DEPARTMENT OF THE INTERIOR

U.S. GEOLOGICAL SURVEY

United States Earthquakes, 1941-1945

By

Coast and Geodetic Survey

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Preface

The serial publication *United States Earthquakes* was initiated in 1928 and has been published annually since that time. The present volume is a reprint of those earthquake reports published for the years 1941 through 1945. There has been no attempt to correct or revise the material contained in this volume. However, some additions and corrections to previous issues are listed in reports for the following years: 1941, p. 69; 1942, p. 38; 1943, p. 47; and 1945, p. 37.

With this reprint, all of the older issues of the annual *United States Earthquakes* series are now available. Those desiring copies of *United States Earthquakes, 1928–1935* and *United States Earthquakes, 1936–1940,* may purchase them from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402. The prices of these paperbound reprints are $1.75 and $2.25, respectively.

Copies of the annual reports for the years 1946 through 1967 are available from the National Earthquake Information Center, Coast and Geodetic Survey, Rockville, Md. 20852. A price list will be furnished upon request.

Serial No. 655

UNITED STATES EARTHQUAKES

1941

By

FRANK NEUMANN

Principal Mathematician

U.S. DEPARTMENT OF COMMERCE

COAST AND GEODETIC SURVEY

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CONTENTS

ILLUSTRATIONS

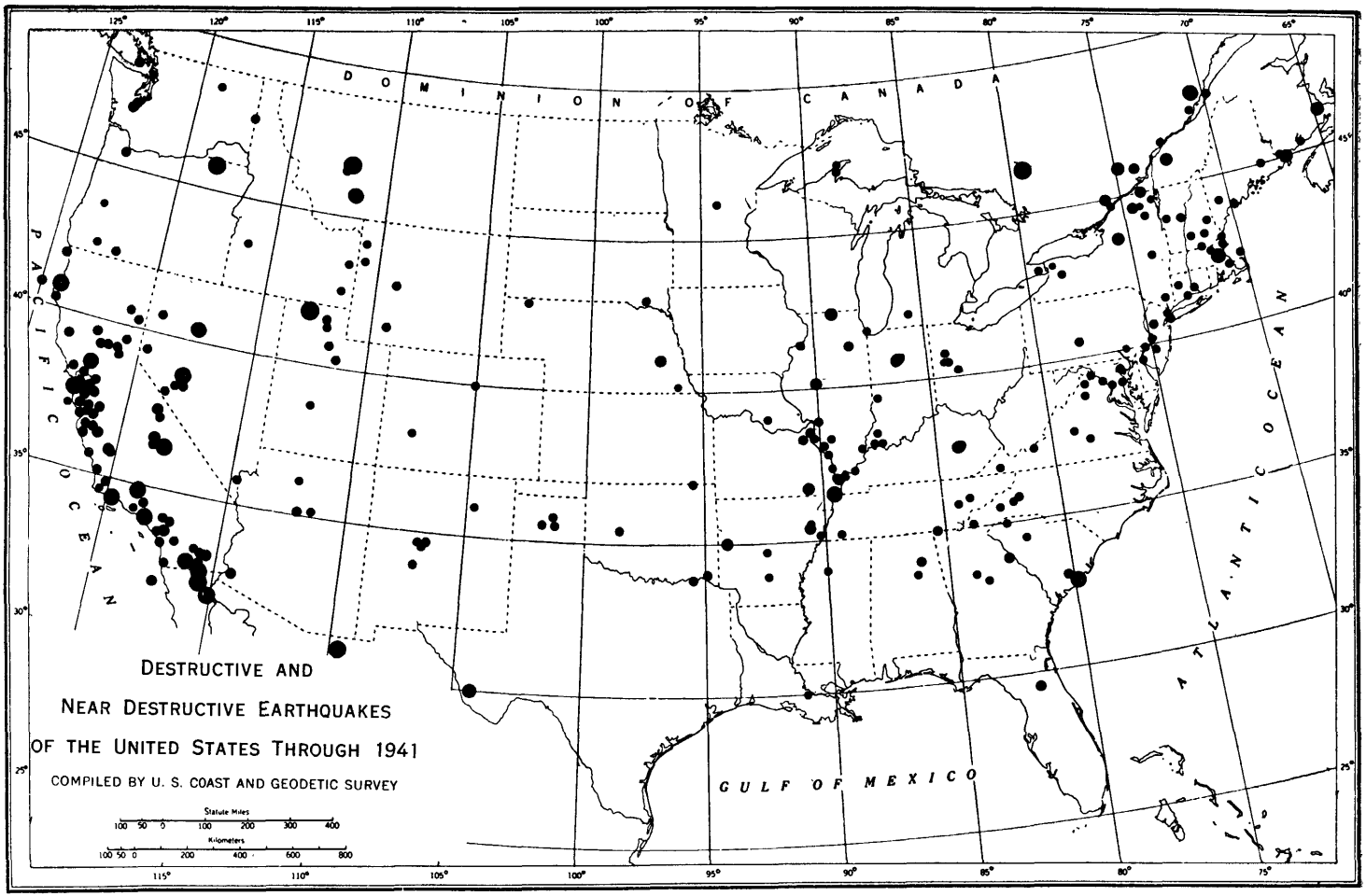

FIGURE 1.—Destructive and near-destructive earthquakes of the United States through 1941.

UNITED STATES EARTHQUAKES, 1941

INTRODUCTION

This publication is a summary of earthquake activity in the United States and the regions under its jurisdiction for the calendar year 1941. 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 recent 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 1941:

Arizona.—Dean G. M. Butler, University of Arizona, Tucson.
Colorado.—Prof. C. A. Heiland, Colorado School of Mines, Golden.
Idaho.—Prof. Vernon E. Scheid, University of Idaho, Moscow.
Montana.—Dr. Francis A. Thomson, Montana School of Mines, Butte.
Nevada.—Prof. Vincent P. Gianella, University of Nevada, Reno.
Oregon.—Dean E. L. Packard, Oregon State Agricultural College, Corvallis.
Utah.—Prof. Hyrum Schneider, 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

[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.

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) press dispatches published by Georgetown University Seismological Station; (8) reports of the Hawaiian Volcano Obervatory: (9) reports of the Weather Bureau of the Philippine Islands; and (10) 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 San Francisco Field Station of the Survey.

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 new 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 the air.

An asterisk (*) indicates that the time is taken from an instrumental report and is reliable. In other instances quite large deviations are frequently reported.

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 under the direction of Prof. Perry Byerly or the Seismological Laboratory of the California Institute of Technology, at Pasadena. The bulletins of these institutions should be consulted for further details and often for data on additional shocks.

Time is indicated as continuous from 0 to 24 hours, beginning and ending at midnight. Local standard time is used.

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 to Earthquake Reports for the Pacific Coast and the Western Mountain Region." The reports are in mimeographed form and tabulate in unabridged 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 and "affected area" maps. In figure 2 the relative intensity of a shock is indicated by the size of the dot.

Teleseismic results.—On page 25 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 and the results broadcast without delay to Europe and points in the Pacific. Postal card reports are also issued.

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, 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

EARTHQUAKE ACTIVITY IN THE VARIOUS STATES

Arizona: Light shocks on March 21 and 27.

Arkansas: Light shock on October 8, also felt in Tennessee.

California: In northern California the most important shock was that of October 3. In the San Francisco Bay region moderate shocks occurred on April 14, May 27, and September 17. In southern California the Torrance-Gardena earthquake of November 14, intensity VIII, was the outstanding shock of the year in the United States. The Santa Barbara shock of June 30 also reached intensity VIII. Other important shocks occurred on September 21 and October 21. Strong shocks occurred in the Ownes Valley area on September 14 and December 20.

Colorado: Light shocks at one place on February 13, 21, and 27; one other on August 29.

Illinois: Light shock on October 21 felt in southern Illinois and Kentucky.

Kentucky: See Illinois.

Maine: Light shock on August 30.

Mississippi: Light shock on June 28.

Missouri: Light shock on October 26.

Montana: Light shocks on February 27, March 5, and September 28.

Nevada: Moderate shocks near Boulder Dam on March 22, September 3 and 5. In other parts of the State a moderate shock occurred on May 5 and October 14, and light ones occurred on January 27, July 17, and August 29.

New Mexico: Moderate shock on August 4.

New Hampshire: A light shock on January 20 was the 17th aftershock since the widespread December 20, 1940, earthquake.

New York: Five light shocks in 4 sections of the State on February 1, July 28, October 9 and 20, and December 12.

North Carolina: Light shock on May 10.

Oklahoma: Light shock on October 18.

Oregon: A strong shock on December 29; light shocks on February 16, July 6, October 19 and 31.

South Dakota: Moderate shock on May 25.

Tennessee: Light shocks in eastern part on March 4 and September 8; one moderate shock in the western part on November 16 and a light one on November 14. See Arkansas.

Utah: Light shock on June 20.

Washington: Moderately strong shock in central portion on April 7; weak and widely spread shocks on January 3, April 6 and 12, and July 29.

Alaska: One strong shock on the Kenai Peninsula area on July 29. Many minor shocks in the same area and in the Fairbanks region.

Hawaiian Islands: Moderately strong shock felt all over Island of Hawaii on September 25. Activity in minor shocks was normal.

Philippine Islands: No shock of outstanding importance. The strongest were near Manila on April 18, and in southern Luzon on November 6.

Puerto Rico: Several light shocks were felt on October 2 and 3.

Panama Canal Zone: A moderate shock was felt throughout Panama on March 9. and an offshore shock, on the Pacific side, caused some damage in eastern Costa Rica and western Panama on December 5. Other activity was minor.

NORTHEASTERN REGION

(75TH MERIDIAN OR EASTEEN STANDARD TIME)

NOTE.—See bulletins of all seismographic stations in the region for additional information. "NESA" refers to Northeastern Seismological Association.

January 20: Night. Ossipee, N. H. Homes shaken within a 20-mile radius of Ossipee. Seventeenth shock felt since the earthquake of December 20.

February 1: 13:28. Canton, N. Y. Slight shock.

July 28: 19:24. Mt. Kisco and White Plains, N. Y. Felt, according to NESA bulletin.

August 30: 10:22. Houlton, Maine. Felt, according to NESA bulletin.

October 9: 17:07. Watertown, N. Y. Slight shock.

October 20: 16:29. Watertown, N. Y. Slight shock.

December 12: 18:30. Dannemora, N. Y. Slight shock.

EASTERN REGION

(75TH MERIDIAN OR EASTERN STANDAED TIME)

March 4: 1:15. Knoxville, Tenn. Slight shock; loud rumbling noise.

May 10: 6:12. Asheville, N. C. Slight shock felt in northern and western parts of the city.

September 8: 4:45. Chattanooga, Tenn. Earthquake accompanied by a rumbling sound was felt over an area of about 100 square miles. Strong in the Lookout Mountain section.

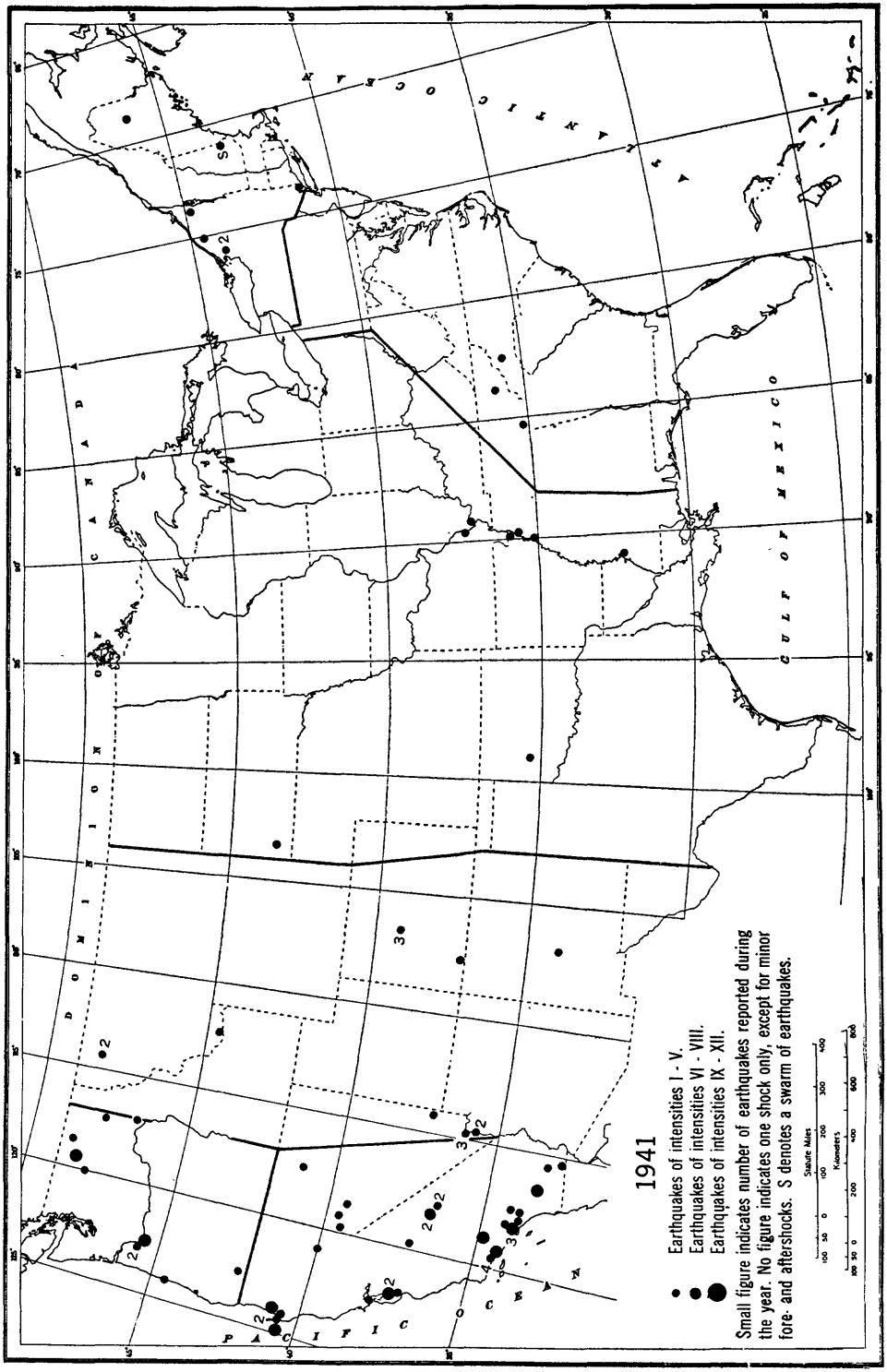

FIGURE 2.—Earthquake epicenters, 1941.

CENTRAL REGION

(90TH MERIDIAN OR CENTRAL STANDARD TIME)

May 25: 0:25. Hot Springs, S. Dak. One wall reported cracked. Pictures and light fixtures swayed at Hot Springs, Rapid City, and Martin. Not felt at Longvalley, Belvidere, Oelrichs, and Cottonwood.

June 28: 12:30. Vicksburg, Miss. Slight shock.

October 8: 1:51.* Blytheville, Ark., and Tiptonville, Tenn. Slight damage reported.

October 18: 1:48.* Bessie and Clinton, Okla. Felt by 75 percent of population in Bessie; dishes rattled. Evidently not quite so strong at Clinton although the press reported cracks in the walls of one building; dishes and windows rattled. Not felt at 6 nearby towns canvassed by the U. S. Weather Bureau Office at Oklahoma City.

October 21: 10:53. Cairo, Ill., and Wickliffe, Ky. At Cairo furniture swayed and dishes rattled.

October 26: 22:00. Cape Girardeau, Mo. Felt by several.

November 14: 21:07. Memphis, Tenn. Slight shock felt by many.

November 16: 21:09. Western Tennessee. Intensity V at Covington where the shock was felt by all and cracks were reported in the courthouse. At Henning it was felt by many, an explosive noise preceding the trembling. Also felt at Memphis, Millington, Fraser, Ripley, Dyersburg, and Pleasant Hill.

WESTERN MOUNTAIN REGION

(105TH MERIDIAN OR MOUNTAIN STANDARD TIME)

NOTE.—Only the more important shocks felt at Boulder Dam, and the more important aftershocks at Helena, Mont., are listed. The unabridged records are published in Abstracts of Earthquake Reports for the Pacific Coast and Western Mountain Region.

February 13: 3:30. Aspen, Colo. Felt down valley as far as Snowmass store. Windows rattled and some objects were visibly disturbed.

February 21: 14:22. Aspen, Colo. Felt by many.

February 27: Aspen, Colo. Felt.

February 27: 20:28. Monida, Mont. Felt by practically everyone. Windows shook and dishes rattled. Also felt at Lima. Recorded on seismographs at Butte, Mont., and Logan, Utah.

March 5: 22:10 and 22:55. Kalispell, Mont. Distinct shock felt in Flathead Valley. Also felt at Eagan, S. Dak.

March 21: (Evening). Willow Beach, Ariz. Felt by all. Small objects moved.

March 22: 4:08.* Boulder City and power plant. Harder than the usual run of light shocks. Few awakened at Boulder City. Recorded on local seismographs.

March 27: 22:30. Willow Beach, Ariz. Felt by many; by some outdoors.

May 5: 20:12.* Southeastern Nevada, near Caliente. Epicenter about 8 miles SSE of Joseco, Nev., according to Lake Mead Seismological Party. About 37.3° north, 114.3° west, according to Pasadena. Felt at Joseco and Caliente. At Joseco it was felt outdoors by some, but few were frightened.

June 20: 8. 20.* Logan, Utah. Intensity III shock felt and recorded on local seismograph. (Information obtained too late for insertion on map, Fig. 2.)

August 4: 0:40. Socorro, N. Mex. Many residents were awakened; a few left their homes. In one home plaster fell from walls. At McGaffey, 123 miles north of Socorro, hanging objects swung and a few residents were awakened.

August 29: 4:34. Bayfield, Colo. Felt from Bayfield up the Los Pinos River valley to the Vallecinto Dam 15 miles north of Bayfield. In Bayfield some dishes were knocked from a shelf and some furniture moved slightly. Horses were frightened.

August 29: 5:09. Winnemucca, Nev. Slight shock reported by several. Some objects disturbed. Also felt at McDermitt, 72 miles north of Winnemucca.

September 3: 14:25. *Boulder City and power plant. Epicenter 4 miles east of Boulder Dam. Felt by many. Rumbling noise heard. Recorded locally on seismographs.

September 5: 6:11.* Boulder City and power plant. Felt by many at both places. Recorded on local seismographs.

September 28: 2:00. Kalispell, Mont. Felt at Kalispell, Big Fork, Columbia Falls, Somers, Belton, and Whitefish. At Big Fork apples were shaken from trees and an entire family was awakened. At Kalispell it was felt by nearly everyone and many awakened. Hanging objects swung. A rumbling sound preceded the shock.

CALIFORNIA AND WESTERN NEVADA

(120TH MERIDIAN OR PACIFIC STANDARD TIME)

NOTE.—All places are in California unless otherwise stated. "P" written after the location of an epicenter means that the location was reported by the Seismological Laborrtory of the California Institute of Technology at Pasadena. "B" refers likewise to the Seismological Station of the University of California at Berkeley. The Berkeley data, however, are not available as this publication goes to press. More details will be found in Abstracts of Earthquake Reports for the Pacific Coast and Western Mountain Region. The Bulletin of the Seismological Society of America is referred to as the "SSA Bulletin".

When more than one degree of intensity is reported from a town, the town is listed under the highest intensity reported.

January 9: 2:29.* Lower California. Epicenter about 31.7° north, 115.1° west, P. Felt in San Diego.

January 19: 22:14.* Felt at Eureka, Blue Lake, Upper Mattole, and Ferndale.

January 20: 5:58.* Near Buena Vista Lake. Epicenter about 35°20′ north, 119°15′ west, P. Felt at Buttonwillow and McKittrick.

January 23: 4:03.* Humboldt Bay region. Felt over land area approximately 2,000 square miles. Maximum intensity V. A strong-motion record was obtained on the accelerograph at Ferndale.

INTENSITY V:

At Punta Gorda Light Station plaster was cracked and water spilled from indoor containers. Many or all were awakened at Dyerville, Eureka, Ferndale, Fields Landing, Miranda, Rio Dell, Shelter Cove, Shively, and Weott. At Ferndale hanging objects swung, and at Bridgeville trees and bushes shook slightly.

Also felt at Alder Point, Arcata, Blue Lake, Briceland, Cape Mendocino, Carlotta, Ettersburg, Forest Glen, Fortuna, Kneeland, Loleta, Rockport, Sawyers Bar, Scotia, and Westport.

Not felt at 24 other places canvassed.

January 27: 23:16. Fallon, Nev. Light shock accompanied by subterranean sounds. Two shocks recorded at Tinemaha, at 23:08 and at 1:23 on January 28.

January 29: 17:35.* Near Whittier. Epicenter 33°58′ north, 118°03′ west, P. Felt generally in the Los Angeles basin. Felt strongest at Alhambra, Burbank, Los Angeles, Norwalk, and San Gabriel. Some plaster was shaken down and a few dishes were broken. There were several cases of water spilling from indoor containers.

Also felt at Altadena, Compton, El Monte, Gardena, Huntington Park, Keystone, Pasadena, Pico, Riverside, Santa Monica, and Whittier. At Point Fermin the tip of the point slid another 4.5 feet toward the ocean.

Not felt at Balboa and Fontana.

February 5: 5:33.* Near head of Gulf of California. Epicenter about 31.7° north, 115.1° west, P. Felt at San Diego. Not felt at Riverside.

February 8: 7:59.* Near Santa Barbara. Epicenter about 34°33′ north, 119°41′ west, Felt at Santa Barbara.

February 9: 1:45.* Off coast near Eureka. Epicenter about 40.9° north, 125.4° west. Felt over a land area of approximately 17,000 square miles in California and southern Oregon as shown on map. Maximum intensity VI. Cracked plaster was reported in some instances, but there was no structural damage. The earthquake occurred during a heavy rain and wind storm. Strong-motion records were obtained from the instruments at Ferndale and Eureka.

INTENSITY VI:

Arcata.—All awakened and many frightened. Vase overturned and broken.
Eureka.—Small objects overturned.
Ferndale.—Everyone awakened, many frightened. Small objects overturned and knicknacks fell.
Punta Gorda Light Station.—Slight damage from cracked plaster.
Shelter Cove.—Everyone ran from home of observer. Several places along the bluff slid in.

INTENSITY V:

Bridgeville.—Many awakened and frightened.
Carlotta.—Many awakened.
Crescent City.—Many awakened. Clocks stopped.
Fields Landing.—Many awakened and frightened. Small objects and furnishings moved.
Forest Glen.—All awakened. Liquid spilled from containers.
Fort Seward.—Many awakened. Trees and bushes shaken strongly.
Fortuna.—Many awakened.
Garberville.—Many awakened.
Klamath.—Many awakened.
Loleta.—Many awakened. Water spilled from indoor containers. Hanging objects swung.
Orick.—Many awakened. Light fixtures swung. Trees and bushes shaken slightly.
Orleans.—Many awakened. Hanging objects swung. Small objects and furnishings moved.
Scotia.—Many awakened.
South Fork.—All awakened.
Trinidad.—Many awakened. Hanging objects and doors swung.
Upper Mattole.—All awakened.
Weott.—Many awakened. Small objects moved. Trees and bushes shook slightly.
Willow Creek.—Many awakened.

INTENSITY V IN OREGON:

Grants Pass.—Many awakened. Wooden bowls moved. Floor in hotel visibly shaken.
Port Orford.—Many awakened.

INTENSITY IV:

Alderpoint, Benbow, Blue Lake, Briceland, Cape Mendocino, Ettersburg, Harris, Honeydew, Hoopa, Hyampom, Island Mountain, Mendocino, Miranda, Mount Shasta City, Petaluma, Point Arena, Rockport, San Francisco, Smith River, Yager, Zenia.

INTENSITY IV IN OREGON:

Agness, Brookings, Glendale, Medford, O'Brien and Cave Junction.

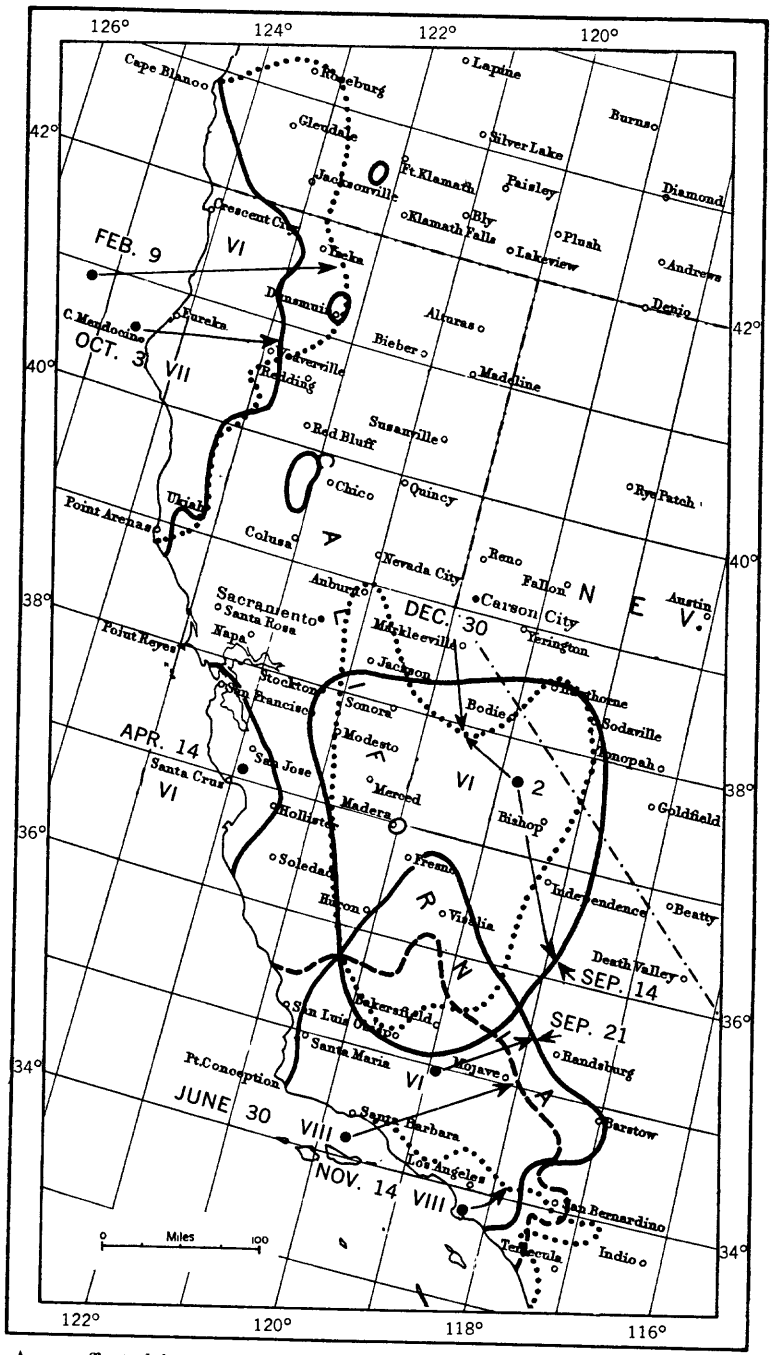

FIGURE 3.—Areas affected by the more important earthquakes of California and western Nevada in 1941.

INTENSITY I TO III:

Blocksburg, Bolinas, Camp Grant (South Fork), Cummings, Fort Bragg, Laytonville, Longvale, Sawyers Bar, Weaverville, Willits, Yreka.

INTENSITY I TO III IN OREGON:

Blaine, Gold Beach, Roseburg (Weather Bureau Office).

Not felt at 51 places canvassed in California and 23 in Oregon.

February 10: 22:44.* Santa Barbara. Epicenter 34°16′ north, 119°34′ west, P. Felt in Santa Barbara. Police, fire department, and newspaper switchboards were jammed with hundreds of calls, according to the press.

February 20: 8:55.* Near Saugus. Epicenter about 34°31′ north, 118°33′ west, P. Felt at Acton and Saugus. At Saugus liquids spilled from containers and trees and bushes shook slightly.

February 21: 2:43.* Sierra Nevada, near Weldon. Epicenter 35°42′ north, 118°22′ west, P. Felt by many at Kernville. Few awakened.

February 23: 10:36.* San Jacinto fault, Coahuila Valley. Epicenter about 33°30′ north, 116°29′ west, P. Felt at Indio, Mount Laguna, San Diego, Spring Valley, Thermal, and Warner Springs.

Not felt at 9 other places canvassed.

February 26: 5:09.* Imperial Valley, near Niland. Epicenter about 33.3° north, 115.5° west, P. At Westmorland all were awakened and frightened. Small objects and furnishings moved and hanging objects swung. Clocks stopped. At Brawley and Calipatria many were awakened.

February 26: 6:02.* Imperial Valley near Niland. Epicenter about 33.3° north, 115.5° west, P. Many awakened at Calipatria.

Not felt at Ogilby.

February 28: 12:14. Weott and Scotia. Trees and bushes shaken slightly at Weott.

March 2: 12:18.* Los Angeles area. Epicenter about 33°59′ north, 118°18′ west, P. Felt in Wilshire District of Los Angeles.

Not felt at Maywood.

March 5: 23:18. San Leandro, Mills College, and Lake Merrit, slight shock. Recorded on the Berkeley seismographs.

March 14: 21:46.* Lower California. Epicenter about 28.1° north, 113.6° west. Felt by few in San Diego.

March 15: 23:55. Benbow. Few awakened by light shock recorded on seismograph at Tinemaha.

March 17: 22:37. Imperial Valley. Many awakened in Brawley. Recorded on seismograph at Riverside.

March 18: 16:16. Hollister and Salinas. Windows rattled at Hollister.

March 20: 19:14.* Santa Ana Mountains. Epicenter 33°41′ north, 117°32′ west, P. Felt in the Silverado Canyon.

March 21, 22: 19:12, 24:00, 4:00. Three shocks felt in the Silverado Canyon.

March 25: 15:44.* San Bernardino Valley. Epicenter 34°13′ north, 117°28′ west, Lytle Creek region, P. At Alta Loma plaster cracked and small objects overturned. Also felt at San Bernardino, Cajon, Corona Ranger Station, Fontana, Llano, Lytle Creek Ranger Station, Riverside, and Victorville.

March 27: 2:45.* Madera County. Epicenter 37.2° north, 119.8° west, P. At Raymond many awakened and small objects and furnishings moved. At Yosemite National Park many awakened and a roaring noise was heard by some. In Mariposa County residents were awakened by two shocks like an underground blast. Also felt at Knolls.

March 27: 17:35.* Plaster City. Small objects and furnishings moved. Recorded on seismograph at Riverside.

March 31: 23:05.* Sunol. Slight shock. Recorded definitely on seismographs at Tinemaha and Haiwee.

April 5: 4:41.* Alpine County. At Woodfords the shock was felt by many, and loud sounds were heard. At Markleeville a clock stopped. A slight shock reported from Yosemite National Park one hour later was probably identical with this.

April 9: 9:08* and 9:40.* Probably Gulf of California. Epicenter about 31° north, 114° west, P. Felt by many in San Diego. Chandeliers swayed.

April 10: 17:20.* Santa Ana Canyon. Epicenter 33°54′ north, 117°35′ west, Elsinore Fault zone, P. At Corona Ranger Station small objects moved and trees and bushes shook slightly. Also felt at Fontana, La Verne, Riverside, and San Bernardino.

April 14: 8:17.* Lower San Francisco Bay and Monterey Bay regions. Felt over a land area of approximately 5,000 square miles as shown on map. Maximum intensity approximately VI.

INTENSITY VI:

Alma.—All frightened. Trees and bushes shaken strongly.

Aptos.—Small objects moved, dishes and cans knocked off shelves.

Capitola.—Many frightened. Cans shaken from shelves in grocery store. Damage slight.

Santa Cruz.—Walls cracked slightly. Buildings and trees swayed visibly. Thunderous subterranean sounds were heard at time of shock.

Soquel.—Small objects overturned.

INTENSITY V:

Small objects were moved in San Francisco, Saratoga, and Watsonville. At San Martin all were awakened.

INTENSITY IV:

Almaden, Ben Lomond, Big Sur, Boulder Creek, Carmel, Colma, Davenport, Felton, Gilroy, Hollister, Holy City, Laurel, Los Gatos, Madrone, Moss Beach, Olympia, Spreckels.

INTENSITY I TO III:

Brookdale, Coyote, Hayward, Marina, Monterey, Pacific Grove, Salinas, San Bruno, San Juan Bautista, Seaside, Sunnyvale.

Not felt at 57 places canvassed.

April 18: 17:46.* Near Long Beach. Epicenter 33°48′ north, 118°12′ west, P. Felt at Compton, according to the press.

April 24: 10:46.* Off Huntington Beach. Epicenter 33°37′ north, 118°02′ west, P. Felt at Huntington Beach.

May 1: 5:29.* Northern California. Plumas and Butte Counties. Epicenter about 40° north, 121° west, P. Felt at Almanor, Caribou, De Sabla, Lassen, and Stirling City; also Bucks and Prattville Powerhouses. At Caribou the shock was felt by many and rumbling sounds were heard at time of shock.

May 13: 8:02.* Off Cape Mendocino. Epicenter 40.3° north, 125.0° west. Felt along the coast at widely separated points and at 2 towns in Oregon. Maximum intensity V.

A record was obtained on the strong-motion seismograph at Ferndale. At Loleta many awakened. At Santa Cruz plaster was reported cracked. Hanging objects swung at Ferndale, Rio Dell, Rockport, and Willitts. Also felt at Arcata, Ben Lomond, Blue Lake, Bolinas, Carlotta, Ettersburg, Eureka, Fort Bragg, Petrolia, Redwood City, San Francisco, Scotia, Shively, Trinidad, Ukiah, Upper Mattole, and Wildwood. Felt at DePoe Bay and Knappa in Oregon.

Not felt at 40 other places canvassed in California nor at 40 in Oregon.

May 14: 19:29 and 22:00. Coalinga. Hanging objects swung. Recorded indefinitely at Pasadena, Tinemaha, and Mt. Wilson.

May 21: 15:43. Probably Gulf of California. Epicenter 29°? north, 113°? west, P. Felt in San Diego.

May 27: 22:23.* San Francisco and Monterey Bay regions. Felt over land area of approximately 4,500 square miles. Maximum intensity about VI. Plaster was reported cracked in one town.

INTENSITY VI:

San Martin.—Many awakened and frightened. Plaster cracked, hanging objects swung. Damage slight.

INTENSITY V:

Many were awakened at Boulder Creek, Niles, San Carlos, and Soquel. Small and hanging objects were disturbed at Kentfield, Los Gatos, Manor, San Carlos, and San Francisco.

INTENSITY IV:

Almaden, Alvarado, Aptos, Ben Lomond, Berkeley, Bolinas, Burlingame, Campbell, Corte Madera, Davenport, El Granada, Gilroy, Half Moon Bay, Laurel, Los Altos, Madrone, Mill Valley, Milpitas, Morgan Hill. Newark, Olympia, Redwood City, Ross, San Gregorio, San Jose, San Juan Bautista, San Mateo, Santa Cruz, Sausalito, Sunnyvale.

INTENSITY I TO III:

Alameda, Coyote, Montara, Moraga, Oakley, Pescadero, Pleasanton, Tiburon.

Not felt at 41 other places canvassed.

June 2: 17:20.* Off Huntington Beach. Epicenter about 33°37′ north, 118°02′ west, P. Felt at Seal Beach.

June 4: 0:56.* Near Santa Ana. Epicenter 33°45′ north, 117°50′ west, P. In Santa Ana many residents were awakened. At Newport Beach few were awakened and hanging objects swung. Also felt 3 miles south of Anaheim.

June 4: 5:47. Sierra Madre Mts. Epicenter about 34°17′ north, 117°43′ west, P. Felt outdoors by some and awakened a few at Valyermo Ranger Station.

June 7: 18:18.* Near Independence. Epicenter 36°43′ north, 118°10′ west, P. Felt by many at Independence. Stove and furniture rattled.

June 11: 5:27. Lower Los Angeles County. Epicenter 33°47′ north, 118°25′ west. Felt at Redondo, Hermosa, and Manhattan Beaches, according to the press.

June 25: 9:15.* Lower California. Epicenter about 32.5° north, 115.9° west, P. Felt at Calipatria and Carriso Gorge.

June 30: 23:51.* Santa Barbara channel. Epicenter 34°20′north, 119°35′ west, P. Maximum intensity VIII. Land area affected about 20,000 square miles as shown on the map. The intensity was in the lower bracket of VIII at Santa Barbara and Carpinteria and VII at Goleta and Ventura. The total damage was estimated around $100,000, of which 25 percent was damage to drug and liquor stocks and 10 percent to plate glass. An article on the earthquake appears in the October 1941 issue of "Building Standards Monthly."

The outstanding features included a small slide which covered the railroad and reached the highway about twenty miles south of Santa Barbara on Highway 101; temporary suspension of telephone service between Santa Barbara, Carpinteria, Ventura, and San Luis Obispo; the toppling of 600,000 board feet of lumber standing on end, 2,000 stacked cases of lemons, and a number of bookcases; and the snapping off of many street lamps in Santa Barbara.

Strong-motion seismograph records were obtained at Santa Barbara, Hollywood, Los Angeles, Vernon, and Long Beach.

INTENSITY VIII:

Carpinteria.—Damage was proportionately higher than in Santa Barbara. About 25 chimneys and a number of walls fell, and the cornice of 1 building was shaken off. Pictures and plaster fell, and dishes and windows were broken.

Santa Barbara.—Thirty glass-topped street lamps were snapped off. Bricks were dislodged from some buildings and several buildings were cracked, but none was seriously damaged. In several old school buildings some plaster cracked or fell, but there was no structural damage to any schools. One chimney toppled down. The loss due to shattering of plate-glass windows amounted to approximately $10,000. Art and curio shops suffered from $5,000 to $10,000 loss. Practically every store in the 600 to 1,000 blocks of State Street suffered considerable inside damage.

Sidewalks buckled in a few places and there were 17 breaks in the larger water mains in addition to 18 service breaks. Power and gas were shut off in a few sections to check operations. In the County Law Building large book shelves toppled, and there were many instances of broken dishes, windows, and furniture. Liquids spilled from indoor and outdoor containers.

INTENSITY VII:

Goleta.—All residents were awakened and a few frightened. Plaster, windows, walls, and chimneys were cracked. Knickknacks, books, and pictures fell, and there was some fall of plaster. Dishes, windows, and furniture were reported broken. Liquids spilled from indoor and outdoor containers. Trees and bushes were shaken strongly.

Ventura.—Some cracked walls and fall of plaster were reported. Windows and dishes were broken. There was considerable damage to glass goods in stores.

INTENSITY VI:

Fillmore.—All were awakened and frightened. Clocks stopped.

Kern.—Dishes were broken and clocks stopped. According to the press, there was a flood of telephone calls to local law enforcement agencies. One sleeper reported he fell out of bed.

Keystone.—Many awakened and frightened. Plaster was cracked and liquids spilled from indoor containers. Damage slight.

Los Alamos.—Many awakened. Vases and small objects overturned. Damage slight. Many clocks stopped.

Ojai.—Some walls cracked very slightly. Trees and street lamps swayed visibly. A few small objects were overturned.

Oxnard.— Many were alarmed. Clocks stopped. No appreciable damage.

Port Hueneme.—Awakened all and frightened many. Plaster cracked. Trees and bushes shaken moderately.

Santa Paula.—All awakened. Vases overturned. Trees and bushes shook moderately.

Summerland.—All awakened and frightened. Vases and small objects overturned. Damage slight.

Wheeler Springs.—Many frightened. Mirror broken. Hanging objects swung.

INTENSITY V:

Acton, Altadena, Arlight, Artesia, Arvin, Balboa, Betteravia, Buellton, Burbank, Camarillo, Canoga Park, Casmalia, Cayucos, Chatsworth, Compton, Concepcion, El Segundo, Gaviota, Glendale, Hermosa Beach, Inglewood, La Crescenta, Laguna Beach, Lancaster, Lomita, Lompoc, Long Beach, Los Angeles, Los Olivos, Maywood, McKittrick, Montalvo, Moorpark, Mt. Figueroa Lookout, Newbury Park, Newport, Nipomo, North Hollywood, Oceano, Orcutt, Pasadena, Pattiway, Piru, Sandberg, San Nicolas Island, San Pedro, Santa Ana, Santa Maria, Santa Monica, Santa Inez, Sierra Madre, Simi, Stanton, Sunland, Surf, Tehachapi, Upper Sespe Mts., Valyermo, Wheeler Ridge, Whittier.

At most of these places many residents were awakened and some frightened. In a small number of cases hanging objects swung and trees and bushes were shaken slightly. Los Angeles reported slight swaying of some buildings.

INTENSITY IV:

Adelanto, Alhambra, Arroyo Grande, Avalon, Bakersfield, Bellflower, Brea, Buttonwillow, Caliente, Creston, El Toro, Fellows, Grapevine, Guadalupe, Hollywood, Huntington Beach, Huntington Park, La Canada, Lake Arrowhead, Littlerock, Manzanita Lookout, Maricopa, Mount Wilson, Moreno, Olive View, Ontario, Point Conception Light Station, San Dimas, San Juan Capistrano, Santa Susana, Saticoy, Seal Beach, Shafter, Shandon, South Gate, Taft, Topanga, Tupman, Van Nuys, Yorba Linda.

INTENSITY I TO III:

Delano, Etiwanda, Llano, Mojave, Palmdale, Point Loma, Pozo, Pomona, Redlands, Riverside, Rosamond, San Bernardino, San Diego, Santa Margarita, Tipton, Tujunga, Wasco, Wrightwood.

Not felt at 54 other places canvassed.

July 1: 15:54.* Near Santa Barbara. Epicenter 34°20′ north, 119°35′ west, P. Felt at Fillmore, Gaviota, Los Alamos, and Santa Barbara. Felt by nearly everyone at Los Alamos.

July 6: 0:47.* Ukiah. Felt by several. Awakened all at a point 15 miles northwest of Ukiah.

July 12: 8:18.* Near Santa Barbara. Epicenter 34°20′ north, 119°35′ west, P. Felt rather strongly at Montrose, Saticoy, and Wheeler Springs. Also felt at Fillmore, Glendale, Los Angeles, and Saugus.

July 17: 19:54.* Western Nevada. Epicenter about 40° north, 119° west, P. Felt at Wadsworth, Nev.

July 22: 10:52.* Imperial Valley. Epicenter about 32°44′ north, 115°27′ west, P. Felt at Brawley, Westmorland, and Calipatria. At Brawley a few cracks appeared in walls of buildings in the business district.

July 23: 13:13.* Marin County. Strongest at Kentfield where some residents ran from their homes and mirrors moved. At Novato a wall was reported cracked. Intensity IV at Ross, San Rafael, and Sausalito Also felt at Ignacio, Olema Petaluma, San Francisco, Berkeley, Richmond, Napa, and Vallejo.

July 25: 23:32.* Los Angeles County. Epicenter about 33°37′ north, 118°02′ west, P. Felt near Huntington Beach.

August 10: 4:08.* Los Angeles County. Epicenter about 34°01′ north, 117°53′ west, near Walnut, P. Felt at Claremont.

August 17: 3:14.* Owens Valley. Epicenter about 36.5° north, 118.0° west, near Lone Pine, P. Many awakened at Keeler. At Lone Pine china was dislodged in several homes.

August 25: 20:31.* Hollister. Slight shock recorded at Tinemaha.

September 1: 21:48. Pope Valley. A few awakened at St. Helena. Recorded at Tinemaha.

September 7: 19:12:45* and 19:14:23.* Near Santa Barbara. Epicenter 34°20′ north, 119°35′ west, P. Twin shocks of about the same magnitude were felt over a land area of approximately 1,500 square miles. Maximum intensity V was reported from Goleta and Santa Barbara. A strong-motion record was obtained on the accelerograph in Santa Barbara.

At Goleta small objects and furnishings moved and hanging objects swung. At Santa Barbara some dishes were reported broken, many residents were frightened, and trees and bushes were shaken slightly. Similar intensity was reported from Los Alamos and Summerland. Also felt at Buellton, Carpinteria, Los Olivos, Santa Inez, Ventura, and Lompoc. It was not felt at Maricopa and San Onofre.

September 7: 20:45.* Near Santa Barbara. Epicenter 34°20′ north, 119°35′ west, P. Felt at Santa Barbara.

September 8: 19:23.* Near Santa Barbara. Epicenter 34°20′ north, 119°35′ west, P. Felt at Santa Barbara.

September 12: 19:25.* Near Riverside. Epicenter about 33°50′ north, 117°20′ west, the Gavilan district, P. Felt at Fawnskin (Big Bear Ranger Station).

September 13: 5:05. Off La Jolla. Felt by many at Point Loma. Hanging objects swung and subterranean sounds were heard. (Possibly same shock as one recorded on September 14 at 15:51.* Epicenter about 32°53′ north, 117°24′ west, about 15 miles off La Jolla, P.)

September 14: 8:44,* 8:55,* 10:21,* 10:39,* 10:54.* Owens Valley, near Rock Creek. Epicenter 37°34′ north, 118°44′ west, P. Maximum intensity VI–VII. Higher intensities probably occurred but were not reported because of sparseness of population. The magnitudes of the five shocks listed were respectively 6, 4.5, 5.5, 6, and 4, according to the Pasadena magnitude scale. Area affected, about 30,000 square miles, mostly in California. Rock slides in the mountains raised huge clouds and blocked roads and trails. Highway 395 was blocked at two points by large boulders, and an unoccupied cabin was destroyed. All residents of the Rock Creek and Mono Creek basins were frightened.

Because of confusion in the times of occurrence listed on many of the reports, the following abstracts will include information on all of the shocks. In "Abstracts of Earthquake Reports for the Pacific Coast and Western Mountain region" for this period the data are separated into 3 groups, those for the 8:43 shock and various others, the 10:21, and the 10:39 shocks.

Strong-motion records of the 8:43, 10:21, and 10:39 shocks were obtained at Bishop.

INTENSITY VI:

Benton.—All were frightened. Plaster and walls cracked, knickknacks, books, and pictures fell.
Columbia.—Small objects moved, and knickknacks fell.
Coulterville (Trumbull Peak Lookout).—Small objects moved, knickknacks fell.
Doyles.—Fireplace damaged.
Groveland (Wood Ridge Lookout).—Small objects moved, knickknacks fell.
Groveland (Tuolumne Ranger Station).—Small objects moved, knickknacks fell.
Incline Ranger Station.—Small objects moved, knickknacks fell.
Incline Guard Station.—Trees and bushes shaken moderately.
North Fork.—Small objects overturned.
Oakhurst (Miami Ranger Station).—Chimney and walk cracked.
Pinedale.—One adobe wall cracked, floor lamps moved.
Pineridge Shaver Ranger Station.—Walls and chimneys cracked; trees and bushes shaken strongly. All frightened.
Tuolumne.—Small objects moved, knickknacks fell.
Yosemite Valley.—Canned goods tumbled from shelves. Several chimneys damaged. Small objects were overturned, and a chandelier swung through a wide arc.

INTENSITY V:

Ash Peak Lookout (Sequoia National Park).—Wooden walls cracked; trees and bushes shaken moderately.
Auberry, 10 miles north of.—Felt by all. Hanging objects swung. Shock preceded by rumbling noise.
Big Creek.—Small objects and furnishings moved. Rumbling sounds heard during shock by many.
Breckenridge Lookout.—Small objects moved.

Cathay Valley.—Small objects and mirror moved. Bed shaken distinctly.
Delpiedra.—Small objects and furnishings moved; trees and bushes shook moderately.
Dunlap.—Small objects moved. Trees and bushes shook strongly.
El Portal.—Small objects and furnishings moved; large rockery shaken.
Fresno.—Tall buildings swayed slightly; furniture was displaced and chandelier swayed. Press reported some plaster cracked.
Friant.—Disturbed objects observed by many; suspended rope swung moderately.
Jamestown.—Plaster cracked.
Kaweah.—Liquids spilled from containers; trees and bushes shook strongly. Many frightened. Rumbling noise.
Lakeshore (Kaiser Diggings).—Felt by all. Trees and bushes shook slightly.
Lakeshore (High Sierra Ranger Station).—Felt by all. Trees and bushes shook slightly.
Laws.—Trees and bushes shook strongly. Clocks stopped.
Lone Pine.—Small objects and furnishings moved.
Madera.—Buildings swayed. Bumping subterranean sounds heard during one shock.
Mammoth Lakes.—Several small slides of stones near Convict Lakes and along Rock Creek Road; slight damage to roads. Terrific rumble heard with many landslides on higher mountains.
Mammoth Lakes District (Crystal Crag).—Rocks fell from cliff. Part of mountain east of Twin Lakes slipped off. Many frightened at Tamarack Lodge.
Newman.—Chandelier swung.
Oakhurst.—Felt by all. Pictures swayed.
O'Neals.—Small objects and furnishings moved.
Pineridge.—Many frightened. Small objects moved up and down.
Pine Creek Canyon (about 15 miles west of Bishop).—Felt by all. Trees and bushes shaken moderately. One observer reported the following: "I was on my way to a mill in Pine Creek Canyon when the last and most severe shock occurred and happened to be immediately across the stream (Pine Creek) from a long swale heading on the very top of Mt. Tom and descending almost in a straight line to Pine Creek. * * * I noticed the rocks hurtling down the mountain side, accompanied by a large cloud of dust. * * * Many of the boulders weighed several tons and literally hundreds of them were in the air over a period of at least three or four minutes, possibly longer. * * * Considerably rolling stock was found lodged in the road and in some instances had to be removed before traffic could be resumed."
Porterville.—Plaster cracked in a few houses; handing objects swung.
Raisin.—Small objects and furnishings moved. Some frightened.
Reds Meadow Guard Station (Mammoth Lakes).—Rocks fell from sides of road, cut, and canyons. Dishes moved.
Reedley.—Plaster cracked; damage slight.
Riverdale.—Small objects moved.
Shaver Lake.—Pine cones and limbs fell from trees. Rumbling sounds.
Sonora.—Small objects moved. Trees and bushes shook moderately.

INTENSITY V IN NEVADA:

Dyer.—Plaster cracked; damage slight.
Mount Montgomery.—Small objects overturned; canned goods moved.

INTENSITY IV:

Academy, Bakersfield, Benton, Big Meadow Guard Station (Pinehurst Ranger Station), Big Oak Flat, Bigpine (Powerhouse), Bishop, Bodfish, Bridgeport, Buttonwillow, Camp Mather, Cathay Valley, Choice Valley (Cholame), Clovis (7 miles northeast of), Coalinga, Coulterville, Corcoran, Cutler, Dardanelle, Deep Springs, Dos Palos, Ducor, Dunlap, El Portal, Exeter, Fresno and mountain area, Friant, Grizzly Flats, Hanford, Havilah, Hume Lake, Huntington Lake, Huron, Independence, Kaweah, Kerman, Kernville, Kettleman City, Lakeshore, LaGrange, Laton, Laws, Lemon Cove, Lindsay, Lone Pine, Lost Hills, Madera, Mammoth Lakes, McKittrick, Mendota, Mt. Baldy Lookout, Navalencia, Newman, North Fork, Oakdale, Oasis, Oilfields, O'Neals, Orange Cove, Pinehurst Ranger Station, Pineridge, Pond, Prather, Reedley, Riverdale, Sacramento, Sanger, Selma, Sequoia National Park, Snelling, Sonora, South Lake, Springville, Stratford, Squaw Valley, Three Rivers, Tipton, Tollhouse, Tranquillity, Usona, Visalia, Wawona, Woodlake, Yosemite Valley.

INTENSITY IV IN NEVADA:

Hawthorne, Mina.

INTENSITY I TO III:

Arvin, Bakersfield, Bear Valley, Buttonwillow, Copperopolis, Cutler, Ducor, Hollister, Ione, June Lake, Kerman, Laton, Leevining, LeGrand, Linden, Long Barn, Navalencia, O'Neals, Sacramento, Selma, Shafter, Stanislaus, Stockton, Stratford, Three Rivers, Tollhouse, Traver, Tulare, Ventucopa, Vernalis.

Not felt at 83 places canvassed in California and 8 places in Nevada.

September 14: 13:16.* Owens Valley. Epicenter 37°34′ north, 118°44′ west, near Rock Creek, P. Felt at Big Creek.

September 14: 17:37.* Near Santa Barbara. Epicenter 34°20′ north, 119°35′ west, P. Felt at Santa Barbara, Goleta, and Summerland. Maximum intensity at Santa Barbara; many frightened, trees and bushes shaken slightly.

A strong-motion record was obtained on the Santa Barbara accelerograph.

September 17: 23:33.* San Francisco and Monterey Bay regions. Epicenter about 37.4° north, 122.0° west. Felt over a land area of approximately 4,500 square miles. Maximum intensity approximately V, reported from many places.

Strong-motion records were obtained from the accelerographs in San Jose.

INTENSITY V:

Alvarado, Alviso, Berkeley, Boulder Creek, Burlingame, Colma, El Granada, Felton, Half Moon Bay, Hayward, Mill Valley, Milpitas, Mount Hamilton, Newark, Olympia, Redwood City, San Francisco, Santa Cruz, Saratoga, Soquel, and Sunnyvale. At all of these places many residents were awakened and some frightened. In San Francisco disturbed objects were observed by a few, and there were a few reports of suspended objects swinging. In some sections of the city the shock was not felt. At Milpitas liquids were spilled from containers and trees and bushes shook moderately. Santa Cruz reported roaring sounds before the shock. At San Jose the telephone company reported a flood of calls.

INTENSITY IV:

Alamo, Aptos, Ben Lomond, Bolinas, Coyote, Daly City, Hollister, Holy City, Loma Mar, Madrone, Millbrae, Montara, Monterey, Mountain View, Morgan Hill, Niles, Oakland, Palo Alto, Pleasanton, Pescadero, Richmond, San Bruno, San Jose, San Lorenzo, San Martin, San Rafael, Sausalito, South San Francisco, Stockton, Vallejo, Vernalis, Warmsprings.

INTENSITY I TO III:

Alma, Big Basin, Big Sur, Carmel Valley, Glenwood, Livermore, Los Gatos, Pinole, San Carlos San Juan Bautista, Stinson Beach.

Not felt at 45 places canvassed.

September 21: 11:53.* Southern California. Epicenter 34°52′ north, 118°56′ west, near Cuddy Valley, P. Felt over a land area of approximately 26,000 miles. A maximum intensity of approximately VI was reported from several places.

INTENSITY VI:

Gorman.—Dishes reported broken.

Lebec.—Lamps swayed and objects fell from shelves.

Los Angeles.—Generally felt. One observer reported swinging of pictures and mirror. Small vase thrown from the mantle. Trees and bushes shaken slightly.

Taft.—Knickknacks fell.

Wheeler Ridge.—Many frightened. Small objects overturned; knickknacks and pictures fell.

INTENSITY V:

Antelope Valley (Lancaster).—A few frightened. House cracked.

McKittrick.—Small objects and furnishings moved; clocks stopped.

Rosamond.—Felt by some outdoors. Small objects moved; water spilled from indoor containers.

Sandberg.—Felt by all. Trees and bushes shaken moderately.

INTENSITY IV:

Acton, Adelanto, Bakersfield, Buttonwillow, Caliente, Camarillo, Ducor, Fillmore, Glendale, Goleta, Grapevine, Lancaster, Los Alamos, Lost Hills, Mojave, Olive View, Pasadena, Porterville, Pozo, San Gabriel, Santa Ana, Shafter, Tehachapi, Ventucopa, Wasco, Weldon, Wheeler Springs.

INTENSITY I TO III:

Barstow, Camp Nelson (near Lindsay), Cantil, Culver City, El Segundo, Hollywood, Huntington Park, Inglewood, Kernville, Kettleman City, Lindsay, Montebello, Mount Wilson, Muroc, Pomona, Sanger, Santa Monica, Victorville, Whittier.

Not felt at 8 other places canvassed.

September 21: 19:56.* Owens Valley. Epicenter 37°34′ north, 118°44′ west, P. At Owens River Gorge Power Plants (Bishop) and at Lakeshore (High Sierra Ranger Station) trees and bushes were shaken.

September 24: 21:13.* Near Santa Barbara. Epicenter 34°20′ north, 119°35′ west, P. At Santa Barbara and Goleta some residents were awakened and a few frightened. At Goleta small objects moved.

September 25: 17:55.* Hollister. Felt by many in Hollister and by a few at Salinas. Weak record obtained on seismograph at Tinemaha.

October 3: 8:13.* Epicenter at sea off Cape Mendocino, 40°6. north, 124.6° west. Felt over a land area of approximately 12,000 square miles in northwestern California and southwestern Oregon, as shown on map. Maximum intensity about VII at Eureka.

Strong-motion records were obtained on the seismographs at Eureka and Ferndale.

INTENSITY VII:

Eureka.—Many residents frightened. Chimneys were twisted and cracked; some plaster fell. Trees and bushes shaken moderately. Some clocks stopped. Subterranean sound like rushing wind.

INTENSITY VI:

Ferndale.—A few frightened. Dishes, windows, and furniture broken. Vases, small objects, and furniture overturned. Some plaster cracked. Pictures and books fell; some pendulum clocks stopped.

Fields Landing.—All frightened; books fell; vases overturned; water spilled from containers and tanks.

Korbel.—All frightened. Walls and plaster cracked; large tanks shaken. Telephone wires, trees, and bushes shaken.

Pepperwood.—All frightened. Small objects and vases overturned; knickknacks fell. Damage slight.

Punta Gorda.—Walls and plaster cracked; water spilled from indoor and outdoor containers.

Rio Dell.—Many frightened. Small objects overturned and knickknacks fell.

Rockport.—Small objects moved; knickknacks fell.

Upper Mattole.—Bricks fell from one chimney. Small objects and furnishings moved. Trees and bushes shaken slightly.

INTENSITY V:

Arcata, Benbow, Briceland, Cape Mendocino, Carlotta, Dyerville, Garberville, Holmes, Hyampom, Kneeland, Loleta, Petrolia, Wildwood. At most of these places the shock was felt by the majority of the population, and some were frightened. At many of them trees and bushes were shaken moderately, suspended objects swung, and small objects and furnishings moved. At Loleta water spilled from indoor containers and clocks stopped. At Garberville pictures fell.

INTENSITY IV:

Alderpoint, Big Bar, Blue Lake, Branscomb, Bridgeville, Burnt Ranch, Capetown, Cummings, Denny, Dunsmuir, Elk, Ettersburg, Forest Glen, Fort Bragg, Fortuna, Happy Camp, Hartsook, Harris, Hayfork, Honeydew, Hoopa, Island Mountain, Klamath, Littleriver, Longvale, Miranda, Mount Shasta, Orick, Orland, Orleans, Piercy, Point Arena, Salyer, San Francisco, Sawyers Bar, Scotia, Smith River, Somesbar, Trinidad, Ukiah, Weaverville, Weitchpec, Weott, Willits, Willow Creek, Willows.

INTENSITY IV IN OREGON:

Harbor, Pistol River.

INTENSITY I TO III:

Blocksburg, Crescent City, Fort Jones, Junction City, Mad River, San Rafael, Spyrock, Stinson Beach, Vina, Zenia.

INTENSITY I TO III IN OREGON:

Grants Pass, Port Orford.

Not felt at 91 places canvassed in California nor at 22 in Oregon.

October 3: 21:59.* Los Angeles County. Epicenter 33°47′ north, 118°25′ west, P. Felt at Palos Verdes, Redondo Beach, Hermosa Beach, Manhattan Beach, and El Segundo.

October 12: 23:25.* Owens Valley. Epicenter 37°34′ north, 118°44′ west, P. Felt at Bishop (Owens River Gorge).

October 14: 8:30. Near Reno, Nevada. Felt in Reno by about 1/10 of the population. Strongest in the south and southeast portion of the town and in the Washoe Valley to the south. Shock believed responsible for shutting off heavy flow of water on an excavation project. Displaced objects reported by several.

Nine miles southeast of Truckee, snow slid off roof of the Martis Peak Lookout building. Small objects were moved at Loyalton. Also felt at Boca, Brushy Springs, Donner Summit, Devils Peak, Norden, north of Rubicon River (Placer County), Robbs Peak, and Verdi.

October 18: 2:38.* Owens Valley. Epicenter 37°34′ north, 118°44′ west, P. Felt at Bishop.

October 21: 22:57.* Los Angeles County. Gardena area. Epicenter 33°49′ north, 118°13′ west, P. Land area affected, about 2,000 square miles. Maximum intensity VII. Damage was confined to an area including Compton, Hynes, Moneta, Gardena, downtown Los Angeles, Westwood, and the Dominguez Oil Field. A large part of the information following is abstracted from an unpublished report by M. H. Gilmore of the Los Angeles office of the Coast and Geodetic Survey.

Outside of an unusual amount of damage in the oil fields, severe damage was limited to one building, cracked walls and plaster, broken windows, glassware, bottles, etc. Some heavy machinery was loosened. Thirty out of 65 gas shut-off valves installed in schools operated. Based on an average of the durations reported, the shock lasted about 10 seconds. There were no outstanding directional characteristics.

The greatest damage was in the West Dominguez Oil Field east of Gardena. Almost all of the wells went off production temporarily, and a small number required redrilling. The tubing of the wells was damaged at depths greater than 5,000 feet. According to the oil company officials, the rock displacement must have been between 5 and 10 inches.

Strong-motion records were obtained at Hollywood, Vernon, Westwood, Long Beach, and at three points in downtown Los Angeles.

INTENSITY VII:

Compton.—Many cracks developed in buildings and plaster, and some windows and dishes were broken. The greatest damage occurred in drugstores from loss of stock. In a large feedstore most of the stacks of grain were knocked down. A valuable clock was reported thrown to the floor and smashed. The damage was less than in Gardena.

Gardena.—Damage was estimated at $10,000. Many buildings were cracked. Several large plate glass windows and many small ones were broken, and merchandise stocks were damaged. In several stores workers spent most of the night clearing away the bedris. In one shop the soda fountain equipment was twisted on its base. Cracks opened up in the walls of two banks buildings. Private

residences were rocked and furniture slid out of place. Some lights and telephones were out for a short time.

Keystone.—Considerable damage resulted from broken plaster and dishes, cracked walls, and twisted chimneys. One double bed on casters shifted 5 feet. Power poles were badly shaken and railroad switch machines thrown out of adjustment.

Moneta.—The fire walls on 1 building were thrown down, and small cracks appeared in the walls of the nearby post-office building. Some chimneys were cracked.

INTENSITY VI:

Hollywood.—Knickknacks fell; trees and bushes shook slightly.

Hondo.—Plaster cracked.

Hynes.—Old cracks in post-office walls made wider.

Long Beach.—Nearly everyone awakened; many frightened. Some knickknacks, books, and pictures fell. Vases overturned. Trees and bushes shaken moderately.

Los Angeles.—Nearly everyone awakened. Hotel fire escapes in downtown Los Angeles were reported alive with people. Damage confined to cracks in walls and plaster. A few small cracks opened up in the Chamber of Commerce building and in the post office and courthouse. There were few other cases of this kind. Loose and hanging objects were generally disturbed; door bells rang and some burglar alarms were set off.

Lomita.—Plaster cracked; small objects and furnishings shifted.

Lynwood.—Plaster cracked; slight damage to crockery. Press reported some stock shaken from shelves.

Manhattan Beach.—Plaster cracked; damage slight.

Maywood.—Awakened and frightened all.

Venice.—Plaster cracked.

Walteria.—Small objects shifted; trees and bushes shook slightly.

Wilmington.—All awakened.

INTENSITY IV:

Alhambra, Anaheim, Beverly Hills, Duarte, East Los Angeles, El Segundo, Fullerton, Glendale, Hawthorne, Huntington Beach, Inglewood, Los Alamitos, Montalvo, Monterey Park, Norwalk, Oxnard, Reseda, Santa Ana, Santa Monica, Whittier, Willowbrook.

INTENSITY I TO III:

Brea, Cornell, La Canada, La Habra, Newport Beach and Balboa, Pasadena, Phelan, Pomona, Riverside San Fernando, Santa Paula, Simi, Topanga, Van Nuys, West Los Angeles.

Not felt at 40 other places canvassed.

October 22: 2:32.* Los Angeles County, Gardena area. Epicenter 33°47′ north, 118°12′ west, P.

Strong-motion records of this aftershock were obtained from instruments at Long Beach and at one point in downtown Los Angeles.

INTENSITY VI:

Compton.—Small objects overturned; clocks stopped.

Gardena.—Many awakened and frightened. Plaster cracked; small objects overturned; knickknacks fell.

Hondo.—Plaster, windows, walls, and chimneys reported cracked.

Pacific Palisades.—Plaster cracked, small objects overturned.

INTENSITY V:

Anaheim, Clearwater, Downey, Garden Grove, Hermosa Beach, Hynes, Lomita, Lynwood, Moneta, Walteria, Willowbrook. At all of these points most of the residents were awakened. At Walteria small objects moved. At Hermosa Beach the shock was felt by some outdoors.

INTENSITY IV:

Bellflower, Culver City, Fullerton, Los Alamitos, Montalvo, Simi, Terminal Island, Torrance.

INTENSITY I TO III:

Calabasas, Cornell, Oxnard, Pomona, Riverside, San Fernando, Van Nuys.

Not felt at 46 other places canvassed.

October 23: 12:45.* Owens Valley. Epicenter 37°34′ north, 118°44′ west, P. Trees and bushes shaken slightly at Delpiedra.

October 24: 23:08. Las Plumas and Willows. At Willows small objects were thrown to the floor.

October 26: 16:42.* Owens Valley. Epicenter 37°34′ north, 118°44′ west, P. Trees and bushes shaken slightly at Bishop.

November 1: 10:10.* Owens Valley. Epicenter 34°36′ north, 118°35′ west, north of Castaic, P. At Bishop (Owens River Gorge) all were frightened and small objects shifted. Also felt at Fairmont, Bishop (Adams Main Powerhouse) and Laws.

November 5: 8:36. Off Point Conception. Epicenter about 35°? north, 121°? west, P. Felt at San Simeon (Salmon Creek Guard Station).

November 6: 2:32. Humboldt County. Felt at Eureka, Ferndale, and Petrolia. Recorded on seismograph at Ferndale.

November 10: 5:22. Off Huntington Beach. Epicenter 33.6° north, 118.0° west, P. Felt at Huntington Beach.

November 11: 21:33. Tulare County. Felt at Kaweah and Springville. Recorded at nearby seismograph stations.

November 14: 0:42.* Los Angeles County, Torrance-Gardena area. Epicenter 33°47′ north, 118°15′ west, P. Land area affected about 3,600 square miles as shown on map. Maximum intensity VII–VIII. No casualties. Damage approximately $1,000,000.

Most of the following descriptive material for the central area is taken from an unpublished report of M. H. Gilmore and R. A. Wheeler of the Coast and Geodetic Survey, who covered the shock from the Los Angeles office of the Bureau. A summary of that report and additional material will be found in "Abstracts of Earthquake Reports for the Pacific Coast and Western Mountain Region, October 1, 1941, to December 31, 1941".

Strong-motion seismograph records were obtained at Vernon, Long Beach, Westwood, Hollywood and at 3 places in downtown Los Angeles.

The shock caused more damage in the Los Angeles area than any since the Long Beach earthquake of 1933. In and around Torrance and Gardena at least 50 buildings were severly damaged. At Redondo Beach, Long Beach, San Pedro, Wilmington, Lometa, and downtown Los Angeles the damage was only slight. No visible fault slipping was reported. The shock lasted from 5 to 15 seconds, averaging about 10 seconds. No special directional characteristic was observed in so far as it could be determined by falling walls, although in most cases pipe lines appeared to be pulled loose in a north-south direction. A spectacular display of blue flame resulted from the blowing out of a transformer at the Los Angeles shipyard. Suburban areas were darkened from 30 seconds to 5 minutes and longer as power lines fell. In some places telephone service was interrupted.

In spite of the large amount of damage, there was no major structural failure in any school building or other building designed and built to resist earthquake forces. The Gardena Post Office was an outstanding example. In this building there was no damage beyond slight cracks in the plaster and a settlement crack in a basement partition wall. Brick residences in Gardena, built 9 years ago, showed no damage. Many of the damaged buildings showed that failure was due either to poor workmanship, poor design, or both.

In the oil fields 2 tanks were demolished, 2 buckled badly, and a 6-inch pipe line broke in 4 additional places after having broken in 1 place during the October 21 earthquake; and an 8-inch natural gas pipe line burst. Fire was averted in all cases and most of the oil was recovered. Ground cracks were found in several cases near the broken oil line.

INTENSITY VII TO VIII:

Torrance.—The following quotations are taken from the press: "In the Torrance-Gardena sector the swaying east-west temblor knocked bricks and cornices from buildings, bowled store stocks from shelves, sent hotel and home residents fleeing in night clothes, snapped oil and pipe lines, and opened a two-foot crack in the pavement." "Torrance took the brunt of the shocks and hardly a building of any appreciable size in the town escaped damage. The business section looked like it had undergone a full scale bombing raid."

Damage to plate glass was estimated at $25,000. In 1 liquor store 15 thousand dollars' worth of stock was thrown to the cement floor and ruined. Some stores had their shelves wired to prevent such occurrences. Part of the roof over the stage of a theater collapsed and the fire wall of a hotel caved in wrecking a low building beside it. An old market was wrecked in a similar way when a corner of the Masonic Temple collapsed. The fire station was "so badly damaged" that it was abandoned. Brick chimneys and fireplaces were down over most of the city, about 50 percent being damaged, twisted, broken loose, or thrown completely to the ground. Brick buildings were especially hard hit in the residential section; walls were cracked, bricks were toppled from corners, and brick colums were damaged. Several houses were moved off their foundations. In the library building all of the books were knocked off the shelves and cases which were not fastened to the wall overturned. In the chemical laboratory of the high school all loose bottles of chemicals were thrown to the floor and broken. The building itself suffered structural damage and was temporarily closed. Books and bookcases were thrown to the floor. A brick school about 4 miles east of Torrance suffered such severe structural damage that it was condemned.

Gardena.—There was considerable damage in the Monita section. A collapsing wall of a 2-story structure destroyed the roof of a 1-story adjoining building damaging practically the entire contents. Quite a few fire walls were down. The whole corner of one brick building was pulled away from the rest of it. In the residential area many chimneys were down, broken loose, or twisted at the roof line. Practically all new buildings escaped structural and chimney damage.

Along Gardena Boulevard for 2 or 3 blocks on each side of Vermont Avenue windows were broken, littering the sidewalks with glass. Bricks were loosened from walls, cornices, and fire walls; and goods in stores were thrown to the floor. The Bank of America building was severely damaged, and the roof of a nearby newspaper building nearly collapsed. Some fire walls were down. Two buildings on the north side of Gardena Boulevard were condemned.

The Gardena Elementary School building was condemned, although little damage was visible on the outside. The structure had been damaged in the October 21 earthquake and the November 14 shock caused ragged cracks to appear on the first and second floors. No damage was visible on a nearby frame building resting on a high brick foundation. One of the smaller buildings of the high school was damaged.

INTENSITY VII:

Huntington Park.—There was considerable damage to masonry; plaster cracked and dishes were broken.

Lomita.—There was some damage from cracked walls and plaster and broken dishes. Pictures fell. One observer saw power lines striking each other and causing flashes.

Redondo Beach.—Some bricks fell from chimneys and a few windows were broken.

INTENSITY VI.

Bellflower.—Slight damage from cracked plaster. Small objects shifted.

Compton.—Plaster cracked and small objects overturned.

Hawthorne.—Plaster, pictures, and books fell; vases overturned.

Hermosa Beach.—Walls, chimneys, windows and plaster cracked. Books and knickknacks fell.

Hollywood.—Sidewalks cracked. Small objects and furnishings moved. Damage slight.

Long Beach.—Plaster, windows, walls, and chimneys cracked. Damage slight.

Lawndale.—All were awakened and many frightened. Plaster cracked, and there were some reports of cracked plaster, windows, walls, and chimneys; damage slight. Some chandeliers swung violently.

Los Alamitos.—Plaster cracked.

Los Angeles.—Practically everyone was awakened and many were frightened. Damage was very slight. The city hall, the post office and courthouse, and the Chamber of Commerce building reported slight cracks in plaster. In the latter building old cracks which had been painted over opened up again. In some parts of the city brick structures were slightly damaged and furniture was shifted. Many reported the moving of small objects, swinging of hanging objects, the ringing of doorbell chimes, and the swinging of pictures.

Lynwood.—Small objects overturned.

Manhattan Beach.—Some vases overturned; knickknacks fell. Electric power was off for five minutes.

Mar Vista.—Plaster cracked and 1 card table overturned.

Maywood.—There was considerable damage to the fire department building; the south dormitory wall moved ½ inch and the brick reinforced hose tower was cracked on all sides. In other parts of the town plaster was cracked and furnishings shifted.

North Long Beach.—Pictures fell; small objects overturned.

Palos Verdes Estates.—Small objects overturned.

San Pedro.—One observer reported furniture, small objects, and vases overturned.

Southgate.—Plaster cracked; damage slight.

Walteria.—Small objects overturned.

Willowbrook.—Dishes broke; plaster cracked. Damage slight.

Wilmington.—Small objects overturned, books fell, and plaster cracked.

INTENSITY V:

Artesia, Avalon, Beverly Hills, Clearwater, Culver City, Downey, El Segundo, Fullerton, Hondo, Huntington Beach, Hynes, Inglewood, Laguna Beach, Newport Beach, Norwalk, Pasadena, San Gabriel, Santa Ana, Stanton, Terminal Island, Topanga, Van Nuys, Venice, and Whittier. At nearly all of these places many residents were awakened and some frightened. There were many reports of the shifting of small objects. At a few places clocks stopped. At Huntington Beach a 35-pound weight hanging 22 inches from a ceiling swung through a 9-inch arc.

INTENSITY IV:

Alhambra, Anaheim, Arcadia, Arlington, Balboa, Burbank, Carpinteria, Cornell, Corona, El Toro, Garden Grove, Glendale, La Habra, Monterey Park, Moreno, Oceanside, Olive, Pacific Palisades, Pico, Reseda, Riverside, San Juan Capistrano, Santa Monica, Spadra, West Los Angeles.

INTENSITY I TO III:

Baldwin Park, Cabazon, Calabasas, De Luz, Etiwanda, Glendora, Hemet, La Crescenta, Maricopa, Norco, Orange, San Diego, San Fernando, San Jacinto, Saticoy, Summit, Ventura.

Not felt at 71 other places canvassed.

November 14: 1:42.* Strong aftershock of the preceding earthquake. Epicenter 33°47′ north, 118°15′ west, P. Reported felt at Glendale, Long Beach, Mar Vista, Maywood, and Torrance. Strongest at Torrance where damage from previous shock was increased. At Long Beach pictures and knickknacks fell and small cracks were reported in exterior stucco.

November 18: 10:08.* Near Santa Barbara. Epicenter about 34°20′ north, 119°35′ west, P. Felt at Santa Barbara and Carpinteria.

November 21: 8:56.* Near Santa Barbara. Epicenter about 34°20′ north, 119°35′ west. Felt at Santa Barbara and Goleta.

November 24: 2:45. Near Cape Mendocino. Felt at Cape Mendocino Light Station, Eureka, Ferndale, and Petrolia.

November 24: 3:00. Near Cape Mendocino. Felt at Rio Dell and South Fork. Hanging objects swung at Rio Dell. Not felt at Santa Rosa.

November 27: 9:33.* Los Angeles County. Epicenter about 33°59′ north, 118°12′ west, P. Felt in Los Angeles, Huntington Park, Lynwood, and Maywood. Very light in Los Angeles; some hanging objects swung. At Maywood rumbling noises were heard after first bump.

November 27: 18:25.* Southern California. Epicenter about 33°17′ north, 117°05′ west, P. Felt at Escondido and Santa Ysabel.

December 1: 6:00.* Near Catalina Island. Epicenter about 33°18′ north, 118°15′ west, P. Many awakened at Avalon.

December 6: 23:35. Humboldt County. Felt at Orleans, Hoopa, and Salyer Ranger Station. Strongest at Hoopa and Salyer. Lamps overturned at Hoopa.

December 22: 17:19.* Off Newport Beach. Epicenter about 33°34′ north, 117°59′ west, P. Felt at Newport Beach.

December 23: 23:30.* Imperial Valley. Epicenter about 32.6° north, 116.1° west, P. Many awakened at Plaster City. Also felt at El Centro.

December 30: 22:49.* Owens Valley. Epicenter 37°34′ north, 118°44′ west, P. Felt over a land area of approximately 28,000 miles as shown on map. Maximum intensity VI.

INTENSITY VI:

Owens River Gorge (Adams Main Powerhouse.)—All awakened. Chimneys twisted; plaster cracked, damage slight.

INTENSITY V:

Benton, Fresno (Weather Bureau Office), Kings Canyon National Park, Laws, Pinehurst Ranger Station, Tinemaha Dam, and Yosemite National Park. At most of these places many residents were awakened and some frightened. Hanging objects swung and objects moved. At Fresno several downtown offices were flooded with telephone calls following the temblor. In several homes chandeliers swayed and a number of observers reported seeing flashes like lightning in the northeast section.

INTENSITY V IN NEVADA:

Dyer.—Many awakened, some frightened. Plaster cracked. Damage slight.

INTENSITY IV:

Auberry, Bishop, Bodfish, Crane Valley, Delpiedra, Dunlap, Friant, Giant Forest, Hanford' Kern River Powerhouse No. 3, Kernville, Madera, Martell, McKittrick, Mendota, Merced, North Fork, Sequoia National Park, Stratford, Visalia, Westhaven, Woodlake, Woody.

INTENSITY I TO III:

Coalinga, Georgetown, Los Hills.

INTENSITY III IN NEVADA:

Hawthorne.

Not felt at 14 other places canvassed in California nor at 3 in Nevada.

December 31: 0:08.* 3:15.* Owens Valley. Epicenter 37°34′ north, 118°44′ west, P. Felt in Owens River Gorge.

WASHINGTON AND OREGON

(120TH MERIDIAN OR PACIFIC STANDARD TIME)

NOTE.—More details will be found in Abstracts of Earthquake Reports for the Pacific Coast and Western Mountain Region.

January 3: 13:20. Pullman, Wash. Light shock caused some hanging objects to swing. Felt by several.

February 9: 1:45.* See California and Western Nevada section.

February 16: Portland, Oreg. Light shock reported from scattered parts of Portland.

April 6: About 16:00. Republic, Wash. Light shock accompanied by rumbling sounds felt by few.

April 7: 1:25. North central Washington, Okanogan County. Shock approaching intensity VI felt over approximately 5,500 square miles as shown on map.

Intensity VI at Mazama where one observer reported stove moved and furniture overturned; slight damage.

Intensity V at Nespelem, Okanogan, and Omak. At Okanogan many residents were awakened and some frightened; small objects and pictures moved and several residents reported being nearly thrown out of bed. At Omak some plaster was reported cracked.

Intensity IV at Aeneas, Carlton, Chelan, Loomis, Manson, Mason City, Methow, Pateros, Riverside, Tonasket, Twisp, Wauconda, and Winthrop.

Intensity I to III at Chelan Falls, Mallott, and Monse.

Not felt at 17 other places canvassed.

April 12: 9:40. North central Washington. Aftershock of earthquake of April 7 felt at Chelan, Chelan Falls, Lakeside, Methow, Pateros, and Waterville. Strongest at Methow and Waterville. Not felt at 11 other places reporting.

July 6: 19:30. Medford, Oreg. Felt by fire lookouts near Medford.

July 29: 12:17. Spokane, Wash. Slight shock felt in city by few; and recorded on the seismograph at Mount Saint Michaels. Faint rumbling sounds heard.

October 19: 22:05. Seal Rock, Oreg. Slight shock.

October 31: 4:43. Portland, Oreg. A few west side residents awakened. Door rattled and beds shook. Also felt at North Head, Wash., Weather Bureau office.

December 29: 10:37. Portland, Oreg. A shock of intensity VI affected about 5,000 square miles in the vicinity of Portland as shown on the map.

INTENSITY VI IN OREGON:

Portland.—Press reports a downtown display window shattered and a few other windows broken in various sections of the city. Felt by practically everyone. Many objects reported displaced and some trees and bushes shaken.

Hillsboro.—Plaster cracked; small objects and furnishings moved.

Sherwood.—Many frightened. Plaster cracked; trees and bushes shook moderately.

Yamhill.—Chimneys cracked; vases overturned. Hanging objects swung; school bell rang. Many frightened.

INTENSITY VI IN WASHINGTON:

Vancouver.—Vases overturned; knickknacks fell. Small objects moved; trees and bushes shook slightly.

Woodland.—Plaster cracked, small objects shifted.

INTENSITY V IN OREGON:

Buxton, Carlton, Huber, McMinnville, Milwaukee, Portland, Sandy, Tigard, Warren, and Zigzag. At Milwaukee knickknacks fell and many residents awakened. Buxton reported plaster cracked. All places reported either displaced objects or trees and bushes shaken.

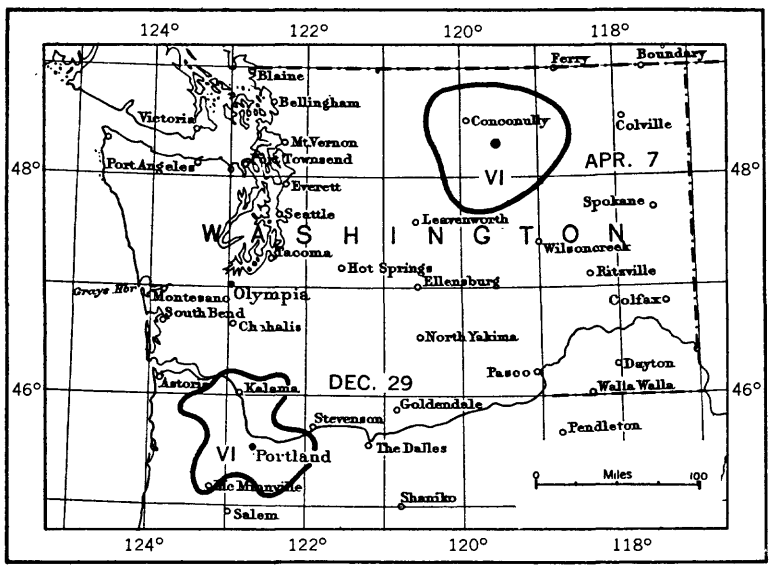

FIGURE 4.—Areas affected by the Washington earthquake of April 7, 1941, and the Oregon-Washington earthquake of December 29, 1941.

Intensity IV in Washington at Amboy, Ariel, Camas, Carrols, Cougar, Orchards, Ridgefield Intensity IV in Oregon at Amity, Banks, Beavercreek, Canby, Cherry Grove, Colton, Corbett, Dundee, Forest Grove, Gaston, Gladstone, Mist, Oregon City, Oswego, St. Helens, Timber, Veronia, Willamette, Wilsonville.

Intensity I to III in Washington at Brush Prairie, Elsie, South Bend. Intensity I to III in Oregon at Bonneville, Boring, Clatskanie, Dilley, Gresham.

Not felt at 15 places canvassed in Washington, nor at 42 in Oregon.

ALASKA

(150TH MERIDIAN TIME)

January 12: 0:07. Fairbanks. Slight.
January 21: 20:37. Fairbanks. Slight.
February 2: 1:58. Anchorage. Slight.
February 7: 8:14. Fairbanks. Slight.
March 1: 17:56. Fairbanks. Slight.
March 4: 17:56, 21:35, and 22:50. Fairbanks. Slight.
March 28: 4:29. Fairbanks. Moderate shock felt by large part of population. Some alarm; no damage. Windows and dishes rattled and pictures were displaced on walls.
March 31: 6:56. Fairbanks. Slight.

April 21: 9:34. Near Unalaska. Epicenter about 53° north, 166° west in the North Pacific. Felt at Unalaska.
April 30: 12:55. Fairbanks. Slight.
April 30: 21:15. Unalaska. Slight.
May 16: 19:35. Fairbanks. Slight.
May 18: 3:05. Fairbanks. Slight.
June 11: 11:46. Anchorage. Slight.
June 12: 15:15. Fairbanks. Slight.
July 1: 5:59. Fairbanks. Slight.
July 20: 22:43. Fairbanks. Slight.
July 25: 00:01. Fairbanks. Slight.
July 26: 00:46. Fairbanks. Slight.
July 29: 15:52.* Kenai Peninsula area. Epicenter about 60.9° north, 149.2° west. At Anchorage many residents were frightened; plaster and pictures fell and grocery stocks were thrown to the floor; dishes were broken and windows cracked. Trees and bushes were shaken strongly and 4 breaks in pipes were reported. An isolated building was shaken from its foundations and ruined. Aftershocks were reported at 16:03, 16:35, and 23:11.
August 9: 21:06 and 21:34. Juneau. Slight.
August 12: 4:05. Nome. Slight.
August 31: 10:55. Fairbanks. Slight.
September 15: 9:22. Nome. Slight.
September 19: 4:03. Anchorage. Slight.
September 21: 10:56. Anchorage. Slight.
September 22: 18:16. Anchorage. Slight.
October 5: 10:30. Attu Island. School building swayed visibly. Slight.
October 14: 17:20 Fairbanks. Slight.
October 26: 21:15. Anchorage. Two slight shocks. Teletypewriter disturbed; clock rattled.
October 28: 00:14. Fairbanks. Slight.
October 31: 18:39. Fairbanks. Slight.
November 15: 3:15. Fairbanks. Slight.
December 5: 23:00. Fairbanks. Slight.
December 7: 15:35. Fairbanks. Slight.
December 7: 15:50. Juneau. Slight. Possibly same as preceding shock.
December 14: 1:21. Anchorage. Slight.
December 20: 2:47. Fairbanks. Slight.
December 28: 15:40, 19:58, and 20:52. Anchorage. Slight shocks.
December 31: 22:01. Fairbanks. Slight.

