked chimneys. Plaster, pictures, and books fell.
Gouverneur.—Cracked walls. Slight damage to masonry.
Norwood.—Books, pictures, and knickknacks fell. Awakened all.
St. Regis Falls.—Broke dishes. Plaster, pictures, and knickknacks fell. Overturned vases.
Watertown.—Awakened all. Broke dishes. Overturned vases. Plaster and pictures fell.
Winthrop.—Grocery stocks fell. Broke glass containers and dishes.

INTENSITY V IN MASSACHUSETTS:

Great Barrington.

INTENSITY V IN NEW YORK:

Albany, Auburn, Baldwinville, Batavia, Bath, Binghamton, Canton, Cape Vincent, Chatham, Colton, Dannemora, Deposit, Elizabethtown, Elmira, Fort Edward, Mineville, Olean, Oneonta, Oswego, Oxford, Parishville, Post Jarvis, Plattsburg, Pulaski, Rochester, Rouses Point, Saratoga Springs, Sherburne, Speculator, Tupper Lake, Utica, Waverly, Wellsville, and Whitehall.

INTENSITY V IN VERMONT:

Burlington, Rutland, and Saint Albans.

INTENSITY IV IN CONNECTICUT:

Danbury, Hartford, Marion, New Britain, New Haven, New Milford, Meriden, Stratford, Torrington, and West Cornwall.

INTENSITY IV IN MAINE:

Lewiston, Farmington, Skowhegan, and Waterville.

INTENSITY IV IN MASSACHUSETTS:

Amherst, Athol, Concord, Greenfield, North Adams, Pittsfield, Plymouth, Springfield, and Turners Falls.

INTENSITY IV IN NEW HAMPSHIRE:

Berlin, Claremont, Colbrook, Concord, Conway, Dover, Exeter, Gorham, Graveton, Hanover, Keene, Laconia, Littleton, Manchester, Newport, North Wakefield, Plymouth, Walpole, Woodstock, and Whitefield.

INTENSITY IV IN NEW JERSEY:

Newark and Trenton.

INTENSITY IV IN NEW YORK:

Amsterdam, Belmont, Boonville, Buffalo, Cobleskill, Cooning, Dansville, Dunkirk, Ellenburg, Fulton, Geneva, Hamilton, Hoosick Falls, Hornell, Hudson, Ithaca, Johnstown, Kingston,

Lake Placid, Little Falls, Lockport, Lawville, Niagara Falls, Newark, Norwich, Owego, Port Henry, Raquette Lake, Sackets Harbor, Salamanca, Schenectady, Sidney, Skaneateles, Springville, Syracuse, and Ticonderoga.

INTENSITY IV IN PENNSYLVANIA:

Erie, Milford, New Castle, Philadelphia, Scranton, Towanda, and Wilkes-Barre.

INTENSITY IV IN VERMONT:

Bennington, Brandon, Brattleboro, Charlotte, Island Pond, Middlebury, Montpelier, Newport, Richford, Rochester, Shelbourne Village, South Hero, St. Johnsbury, White River Junction, and Winooski.

INTENSITY I TO III IN CONNECTICUT:

Plainfield.

INTENSITY I TO III IN DELAWARE:

Seaford and Wilmington.

INTENSITY I TO III IN ILLINOIS:

Chicago and Princeton.

INTENSITY I TO III IN INDIANA:

Indianapolis, South Bend, and Fort Wayne.

INTENSITY I TO III IN MAINE:

Augusta, Bangor, Bar Harbor, Dover-Foxcroft, Eastport, Oldtown, Portland, Rangeley, and Rumford.

INTENSITY I TO III IN MARYLAND:

Baltimore and Westminster.

INTENSITY I TO III IN MASSACHUSETTS:

Boston, Gloucester, East Wareham, Fall River, Lowell, Newburyport, Plymouth, and Taunton.

INTENSITY I TO III IN MICHIGAN:

Lansing, Saginaw, Alpena, Detroit, Grand Rapids, and Sault Ste. Marie.

INTENSITY I TO III IN NEW HAMPSHIRE:

Nashua and Portsmouth.

INTENSITY I TO III IN NEW JERSEY:

Atlantic City, Freehold, and Cape May.

INTENSITY I TO III IN OHIO:

Akron, Ashland, Canton, Bryan, Cincinnati, Cleveland, Mansfield, and Toledo.

INTENSITY I TO III IN PENNSYLVANIA:

Allentown, Corry, Danville, Erie, Franklin, Harrisburg, Indiana, Meadville, Philadelphia, Reading, and Williamsport.

INTENSITY I TO III IN RHODE ISLAND:

Kingston, Lansdale, Providence, Wakefield, and Woonsocket.

INTENSITY I TO III IN VERMONT:

West Burke.

INTENSITY I TO III IN VIRGINIA:

Norfolk and Richmond.

INTENSITY I TO III:

Washington, D. C.

INTENSITY I TO III IN WEST VIRGINIA:

Parkersburg.

INTENSITY I TO III IN WISCONSIN:

Milwaukee.

Negative reports were received from eighty-eight places.

October 31: 04.42. Massena, New York, and Cornwall, Ontario. Light aftershock of September 5 earthquake. This shock was also felt at Canton, Dannemora, Malone, and Potsdam. It was recorded by seismographs at Ottawa, Seven Falls, and Shawinigan Falls in Canada.

December 13: 23:15. Center probably between New Britain and Wallingford, Connecticut. Press reports indicated it was felt over the entire state. Specific reports when plotted indicated the area east of a line running northeast from Bridgeport to Putnam may not have been shaken. This may be related to geology of the region but no reliable conclusion can be drawn since there is reason to believe that effects may not have been fully reported.

INTENSITY IV:

Wallingford.

INTENSITY I TO III:

Avon, Berlin, Bridgeport, Bristol, East Hampton, Hartford, Middletown, Milford, New Britain, New Haven, Putnam, Willimantic, and Torrington.

INTENSITY I TO III IN NEW YORK:

Poughkeepsie.

EASTERN REGION

(60TH MERIDIAN OR EASTERN WAR TIME)

January 8: Time not given. Wilmington, Delaware (press), "For 45 seconds Saturday, persons from six miles south of here to the southwestern outskirts of Philadelphia felt the ground tremble with varying degrees of intensity. Windows rattled, houses shook, but there was no sound. Seismographs failed to disclose an earthquake, the Army and Navy said there were no explosions in the area."

January 28: 13:30. Summerville, South Carolina. Felt by many. No damage.

CENTRAL REGION

(75TH MERIDIAN OR CENTRAL WAR TIME)

January 7: 00:18*. Brazeau, Cape Girardeau, Jackson, Oak Ridge, Perryville, and Uniontown, Missouri. Not generally felt, apparently strongest at Brazeau and Jackson.

September 25: 06:37. Light shock apparently strongest at St. Louis and Webster Groves, Missouri and at East St. Louis, Illinois where windows and dishes rattled. Felt slightly at Cairo and Springfield, Illinois and at Mt. Vernon, Indiana.

November 13: 06:52. Press reports stated the center apparently was near Anna and Botkins, Ohio. No damage. It was also felt at Beaver Dam, Findlay, Kenton, Lakeview, Lima, Sidney, and Van Wert, Ohio, and Indianapolis, Indiana.

November 16: 13:35 and 13:49. Escanaba, Michigan. Light shock felt by several and was recorded on barograph.

WESTERN MOUNTAIN REGION

(90TH MERIDIAN OR MOUNTAIN WAR TIME)

NOTE.—Only the more important shocks felt at Boulder Dam and the more important aftershocks at Helena, Montana are listed.

January 30: 22:24:58*. Epicenter 36.9° north, 112.4° west, P. Fredonia, Arizona. Motion rapid, abrupt beginning, lasting 3 seconds. Felt by many. Direction SW. Rattled windows and doors. Hanging objects swung.

January 31: 17:22:19*. Boulder City, Nevada. Motion rapid, slight, abrupt beginning, lasting 3 seconds. Building quivered.

February 27: 19:29*. Boulder City (Boulder Power Plant), Nevada. Motion slight, lasting 2 seconds. Felt by several.

March 26: 15:33:09*. Boulder City, Nevada. Two shocks, about 1 second apart. Motion rapid, lasting 3 to 4 seconds. Rattled windows and doors. Felt by several.

May 3: 18:45. St. George, Utah. Very slight shock lasting momentarily. Felt by many. Walls creaked. Slight noise heard.

May 4: 03:01:14*. Boulder City, Nevada. Three shocks felt within 10 seconds. Motion rapid. One shock lasted three seconds. Felt by observer in home. Rattled windows. Second shock was heaviest and of longest duration.

May 9: 13:53* and 13:58*. Mullan and Burke, Idaho. A press report stated: "An earthquake was felt about 2 p.m. on May 9th in Burke and Mullan, but so far no reports have been received that the shock extended to any other part of the district. The seismograph at Mount St. Michael's Scholasticate near Spokane, Washington, showed minor tremors from 1:53 to 1:58 p.m., PWT, when the major shock was recorded. Residents in various places in Mullan and Burke reported they felt one shock which they described as very distinct. Some said their first thought was that a huge weight had dropped suddenly to the ground, while one woman said she thought two freight cars had collided. Another report was that there was a decided east-west sway to the tremor. Workers in the 'Midnight' above Mullan also reported feeling the tremor. The shock caused a staging to fall in a slope off the 4,450-foot level in the Morning Mine at Mullan and one worker was buried in the muck to his knees, causing

body injuries. Three other Morning Mine workers were peppered by flying rock when the slippage broke timbers and knocked out headings in another section of the mine. Mine officials said that no cave-in occurred and no ground was lost although the tremor was felt throughout the workings."

A special report from Burke stated that the shock was felt by many there.

May 10: 06:07:26*. Boulder City, Nevada. Rapid motion, lasting 1 second. Felt by observer.

May 10: 19:04:22*. Boulder City, Nevada. Motion rapid, lasting 1 second. Felt by several in home.

May 15: 22:21:14*. Boulder City, Nevada. Abrupt motion, lasting less than 1 second. Felt by observer. Rattled windows.

May 15: 22:35:07*. Boulder City, Nevada. Light quiver lasting 1 to 2 seconds. Felt by several. Windows rattled.

May 16: 10:31:40*. Boulder City, Nevada (Municipal Building). Momentary quiver felt.

May 17: 06:16:30*. Boulder City, Nevada. Momentary quiver felt.

May 27: 03:44:37*. Epicenter five miles northwest of Boulder Dam, BC. Boulder City, Nevada observer felt shock—"Very light. Typical shock for this locality."

May 28: 05:38:05*, 11:41:15*. Epicenter 2 miles northwest of Boulder City, Nevada, BC.

May 28: 12:08:25*. Epicenter 1 mile northwest of Boulder City, Nevada, BC.

May 28: 12:56:25*, 15:42:55*, 15:44:50*, and 17:28:51*, BC. A series of very light shocks reported felt by one person.

May 30: 01:01:52*, BC. Boulder City, Nevada. A very light shock of momentary duration. Awakened observer.

May 30: 22:40:11*, BC. Boulder City, Nevada. Felt by several.

May 31: 06:07:39*, BC. Boulder City, Nevada. Light shock felt.

June 1: 04:21:34*, BC. Boulder City, Nevada. Light shock of momentary duration felt by one person.

June 4: 06:01:40*, BC. Boulder City, Nevada. Motion rapid, abrupt beginning, momentary duration. Felt by observer. Typical noise from light shock.

June 4: 08:17:46*, BC. Boulder City, Nevada. Motion rapid, abrupt beginning, momentary duration. Felt by observer and others. Typical light shock.

June 5: 09:45. Monroe, Utah. One short, sharp shock felt by several in community.

June 6: 17:18. Helena, Montana. Moderate tremor.

June 13: 05:48. Cedar City, Utah. Motion slow, lasting 2 or 3 seconds. Felt by two in home. Direction E. Shifted bed.

June 15: 19:13:02*, BC. Boulder City, Nevada. Motion rapid, lasting 1 second. Rattled windows.

June 15: 19:24:50*. Epicenter 2 miles NW. of Boulder City, Nevada, BC. Felt by several at Boulder City. Light shock.

June 16: 00:02:22*. Epicenter 2 miles SW. of Boulder Dam, Nevada, BC. Awakened two at Boulder City.

June 16: 23:19:48*. Epicenter 1 mile E. of Boulder City, Nevada, BC. Light shock felt by several in Boulder City. Windows rattled.

June 21: 01:30. Big Prairie Ranger Station (Sec. 10, T20N, R13W, Kalispell, Montana). Bumping motion with abrupt onset. Felt by several. Loose objects rattled and buildings creaked. Bumping, thunderous subterranean sounds heard before shock. Awakened persons at Salmon Forks Cabin (Sec. 35, T22N, R14W).

June 29: 02:05* and 02:10*, BC. Boulder City, Nevada. Very light shocks of momentary duration felt by a few people.

July 12: 13:30.4*. Epicenter about 44.7° north, 115.2° west, W. Seafoam, Idaho. Intensity VII. This earthquake was felt over a large area, about 70,000 square miles, in the States of Idaho, Montana, Oregon, and Washington. Vicinity of Seafoam (press), "On Tuesday, July 11, a man on the range near Sheep Mountain on Fontez Creek heard rumblings resembling distant thunder and felt one earth tremor. The next day, Wednesday, July 12th, the first heavy shock was felt at the Seafoam Ranger Station. It came suddenly and was accompanied by very heavy rumblings. The buildings shook so hard that the occupants thought they were coming apart. A new cabin, set on concrete piers, was nearly displaced. The second shock came about 1:55 p.m. and was somewhat less severe. The quakes continued until about 10 p.m., at which time 17 in all had been felt, all of them being quite severe and the last one being particularly strong, although not as strong as the first one. The first shock was very strong. One man reported that the mountain on which he was working moved at least a foot. When he first felt the shock he was bent over. To keep his balance he had to brace himself and was unable to rise during the tremor. Another man, working on a fault several miles up Seafoam Creek, reported that it must have been particularly severe there. He re-

ported that the rocks rose at least a foot into the air and that it looked like someone had set off a series of blasts all the way up the hill. He states that the ground rose at least a foot all along the hill. He managed to get behind a big fir tree and avoid the boulders that crashed down where he was working. Two men were going down Rapid River and had just climbed out of the canyon wall and heard a terrific roar behind them. Upon their return two days later they found that a whole section of the canyon wall and trail just below Lime Creek had caved into the river. They experienced extreme difficulty in returning over the obstacle. Greyhound Lookout felt the quakes. A man sitting on the ground at Little Soldier Mountain reported that he could not rise during the earthquake. A rock weighing at least five tons crashed into the road over Vanity Summit, making an 18-inch impression in the

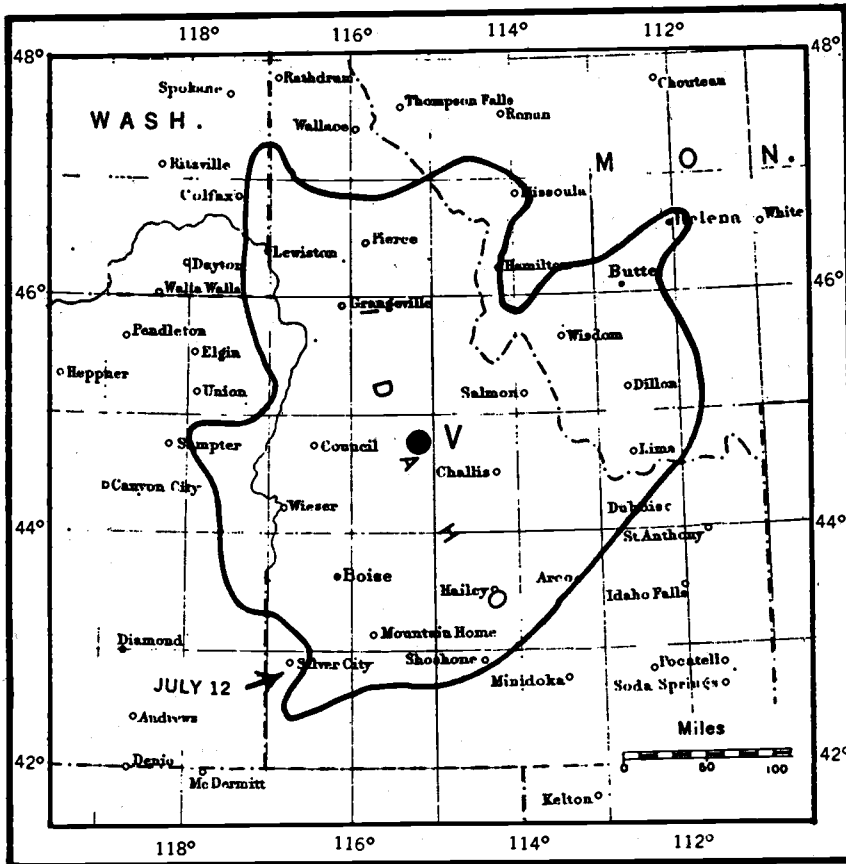


FIGURE 4.—Area affected by the Idaho earthquake of July 12, 1944.

middle. Rocks also crashed across the trail for several days on Fontez Creek near Sheep Mountain and cracks were opened in the trail up Duffield Canyon over 100 yards long. Along the road below Seafoam cracks from one inch to three inches wide were opened. These extended for several hundred yards in a continuous break. People at Seafoam felt this quake and thought it must have been centered near Sheep Mountain. It seemed like the atmosphere was very heavy and that the sun was shadowed just before the quakes. All seemed to be accompanied by rumblings which at times were very loud. Following the quakes 5 o'clock Thursday morning, several more were felt that day and the next. These were not severe, but were strong enough to rattle windows. Up until 2:40 Saturday they were mild, but we had experienced 35 separate and distinct shocks."

INTENSITY VII IN IDAHO:

- Cascade.*—Motion rapid, lasting 30 to 45 seconds. Felt by many. Windows rattled and two chimneys fell. Shifted chair. Damage slight.
- Seafoam and vicinity.*—See press report quoted above. The intensity may have been greater than VII as indicated in the reports of rock falls.

INTENSITY VI IN IDAHO:

Atlanta.—Motion slow, lasting a few seconds. Felt by many in post office; outdoors by some. Windows and dishes rattled. Hanging objects swung. Furnishings shifted and knickknacks fell.

Big Creek.—Motion rapid, lasting two minutes. Felt by many. Windows and doors rattled. House creaked. Trees and bushes were shaken moderately. Knickknacks, books, and pictures fell.

Clayton.—Motion jerky, lasting 1 minute. Felt by many in community; outdoors by some. Rattled windows and dishes. Shifted small objects. Pictures fell.