HAWAIIAN ISLANDS

[157– MERIDIAN (WEST) TIME]

NOTE.—In the case of these islands with their many earthquakes of volcanic origin, only the stronger ones are listed. Reports of the Hawaiian Volcano Observatory under the jurisdiction of the National Park Service give all details. "HVO" indicates that the epicenter was determined by the Hawaiian Volcano Observatory.

January 17: 7:30.* Origin 14 miles under west slope of Hualalai near seacoast at Kaiwi Point, 19°40.3′ north, 156°03.5′ west, HVO. Felt at Naalehu, Kailua, Hookena, Hilo, and strongly felt by everyone at Puuwaawaa.
April 20: 10:46.* Origin 0.3 mile south of Keanakakoi Crater, depth 1.0 mile, 19°23.9′ north 155°16.0′ west, HVO. Generally felt in the Kilauea area, Kau, and Kano, and by some in Hilo.
July 8: 10:14.* Kilauea Crater, HVO. Felt by many at Kilauea.
September 25: 7:18.* Origin, southeast flank of Mauna Loa, 4.0 miles north of Kapapala Ranch House, depth 7.0 miles, HVO. Felt sharply over whole island of Hawaii, and by some in Honolulu. Several thousand dollars' worth of damage at Pahala, Hawaii. Dismantled all seismographs on Hawaii and one on Maui.
At Pahala safes were moved over 1 inch northward, plaster cracked, pipes were sprung, roadfills cracked, and some shoulders failed. Furniture overturned and dishes were broken in homes. Pharmaceuticals at the Pahala hospital, chemicals in the Pahala sugar laboratories, and package goods in stores were thrown from shelves. Some persons were injured in flight from their houses.
At Kapapala Ranch 2 windows and many dishes were broken, and several stone walls were partially thrown down. At Kealakekua a few books were thrown from shelves. At Hilo an old earthquake crack in one building reopened.
Boulders were shaken loose from steep slopes at the head of Wood Valley and on Hilina Pali. Numerous slides from Halemaumau's walls caused great dust clouds. Many claimed the shock was the strongest in 30 years.
All of the information on this shock has been taken from the HVO "Volcano Letter."
An aftershock at 7:30 was sharply felt at Pahala and Kapapala.
September 25: 7:43.* Origin probably near Ainapo, perhaps 20 miles deep, HVO. Sharply felt at Pahala and Kapapala.
September 25: 8:28.* 2.0 miles northeast of Kapapala Ranch House, 7.0 miles deep, HVO. Felt generally at Pahala and Kapapala.

September 25: 13:25.* Southeast flank of Mauna Loa, 4.0 miles north northwest of Kapapala Ranch House, 7.0 miles deep, HVO. Felt by many persons at Kapapala and Pahala.

October 25: 8:54.* Origin, north slope of Mauna Kea near Waimea, HVO. Generally felt on island of Hawaii.

November 14: 0:51* to 17:34.* Eight feeble shocks plainly felt at Waimea and lightly at widely scattered points on island of Hawaii.

November 16: 9:41.* Origin near Waimea, 27 miles deep, HVO. Generally felt over island of Hawaii; some slight damage; instruments dismantled.

November 18: 2:56.* Origin near Waimea, 27 miles deep, HVO. Strongly felt on island of Hawaii and to a lesser degree on Maui.

November 18: 10:30* and 10:33.* Generally felt on island of Hawaii.

November 22: 21:23.* Origin near Waimea, HVO. Generally felt on island of Hawaii and by a few persons on Maui.

PHILIPPINE ISLANDS

[120TH MERIDIAN (EAST) TIME]

NOTE.—Only the more important shocks are listed and the list may be incomplete as only instrumental reports were available. Reports of the Weather Bureau of the Philippine Islands should be consulted for full details.

February 4: 22:05.* Epicenter 10°25′ north, 126°33′ east, depth 200 km., according to Manila. Felt at Butuan, Baguio and other places.

February 18: 2:06.* Epicenter 15°17′ north, 120°03′ east, depth about 75 km., according to Manila. Felt in western Luzon and Manila.

April 18: The press reports that an earthquake of moderate intensity shook Manila and many provinces. First reports indicated some damage but no casualties.

September 28: 17:58.* Epicenter 14°40′ north, 119°40′ east, according to Manila. Felt in Manila and on Corregidor.

November 6: 1:39. The press reports an earthquake which caused considerable property damage and numerous injuries in Albay Province in southern Luzon.

PUERTO RICO

[60TH MERIDIAN TIME]

October 2: 22:21.* Felt generally in San Juan and by many persons at Orocovis. Probably felt over a large part of the island. San Juan seismograph record indicates an epicentral distance of 50 to 70 km. (S−P=6 sec.) with epicenter along a line N.75°W.–S.75°E.

A stronger shock recorded, but not reported felt, at 18:33 on October 3 was about 200 km. from San Juan (S−P=19 sec.) along a line N. 80°E.–S. 80°W. through the station. Lighter shocks were recorded at 19:48 on October 3, and at 3:22 and 9:18 on October 4.

PANAMA CANAL ZONE

[75TH MERIDIAN TIME]

NOTE.—Instrumental times given below are the arrival times of the first recorded phases on the seismograph at Balboa Heights unless otherwise stated.

March 9: 22:48.* Felt by many at Balboa Heights.

March 9: 23:06.* Western Panama. Epicenter approximately 9.0° north, 81.8° west, according to Jesuit Seismological Association bulletin. Felt throughout Panama; intensity III. Many aftershocks recorded on the Balboa Heights seismograph.

March 9: 23:16.* Felt throughout Canal Zone; intensity II.

March 10: 1:10.* Felt by a few at Balboa Heights.

November 22: 0:24.* Felt at Balboa Heights; intensity I.

December 5: 15:47.* Offshore, in Pacific Ocean, near Panama-Costa Rica boundary, 8.4° north, 83.2° west. Damage reported in eastern Costa Rica and western Panama. Intensity IV at Balboa Heights; seismograph clock stopped. On the Balboa Heights seismograph 7 aftershocks were recorded on the 5th; and 40, 34, and 10 aftershocks on the 6th, 7th, and 8th respectively.

Press dispatches reported that the municipal building and a school were toppled at Santiago (midway between Panama City and David), but that most of the damage occurred in the vicinity of David.

Dispatches from Costa Rica stated that considerable property damage occurred in the central plateau region. Ten houses at Santo Domingo Heredia, 10 miles north of San Jose, were destroyed, and there was damage at Guadalupe, Corralillo Cartago, and Puerta Jiminez. See section of this report on Unclassified Regions for shocks felt at sea; also Tidal Observations, under Miscellaneous Activities.

UNCLASSIFIED REGIONS

EARTHQUAKES FELT AT SEA

NOTE.—The information in this category is taken from Hydrographic Office Bulletins unless otherwise noted.

January 5: 18:48, G. C. T. Celebes Sea. 2°48′ north, 122°17′ east. Ship vibrated severely for 4 or 5 seconds. After an interval of about 10 seconds the vibration was repeated for another 4 or 5 seconds.

January 27: 23:05, G. C. T. West Indies. 18°44′ north, 73°15′ west. Shock was sudden and severe, being felt throughout the ship. Lighter shocks felt at 23:07 and 23:20.

April 15: 19:10, G. C. T. Off west coast of Mexico. The disturbance was reported by 6 vessels reporting positions as follows:

17°12′ north, 103°16′ west.—Violent vibration at 19:10. Lighter vibration at 19:12.

17°44′ north, 102°33′ west.—Considerable vibration for 30 seconds. A severe 5-second shock occurred 36 minutes later.

17°52′ north, 103°16′ west.—Heavy seismic shock lasted about 1 minute. Difficulty experienced in steering vessel.

18°03′ north, 103°16′ west.—A severe 2-minute vibration; engine was stopped for 10 minutes. At 19:13 clouds of dust were observed in the mountains along the coast for about 10 or 15 minutes; but nothing was visible beyond 18°10′ north, 103°18′ west. A light 3-second vibration occurred at 19:48 causing clouds of dust to appear again.

18°03′ north, 103°19′ west.—Vessel shook severely for about 2 minutes; engine was stopped for inspection of vessel. About 3 minutes after the first shock a lighter 10-second one occurred. At 19:44 another shock was felt at 18°07′ north, 103°24′ west, but it was less severe than the first. A large deckload of steel assembly, some pieces weighing 6 tons, was caused to shift about 6 inches and to jump as much as 5 to 6 inches up and down from its blocks. After the first shock dust clouds began to rise from the hills and mountains around Maruata Bay and Point San Telmo. Also, a dust haze and smoke enveloped Colima Volcanoes which had been visible before. The surf on the beach seemed to rise higher after the shock. The swell increased slightly. The dust cleared to a marked degree before the second large shock, and the dust clouds were greater this time around Maruata Bay.

18°04′ north, 103°57′ west.—Violent shock felt and rumbling sound heard. Engine was stopped for examination of vessel. The shock lasted about 3 minutes. A lighter shock occurred 40 minutes later. A line of heavy dust was visible along the shore.

December 6: 21:23, G. C. T. Off west coast of Costa Rica. 8°35′ north, 84°27′ west. Heavy 3-second earth shock experienced. See earthquake of December 5 in the Panama Canal Zone.

EARTHQUAKES FELT ON LAND

March 23: 4:02, E. S. T. Swan Island, VI. (Swan Island is in the West Indies between Honduras and Cuba, about 17.5° north, 83.9° west. Reports from there are furnished by the local Weather Bureau Office.) Buildings swayed visibly and heavy objects were displaced. Pen of the microbarograph (mounted on a shelf) was displaced upward ¾ inch; those of the hygrothermograph were displaced about 1/32 inch. The onset of the shock was rapid, reaching a peak in 5 seconds. Total duration, 15 seconds.

A 125-foot sailing schooner anchored about ¾ mile off the west end of the island was shaken violently.

April 26: 21:00, E. S. T. Swan Island. Felt by all. Steel antenna towers rattled considerably; small objects were slightly displaced.

April 27: 5:22, E. S. T. Swan Island. Felt by all. Slowly increasing roar heard. Radio towers swayed slightly. Disturbance reached peak intensity in 4 or 5 seconds and ended at 7 seconds.

May 5: 9:52, E. S. T. Swan Island. Suspended objects swayed slightly.

July 16: 22:08, E. S. T. Swan Island. Slight shock felt by all. Microbarograph pen displaced 3/16 inch.

October 10: 9:44, E. S. T. Swan Island. Slight shock jerked radio towers.

November 12: 7:29, E. S. T. Swan Island. Slight shock accompanied by sounds like distant thunder. Outside wires and cables shook considerably.

December 12: 1:30 (local time) Port au Prince, Haiti. Two slight shocks reported.

MISCELLANEOUS ACTIVITIES

GEODETIC OPERATIONS OF SEISMOLOGICAL INTEREST

In May and June 1941 the first-order lines in the vicinity of El Centro, California, were releveled to detect possible movement resulting from the earthquake of May 18, 1940. The portions of the lines releveled were El Centro to Niland, California, El Centro to Jacumba, California, and El Centro, California, to Yuma, Arizona. This releveling has been adjusted and the results are available for distribution.

During the spring of 1941, repeat observations were made at about 50 triangulation stations in Southern California, in the vicinity of El Centro. The work extends from a fixed line near the Arizona State line, 50 miles east of El Centro, to other fixed lines 40 miles west and 50 miles north of El Centro. The original determinations of these stations were made in 1934 and 1939. The purpose of the repeat observations was to determine what earth movements, if any, occurred because of the earthquake of May 18, 1940. The final adjustment of the 1941 work has not been made because of the pressure of war activities.

TIDAL DISTURBANCES OF SEISMIC ORIGIN

The Panama-Costa Rica earthquake of December 5, 1941, was recorded on a recording tide gage at Punta Arenas, Costa Rica. This station is one of a group of 14 Central and South American stations established through the cooperation of the countries concerned with the United States Government. The project was sponsored by the United States Department of State and carried out by the Coast and Geodetic Survey cooperating with local authorities.

At Punta Arenas, on December 5, the record showed 2 separate disturbances; the first beginning at 15:45 (90th meridian time), December 5th and continuing for about 6 hours. The average range was about ¾ foot and the period about ¾ hour.

The second disturbance began at 16:20 (90th meridian time), December 6th and continued for about 8 hours. The range averaged less than ¼ foot and the average period was between 10 and 15 minutes. Both records were made at times of local high tide.

SEISMOLOGICAL OBSERVATORY RESULTS

The Coast and Geodetic Survey publishes the results of its teleseismic stations and cooperating stations monthly 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 to the Director of the Coast and Geodetic Survey.

Instrumental results are published for the following observatories:

Balboa Heights, C. Z. (the Panama Canal).
Bermuda (Meteorological Station, St. George's, and International Union of Geodesy and Geophysics).
Boulder City, Nev. (Bureau of Reclamation, National Park Service).
Bozeman, Mont. (Montana State College).
Burlington, Vt. (University of Vermont).
Butte, Mont. (Montana School of Mines).
Chicago, Ill. (University of Chicago and United States Weather Bureau).
College, Alaska (University of Alaska).
Columbia, S. C. (University of South Carolina).
Des Moines, Iowa (Private station, M. M. Seeburger, director).
East Machias, Maine (Massachusetts Institute of Technology).
Honolulu, T. H. (University of Hawaii).
Huancayo, Peru (Carnegie Institution of Washington).
Ivigtut, Greenland (Geodaetisk Institut, Copenhagen, Denmark).
Lincoln, Nebr. (Nebraska Wesleyan University).
Logan, Utah (Utah State Agricultural College).
Montezuma, Chile (Smithsonian Institution).
Philadelphia, Pa. (The Franklin Institute).
Rockefeller Mountain, Antarctica (Byrd Expedition).
Salt Lake City, Utah (University of Utah).
San Juan, P. R.
Seattle, Wash. (University of Washington).
Scoresby-Sund, Greenland (Geodaetisk Institut, Copenhagen, Denmark).
Sitka, Alaska.
Tucson, Ariz.
Ukiah, Calif. (International Latitude Observatory).

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

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

Balboa Heights, Burlington, Des Moines, East Machias, 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.

The Rockefeller Mountain station was operated through parts of November and December, 1940 by the U. S. Antarctic Service, Admiral Richard E. Byrd in charge of the expedition. The instruments were loaned by The Franklin Institute of Philadelphia, and operated by Mr. Roy O. Fitzsimmons, Physicist. The Coast and Geodetic Survey cooperated in preparing the instruments for Antarctic use.

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

The provisional epicenter results for 1941 were not ready when this publication went to press. Those for the year 1940 are listed in table 1.

TABLE 1.—*Summary of instrumental epicenters for 1940*

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 near-by stations are usually given preference. More detailed information will be found in the Seismological Bulletins (formerly Seismographic Reports) of the Coast and Geodetic Survey, and in the bulletins of other organizations and stations.

1940	Greenwich civil time at origin		Region and focal depth	Coordinates of provisional epicenter	
				Latitude	Longitude
	h	*m*		°	°
Jan. 1	12	15.2	Fiji Islands. Depth about 550 km	17.2 S.	178.7 W.
Jan. 2	11	7.3	Southwest of Easter Island. Depth normal	28.6 S.	113.8 W.
Jan. 4	1	10.3	Northeast of New Zealand. Depth normal	34 S.	162 W.
Do	8	7.2	Southern California, near Clark Lake. Depth normal	38.3 N.	116.3 W.
Jan. 5	6	20.9	Off southwestern California. Depth normal	33.1 N.	119.5 W.
Jan. 6	8	15.7	Southeast of Kurile Islands. Depth normal	44.6 N.	151.7 E.
Do	14	3.4	East of Loyalty Islands. Depth about 90 km	21.9 S.	171.0 E.

TABLE 1.—*Summary of instrumental epicenters for 1940*—Continued

1940	Greenwich civil time at origin	Region and focal depth	Coordinates of provisional epicenter	
			Latitude	Longitude
	h *m*		°	°
Jan. 7	3 22.7	Southeast of Honshu Island, Japan. Depth normal	34.2 N.	141.7 E.
Do	5 3.1	Southern California, east of Salton Sea. Depth normal	33.4 N.	115.6 W.
Do	7 12.7	....do	33.4 N.	115.6 W.
Do	21 34.8	Northern Peru. Depth about 100 km	6.5 S.	78 W.
Jan. 10	11 17.5	Central China. Depth normal	34.5 N.	98 E.
Jan. 13	7 49.1	Southwestern California. By Pasadena. Depth normal	33.8 N.	118.1 W.
Jan. 16	18 56.1	San Bernardino Mountains, Southern California. Depth normal	34.2 N.	116.8 W.
Jan. 17	1 15.0	East of Marianas Islands. Depth about 75 km	17.2 N.	148.2 E.
Jan. 19	10 6.4	Southern California, west of Salton Sea. Depth normal	33.4 N.	116.4 W.
Do	13 53.1	Northwest of Samoa Islands. Depth probably normal	11 S.	173.5 W.
Jan. 20	9 58.1	South Pacific Ocean. Depth normal	52.5 S.	134.5 W.
Jan. 21	2 45.6	China Sea. Depth about 350 km	27.5 N.	126.5 E.
Jan. 21	4 19.6	Northeast of North Island, New Zealand, Depth about 225 km	35 S.	175 W.
Jan. 26	6 41.8	North of New Hebrides. Depth 100 km	14.5 S.	167.5 E.
Do	17 4.6	East of Ryukyu Islands, Japan. Depth normal	26.1 N.	132.1 E.
Jan. 27	14 49.7	Off southeastern Honshu Island, Japan. Depth normal	34 N.	139 E.
Jan. 28	7 27.8	Off western Peru. Depth normal	12 S.	82 W.
Do	8 27.9	Northwestern Canada. Depth normal	62.7 N.	137 W.
Jan. 29	1 59.2	Near Verruga, southern California. Depth normal	33.1 N.	116.4 W.
Feb. 7	17 16.1	Aleutian Islands. Depth 75 km	52.0 N.	174.0 E.
Feb. 8	8 5.8	Northeastern California. Depth normal	40.4 N.	121.7 W.
Feb. 9	1 53.0	Vallecito Mountains, southern California. Depth normal	33.0 N.	116.2 W.
Do	11 11.3	Elsinore Fault, southern California. Depth normal	33.4 N.	117.1 W.
Do	11 44.5	Terwilliger Valley, southern California. Depth normal	33.5 N.	116.6 W.
Do	11 48.4	Elsinore Fault near Pala, southern California. Depth normal	33.3 N.	117.1 W.
Do	13 53.7	Off northeastern Honshu Island, Japan. Depth normal	40.2 N.	142.5 E.
Feb. 11	15 47.5	Southern California. Depth normal	34.0 N.	117.0 W.
Feb. 12	0 01.6	Northern Chile. Depth about 100 km	26.7 S.	70.7 W.
Do	5 25.6	Aleutian Islands. Depth normal	50 N.	179 E.
Do	8 21.0	Southwest of Tonga Islands. Depth about 200 km	23.0 S.	177.7 W.
Do	9 17.8	Alaska Peninsula. Depth about 50 km	55.0 N.	161.9 W.
Feb. 13	23 52.3	Northern California. Depth normal	39.6 N.	123.7 W.
Feb. 14	1 58.0	Northern Celebes. Depth normal	1 N.	123 E.
Feb. 19	12 06.9	Southern California. Depth normal	34 N.	117.0 W.
Feb. 20	2 18.3	North of the New Hebrides. Depth about 200 km	14.2 S.	167.4 E.
Do	12 54.9	New Amsterdam Island. Depth about 150 km	37.5 S.	77.5 E.
Feb. 22	10 38.0	Southern California. Depth normal	33.8 N.	117.3 W.
Do	13 30.6	Northeast of Luzon Island, Philippine Islands. Depth normal	20.0 N.	123.3 E.
Feb. 23	0 40.1	Adriatic Sea. Depth normal	40.7 N.	18.8 E.
Feb. 24	9 38.0	Eastern California. Depth normal	37.5 N.	118.5 W.
Do	12 0.1	Northern New Guinea. Depth normal	2.5 S.	141.5 E.
Feb. 25	7 58.1	Off southwestern Panama. Depth normal	7 N.	82.5 W.
Feb. 27	12 12.5	Off northern Guiana. Depth normal	8 N.	58 W.
Feb. 28	17 28.1	Southern California. Depth normal	33.1 N.	116.1 W.
Feb. 29	16 7.7	Crete. Depth normal	35.1 N.	25.6 E.
Mar. 2	13 27.1	Western California. Depth normal	37 N.	122 W.
Mar. 3	0 5.6	West of the New Hebrides. Depth normal	17.9 S.	167.5 E.
Mar. 4	19 59	Northeast of Brazil. Depth normal	15.2 N.	44.1 W.
Mar. 5	17 6.1	Southern California. Depth normal	34.1 N.	117.3 W.
Do	23 0.5	Eastern Alaska. Depth normal	64.5 N.	145.5 W.
Do	23 54.7	Eastern central Alaska. Depth normal	64 N.	147.5 W.
Mar. 6	5 51.5	Central Alaska. Depth normal	63.9 N.	150.5 W.
Mar. 7	7 8.6	South Pacific Ocean. Depth normal	33 S.	110.5 W.
Mar. 9	5 4.7	Central Alaska. Depth normal	65.2 N.	152 W.
Do	10 47.1	Northwest of Bonin Islands. Depth about 500 km	27.8 N.	139.6 E.
Do	15 47.3	Off southwestern Panama. Depth normal	5 N.	82.5 W.
Mar. 10	18 1.9	Southern Nevada. Depth normal	37 N.	115 W.
Mar. 11	0 6.5	....do	37 N.	115 W.
Do	11 25.6	Off northeastern Honshu Island. Depth normal	41.1 N.	142.2 E.
Mar. 14	18 23.0	South of Tasmania. Depth about 170 km	54.5 S.	147 E.
Do	21 25.6	Northwestern Mexico. Depth normal	28.1 N.	111.1 W.
Do	21 31.3	Southwestern Mexico. Depth normal	20 N.	105 W.
Mar. 16	20 40.7	South of Alaska. Depth normal	55 N.	156 W.
Mar. 18	5 39	South of Kermadec Islands. Depth normal	31.3 S.	178.4 W.
Mar. 19	4 35.6	Northeastern Baluchistan. Depth normal	29 N.	67 E.
Mar. 20	0 35.4	Off northwestern United States. Depth normal	46 N.	138 W.
Do	2 45.7	Off Vancouver Island. Depth normal	49 N.	129 W.
Do	10 22.4	Southeastern California. Depth normal	38.1 N.	116.1 W.
Mar. 21	13 53	South of Java. Depth about 100 km	10.1 S.	108.2 E.
Mar. 24	11 48.2	Southern Bolivia. Depth normal	21.5 S.	63 W.
Mar. 25	21 18.3	Eastern California. Depth normal	36.8 N.	117.1 W.
Mar. 27	12 31.4	Aleutian Islands. Depth about 100 km	52.2 N.	179.5 E.
Mar. 28	15 48.5	China Sea, off northwestern Mindoro Island, Philippine Islands	13.5 N.	120 E.
Do	17 48.6	Off southern El Salvador. Depth about 75 km	12.2 N.	89.5 W.
Mar. 29	21 37.2	Off western Sumatra. Depth normal	2 N.	95.5 E.
Mar. 30	4 46.4	Off southwestern Guatemala. Depth normal	14.2 N.	92.1 W.
Mar. 31	16 52.5	Off northwestern Chile. Depth normal	18.8 S.	70.9 W.
Apr. 1	11 19	Northern New Guinea. Depth normal	3.3 S.	139.7 E.
Apr. 5	16 35.4	Volcano Islands. Depth about 200 km	25 N.	141.5 E.
Apr. 7	8 42.0	Southern Nevada. Depth normal	37 N.	115 W.
Apr. 8	8 49.3	Western Argentina. Depth normal	33 S.	70 W.
Apr. 11	9 4.1	East of Kurile Islands. Depth normal	47.1 N.	154.4 E.
Apr. 12	5 54.2	East of Honshu Island, Japan. Depth normal	38.4 N.	141.8 E.
Apr. 13	6 28.9	Northern Turkey. Depth normal	40.5 N.	37.5 E.
Do	20 18.2	South of Sumatra. Depth about 200 km	7 S.	104 E.

TABLE 1.—*Summary of instrumental epicenters for 1940*—Continued

1940	Greenwich civil time at origin		Region and focal depth	Coordinates of provisional epicenter	
				Latitude	Longitude
	h	m		°	°
Apr. 14	9	33.3	North of Tonga Islands. Depth about 200 km	16.5 S.	174 W.
Do	14	56.3	Kurile Islands. Depth 100 km	44.4 N.	149.5 E.
Apr. 16	6	7.7	Aleutian Islands. Depth normal	51.8 N.	173.1 E.
Do	6	43.1	do	52.7 N.	173.2 E.
Apr. 17	21	34.5	Solomon Islands. Depth normal	9 S.	157.8 E.
Apr. 18	18	43.7	Southern California. Depth normal	34.1 N.	117.4 W.
Do	19	43.5	East of New Britain Island. Depth about 100 km	5.3 S.	153.1 E.
Do	21	21.9	Southern California. Depth normal	33.2 N.	115.5 W.
Apr. 19	0	6.8	Aleutian Islands. Depth normal	52.3 N.	173.9 E.
Do	14	40	Kurile Islands. Depth probably 100 km	49.3 N.	155.9 E.
Apr. 20	14	46	Southeast of Mindanao Island, Philippine Islands. Depth 150 km	6.0 N.	126.7 E.
Do	20	18.0	Southern Honshu Island, Japan. Depth 350 km	34.5 N.	135.5 E.
Apr. 24	10	22.1	West of New Britain Island. Depth normal	5.5 N.	148 E.
Apr. 25	10	18.7	Northwest of Samoa. Depth normal	8.5 S.	176.5 W.
Apr. 27	9	35.6	Northeast of Solomon Islands. Depth normal	5 S.	165 E.
Do	10	33.2	Southwest of Liberia. Depth normal	1 N.	20 W.
Do	18	5.1	Northeast of Solomon Islands. Depth normal	5.5 S.	166.5 E.
Apr. 29	6	56.7	Northern Lower California. Depth normal	32 N.	115 W.
Do	7	33.2	do	32 N.	115 W.
Do	8	48.1	do	32.7 N.	115.5 W.
Do	15	11.9	East of Hokkaido Island, Japan. Depth normal	42.8 N.	148.7 E.
May 1	2	33.3	Western Argentina	30 S.	70 W.
May 2	0	53.1	Northern Lower California	32.1 N.	116.7 W.
Do	8	24.1	East of the New Hebrides. Depth about 450 km	18 S.	170 E.
May 4	7	24.2	Aleutian Islands. Depth normal	52.7 N.	173.0 E.
Do	16	44.5	Western Peru. Depth normal	6.8 S.	80.1 W.
Do	21	1.9	Northeastern Persia. Depth normal	35.5 N.	58.9 E.
May 5	2	3.7	Northwestern Peru. Depth about 40 km	6.8 S.	80.0 W.
Do	9	38.7	Southern California. Pinto Mountains	34.0 N.	115.7 W.
May 7	21	33.7	Southern California	34.1 N.	116.3 W.
Do	22	23.6	Southern Russia (Georgia). Depth normal	42 N.	43 E.
May 10	1	25.1	Off western Mexico. Depth normal	22.5 N.	108.5 W.
Do	1	43.5	do	21.5 N.	109 W.
Do	14	46.5	Southern California	33.7 N.	116.3 W.
Do	18	59.8	Off southern Java. Depth about 100 km	9.2 S.	107.7 E.
May 11	13	54.7	Aleutian Islands. Depth normal	52.5 N.	173.3 E.
Do	21	0.3	Central Burma. Depth normal	23.8 N.	94.4 E.
May 12	20	43.8	Off western Mexico. Depth normal	19.5 N.	106.5 W.
May 17	1	59.7	Off southwestern Panama. Depth apparently shallow	7.6 N.	82.0 W.
May 18	5	4	Southern California. Depth normal	34.1 N.	116.3 W.
Do	5	51.4	Southern California	34.1 N.	116.3 W.
Do	6	4.5	do	34.1 N.	116.3 W.
Do	7	21.6	do	34.1 N.	116.3 W.
Do	9	15.2	do	34.6 N.	118.9 W.
Do	13	47.3	do	34.1 N.	116.3 W.
May 19	2	26.0	do	34.1 N.	116.3 W.
Do	2	27.5	do	34.1 N.	116.3 W.
Do	3	51.7	do	34.1 N.	116.3 W.
Do	4	36.7	do	32.8 N.	115.5 W.
Do	6	35.4	do	32.8 N.	115.5 W.
Do	7	1.6	do	32.8 N.	115.5 W.
Do	8	2.9	Northern Lower California	30 N.	115 W.
Do	8	55.3	Southern California	32.8 N.	115.5 W.
Do	9	17.3	do	32.6 N.	115.5 W.
Do	12	9.5	do	32.8 N.	115.5 W.
Do	13	40.9	do	32.8 N.	115.5 W.
Do	15	17.9	Okhotsk Sea. Northwest of Kurile Islands. Depth 575 km	50.9 N.	148.8 E.
Do	15	30.6	Southern California	32.8 N.	115.5 W.
Do	15	51.8	do	32.8 N.	115.5 W.
Do	18	6.3	Northern Lower California	30 N.	115 W.
Do	18	16.5	Southern Mozambique, South Africa. Depth normal	22 8 S.	32.5 E.
Do	19	7.1	Northern Lower California	30 N.	115 W.
Do	19	39.7	Southern California	34.1 N.	116.3 W.
May 20	6	27.3	do	32.8 N.	115.5 W.
Do	7	6.0	do	32.8 N.	115.5 W.
Do	11	13.4	do	32.8 N.	115.5 W.
May 21	12	41.6	do	32.8 N.	115.5 W.
Do	14	0.4	do	32.8 N.	115.5 W.
Do	18	48.9	Southwest of Tonga Islands. Depth about 350 km	22.3 S.	178.0 W.
Do	21	29.9	Southern California	32.8 N.	115.5 W.
May 22	6	31.6	do	34.1 N.	116.3 W.
Do	10	58.7	do	32.8 N.	115.5 W.
Do	14	10.1	do	34.1 N.	116.3 W.
Do	18	35.1	do	32.8 N.	115.5 W.
Do	20	56.3	do	32.8 N.	115.5 W.
May 23	0	12.3	do	32.8 N.	115.5 W.
Do	3	18.3	do	32.8 N.	115.5 W.
Do	6	1.7	South of Aleutian Islands. Depth normal	49.5 N.	177.5 E.
May 24	16	34	Western Peru. Depth about 75 km	10.2 S.	77.4 W.
Do	21	57.9	Off western Peru. Depth normal	11.4 S.	78.1 W.
May 26	8	50.5	Northern Lower California	31 N.	115 W.
May 27	3	27.4	Southern California	34.1 N.	116.3 W.
May 28	9	40.7	Northern New Guinea. Depth normal	2.3 S.	139.1 E.
May 29	1	57.9	Northwestern Canada. Depth normal	66.2 N.	134 W.
May 31	0	41.2	Samoa Islands. Depth normal	13.4 S.	173.1 W.
Do	4	56.2	South Pacific Ocean, west of Galapagos Islands. Depth normal	4 S.	105 W.

TABLE 1.—*Summary of instrumental epicenters for 1940*—Continued

1940	Greenwich civil time at origin	Region and focal depth	Coordinates of provisional epicenter	
			Latitude	Longitude
	h *m*		°	°
June 1	5 27.0	Southern California. Depth normal	34.0 N.	116.3 W.
Do	5 56.8	Southern California	34.0 N.	116.3 W.
Do	6 54.5	Southern California	34.0 N.	116.3 W.
Do	23 59.6	Southern California	32.8 N.	115.5 W.
June 2	6 13.2	Southern California	34.0 N.	116.3 W.
Do	11 37.6	Aleutian Islands. Depth normal	50.3 N.	179 W.
Do	12 09.6	Southwest of Guam. Depth normal	11.3 N.	138.9 E.
June 3	18 05.3	Gulf of California. Depth normal	25.2 N.	110.0 W.
June 4	10 35.2	Southern California	33.1 N.	116.4 W.
Do	13 03.3	Southern California	32.8 N.	115.5 W.
June 5	11 01.2	Northwestern Canada. Depth normal	67.0 N.	136 W.
Do	21 12.4	Southern California	32.8 N.	115.5 W.
Do	22 53.7	do	32.8 N.	115.5 W.
June 6	22 21.2	do	34.1 N.	116.3 W.
Do	23 21.1	do	33.3 N.	116.4 W.
Do	23 28.4	do	32.9 N.	115.2 W.
Do	23 47.8	do	34.1 N.	116.3 W.
Do	23 56.6	do	34.1 N.	116.3 W.
June 7	5 11.8	do	32.8 N.	115.5 W.
Do	7 17.3	Off southeastern New Guinea. Depth normal	9.7 S.	150.9 E.
Do	15 35.6	do	34.1 N.	116.3 W.
Do	21 46.2	do	34.1 N.	116.3 W.
June 8	17 10.5	do	34.1 N.	116.3 W.
June 11	8 42.2	North of Timor Island. Depth normal	8.0 S.	125.0 E.
Do	18 50.2	Southwestern Canada	53 N.	125 W.
Do	19 51.3	Southern California	34.1 N.	116.3 W.
Do	20 35.5	do	34.1 N.	116.3 W.
June 12	5 37.4	South of Kurile Islands. Depth normal	44.5 N.	149.5 E.
Do	13 59.8	East of Honshu Island, Japan. Depth normal	35.6 N.	142.4 E.
Do	14 11.4	do	36 N.	140.5 E.
Do	18 37.0	Off southeastern Japan. Depth about 100 km	32 N.	141.5 E.
June 13	16 54	Southern California	34.1 N.	116.3 W.
June 14	10 20.6	do	34.1 N.	116.3 W.
Do	13 57.6	do	34.1 N.	116.3 W.
Do	21 58.8	do	34.1 N.	116.3 W.
June 15	9 9.2	East of Honshu Island, Japan. Depth normal	35.8 N.	141.5 E.
June 17	10 26.8	Off northern Hawaii. Depth normal	20.7 N.	155.3 W.
June 18	6 14.5	Southern California	34.1 N.	116.3 W.
Do	13 52.6	Off southern Mindanao Island, Philippine Islands. Depth about 600 km	5.6 N.	123.8 E.
Do	18 39	Aleutian Islands. Depth normal	52.7 N.	173.5 E.
June 22	11 36.7	Off eastern Celebes. Depth about 200 km	.3 S.	122.8 E.
June 23	6 55.6	East of Greenland. Depth normal	74.8 N.	14.5 W.
Do	18 59.6	Northern Venezuela. Depth normal	9.7 N.	67.8 W.
Do	21 41.5	Gulf of California. Depth normal	25.9 N.	109.9 W.
June 24	16 39.6	Southern California	34.1 N.	116.3 W.
June 25	2 52.4	Off southeastern Kamchatka Peninsula. Depth normal	52.0 N.	159 E.
June 26	4 54.7	Southern California	32.8 N.	115.5 W.
Do	8 0.3	Off southern Sumatra. Depth about 200 km	5 S.	102.5 E.
June 27	6 52.3	Off southern Japan. Depth about 400 km	30 N.	138 E.
June 28	20 52.1	Southern California	32.8 N.	115.5 W.
July 1	21 29.7	North of Azores. Depth normal	42.6 N.	28.8 W.
July 2	1 36.6	Off eastern Honshu Island, Japan. Depth normal	35 N.	142 E.
Do	19 09.9	Northeast of Fiji Islands. Depth normal	13.5 S.	178 W.
July 3	16 01.3	West of Queen Charlotte Islands, Canada. Depth normal	53 N.	133.5 W.
July 4	3 46.1	Southern California	32.8 N.	115.5 W.
Do	9 00.6	Off Hokkaido Island, Japan. Depth about 260 km	44.5 N.	143.5 E.
July 5	14 03.9	Northeast of Tonga Islands. Depth normal	17.5 S.	172.5 W.
July 6	3 40.3	Off northeastern Venezuela. Depth 160 km	13 N.	61.4 W.
July 7	18 43.0	Southern California	31.7 N.	115.1 W.
July 8	10 04.8	Nevada	38.6 N.	117.8 W.
Do	10 57.7	East Central California	37.5 N.	119.0 W.
Do	15 16.3	West of Bonin Islands, Japan. Depth about 400 km	27 N.	139 E.
July 10	5 49.9	Manchukuo, eastern Asia. Depth about 600 km	44.3 N.	130.2 E.
July 13	16 39.4	Southern California. San Jacinto Fault	33.1 N.	116 W.
Do	16 47.4	Off southwestern Panama. Depth normal	7.5 N.	82.0 W.
Do	17 45.2	Southern California. San Jacinto Fault	33.1 N.	116 W.
Do	22 50.8	do	33.1 N.	116 W.
July 14	0 1.7	do	33.1 N.	116 W.
Do	5 52.9	Aleutian Islands. Depth about 80 km	51.7 N.	178.5 E.
Do	15 31.5	Off Honshu Island, Japan. Depth normal	36 N.	141 E.
July 15	2 32.7	Southern California, Imperial Valley	32.8 N.	115.5 W.
July 16	0 56.5	Probable epicenter. Aleutian Islands. Depth 75 km	52 N.	178 W.
Do	3 17.6	Northeast of Hawaii. By Hawaiian Volcano Observatory. Depth normal	20.9 N.	155.1 W.
Do	22 05.9	Probable epicenter. North of Tonga Islands. Depth about 150 km	16 S.	174 W.
July 19	4 47.5	Probable epicenter. Aleutian Islands	53 N.	174 E.
July 20	1 53.9	South of Samoa Islands. Depth normal	15.4 S.	172.2 W.
July 21	0 02.0	Off northeastern Honshu Islands, Japan	40.5 N.	141.7 E.
Do	5 16.0	Off southeastern New Hebrides Islands. Depth about 150 km	19 S.	170 E.
Do	8 36.0	Southern California. San Jacinto Fault	33.1 N.	116 W.
Do	15 38.6	Off northern Celebes. Depth about 100 km	2.5 N.	122.4 E.
Do	18 28.3	South of Fiji Islands. Depth about 550 km	23 S.	179 W.
July 22	23 00.6	East central California	37.6 N.	118.9 W.
July 24	14 32.7	East of Hokkaido Island, Japan. Depth normal	43.5 N.	147.5 E.
July 27	13 32.5	Southern Guatemala. Depth 90 km	14.3 N.	91.5 W.
July 29	20 53.4	Southern California. San Jacinto Fault	33.1 N.	116 W.
July 30	0 12.3	Turkey. Depth normal	38.5 N.	33.5 E.

TABLE 1.—*Summary of instrumental epicenters for 1940*—Continued

1940	Greenwich civil time at origin	Region and focal depth	Coordinates of provisional epicenter	
			Latitude	Longitude
	h m		°	°
July 30	15 27.2	Off southwestern Panama. Depth normal	4.7 N.	82.5 W.
Do	16 05.4	Off southeastern Cuba. Depth normal	19.4 N.	75.1 W.
Do	21 52.6	Probable epicenter. Off southwestern Peru	15 S.	78 W.
July 31	11 39.3	Off southeastern New Guinea	10.5 S.	148.5 E.
Aug. 1	12 39.6	Northwest of Kermadec Islands. Depth 490 km	26.3 S.	179.8 E.
Do	15 08.4	Off western Hokkaido Island, Japan. Depth about 50 km	44.7 N.	138.8 E.
Do	19 31.7	Southern California. Little San Bernardino Mountains	34.1 N.	116.3 W.
Aug. 4	9 16.0	Honshu Island, Japan	38 N.	140 E.
Do	16 06.6	Probable epicenter. Southern Peru. Depth about 50 km	15 S.	73 W.
Do	18 15.3	Southern California. Little San Bernardino Mountains	34.1 N.	116.3 W.
Aug. 5	8 19.8	Aleutian Islands	53 N.	178 W.
Do	9 55.2	Off eastern China, in Gulf of Liaotung. Depth normal	39.9 N.	120.8 E.
Aug. 7	2 56.0	Northern Chile. Depth about 115 km	22.5 S.	68 W.
Aug. 9	13 43.8	Vicinity of Martinique Island		
Aug. 11	16 46.7	Southwest of Samoa Islands. Depth normal	15.4 S.	173.1 W.
Aug. 13	15 36.8	Western Honshu Island, Japan	35.5 N.	133 E.
Do	22 07.5	Near Oil City, California. Depth normal	36.2 N.	120.3 W.
Aug. 15	2 51.7	Probable epicenter. Western Panama	8.5 N.	82.5 W.
Do	4 37.0	Off Oregon coast	43 N.	130 W.
Do	21 23.5	Marianas Islands. Depth about 150 km	18.3 N.	145.9 E.
Aug. 18	5 55.1	Southeast of Tonga Islands. Depth normal	26.5 S.	173 W.
Aug. 20	5 1.9	Off southern Honshu Island, Japan	33.7 N.	139.4 E.
Do	17 29.7	Off eastern New Guinea. Depth normal	6.5 S.	149 E.
Aug. 22	3 27.3	Southeast of Unalaska Island. Aleutian Islands. Depth about 60 km	53 N.	165 W.
Do	11 03.5	Off southwestern Panama. Depth normal	7.9 N.	82.3 W.
Aug. 24	7 53.2	Probable epicenter. South of Alaska	53 N.	154 W.
Do	13 31.1	West of Samoa Island. Depth normal	14 S.	173.5 W.
Aug. 25	10 31.7	Probable epicenter. Honshu Island, Japan	36.5 N.	139 E.
Aug. 26	2 28	Peru. Depth about 110 km	11.5 S.	75.5 W.
Do	5 0.8	North of Galapagos Islands. Depth normal	1.2 N.	90.7 W.
Aug. 28	12 28.5	Southeast of Fiji Islands. Depth about 200 km	20 S.	178 W.
Do	15 17.1	Kurile Islands. Depth normal	45.7 N.	147.8 E.
Aug. 30	16 34.2	Southern California. Imperial Valley	32.8 N.	115.5 W.
Aug. 31	17 12.7	Off southwestern Peru	17 S.	78 W.
Sept. 2	8 44.6	North of Hawaii. By Hawaiian Volcano Observatory	21 N.	155.3 W.
Sept. 3	1 28.0	East of Loyalty Islands. Depth about 110 km	22.2 S.	171.6 E.
Do	14 40.6	Probable epicenter. Tibet. Depth normal	32 N.	93 E.
Sept. 5	9 33.2	Southern California. Little San Bernardino Mountains. Depth normal	34.1 N.	116.3 W.
Sept. 6	2 51.4	Off eastern Kamchatka. Depth about 50 km	56 N.	162 E.
Sept. 7	10 38.6	Montgomery County, California	36.5 N.	121.5 W.
Do	13 02.1	do	36.5 N.	121.5 W.
Do	19 23.7	Off northeastern Mindanao Island, Philippine Islands. Depth 110 km	9 N.	126.8 E.
Sept. 8	10 15.3	East of Commander Islands, Bering Sea. Depth probably about 100 km	54.5 N.	170.5 E.
Sept. 9	23 01.1	Near Alaska Peninsula	53.8 N.	161.9 W.
Sept. 12	0 06.5	Northern Lower California. Depth normal	31.7 N.	115.1 W.
Do	0 15.5	do	31.7 N.	115.1 W.
Do	0 21.5	In Gulf of Tongking. Southern China	19.2 N.	107.1 E.
Do	9 21.5	Probable epicenter. Northwest of Samoa Islands. Depth about 200 km	12 S.	176.5 W.
Do	13 17.1	Off northern New Britain Island. Depth about 80 km	4.5 S.	150.5 E.
Sept. 13	11 50.0	Near head of Gulf of California. Depth normal	32.1 N.	114.3 W.
Do	14 45.8	Off northern Lower California. Depth normal	32.1 N.	117.8 W.
Do	22 55.1	do	32.1 N.	117.8 W.
Sept. 14	2 31.1	South of Alaska. Depth normal	52.9 N.	156 W.
Do	18 05.5	Probable epicenter. Southeast of New Britain Island	7.9 S.	152.4 E.
Sept. 16	2 48.2	Southern California. Imperial Valley. Depth normal	32.7 N.	115.5 W.
Sept. 17	8 52.0	Probable region of epicenter. Off Peru	10 S.	80 W.
Sept. 18	15 09.2	Probable epicenter. Bolivia-Chile boundary. Depth 115 km	22 S.	68 W.
Sept. 19	1 33.2	Southern California. Little San Bernardino Mountains. Depth normal	34 N.	116.5 W.
Do	8 20.6	Central California. Depth normal	38 N.	121 W.
Do	18 19.7	Southeast of Loyalty Islands. Depth about 75 km	23.5 S.	170.9 E.
Sept. 20	0 02.9	Southeast of Loyalty Islands	23 S.	171 E.
Do	12 21.9	Southern Nevada. Depth normal	36.5 N.	115 W.
Sept. 21	13 49.0	Northeast Afghanistan. Depth about 220 km	37 N.	71.5 E.
Sept. 22	22 11.9	Southwest of Samoa Islands	15 S.	173 W.
Do	22 51.9	Mindanao Island, Philippine Islands. Depth about 700 km	7.5 N.	124.5 E.
Sept. 23	7 15.2	Northern Argentina. Depth about 550 km	22.3 S.	63.7 W.
Do	10 28.9	Greenland	67.5 N.	44.5 W.
Sept. 24	0 47.4	Probable epicenter. Northeastern New Guinea. Depth about 100 km	4 S.	144 E.
Sept. 25	14 28.9	Probable epicenter. South of Sumba Island. Netherlands East Indies	11 S.	119 E.
Sept. 26	3 56.5	South of Santa Cruz Islands. Depth about 150 km	12 S.	166.5 E.
Sept. 27	17 03.6	Northwestern California. Depth normal	40 N.	124 W.
Sept. 29	1 21.4	Andes Mountains, western Argentina. Depth about 110 km	34.1 S.	69.2 W.
Do	5 57.2	Off Queen Charlotte Islands, Canada. Depth normal	54 N.	134 W.
Sept. 30	11 13.3	North of Kermadec Islands. Depth 100–150 km	27 S.	178 W.
Do	14 10.6	do	27 S.	178 W.
Oct. 1	10 43.5	Off Chile. Depth about 350 km	26.2 S.	71.2 W.
Do	20 43.2	Off western Mexico	22 N.	129 W.
Do	21 38.6	Southwest of New Zealand	59 S.	163 E.
Oct. 2	3 15.8	Costa Rica. Depth normal	9.9 N.	84.1 W.
Do	4 06.3	South of Samoa Islands. Depth normal	15.5 S.	173.5 W.
Do	10 24.0	Probable epicenter. East of Kermadec Islands	30.5 S.	172 W.
Oct. 3	4 56.0	Southern Bolivia. Depth about 100 km	21 S.	66.5 W.
Oct. 4	7 55.3	Southern Peru. Depth about 200 km	17.8 S.	70.4 W.
Do	9 33.7	do	17.8 S.	70.4 W.
Oct. 5	4 46.6	do	17.8 S.	70.4 W.
Do	9 32.4	South of Aleutian Islands. Depth probably about 100 km	50 N.	175 E.
Do	14 38.7	Off western Costa Rica. Depth normal	9.2 N.	84.2 W.
Do	17 17.6	Costa Rica. Depth about 150 km	9.7 N.	83.3 W.

TABLE 1.—*Summary of instrumental epicenters for 1940*—Continued

1940	Greenwich civil time at origin		Region and focal depth	Coordinates of provisional epicenter	
				Latitude	Longitude
	h	*m*		°	°
Oct. 6	15	35.7	Southern Peru. Depth about 200 km	17.8 S.	70.4 W.
Do	15	38.8	do	17.8 S.	70.4 W.
Do	18	19.9	Southern California. West of Salton Sea	33.1 N.	116.1 W.
Oct. 7	1	25.7	North Island, New Zealand. Depth about 200 km	38.5 S.	176.1 E.
Do	6	43.0	Off southern Mindanao Island, Philippine Islands. Depth abont 120 km.	4.9 N.	126.1 E.
Oct. 10	17	07.9	Southern California, Imperial Valley	32.8 N.	175.5 W.
Oct. 11	5	57.2	Southern California, Santa Monica Bay	33.8 N.	118.6 W.
Do	7	53.1	Southern Alaska. Depth about 35 km	60 N.	153 W.
Do	18	41.2	Chile	41 S.	73 W.
Oct. 12	0	24.0	Southern California, Santa Monica Bay	33.8 N.	118.6 W.
Do	2	48.5	Probable epicenter. Southeastern Mexico. Depth about 200 km	18 N.	89 W.
Do	2	58.9	Southern Peru. Depth about 200 km	17.8 S.	70.4 W.
Do	3	45.7	Off Lower California	31.7 N.	116.5 W.
Oct. 13	13	25.7	Southeast of Loyalty Islands. Depth 200 km(?)	23 S.	171 E.
Oct. 14	20	51.2	Southern California, Santa Monica Bay	34.8 N.	118.6 W.
Oct. 15	6	35.0	Probable epicenter. Okhotsk Sea, off Kamchatka. Depth about 40 km	55 N.	155 E.
Do	7	54.3	Southern Peru. Depth about 200 km	17.8 S.	70.4 W.
Oct. 16	17	52.2	Southern California. West of Salton Sea	33.2 N.	116.1 W.
Oct. 17	10	18.1	Southern California, Imperial Valley	32.8 N.	115.5 W.
Oct. 19	10	57.3	Southeast of Solomon Islands	13 S.	162 E.
Oct. 21	6	49.6	Southern California near Aguanga	33.1 N.	116.4 W.
Do	20	15.7	Solomon Islands. Depth about 125 km	7 S.	156 E.
Oct. 22	6	37.0	Eastern Rumania. Depth about 125 km	45.8 N.	26.8 E.
Do	11	00.8	Northern California	40.5 N.	124 W.
Oct. 23	2	22.8	Northern Pern. Depth about 140 km	5.6 S.	76.4 W.
Oct. 24	20	06.8	Off Chile. Depth about 90 km	33.5 S.	73 W.
Oct. 26	1	24.4	Southern Utah	38 N.	113 W.
Do	11	21.6	Southern California, Vallecito Mountains	33 N.	116.3 W.
Oct. 27	5	35.6	Costa Rica. Depth normal	9.8 N.	84.4 W.
Do	10	36.2	Northern Chile. Depth normal	20 S.	69 W.
Do	19	53.5	Gulf of California	30 N.	114 W.
Do	22	29.3	Northwest Washington State	47.2 N.	123.4 W.
Oct. 28	1	18.6	Probable epicenter. Felt in Argentina	31 S.	73.5 W.
Do	22	21.1	Southwestern Nevada	37.4 N.	117 W.
Oct. 30	3	10.2	Probable epicenter. Off northeastern Brazil	2 S.	21 W.
Do	11	48.5	Near Fiji Islands. Depth about 600 km	22 S.	179 W.
Do	22	59.7	Northern Japan. Depth probably about 300 km	46 N.	142 E.
Oct. 31	2	08.5	East of Martinique Island. Depth about 60 km	15.4 N.	59.8 W.
Do	10	43.9	Western India. Depth normal	24 N.	70.5 E.
Nov. 1	7	25.1	Southern California. Depth normal	33.8 N.	118.6 W.
Do	15	52.7	Off coast of Mexico. Depth approximately 120 km	18 N.	107 W.
Do	20	00.8	Southern California. Depth normal	33.6 N.	118.2 W.
Nov. 2	2	58.4	do	33.8 N.	118.6 W.
Nov. 7	10	57.9	Near Bonin Islands. Depth about 500 km	29 N.	139 E.
Nov. 8	10	34.2	New Hebrides region. Depth normal	16 S.	168.7 E.
Nov. 9	10	59.2	do	12 S.	168 E.
Nov. 10	1	39.1	Roumania. Destructive. Depth about 150 km	45.9 N.	26.6 E.
Do	20	40.4	Off coast of Nicaragua	17 N.	83.1 W.
Nov. 16	2	26.5	West of Aleutian Islands	51.3 N.	168.0 E.
Nov. 17	3	56.5	Off Oregon coast	44.8 N.	130 W.
Do	7	23.1	Off coast of California	40 N.	125 W.
Nov. 19	15	01.6	Sea of Okhotsk	59 N.	142 E.
Do	16	47.7	Southern California. Depth normal	32.8 N.	116 W.
Do	18	34.5	Off northern California	40 N.	125 W.
Nov. 22	9	10.2	New Hebrides Islands	6 S.	152 E.
Nov. 23	3	48.8	Off west coast of Costa Rica	9 N.	84.4 W.
Do	3	53.0	Southern California	33.2 N.	116.1 W.
Nov. 24	13	04.7	do	32.8 N.	115.5 W.
Nov. 27	14	41.6	New Britain	3.3 S.	151.0 E.
Dec. 1	21	10.5	Off west coast of Panama	7.1 N.	83.5 W.
Dec. 4	13	5.7	Near New Guinea. Depth probably less than 100 km	4 S.	132 E.
Dec. 7	3	19.9	Off west coast of Costa Rica	9 N.	84 W.
Do	14	16.5	Southern California	31.7 N.	115.1 W.
Dec. 15	23	53.1	Near coast of Salvador	3.6 N.	90.1 W.
Dec. 18	5	32	Banda Sea	5.8 S.	128.3 E.
Dec. 20	7	27.4	NewHampshire. Depth approximately 35 km	43.8 N.	71.3. W.
Do	23	41.0	Humboldt and Mendocino Counties. California	39.5 N.	123.5 W.
Dec. 22	12	31.6	Fiji Islands	17 S.	178 W.
Do	19	59.8	Near Lake Titicaca, Peru. Depth approximately 250 km	15.5 S.	69 W.
Dec. 23	21	50.5	Near Helena, Montana	45.5 N.	112.5 W.
Dec. 24	13	43.8	New Hampshire. Depth approximately 35 km	43.8 N.	71.3 W.
Dec. 28	16	37.8	Marianas Islands. Depth approximately 60 km	18.1 N.	147.8 E.
Dec. 29	16	38	Off coast of Ecuador	2 N.	81 W.
Do	18	05.1	Near southwest coast of Panama	7.3 N.	83.2 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 eight preceding issues of this series, Serials 579, 593, 600, 610, 619, 629, 637, and 647, 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. 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.

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. 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.

For 1941 the only record thus processed was the Santa Barbara accelerograph record of the Santa Barbara Channel earthquake of June 30. Tabulations of the measured and computed ordinates of the curves shown in figures 8, 9, and 10 may be obtained for special investigations by writing to the Director, Coast and Geodetic Survey, Washington.

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

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 1.43 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 3 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 3 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.

TABLE 2.—***List of shocks recorded and records obtained on strong-motion seismographs in 1941***

Date, epicenter, and recording station	Records		
	Accelerograph	Displacement meter	Weed strong-motion seismograph
Jan. 23: northern California:			
Ferndale	1		
Feb. 9: northern California:			
Ferndale	1		
Eureka	1	1	
May 13: northern California:			
Ferndale	1		
June 30: Santa Barbara:			
Santa Barbara, including two aftershocks	3		
Hollywood	3		
Los Angeles Subway Terminal	2	1	
Los Angeles Chamber of Commerce	2		
Long Beach	1		
Vernon	1		
Sept. 3: Boulder Dam:			
1215 Gallery	1		
Intake Tower	1		
Oil House	1		
Sept. 7: Santa Barbara:			
Santa Barbara	1		
Sept. 14: Owens Valley:			
Bishop (two shocks)	2		
Sept. 14: Santa Barbara region:			
Santa Barbara	1		
Sept. 17: San Francisco Bay region:			
San Jose	2		
Oct. 3: northern California:			
Eureka	1	1	
Ferndale	1		
Oct. 21: Los Angeles County:			
Gardena			
Long Beach	1		
Los Angeles Subway Terminal	2	1	
Vernon	1		
Westwood	1		
Los Angeles Chamber of Commerce	1		
Los Angeles Edison Bldg	1		
Hollywood Storage Company Bldg	3		
Oct. 22: Los Angeles County:			
Gardena			
Long Beach	1		
Los Angeles Subway Terminal	2	1	
Nov. 14: Los Angeles County:			
Torrance-Gardena			
Vernon	1		
Long Beach	1		
Westwood	1		
Hollywood Storage Company Bldg	3		
Los Angeles Edison Bldg	1		
Los Angeles Chamber of Commerce	2		
Los Angles Subway Terminal	2	1	
Santa Ana			1
Total	51	5	1

NORTHERN CALIFORNIA EARTHQUAKE OF JANUARY 23

Epicenter roughly 10 miles offshore near Cape Mendocino. Maximum intensity on shore, V.

Ferndale.—Figure 5. Station about 18 miles S. 81° E. of epicenter. Intensity V. Maximum acceleration 19 cm./sec.^{2}

NORTHERN CALIFORNIA EARTHQUAKE OF FEBRUARY 9

Epicenter about 55 miles off Humboldt Bay. Maximum intensity on shore, VI. Felt also over large area in Oregon.

Ferndale.—Figure 5. Station about 65 miles S. 70° E. of epicenter. Intensity, VI. Maximum acceleration 47 cm./sec.^{2}

Eureka.—Figure 6. Station about 65 miles S. 80° E. of epicenter. Intensity, VI. Maximum acceleration 12 cm./sec.^{2} Maximum recorded displacement 0.6 cm.

NORTHERN CALIFORNIA EARTHQUAKE OF MAY 13

Epicenter about 35 miles offshore, near Cape Mendocino. Maximum intensity on shore, V.

Ferndale.—Figure 7. Station about 40 miles S. 85° E. of epicenter. Maximum acceleration 10 cm./sec ^{2}

SANTA BARBARA EARTHQUAKE OF JUNE 30

Epicenter in Santa Barbara Channel; maximum intensity on shore, VIII. About $100,000 damage at Santa Barbara and nearby points.

Santa Barbara.—Figures 8, 9 and 10. Station about 10 miles N. 35° W. of epicenter. Intensity VIII at Santa Barbara and Carpinteria. Maximum acceleration at Santa Barbara 172 cm./sec.^{2}; maximum velocity and displacement, based on analysis by integration, respectively 16 cm./sec. and 2.0 cm. These values are not resultant motions. Two aftershocks were recorded on the same day having amplitudes of 33 and 15 cm./sec.^{3} See Fig. 14.

Hollywood.—Figure 11. Stations about 73 miles S. 78° E. of epicenter. Intensity, IV. Records were obtained from the basement and penthouse of the Hollywood Storage Company building and on the adjoining lot. Maximum intensities were 4 cm./sec.^{2}, 19 cm./sec.^{2}, and 5 cm./sec.^{2} respectively.

Los Angeles Subway Terminal.—Figure 12. Station about 78 miles S. 76° E. of epicenter. Intensity IV to V. Maximum accelerations in basement and on the thirteenth floor of the Terminal building, respectively 2 cm./sec.^{2} and 9 cm./sec.^{2} Maximum displacement recorded in the basement was 0.2 cm.

Los Angeles Chamber of Commerce Building.—Figure 13. Station about 78 miles S. 76° E. of epicenter. Intensity, IV to V. Maximum accelerations in basement and penthouse, respectively 2 cm./sec.^{2} and 9 cm./sec.^{2}

Long Beach.—Figure 7. Station about 87 miles S. 65° E. of epicenter. Intensity, V. Maximum acceleration 4 cm./sec.^{2}

Vernon.—Figure 7. Station about 80 miles S. 76° E. of epicenter. Intensity, probably V. Maximum acceleration 4 cm./sec.^{2}

BOULDER DAM EARTHQUAKE OF SEPTEMBER 3

Epicenter about 4 miles east of Boulder Dam. Maximum intensity near dam about V.

1215 Gallery.—Figure 15. Station about 4 miles west of epicenter. Maximum acceleration 12 cm./sec.^{2}

Intake Tower.—Figure 15. Station about 4 miles west of epicenter. Maximum acceleration 15 cm./sec.^{2}

Oil House.—Figure 15. Station about 4 miles west of epicenter. Maximum acceleration 5 cm./sec.^{2}

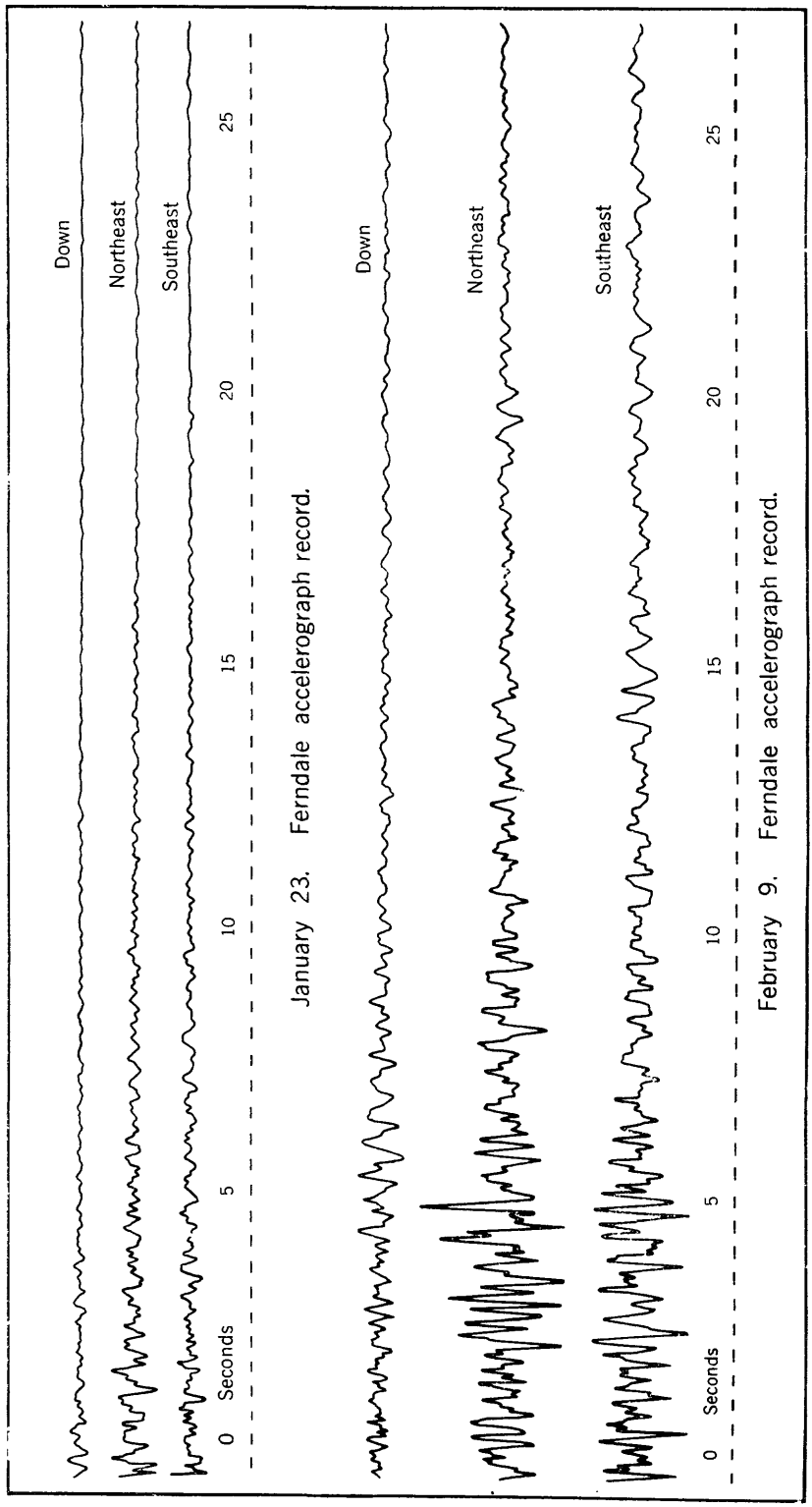

FIGURE 5.—Tracings of accelerograph records obtained at Ferndale on January 23 and February 9, 1941.

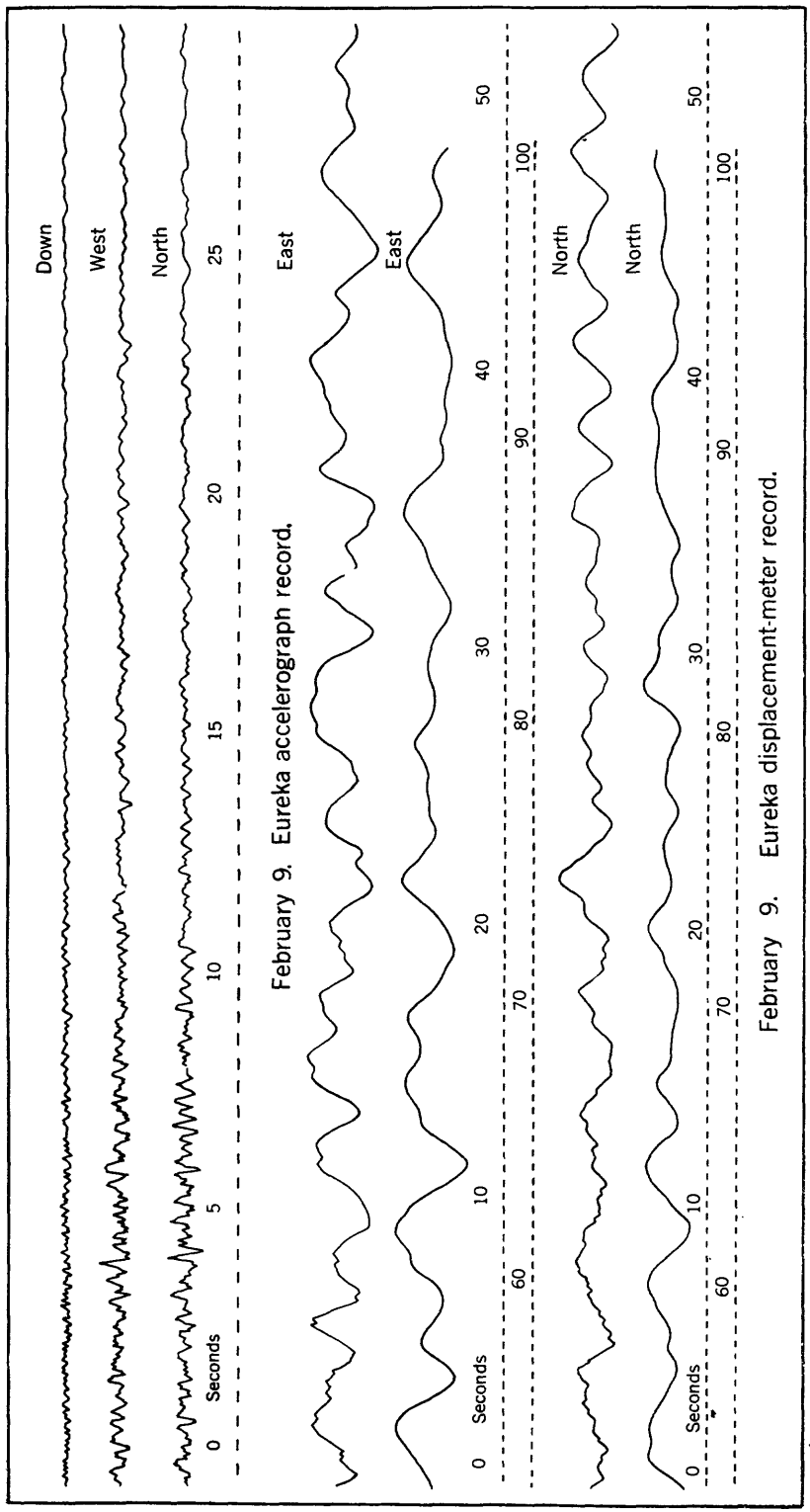

FIGURE 6.—Tracings of strong-motion seismograph records obtained at Eureka on February 9, 1941.

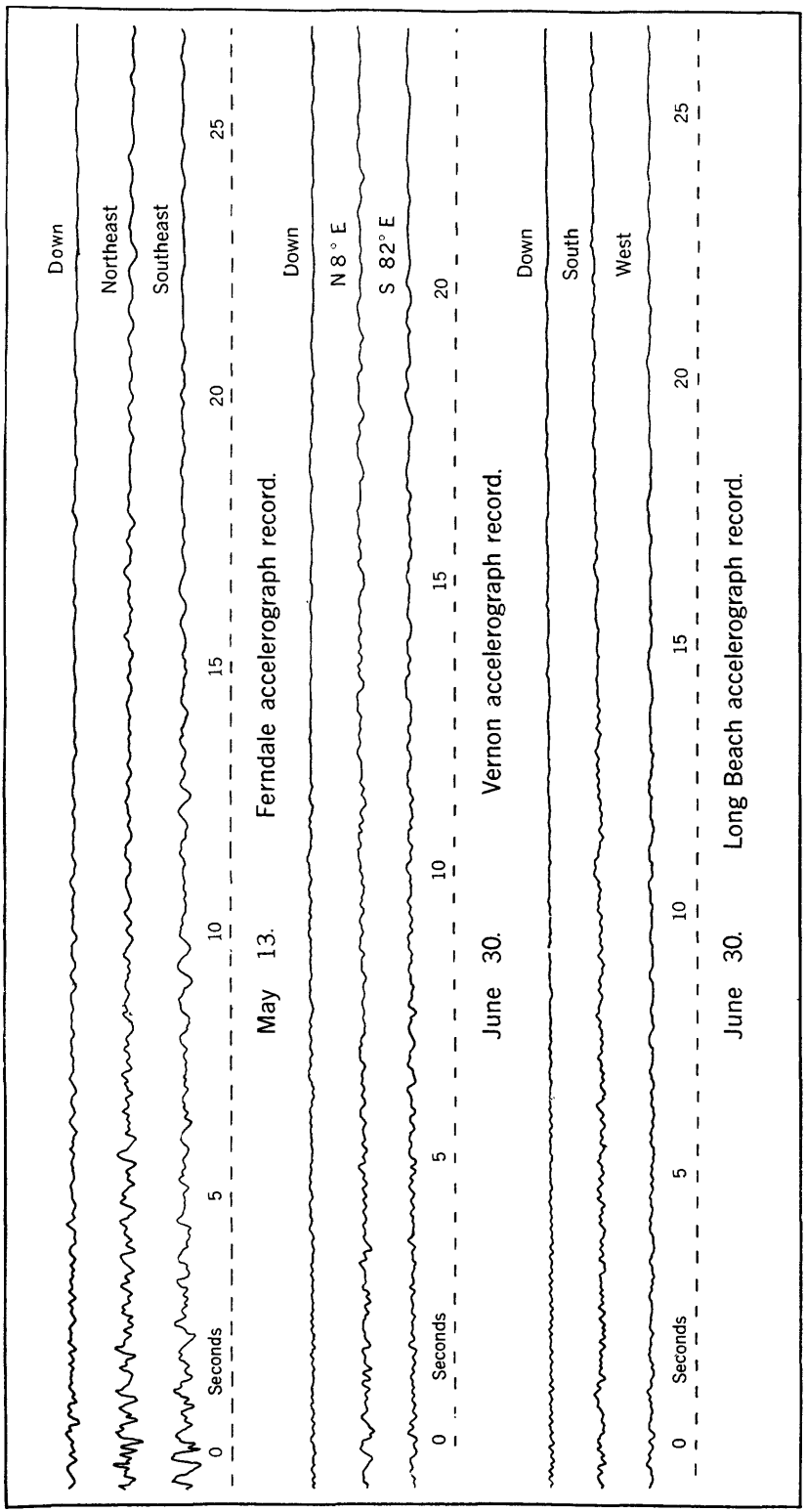

FIGURE 7.—Tracings of accelerograph records obtained at Ferndale on May 13, 1941, and at Vernon and Long Beach on June 30, 1941.

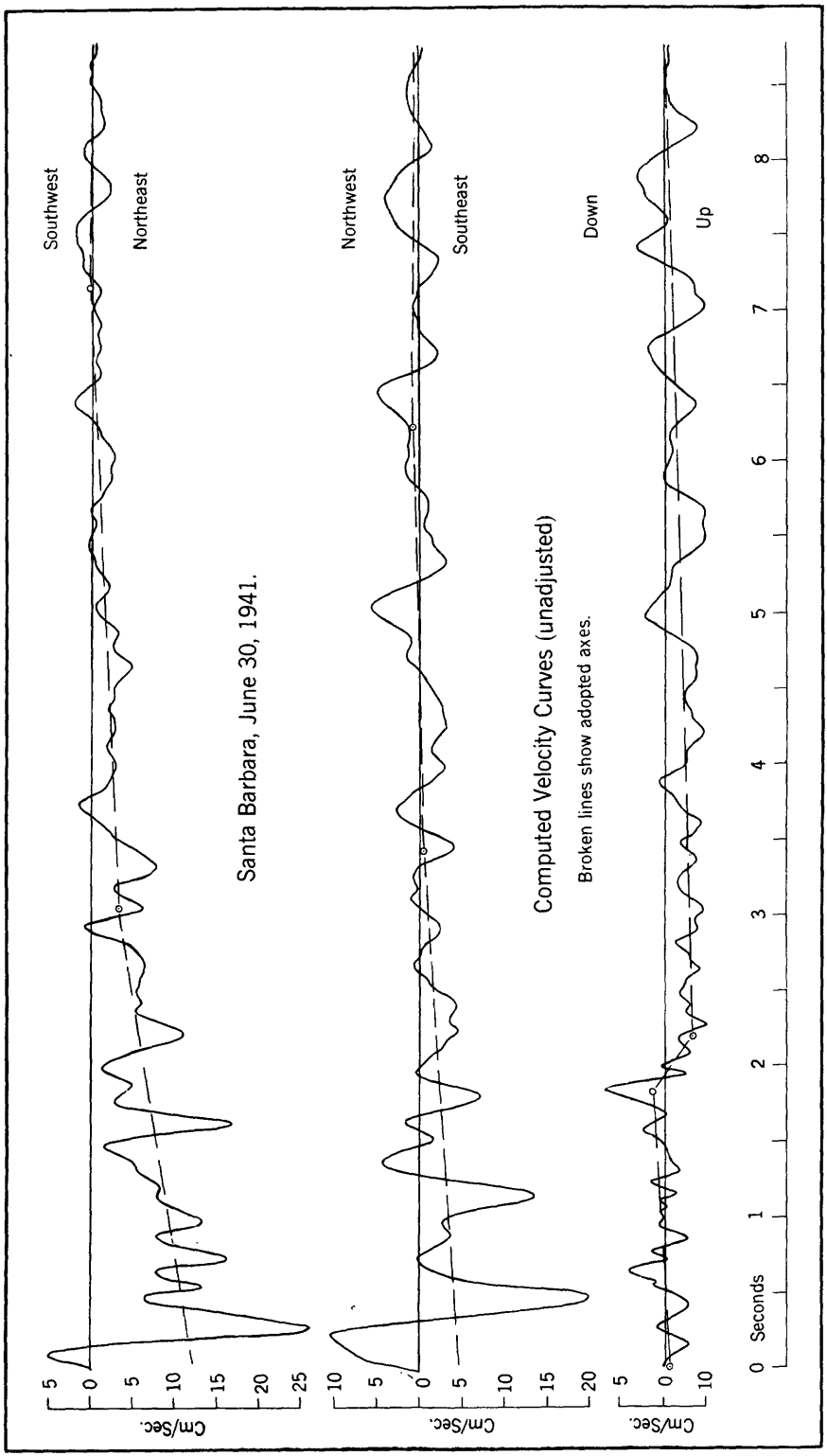

FIGURE 9.—Velocity computed from the Santa Barbara accelerograph record of June 30, 1941.

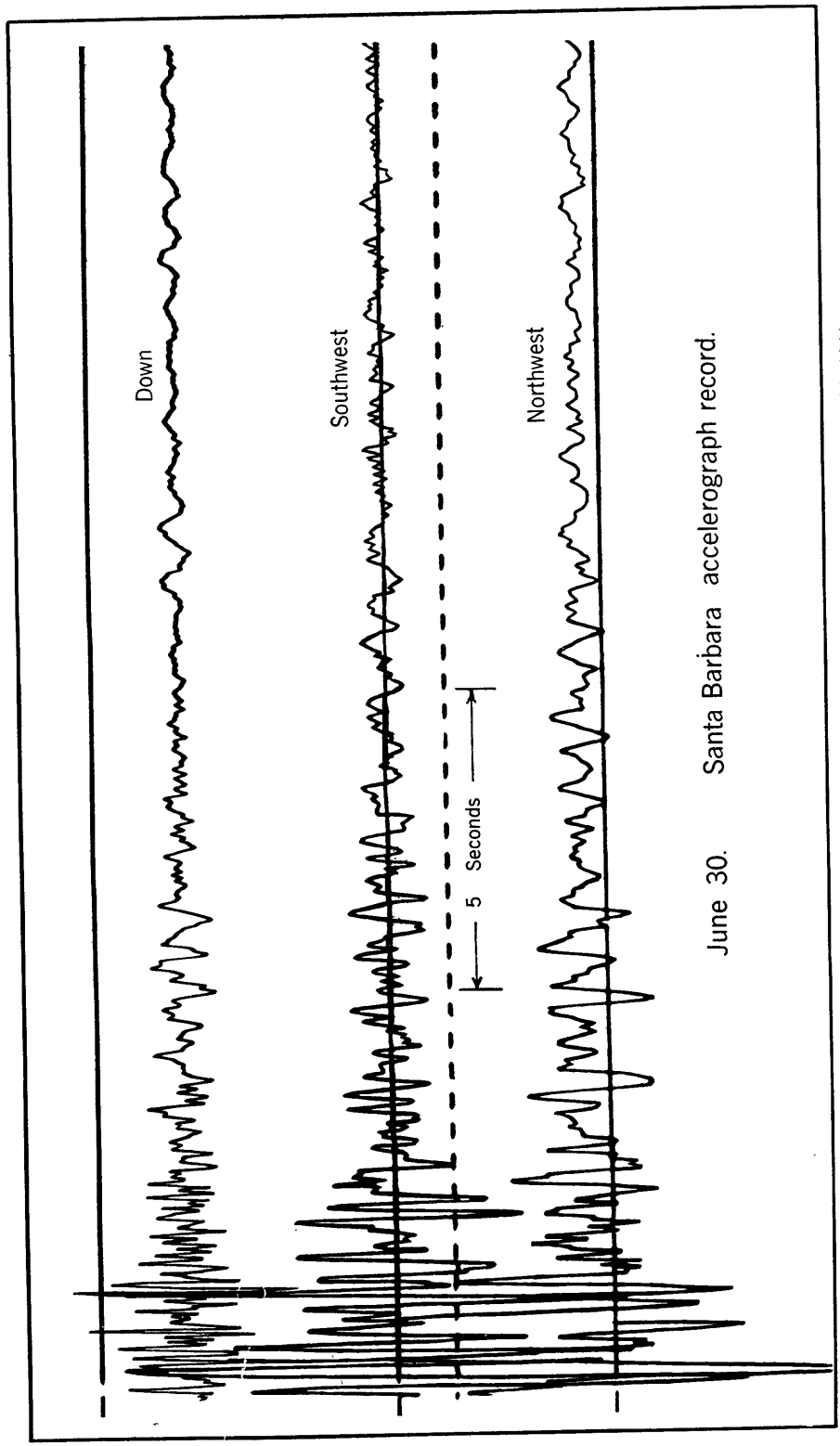

FIGURE 8.—Original accelerograph record obtained at Santa Barbara on June 30, 1941.

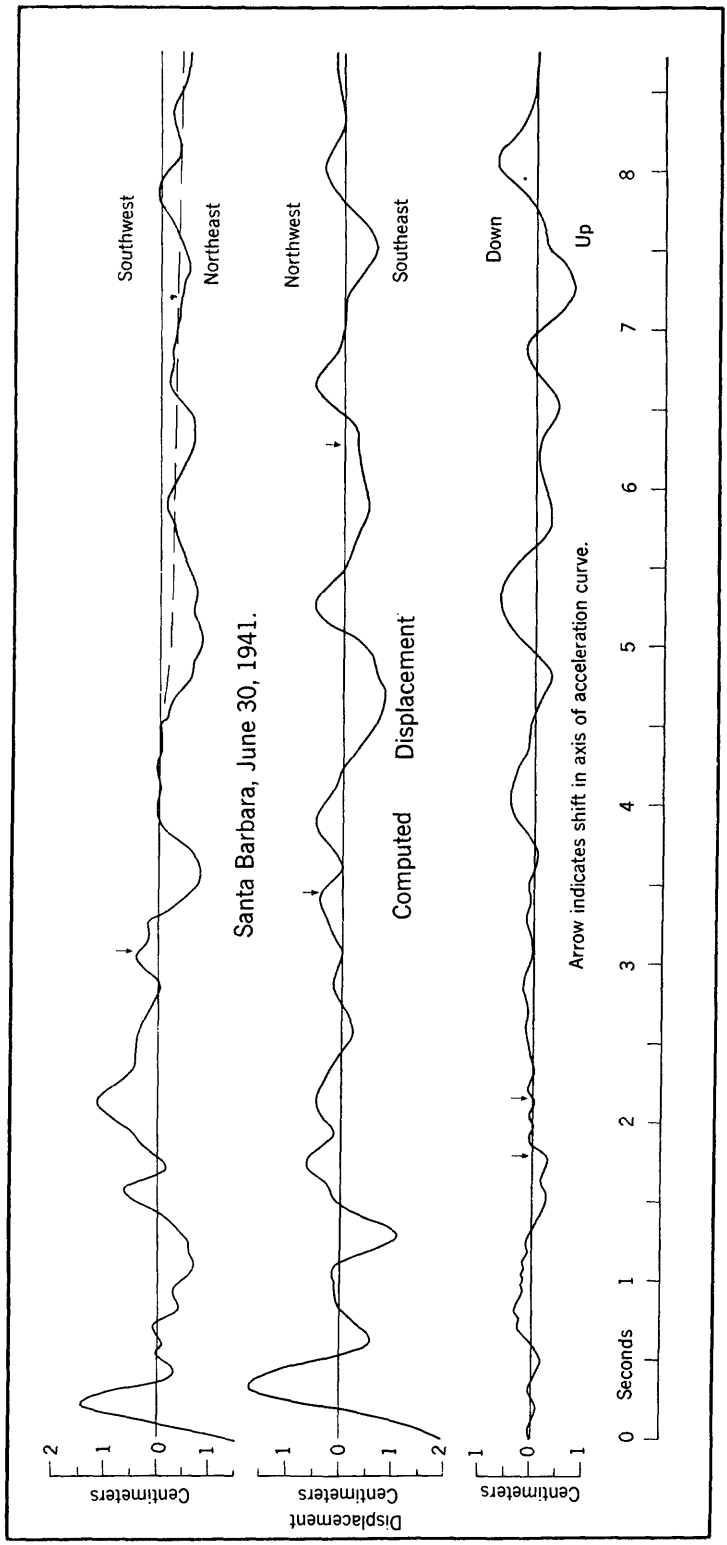

FIGURE 10.—Displacement computed from the Santa Barbara accelerograph record of June 30, 1941.

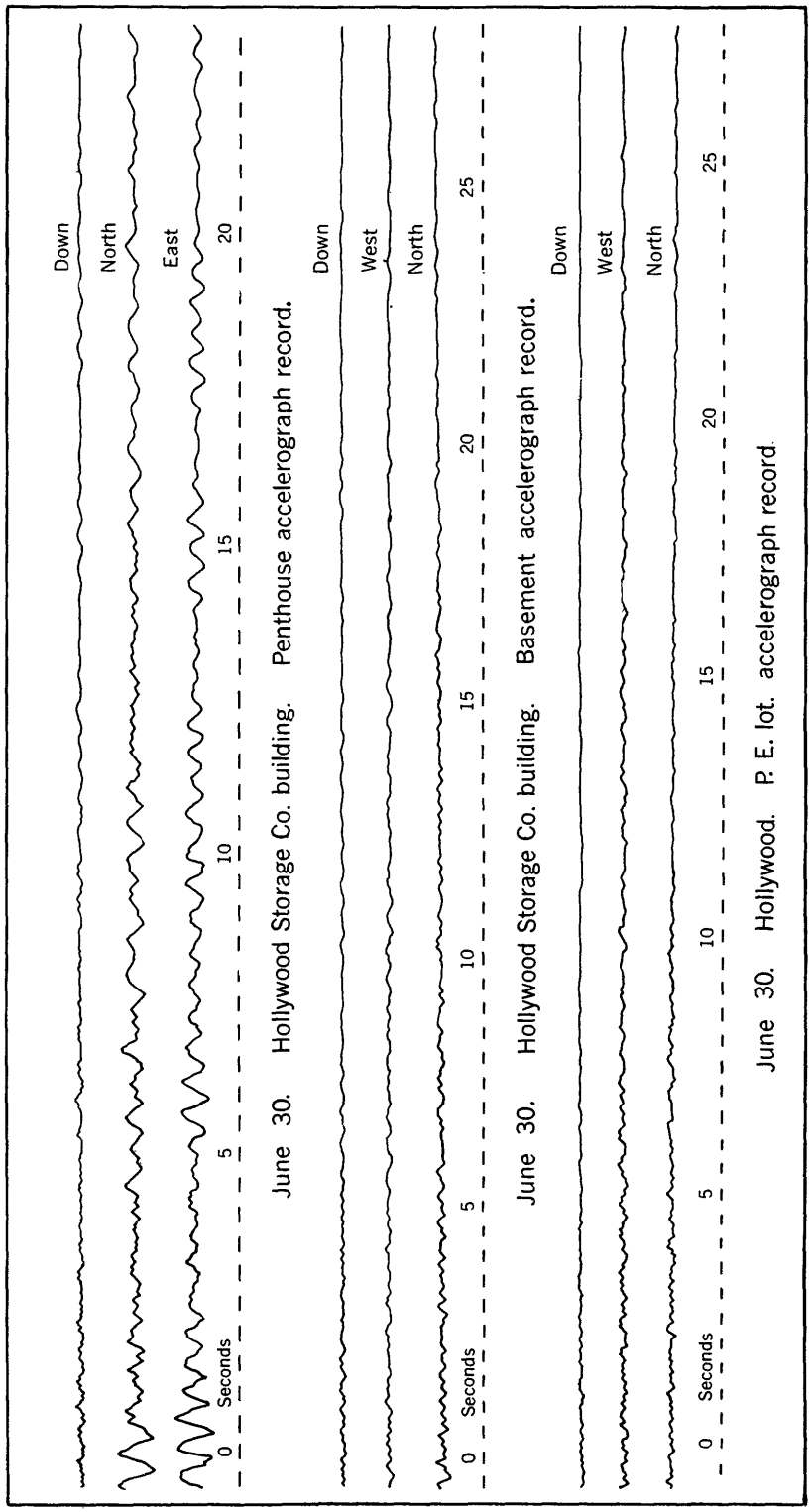

FIGURE 11.—Tracings of accelerograph records obtained at Hollywood on June 30, 1941.

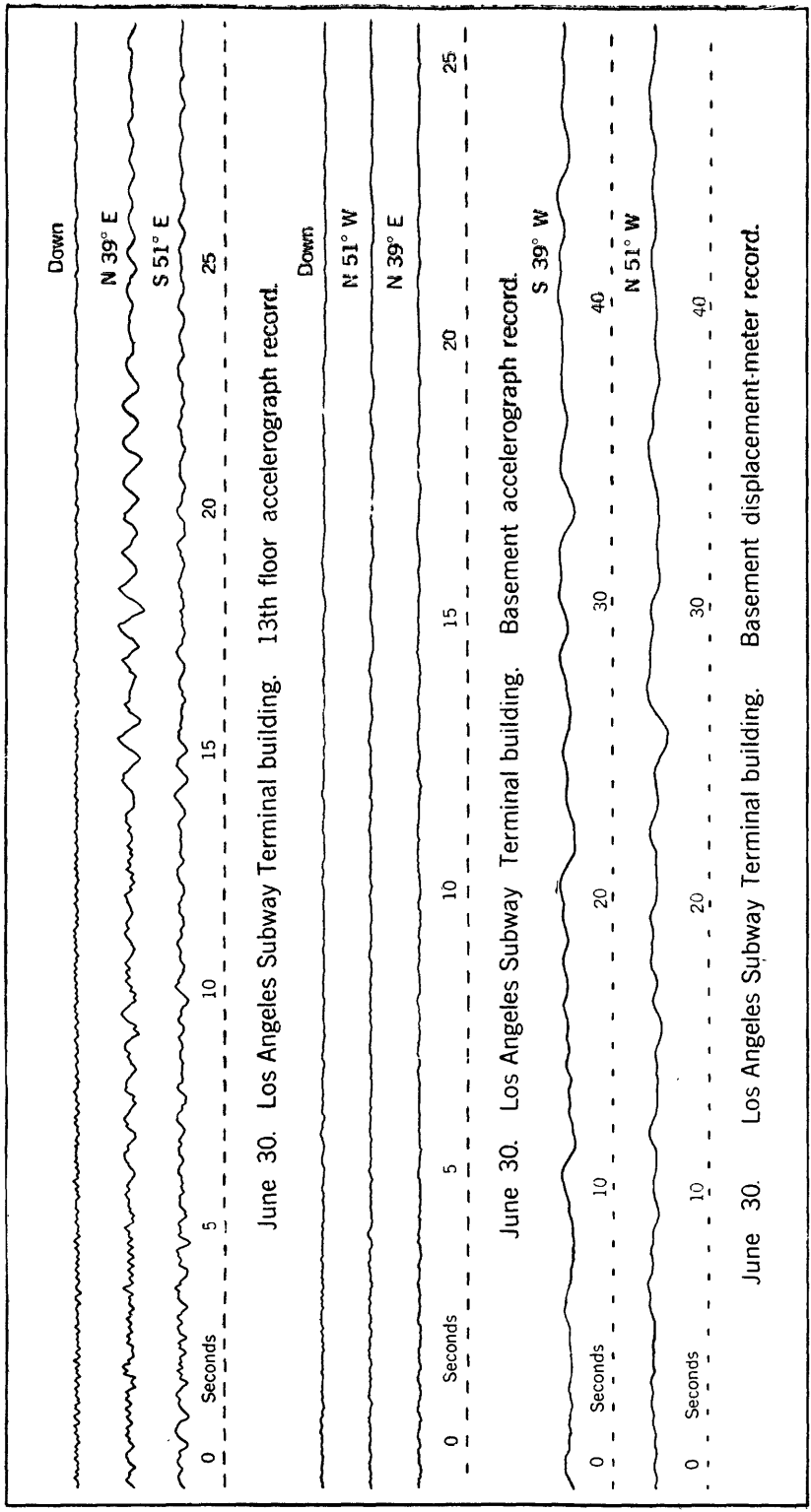

FIGURE 12.—Tracings of strong-motion seismograph records obtained at the Los Angeles Subway Terminal building on June 30, 1941.

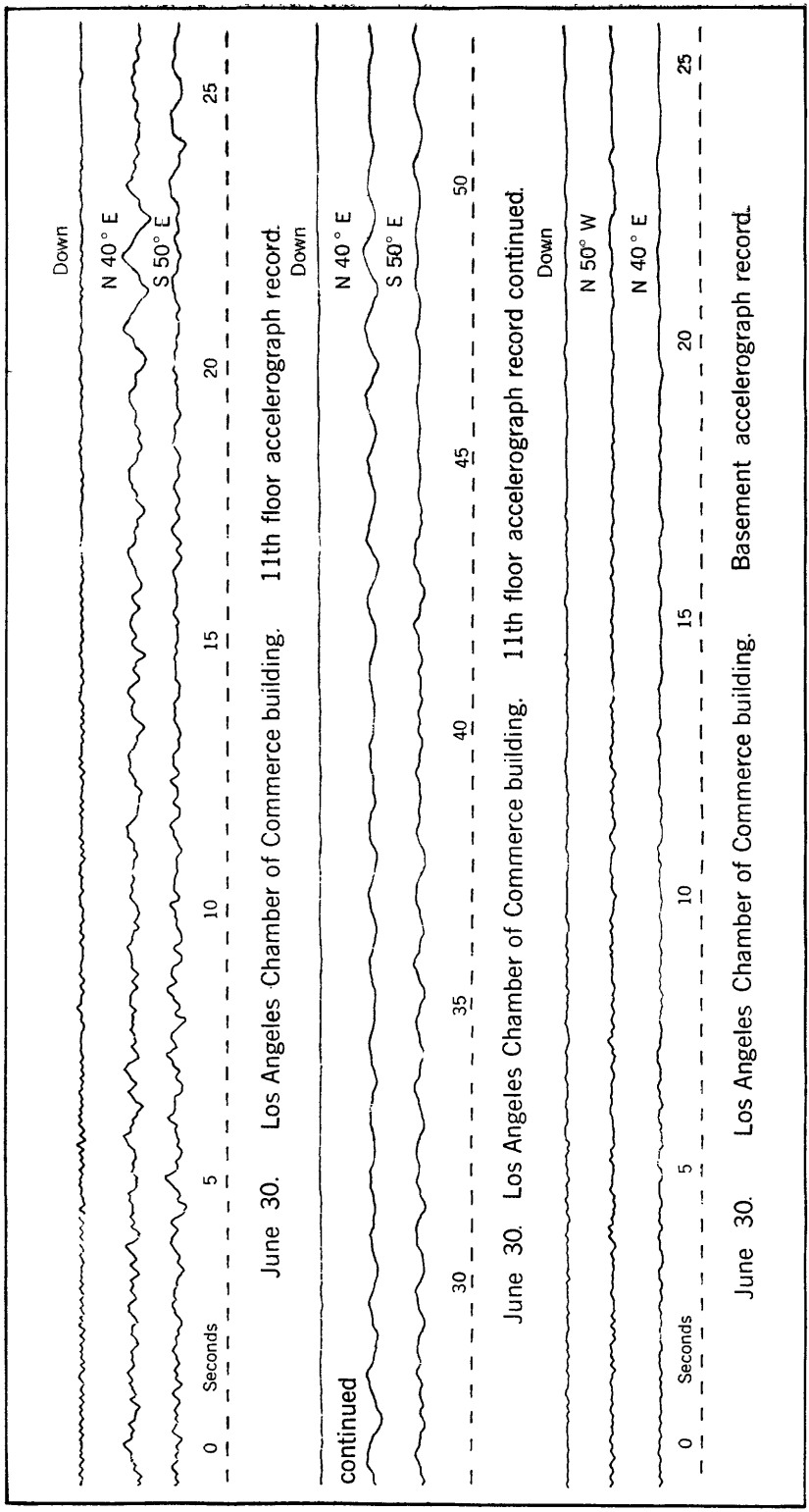

FIGURE 13.—Tracings of accelerograph records obtaind in the Los Angeles Chamber of Commerce building on June 30, 1941.

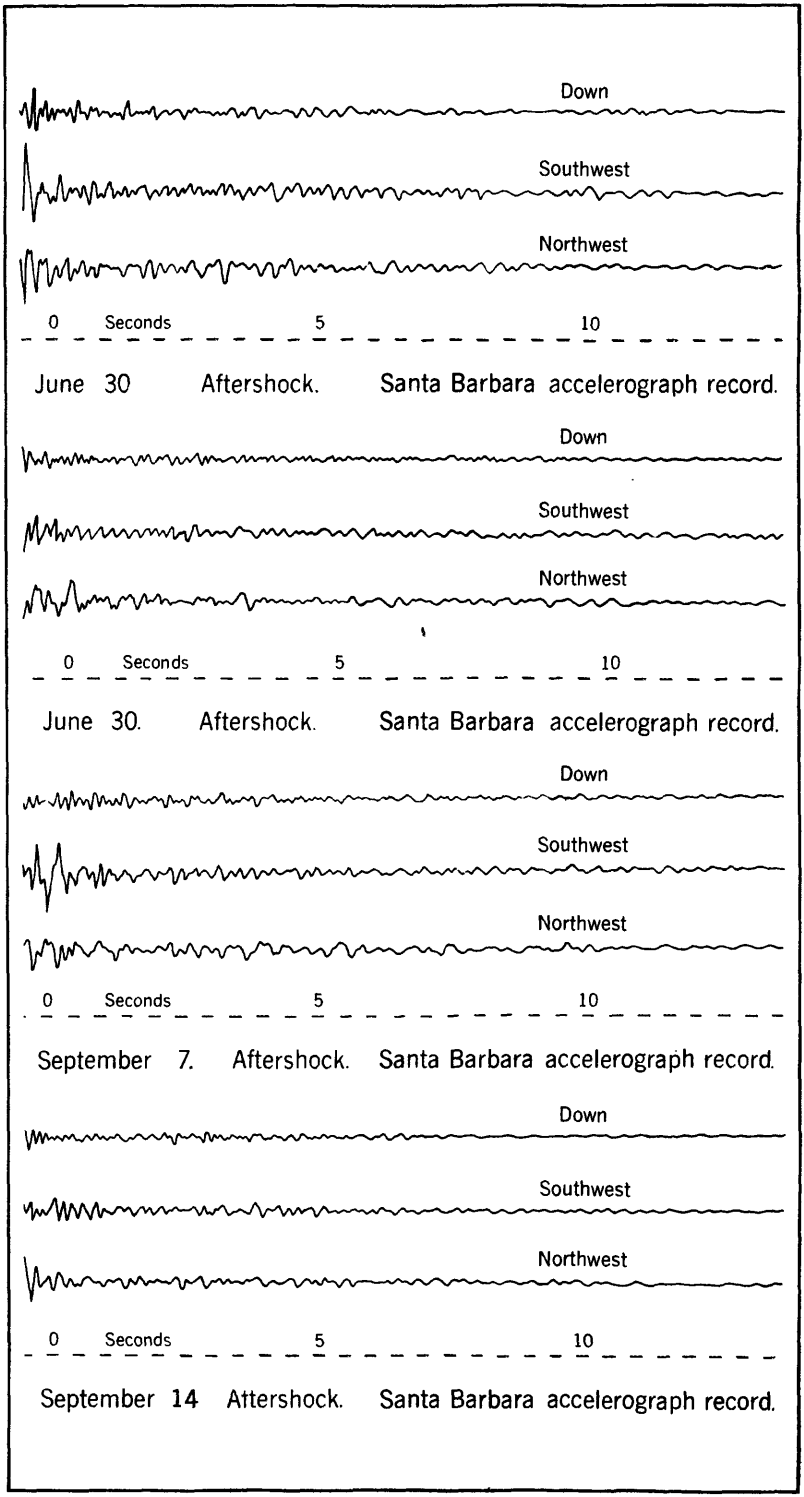

FIGURE 14.—Tracings of accelerograph records obtained at Santa Barbara on June 30 and September 7 and 14, 1941.

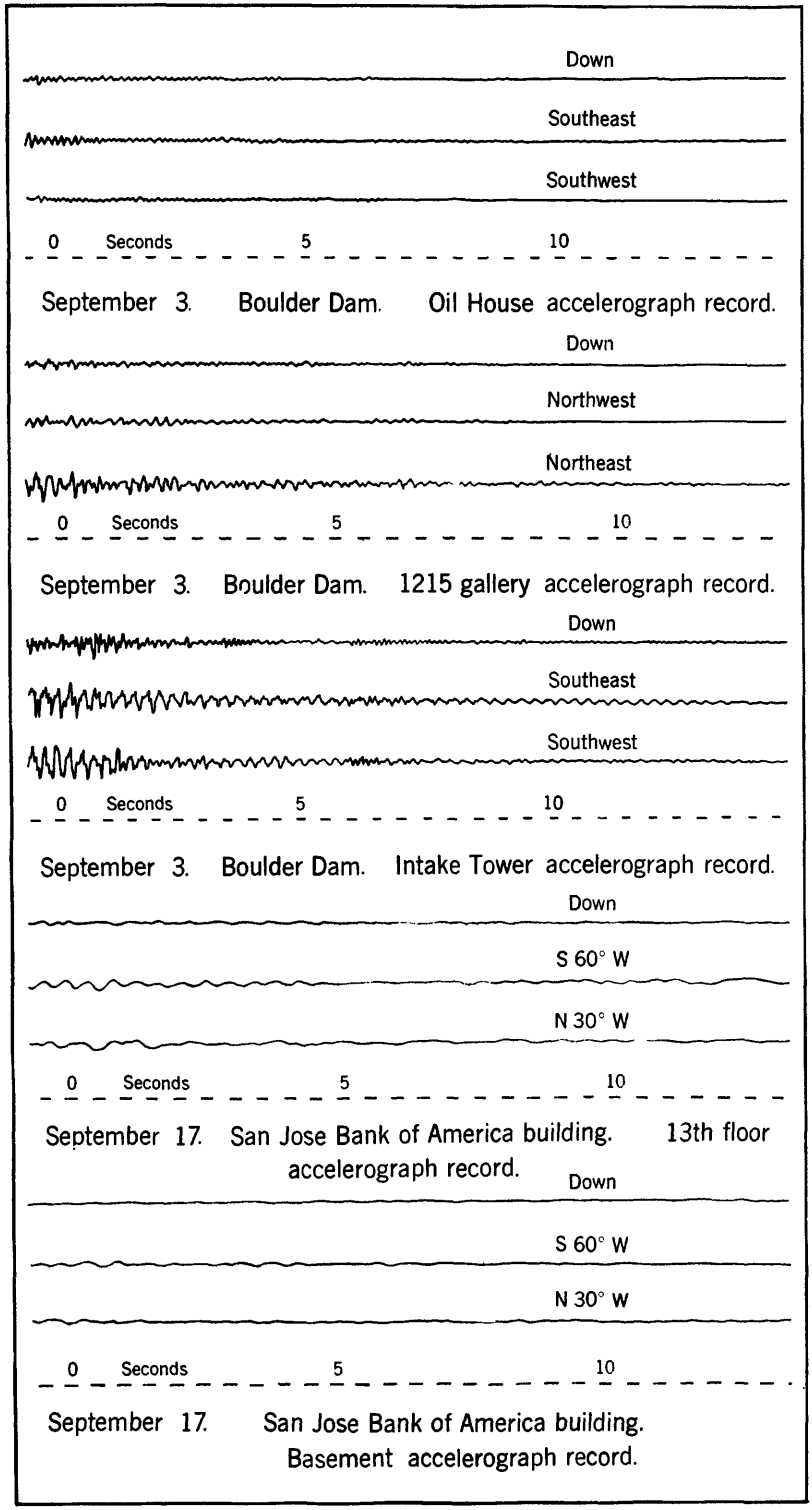

FIGURE 15.—Tracings of accelerograph records obtained at Boulder Dam on September 3, 1941, and at San Jose on September 17, 1941.

SANTA BARBARA EARTHQUAKE OF SEPTEMBER 7

Epicenter in Santa Barbara Channel; maximum intensity unknown. Aftershock of the June 30 earthquake.

Santa Barbara.—Figure 14. Station about 10 miles N. 35° W. of epicenter. The record reproduced in figure 14 is for the shock at 19:12:45. Maximum acceleration, 25 cm./sec.^{2}

There is no positive way of determining whether the last Santa Barbara record in figure 14 (dated September 14) was made at 19:14:23 on September 7 or at 17:37:02 on September 14. According to the Seismological Laboratory at Pasadena both of these shocks were of the same magnitude. Prof. Byerly reports that the Mount Hamilton records show about the same amplitudes for the 2 shocks on September 7, but amplitudes only half as great for the shock on the 14th. As the second Santa Barbara record at the bottom of figure 14 also shows amplitudes about one-half those of the shock at 19:12:45 on the 7th, it is assumed that second Santa Barbara record was made on the 14th.

OWENS VALLEY EARTHQUAKES OF SEPTEMBER 14

Epicenters in the Rock Creek and Mono Creek basins. Maximum intensities, VI to VII, occurred in a sparsely settled region.

Bishop.—Figure 22 shows only the 10:21 accelerograph record. Records of the 8:44 and 10:39 shocks were obtained but due to irregular motion of the recording paper they were too difficult to trace and modify with confidence, and are therefore not reproduced. They are very similar in type to the record of the 10:21 shock. The highest accelerations were recorded during the 10:39 shock shown in figure 22, namely, 16 cm./sec.^{2} For the records preceding and following this they were 9 and 11 cm./sec.^{2}, respectively.

Station about 23 miles S. 55° E. of epicenter. Intensity at Bishop for all three shocks was about IV.

SANTA BARBARA EARTHQUAKE OF SEPTEMBER 14

Epicenter in Santa Barbara Channel; maximum intensity unknown. Aftershock of the June 30 earthquake. See note under Santa Barbara shock of September 7.

Santa Barbara.—Figure 14. Station about 10 miles N. 35° W. of epicenter. Intensity about V. Maximum acceleration 18 cm./sec.^{2}

SAN FRANCISCO BAY REGION EARTHQUAKE OF SEPTEMBER 17

Epicenter from local instrumental data not yet reported; provisionally estimated at 37.4° north, 122.0° west. Intensity V was reported from many places.

San Jose.—Figure 15. Distance and direction of station from provisional epicenter 7 miles S. 53° E. Intensity in San Jose, about IV. Maximum acceleration recorded in basement of Bank of America building, 3 cm./sec.^{2}; on thirteenth floor, 4 cm./sec.^{2}

NORTHERN CALIFORNIA EARTHQUAKE OF OCTOBER 3

Epicenter off Cap Mendocino. Maximum intensity on shore, about VII.

Eureka.—Figure 16. Station about 25 miles N. 60° E. of epicenter. Intensity VII in Eureka. Maximum acceleration, 18 cm./sec.^{2}; maximum recorded displacement 0.8 cm.

Ferndale.—Figure 17. Station about 15 miles S. 75° E. of epicenter. Intensity VI in Ferndale. Maximum acceleration, 116 cm./sec.^{2}

GARDENA EARTHQUAKE OF OCTOBER 21

Epicenter in the Gardena area of Los Angeles County; maximum intensity VII. Greatest damage in the West Dominguez Oil Field east of Gardena.

Los Angeles Chamber of Commerce Building.—Figure 20. Station about 16 miles N. 10° W. of epicenter. Intensity about VI. Maximum acceleration 18 cm./sec.^{2} No record from eleventh floor accelerograph.

Los Angeles Subway Terminal Building.—Figure 19. Station about 16 miles N. 8° W. of epicenter. Intensity about VI. Maximum acceleration in basement, 9 cm./sec.^{2}; maximum recorded displacement 0.23 cm. Maximum acceleration on thirteenth floor, 30 cm./sec.^{2}

Los Angeles Edison Building.—Figure 22. Station about 16 miles N. 8° W. of epicenter. Intensity about VI. Maximum acceleration 9 cm./sec.^{2}

Vernon.—Figure 20. Station about 12 miles N. 5° E. of epicenter. Intensity about VI. Maximum acceleration 17 cm./sec.^{2}

Long Beach.—Figure 20. Station about 2 miles S. 20° E. of instrumental epicenter. Intensity about VI. Maximum acceleration 32 cm./sec.^{2}

Westwood.—Figure 21. Station 20 miles N. 20° W. of epicenter. Intensity about VI. Maximum acceleration 5 cm./sec.^{2}

Hollywood Storage Co. Building.—Figure 18. Station 20 miles N. 20° W. of epicenter. Intensity about VI. Maximum acceleration in basement, 6 cm./sec.^{2}; in penthouse, 21 cm./sec.^{2}

Lot near Hollywood Storage Co. Building.—Figure 18. Station 20 miles N. 20° W. of epicenter. Intensity about VI. Maximum acceleration 6 cm./sec.^{2}

GARDENA AFTERSHOCK OF OCTOBER 22

Epicenter in the Gardena area of Los Angeles County. Maximum intensity VI.

Long Beach.—Figure 21. Station 1 mile N. 30° W. of instrumental epicenter. Intensity probably IV. Maximum acceleration 8 cm./sec.^{2}

Los Angeles Subway Terminal Building.—Figure 21. Station 18 miles N. 8° W. of epicenter. Intensity probably III. Maximum acceleration in basement, 1 cm./sec.^{2}; on thirteenth floor 4 cm./sec.^{2}

TORRANCE-GARDENA EARTHQUAKE OF NOVEMBER 14

Epicenter in the Torrance-Gardena area of Los Angeles County. Maximum intensity VII–VIII. Damage approximately $1,000,000. No casualties. At least 50 buildings severely damaged.

Vernon.—Figure 26. Station 15 miles N. 12° E. of epicenter. Intensity VI. Maximum acceleration 19 cm./sec.^{2}

Long Beach.—Figure 22. Station 4 miles S. 80° E. of epicenter. Intensity VI. Maximum acceleration 49 cm./sec.^{2}

Westwood.—Figure 26. Station 20 miles N. 4° W. of epicenter. Intensity VI. Maximum acceleration 9 cm./sec.^{2}

Hollywood Storage Co. Building.—Figure 23. Station 21 miles N. 10° W. of epicenter. Intensity VI. Maximum acceleration in basement, 6 cm./sec.^{2}; in penthouse 25 cm./sec.^{2}

Lot near Hollywood Storage Co. Building.—Figure 23. Station 21 miles N. 10° W. of epicenter. Intensity VI. Maximum acceleration 8 cm./sec.^{2}

Los Angeles Edison Building.—Figure 26. Intensity VI. Station 17 miles due north of epicenter. Maximum acceleration 9 cm./sec.^{2}

Los Angeles Chamber of Commerce Building.—Figure 25. Intensity VI. Station 17 miles due north of epicenter. Maximum acceleration 14 cm./sec.^{2} in basement; 38 cm./sec.^{2} on eleventh floor.

Los Angeles Subway Terminal Building.—Figure 24. Intensity VI. Station 17 miles due north of epicenter. Maximum acceleration 9 cm./sec.^{2} in basement; 33 cm./sec.^{2} on thirteenth floor.

Santa Ana.—Record on Weed strong-motion seismograph too indefinite for reproduction. Station 22 miles S. 82° E. of epicenter. Intensity V. Maximum acceleration about 6 cm./sec.^{2}

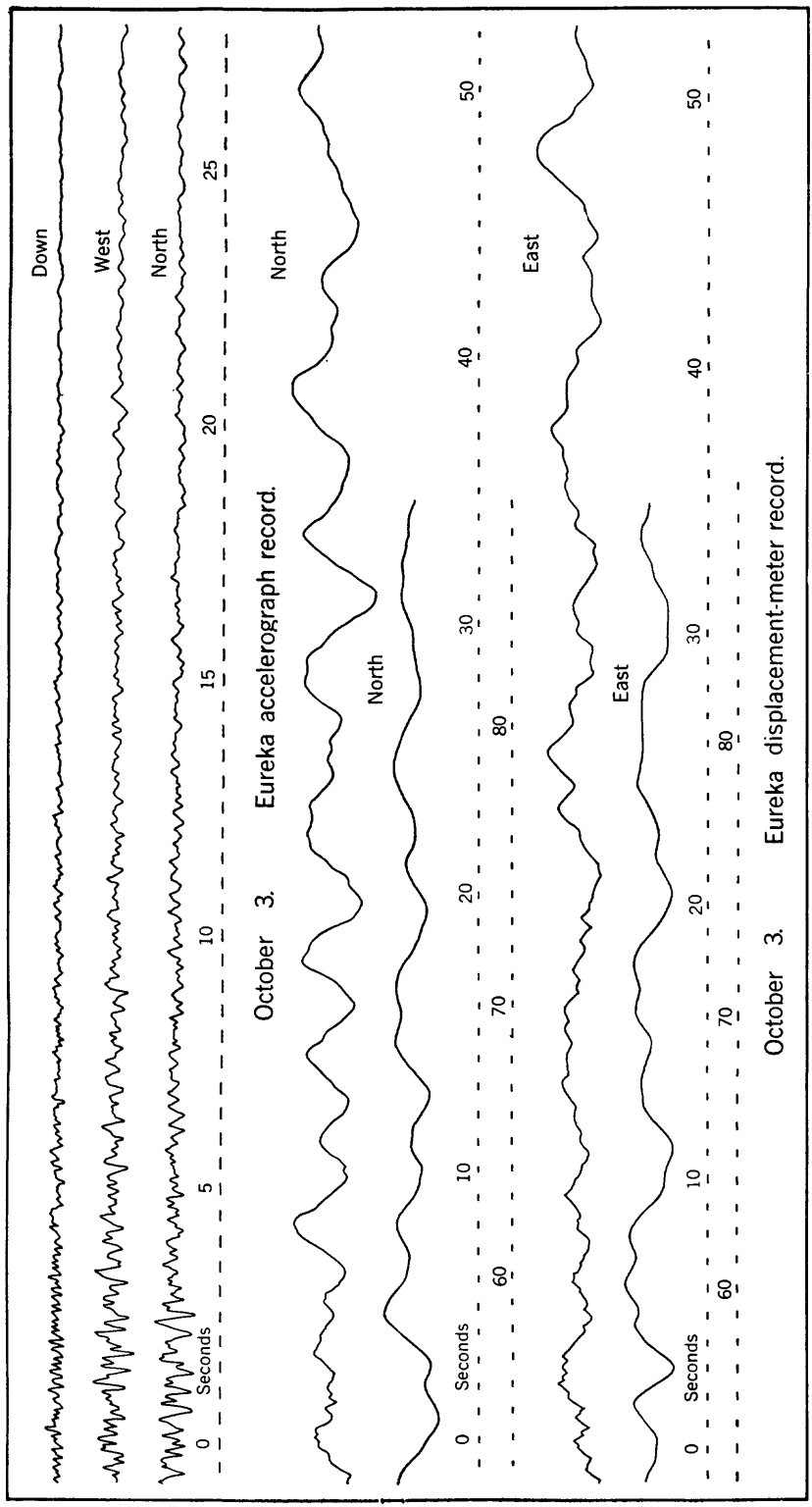

FIGURE 16.—Tracings of strong-motion seismograph records obtained at Eureka on October 3, 1941.

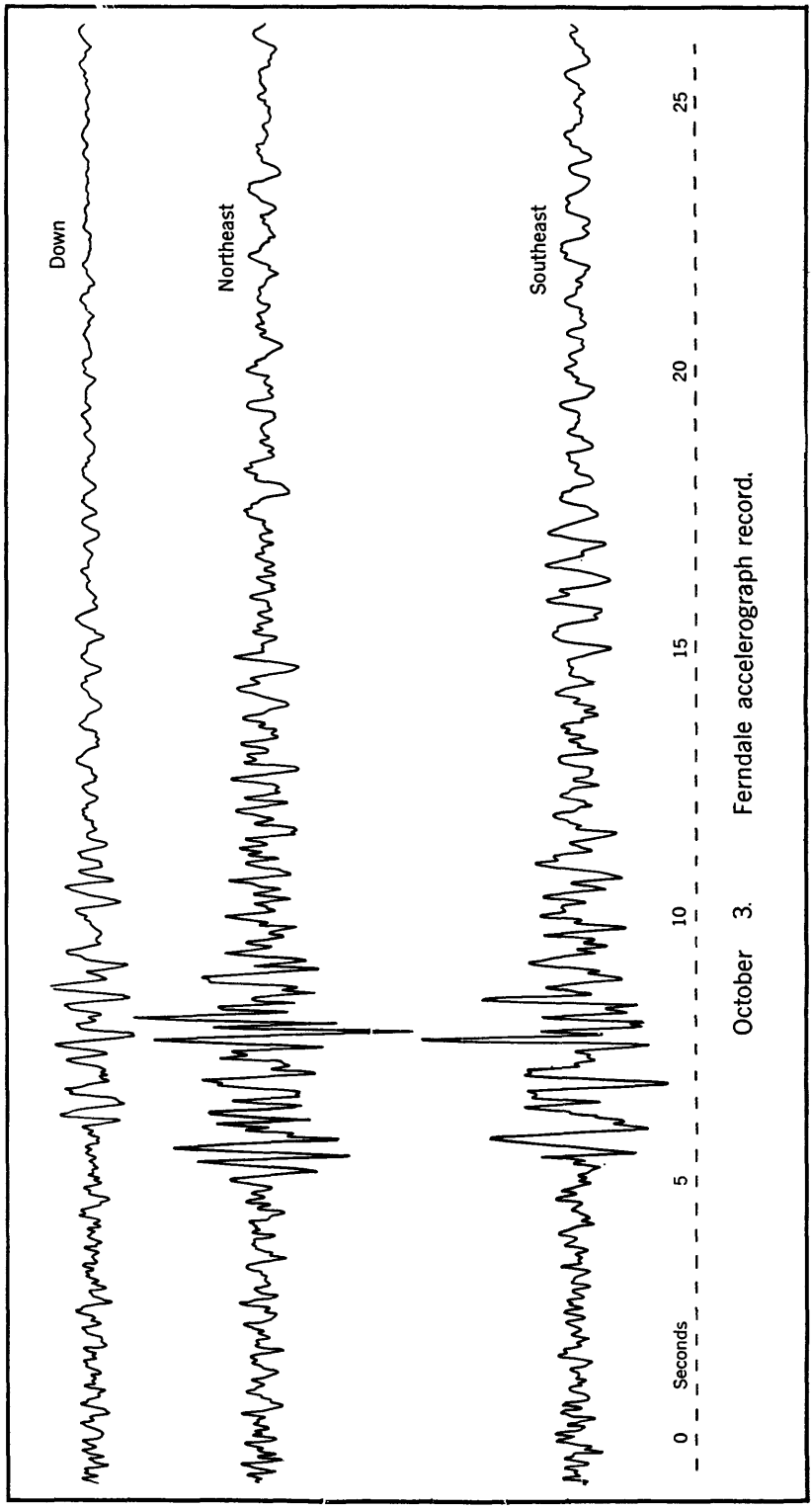

FIGURE 17.—Tracings of accelerograph record obtained at Ferndale on October 3, 1941.

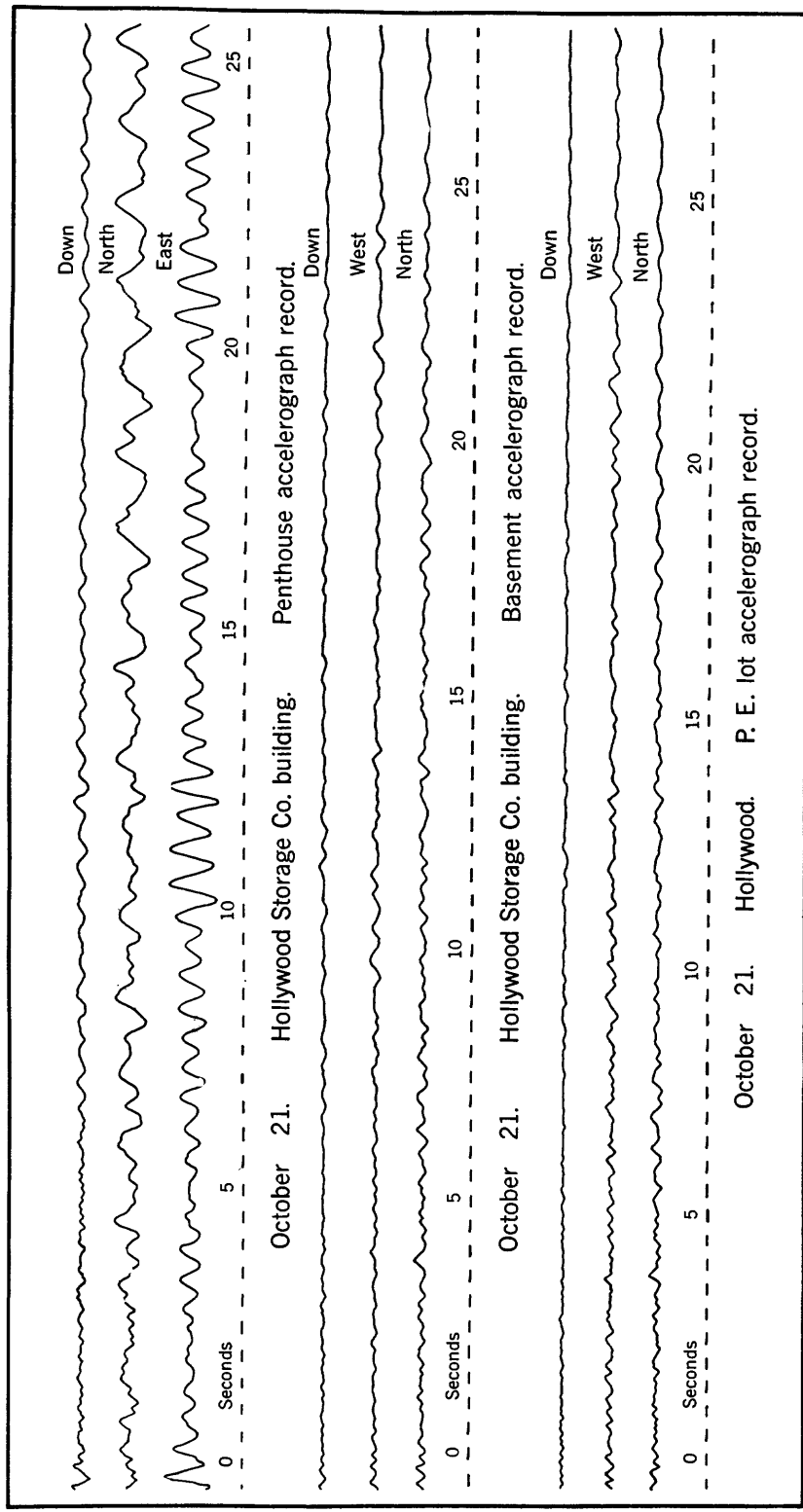

FIGURE 18.—Tracings of accelerograph records obtained at Hollywood on October 21, 1941.

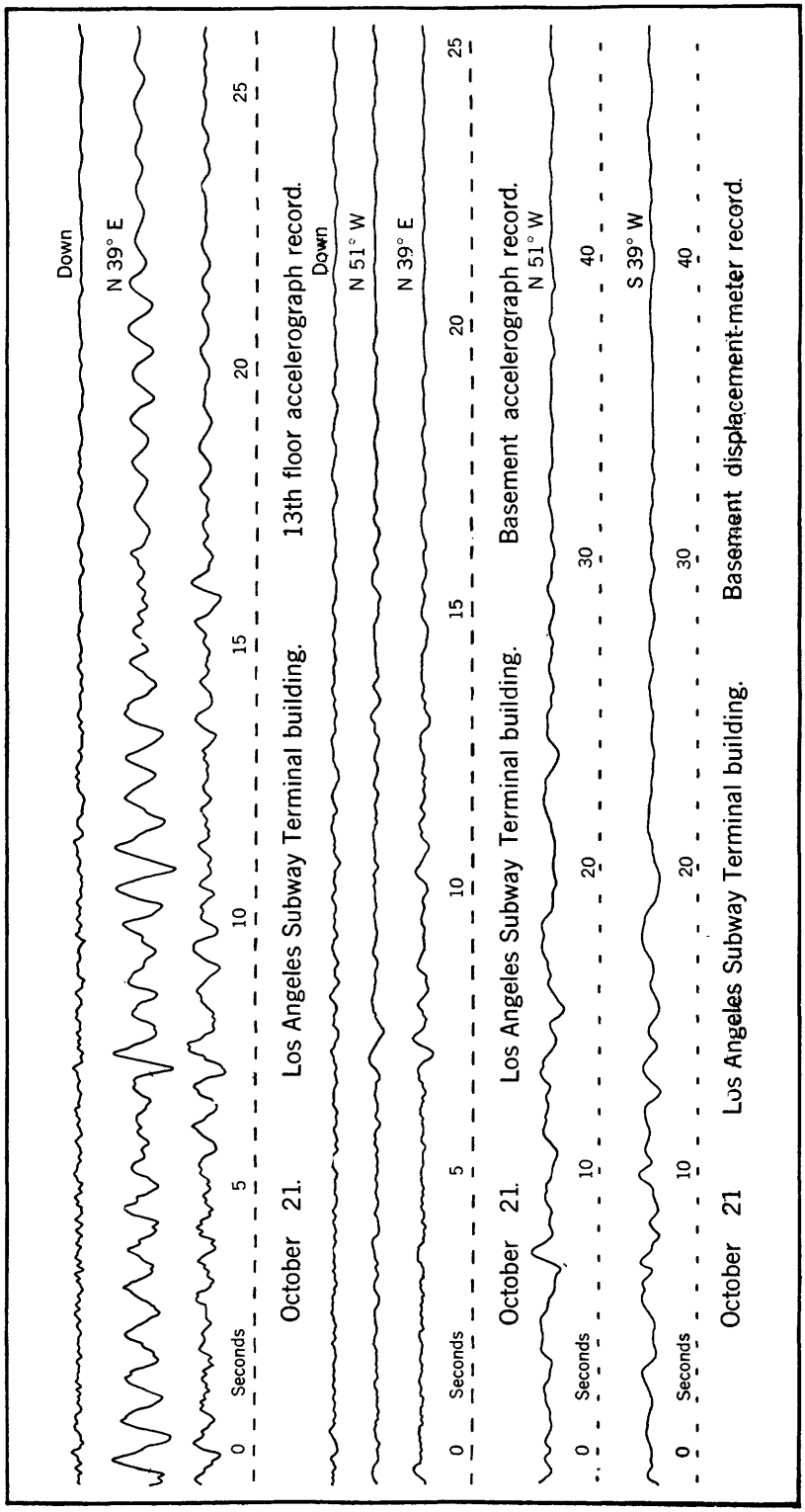

FIGURE 19.—Tracings of strong-motion seismograph records obtained in the Los Angeles Subway Terminal building on October 21, 1941.

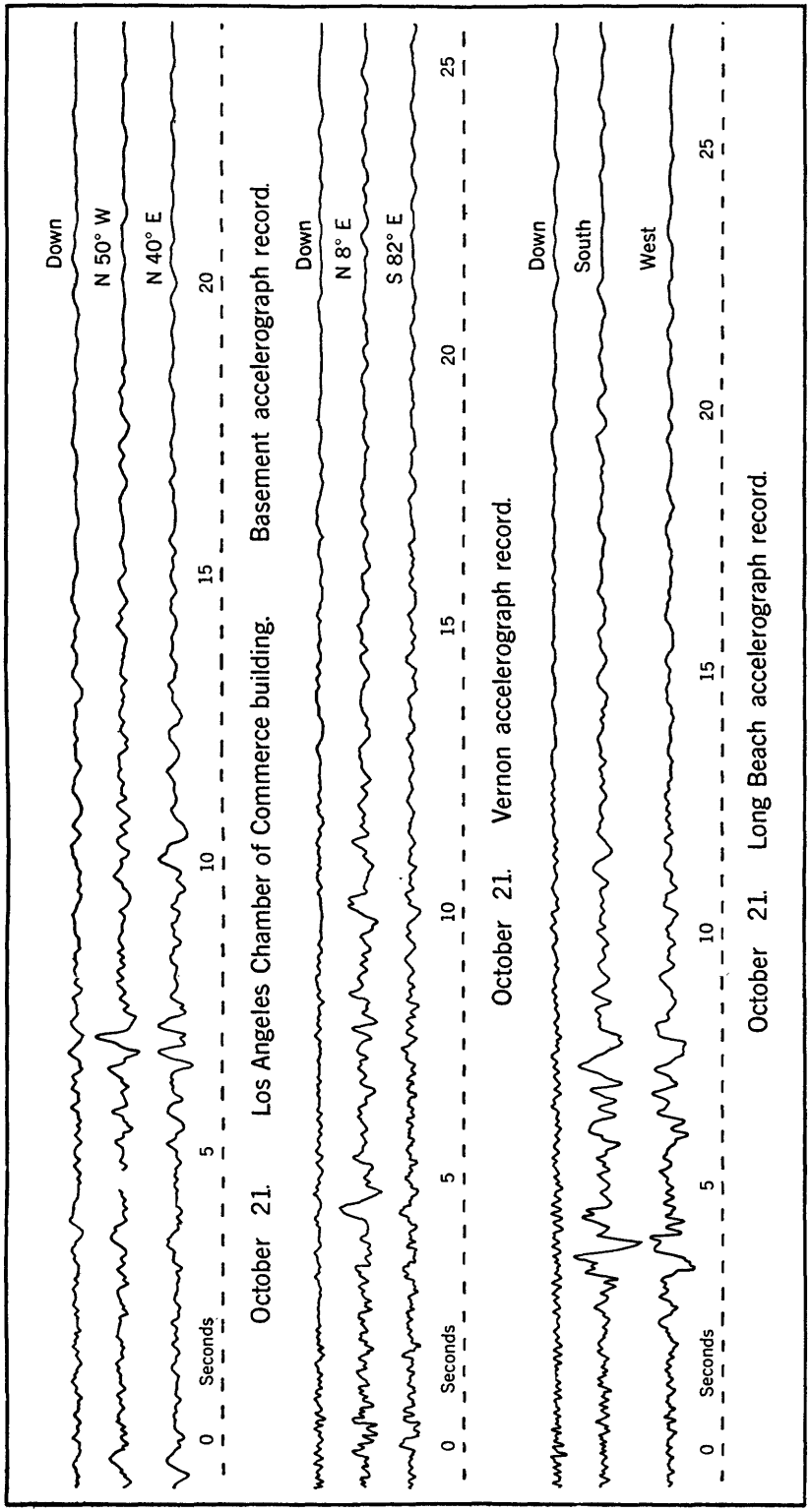

FIGURE 20.—Tracings of accelerograph records obtained in the Los Angeles Chamber of Commerce building and at Vernon and Long Beach on October 21, 1941.

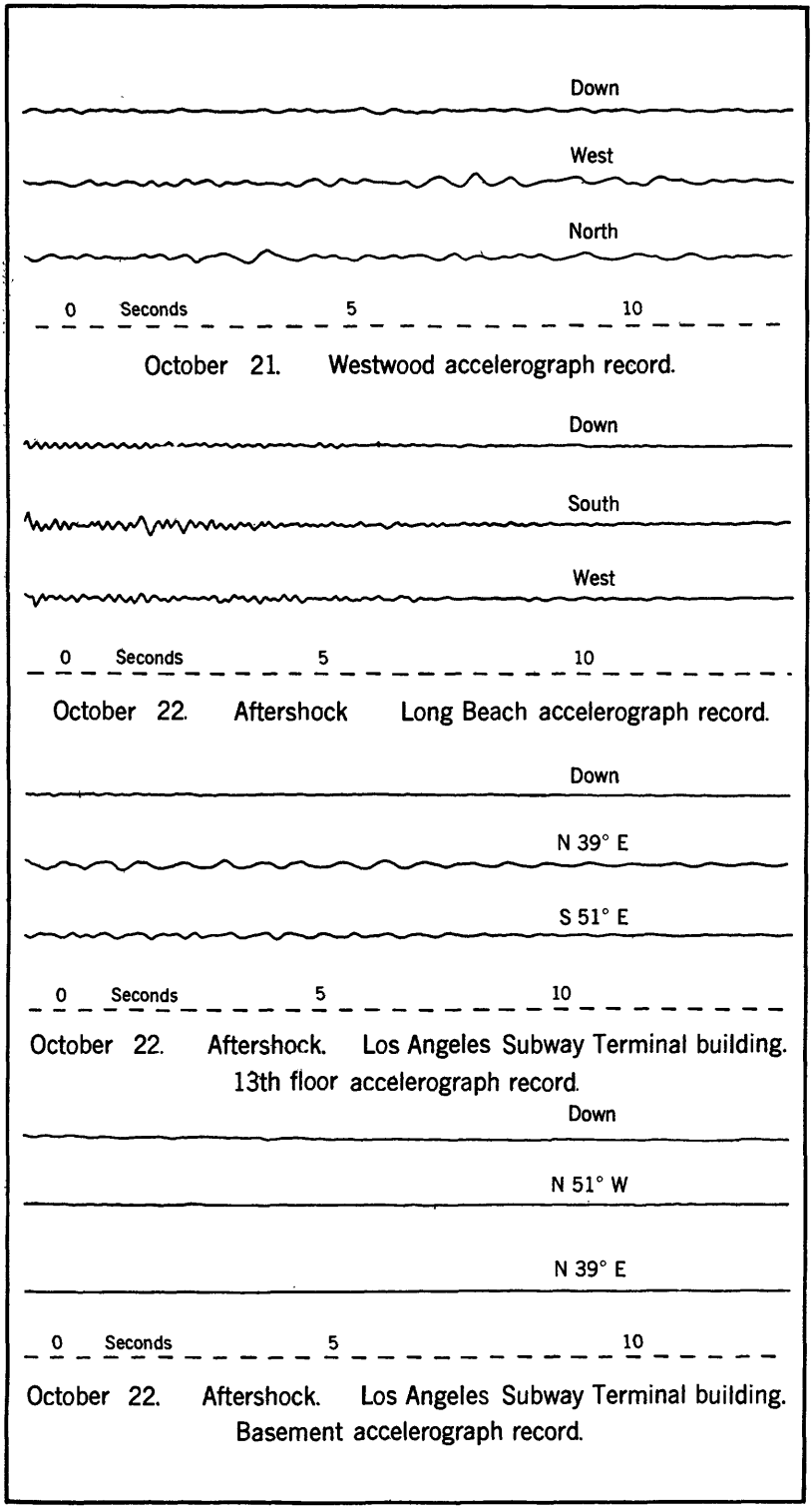

FIGURE 21.—Tracings of accelerograph records obtained at Westwood on October 21, 1941, and at Long Beach and in the Los Angeles Subway Terminal building on October 22, 1941.

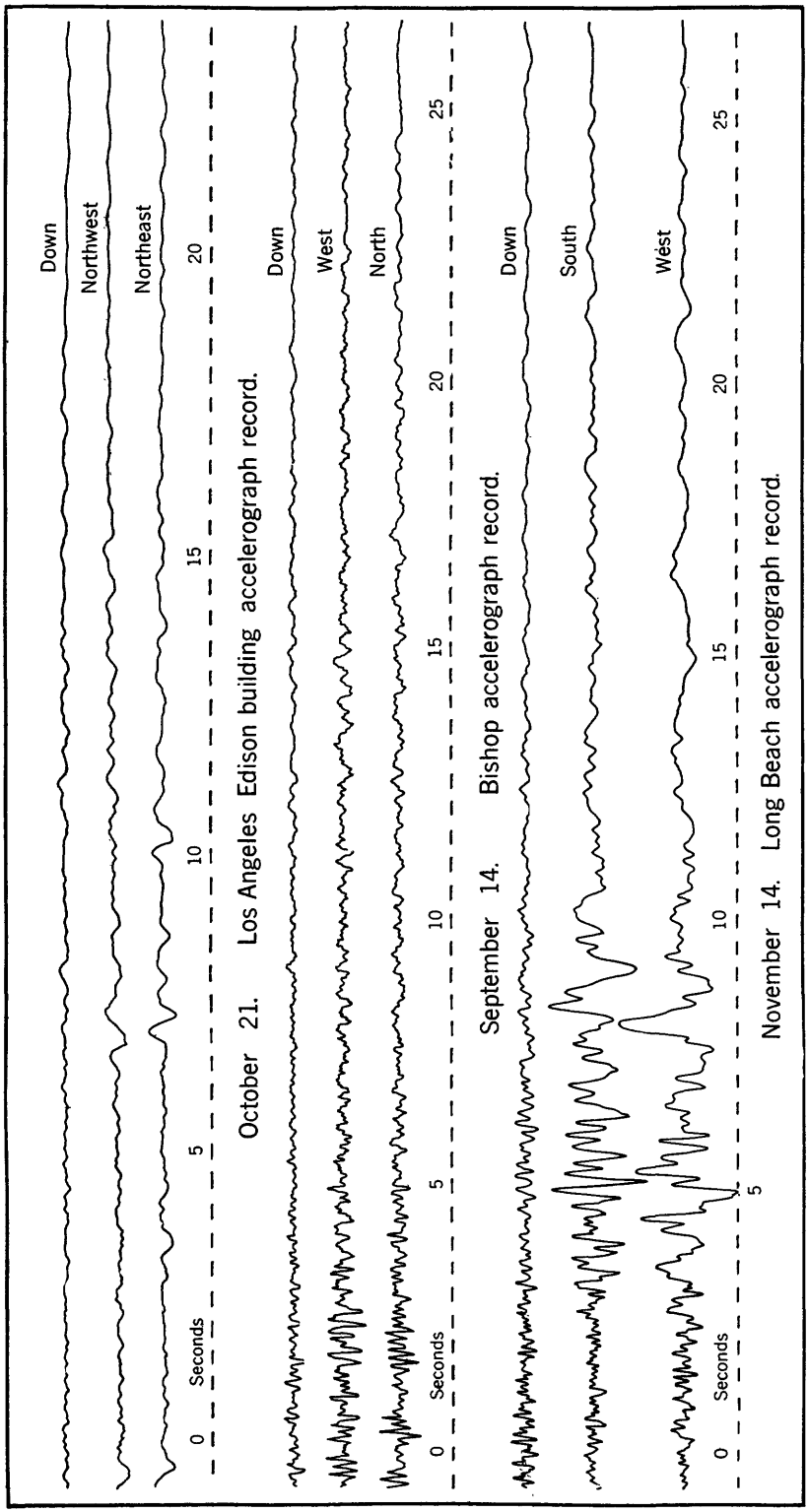

FIGURE 22.—Tracings of accelerograph records obtained in the Los Angeles Edison building on October 21, 1941, at Bishop on September 14, 1941, and at Long Beach on November 14, 1941.

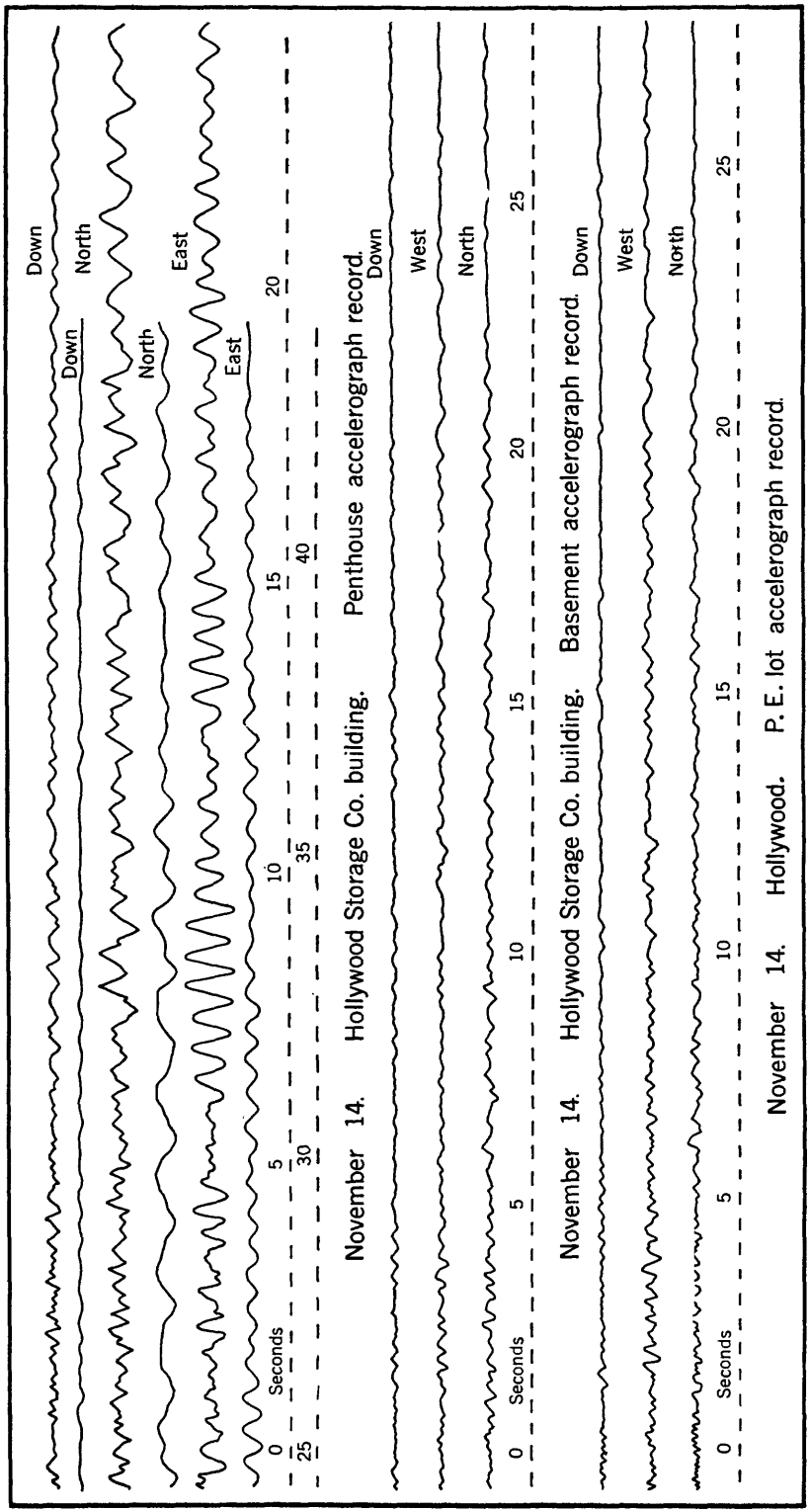

FIGURE 23.—Tracings of accelerograph records obtained at Hollywood on November 14, 1941.

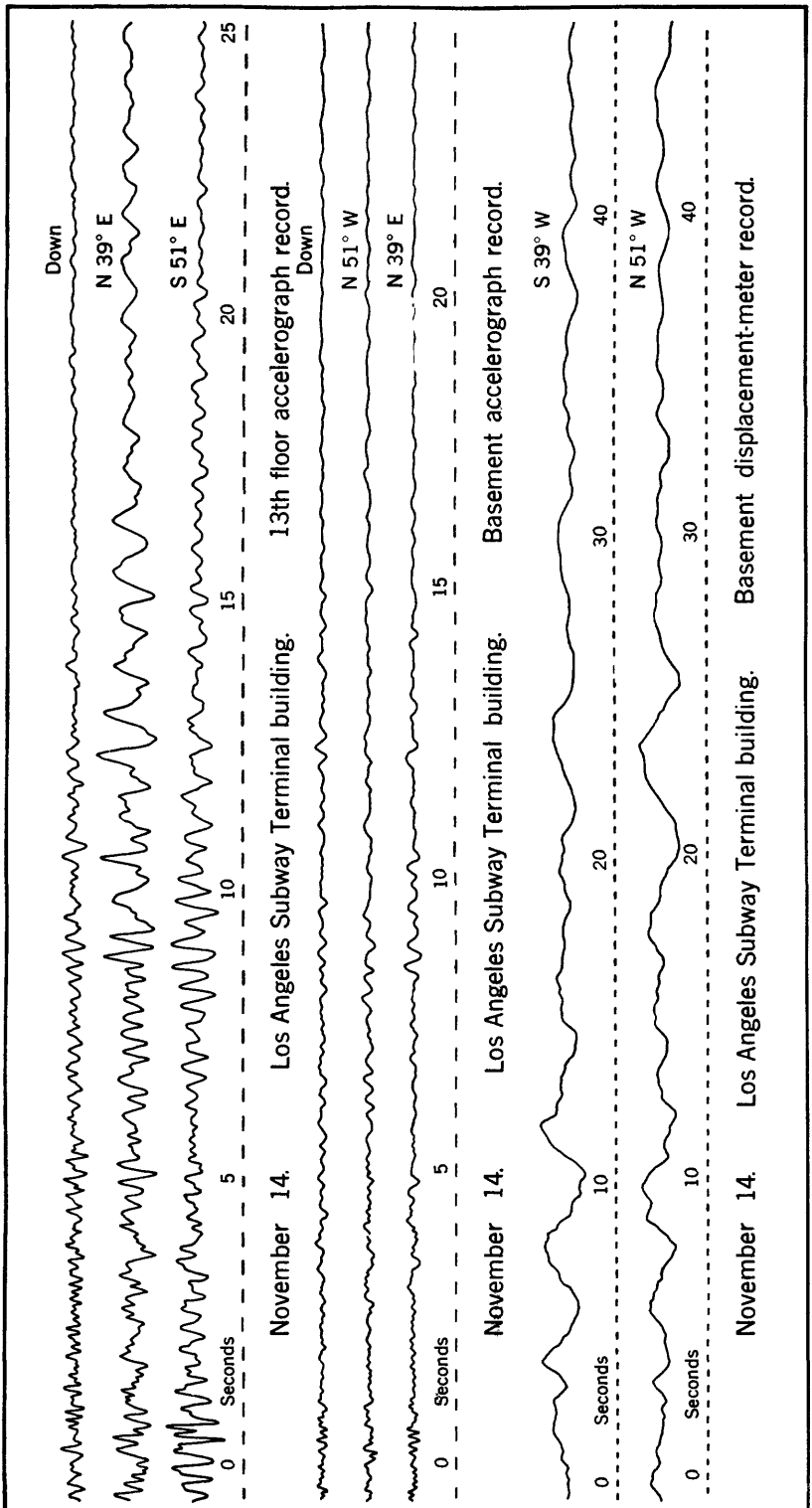

FIGURE 24.—Tracings of strong-motion seismograph records obtained in the Los Angeles Subway Terminal building on November 14, 1941.

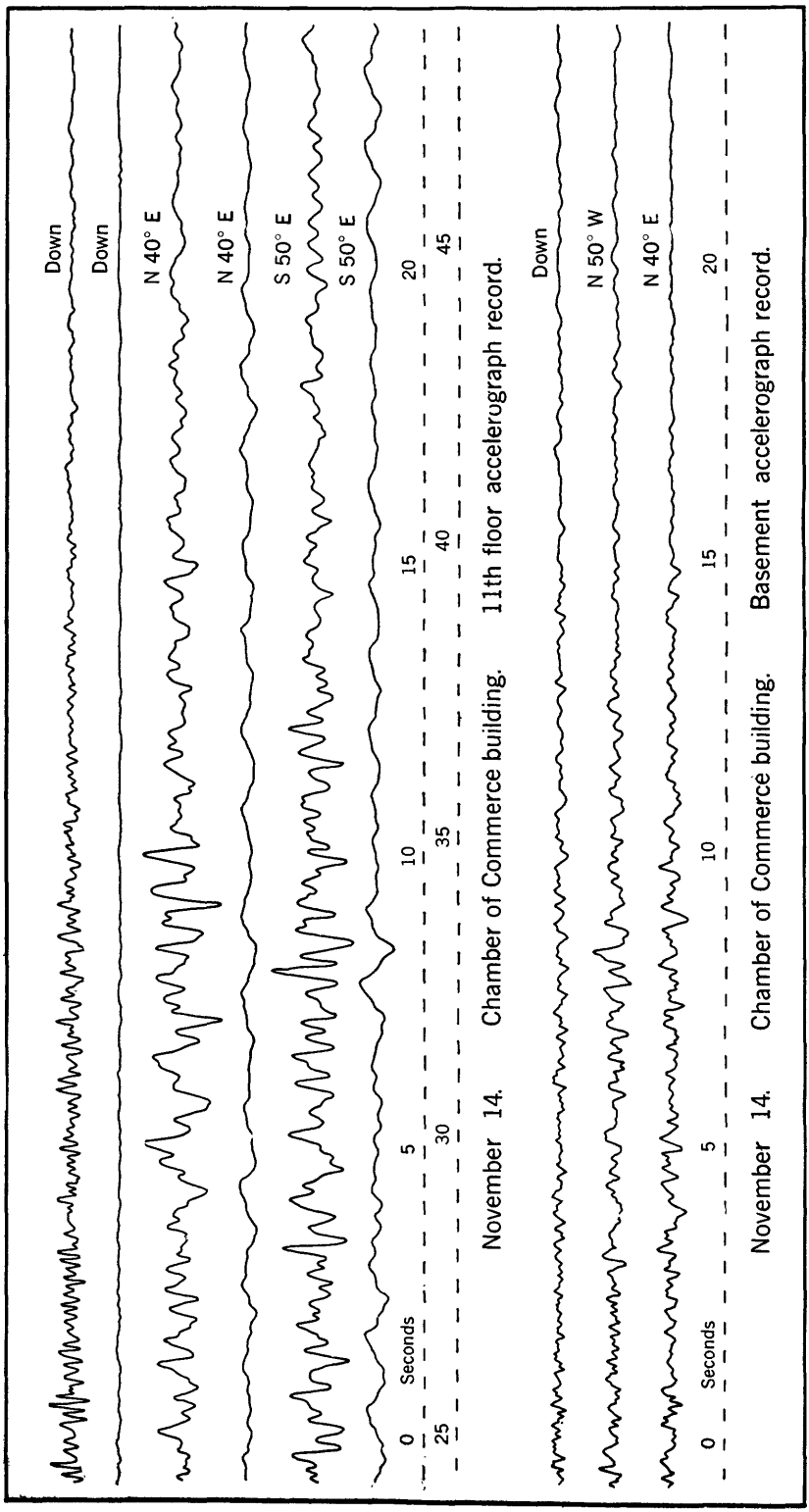

FIGURE 25.—Tracings of accelerograph records obtained in the Los Angeles Chamber of Commerce building on November 14, 1941.

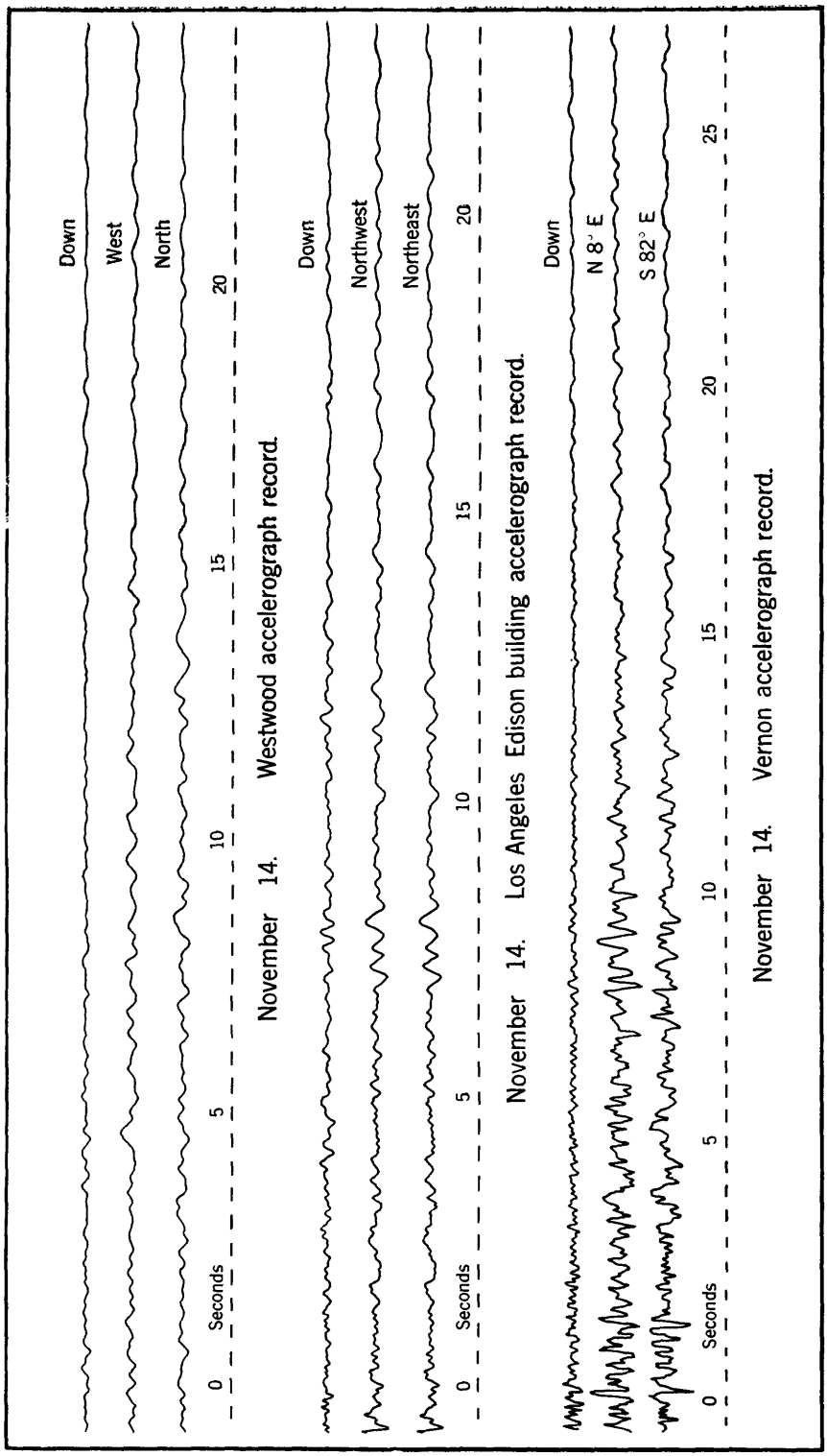

FIGURE 26.—Tracings of accelerograph records obtained at Westwood, Vernon, and in the Los Angeles Edison building on November 14, 1941.

TABLE 3.—*Summary of strong-motion seismograph data for the year 1941*

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

Station and component	Earth-wave period	Maximum accelera-tion	Maximum displace-ment	Remarks
NORTHERN CALIFORNIA EARTHQUAKE OF JAN. 23				
Ferndale accelerograph:	*Seconds*	*Cm./sec.²*	*Cm.*	
Vertical	0.37	5	0.017	
	0.32	9	0.022	
Southwest-northeast	0.76	6	0.086	Shorter period motion superposed.
	0.44	4	0.018	
	0.39	19	0.072	At beginning of record. Possibly preceded by stronger motion. Superposed on longer period.
Northwest-southeast	0.36	6	0.019	Poorly defined waves.
	0.16	15	0.010	At beginning of record. Possibly preceded by stronger motion.
NORTHERN CALIFORNIA EARTHQUAKE OF FEB. 9				
Ferndale accelerograph:				
Vertical	0.56	16	0.126	
	0.25	11	0.017	
Southwest-northeast	0.93	4	0.086	
	0.60	13	0.119	
	0.25	38	0.060	
	Irregular	47	----	
Northwest-southeast	0.85	12	0.217	
	0.60	12	0.108	
	0.33	33	0.093	
Eureka accelerograph:				
Vertical	0.18	2	0.002	
	0.09	2	0.001	
	Irregular	4	----	
North-south	0.83	1	0.019	Poorly defined.
	0.37	7	0.025	Long train of irregular waves.
	0.26	8	0.013	
East-west	0.34	7	0.020	
	0.26	12	0.021	Rather irregular waves.
	0.21	6	0.007	At beginning of record. Possibly preceded by stronger motion.
Eureka displacement meter:				
North-south	3.63	2	0.54	
	2.50	2	0.33	
	5.98	1	0.37	
East-west	4.09	1	0.58	
	3.63	2	0.52	
NORTHERN CALIFORNIA EARTHQUAKE OF MAY 13				
Ferndale accelerograph:				
Vertical	0.41	2	0.009	
	Irregular	5	----	
Northeast-southwest	0.47	4	0.021	
	0.40	4	0.017	Long train.
	0.17	7	0.005	
Northwest-southeast	0.67	6	0.068	
	0.49	7	0.042	
SANTA BARBARA EARTHQUAKE OF JUNE 30				
Santa Barbara accelerograph:				
Vertical	0.86	8	0.148	Long train.
	0.63	12	0.119	
	0.13	76	0.034	
Northeast-southwest	1.01	9	0.230	
	0.63	19	0.193	
	0.33	155	0.422	
	0.24	172	0.248	
Southeast-northwest	1.06	7	0.210	
	0.63	31	0.315	
	0.32	113	0.293	
	0.21	126	0.134	Off sheet at 1 place, amplitude approximated.
Hollywood Storage Co. Bldg., adjoining lot accelerograph:				
Vertical	Irregular	2	----	
North-south	0.61	2	0.19	
	0.41	5	0.022	At beginning of record. Possibly preceded by stronger motion.
East-west	0.59	3	0.025	
	Irregular	3	----	

TABLE 3.—***Summary of strong-motion seismograph data for the year 1941***—Continued

SANTA BARBARA EARTHQUAKE OF JUNE 30—Continued

Station and component	Earthwave period	Maximum acceleration	Maximum displacement	Remarks
	Seconds	*Cm./sec.²*	*Cm.*	
Hollywood Storage Co. Bldg., basement accelerograph:				
Vertical	0.46	2	0.011	Long train.
	Irregular	2		
North-South	0.44	2	0.012	
	0.26	3	0.005	
	Irregular	4		Do.
East-west	0.59	2	0.18	
	Irregular	3		
	Irregular	2		At beginning of record. Possibly preceded by stronger motion.
Hollywood Storage Co. Bldg., penthouse accelerograph:				
Vertical	0.47	2	0.011	
	0.46	3	0.016	Short period motion superposed.
North-south	1.25	3	0.11	
	0.71	15	0.19	At beginning of record. Possibly preceded by stronger motion.
	0.60	8	0.071	Long train of waves.
East-west	0.53	14	0.10	Do.
	0.48	19	0.11	Regular waves at beginning of record. Possibly preceded by stronger motion.
Los Angeles Chamber of Commerce Bldg., basement accelerograph:				
Vertical	Irregular	1		
S. 50° E.-N. 50° W	Irregular	2		
S. 40° W.-N. 40° E	Irregular	2		
Los Angeles Chamber of Commerce Bldg., eleventh floor accelerograph:				
Vertical	0.17	3	0.002	
S. 40° W.-N. 40° E	1.33	9	0.42	
	1.27	4	0.18	Long train.
N. 50° W.-S. 50° E	1.19	4	0.14	
	Irregular	7		
Los Angeles Subway Terminal, basement accelerograph:				
Vertical	Irregular	2		
S. 51° E.-N. 51° W	Irregular	2		
S. 39° W.-N. 39° E	Irregular	2		
Los Angeles Subway Terminal, basement displacement meter:				
N. 39° E.-S. 39° W	Irregular		0.15	
S. 51° E.-N. 51° W	Irregular		0.18	
Los Angeles Subway Terminal, thirteenth floor accelerograph:				
Vertical	0.18	2	0.002	
	0.14	2	0.001	
S. 39° W.-N. 39° E	0.79	9	0.14	Long train.
	0.56	5	0.039	At beginning of record. Possibly preceded by stronger motion.
N. 51° W.-S. 51° E	0.65	6	0.64	
	0.65	5	0.56	
Vernon accelerograph:				
Vertical	Irregular	1		
S. 8° W.-N. 8° E	0.58	4	0.031	
	0.18	3	0.002	
N. 82° W.-S. 82° E	0.51	3	0.018	Rather irregular.
	Irregular	4		
Long Beach accelerograph:				
Vertical	0.14	2	0.001	
North-south	Irregular	4		At beginning of record. Possibly preceded by stronger motion
East-west	0.66	2	0.022	
	0.22	2	0.002	

FIRST SANTA BARBARA AFTERSHOCK OF JUNE 30

Santa Barbara accelerograph:				
Vertical	0.29	3	0.006	
	0.15	18	0.011	
Northeast-southwest	0.27	33	0.061	At beginning of record. Possibly preceded by stronger motion.
Southeast-northwest	0.24	18	0.027	
	0.18	4	0.003	

TABLE 3.—*Summary of strong-motion seismograph data for the year 1941*—Continued

SECOND SANTA BARBARA AFTERSHOCK OF JUNE 30

Station and component	Earth-wave period	Maximum accelera-tion	Maximum displace-ment	Remarks
	Seconds	*Cm./sec.²*	*Cm.*	
Santa Barbara accelerograph:				
Vertical	0.15	4	0.002	
	0.12	10	0.003	At beginning of record. Possibly preceded by stronger motion.
Northeast-southwest	0.16	5	0.003	
	0.13	11	0.005	Do.
Southeast-northwest	0.26	12	0.021	
	Irregular	15	----	Do.

BOULDER DAM EARTHQUAKE OF SEPT. 3

Boulder Dam, oil house accelerograph:				
Vertical	0.12	3	0.001	
Northwest-southeast	0.12	5	0.002	At beginning of record. Possibly preceded by stronger motion.
Northeast-southwest	Irregular	2	----	Weak aftershock, about 23 seconds later, noticeable only on this component.
Boulder Dam, 1215 gallery accelerograph:				
Vertical	Irregular	4	----	
Northwest-southeast	0.19	3	0.003	Long train.
	0.18	4	0.003	
Northeast-southwest	0.16	5	0.003	
	0.15	6	0.004	
	Irregular	12	----	At beginning of record. Possibly preceded by stronger motion.
Boulder Dam, intake tower accelerograph:				
Vertical	0.09	11	0.002	At beginning of record. Possibly preceded by stronger motion.
	0.09	9	0.002	
Northwest-southeast	0.22	15	0.018	Long train of waves at beginning of record. Possibly preceded by stronger motion.
Northeast-southwest	0.25	14	0.018	Rather long train of waves. At beginning of record. Possibly preceded by stronger motion.

SANTA BARBARA EARTHQUAKE OF SEPT. 7 AT 19:13

Santa Barbara accelerograph:				
Vertical	0.14	6	0.003	
	0.13	6	0.002	At beginning of record. Possibly preceded by stronger motion.
Northeast-southwest	0.32	17	0.043	
	0.18	7	0.006	Do.
	0.14	7	0.003	
Northwest-southeast	0.48	3	0.018	
	0.32	2	0.005	
	Irregular	----	----	Do.

OWENS VALLEY EARTHQUAKE OF SEPT. 14 AT 8:44

Bishop accelerograph:				
Vertical	2.06	2	0.21	
	0.93	1	0.022	
North-south	Irregular	8	----	Period indistinguishable on account of drum irregularity. At beginning of record. Possibly preceded by stronger motion.
East-west	1.31	4	0.17	
	Irregular	9	----	Period indistinguishable on account of drum irregularity.

OWENS VALLEY EARTHQUAKE OF SEPT. 14 AT 10:21

Bishop accelerograph:				
Vertical	0.41	2	0.008	
	Irregular	10	----	
North-south	0.88	3	0.058	
	0.15	10	0.005	At beginning of record. Possibly preceded by stronger motion.
	0.13	13	0.005	Long train.
East-west	0.36	4	0.014	
	0.24	9	0.013	
	Irregular	16	----	At beginning of record. Possibly preceded by stronger motion.

TABLE 3.—*Summary of strong-motion seismograph data for the year 1941*—Continued

OWENS VALLEY EARTHQUAKE OF SEPT. 14 AT 10:39

Station and component	Earth-wave period	Maximum acceleration	Maximum displacement	Remarks
	Seconds	*Cm./sec.²*	*Cm.*	
Bishop accelerograph:				
Vertical	0.67	3	0.037	
	0.35	4	0.012	
North-south	0.61	3	0.025	
	Irregular	11		
East-west	0.74	4	0.055	
	0.28	8	0.017	Disturbed by irregular drum motion.
	0.22	8	0.010	

SANTA BARBARA EARTHQUAKE OF SEPT. 14

Santa Barbara accelerograph:				
Vertical	0.33	2	0.005	
	0.18	8	0.006	At beginning of record. Possibly preceded by stronger motion.
Northeast-southwest	0.19	6	0.005	
	0.17	9	0.006	At beginning of record. Possibly preceded by stronger motion.
Northwest-southeast	0.22	18	0.022	Do.