Hailey.—Motion slow. Felt by several in home; outdoors by some. Rattled dishes. Trees and bushes were shaken slightly. Cracked plaster and chimneys. Damage slight.

INTENSITY V IN IDAHO:

Boise, Cambridge, Forney, Goodrich, Idaho City, Lowman, Pine, Rocky Bar, Salmon, and Yellow Pine.

INTENSITY V IN MONTANA:

Wisdom.

INTENSITY V IN OREGON:

Vale.

INTENSITY IV IN IDAHO:

Baker, Brunneau, Carmen, Challis, Cottonwood, Council, Crouch, Dixie, Donnelly, Ellis, Elk River, Emmett, Fairfield, Garden Valley, Gilmore, Grangeville, Hammett, Heath, Howe, Ketchum, Leadore, Lemhi, Lewiston, McCall, May, Midvale, Mountain Home, New Meadows, North Fork, Obsidian, Old, Patterson, Payette, Pierce, Shoup, Stanley, Sunbeam, Sweet, Tendo, Warm Lake, Wildhorse, and Weiser.

INTENSITY IV IN MONTANA:

Anaconda, Armstead, Conner, Dillon, Hamilton, Missoula, Norris, and Polaris.

INTENSITY IV IN OREGON:

Baker, Adrian, Nyssa, and Robinette.

INTENSITY IV IN WASHINGTON:

Farmington, Pullman, and Palouse.

INTENSITY I TO III IN IDAHO:

Caldwell, Gibbonsville, Gooding, and Richfield.

INTENSITY I TO III IN MONTANA:

Deer Lodge, Jackson, Kalispell, Monida, Reichle, Sheridan, and Stevensville.

Negative reports were received from thirty-five places in Idaho, Montana, Oregon, and Washington.

July 13: 20:21*. Boulder City, Nevada. Very light shock felt.

July 16: 12:46*. Boulder City, Nevada. Very light shock felt.

July 16: 18:05. Kalispell, Montana. Trembling motion, barely perceptible. Felt by a few. Barometer in Weather Bureau Office swung.

July 18: 05:50. Kalispell, Montana. Trembling motion, barely perceptible. Felt by a few. Barometer in Weather Bureau office swung.

July 24: 18:00. Cottonwood, Idaho, 3 miles west of. Motion slow, lasting 2 seconds. Felt by several in community. Direction E-W. Windows rattled and walls creaked.

July 26: 18:50 and 19:50. Big Creek, Idaho. Small objects overturned. Also felt distinctly at a point forty miles east of Big Creek. Felt lightly at Boise, Garden Valley, and Sunbeam.

August 2: 22:24*. Epicenter about seven miles north of Boulder City, Nevada, BC. Felt lightly.

August 10: 17:50*. Boulder City, Nevada. Slight shock felt.

August 12: 15:08*. Boulder City, Nevada. Very light shock felt.

September 4: 03:26*. Epicenter about five miles southeast of Boulder Dam, BC. Awakened a few at Boulder City. Felt by several at Boulder Power Plant.

September 5: 12:20. Helena, Montana. One weak tremor, lasting 1 second.

September 7: 10:24*. Boulder City, Nevada. Slight earth rumble of two-second duration.

September 8: 22:30. This earthquake, centering in western Colorado, was felt over an area of approximately 3,000 square miles. From reports received a maximum intensity of VI was indicated at several localities. Montrose (press), "Dishes and windows rattled and beds shook in Montrose, at 10:30 p.m. Friday as a slight earth tremor was felt there and in several other southwestern Colorado communities. No damage or injury was reported. The temblor

lasted about a minute in Montrose, and a few residents rushed into the streets. The earth movement also was felt at Delta, 22 miles northwest of Montrose; at Olathe, and at Ridge-way, 20 miles south of Montrose. Reports from representatives of the Public Service Company of Colorado stated slight tremors were felt at Bigelow and Rhudi, on the Frying Pan River. One woman said dishes were broken in her cabin in Evergreen, but no other reports from the Evergreen district were received, and officials at Evergreen said no other residents there had felt any tremors."

INTENSITY VI:

Basalt.—Motion rapid, lasting 2 or 3 seconds. Felt by many in home and community. Rattled windows. Overturned small objects. Cracked walls and chimneys. Bricks fell from chimneys. Damage slight. A number of rocks were loosened and rolled onto the road.

Montrose.—Gradual onset. Felt by many. Buildings creaked and loose objects rattled. Plaster cracked in a few instances.

Riland.—Continuous vibration for one minute. Felt by all in home. A log house strongly built was slightly moved out of line. Direction E-W.

INTENSITY V:

Aspen, Eagle, Edwards, Gilman, and Grand Junction.

INTENSITY IV:

Crawford, Glenwood Springs, Minturn, Molina (3 miles S of), and Sapinero.

INTENSITY I TO III:

Cedaredge, Gypsum, and Steamboat Springs.

Negative reports were received from twenty-seven places.

September 12: 08:45. Helena, Montana. One weak tremor, lasting 2 seconds.

September 14: 08:42*. Boulder City, Nevada. Very light shock felt.

September 24: 15:36*. Epicenter 6½ miles southeast of Boulder Dam, Nevada, BC. Felt by several.

October 2: 20:27, 20:30, and 20:36. Yellowstone National Park (south entrance), Wyoming. Three distinct tremors were felt. The first at 08:27 p.m. was weak, the second immediately following was strong enough to rattle dishes and swing suspended objects in a SE direction, the third at 08:36 p.m. was slight. Three persons at station in two separate buildings felt these shocks. The first movement at 08:27 p.m. appeared slow followed immediately by a rapid shaking of the building. The first two shocks were felt by several persons at the Flag Ranch, two miles south of this station. The third shock was felt by at least three persons at the Flag Ranch. Frightened all at the station. At Moran it was felt with abrupt onset and E-W swaying. Dislodged canned goods. Subterranean sounds were heard by several. Hanging objects swung. Buildings swayed slightly. Shock was reported to observer from 14 miles west and also 12 miles east of Moran.

October 5: 08:05. Aspen, Colorado. Motion rapid, lasting 3 seconds. Felt by many. Awakened some. Rattled windows. Hanging objects swung.

October 8: 04:40. Grover, Wyoming. Motion trembling, with abrupt onset. Felt by several. Loose objects rattled and buildings creaked.

October 8: 21:29:42*. Epicenter 3 miles SSW of Boulder Dam, Nevada, BC. Felt by several at Boulder City. Windows rattled.

October 11: Time not given. Thermopolis, Wyoming (press), "Thermopolis residents reported feeling a slight tremor today. They said buildings shook and several earth slides were reported in the vicinity of Thermopolis. A highway department crew foreman said rocks slid from high on the walls of Wind River canyon after the tremor and had to be cleared from the highway. The superintendent of Hot Springs State Park said the tremor caused a caving of earth on the south rim of the large hot spring in the park."

October 15: 01:30:12.4*. Epicenter probably 5 miles south of Boulder Dam, Nevada, BC. Felt lightly by several at Boulder City.

October 15: 04:40:07.4*. Epicenter 3 miles northwest of Boulder City, Nevada, BC. Many were awakened in Boulder City.

October 15: 05:20. Boulder City, Nevada. Felt by several.

October 15: 12:20. Boulder City, Nevada. Felt by several.

October 15: 12:41:56.9*. Epicenter 1½ miles northwest of Boulder City, Nevada, BC. Felt lightly in Boulder City.

October 15: 16:38:20.9*. Epicenter 2 miles northwest of Boulder City, Nevada, BC. Felt lightly in Boulder City.

October 21: 03:50:14*. Epicenter 3 miles southwest of Boulder Dam, Nevada, BC. Felt lightly in Boulder City.

October 24: 02:37:14*. Epicenter within 1 or 2 miles of Boulder City, Nevada (probably north), BC. Rapid motion of momentary duration rattled windows and doors in Boulder City. Many were awakened.

October 25: 14:25. Canyon, Yellowstone National Park, Wyoming. Felt by two. Hanging light swung.

November 21: 00:34*. Epicenter 1 mile north of Boulder City, Nevada, BC. Felt by several. Windows rattled.

November 26: 05:15*. Epicenter 2½ miles NNW of Boulder City, Nevada, BC. Felt by a few.

November 29: 06:20. Boulder City, Nevada. Felt by several. Rattled doors and windows.

November 29: 09:00. Helena, Montana. Weak shock, lasting 2 seconds.

CALIFORNIA AND WESTERN NEVADA

(105TH MERIDIAN OR PACIFIC WAR TIME)

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

January 10: 07:39*, P. Mineral. Felt. Noticed by only one family in area.

January 10: 21:55. Mineral. Duration two or three seconds. Felt by several. Floor lamp vibrated.

January 10: 22:52. Mineral. Duration two or three seconds. Felt by several.

January 12: 08:03. Epicenter not located. Probably was off coast. Intensity V at Cape Mendocino, Eureka, and Ferndale. Intensity IV. at Cummings, Scotia, Upper Mattole, and Westport.

January 12: 16:30. San Anselmo. Intensity IV. Felt by all. Second shock followed first within a few seconds and was shorter.

January 14: 01:08:21*. Epicenter 33°44' north, 118°09' west, P. Near Seal Beach. Long Beach (press) "The ground shuddered while Long Beach slept early today, but the disturbance was so slight that the slumbers of the citizens were not interrupted. The quake was not felt in near-by communities."

January 14: 21:24. Ferndale and Upper Mattole. Intensity IV. Felt by many.

January 15: 19:26. Ferndale and Upper Mattole. Intensity IV. Felt generally at Upper Mattole.

January 17: 07:23. Mineral. Felt by several in community.

January 19: 17:30. Livermore. "An earthquake shock of minor intensity was recorded in this area. No damage." (SSA Bulletin, April 1944.)

January 22: 14:24:53*. Epicenter 35°33' north, 118°55' west, P. Felt eighteen miles east of Bakersfield.

January 22: 14:39:31*. Epicenter 35°33' north, 118°55' west, P. One slight bump felt eighteen miles east of Bakersfield.

January 26: 06:17:48*. Epicenter 35°33' north, 118°55' west, P. One slight bump felt eighteen miles east of Bakersfield.

January 26: 21:52. Not recorded by Seismological Laboratory stations. Bumping motion felt by several. Windows rattled.

January 27: 04:17:36*. Epicenter 35°33' north, 118°55' west, P. At Kern Canyon a bumping motion awakened the observer. A slight bumping was felt by three families eighteen miles east of Bakersfield.

January 27: 14:10:12*. San Jose (press) "An earthquake, evidently felt only in the southeastern section of San Jose, registered on all components of the Ricard Memorial Observatory seismograph, University of Santa Clara, at 2:10:12 p.m. It lasted one minute. Naglee Park residents evidently felt the shock more severely than other sections of the city. Seismologists placed the epicenter within a radius of 10 miles of the Observatory."

January 28: 20:26:20*. Epicenter 35°33' north, 118°55' west, P. Felt by several at Kern Canyon, also at a point eighteen miles east of Bakersfield.

January 31: 00:28:48*, 00:43:49*, 01:16:59*, 07:09:49*. Epicenter 35°33' north, 118°55' west, P. Bakersfield (press), "A series of earth shocks, moderate in intensity and climaxing in four shocks in about six hours, were reported this morning by California Edison Company's Powerhouse at the mouth of Kern River. Four distinct shocks were felt, none heavy enough to do damage."

January 31: 00:28:48*. Eighteen miles east of Bakersfield. Moderate bumping. Windows and dishes rattled.

January 31: 00:43:49*. Eighteen miles east of Bakersfield. Slight bumping.

January 31: 01:16:59*. Eighteen miles east of Bakersfield. Slight bumping.

January 31: 07:09:49*. Eighteen miles east of Bakersfield. Felt.

February 3: 09:05:38*. Epicenter 35°33' north, 118°55' west, P. Eighteen miles east of Bakersfield. Felt by two persons. Rumbling subterranean sounds were heard at time of shock.

February 16: 21:33:44*. Epicenter about five miles south of Berkeley, B. This shock was felt over an area of about 400 square miles. The outer limits of the felt area included

Crockett, southeasterly through Moraga to Hayward, thence northwesterly through San Lorenzo to Oakland and Richmond.

INTENSITY VI:

San Leandro.—Plaster cracked, knickknacks and vases fell.

INTENSITY V:

Alameda and Moraga.

INTENSITY IV:

Emeryville, Hayward, Oakland, San Lorenzo, and Walnut Creek.

INTENSITY I TO III:

Canyon and St. Mary's College.

Negative reports were received from twenty-one places.

March 12: 14:48. Oakland. Felt by all in home.

March 13: 07:45. San Jose. "An earthquake shock described as 'sharp' in some parts of San Jose was felt. Lick Observatory seismograms showed that it was a light and local one. A similar report was received from the Rosicrucian planetarium." (SSA Bulletin, July 1944.)

March 13: 18:28. Fairfield. Lasted one second. Felt by many and frightened a few in community.

March 15: 01:15:06*, B. Aptos and San Jose. This shock was felt over an area of about 2,000 square miles. The outer limits of the felt area included San Rafael, southeasterly through San Leandro, Mt. Hamilton, Hollister to Chualar, thence northwesterly along the coast through Salinas, Castroville, Santa Cruz, Pescadero, to San Francisco.

INTENSITY V:

Aptos and San Jose.—Shifting of small objects, many awakened.

INTENSITY IV:

Ben Lomond, Castroville, Chualar, Felton, Gilroy, Hollister, Madrone, Morgan Hill, Moss Landing, Salinas, San Carlos, San Juan Bautista, San Leandro, San Martin, Santa Cruz, South San Francisco, Sunnyvale, and Watsonville.

INTENSITY I TO III:

Agnew, Aromas, Boulder Creek, Hayward, Holy City, Irvington, Los Gatos, San Rafael, Saratoga, and Soquel.

Negative reports were received from thirty-two places.

March 29: 21:15. Point Bonita Light Station (Fort Barry). Felt by several and awakened some in community. Rattled windows.

April 12: 09:30. Ortega Hill and Rincon. "A sharp earthquake rocked the area between Ortega Hill and Rincon, residents of this district reported. Apparently the shock was local, since it was not felt in Santa Barbara." (SSA Bulletin, July 1944.)

April 12: 18:55:40.2*, BC. Chrome, foothill area. Intensity V. Motion rapid, lasting a few seconds, accompanied by roaring noise like an explosion. Felt by many in community. Frightened all in home. Rattled windows. Shifted small objects. Loosened gas pipe connections, according to one observer. Also felt twenty miles west of Red Bluff.

April 15: 21:10:02*. Epicenter about 34°10' north, 117°29' west, P. Etiwanda. Motion moderate. Felt by many. Walls creaked. Direction NE.

April 25: 06:37. San Leandro. Motion rapid, lasting two seconds. Felt by many in home.

May 2: 21:05. San Jose. "A light earthquake estimated to have centered 15 miles southeast of San Jose was felt in the city last night. The seismologist in charge of the Ricard Memorial Observatory, University of Santa Clara, said the record began at 49 seconds after 9:05 p.m., PWT. Some residents of the area reported feeling the shock. It was also noticed at Lick Observatory." (SSA Bulletin, July 1944.) At Ben Lomond it was felt by many in home.

May 4: 13:10. Hayward. Felt by one observer. One second duration. Direction NW. Trees and bushes were shaken slightly.

May 15: 17:45. Los Banos. "Several residents of Los Banos reported feeling a slight earthquake at approximately 5:45 p.m., PWT., May 15. It shook light fixtures and rattled windows." (SSA Bulletin, July 1944.)

May 31: 17:50:43*. Epicenter about 35°32' north, 118°47' west, P. Felt at Bakersfield and Kern Canyon. Motion rapid, lasting one to two seconds. Felt by several in home and community, outdoors by some. Rattled windows.

May 31: 18:35*. Epicenter about 35°32' north, 118°47' west, P. Felt at Bakersfield and Kern Canyon. Motion rapid, lasting one to two seconds. Felt by many in home and in community, outdoors by some. Rattled windows.

June 1: 23:27:53*, BC. Epicenter 10 to 13 miles distant. Shasta seismological station near Redding. Motion rapid. Felt by many in home and in community. Doors rattled. "Single jolt resembling nearby lightning. Many noted resemblance to Boulder City earthquakes."

June 5: 16:40. Eureka. Motion trembling, with abrupt onset. Felt by few.

June 5: 17:38:53.3*, BC. Loleta. Gradual motion, lasting ten seconds. Felt by many. Rattled windows, house creaked. Trees and bushes were shaken slightly.

June 5: 18:39. Owens River Gorge, Adams Main Powerhouse. Momentary duration. Felt by several, outdoors by some. Hanging objects swung. One observer felt a sudden rise of the floor.

June 7: 14:10:57*. Epicenter about 34°13' north, 117°30' west, P. San Andreas Fault zone, near Cajon. Motion rapid with abrupt beginning, lasting three seconds. Felt by many. Rattled windows. Direction NW.

June 8: 15:00. Victorville. Very light trembling motion. Felt by a few.

June 10: 04:11:49.9*, 04:15:31*, 04:26:11*. Epicenter 33°58' north, 116°48' west, P. San Andreas Fault, near Cabazon. The shocks did no damage but were distinctly felt at Banning and Cabazon which are only a few miles from the epicentral position.

INTENSITY V:

Banning, Cabazon, Coachella, Fawnskin, Keen Camp, and Lake Arrowhead.

INTENSITY IV:

Elsinore, Hemet, Indio, Wildomar, and Yucaipa.

INTENSITY I TO III:

Mt. Wilson and Riverside.

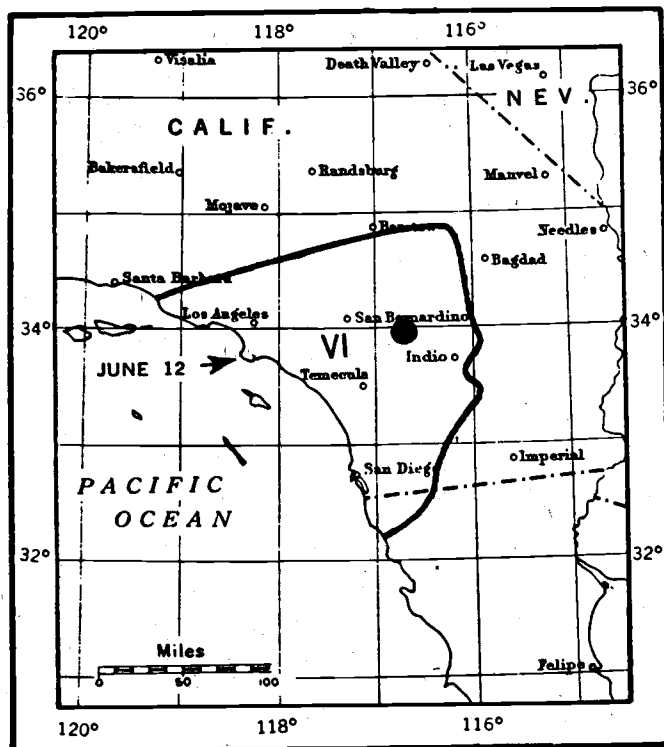


FIGURE 5.—Area affected by the earthquake of June 12, 1944.