SAN FRANCISCO BAY REGION EARTHQUAKE OF SEPT. 17

San Jose Bank of America Bldg., basement accelerograph:				
Vertical	0.50	1	0.006	Very weak.
N. 60° E.-S. 60° W	0.41	2	0.008	
	0.57	3	0.025	
	0.56	2	0.016	
N. 30° W.-S. 30° E	0.56	3	0.024	Possibly preceded by stronger motion.
	0.5	1	0.006	
San Jose Bank of America Bldg., thirteenth floor accelerograph:				
Vertical	0.38	2	0.007	Regular waves.
	0.47	1	0.006	
N. 60° E.-S. 60° W	0.42	2	0.010	Possibly preceded by stronger motion.
	0.45	4	0.021	
	0.42	1	0.005	
	0.93	2	0.44	Very long weak period.
S. 30° E.-N. 30° W	0.33	2	0.005	Irregular waves.
	0.59	3	0.027	Do.
	0.69	1	0.012	

NORTHERN CALIFORNIA EARTHQUAKE OF OCT. 3

Eureka accelerograph:				
Vertical	0.34	4	0.012	
	0.15	11	0.006	
North-south	0.38	7	0.025	
	0.29	11	0.022	
	0.21	18	0.020	
East-west	0.29	12	0.023	Irregular waves.
	0.20	15	0.015	Series of waves.
	0.19	7	0.006	
Eureka displacement meter:				
North-south	1.90	4	0.36	
	4.40	1	0.66	
	6.36	2	0.31	
East-west	5.67	1	0.40	
	1.23	4	0.19	
	5.23	1	0.63	
	7.4	1	0.51	
Ferndale accelerograph:				
Vertical	0.42	19	0.084	
	0.35	19	0.058	
	0.35	36	0.109	
	0.32	16	0.039	
Southwest-northeast	0.78	29	0.430	
	0.58	44	0.370	
	0.42	20	0.088	
	0.38	78	0.282	
	0.27	73	0.133	
Northwest-southeast	0.94	64	1.416	
	0.60	31	0.279	
	0.45	116	0.616	
	0.29	59	0.124	

TABLE 3.—*Summary of strong-motion seismograph data for the year 1941*—Continued

GARDENA EARTHQUAKE OF OCT. 21

Station and component	Earth-wave period	Maximum acceleration	Maximum displacement	Remarks
	Seconds	*Cm./sec.²*	*Cm.*	
Los Angeles Chamber of Commerce Bldg., basement accelerograph:				Two series of large amplitude waves on horizontal component about five seconds apart.
Vertical	0.55	5	0.039	
	0.47	2	0.011	
S. 50° E.-N. 50° W	0.59	18	0.156	
	0.52	14	0.095	
S. 40° W.-N. 40° E	0.59	9	0.078	
	0.51	13	0.095	
	0.36	15	0.048	
Los Angeles Subway Terminal, basement accelerograph:				
Vertical				Waves of small amplitude.
S. 39° W.-N. 39° E	0.88	6	0.117	
	0.60	5	0.045	Fairly smooth sinusoidal waves.
N. 51° E.-S. 51° W	0.62	9	0.086	
	0.48	6	0.035	
Los Angeles Subway Terminal, basement displacement meter:				
N. 39° E.-S. 39° W	1.5	4	0.23	
	Irregular		0.2	
S. 51° E.-N. 51° W	1.08	8	0.23	
	Irregular		0.20	
Los Angeles Subway Terminal, thirteenth floor accelerograph:				
Vertical	0.18	3	0.003	Very irregular.
	0.51	3	0.019	
	0.75	4	0.057	
N. 39° E.-S 39° W	0.74	16	0.224	Possibly preceded by stronger motion.
	0.63	17	0.171	
	0.75	30	0.408	
	0.82	7	0.115	
N. 51° W.-S 51° E	0.64	8	0.083	Smaller waves superposed.
	0.54	5	0.037	
	0.59	9	0.079	
	0.76	5	0.073	
Los Angeles Edison Bldg. accelerograph:				
Vertical	0.54	2	0.015	Smaller waves superposed.
	0.34	2	0.005	
	0.80	2	0.032	
North-west	0.54	7	0.052	Possibly preceded by stronger motion.
	0.59	2	0.017	
	0.64	4	0.042	
	0.79	3	0.047	
North-east	0.50	9	0.057	Possibly preceded by stronger motion.
	0.49	5	0.031	Very irregular waves.
	0.42	8	0.035	
	0.70	2	0.025	
Vernon accelerograph:				
Vertical				Amplitudes too small.
North-south	0.58	9	0.076	
	0.53	11	0.078	
	0.34	17	0.050	
East-west	0.44	7	0.037	
	0.42	7	0.031	
Long Beach accelerograph:				
Vertical	0.11	5	0.002	
North-south	0.76	23	0.332	
	0.62	5	0.048	
	0.47	32	0.180	
	0.19	14	0.013	Series of large amplitude waves beginning about 4 seconds after start. Duration about 5 seconds.
East-west	0.71	8	0.10	Series of large amplitude waves about 3 seconds after start. Duration about 7 seconds.
	0.60	21	0.189	
	0.47	13	0.072	
Westwood accelerograph:				
Vertical	0.52	2	0.013	Weak.
	0.54	2	0.015	
North-south	0.46	2	0.011	Possibly preceded by stronger motion.
	0.82	5	0.086	
	0.65	3	0.032	
East-west	0.34	3	0.009	Irregular.
	0.48	5	0.029	
	0.76	3	0.043	
Hollywood Storage Co. Bldg., adjoining lot accelerograph:				
Vertical	0.12	1	0.001	Very weak.
	0.45	2	0.011	
	0.86	2	0.038	
	0.90	2	0.041	
North-south	0.18	3	0.003	Possibly preceded by stronger motion.
	0.21	4	0.004	
	0.63	2	0.020	

TABLE 3.—*Summary of strong-motion seismograph data for the year 1941*—Continued

GARDENA EARTHQUAKE OF OCT. 21—Continued

Station and component	Earthwave period	Maximum acceleration	Maximum displacement	Remarks
Hollywood Storage Co. Bldg., adjoining lot accelerograph—Continued.	*Seconds*	*Cm./sec.²*	*Cm.*	
East-west	0.28	5	0.010	Possibly preceded by stronger motion.
	0.29	3	0.007	
	0.54	6	0.044	Irregular waves.
	0.51	3	0.019	
Hollywood Storage Co. Bldg., basement accelerograph:				
Vertical	0.36	2	0.007	Possibly preceded by stronger motion.
	0.48	2	0.012	Small waves superposed.
	0.64	4	0.044	Irregular waves.
North-south	0.24	5	0.007	Possibly preceded by stronger motion.
	0.42	3	0.015	Smaller waves superposed.
	0.50	5	0.031	Irregular waves.
	0.68	6	0.072	
East-west	0.22	3	0.003	Possibly preceded by stronger motion.
	0.52	1	0.007	Irregular waves.
	0.64	5	0.052	
Hollywood Storage Co. Bldg., penthouse accelerograph:				
Vertical	0.60	5	0.045	
North-south	1.33	11	0.484	
	0.92	18	0.385	
	0.63	14	0.128	
East-west	0.68	18	0.20	Series of smooth waves.
	0.62	21	0.205	
GARDENA AFTERSHOCK OF OCT. 22				
Long Beach accelerograph:				
Vertical	0.17	2	0.001	Weak.
	0.20	1	0.001	
North-south	0.38	8	0.032	Possibly preceded by stronger motion.
	0.33	6	0.016	
	0.36	2	0.07	
East-west	0.26	5	0.008	Very irregular waves.
	0.20	4	0.004	
	0.41	1	0.004	
Los Angeles Subway Terminal, basement accelerograph:				
Vertical	0.39	1	0.004	Very weak.
S. 51° E.-N 51° W	0.35	1	0.003	Do.
	0.51	1	0.007	
S. 39° W.-N 39° E.	0.40	1	0.004	Do.
Los Angeles Subway Terminal, thirteenth floor accelerograph:				
Vertical	0.30	1	0.002	Very weak.
S. 39° W.-N 39° E	0.80	4	0.064	Regular.
	0.89	2	0.040	
N. 51° W.-S 51° E	0.37	2	0.007	
	0.51	3	0.020	Irregular.
	0.62	2	0.020	
TORRANCE-GARDENA EARTHQUAKE OF NOV. 14				
Los Angeles Subway Terminal, basement accelerograph:				
Vertical	0.10	3	0.001	Irregular waves.
	0.39	2	0.007	
	0.33	3	0.008	
N. 51° W.-S 51° E	0.29	3	0.007	Possibly preceded by stronger motion.
	0.28	2	0.004	
	0.45	3	0.015	
N. 39° E.-S 39° W	0.11	2	0.001	Short periods at beginning.
	0.41	4	0.017	
	0.40	7	0.029	
	0.33	2	0.005	
Los Angeles Subway Terminal, basement displacement meter:				
N. 39° E.-S. 39° W	3.67	1	0.29	
	Irregular	----	0.42	
S. 51° E.-N. 51° W	5.38	1	0.40	
	4.89	1	0.30	
	2.77	1	0.28	
	Irregular	----	0.45	
Los Angeles Subway Terminal, thirteenth floor accelerograph:				
Vertical	0.36	9	0.029	
	0.24	7	0.010	
	0.19	8	0.007	
S. 51° E-N. 51° W	0.76	5	0.072	
	0.36	23	0.076	
	0.30	20	0.046	

TABLE 3.—*Summary of strong-motion seismograph data for the year 1941*—Continued

TORRANCE-GARDENA EARTHQUAKE OF NOV. 14—Continued

Station and component	Earth-wave period	Maximum acceleration	Maximum displacement	Remarks
Los Angeles Subway Terminal, thirteenth floor accelerograph—Continued.	*Seconds*	*Cm./sec.²*	*Cm.*	
S. 39° W.-N. 39° E.	0.42	17	0.075	
	0.41	7	0.030	
	0.23	23	0.031	
Los Angeles Chamber of Commerce Bldg., basement accelerograph:				
Vertical	0.42	6	0.025	
S. 40° W.-N. 40° E.	0.31	4	0.009	
	0.27	4	0.007	
	0.22	9	0.011	
N. 50° W.-S. 50° E.	0.42	14	0.062	
	0.26	8	0.014	
Los Angeles Chamber of Commerce Bldg., eleventh floor accelerograph:				
Vertical	0.22	8	0.10	
	0.17	10	0.007	Series of regular short period waves of 12-second duration.
S. 40° W.-N. 40° E.	0.42	17	0.075	
	0.38	33	0.119	
	0.27	16	0.029	
	0.22	8	0.010	
N. 50° W.-S. 50° E.	0.48	38	0.220	
	0.44	24	0.126	
	0.40	35	0.140	
Long Beach accelerograph:				
Vertical	0.17	8	0.006	
	0.14	9	0.004	
North-south	0.37	12	0.041	Beginning of a series of long period waves 3.5 seconds after start of record.
	0.32	36	0.092	
	0.32	14	0.038	
East-west	0.66	49	0.531	
	0.52	21	0.142	
	0.17	33	0.023	
Hollywood Storage Co. Bldg., adjoining lot accelerograph:				
Vertical	0.30	3	0.007	Weak.
	0.39	1	0.004	
	0.51	2	0.013	
North-south	0.11	2	0.001	Irregular at beginning.
	0.30	4	0.009	
	0.49	3	0.018	
	0.52	1	0.007	
East-west	0.14	2	0.001	Possibly preceded by stronger motion.
	0.26	5	0.009	
	0.29	8	0.017	
	0.50	4	0.025	
Hollywood Storage Co. Bldg., basement accelerograph:				
Vertical	0.41	2	0.008	Very irregular waves.
	0.42	3	0.014	
	0.52	1	0.007	
North-south	0.36	2	0.007	Smaller waves superposed.
	0.52	3	0.020	
	0.41	2	0.009	
East-west	0.17	2	0.002	Very irregular waves.
	0.16	6	0.004	
	0.54	2	0.015	
	0.81	3	0.051	
Hollywood Storage Co. Bldg., penthouse accelerograph:				
Vertical	0.36	6	0.021	
	0.32	5	0.012	
North-south	0.74	11	0.151	
	0.56	7	0.055	
	0.50	17	0.106	
East-west	0.63	25	0.249	
	0.53	7	0.049	
	0.53	10	0.070	Series of regular waves.
Vernon accelerograph:				
Vertical	0.24	6	0.009	
	0.19	6	0.005	Period timing uncertain because of irregular drum rate.
North-south	0.24	14	0.020	
	0.14	13	0.006	
	0.12	19	0.007	
East-west	0.43	8	0.037	
	0.26	19	0.032	
	0.17	9	0.007	
Westwood accelerograph:				
Vertical	0.29	1	0.002	Weak.
	0.44	2	0.009	
	0.58	2	0.017	
North-south	0.32	4	0.010	Irregular.
	0.45	7	0.036	
	0.55	2	0.015	

TABLE 3.—*Summary of strong-motion seismograph data for the year 1941*—Continued

TORRANCE-GARDENA EARTHQUAKE OF NOV. 14—Continued

Station and component	Earth-wave period	Maximum acceleration	Maximum displacement	Remarks
	Seconds	*Cm./sec.*[2]	*Cm.*	
Westwood accelerograph—Continued.				
East-west	0.43	3	0.013	Possibly preceded by stronger motion.
	0.53	5	0.036	
	0.65	9	0.097	
	0.45	7	0.036	
Los Angeles Edison Bldg. accelerograph:				
Vertical	0.12	2	0.001	Short periods at beginning.
	0.38	4	0.014	
	0.53	1	0.007	
S. 50° E.-N. 50° W	0.15	9	0.005	Sharp impulse at beginning.
	0.18	3	0.003	
	0.40	5	0.020	
	0.32	2	0.005	
S. 40° W.-N. 40° E.	0.13	5	0.002	Sharp impulse at beginning.
	0.32	6	0.016	
	0.34	6	0.018	
Santa Ana Weed seismograph:				Poor record. Maximum trace amplitude 0.3 mm.
Northeast-southwest	1.5	6	0.3	
	0.6	2	0.02	
Southeast-northwest	1.5	4	0.2	
	0.9	2	0.03	

TABLE 4.—*Instrumental constants of strong-motion seismographs in 1941*

NORTHERN CALIFORNIA EARTHQUAKE OF JANUARY 23

Station and instrument	Orientation of instrument[1]	Pendulum period	Static magnification	Sensitivity[2]	Damping ratio	Instrument number
		Sec.		*Cm.*		
Ferndale; accelerograph No. 28	Up-down	0.097	102	2.42	10.5	V-10
	S.45°W.-N.45°E	0.097	114	2.71	10	L-4
	N.45°W.-S.45°E	0.097	110	2.62	10.5	T-15

NORTHERN CALIFORNIA EARTHQUAKE OF FEBRUARY 9

Ferndale; accelerograph No. 28	Up-down	0.097	102	2.42	12.5	V-10
	S.45°W.-N.45°E	0.096	113	2.64	10	L-4
	N.45°W.-S.45°E	0.099	108	2.68	11.5	T-15
Eureka:[3]						
Accelerograph No. 30	Up-down	0.099	102	2.54	9.5	V-29
	E.-W	0.098	109	2.66	9.5	L-13
	S.-N	0.099	111	2.76	8.5	T-8
Displacement meter No. 13	S.-N	9.83	1.14		8.7	R-13
	W.-E	9.80	1.14		9.5	L-13

NORTHERN CALIFORNIA EARTHQUAKE OF MAY 13

Ferndale; accelerograph No. 28	Up-down	0.098	100	2.42	9	V-10
	S.45°W.-N.45°E	0.100	108	2.74	9	L-4
	N.45°W.-S.45°E	0.098	110	2.69	10	T-15

SANTA BARBARA EARTHQUAKE OF JUNE 30

Santa Barbara; accelerograph No. 26	Up-down	0.099	105.7	2.52	10	V-11
	NE.-SW	0.100	111.3	2.71	10	L-24
	SE.-NW	0.100	106.6	2.59	8	T-6
Hollywood Storage Co. Bldg.:[3]						
Adjoining lot accelerograph No. 41	Up-down	0.101	76.0	1.92	7	V-114
	E.-W	0.101	82.6	2.18	9	L-94
	S.-N	0.099	76.4	1.90	9	T-104
Basement accelerograph No. 42	Up-down	0.100	80.8	2.01	9	V-115
	E.-W	0.096	84.6	1.97	10	L-95
	S.-N	0.100	80.6	2.04	10	T-105
Penthouse accelerograph No. 40	Up-down	0.097	78.6	1.83	8	V-113
	S.-N	0.102	78.4	1.96	8	L-93
	W.-E	0.094	82.1	1.87	8	T-103
Los Angeles Chamber of Commerce Bldg.:[3]						
Basement accelerograph No. 21	Up-down	0.099	110.0	2.68	8	V-28
	S.50°E.-N.50°W	0.101	109.5	2.72	8	L-9
	S.40°W.-N.40°E	0.097	108.0	2.79	9	T-26
Eleventh floor accelerograph No. 22	Up-down	0.100	108.5	2.72	12	V-25
	S.40°W.-N.40°E	0.098	107.8	2.79	10	L-3
	N.50°W.-S.50°E	0.101	109.7	2.72	7	T-18

See footnotes at end of table.

TABLE 4.—*Instrumental constants of strong-motion seismographs in 1941*—Continued

SANTA BARBARA EARTHQUAKE OF JUNE 30—Continued

Station and instrument	Orientation of instrument	Pendulum period	Static magnification	Sensitivity	Damping ratio	Instrument number
		Sec.		*Cm.*		
Los Angeles Subway Terminal Bldg.:[3]						
Basement accelerograph No. 38	Up-down	0.099	79.8	1.98	7	V-111
	S.51°E.-N.51°W	0.097	80.8	1.92	9	L-91
	S.39°W.-N.39°E	0.098	77.1	1.88	8	T-101
Basement displacement meter No. 15.	N.39°E.-S.39°W	10.0	1.14		10	R-15
	S.51°E.-N.51°W	10.0	1.14		8	L-15
Thirteenth floor accelerograph No. 39.	Up-down	0.101	84.2	2.15	11	V-12
	S.39°W.-N.39°E	0.101	80.4	2.04	8	L-92
	N.51°W.-S.51°E	0.101	81.7	2.06	11	T-102
Vernon; accelerograph No. 1	Up-down	0.100	108	2.78	7.5	V-66
	S.8°W.-N.8°E	0.101	103	2.68	13	L-64
	N.82°W.-S.82°E	0.096	108	2.53	9.5	T-65
Long Beach; accelerograph No. 24	Up-down	0.099	112	2.75	11	V-7
	N.-S	0.101	108	2.73	9	L-2
	E.-W	0.098	107	2.51	8	T-17

FIRST AND SECOND AFTERSHOCKS OF SANTA BARBARA EARTHQUAKE OF JUNE 30

No change in constants of Santa Barbara accelerograph

BOULDER DAM EARTHQUAKE OF SEPTEMBER 3

Boulder Dam:[3]						
Oil house accelerograph No. B-3	Up-down	0.104	79	2.16	11	V-148
	N.45°W.-S.45°E	0.099	79	2.00	10	L-146
	N.45°E.-S.45°W	0.100	78	1.97	7	T-147
1215 gallery accelerograph No. B-1	Up-down	0.102	74	2.03	11	V-142
	S.45°E.-N.45°W	0.100	75	1.95	11	L-140
	S.45°W.-N.45°E	0.102	73	1.97	8	T-141
Intake tower accelerograph No. B-2	Up-down	0.099	80	2.03	10	V-145
	N.45°W.-S.45°E	0.099	78	1.97	12	L-143
	N.45°E.-S.45°W	0.098	74	1.80	11	T-144

SANTA BARABRA EARTHQUAKE OF SEPT. 7

Santa Barbara; accelerograph No. 26	Up-down	0.099	105	2.60	9	V-11
	NE.-SW	0.100	111	2.80	10	L-24
	SE.-NW	0.100	107	2.71	8	T-6

OWENS VALLEY EARTHQUAKES OF SEPT. 14 AT 8:44, 10:21, AND 10:39

Bishop; accelerograph No. 12	Up-down	0.101	110	2.78	10	V-23
	E.-W	0.100	107	2.72	9	L-36
	S.-N	0.099	108	2.67	9	T-19

SANTA BARBARA EARTHQUAKE OF SEPT. 14

Santa Barbara; accelerograph No. 26	Up-down	0.099	105	2.60	9	V-11
	NE.-SW	0.100	111	2.80	10	L-24
	SE.-NW	0.100	107	2.71	8	T-6

SAN FRANCISCO BAY REGION EARTHQUAKE OF SEPT. 17

San Jose:[3]						
Basement accelerograph No. 8	Up-down	0.099	110	2.72	9	V-49
	N 60° E.-S. 60° W	0.098	107	2.60	9	L-50
	S. 30° E.-N. 30° W	0.100	107	2.72	8	T-51
Thirteenth floor accelerograph No. 27.	Up-down	0.098	109	2.65	12	V-27
	N. 60° E.- S. 60° W	0.098	108	2.62	11	L-22
	S. 30° E.-N. 30° W	0.100	110	2.78	9	T-1

NORTHERN CALIFORNIA EARTHQUAKE OF OCT. 3

Eureka:[3]						
Accelerograph No. 30	Up-down	0.100	103	2.62	9	V-29
	E.-W	0.099	108	2.67	10	L-13
	S.-N	0.100	108	2.74	8	T-8
Displacement meter No 13	S.-N	9.79	1.14		9.8	R-13
	W.-E	9.62	1.14		8.5	L-13
Ferndale; accelerograph No. 28	Up-down	0.098	100	2.44	9	V-10
	S. 45° W.-N. 45° E	0.099	111	2.75	9	L-4
	N. 45° W.-S. 45°E	0.099	109	2.70	10	T-15

See footnotes at end of table.

TABLE 4.—*Instrumental constants of strong-motion seismographs in 1941*—Continued

GARDENA EARTHQUAKE OF OCT. 21

Station and instrument	Orientation of instrument	Pendulum period	Static magnification	Sensitivity	Damping ratio	Instrument number
		Sec.		*Cm.*		
Los Angeles Chamber of Commerce Bldg.:[3]						
Basement accelerograph No. 21	Up-down	0.100	108	2.74	10	V-28
	S. 50° E.-N. 50° W	0.102	108	2.86	9	L-9
	S. 40° W.-N. 40° E	0.098	107	2.60	10	T-26
Los Angeles Subway Terminal Bldg.:[3]						
Basement accelerograph No. 38	Up-down	0.099	76	1.90	8	V-111
	S. 51° E.-N. 51.° W	0.097	81	1.92	9	L-91
	S. 39° W.-N. 39° E	0.097	80	1.90	10	T-101
Basement displacement meter No. 15	N. 39° E.-S. 39° W	10.00	1.14		10	R-15
	S. 51° E.-N. 51° W	10.00	1.14		10	L-15
Thirteenth floor accelerograph No. 39.	Up-down	0.100	82	2.08	10	V-112
	S. 39° W.-N.39° E	0.101	81	2.09	10	L-92
	N. 51° W.-S. 51° E	0.101	81	2.10	11	T-102
Long Beach; accelerograph No. 24	Up-down	0.100	109	2.77	10	V-7
	N.-S	0.101	106	2.72	9	L-2
	E.-W	0.098	109	2.66	9	T-17
Vernon; accelerograph No. 1	Up-down	0.100	109	2.76	10	V-66
	S.-N	0.100	107	2.71	13	L-64
	W.-E	0.097	105	2.49	8	T-65
Westwood; accelerograph No. 20	Up-down	0.099	114	2.82	10	V-30
	E.-W	0.099	108	2.68	10	L-5
	S.-N	0.100	110	2.77	12	T-34
Los Angeles Edison Bldg. accelerograph No. 6.	Up-down	0.101	107	2.76	10	V-67
	SE.-NW	0.098	110	2.66	10	L-68
	SW.-NE	0.100	107	2.72	10	T-69
Hollywood Storage Co. Bldg.:[3]						
Adjoinging lot accelerograph No. 41	Up-down	0.100	76	1.92	9	V-114
	E.-W	0.103	82	2.22	10	L-94
	S.-N	0.100	76	1.91	10	T-104
Basement accelerograph No. 42	Up-down	0.100	79	2.01	10	V-115
	E.-W	0.097	82	1.94	10	L-95
	S.-N	0.101	80	2.07	10	T-105
Penthouse accelerograph No. 40	Up-down	0.102	78	2.06	9	V-113
	S.-N	0.105	80	2.24	8	L-93
	W.-E	0.101	79	2.04	12	T-103

GARDENA AFTERSHOCK OF OCT. 22

No change in constants at Long Beach and Los Angeles Subway Terminal Building

TORRANCE-GARDENA EARTHQUAKE OF NOV. 14

Westwood; accelerograph No. 20	Up-down	0.099	114	2.82	10	V-30
	E.-W	0.099	108	2.68	10	L-5
	S.-N	0.100	110	2.77	12	T-34
Hollywood Storage Co. Bldg.:[3]						
Adjoining lot accelerograph No. 41	Up-down	0.101	76	1.96	10	V-114
	E.-W	0.102	82	2.17	10	L-94
	S.-N	0.098	76	1.84	10	T-104
Basement accelerograph No. 42	Up-down	0.100	79	2.01	10	V-115
	E.-W	0.097	82	1.94	10	L-95
	S.-N	0.100	80	2.03	10	T-105
Penthouse accelerograph No. 40	Up-down	0.102	78	2.06	9	V-113
	S.-N	0.105	80	2.24	8	L-93
	W.-E	0.102	79	2.09	10	T-103
Vernon; accelerograph No. 1	Up-down	0.100	109	2.76	10	V-66
	S.-N	0.100	107	2.71	16	L-64
	W.-E	0.096	105	2.44	10	T-65
Long Beach; accelerograph No. 24	Up-down	0.099	111	2.75	9	V-7
	N.-S	0.102	105	2.77	9	L-2
	E.-W	0.098	105	2.55	8	T-17
Los Angeles Edison Bldg. accelerograph No. 6.	Up-down	0.101	107	2.75	11	V-67
	SE.-NW	0.099	110	2.72	10	L-68
	SW.-NE	0.100	107	2.72	10	T-69
Los Angeles Chamber of Commerce Bldg.:[3]						
Basement accelerograph No. 21	Up-down	0.101	108	2.80	10	V-28
	S.50°E.-N.50°W	0.103	108	2.91	9	L-9
	S.40°W.-N.40°E	0.100	107	2.71	10	T-26
Eleventh floor accelerograph No. 22	Up-down	0.100	107	2.70	10	V-25
	S.40°W.-N.40°E	0.099	108	2.68	11	L-3
	N.50°W.-S.50°E	0.100	108	2.74	8	T-18
Los Angeles Subway Terminal Bldg.:[3]						
Basement accelerograph No. 38	Up-down	0.100	76	1.94	8	V-111
	S.51°E.-N.51°W	0.097	81	1.92	9	L-91
	S.39°W.-N.39°E	0.098	79	1.92	10	T-101
Basement displacement meter No. 15.	N.39°E.-S.39°W	10.10			10	R-15
	S.51°E.-N.51°W	10.00			8	L-15
Thirteenth floor accelerograph No. 39.	Up-down	0.101	82	2.12	10	V-112
	S.39°W.-N.39°E	0.100	81	2.05	9	L-92
	N.51°W.-S.51°E	0.100	81	2.06	11	T-102
Santa Ana; Weed seismograph No. 12	SE.-NW	0.17	7.6	.56	3	R-12
	NE.-SW	0.18	7.3	.60	3	L-12

[1] The direction on the left ("Up" in the first case) indicates the direction of pendulum displacement, relative to instrument pier, which will displace the trace upward on the original seismogram.

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

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

STRONG-MOTION SEISMOGRAPH STATIONS, 1941

During 1941 all strong-motion seismograph installations remained substantially the same as listed in table 6 of Serial 637, United States Earthquakes, 1939, with the changes described on page 56 of Serial 647, United States Earthquakes, 1940. Simultaneous timing mechanisms were installed in several instances where there was more than one instrument in a building; and new optical systems were installed in a number of accelerometers for the purpose of increasing the recording range by decreasing the sensitivity. In such cases records are made with both the regular and the insensitive light spots.

TILT OBSERVATIONS

Three Merritt tiltmeters, described in Special Publication 201, Earthquake Investigation in California, 1934–1935, were kept in continuous operation during the entire year with the cooperation of the University of California. Figure 27 shows the tiltgrams from these three instruments for 1941. Tiltmeter No. 3 showed a net tilt of 15 seconds to the north and 7 seconds to the east, and tiltmeter No. 4 showed a net tilt of 7 seconds to the north and 9 seconds to the east. Both are on the southwest side of the Hayward Fault zone, and both show the same general tilt to the northeast. Tiltmeter No. 1, which is northeast of the fault zone, was adjusted during the first part of December. There was some drifting after this date before the instrument became stable again. From January 1 to December 2 the net tilt was about 1 second to the north and practically no tilt in the east-west direction, indicating that this block remained very stable during the year. There were 6 earthquake shocks within 50 miles of these tiltmeters during 1941, but no unusual tilt was noted at these times.

Tiltmeter No. 1 showed a peculiar vibratory activity at times which is described in detail in a paper by Mr. F. P. Ulrich entitled "Progress Report of Seismological Work, 1941." The report is published in the October 1942 issue of the Bulletin of the Seismological Society of America.

1933–40: Fluctuations of water level in wells, for earthquakes of March 11, 1933 (Long Beach), November 10, 1938 (Alaska), January 25, 1939 (Chile), December 26, 1939 (Turkey), May 19, 1940 (California), all G. M. T. The records for 124 wells in the United States are discussed by G. A. La Rocque, Jr., of the U. S. Geological Survey in a paper entitled "Fluctuations of Water Level in Wells in the Los Angeles Basin, California, during Five Strong Earthquakes, 1933–1940." Published in Transactions of the American Geophysical Union, Twenty-second Annual Meeting, April 30–May 3, 1941; also in Earthquake Notes, Vol. XIII, Numbers 1 and 2. The maximum surge reported is 10.58 feet. Ten references are also given on other papers on water-level fluctuations.

1940, December: New Hampshire earthquakes. See "Macroseismic Study of the New Hampshire Earthquakes of December 1940," by James J. Devlin, S. J., Lawrence C. Languth, S. J., and R. L. Arringdale, in the Bulletin of the Seismological Society of America, Vol. 2, Number 2, April 1942; ibid., Instrumental Study of the New Hampshire Earthquakes of December 1940, by L. Don Leet and D. Linehan, S. J.; ibid., Geology of the Central Area of the Ossippee Mountains, New Hampshire Earthquakes, by Marland P. Billings; ibid., Mechanism of Earthquakes Where There is no Surface Faulting, by L. Don Leet. Abstracts of the first two papers appear in Earthquake Notes, Numbers 1 and 2, September 1941.

1940 December 25: See The North Carolina Earthquake of December 25, 1940, V. C. Stechschulte, S. J., Proc. Amer. Geoph. Union, Twenty-second Annual Meeting, April 30–May 3, 1941.

Serial No. 662

UNITED STATES EARTHQUAKES

1942

By

RALPH R. BODLE

Magnetic and Seismological Observer

U.S. DEPARTMENT OF COMMERCE

COAST AND GEODETIC SURVEY

WASHINGTON : 1944

CONTENTS

ILLUSTRATIONS

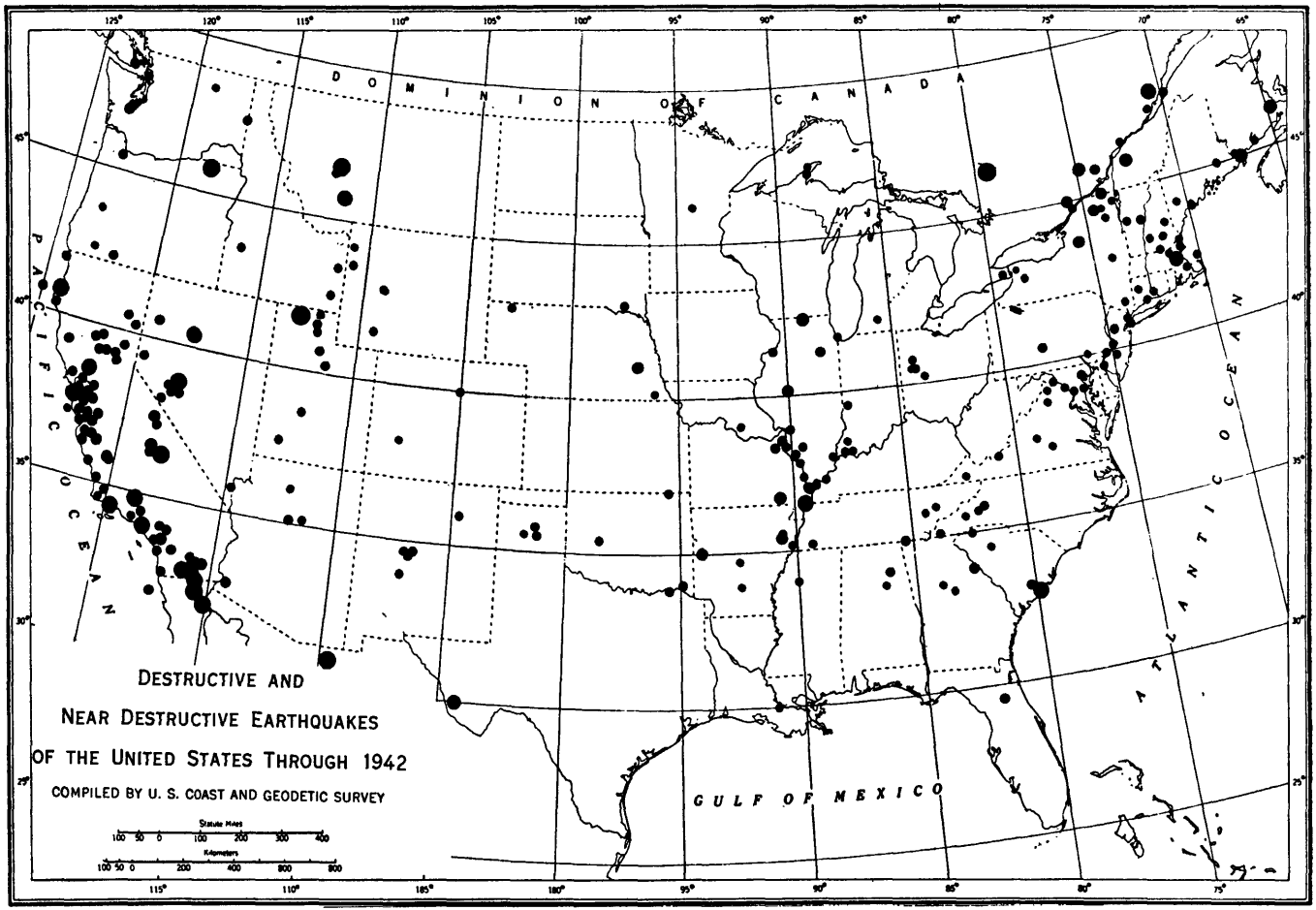

FIGURE 1.—Destructive and near destructive earthquakes in the United States through 1942.

UNITED STATES EARTHQUAKES, 1942

INTRODUCTION

THIS publication is a summary of earthquake activity in the United States and the regions under its jurisdiction for the calendar year 1942. 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 recent 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 1941:

Arizona.—Dean G. M. Butler, University of Arizona, Tucson.
Colorado.—Prof. C. A. Heiland, Colorado School of Mines, Golden.
Idaho.—Prof. Vernon E. Scheid, University of Idaho, Moscow. (To August 1942)
Prof. J. D. Forrester, University of Idaho, Moscow. (From August 1942)
Montana.—Dr. Francis A. Thomson, Montana School of Mines, Butte.
Nevada.—Prof. Vincent P. Gianella, University of Nevada, Reno.
Oregon.—Dean E. L. Packard, Oregon State Agricultural College, Corvallis.
Utah.—Prof. Hyrum Schneider, University of Utah, Salt Lake City. (To April 1942)
Prof. J. Stewart Williams, University of Utah, Salt Lake City. (From April 1942)
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

[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.

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 San Francisco Field Station of the Survey.

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 the air.

An asterisk (*) indicates that the time is taken from an instrumental report and is reliable. In other instances quite large deviations are frequently reported.

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 under the direction of Prof. Perry Byerly or the Seismological Laboratory of the California Institute of Technology, at Pasadena. The bulletins of these institutions should be consulted for further details and often for data on additional shocks.

Time is indicated as continuous from 0 to 24 hours, beginning and ending at midnight.

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 unabridged 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 and "affected area" maps. In figure 2 the relative intensity of a shock is indicated by the size of the dot.

Teleseismic results.—On page 18 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 and others interested.

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

EARTHQUAKE ACTIVITY IN THE VARIOUS STATES

California: The shock of October 21, intensity VII, felt in southern California and western Nevada was the strongest of the year. Additional shocks of intensity V and over occurred in northern and central California on August 18, September 29, November 18, December 17 and 29. Similar shocks occurred in southern California on May 23, September 16, October 19 and 20.

Connecticut: A slight shock was reported on December 9 at Hartford but it was not recorded on seismographs in the region.

Florida: Several tremors of uncertain origin were reported on January 19.

Idaho: Light shocks reported on March 2 and April 18. A shock on November 1 reached intensity VI.

Illinois: Light shocks occurred on March 1 and 29, August 31, and November 17.

Kansas: Light shock felt on September 10.

Maine: Slight shock felt on March 8.

Massachusetts: A local shock was recorded on June 15 but apparently it was not felt.

Missouri: Slight shock felt on December 27.

Montana: Local shocks occurred on March 3, September 25, November 1. A shock felt on November 1 centered in northern Idaho. A number of weak shocks felt at Helena are not listed.

Nevada: Moderate shocks were felt on June 4 and 10, August 11, September 8, December 3.

New Mexico: A sharp local shock was felt on December 27.

Oklahoma: A light shock was felt on June 11.

Oregon: Moderate shocks were felt on June 12 and November 1.

South Carolina: A light shock felt on October 31.

South Dakota: A light shock was felt on March 11.

Utah: The strongest shock, intensity VI, occurred on August 30. Minor shocks were felt on March 28, April 18, June 4, September 17, 18, 26, and 28.

Virginia: Slight shocks were felt on January 3 and October 6.

Washington: The strongest shock, centering in Idaho, occurred on November 1. Lighter shocks were felt on January 30, February 23, May 11 and 12, October 14, November 1, December 1 and 14.

Wyoming: Local shocks were felt on February 25, March 22, August 5, September 25, November 1, December 11.

Alaska: Twelve minor shocks were reported. Seven were felt at Fairbanks—June 30, July 21, September 9, 13, and 27, November 19, December 14. Three were felt at Anchorage—May 19, June 4, December 5. Two were felt in Nome—April 13, May 29.

Hawaii: A number of minor shocks were reported in the general region of Kilauea Volcano.

Panama Canal Zone: Minor shocks were felt on March 2 and 12, October 1, three on December 22, and one on December 26. The strongest was on March 2 and was felt on both the Atlantic and Pacific coasts.

NORTHEASTERN REGION

(EASTERN WAR OR 60TH MERIDIAN TIME)

NOTE.—See bulletins of all seismographic stations in the region for additional information.

March 8: 19:38. Slight shock centering about 9 miles northwest of Lewiston, Me. The seismological observatory at Weston, Mass., made a study of this earthquake in cooperation with the U. S. Coast and Geodetic Survey. A special report by W. H. Weeks appears in EARTHQUAKE NOTES of the Eastern Section, Seismological Society of America, for April 1942. The shock was felt at Auburn, Cape Elizabeth, Fayette, Lewiston, Portland, Sabattus, South Windham, and Turner, Me.

December 9: About 14:00. Hartford, Conn., slight shock reported by the press. It was not recorded by the seismograph at Weston, Mass.

EASTERN REGION

(EASTERN WAR OR 60TH MERIDIAN TIME)

January 3: 3:30 to 4:00. Lynchburg, Va. Slight shocks reported by 4 persons. The duration of approximately ½ hour makes the seismic origin questionable.

January 19: 14:05 to 14:15. Florida. Several evenly spaced tremors rattled windows and were felt at several places from Miami to the Everglades and Fort Myers. Though no one heard explosions with the tremors there is some doubt about their seismic origin especially because they were reported as "evenly spaced."

October 6: 22:15. Apparently centered in Buckingham County, Va. Light shock felt at Darlington Heights, Dillwyn, Farmville, New Canton, and Rice.

October 31: 22:20. Winnsboro, S. C. Light shock felt in this town and vicinity. It was felt by only a few.

CENTRAL REGION

(CENTRAL WAR OR 75TH MERIDIAN TIME)

March 1: 9:43.1. Epicenter 41°14′ north, 89°44′ west according to St. Louis University seismograph station. The position is about 9 miles east of Kewanee, Ill. The seismograph station at Loyola Uni-

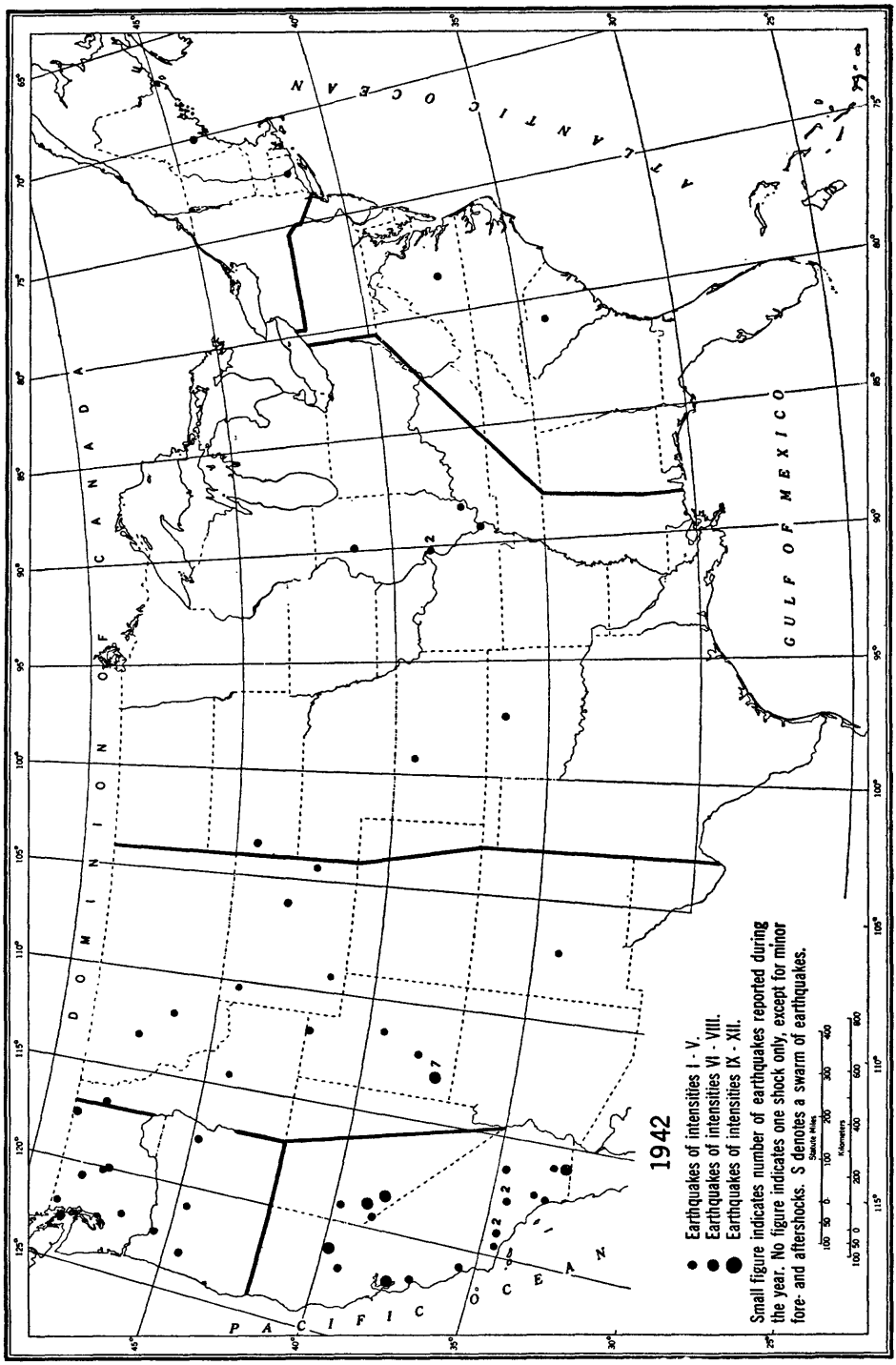

FIGURE 2.—Earthquake epicenters, 1942.

versity, Chicago, reported that the shock was felt in the counties of Rock Island, Henry, Bureau, Mercer, Knox, Stark, and Peoria. Press reports indicated that the shock was strongest at Kewanee and Buda where buildings were shaken and windows rattled without damage. A questionnaire survey indicated the shock was also felt at Brimfield, Buda, Cambridge, Galesburg, Galva, Toulon, and Moline.

March 11: 11:55. Near Sturgis, S. D. Light shock felt in Deadwood, Fort Meade, Lead, Piedmont, Sturgis, Terraville, Trojan, Whitewood, and Black Hawk. Northern Black Hills region.

March 29: 7:43.1. Time according to St. Louis. Reported felt distinctly at Harrisburg and Eldorado, Ill.

June 11: 23:50. Light shock centered in the vicinity of Enid, Okla. It was felt over an area of approximately 1500 square miles. Reported felt at Ames, Billings, Breckinridge, Covington, Enid, Fairmont, Garber, Garfield, Hennessy, Hillsdale, Hunter, Kremlin, Lahoma, Lamont, Nash, Saltfork, and Waukomis.

Reported not felt at Fairview, Hayward, Jet, Loyal, Lucien, Pond Creek, Ringwood, Sand Creek, Tonkawa.

August 31: 4:28. Cairo, Ill. Felt by many. Strong enough to awaken some people. Not reported from neighboring towns.

September 10: 4:00 (about). Felt at Hays, Stockton, and Plainville, Kans. The vibrations were strong enough to awaken some in Hays.

November 17: 13:18. East St. Louis, Ill. Slight shock. Felt from Maplewood Park to Fairmont City, Mo.

December 27: Time not given. Slight shock felt in Maplewood, Mo., according to the press.

WESTERN MOUNTAIN REGION

(MOUNTAIN WAR OR 90TH MERIDIAN TIME)

NOTE.—Only the more important shocks felt at Boulder Dam, and the more important aftershocks at Helena, Mont., are listed. The unabridged records are published in Abstracts of Earthquake Reports for the Pacific Coast and Western Mountain Region.

February 25: 8:10 (about). Wyoming. Reported strong enough to crack plaster and cause knickknacks to fall at Jay Em and Fort Laramie. Also felt at Lusk, Manville, and Van Tassell. The report from Jay Em states, "The shock seemed to extend 25 miles in each direction from Jay Em." Negative reports were received from six places.

March 2: 15:30. Clayton, Idaho. (Ranger Station.) Light shock rattled dishes and windows. Upper story of building rumbled and vibrated.

March 3: 15:12. Helena, Mont. Light shock felt by many in office building. Windows rattled. Trees and bushes shaken slightly. Reported not felt in 6 places.

March 22: 0:00 (about). Rock Springs, Wyo. Press reports slight shock felt here. Considered likely that it may have been the result of collapse in an old mine tunnel somewhere in the vicinity.

March 28: 8:10 and 10:00. Circleville, Utah. Two distinct shocks felt. Rattled windows and dishes, creaking walls heard by many. Roaring sounds preceded shock.

April 18: 0:45. Northern Utah. Intensity strongest at Newton in Cache County where lighting fixtures rattled and pictures moved. Awakened everyone in Hansel Valley; awakened some in Blue Creek, Box Elder County. Rattled windows at Clarkston, Logan, and Wellsville in Cache County. The shock was also felt at Burley in Idaho.

April 18: 12:15. Light shock felt. Rattled dishes at Malad City, Idaho.

June 4: 9.26 (about). Boulder City, Nev. Intensity V. Distinctly felt. Rattled dishes. Some plaster cracked.

June 4: 17:04. Utah. Press reports distinct earth tremors felt in Sanpete County at Mt. Pleasant, Fairview, and Ephraim. Also reported felt at Nephi in Juab County. Felt slightly at Manti. Professor J. Stewart Williams, Utah State Agricultural College, reported the following: "Two distinct shocks, the second one about twice as strong as the first, were felt. Felt over an area centering in northwest Sanpete County and extending as far as Ephraim on the south and Nephi on the north. Intensity may have reached V at the epicenter, since one report from Ephraim indicated an intensity of II or III. It may have originated on the fault that bounds Sanpete Valley on the west."

August 5: 15:34. West Thumb Ranger Station, Yellowstone Park, Wyo. Intensity V. Felt by all. Rattled windows and dishes.

August 11: 4:14:05. Boulder City, Nev. Intensity V. Awakened all and did minor damage. Heaviest shock since May 1939. Three strong-motion records were obtained. Concrete floor crack reported. Trees swayed; walls creaked; doors and windows rattled. Intensity IV at Basic Magnesium townsite (10 miles northwest of Boulder City), Boulder Dam, and at a Railroad Pass (4 miles west of Boulder City). Felt slightly at Pittman.

Not felt at Whitman, 14 miles northwest of Boulder City, Las Vegas, Overton, on Kingman road 20 to 40 miles south of Boulder Dam, or at Searchlight.

August 30: 17:08. Intensity VI at Cedar City, Utah, where bricks were shaken from a chimney in the northeast part of town. Plaster shaken from walls of 1 house and cracked in another on West Ninth Street. Felt at points 2½ miles west, 2 miles west by north, 5 miles north-northeast, and at Hamilton's Fort 6 miles southwest of Cedar City. Reported not felt at Enoch, Kanarra, and Summit.

September 8: 23:15. Intensity V at Boulder City, Nev. Three strong-motion records were obtained and showed that there were 2 shocks about 7 seconds apart. The epicenter is thought to have

been about 6½ miles north-northeast of Boulder Dam near the southeast shore of the lake. At Boulder City the shock was felt by all and rattled windows, doors, and dishes without damage. Also felt sharply in Las Vegas. It was felt with intensity IV and under at Boulder Dam Power House, Basic City, and Lake Mead (Haulapai Lodge).

September 17: 19:00 and 21:00 (between). Cedar City, Utah. Felt by a group of people in church and by 1 person at a point 2½ miles west of Cedar City.

September 18: 0:20. Cedar City, Utah. Intensity IV. Felt generally and awakened 3 people. Also felt at a point 2½ miles west and at Hamilton's Fort. Not felt at Enoch, Kanarra, and Summit.

September 25: 8:50. Lake Ranger Station, Yellowstone Park, Wyo. Intensity IV. Felt by all in community.

September 25: 23:15. Flathead and Powell Counties, Mont. W. E. Maughan of the U. S. Weather Bureau at Helena reported, "The shock was felt over a considerable portion of the upper valley of the south fork of the Flathead River in southern Flathead and northern Powell Counties. This area is rather isolated. No damage occurred so far as known." Reported intensity V at Spotted Bear Ranger Station, Sec. 17, T25N, R15W, Flathead County, and at Big Prairie Ranger Station, Sec. 10, T20N, R13W, Powell County, where it was generally felt. Dishes fell from shelves and cans fell from drain board.

The District Forest Ranger reported that the shock was distinctly felt on the south fork of the Flathead River at Black Bear Ranger Station, Sec. 27, T23N, R14W, and at Limestone Cabin, Sec. 13, T25N, R14W. At the latter he reported that the intensity was apparently strongest as a well piled and braced pile of wood was tipped over. At all points except Spotted Bear Station employees were in bed but were awakened when the buildings creaked and swayed noticeably.

September 26: 2:00. Felt slightly 2½ miles west of Cedar City and at Hamilton's Fort, Utah.

September 26: 6:16. Cedar City, Utah. Intensity V. Most people awakened. Numerous inquiries indicated that the shock was noticed at Hamilton's Fort and to the west of Cedar City. Not felt at Enoch, Kanarra, and Summit.

September 26: 6:36. Cedar City, Utah. Felt by several.

September 26: 9:50. Cedar City, Utah. Intensity VI. Felt by most people. Plaster cracked and one plate glass window broken. Also felt at Hamilton's Fort and on ranches immediately west of Cedar City. Not felt at Enoch, Kanarra, and Summit.

September 28: 8:30 (about). Zion National Park, Utah. Felt by observer. Windows rattled.

November 1: 9:10 and 9:45. Yellowstone Park (Snake River). Felt by 3 people.

November 1: 9:40. Old Faithful and at Snake River, Yellowstone Park, Wyoming. Felt by all in the area. Rattled windows.

November 1: 12:50. Northern Idaho and parts of Washington and Montana. Instrumental epicenter about 48.0° north ,116.7° west. Maximum intensity VI. Area affected, 25,000 square miles. See map, p. 25. The Northern Pacific Railroad partially suspended operation to inspect the right of way for boulders and slides. No damage of consequence. Some furniture was reported shifted and in a few cases residents fled from buildings.

INTENSITY VI:

Sand Point, Idaho.—Some church services were disrupted, and residents ran from their houses. Bottles were shaken from store shelves; small furnishings moved, vases overturned. Trees and bushes were shaken moderately.

Colfax, Washington.—Small furnishings shifted, vases overturned and knickknacks fell.

INTENSITY V:

Coeur d'Alene, Hope, and Porthill in Idaho; Kalispell and Marion in Montana; Newport, Metaline Falls and Northport in Washington. At Coeur d'Alene some chimney bricks were displaced; plaster cracked at Hope. Small objects shifted, suspended objects swayed, windows rattled, and subterranean sounds were heard in the various places listed.

INTENSITY IV:

Avery, Bonners Ferry, and Kellogg, in Idaho; Libby, Rexford, Thompson Falls, and Troy in Montana; Cheney, Clayton, Coulee Dam, Gifford, Newport, and Spokane in Washington.

INTENSITY III AND UNDER:

Wallace in Idaho; Fortine, Heron, Paradise, and Polebridge in Montana; Pullman, Chewelak, Grand Coulee and Deer Park in Washington.

Not felt at Lewiston, Idaho; Haugan, Montana; 28 places canvassed in Washington and 36 in Oregon.

Two light aftershocks felt at 9:42 and 13:15. All three shocks were recorded on the seismograph at Mount St. Michaels.

December 11: 5:15. Sharp shock apparently strongest at Casper and Columbine, Wyoming, where many were awakened, dishes rattled, and doors swung. Felt generally in both places. Felt strongly at Edgerton and Glenrock, also.

Not felt at Bear Creek, Kaycee, Natrone, Powder River, Shoshoni, Sussex, and Waltman.

December 27: 21:45. Magdalena, New Mexico. Sharp shock felt by many. Rattled doors and windows.

CALIFORNIA AND WESTERN NEVADA

(PACIFIC WAR OR 105TH MERIDIAN TIME)

NOTE.—All places are in California unless otherwise stated. "P" written after the location of an epicenter means that the location was reported by the Seismological Laboratory of the California Institute of Technology at Pasadena. "B" refers likewise to the Seismological Station of the University of California at Berkeley. The Berkeley data, however, are not available as this publication goes to press. More details will be found in Abstracts of Earthquake Reports for the Pacific Coast and the Western Mountain Region issued by the U. S. Coast and Geodetic Survey. The Bulletin of the Seismological Society of America is referred to as the "SSA Bulletin."

When more than one degree of intensity is reported from a town, the town is listed under the highest intensity reported.

January 6: 2:20* and 2:23.* Recorded at Tinemaha, P. Priest Valley. Two distinct shocks felt by several.

January 8: 23:28:07.* South of Riverside. Epicenter 33°53′ north, 117°27′ west, P. Rattled doors and windows. Reported felt at Fontana and Riverside. Reported as not felt in Los Angeles.

January 14: 2:44,* P. Reported strongest at Chualar and Hollister where many were awakened, walls creaked, and windows rattled. Also felt at Big Sur, Gonzales, and Pinnacles.

January 15: 5:30. Upper Mattole. A heavy jar felt by many and awakened many.

FIGURE 3.—Areas affected by the more important earthquakes of California and western Nevada in 1942.

January 17: 20:03:9.* Epicenter about 36.3° north, 121.2° west, P. Felt at King City and Pinnacles where dishes rattled and walls creaked.

January 18: 0:17 (about). P. Felt at Cape Mendocino, Ferndale, Petrolia, and Scotia. Apparently strongest at Ferndale where many were awakened, walls creaked and hanging objects swung.

January 18: 4:35. Felt slightly at Pinnacles.

January 18: 9:50. Felt by several at Pinnacles.

January 24: 14:41:48.* Epicenter 32°48′ north, 117°50′ west, P. Light shock felt at Avalon and San Diego.

January 31: 1:05:16.* Epicenter about 34°07′ north, 117°23′ west, P. Felt slightly at Fontana.

February 1: 8:18:28.* Epicenter 34°24′ north, 116°55′ west, Lucerne Valley, P. Light shock felt at Fawnskin, Twin Peaks, and Yucaipa. Reported not felt in Los Angeles.

February 3: 19:21:15,* 19:25:26,* and 19:32:03.* Epicenter near 37°34′ north, 118°44′ west, P. Bishop (Long Valley Reservoir). Rattled windows and spilled liquids from containers.

February 4: 2:08:4.* Epicenter about 37.0° north, 121.3° west, P. Felt strongly at Hollister with an aftershock at 4:05. Many were awakened, damage to 2 chimneys reported, pendulum clocks stopped, most people alarmed.

February 11: 20:04* and 20:08.* Recorded at Tinemaha, P. Two very slight shocks felt at Hollister.

February 13: 4:00. Three miles southeast of Mecca. One sharp bump felt by many caused lighting fixtures to swing. (Possibly this may be shock listed by Pasadena at 3:26:11,* epicenter 33°48′ north, 116°07′ west, northeast of Indio.)

February 19: 11:33.* Recorded at Tinemaha, P. Felt lightly at Pinnacles.

February 25: 9:09.4* and 9:12.1.* Epicenter about 38.4° north, 118.5° west, Nevada, P. Felt by many in Hawthorne where canned goods on shelves were displaced to the south.

February 26: 16:30 and 17:13 (about). Seven Oaks. Light shock felt by several.

February 26: 18:08:53.* Epicenter 34°20′ north, 117°00′ west, San Bernardino Mountains, P. Light shock felt at Fawnskin and Twin Peaks (Strawberry Peak Lookout). Three shocks were felt at Twin Peaks at 18:09:15, 18:09:30, and 18:09:40.

February 26: 18:28:55.* Epicenter 33°47′ north, 118°25′ west, off Palos Verdes, P. Felt at Hermosa Beach, Manhattan Beach, Palos Verdes, Redondo Beach, and Santa Monica.

February 28: 22:10. Fort Ross (Jenner). "One sharp concussion felt, apparently from the southwest. Felt in three separate dwellings. In two houses the people were in bed. Observer standing felt the house jar and windows rattle; those in bed felt the house shake."

March 1: 12:12* and 19:00.* Epicenter about 33°40′ north, 116°10′ west, Coachella Valley, P. Rattled windows at Mecca. Another small sharp shock felt at 19:00.

March 2: 18:03:24.* Epicenter about 34°00′ north, 115°45′ west, P. Felt at Coachella, Hemet, and Twentynine Palms. May have been strongest at Twentynine Palms where small objects were moved.

March 4: 4:02:12.* Epicenter about 34°00′ north, 115°45′ west, Pinto Mountains, P. Many awakened at Twentynine Palms.

March 5: 19:03.* Recorded at Tinemaha, P. Sharp shock felt by many at Watsonville (Pajaro Valley)—press.

March 6: 4:00. Mineral. Strong enough to cause buildings to creak (SSA Bulletin).

March 21: 10:10. Stewarts Point. Felt by all. Rattled windows.

March 24: 17:00. Light shock felt at Pinnacles.

March 27: 18:06:50.* Epicenter about 33°28′ north, 116°35′ west, Terwilliger Valley, P. Slight shock felt at Santa Ysabel.

March 31: 7:22.* Recorded at Tinemaha, P. Light shock felt at Hollister. Rattled dishes.

April 4: 8:11:31.* Epicenter about 34°47′ north, 116°28′ west, Mojave Desert, west of Ludlow, P. Felt by all at Pisgah Substation 40 miles east of Barstow. No damage.

April 4: 11:02:27.* Epicenter about 34°00′ north, 117°24′ west, very near Riverside, P. Slight shock felt at Riverside.

April 5: 2:20:39.* San Jacinto Fault. Epicenter 33°12′ north, 116°14′ west, P. Felt by several at Descanso Ranger Station.

April 5: 7:10.* Light shock felt at Bucks Lake, Caribou, and Prattville. Rattled windows.

April 7: 4:03.* Hollister. Felt by several. Rattled windows.

April 8: 7:20. Light shock apparently felt strongest at Soledad and Greenfield where many felt it. Trees and bushes shaken slightly at Soledad. Also felt at Pinnacles.

April 10: 7:19:52.* Epicenter about 34°47′ north 116°28′ west, P. Mojave Desert west of Ludlow. Felt by all at Pisgah Substation 40 miles east of Barstow. About intensity V.

April 10: 22:14:18.* Epicenter about 34°45′ north, 116°28′ west, P. Mojave Desert west of Ludlow. Lightly felt at Pisgah Substation 40 miles east of Barstow.

April 11: 1:40.* Awakened many at Hollister. Also felt at Soledad.

April 11: 2:20. Salinas. Light shock felt by several.

April 26: 8:10:23.* Epicenter about 33°57′ north, 116°44′ west, near Cabazon, P. Awakened all at Cathedral City. Press reported shock was also felt slightly at Banning.

April 27: 4:27.9.* Epicenter about 32.0°? north, 117.0°? west, off Baja California. Felt by many and awakened several at Point Loma.

April 29: 5:13:00.* Epicenter about 33°32′ north, 117°18′ west, P. Awakened many, rattled dishes, and stopped electric clocks at Elsinor. Also awakened many in Alberhill. Press reports indicate the shock was felt at Riverside and adjacent towns.

May 4: 3:57:29.* Epicenter about 33°43′ north, 116°42′ west, San Jacinto Fault near Hemet Reservoir, P. Reports indicate light tremor felt in region around San Jacinto (SSA Bulletin, July 1942).

May 5: 5:33. Los Gatos. Felt by nearly all.

May 23: 8:47:29.* Epicenter about 32°59′ north, 115°59′ west, San Jacinto Fault near Carrizo Creek, P. One strong-motion record obtained at El Centro. Plaster reported cracked about 4 miles east of Descanso (Intensity V). The shock was felt without damage at Aguanga, Alpine, Borego Valley, Calipatria, Campo, Descanso Ranger Station, Dulzura (Barrett Dam), El Centro, Escondido, Heber, Hipass, Holtville, Jacumba, Jamul, Lakeside, Mecca, Mesa Grande, Mount Laguna, Palomar Mountain, Pine Valley, Plaster City, Potrero, Ramona, San Diego, Santa Ysabel, San Ysidro, Seeley, and Warner Springs. Negative reports were received from 17 towns.

May 26: 21:00. Coalinga. "Residents of Coalinga were startled by a sharp but short earth tremor about 9 p.m. Reports from many homes said that the buildings creaked and fixtures swung noticeably. No damage was reported." (SSA Bulletin, July 1942)

May 31: 9:38.* Watsonville. Felt by many. House creaked and hanging objects swung.

June 5: 5:33.* Felt over a land area of approximately 2500 square miles in the vicinity of Monterey Bay. Maximum intensity of approximately V reported from Aptos, Boulder Creek, and Watsonville, where many were awakened by the vibrations and rattling windows. No damage. Also felt at Big Sur, Carmel, Hollister, Laurel, Los Gatos, Marina, Monterey, Morgan Hill, Salinas, San Anselmo, San Jose, Soquel, and South San Francisco.

Negative reports were received from 50 towns.

June 5: 23:42:11.* Epicenter about 34°21′ north, 119°51′ west, P. Light shock felt at Goleta.

June 8: 22:06:33.* Epicenter about 33°20′ north, 116°14′ west, San Jacinto Fault near Clark Lake P. Felt strongest at Westmorland where many were awakened. It was also felt at Anza, Hipass, Indio, Keen Camp (Thomas Mt.), Mecca, Mesa Grande, Mount Laguna, Potrero, and Thermal.

June 9: 7:10.* Slight shock felt in Hollister.

June 10: 15:51.* Recorded at Boulder City. Intensity VI at Verdi, Nev., where hanging objects swung and knickknacks fell. V at Fallon, Reno, and Steamboat, Nev. Felt intensity IV and under in Nevada—Carson City, Glenbrook, Hazen, Minden, Nixon, Sparks, and Wadsworth; in California—Baxter, Boca, Doyle, Floriston, Georgetown, Loyalton, Milford, Nevada City, Portola, Soda Springs, Tahoe, and Vinton. Forty negative reports received.

June 12: 15:28:26.* Epicenter about 35.4° north, 118.5° west, near Edison. Felt by several at Bakersfield.

June 18: 16:33.* San Jose. Recorded at University of Santa Clara. Press reported it was felt by some people.

June 22: 15:13:51 and 16:51:03.* Epicenter 36°15′ north, 117°58′ west, near Haiwee, P. Light shock felt at Coso Junction and vicinity, especially at South Haiwee Reservoir and South Haiwee.

June 29: 14:07.5.* Epicenter about 35.6° north, 120.8° west, San Luis Obispo County. Felt by many, rattled dishes and windows at Cambria and San Luis Obispo.

July 4: 1:52:25.* Epicenter about 36°15′ north, 117°58′ west, near Haiwee, P. Rattled windows at Coso Junction (Haiwee Power Plant).

July 4: 10:23:28.* Los Angeles. Epicenter 34.0° north, 118.3° west. Felt by several.

July 5: (no time given). Healdsburg. "Residents of Healdsburg, Sonoma County, reported four ground shocks. No damage was caused." (SSA Bulletin, October 1942.)

July 6: 14:11:40.* Epicenter about 37°34′ north, 118°44′ west, northern Owens Valley. Felt at Bishop (Long Valley Reservoir). Felt by several. Windows rattled.

July 9: 5:23.* Recorded at Tinemaha. Felt at Williams, Colusa County, by many.

July 10: 15:57. Carson City, Nev. Felt by many on second floor of State Capitol Building.

July 11: 9:41.8 and 9:45.7.* Epicenter about 38.3° north, 116.1° west, Nevada. Press reports 2 slight shocks rattled windows and were felt in Tonopah and Manhattan.

July 12: 22:12.* Recorded at Tinemaha. Felt at Williams where house creaked.

July 14: 9:42.* Recorded at Tinemaha. Felt at Williams. House creaked slightly and hanging doors swung. Press reports indicate the shock was also felt at Colusa.

July 16: 2:29. Pigeon Point Light Station (Pescadero). Felt by several. Windows rattled and house creaked.

August 6: 16:43:10.* San Diego. Felt by many. Also reported felt at Point Loma and Mission Hills.

August 8: 15:31.* Recorded at Tinemaha. Felt by many at Hollister. Windows rattled.

August 8: 18:18.* Recorded at Tinemaha. Felt by many at Hollister.

August 10: 2:26:57.* Epicenter about 35°44′ north, 118°25′ west, near Kernville. Awakened many in Kernville.

August 10: 5:00. Light shock felt strongest at Mill Valley, IV. Also felt slightly in San Francisco.

August 10: 22:30. Manzanita Lake. Intensity V. Felt by several. Shifted small objects and shook beds. Trailer house vibrated.

August 14: 8:14. Felt by several at Antioch. Loose objects rattled. Greenhouse rattled.

August 18: 14:55.4.* Epicenter about 38.6° north, 118.5° west, Mineral County, Nevada, P. The shock was felt over an area of approximately 7000 square miles in the vicinity of Hawthorne, Nev. One strong-motion record obtained at Hawthorne. The felt area extended northerly to Fallon, Nev., southerly to Dyer, Nev., and westerly to Bridgeport, Calif. Maximum intensity was about V or VI at Mason and Mount Montgomery, Nev. At Mount Montgomery dishes fell and lathe on veneer board panels cracked loose; at Mason it was reported that weighing scales were moved on a store counter.

Intensity IV was reported in Nevada at Fallon, Hawthorne, Luning, and Yerington; and in California at Benton, Bodie, and Bridgeport.

Also felt at Dyer, Manhattan, Silver Peak, and Tonapah in Nevada.

Reported not felt at Smith and Wellington.

August 19: 8:57:10.* Epicenter about 33°47′ north, 117°45′ west, near El Modena in Orange County. Felt slightly at Alberhill.

August 22: 5:59:13.* Epicenter about 34°07′ north, 116°45′ west, near Mt. San Gorgonio, P. Felt by many and rattled doors at Fawnskin.

August 24: 7:54:19.* Epicenter about 34°14′ north, 117°13′ west, near Lake Arrowhead (Sec. 15, T2N, R3W, SBM), P. Felt by several. Effect on dishes and other small objects slight but noticeable at Lake Arrowhead.

August 30: 22:28.* Recorded at Tinemaha. "A Watsonville newspaper reported that a sharp temblor jarred Pajaro Valley residents at 10:27 p. m., PWT, but caused no damage." (SSA Bulletin, October 1942).

September 2: 15:03.* Recorded at Tinemaha. Felt by several at Schurz, Nev. Windows rattled. Trees, bushes shaken slightly.

September 3: 7:06:01.* Epicenter about 34°29′ north, 118°59′ west, near Fillmore, Calif. Felt strongest, intensity V, at Fillmore where all were awakened, windows rattled and some water pipes disturbed. Also reported felt at Ojai and Piru.

September 3: 23:34:33.* Epicenter about 34°29′ north, 118°59′ west, near Fillmore, Calif., P. Felt as far as Los Angeles and Pasadena. Intensity V at Fillmore where it was felt by all and awakened everyone. Also felt at Piru.

September 11: 11:30. Kernville. Light shock felt by many in community. Rattled windows.

September 12: 10:49.* Recorded at Tinemaha. Felt at Hollister. Felt by many. House creaked. Trees and bushes shaken slightly.

September 16: 18:54:07.* Epicenter about 34°24′ north, 117°43′ west, San Andreas Fault zone near Valyermo, P. Intensity V at Swartout (Big Pines Recreation Area) and Wrightwood. Felt at Los Angeles County Flood Control Dams Nos. 1 and 2 in San Gabriel Canyon. Also at Glendora and Valyermo.

September 18: 9:50:35.* Epicenter about 33°09′ north, 116°04′ west, San Jacinto Fault near San Felipe Creek, P. Felt by Navy construction crew at Sandy Beach Naval Base 25 miles northwest of Westmorland. Not felt at Dorris.

September 21: 00:07:54.* Epicenter about 33°32′ north, 116°38′ west, San Jacinto Fault near Anza, P. Intensity IV at Big Bear Lake and Cabazon where house creaked and windows rattled.

September 25: 0:19. Rattled windows at El Cerrito. SSA Bulletin, October 1942, reported, "A small shock recorded at 12:19 a. m., PWT, centering 5 miles from the university campus, was felt by some Berkeley residents who were awakened by it."

September 25: 1:12. Los Angeles. Light shock in southwest part of Los Angeles. Felt by very few.

September 25: 2:07:10.* Epicenter about 33°57′ north, 118°10′ west, Norwalk Fault near Downey, P. Felt in south and east districts of Los Angeles according to the press. Many awakened in Lynwood.

September 28: 1:37.* Recorded at Tinemaha. Intensity IV at Williams. SSA Bulletin, October 1942, reported, "A Sacramento, California, newspaper reported that on September 28th a tremor occurred at approximately 1:30 a. m., PWT. It awakened hundreds of Colusa County residents, and was strong enough to shake homes violently, rattled windows, and caused dishes to fall."

September 29: 1:29.* Recorded at Tinemaha. Intensity V at Williams and Willows where many were awakened, dishes rattled, and trees and bushes were shaken slightly. Also felt at Grimes, Maxwell, Meridian, Monticello, and Colusa. SSA Bulletin, October 1942, reported, "On September 29th at approximately 1:30 a. m. another earthquake occurred which frightened pheasants in the area from their nesting places. The first shock on September 29th was said to have been followed by a lighter one, and was reported felt in Monticello, Napa County, and at Meridian. The bridge tender at Meridian reported that concrete was cracked in several places."

October 4: 3:00. Santa Ynez (on Santa Ynez Peak). Reported by 1 observer as about intensity IV.

October 6: 12:45.* Crane Flat Ranger Station and Yosemite Valley. Yosemite National Park. Trees and bushes shaken moderately and dishes rattled. Felt by all. At Mather it was felt by several and was accompanied by rattling of windows.

October 13: 12:45. Felt by residents of El Portal according to Press.

October 14: 4:53:26.* Recorded at Haiwee and Tinemaha. Slight shock felt by several at Kernville.

October 15: 5:09.* Camp Richardson near Lake Tahoe. Felt by several and rattled dishes. Also felt lightly at Truckee.

October 15: 6:54:05.* Moderate shock rattled windows and wakened many. No damage. Felt intensity IV and under at Big Sur, Gonzales, Greenfield, Hollister, Salinas, and Soledad.

October 16: 23:10. St. Helena (Pope Valley). Felt by several. Windows rattled and doors creaked.

October 18: 1:00. Cambria. Very slight. Felt by only a few.

October 18: 5:01.7.* Cambria. Epicenter roughly 36° north, 121° west. Intensity V. Felt by many. House creaked. Plaster cracked and many awakened. Pendulum clocks facing northeast were stopped.

October 19: 3:23. Intensity V at Santa Barbara where plaster cracked, small objects moved and teletype machine rocked.

October 20: 3:25. Cambria. Intensity V. Awakened and frightened many in the community.

October 21: 9:22:13.* Near Borego Valley. Epicenter about 32°58′ north, 116°00′ west, P. Figure 3. This is in the San Jacinto Fault zone, though possibly not on the principal fault. The shock was felt over an area of about 35,000 square miles in southern California and western Arizona. Intensity VII was reached at Carrizo Gorge about 12 miles north of Jacumba where slides broke bridge timbers and wiring on the S.D. and E.R.R.

Twenty-two records were obtained from 14 strong-motion seismographs in southern California. The instruments were located in the following places: Colton, El Centro, Hollywood, Long Beach, Los Angeles, Vernon, San Diego, and Santa Ana.

INTENSITY VII:

Carrizo Gorge (near Jacumba).—Considerable damage. "Rocks falling from hillside broke electric wires and bridge timbers. Fifteen small shocks during the day."

INTENSITY VI:

Calexico.—Felt by all. Books and dishes were moved to edges of shelves; pendulum clocks stopped.
Calipatria.—Cracked plaster and overturned small objects. "Crack in rear of building opened several inches."
Campo.—Knickknacks fell. Felt by all. "Local grammar school teacher sent the children home."
Dulzura.—Felt by all. Overturned small objects.
El Centro.—Very hard shock cracked plaster and overturned a few small objects. "No damage reported outside of pictures and dishes, although the shock seemed heavy enough to cause considerable damage."
Hemet.—Felt by many. Knickknacks fell. Pendulum clocks stopped.
Hipass.—Felt by all. Shifted small objects and overturned vases.
Holtville.—Plaster cracked, pendulum clocks stopped. Felt by all.
Imperial.—Cracked plaster, broke dishes, and stopped pendulum clocks. Files swayed and safe moved from east to west.
Jacumba.—Felt by all. Dishes broken. Small objects shifted and vases were overturned.
Lakesside.—Felt by all. Knickknacks fell.
Miramar.—Felt by all. Plaster cracked.
National City.—Felt by all. Many frightened. Pendulum clocks stopped.
Niland.—Plaster cracked and small objects overturned. Felt by all.
Palos Verdes Estates.—Overturned small objects. Felt by all.
Potrero.—Cracked plaster and windows. Small objects overturned.
San Diego.—Generally felt. Cracked plaster and windows. Clock with 18-inch pendulum stopped. Some plaster fell. Canned goods fell to floor at one point. "At the pier at the foot of F street the concrete floor of the wharf was noticed by many to have a distinct west to east roll. This goes out from shore in a westerly direction."
San Jacinto.—Knickknacks fell. Felt by all. Power pole with heavy transformer swung north-south.
Santa Ysabel.—Felt by all. Cans fell off shelves.
Warner Springs.—Cracked plaster. Knickknacks fell. Felt by all. Pendulum clocks stopped.

INTENSITY V:

Aguanga.—Felt by all. Windows rattled. Trees and bushes shaken moderately.
Alpine.—Felt by all. Trees, bushes shaken strongly.
Anza.—Felt by all. Rattled windows.
Banning.—Felt by many. Building creaked and rattled.
Beaumont.—Felt by many. Rattled windows and moved small objects. One person reported swaying of parked automobile.
Borego (Borego Valley).—Felt by all. Trees, bushes shaken strongly. "Strongest ever felt here."
Brawley.—Frightened many and was felt by all. Trees, bushes shaken moderately.
Coachella.—House creaked. Frightened many. Pendulum clocks stopped.
Desert Center.—Telephone shaken off wall. Lamps, chairs, and beds swayed.
Escondido.—Felt by all. Rattled windows. Trees, bushes shaken slightly.
Heber.—Frightened many. Rattled windows and shifted small objects.
Indio.—Felt by many. Rattled loose objects. Trees and poles swayed.
Los Angeles.—Felt by all. Shifted small objects and cracked plaster slightly. Caused slight nausea in some instances. "The earthquake was felt by nearly everyone on the upper floors of tall buildings, but by very few, if any, on the ground. It was a long period, slow motion."
Mesa Grande.—Frightened many and felt by all. Rattled windows. Trees, bushes shaken strongly.
Mt. Laguna.—Felt by all. Violent rattling of windows. Small objects shifted. "The jar of the first quake was the strongest experienced here on the mountain by residents of 20 years. After the first quake there were intermittent quakes, very slight, up to the time of reporting."
Oceanside (Camp Pendleton).—Felt by all. House creaked and windows rattled.
Palm City.—Felt by all and frightened many.
Palm Springs.—Felt by all. Trees swayed slightly. Office chair on rollers seemed to move north and south. Loose objects rattled.
San Bernardino.—Felt by all. Hanging objects swung.
Santa Ana.—Felt by many. Rattled windows. Walls creaked.
Temecula.—Felt by all and frightened many. Trees, bushes shaken strongly.
Twentynine Palms.—Felt by many. Disturbed objects observed by several.
Valley Center.—Felt by all and rattled windows.

INTENSITY V IN ARIZONA:

Yuma.—Felt by many. Some objects slightly displaced.

INTENSITY IV:

Alberhill, Blythe, Burbank, Cabazon, Compton, Costa Mesa, Crucero, Del Mar, Descanso, East Highlands, El Cajon, Fallbrook, Fullerton, Glendale, Hawthorne, Hollywood, Jamul, Keen Camp, Laguna Beach, La Habra, La Jolla, La Mesa, Lake Arrowhead, Lake Arrowhead Village, Lomita, Long Beach, Ludlow, Midland, Newport Beach, Oceanside, Ontario, Placentia, Plaster City, Pomona, Riverside, Sage. San Dimas, San Juan Capistrano. San Pedro. Seal Beach, Solano Beach. South Gate, Spadra, Stanton, Sunset, Terminal Island, Thermal, Thousand Palms, Twentynine Palms, Valyermo, Van Nuys, Victoryville, Vista, Yermo, and Yucaipa.

INTENSITY IV IN ARIZONA:

Mobile, Parker, and Wellton.

INTENSITY III AND UNDER:

Action, Adelanto, Alhambra, Altadena, Bellflower, Beverly Hills, Buena Park, Cornell, Elsinore, Etiwanda, Forest Home, Gardena, Huntington Park, Lakeview, Manhattan, Needles, North Hollywood, Rosemead, Torrance, and Walteria. Also at Quartzsite in Arizona.

Twenty-four towns reported that the shock was not felt.

Not felt reports received from 13 towns in Arizona.

October 21: 11:15. El Centro. Small shock reported.

October 21: 18:50:38.* Epicenter about 33°14′ north, 115°43′ west, west of Niland, P. Probably strongest at San Jacinto where walls creaked and knickknacks fell.

Also reported felt at Anza, Blythe, El Centro, Hemet, Holtville, San Diego, Santa Ysabel, Thermal, and Twentynine Palms.

October 22: 5:00. Lake Tahoe. Felt by several according to a Truckee newspaper.

October 22: 18:12.* Epicenter 33.0° north, 116.0° west, Santa Ysabel. Slight shock rattled windows and made walls creak.

October 25: 1:34. Recorded at Riverside. Mt. Laguna. Felt by few. Rattled windows and doors; house creaked.

October 25: 11:59:39.* Epicenter about 32°57′ north, 116°09′ west, P. Rattled windows and doors at Jacumba (Carrizo Gorge). Felt lightly at El Centro and San Diego.

October 25: 19:55. San Diego. Five light tremors felt according to press.

October 25: 20:02:15.* Epicenter 33°14′ north, 115°43′ west, west of Niland, P. Slightly felt at El Centro.

October 27: 12:08. Santa Ysabel. Rattled windows, doors; walls creaked.

October 29: 8:56:00* and 9:21:57.* Epicenter about 32°58′ north, 116°00′ west, near Borego Valley, P. Felt slightly in San Diego, and at U. S. Weather Bureau Station at Lindbergh Field nearby. The second shock was reported felt at Mt. Laguna and Santa Ysabel in addition.

October 29: 13:51:04.* Epicenter about 33°04′ north, 116°00′ west. San Diego. Felt by several. Thirty seconds duration.

October 29: 17:55:18.* Epicenter about 37°34′ north, 118°44′ west. north Owens Valley, P. Yosemite National Park. Two shocks felt by several. Windows rattled. Hanging objects swung.

October 29: 22:35:45.* Epicenter about 33°00′ north, 116°05′ west, near Borego Valley, P. Felt by several in Mt. Laguna and San Diego.

October 31: 3:51:13.* Epicenter about 35°46′ north, 120°15′ west, near Parkfield, P. Awakened many at Parkfield and San Miguel. Felt slightly at Paso Robles.

October 31: 8:07:58.* Epicenter about 32°58′ north, 116°23′ west, Santa Ysabel. Felt by several. Windows, doors rattled. Walls creaked.

November 2: 14:55. Dyerville. Slight. Felt outdoors by some.

November 2: 20:56:18.* Epicenter about 37°34′ north, 118°44′ west, northern Owens Valley, P.

INTENSITY V:

Bishop (near Owens River Gorge).—Felt by several. House frame creaked. One observer reported, "Moved chair (on castors) in which I was sitting about 6 inches."

INTENSITY III AND UNDER:

Bishop (Power Plants, Owens River Gorge).—Felt by all. Two shocks; second strongest. House creaked.

Sanger (Fresno County, Trimmer Route, Sierra National Forest).—Windows rattled; walls creaked.

November 3: 3:19.* Ludlow. Felt by many. Windows rattled.

November 6: 21:39:06.* Epicenter about 32°58′ north, 116°00′ west, P. One mile north of El Centro. Observer heard windows rattle and house frame creak.

November 6: On this date a shock was felt by several at S.C.E.Co., camp near Kernville; windows and dishes rattled, but the time was not reported.

November 13: 2:15:2.* Recorded at Tinemaha and Haiwee. Kernville. Felt by several. Windows rattled.

November 18: 13:20:* and 13:35.* Recorded at Tinemaha. Intensity VI at Striling City. Felt by all and frightened many. Knickknacks and pictures fell. Overturned small objects. Trees swayed; small branches fell. Also felt at Chico, Feather River Canyon, Las Plumas and Storrie (Bucks Creek Power House).

November 25: 11:47:05.* Compton. Epicenter about 33°57′ north, 118°08′ west, near Downey, P. Press reports indicate that windows and dishes rattled at Compton. It was also felt at Clearwater, Long Beach, and Haynes.

November 27: 14:30. Caribou and Butte Valley (Plumas County). Felt by several. Rattled dishes.

December 2: 4:46:00.* Santa Barbara. Epicenter about 34°20′ north, 119°35′ west, P. Intensity V. Awakened many. Walls creaked and windows rattled.

December 3: 2:44.7.* Epicenter near 39.7° north, 119.3° west, nearly north of Wadsworth, Nev. Figure 3. Field investigations made by Professor Vincent P. Gianella, University of Nevada, indicated that the epicenter "lay along a line extending from the southwest corner of Pyramid Lake southerly through Derby in the Truckee Canyon." This is in reasonable agreement with the instrumental determination.

The shock was felt over an area of about 24,000 square miles, in east-central California and western Nevada. Intensity VI was reported from Fernley, Fallon, and Reno, Nev., where small objects were overturned and fell. Cracking of plaster was reported from Reno. Also, a heavy safe was reported shifted in Reno.

INTENSITY V IN NEVADA:

Lovelock.—Lasted one and one half minute. Awakened all in home. Walls creaked. Strong jumpy shock, interval of one minute, then slow, wavy motion.

Minden.—Felt by and awakened many. Windows rattled and hanging objects swung.

Steamboat.—Two shocks of one and one half minutes, and four minutes. Awakened all. Small objects and furnishings were moved.

INTENSITY V IN CALIFORNIA:

Emigrant Gap (Spaulding Camp).—Three shocks observed by several. Loose objects rattled and building creaked.

Marysville.—Felt by several. Small objects and furnishings shifted. Windows rattled.

Nevada City.—Many awakened by rapid motion.

INTENSITY IV:

Carson City, Mason, Nixon, Smith, Stillwater, Sulphur, and Winnemucca in Nevada. Alleghany, Bridgeport, Chilcoot, Coloma, Downieville, Foresthill, Grass Valley, Grizzly Flats, Jackson, Placerville, Quincy, and Sacramento in California.

INTENSITY III AND UNDER:

El Dorado, Sierra City, and Tahoe in California.

Reported not felt at 9 places in California and 2 in Nevada.

December 5: 18:36:03.* Beverly Hills. Epicenter about 33°59′ north, 118°23′ west. According to press, a single sharp jolt was felt. No damage was reported.

December 12: 1:59.9.* Epicenter roughly 37.6° north, 118.7° west. Felt slightly at Bishop (Owens River Gorge). Walls creaked and windows rattled.

December 12: 3:10. Markleeville. Slight. No details.

December 14: 5:13.8.* Epicenter roughly 38.7° north, 119.7° west. Markleeville, Calif., and Minden, Nev. Slight shock rattled windows.

December 17: 8:07:42.* (Aftershocks at 12:59.1,* 13:03.0,* 14:46.2,* the shock at 14:46.2* being "fairly hard.") Epicenter 38°44′ north, 119°41′ west, P. Intensity V at Markleeville and Topaz where many or all were awakened, small objects shifted and windows rattled. Also felt strongly at Bijou, Grass Valley, Grizzly Flats, Jackson, and in the vicinity of Sonora.

December 17: 17:16. Hollister. Light shock felt by many. Rattled windows.

December 17: 22:48. Reno, Nev. Professor Vincent P. Gianella of the University of Nevada reported that the shock was recorded there and that it was "felt by few in Reno but strongly felt in Carson Valley and points to the south and east. I judge that its epicenter was somewhere in the vicinity of Sweetwater."

December 18: 17:47.9* and 17:52.9.* Markleeville. Two shocks felt.

December 19: 22:47.7.* Markleeville. Shock felt.

December 20: 4:12.7,* 23:00, 23:10. Markleeville. Three shocks felt. The shock at 4:12.7* was a "fairly hard shock."

December 21: 22:58 and 23:02.6.* Salt Springs Power House (near Jackson). Awakened one and rattled dishes.

December 21: 23:02.6.* Markleeville. One shock felt.

December 28: 8:10 (about). Mill Valley. Felt by many. Doors rattled.

December 29: 11:18. Intensity VI at Cowell and San Leandro. Figure 3. One strong motion record was obtained at Chabot Observatory in east Oakland. The shock centered in the San Francisco Bay region, probably between Hayward and San Leandro. It was felt over an area of about 2200 square miles.

INTENSITY VI:

Cowell.—Plaster cracked and knickknacks fell. Pendulum clocks stopped. Felt by many.

San Leandro.—House creaked. Small objects and furnishings shifted. Knickknacks fell.

INTENSITY V:

Berkeley.—A sharp shock felt by all rattled windows and doors.

Half Moon Bay.—A shock felt by several rattled windows and overturned vases.

Oakland.—Numerous reports indicate the shock was generally felt in Oakland where airport towers swayed sufficiently to tighten telephone wires. Some lighting fixtures fell. Windows and doors rattled.

Orinda.—Felt by many. Motion rapid like an explosion.

San Francisco.—Many reports indicate the shock was generally felt here. Small furnishings and pictures were moved. Windows rattled.

INTENSITY IV:

Burlingame, Hayward, Lafayette, Martinez, Mill Valley, Moss Beach, Petaluma, Redwood City, St. Marys College, San Bruno, San Mateo, and Walnut Creek.

INTENSITY III AND UNDER:

Emeryville, Niles, Pinole, San Anselmo, Sausalito, Sebastapol, Sunnyvale, and Vallejo.
Reported not felt at 14 other places canvassed.

WASHINGTON AND OREGON

(PACIFIC WAR OR 105TH MERIDIAN TIME)

January 30: 22:54. May have centered near San Juan Island, Wash., though the data are not complete enough to draw a definite conclusion. The shock was felt in Canada, especially in Vancouver, but details are not available. It was not a strong shock. Some towns within the felt area returned negative reports. Felt reports were received from Blaine, Coupeville, Everson, Marietta, Mount Vernon, Point Roberts, Port Angeles, Pysht, Sedro-Wooley, Sekiu, and Sumas.

Not felt in 22 places, including Anacortes, Bellingham, Clallam Bay, Friday Harbor, and Port Townsend.

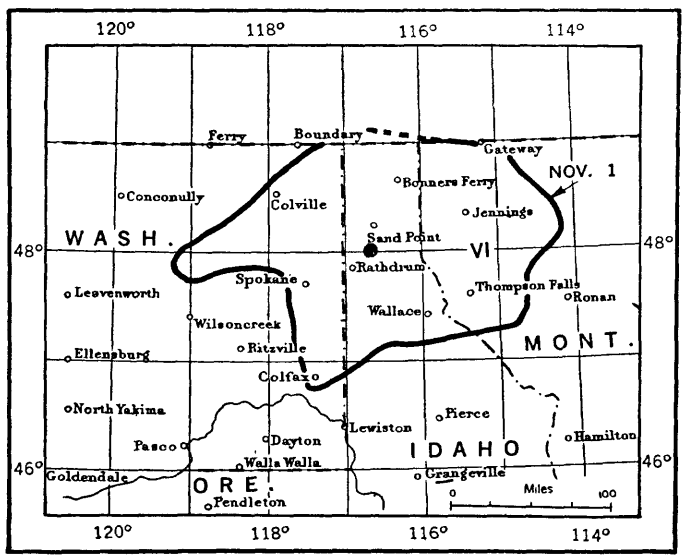

FIGURE 4.—Areas affected by the Washington-Idaho-Montana earthquake of November 1, 1942.

February 23: 7:03. Washington. Light shock felt at Chelan, Chelan Falls, Cle Elum, Ellensburg, Entiat, Morton, Omak, and Wenatchee. Reported not felt at 58 places.

May 11: 3:50. Felt in Washington at Lynden where the walls creaked and some people were awakened. Reported not felt at 12 towns.

May 11: 13:00. Felt slightly in Washington at Nooksack. Six towns reported the shock was not felt.

May 12: 17:52. Oregon. Maximum intensity V reported at Corvallis where it was felt by many. Not felt reports were received from 5 towns including Corvallis.

June 12: 2:30. Oregon. Northwest part of Baker County. Press reports indicate that the shock was felt at Baker, Halfway, Eagle Valley, Pine, and Richland. Reported strongest at Halfway and Eagle Valley. Broken dishes reported at halfway and a table upset at Eagle Valley. Maximum intensity about V.

October 14: 4:30. Intensity V at Stehekin, Wash., and south of Mt. McGregor, where all were awakened, plaster cracked, and large rocks were sent crashing down the mountainside.

The shock was also felt in Washington at Holden, Lucerne, and Mazama. Negative reports were received from 9 towns.

November 1: 10:00. Intensity V at Portland, Oreg., where plaster cracked, windows rattled, and small objects were shifted.
November 1: 11:50.* Northern Idaho earthquake felt strongly in Washington. See Western Mountain Region for complete details.
November 1: 12:30. Madras, Oreg. Light shock rattled doors.
December 1: 6:35. Entait, Wash. Light shock rattled windows.
December 14: 19:45. Eatonville (Clear Lake), Wash. Light shock felt by several. Rattled doors, windows, and dishes.

ALASKA

(135TH MERIDIAN TIME)

January 30: 3:58. Fairbanks. Sharp shock felt by several.
April 13: 12:05. Nome. Light shock felt by several.
May 19: 1:35. 4:05, and 4:15. Anchorage. A series of light shocks felt by several.
May 29: 17:15. Nome. Slight shock felt by several. Barograph pen displaced ¼ inch. "Pedestal lamp in dentist's office observed swinging in 1 foot arc."
June 4: 15:55. Anchorage. Slight shock felt by several.
July 21: 1:55. Fairbanks. Slight shock felt by several.
September 9: 16:29. Fairbanks. Slight shock felt by several.
September 13: 22:30. Fairbanks. Slight shock felt by several.
September 17: 23:50. Fairbanks. Several shocks in 30 seconds. One was severe.
November 19: 4:20. Fairbanks. Slight shock felt by several.
December 5: 3:45. Anchorage. Sharp shock rattled dishes. Recording rain gauge pen made distinct jogs.
December 14: 7:37. Fairbanks. Slight shock felt by several.

HAWAIIAN ISLANDS

(HAWAIIAN STANDARD TIME)

NOTE.—In the case of these islands with their many earthquakes of volcanic origin, only the stronger ones are listed. Reports of the Hawaiian Volcano Observatory under the jurisdiction of the National Park Service and the University of Hawaii give all details.

January 25: 6:13. Slight. Broke dishes at Kilauea Military Camp.
March 20: 23:05. Widely felt on southwest rift of Mauna Loa. Stopped clocks in South Kona.
April 26: 23:41. Moderate. Felt at Kilauea and in Hilo.
July 9: 3:00. Slight. Felt at Kilauea and strongly at Kohala.
September 27: 2:57 and 17:36. Slight. Felt at Kilauea.

PHILIPPINE ISLANDS

Reports from the Philippine Islands have been suspended for the duration of the war.

PUERTO RICO

No activity was reported from Puerto Rico during the year.

PANAMA CANAL ZONE

(EASTERN WAR TIME)

NOTE.—Instrumental times given below are the arrival times of the first recorded phases on the seismograph at Balboa Heights unless otherwise stated.

March 2: 4:40.* Felt by a few in Panama City and Ancon on the Pacific coast and at New Cristobal on the Atlantic coast; also at Chico and Candelaria on the upper Chagres River.
March 12: 22:32.* Felt slightly at Balboa Heights.
October 1: 20:01.* Felt by a few on the Pacific coast.
December 22: 2:25.* Felt by a few on the Pacific coast.
December 22: 20:49.* Felt by a few on the Pacific coast.
December 22: 21:13.* Felt by many on the Pacific coast.
December 26: 8:32.* Felt by a few in Balboa and Cristobal.

UNCLASSIFIED REGIONS

January 31: 22:47. Local time. Vancouver, B. C. An earth tremor shook buildings in the downtown and residential districts. Two distinct shocks were felt. Chandeliers and lights swung. No damage.
September 27: 11:54, Eastern War Time. Santiago, Cuba. Light shock felt.
November 2: 0:22, Eastern War Time. Swan Island. Slight shock felt. Barograph pen disturbed. (Note.—Swan Island is in the western Caribbean Sea near 17.8° north latitude and 84.0° west longitude.)

MISCELLANEOUS ACTIVITIES

GEODETIC WORK OF SEISMOLOGICAL INTEREST

No geodetic work of seismological interest was done during the calendar year 1942.

TIDAL DISTURBANCES OF SEISMIC ORIGIN.

Tidal disturbances were noted for one earthquake during the year. The shock occurred on August 24 at 17 hours 51 minutes, 75th meridian time. It was destructive at Nazca and Ica, Peru, and had an estimated focal depth of 150 kilometers. Tidal disturbances were recorded at two tide stations in Peru, namely Materani and Callao. These are in a group of 14 stations located in Central and South American Countries through cooperation with the United States Government. The projects were sponsored by the United States Department of State and carried out by the Coast and Geodetic Survey in cooperation with local authorities.

1. Materani (near Mollendo) is about 230 miles in a southeasterly direction from the epicentral region. A clearly defined disturbance begins on the tide record at 18h 30m, 75th meridian time. This is approximately 39 minutes after the earthquake occurred indicating a hypothetical velocity of about 368 miles per hour. This velocity is hypothetical because it is based on an overland path.

2. Callao is about 230 miles in a northwesterly direction from the epicentral region. A disturbance with a somewhat indefinite onset begins on the record at about 19h 30m, 75th meridian time. This is approximately 1h 39m after the earthquake occurred and indicates a hypothetical velocity of nearly 145 miles per hour under circumstances similar to those for Materani.

Both of these velocities are based on the overland distances from the epicentral position to the recording stations. Since the lines run inshore near the coast the actual distances traveled by the disturbance along the water routes were slightly greater with a corresponding increase in the indicated velocities. There is no satisfactory way of determining the actual origin point or the courses taken by the recorded disturbances. The values given must therefore be considered as somewhat smaller than the maximum possible velocities on the assumption that the source of the sea waves was equidistant from the recording stations, as is the case for the instrumental epicenter.

There is no immediate explanation of the wide difference in the two velocities beyond a suggestion that the water waves might have resulted from a submarine slide or slides caused by the earthquake. The most probable location of such phenomena would be some distance off shore along the edge of the continental shelf. In such a case the sea wave could have originated at a point more nearly equidistant from the recording stations and therefore resulted in more nearly equal velocities.

A second disturbance of doubtful character was reported through the press stating that Gorgona Island in Buenaventura Bay "was submerged by a huge wave" shortly after the earthquake of May 22. This shock occurred to 10h 30m, G.C.T., and was felt in Colombia, South America, at a point inland from Buenaventura Bay. There is doubt about the exact nature of this disturbance because a tide staff record taken in the bay shows no unusual changes during the period in question.

SEISMOLOGICAL OBSERVATORY RESULTS

The Coast and Geodetic Survey publishes the results of its teleseismic stations and cooperating stations monthly 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 to the Director of the Coast and Geodetic Survey.

Instrumental results are published for the following observatories:

Balboa Heights, C. Z. (the Panama Canal).
Bermuda (Meteorological Station, St. George's, and International Union of Geodesy and Geophysics).
Boulder City, Nev. (Bureau of Reclamation, National Park Service).
Bozeman, Mont. (Montana State College).
Burlington, Vt. (University of Vermont).
Butte, Mont. (Montana School of Mines).
Chicago, Ill. (University of Chicago and United States Weather Bureau).
College, Alaska (University of Alaska).
Columbia, S. C. (University of South Carolina).
Des Moines, Iowa (Private station, M. M. Seeburger, director).
East Machias, Maine (Massachusetts Institute of Technology).
Honolulu, T. H. (University of Hawaii).
Huancayo, Peru (Carnegie Institution of Washington).
Ivigtut, Greenland (Geodaetisk Institut, Copenhagen, Denmark).
Lincoln, Nebr. (Nebraska Wesleyan University).
Logan, Utah (Utah State Agricultural College).
Montezuma, Chile (Smithsonian Institution).
Philadelphia, Pa. (The Franklin Institute).
Salt Lake City, Utah (University of Utah).
San Juan, P. R.
Seattle, Wash. (University of Washington).
Scoresby-Sund, Greenland (Geodaetisk Institut, Copenhagen, Denmark).
Sitka, Alaska.
Tucson, Ariz.
Ukiah, Calif. (International Latitude Observatory).

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

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

Balboa Heights, Burlington, Des Moines, East Machias, 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 Scoresby-Sund and Ivigtut, in Greenland.

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

The provisional epicenter results for 1942 were not ready when this publication went to press. Those for the year 1941 are listed in table 1. Those for the stronger shocks of 1942 are listed in table 2.

TABLE 1.—*Summary of instrumental epicenters for 1941*

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 near-by stations are usually given preference. More detailed information will be found in the Seismological Bulletins (formerly Seismographic Reports) of the Coast and Geodetic Survey, and in the bulletins of other organizations and stations.

1941	Greenwich civil time at origin	Region and focal depth	Coordinates of provisional epicenter	
			Latitude	Longitude
	h *m*		° ′	° ′
Jan. 2	16 49.5	Celebes Sea. Depth 500 km	2.5 N.	123.5 E.
Jan. 3	9 16.0	Guatemala	15.8 N.	91.2 W.
Jan. 5	18 47.1	Celebes Sea. Depth 100 km	2.1 N.	122.9 E.
Jan. 6	9 48.5	Southwest of Nicaragua	11.8 N.	86.2 W.
Jan. 9	9 28.7	Lower California	31.7 N.	115.1 W.
Jan. 11	8 31.8	Arabia	16 N.	44.5 E.
Jan. 12	12 08.0	Lower California	31.7 N.	116.5 W.
Jan. 13	16 27.8	New Britain. Depth 100 km	4.6 S.	151.2 E.
Jan. 14	10 27.9	Aleutian Islands	54 N.	156.5 W.
Jan. 17	12 35.6	Near Puerto Rico	18.8 N.	62.8 W.
Jan. 19	3 13.4	South Atlantic Ocean	51 S.	35 W.
Jan. 20	3 37.1	Cyprus. Destructive. Depth 100 km	35.2 N.	33.8 E.
Jan. 20	13 58.3	California	35.3 N.	119.2 W.
Jan. 21	12 42.0	India. Depth 200 km	27.7 N.	82.0 E.
Jan. 24	5 44.1	Peru. Depth 200 km	4.1 S.	76.2 W.
Jan. 24	15 36.0	Mid-Atlantic Ocean. Depth slightly below normal	0.8 N.	19.8 W.
Jan. 25	23 35.0	Near Samoa Islands. Depth slightly below normal	12 S.	177 W.
Jan. 30	1 34.8	California	34.0 N.	118.0 W.
Feb. 2	23 38.5	Near coast of Colombia	6.1 N.	77.2 W.

TABLE 1.—*Summary of instrumental epicenters for 1941*—Continued

1941	Greenwich civil time at origin		Region and focal depth	Coordinates of provisional epicenter	
				Latitude	Longitude
	h	m		° ′	° ′
Feb. 4	14	03.1	Philippine Islands. Depth 500 km	9.5 N.	124 E.
Feb. 5	13	33.1	Lower California. Depth normal	31.7 N.	115.1 W.
Feb. 7	15	13.6	Bering Sea. Depth 60 km	57.2 N.	164.7 E.
Feb. 8	18	46.1	Celebes	1 N.	122 E.
Feb. 9	9	44.1	Off coast of California	40.6 N.	125.3 W.
Feb. 9	19	19.5	Near New Ireland	3 S.	153.5 E.
Feb. 11	4	50.8	Off coast of California. Aftershock	40.6 N.	125.3 W.
Feb. 11	14	35.6	Off south coast of Mexico	15.4 N.	94.7 W.
Feb. 13	11	32.5	Colorado	38.9 N.	106.8 W.
Feb. 13	14	49.5	Off west coast of Mexico	24 N.	108.5 W.
Feb. 13	21	09.0	Gulf of California (?) Foreshock. Depth normal	29 N.	115 W.
Feb. 13	22	11.0	----do	29 N.	115 W.
Feb. 14	1	09.0	Gulf of California (?) Depth normal	29 N.	115 W.
Feb. 14	18	55.0	South Pacific Ocean	56 S.	133 W.
Feb. 15	9	56.3	Near coast of Guatemala	14.5 N.	92.0 W.
Feb. 16	16	39.0	Iran. Destructive	33.5 N.	58.5 E.
Feb. 19	10	11.9	Arizona	34 N.	111 W.
Feb. 20	16	54.5	California. Depth normal	34.5 N.	118.6 W.
Feb. 21	22	05.4	Off coast of California. Depth normal	33.5 N.	118.3 W.
Feb. 22	19	14.8	Southwest of Fiji. Depth 500 km	20.5 S.	173 E.
Feb. 23	8	12.0	Gulf of California. Depth normal	31 N.	115 W.
Feb. 23	11	32.2	Mexico	18 N.	100 W.
Feb. 23	18	36.2	California. Depth normal	33.5 N.	116.5 W.
Feb. 25	5	37.7	Near Timor Island. Depth 100 km	9 S.	125 E.
Feb. 26	13	09.5	California	33.3 N.	115.5 W.
Feb. 27	10	44.1	South of Mindanao Island	4 N.	127 E.
Feb. 28	3	28.0	Montana	44.8 N.	112.4 W.
Feb. 28	6	19.8	Colorado	37.8 N.	108.5 W.
Mar. 1	3	52.8	Greece	39.5 N.	22.3 E.
Mar. 1	12	47.1	California. Depth normal	33.4 N.	115.6 W.
Mar. 4	21	39.1	Off west coast of Mexico	18.5 N.	107 W.
Mar. 7	2	37.0	Gulf of California? Depth normal	31 N.	115 W.
Mar. 9	16	50.4	Off Pacific coast of Panama	4.5 N.	82 W.
Mar. 10	3	47.5	Near coast of Panama	8 N.	81 W.
Mar. 10	4	05.7	Off Pacific coast of Panama	7.5 N.	80.7 W.
Mar. 10	20	47.6	California. Depth normal	33.1 N.	116.0 W.
Mar. 12	2	53.3	Leeward Islands	16 N.	61 W.
Mar. 12	14	16.6	Off coast of Japan	39.3 N.	143.2 E.
Mar. 12	21	36.9	Pacific Ocean east of Japan	40 N.	143.5 E.
Mar. 15	5	46.3	Lower California	28.2 N.	113.2 W.
Mar. 16	7	42.5	Kurile Islands, Japan. Depth 150 km	49.9 N.	157.2 E.
Mar. 16	16	35.2	Sicily. Depth 100 km	37.9 N.	12.5 E.
Mar. 18	18	09.3	California.* Depth normal	33.3 N.	115.5 W.
Mar. 19	2	45.0	Near Japan. Depth 100 km	40 N.	143 E.
Mar. 21	3	13.9	California. Depth normal	33.7 N.	117.5 W.
Mar. 21	7	58.1	Atlantic Ocean. Depth slightly below normal	6.9 N.	34.4 W.
Mar. 22	8	22.7	Off coast of California. Depth normal	33.5 N.	118.1 W.
Mar. 22	12	08.1	Nevada	36.0 N.	114.6 W.
Mar. 23	9	00.5	Western Caribbean off Honduras	17.0 N.	83.8 W.
Mar. 23	21	08.9	California. Depth normal	33.4 N.	115.6 W.
Mar. 25	23	43.7	----do	34.2 N.	117.5 W.
Mar. 28	22	30.2	Near Kermadec Islands. Depth 100 km	30 S.	178.0 W.
Apr. 1	10	41.0	South of Kodiak Island	55.9 N.	153.6 W.
Apr. 2	15	46.5	Near Kermadec Islands	31.5 S.	179.5 E.
Apr. 3	14	55.3	Near Bolivia-Argentine border. Foreshock. Depth 300 km	22.5 S.	67 W.
Apr. 3	15	21.7	Near Bolivia-Argentine border. Depth 300 km	22.4 S.	67.0 W.
Apr. 6	7	19.7	Gulf of California	25 N.	110 W.
Apr. 6	22	55.3	El Salvador. Destructive	13.9 N.	88.8 W.
Apr. 7	20	08.6	Off coast of Chile	31 S.	75 W.
Apr. 7	23	29.3	South of Jamaica, Caribbean Sea	17.6 N.	78.3 W.
Apr. 8	3	47.2	Caribbean Sea	18 N.	79 W.
Apr. 8	10	06.4	South of Jamaica, Caribbean Sea	17.5 N.	77.5 W.
Apr. 8	18	10.0	Gulf of California(?) Depth normal	31 N.	114 W.
Apr. 9	15	50.0	----do	31 N.	114 W.
Apr. 9	16	09.0	----do	31 N.	114 W.
Apr. 9	17	08.5	Gulf of California(?)	31 N.	114 W.
Apr. 9	17	39.7	----do	31 N.	114 W.
Apr. 11	23	26.1	----do	31 N.	114 W.
Apr. 15	19	09.9	Mexico. Destructive	18.7 N.	102.9 W.
Apr. 15	19	45.9	Mexico. Aftershock	19 N.	103 W.
Apr. 15	23	42.8	----do	18 N.	103 W.
Apr. 16	1	38.6	----do	18.7 N.	102.7 W.
Apr. 18	6	16.1	Near Loyalty Islands	21 S.	170 E.
Apr. 19	7	53.7	Tibet	39 N.	97 E.
Apr. 20	17	38.5	Afghanistan. Destructive	39.5 N.	71 E.
Apr. 21	2	54.0	Aleutian Islands	53.1 N.	166.0 W.
Apr. 21	18	32.1	----do	54 N.	165.5 W.
Apr. 21	22	27.7	Loyalty Islands	21 S.	169 E.
Apr. 23	5	24.4	California. Depth normal	38.1 N.	116.4 W.
Apr. 24	1	04.3	Caribbean Sea near Jamaica	17.3 N.	77.5 W.
Apr. 25	12	11.9	Lower California	27.4 N.	115.2 W.
Apr. 27	5	34.5	Caribbean Sea near Jamaica	17.5 N.	79 W.
Apr. 27	13	01.6	Asia Minor	40 N.	35 E.
Apr. 28	19	43.6	Mexico. Destructive	19 N.	103 W.
Apr. 29	1	35.7	Australia	27 S.	117 E.

TABLE 1.—*Summary of instrumental epicenters for 1941*—Continued

1941	Greenwich civil time at origin	Region and focal depth	Coordinates of provisional epicenter	
			Latitude	Longitude
	h m		° ′	° ′
Apr. 30	9 45.6	Off east coast of Japan	34 N.	143 E.
May 1	7 07.8	Aleutian Islands	53.5 N.	166.0 W.
May 2	9 55.3	Solomon Islands. Depth 100–150 km	5 S.	153 E.
May 4	22 07.7	Australia	23 S.	142 E.
May 5	15 18.4	Manchukuo. Destructive	46 5 N.	126.9 E.
May 6	3 11.7	Nevada	37.3 N.	114.2 W.
May 7	19 33.9	Kurile Islands, Japan	45 N.	147 5 E.
May 8	10 21.8	Fiji Islands. Depth 600 km	18 S.	178 W.
May 9	5 32.6	Southeast Luzon, Philippine Islands	14 N.	123 E.
May 9	9 32.2	Off coast of Japan	40 N.	142 5 E.
May 9	9 37.9	Off coast of Japan. Aftershock	40 N.	142.5 E.
May 11	5 08.0	Peru	11.5 S.	76.9 W.
May 11	13 29.0	Near Pacific coast of Guatemala	14 5 N.	91.5 W.
May 13	16 01.8	Off coast of California	40 4 N.	126.0 W.
May 14	7 36.4	Greece	39.5 N.	23 E.
May 16	2 36.4	Off coast of California. Aftershock	40 4 N.	126.0 W.
May 16	7 14.5	Burma	23 5 N.	99 E.
May 17	2 24.9	Queen Charlotte Islands	10 S.	166.5 E.
May 21	23 43.0	Gulf of California	29 N.	113 W.
May 23	19 51.9	Turkey	37.0 N.	28.0 E.
May 30	17 29.7	Tonga Island region	22 S.	176 W.
June 4	8 47.3	California. Depth normal	35 4 N.	119.3 W.
June 4	8 56.0	----do	33 8 N.	117.8 W.
June 6	19 38.8	Nevada	36.9 N.	115.7 W.
June 6	21 01.6	Near east coast of Greenland	71 N.	17 W.
June 9	6 17.4	Off coast of Oregon	42.7 N.	126.1 W.
June 9	8 43.9	Off coast of Oregon. Aftershock	42.5 N.	125 W.
June 10	20 38.6	Iran	32 N.	47 E.
June 11	6 32.0	Off coast of California	40 N.	129 W.
June 11	23 13.4	China	29 5 N.	103 E.
June 13	15 01.4	Mexico	19 N.	103 W.
June 13	22 13.8	Marianas Islands	17 N.	150 E.
June 16	11 27.5	Philippine Islands	7 N.	127 E.
June 18	11 09.2	North Atlantic	52.5 N.	34.1 W.
June 18	20 58.9	East Indies	0	126 E.
June 21	17 41.5	Tonga Islands region. Depth 500 km	20 S.	178.5 W.
June 23	9 28.7	Celebes	2 S.	120 E.
June 25	17 15.0	Lower California. Depth normal	32.5 N.	115 9 W.
June 26	11 52.0	Bay of Bengal	12.8 N.	92.7 E.
June 27	7 55.8	Australia	26 S.	137 E.
June 27	17 11.7	Mexico. Depth 200 km	17 0 N.	93.1 W.
June 27	19 04.1	Bay of Bengal	11 N.	91.5 E.
June 29	22 06.7	Loyalty Islands. Depth 100 kn	21 S.	169 E.
June 30	15 57.3	California. Depth normal	33.1 N.	116.1 W.
June 30	16 57.0	Off coast of Lower California. Foreshock. Depth normal	25 N.	113 W.
June 30	17 04.2	Off coast of Lower California. Depth normal	25 N.	113 W.
July 1	6 25.9	Siberia	53 N.	107 E.
July 1	7 50.9	California. Depth normal	34.3 N.	119.6 W.
July 1	23 54.0	----do	34.3 N.	119.6 W.
July 3	7 11.7	Argentina	31.8 S.	68.1 W.
July 6	0 34.3	Southeast of Japan	31.3 N.	140 E.
July 6	21 13.8	----do	34 N.	143 E.
July 10	3 22.0	Marianas Islands	14 N.	146 E.
July 10	9 29.9	Chile. Depth 200 km	17.5 S.	70 W.
July 10	10 16.6	Marianas Islands	13 5 N.	146.5 E.
July 11	1 16.6	Off coast of Colombia	5 3 N.	82.7 W.
July 11	1 59.5	----do	5.3 N.	82.5 W.
July 12	16 18.0	California. Depth normal	34.3 N.	119.6 W.
July 13	15 00.3	Gulf of California	29.5 N.	113 W.
July 13	15 39.6	Aegean Sea	38.0 N.	26.1 E.
July 16	3 13.4	Gulf of California	24.3 N.	109 2 W.
July 17	7 48.0	West of Galapagos Islands	4 5 S.	105 W.
July 17	22 08.9	Near Iceland	78.5 N.	7 E.
July 18	3 53.9	Nevada	39.5 N.	118.8 W.
July 19	2 07.3	Off west coast of Mexico	16.5 N.	101 W.
July 19	9 24.3	East of the Azores	38.9 N.	21.4 W.
July 19	15 13.2	Japan	31.3 N.	132.7 E.
July 20	6 01.0	Near Loyalty Islands	22 S.	171.5 E.
July 21	16 36.1	Off coast of Liberia	1.0 S.	18.5 W.
July 22	18 52.1	California. Depth normal	32.7 N.	115.4 W.
July 23	1 17.4	Off west cost of Mexico	18.9 N.	106.8 W.
July 23	9 30.0	East of Japan	38.5 N.	149 E.
July 23	21 04.8	Off coast of Guatemala	14.9 N.	93.4 W.
July 24	5 10.6	Near Pacific coast of Panama	7.5 N.	83 W.
July 24	10 30.6	Near coast of El Salvador	13.5 N.	91.5 W.
July 24	13 52.9	Japan. Depth 200 km	28 N.	129 E.
July 26	20 11.3	Marianas Islands	15.9 N.	145.8 E.
July 30	2 51.4	Alaska	60.9 N.	151.4 W.
Aug. 2	11 41.5	Kermadec Islands. Depth 100 km	30.0 S.	177.6 W.
Aug. 3	10 44.3	Off coast of Chile	31 S.	72 W.
Aug. 3	19 55.8	Lower California. Depth normal	32.1 N.	116.7 W.
Aug. 4	0 25.0	Off west coast of Mexico	19.5 N.	109.5 W.
Aug. 4	10 53.4	Aleutian Islands. Depth 100 km	53.2 N.	179.7 W.
Aug. 6	6 15.2	Alaska. Depth 200 km	55.7 N.	162.4 W.
Aug. 10	5 05.2	Alaska	59.4 N.	138.0 W.

TABLE 1.—*Summary of instrumental epicenters for 1941*—Continued

1941	Greenwich civil time at origin	Region and focal depth	Coordinates of provisional epicenter	
			Latitude	Longitude
	h m		° ′	° ′
Aug. 10	17 02.8	Peru	5 S.	88 W.
Aug. 10	19 17.3	Argentina	25 S.	65.5 W.
Aug. 14	1 43.9	Argentina. Depth 300 km.	23.4 S.	66.8 W.
Aug. 15	6 09.4	Northwest of Cape Verde Islands	19.0 N.	26.2 W.
Aug. 19	10 02.7	California. Depth normal	33.1 N.	116.1 W.
Aug. 19	16 19.5	Nicobar Islands, Indian Ocean	8 N.	92 E.
Aug. 19	17 40.4	Queen Charlotte Islands	13.5 S.	166 E.
Aug. 21	0 01.4	Gulf of California	30.8 N.	113.9 W.
Aug. 22	18 56.8	Queen Charlotte Islands	14 S.	168 E.
Aug. 25	3 03.9	Off southern coast of Mexico	16.1 N.	99.6 W.
Aug. 27	18 31.5	----do	15.9 N.	98.4 W.
Aug. 28	3 49.1	Off west coast of Mexico	20 N.	110 W.
Aug. 28	6 45.3	----do	20 N.	110 W.
Aug. 28	20 27.2	North of Tonga Islands	16 S.	175 W.
Aug. 29	13 10.0	Nevada	40.8 N.	118.5 W.
Aug. 29	19 14.3	Nevada. Aftershock	40.8 N.	118.5 W.
Aug. 30	9 36.3	North of Marianas Islands	18.4 N.	147.1 E.
Aug. 30	13 06.9	----do	18.2 N.	147.1 E.
Aug. 30	13 28.9	Nevada	40.9 N.	118.3 W.
Sept. 3	4 22.0	Off west coast of Guatemala	14.5 N.	94 W.
Sept. 4	10 21.7	Region of New Britain. Depth 100 km.	5 S.	153 E.
Sept. 5	23 21.5	East of Kamchatka Peninsula	54 N.	166 E.
Sept. 7	0 50.9	Arctic Ocean northeast of Iceland	71.7 N.	3.8 W.
Sept. 7	22 22.8	Chile	19 S.	69.5 W.
Sept. 8	3 12.8	California	34.3 N.	119.6 W.
Sept. 8	11 19.7	Near west coast of Colombia	5 N.	78 W.
Sept. 9	7 19.7	Solomon Islands	7.0 S.	154.9 E.
Sept. 12	7 02.0	North of New Guinea	0.5 S.	143.0 E.
Sept. 13	18 14.9	Off west coast of Mexico	18.8 N.	106.7 W.
Sept. 13	20 59.1	California	35.9 N.	116.8 W.
Sept. 14	4 08.7	Near west end of New Guinea	1 S.	132 E.
Sept. 14	16 43.5	California	37.6 N.	118.7 W.
Sept. 14	16 55.0	----do	37.6 N.	118.7 W.
Sept. 14	18 21.3	----do	37.6 N.	118.7 W.
Sept. 14	18 39.2	----do	37.6 N.	118.7 W.
Sept. 15	1 37.0	----do	34.3 N.	119.6 W.
Sept. 16	21 39.1	Kermadec Islands	28.5 S.	178 W.
Sept. 17	6 47.9	Celebes Island region	0.5 N.	125 E.
Sept. 18	13 14.2	Peru. Depth 100 km.	13.7 S.	71.9 W.
Sept. 18	18 18.4	Samoa Islands	15.5 S.	172 W.
Sept. 21	19 53.1	California	34.9 N.	118.9 W.
Sept. 24	1 01.3	Kurile Islands, Japan	50 N.	158.5 E.
Sept. 25	17 48.6	Hawaii. Destructive	19.4 N.	155.5 W.
Sept. 28	5 33.6	Aleutian Islands	56 N.	164 W.
Sept. 29	17 08.2	Southeast of New Hebrides Islands	22 S.	174.5 E.
Sept. 30	8 19.3	Solomon Islands	9.5 S.	160 E.
Oct. 1	19 49.6	Off Vancouver Island	49.5 N.	130 W.
Oct. 3	16 13.2	Off coast of California. Destructive	40.7 N.	125.0 W.
Oct. 5	10 11.2	Samoa Islands	15.5 S.	173 W.
Oct. 6	6 59.0	Off coast of Cahfornia	40.7 N.	125.0 W.
Oct. 8	4 22.2	Near west coast of Costa Rica	10.3 N.	85.9 W.
Oct. 14	16 36.1	Aleutian Islands	51 N.	178 W.
Oct. 15	0 07.1	Peru. Depth 100 km.	16 S.	73.5 W.
Oct. 15	9 35.3	----do	16 S.	73.5 W.
Oct. 16	15 10.6	New Hebrides Islands	17.0 S.	167 E.
Oct. 22	6 57.3	California	33.8 N.	118.2 W.
Oct. 27	7 14.2	Alaska	61 N.	161 W.
Oct. 27	12 13.2	California	41.5 N.	123 W.
Oct. 28	10 33.9	----do	41.5 N.	123 W.
Oct. 31	12 41.0	Off coast of Oregon	43.9 N.	128.1 W.
Nov. 1	14 24.6	California. Depth normal	32.7 N.	115.8 W.
Nov. 4	2 26.8	Tonga Island region. Depth 600 km.	18 S.	178.5 W.
Nov. 5	13 05.4	Southeast of New Hebrides. Depth 100 km.	23 S.	172.5 E.
Nov. 5	17 38.8	Mindoro Sea, Philippine Islands. Depth 100 km.	11 N.	121 E.
Nov. 6	7 06.8	West of Queen Charlotte Islands	13.5 S.	163.5 E.
Nov. 6	12 29.6	Aleutian Islands	54 N.	164.5 W.
Nov. 6	17 31.9	West of Vancouver Island	49 N.	130 W.
Nov. 6	18 11.4	----do	49 N.	129 W.
Nov. 8	23 37.4	Celebes Sea	1.2 N.	122.5 E.
Nov. 10	9 44.9	Chile. Depth 200 km.	22.5 S.	68 W.
Nov. 12	10 04.7	Turkey. Destructive	36.8 N.	38.7 E.
Nov. 14	6 49.3	Sea of Okhotsk, near Kurile Islands, Japan	50 N.	151 E.
Nov. 14	8 41.6	California. Depth normal	33.8 N.	118.2 W.
Nov. 15	4 19.9	Sandwich Islands	59.5 S.	27.5 W.
Nov. 16	9 39.7	El Salvador	13.7 N.	88.2 W.
Nov. 18	10 14.6	Near South Orkney Islands	59.5 S.	51 W.
Nov. 18	16 46.4	Japan. Destructive	32.3 N.	132.0 E.
Nov. 21	16 57.0	California. Depth normal	34.3 N.	119.6 W.
Nov. 22	5 23.6	Panama	7.7 N.	80.8 W.
Nov. 24	21 46.3	Kermadec Islands	28.1 S.	177.4 W.
Nov. 25	18 03.9	Off coast of Portugal	37.6 N	18.7 W.
Nov. 26	8 23.1	Mexico	16 N.	97.5 W.
Dec. 1	19 56.3	South of Falkland Islands	54 S.	60 W.
Dec. 2	2 59.3	California	32.6 N.	115.5 W.
Dec. 5	20 47.0	Near coast of Costa Rica. Destructive	8.4 N.	83.0 W.
Dec. 6	1 25.0	Costa Rica	10.3 N.	85.2 W.

TABLE 1.—*Summary of instrumental epicenters for 1941*—Continued

1941	Greenwich civil time at origin	Region and focal depth	Coordinates of provisional epicenter	
			Latitude	Longitude
	h *m*		° ′	° ′
Dec. 6	21 24.7	Near coast of Costa Rica	8.5 N.	84.4 W.
Dec. 6	23 54.6	Costa Rica	8.4 N.	83.3 W.
Dec. 7	4 23.1	do	8.4 N.	83.3 W.
Dec. 7	11 41.9	do	8 N.	83 W.
Dec. 8	7 41.2	do	8.4 N.	83.3 W.
Dec. 14	16 21.7	Nevada	36.0 N.	114.8 W.
Dec. 16	19 19.6	Japan. Destructive	24 N.	120 E.
Dec. 21	5 37.2	Argentina	32.5 S.	67 W.
Dec. 23	1 20.0	Off coast of California	33.6 N.	118.0 W.
Dec. 23	11 16.2	California	34.0 N.	116.3 W.
Dec. 24	3 34.5	Mexico	26.5 N.	108 W.
Dec. 24	7 30.2	California	32.6 N.	116.1 W.
Dec. 24	12 02.4	Mexico	26.5 N.	108 W.
Dec. 27	18 17.6	Southwest of Portugal. Depth 100 km.	36.6 N.	10.8 W.
Dec. 31	6 48.7	California	37.6 N.	118.7 W.
Dec. 31	17 36.1	Off coast of Ecuador. Destructive	2.5 S.	81.5 W.

TABLE 2.—*Principal earthquakes of the world from January 1942 to December 1942, 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.

An asterisk (*) indicates local time.

Date	Origin Time G. C. T.	Place	Provisional Epicenters		Remarks. Depths. Principal facts.
			Lat.	Long.	
1942	*h* *m*		°	°	
Jan. 20	6 25.6	Mexico, off west coast	17.9 N.	105.6 W.	
Jan. 27	13 29.3	New Guinea	3.9 S.	135.3 E.	Magnitude 7, Pasadena scale.
Jan. 29	9 23.8	New Hebrides	19 S.	169 E.	150 km deep.
Feb. 21	7 07.8	Japan, near Sendai	38.2 N.	141.5 E.	70 km deep.
Mar. 1	9 52.0	El Salvador, off coast	13.3 N.	91.2 W.	
Mar. 5	19 48.2	Japan, Hokkaido	44.7 N.	141.1 E.	200 km. deep.
Mar. 19	11 59.4	British Columbia, off coast	51.2 N.	130.0 W.	
Mar. 20	1 13.0	Aleutians, near Fox Is.	52.4 N.	167.7 W.	
Mar. 21	23 20.8	Japan, south of	29 N.	132 E.	
Apr. 6		Bulgaria			Tutrakan. 100 homes reported destroyed. No casualties.
Apr. 8	15 40.3	Philippines, near Mindoro	12.5 N.	120 E.	
Apr. 13	7 46.2	Middle Atlantic Ocean	3 S.	14 W.	
May 14	2 13.4	Ecuador, Guyas Province	0.3 S.	80.0 W.	$2,500,000 damage. 200 killed. Four strong aftershocks recorded; another June 16. See July 4.
May 22	10 30.6	Colombia	4.6 N.	74.5 W.	Nearly all buildings in Girardot damaged. See section on Tidal Disturbances.
May 28	1 01.8	Celebes Is.	0.4 S.	122.6 E.	100 km deep.
June 5		Argentina			Canada Seca, Malvinas, Villa Ternel and Salta de la Rosa Districts. 50 per cent of homes reported destroyed.
June 14	3 09.6	Marianas Is.	15.0 N.	143.8 E.	
June 18	9 30.9	Caroline Is., west of	9.5 N.	138.9 E.	
June 20	10 02.1	Mexico	19.0 N.	100.7 W.	65 km deep. Felt in Mexico City.
June 24	11 16.6	New Zealand, North Is.	40.9 S.	175.4 E.	IX + R.-F. scale in Wairarapa district. 36 buildings badly damaged in Wellington. 100 km deep.
June 29	6 26.8	Chile, Santiago and Valparaiso	33.5 S.	70.5 W.	Moderate damage in both cities. 37 injured. 200 km deep.
July 4	4 59.5	Ecuador, near coast	0.5 N.	80.5 W.	18 epicenters reported between July 1 and 10. Others later. See May 14.
July 7	3 53.8	Tonga Is. region	21.4 S.	177.8 W.	400 km deep.
July 8	6 55.6	Chile	25.0 S.	69.7 W.	Deeper than normal. Felt at Copiapo.
July 25	6 22.5	Philippine Is., Samar	11.9 N.	125.5 E.	
July 29	22 49.2	Banda Sea	2.8 S.	127.9 E.	
Aug. 1	12 34.0	New Zealand, North Is.	41.1 S.	176.2 E.	XIII + R.-F. scale in Wairarapa district. Damage but no casualties.
Do.	14 -----	Probably Antarctic region			Southwest of Australia.
Aug. 2	11 35*	New Zealand			Considerable damage on North Is. No casualties.
Aug. 6	23 37.0	Guatemala	14.1 N.	90.9 W.	Acatengo destroyed. 9 killed, hundreds injured. Damage in western and central Guatemala and Mexico.
Aug. 13	15 44.7	Solomon Is. region	8 S.	156.5 E.	
Aug. 23	6 35.7	Kamchatka, east of	54.8 N.	164.8 E.	150 km deep.
Aug. 24	22 50.7	Peru, near Lima	14.7 S.	75.0 W.	Destructive at Nazca and Ica. 22 killed; 50 injured. Possibly 150 km deep. Another epicenter reported on 25th. See section on Tidal Disturbances.

TABLE 2.—***Principal earthquakes of the world from January 1942 to December 1942, inclusive***—Continued

Date	Origin Time G. C. T.	Place	Provisional Epicenters		Remarks. Depths. Principal facts.
			Lat.	Long.	
1942	*h* *m*		°	°	
Sept. 9	1 05.4	Aleutian Is. near Unalaska	53.0 N.	165.7 W.	100 km deep. Aftershock on 25th.
Sept. 26	4 00.3	El Salvador	12.8 N.	87.7 W.	Near San Salvador.
Oct. 20	23 21.8	Philippine Is., Mindoro Sea	7 N.	123 E.	
Oct. 26	21 09.2	Kurile Is.	45.8 N.	152.0 E.	
Nov. 6	13 31.2	Peru	6.2 S.	76.5 W.	100 km. deep.
Nov. 10	11 41.4	Off South Africa	48 S.	32 E.	
Nov. 12	4 55.5	Mexico	16.6 N.	94.5 W.	Felt in Oaxaca. 100 km deep.
Nov. 15		Turkey			Some casualties and severe damage in Anatolia.
Nov. 25	1 18.0	Mexico	16.9 N.	97.7 W.	
Nov. 26	14 27.6	Kurile Is.	46 N.	149 E.	200 km deep.
Nov. 28	10 38.7	Atlantic Ocean	7.0 N.	35.5 W.	
Dec. 3		Turkey, Anatolia			4 killed, 9 injured near Circum.
Dec. 9	22 19.0	Aleutian Is., near Unalaska	53.4 N.	166.0 W.	
Dec. 20	14 03.0	Turkey, Anatolia	40 N.	37 E.	Erba destroyed; Niksar and Tokat hard hit. 1000 killed, 600 injured, 5000 buildings destroyed or damaged. Also destructive aftershocks.
Dec. 26	12 31.8	Colombia	9.6 N.	75.6 W.	Churches and houses reported destroyed in Bolivar Province.
Dec. 31	12 03.6	Atlantic Ocean	17.5 N.	47.0 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 eight preceding issues of this series, Serials 579, 593, 600, 610, 619, 629, 637, and 647, 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 1942" 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.

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 1942 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 centimeters per second for acceleration. It is sometimes desirable to express acceleration in terms of the acceleration of gravity, indicated by "g." which is equal to 980 cm./sec.^{2} For practical purposes it is only necessary to point off three decimal places to convert cm./sec.^{2} to "g."

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 1.43 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 3 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 3 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.

Beginning with this issue acceleration scales are being 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 as outlined in the section entitled "Principal Changes in Strong-Motion Instrument Equipment During 1942".

In the notes following table No. 3 listing the strong-motion records obtained during 1942 the maximum values of acceleration and displacement given refer to the maximum values for individual components. They are not resultant values unless so stated. The actual maximum may consequently be considered as greater than those given in practically all cases.

TABLE 3.—***List of shocks recorded and records obtained on strong-motion seismographs in 1942***

Date, epicenter, and recording station	Records			Date, epicenter, and recording station	Records		
	Accelerograph	Displacement meter	Weed strong-motion seismograph		Accelerograph	Displacement meter	Weed strong-motion seismograph
May 23: southern California: El Centro	1			Oct. 21: Borego Valley—continued:			
Aug. 11: Boulder Dam:				Los Angeles Chamber of Commerce	2		
1215 gallery	1			Los Angeles Subway Terminal	1	1	
Intake tower	1			Long Beach	1		
Oil house	1			San Diego	1		
Aug. 18: Hawthorne, Nevada	1			Vernon	1		
Sept. 8: Boulder Dam:				Dec. 29: San Francisco Bay:			
1215 gallery	1			Oakland-Chabot Observatory			1
Intake tower	1						
Oil house	1						
Oct. 21: Borego Valley:[1]							
Colton	1	1					
El Centro	1			Totals	19	2	1
Hollywood Storage Company Building	3						

[1] A number of aftershocks were recorded. In all 22 records were obtained though some were too weak to be of value.

SOUTHERN CALIFORNIA EARTHQUAKE OF MAY 23

Epicenter on the San Jacinto fault near Carrizo creek. Maximum intensity, IV.

El Centro.—Figure 5. Station about 28 miles southeast of the epicenter. Intensity IV. Periods were about 0.4 to 0.7 seconds. Computed maximum displacement approximately 0.06 cm.

BOULDER DAM EARTHQUAKE OF AUGUST 11

Epicenter about 4 to 6 miles south of Boulder Dam. Maximum intensity about V. Stations at or near the dam.

1215 Gallery.—Figure 5. Station north of epicenter. Maximum acceleration 37 cm/sec.^{2} Computed maximum displacement 0.007 cm.

Intake Tower.—Figure 5. Station north of epicenter. Maximum acceleration 67 cm/sec.^{2} Computed maximum displacement 0.043 cm.

Oil House.—Figure 5. Station north of epicenter. Maximum acceleration 44 cm/sec.^{2} Computed maximum displacement 0.011 cm.

HAWTHORNE EARTHQUAKE OF AUGUST 18

Epicenter about 10 miles northeast of Hawthorne, Nevada. Maximum intensity approximately V.

Hawthorne.—Figure 5. Intensity IV. Maximum acceleration 7 cm/sec.^{2} Computed maximum displacement 0.030 cm.

BOULDER DAM EARTHQUAKE OF SEPTEMBER 8

Epicenter about 6 miles north northeast of Boulder Dam. All stations are in or near the dam. Maximum intensity about V.

1215 Gallery.—Figure 6. Maximum acceleration 32 cm/sec.^{2} Computed maximum displacement 0.022 cm.

Intake Tower.—Figure 6. Maximum acceleration 48 cm/sec.^{2} Computed maximum displacement 0.030 cm.

Oil House.—Figure 6. Maximum acceleration 17 cm/sec.^{2} Computed maximum displacement 0.005 cm.

BOREGO VALLEY EARTHQUAKE OF OCTOBER 21

Epicenter in the San Jacinto fault zone near Borego Valley. Figure 3. Maximum intensity about VII. The principal damage resulted from rock slides at a point about 12 miles north of Jacumba where a bridge was damaged.

Colton.—Figure 8. About 110 miles southeast of the epicenter. Intensity IV. Maximum acceleration 9 cm/sec.^{2} Maximum computed displacement about 0.012 cm. The displacement meter record indicated a maximum displacement of 0.043 cm combined with a 9 second period.

El Centro.—Figure 7. About 30 miles southeast by east from the epicenter. Intensity VII. Maximum acceleration 56 cm/sec.^{2} Maximum computed displacement 0.126 cm.

Hollywood.—Figure 8. About 150 miles northwest by west from the epicenter. Intensity III. Only the penthouse and adjoining P. E. lot records are shown in the figure. The basement record (Hollywood Storage Company Building) is not shown since it is very similar to the one obtained on the P. E. lot. The maximum recorded accelerations and maximum computed displacements follow:

Station	*Acceleration*	*Displacement*
Hollywood Storage Company Basement	3 cm/sec.^{2}	0.032 cm
Hollywood Storage Company Penthouse	8 cm/sec.^{2}	0.212 cm
Hollywood Storage Company, P. E. lot	4 cm/sec.^{2}	0.032 cm

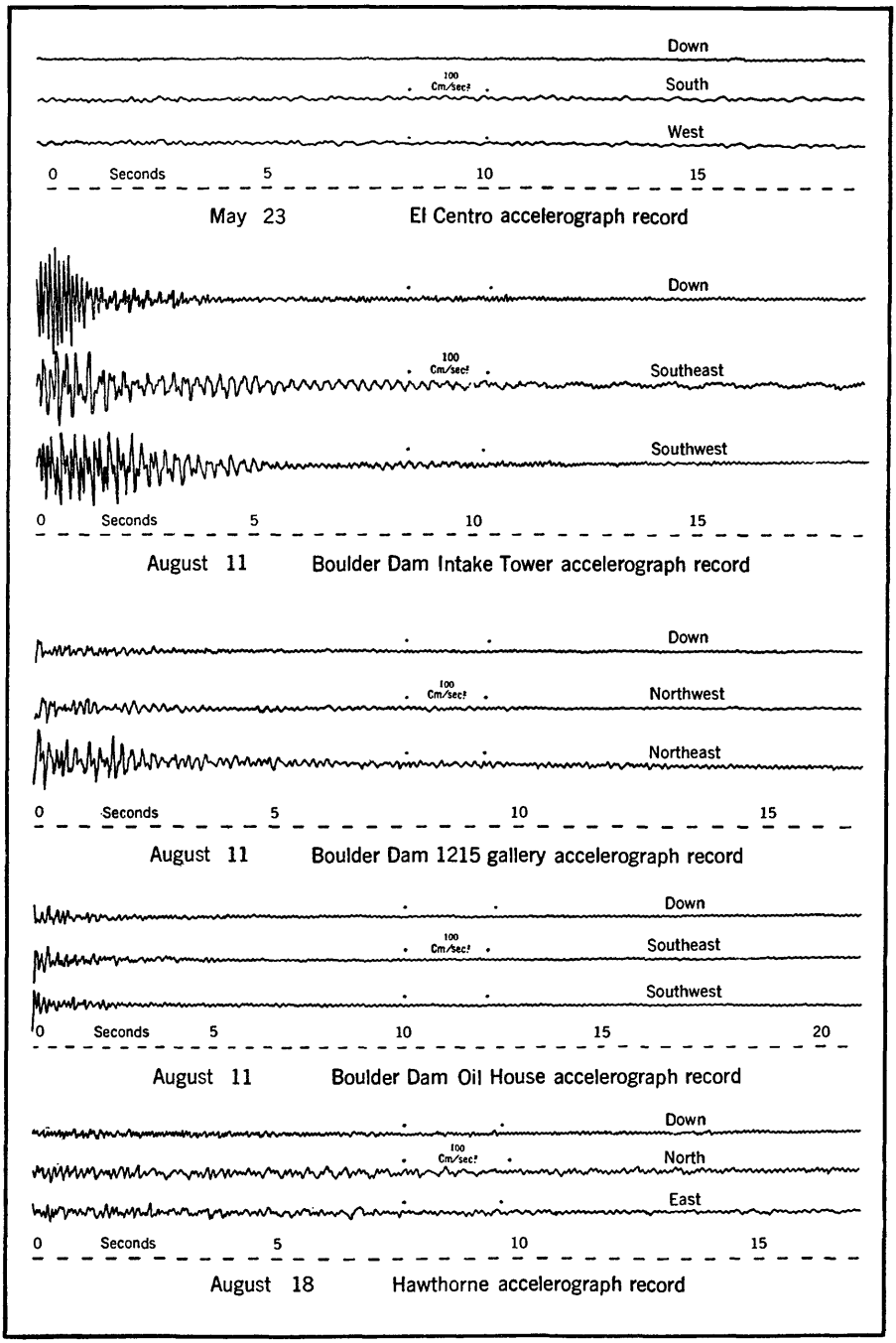

FIGURE 5.—Tracings of the accelerograph record obtained at El Centro on May 23, Boulder Dam on August 11, and at Hawthorne on August 18, 1942.

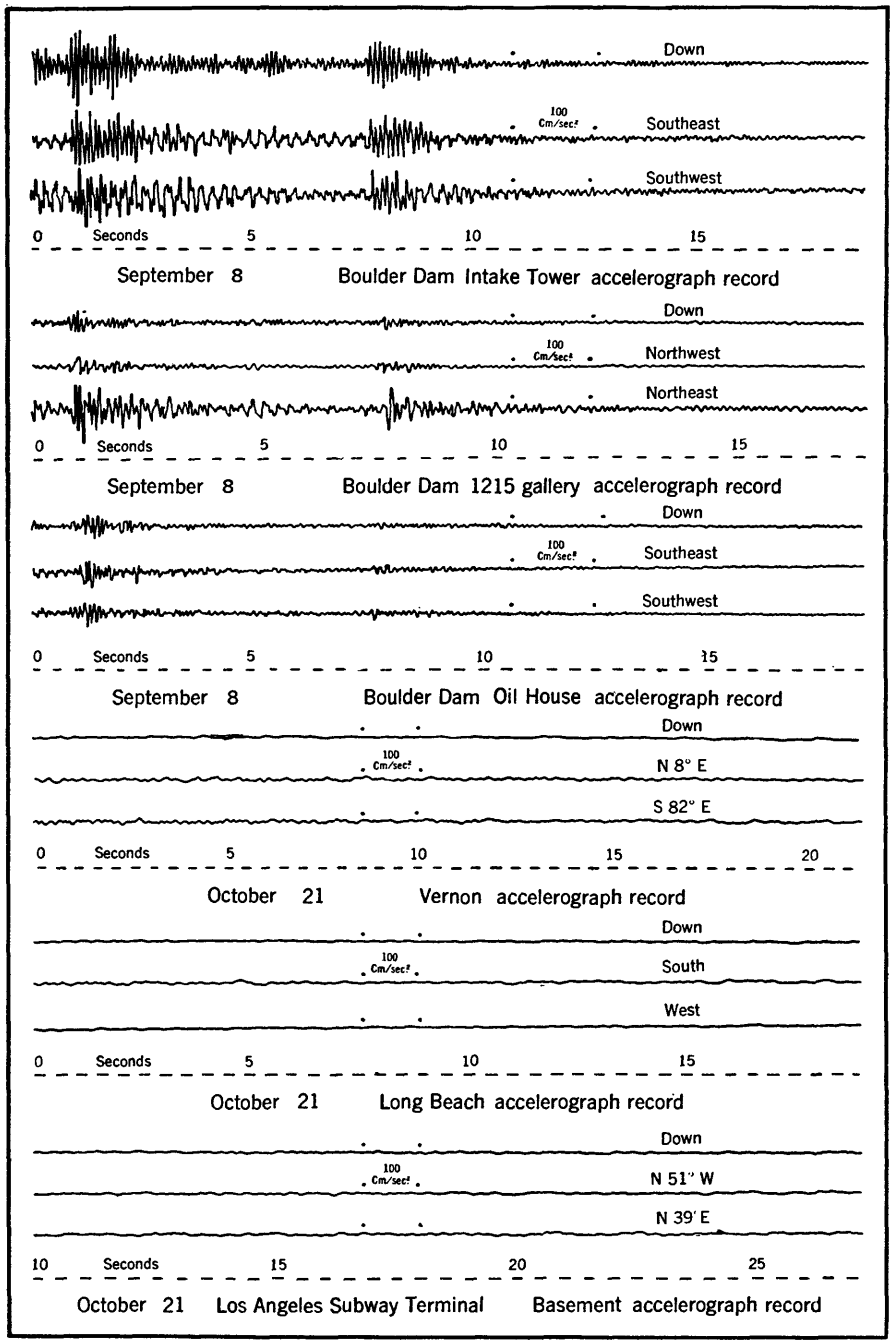

FIGURE 6.—Tracings of accelerograph records obtained at Boulder Dam on September 8, Vernon, Long Beach, and Los Angeles on October 21, 1942.

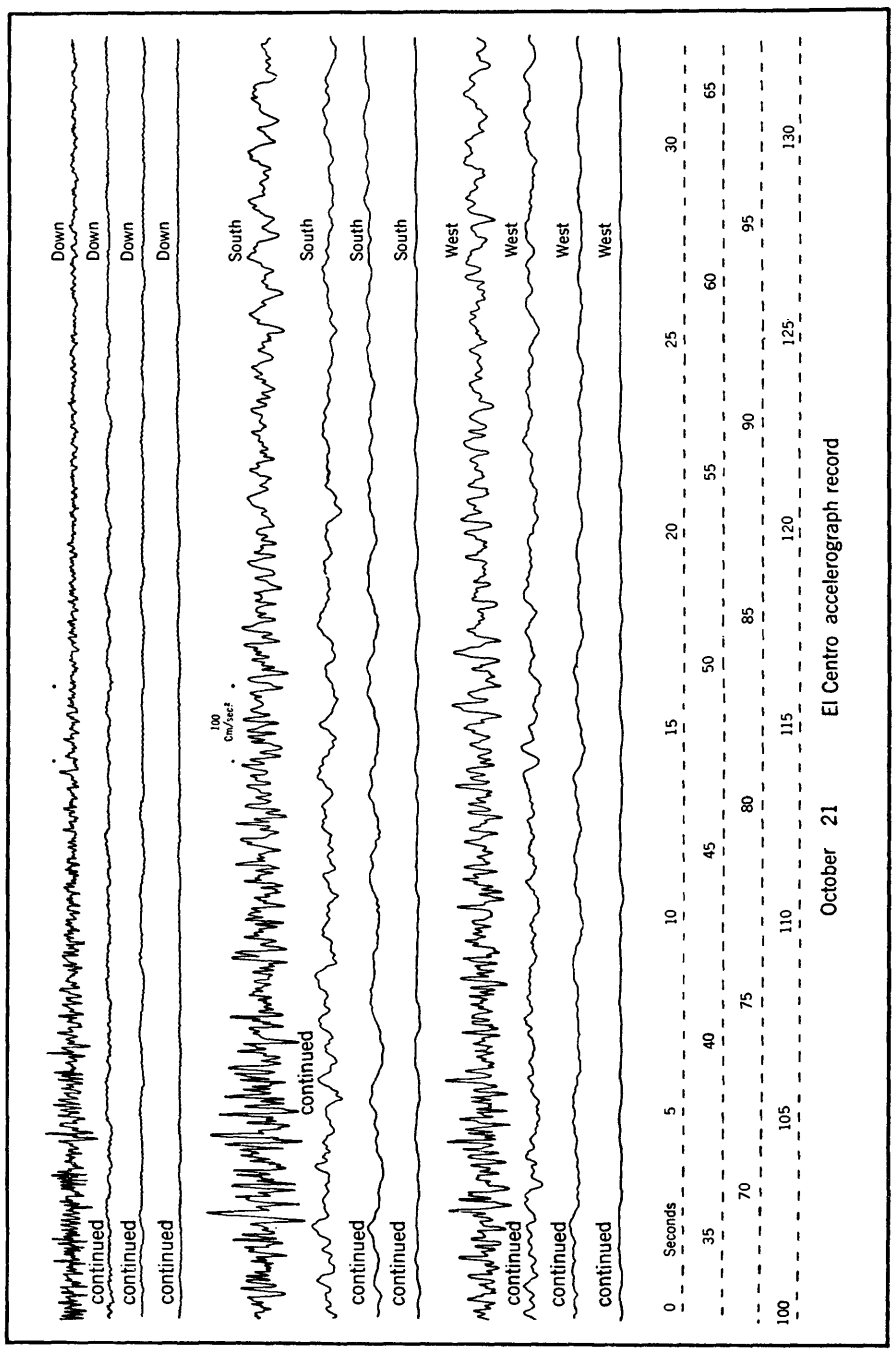

FIGURE 7.—Tracings of accelerograph records obtained at El Centro on October 21, 1942.

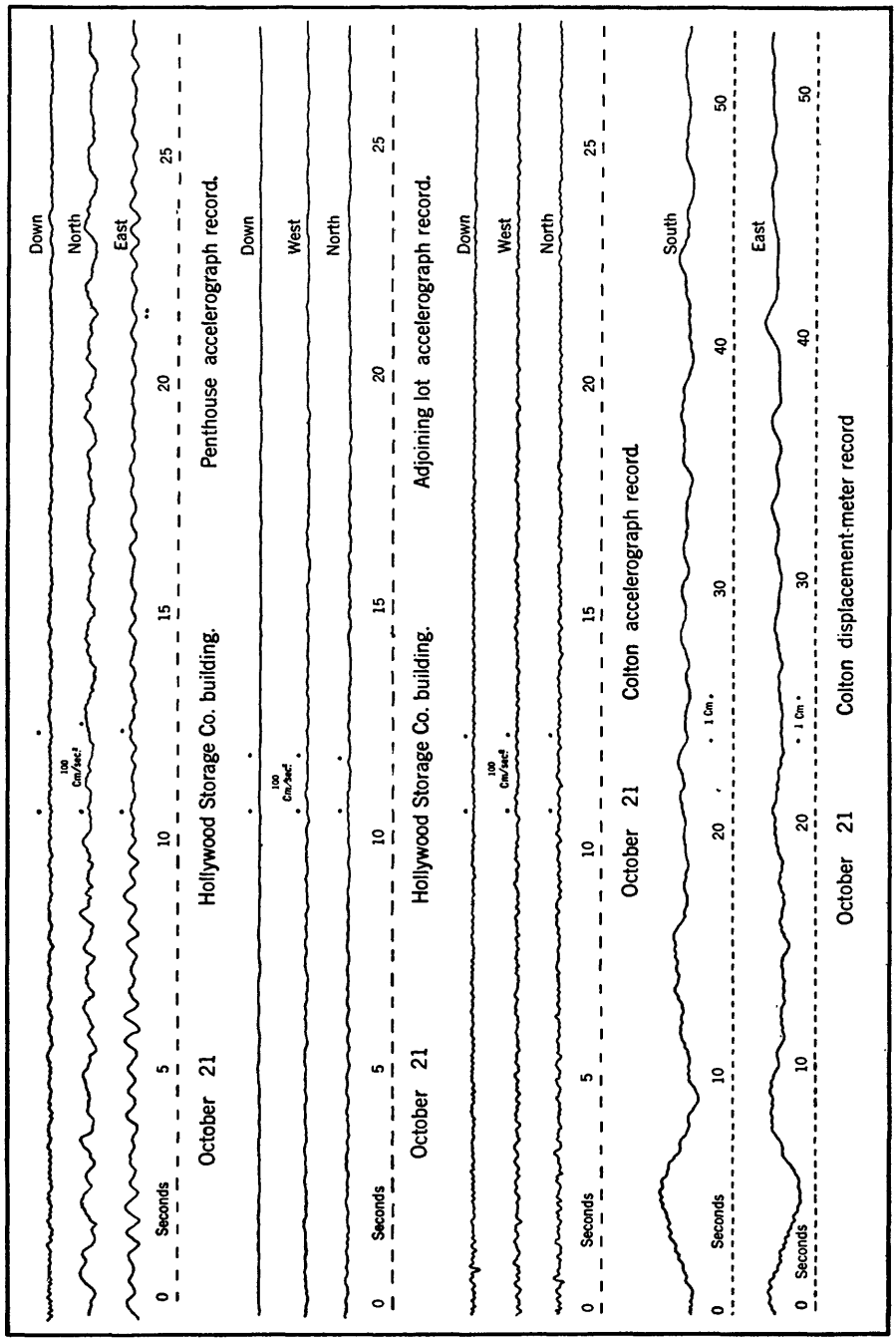

FIGURE 8.—Tracings of accelerograph records obtained at Hollywood and Colton on October 21, 1942. Also the Colton displacement meter record for the same date.

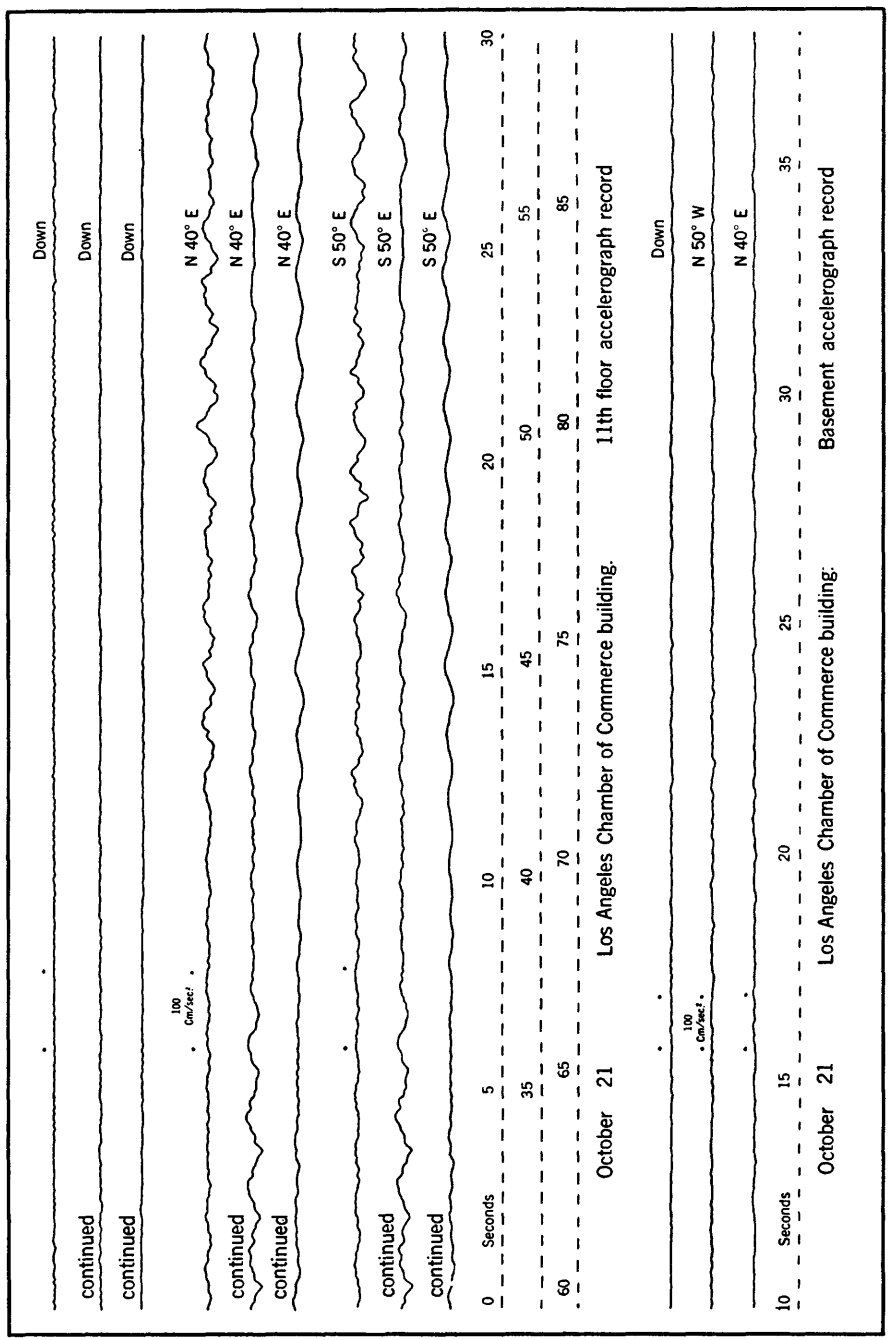

FIGURE 9.—Tracings of the accelerograph records obtained at Los Angeles on October 21, 1942.

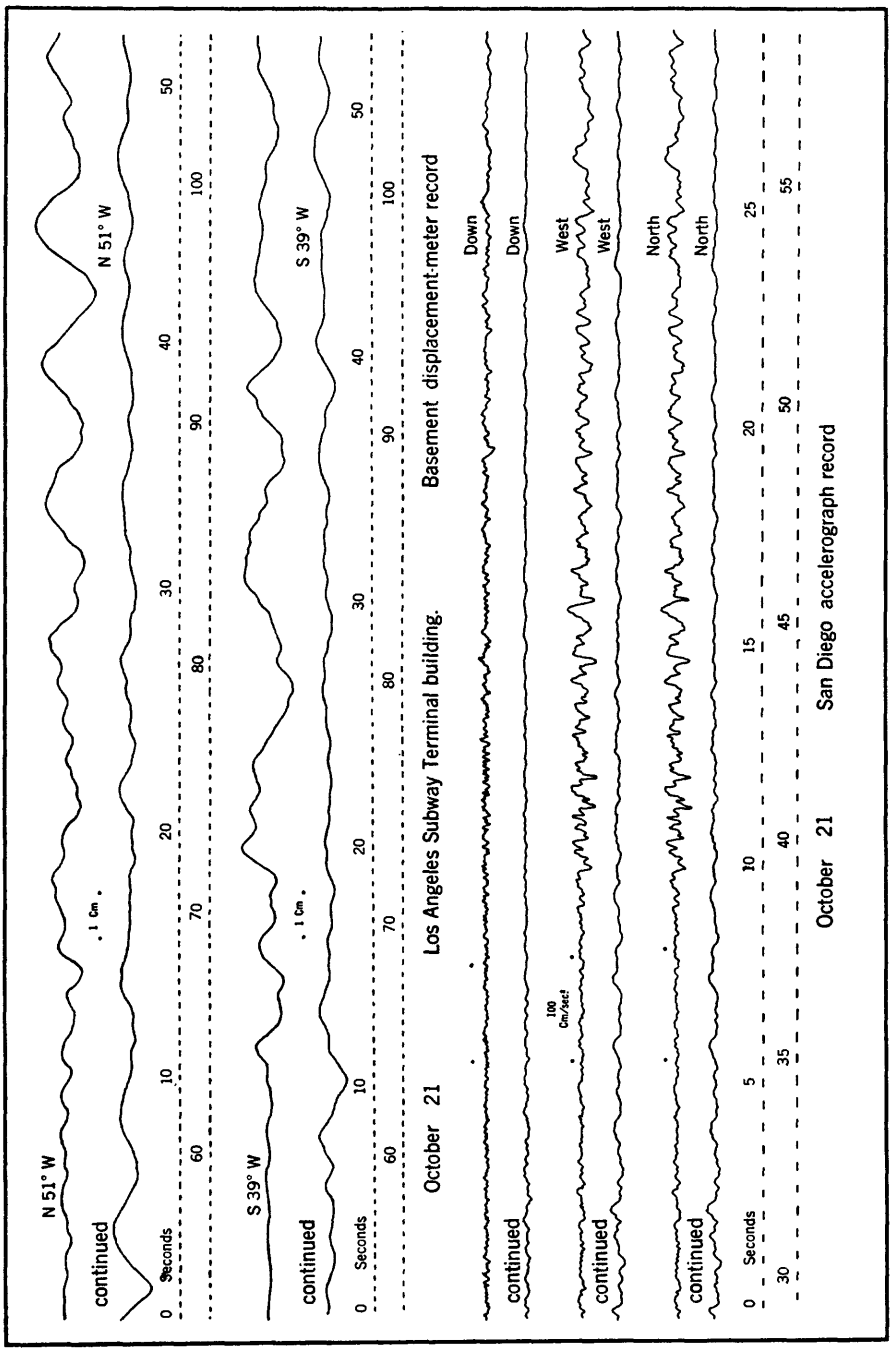

FIGURE 10.—Tracings of the Los Angeles Subway Terminal displacement meter record and the San Diego accelerograph record obtained on October 21, 1942.

Los Angeles.—Figures 9 and 10. About 145 miles northwest by west from the epicenter. Intensity V. The maximum recorded accelerations and maximum computed displacements follow:

Station	*Acceleration*	*Displacement*
Chamber of Commerce Basement	4 cm/sec.^{2}	0.012 cm
Chamber of Commerce 11th floor	9 cm/sec.^{2}	0.231 cm
Subway Terminal Basement	2 cm/sec.^{2}	0.042 cm
Subway Terminal Displacement Meter	.....	0.04 cm

Long Beach.—Figure 6. About 140 miles west northwest from the epicenter. Intensity IV. Maximum recorded acceleration 3 cm/sec.^{2} Computed maximum displacement 0.041 cm.

San Diego.—Figure 10. About 70 miles west southwest from the epicenter. Intensity about VI. Maximum recorded acceleration 26 cm/sec.^{2} Computed maximum displacement 0.063 cm.

Vernon.—Figure 6. About 140 miles west northwest from the epicenter. Intensity V. Maximum recorded acceleration 3 cm/sec.^{2} Computed maximum displacement 0.011 cm.

SAN FRANCISCO BAY REGION EARTHQUAKE OF DECEMBER 29

This shock was local to the San Francisco Bay region. Maximum intensity about VI.

Oakland (Chabot Observatory).—Direction and distance to epicenter not known. Maximum acceleration computed from Weed strong motion seismograph record 3 cm/sec.^{2} Computed maximum displacement about 0.007 cm. The record was too small for reproduction.

TABLE 4.—***Summary of strong-motion seismograph data for the year 1942***

[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.]

EL CENTRO EARTHQUAKE OF MAY 23

The record was weak and yielded no data of significance. Amplitudes on the vertical component were too small for measurement, while those of the horizontal components were only about one millimeter maximum amplitude. The periods were about 0.4 to 0.7 second. Maximum displacement was approximately 0.06 cm.

BOULDER DAM EARTHQUAKE OF AUG. 11

Station and component	Earth-wave period	Maximum acceleration	Maximum displacement	Remarks
	Seconds	*Cm/sec²*	*Cm*	
Boulder Dam, oil house accelerograph:				
Vertical	0.11	14	0.004	At beginning of record. Possibly preceded by stronger motion.
	0.18	5	0.004	Irregular waves.
Northwest-southeast	0.13	27	0.011	At beginning of record. Possibly preceded by stronger motion.
	0.16	2	0.002	
Northeast-southwest	0.10	44	0.011	At beginning of record. Possibly preceded by stronger motion.
	0.10	4	0.001	Irregular waves.
Boulder Dam, 1215 gallery accelerograph:				
Vertical	0.10	14	0.003	At beginning of record. Possibly preceded by stronger motion.
	0.16	2	0.001	Irregular waves.
Northwest-southeast	0.11	21	0.006	At beginning of record. Possibly preceded by stronger motion.
	0.14	8	0.004	Sinusoidal waves.
Northeast-southwest	0.09	37	0.007	At beginning of record. Possibly preceded by stronger motion.
	0.18	9	0.005	
Boulder Dam, intake tower accelerograph:				
Vertical	0.13	67	0.028	Large regular amplitudes at beginning for one second.
	0.12	12	0.004	Irregular waves.
Northwest-southeast	0.18	53	0.043	At beginning of record.
	0.24	25	0.036	Irregular motion superposed.
	0.27	16	0.030	Short period motion superposed.
Northeast-southwest	0.17	54	0.034	Large amplitude for one second duration.
	0.21	14	0.009	Irregular waves.
	0.18	4	0.004	

TABLE 4.—*Summary of strong-motion seismograph data for the year 1942*—Continued

HAWTHORNE EARTHQUAKE OF AUG. 18

Station and component	Earth-wave period	Maximum acceleration	Maximum displacement	Remarks
	Seconds	*Cm/sec²*	*Cm*	
Hawthorne accelerograph:				
Vertical	0.08	3	0.001	Small amplitudes.
	0.13	4	0.002	
North-south	0.11	7	0.002	At beginning of record. Possibly preceded by stronger motion.
	0.45	6	0.030	Short period waves superposed on longer periods.
East-west	0.12	7	0.003	At beginning of record. Possibly preceded by stronger motion.
	0.31	5	0.001	Irregular waves.

BOULDER DAM EARTHQUAKE OF SEPT. 8

Boulder Dam, oil house accelerograph:				
Vertical	0.10	5	0.001	Small irregular waves.
	0.11	12	0.004	
	0.13	4	0.001	Irregular waves.
Northwest-southeast	0.19	5	0.004	Short periods superposed.
	0.11	17	0.005	Irregular waves.
	0.10	8	0.002	
Northeast-southwest	0.11	5	0.001	Very small amplitudes.
	0.11	15	0.005	Irregular waves.
	0.08	4	0.001	
Boulder Dam, 1215 gallery accelerograph:				
Vertical	0.11	13	0.004	Regular waves preceded by waves of small amplitude at beginning.
	0.12	8	0.003	
Northwest-southeast	0.21	11	0.011	Irregular waves preceded by waves of small amplitude at beginning.
	0.24	4	0.006	
	0.12	7	0.002	Irregular waves.
Northeast-southwest	0.13	14	0.006	Irregular waves at beginning of record.
	0.09	32	0.006	
	0.30	10	0.022	
	0.14	27	0.013	
Boulder Dam, intake tower accelerograph:				
Vertical	0.09	24	0.005	Regular waves at beginning of record.
	0.08	48	0.008	Regular waves for one second duration.
	0.09	30	0.006	
Northwest-southeast	0.06	35	0.003	Preceded by short period waves at beginning of record.
	0.22	12	0.014	Irregular waves.
	0.09	17	0.003	Regular waves for one second.
Northeast-southwest	0.22	25	0.030	At beginning of record. Short periods superposed.
	0.09	28	0.006	
	0.20	16	0.016	Irregular waves.
	0.13	26	0.011	

BOREGO VALLEY EARTHQUAKE OF OCT. 21

Colton accelerograph:				
Vertical	0.07	3	0.001	Regular waves at beginning.
	0.16	8	0.003	One wave.
East-west	0.20	4	0.004	Long irregular periods at beginning.
	0.17	3	0.012	Rather weak waves.
North-south	0.14	9	0.004	At beginning possibly preceded by stronger motion.
	0.19	7	0.007	Irregular waves.
	0.39	2	0.008	Short periods superposed on long periods.
Colton displacement meter:				
East-west	7.10	2	0.040	At beginning.
	1.50	1	0.020	
	1.90	1	0.020	Regular waves.
North-south	9.20	2	0.043	At beginning.
	1.70	1	0.015	Regular waves.
El Centro accelerograph:				
Vertical	0.10	14	0.003	Regular waves.
	0.11	25	0.008	
	0.30	6	0.014	
North-south	0.09	8	0.002	Possibly preceded by stronger motion.
	0.31	56	0.126	Large amplitudes.
	0.17	10	0.005	Very irregular.
	0.41	9	0.036	
East-west	0.21	8	0.009	Possibly preceded by stronger motion.
	0.27	48	0.088	Large amplitudes.
	0.23	29	0.038	
	0.43	25	0.115	Irregular.
Hollywood Storage Co. Bldg., adjoining lot accelerograph:				
Vertical	0.49	2	0.012	Very weak record.
East-west	0.41	4	0.016	Possibly preceded by stronger motion.
	0.39	1	0.004	
North-south	0.21	3	0.032	
	0.38	1	0.004	

TABLE 4.—*Summary of strong-motion seismograph data for the year 1942*—Continued

BOREGO VALLEY EARTHQUAKE OF OCT. 21—Continued

Station and component	Earth-wave period	Maximum acceleration	Maximum displacement	Remarks
	Seconds	*Cm/sec²*	*Cm*	
Hollywood Storage Co. Bldg., basement accelerograph:				
Vertical	0.31	2	0.004	Very weak record.
East-west	0.65	3	0.032	Irregular waves.
	0.82	1	0.018	
North-south	0.37	2	0.007	
	0.68	1	0.012	
Hollywood Storage Co. Bldg., penthouse accelerograph:				
Vertical	0.35	4	0.012	Short periods superposed on long periods.
East-west	1.1±	7	0.212	Long irregular periods.
	0.72	8	0.104	Regular waves.
	1.3±	2	0.084	
North-south	0.47	6	0.033	Prevailing period.
	0.60	3	0.027	
Los Angeles Chamber of Commerce Bldg., basement accelerograph:				
Vertical	0.47	2	0.011	Very weak record.
S. 50° E.-N. 50° W	1.10	4	0.012	Do.
S. 40° W.-N. 40° E	0.41	2	0.008	Do.
Los Angeles Chamber of Commerce Bldg., 11th floor accelerograph:				
Vertical	0.47	1	0.005	Weak.
	0.39	1	0.004	
S. 40° W.-N. 40° E	1.3±	3	0.128	Short periods superposed on long periods.
	1.15	7	0.231	Large irregular waves.
S. 50° E.-N. 50° W	1.54	7	0.042	Short period superposed.
	1.30	9	0.038	Do.
Los Angeles Subway Terminal, basement accelerograph:				
Vertical	0.52	1	0.006	Very weak record.
S. 50° E.-N. 50° W	0.40	2	0.008	
S. 40° W.-N. 40° E	0.38	1	0.004	
	0.92	2	0.042	
Los Angeles Subway Terminal, basement displacement meter:				
N. 39° E.-S. 39° W	2.10	1	0.030	Irregular waves.
	3.50	1	0.040	
	4.10	1	0.020	
S. 51° E.-N. 51° W	1.10	1	0.010	
	0.90	1	0.010	
	2.60	1	0.050	Regular long waves.
Long Beach accelerograph:				
Vertical	0.16	2	0.001	Very weak record.
East-west	0.39	1	0.004	
North-south	0.74	3	0.041	Short period superposed.
	0.49	1	0.006	
San Diego accelerograph:				
Vertical	0.11	2	0.006	Possibly preceded by stronger motion.
	0.14	6	0.023	Short periods superposed.
	0.43	4	0.018	
East-west	0.49	5	0.031	
	0.32	14	0.036	Irregular.
	0.54	7	0.052	
North-south	0.52	5	0.035	Shorter periods superposed.
	0.21	26	0.029	
	0.32	25	0.063	
Vernon accelerograph:				
Vertical	0.42	1	0.004	Very weak record.
S. 8° E.-N. 8° W	0.35	3	0.009	Regular waves.
	0.37	2	0.007	
S. 82° W.-N. 82° E	0.47	2	0.011	Short periods on long periods.
Oakland, Chabot Observatory, Weed seismograph:				
Northeast-southwest	0.30	3	0.007	One wave.
Northwest-southeast	0.35	2	0.005	Average of six waves.

TABLE 5.—*Instrumental constants of strong-motion seismographs in 1942*

SOUTHERN CALIFORNIA EARTHQUAKE OF MAY 23

Station and instrument	Orientation of instrument [1]	Pendulum period	Static magnification	Sensitivity [2]	Damping ratio	Instrument number
		Sec.		*Cm.*		
El Centro; accelerograph No. A-4	Up-down	0.099	78	1.93	4.5	V–10
	N.-E.	0.100	77	1.96	5	L–4
	E.-W.	0.099	78	1.97	9	T–15

[1] The direction on the left ("Up" in the first case) indicates the direction of pendulum displacement, relative to instrument pier, which will displace the trace upward on the original seismogram.

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

TABLE 5.—*Instrumental constants of strong-motion seismographs in 1942*—Continued

Station and instrument	Orientation of instrument [1]	Pendulum period	Static magnification	Sensitivity [2]	Damping ratio	Instrument number
BOULDER DAM EARTHQUAKE OF AUG. 11						
Boulder Dam:[3]		*Sec.*		*Cm.*		
Oil house accelerograph No. B-3	Up-down	0.106	79	2.25	10	V-148
	N.45° W.-S.45° E.	0.102	79	2.08	9	L-146
	N.45° E.-S.45° W.	0.102	78	2.05	8	T-147
1215 gallery accelerograph No. B-1	Up-down	0.102	77	2.03	12	V-142
	S.45° E.-N.45° W.	0.100	75	1.97	11	L-140
	S.45° W.-N.45° E.	0.103	73	1.95	8	T-141
Intake tower accelerograph No. B-2	Up-down	0.101	80	2.07	8	V-145
	N.45° W.-S.45° E.	0.101	78	2.00	7	L-143
	N.45° E.-S.45° W.	0.100	74	1.87	8	T-144
WESTERN NEVADA EARTHQUAKE OF AUG. 18						
Hawthorne; accelerograph No. 25	Up-down	0.095	109	2.47	8	V-31
	S.-N.	0.100	106	2.67	8	L-35
	W.-E.	0.095	106	2.42	8	T-14
BOULDER DAM EARTHQUAKE OF SEPT. 8						
Boulder Dam:[3]						
Oil house accelerograph No. B-3	Up-down	0.106	79	2.25	10	V-148
	N.45° W.-S.45° E.	0.102	79	2.04	9	L-146
	N.45° E.-S.45° W.	0.102	78	2.05	8	T-147
1215 gallery accelerograph No. B-1	Up-down	0.102	77	2.03	12	V-142
	S.45° E.-N.45° W.	0.102	75	1.97	10	L-140
	S.45° W.-N.45° E.	0.103	73	1.95	8	T-141
Intake tower accelerograph No. B-2	Up-down	0.101	80	2.11	8	V-145
	N.45° W.-S.45° E.	0.101	78	2.04	7	L-143
	N.45° E.-S.45° W.	0.100	74	1.91	8	T-144
SOUTHERN CALIFORNIA EARTHQUAKE OF OCT. 21						
Colton:						
Accelerograph No. A-38	Up-down	0.099	76	1.90	8	V-111
	E.-W.	0.097	81	1.92	9	L-91
	S.-N.	0.098	79	1.92	9.5	T-101
Displacement meter No. D-16	W.-E.	10.0	1	----------	9	
	N.-S.	10.0	1	----------	10	
El Centro; accelerograph No. A-4	Up-down	0.099	78	1.93	4.5	V-10
	N.-E.	0.100	77	1.96	5	L-4
	E.-W.	0.099	78	1.97	9	T-15
Hollywood Storage Co. Bldg.:[3]						
Adjoining lot accelerograph No. A-1	Up-down	0.069	116	1.40	10	V-66
	E.-W.	0.069	114	1.41	6	L-64
	S.-N.	0.069	107	1.33	8	T-65
Basement accelerograph No. A-22	Up-down	0.070	103	1.27	7	V-25
	E.-W.	0.069	111	1.34	4.5	L-3
	S.-N.	0.070	109	1.36	5.5	T-18
Penthouse accelerograph No. A-40	Up-down	0.101	78	2.02	7	V-113
	S.-N.	0.105	80	2.24	8	L-93
	W.-E.	0.102	79	2.09	8.5	T-103
Los Angeles Chamber of Commerce Bldg.:[3]						
Basement accelerograph No. A-21	Up-down	0.067	116	1.32	10	V-28
	S.50° E.-N.50° W.	0.068	113	1.34	7	L-9
	S.40° W.-N.40° E.	0.070	112	1.39	5	T-26
Eleventh floor accelerograph No. A-42.	Up-down	0.100	79	2.01	9	V-115
	S.40° W.-N.40° E.	0.098	82	1.98	9	L-95
	N.50° W.-S.50° E.	0.101	80	2.07	7.5	T-105
Los Angeles Subway Terminal Bldg.:[3]						
Basement accelerograph No. A-3	Up-down	0.069	116	1.40	11	V-58
	S.51° E.-N.51° W.	0.068	120	1.38	10	L-59
	S.39° W.-N.39° E.	0.069	116	1.43	10	T-60
Basement displacement meter No. D-13.	N.39° E.-S.39° W.	9.8	1	----------	10	
	S.51° E.-N.51° W.	10.0	1	----------	12	
Long Beach; accelerograph No. A-24	Up-down	0.071	115	1.47	10	V-30
	N.-S.	0.070	113	1.36	8	L-5
	E.-W.	0.071	112	1.43	10	T-34
San Diego; accelerograph No. A-5	Up-down	0.098	102	2 49	8	V-70
	E.-W.	0.100	104	2.65	8	L-71
	S.-N.	0.102	108	2.85	9	T-72
Vernon; accelerograph No. A-41	Up-down	0.071	109	1.39	10	V-47
	S.8° W.-N.8° E.	0.070	115	1.43	10	L-37
	N.82° W.-S.82° E.	0.068	116	1.35	6.5	T-48
Oakland; Chabot Obsy. accelerograph No. W-3.	SW-SE	0.19	8.2	0.61	2	
		0.19	8.2	0.61	2	
SAN FRANCISCO BAY REGION EARTHQUAKE OF DEC. 29						
Oakland; Chabot Obsy. accelerograph No. W-3.	SW-SE	0.19	8.2	0.61	2	
		0.19	8.2	0.61	2	

[1] The direction on the left ("Up" in the first case) indicates the direction of pendulum displacement, relative to instrument pier, which will displace the trace upward on the original seismogram.

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

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

CHANGES IN STRONG-MOTION INSTRUMENT EQUIPMENT DURING 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 the third quarter. 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) conglomerate 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 12 inch drums as compared with the six inch.

On September 1 the Golden Gate Park station was discontinued and the equipment transferred to the University of San Francisco.

On March 19 simultaneous time markers were installed on the accelerographs in the Bank of America Building at San Jose.

During the year double magnification systems were installed on the accelerographs at Ferndale, El Centro, Long Beach and Santa Barbara.

A tiltmeter station was installed at Long Beach during February.

TILT OBSERVATIONS

With the cooperation of the University of California three tilt meters were kept in operation at Berkeley during the entire year. The tilt-graph from these instruments for 1942 is shown in figure 11. A tilt meter was installed at Long Beach during the latter part of April and was operated cooperatively with the Long Beach Harbor Department. Figure 12 shows the tilt-graph for this instrument.