June 11: 03:15. Alpine. Intensity IV. Trembling motion, then hard shock and jar. Felt by many. Loose objects rattled. Some rumbling heard. Awakened observer. Frightened one.

June 11: 09:18*, B. Hollister. Intensity V. This shock was slightly felt at Tres Pinos about seven miles southeast of Hollister. A record was obtained on the Hollister Weed strong-motion seismograph.

Negative reports were received from eight places.

June 12: 03:45:34*, 04:16:35.3*. Epicenter 33°58' north, 116° 45' west, P. San Andreas Fault, north of Cabazon. These shocks were felt over an area of approximately 16,000 square miles in southern California. See map page 16. A maximum intensity of VI was reported from Banning where plaster was cracked. Small objects overturned in Los Angeles. Intensity V was reported from numerous localities where shifting of small objects occurred, or the shock was reported as being felt by practically everyone. No damage other than that of cracked plaster was reported. Five shocks were reported felt at Banning and Hemet. Many towns felt two shocks. Strong-motion records were obtained from the two accelerographs and the displacement meter in the Subway Terminal Building in Los Angeles.

Banning.—Motion moderate, lasting four seconds. Awakened all and frightened many in community. Rattled windows, house creaked. Overturned vases. Broke dishes. Cracked plaster; some plaster fell. Small shocks at 06:10, 06:50, and 08:30. Slight rumble preceded the first main shock, but the second was abrupt with no noise preceding. Second shock caused lights to swing vigorously in a NNW-SSE direction.

Corona.—Motion rapid, beginning abrupt. Rattled windows and doors. Overturned vases.

INTENSITY V:

Aguanga, Altadena, Baldwin Park, Barrett Dam, Burbank (Airport Weather Station), Coachella, Colton, Covina, Crestline, Fallbrook, Fawnskin, Hollywood, Indio, Keen Camp, Los Angeles, Lake Arrowhead (Sec. 22, T2N, R3W), Lucerne Valley, Mecca, Moreno, Pasadena, Riverside, San Pedro, Seven Oaks, and Temecula.

INTENSITY IV:

Acton, Adelanto, Alhambra, Alpine, Arlington, Artesia, Beaumont, Bellflower, Cabazon, Campo, Cajon, Del Mar, Descanso, Elsinore, Escondido, Etiwanda, Fontana, Fullerton, Glendale, Glendora, Glenn Ranch, Hemet, Highland, Huntington Beach, Inglewood, La Canada, La Crescenta, Laguna Beach, La Habra, Lakeside, Long Beach, Ludlow, Lynwood, Maywood, Mesa Grande, Montebello, Monrovia, Mount Laguna, Newport Beach, Oceanside, Ontario, Orange, Oxnard, Pala, Palm Springs, Palos Verdes Estates, Pomona, San Bernardino, San Diego, San Dimas, San Gabriel, San Juan Capistrano, San Marcos, San Onofre, Santa Ana, Santa Monica, Santa Ysabel, South Gate, Thermal, Topanga, Twentynine Palms, Twentynine Palms (35 miles W of), Valyermo, Victorville, Warner Springs, Whittier, Wildomar, and Yucaipa.

INTENSITY I TO III:

Culver City, Gardena, Hesperia, and Tujunga.

Negative reports were received from thirty-six places.

June 13: 01:27:32*, 01:46:43*, and 04:07:24*. Epicenter about 34°40' north, 120°30' west, P. Near Lompoc (press), "Three little earthquakes were felt early Tuesday morning that were severe enough to make houses rattle and awaken people. No damage was reported. Some people claim they felt two other tremors."

INTENSITY VI:

Los Alamos.—Four shocks at 01:27*, 01:47*, 04:07*, and 08.00. Felt by many. Bumping motion. Windows rattled and house creaked. Whistling subterranean sounds were heard before shock by many. Visible swaying of buildings and trees. A few articles fell off shelves in stores.

Santa Maria.—Motion slow, lasting 30 seconds. Awakened many in home. Windows rattled. Direction N.

June 14: 16:40 and 17:22. Reno, Nevada (Weather Bureau station). Felt by observer only. Trembling motion, with rapid onset. Sharp marks appeared on barograph trace. Noise of wind prevented hearing any sounds.

June 18: 17:03:33* and 20:06:07*. Epicenter about 33°52' north, 118°13' west, P. Inglewood Fault near Dominguez Junction. These shocks were felt over an area of about 12,000 square miles in southern California. See maps pages 18 and 19. Intensity VI was reached at several localities which reported overturned objects, cracked plaster, and broken windows. Strong-motion records were obtained from practically all instruments in the Los Angeles area.

Los Angeles (press), "Five earthquake shocks, including two sharp tremors at 5:03 and 8:06 p.m. on June 18th and two others early on the morning of the 19th, left minor property damage, scattered broken windows, and jangled nerves in the Los Angeles area today. Seismologists reported that the four shocks were the heaviest since the Long Beach earthquake of 1933. Last night's sharp tremors set fixtures dancing in homes, dishes crashed to the floor, buildings swayed, burglar alarms clattered and many persons fled to the streets. It was the second disturbance of the earth's crust in a week, minor quakes having been recorded last Monday. The lesser shocks occurred at 12:29 a.m., with Hawthorne, South Gate, and Huntington Park the apparent center, and at 12:53, with Compton the center. They were believed to have been caused by a shift of the Inglewood Fault, which extends southward through the Signal Hill oilfields and Huntington Park into Mexico. A four-foot marble slab toppled 12 feet from the front of a dress shop at 118 North Pacific Avenue in Redondo Beach. During the first shock, which was the most generally felt and heaviest one, three women attending baccalaureate services at the South Gate High School fainted. The sheriff's radio system and a number of traffic lights were momentarily disrupted, but no gas or electric

facilities were damaged. The beach communities from Long Beach to Santa Monica absorbed the heaviest jolts. The quakes seemed to lose their effect further inland."

Pasadena (press), "The first tremor was an undulating quake, and the second a sharp, jarring one. Dishes shook from shelves, canned goods toppled in grocery stores and other minor damage was reported in the Compton-Torrance area. Temple City sheriff's substation was kept busy answering calls on the first shock but did not feel the second jar. The situation was reversed in San Gabriel where only a mild shock was felt at 5:03 p.m. but a rolling 12-second quake reported at 8:06 p.m. by police. Monrovia felt the first shock but not the second. Alhambra police felt both quakes and had only a few calls from curious residents. Altadena sheriff's substation reported very light shocks both times and no telephone calls. South Pasadena and San Marino police also reported only light quakes. It was the same in Arcadia and Montrose. Police in Sierra Madre did not feel either shock and had no telephone calls from residents who did."

First shock, 17:03:33.*

INTENSITY VI:

Compton.—Felt by all in community. Rattled windows, walls creaked. Overturned vases.

Hollywood.—Felt by many in home. Direction N-S. Frightened many in community. Rattled windows, house creaked. Hanging objects swung; pendulum clocks stopped. Trees and bushes were shaken strongly. Shifted small objects; knickknacks fell.

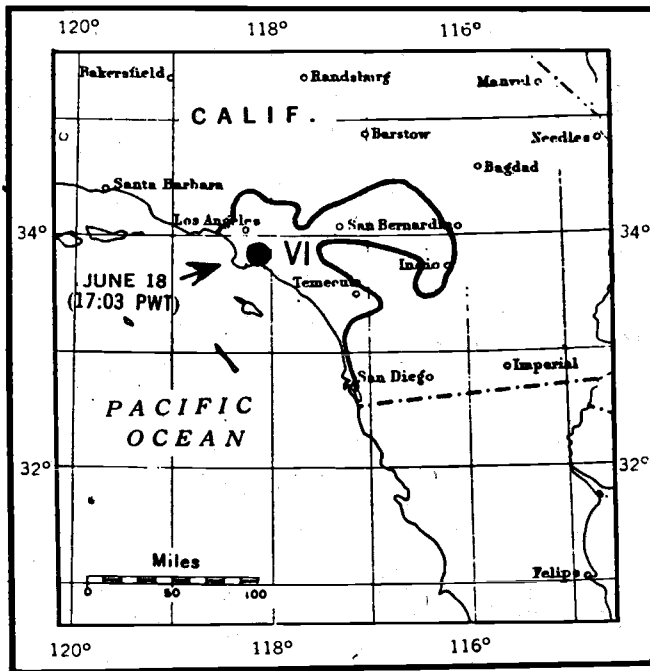


FIGURE 6.—Area affected by the earthquake of June 18, 1944, at 17h 03m., P.W.T.

Huntington Park.—Felt by all. Direction NE. Windows rattled, house creaked. Hanging objects swung NE. Shifted small objects, overturned vases. Cracked plaster and chimneys. Knickknacks fell. Damage slight.

Lynwood.—Motion rapid, accompanied by rumble, lasting 15 seconds. Felt by all in community. Frightened many in community. Rattled windows, house creaked. Shifted small objects, overturned vases. Cracked plaster on all walls. "A very heavy shock."

Maywood.—Motion slow and sharp, lasting 3 seconds. Felt by all. Direction outdoors E-W. Frightened all in community. Rattled windows, house creaked. Hanging objects swung E-W. Trees and bushes were shaken moderately. Cracked plaster and windows. Knickknacks and plaster fell. Damage slight.

South Gate.—Motion rapid. Felt by all. Awakened and frightened all in community. Rattled windows, house creaked. Overturned small objects, knickknacks and books fell.

Willowbrook.—Motion rapid, lasting 6 seconds. Felt by many in home. Rattled windows, house creaked. Direction W-E. Frightened many in home. Overturned vases and small objects, knickknacks and books fell. Broke dishes.

INTENSITY V :

Beverly Hills, La Mirada, Long Beach, Los Angeles, Santa Ana, Torrance, Walnut, and Whittier.

INTENSITY IV :

Alhambra, Clearwater, Forest Home, Fullerton, Hermosa Beach, Hynes, Keen Camp, Los Alamitos, Manhattan Beach, Montebello, Puente, Sage, San Gabriel, San Pedro, and Seven Oaks.

INTENSITY I TO III :

Culver City, Gardena, Oceanside, Olive View, Palm Springs, Palos Verdes Estates, Pasadena, San Bernardino, San Diego, and San Dimas.

Negative reports were received from twenty-eight places.

Second shock, 20:06:07.*

INTENSITY VI :

Gardena.—Felt by all in home. Direction S-N. Rattled windows and doors. Hanging objects swung. Cracked plaster and chimneys. Knickknacks, books, and pictures fell. Broke dishes. Damage slight to brick and masonry.

Lynwood.—Motion rapid, abrupt, lasting a few seconds. Felt by all; frightened all in community. Rattled windows, house creaked. Hanging objects swung S-N. Trees and bushes were shaken slightly. Overturned small objects.

Maywood.—Motion rapid, lasting 3 seconds. Awakened and frightened all in community. Rattled windows, house creaked. Hanging objects swung NE-SW. Trees and bushes were shaken slightly. Cracked plaster. Broke windows.

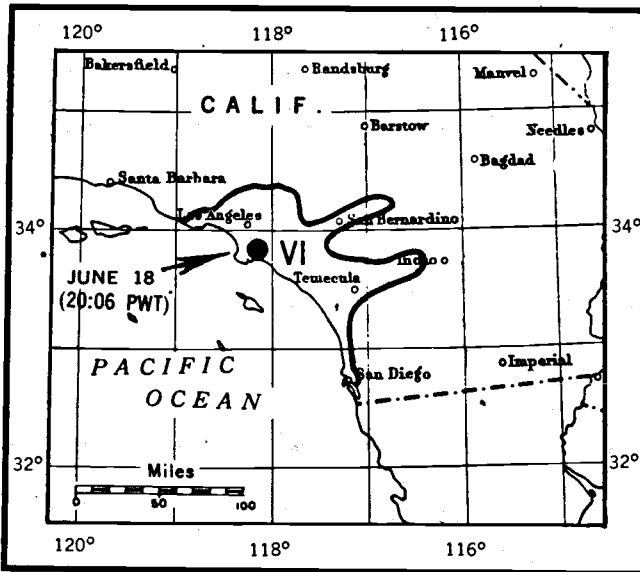


FIGURE 7.—Area affected by the earthquake of June 18, 1944, at 20h 06m., P.W.T.

South Gate.—Motion rapid. Felt by all in community. Frightened all in home. Rattled windows and dishes, house creaked. Overturned small objects.

Torrance.—Motion rapid, abrupt, lasting about 15 seconds. Felt by all; frightened all in community. Direction SW-NE. Rattled windows. Hanging objects swung. Overturned vases. Pictures fell.

INTENSITY V :

Hermosa Beach, Huntington Park, Long Beach, Los Angeles, Pacific Palisades, San Pedro, and Whittier.

INTENSITY IV :

Alhambra, Anaheim, Artesia, Bell, Beverly Hills, Burbank, Clearwater, Compton, Hynes, Keen Camp, Los Alamitos, Manhattan Beach, Ocean Park, Pasadena, San Pedro, Seven Oaks, and Willowbrook.

INTENSITY I TO III:

Covina, Culver City, Palm Springs, Palos Verdes Estates, San Diego, and Santa Ana. Negative reports were received from twenty-eight places.

June 19: 00:28:50*, 00:53:11*. Epicenter about 33°52' north, 118°13' west, P. Inglewood Fault near Dominguez Junction. These shocks were mild and were felt over a much more limited area than those of the 18th. The felt area covered approximately 3,000 square miles in southern California. One isolated report came from Palm Springs. One report of slight plaster cracks was received from Gardena (possibly cracks from the shocks of the 18th). Reports generally stated that loose objects rattled and houses creaked.

INTENSITY V:

Gardena and Huntington Beach.

INTENSITY IV:

Burbank, Huntington Park, Long Beach, Los Alamitos, Los Angeles, Lynwood, Maywood, Olive View, Torrance, and Whittier.

INTENSITY I TO III:

La Mira, Palm Springs, Santa Ana, South Gate, and Willowbrook.

Negative reports were received from twenty-five places.

June 24: 00:14*, 00:23*, P. Hollister. Motion rapid, lasting 1 second each. Felt by several. Rattled windows, house creaked. Hanging objects swung.

June 24: 17:50:20*. Epicenter about 33°44' north, 116°44' west, P. San Jacinto Fault zone near Idyllwild. Felt by several at Hemet. Motion slow, lasting 8 seconds. Direction N-S. Rattled windows slightly.

June 26: 06:02. Pasadena. "A very tiny earth shock was recorded at the Seismological Laboratory of the California Institute of Technology. The disturbance was local and was felt by only a few persons." (SSA Bulletin, October 1944.)

July 2: 22:38:23*. Epicenter about 35°21' north, 117°52' west, P. Garlock Fault near Saltdale.

INTENSITY VI:

Cantil.—Motion rapid, lasting 10 seconds. Direction W-E. Awakened all in community. Windows rattled, house creaked. Plaster was cracked. Damage slight.

INTENSITY V:

Monolith.

INTENSITY IV:

Bakersfield (Kern Canyon), Glenville, Kernville, and Rosamond.

INTENSITY I TO III:

Riverside.

Negative reports were received from two places.

July 8: 18:54:39*. Epicenter about 37°30' north, 118°35' west, P. Near Owens River Gorge. Motion abrupt, lasting 2 seconds. Hanging objects swung. No damage.

July 11: 15:30. San Benito. Motion slow, lasting 1 second. Rattled windows, house creaked.

July 17: 14:47*, P. San Martin. Motion rapid, lasting 5 seconds. Felt by many in community. Direction N-S. Rattled windows and doors.

July 19: 08:28* and 10:20*, P. Crows Landing. "Two earthquake shocks were reported to have been felt here on the morning of July 19th, the first at 08:28 o'clock and the second about 10:20. The latter was reported to have been the more severe and was described by some as the most violent ever felt in this section." (SSA Bulletin, October 1944.)

July 24: 03:47*, P. Livermore. "A brief but distinct earthquake jarred Livermore and rattled its windows at 03:45 on July 24th, the sheriff's office reported. Only a few residents were awakened and no damage was reported." (SSA Bulletin, October 1944.)

July 26: 15:59:55*. Epicenter about 33°47' north, 118°15' west, P. Near Wilmington. No damage.

INTENSITY IV:

Los Angeles and Lynwood.

INTENSITY I TO III:

Maywood.

July 26: 21:45:18*. Epicenter about 35°42' north, 118°20' west, P. Near Weldon. A light local shock was felt with intensity IV at Kernville and Isabella Ranger Station.

July 29: 20:42*, P. Weaverville (Forest Service). Motion rapid, abrupt, lasting a few

seconds. Felt by many. Dishes rattled and walls creaked. Trees and bushes were shaken slightly. Shock was felt by several lookouts, according to observer.

August 3: 23:46:57*. Epicenter about 32°58' north, 116°00' west, P. Near Borego Valley. Motion abrupt, lasting 1 minute. Felt by observer. Direction N-S. Windows rattled and house creaked. This shock was immediately followed by two lesser ones.

August 6: 09:30(?). Costa Mesa. "There was a shaking of the earth in Costa Mesa. Very few residents were aware of it, and the only evidence to be reported occurred in a store, where a shelf carrying a heavy load of mirrors and glass was moved out several inches from the wall." (SSA Bulletin, October 1944.)

August 6: 18:18.9*. Epicenter about 39.5° north, 120.0° west, P. Vicinity of Reno, Nevada. Rapid up-and-down movement. Building creaked. Extremely light shock.

August 10: 06:43. Bishop (Adams Main Powerhouse). Motion rapid, lasting 1 second. Felt by observer. Direction N. Shifted chair.

August 12: 17:10 and 17:11. Five Points (Fresno County). Motion trembling, rapid onset. Felt by observer.

August 15: 23:32:28*. Epicenter about 33°42' north, 118°06' west, P. Near Sunset Beach. Long Beach (press), "Residents of this city experienced a single, sharp earthquake last night, accompanied by a loud noise, which caused many of them to think an explosion had occurred. The telephone calls clogged police switchboards and even Army and Navy offices received queries."