The Berkeley tilt-graph for the year 1940 is shown in figure 13. It is reproduced in this publication because it was omitted from Serial No. 640, "United States Earthquakes, 1940", when the graph for 1941 was inadvertently inserted. No change, however, is required in the text. (Figures 11, 12, and 13 face page 38.)

ADDITIONS AND CORRECTIONS TO PREVIOUS PUBLICATIONS

1939. Serial 637, p. 53. The position given for the strong-motion station at Westwood is in error. The correct position is 34° 04.20′ N., 118° 26.85′ W. This means that the epicentral distances given in the annual publication for 1941, Serial No. 655, p. 46, should read approximately two miles greater or about 22 miles.

1939 additions.

April 13: 11:45. According to the Oregon Journal an earthquake was felt in the southeastern part of Portland.

June 24: ..:... Residents of Huntsville, Alabama, reported a slight earthquake shortly after dawn.

October 10: "Early". Residents of Tilton, Northfield, and Sanbornton, New Hampshire, reported an earthquake.

October 11: No time given. Three shocks were felt in southern New Hampshire. Reports from Derry, East Manchester, and Goffstown told of houses shaking and a dull roar at times.

November 26: 22:41. An earthquake was felt in the Santa Cruz Mountains near the summit east of the Santa Cruz-Los Gatos highway in the vicinity of Burrell and Highland, California.

December 5: 14:16. A slight shock was felt at Huntington Park, Long Beach, and Compton, California.

1940 additions.

February 12: 19:12. An earthquake strong enough to rattle dishes was felt in Watsonville, California.

February 12: 20:10. A slight earthquake was felt at Tulare, California.

February 14: 11:00. A shock was felt at Redding, California.

February 24: ..:... Shortly before midnight a slight earthquake was felt at El Centro, California.

February 24: 12:34. An earthquake was felt in Grass Valley, California, causi. electric lights to swing.

February 27: 21:14. A slight tremor was felt by residents of North Berkeley, Cs fornia.

March 6: 2:... Light sleepers were awakened by a minor tremor in San Jos California.

April 20: 6:00. An earthquake was felt in Redding, California.

May 1: 1:00. Shortly after 1:00 a. m. three slight shocks were felt in Calexic California.

June 29: ..:... Residents of Hemet, California, in the San Jacinto Valley and th San Jacinto Mountain area felt an earthquake accompanied by a rumbling noise ear on June 29.

July 5: 16:40. An earth tremor which shook buildings and rattled dishes was felt at the Napa, California, State Hospital for the Insane. Nearby residents in the Imola district also reported feeling the tremor. In Napa a mile distant the tremor was not felt

July 7: 5:16. Slight shock rattled windows at San Leandro, California. It was also reported felt in the Mira Vista district of Richmond.

July 22: 1:45. Slight shock felt on Santa Catalina Island off the coast of California

July 27: 13:15. An earthquake was felt in the downtown district of San Dieg California, and in the area around Park Boulevard and University Avenue.

July 31: 16:40. Two distinct shocks were felt within a mile radius of the Belmont, California, fire house. They were not felt generally in town.

August 21: 7:02. An earthquake was felt in San Leandro and Oakland, California.

October 21: 11:09. A slight earthquake was felt in Los Angeles.

November 19: 1:15. An earthquake awakened light sleepers in Santa Cruz, California.

Tilt-graph for 1940. See statement under the heading "Tilt Observations".

Serial No. 672

UNITED STATES EARTHQUAKES

1943

By

RALPH R. BODLE

Geophysicist

U.S. DEPARTMENT OF COMMERCE

COAST AND GEODETIC SURVEY

WASHINGTON : 1945

CONTENTS

ILLUSTRATIONS

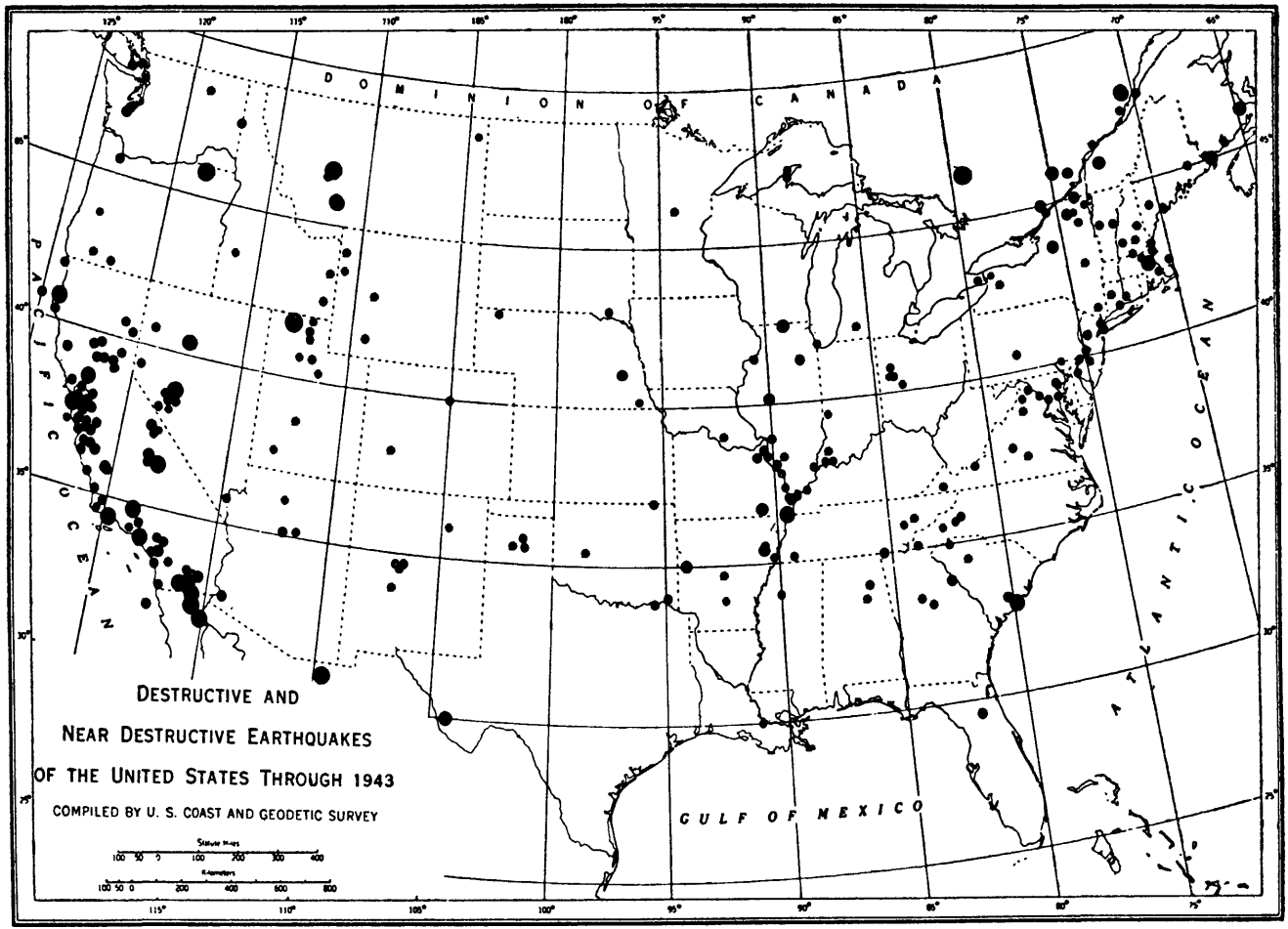

FIGURE 1.—Destructive and near destructive earthquakes in the United States through 1943.

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 the air.

An asterisk (*) indicates that the time is taken from an instrumental report and is reliable. In other instances quite large deviations are frequently reported.

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.

Time is indicated as continuous from 0 to 24 hours, beginning and ending at midnight.

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 unabridged 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 and "affected area" 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.

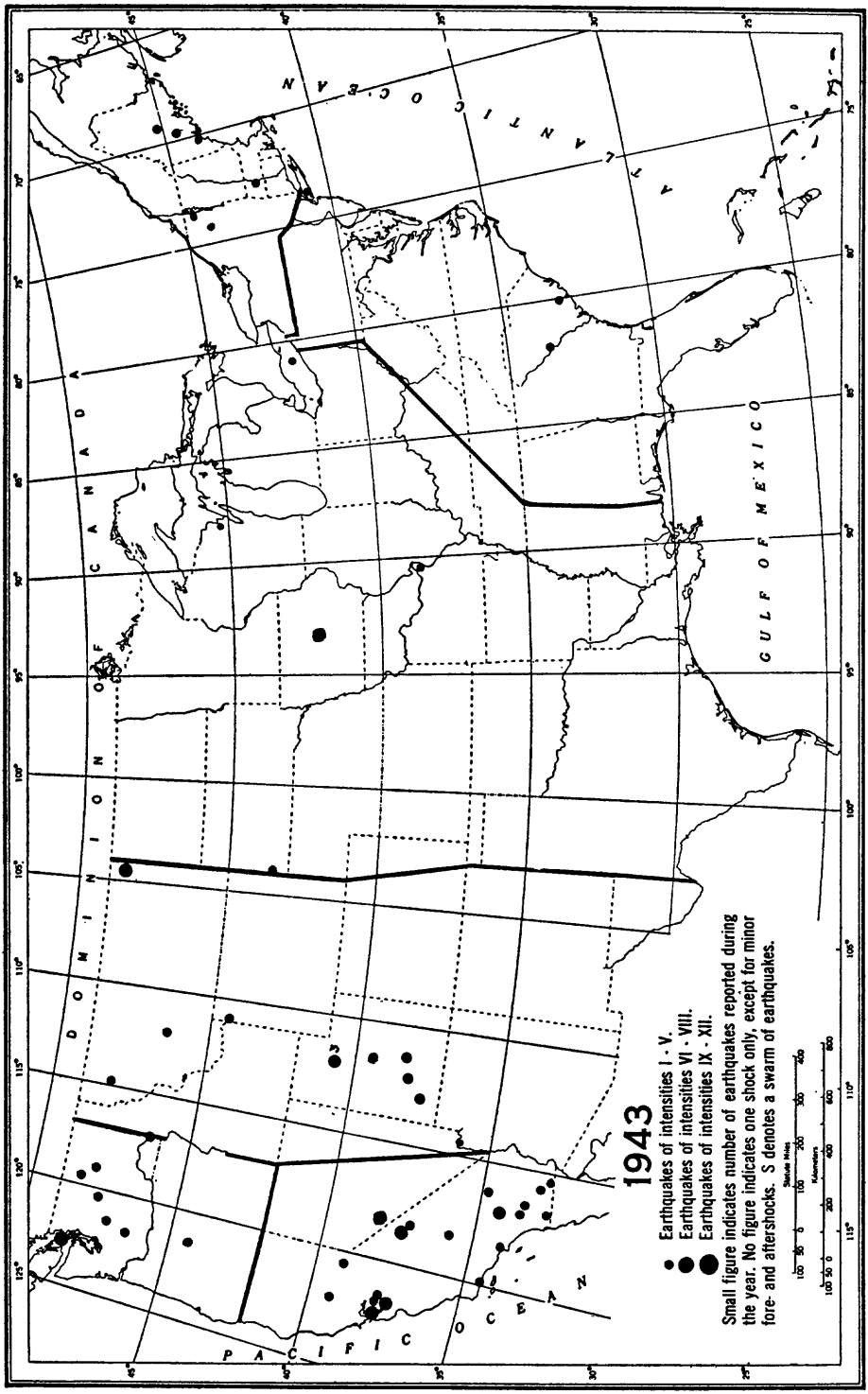

FIGURE 2.—Earthquake epicenters, 1943.

UNITED STATES EARTHQUAKES, 1943

INTRODUCTION

THIS publication is a summary of earthquake activity in the United States and the regions under its jurisdiction for the calendar year 1943. 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 recent 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 1943:

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.
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.

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[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.

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.)

NONINSTRUMENTAL RESULTS

EARTHQUAKE ACTIVITY IN THE VARIOUS STATES

Arizona: Slight shock on July 20.
California: Five shocks, intensity VI: May 31, August 8 and 28, October 25, and November 16. Eleven shocks, intensity V: March 16 and 30, April 15, 26, and 30, May 8, July 9, November 14, 15, 17, and December 16. There were also a number of minor shocks reported.
Colorado: Slight shock on September 3.
Idaho: Minor shock on April 14.
Maine: Three shocks: January 14, February 10, and December 19.
Massachusetts: Minor earthquake on March 31.
Missouri: Light shock on June 8.
Montana: One shock, intensity VI: June 24. Light shocks on January 1, June 25, August 24, and December 12.
Nevada: One moderate shock, intensity VI: August 8. Minor shocks on January 23 and 26, February 3, March 22, April 8, May 5 and 29, June 4 and 6, September 9 and 19, November 5, and December 9 and 10.
New York: Minor shock on July 6.
Ohio: Shock of March 8, maximum intensity IV, centered in Lake Erie.
Oregon: Minor shocks on June 24 and August 4.
South Carolina: December 28, intensity IV.
South Dakota: Minor shock on May 16.
Utah: One shock, intensity VI: February 22. Weaker shocks on January 16, February 22, March 12, April 10 and 11, August 13, November 3, and December 9 and 10.
Washington: One shock, intensity VI: November 28; and one shock,intensity V: April 23. Weaker shocks on April 14, June 13, July 11, September 22, and October 6, 9, and 27.
Wisconsin: Light shock on February 9.
Wyoming: Light shocks on February 3 and September 6.
Alaska: Minor shocks on February 14 and 17, April 2 and 9, May 1, 18 and 31, July 6 and 27, August 25, September 26, November 2, 3, 11 and 13, and December 29.
Hawaii: Minor shocks on March 25, June 14, July 1, October 16 and 20, November 10, and December 22.
Panama Canal Zone: One moderate shock, intensity V, on May 2.
Puerto Rico: Minor shocks on April 22, and July 28 and 29.

NOTE.—The shock of January 14 centering in Maine was also felt in Vermont, New Hampshire, Massachusetts, Connecticut, and Rhode Island.
The shock of March 8 centering in Lake Erie was felt in Michigan, New York, Ohio, Pennsylvania, and West Virginia.
The shocks of March 30 and May 31 centering in California were also felt in Nevada.
The shock of August 8 centering in Nevada was also felt in California.

NORTHEASTERN REGION

(60TH MERIDIAN OR EASTERN WAR TIME)

January 14: 17:32.6. Central Maine.—Epicenter about 45.3° north, 69.6° west, according to the Northeastern Seismological Association. The geographic position was determined from seismographic data and is several miles west of Dover-Foxcroft. The shock was felt over an area of approximately 50,000 square miles in the United States. See map page 6. No data are available on effects in Canada. The distribution of the felt intensities was quite irregular and did not indicate the central area as well as usual. Collection of the felt reports and computation of the epicentral position was done by personnel of the Seismograph Station at Weston College, Weston, Massachusetts. The shock was strongest at Dover-Foxcroft and Old Town, Maine where it was generally felt. Estimated intensity was V. The same intensity was estimated for Lisbon, Maine; and Whitefield, New Hampshire, due to the cracking of plaster, but at these places the shock was reported felt by "many" instead of "all."

INTENSITY IV:

Bangor, Belfast, Benton, Cape Elizabeth, Ellsworth, Enfield, Farmington, Freeport, Greenville, Lewiston, Lincoln, Livermore, Portland, Richmond, Rumford, Surry, Westbrook, Westbrookfield, West Farmington, West Paris, and Yarmouth in Maine.
Greenfield in Massachusetts.
Bethlehem, Concord, Conway, Goffstown, Gorham, Groveton, Lisbon, North Conway, and West Stewartstown in New Hampshire.
Bellows Falls, Enosburg, Newport, and St. Johnsbury in Vermont.

INTENSITY III AND UNDER:

Auburn, Augusta, Bar Harbor, Bangor, Bath, Belfast, Belgrade, Brewer, Brooks, Brunswick, Carmel, Chesuncook, Conway, Cumberland Center, Dead River, Fort Fairfield, Franklin, Garner, Greenville, Harrington, Hollowell, Intervale, Lowell, Manchester, Manchester Four Corners, McKinley, Newport, North Bridgetown, Northport, Penobscot, Portland, Rochester, Rockland, Rumford, Saco, Scarboro, Seal Harbor,

Springvale, Stratton, Tamworth, Tarratine, Thompson's Point, Topsham, Unity, Waldoboror, Waterville, Wicasset, and Wytopitlock in Maine.

Hartford, New Haven, Warehouse Point, and Windsor Locks in Connecticut.

Amesbury, Amherst, Boston, Concord, Gloucester, Greenfield, Ipswich, Lawrence, Lowell, Newburyport, Plymouth, and Williamstown in Massachusetts.

Berlin, Canaan, Center Effingham, Claremont, Dover, Enfield, Henniker, Lancaster, Laconia, Lebanon, Littleton, Madison, Meredith, Newport, Salem, West Campton, and Wolfeboro in New Hampshire.

Bronxville, Lake Placid, and Syracuse in New York.

Barnet, Burlington, Craftsbury, McIndoe Falls, Montpelier, Northfield, Proctorsville, Rutland, West Burke, White River, and Woodstock in Vermont.

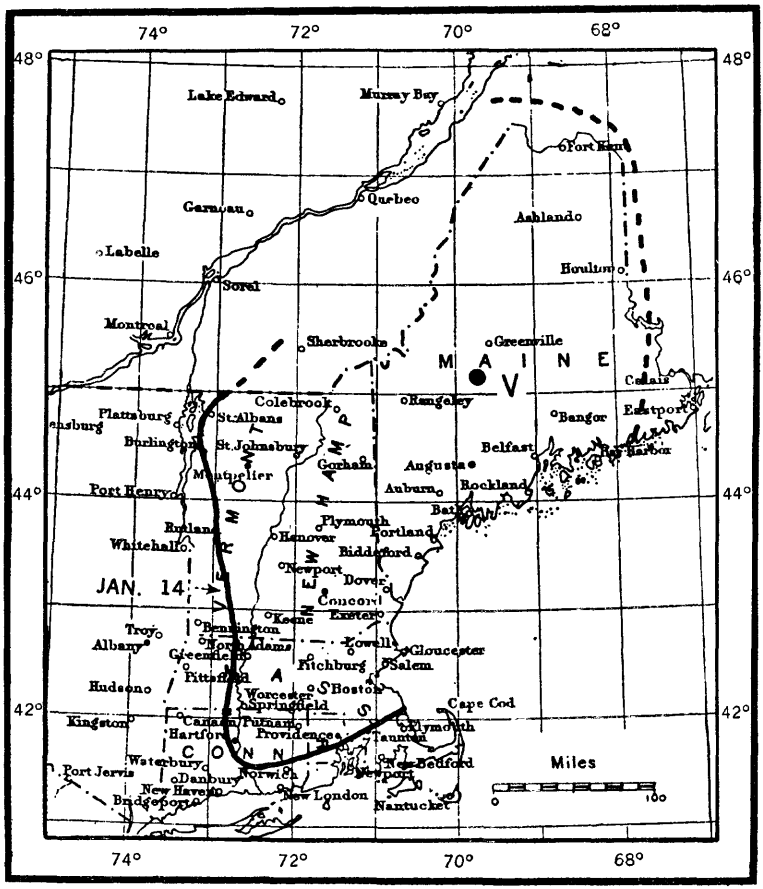


FIGURE 3.—Area affected by the New England earthquake of January 14, 1943.

February 10: 05:45. Portland, Maine. Light shock felt by many. A few cracks reported in one building.

March 31: 07:30. Northampton, Massachusetts. A slight tremor was reported felt here. Landslide on west bank of Connecticut River dislocated Boston-Maine railroad tracks. Slight disturbance recorded on Weston seismograph at 07:47, but not definitely connected with the landslide at Northampton.

July 6: 18:10. Dannemora, Lake Placid, Sunmount, and Canton, New York; and St. Albans and Burlington, Vermont. Light shock felt. Press reports indicate the shock was felt strongly at St. Albans where an explosion was suspected as people "gathered on lawns and sidewalks" to discuss the happening. St. Albans is the most easterly of all the places reporting the shock. Though the shock was felt strongest here, the true epicenter was probably elsewhere unless the shock was felt at points further east which did not report the fact.

December 19: 04:10. Waterville, Winslow, Fairfield, and East Benton, Maine. Only a few people recognized it as an earthquake. Some suspected an earthquake and called the newspaper in Waterville for confirmation.

EASTERN REGION

(60TH MERIDIAN OR EASTERN WAR TIME)

April 13: 11:00. Louisville, Kentucky. A number of reports received indicate a shock was felt by many people in south and east Louisville. The Weather Bureau Observer stated: "We believe that it was caused by blasting or by the firing of heavy guns at Fort Knox. We do not regard it as a real earthquake..."

July 28: 23:30. Augusta, Georgia. Light shock reported by two people. The shock was not generally felt. Seismic origin doubtful.

December 28: 10:25. Summerville, South Carolina. Felt by many people as three decided bumps. The intensity was about IV.

CENTRAL REGION

(75TH MERIDIAN OR CENTRAL WAR TIME)

February 9: 18:21. Thunder Mountain, Marinette County, Wisconsin. Light shock felt by several people in the vicinity of Thunder Mountain and Thunder Lake in the northern half of Township 32 and the southern half of Township 33 North, Range 18 East. According to reports similar shocks have been felt occasionally for many years but have not been severe enough to cause damage.

March 8. 22:25.5* Lake Erie. A study of the seismograph records indicated that the epicenter was in the region of 42.2° north, 80.9° west. The location of the epicenter apparently explains the general lack of a well-defined intensity area. See map page 7. Of the places reporting the higher intensities, Cleveland and Conneaut are nearest the epicentral area.

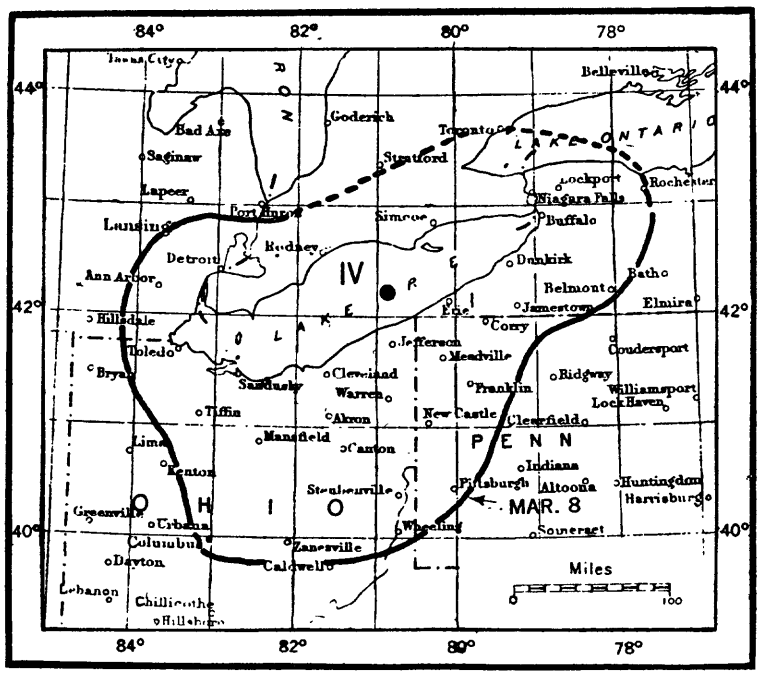


FIGURE 4.—Area affected by the Lake Erie earthquake of March 8, 1943.

INTENSITY IV:

Conneaut and Cleveland, Ohio. Detroit and Grosse Pointe, Michigan.

INTENSITY III AND UNDER:

Adrian, Ann Arbor, Dearborn, Detroit, Flint, Grand Rapids, Mount Clemens, River Rouge, Wyandotte, and Yipsilante, Michigan.

Akron, Ashtabula, Beverly, Canton, Chagrin Falls, Columbus, Dayton, Delaware, Elyria, Jefferson, Lakewood, Lorain, Marion, Massilon, Norwalk, Painesville, Phalanx, Philo, Ravenna, Sandusky, Tiffin, Toledo, Warren, Wooster, Youngstown, and Zanesville, Ohio.

Bradford, Butler, Erie, Franklin, Johnstown, Meadville, New Castle, Oil City, Pittsburgh, Union City and Warren, Pennsylvania.

Buffalo, Dunkirk, Hamburg, Hornell, Jamestown, Lewiston, Niagagra Falls, North Buffalo, and Rochester, New York.

Wheeling, West Virginia.

Press reports indicate that the shock was felt at Hamilton, London, and Toronto, Canada. Information on felt effects in Canada is incomplete and is not the result of a systematic questionnaire canvass.

May 16: 14:40. Hot Springs, South Dakota, and southward for several miles. Felt by many "like heavy trucks rumbling down a street." Dishes rattled. Felt on Battle Mountain in the Black Hills.

June 8: 14:50. Webster Groves, Missouri. A light shock was felt by several. Described as a "bumping thud like a hot-water heater exploding."

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. The unabridged records are published in Abstracts of Earthquake Reports for the Pacific Coast and Western Mountain Region. An asterisk (*) indicates instrumental time.

January 1: 18:46. Marion, Montana. Abrupt trembling felt, accompanied by loud subterranean sounds like a deep underground explosion.

January 16: 05:50.3.* Cedar City, Utah. A press report stated: "An earthquake of considerable intensity awakened Cedar City residents at 05:50 a.m. Saturday, but no serious damage was reported. The shock rattled windows, and toppled dishes. Parley Dalley, Branch Agricultural College geologist, descsribed the shock as probably more intense but of briefer duration than the worst of the series of tremors felt here last September. He ascribed it to a movement in the Hurrican Fault which extends well under this area. The shock was felt with equal intensity at Enoch, six miles north, and at Hamiltons Fort, five miles south. Kanarraville residents said it was not felt there."

January 23: 22:30. Boulder City, Nevada. Moderate shock felt.

January 26: 07:01. Boulder City, Nevada. Moderate shock felt.

February 3: 03:01. Boulder City, Nevada. Moderate shock felt.

February 3: 05:15 to 09:30. Yellowstone Park (Old Faithful), Wyoming. Intensity IV. All awakened. Houses creaked and widows rattled. "Six different quakes between 05:15 and 09:30 a.m.; severest was at 09:15 a. m."

February 22: 08:20. Utah. Central area was probably between Salt Lake City and Bingham. The shock was recorded by the seismographs at Salt Lake City and Logan, but the resulting data were not sufficient to determine an accurate epicenter. According to Professor J. Stewart Williams, Utah State Agricultural College, Logan, this shock originated in, or in a branch of, the Wasatch fault zone at considerable depth. The extension of the felt area to the west he believes is due to deep alluvium under such places as Grantsville and Tooele while points to the east are essentially on a bedrock block.

INTENSITY VI:

Bingham Canyon.—Felt by all. "In a new brick building at the Bingham High School, much plaster was shaken from the wall and ceiling. It was felt generally throughout this section or range of mountains."

Magna.—Felt generally. Cracked plaster, windows and chimneys. Clock thrown from stove at one point just east of Magna. Oven door fell down.

Salt Lake City.—Felt by many. Cracked plaster and windows. Knickknacks fell.

INTENSITY V:

Copperton, Draper, Midvale, Murray, Sandy, and Woods Cross.

INTENSITY IV:

Bountiful, Layton, Pleasant Grove, Provo, and Tooele.

INTENSITY I TO III:

Grantsville, Keetley, Lehi, Midway, Ogden, and Spanish Fork. Negative reports were received from twenty-one places.

February 22: 22:50. Hunter, Magna, and Garfield, Utah. Light shock felt. Observer's husband stated that he felt other shocks at 5:30 and 6:30 a.m.

March 12: 07:45. Ephraim, Utah. Light shock felt by several and awakened some. Windows and doors rattled.

March 22: 21:20. Boulder City, Nevada. Moderate shock felt.

April 8: 11:27. Boulder City, Nevada. Powerhouse. Felt by several. Rattled windows and doors.

April 8: 11:35. Boulder City, Nevada. Powerhouse. Felt by several. Rattled windows and doors.

April 10: 17:42. Salt Lake City, Utah. The Press reported: "A temblor of undetermined extent shook the Salt Lake-Magna area April 10, but damages apparently were negligible. It was particularly distinct in the business district and the western half of the city. The tremor lasted several seconds." Felt slightly at Magna, also at Murray, where trees and bushes shook slightly.

April 11: 14:32. Salt Lake City, Utah. According to the press, "Sunday's quake seemed to center in the Parley's Canyon area. One man residing near the Parley's Canyon 'highline' and one woman, residing near the Mountain Dell reservoir, reported the temblor as 'quite heavy.' A distinct rumble was heard in the Mountain Dell area at the time of the quake."

At Grantsville, windows rattled and walls creaked. Few awakened.

April 14: 03:53. Lewiston, Idaho. Intensity IV. According to the press two distinct shocks were felt in Lewiston and nearby areas. The second shock came after an interval of possibly two seconds. The shocks rattled dishes and swayed beds. Clocks were toppled and windows rattled, but no damage was reported. The first shock was the sharpest and was more noticeable in the outlying districts. Reports stating that the earthquake was felt slightly were received from Sweetwater, Culdesac, Slickpoo, Orofino, the Soldier Meadow area, Craigmont, Reubens, and Uniontown. Residents of Orofino thought it was an explosion when dishes rattled and a few pictures fell.

May 5: 22:10. Boulder City, Nevada. Felt by many in home. Dishes rattled.

May 29: 23:17. Boulder City, Nevada. Power Plant. Felt by all. Windows rattled.

June 4: 02:45. Boulder City, Nevada. Awakened a few people. Windows rattled.

June 6: 13:58. Boulder City, Nevada. Felt by several, windows and doors rattled. This shock was followed by a very small aftershock.

June 24: 22:29. Southern Sheridan County, Montana. The shock was felt strongest around Homestead and Froid.

INTENSITY VI:

Froid.—Felt by many. Buildings swayed slightly and creaked. A well-constructed granary cracked so severly that wheat spilled out. The report from this town stated: "One man north of Brockton was outside when it occurred. He said it felt as though the earth was heaving up and down."

Homestead.—Felt by many. Faint subterranean sounds heard. House creaked and chandeliers swayed. Basement walls reported cracked.

Redstone.—Chandeliers swung, chimneys cracked.

Reserve.—Two shocks. Thunderous, roaring subterranean sounds. Many cracks in plaster. Chimneys damaged.

INTENSITY IV:

Medicine Lake and McCake: No additional reports were received.

June 25: 16:20 and 18:58. Helena, Montana. Two weak shocks felt.

July 20: 00:00. Upper end of Lake Mead, Arizona. Awakened Observer employed on the Colorado-up-river Expedition.

August 13: 23:40. Grover, Utah. Felt by several. Houses creaked and windows rattled. Press reports state that four distinct tremors were felt and a number of families awakened. The center of the quake seemed to be at the A.P.Clark farm, one and one-half miles west of Grover. It was accompanied by a rumbling sound. Residents of Auburn felt the shock, but it was not felt at Afton.

August 24: 06:58. Kalispell, Montana. Felt by several; houses creaked and windows rattled. Faint subterranean scraping sounds were heard.

September 3: 05:25. Ophir and Tulluride, in San Miguel County, Colorado. Disturbed objects and subterranean sounds were observed by several.

September 6: 09:00. Strongest at Buffalo (Johnson County) and Kaycee in Wyoming. At Buffalo there was a swaying motion felt by many. Houses creaked and windows rattled. A distinct sway was felt at a cabin ten miles south. It was also felt by one person at Sheep Mountain Lookout. At Kaycee, houses creaked and windows rattled. The shock was felt slightly at Arvada, Sheridan and Sussex.

September 9: 04:34.* Boulder City, Nevada. A shock of about two seconds duration rattled windows and awakened a few people.

September 19: 17:39.* Boulder City and Boulder Dam, Nevada. Felt strongest at the former where many heard sounds like thunder.

November 3: 04:30. Sevier, Utah. Awakened and frightened all in the community. Windows rattled. Also felt at Joseph where windows rattled. Not felt at Elsinore and Marysvale.

November 3: 06:30. Sevier, Utah. Slight shock felt.

November 3: 21:00. Sevier, Utah. Slight shock felt.

November 5: 21:45, 21:54 and 21:56. Caliente, Nevada. (Matthews Ranch and Beaver Dam Wash.) All awakened. Windows rattled. The second shock was heaviest, the third was light.

December 9: 11:06. Cedar City, Utah. Walls creaked. Doors and windows rattled. One report stated three shocks occurred: 11:05,11:17 and 13:21.

December 10: 02:30. (a.m. or p.m. not given) Cedar City, Utah, Slight shock felt.

December 12: 06.41. Helena, Montana. Moderate shock, lasting two seconds.

CALIFORNIA AND WESTERN NEVADA

(105TH MERIDIAN OR PACIFIC WAR TIME)

NOTE.—All places are in California unless otherwise stated. "P" written after the location of an epicenter means that the location was reported by the Seismological Laboratory of the California Institute of Technology at Pasadena. "B" refers likewise to the Seismological Station of the University of California at Berkeley. The Berkeley data, however, are not available as this publication goes to press. More details will be found in Abstracts of Earthquake Reports for the Pacific Coast and Western Mountain Region. The Bulletin of the Seismological Society of America is referred to as the "SSA Bulletin."

When more than one degree of intensity is reported from a town, the town is listed under the highest intensity reported. An asterisk (*) indicates instrumental time.

January 2: 07:11:18.* Epicenter 33° 25′ north, 116° 25′ west, P. Near Santa Rosa Mountains.

INTENSITY IV:

Estelle Lookout (Section 2, T5S, R5W, SBM, USFS), Fawnskin, Riverside, San Jacinto, and Santa Ysabel.

INTENSITY I TO III.

Banning, Escondido, and San Diego.

February 4: 14:22.9* Epicenter 36.2° north, 118.5° west, P. Kern River, west of Haiwee. Felt intensity IV in Giant Forest, Sequoia National Park (Section 1, T15S, R30E, MDM). Felt slightly in Tulare County (T16S, R29E).

February 28: 22:25. Reno, Nevada. Sharp local shock with subterranean rumbling felt by many. Hanging objects moved slightly.

March 10: 18:14:25.* Comptche, Potter Valley, and Stonyford. (W. L. Wrocklage, Ukiah). Intensity IV. Hanging objects swung and windows rattled. A few people felt the shock in Ukiah.

March 11 to 29: Olancha. No times given by the observer who reported a series of light shocks and stated: "We live in the mountains. These quakes are not felt within a mile east of us, except one hard quake which was felt at North and South Haiwee Dams. Every day last fall, three to six shocks; sometimes loud crackling noises in air, without the ground tremors. The same thing going on now for the past three weeks. Another sharp quake at time of filling out this report form at 11:18 a. m., March 29, 1943. Last year I inquired from the Bakersfield side of the Sierras—none felt—same this time. Quakes seem to be centered in Monachee Meadows, on west slope of Sierras, between Round Mountain and Olanchee Peak. These quakes coming harder and oftener every day."

In response to an inquiry the Seismological Laboratory at Pasadena reported: "We have checked the Haiwee seismograph records for confirmation of the Olancha report. Seismic activity was rather high in March and in the beginning of April but seems to have subsided somewhat now. The magnitude of the shocks rarely exceeds III. The only shock for which a time is given in the report is confirmed by the Hiawee seismograph records. The epicenters must be very close to Haiwee. Haiwee recorded shocks on March 11 at 08:02*, March 12 at 13:18*, and March 16 at 02:59.* A long series began on March 23 at 13:57.* One hundred forty-nine tremors were recorded during the remainder of March. Two of these were large enough to be located: March 25 at 20:50:44* with epicenter at 36° 09′ north, 117° 57′ west, and March 29 at 03:28:11* with the same epicenter."

March 16: 17:40:44.* Epicenter 32° 44′ north, 115° 26′ west, P. Imperial Fault, Imperial Valley. Felt by all at El Centro and Heber with intensity V and IV, respectively. Walls creaked and windows rattled.

March 16: 17:52:20.* Epicenter 32° 44′ north, 115° 26′ west, P. Aftershock. Felt by several at El Centro.

March 16: 17:56:34.* Epicenter 32° 44′ north, 115° 26′ west, P. Felt by many at El Centro.

March 29: 04:45.* Pleasanton. Press reports stated that the shock was recorded on the seismographs at the University of California and at the University of Santa Clara. Three shocks at 04:33, 04:45, and 05:04 were felt at Pleasanton. Many were awakened. The report stated: "Three shocks Saturday, March 27 around 11 p.m. and one about 1 a.m., Sunday, March 28. I did not feel them. Light shocks were felt by some around 8 a. m., March 29."

March 29: 04:55. El Granada. Felt by several. Rattled windows.

March 30: 14:07.* Epicenter 39.0° north, 120.5° west, P. Central Lake Tahoe region. About 15,000 square miles were affected in eastern California and western Nevada. See map page 11. Also recorded on the seismograph at the University of Nevada. Blue Canon and Truckee, California; and Reno Airport and Stewart, Nevada reported light objects fell and all or a large portion of the population felt the shock. Maximum intensity estimated as V. Lighter shocks were reported felt in Truckee at 13:30 and 17:00.

INTENSITY IV:

Emigrant Gap, Homewood, Loyalton, Markleeville, Nevada City, and Portola.

INTENSITY IV IN NEVADA:

Carson City, Fernley, Minden, Reno, and Sparks.

INTENSITY I TO III:

Bijou, Colusa, Downieville, Las Plumas, Marysville, Sacramento, Sierra City, and Soda Springs.

Negative reports were received from eleven places in California and six places in Nevada.

April 1: 14:06.* Truckee, P. Felt by a few.

April 6: 02:03:24.* Epicenter 33° 40′ north, 116° 51′ west, P. Hemet. Press reports indicated the shock was felt in the Hemet-San Jacinto Valley.

April 8: 06:22:41.* Epicenter 34° 33′ north, 118° 57′ west, P. Filmore. It was felt by many. Windows rattled.

April 15: 08:31:51.* West-centrai California, P. This shock, one of a series occurring on April 15th, was felt over an area of approximately 2,000 square miles. Maximum intensity of V was reported from Tracy where a heavy floor lamp was shaken. Reports are confusing as to the exact time of the strongest shock, but data from the seismograms recorded at the Seismological Laboratory at Pasadena indicate that the shock at 08:31:51* was probably much stronger than the others.

According to the press, a series of eleven shocks was felt in Livermore Valley as indicated in reports to to the Sheriff's Office; (05:29, sharp; 06:23, light; 08:23, sharp; 08:31, light; 08:32, heavy; 08:35, 08:38, 08:50, and 09:03, light; 11:00, sharp; 15:08, light). Most people stated that the shocks at 08:32 and 11:00 were the strongest.

Press reports from Santa Clara stated that a series of fifteen distinct shocks were recorded on the seismograph there. [This report also stated that plaster was cracked at the Livermore Veterans' Hospital and that wine bottles were shaken off the shelves of a Livermore winery.

INTENSITY IV:

Byron, Lafayette, Livermore, Moss Beach, Newark, San Francisco, Stockton, Vernalis, and Walnut Creek.

INTENSITY I TO III:

Berkeley, Brentwood, Concord, and Palo Alto.
Negative reports were received from fourteen places.

April 15: 10:30:30.* Vacaville, P. Felt by many. Houses creaked and windows rattled.
April 15: 11:00:08.* Brentwood, P. Slight shock not generally felt.
April 18: 00:48.* Truckee, P. Moderate shock felt.
April 21: 16:40:33*, and others at 10:12:53*, 16:29:00*, and 16:58:46.* Livermore, P. Press reports stated that four quakes were recorded at the University of Santa Clara and were felt in Livermore.

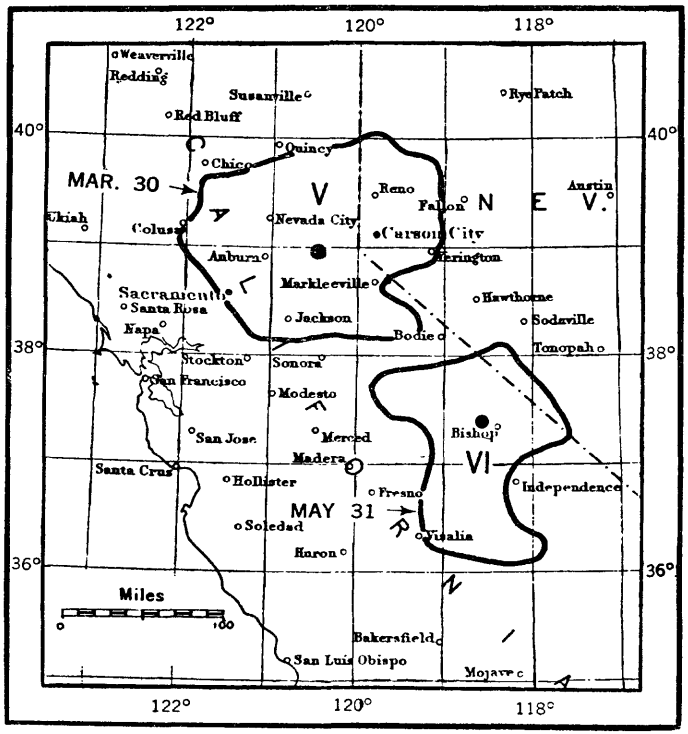


FIGURE 5.—Areas affected by the California earthquakes of March 30 and May 31, 1943.

INTENSITY IV:

Dublin, Newark and Livermore Substations (P.G. & E.),Pleasanton, and San Francisco.

INTENSITY III:

Livermore.

April 26: 04:54:50*, and 05:02:58.* Dublin, Livermore, Moraga, and Niles, P. The earthquake at 04:54:50* affected an area of approximately 1500 square miles. Maximum intensity of V was reported from Dublin, as well as the shifting of small objects. The shock was felt by many in the other places. Windows, doors, and dishes rattled. Press reports stated that two shocks were recorded on the University of California seismograph at 04:54:50* and 05:02:58.* The second shock was reported as "very small."

INTENSITY IV:

Alvarado, Decota, Diablo, Holt, Rio Vista, Sunol, Sunnyvale, and Walnut Creek.

INTENSITY I TO III:

Byron, Centerville, El Granada, Glenwood, and San Ramon.
Negative reports were received from twenty places.

April 26: 05:02:58.* Decota, Livermore, and Pleasanton, P. Intensity IV. Livermore reported additional shocks at 05:15, 05:40, and 11:24:35.* The latter was recorded on the seismograph at Pasadena.

April 26: 08:40. Isleton. Light shock felt by several in homes. Not recorded by the seismograph at Tinemaha.

April 28: 23:11:29.* Livermore, P. Slight shock felt by several. A second shock was felt slightly the following morning at 01:09.

April 30: 19:52.* Livermore, P. Intensity V. Felt by all. Buildings creaked. Windows rattled. Recorded on the seismograph at the University of California.

*April 30:*22:00. Grass Valley. The SSA Bulletin for July 1943 states: "A slight earthquake shock accompanied by a sound, was felt in Nevada City shortly after 10:00 p.m. P.W.T. No damage was reported." The shock was not recorded on the seismograph at Tinemaha.

May 3: 16:22:47.* Epicenter 33° 59′ north, 117° 17′ west, P. Felt by several in Riverside.

May 5: 04:49 and 23:03. Livermore, Arroyo Sanitarium. Many awakened and frightened. Walls creaked and windows rattled.

May 5: 11:07.* Livermore, Veterans Administration, P. Felt by all in home. The Pasadena seismogram showed a small indefinite disturbance at this time; possibly not an earthquake.

May 5: 22:05. Sierra City. "Two shocks, resembling an explosion or underground blast, were felt here by many." The shock was not recorded on the Pasadena seismograph.

May 7: 21:42.4.* Epicenter about 35.7° north, 118.4° west, P. Felt by many in homes at Kernville. Windows rattled and walls creaked.

May 8: 05:30:30.* West-central California. Livermore, P. A relatively small area of about 500 square miles was affected. Intensity V at Livermore. All were awakened in the hospital where walls creaked and windows rattled. Weaker shocks were felt at 02:30, 03:20, and 06:30.

The shock was recorded by the accelerograph at the Veterans' Hospital about five miles south of Livermore.

INTENSITY IV:

Hayward, Holt, and Milpitas.

INTENSITY I TO III:

Banta, Centerville, and Sunol.
Negative reports were received from thirty places.

May 9: 10:18:37.* Epicenter about 33° 03′ north, 115° 40′ west, P. According to the SSA Bulletin, June 1943, "A light earthquake shook Brawley and Niland at 10:18 a. m."

May 17: 12:45. Livermore, Arroyo Sanitarium. Many awakened. Windows rattled. Not recorded at Tinemaha.

May 18: 15:35:35.* Epicenter 33° 40′ north, 118° 05′ west, P. Felt very briefly at Long Beach.

May 19: 10:55:24.* Epicenter 35° 43′ north, 118° 26′ west, P. Felt by several. Rattled windows at Kernville.

May 23: 04:38. Ferndale. Felt by many. Walls creaked. Many awakened. At Scotia, walls creaked and windows rattled, but the shock was felt by only a few.

INTENSITY IV:

Briceland.

INTENSITY III:

Ferndale, Scotia, and Upper Mattole.

May 28: 21:57:50.* Livermore, P. Awakened many in homes and in the community.

May 29: 18:04:16.* Livermore, B. Recorded on the accelerograph at the Veterans' Hospital about five miles north where it was generally felt. The shock must have been quite local as only one felt report was received from the town of Livermore.

May 29: 19:39:15.* Epicenter 32° 58′ north, 116° 00′ west, P. Rattled windows and shook trees and bushes slightly at Borego Valley.

May 30: 00:50:54.* Epicenter 36° 08′ north, 117° 58′ west, P. Felt by a few at Haiwee Power Plant (Coso Junction). Windows rattled and houses creaked.

May 31: 13:16:53.* Epicenter 37° 23′ north, 118° 36′ west, P. This shock was felt over an area of approximately 5,500 square miles with a maximum intensity of VI at Bishop where plaster was cracked in the school building. See map page 11.

A strong-motion record was obtained on the accelerograph located at Bishop.

INTENSITY V:

Olancha, Owens River Gorge (near Bishop), and Tungsten City.

INTENSITY IV:

Benton, Bigpine, Dunlap, and King's Canyon National Park.

INTENSITY I TO III:

June Lake, Laws, and Yosemite National Park.
Negative reports were received from eight places.

June 2: 21:39:37.* Epicenter 33° 30′ north, 116° 45′ west, P. Felt by all with intensity IV at Oak Grove Ranger Station (Aguanga).

June 3: 19:19* and 22:10.* Potter Valley Powerhouse and north to northeast of Willits. (W. L. Wrocklage, Ukiah). Both shocks were light. The one at 19:19 was the stronger. They were recorded on the seismograph at Ukiah.

June 4: 02:50 and 04:53. Willits. Light shocks felt in north to northeast area.

June 8: 01:56. Monterey. Intensity IV. Felt by many. Awakened many and rattled windows. Observer was unable to determine whether it was an earthquake or the result of gun fire off Yankee Point.

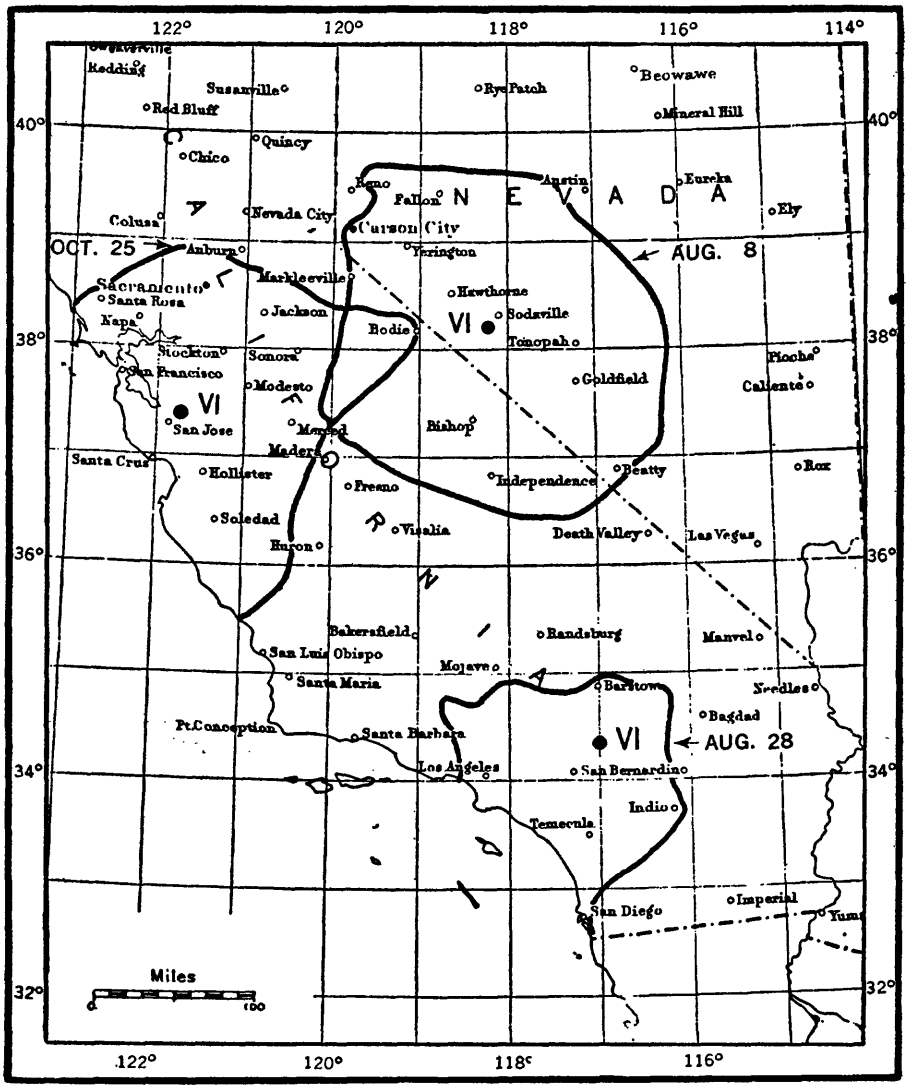


FIGURE 6.—Areas affected by the California and Nevada earthquakes of August 8, August 28, and October 25, 1943.

June 18: 09:15:46.* Epicenter 33° 07′ north, 116° 07′ west, P. Felt intensity IV at Santa Ysabel where walls creaked and hanging objects swung. Felt by a few in San Diego.

June 25: 10:00. Five miles south of Miranda. Intensity III. Felt by two. Felt as though building had been given a push.

June 28: 21:54 and 21:55. Livermore. These were the thirty-sixth and thirty-seventh in a series which began in March. Many persons reported feeling a rather long earthquake, with a rolling motion, rather than the sharp jolt usually felt.

A strong-motion record was obtained on the accelerograph located at Livermore.

June 30: 01:09. Mojave (Section 20, T10N, R12W, SBBM). Heard by two persons. Observer reported five definite thumps and sounds. Some sand fell from crack in wall. Soot fell from closed chimney to top of stove. Clock facing west stopped.

June 30: 08:15:41.* Oakland Hills, B. Slight tremors felt. Recorded at Berkeley where center was estimated to be about five miles from the University.

July 4: 14:53:10.* Epicenter 33° 57′ north, 117° 37′ west, P. Intensity IV at El Carriso Guard Station (Elsinore), Ontario, and Upland.

July 6: 04:05. Livermore. Light shock. Not recorded on the Tinemaha seismograph about 200 miles distant.

July 9: 20:12:33.* Epicenter 35° 44′ north, 118° 14′ west, P. Felt by many with intensity V in the mountains west of Inyokern. Windows rattled. Boulders were shaken loose on the mountain side.

July 14: 17:44.7.* Near Avenal, P. Windows and doors rattled.

July 17: 06:02.* Bigpine Powerhouse No. 3, P. Light shock rattled doors. Hanging objects swung. Very small shock recorded at Tinemaha at 06:02. The observer reported this shock at 05:10.

July 21: 17:10.* Ukiah and Redwood Valley. (H. G. Wrocklage, Ukiah). Felt with intensity IV. Slightly felt by two people at Elk. Recorded on the Berkeley seismograph.

July 28: 20:16.* San Diego, P. Very light shock reported felt.

August 4: 13:50:05* and 14:17:46.* Livermore, Arroyo Sanitarium, P. Felt slightly.

August 8: 22:30:04.* Epicenter 38° 12′ north, 118° 12′ west, P. The shock was felt over an area of about 34,000 square miles in east-central California and western Nevada. See map p. 13. Intensity VI was reported from Basalt, Nevada where it was reported that dishes fell, and from Dyer and Fallon, Nevada where it was reported that plaster and walls were cracked. The seismological Laboratory at Pasadena reported: "There were no aftershocks comparable with the main shock (22:30:04*). The four largest were on the 8th at 22:23* and 23:27*, and on the 9th at 00:44* and 21:43*."

INTENSITY V:

Keeler and Pinehurst Ranger Station, (Section 21, T14S, R28E, Miramonte).

INTENSITY V IN NEVADA:

Goldfield and Schurz.

INTENSITY IV:

Bigpine, Bishop, Bridgeport, Leevening, Huntington Lake, June Lake, Laws, Lone Pine, Owens River Gorge, Tinemaha Dam, Topaz, and Yosemite National Park.

INTENSITY IV IN NEVADA:

Beatty, Carson City, Fernley, Gabbs, Hawthorne, Ione, Luning, Stillwater, Tonopah, and Yerington.

INTENSITY I TO III:

Deep Springs and Sacramento.
Negative reports were received from five places in Nevada and twelve places in California.

August 8: 23:27.* Bishop, Bridgeport, and Leevening, P. Aftershock.

August 9: 04:17.* Lone Pine, P. "Shock felt with about the intensity and duration as the one of August 8 at 22:30." Small shock recorded at Tinemaha, but not at Haiwee.

August 11: 09:01:02.* Epicenter 33° 48′ north, 117° 52′ west, P. Near Anaheim. Press reports stated: "The quake was felt at various spots in southern California where it rattled windows but did no damage." It was felt by a few people in Pasadena.

August 12: 21:49.* Tinemaha and Livermore, P. Extremely small seismic motion recorded at Tinemaha. Intensity IV at Livermore. Felt by many at hospital. Windows rattled and houses creaked. Observer reports fourteen shocks were felt during the month of August.

August 17: 08:50:58.* Epicenter 32° 58′ north, 116° 00′ west, P. Near Borego Valley. Intensity IV at Carriso Gorge, Tunnel 15 (Jacumba). Windows rattled and walls creaked.

August 27: 01:16:53.* Epicenter 34° 26′ north, 119° 52′ west, P. Felt intensity IV in Santa Barbara. Felt by many who were awakened and frightened.

August 28: 20:45:13.* Epicenter 34° 16′ north, 116° 58′ west, P. Shock felt over an area of about 16,000 square miles. See map p. 13. The Seismological Laboratory at Pasadena recorded a foreshock at 20:43:09*, the main shock at 20:45:13*, together with aftershocks at 20:57:54* and 22:16:30.*An intensity of VI was reported from Lake Arrowhead, Big Bear Lake District, and Seven Oaks (Converse Ranger Station) where objects overturned, and knickknacks and pictures fell.

Accelerograph and displacement-meter records were obtained in Hollywood, Los Angeles, Colton, San Bernardino, and San Diego. See section on "Strong-Motion Seismograph Results" for details.

INTENSITY VI:

Big Bear Lake District (*Fawnskin*).—All awakened and many frightened. Small objects overturned. Houses creaked. Damage slight.

Lake Arrowhead, (Section 22, T2N, R3W, SBBM).—Many awakened. Houses creaked. Visible swaying of buildings and trees. Candles, dishes, and ornaments fell in a northeast direction.

Lake Arrowhead.—Felt by all. Small objects overturned and dishes were broken. Houses creaked.

Converse Ranger Station (*Seven Oaks*).—Felt by all. Overturned small objects. Trees and bushes shook moderately. Four shocks in all were felt from 20:43:09* to 22:16:30.*

INTENSITY V:

Banning, Big Bear Ranger Station (Section 8, T2N, R1E, SBBM), Colton, Corona, Fallbrook, Fullerton, Glenn Ranch, Los Angeles, Mentone (Section 13, T1S, R2W), Riverside, and San Dimas.

INTENSITY IV:

Acton, Adelanto, Alberhill, Anza, Azusa, Balboa, Barstow, Beaumont, Cabazon, Cajon, Coachella, Corona Ranger Station, De Luz, Eagle Rock, Elsinore, Escondido, Etiwanda, Fontana, Glendale, Keen Camp, La Crescenta, La Habra, Lancaster, La Jolla, Lynwood, Long Beach, Mojave (Section 20, T10N, R12W, SBBM), Monrovia, Palmdale, Palm Springs, Pasadena, San Diego, San Gabriel, San Jacinto, San Juan Capistrano, San Onofre, San Pedro, Santa Ana, Swartout, Temecula, Victorville, Warner Springs, Wildomar, and Winchester.

INTENSITY I TO III:

Baldwin Park, Castaic, Covina, El Toro, Gorman, Idyllwild, Ludlow, Newport Beach, Pomona, Sepulveda, Thermal, and Wrightwood.

Negative reports were received from twenty-four places.

September 6: 01:30. Ferndale. Felt by many. Walls creaked and windows rattled.

September 11: 10:30. Scotia. Houses creaked. Felt by several.

September 13: 05:40. Paso Robles. Shock felt with strong rumblings. Possibly gun fire.

September 14: 08:46.4.* Epicenter in general vicinty of Sierraville, P. Felt by six persons in Sierraville. Hanging objects swung.

September 16: 00:52:22.* Epicenter 36° 01′ north, 117° 56′ west, P. Near Haiwee. At Trona many were awakened, houses creaked, and windows rattled.

September 23: 05:39. El Centro. SSA Bulletin, January 1944 states: "Two minor earthquakes were felt in El Centro. Sleepers were awakened but there was no property damage."

September 23: 06:21:37.* Epicenter 33° 59′ north, 118° 18′ west, P. Intensity IV in Los Angeles where it was felt as a sudden jar, and windows rattled.

September 24: 06:00. Salinas. Felt in homes. Beds rattled.

September 26: 10:48.* San Jose. Intensity IV. Rattled windows and dishes. Press reports indicated the shock was probably heaviest at Plaza Square and that it was recorded on the seismograph at Santa Clara University.

October 1: 23:56.* Ferndale, P. Felt by many. Walls creaked. Windows and doors rattled. Also reported felt at Fortuna and near Cape Mendocino.

October 4: 17:17. San Francisco. Slight shock. Observer reported it as: "Barely perceptible. May not have been an earthquake."

October 5: 13:20. Ferndale. Felt by many. Houses creaked. Felt by several in Upper Mattole.

October 10: 21:53:22.* Epicenter 34° 00′ north, 116° 41′ west, P. Felt by many in Banning where a one-second jolt rattled windows and doors. One instance of cracked plaster was reported in Palm Springs.

October 13: 22:50.* Maxwell and Williams, P. Felt by several. Walls creaked and windows rattled. Frightened fowl. Also felt at Oroville and Gridley. At the latter place it caused a rocking chair to rock. According to the press some people in Oroville were awakened.

October 14: 07:28:44.* Epicenter 34° 20′ north, 116° 53′ west, P. San Bernardino Mountains, north of Big Bear Lake. Felt by several at San Diego.

October 14: 15:27.* Maxwell and Gridley, P. Walls creaked and dishes rattled. Felt by many at Maxwell. Also felt slightly at Oroville and Williams.

October 15: 09:50:01.* Epicenter 34° 20′ north, 116° 52′ west, P. San Bernardino Mountains. Felt by all in homes at Fawnskin. Windows rattled and houses creaked.

October 22: 05:00 (about). San Ardo. Two shocks, two or three minutes apart, felt by several in the community.

October 23: 17:29:21.* Near Riverside, P. Felt at Riverside, Estelle Lookout (Corona) and Idyllwild Ranger Station.

October 25: 21:50:53.* Central California, B. The earthquake was of moderate intensity but widely felt. It was recorded on the seismograph at the University of California and the epicenter placed along the Calaveras Fault about four and one-half miles northwest of Mount Hamilton, California. An area of about 20,000 square miles was affected. In the epicentral area there was some falling of plaster and a few broken windows. A maximum intensity of VI was reported. See map page 13.

A number of strong-motion records were obtained in Oakland, San Francisco, San Jose, Martinez, and Livermore. Details of these results will be found under the section on "Strong-Motion Seismograph Results."

INTENSITY VI:

Alviso.—Felt by all in community. Cracked windows and plaster. Books and plaster fell. Awakened and frightened many. Slight damage.

Boulder Creek.—Strongest felt for several years. Awakened many. Cracked plaster and overturned small objects.

Castroville.—Felt by many. Shifted small objects and cracked plaster.

Cupertino.—Felt by many and awakened many. Overturned small objects and furniture. Cracked plaster and windows. Many frightened.

Decoto.—Overturned small objects. Felt by all. Frightened and awakened many. Pictures fell.

Half Moon Bay.—Awakened and frightened many. Pendulum clocks facing north and south were stopped.

La Honda.—Felt by all. Many awakened. Houses creaked and small objects were overturned. Damage slight.

Los Gatos.—Windows rattled severely. Felt by many as beds moved and lamps swayed. Small objects and vases overturned. Some windows cracked and plaster fragments fell. Visible swaying of buildings.

Milpitas.—"Hardest shake since 1912." Awakened all and frightened many in homes. Trees and bushes shaken strongly. Small objects overturned. Plaster cracked. Pendulum clocks stopped and pictures fell.

Mountain View.—Considerable damage to glass windows. Awakened and frightened many. Small objects overturned.

Palo Alto.—Felt by all. Buildings creaked and a few windows cracked. Trees and bushes shaken strongly. Many awakened.

San Jose.—Many awakened. Walls, plaster, and windows cracked. Dishes broken and water spilled from indoor containers. Loud rustling noise heard. Small objects overturned and clocks stopped.

San Martin.—Felt by all. Dishes rattled and walls creaked. Small objects overturned and knick-knacks fell.

Santa Cruz.—Felt by all. Many awakened. Trees shaken moderately and automobiles moved. Walls creaked and small amount of plaster cracked.

Sausalito.—All freightened and many awakened. Houses creaked and some plaster cracked. Damage slight.

Sunnyvale.—Chandelier broken. Felt by all. Many awakened and frightened. Damage slight. Pendulum clock facing north stopped.

Tracy.—Awakened and frightened many. Walls creaked and small objects overturned.

Vallejo.—Felt by all. Plaster cracked. Many awakened and frightened.

Watsonville.—Many awakened and frightened. Houses creaked. Slight damage. Hanging objects swung.

INTENSITY V:

Agnew, Alma, Bayshore, Ben Lomond, Berkeley, Bolinas, Burlingame, Capitola, Corte Madera, Davenport, Emeryville, Gilroy, Hollister, Holy City, Inverness, Lafayette, Livermore, Lodi, Los Altos, Martinez, Mill Valley, Morgan Hill, Newark, Oakland, Patterson, Redwood City, Ross, San Bruno, San Francisco, San Gregorio, San Mateo, San Rafael, Santa Rosa, Saratoga, and Stockton.

INTENSITY IV:

Alameda, Alcatraz, Angels Camp, Antioch, Bodega Bay, Bridgeport, Carmel, Chinese Camp, Crockett, Davis, Delhi, Fairfield, Glen Ellen, Gustine, Ignacio, Imola, Ione, Irvington, Isleton, Jackson, Jenner (Fort Ross), Kentfield, King City, Knights Ferry, LaGrange, Livingston, Manteca, Martell, Millbrae, Modesto, Moraga, Moss Landing, Napa, Niles, Oakdale, Olema, Orinda, Petaluma, Pescadero, Pinnacles, Pinole, Pleasanton, Rockaway Beach, San Ramon, San Leandro, Seaside, Sloughhouse, South Dos Palos, Stinson Beach, Suisun, Thornton, Tiburon, Tracy, Vacaville, and Vernalis.

INTENSITY I TO III:

Belmont, Chualar, Lafayette, Lockeford, Los Banos, Merced, Monterey, Pinecrest, Sacramento, Saint Helena, Salinas, San Ardo, San Juan Bautista, Volta, and Yosemite National Park.

Negative reports were received from forty-one places.

October 26: 04:58.* Lakeport, Potter Valley and Upper Lake, P. Light shock felt. Also felt, with varying intensity, at Ukiah.

October 26: 15:10. Los Alamos. Felt by a few. Buildings creaked.

October 29: 09:31:09.* Epicenter 33° 47′ north, 117° 52′ west, P. Press reports indicated it was felt at Santa Ana and Orange.

October 31: 06:12:10.* Epicenter 33° 47′ north, 116° 12′ west, P. Little San Bernardino Mountains near Indio. Moderate shock caused buildings to creak. A rumbling sound was heard. Felt slightly at Thermal.

October 31: 13:00. Lonoak. Light shock felt by several in homes.

November 2: 09:47:59*, 09:54:14*, 09:56:02*, 09:57:16*, 10:42:28*, 10:50:41*, 10:53:05*, 11:01:13*, 11:01:34*, and 11:51. Epicenter 32° 58′ north, 116° 00′ west, P. The series rattled windows at Jacumba (Carriso Gorge). It was felt by a few at Oak Grove Ranger Station (Aguanga) where trees and bushes were shaken slightly.

November 8: 04:33:46.* Epicenter 36° 00′ north, 119° 55′ west, P. Kettleman Hills. Felt at Avenal. Moderate shock rattled windows. Many awakened.

November 11: 03:10 (about). Dyerville, Eureka, Ferndale, Scotia, and Upper Mattole. Felt by many. Walls creaked and windows rattled. May have been strongest at Ferndale and Scotia.

November 13: 21:45.8.* Epicenter 38.2° north, 119.0° west, P. Bridgeport and Bridgeport Dam. Light shock. One sudden drop felt by several. "Night watchman 1,000 feet to south of where I was sitting, as well as people in the town of Bridgeport, six miles to the south, report a swaying movement, although slight."

November 14: 05:21:07.* Epicenter 33° 46′ north, 116° 48′ west, P. San Jacinto fault. Felt by many at Hemet where windows rattled and houses creaked.

November 14: 13:00 (About). French Corral. "Community felt slight shock around 1 p. m." Too slight to register.

November 14: 15:03. Willows (Section 9, T19N, R3W). Bumping motion felt by many. Buildings creaked and loose objects rattled.

November 14: 22:37. Colusa and Oroville. Colusa press reports stated that four shocks were felt there at 11:29, 15:03, 22:37, and 23:56 with the one at 22:37 being the strongest. Plaster was cracked. This series of shocks was felt over approximately 5,000 square miles in north-central California. Oroville press reports mentioned two shocks were felt, and stated that the one at 22:37 caused two desks to jump off the floor in a theater office.

INTENSITY V:

Colusa and Oroville.

INTENSITY IV:

Butte City, Dunnigan (1 mile south and 1 mile east), Maxwell, Meridian, Sites, Williams, Willows, and Yuba City.

INTENSITY I TO III:

Chico, Clear Lake Highlands, Knights Landing, Yolo, and Zamora.
Negative reports were received from twenty-three places.

November 15: 23:15. Colusa and vicinity. Colusa papers stated there had been five definite shocks in 48 hours (November 14th, 15th, and 16th) with a probable total of eight including very light shocks. The shock at 23:15 was reported by some to have been as strong as the one on the 14th.

INTENSITY V:

Colusa, Oroville, and Stonyford.

INTENSITY IV:

Butte City, Chico, Las Plumas, Maxwell, Meridian, Sites, Williams, and Yuba City.

INTENSITY I TO III:

Willows.
Negative reports were recieved from eighteen places.

November 16: 04:25. Williams. Two shocks with east-west motion awakened all. Two lighter shocks were felt about 30 minutes later.

November 16: 11:21. Colusa and vicinity. Estimated intensity IV at Butte City, Colusa, Maxwell, Sites, and Williams.

INTENSITY III:

Chico, Meridian, and Zamora.
Negative reports were recieved from twenty-three places.

November 16: 14:38. San Leandro. Field investigation revealed that damage was confined to a small area in San Leandro.

A strong-motion record was obtained on the Weed accelerograph at the Chabot Observatory in Oakland.

A report on field investigations stated that of those cases where damage was more severe the outstanding case was that of a dwelling on Alice Street where the chimney to an open fireplace had pulled away from the wall of the house and left a crack at the eaves about 2½ inches wide between the chimney and the building. There was evidence that the house had shifted ¼ inch on its foundation in a southeast direction. Another building showed severe strain as the stucco had fine cracks all around following studding, sill and caps. A second chimney on the south side of another house cracked away leaving an opening about an inch wide. The San Leandro press reported: "San Leandrians were aware of two quick shakes in rapid succession accompanied by the sound of an explosion. Unlike the usual disturbance the shock was accompanied by heavy blast-like concussions which bulged and shook huge glass windows. So loud was the accompanying noise that for several hours it was a case for argument whether what had happened was an earthquake or an explosion. Phone calls were made to Hayward and Berkeley, but the shock was not felt there."

INTENSITY VI:
San Leandro.—See previous paragraphs.

INTENSITY V:

Centerville and Oakland.

INTENSITY IV:

Decoto, Diablo, Hayward, Pleasanton, and San Ramon.

INTENSITY I TO III:

Alameda and San Francisco.
Negative reports were received from ten places.

November 17: 00:12. Colusa. Press reports stated: "An initial sharp jolt, lapse of a few seconds, then a moderate shaking that lasted for perhaps eight seconds was felt by Colusans."
November 17: 04:28:41.* Epicenter 33° 55′ north, 116° 42′ west, P. Felt with intensity V in Yucaipia region. Many were awakened and frightened. Windows and dishes rattled.

INTENSITY IV:

Banning, Elsinore, Fawnskin, Hemet, Indio (two miles west), Idyllwild, Riverside, and Thermal.

November 23: 06:42. Pleasanton. Felt by many.
November 30: 21:51. San Benito. Slow motion lasting one second.
December 4: 13:15. Colusa and vicinity. Heavy jolt felt by many. No damage.

INTENSITY IV:

Colusa, Meridian, and Willows.

INTENSITY III:

Sacramento.

December 7: 07:46:40.* Epicenter 34° 01′ north, 118° 22′ west, P. Light shock felt in southwest Los Angeles, Inglewood, and San Pedro.
December 16: 17:19:25.* Epicenter 37° 06′ north, 118° 16′ west, P. Felt by many at Bigpine. Walls creaked and windows rattled.
December 16: 20:54:35.* Epicenter 37° 06′ north, 118° 16′ west, P. Felt at Bigpine and Tinemaha Reservoir. "This shock was one short jerk from west to east. No vibration immediately following. A few minor vibrations 15 to 30 minutes later."
December 16: 21:38:00.* Epicenter 37° 06′ north, 118° 16′ west, P. Felt with intensity V at Bigpine Power Plant No. 3 and Division Creek Power Plant No. 2 (Independence). Awakened many. Houses creaked and windows rattled.

INTENSITY IV:

Bigpine and Tinemaha Reservoir.

December 18: 03:34. Division Creek Power Plant, No. 2 (Independence). Slight shock rattled windows and shook trees and bushes.
December 18–19: "Livermore was rocked by two brief but sharp earthquakes on December 18 and 19. One occurred at 17:57 on the 18th, lasting less than a minute; the other, shortly before 19:00 on the 19th." (SSA Bulletin, January 1944.)
December 19: 18:45. Pleasanton. Felt by many. Windows rattled. Trees and bushes were shaken slightly.
December 22: 08:50:28.* Epicenter 34° 20′ north, 115° 48′ west, P. According to the press, the Seismological Laboratory at Pasadena estimated the center to be in the desert northeast of the Imperial Valley. The press also stated that the earthquake shook the Metropolitan Water District's Iron Mountain Station. Intensity IV at Ludlow and Amboy, where it was felt by many. Intensity I to III at Los Angeles and Needles.
December 30: 01:30. Greenville. Two shocks felt by only a few. Houses creaked.

WASHINGTON AND OREGON

(105TH MERIDIAN OR PACIFIC WAR TIME)

NOTE.—More details will be found in Abstracts of Earthquake Reports for the Pacific Coast and Western Mountain Region. An asterisk (*) indicates instrumental time.

April 14: 03:53. Clarkston, Washington. Felt by several. Dishes and windows rattled. "The fowls were disturbed and flew about."
April 23: 16:10:46.* (D. S. Carder, Lake Mead Seismological Party). The epicentral area was probably between Leavenworth and Entiat. The total affected area was about 10,000 square miles, north and south from Tonasket and Sunnyside, east and west from Coulee Dam to the crest of the Cascade Mountains at Scenic. See map page 19.

INTENSITY V:

Entiat.—Felt by all.
Leavenworth.—Felt by many in houses and by some out-of-doors. Houses creaked and windows rattled. Knickknacks fell.

Republic.—Strong shock. Shook dishes and sent slide of gravel and rocks down mountain. It was followed by a loud explosive noise. Pictures swayed.

INTENSITY IV:

Chelan, Ephrata, Lakeside, Odessa, Pateros, Scenic, Tonasket, Waterville, and Wenatchee.

INTENSITY I TO III:

Connell, Coulee Dam, and Sunnyside.
Negative reports were received from thirty-seven places.

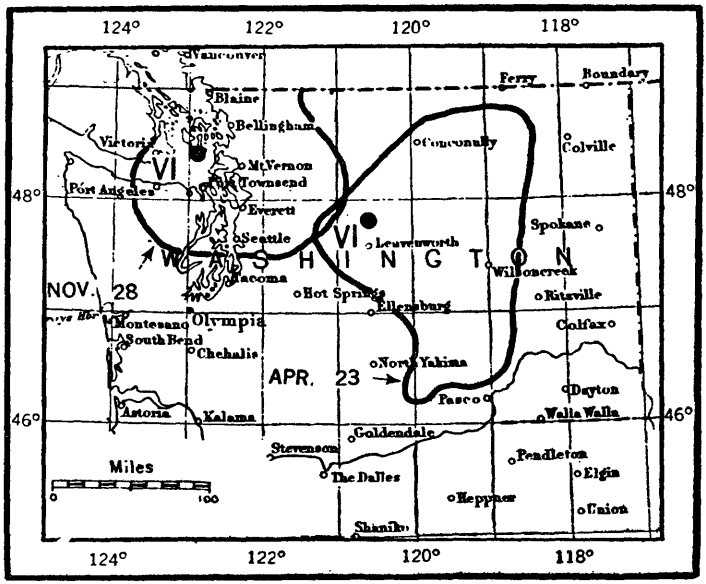


FIGURE 7.—Areas affected by earthquakes in the state of Washington on April 23 and November 28, 1943.

June 13: 06:20. Entiat, Washington. Windows rattled.
June 24: 09:44. Bend, Oregon. Felt by a few. Slight tremor felt by all upstairs.
July 11: 21:40. Longmire (Mt. Rainier National Park). Felt by many. Windows rattled, walls creaked. Negative reports were received from twelve places.
August 4: Rockville, Oregon. A special report states that minor tremors were being felt at the Leake ranch and had been more or less continuous for three days. Similar disturbances have been noted at this point two or three times a year for the past six or seven years. They usually last for a week or ten days. The tremors are probably related to a steamvent in the hillside northeast of the ranch. This vent was first noticed several years ago and still steams in cold weather, melting the snow nearby. The observer stated that she lived in Santa Barbara, California at the time of the San Francisco earthquake and knows the characteristics of an earthquake.
September 22: 21:50. Coulee Dam, Mason City, and Grand Coulee, Washington. Felt by many as windows rattled and houses creaked slightly. Direction of motion was up and down. Negative reports were received from nine places.
October 6: 08:09. Snoqualmie, North Bend, and Preston, Washington. Generally felt in these places where windows rattled and houses creaked. Negative reports were received from seven places.
October 9: 05:56. Entiat and Waterville, Washington. Light shock rattled windows and dishes. Clocks stopped. Negative reports were received from six places.
October 27: 01:54. Okanogan, Washington. Felt by many and awakened many. Slightly felt at Coulee Dam (Right Powerhouse Guard Station), and twelve miles from Wauconda. Not felt at Chesaw, Laurier and Republic.
November 28: 17:43. Puget Sound Region. Felt over an area of about 9,000 square miles in the state of Washington. Intensity VI was reported from Richardson where chimneys were cracked. Vancouver, British Columbia, and Vancouver Island trembled under two distinct shocks. See map page 19.

INTENSITY VI:

Richardson.—Felt by many. Windows rattled and small objects and furniture shifted. Chimneys cracked.

INTENSITY V:

Coupeville, Eastsound, La Conner, Langley, Quilcene, and Roche Harbor.

INTENSITY IV:

Anacortes, Arlington, Bellingham, Chimacum, Darrington, Edison, Everett, Granite Falls, Lynden, Mt. Vernon, Oak Harbor, Olga, Port Angeles, Port Ludlow, Scenic, Seattle, near Bremerton, (Section 25, T24N, R1E) Sequim, Startup, and Sultan.

INTENSITY I TO III:

Cle Elum, Concrete, Nooksack, Port Townsend, and Sedro-Woolley.
Negative reports were received from fifty-two places.

ALASKA

(150TH MERIDIAN TIME)

February 14: 16:22. Fairbanks. "One sharp shock" felt by several.
February 17: 00:50. Fairbanks. Slight earth tremor felt by several.
April 2: 17:19. Fairbanks. Slight tremor felt by several.
April 9: 03:00. Anchorage, near Merrill Field. Many awakened but most did not realize what woke them.
May 1: 18:50. Fairbanks. "One single, sharp shock" felt by several.
May 18: 23:27. Kotzebue. A slight trembling ending with a sharp shock was felt by several.
May 31: 23:21. Yukon Standard Time. Northway. Slight shock felt by Weather Observer in one story wooden building resting on piling in a silt-sand foundation.
July 6: 12:04. Anchorage. Felt by many in Anchorage but not noticed in Weather Bureau Office two miles east of town. The shock caused "trembling such as vibrations from a steam engine."
July 27: 18:05. Anchorage. Slight shock felt by several. Windows rattled.
August 25: 09:56. Anchorage. Slight shock rattled windows and was felt by several.
September 26: 23:45. Anchorage. Slight tremor felt by several.
November 2: 04:30. Fairbanks. Slight shock felt by one as a west to east rocking motion.
November 3: 04:32.3.* Anchorage. Sharp shock with abrupt heaving motion made doors swing and windows rattle. Generally felt. A light after-shock occurred at 05:40. Several slight tremors were felt at intervals until about 07:30. Pen on recording rain gage made mark about ¾ inch wide at time of main shock. Similar marks were recorded on the barograph traces. Epicenter probably near 62° north, 151° west.

Felt at McGrath 04:33. Slight shock reported by Weather Bureau Observer as continuing for about fifteen seconds. "Wall clocks in the Civil Aeronautics Administration and Weather Bureau Offices were stopped. The barograph trace showed no indication of the quake____."

Felt at Bethel 04:37. Tremors lasting 20 seconds were felt by several. Faint rumbling underground and moderately loud cracking of ice was heard. Building swayed. "The noise moved down the river quickly and then seemed to pass under the station making the earth tremble comparable to a locomotive passing. The ice in the river made a cracking noise for about an hour after the tremors, which lasted about 20 seconds."

November 11: 14:36. Fairbanks (Garden Island). Single sharp shock felt by several. Dishes rattled.
November 13: 15:25. Fairbanks (Garden Island). Single slight shock felt by a few.
December 29: 17:55. Fairbanks. Slight tremors felt by several.

HAWAIIAN ISLANDS

(HAWAIIAN STANDARD TIME)

NOTE.—In the case of these islands with their many earthquakes of volcanic origin, only the stronger ones are listed. Reports of the Hawaiian Volcano Observatory under the jurisdiction of the National Park Service and the University of Hawaii give all details.

March 25: 13:05. Mauna Loa. Slight.
June 14: 21:38. Island of Hawaii near Waima. Slight.
July 1: 1:51. Felt locally at Volcano Observatory and at Kapopala near Ainapo. Slight.
October 16: 2:36. East slope of Mauna Kea. Felt slightly at Hakalan.
October 20: 2:07. Felt at Volcano Observatory and at Hilo. Slight.
November 10: 16:22. Widely felt on southern half of Hawaii. Stone walls were thrown down southwest of Pahala. Moderate.
December 22: 19:50. Felt at Volcano Observatory and at Hilo on the southwest slope of Mauna Loa. Slight.

PANAMA CANAL ZONE

(EASTERN WAR TIME)

May 2: 13:18:47.* This shock as felt at Balboa Heights was rated at intensity V, and was the heaviest shock in the Canal Zone since May 6, 1936. The time of the first onset as recorded on the seismographs was 13:18:47. The pendulum clock used as a time marker for the seismograph record was stopped one minute and one second later at 13:19:48. Out of seven pendulum clocks in the Administration Building

at Balboa Heights, five were stopped and two continued to run. A six-pin seismometer installed at Miraflores Locks, consisting of six steel pins one fourth inch in diameter and ranging in height from 6 to 15 inches, had all six pins knocked over. The shock was generally felt by residents of the Canal Zone and many were alarmed and ran out of doors. Some dishes and mirrors were broken but there was no material damage. The U. S. Coast and Geodetic Survey accelerograph installed in the basement of the Administration Building at Balboa Heights was not operated.

The first two minutes of record on the seismograph is very indistinct on account of the rapid vibrations and it is impossible to identify the onset of the "S" waves. However the seismograph record shows that the main shock was followed within the next 12 hours by nine aftershocks in some of which the "P" and "S" waves are clearly shown. None of these aftershocks were strong enough to be felt in the Canal Zone.

Distance to epicenter estimated to be about 125 miles.

PHILIPPINE ISLANDS

Reports from the Philippine Islands have been suspended for the duration of the war.

PUERTO RICO

(60TH MERIDIAN TIME)

April 22: 17:16. San Juan, Puerto Rico. Slight shock felt by several in Weather Bureau Office. Recorded on the seismograph at the U. S. Coast and Geodetic Survey station near San Juan.

July 28: 23:02. Felt in San Juan by many. Instrumental data indicated the shock centered near 19.0° north, 67.2° west, about thirty-five miles off northwestern Puerto Rico.

One hundred twenty aftershocks were recorded on the seismograph near San Juan.

July 29: 21:04. San Juan, Puerto Rico. Considerably less intense than the shock on the 28th, but was of sufficient intensity to stop the pendulum clock in the Weather Bureau Office. It was felt by thousands of persons in Puerto Rico.

UNCLASSIFIED REGIONS

EARTHQUAKES FELT ON LAND.

April 1: 19:32, Eastern War Time. Swan Island (near 17.5° north, 83.9° west). Estimated intensity IV. Twenty of the twenty-five people on the island felt the shock. The barograph and thermograph traces at the Weather Bureau showed slight displacement. No damage.

The shock was reported felt on a forty-ton schooner approaching from the north about three miles off shore.

April 19: 23:49, Eastern War Time. Swan Island. Abrupt rocking motion felt by all. The barograph trace showed a slight displacement. No damage.

December 21: 09:46, Eastern War Time. Island of Aruba, Netherland West Indies. A minor earthquake was reported felt. Instrumental data indicated the epicenter was in the region of 13.3° north, 70.4° west. This position is off-shore and about fifty miles northwest of Aruba.

December 22: 08:51, Eastern War Time. Similar to quake of December 21.
December 23: 11:45, Eastern War Time. Similar to quake of December 21.
December 23: 20:57, Eastern War Time. Similar to quake of December 21.

MISCELLANEOUS ACTIVITIES

GEODETIC WORK OF SEISMOLOGICAL INTEREST

No triangulation or leveling of seismological interest was executed during the calendar year 1943.

TIDAL DISTURBANCES OF SEISMIC ORIGIN

Seismic sea wave disturbances were noted for only one earthquake during the year. The earthquake occurred on April 6, 1943 at 16h 07.3m, G. C. T. Seismographic data indicates the shock centered near 31.5° south, 71.4° west. It was destructive at Salamanca and Illapel, Chile.

The marigram on which the seismic wave was recorded shows that the water wave arrived at Valparaiso at about 16h 30m, G. C. T. (see Figure 13) and continued recording for about 36 hours. Initial ranges were just over three feet. Periods were indefinite and variable but averaged about 40 minutes. The geographic position of this recorder was 33° 01.5′ south, 71° 38.4′ west. Distance and direction from epicenter to recorder was roughly 100 miles, south 7° west.

This station is one of a group of 14 stations located in central and South American countries through cooperation with the United States Government. The projects were sponsored by the United States Department of State and were carried out by the Coast and Geodetic Survey in cooperation with local authorities.