August 25: 00:30:25*. Epicenter about 34°00' north, 116°42' west, P. Coachella. The motion was rapid, sharp, and severe, lasting 5 seconds. Direction up and down. Awakened many in community. Windows rattled, house creaked. Hanging objects swung. At Palm Springs it was felt as one sudden jolt.

August 26: 11:35. Santa Clara (press), "An earthquake shook the southwest side of the valley at 11:35 a.m. today. The epicenter was placed at about 10 miles from the University of Santa Clara. Two inquiries were received from people who felt it."

August 29: 23:52* and 23:57*, BC. Two shocks, with rapid onset. Felt by two persons.

August 31: 22:29*. Epicenter about 15 miles SE of Shasta Dam, BC. Redding and Shasta seismological station. Motion rapid, lasting about 5 seconds. Felt by many. Rattled windows. Most of those awake and not greatly active felt this shock, according to observer.

September 3: 19:47:46*. Epicenter about 35.0° north, 120.0° west, P. Los Alamos. Motion bumping, with abrupt onset. Felt by many. Windows rattled and house creaked. Second shock was felt by a few at 22:00. Hanging electric lights swayed.

September 9: 03:15 (about). Gridley. Trembling motion with abrupt onset. Awakened several. One person reported visible swaying of buildings.

September 13: 19:02:20*. Epicenter about 37°34' north, 118°44' west, P. Long Valley and Owens Valley Gorge, near Bishop. Motion slow, lasting 2 seconds. Felt by several.

September 15: 07:12.7*. Epicenter about 34.7° north, 120.2° west, P. Los Alamos. Bumping motion felt by a few. Loose objects rattled and house creaked. Hanging lights swung. Another shock was reported felt at 12:00.

September 17: 18:30.0*. Epicenter about 35.8° north, 120.0° west, P. Kettleman Hills region. Parkfield. Rapid motion, long duration. Felt by all in home, outdoors by some. Direction N-S. Windows and doors rattled. Trees and bushes were shaken slightly.

September 21: 10:18*, P. Epicenter probably in the Cape Mendocino area. Intensity IV at Scotia and Eureka. Strong-motion earthquake records were obtained from the instruments located at Eureka and Ferndale.

September 22: 08:55. Scotia. Rapid motion lasting three or four seconds. Felt by several. Windows rattled and house creaked.

September 24: 16:00. Santa Cruz. Sudden hard bumping, then trembling in N-S direction. Felt by several. Loose objects rattled; building creaked. Moderately loud crackling and rattling subterranean sounds were heard.

September 25: 01:00. Santa Cruz. Shock similar to the one at 16:00 on September 24.

October 1: 08:18. Potter Valley. Moderate shock felt by many in home.

October 9: 08:02. Maywood. A rumbling explosive jar. The vibration seemed to be in the air and lasted three seconds. Felt by many. Rattled windows.

October 19: 01:37, 02:07, 03:00, and 06:00. Santa Rosa (press), "Mystery continued to shroud the origin of four sharp jolts that awakened Santa Rosans within a period of six hours early today. Some described the shocks as earthquakes, others declared they felt concussions similar to that which occurred on the night of the Port Chicago explosion, and others said it was just a 'big noise' that sounded like a truck hitting the side of a house. Professor Perry Byerly, University of California seismologist, reported that no earthquakes were recorded on the delicate seismograph at the university. A check with Army and Navy authorities and the Coast Guard failed to reveal any explosions or heavy gunfire off the coast, and no industrial explosions were reported. Nevertheless, scores of Santa Rosans, employees of the county hospital and ranchers residing north of that institution distinctly felt the severe shocks. One theory that there had been a slip or settling along an earthquake fault extending to The

Geysers was given some credence, although no official finding was reached." One observer in Santa Rosa stated: "We in our neighborhood believe this to be an earthquake. I was awakened and did not sleep again. It felt here as former earthquakes have."

October 23: 14:00:39*. Epicenter 33°43' north, 116°45' west, P. Terminal Island. Intensity IV according to information telephoned to the Pasadena Seismological Laboratory.

October 28: 11:30:16*. Epicenter 33°58' north, 116°45' west, P. San Andreas Fault, north of Cabazon. Very sharp jolt at Lake Arrowhead. Abrupt beginning, lasting about 3 seconds. Felt by many. Windows rattled and house creaked. Moderately faint subterranean sounds were heard by many at time of shock. Felt by several at Riverside and Thermal.

November 7: 07:48:17*. Epicenter 34°13' north, 117°10' west, P. Lake Arrowhead. Motion abrupt, momentary duration. Felt by many in community, by some outdoors. Direction SW-NE. Awakened some in community. Rattled windows slightly. Hanging objects swung.

November 10: 01:06:46.8*. Epicenter probably 12 to 13 miles SE of Shasta, BC. A press report stated: "Scores of persons in Redding and the dam area were awakened shortly after 1 a.m. today by a sharp shock which many thought at the time was an explosion but which today was believed to have been due to the settling of the bottom of Shasta Lake under the pressure of stored water. The U. S. Bureau of Reclamation seismograph recorded a sharp disturbance at 1:06:47 a.m. The Redding police department received a number of telephone calls after the shock, most residents believing they had heard an explosion." Reports from observers stated it was felt by many in the community and 1 mile south. Rattled windows slightly. "Characteristic of fast freight train heavily loaded passing through, which effects are quite common here." At the Shasta seismological station the motion was rapid, lasting about 1 minute. It was felt by several in home and community.

November 14: 23:50. Hollister. Motion slow, lasting several seconds. Felt by observer. Rattled windows and doors. House creaked.

November 16: 11:04. Oakland (press), "An earthquake that was felt in the Bay area today was registered at 11:04 a.m. on the University of California seismograph, according to Professor Perry Byerly. He said the earthquake centered 5 to 10 miles from the University of California campus." The shock was felt over an area of about 2,000 square miles. Outer limits of the felt area extended from San Rafael southeast to Brentwood, southwest to Ben Lomond, thence to San Gregoria on the coast, to San Rafael.

INTENSITY IV:

Alameda, Berkeley, Brentwood, Lafayette, Oakland, San Gregorio, and San Leandro (U. S. Naval Hospital).

INTENSITY I TO III:

Ben Lomond, Diablo, San Bruno, San Francisco, San Jose, and San Rafael.

Negative reports were received from twelve places.

November 16: 16:54. This shock was felt over an area of about 600 square miles. Maximum intensity of V was reported from Upper Mattole where it was felt by many and small objects were shifted. A strong-motion earthquake record of this shock was obtained from the accelerograph located at Ferndale.

INTENSITY IV:

Ferndale, Field Landing, and Scotia.

INTENSITY I TO III:

Pertola.

Negative reports were received from ten places.

November 16: 17:32:49*. Epicenter 37°19' north, 118°23' west, P. Owens River Gorge, Adams Main Powerhouse (near Bishop). Motion slow, lasting 3 seconds. Felt by and frightened all in Powerhouse. Direction NW-SE. "First time I felt an earthquake while in plant." Felt by several in homes where windows rattled.

November 19: 15:20.8*. Epicenter 36.5° north, 117° west, P. Death Valley, National Monument. Motion trembling, abrupt. Felt by many. Rattled loose objects. House creaked. Thunderous sounds heard. Agitated water in pool. "While sitting in lounge chair directly next to fireplace a distant rumbling was heard and a violent concussion came down the fireplace. Jumped up and looked at water in pool outside and it was rippling although no wind was blowing. Went outside and all persons were out of their homes speaking of an earthquake. One person 25 miles north of us was lying down and felt it. He reported the time as 3:20 p.m."

November 25: 09:00. San Jose. "A small earth shock was recorded on the seismograph at Ricard Observatory, University of Santa Clara. Several persons in San Jose and a resident in Willow Glen reported feeling the shock." (SSA Bulletin, January 1945.)

November 25: 20:47:30. Ben Lomond. Rocking motion, with rapid onset. Felt by three persons. Direction N-S. Rattled loose objects. Buildings creaked.

November 26: 08:30. Northwest Section of Inyo County, California Electric Power Plant (near Bishop). One severe bump followed by a two-second light rumbling. Felt by observer. Rattled loose objects. Building creaked. Electric light poles swayed.

November 30: 11:53:15*. Epicenter 34°43' north, 120°25' west, P. Los Alamos. One long shake, bumping motion, with abrupt onset. Felt by many. Electric wires shook lively and some reported dishes rattled. Felt also at Los Olivos.

December 5: 02:01:12*. Epicenter 35°53' north, 118°24' west, P. Kern River Powerhouse No. 3 (near Kernville). Motion rapid. Felt by many in home and community. Awakened many. Rattled dishes. "Heaviest shock of the four on this date."

December 5: 03:30 (about). Kern River Powerhouse No. 3 (near Kernville). Motion rapid, short, sharp. Felt by several in home and community.

December 5: 05:01:22*. Epicenter 35°53' north, 118°24' west, P. Kern River Powerhouse No. 3 (near Kernville). Motion rapid, short, sharp. Felt by several.

December 5: 21:16:26*. Epicenter 35°53' north, 118°24' west, P. Kern River Powerhouse No. 3 (near Kernville). Motion slow, lasting 3 seconds. Felt by many. Windows rattled.

December 13: 16:51:56*. Epicenter 33°50' north, 117°50' west, P. Santa Ana. Motion rapid, lasting 3 seconds. Direction NE. Windows rattled; walls creaked. Hanging objects swung NE. This shock was felt with similar intensity at Yorba Linda.

December 16: 00:10. Navelencia, north of Reedley. Motion slow, lasting several seconds. Felt by two in home. "A quivering motion, too light to have been felt by a person asleep, but very noticeable to one awake."

December 21: 19:20:14*. Epicenter 34°15' north, 117°35' west, P. San Andreas Fault Zone, near Mt. San Antonio. At Wrightwood (Big Pines Recreation Area) a rapid motion lasting 15 seconds was felt by several in home. Windows and doors rattled; walls creaked.

December 23: 01:16:22*. Epicenter 36°24' north, 117°55' west, P. Intensity IV at Keeler and Lone Pine.

December 30: 11:16:43*, BC. Mineral. Motion rapid, lasting 2 seconds. Felt by observer.

WASHINGTON AND OREGON

(105TH MERIDIAN OR PACIFIC WAR TIME)

January 9: 04:28:03*. Yakima, Washington (press), "Houses in Yakima were shaken today. Several reports have been received that windows in homes were shaken and dishes rattled as if from an explosion."

January 28: 23:30. Chelan Falls, Washington. Short, slight shock felt.

March 5: 06:00. Dallas, Oregon (press), "Dallas and a district of some eight or ten miles around the city apparently were visited by a noticeable but not destructive earthquake shock about 06:00 a.m. Sunday. Many described it as so marked that they thought for an instant a car or truck had crashed into their homes. Apparently about four out of five homes situated in all parts of the city noticed the shock; although it came at an hour and a day when most people were still asleep. An earlier shock was reported by a much smaller number around 2:30 or 3:00 the same morning. There was no damage of any kind reported. Many at first thought it was heavy cannonading or an explosion. The absence of news reports from other sections indicated that the disturbance was local or at least was more severe here than elsewhere in the state."

March 30: 20:30. Clear Lake (Eatonville), Washington. Motion rapid, brief, very distinct. Felt by many in the Nisqually Power Plant. Direction NE. Rattled windows and doors.

March 31: 14:15. Olympia, Washington. This shock was felt over an area of approximately 2500 square miles. Outer limits of the felt area included Hoodspport east of Cedar Falls, south of Longmire, thence northwesterly to Olympia to Hoodspport. One isolated report came from Port Angeles some distance to the north. From the felt effects it appears the center may have been in the area between Olympia and Tacoma.

INTENSITY V:

Grapeview, Olympia, Orting, Shelton, and Tacoma.

INTENSITY IV:

Cedar Falls, Clear Lake, Hoodspport, Longmire, Puyallup, and Tumwater.

INTENSITY I TO III:

Elbe, Port Angeles, and Wilkeson.

Negative reports were received from sixteen places.

March 31: Between 21:30 and 22:00. Spirit Lake, Washington. Bumping motion with abrupt onset. Felt by several. Moderately loud sounds were heard.

May 9: 20:30. North Bend, Washington. Two shocks about three seconds apart. Sharp, rapid motion. Felt by several.

September 1: 18:25:14*, BC. Walla, Walla, Washington (press), "Dishes and windows rattled and houses in the Birkney district here quivered when an apparent earth shock was felt by several families who reported the incident as having occurred at 6:25 p.m. Friday. A shock was also felt by residents of the Cottonwood and Russel Creek districts at the same time. No damage was reported."

September 7: 23:16:52*, BC. Elbe and Olympia, Washington. Light shock felt.

September 18: 01:14 and 01:52:27*, BC. Tacoma, Washington (press), "Many Tacomans were awakened shortly before 2 a.m., Monday, by what they believe to be an earthquake. Slight tremors were recorded by the seismograph at the University of Washington at 01:14 and 01:52, indicating a center 50 miles south of Seattle. Numerous Tacomans telephoned the press to report being awakened by the tremors. Some said the second tremor was more noticeable than the first, rattling dishes, swinging chandeliers and other unsecured objects. The State Patrol said that residents of Olympia flooded the office in the capital city with telephone calls following the tremors." It was strongly felt at Olympia where many were awakened, but only lightly felt at Lakebay.

September 19: 20:00. Rockville, Oregon. Rapid motion, long duration, felt by two persons. Windows rattled.

October 7: 11:45. Chelan Falls, Washington. Rapid motion with abrupt beginning. Slight shock felt by a few.

October 31: 04:34:28.7*, BC. Entiat, Washington. Intensity V. Felt by all. Houses shook. Direction west.

INTENSITY IV:

Orondo and Waterville.

INTENSITY I TO III:

Chelan Falls and Lakeside.

Negative reports were received from two places.

December 6: 21:48. Hoquiam, Washington. Slight swaying with abrupt beginning. Dishes rattled. "Persons living in the hill districts were the only ones that felt the tremor. At Greys Harbor Junior College a large brick chimney was caused to swing 18 inches out of line at the top of the building."

December 25: 06:12:08.8*, BC. Entiat Valley, Washington. Rapid motion lasting one minute. Felt by several. Rattled windows.

ALASKA

(150TH MERIDIAN TIME)

January 26: 13:55. Anchorage. Light shock felt by several. "Mercurial barometers on wall swung with a northeast-southwest motion."

January 28: 16:48. McGrath. Slight shock felt for about forty seconds. Motion appeared to be east-west.

February 25: 20:30. Kutzebue. Generally felt. No damage.

February 26: 13:22. Anchorage. Slight shock felt by several. "Mercurial barometer hanging freely swung about two inches in north-south direction."

February 28: 08:46. Slaterville. Slight shock felt by several.

July 18: 13:29. Anchorage. Slight tremor felt by several.

July 30: 11:48. Anchorage. Light shock felt by several.

October 20: 10:34. Anchorage. Felt by several people.

HAWAIIAN ISLANDS

(HAWAIIAN STANDARD TIME)

November 12: 04:56. Southwest of Halemaumau. Widely felt in southern half of Hawaii. Moderate. Dismantled seismographs at Hilo and Kona as well as at the Hawaiian Volcano Observatory.

December 27: 03:42. Eastern edge of Mokuaweoweo. Strong. Dismantled all seismographs on Hawaii. Plainly felt on Oahu. Some objects toppled from shelves at places as widespread as Pepeekeo and Naalehu. Stone fences were thrown down in vicinity of Hilea.

PHILIPPINE ISLANDS

Reports from the Philippine Islands were suspended during the war.

PUERTO RICO

(60TH MERIDIAN TIME)

December 1: 00:45. Santurce. Light shock felt.

PANAMA CANAL ZONE

No earthquakes were reported felt in the Panama Canal Zone during 1944.

MISCELLANEOUS ACTIVITIES

GEODETIC WORK OF SEISMOLOGICAL INTEREST

No activities of geodetic leveling and triangulation directly connected to seismological interest were executed during the calendar year 1944.

TIDAL DISTURBANCES OF SEISMIC ORIGIN

The principal seismic sea wave records of the year resulted from the great Japanese earthquake of December 7, 1944. The Coast and Geodetic Survey tide gages at Massacre Bay; Attu Island, Alaska; San Diego, California; and Terminal Island, California, recorded effects of the resulting seismic sea wave. Effects at the two latter stations were minor and accordingly are not reproduced in this publication. The record at Massacre Bay was quite pronounced and a tracing appears in figure 8.

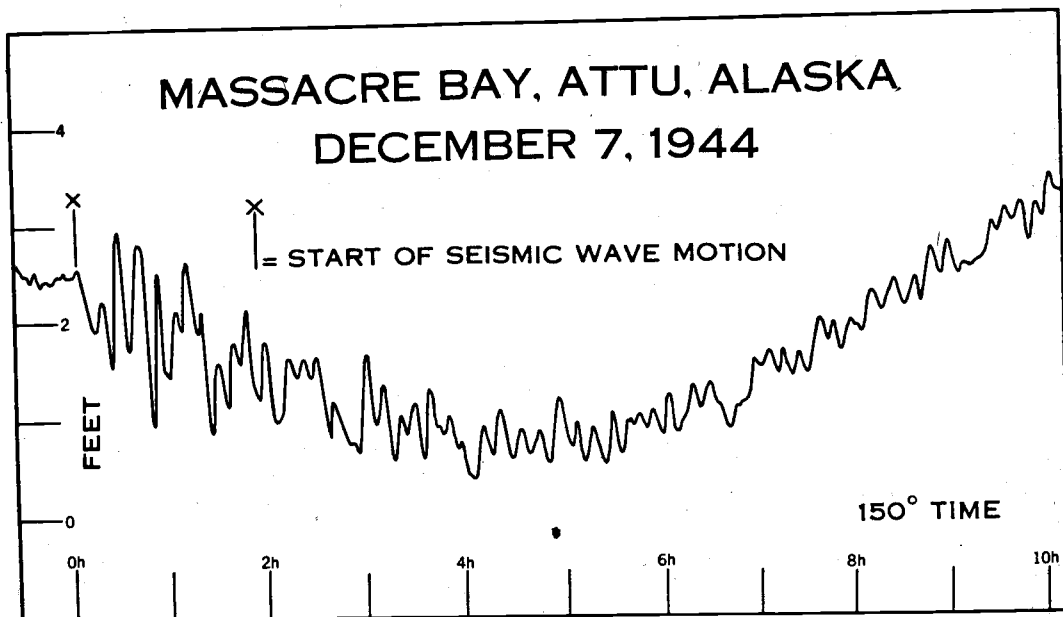


FIGURE 8.—Tracings of marigram obtained at Massacre Bay, Attu, Alaska, on December 7, 1944.

EARTHQUAKE FLUCTUATION IN WELLS

In recent years it has been found that earthquakes may cause fluctuations in well water levels. Some wells are apparently more effected than others, probably due to geological conditions at the well site. The earthquake center may be nearby or, in some instances, at distances approaching the antipodes.

For the purpose of more thorough studies of both phenomena the U. S. Geological Survey has furnished and authorized publication of the following tabular data. They include descriptions of the wells and tabulations of well water levels taken from the records of automatic recorders.

Table 1.—Earthquake Fluctuations in Wells in Southeastern Florida, January 1 to September 30, 1944

Well No.	Date	Time (E.W.T.)	Depth to water in feet			Amplitude of fluctuation in feet
			Mean height	High	Low	
F-179.....	1-10-44	16:10	9.76			Less than 0.01
F-210.....	1-10-44	16:10	9.87			0.03
S-68.....	1-10-44	15:45	9.81	9.86	9.89	0.02
S-329.....	1-10-44	16:10	7.03	9.80	9.82	0.02
F-210.....	1-31-44	23:55	9.73	7.02	7.04	0.02
S-19.....	1-31-44	23:55	7.71	9.72	9.74	0.02
S-68.....	1-31-44	23:55	9.85			Less than 0.01
S-329.....	1-31-44	23:55	7.38	9.845	9.86	0.015
F-210.....	2- 3-44	08:35	9.80	7.37	7.39	0.02
F-210.....	3-31-44	16:30	10.13			Less than 0.01
F-210.....	6-16-44	18:00	9.72	9.71	9.725	Less than 0.01
F-179.....	6-28-44	04:00	9.57	9.605	9.54	0.015
F-210.....	6-28-44	04:00	9.76	9.66	9.88	0.065
F-213.....	6-28-44	04:00	17.31	17.28	17.34	0.22
S-18.....	6-28-44	04:00	9.07	9.06	9.085	0.06
S-19.....	6-28-44	04:00	8.75	8.63	8.86	0.025
S-68.....	6-28-44	04:00	10.79	10.75	10.85	0.23
S-1042.....	6-28-44	04:00	8.27	8.17	8.38	0.10
S-1042.....	7-12-44	21:00	8.72	8.38	8.80 ¹	0.21
F-179.....	8-24-44	20:15	9.48			App. 0.65
F-210.....	8-24-44	20:30	9.67			Less than 0.01
S-19.....	8-24-44	19:45	7.63			Less than 0.01
S-68.....	8-24-44	19:45	9.51	9.49	9.52	Less than 0.01
S-1042.....	8-24-44	20:15	6.62			0.03
S-329.....	9-19-44	10:00	6.17	6.16	6.175	Less than 0.01
S-1042.....	9-19-44	10:00	6.95	6.92	6.97	0.015
						0.05

¹Lowest not recorded because pen stuck.

Table 2.—Summary of Earthquake Disturbances at Stream Gaging Stations in New York September 5, 1944.

Station	Latitude	Longitude	Time (E.W.T.)	Amplitude of Fluctuation	Remarks
Raquette River at Piercefield.....	44 14 05	74 34 20	00:30	.01	Single trace.
Raquette River at Raymondville....	44 50 20	74 58 45	00:35	.02	Do.
St. Regis River at Brasher Center...	44 51 50	74 46 45	00:40	.03	Stage .02 feet below previous and subsequent record during this period.
			to 01:00	.025	
Salmon River at Chasm Falls.....	44 45 20	74 13 10	00:30		
			to 03:45	.005	Continuing fluctuation.
Chateaugay River at Chateaugay... Richelieu River (Lake Champlain) at Rouses Point.....	44 54 35	74 05 10	00:30	.015	Heavy single trace.
East Branch of Ausable River at Ausable Forks.....	44 59 45	73 21 40	00:35	.01	Single trace.
Cedar Swamp Creek at Glen Cove...	44 26 20	73 40 55	00:35	.005	Drop in stage.
	40 51 45	73 38 05	00:25	+ .020	
Mill Neck Creek at Mill Neck.....	40 53 15	73 33 55		-.015	Single trace.
Nissequogue River at Smithtown....	40 50 55	73 13 25			No visible disturbance.
			00:40	+ .01	
Peconic River at Riverhead.....	40 54 50	72 41 10	01:00	-.003	Single trace.
				+ .014	
Carmans River at Yaphank.....	40 49 50	72 54 20	00:20	+ .007	Do.
				-.007	
Connetquot River (No. 1) at Oakdale.	40 44 50	73 09 00	00:40	+ .01	Do.
				-.01	
Connetquot River (No. 2) at Oakdale. (¼ mi. NE of Gage No. 1).....			00:40	+ .01	Do.
Massapequa Creek at Massapequa...	40 41 20	73 27 20	00:40	+ .002	Do.
Wantagh Stream at Wantagh.....	40 40 50	73 30 45	00:40	+ .005	Do.
East Meadow Brook at Freeport.....	40 39 55	73 34 10	00:40	+ .004	Do.
				-.005	
Pines Brook at Malverne.....	40 40 00	73 39 30	00:45	+ .006	Do.
				-.004	
Croton River at Croton.....	41 13 30	73 51 35	00:35	-.004	Do.

SEISMOLOGICAL OBSERVATORY RESULTS

The Coast and Geodetic Survey publishes the results of its teleseismic stations and co-operating stations quarterly in mimeographed form. In these reports all seismogram interpretations are tabulated, together with epicenters based on the published data and instrumental results received from seismological stations in all parts of the world. These reports will be furnished upon request made to the Director of the Coast and Geodetic Survey.

Instrumental results are published for the following observatories:

- Balboa Heights, Canal Zone. (The Panama Canal.)
- Bermuda. Meteorological Station, St. George's, and International Union of Geodesy and Geophysics.)
- Bozeman, Montana. (Montana State College.)
- Burlington, Vermont. (University of Vermont.)
- Butte, Montana. (Montana School of Mines.)
- Chicago, Illinois. (University of Chicago and United States Weather Bureau.)
- College, Alaska. (University of Alaska.)
- Columbia, South Carolina. (University of South Carolina.)
- Honolulu, T. H. (University of Hawaii.)
- Huancayo, Peru. (Carnegie Institution of Washington.)
- Ivigtut, Greenland. (Geodætisk Institut, Copenhagen, Denmark.)
- Lincoln, Nebraska. (Nebraska Wesleyan University.)
- Logan, Utah. (Utah State Agricultural College.)
- Montezuma, Chile. (Smithsonian Institution.)
- Philadelphia, Pennsylvania. (The Franklin Institute.)
- Rapid City, South Dakota. (South Dakota State School of Mines.)
- Salt Lake City, Utah. (University of Utah.)
- San Juan, Puerto Rico.
- Seattle, Washington. (University of Washington.)
- Scoresbysund, Greenland. (Geodætisk Institut, Copenhagen, Denmark.)
- Sitka, Alaska.
- Tucson, Arizona.
- Ukiah, California. (International Latitude Observatory.)

San Juan, Sitka, Tucson, and Ukiah are Coast and Geodetic Survey stations.

Bermuda, Bozeman, Butte, Chicago, College, Columbia, Honolulu, Lincoln, Rapid City, and Salt Lake City are cooperative stations.

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

Through arrangements made by the International Union of Geodesy and Geophysics the Coast and Geodetic Survey is temporarily aiding in the maintenance of the Danish stations at Scoresbysund and Ivigtut, in Greenland.

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

The provisional epicenter results for 1944 were not ready when this publication went to press. Those for the year 1943 are listed in table 3. Those for the stronger shocks of 1944 are listed in table 4.

Table 3.—Summary of Instrumental Epicenters for 1943

NOTE.—The provisional epicenters in this table are primarily intended to cover earthquakes recorded in the United States. Some of them have been determined by the Coast and Geodetic Survey, and some have been taken from the reports of other organizations and stations. In many cases, as with Pasadena epicenters for instance, the original coordinates are known to the nearest minute but have been changed in this table to the nearest one-tenth degree. The epicenters reported by nearby stations are usually given preference. More detailed information will be found in the Seismological Bulletins (formerly Seismograph Reports) of the Coast and Geodetic Survey, and in the bulletins of other organizations and stations.

1943	Greenwich civil time at origin		Region and focal depth	Coordinates of provisional epicenter	
				Latitude	Longitude
Jan. 2.....	14	11.3	San Jacinto Fault, California. Felt.....	33.4 N.	116.4 W.
Jan. 8.....	0	24.1	California.....	33.0 N.	116.0 W.
Jan. 10.....	9	49.7	Off west coast of Mexico.....	19 N.	108 W.
Jan. 14.....	21	32.6	Maine. Felt.....	45.3 N.	69.6 W.
Jan. 16.....	11	50.3	Utah. Felt.....	37.7 N.	113.0 W.
Jan. 17.....	17	02.2	Off west coast of lower California.....	24 N.	113 W.
Jan. 23.....	13	30.0	Atlantic Ocean. East of Puerto Rico.....	18.8 N.	61.0 W.
Jan. 24.....	9	26.7	Near coast of Guatemala.....	14.9 N.	91.0 W.
Jan. 27.....	2	45.2	Aleutian Islands. Slightly deeper than normal.....	51 N.	179.5 W.
Jan. 30.....	5	33.1	Ecuador. Depth about 100 km.....	2.1 S.	80.0 W.
Jan. 31.....	8	28.9	Near west coast of Mexico. Depth about 100 km.....	17.8 N.	93.7 W.
Feb. 3.....	15	16.3	Yellowstone National Park.....	44.5 N.	111 W.
Feb. 5.....	3	52.3	Lower California.....	20 N.	115.5 W.
Feb. 7.....	4	24.8	South of Tonga Islands.....	24.5 S.	176 W.
Feb. 8.....	20	10.6	Ecuador.....	2.5 S.	80 W.
Feb. 16.....	7	28.6	Southeastern Peru. Depth slightly greater than 100 km.....	13.9 S.	70.8 W.
Feb. 16.....	14	38.1	Solomon Islands.....	10 S.	162 E.
Feb. 22.....	9	20.8	Near coast of Colima, Mexico. Destructive.....	17.9 N.	101.1 W.
Feb. 22.....	14	20.0	Utah. Felt.....	41 N.	111.5 W.
Feb. 24.....	4	24.0	Aftershock of Colima, Mexico quake.....	18 N.	101 W.
Feb. 28.....	16	40.1	Southern Quebec, Canada. Felt.....	45.5 N.	75 W.

Table 3.—Summary of Instrumental Epicenters for 1943—Continued

1943	Greenwich civil time at origin	Region and focal depth	Coordinates of provisional epicenter	
			Latitude	Longitude
	<i>h m</i>		<i>° ' "</i>	<i>° ' "</i>
Mar. 4	6 32.4	Tonga Island region. Depth possibly 600 km.	22 S.	179 W.
Mar. 5	0 31.7	South of Panama.	5.1 N.	82.6 W.
Mar. 6	20 14.5	Nevada.	37.4 N.	114.1 W.
Mar. 7	3 01.7	Near east coast of Kamchatka.	59 N.	116 E.
Mar. 7	20 58.5	California.	33.0 N.	116 W.
Mar. 9	3 25.4	Ohio. Felt.	41.6 N.	81.3 W.
Mar. 9	9 49.0	Near Sandwich Islands.	60 S.	29 W.
Mar. 11	1 13.2	Northwestern California.	39.5 N.	123.5 W.
Mar. 11	9 34.1	Near Loyalty Islands.	21.5 S.	170.5 E.
Mar. 14	11 59.3	East of Honshu Island, Japan.	36.5 N.	140 E.
Mar. 14	12 42.1	do.	36.5 S.	142 E.
Mar. 14	17 11.0	Near Loyalty Islands.	22 S.	170.5 E.
Mar. 14	18 37.8	Northern Chile. Slightly deeper than 200 km.	20.5 S.	69 W.
Mar. 15	2 24.5	Near Loyalty Islands.	22 S.	169 E.
Mar. 15	4 47.9	Near Caroline Islands.	9.5 N.	141.5 E.
Mar. 15	14 09.4	California.	33.0 N.	116.0 W.
Mar. 15	22 59.3	West of Samoa Islands. Possibly slightly deeper than 300 km.	14.5 S.	176.5 W.
Mar. 16	9 47.4	Off coast of Ecuador.	0 N.	81.5 W.
Mar. 16	9 51.9	do.	0 N.	81.5 W.
Mar. 17	0 40.7	Imperial Valley Fault, California.	32.7 N.	115.4 W.
Mar. 17	0 52.3	do.	32.7 N.	115.4 W.
Mar. 17	0 58.6	do.	32.7 N.	115.4 W.
Mar. 17	22 57.6	Chile. Slightly deeper than normal.	25 S.	69.5 W.
Mar. 20	4 50.6	Near Fiji Islands.	16.5 N.	175.5 E.
Mar. 20	20 51.9	Gulf of California.	29.6 N.	113.3 W.
Mar. 21	20 35.7	New Britain Islands.	6 S.	151.5 E.
Mar. 25	18 27.4	Near Sandwich Islands.	60 S.	31 W.
Mar. 26	17 38.2	South of Tonga Islands. Depth about 75 km.	22.9 S.	176.0 W.
Mar. 29	11 46.0	California. Felt.	37.5 N.	121.9 W.
Mar. 30	21 07.5	do.	39.0 N.	120.5 W.
Apr. 5	3 08.8	Northern Peru. Slightly deep.	7.5 S.	77.5 W.
Apr. 5	20 45.1	Off east coast of New Guinea.	5 S.	147 E.
Apr. 6	16 07.3	Central Chile. Destructive. Depth about 100 km.	31.5 S.	71.4 W.
Apr. 7	13 07.1	do.	31.5 S.	71.5 W.
Apr. 7	23 18.0	do.	31.5 S.	71.5 W.
Apr. 9	8 48.8	Mariana Islands. Slightly deeper than 100 km.	18.8 N.	145.9 E.
Apr. 11	14 46.1	Honshu Islands, Japan. Depth about 100 km.	37 N.	141 E.
Apr. 13	8 57.5	Off coast of Peru. Felt.	17.5 S.	73.5 W.
Apr. 15	11 34.8	Aftershock of Chile quake (Apr. 6).	31.5 S.	72.5 W.
Apr. 15	15 31.0	California.	38 N.	122 W.
Apr. 19	1 19.2	Swan Island. Felt.	17 N.	81.5 W.
Apr. 23	18 07.7	Northern Chile.	21.5 S.	69 W.
Apr. 27	19 28.0	California.	33.0 N.	116.0 W.
Apr. 28	17 23.7	Off coast of Ecuador.	1 S.	82 W.
Apr. 28	23 43.2	Near Tonga Islands. Depth about 500 km.	25 S.	179.5 W.
Apr. 29	15 24.8	Kurile Islands, Japan.	44.5 N.	148 E.
May 2	17 18.1	South of Panama. Felt.	6.8 N.	80.8 W.
May 3	1 59.2	Philippine Islands.	12.5 N.	125 E.
May 3	10 17.1	Lower Mexico.	18 N.	94.5 W.
May 7	20 22.8	Honshu Island, Japan.	41 N.	140 E.
May 9	17 18.6	California.	33.1 N.	115.7 W.
May 12	8 23.0	Tonga Island region. Depth about 100 km.	22 S.	172 W.
May 13	23 16.3	Southeastern Alaska.	62 N.	155 W.
May 17	7 47.2	Near coast of Ecuador.	0.5 N.	79 W.
May 22	9 01.9	Near coast of central Chile. Slightly deeper than normal.	31.5 S.	71.5 W.
May 25	23 07.6	Off coast of Mindanao Island in Philippines.	6.8 N.	127.2 E.
May 28	10 31.5	Off west coast of Mexico.	18.0 N.	105.9 W.
May 31	20 16.9	California. Felt.	37.4 N.	118.6 W.
June 1	4 15.1	Off west coast of Mexico.	19.4 N.	109.0 W.
June 1	16 11.0	Off southern coast of Mexico.	16 N.	101 W.
June 2	5 24.1	Off coast of Honduras.	16.7 N.	86.0 W.
June 3	19 53.7	South of Samoa Islands.	16 S.	173 W.
June 3	20 48.1	do.	16 S.	173 W.
June 8	1 15.6	Atlantic Ocean. West of Azores.	35 N.	35 W.
June 8	20 42.7	Sumatra.	3 S.	103 E.
June 12	19 21.7	California.	33.3 N.	116.1 W.
June 13	5 11.7	Near southern coast of Hokkaido.	42.3 N.	142.5 E.
June 13	8 37.0	do.	42.3 N.	143.0 E.
June 14	17 23.6	Gulf of California.	28.5 N.	112 W.
June 15	11 10.8	Near southern coast of Hokkaido.	42.0 N.	142.2 E.
June 15	18 21.7	Off coast of Guatemala.	14.6 N.	93.0 W.
June 18	16 25.8	California.	33.1 N.	116.1 W.
June 18	19 23.5	South of Samoa Islands.	16 S.	173 W.
June 19	9 07.0	do.	16 S.	173 W.
June 20	15 32.9	Near northwest coast of Turkey. Destructive.	40.6 N.	30.5 E.
June 20	17 39.6	South Atlantic Ocean.	11.2 S.	14.3 W.
June 23	17 17.7	Northern Chile.	31 S.	70 W.
June 24	20 21.7	New Hebrides Islands. Depth about 200 km.	16 S.	168 E.
June 25	4 25.4	Northeastern Montana.	48.5 N.	105 W.
June 25	6 09.9	California.	33.2 N.	115.8 W.
June 25	7 17.0	do.	33.2 N.	115.8 W.
June 25	19 13.5	Tonga Island region. Depth about 500 km.	17.7 S.	178.3 W.
June 28	15 05.6	Aleutian Islands.	52 N.	178 W.
June 29	9 05.1	Celebes Sea. Depth slightly less than 200 km.	3 N.	126 E.
June 30	20 12.9	Near southwest coast of Peru. Depth about 100 km.	16.3 S.	73.0 W.
July 4	9 52.0	Off coast of Costa Rica.	9.0 N.	84.7 W.