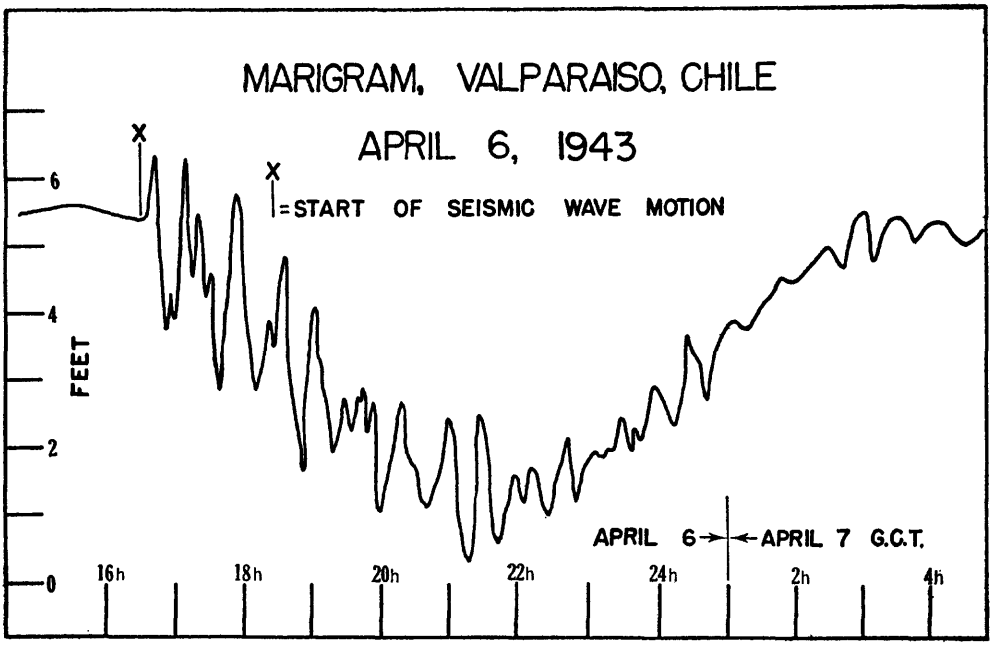


FIGURE 8.—Marigram obtained at Valparaiso, Chile on April 6, 1943.

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 affected 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 southern Florida—January 1 to December 31, 1943*

Well No.	Date	Time (E.W.T.)	Depth to water in feet				Amplitude of fluctuation in feet
			Before disturbance	After disturbance	At highest point of fluctuation	At lowest point of fluctuation	
S-1042	1-24-43[a]	15:45	8.365	8.365			Less than 0.01
S-1042	1-27-43	17:00	8.456	8.459			Less than 0.01
S-182	1-28-43	01:00	11.195	11.20			Less than 0.01
S-1042	1-28-43	01:00	8.46	8.435	8.435	8.46	0.025
F-179	1-28-43	01:00	10.06	10.055	10.052	10.067	0.015
F-213	1-28-43	01:00	17.39	17.39	17.374	17.395	0.021
G-72	1-28-43	01:15	7.942	7.93	7.928	7.942	0.014
F-210	1-29-43	09:00	10.11	10.113	10.1092	10.119	0.01
S-1042	2-22-43[a]	05:45	8.62	8.62	8.528	8.698	0.17
S-68	2-22-43[a]	05:45	10.995	11.01	10.945	11.065	0.12
S-18	2-22-43[a]	05:45	9.345	9.345	9.315	9.375	0.06
G-72	2-22-43[a]	05:45	8.25	8.25	8.24	8.26	0.02
F-179	2-22-43[a]	05:45	10.20	10.19	10.168	10.214	0.046
F-210	2-22-43[a]	No record	10.23	10.23	10.158	10.22	0.072
F-210	4- 6-43[a]	13:00	9.965	9.952	9.936	9.973	0.037
S-1042	4- 6-43[a]	12:15	8.90	8.915	8.862	8.976	0.114
F-179	4- 6-43[a]	13:00	9.80	9.80			Less than 0.01
S-68	4- 6-43[a]	13:00	10.33	10.33	10.32	10.345	0.025
F-213	4- 6-43[a]	13:00	17.43	17.42*	17.405	17.433	0.028
G-72	4- 6-43[a]	13:00	8.18	8.18			Less than 0.01
S-19	4- 6-43[a]	13:00	8.38	8.375	8.353	8.40	0.047
S-18	4- 6-43[a]	13:00	9.53	9.54*	9.53	9.54	0.01
F-210	4-19-43	10:00	10.07	10.06	10.05	10.07	0.02
S-1042	4-19-43	10:00	8.97	8.97			Less than 0.01
S-68	4-19-43	10:00	9.635	9.625	9.615	9.64	0.025
S-19	4-19-43	10:00	8.355	8.33	8.325	8.355	0.03
F-210	5- 2-43[a]	13:45	9.91	9.91	9.875	9.95	0.075
S-1042	5- 2-43[a]	13:45	9.21	9.21	9.185	9.235	0.05
F-179	5- 2-43[a]	13:45	9.80	9.80	9.797	9.81	0.013
S-68	5- 2-43[a]	13:45	9 90	9.90	9.875	9.92	0.045
F-213	5- 2-43[a]	13:45	17.62	17.65*	17.62	17.655	0.035
S-19	5- 2-43[a]	13:45	8.355	8.355	8.325	8.385	0.06
S-18	5- 2-43[a]	13:45	9.273	9.271*			Less than 0.01
F-179	5-17-43	09:30	9.805	9.805	9.798	9.81	0.012
F-213	5-17-43	09:30	17.295	17.285*	17.28	17.295	0.015
F-210	5-17-43	09:30	9.90	9.89	9.885	9.90	0.015
F-179	5-26-43[a]	12:00	9.485	9.485			Less than 0.01
S-1042	5-26-43[a]	12:00	9.52	9.515	9.51	9.52	0.01
F-210	6- 8-43[a]	18:30	9.057	9.06			Less than 0.01
S-1042	6- 8-43[a]	18:30	8.928	8.932			Less than 0.01
S-68	6- 8-43[a]	18:30	9.55	9.55			Less than 0.01
F-210	6- 9-43[a]	00:30	9.075	9.08	9.072	9.085	0.013
S-1042	6- 9-43[a]	00:30	8.933	8.928	8.918	8.943	0.025
S-68	6- 9-43[a]	00:30	9.57	9.565	9.555	9.58	0.025
S-329	6- 9-43[a]	00:30	7.75	7.75	7.745	7.755	0.01
F-210	6-15-43[a]	14:30	9.405	9.41	9.353	9.463	0.11
S-1042	6-15-43[a]	14:30	9.11	9.11	9.082	9.152	0.07
F-179	6-15-43[a]	14:30	9.55	9.552	9.53	9.57	0.04
S-68	6-15-43[a]	14:30	9.82	9.82	9.782	9.85	0.068
F-213	6-15-43[a]	14:30	17.66	17.69*	17.66	17.705	0.045
S-19	6-15-43[a]	14:30	7.805	7.82	7.765	7.86	0.095
F-210	6-15-43[a]	17:00	9.42	9.42	9.415	9.425	0.01
S-1042	6-15-43[a]	17:00	9.115	9.115	9.11	9.12	0.01
S-68	6-25-43	10:00	9.615	9.615	9.615	9.625	0.01
S-1042	6-25-43	10:00	8.755	8.75	8.75	8.76	0.01
F-210	6-25-43	10:00	9.75	9.75			Less than 0.01
F-210	7-28-43[a]	23:15	9.14	9.14			Over 1.00[b]
S-1042	7-28-43[a]	23:30	7.14	7.14			Over 1.00[b]
S-329	7-28-43[a]	23:15	6.46	6.46			Over 1.00[b]
F-179	7-28-43[a]	23:15	9.44	9.46	9.12	9.80	0.68
S-68	7-28-43[a]	23:15	8.92	8.92	8.48	9.40	0.92
S-18	7-28-43[a]	23:15	8.03	8.04	7.91	8.17	0.26
G-72	7-28-43[a]	23:15	4.55	4.55	4.48	4.61	0.13
G-3	7-28-43[a]	23:45	6.79	6.775	6.79	6.775	0.015
F-213	7-28-43[a]	23:15	17.46	17.49*	17.02	17.96	0.94
S-182	7-28-43[a]	23:15	9.76	9.77	9.76	9.77	0.01

TABLE 1.—*Earthquake Fluctuations in Wells in southern Florida—January 1 to December 31, 1943*—Continued

Well No.	Date	Time (E.W.T.)	Depth to water in feet				Amplitude of fluctuation in feet
			Before disturbance	After disturbance	At highest point of fluctuation	At lowest point of fluctuation	
F-210	7-29-43[a]	21:05	9.18	9.18			Less than 0.01
S-68	7-29-43[a]	21:05	8.98	8.98			Less than 0.01
F-210	8-15-43	15:00	9.20	9.20			Less than 0.01
S-68	8-15-43	15:00	8.36	8.37	8.36	8.37	0.01
F-210	8-31-43[a]	12:15	8.09	8.085	8.08	8.09	0.01
S-68	8-31-43[a]	12:15	7.75	7.75	7.748	7.76	0.012
S-19	8-31-43[a]	12:15	6.06	6.06			Less than 0.01
S-329	8-31-43[a]	12:15	5.44	5.44			Less than 0.01
F-213	8-31-43[a]	12:15	16.94	16.94			Less than 0.01
F-210	9- 6-43[a]	00:30	8.50	8.50	8.49	8.505	0.015
S-68	9- 6-43[a]	00:30	8.455	8.455	8.45	8.465	0.015
S-329	9- 6-43[a]	00:30	5.54	5.535	5.43	5.542	0.012
S-19	9-23-43[a]	11:15	6.675	6.685	6.675	6.69	0.015
F-210	9-23-43[a]	11:15	8.632	8.64	8.632	8.642	0.01
S-68	9-23-43[a]	11:15	8.91	8.91	8.90	8.915	0.015
S-1042	9-23-43[a]	12:20	6.52	6.53	6.52	6.53	0.01
S-329	9-23-43[a]	11:15	5.06	5.07	5.06	5.07	0.01
S-68	9-27-43	04:00	8.86	8.86			Less than 0.01
F-210	9-27-43	04:00	8.72	8.71	8.70	8.72	0.02
F-210	11- 3-43[a]	10:45	9.02	9.02	8.82	9.20	0.38
S-1042	11- 3-43[a]	12:30	7.505	7.52	7.38	7.67	0.29
S-19	11- 3-43[a]	10:45	6.70	6.70	6.46	6.93	0.47
F-179	11- 3-43[a]	11:45	8.95	8.96	8.93	9.00	0.07
F-213	11- 3-43[a]	11:15	17.37	17.37	17.35	17.38	0.03
G-72	11- 3-42[a]	10:45	3.63	3.635	3.62	3.65	0.03
S-329	11- 3-43[a]	11:00	5.52	5.52	5.39	5.64	0.25
S-18	11- 3-43[a]	11:45	7.99	8.00	7.98	8.02	0.04
S-68	11- 3-43[a]	11:45	9.05	9.05	8.98	9.13	0.15
F-210	11- 6-43[a]	05:00	9.15	9.15	9.14	9.165	0.025
S-1042	11- 6-43[a]	06:15	7.58	7.59	7.58	7.595	0.015
S-19	11- 6-43[a]	06:15	6.45	6.45	6.44	6.46	0.02
F-213	11- 6-43[a]	06:00	17.22	17.22			Less than 0.01
G-72	11- 6-43[a]	05:45	3.65	3.65			Less than 0.01
S-329	11- 6-43[a]	05:45	5.67	5.67	5.65	5.68	0.03
S-68	11- 6-43[a]	06:15	8.96	8.96	8.95	8.98	0.03
S-1042	12- 8-43	16:30	7.49	7.49			Less than 0.01
F-210	12- 8-43	16:30	9.525	9.53	9.525	9.535	0.01
S-19	12- 8-43	16:00	6.89	6.89			Less than 0.01
S-68	12- 8-43	16:00	9.13	9.13	9.12	9.14	0.02
S-19	12-21-43[a]	10:15	7.15	7.15			Less than 0.01
S-19	12-23-43[a]	12:10	7.15	7.15			Less than 0.01
S-19	12-23-43[a]	16:30	7.15	7.15			Less than 0.01
F-210	12-23-43[a]	16:15	9.71	9.72	9.71	9.725	0.015
F-179	12-23-43[a]	13:00	9.63	9.63			Less than 0.01
S-18	12-23-43[a]	16:00	8.64	8.64			Less than 0.01
S-68	12-23-43[a]	16:30	9.33	9.33	9.33	9.34	0.01

[a] Date corresponds with that for which U. S. C. & G. S. reported an earthquake disturbance.
[b] Recorder drum rotated more than length of chart; hence highest and lowest fluctuation and maximum amplitude are not available.
[c] Tidal.

TABLE 2.—*Descriptions of Wells in southern Florida*

Well No.	Location	Owner	Depth*	Casing Diam.	Finish	Record	Formation
G-72	NW¼NE¼ sec. 3, T. 52 S., R. 39 E., Fla. Rt. 26 at Dade-Broward line.	U. S. Geological Survey.	4.6	8	Open hole; non-artesian.	Stevens Type F weekly water stage recorder operating at a normal gage height ratio of 1 to 1.	Sandy limestone.
F-179	SE¼NW¼ sec. 16, T. 54 S., R. 41 E., southwest sec. of Miami, Fla.	City of Miami	77.1	6	Open hole; non-artesian.	Stevens Type F weekly water stage recorder operating at a normal gage height ratio of 1 to 1.	Calcareous sandstone or sandy limestone.
F-210	SW¼NE¼ sec. 13, T. 53 S., R. 41 E., northwest sec. of Miami, Fla.	City of Miami	111.7	6	Open hole; non-artesian.	Stevens Type F weekly water stage recorder operating at a normal gage height ratio of 1 to 1.	Calcareous sandstone or sandy limestone.
F-213	SW¼SW¼ sec. 15, T. 54 S., R. 41 E., Coconut Grove, Fla.	City of Miami	69.1	6	Open hole; non-artesian.	Stevens Type F weekly water stage recorder operating at a normal gage height ratio of 1 to 1.	Calcareous sandstone or sandy limestone.
S-18	NW¼NW¼ sec. 15, T. 52 S., R. 41 E., near OpaLocka, Fla.	Mrs. LaFlesh	51.6	8	Open hole; non-artesian.	Lietz weekly water stage recorder operating at a normal gage height ratio of 1 to 1.	Calcareous sandstone or sandy limestone.
S-19	NW¼NE¼ sec. 25, T. 53 S., R. 40 E., Miami Springs, Fla.	City of Miami	94.8	6	Open hole; non-artesian.	Leitz weekly water stage recorder operating at a normal gage height ratio of 1 to 1.	Calcareous sandstone or sandy limestone.
S-68	SW¼NW¼ sec. 19, T. 53 S., R. 41 E., Miami Springs, Fla.	City of Miami	64	6	Open hole; non-artesian.	Stevens Type F weekly water stage recorder operating at a normal gage height ratio of 1 to 1.	Calcareous sandstone or sandy limestone.
S-182	NW¼NW¼ sec. 5, T. 56 S., R. 40 E., near Peters, Fla.	International Fruit Corp.	32.7	6	Open hole; non-artesian.	Lietz weekly water stage recorder operating at a normal gage height ratio of 1 to 1.	Calcareous sandstone or sandy limestone.
S-329	SW¼NE¼ sec. 12, T. 50 S., R. 41 E., near Ft. Lauderdale, Fla.	City of Ft. Lauderdale.	67.9	4	Open hole; non-artesian.	Stevens Type F weekly water stage recorder operating at a normal gage height ratio of 1 to 1.	Calcareous sandstone with large amount of loose fine sand.
S-1042	NW¼NE¼ sec. 22, T. 46 S., R. 42 E, west of Delray, Fla.	Lake Worth Drainage District.	119.6	4	Open hole; non-artesian.	Stevens Type F weekly water stage recorder operating at a normal gage height ratio of 1 to 1.	Calcareous sandstone or sandy limestone.

*Feet below land surface.

TABLE 3.—*Earthquake Fluctuations in Well at Baton Rouge, Louisiana*

Well No.	Date	Time (C.W.T.)	Depth to water in feet				Amplitude of fluctuation in feet
			Before disturbance	After disturbance	At highest point of fluctuation	At lowest point of fluctuation	
FB-128	4-6-43	11:30	87.21	87.20	87.19	87.21	0 02

TABLE 4.—*Description of Well at Baton Rouge, Louisiana*

Well No.	Location	Owner	Depth*	Casing Diam.	Finish	Recorder	Formation
FB-128	135 South 15th Street, Baton Rouge, La.	Ice Service, Incorporated.	412	8	Artesian	Float type recorder.	Sand.

*Feet below land surface.

TABLE 5.—*Earthquake Fluctuations in Wells at State College, Mississippi*

Well No.	Date	Time (C.W.T.)	Depth to water in feet				Amplitude of fluctuation in feet
			Before disturbance	After disturbance	At highest point of fluctuation	At lowest point of fluctuation	
	11-3-43	10:00			Deep well		0.085
	11-6-43	5:30					0.017

TABLE 6.—*Earthquake Fluctuations in Wells in Utah—January 1 to December 31, 1943*

Well No.	Date	Time (M.W.T.)	Depth to water in feet				Amplitude of fluctuation in feet
			Before disturbance	After disturbance	At highest point of fluctuation	At lowest point of fluctuation	
(C-2-6)36cdd	2-22-43	3:17	79.81	79.81	79.32	80.18	0.86
(C-2-4)33addl	2-22-43	3:30	37.19	37.19	36.98	37.29	0.31
(C-2-4)33addl	4- 6-43	10:45	36.44	36.44	36.38	36.50	0.12
(C-2-6)36cdd	4- 6-43	11:00	79.43	79.43	79.38	79.51	0.13
(C-2-6)36cdd	5-30-43	17:30	79.46	79.46	79.34	79.65	0.31
(B-6-1)30ccal	7-24-43	23:45	29.76	29.76	29.68	29.84	0.16
(C-35-11)21dbdl	12- 9-43	11:00	25.10	25.10	25.09	25.12	0.03

TABLE 7.—*Descriptions of Wells in Utah*

Well No.	Location	Owner	Depth*	Casing Diam.	Finish	Recorder	Formation
(C-2-4)33addl	SW¼SW¼NE¼ sec. 33, T. 2 S., R. 4 W., Salt Lake base and meridian.	Ida L. Clegg	165	6	Artesian	Float type recorder	Sand and gravel.
(C-2-6)36cdd	SE¼SE¼SW¼ sec. 36, T. 2. S., R. 6. W., Salt Lake base and meridian.	Fred Arbon	176	6	Artesian	Float type recorder	Gravel.
(B-6-1)30ccal	NW¼SW¼SW¼ sec. 30, T. 6. N., R 1 W., Salt Lake base and meridian.	California Packing Corporation.	731	10	Artesian	Float type recorder	Sand and gravel.
(C-35-11)21dbdl	SE¼NW¼SE¼ sec. 21, T. 35 S., R. 11 W., Salt Lake base and meridian.	D. C. Urie	228	12	Artesian	Float type recorder	Sand and gravel.

*Feet below land surface.

SEISMOLOGICAL OBSERVATORY RESULTS

The Coast and Geodetic Survey publishes the results of its teleseismic stations and cooperating 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. (Geodaetisk Institut, Copenhagen, Denmark.)
Lincoln, Nebraska. (Nebraska Wesleyan University.)
Logan, Utah. (Utah State Agricultural College.)
Montezuma, Chile. (Smithsonian Institution.)
Philadelphia, Pennsylvania. (The Franklin Institute.)
Salt Lake City, Utah. (University of Utah.)
San Juan, Puerto Rico.
Seattle, Washington. (University of Washington.)
Scoresbysund, Greenland. (Geodaetisk 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, 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 1943 were not ready when this publication went to press. Those for the year 1942 are listed in table 8. Those for the stronger shocks of 1943 are listed in table 9.

TABLE 8.—*Summary of instrumental epicenters for 1942*

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 near-by stations are usually given preference. More detailed information will be found in the Seismological Bulletins (formerly Seismographic Reports) of the Coast and Geodetic Survey, and in the bulletins of other organizations and stations.

1942	Greenwich civil time at origin		Region and focal depth	Coordinates of provisional epicenter	
				Latitude	Longitude
	h	m		° ′	° ′
Jan. 5	22	35.1	Costa Rica	8.5 N.	83 W.
Jan. 7	10	47.9	New Britain	6.5 S.	150 E.
Jan. 8	15	12.6	Northern Peru. Depth possibly 100 km	6.5 S.	78.5 W.
Jan. 9	6	28.1	Near Riverdale, California. Felt	33.9 N.	117.4 W.
Jan. 12	16	07.3	Solomon Islands	8 S.	156.5 E.
Jan. 16	21	53.9	Tonga Island region	15 S.	177.5 W.
Jan. 17	10	26.2	Samoa Islands	15 S.	171 W.
Jan. 17	23	19.3	West coast of Mexico	17.5 N.	100 W.
Jan. 18	7	17.3	Off coast of California	41 N.	125 W.
Jan. 20	6	25.6	West coast of Mexico	17.9 N.	105.6 W.
Jan. 24	21	41.8	California	32.8 N.	117.8 W.
Jan. 27	13	29.2	New Guinea	3.9 S.	135.3 E.
Jan. 29	9	23.8	New Hebrides Islands. Depth about 150 km	19 S.	169 E.
Jan. 31	6	49.2	Near Vancouver, British Colombia	51 N.	124 W.
Feb. 1	15	15.9	California	34.4 N.	116.9 W.
Feb. 1	15	18.5	----do	34.4 N.	116.9 W.
Feb. 1	16	03.6	----do	34.4 N.	116.9 W.
Feb. 2	5	56.8	----do	34.4 N.	116.9 W.
Feb. 2	11	30.2	----do	34.4 N.	116.9 W.
Feb. 4	9	08.4	----do	37.0 N.	121.3 W.
Feb. 7	0	13.8	----do	33.1 N.	116.0 W.

TABLE 8.—*Summary of instrumental epicenters for 1942*—Continued

1942	Greenwich civil time at origin		Region and focal depth	Coordinates of provisional epicenter	
				Latitude	Longitude
	h	*m*		° ′	° ′
Feb. 11	11	21.2	Gulf of California	26.5 N.	100.5 W.
Feb. 12	5	56.6	Queen Charlotte Islands	14 S.	164.5 E.
Feb. 13	6	18.9	Tonga Island region	20 S.	175 W.
Feb. 13	10	26.2	California	33.8 N.	116.1 W.
Feb. 16	18	08.1	Queen Charlotte Islands	11.5 S.	167.5 E.
Feb. 21	7	07.8	Japan. Depth about 70 km	38.2 N.	141.5 E.
Feb. 23	2	44.0	Guatemala	15.5 N.	92 W.
Feb. 27	1	08.9	California	34.3 N.	117.0 W.
Feb. 27	8	23.0	East coast of Yucatan	18.5 N.	87.5 W.
Mar. 1	9	52.0	Off coast of El Salvador	13.3 N.	91.2 W.
Mar. 1	17	34.9	Off coast of Ecuador	3 N.	81.5 W.
Mar. 1	19	12.4	Southern California	33.7 N.	116.2 W.
Mar. 3	1	03.4	Southern California. Felt	34.0 N.	115.8 W.
Mar. 4	3	36.7	New Guinea	6.5 S.	145 E.
Mar. 4	11	02.2	Southern California. Felt	34.0 N.	115.8 W.
Mar. 5	19	48.2	Japan. Depth about 200 km	44.7 N.	141.1 E.
Mar. 6	20	08.7	New Hebrides Islands	16 S.	168 E.
Mar. 8	4	46.6	Atlantic Ocean	1.0 S.	29.5 W.
Mar. 9	10	19.7	Near Haiti, West Indies	19 N.	73 W.
Mar. 19	11	59.4	Off coast of British Colombia	51.2 N.	130.0 W.
Mar. 20	1	13.0	Aleutian Islands	52.4 N.	167.7 W.
Mar. 21	23	20.8	South of Japan	29 N.	132 E.
Mar. 28	14	10.5	Circleville, Utah. Felt	38.5 N.	112.5 W.
Mar. 29	4	45.2	Southern California	34.0 N.	115.8 W.
Mar. 30	9	08.8	North Atlantic Ocean	34 N.	35 W.
Apr. 4	15	11.5	Mojave Desert, California. Felt	34.8 N.	116.5 W.
Apr. 5	9	20.6	California. Felt	33.2 N.	116.2 W.
Apr. 8	15	40.3	Philippine Islands	12.5 N.	120.0 E.
Apr. 11	1	25.1	Guatemala	15.3 N.	91.1 W.
Apr. 11	5	29.2	California	33.8 N.	116.0 W.
Apr. 13	7	46.2	Off coast of Liberia	3 S.	14 W.
Apr. 16	7	28.6	Southeast of Catalina Island, California	33.4 N.	118.2 W.
Apr. 18	5	45.7	Northern Utah	41.5 N.	112.3 W.
Apr. 20	8	40.3	Japan	36.5 N.	139.0 E.
Apr. 22	11	49.4	Gulf of Panama	8.0 N.	80.5 W.
Apr. 22	23	20.2	....do	7.3 N.	82.2 W.
Apr. 25	19	38.1	Santo Domingo, West Indies	19.0 N.	70.5 W.
Apr. 26	15	10.4	California. Felt	34.0 N.	116.7 W.
Apr. 27	11	27.9	Off coast of Lower California	32.0 N.	117.0 W.
Apr. 29	11	40.8	Queen Charlotte Islands	13.5 S.	167.0 E.
May 6	21	18.2	Near coast of Venezuela	11 N.	66 W.
May 6	22	50.3	....do	11 N.	66 W.
May 8	17	08.1	California	34.0 N.	116.2 W.
May 10	12	25.4	Near coast of Venezuela	11 N.	66 W.
May 14	2	13.4	Ecuador. Destructive. Great loss of life	0.3 S.	80.0 W.
May 14	2	54.3	Ecuador. Aftershock	0	80 W.
May 14	8	38.7	....do	0	80 W.
May 14	15	46.7	....do	0	80 W.
May 15	2	51.9	Greenland Sea	61 N.	30 W.
May 15	10	50.6	Ecuador. Aftershock	0	80 W.
May 15	14	51.3	....do	0	80 W.
May 15	18	12.0	....do	0	80 W.
May 16	3	28.2	Off coast of Peru	16 S.	73 W.
May 16	18	58.0	Ecuador. Aftershock	0	80 W.
May 17	15	14.2	....do	0.3 S.	80.0 W.
May 22	10	30.6	Near Bogota, Colombia. Felt	4.6 N.	74.5 W.
May 22	15	18.5	California	34.4 N.	116.8 W.
May 23	15	47.5	California. Felt	33.0 N.	116.0 W.
May 24	8	22.4	California. Aftershock	33.0 N.	116.0 W.
May 28	0	39.8	Northern California	40.8 N.	120.7 W.
May 28	1	01.8	Celebes Islands. Depth about 100 km	0.4 S.	122.6 E.
May 30	7	19.7	Gulf of California	23.0 N.	109.5 W.
May 31	5	20.5	Aleutian Islands	52 N.	173 W.
June 3	16	31.1	New Hebrides Islands	15.1 S.	167.5 E.
June 6	10	39.5	Ecuador	1 N.	80 W.
June 6	14	53.2	New Guinea. Depth about 100 km	6 S.	145 E.
June 7	10	48.1	Ecuador	0	81 W
June 7	22	16.1	California	33.0 N.	116.0 W.
June 9	11	06.8	Off coast of Vancouver, British Colombia	49.5 N.	129.0 W.
June 10	1	08.0	Near Kamchatka Peninsula	57.5 N.	163.0 W.
June 10	20	50.7	Reno, Nevada. Felt	39 N.	119 W.
June 12	2	01.6	British Colombia	61.5 N.	137.5 W.
June 12	10	21.5	Ecuador	2.0 S.	76.9 W.
June 13	4	14.0	Mojave Desert, California	34.2 N.	116.4 W.
June 14	3	09.6	Mariana Islands	15.0 N.	143.8 E.
June 14	21	36.4	Salton Sea, California	33.2 N.	115.8 W.
June 14	22	25.8	....do	33.2 N.	115.8 W.
June 15	13	46.9	Kermadec Islands	33 S.	176 W.
June 15	16	41.6	Off west coast of Mexico	18.9 N.	107.0 W.
June 16	7	42.9	Off coast of Ecuador	0.5 N.	80.9 W.
June 16	21	05.2	....do	0.5 N.	80.9 W.
June 18	9	30.9	West of Caroline Islands	9.5 N.	138.9 E.
June 20	10	02.1	Mexico. Felt	19.0 N.	100.7 W.
June 22	22	13.8	California. Felt	36.2 N.	118.0 W.
June 22	23	51.0	California	36.2 N.	118.0 W.
June 22	23	53.4	....do	36.2 N.	118.0 W.

TABLE 8.—*Summary of instrumental epicenters for 1942*—Continued

1942	Greenwich civil time at origin		Region and focal depth	Coordinates of provisional epicenter	
				Latitude	Longitude
	h	*m*		° ′	° ′
June 24	11	16.6	New Zealand	40.9 S.	175.4 E.
June 24	23	52.7	Salton Sea, California	33.2 N.	115.8 W.
June 28	0	06.9	Coast of El Salvador	13 N.	89 W.
June 29	6	26.8	Central Chile	33.5 S.	70.5 W.
July 1	21	33.7	Coast of Ecuador	0.5 N.	80.5 W.
July 2	7	52.0	----do	0.5 N.	80.5 W.
July 2	8	19.3	----do	0.5 N.	80.5 W.
July 2	13	54.9	----do	0.5 N.	80.5 W.
July 3	2	50.1	India. Felt at Karachi	25 N.	66 E.
July 3	20	59.5	Coast of Ecuador	0.5 N.	80.5 W.
July 3	23	46.4	----do	0.5 N.	80.5 W.
July 4	0	15.2	----do	0.5 N.	80.5 W.
July 4	0	40.6	----do	0.5 N.	80.5 W.
July 4	1	53.1	----do	0.7 N.	80.7 W.
July 4	4	59.5	----do	0.5 N.	80.5 W.
July 4	6	08.6	----do	0.7 N.	80.7 W.
July 4	8	52.4	California. Felt	36.2 N.	118.0 W.
July 5	10	29.9	Coast of Ecuador	0.7 N.	80.7 W.
July 5	10	31.9	----do	0.5 N.	80.5 W.
July 5	14	11.2	----do	0.5 N.	80.5 W.
July 5	23	16.1	Santo Domingo, West Indies	19 N.	70 W.
July 6	16	21.2	Coast of Ecuador	0.5 N.	80.5 W.
July 7	3	53.8	Tonga Island region. Depth about 400 km	21.4 S.	177.8 W.
July 7	12	37.7	Coast of Ecuador	0.7 N.	80.5 W.
July 7	13	40 1	----do	0.5 N.	80.5 W.
July 8	6	55.6	Chile. Felt at Copiapo. Slight depth	25.0 S.	69.7 W.
July 8	19	19.6	Chile	25 S.	69 W.
July 8	22	30.9	Coast of Ecuador	0.7 N.	80.5 W.
July 10	4	49.9	----do	0.7 N.	80.5 W.
July 11	16	41.9	Nevada. Felt	38.5 N.	117.1 W.
July 11	16	45.7	----do	38.3 N.	116.1 W.
July 12	5	15.3	Coast of Ecuador	0.3 N.	80.1 W.
July 20	13	31.9	South Pacific Ocean	35.5 S.	99 W.
July 21	7	47.8	Northern Argentina	20.5 S.	64.0 W.
July 21	8	43.8	Colombia	15 S.	75 W.
July 24	11	51.7	Near Aleutian Islands	51 N.	172 E.
July 25	6	22.5	Philippine Islands	11.9 N.	125.5 E.
July 25	15	18.9	Off coast of Ecuador	5 S.	104 W.
July 29	22	49.2	Region of Banda Sea	2.8 S.	127.9 E.
Aug. 1	12	34.0	New Zealand. Extensive damage	41.1 S.	176.2 E.
Aug. 3	20	09.0	Tonga Island region	25 S.	174 W.
Aug. 6	23	37.0	Guatemala and El Salvador. Nine killed	14.1 N.	90.9 W.
Aug. 7	1	15.6	Mojave Desert, California	34.3 N.	116.4 W.
Aug. 7	1	24.0	----do	34.3 N.	116.4 W.
Aug. 7	1	53.2	----do	34.3 N.	116.4 W.
Aug. 7	6	04.8	Guatemala. Aftershock	14.1 N.	90.9 W.
Aug. 8	0	20.2	Japan	42 N.	144 E.
Aug. 8	22	36.5	Guatemala	14.0 N.	91.0 W.
Aug. 9	13	54.7	Mojave Desert, California	34.3 N.	116.4 W.
Aug. 11	4	48.3	Guatemala	14.0 N.	91.0 W.
Aug. 11	7	11.5	----do	14 N.	91 W.
Aug. 11	10	14.0	Nevada. Felt	35.8 N.	114.8 W.
Aug. 13	15	44.7	Solomon Islands	8.0 S.	156.5 E.
Aug. 13	19	28.1	Peru	10 S.	78 W.
Aug. 14	20	50.4	Off coast of Mexico	17.5 N.	108 W.
Aug. 15	15	02.1	New Guinea	4 S.	144 E.
Aug. 16	20	07.8	Guatemala	14.0 N.	90.9 W.
Aug. 18	21	55.4	Nevada. Felt	38.6 N.	118.5 W.
Aug. 19	15	57.2	California. Felt	33.8 N.	117.8 W.
Aug. 20	6	30.6	California	34.0 N.	116.4 W.
Aug. 20	12	09.6	----do	37.6 N.	118.7 W.
Aug. 20	22	37.0	Guatemala	14 N.	91 W.
Aug. 21	23	36.7	California	37.6 N.	118.7 W.
Aug. 22	8	31.4	Aleutian Islands	54 N.	164 W.
Aug. 22	9	00.8	Region of Japan	32 N.	135 E.
Aug. 22	12	59.2	California. Felt	34.1 N.	116.8 W.
Aug. 23	6	35.7	Kamchatka. Depth about 150 km	54.8 N.	164.8 E.
Aug. 24	22	50.7	Peru. Destructive. Twenty-two killed. Depth about 150 km	14.7 S.	75.0 W.
Aug. 25	20	16.0	Peru. Aftershock. Depth about 150 km	15 S.	75 W.
Aug. 27	6	14.2	Albania. Considerable damage. A number killed	42 N.	20 E.
Aug. 29	1	39.4	Tonga Island region. Depth about 500 km	26 S.	177 W.
Aug. 29	21	40.3	Guatemala	14 N.	91 W.
Aug. 31	6	39.4	Peru	7 S.	77 W.
Sept. 2	3	17.2	Aleutian Islands	52.4 N.	169.6 W.
Sept. 3	14	06.0	California. Felt	34.5 N.	119.0 W.
Sept. 4	2	53.9	Guatemala	14.5 N.	91.3 W.
Sept. 4	6	34.6	California. Felt	34.5 N.	119.0 W.
Sept. 4	17	46.1	Aleutian Islands	52.5 N.	170.0 W.
Sept. 6	15	53.4	Chile	28.5 S.	71.5 W.
Sept. 8	18	07.3	Japan	36.5 N.	139.5 E.
Sept. 9	1	05.4	Aleutian Islands. Depth about 100 km	53.0 N.	165.7 W.
Sept. 14	11	31.2	Loyalty Islands. Depth about 200 km	22 S.	172 E.
Sept. 17	1	54.1	California. Felt	34.4 N.	117.7 W.
Sept. 22	0	46.2	Off coast of Chile	37.5 S.	98.0 W.
Sept. 24	3	39.0	Near Formosa	25 N.	123 E.
Sept. 25	8	14.1	Aleutian Islands	53 N.	168 W.

TABLE 8.—*Summary of instrumental epicenters for 1942*—Continued

1942	Greenwich civil time at origin		Region and focal depth	Coordinates of provisional epicenter	
				Latitude	Longitude
	h	m		° ′	° ′
Sept. 26	4	00.3	San Salvador	12.8 N.	87.7 W.
Sept. 27	17	02.2	Guatemala	14.5 N.	91 W.
Sept. 29	8	28.2	California. Felt	39.4 N.	122.4 W.
Sept. 29	12	45.4	Off coast of Panama	5.5 N.	83.0 W.
Oct. 6	2	58.3	Off coast of Oregon	43.5 N.	126.8 W.
Oct. 6	11	50.3	Solomon Islands	6.5 S.	155.5 E.
Oct. 8	3	02.7	Off coast of Colombia	5.9 N.	82.7 W.
Oct. 8	20	02.6	Queen Charlotte Islands	11.0 S.	164.5 E.
Oct. 12	1	16.3	Off coast of Peru	16.5 S.	74.4 W.
Oct. 14	0	14.9	Arizona	32.5 N.	113.5 W.
Oct. 16	10	07.4	California	36.2 N.	118.0 W.
Oct. 18	5	24.8	Gulf of California	22.5 N.	108.5 W.
Oct. 20	23	21.8	Philippine Islands	7 N.	123 E.
Oct. 21	16	22.2	California. Felt	33.0 N.	116.0 W.
Oct. 22	1	50.6	----do	33.2 N.	115.7 W.
Oct. 25	18	59.6	----do	33.0 N.	116.2 W.
Oct. 26	21	09.2	Kurile Islands	45.8 N.	152.0 E.
Oct. 28	10	44.7	Mexico	15.4 N.	96.0 W.
Nov. 1	15	41.1	Yellowstone National Park	44.8 N.	111.3 W.
Nov. 1	18	50.1	Washington. Felt	48.1 N.	116.6 W.
Nov. 2	12	59.7	California	33.0 N.	116.0 W.
Nov. 2	23	59.6	Region of Friendly Islands	18.5 S.	174.0 W.
Nov. 3	5	06.5	California	33.0 N.	116.0 W.
Nov. 3	10	18.6	----do	33.0 N.	116.0 W.
Nov. 3	23	37.8	South of Panama	7 N.	82 W.
Nov. 5	11	26.8	New Hebrides Islands. Slightly deeper than normal	18 S.	168 E.
Nov. 5	11	47.6	Guatemala	15.5 N.	91.5 W.
Nov. 6	13	31.2	Peru. Slightly deeper than normal	6.2 S.	76.5 W.
Nov. 7	7	32.3	East Indies. Depth possibly 200 km	9 S.	123 E.
Nov. 8	10	16.7	Off coast of Peru	16 S.	76 W.
Nov. 9	20	34.4	Mojave Desert, California	34.6 N.	116.0 W.
Nov. 9	21	55.5	Ecuador	0	81 W.
Nov. 10	11	41.4	South of Africa	48 S.	32 E.
Nov. 11	2	02.6	Peru	6.5 S.	75.5 W.
Nov. 11	13	06.0	Costa Rica	9.6 N.	83.9 W.
Nov. 12	0	07.6	California	33.0 N.	116.0 W.
Nov. 12	4	55.5	Mexico. Damage in Tehuantepec. Depth about 100 km	16.6 N.	94.5 W.
Nov. 12	15	26.2	Off coast of Ecuador	0.1 S.	81.0 W.
Nov. 12	17	56.2	Salton Sea, California	33.2 N.	115.6 W.
Nov. 12	18	00.0	Off coast of Ecuador	0	81 W.
Nov. 12	22	30.2	----do	0	81 W.
Nov. 14	5	21.2	New Guinea	6.5 S.	148.5 E.
Nov. 14	6	19.1	Off coast of Ecuador	0	81 W.
Nov. 14	17	58.9	----do	0	81 W.
Nov. 14	20	57.0	----do	0	81 W.
Nov. 15	0	46.0	----do	0	81 W.
Nov. 15	17	12.1	Japan. Slightly deeper than normal	37.5 N.	142.0 E.
Nov. 17	23	19.3	Peru	16.5 S.	73.0 W.
Nov. 19	8	51.9	Ecuador. Felt	0	81.5 W.
Nov. 19	9	08.8	----do	0	81.5 W.
Nov. 19	12	15.3	California	33.1 N.	116.4 W.
Nov. 19	14	40.0	Off coast of Ecuador	0	81.5 W.
Nov. 22	6	39.8	California	33.0 N.	116.0 W.
Nov. 25	1	18.0	Mexico. Slightly deeper than normal	16.9 N.	97.7 W.
Nov. 26	14	27.6	Kurile Islands. Depth possibly 200 km	46 N.	149 E.
Nov. 27	10	55.8	Off coast of California	42.2 N.	126.0 W.
Nov. 28	10	38.7	Atlantic Ocean	7.0 N.	35.5 W.
Nov. 30	0	47.8	Argentina. Depth about 500 km	27.8 S.	62.8 W.
Dec. 3	9	44.6	California and Nevada. Felt	39.9 N.	119.4 W.
Dec. 4	15	25.4	New Britain	5 S.	152 E.
Dec. 5	14	28.5	Alaska Peninsula	58.7 N.	152.3 W.
Dec. 9	22	19.0	Aleutian Islands	53.4 N.	166.0 W.
Dec. 10	1	59.0	California	33.0 N.	116.0 W.
Dec. 12	13	54.8	Off coast of Mexico	19.5 N.	110.0 W.
Dec. 14	3	05.7	Lower California	30.3 N.	116.0 W.
Dec. 14	3	08.0	----do	30.3 N.	116.0 W.
Dec. 14	13	59.4	North Atlantic Ocean	23.5 N.	44.5 W.
Dec. 15	9	09.0	Off coast of Ecuador	0.5 S.	81.5 W.
Dec. 16	2	44.7	----do	0	81 W.
Dec. 17	15	07.7	California. Felt	38.9 N.	119.5 W.
Dec. 20	14	03.0	Central Turkey. Destructive	40 N.	37 E.
Dec. 22	4	14.7	Southwest of Samoa	16.0 S.	174.5 W.
Dec. 22	6	24.9	South of Panama	7.5 N.	79.5 W.
Dec. 23	1	12.8	----do	7.5 N.	79.5 W.
Dec. 23	7	43.1	California	33.3 N.	115.7 W.
Dec. 23	13	59.2	Solomon Islands	9 S.	161 W.
Dec. 26	12	31.8	North coast of Colombia	9.6 N.	75.6 W.
Dec. 27	16	39.9	Southeast of Japan	31 N.	142 E.
Dec. 29	6	50.0	South of Panama	8.0 N.	79.5 W.
Dec. 31	12	03.6	Atlantic Ocean	17.5 N.	47.0 W.
Dec. 31	19	14.1	----do	17.5 N.	47.0 W.

TABLE 9.—*Principal earthquakes of the world from January 1943 to December 1943, 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.
An asterisk (*) indicates local time.

Date	Origin time G. C. T.		Place	Provisional Epicenters		Remarks. Depths. Principal facts.
				Latitude	Longitude	
1943	h	m		°	°	
Jan. 29			Bosnia			During previous month 19 lives reported lost; 12 towns damaged.
Jan 30	5	01	Peru			Yanaoca, Cuzco Province. 200 reported killed.
Jan 30	5	33.1	Ecuador	2.1 S.	80.0 W.	Depth about 100 km. Many buildings damaged in Guayaquil.
Feb. 16	7	28.7	Southeastern Peru	13.9 S.	70.8 W.	Depth about 100 km.
Feb. 22	9	20.8	Mexico	17.9 N.	101.5 W.	Destructive in region of Colima. 5 killed in Mexico City. About 230 km from Paricutin Volcano.
Mar. 4	6	32.4	Tonga Island region	22 S.	179 W.	Depth about 600 km.
Mar. 14	18	37.8	Northern Chile	20.5 S.	69 W.	Depth probably slightly more than 200 km.
Mar. 15	22	59.3	West of Samoa	14.5 S.	176.5 W.	Depth probably slightly more than 300 km.
Apr. 6	16	07.3	Central Chile	31.5 S.	71.4 W.	Depth about 100 km. Destructive at Salamanca and Illapel. 18 killed; 80 injured at Ovalle.
Apr. 9	8	48.8	Mariana Islands	18.8 N.	145.9 E.	Depth slightly over 100 km.
Apr. 11	14	46.1	Japan	37 N.	141 E.	Depth about 100 km.
Apr. 19	1	19.2	Caribbean Sea	17.0 N.	81.5 W.	Felt at Swan Island. Not a strong shock.
Apr. 28	23	43.2	South of Tonga Islands	25 S.	179.5 W.	Dept about 500 km.
May 2	17	18.2	Panama	6.8 N	80.8 W.	Felt in Balboa. V R-F scale.
May 28			Germany			Damage near Stuttgart.
June 8	1	15.6	Atlantic Ocean	35 N.	35 W.	West of Azores Islands.
June 20	15	32.9	Turkey	40.6 N.	30.5 E.	Destructive. 285 killed; many injured in Anatolia. Great damage in Adapazari.
June 24	20	21.7	New Hebrides Islands	16 S.	168 E.	Depth about 200 km.
June 25	19	13.5	Tonga Islands	17.7 S.	178.3 W.	Depth about 500 km.
June 29	9	05.1	Celebes Sea	3 N.	126 E.	Depth nearly 200 km.
June 30	20	12.9	Peru	16.3 S.	73.0 W.	Depth about 100 km.
July 11	2	10.4	Kermadec Islands	34 S.	178 W.	Depth about 200 km.
July 29	3	02.2	Northwest of Puerto Rico	19.0 N.	67.1 W.	Felt strongly in Puerto Rico. No damage.
Aug. 1	16	18.7	New Hebrides Islands	20.3 S.	170.1 E.	Depth slightly more than 200 km.
Sept. 10	8	36.9	Japan	35.3 N.	133.9 E.	Destructive. Fifty percent of Tottori buildings were destroyed. 1400 killed and injured.
Oct. 21	23	08.2	Fiji Islands	15.1 S.	177.2 W.	Slight depth.
Nov. 26	22	20.6	Turkey	41 N.	33.5 E.	Reports stated about 1400 buildings were destroyed; same number damaged in northern Anatolia. 2900 deaths. Many injured. Epicenter in region east of Ankara.
Dec. 1	10	34.7	Bolivia	21.2 S.	68.7 W.	Depth slightly less than 100 km.
Dec. 5			Turkey			Northeastern Anatolia. 550 reported killed; 12 villages destroyed.
Dec. 21	13	46.3	Gulf of Venezuela	12.8 N.	71.2 W.	Slight depth.
Dec. 23	15	56.1	Gulf of Venezuela	12.8 N.	71.2 W.	do

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 ten preceding issues of this series, Serials 579, 593, 600, 610, 619, 629, 637, 647, 655, and 662, 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 1943" 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.

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 1943 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 centimeters per second for acceleration. It is sometimes desirable to express acceleration in terms of the acceleration of gravity, indicated by "g" which is equal to 980 cm./sec.^{2} For practical purposes it is only necessary to point off three decimal places to convert cm./sec.^{2} to "g."

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 11 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 11 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) conglomerate 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 10 listing the strong-motion records obtained during 1943 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 11 maximum recorded acceleration is not necessarily associated with the same ground period as the maximum computed displacement.

LIVERMORE EARTHQUAKE OF MAY 8

This shock was not located instrumentally but apparently centered near Livermore where the maximum intensity of V was reported.

Veterans' Hospital.—Figure 9. Maximum acceleration 20 cm./sec.^{2} Computed maximum displacement .006 cm.

LIVERMORE EARTHQUAKE OF MAY 29

A local shock was felt strongest at the Veterans Hospital about five miles north of Livermore. Not located instrumentally.

Veterans' Hospital.—Figure 9. Maximum acceleration 40 cm./sec.^{2} Computed maximum displacement .054 cm.

TABLE 10.—*List of shocks recorded and records obtained on strong-motion seismographs in 1943*

Date, epicenter, and recording station	Records			Date, epicenter, and recording station	Records		
	Accelerograph	Displacement meter	Weed strong-motion seismograph		Accelerograph	Displacement meter	Weed strong-motion seismograph
May 8: Central California: Livermore.	1			October 25: Central California:			
May 29: Central California: Livermore.	1			Livermore	1		
May 31: East-central California: Bishop.	1			Martinez, Suisun Bay Bridge.	2		
June 28: Central California: Livermore.	1			Oakland City Hall	2		
August 8: Western Nevada: Hawthorne.	1			San Jose	2*		
August 28: Southern California:				San Francisco Alexander Building.	3		
Hollywood Storage Company Building.	2			San Francisco Southern Pacific Building.	2	1	
Pacific Electric Company lot near Hollywood Storage Company.	1			San Francisco Shell Building.	3		
Los Angeles Subway Terminal.	2	1		San Francisco Sutter Building.	2		
Los Angeles Chamber of Commerce.	2			Oakland—Chabot Observatory.			1
Colton	1	1		November 16: San Leandro:			
San Diego	1			Oakland—Chabot Observatory.			1
San Bernardino			1	Totals	30	3	3

*Plus one aftershock.

EAST-CENTRAL CALIFORNIA EARTHQUAKE OF MAY 31

Epicenter in Round Valley about ten miles west of Bishop. Maximum intensity VI.

Bishop.—Figure 10. Maximum acceleration 35 cm./sec.^{2} Computed maximum displacement .017 cm.

LIVERMORE EARTHQUAKE OF JUNE 28

Local shock centering near Livermore. Maximum intensity about IV.

Veterans' Hospital.—Figure 9. Maximum acceleration 16 cm./sec.^{2} Computed maximum displacement .010 cm.

WESTERN NEVADA EARTHQUAKE OF AUGUST 8

Epicenter near Filben, Nevada. Maximum intensity VI. The accelerograph was about thirty-five miles northwest of the epicenter.

Hawthorne.—Figure 10. Maximum acceleration 8 cm./sec.^{2} Computed maximum displacement .007 cm.

SOUTHERN CALIFORNIA EARTHQUAKE OF AUGUST 28

Epicenter near Big Bear Lake. Maximum intensity VI.

Los Angeles Chamber of Commerce, 11th floor.—Figure 10. Station about 75 miles nearly west from the epicenter. Maximum acceleration 3 cm./sec.^{2} Computed maximum displacement .047 cm.

Hollywood Storage Company Building, Penthouse.—Figure 9. Station about 95 miles northwest from the epicenter. Maximum acceleration 15 cm./sec.^{2} Computed maximum displacement .090 cm.

Colton.—Figure 13. Station about 15 miles south southwest from the epicenter. Maximum acceleration 11 cm./sec.^{2} Computed maximum displacement .031 cm.

Colton.—Figure 9.—The displacement meter recorded a maximum displacement of .100 cm. Computed maximum acceleration 2 cm./sec.^{2}

CENTRAL CALIFORNIA EARTHQUAKE OF OCTOBER 25

Epicenter on the Calaveras fault about four and one-half miles northwest of Mount Hamilton. Maximum intensity VI.

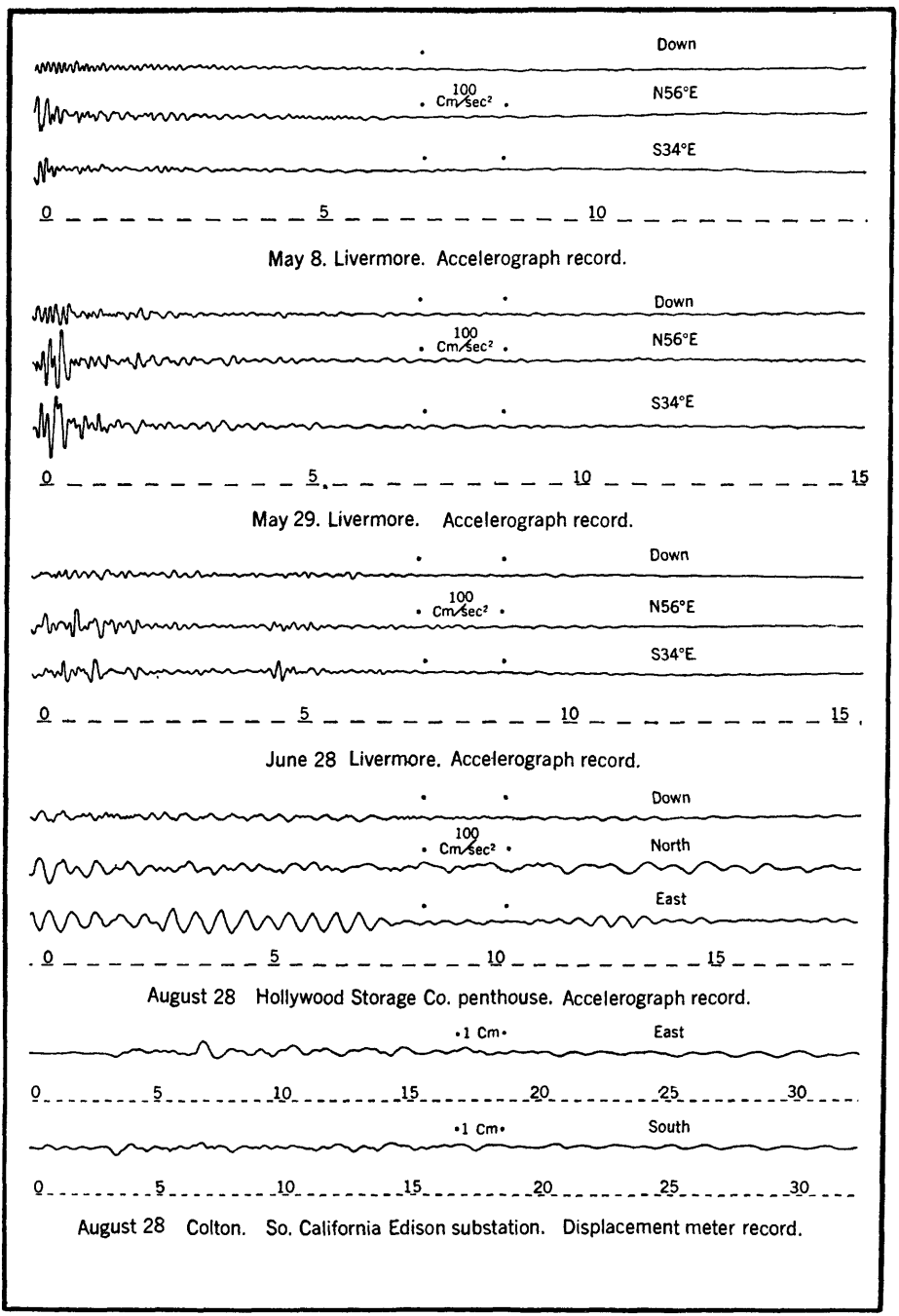


FIGURE 9.—Tracing of accelerograph records obtained at Livermore on May 8, May 29, and June 28; at Hollywood Storage Company Penthouse on August 28; and tracing of displacement-meter record obtained at Colton on August 28, 1943.

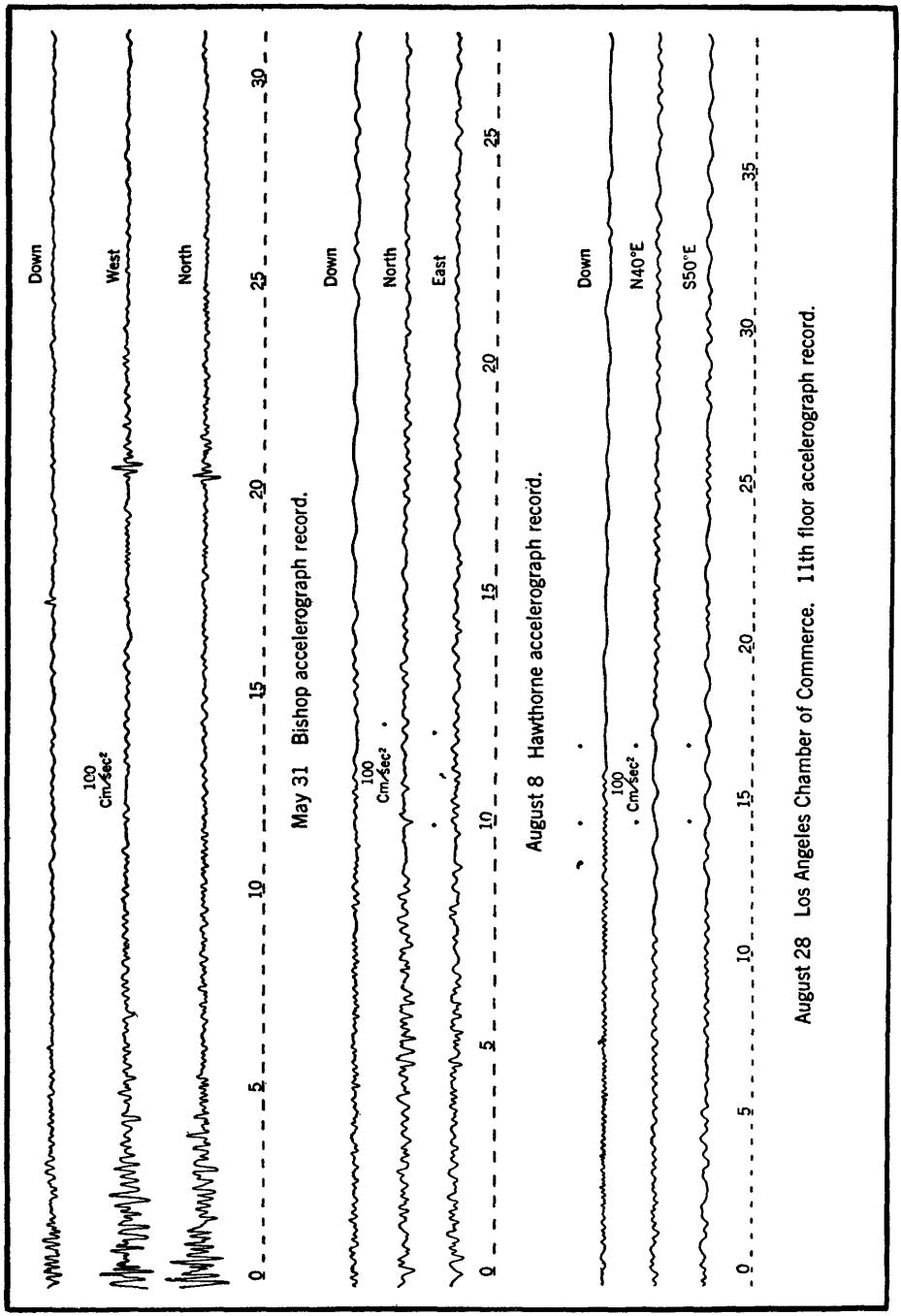


FIGURE 10.—Tracings of accelerograph records obtained at Bishop on May 31; at Hawthorne on August 8; and, on the 11th floor of the Los Angeles Chamber of Commerce on August 28, 1943.

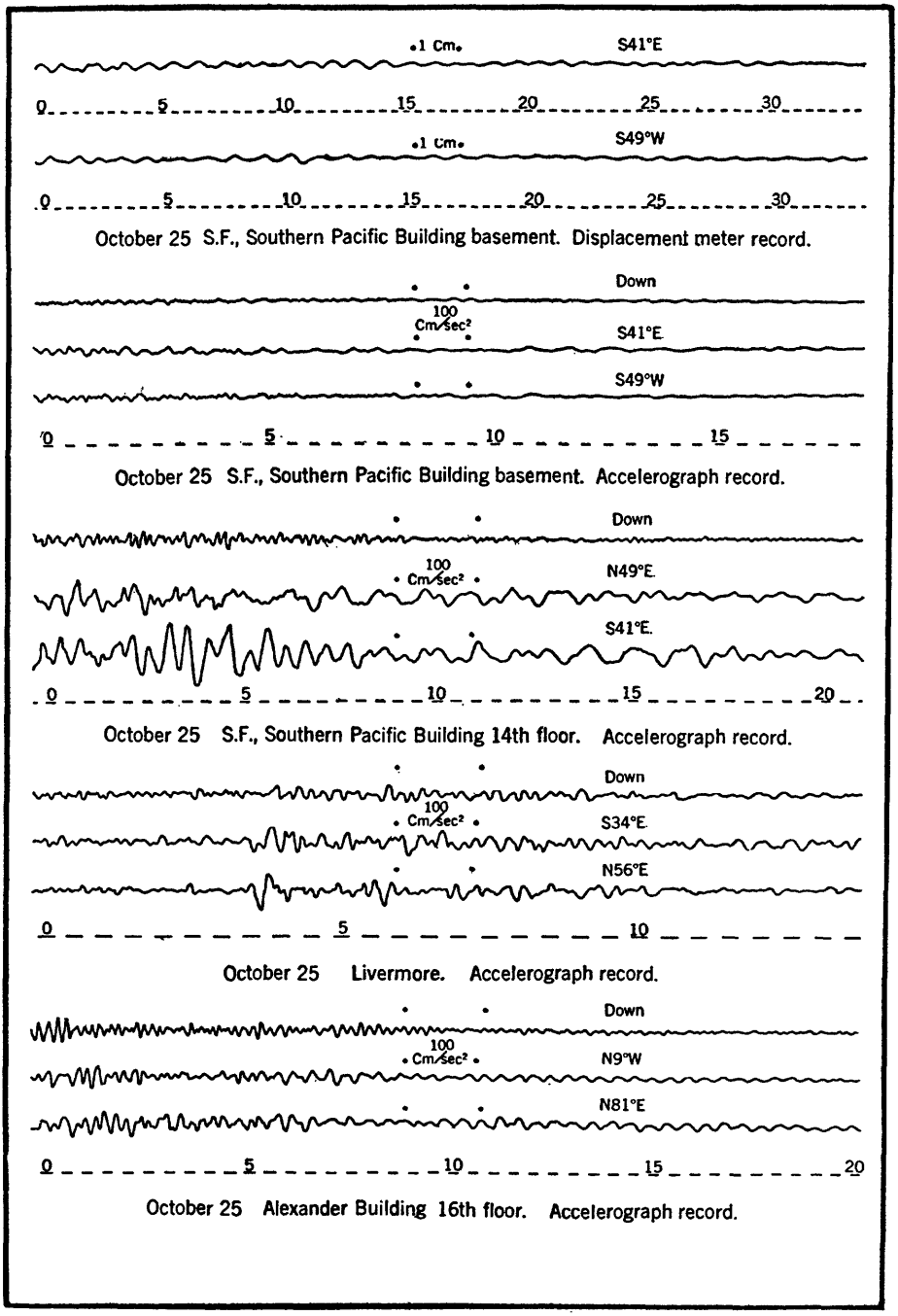


FIGURE 11.—Tracings of displacement-meter and accelerograph records obtained in the basement of the San Francisco Southern Pacific Building on October 25, 1943; accelerograph records obtained on the 14th floor of the San Francisco Southern Pacific Building; at Livermore; and, on the 16th floor of the San Francisco Alexander Building.

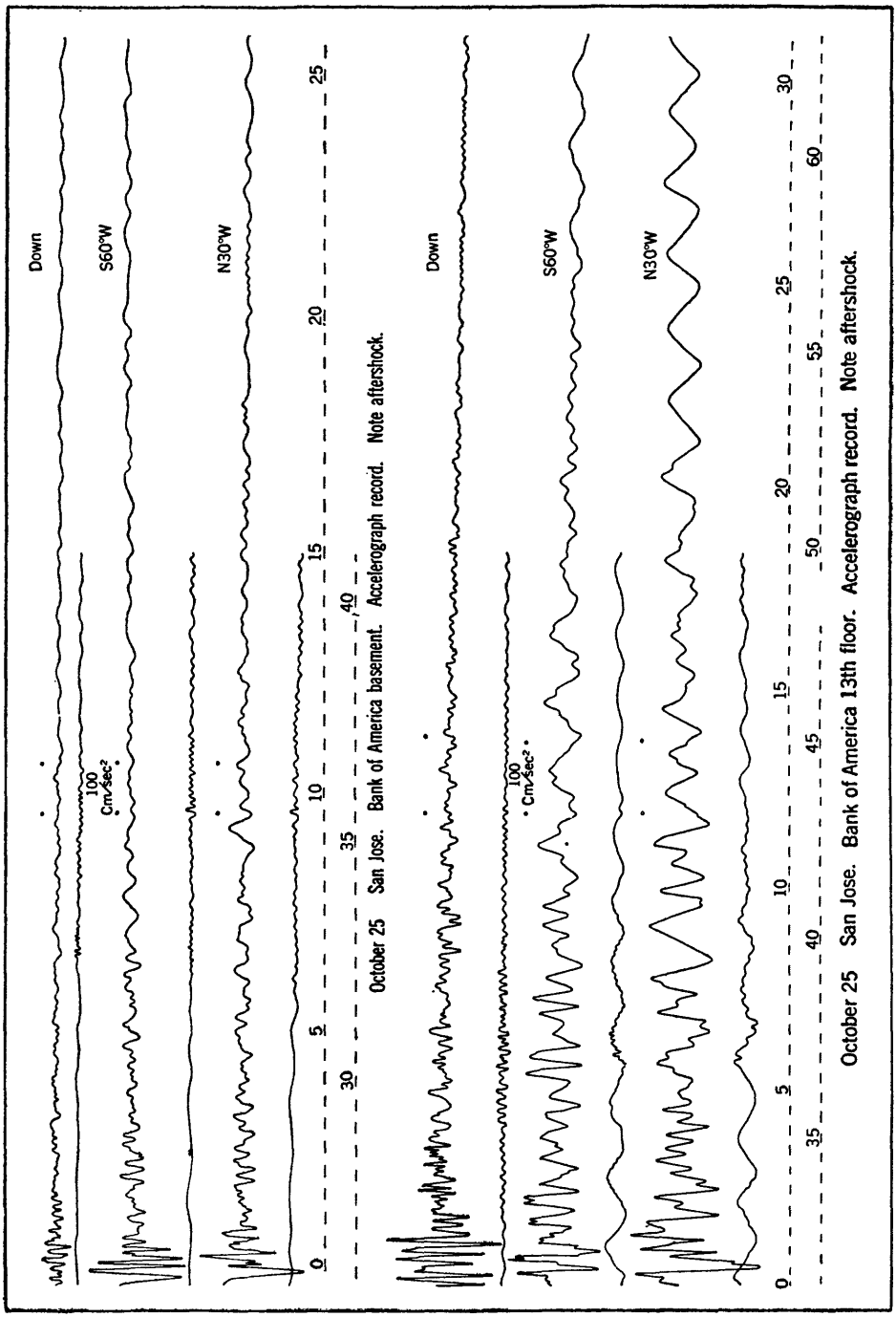


FIGURE 12.—Tracings of accelerograph records obtained in the basement and on the 13th floor of the San Jose Bank of America on October 25, 1943.

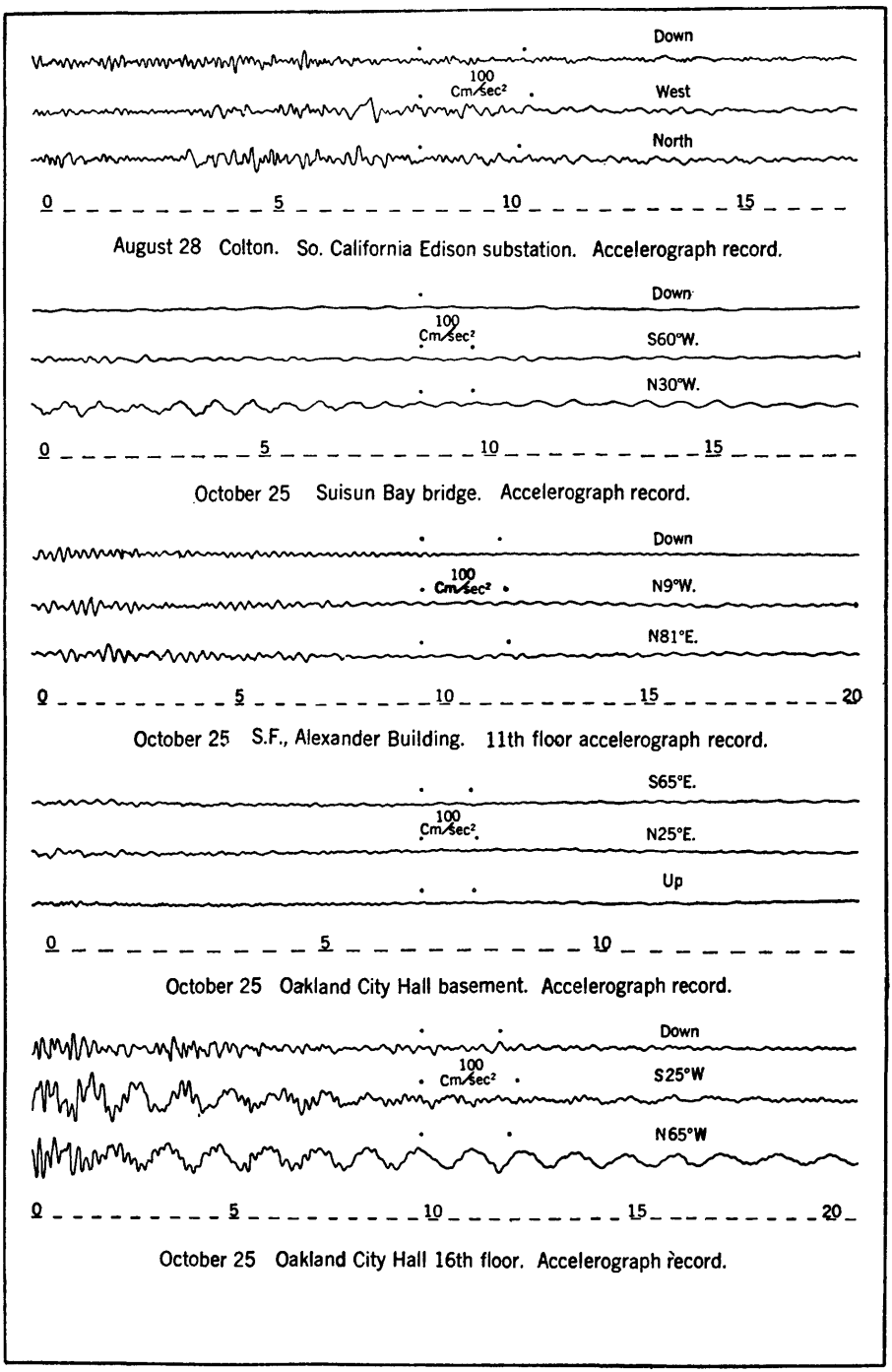


FIGURE 13.—Tracings of accelerograph records obtained at Colton on August 28; at Martinez, Suisun Bay Bridge; on 11th floor of the San Francisco Alexander Building; and, in the basement and on the 16th floor of the Oakland City Hall on October 25, 1943.

San Jose Bank of America, Basement.—Figure 12. Station about 14 miles west southwest of epicenter. Maximum acceleration 138 cm./sec.^{2} Computed maximum displacement .459 cm.

San Jose Bank of America, 13th floor.—Figure 12. Maximum acceleration 254 cm./sec.^{2} Computed maximum displacement 7.636 cm.

San Francisco Southern Pacific Building.—Figure 11. Station about 30 miles northwest by north of epicenter. Maximum acceleration 17 cm./sec.^{2} Computed maximum displacement .182 cm.

The displacement meter recorded a maximum displacement of .23 cm. Computed maximum acceleration 13 cm./sec.^{2}

San Francisco Southern Pacific Building, 14th floor.—Figure 11. Maximum acceleration 62 cm./sec.^{2} Computed maximum displacement .921 cm.

Livermore.—Figure 11. Station about 18 miles north by west of epicenter. Maximum acceleration 46 cm./sec.^{2} Computed maximum displacement .083 cm.

Martinez, Suisun Bay Bridge.—Figure 13. Station about 50 miles northwest by north of epicenter. Maximum acceleration 31 cm./sec.^{2} Computed maximum displacement .558 cm.

San Francisco Alexander Building, 11th floor.—Figure 13. Station about 48 miles northwest by west of epicenter. Maximum acceleration 20 cm./sec.^{2} Computed maximum displacement .027 cm.

San Francisco Alexander Building, 16th floor.—Figure 11. Maximum acceleration 30 cm./sec.^{2} Computed maximum displacement .090 cm.

Oakland City Hall, Basement.—Figure 13. Station about 43 miles northwest by west of epicenter. Maximum acceleration 10 cm./sec.^{2} Computed maximum displacement .020 cm.

Oakland City Hall, 16th floor.—Figure 13. Maximum acceleration 46 cm./sec.^{2} Computed maximum displacement 2.310 cm.

SAN LEANDRO EARTHQUAKE OF NOVEMBER 16

Epicenter in San Leandro. Maximum intensity VI.

Chabot Observatory.—Maximum acceleration 7 cm./sec.^{2} Computed maximum displacement .004 cm. This station is on rock foundation.

TABLE 11.—***Summary of strong-motion seismograph data for the year 1943***

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

Station and component	Earthwave period	Maximum acceleration	Maximum displacement	Remarks
	Seconds	*Cm/sec.^{2}*	*Cm.*	
LIVERMORE EARTHQUAKE OF MAY 8				
Livermore accelerograph:				
Vertical	0.10	4	0.001	
SW: 236°	.15	21	011	
	.24	4	.006	
	.20	3	.003	
NW: 326°	.10	20	.005	
	.30	2	.005	
LIVERMORE EARTHQUAKE OF MAY 29				
Livermore accelerograph:				
Vertical	0.10	11	0.003	
	.07	1	.001	
	.29	4	.009	
SW: 236°	.20	35	.035	Combined with a 0.13 wave.
	.11	3	.001	
	.15	10	.006	Irregular.
	.30	2	.005	End portion.
NW: 326°	.10	20	.005	
	.23	40	.054	Principal portion.
	.26	6	.010	End portion.

TABLE 11.—*Summary of strong-motion seismograph data for the year 1943*—Continued

OWENS VALLEY EARTHQUAKE OF MAY 31

Station and component	Earth-wave period	Maximum acceleration	Maximum displacement	Remarks
	Seconds	*Cm/sec.²*	*Cm.*	
Bishop accelerograph:				
Vertical	0.18	11	0.009	
	.30	4	.009	
	.21	2	.002	
E: 90°	.10	25	.006	
	.15	20	.011	
	.16	15	.010	
	.20	15	.015	
N: 0°	.14	35	.017	Start of record.
	.10	8	.002	
	.16	6	.004	

Twenty seconds later another shock of about one-third the amplitude of this one was recorded.

LIVERMORE EARTHQUAKE OF JUNE 28

Livermore accelerograph:				
Vertical	0.09	3	0.001	Weak record.
	.10	3	.001	Irregular motion.
	.15	4	.002	
SW: 236°	.10	10	.003	Possibly preceded by stronger motion.
	.10	16	.004	Strong waves.
	.15	6	.003	
	.11	4	.001	Irregular waves.
NW: 326°	.11	12	.004	Strong motion.
	.17	14	.010	Strong motion.
	.17	12	.008	
	.19	4	.004	Weak irregular motion.

EAST-CENTRAL CALIFORNIA EARTHQUAKE OF AUGUST 8

Hawthorne accelerograph:				
Vertical	0.15	3	0.002	Irregular short periods superposed.
	.26	3	.005	
	.16	2	.001	
E: 90°	.18	8	.007	Irregular waves.
	.14	5	.002	
	.26	3	.005	
N: 0°	.14	4	.002	Very irregular.
	.15	8	.005	
	.33	3	.008	

SOUTHERN CALIFORNIA EARTHQUAKE OF AUGUST 28

Hollywood Storage Company Basement accelerograph:				
Vertical	0.45	3	0.015	Very weak trace.
	.39	3	.011	
E: 90°	.37	5	.017	Possibly preceded by stronger motion.
	.49	2	.012	
N: 0°	.34	3	.009	
	.43	1	.005	
Hollywood Storage Company P. E. Lot accelerograph:				
Vertical	.36	1	.003	
E: 90°	.23	4	.005	Irregular.
	.28	2	.004	
	.27	1	.002	
N: 0°	.32	7	.018	Possibly preceded by stronger motion.
	.37	4	.014	
	.32	1	.003	End portion.
Hollywood Storage Company Penthouse accelerograph:				
Vertical	.44	6	.030	Long periods at beginning.
	.41	4	.017	
N: 0°	.49	15	.090	
	.71	5	.064	Rather long periods.
	.59	2	.018	Sinusodial waves at end.
E: 90°	.46	13	.070	Sinusodial waves.
	.44	7	.035	
	.49	2	.012	
Los Angeles Subway Terminal 13th floor accelerograph:				
Vertical	.18	2	.002	Rather weak.
	.16	2	.002	
SW: 219°	.71	10	.120	Long period waves.
	.60	4	.036	
	.64	1	.010	
NW: 309°	.54	5	.037	Irregular long periods.
	.62	3	.029	

TABLE 11.—*Summary of strong-motion seismograph data for the year 1943*—Continued

SOUTHERN CALIFORNIA EARTHQUAKE OF AUGUST 28—Continued

Station and component	Earth-wave period	Maximum accelera tion	Maximum displace-ment	Remarks
	Seconds	*Cm/sec.*^{2}	*Cm.*	
Los Angeles Subway Terminal Basement accelerograph:				
Vertical	.16	1	.001	Very weak.
SE: 129°	.40	2	.008	
	.35	1	.003	Weak.
SW: 219°	.47	2	.010	
	.30	1	.002	
Los Angeles Subway Terminal Basement displacement meter:				
SE: 129°	1.08	1	.030	Very weak.
NE: 39°	.89	1	.020	
Los Angeles Chamber of Commerce 11th floor accelerograph:				
Vertical	.31	1	.002	Shorter period superposed.
SW: 220°	.37	2	.003	
	.76	2	.029	Regular.
	.95	1	.023	
NW: 310°	.79	3	.047	Irregular.
	.74	3	.042	Sinusoidal.
	.66	2	.022	
Los Angeles Chamber of Commerce Basement accelerograph:				
Vertical	.45	1	.055	Weak.
SE: 130°	.33	1	.003	Very weak.
	.46	1	.004	
SW: 220°	.28	1	.002	
	.29	1	.002	
Colton accelerograph:				
Vertical	.13	8	.001	
	.14	11	.005	Irregular waves superposed on longer periods.
	.13	5	.002	
E: 90°	.56	4	.031	
	.30	7	.015	Very irregular waves.
	.32	4	.010	
N: 0°	.11	4	.001	
	.15	10	.005	Irregular.
	.46	5	.027	Short periods superposed.
Colton displacement meter:				
E: 90°	1.28	2	.084	Irregular at beginning.
	1.60	1	.065	
	1.38	1	.049	End of record.
N: 0°	2.00	1	.100	
	1.06	1	.026	
San Diego accelerograph:				
Vertical	.15	2	.001	
E: 90°	.30	3	.002	Sinusodial.
	.64	1	.011	
N: 0°	.64	2	.022	Short periods superposed.
	.48	1	.006	
San Bernardino Weed seismograph:				
NE: 45°	.33	3	.008	Well defined.
	.35	2	.006	
NW: 315°	.23	2	.003	

CENTRAL CALIFORNIA EARTHQUAKE OF OCTOBER 25

Livermore accelerograph:				
Vertical	0.14	8	0.004	Short periods superposed on irregular long periods.
	.22	11	.013	
	.19	13	.012	
	.23	17	.022	
	.42	6	.027	Weak.
NW: 326°	.16	12	.007	Irregular.
	.29	32	.065	Strong phase.
	.32	26	.068	
	.40	14	.056	Somewhat sinusoidal near end.
SW: 236°	.15	23	.013	Weak beginning.
	.27	46	.083	Strong phase.
	.26	31	.053	
	.44	19	.039	Irregular.
Martinez, Suisun Bay Bridge accelerograph:				
Vertical	.74	4	.056	Very weak short periods superposed on long periods.
SE: 150°	.28	10	.020	Weak beginning.
	.29	22	.045	
	.31	9	.021	
	.50	6	.031	Long weak traces near end for many seconds.
NE: 60°	.85	31	.558	Short periods superposed on long periods.
	.66	12	.123	Sinusoidal traces for most of record .