Table 3.—Summary of Instrumental Epicenters for 1943—Continued

1943	Greenwich civil time at origin		Region and focal depth	Coordinates of provisional epicenter	
				Latitude	Longitude
July 5	21	07.9	Off southern coast of Peru. Depth about 100 km.	16.6 S.	74.0 W.
July 6	13	13.9	North Atlantic Ocean, west of Azores.	32. N.	42. W.
July 6	22	10.2	Vermont. Felt.	44.9 N.	73.2 W.
July 7	12	45.2	New Britain Islands.	5 S.	151 E.
July 9	23	28.5	Aleutian Islands.	52 N.	187 W.
July 11	2	10.4	Near Kermadec Islands. Depth about 200 km.	34 S.	178 W.
July 15	21	38.0	Off northern coast of California.	33.0 N.	118.5 W.
July 17	5	02.0	California.	32.3 N.	115.5 W.
July 21	4	13.7	South of Easter Islands.	36 S.	109 W.
July 22	2	09.3	Off coast of Ecuador.	0 S.	81.5 W.
July 23	14	53.1	Southeastern Java. Depth about 100 km.	8 S.	111 E.
July 28	4	04.8	Near Kenay Peninsula, Alaska. Depth about 100 km.	59.8 N.	149.0 W.
July 29	3	02.2	Off northern coast of Puerto Rico. Felt.	19.0 N.	67.1 W.
July 30	1	02.5	do.	19.0 N.	67.1 W.
July 31	3	22.2	do.	19.0 N.	67.1 W.
Aug. 1	16	18.7	East of Loyalty Islands. Depth about 200 km.	20.3 S.	170.1 E.
Aug. 8	0	38.7	Aftershock of Puerto Rico quake (July 29).	19.0 N.	67.5 W.
Aug. 9	5	30.1	Nevada. Felt.	38.2 N.	118.2 W.
Aug. 10	15	13.4	Off east coast of Kamchatka.	55.5 N.	163 E.
Aug. 12	4	50.5	Japan.	36 N.	140 E.
Aug. 13	7	37.2	Atlantic Ocean.	1 N.	29.5 W.
Aug. 14	8	07.8	Kermadec Islands.	33 S.	178 W.
Aug. 15	0	13.2	Off northern coast of Puerto Rico.	19 N.	67.5 W.
Aug. 17	15	51.0	California. Felt.	33.0 N.	116.0 W.
Aug. 18	0	30.3	California.	35.8 N.	116.5 W.
Aug. 22	11	03.5	Aleutian Islands.	51 N.	176 W.
Aug. 27	0	41.4	East of Kermadec Islands.	29 S.	172 W.
Aug. 29	3	43.2	California. Felt.	34.3 N.	117.0 W.
Aug. 29	3	45.2	do.	34.3 N.	117.0 W.
Aug. 29	3	57.9	do.	15.0 N.	91.2 W.
Aug. 31	16	10.7	Guatemala. Slightly deeper than normal.	3.5 N.	124 E.
Sept. 5	8	34.5	Celebes Sea.	53.2 S.	159.1 E.
Sept. 6	3	41.5	Southeast of New Zealand.	19.0 N.	66.8 E.
Sept. 10	2	31.6	North of Puerto Rico.	35.3 S.	133.9 E.
Sept. 10	8	36.9	Honshu Island, Japan. Destructive.	14.8 S.	174.7 W.
Sept. 11	19	34.0	Samoa Islands.	23 S.	170.5 E.
Sept. 14	2	01.2	Near Loyalty Islands. Deeper than normal.	22 S.	170.5 E.
Sept. 14	3	47.2	Near Loyalty Islands.	30 S.	177.5 W.
Sept. 14	7	18.2	Kermadec Islands. Depth about 100 km.	36.0 N.	117.9 W.
Sept. 16	0	16.2	California.	36.0 N.	117.9 W.
Sept. 16	7	52.4	do.	14.5 S.	167 E.
Sept. 17	10	09.3	New Hebrides Islands.	30.5 S.	114 W.
Sept. 19	4	47.6	Southwest of Easter Islands.	19.5 N.	109.2 W.
Sept. 20	0	53.7	Off west coast of Mexico.	34.5 S.	179.5 W.
Sept. 22	23	18.2	Near Kermadec Islands.	29.3 N.	112.5 W.
Sept. 23	12	37.3	Gulf of California. Felt.	15.0 N.	91.4 W.
Sept. 23	15	00.6	Guatemala.	36.5 N.	73 E.
Sept. 24	11	31.4	Northern India.	5 N.	82.5 W.
Sept. 26	22	38.2	South of Panama.	29.8 S.	117.9 W.
Sept. 27	22	03.8	Kermadec Islands. Depth about 100 km.	7.5 N.	38 W.
Oct. 1	17	53.0	Atlantic Ocean.	40.6 N.	124.9 W.
Oct. 2	6	56.7	California. Felt.	16.5 N.	94 W.
Oct. 2	11	22.9	Near coast of southern Mexico.	38 N.	26.5 W.
Oct. 3	0	52.8	Azores.	43 N.	13 E.
Oct. 3	8	28.3	Italy.	15.5 S.	168 E.
Oct. 4	10	39.7	New Hebrides Islands region.	26 N.	110 W.
Oct. 13	4	44.8	Gulf of Mexico.	34.3 N.	116.9 W.
Oct. 14	14	28.7	California.	36.4 N.	27.9 E.
Oct. 15	16	50.0	California. Felt.	15 S.	177 W.
Oct. 16	13	08.8	Near west coast of Turkey.	28 N.	94 E.
Oct. 21	23	08.2	Near Fiji Islands.	48 N.	156 E.
Oct. 23	17	23.3	Assam.	22.5 S.	174 W.
Oct. 24	13	40.3	Kurile Islands region.	53.5 N.	160 E.
Oct. 24	16	04.6	Tonga Islands region.	37.5 N.	122.1 W.
Oct. 24	23	22.8	Near east coast of Kamchatka.	33 N.	115 W.
Oct. 26	4	50.5	California. Felt.	33.8 N.	116.2 W.
Oct. 28	5	58.9	California.	33.0 N.	116.0 W.
Oct. 31	13	12.2	do.	33.0 N.	116.0 W.
Nov. 2	16	48.0	California. Felt.	33.0 N.	116.0 W.
Nov. 2	16	54.2	do.	33.0 N.	116.0 W.
Nov. 2	16	57.3	do.	33.0 N.	116.0 W.
Nov. 2	17	42.5	California.	33.0 N.	116.0 W.
Nov. 2	17	50.7	California. Felt.	33.0 N.	116.0 W.
Nov. 2	18	01.2	do.	33.0 N.	116.0 W.
Nov. 2	18	08.5	Near Sandwich Islands.	57 S.	30 W.
Nov. 3	14	32.3	Alaska. Felt.	61.9 N.	150.7 W.
Nov. 3	22	02.0	Near coast of Peru.	13 S.	77 W.
Nov. 4	6	09.5	Near coast of Kamchatka.	57 N.	161 E.
Nov. 6	8	31.6	West coast of New Guinea.	5.5 S.	134 E.
Nov. 8	6	59.3	Arctic Ocean, northeast of Greenland.	81 N.	2.5 E.
Nov. 9	11	46.5	Kurile Islands region.	45.5 N.	148 E.
Nov. 13	18	43.9	Loyalty Islands region.	19.5 S.	170 E.
Nov. 16	11	38.0	Near southwest coast of Peru. Depth about 100 km.	16 S.	74 W.
Nov. 16	18	09.2	California.	33.0 N.	116.0 W.
Nov. 17	11	28.7	California. Felt.	33.9 N.	116.7 W.
Nov. 21	19	42.0	Southern Mexico.	18 N.	98.5 W.
Nov. 24	13	17.2	Southeast of Formosa.	23 N.	142 E.

Table 3.—Summary of Instrumental Epicenters for 1943—Continued

1943	Greenwich civil time at origin		Region and focal depth	Coordinates of provisional epicenter			
				Latitude		Longitude	
	<i>h</i>	<i>m</i>					
Nov. 26.....	22	20.6	Turkey. Destructive. Loss of life.....	41	N.	34	E.
Nov. 28.....	17	11.2	Near west coast of Kamchatka.....	55	N.	157	E.
Nov. 29.....	19	37.0	Northwestern Argentina.....	28	S.	68	W.
Dec. 1.....	6	04.8	New Guinea region. Slightly deeper than normal.....	4	S.	144.5	E.
Dec. 1.....	10	34.7	Northern Chile. Depth about 100 km.....	21	S.	68.5	W.
Dec. 2.....	1	54.0	Kermadec Islands region.....	30	S.	178	W.
Dec. 2.....	5	08.9	Off coast of Formosa.....	23	N.	122	E.
Dec. 3.....	4	38.0	New Guinea region.....	3	S.	140	E.
Dec. 3.....	6	52.8	Near coast of Hokkaido Island, Japan.....	43	N.	144	E.
Dec. 7.....	1	07.3	Off coast of southern Mexico.....	15.8	N.	94.1	W.
Dec. 8.....	19	38.9	do.....	15.5	N.	94.0	W.
Dec. 17.....	0	19.4	California. Felt.....	37.1	N.	118.3	W.
Dec. 17.....	4	38.0	do.....	37.1	N.	118.3	W.
Dec. 21.....	13	46.3	Near northwest coast of Venezuela.....	12.8	N.	71.2	W.
Dec. 22.....	7	01.9	South-central Ecuador. Depth about 150 km.....	3	S.	77	W.
Dec. 22.....	12	52.9	Near northwest coast of Venezuela.....	11.6	N.	70.0	W.
Dec. 22.....	15	50.5	California. Felt.....	34.3	N.	115.8	W.
Dec. 23.....	15	56.0	Near northwest coast of Venezuela.....	12.2	N.	70.8	W.
Dec. 23.....	19	00.2	Solomon Islands region. Slightly deeper than normal.....	6	S.	153.5	E.
Dec. 24.....	1	00.2	Near northwest coast of Venezuela.....	12.9	N.	71.0	W.
Dec. 24.....	11	44.5	Solomon Islands region.....	6	S.	154	E.
Dec. 25.....	4	32.2	do.....	6	S.	155	E.
Dec. 25.....	8	17.5	Gulf of California.....	25	N.	110.5	W.
Dec. 27.....	3	55.3	Kermadec Islands region.....	32	S.	178	W.
Dec. 30.....	22	02.5	New Guinea region.....	6	S.	148	E.

Table 4.—Principal earthquakes of the world from January 1944 to December 1944, inclusive.

This table lists (1) the strongest shocks of the period as revealed by seismographic records, particularly those of western hemisphere stations, (2) important destructive and near destructive earthquakes, and (3) earthquakes of unusual interest outside the two preceding categories.

Date	Origin Time G. C. T.		Place	Provisional Epicenters		Remarks, Depths, Principal facts.
				Latitude	Longitude	
	<i>h</i>	<i>m</i>				
Jan. 7.....	2	49.3	Eastern New Guinea.....	4.5 S.	143 E.	Depth 120 km.
Jan. 10.....	20	09.9	Mexico.....	17.4 N.	100.9 W.	Damage in state of Guerrero.
Jan. 15.....	23	49.4	Argentina.....	31.5 S.	68.5 W.	Destructive at San Juan, Argentina. 8,000 killed, 12,000 injured, \$100,000,000 property damage.
Feb. 1....	03	22.5	Turkey.....	41.0 N.	33.0 E.	Destructive in Anatolia. 1,000 killed. Gerede nearly destroyed. Strong shocks recorded instrumentally on 3rd and 10th. On 6th press reported 1,500 killed in Bolu; and 2,381 killed, about 3,000 injured, in the entire series of shocks.
Feb. 29....	03	41.9	Peru.....	14.8 S.	70.7 W.	Depth about 200 km.
Mar. 9....	22	13.1	East Turkistan.....	45 N.	83 E.	
Apr. 23....	10	57.7	Tonga Islands.....	22 S.	177½ W.	Depth slightly less than 400 km.
Apr. 26....	1	54.3	New Guinea.....	1 S.	135 E.	
Apr. 27....	14	38.2	do.....	1 S.	135 E.	
May 14....	08	51.6	Southwest of Tonga Islands.....	23 S.	179½ E.	Depth about 600 km.
May 25....	01	06.5	do.....	22 S.	179 W.	do.
June 8....	02	38.3	Peru.....	9½ S.	73½ W.	do.
June 28....	07	58.9	Off coast of Guatemala.....	14.8 N.	92.4 W.	Slight depth.
July 12....	19	30.4	Idaho.....	44.7 N.	115.2 W.	Approximately \$2,000,000 property damage. Cornwall, Ontario, and Massena, N. Y.
Sept. 5....	00	39	St. Lawrence Valley.....	45.0 N.	74.8 W.	
Sept. 11...	09	45.4	Melucca Passage.....	1 N.	127 E.	
Sept. 23...	12	13.3	Kamchatka.....	54 N.	161½ E.	
Oct. 5.....	17	28.4	Southeast of Loyalty Islands.....	22½ S.	172 E.	Depth about 100 km.
Oct. 6.....	02	34.6	Western Turkey.....	39 N.	27 E.	Approximately 50 killed and some property damage.
Oct. 23....	23	40.0	Ecuador.....	0.5 N.	80.0 W.	Felt at Guayaquil.
Nov. 15....	20	47.0	South of Mindanao.....	4 N.	128½ E.	
Nov. 24....	04	49.1	New Hebrides Islands.....	19 S.	169 E.	Depth about 200 km.
Dec. 1....	04	00.6	Tonga Islands.....	21 S.	178½ W.	Depth about 600 km.
Dec. 7....	04	35.7	Off Honshu Island.....	33 N.	137 E.	Considerable property damage.
Dec. 10....	16	25.1	New Hebrides Islands.....	18½ S.	168 E.	Depth slightly less than 100 km.
Dec. 12....	04	17.2	Aleutian Islands.....	53½ N.	180 W.	

STRONG-MOTION SEISMOGRAPH RESULTS

INTRODUCTION

During the latter part of 1932, the Coast and Geodetic Survey inaugurated a program of recording strong ground movements in the seismically active regions of the country to obtain data needed in the design of earthquake-resisting structures. Notes pertinent to the development of this program will be found in the eleven preceding issues of this series, Serials 579, 593, 600, 610, 619, 629, 637, 647, 655, 662, and 672, and in Special Publication 201, "Earthquake Investigations in California, 1934-35." Material in the "United States Earthquakes" series is restricted to the analysis of strong-motion seismograph records but brief notes on station and instrumental changes will be found under the heading "Changes in Strong-Motion Instrumental Equipment during 1944" near the end of this report. Special Publication 201 is much broader of scope, containing data on structural and ground vibrations and detailed descriptions of the various activities which comprise the seismological program as a whole. The reader is also referred to Special Publication 206, "Selection, Installation, and Operation of Seismographs," for descriptive material on strong-motion instruments and vibration meters in addition to similar information on teleseismic instruments.

New equipment.—A mechanical vibration recorder was suggested by Professor R. R. Martel of the California Institute of Technology to obtain additional data needed in engineering-seismological studies, and is to be a supplement to the instruments already in operation in this program. Both Professor Martel and Mr. Franklin P. Ulrich, Chief of the Seismological Field Survey of the U. S. Coast and Geodetic Survey, designed the instrument which was constructed under Mr. Ulrich's supervision. The instrument is essentially a series of twelve steel bars approximately eighteen inches long by three-fourths inch square mounted horizontally on ball bearings. Springs are attached to each end of the bars with such a tension as to give natural periods of oscillations ranging from .114 sec. to 2.4 sec. Attached to the middle of each bar is a stylus which records on a smoked glass plate with three traces appearing on each plate. For an upward trace on the record the longitudinal motion is NE 85°.

Interpretation of records.—The following analyses are based on the assumption of simple harmonic motion. This refers especially to the computation of displacement from accelerograph records. As most accelerograph records are of irregular character, and the character of the longer-period waves is often obscured by the superposing of shorter-period waves of relatively large amplitude, the estimates of displacement must be considered as only approximate. One must refer to the illustrations of the curves themselves to evaluate the probable accuracy of the estimated displacements.

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 accuracy of such work, as well as an appraisal of instrumental performance, has been definitely established through accelerometer shaking table tests made at, and with the cooperation of, the Massachusetts Institute of Technology. (Bulletin of the Seismological Society of America, Vol. 33, No. 1, January 1943.) In the displacement results the errors of mensuration, computation, and adjustment can be kept within a range of 1 cm. Errors due to minute shiftings of the zero positions of the pendulums on pivot accelerometers increase this range of error to about 2 or 3 cm. In both cases the errors apply only to displacements of a slow drifting type, somewhat similar to waves of about 10 seconds period and over. But they represent motions that are necessarily associated with extremely small accelerations and are therefore of no significance in engineering studies.

None of the 1944 records was strong enough to require integration.

Units Used.—Quantitative results are expressed in c. g. s. units; centimeters or millimeters for displacement; centimeters per second for velocity; and centi-

meters per second per second for acceleration. It is sometimes desirable to express acceleration in terms of the acceleration of gravity, indicated by "g" which is equal to 980 cm./sec.² For practical purposes it is only necessary to point off three decimal places to convert cm./sec.² to "g."

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.	= 10 mm.
1 cm./sec.	= 0.03281 ft./sec.	0.1 g.	= 98 cm./sec. ²	= 3.215 ft./sec. ²
1 cm./sec. ²	= 0.03281 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 seismograms are usually tracings of the original records and must not be accepted as genuine copies. 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 address the Director of the Coast and Geodetic Survey for further particulars.

The tabulated instrumental constants refer to the original records. The tracings in this publication are reduced so that the same scales do not apply. The reductions are approximately in the ratio of 1.76 to 1.

NOTES ON STRONG-MOTION SEISMOGRAPH RECORDS

The practice of attempting to describe the seismograms in detail in the text is believed to be rather superfluous because the outstanding periods are listed in tables, such as table 6 in this issue and the illustrations provide a far better picture of the records than can be obtained in any other way. The following notes will therefore contain only such information on the earthquakes and the records which may not be evident from Table 6 or from the illustrations. For convenience certain fundamental information on the earthquakes will be repeated from the noninstrumental part of the publication.

It is well to repeat here that, as the measurement of periods on records of this nature is dependent largely on the judgment of the person reading them, 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.

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. A similar scheme is adopted for other types of curves. These dots provide a quick means for making auxiliary scales in cases where an investigator desires to make rough measurements on the published curves. They are especially necessary at this time in view of the instrumental changes begun in 1942.

The pendulum periods of a number of accelerographs in southern California were reduced from 0.1 second to about 0.07 second. Also a number of the six-inch and twelve-inch recorders were interchanged. Most of this work was done during 1942. The purpose was to arrange the instruments so that their recording capacities would more nearly equal the accelerations which might be expected at the various station sites. As a result of previous experience the following expectable earthquake accelerations were used in determining the adjustment and placement; (a) rock foundation 25 percent of gravity, (b) con-

glomerate foundations 40 percent of gravity, (c) alluvium 70 percent of gravity, (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 gravity respectively. In order to realize the desired recording capacities it was necessary to shift a number of accelerographs because of the greater recording range of the twelve-inch drums as compared with the six-inch.

In the notes following Table 5 listing the strong-motion records obtained during 1944 the maximum values of acceleration and displacement are given for each station. Accelerations shown may have been recorded by any one of the three components. As will be seen in table 6 maximum recorded acceleration is not necessarily associated with the same ground period as the maximum computed displacement.

Table 5.—List of shocks recorded and records obtained on strong-motion seismographs in 1944.

Date, epicenter, and recording station	Records		
	Accelerograph	Displacement meter	Weed strong-motion seismograph
June 11: Northern California Hollister.....			1
June 12: Los Angeles region: Los Angeles Subway Terminal.....	2	1	
June 12: Aftershock: Los Angeles Subway terminal.....	2	1	
June 18: Los Angeles region: Vernon C.M.D. Terminal. Hollywood Storage Company.....	1		
Los Angeles Chamber of Commerce.....	3		
Los Angeles Subway Terminal.....	2	1	
Los Angeles Edison Building.....	1		
Long Beach.....	1		
June 18: Aftershock: Vernon C.M.D. Terminal. Hollywood Storage Company.....	1		
Los Angeles Chamber of Commerce.....	3		
Los Angeles Subway Terminal.....	1		
Los Angeles Edison Building.....	2	1	
Long Beach.....	1		
September 21: Northern California: Ferndale.....	1		
Eureka.....	1	1	
November 18: Northern California: Ferndale.....	1		
Totals.....	26	5	1

NORTHERN CALIFORNIA EARTHQUAKE OF JUNE 11.

Epicenter in the Hollister area. Maximum intensity V.

Hollister.—Record on Weed seismograph too indefinite for reproduction. Maximum intensity V felt in same building where the instrument was located. Maximum acceleration 2 cm/sec.² Computed maximum displacement .02 cm.

LOS ANGELES EARTHQUAKE OF JUNE 12. (03:46)

Epicenter from local instrumental data, 33°58' north, 116°45' west, in San Andreas Fault, north of Cabazon. Maximum intensity VI at a few places.

Los Angeles Subway Terminal.—Station 86 miles SE 86° of epicenter. In-

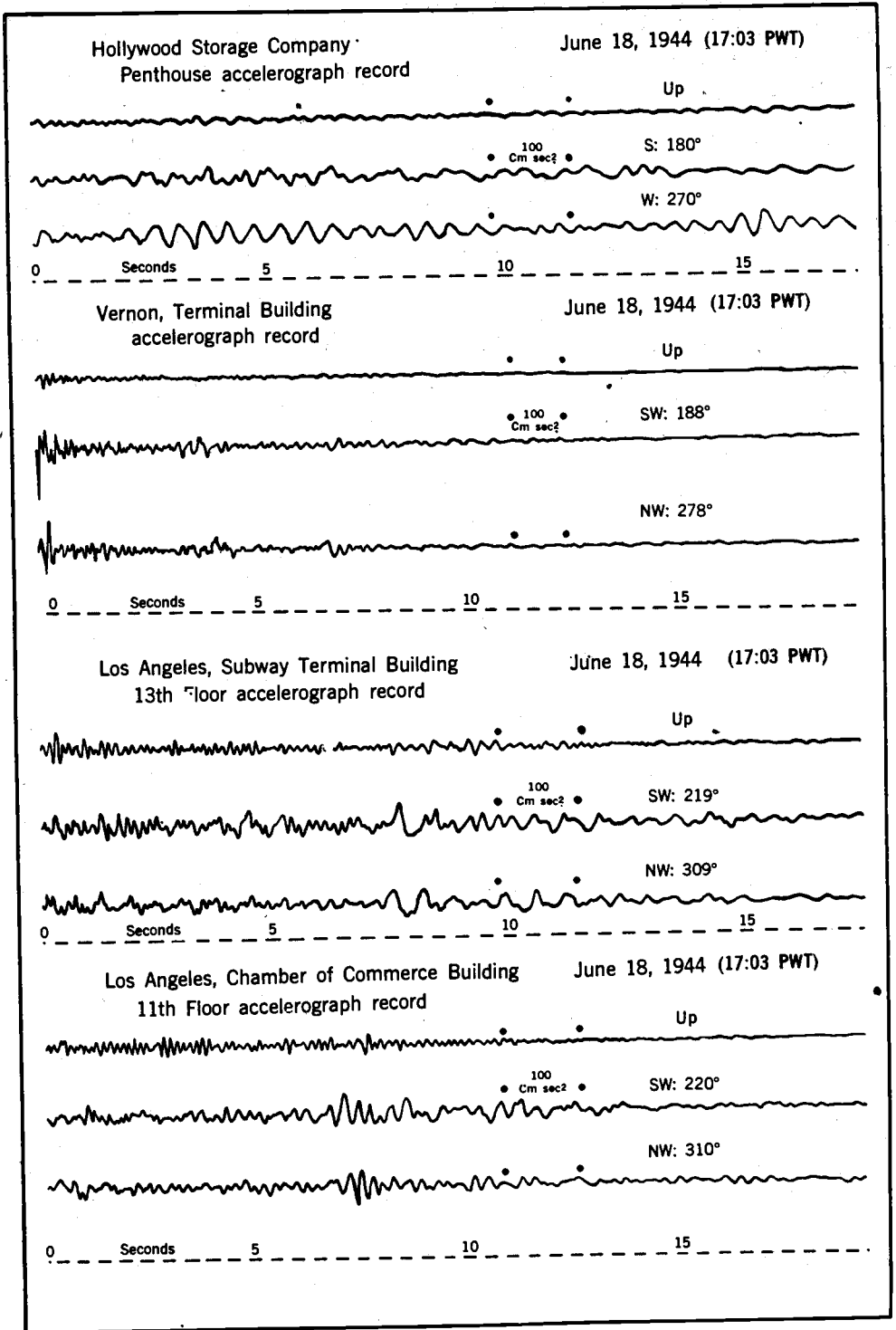


FIGURE 9.—Tracings of accelerograph records obtained at Hollywood Storage Company, penthouse; Vernon C.M.D. Terminal; Los Angeles Subway Terminal, 13th floor; and Los Angeles Chamber of Commerce, 11th floor on June 18, 1944, at 17:03 P.W.T.

tensity V in Los Angeles. Maximum acceleration 7 cm/sec.^2 and computed maximum displacement .053 cm on thirteenth floor; maximum acceleration 4 cm/sec.^2 and computed maximum displacement .002 cm. in basement.

LOS ANGELES EARTHQUAKE OF JUNE 12. (04:17)

Epicenter from local instrumental data, $33^\circ 58'$ north, $116^\circ 45'$ west, in San Andreas Fault, north of Cabazon. Maximum intensity VI at a few places.

Los Angeles Subway Terminal.—Station 86 miles SE 86° of epicenter. Intensity V in Los Angeles. Maximum acceleration 7 cm/sec.^2 and computed maximum displacement .132 cm. on thirteenth floor; maximum acceleration 4 cm./sec.^2 and computed maximum displacement .004 cm. in basement.

LOS ANGELES EARTHQUAKE OF JUNE 18. (17:03)

Epicenter from local instrumental data, $33^\circ 52'$ north, $118^\circ 13'$ west, in Inglewood Fault, near Dominguez Junction. Maximum intensity VI at many places.

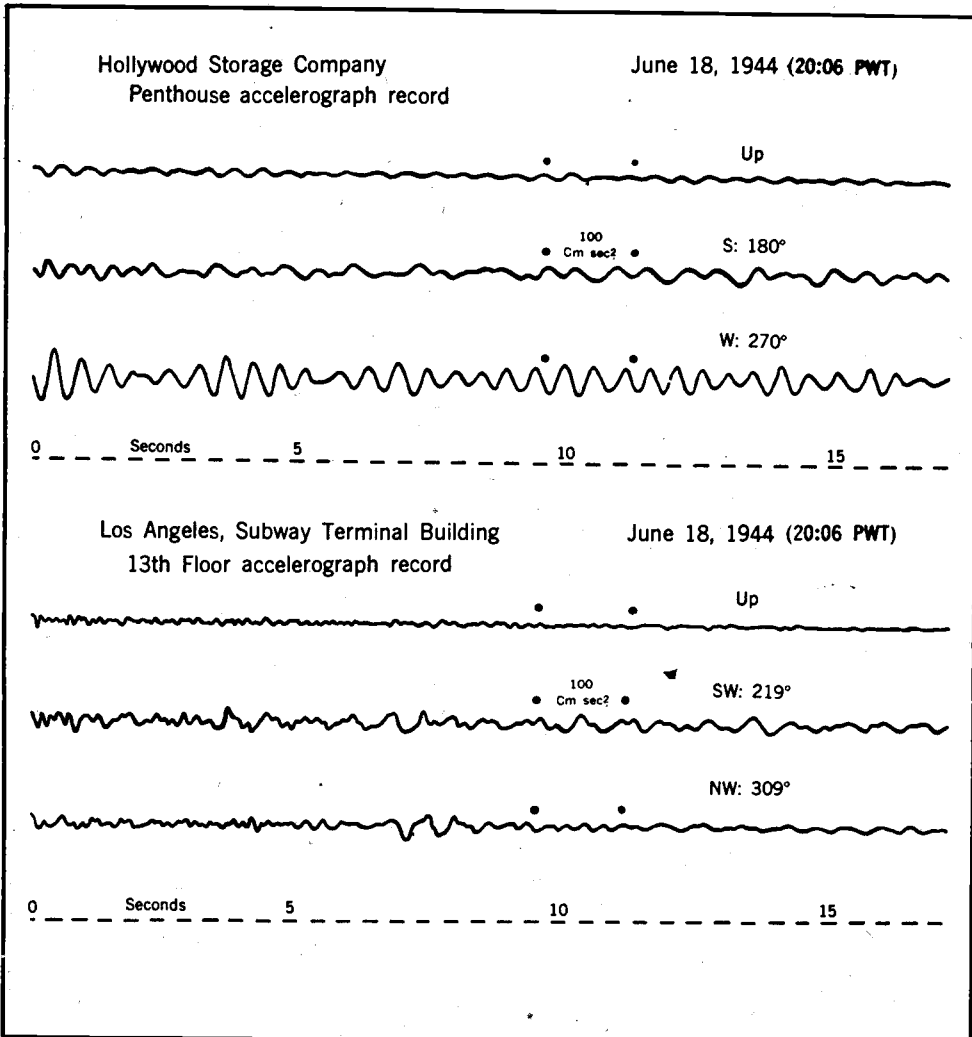


FIGURE 10.—Tracings of accelerograph records obtained at Hollywood Storage Company, penthouse; and Los Angeles Subway Terminal, 13th floor on June 18, 1944, at 20:06 P.W.T.

Vernon C. M. D. Terminal.—Figure 9. Station 9 miles NE 9° of epicenter. Intensity V in Los Angeles. Maximum acceleration 110 cm/sec.² Computed maximum displacement .101 cm.

Hollywood Storage Company.—Figure 9. Station 16 miles NW 333° of epicenter. Intensity V in Los Angeles. Maximum acceleration 33 cm/sec.² and computed maximum displacement .346 cm. in penthouse; maximum acceleration 10 cm/sec.² and computed maximum displacement .081 cm. in basement; maximum acceleration 9 cm/sec.² and computed maximum displacement .019 cm. in P. E. lot.

Los Angeles Chamber of Commerce.—Figure 9. Station 12 miles NW 343° of epicenter. Intensity V in Los Angeles. Maximum acceleration 42 cm/sec.² and computed maximum displacement .276 cm. on eleventh floor; maximum acceleration 19 cm/sec.² and computed maximum displacement .032 cm. in basement.

Los Angeles Subway Terminal.—Figure 9. Station 13 miles NW 350° of epicenter. Intensity V in Los Angeles. Maximum acceleration 35 cm/sec.² and computed maximum displacement .203 cm. on thirteenth floor; maximum acceleration 18 cm/sec.² and computed maximum displacement .014 cm. in basement. Maximum displacement .8 cm. recorded on displacement meter and computed maximum acceleration 46 cm/sec.²

Los Angeles Edison Building.—Station 13 miles NW 350° of epicenter. Intensity V in Los Angeles. Maximum acceleration 12 cm/sec.² Computed maximum displacement .029 cm.

Long Beach.—Station 4 miles SE 163° of epicenter. Intensity V in Long Beach. Maximum acceleration 25 cm/sec.² Computed maximum displacement .050 cm.

LOS ANGELES EARTHQUAKE OF JUNE 18. (20:06)

Epicenter from local instrumental data, $33^{\circ}52'$ north, $118^{\circ}13'$ west, in Inglewood Fault, near Dominguez Junction. Maximum intensity VI at many places.

Hollywood Storage Company.—Figure 10. Station 16 miles NW 333° of epicenter. Intensity V in Los Angeles. Maximum acceleration 58 cm/sec.² and computed maximum displacement .365 cm. in penthouse; maximum acceleration 12 cm/sec.² and computed maximum displacement .113 cm. in basement; maximum acceleration 5 cm/sec.² and computed maximum displacement .016 cm. in P. E. lot.

Los Angeles Subway Terminal.—Figure 10. Station 13 miles NW 350° of epicenter. Intensity V in Los Angeles. Maximum acceleration 27 cm/sec.² and computed maximum displacement .254 cm. on thirteenth floor; maximum acceleration 7 cm/sec.² and computed maximum displacement .044 cm. in basement. Maximum displacement 1.0 cm. recorded on displacement meter and computed maximum acceleration 49 cm/sec.²

Vernon C. M. D. Terminal.—Station 9 miles NE 9° of epicenter. Intensity V in Los Angeles. Maximum acceleration 25 cm/sec.² Computed maximum displacement .020 cm.

Los Angeles Chamber of Commerce.—Station 12 miles NW 343° of epicenter. Intensity V in Los Angeles. Maximum acceleration 13 cm/sec.² and computed maximum displacement .014 cm. in basement.

Los Angeles Edison Building.—Station 13 miles NW 350° of epicenter. Maximum acceleration 5 cm/sec.² Computed maximum displacement .118 cm.

Long Beach.—Station 4 miles SE 163° of epicenter. Intensity V in Long Beach. Maximum acceleration 11 cm/sec.² Computed maximum displacement .118 cm.

NORTHERN CALIFORNIA EARTHQUAKE OF SEPTEMBER 21.

Epicenter in Cape Mendocino area. Maximum intensity IV.

Ferndale.—Maximum acceleration 7 cm/sec.² Computed maximum displacement .019 cm.

Eureka.—Maximum acceleration 6 cm/sec.² Computed maximum displacement .007 cm. Displacement meter record is too indefinite for reproduction.

NORTHERN CALIFORNIA EARTHQUAKE OF NOVEMBER 16.

Epicenter in Cape Mendocino area. Maximum intensity V.

Ferndale.—Maximum acceleration 3 cm/sec.² Computed maximum displacement .002 cm.

Table 6.—Summary of strong-motion seismograph data for the year 1944.

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

NORTHERN CALIFORNIA EARTHQUAKE OF JUNE 11.

Station and component	Earth-wave period	Maximum acceleration	Maximum displacement	Remarks
	Seconds	Cm/sec. ²	Cm.	
Hollister Weed seismograph:				
SE: 135°.....	0.6	2	0.02	Weak record.
SW: 225°.....	.8	1	.02	

LOS ANGELES EARTHQUAKE OF JUNE 12 (03:46).

Los Angeles Subway Terminal 13th floor accelerograph:				
Vertical, up.....	.13	3	.001	Small sinusoidal waves.
	.19	2	.002	
SW: 219°.....	.65	5	.053	Short period waves superposed.
	.64	3	.031	
SE: 129°.....	.55	7	.053	Short period waves superposed.
	.55	5	.038	
Los Angeles Subway Terminal basement accelerograph:				
Vertical, up.....	.14	2	.001	Very weak.
SE: 129°.....				Too weak.
SW: 219°.....	.13	4	.002	Very weak.
Los Angeles Subway Terminal basement displacement meter.....				Both components extremely weak.

LOS ANGELES EARTHQUAKE OF JUNE 12 (04:17).

Los Angeles Subway Terminal 13th floor accelerograph:				
Vertical, up.....	0.15	7	0.004	Weak record.
	.18	2	.002	
SW. 219°.....	.49	22	.132	At beginning of record. Shorter periods superposed.
	.61	6	.057	
NW. 309°.....	.59	5	.044	At beginning of record. Shorter periods superposed.
	.48	16	.093	
	.63	4	.040	
Los Angeles Subway Terminal basement accelerograph:				
Vertical, up.....	.17	3	.002	Very weak.
SE. 129°.....	.17	2	.001	Do.
SW. 219°.....	.13	4	.002	Weak irregular waves.
	.30	2	.004	
Los Angeles Subway Terminal basement displacement meter.....				Both components extremely weak.

LOS ANGELES EARTHQUAKE OF JUNE 18 (17:03).

Hollywood Storage Company pent-house accelerograph:				
Vertical, up.....	0.26	6	0.010	Irregular motion.
	.43	7	.032	
	.47	9	.050	Sinusoidal waves.
S. 180°.....	.24	11	.016	At beginning of record, possibly preceded by stronger motion.
	.76	23	.346	
	.68	10	.117	

Table 6.—Summary of strong-motion seismograph data for the year 1944—Continued

LOS ANGELES EARTHQUAKE OF JUNE 18 (17:03).—Continued

Station and component	Earth-wave period	Maximum acceleration	Maximum displacement	Remarks
	Seconds	Cm./sec. ²	Cm.	
W. 270°.....	.38	18	.065	Shorter periods superposed. Sinusoidal waves. Do.
	.47	28	.151	
	.51	33	.218	
	.54	5	.037	
Hollywood Storage Company basement accelerograph:				
Vertical, up.....	.30	5	.011	Weak record.
	.31	4	.009	
E. 90°.....	.28	10	.019	Small amplitudes.
	.73	6	.081	
S. 180°.....	.28	7	.013	
	.32	8	.021	
	.35	6	.019	
Hollywood Storage Company P. E. lot accelerograph:				
Vertical, up.....	.18	3	.002	Weak.
	.23	5	.007	
E. 90°.....	.28	9	.019	Irregular waves.
	.19	8	.007	
S. 180°.....	.19	6	.005	
	.20	7	.007	
	.36	4	.013	
Los Angeles Chamber of Commerce 11th floor accelerograph:				
Vertical, up.....	.07	17	.002	At beginning of record. Good sinusoidal wave groups.
	.06	26	.002	
	.09	25	.005	Irregular motion.
	.51	20	.013	
SW. 220°.....	.10	22	.005	Possibly preceded by stronger motion.
	.19	40	.036	
NW. 310°.....	.26	12	.020	Very irregular motion. Group of large waves.
	.14	42	.021	
	.30	12	.027	
	1.10	9	.276	
Los Angeles Chamber of Commerce basement accelerograph:				
Vertical, up.....	.21	10	.011	Weak record.
	.36	5	.016	
SE. 130°.....	.21	16	.017	At beginning of record. Possibly preceded by stronger motion.
	.26	10	.017	
SW. 220°.....	.26	19	.032	
	.25	5	.008	
Los Angeles Edison Building accelerograph:				
Vertical, up.....	.09	6	.001	Regular waves.
	.31	7	.016	
SE. 135°.....	.12	4	.001	Weak.
	.41	7	.029	
SW. 225°.....	.15	12	.007	Regular waves.
	.26	4	.007	
Los Angeles Subway Terminal 13th floor accelerograph:				
Vertical, up.....	.13	35	.014	Sharp uniform waves.
	.15	12	.007	
	.39	5	.019	Sharp short period waves. Short period waves superposed.
SW. 219°.....	.15	27	.015	
	.50	14	.090	
	.24	19	.027	Regular waves.
	.73	15	.203	
NW. 309°.....	.09	19	.003	Very irregular.
	.35	28	.084	
	.60	5	.045	
Los Angeles Subway Terminal basement accelerograph:				
Vertical, up.....	.12	9	.003	
	.30	6	.013	
SE. 129°.....	.13	6	.002	
	.34	5	.014	
SW. 219°.....	.11	18	.005	
	.10	6	.002	
	.27	6	.010	
Los Angeles Subway Terminal basement displacement meter:				
NE. 39°.....	1.10	17	.5	Very irregular motion.
SE. 129°.....	.83	46	.8	
Long Beach accelerograph:				
Vertical, up.....	.20	7	.007	
	.20	4	.004	

Table 6.—Summary of strong-motion seismograph data for the year 1944—Continued

LOS ANGELES EARTHQUAKE OF JUNE 18 (17:03).—Continued

Station and component	Earth-wave period	Maximum acceleration	Maximum displacement	Remarks
	<i>Seconds</i>	<i>Cm./sec.²</i>	<i>Cm.</i>	
N. 0°.....	.31	21	.050	
	.17	25	.017	
	.40	4	.016	
E. 90°.....	.23	14	.018	Weak.
	.30	5	.011	
Vernon C.M.D. Terminal accelerograph:				
Vertical, up.....	.30	23	.052	At beginning of record. Sharp phases.
	.26	6	.010	
SW. 188°.....	.09	110	.022	Very strong motion.
	.27	20	.036	
	.43	10	.047	
	.27	5	.009	
NW. 278°.....	.20	101	.101	Very strong motion.
	.09	40	.008	
	.79	6	.094	

LOS ANGELES EARTHQUAKE OF JUNE 18 (20:06).

Hollywood Storage Company pent-house accelerograph:				
Vertical, up.....	0.47	10	0.056	Shorter period waves superposed.
	.45	9	.046	Regular waves.
	.47	7	.039	
S. 180°.....	.40	16	.064	Regular long period waves.
	.77	15	.225	
	.60	12	.109	
W. 270°.....	.50	58	.365	Large sinusoidal waves.
	.56	23	.184	Do.
	.51	31	.205	
Hollywood Storage Company basement accelerograph:				
Vertical, up.....	.53	6	.043	Long regular periods.
	.52	5	.034	
E. 90°.....	.32	10	.026	
	.33	8	.021	Regular motion.
	.61	12	.113	
S. 180°.....	.34	4	.011	Weak.
	.36	6	.019	
Hollywood Storage Company P.E. lot accelerograph:				
Vertical, up.....	.40	3	.012	
	.46	3	.016	
E. 90°.....	.35	4	.012	
	.22	5	.001	
	.40	3	.012	
180°.....	.36	3	.010	
	.36	5	.016	
	.46	3	.016	
Los Angeles Chamber of Commerce basement accelerograph:				
Vertical, up.....	.11	8	.002	Weak.
	.15	5	.003	
SE. 130°.....	.18	10	.008	Irregular.
	.23	13	.001	
	.19	4	.004	
SW. 220°.....	.13	8	.003	Irregular.
	.31	6	.014	
Los Angeles Edison Building accelerograph:				
Vertical, up.....	.15	4	.002	Weak.
	.51	3	.019	
SE. 135°.....	.27	4	.007	Irregular.
	.55	4	.030	
SW. 225°.....	.47	5	.028	
	.41	2	.028	
Los Angeles Subway Terminal 13th floor accelerograph:				
Vertical, up.....	.15	13	.007	At beginning of record. Possibly preceded by stronger motion.
	.24	9	.012	
	.24	5	.007	Irregular motion.
SW. 219°.....	.18	18	.014	At beginning of record. Possibly preceded by stronger motion.
	.76	21	.309	Very irregular.
	.69	9	.108	
NW. 309°.....	.55	12	.091	Very irregular.
	.61	27	.254	Large waves.
	.45	10	.051	

Table 7.—Instrumental constants of strong-motion seismographs in 1944—Continued

LOS ANGELES EARTHQUAKE OF JUNE 18 (20:06).—Continued				
Station and component	Earth-wave period	Maximum acceleration	Maximum displacement	Remarks
	<i>Seconds</i>	<i>Cm/sec.²</i>	<i>Cm.</i>	
Los Angeles Subway Terminal basement accelerograph:				
Vertical, up.....	.18	2	.002	Very weak.
	.36	4	.013	
SE. 129°.....	.33	5	.013	Weak.
	.50	7	.044	
SW. 219°.....	.33	4	.010	Shorter periods superposed.
	.51	6	.039	
Los Angeles Subway Terminal basement displacement meter:				
NE. 39°.....	.88	49	1.0	Irregular.
	1.10	13	.4	
SE. 129°.....	.95	34	.8	
	2.01	10	1.0	
Long Beach accelerograph:				
Vertical, up.....	.16	4	.003	Weak sinusoidal waves.
	.43	2	.010	
N. 0°.....	.55	8	.061	Shorter periods superposed.
	.70	4	.050	
E. 90°.....	.19	9	.008	Irregular waves.
	.65	11	.118	
Vernon C.M.D. Terminal accelerograph:				
Vertical, up.....	.18	6	.005	Weak record.
	.19	4	.004	
SE. 188°.....	.12	14	.005	
	.16	13	.008	
	.39	4	.015	
NW. 278°.....	.18	25	.020	At beginning of record. Possibly preceded by stronger motion.
	.18	10	.008	
	.21	3	.003	Weak phases.
NORTHERN CALIFORNIA EARTHQUAKE OF SEPTEMBER 21.				
Ferndale accelerograph:				
Vertical, up.....	0.20	3	0.003	Very irregular motion.
	.30	1	.002	
SW. 225°.....	.10	7	.002	Possibly preceded by stronger motion.
	.43	4	.019	Shorter periods superposed.
	.37	2	.007	Do.
NW. 315°.....	.04	5	.001	Possibly preceded by stronger motion.
	.14	4	.002	Irregular waves.
	.34	4	.012	
Eureka accelerograph:				
Vertical, up.....	.04	3	.001	Very weak record.
	.17	2	.001	
NE. 79°.....	.17	6	.005	Shorter periods superposed.
	.27	4	.007	
SE. 169°.....	.16	2	.001	Shorter periods superposed.
	.19	4	.004	Irregular waves.
NORTHERN CALIFORNIA EARTHQUAKE OF NOVEMBER 16.				
Ferndale accelerograph:				
Vertical, up.....	0.14	1	0.001	Very weak record.
	.25	1	.002	
SW. 225°.....	.12	2	.001	Possibly preceded by stronger motion.
	.16	2	.001	Sharp phase.
	.20	1	.001	Irregular motion.
NW. 315°.....	.09	3	.001	Possibly preceded by stronger motion.
	.10	1	.001	Sharp phase.
	.21	1	.001	
	.21	1	.002	Irregular motion.

Table 7.—Instrumental constants of strong-motion seismographs in 1944.

NORTHERN CALIFORNIA EARTHQUAKE OF JUNE 11.						
Station and instrument	Orientation of instrument ¹	Pendulum period	Static magnification	Sensitivity ²	Damping ratio	Instrument number
		sec.	cm.			
Hollister Weed seismograph No. 8.....	SE. 135°.....	0.20	10	1.03	4	.....
	SW. 225°.....	.19	10	0.98	5	.....
LOS ANGELES EARTHQUAKE OF JUNE 12.						
Los Angeles Subway Terminal: ³ 13th floor accelerograph No. 39.....	Up.....	0.101	83	2.14	10	V-112
	SW. 219°.....	.100	81	2.05	8	L-92
	SE. 129°.....	.100	79	2.01	11	T-102
Basement accelerograph No. 3.....	Up.....	.069	116	1.40	8	V-58
	SE. 129°.....	.068	118	1.39	10	L-59
	SW. 219°.....	.069	120	1.44	11	T-60
Basement displacement meter No. 13.	NE. 39°.....	9.8	1.0	.....	9	.....
	SE. 129°.....	10.5	1.0	.....	9	.....
LOS ANGELES EARTHQUAKE OF JUNE 18.						
Hollywood Storage Company: ³ P.E. lot accelerograph No. 1.....	Up.....	0.070	108	1.34	9	V-66
	E. 90°.....	.069	108	1.30	7	L-64
	S. 180°.....	.069	111	1.34	8	T-65
Penthouse accelerograph No. 40.....	Up.....	.099	81	2.00	8	V-113
	S. 180°.....	.100	80	2.02	7	L-93
	W. 270°.....	.100	79	2.03	8	T-103
Basement accelerograph No. 22.....	Up.....	.070	105	1.30	8	V-25
	E. 90°.....	.070	111	1.38	8	L-3
	S. 180°.....	.071	110	1.39	6	T-18
Long Beach Accelerograph No. 24.....	Up.....	.070	113	1.41	10	V-30
	N. 0°.....	.069	113	1.36	9	L-5
	E. 90°.....	.071	110	1.42	11.5	T-34
Los Angeles Chamber of Commerce: ³ 11th floor accelerograph No. 42.....	Up.....	.099	80	1.98	8	V-115
	SW. 220°.....	.098	82	2.00	8.5	L-95
	NW. 310°.....	.098	80	1.95	8.5	T-105
Basement accelerograph No. 21.....	Up.....	.067	107	1.18	9	V-28
	SE. 130°.....	.067	109	1.24	7	L-9
	SW. 220°.....	.068	111	1.30	7	T-26
Los Angeles Edison Building: Accelerograph No. 12.....	Up.....	.070	110	1.37	10	V-67
	SE. 135°.....	.071	109	1.39	11	L-68
	SW. 225°.....	.070	109	1.35	9	T-69
Los Angeles Subway Terminal: ³ 13th floor accelerograph No. 39.....	Up.....	.101	83	2.14	10	V-112
	SW. 219°.....	.100	81	2.05	8	L-92
	NW. 309°.....	.100	79	2.01	11	T-102
Basement accelerograph No. 3.....	Up.....	.069	116	1.40	8	V-58
	SE. 129°.....	.068	118	1.39	10	L-59
	SW. 219°.....	.069	120	1.44	11	T-60
Basement displacement meter No. 13.	NE. 39°.....	9.8	1.0	.....	9	.....
	SE. 129°.....	10.5	1.0	.....	9	.....
Vernon C.M.D. Terminal: Accelerograph No. 41.....	Up.....	.070	109	1.35	8.5	V-47
	SW. 188°.....	.068	115	1.34	8.5	L-37
	NW. 278°.....	.067	116	1.32	8.5	T-48
NORTHERN CALIFORNIA EARTHQUAKE OF SEPTEMBER 21.						
Ferndale accelerograph No. 28.....	Up.....	0.097	71	1.68	10	V-126
	SW. 225°.....	.099	70	1.75	11	L-124
	NW. 315°.....	.100	74	1.87	12	T-125
Eureka accelerograph No. 30.....	Up.....	.070	101	1.25	10	V-29
	NE. 79°.....	.069	107	1.29	9	L-13
	SE. 169°.....	.068	108	1.27	8	T-8

¹The 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.

²The 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.

³Instruments at this station are wired to start simultaneously.

Table 7.—Instrumental constants of strong-motion seismographs in 1944—Continued

NORTHERN CALIFORNIA EARTHQUAKE OF NOVEMBER 16.						
Ferndale accelerograph No. 28.....	Up.....	0.097	71	1.69	10	V-126
	SW. 225°.....	.099	71	1.78	12	L-124
	NW. 315°.....	.100	74	1.87	10	T-125

Table 8.—Changes in strong-motion instrumental equipment during 1944.

Station	Date of Change	Remarks*
Bozeman, Montana.....	September 1944.....	Removed 12-inch recorder No. 47, accelerometers Nos. V-132, L-130, T-131.
Butte, Montana.....	September 20, 1944....	Removed 12-inch recorder No. 46, accelerometers Nos. V-129, L-127, T-128. Installed 6-inch recorder No. 29, accelerometers Nos. V-14, L-35, T-14 from San Francisco Southern Pacific Building basement.
Hawthorne, Nevada.....	March 29, 1944.....	Removed accelerometers Nos. V-31, L-35, T-14. Installed accelerometers Nos. V-27, L-22, T-1 from San Francisco Southern Pacific Building basement. Periods changed from .100 sec. to .087 sec.
San Francisco, California: Alexander Building, 11th floor...	October 17, 1944.....	Removed 12-inch recorder No. 43, accelerometers Nos. V-116, L-96, T-106 temporarily for observation at Ross Dam.
Alexander Building, 16th floor...	February 14, 1944.....	Removed accelerometers Nos. V-110, L-90, T-100. Installed accelerometers Nos. V-11, L-24, T-6.
	October 17, 1944.....	Removed recorder No. 36, accelerometers Nos. V-11, L-24, T-6 temporarily for observation at Ross Dam.
Southern Pacific Building, basement.....	February 14, 1944.....	Removed accelerometers Nos. V-27, L-22, T-1. Installed accelerometers Nos. V-110, L-90, T-100 from San Francisco Alexander Building, 16th floor.
University of San Francisco.....	April 1, 1944.....	Installed experimental mechanical vibration meter recorder. See description of instrument on page 00.
Santiago, Chile.....	March 30, 1944.....	Installed 12-inch recorder No. 50, accelerometers Nos. V-151, L-149, T-150 from University of San Francisco, San Francisco, California. Period of accelerometer approximately .100 sec. Sensitivity approximately .0201.
Lima, Peru.....	April 27, 1944.....	Installed 12-inch recorder No. 44, accelerometers Nos. V-7, L-2, T-17 from Livermore, California. Period of accelerometer approximately .100 sec. Sensitivity approximately .0214.

*Sensitivity in this table is expressed in cm/gal. (Cm. per 1 one-thousandth of "g".)

TILT OBSERVATIONS

With the cooperation of the University of California, three tilt-meters were operated at Berkeley. One instrument was discontinued about November 1. The tilt-graph data obtained from these instruments during 1944 are shown in figure 11, facing page 42.

A fourth tilt-meter was operated at Long Beach, California, in cooperation with the Long Beach Harbor Department. The 1944 tilt-graph results from this station are shown in figure 12, facing page 42.

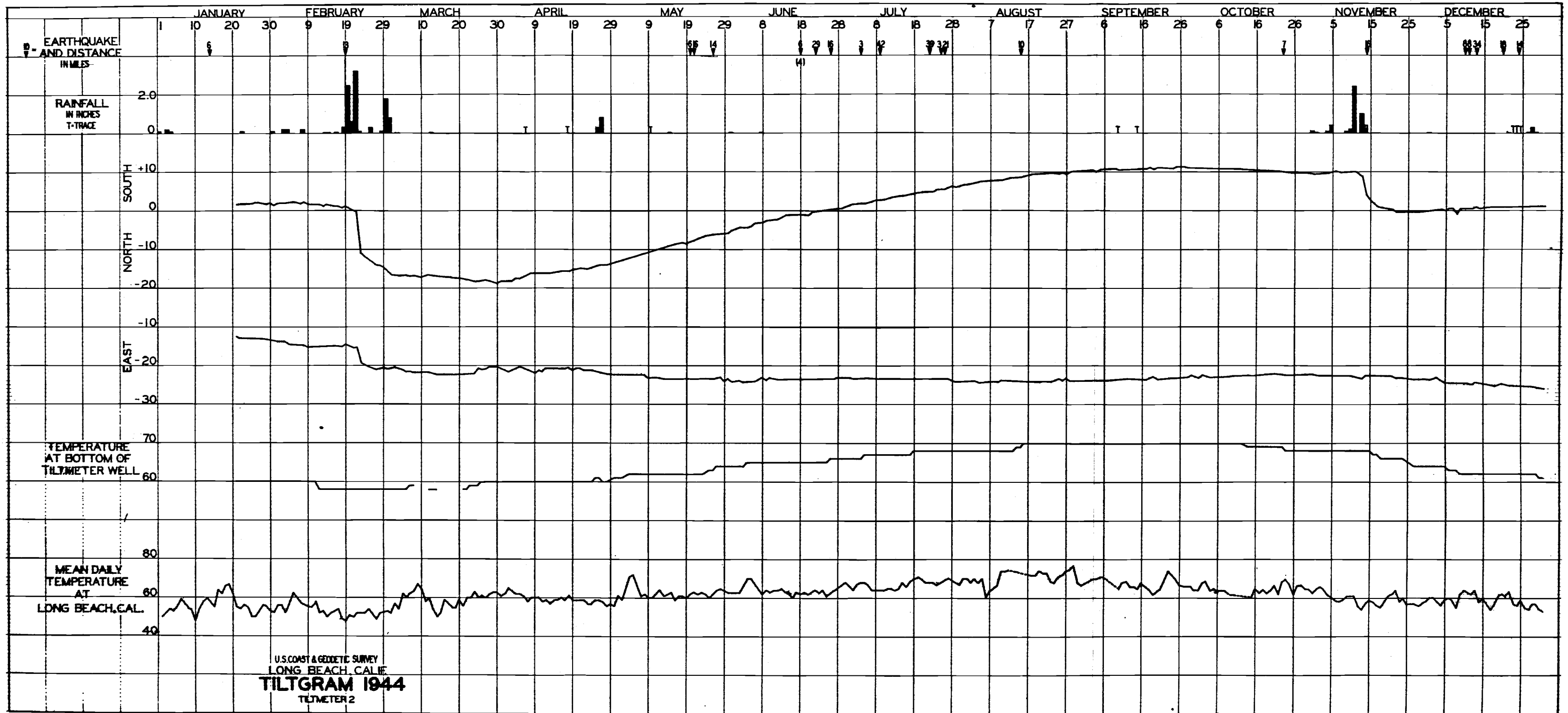


FIGURE 12.—Long Beach tilt-graph for 1944.

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