TABLE 11.—*Summary of strong-motion seismograph data for the year 1943*—Continued

CENTRAL CALIFORNIA EARTHQUAKE OF OCTOBER 25—Continued

Station and component	Earth-wave period	Maximum acceleration	Maximum displacement	Remarks
	Seconds	*Cm/sec.²*	*Cm.*	
Oakland City Hall 16th floor accelerograph:				
Vertical	.15	6	.003	Sharp phases.
	.20	9	.009	
	.45	4	.020	Weak.
SW: 205°	.15	26	.014	Possibly preceded by stronger motion.
	.95	46	.106	Large amplitudes superposed on these long waves.
	1.19	7	.252	
	1.20	9	.329	Sinusoidal for 20 seconds.
NW: 295°	.17	42	.003	Possibly preceded by stronger motion.
	1.46	33	2.310	Long periods near beginning.
	1.40	10	.497	Very regular.
Oakland City Hall Basement accelerograph:				
Vertical	.09	5	.001	Rather weak.
	.29	4	.008	
NW: 295°	.20	3	.003	Weak and irregular.
	.41	5	.020	
SW: 205°	.19	10	.001	Irregular.
	.26	6	.007	
	.26	4	.006	
San Jose Bank of America 13th floor accelerograph:				
Vertical	.20	108	.108	Sharp phases.
	.24	35	.042	Short periods superposed.
	.23	33	.043	
	.22	26	.026	
	.56	6	.042	
SE: 150°	.43	168	.790	Short periods superposed.
	.48	71	.412	Regular.
	1.84	64	5.248	
	1.89	26	2.392	
NE: 60°	.54	254	1.880	Irregular phases.
	.63	128	1.280	Irregular phases.
	1.47	136	7.344	
	1.92	83	7.636	Sinusoidal.
Aftershock:				
Vertical	.18	8	.006	Short periods superposed.
	.24	11	.017	
SE: 150°	.13	5	.002	Superposed on main shock.
NE: 60°	.21	11	.011	Superposed on main shock.
San Jose Bank of America, Basement accelerograph:				
Vertical	.10	25	.001	Possibly preceded by stronger motion.
	.13	54	.003	
	.18	12	.001	
	1.09	11	.307	
SE: 150°	.16	172	.103	Sharp phases.
	.22	41	.049	
	.38	36	.143	Irregular motion.
	.55	9	.068	
NE: 60°	.36	138	.459	Possibly preceded by stronger motion.
	.19	37	.033	
	.29	22	.044	
	.51	39	.257	Irregular.
	.66	9	.099	
Aftershock:				
Vertical	.07	8	.001	Weak.
	.18	6	.004	
SE: 150°	.17	14	.009	Irregular.
	.22	4	.004	
NE: 60°	.22	9	.010	Irregular.
	.20	4	.004	
San Francisco Alexander Building 16th floor accelerograph:				
Vertical	.20	26	.026	Strong at beginning.
	.22	16	.019	
	.18	19	.015	
	.41	5	.021	
SE: 171°	.25	27	.041	Irregular motion.
	.40	22	.090	
	.22	27	.032	
	.41	11	.047	Group of regular waves.
SW: 261°	.42	28	.042	Irregular at beginning.
	.27	30	.032	
	.35	23	.071	
	.42	8	.036	
San Francisco Alexander Building 11th floor accelerograph:				
Vertical	.22	16	.019	Possibly preceded by stronger motion.
	.24	19	.027	
	.21	6	.007	Weak.
SE: 171°	.26	10	.017	Regular at beginning.
	.22	20	.024	
	.25	1	.014	
	.46	2	.011	
SW: 261°	.28	12	.023	
	.24	10	.015	Irregular.
	.32	10	.026	
	.48	3	.017	

TABLE 11—*Summary of strong-motion seismograqh date for the year 1943*—Continued

CENTRAL CALIFORNIA EARTHQUAKE OF OCTOBER 25—Continued

Station and component	Earth-wave period	Maximum accelera-tion	Maximum displace-ment	Remarks
	Seconds	*Cm/sec.²*	*Cm.*	
San Francisco Alexander Building basement accelerograph:				
Vertical	.16	6	.004	Very weak record.
	.25	3	.004	
NW: 351°	.28	10	.020	Weak and irregular.
	.14	7	.003	
	.27	6	.010	
NE: 81°	.26	9	.015	Weak and irregular.
	.31	5	.012	
	.32	3	.007	
San Francisco Southern Pacific building 14th floor accelerograph:				
Vertical	.27	12	.023	Irregular at beginning.
	.20	11	.011	
	.47	3	.016	
	.16	5	.003	Regular chain for five seconds:
SW: 229°	.47	14	.076	
	1.10	30	.921	Irregular long periods.
	1.18	11	.396	
	.93	7	.154	Regular long waves at end;
NW: 319°	.48	25	.147	Possibly preceded by stronger motion.
	.45	62	.316	Strongest motion.
	.92	24	.516	
	.42	7	.031	Regular for nine seconds.
	.97	7	.168	Near end of record.
San Francisco Southern Pacific Building basement accelerograph:				
Vertical	.20	7	.007	Very irregular at beginning.
	.49	9	.055	
NW: 319°	.42	14	.063	Irregular.
	.48	8	.044	
	.76	4	.058	
NE: 49°	.35	17	.053	Weak.
	.19	9	.008	
	1.02	7	.182	
San Francisco Southern Pacific Building basement displacement meter:				
NW: 315°	.77	13	.20	
	1.01	6	.14	Regular waves.
	.84	5	.09	
NE: 45°	.83	6	.13	Rather irregular.
	1.02	9	.23	
	.84	4	.08	Weak.
San Francisco Shell Building 29th floor strong-motion seismograph:				
E: 90°	.29	7	.014	
	.89	14	.280	Irregular motion.
	.70	2	.024	
N: 0°	.69	3	.036	
	1.08	14	.420	Irregular motion.
	1.08	3	.090	
San Francisco Shell Building, 21st floor strong-motion seismograph:				
E: 90°	.27	8	.014	
	.28	16	.032	
	.85	14	.028	Irregular.
N: 0°	.27	11	.022	
	.23	6	.012	Weak.
San Francisco Shell Building basement strong-motion seismograph:				
E: 90°	.90	2	.042	Weak.
N: 0°	.52	2	.014	Weak.
San Francisco Sutter Building, 29th floor strong-motion seismograph:				
E: 90°	.16	3	.022	Very weak.
N: 0°	.15	8	.005	Very weak.
San Francisco Sutter Building basement strong-motion seismograph:				
E: 90°	.11	6	.002	Very weak.
N: 0°	.10		.002	Very weak.
Oakland Chabot Observatory strong-motion seismograph:				
SW: 225°	.24	4	.006	Weak and regular.
SE: 135°	.16	7	.004	Well defined.
	.21	2	.002	

SAN LEANDRO EARTHQUAKE OF NOVEMBER 16

Oakland Chabot Observatory Strong-motion seismograph:				
SW: 225°	0.21	2	0.002	
SE: 135°	.08	7	.001	Single phase.
	.24	3	.004	

TABLE 12.—*Instrumental constants of strong-motion seismographs in 1943*

Station and instrument	Orientation of instrument [1]	Pendulum Period	Static magnification	Sensitivity [2]	Damping ratio	Instrument number
		Sec.		*Cm.*		
LIVERMORE EARTHQUAKE OF MAY 8						
Livermore accelerograph No. 44	Up	0.099	84	2.02	9	V-7
	SW: 236°	.098	84	1.80	7	L-2
	NW: 326°	.099	77	1.92	10	T-17
LIVERMORE EARTHQUAKE OF MAY 29						
Livermore accelerograph No. 44	Up	0.099	84	2.02	9	V-7
	SW: 236°	.098	84	1.80	7	L-2
	NW: 326°	.099	77	1.92	10	T-17
EAST-CENTRAL CALIFORNIA EARTHQUAKE OF MAY 31						
Bishop accelerograph No. 12	Up	0.100	110	2.72	11	V-23
	E: 90°	.100	107	2.68	10.5	L-36
	S: 180°	.99	108	2.66	10	T-19
LIVERMORE EARTHQUAKE OF JUNE 28						
Livermore accelerograph No. 44	Up	0.099	84	2.02	9	V-7
	SW: 236°	.098	84	1.80	7	L-2
	NW: 326°	.099	77	1.92	10	T-17
EAST-CENTRAL CALIFORNIA EARTHQUAKE OF AUGUST 8						
Hawthorne accelerograph No. 25	Up	0.094	109	2.47	9	V-31
	S: 180°	.100	106	2.67	9	L-35
	W: 270°	.097	106	2.42	8	T-14
SOUTHERN CALIFORNIA EARTHQUAKE OF AUGUST 28						
Colton accelerograph No. 38	Up	.100	112	2.66	8	V-111
	E: 90°	.097	112	2.86	9	L-91
	S: 180°	.100	117	2.56	9	T-101
Colton displacement meter No. 16	W: 270°	9.8	1.14		7	
	N: 0°	9.8	1.14		9	
Hollywood Storage Company:[3]						
P. E. Lot accelerograph No. 1	Up	.070	108	1.37	9	V-66
	E: 90°	.070	108	1.35	7	L-64
	S: 180°	.070	111	1.34	9	T-65
Penthouse accelerograph No. 40	Up	.104	81	2.00	8	V-113
	S: 180°	.102	80	2.02	7	L-93
	W: 270°	.101	79	2.00	8	T-103
Basement accelerograph No. 22	Up	.070	103	1.27	5	V-25
	E: 90°	.069	111	1.34	8	L-3
	S: 180°	.070	109	1.36	7	T-18
Los Angeles Subway Terminal:[3]						
13th floor accelerograph No. 39	Up	.100	83	2.10	11	V-112
	SW: 219°	.100	81	2.05	9	L-92
	NW: 309°	.100	80	2.01	12	T-102
Basement accelerograph No. 3	Up	.069	116	1.38	10	V-58
	SE: 129°	.069	118	1.41	11	L-59
	SW: 219°	.070	120	1.43	12	T-60
Basement displacement meter No. 13	NE: 39°	10.4	1.14		11	
	SE: 129°	10.3	1.14		11	
Los Angeles Chamber of Commerce:[3]						
11th floor accelerograph No. 42	Up	.100	80	2.02	10	V-115
	SW: 220°	.098	82	2.00	9	L-95
	NW: 310°	.099	80	1.99	8	T-105
Basement accelerograph No. 21	Up	.067	107	1.26	9	V-28
	SE: 130°	.068	108	1.27	8	L-9
	SW: 220°	.069	111	1.34	7	T-26
San Bernardino Weed Seismograph No. 10	SE: 135°	.18	6.29		2	
	NE: 45°	.18	6.17		2	
San Diego accelerograph No. 5	Up	.098	102	2.49	8	V-70
	E: 90°	.100	104	2.64	9	L-71
	S: 180°	.099	108	2.68	9	T-72

TABLE 12.—*Instrumental constants of strong-motion seismographs in 1943*—Continued

CENTRAL CALIFORNIA EARTHQUAKE OF OCTOBER 25

Station and instrument	Orientation of instrument [1]	Pendulum Period	Static magnification	Sensitivity [2]	Damping ratio	Instrument number
		Sec.		*Cm.*		
Livermore accelerograph No. 44	Up	0.101	84	2.14	8	V-7
	SW: 236°	.099	84	2.02	9	L-2
	NW: 326°	.100	77	1.90	9	T-17
Martinez, Suisun Bay Bridge accelerograph No. 9.	Up	.067	118	1.34	5	V-40
	NE: 60°	.068	116	1.36	5	L-39
	SE: 150°	.070	109	1.36	5	T-38
Oakland Chabot Observatory:						
Weed seismograph No. 3	SW: 225°	.19	8.2	.0075	2	
	SE: 135°	.19	8.2	.0075	2	
Oakland City Hall:[3]						
16th floor accelerograph No. 37	Up	.099	80	1.98	9	V-109
	NE: 25°	.104	88	2.41	7	L-89
	SE: 115°	.104	81	2.21	12	T-99
Basement accelerograph No. 33	NW: 295°	.068	112	1.31	6	V-16
	SW: 205°	.069	116	1.40	4	L-33
	Down	.068	118	1.38	7	T-12
San Francisco Alexander Building:[3]						
16th floor accelerograph No. 36	Up	.101	80	2.06	12	V-110
	SE: 171°	.099	74	1.84	9	L-90
	SW: 261°	.099	79	1.96	12	T-100
11th floor accelerograph No. 43	Up	.098	76	2.08	9	V-116
	SE: 171°	.098	83	2.19	10	L-96
	SW: 261°	.102	85	2.32	9	T-106
Basement accelerograph No. 10	Up	.069	112	1.33	9	V-44
	NW: 351°	.071	128	1.29	18	L-45
	NE: 81°	.068	113	1.28	32	T-46
San Francisco Shell Building:						
29th floor Weed seismograph No. 2	E: 90°	.17	7.3	.0067	2.0	
	N: 0°	.17	7.3	.0067	2.2	
21st floor Weed seismograph No. 5	E: 90°	.19	6.4	.0058	1.4	
	N: 0°	.19	6.4	.0058	1.4	
Basement Weed seismograph No. 4	E: 90°	.17	7.6	.0057	2.0	
	N: 0°	.17	7.6	.0057	2.0	
San Francisco Southern Pacific Building:[3]						
14th floor accelerograph No. 34	Up	.102	83	2.19	7	V-108
	SW: 229°	.102	80	2.12	5	L-88
	NW: 319°	.102	79	2.07	9	T-98
Basement accelerograph No. 27	Up	.067	116	1.32	5	V-27
	NW: 319°	.068	112	1.31	5	L-22
	NE: 49°	.068	113	1.32	4	T-1
Basement displacement meter No. 18	NW: 315°	9.8	1.14	----------	8	
	NE: 45°	9.8	1.14	----------	11	
San Jose Bank of America:[3]						
13th floor accelerograph No. 8	Up	.101	79	2.08	10	V-107
	NE: 60°	.097	78	1.86	10	L-87
	SE: 150°	.098	79	1.91	8	T-97
Basement accelerograph No. 8	Up	.069	110	1.30	12	V-49
	NE: 60°	.068	112	1.30	10	L-50
	SE: 150°	.067	117	1.30	7	T-51
San Francisco Sutter Building:						
29th floor Weed seismograph No. 1	E: 90°	.20	9.0	.0096	2	
	N: 0°	.20	9.0	.0091	2	
Basement Weed seismograph No. 6	E: 90°	.16	8.6	.0055	1.8	
	N: 0°	.16	8.6	.0055	1.8	

SAN LEANDRO EARTHQUAKE OF NOVEMBER 16

Oakland, Chabot Observatory. Weed seismograph No. 3.	SW: 225°	0.19	8.2	0.0075	2	
	SE: 135°	.19	8.2	.0075	2	

[1] The directions given indicate the direction of pendulum displacement relative to instrument pier, which will displace the trace upward on the original seismogram.

Directions for the horizontal components are given first by quadrant followed by specific directions expressed in degrees measured from north around by east.

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

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

TABLE 13.—*Changes in strong-motion instrumental equipment during 1943*

Station	Date of Change	Remarks *
Berkeley, Calif	Oct. 13, 1943	Period of accelerometers changed from .100 to .070 second. Sensitivity changed from approximately .0260 to approximately .0130.
Livermore, Calif.	Dec. 11, 1943	Recorder No. M-44, accelerometers Nos. 2, 7, and 17 removed for shipment to South America. Station discontinued.
Monterey, Calif.	Aug. 26, 1943	Period of accelerometers changed from .100 to .070 second. Sensitivity changed from approximately .0260 to approximately .0130.
Oakland, Calif. City Hall, basement.	Aug. 4, 1943	Period of accelerometers changed from .100 to .070 second. Sensitivity changed from approximately .0260 to approximately .0130.
Oakland, Calif. City Hall, 16th floor.	Aug. 4, 1943	6-inch Recorder No. 10, accelerometers Nos. 44, 45, and 46 removed. 12-inch Recorder No. 37, accelerometers Nos. 89, 99, and 109, formerly in San Francisco, Alexander Building, installed.
Sacramento, Calif.	Aug. 14, 1943	Periods of accelerometers changed from .100 to .070 Second. Sensitivity changed from approximately .0260 to approximately .0130.
San Francisco, Calif. Alexander Building, basement.	July 23, 1943	12-inch Recorder No. 37, accelerometers Nos. 89, 99, and 109 removed. 6-inch Recorder No. 10, accelerometers Nos. 44, 45, and 46, formerly in Oakland City Hall, 16th floor, installed.
San Francisco, Calif., Southern Pacific Building, basement.	Sept. 3, 1943	12-inch Recorder No. 35, accelerometers Nos. 87, 97, and 107 removed. 6-inch Recorder No. 27, accelerometers Nos. 1, 22, and 27, formerly at San Jose Bank of America Building, 13th floor, installed.
San Francisco, Calif., State Building.	Oct. 6, 1943	Period of accelerometers changed from .100 to .070 second. Sensitivity changed from approximately .0260 to approximately .0130.
San Francisco, Calif., University of San Francisco.	Dec. 13, 1943	12-inch Recorder No. 50, accelerometers Nos. 149, 150, and 151 removed for shipment to South America. Station not discontinued but awaiting replacement instrument.
San Jose, Calif., Bank of America Building, basement.	Aug. 24, 1943	Period of accelerometers changed from .100 to .070 second. Sensitivity changed from approximately .0260 to approximately .0130.
San Jose, Calif. Bank of America Building, 13th floor.	Aug. 25, 1943	6-inch Recorder No. 27, accelerometers Nos. 1, 22, and 27 removed. 12-inch Recorder No. 35, accelerometers Nos. 87, 97, and 107, formerly at San Francisco, Southern Pacific Building, basement, installed.
Martinez, Calif., Suisun Bay Bridge.	Aug. 17, 1943	Period of accelerometers changed from .100 to .070 second. Sensitivity changed from approximately .0260 to approximately .0130.
Bishop, Calif.	July 14, 1943	Recorder No. 12 removed. Recorder No. 6, formerly at Los Angeles, Edison Building, installed. Accelerometers not changed.
Los Angeles, Calif., Edison Building, basement.	July 15, 1943	Recorder No. 6 removed. Recorder No. 12, formerly at Bishop, Calif., installed. Accelerometers not changed.
Great Falls, Mont.	May 15, 1943	Station established. Recorder No. 49, accelerometers Nos. 136, 137, and 138, formerly at Missoula, Mont., installed.

*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 kept in operation at Berkeley during the entire year. The tilt-graph of data obtained from these instruments for 1943 is shown in Figure 14.

A fourth instrument was operated at Long Beach in cooperation with the Long Beach Harbor Department. The 1943 tilt-graph for this station is shown in Figure 15.

ADDITIONS AND CORRECTIONS TO PREVIOUS PUBLICATIONS

1942. Serial 662, P. 1. Under the subhead "Earthquake information services" the date at the end of the second paragraph should read 1942.

Page 22, Table 2, "Principal earthquakes of the world from January 1942 to December 1942, inclusive." The intensity given in the remarks column for the shock of August 1 should be VIII.

Page 37. The next to the last paragraph under the heading "Changes in Strong-Motion Instrument Equipment During 1942" should read: During 1942 double magnification systems were installed at El Centro, Pasadena, Santa Barbara, and Westwood. At Long Beach a double magnification instrument was installed in May and replaced by a single magnification instrument in August.

Serial No. 682

UNITED STATES EARTHQUAKES

1944

By

RALPH R. BODLE

Geophysicist

U.S. DEPARTMENT OF COMMERCE

COAST AND GEODETIC SURVEY

WASHINGTON : 1946

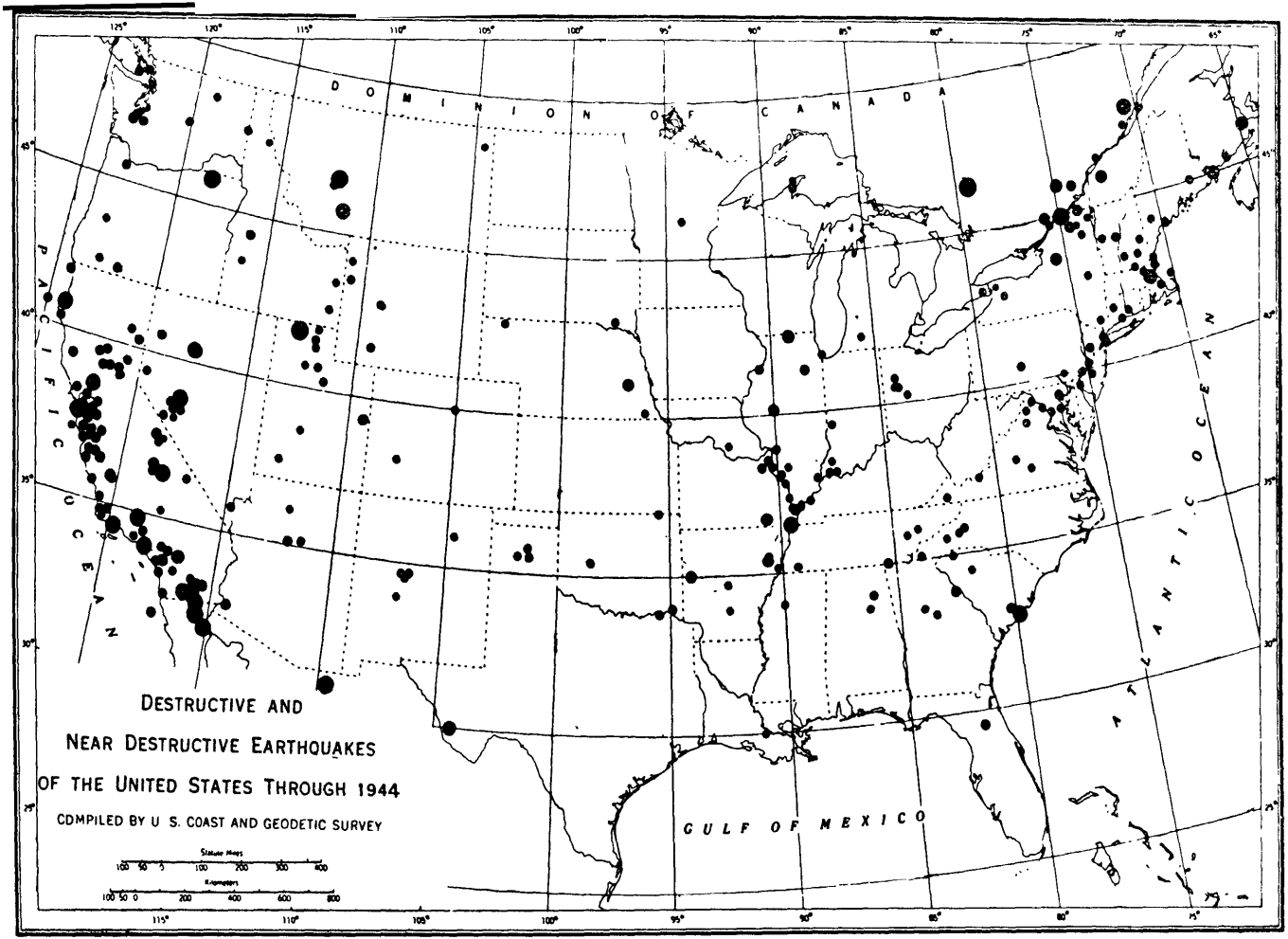


FIGURE 1.—Destructive and near destructive earthquakes in the United States through 1944.

CONTENTS

ILLUSTRATIONS

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.

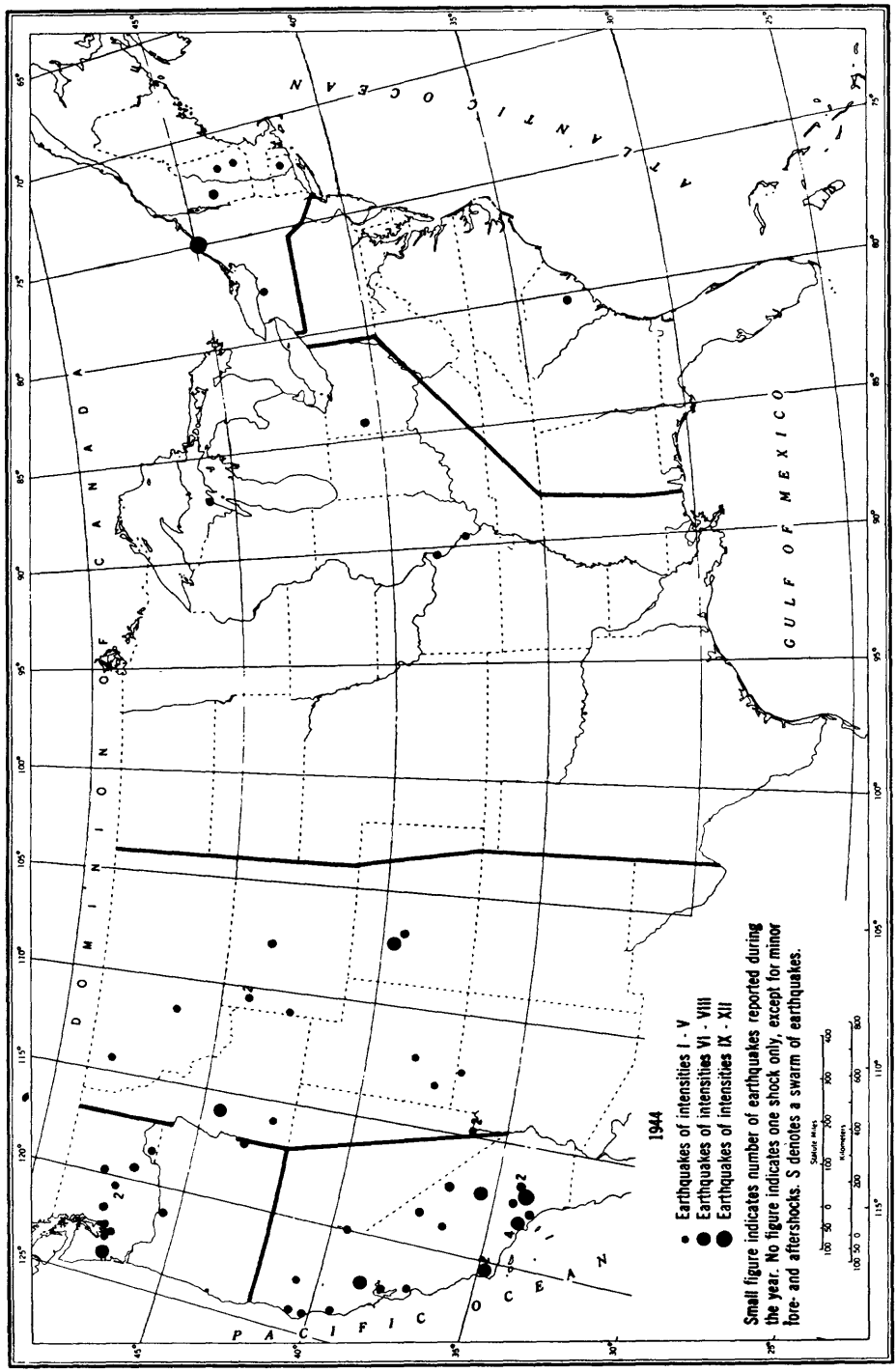


FIGURE 2.—Earthquake epicenters, 1944.

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 unabridged 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

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.)

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 8 (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 Canisiu 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.

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, Oneanta, 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 stope 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

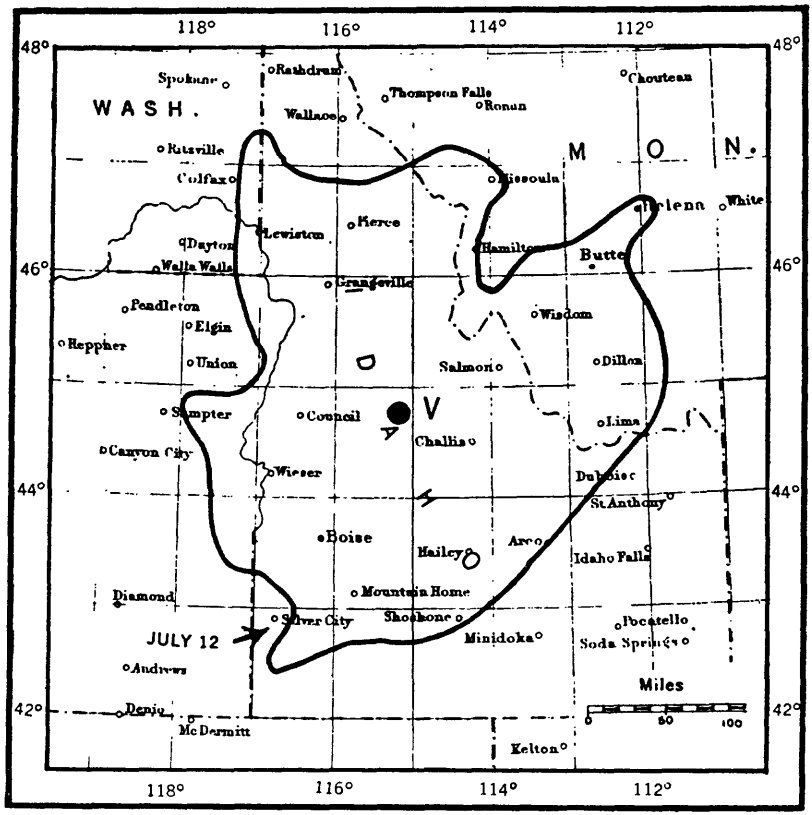


FIGURE 4.—Area affected by the Idaho earthquake of July 12, 1944.

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 knick-knacks 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, Tendoy, 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 Ridgeway, 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: 03:45. Helena, Montana. One weak tremor, lasting 2 seconds.

September 14: 03:42*. 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.

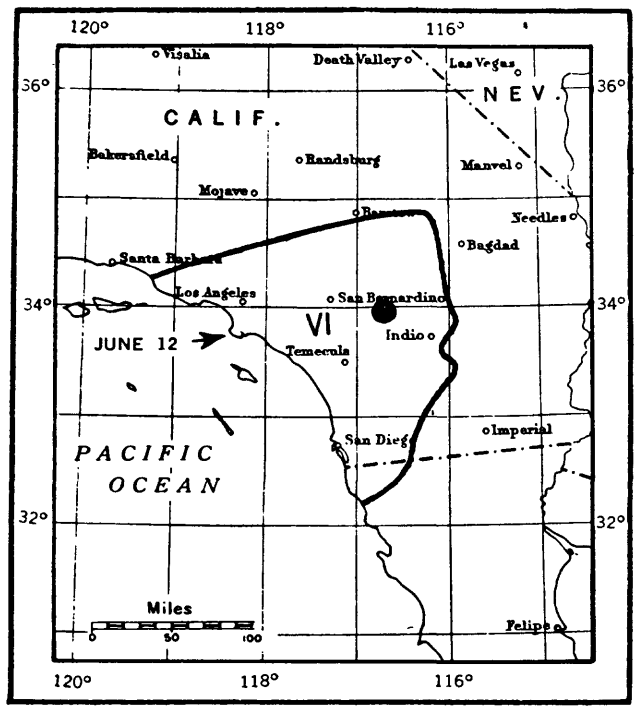


FIGURE 5.—Area affected by the earthquake of June 12, 1944.

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, Topango, 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.

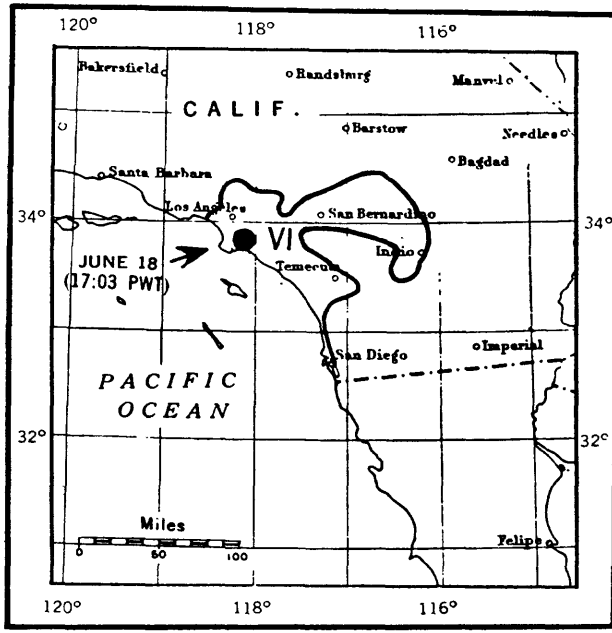


FIGURE 6.—Area affected by the earthquake of June 18, 1944, at 17h 03m., P.W.T.

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.

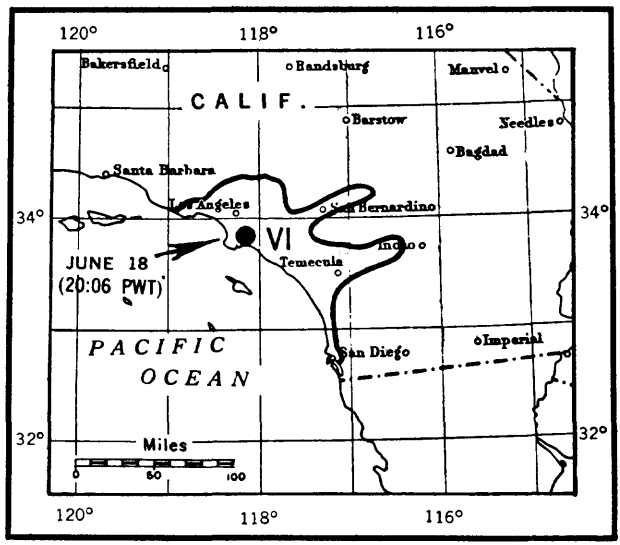


FIGURE 7.—Area affected by the earthquake of June 18, 1944, at 20h 06m., P.W.T.

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: 03:55. 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 18: 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 Hoodsport east of Cedar Falls, south of Longmire, thence northwesterly to Olympia to Hoodsport. 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, Hoodsport, 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.

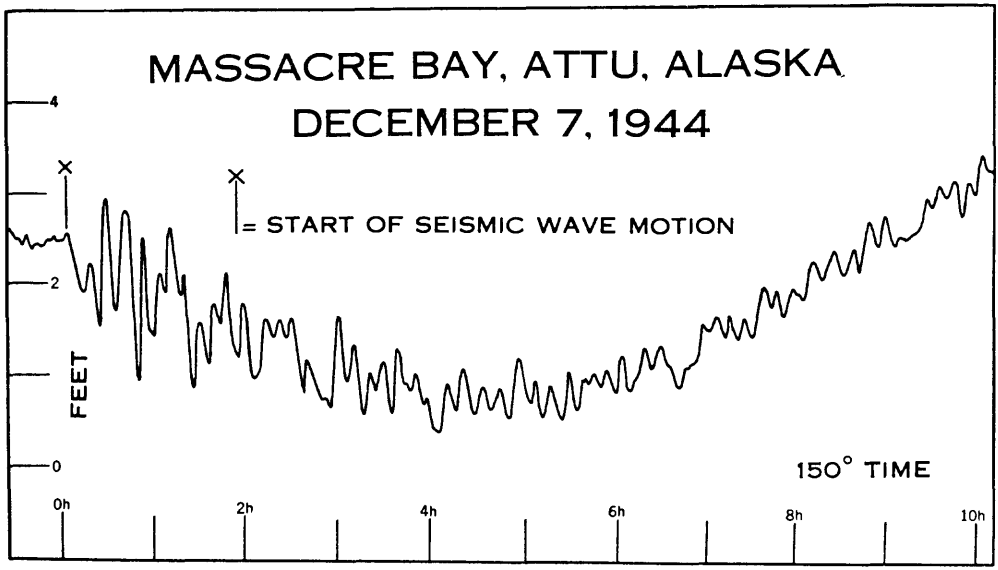


FIGURE 8.—Tracings of marigram obtained at Massacre Bay, Attu, Alaska, on December 7, 1944.

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	9.86	9.89	0.03
S-68	1-10-44	15:45	9.81	9.80	9.82	0.02
S-329	1-10-44	16:10	7.03	7.02	7.04	0.02
F-210	1-31-44	23:55	9.73	9.72	9.74	0.02
S-19	1-31-44	23:55	7.71	.....	.....	Less than 0.01
S-68	1-31-44	23:55	9.85	9.845	9.86	0.015
S-329	1-31-44	23:55	7.38	7.37	7.39	0.02
F-210	2- 3-44	08:35	9.80	.....	.....	Less than 0.01
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	0.015
F-179	6-28-44	04:00	9.57	9.605	9.54	0.065
F-210	6-28-44	04:00	9.76	9.66	9.88	0.22
F-213	6-28-44	04:00	17.31	17.28	17.34	0.06
S-18	6-28-44	04:00	9.07	9.06	9.085	0.025
S-19	6-28-44	04:00	8.75	8.63	8.86	0.23
S-68	6-28-44	04:00	10.79	10.75	10.85	0.10
S-1042	6-28-44	04:00	8.27	8.17	8.38	0.21
S-1042	7-12-44	21:00	8.72	8.38	8.80[1]	App. 0.65
F-179	8-24-44	20:15	9.48	.....	.....	Less than 0.01
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	0.03
S-1042	8-24-44	20:15	6.62	.....	.....	Less than 0.01
S-329	9-19-44	10:00	6.17	6.16	6.175	0.015
S-1042	9-19-44	10:00	6.95	6.92	6.97	0.05

[1]Lowest 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
	° ′ ″	° ′ ″		*feet*	
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 to 01:00	.03 .025	Stage .02 feet below previous and subsequent record during this period.
Salmon River at Chasm Falls	44 45 20	74 13 10	00:30 to 00:45	.005	Continuing fluctuation.
Chateaugay River at Chateaugay	44 54 35	74 05 10	00:30	.015	Heavy single trace.
Richelieu River (Lake Champlain) at Rouses Point	44 59 45	73 21 40	00:35	.01	Single trace.
East Branch of Ausable River at Ausable Forks	44 26 20	73 40 55	00:35	.005	Drop in stage.
Cedar Swamp Creek at Glen Cove	40 51 45	73 38 05	00:25	+.020 −.015	Single trace.
Mill Neck Creek at Mill Neck	40 53 15	73 33 55	.....	.....	No visible disturbance.
Nissequogue River at Smithtown	40 50 55	73 13 25	00:40	+.01 −.01	Single trace.
Peconic River at Riverhead	40 54 50	72 41 10	01:00	−.003 +.014	Do.
Carmans River at Yaphank	40 49 50	72 54 20	00:20	+.007 −.007	Do.
Connetquot River (No. 1) at Oakdale	40 44 50	73 09 00	00:40	+.01 −.01	Do.
Connetquot River (No. 2) at Oakdale (¼ mi. NE of Gage No. 1)			00:40	+.01 −.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 −.005	Do.
Pines Brook at Malverne	40 40 00	73 39 30	00:45	+.006 −.004	Do.
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 cooperating 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. (Geodaetisk 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. (Geodaetisk 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
	h	*m*		°	°
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 S 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
	h *m*		° ′	° ′
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 56.5	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 N.	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 56.6	....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 26	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 15.8	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
	h *m*		° ′	° ′
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.	167 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	0.5 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	34.3 N.	117.0 W.
Aug. 31	16 10.7	Guatemala. Slightly deeper than normal	15.0 N.	91.2 W.
Sept. 5	8 34.5	Celebes Sea	3.5 N.	124 E.
Sept. 6	3 41.5	Southeast of New Zealand	53.2 S.	159.1 E.
Sept. 10	2 31.6	North of Puerto Rico	19.0 N.	66.8 E.
Sept. 10	8 36.9	Honshu Island, Japan. Destructive	35.3 N.	133.9 E.
Sept. 11	19 34.0	Samoa Islands	14.8 S.	174.7 W.
Sept. 14	2 01.2	Near Loyalty Islands. Deeper than normal	23 S.	170.5 E.
Sept. 14	3 47.2	Near Loyalty Islands	22 S.	170.5 E.
Sept. 14	7 18.2	Kermadec Islands. Depth about 100 km	30 S.	177.5 W.
Sept. 16	0 16.2	California	36.0 N.	117.9 W.
Sept. 16	7 52.4	....do	36.0 N.	117.9 W.
Sept. 17	10 09.3	New Hebrides Islands	14.5 S.	167 E.
Sept. 19	4 47.6	Southwest of Easter Islands	30.5 S.	114 W.
Sept. 20	0 53.7	Off west coast of Mexico	19.5 N.	109.2 W.
Sept. 22	23 18.2	Near Kermadec Islands	34.5 S.	179.5 W.
Sept. 23	12 37.3	Gulf of California. Felt	29.3 N.	112.5 W.
Sept. 23	15 00.6	Guatemala	15.0 N.	91.4 W.
Sept. 24	11 31.4	Northern India	36.5 N.	73 E.
Sept. 26	22 38.2	South of Panama	5 N.	82.5 W.
Sept. 27	22 03.8	Kermadec Islands. Depth about 100 km	29.8 S.	117.9 W.
Oct. 1	17 53.0	Atlantic Ocean	7.5 N.	38 W.
Oct. 2	6 56.7	California. Felt	40.6 N.	124.9 W.
Oct. 2	11 22.9	Near coast of southern Mexico	16.5 N.	94 W.
Oct. 3	0 52.8	Azores	38 N.	26.5 W.
Oct. 3	8 28.5	Italy	43 N.	13 E.
Oct. 4	10 39.7	New Hebrides Islands region	15.5 S.	168 E.
Oct. 13	4 44.8	Gulf of Mexico	26 N.	110 W.
Oct. 14	14 28.7	California	34.3 N.	116.9 W.
Oct. 15	16 50.0	California. Felt	34.3 N.	116.9 W.
Oct. 16	13 08.8	Near west coast of Turkey	36.4 N.	27.9 E.
Oct. 21	23 08.2	Near Fiji Islands	15 S.	177 W.
Oct. 23	17 23.3	Assam	28 N.	94 E.
Oct. 24	13 40.3	Kurile Islands region	48 N.	156 E.
Oct. 24	16 04.6	Tonga Islands region	22.5 S.	174 W.
Oct. 24	23 22.8	Near east coast of Kamchatka	53.5 N.	160 E.
Oct. 26	4 50.5	California. Felt	37.5 N.	122.1 W.
Oct. 28	5 58.9	California	33 N.	115 W.
Oct. 31	13 12.2	....do	33.8 N.	116.2 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
	h m		° ′	° ′
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	
	h m		°	°	
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.	
July 12	19 30.4	Idaho	44.7 N.	115.2 W.	Slight depth.
Sept. 5	00 39	St. Lawrence Valley	45.0 N.	74.8 W.	Approximately $2,000,000 property damage. Cornwall, Ontario, and Massena, N. Y.
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	1	.....	.....
Hollywood Storage Company	3	.....	.....
Los Angeles Chamber of Commerce	2	.....	.....
Los Angeles Subway Terminal	2	1	.....
Los Angeles Edison Building	1	.....	.....
Long Beach	1	.....	.....
June 18: Aftershock:			
Vernon C.M.D. Terminal	1	.....	.....
Hollywood Storage Company	3	.....	.....
Los Angeles Chamber of Commerce	1	.....	.....
Los Angeles Subway Terminal	2	1	.....
Los Angeles Edison Building	1	.....	.....
Long Beach	1	.....	.....
September 21: Northern California:			
Ferndale	1	.....	.....
Eureka	1	1	.....
November 16: 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-

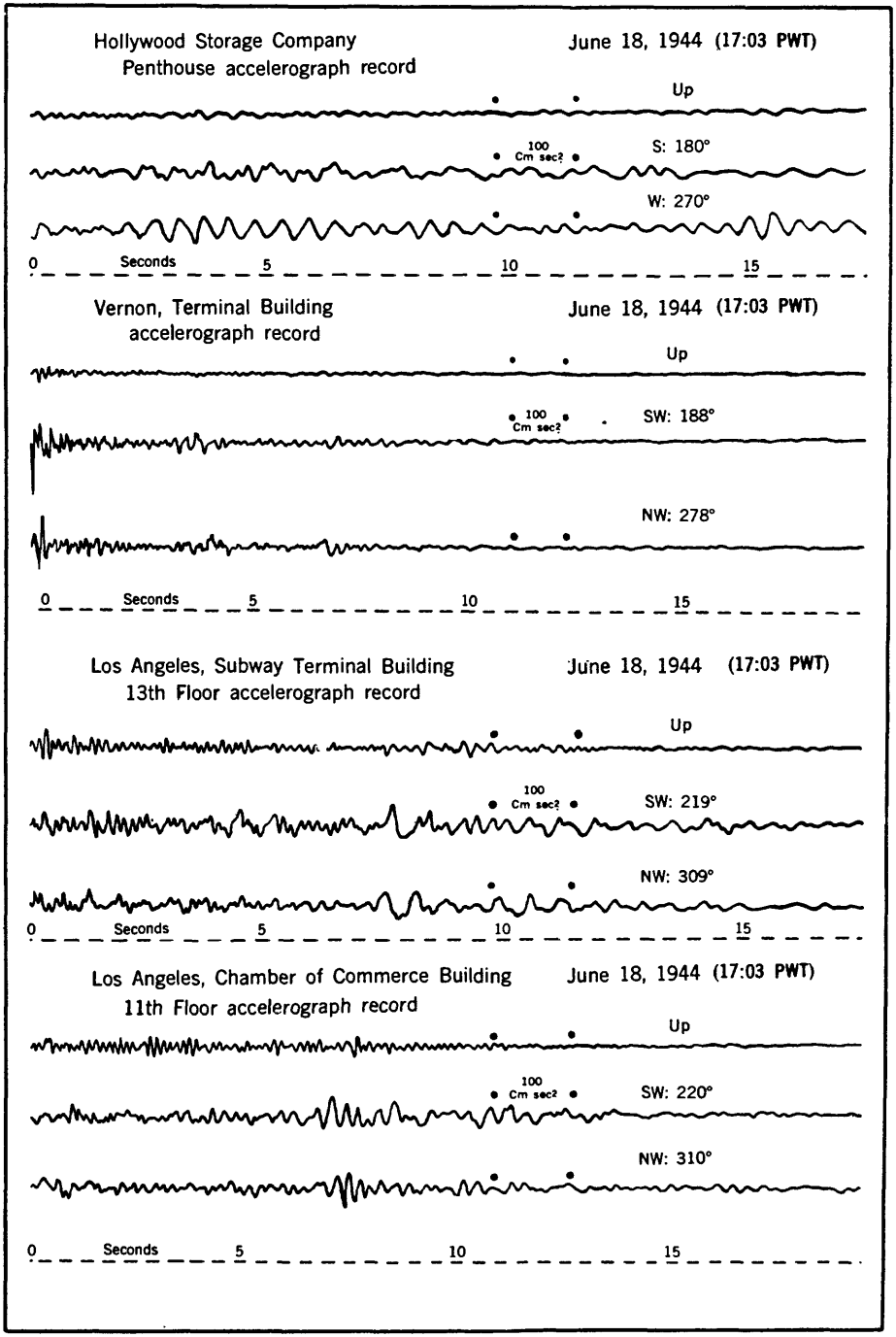


FIGURE 9.—Tracings of accelerograph records obtained at Hollywood Storage Company, penthouse; Vernon C.M.D. Terminal; Los Angeles Subway Terminal, 13th floor; and Los Angeles Chamber of Commerce, 11th floor on June 18, 1944, at 17:03 P.W.T.

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°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. 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°52′ north, 118°13′ west, in Inglewood Fault, near Dominguez Junction. Maximum intensity VI at many places.

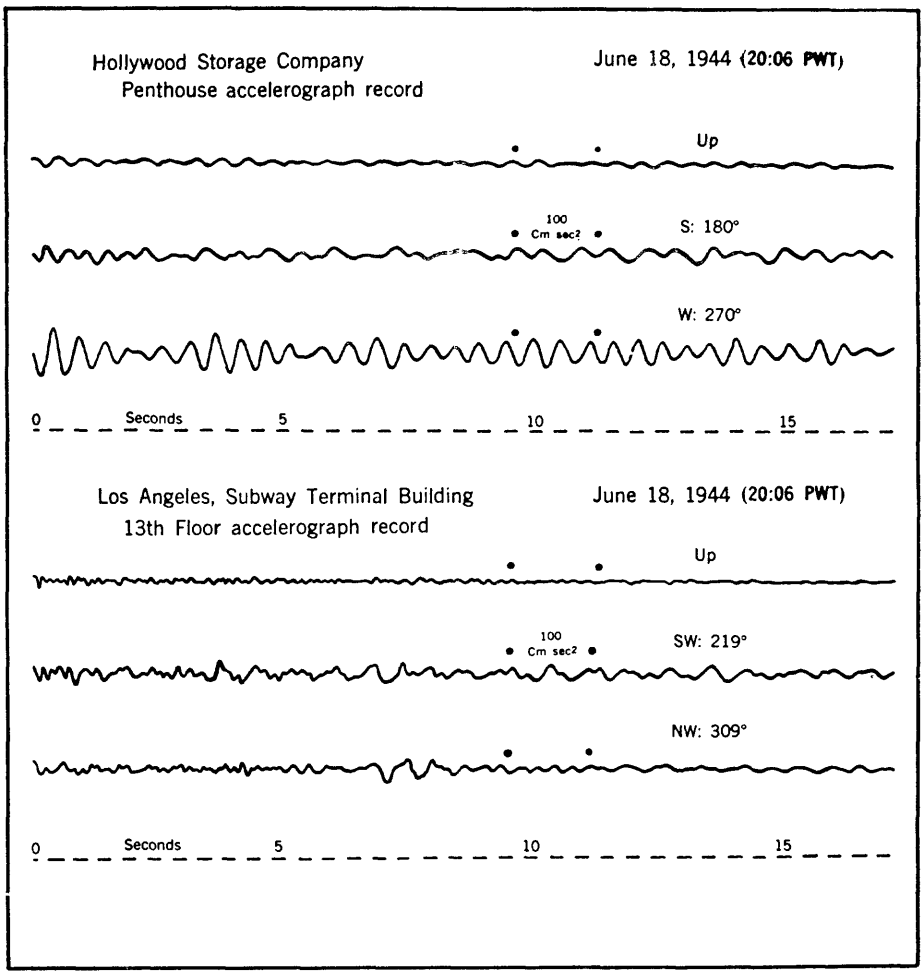


FIGURE 10.—Tracings of accelerograph records obtained at Hollywood Storage Company, penthouse; and Los Angeles Subway Terminal, 13th floor on June 18, 1944, at 20:06 P.W.T.

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°52′ north, 118°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.)

Station and component	Earthwave period	Maximum acceleration	Maximum displacement	Remarks
	Seconds	*Cm/sec.*^{2}	*Cm.*	
NORTHERN CALIFORNIA EARTHQUAKE OF JUNE 11.				
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	
	.59	5	.044	
NW. 309°	.48	16	.093	At beginning of record. Shorter periods superposed.
	.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 penthouse 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.
	.47	28	.151	Sinusoidal waves.
	.51	33	.218	Do.
	.54	5	.037	
Hollywood Storage Company basement accelerograph:				
Vertical, up	.30	5	.011	Weak record.
	.31	4	.009	
E. 90°	.28	10	.019	
	.73	6	.081	Small amplitudes.
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	
	.19	8	.007	Irregular waves.
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	Groups of large waves.
NW. 310°	.26	12	.020	Very irregular motion.
	.14	42	.021	Group of large waves.
	.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	
SW. 219°	.15	27	.015	Sharp short period waves.
	.50	14	.090	Short period waves superposed.
	.24	19	.027	
	.73	15	.203	Regular waves.
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	
SE. 129°	.83	46	.8	Very irregular motion.
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	Earthwave period	Maximum acceleration	Maximum displacement	Remarks
	Seconds	*Cm/sec.²*	*Cm.*	
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 penthouse 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	
	.77	15	.225	Regular long period waves.
	.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
	Seconds	*Cm/sec.*[2]	*Cm.*	
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	.066	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

[1] The directions given indicate the direction of pendulum displacement relative to instrument pier, which will displace the trace upward on the original seismogram.

Directions for the horizontal components are given first by quadrant followed by specific directions expressed in degrees measured from north around by east.

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

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

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 .067 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.

Serial No. 699

UNITED STATES EARTHQUAKES

1945

By

RALPH R. BODLE

Geophysicist

and

LEONARD M. MURPHY

Mathematician

U.S. DEPARTMENT OF COMMERCE

COAST AND GEODETIC SURVEY

WASHINGTON : 1947

CONTENTS

ILLUSTRATIONS

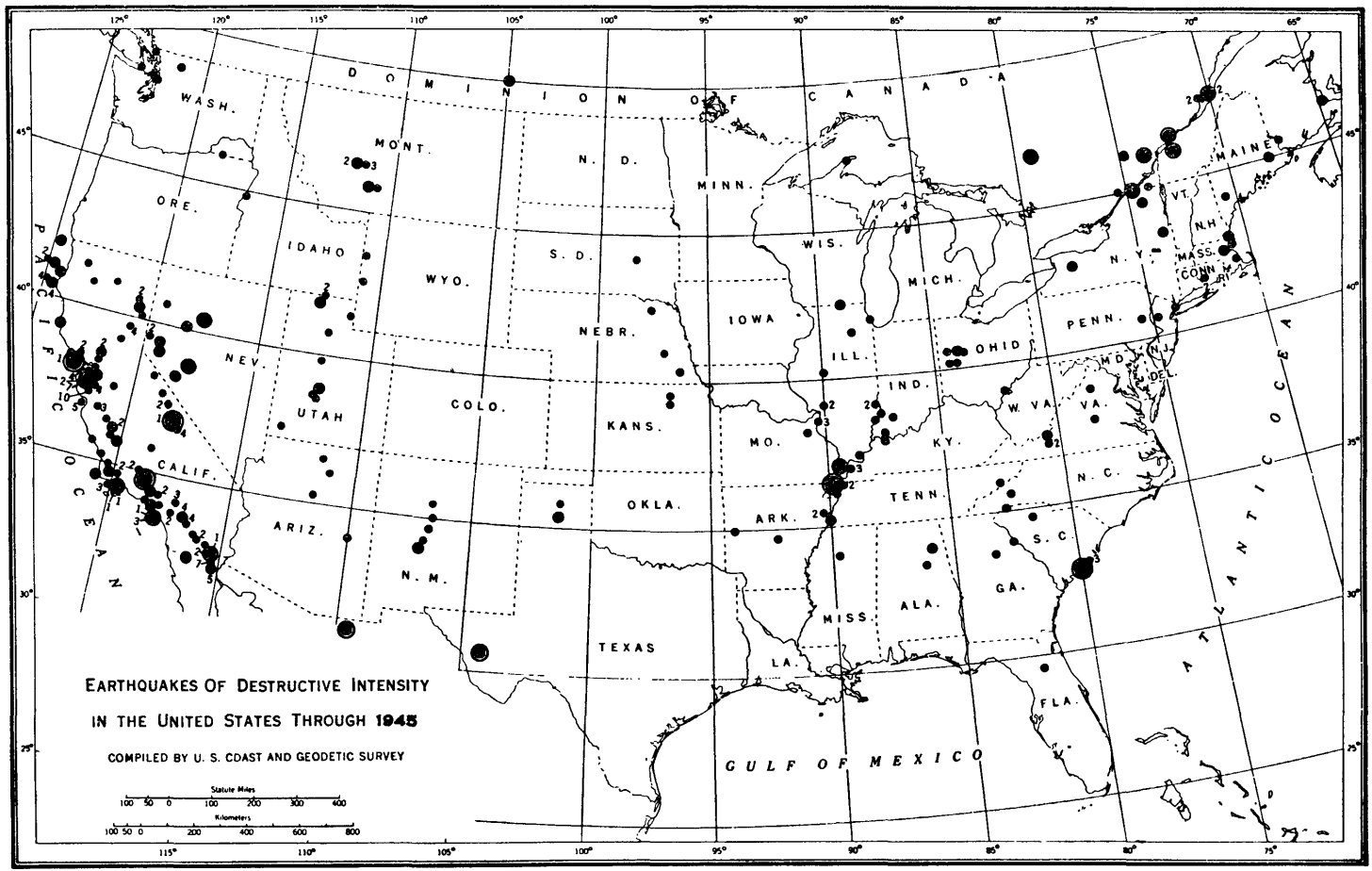


FIGURE 1.—Destructive and near destructive earthquakes in the United States through 1945.

UNITED STATES EARTHQUAKES, 1945

INTRODUCTION

This publication is a summary of earthquake activity in the United States and the regions under its jurisdiction for the calendar year 1945. A history of the more important shocks of the country appears in Serial 609, Earthquake History of the United States: Part I.—Continental United States (Exclusive of California and Western Nevada) and Alaska, Revised (1947) edition; 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 Islands are not included. 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, Dr. Beno Gutenberg in charge, 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 1945.

Arizona—Dean G. M. Butler, University of Arizona, Tucson.
Colorado.—Prof. C. A. Heiland, Colorado School of Mines, Golden.
Idaho.—Dean A. W. Fahrenwald, 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.
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

[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.

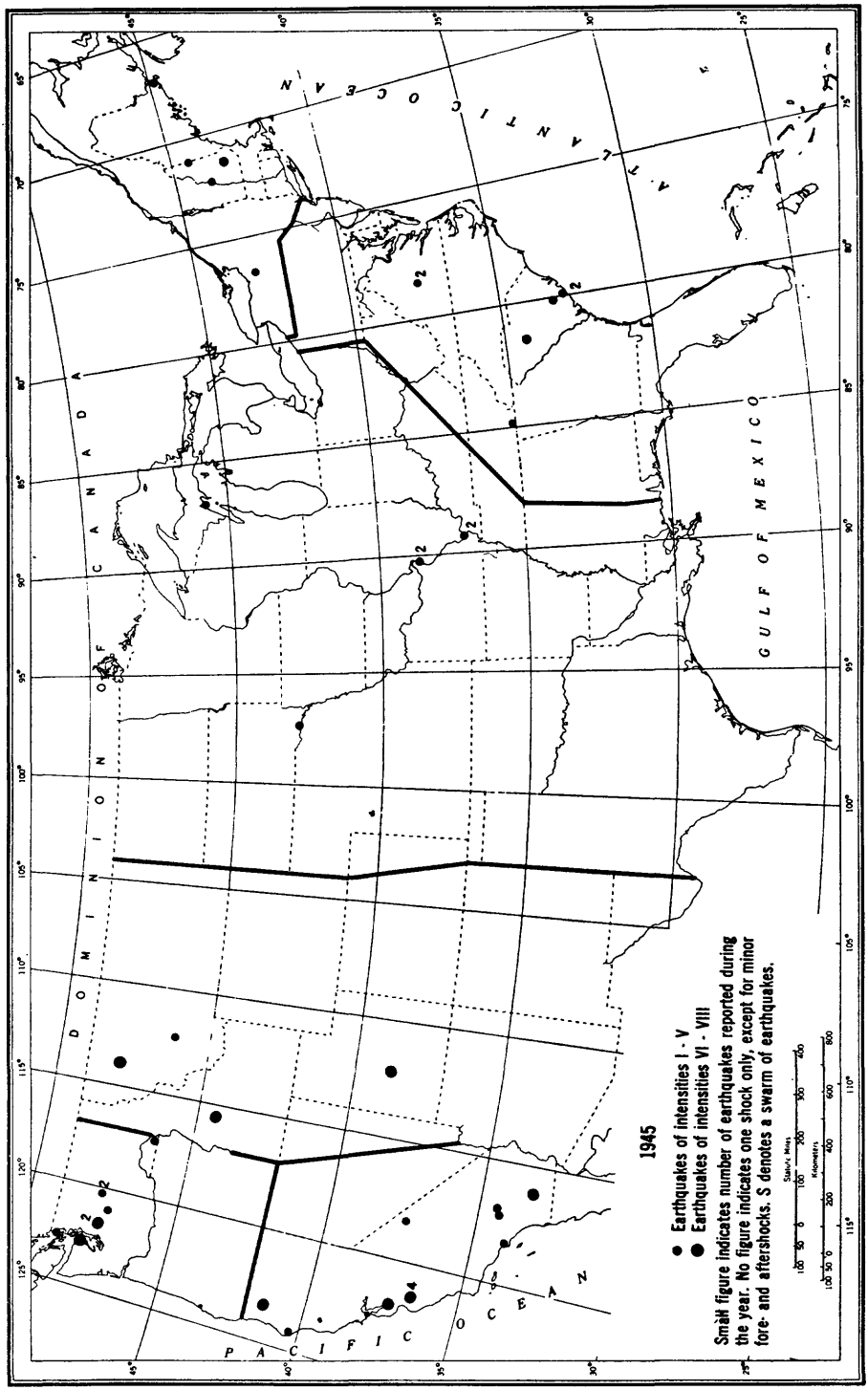


FIGURE 2.—Earthquake epicenters, 1945.

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 also 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 unabridged 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 20 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.

EARTH QUAKE ACTIVITY IN THE VARIOUS STATES

California: January 7, 10, April 1, 19, May 2, 17, 19, August 15, 27. Other minor shocks are not listed here.
Colorado: April 29.
Florida: December 22.
Idaho: February 13, July 9, 19.
Illinois: September 23, November 13.
Maine: July 15,.August 27.
Michigan: May 18.
Missouri: March 27, May 21.
Montana: June 1, September 23. Other minor shocks are not listed here.
Nevada: Eighteen miuor shocks.
New Hampshire: March 22, December 28.
New York: April 15.
South Carolina: January 30, May 18, June 5, July 26.
South Dakota: November 10.
Tennessee: June 13.
Utah: March 28, November 17.
Vermont: August 5.
Virginia: October 10, 12, 29.
Washington: January 3, 27, February 27, March 2, April 29, 30, May 1 (2), 3, September 22, November 11, 23.
Wyoming: April 21, 23 (4), 24 (6), June 23.
Alaska: Jauuary 16, 21, February 8, 10, March 5, April 11, June 3, September 17, October 10, 15, November 16, 17, December 1.
Hawaii: Jauuary 24, March 4, May 19, July 13, August 9, September 19.

NORTHEASTERN REGION

(60TH MERIDIAN OR EASTERN WAR TIME)

March 22: 04:04. Concord, N. H. Light shock awakened some. Two shocks 4 or 5 seconds apart were noted at the city airport.

April 15: 09:15, 10:20, and 11:30. Auburn, Camillus, Marcellus, and South Syracuse, N. Y. Light shocks felt. No damage. All towns reported rumbling noises.

July 15: 06:45. Vicinity of Eastport, Maine. Loud rumbling like extreme heavy thunder or explosion. Buildings swayed. Movement felt strongly in granite building where heavy iron plates in basement rattled. Also felt at Calais, Machias, Pembroke, and Woodland. Water main reported broken at Calais.

August 5: 13:20 to 14:30. Woodstock, Vt. Three light shocks reported.

August 27: 21:37. Eastport, Maine. Light shock reported.

December 28: 06:23. North Conway, N. H. Local shock. One observer stated it seemed like someone in the cellar swung a sledgehammer against the floor under his feet.

EASTERN REGION

(60TH MERIDIAN OR EASTERN WAR TIME)

January 30: 16:20. Summerville, S. C. Felt by many. Rattled doors and windows. No damage.

May 18: 08:20 and 08:40. Charleston, S. C. (three miles southwest of). Sharp bump felt by several. Possibility of blast investigated.

June 5: 08:10. Wappoo Heights, S. C. Light shock felt by several. Bumping motion.

June 13: 22:25. Cleveland, Tenn. A distinct tremor felt strongly in area between Cleveland, Tenn., and Blue Ridge, Ga. Intensity V in Cleveland. Many were alarmed and ran to streets. No damage.

INTENSITY IV:

Athens and Chattanooga.

INTENSITY I TO III:

Bradley, Copperhill, and Ocoee.

INTENSITY I TO III IN GEORGIA:

Blue Ridge.

July 26: 06:32.3.* Epicenter 34.3° north, 81.4° west, W. Thirty miles northwest of Columbia, S. C. No damage. Many reported rumbling noise preceding the earthquake. About 25,000 square miles affected.

INTENSITY IV:

Abbeville, Anderson, Bamberg, Camden, Charleston, Chester, Columbia, and Greenville.

INTENSITY IV IN NORTH CAROLINA:

Ashville and Charlottesville.

INTENSITY I TO III:

Aiken, Lancaster, Langley, Orangeburg, North, Spartanburg, Summerville, and Sumpter.

INTENSITY I TO III IN GEORGIA:

Augusta and Macon.

INTENSITY I TO III IN TENNESSEE:

Knoxville.

October 10: 15:43. New Canton, Va. Felt by many and was accompanied by roaring. Also felt at Arvonia, Bremo Bluff, Buckingham, Dillwyn, and Fork Union.

October 12: 15:00. Dillwyn, Va. Stove pipes and buildings shook. General alarm. Sounds approached from southeasterly direction.

October 29: 21:29. Dillwyn and New Canton, Va. Underground rumblings heard and a number of people awakened at Dillwyn. Ten to twelve seconds duration estimated at New Canton.

December 22: 11:25. Miami Beach and Hollywood, Fla. Press reports stated a slight shock was felt in these places and a weak shock was recorded on the seismograph at Spring Hill College near Mobile, Alabama.

CENTRAL REGION

(75TH MERIDIAN OR CENTRAL WAR TIME)

March 27: 20:46. St. Louis, Mo. Light shock felt.

May 18: 09:26. Escanaba, Mich. Light shock felt by several including the local weather official. All reports came from people located on the middle floors of the taller buildings.

May 21: 02:51. St. Louis, Mo. Light shock rattled dishes in and near the city.

September 23: 01:22. Cairo, Ill. Light shock awakened perhaps 5 percent of the population.

Novemver 10: 03:00. Yankton, S. D. Slight shock felt. Rattled dishes. Felt in Bon Homme and Yankton counties and also in the border areas of counties to the north and west.

November 13: 03:21. Cairo, Ill. Shock generally noted in Illinois and also at Perryville, Mo.

WESTERN MOUNTAIN REGION

(90TH MERIDIAN OR MOUNTAIN WAR TIME)

January 12: 12:48:30.* Epicenter about three miles northwest of Boulder City, BC. Fairly sharp shock felt by many. Rattled windows, doors, and water pipes.

January 15: 06:10. Helena, Mont. One weak tremor, lasting 2 seconds.

January 20: 12:18. Helena, Mont. Double tremor, lasting 2 seconds.

January 23: 05:01. Helena, Mont. Light shock, lasting 1 second.

January 30: 08:00.* Epicenter in lake basin 3 miles northwest of Boulder Dam, BC. Felt by several.

February 2: 06:03. Helena, Mont. Shock with weak to moderate vibrations, lasting 4 seconds.

February 7: 09:23:05.3.* Epicenter 4 to 5 miles southeast of Boulder City, BC. Felt by several in community. Rattled windows and doors.

February 13: 21:01:15.1.* Tentative epicenter 44.7° north, 115.4° west, W. Near Clayton, Idaho. This earthquake was felt over a large portion of Idaho, extreme eastern portions of Washington and Oregon, and the southwestern region of Montana. See map, page 7. Affected area covered approximately 60,000 square miles.

INTENSITY VI:

Clayton.—Motion rapid, lasting 30 seconds. Felt by all in community. Frightened few. Houses creaked and small objects overturned.

Idaho City.—Motion rapid. Felt by many in home and outdoors by some. Broke dishes. Damage slight.

Weiser.—Felt by many. Walls creaked. Hanging objects swung northeast. Cracked plaster.

INTENSITY V:

Atlanta, Big Creek, Boise, Cottonwood, Cuprum. Dixie, Ellis, Mackay, Shoup, Stanley, Tendoy, Warren, White Bird, Wildhorse, and Yellow Pine.

INTENSITY IV:

Calder, Cambridge, Casdade, Challis, Clearwater, Council, Crouch, Donnelly, Elk River, Grangeville, Hailey, Lowman, Lucile, McCall, Mesa, Midvale, Nezperce, North Fork, Orogrande, Orofino, Patterson, Pollock, Riggins, Saint Maries, Salmon, Stibnite, and Sunbeam.

INTENSITY IV IN MONTANA:

Armstead, Deer Lodge, Stevensville, and Virginia City.

INTENSITY IV IN OREGON:

Homestead, Nyssa, Robinette, and Vale.

INTENSITY I TO III:

Caldwell, Gibbonsville, May, Moscow, Obsidian (7 miles south of), Payette, Priest River, Tamarack, and Wallace.

INTENSITY I TO III IN MONTANA:

Conner, Dillon, Hamilton, Kalispell, Reichle, and Wisdom.

INTENSITY I TO III IN OREGON:

Adrian.

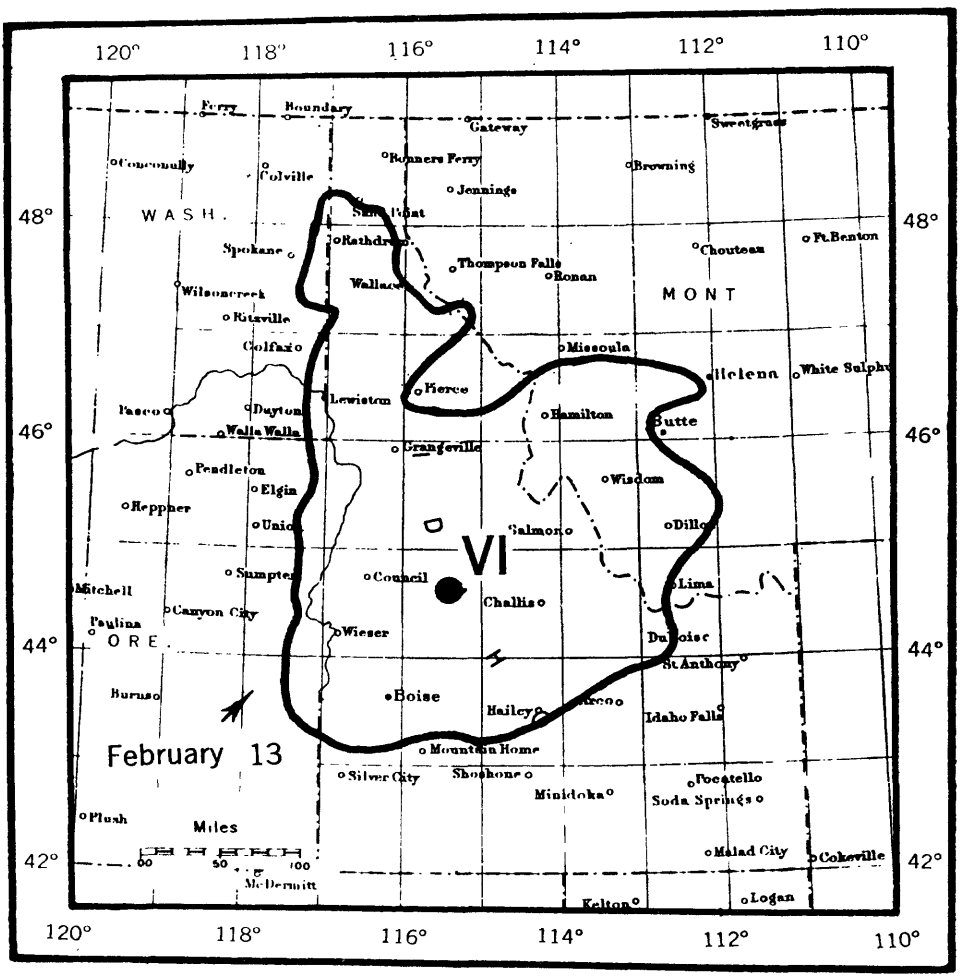


FIGURE 3.—Area affected by the earthquake of February 13, 1945.

INTENSITY I TO III IN WASHINGTON:

Asotin Lamont (7 miles southwest of), Palouse, Pullman, and Spokane.

Negative reports were received from 18 places in Idaho, 10 places in Montana, 11 places in Oregon, and 16 places in Washington.

February 14: 18:49. Helena, Mont. Weak shock, lasting 2 seconds.

February 16: 15:05:32.* Epicenter 3½ miles east of Boulder Dam, BC. Shock of short duration.

February 16: 15:28:32.* Tentative epicenter 2 miles east of Boulder Dam, BC. Shock of short duration.

February 16: 16:10:09.* Epicenter 3 miles southeast of Boulder Dam, BC. Shock of short duration.

February 16: 22:04:14.* Epicenter 3 miles west of Boulder Dam, BC. Shock of short duration.

February 20: 18:15. Absarokee, Mont. (Press), "Tremors of medium intensity shook the mining area 30 miles west of this southern Montana community today. No damage or injuries reported. Felt at the Lower Mouatt Mine, the Upper Mouatt Mine, the Denbow Mine, and in the vicinity of Gardiner."

February 23: 15:13.* Probable epicenter 1 or 2 miles south of Boulder Dam, BC. Felt by few. Rattled windows.

March 1: 09:50, 10:03, and 11:36. Helena, Mont. Weak shocks of 1-second duration.

March 2: 11:43, 20:37, 20:38, and 20:43. Helena, Mont. First, weak, lasting 1 second; second, strong jolting vibration, lasting 2 seconds; third, moderate jolting vibration, lasting 1 second; and fourth, weak, lasting 2 seconds.

March 3: 02:45, 03:05, 03:10, and 03:14. Helena, Mont. Earth tremors of strong intensity accompanied by roaring and rumbling. City was awakened. House timbers creaked and dishes rattled.

March 4: 07:19 and 18:19. Helena, Mont. First, light vibration, lasting 1 second; second, light jolting vibration, lasting 1 second.

March 5: 12:10, 18:45, and 18:57. Helena, Mont. All weak, lasting 1 second.

March 6: 10:54. Helena, Mont. Weak shock, lasting 1 second.

March 15: 11:47. Helena, Mont. Moderate vibration, lasting 2 seconds.

March 18: 02:58, 03:00, 03:02, 06:46, 06:47, 06:48, 06:49, 06:52, 07:01, 07:29, 07:42, and 07:45. Helena, Mont. All shocks were weak with the exception of those occurring at 06:46, 06:52, 07:01, and 07:42 which were moderate jolting vibrations, lasting 2 to 3 seconds.

March 26: 23:13. Helena, Mont. Moderate jolting vibration, lasting 2 seconds.

March 28: 04:40. Nephi, Utah. Motion rapid, lasting 2 seconds. Awakened several. Rattled windows.

April 1: 02:15 and 02:40. Helena, Mont. First, moderate; second, weak.

April 3: 23:45. Helena, Mont. Vibration felt.

April 4: 01:01, 09:45, and 12:41. Helena, Mont. Moderate shocks.

April 5: 03:25, 03:31, 03:45, 04:10, 05:05, 06:25, 12:04, and 18:25. Helena, Mont. Shock at 03:25 was strong jolt, lasting 4 seconds; others were moderate to weak in intensity and lasted from 1 to 2 seconds.

April 8: 18:23. Helena, Mont. Weak shock, lasting 1 second.

April 9: 17:24. Helena, Mont. Weak shock, lasting 1 second.

April 10: 18:10, 19:40, 19:45, 19:55, and 20:40. Helena, Mont. All shocks were weak with the exception of the one at 19:40 which rattled dishes and windows throughout the city and frightened many.

April 11: 07:29 and 11:01. Helena, Mont. Weak shocks, lasting 1 second.

April 13: 00:50, between 00:00 and 01:00, and 06:30. Helena, Mont. First moderate, lasting 2 seconds; others weak, lasting 1 second.

April 14: 07:54. Helena, Mont. Moderate shock, lasting 1 second.

April 15: 12:58. Helena, Mont. Light shock, lasting 1 second.

April 16: 12:20 and 13:10. Helena, Mont. Two weak shocks, lasting 1 second.

April 17: 01:14, and between 22:00 and 23:00. Helena, Mont. First, moderate, lasting 1 second; second, light, lasting 1 second.

April 19: 19:25. Helena, Mont. Light shock, lasting 1 second.

April 20: 04:45 and 22:14. Helena, Mont. Light shocks, lasting 1 second.

April 21: 07:28. Helena, Mont. Weak shock, lasting 1 second.

April 21: 18:32. Yellowstone Park, Wyo. (Canyon and Yellowstone Lake). Felt by several, by some outdoors. Houses creaked. Trees and bushes shaken slightly. Overturned vases and small objects. No damage to buildings.

April 23: 11:31. Yellowstone Park, Wyo. (Lake Station, Lake Hotel). Motion rapid, lasting a few seconds. Felt by observer in lake area. Houses creaked. Overturned vases and small objects.

April 23: 14:24, 14:58, and 15:13. Yellowstone Park, Wyo., (Yellowstone Lake). Motion rapid, lasting 2 seconds. Felt by two. Houses creaked. Overturned small objects. Dull sounds preceded each shock.

April 24: 09:20. Yellowstone Park, Wyo. Motion rapid, lasting about 2 seconds. Felt by few. Rattled windows. Overturned vases and small objects. Aftershocks occurred at 14:46, 15:37, 15:53, 16:16, and 22:25. All were preceded by a moaning sound.

April 29: 11:08 and 11:32. Silverton, Colo. First shock was a heavy muffled noise like the sound of a few boxes of powder exploding, and was accompanied by a distinct up-and-down movement under foot which shook houses and buildings. Some people ran into the streets in alarm. At Tacoma there was a bumping up-and-down motion with rapid onset. Windows rattled. Moderately loud thunderous subterranean sounds were heard.

April 29: 14:16:17.* See Washington and Oregon.

May 6: 11:43. Helena, Mont. Moderate shock, lasting 2 seconds.

May 9: 17:16, 20:16, and 22:04. Helena, Mont. Weak to moderate shocks, lasting 1 second.

May 11: 19:33, 19:36, 19:40, and 20:16. Helena, Mont. All weak shocks, lasting 1 second.

June 1: 10:54.8* Epicenter 46.6° north, 112.0° west, W. Helena, Mont. Felt over approximately 6,000 square miles in southwestern Montana. Maximum intensity V.

The following information is abstracted from a report of a field investigation made by personnel from the office of Dr. Francis A. Thomson, Collaborator in Seismology for the State of Montana. "The earthquake was generally conceded to be the strongest experienced since December 28, 1940. No damage was reported except for a few bricks from old chimneys and from unrepaired brick veneer remaining from 1935. Many of those interviewed reported hearing a rumbling preceding the earthquake, but the noise was not apparent to all. Dishes and windows rattled. There does not appear to have been significant difference between intensities in the bedrock parts of town and the alluvium-filled valley. As usual, the severity reported from a 50-mile radius around Helena varied with the character of the building in which the reporter experienced the tremor."

INTENSITY IV:

Austin, Belt, Big Prairie Ranger Station, Boulder, Butte, Stockett, Townsend, Trident. Wicks, and Wolf Creek.

INTENSITY I TO III:

Anaconda, Deer Lodge, Divide, Francis, Missoula, Norris, Three Forks, and Virginia City.

Negative reports were received from thirty places.

June 1: 11:19, 11:27, 11:40, 12:07, 12:32, 12:35, 12:41, 13:25, and 14:26. Helena, Mont. With the exception of a strong shock at 12:07, these shocks were all weak, lasting about 1 second.

June 2: 16:36 and 16:39. Helena, Mont. Weak shocks, lasting 1 second.

June 3: 15:46 and 16:05. Helena, Mont. First shock moderate; second shock weak, each lasting about 2 seconds.

June 5: 09:12 and 18:52. Helena, Mont. Weak shocks, lasting about 1 second.

June 6: 15:00. Helena, Mont. Moderate shock, lasting about 2 seconds.

June 10: 16:47:17 and 17:25. Helena, Mont. Weak shocks, lasting about 1 second.

June 11: 12:45 and 22:02. Helena, Mont. Weak shocks, lasting about 1 second.

June 13: 03:10 and 13:15. Helena, Mont. Weak shocks, lasting 1 second.

June 15: 15:23. Helena, Mont. Moderate shock, lasting 3 seconds.

June 23: 08:00. La Barge, Wyo. (30 miles west of). Motion rapid, lasting about 2 seconds. Felt by several in camp buildings.

June 24: 04:35. Helena, Mont. Weak shock, lasting 1 second.

June 26: 10:05 and 11:28. Helena, Mont. Moderate shocks, lasting about 2 seconds.

July 4: 03:12. Helena, Mont. Strong shock, lasting 3 seconds.

July 6: 17:01. Helena, Mont. Strong shock, lasting 2 seconds.

July 9: 23:21. Bayview. Idaho. Motion slow, lasting 6 seconds. Felt by several at lake on dock. Beds rattled and hanging objects swung. Water agitated. Loud rumble heard.

July 14: 14:12. Helena, Mont. Slight shock, lasting 2 seconds.

July 15: 15:19. Helena, Mont. Slight shock, lasting 2 seconds.

July 19: 18:30. Boise National Forest, Idaho. One severe and abrupt bump felt by several.

July 26: 10:11. Helena, Mont. Slight shock, lasting 1 second.

July 27: 12:50. Helena, Mont. Slight shock, lasting 2 seconds.

July 27: 03:31.* Boulder City, Nev. Light shock. Felt by several.

July 27: 16:14. Helena, Mont. Slight shock, lasting 2 seconds.

July 30: 22:48.* Boulder City, Nev. Light shock felt by many. No damage.

August 10: 10:57. Helena, Mont. Slight shock, lasting 2 seconds.

August 22: 17:57. Helena, Mont. Slight shock, lasting 1 second.

August 23: 21:35. Helena, Mont. Slight shock, lasting 2 seconds.

August 25: 03:57. Helena, Mont. Slight shock, lasting 1 second.

August 25: 05:50. Helena, Mont. Slight shock, lasting 1 second.

September 18: 15:39. Beowave, Nev. Felt by many. Rattled windows. Houses creaked. Hanging objects swung northeast.

September 23: 03:58.8.* Epicenter 48.0° north, 114.2° west, W. West side of Flathead Lake about 20 miles north of Polson, Mont. Felt over an area of approximately 36,000 square miles. See map.

Maximum intensity VI. The eccentricity of the felt area with respect to the instrumental epicenter is not easily explained.

INTENSITY VI:

Bigfork.—Motion slow, lasting several seconds. Awakened all in home and frightened many. Cracked plaster. Loud rumble heard.

Big Prairie Ranger Station.—Motion rapid, beginning abrupt, lasting about 12 or 15 seconds. Walls creaked. Overturned small objects. Trees and bushes shaken slightly.

DeBorgia.—Motion slow, lasting about 1 minute. Shook beds. Shifted small objects.

Elmo.—Motion slow, lasting 30 seconds. Awakened all in community and frightened many. Overturned vases, cracked chimneys, and broke windows. Damage slight.

Polson.—Very severe shock. Awakened all. Very heavy sound resembling thunder heard. No damage except one broken window.

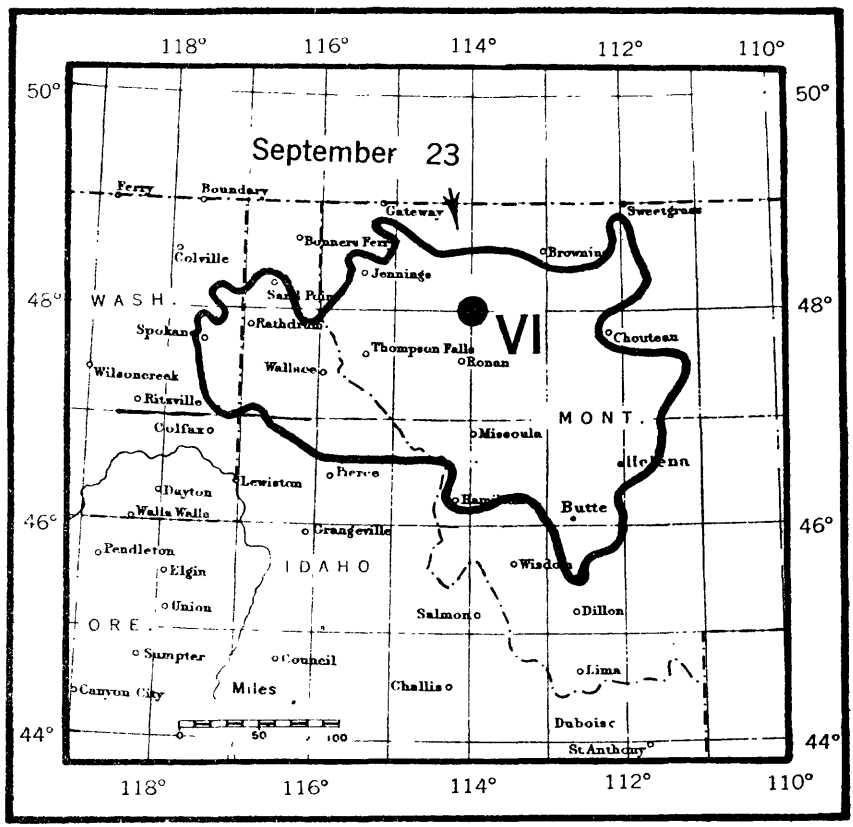


FIGURE 4.—Area affected by the earthquake of September 23, 1945.

INTENSITY VI IN IDAHO:

Bovill.—Felt by several in community. Shifted small objects. Pictures fell.

Mullan.—Motion rapid, lasting about 2 minutes. Awakened many in community. Rattled windows and dishes. Shifted small objects. Cracked wallpaper. Accompanied by faint rumbling or rushing sound.

INTENSITY V:

Dixon, Flathead Lake, Kila, Missoula, Niarada, Olney, Ovando, Paradise, Ravailli, and Whitepine.

INTENSITY V IN IDAHO:

Avery.

INTENSITY IV:

Anaconda, Alberton, Bearmouth, Boulder, Canyon Creek, Cascade, Charlo, Clinton, Columbia Falls, Conrad, Craig, Dayton (1 mile northeast of), Drummond, Eureka, Frenchtown, Glacier Park, Great Falls,

Hamilton, Helena, Heron, Huson, Kalispell, Kevin, Libby, Lincoln, Lolo, Lonepine, Lozeau, Marion, Melrose, Missoula, Pablo, Plains, Rexford, Ronan, Round Butte, Saltese, Somers, Stevensville, St. Ignatius, Trout Creek, Whitefish, Whitehall, Winston, and Yakt.

INTENSITY IV IN IDAHO:

Bungalo Ranger Station, Calder, Sandypoint, and Wallace.

INTENSITY I TO III:

Arlee, Augusta, Belton, Coram, Reichle, Shelby, Thompson Falls, and Wolf Creek.

INTENSITY I TO III IN WASHINGTON:

Coulee Dam, Deer Park, Greenacres, Newport, Oakdale, Spangle, and Spokane.

Negative reports were received from 28 places in Montana, 8 places in Idaho, and 16 places in Washington.

September 28: 17:10. Helena, Mont. Weak shock, lasting 1 second.

October 2: 12:10. Helena, Mont. Moderate shock, lasting 1 second.

October 27: 01:17* and 01:18.* Boulder City, Nev. Light shock rattled windows and doors. Awakened many. Hanging objects swung during the first shock.

November 7: 14:25.* Boulder City and Boulder Power Plant, Nev. Felt by many. Rattled windows.

November 16: 02:49.* Boulder City, Nev. Weak shock.

November 17: 18:15. South-central Utah.

INTENSITY VI:

Glenwood.—Motion slow, lasting 20 seconds. Frightened many. Cracked plaster and chimneys. Damage slight.

Richfield.—Motion slow, lasting 20 seconds. Frightened many. Cracked plaster and chimneys. Pictures fell. Distinct rumble heard prior to shock.

INTENSITY IV:

Monroe.

November 28: 01:51. Boulder City, Nev. slihgt Shock.

November 28: 07:38 and 07:44. Helena, Mont. One moderate and one weak shock. No damage.

November 28: 14:39. Butte, Mont. Motion rapid, momentary duration. Rattled windows.

December 1: 20:10.* Boulder City, Nev. Felt by many. Rattled windows.

December 6: 06:20. Helena, Mont. Light shock, lasting 1 second.

December 17: 19:13.* Boulder City, Nev. Slight shock felt.

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 7: 15:26.* San Benito County, P. Felt over an area of approximately 13,000 square miles in west-central California. Maximum intensity VI. Outer limits of the felt area included San Rafael, southeasterly through La Grange to Yosemite National Park, southwesterly to San Ardo, thence along the coast from Big Sur to San Francisco. Strong motion records were obtained from the two accelerographs at San Jose and from the Weed instrument at Hollister.

INTENSITY VI:

Hollister.—Quite severe swaying of buildings and trees. Cracked plaster and chimneys. Displaced goods on store shelves. Pendulum clocks stopped. Frightened many.

Paicines.—Motion rapid, lasting 10 seconds. Frightened many. Overturned cans. Books and pictures fell.

San Benito.—Motion rapid, lasting 1 minute. Felt by all. Shifted small objects. Knickknacks fell.

INTENSITY V:

Carmel, Los Banos, Monterey, Moss Landing, and Snelling.

INTENSITY IV:

Ahwahee, Ben Lomond, Big Sur, Chualar Canyon, Cupertino, El Nido, Firebaugh, Gilroy, Greenfield, Idria, Irvington, King City, La Grange, Los Gatos, Livingston, Mendota, Merced, Newman, Pacific Grove. Salinas, San Ardo, San Francisco, San Gregorio, San Jose, San Juan Bautista, San Lucas, San Martin, Santa Cruz, and Soledad.

INTENSITY I TO III:

Davenport, La Honda, Le Grand, Livermore, Mount Hamilton, Oakland, San Rafael, Saratoga, Seaside, Tranquillity, and Yosemite National Park.

Negative reports were received from 48 places.

January 7: 17:24. Hollister. Slight shock felt by several.

January 7: 19:30. Hollister. Slight shock.

January 8: 03:22. Hollister. Felt by several. Awakened many in community. Recorded at Tinemaha.

January 10: 11:34. Upper Mattole. Felt over an area of about 400 square miles along the coastal region of northern California, from Fields Landing south to Briceland. Maximum intensity V.

A strong motion record was obtained on the accelerograph in Ferndale.

INTENSITY IV:

Briceland, Carlotta, Ettersburg, Ferndale, Fields Landing, Fortuna, Petrolia, and Scotia.

Negative reports were received from 4 places.

January 18: 22:10:44.6.* Epicenter 33°56.5′ north, 118°19.5′ west, P. Inglewood Fault, 2 miles southeast of Inglewood. Felt over a very small area in southern California. Maximum intensity V reported from Los Angeles where small objects were shifted and windows rattled.

INTENSITY IV:

Beverly Hills, Culver City, Inglewood, and Long Beach.

Negative reports were received from 11 places.

January 24: 05:00. Sierra City. Felt by several. Awakened many in community. Recorded at Tinemaha.

January 25: 21:23:56.* Epicenter 34°12′ north, 117°09′ west, P. Near Lake Arrowhead. Intensity V. Buildings creaked. Rumbling subterranean sounds heard before and during shock. Felt slightly at Riverside.

January 30: 02:38:57.* Epicenter about 33°13′ north, 116°17′ west, P. West-central section of Borego Valley. Felt by many. Rattled windows. Moderately loud rumbling subterranean sounds heard before and after shock. Pendulum clock with pendulum swinging north-south stopped.

January 30: 21:48:35* and 21:53:28.* Epicenter about 35°19′ north, 117°55′ west, P. Near Cantil. Motion rapid, lasting a few seconds. Felt by several in community. Rattled windows slightly. Table lamps wobbled. Second shock was stronger. Sounds preceded each shock.

February 5: 07:43:42.* Epicenter about 33°57′ north, 118°21′ west, P. Inglewood. Felt by many in community. Frightened few. Rattled windows. Also felt in southeastern and southwestern portions of Los Angeles.

February 6: 15:56:11.* Epicenter 33°57′ north, 118°21′ west, P. Inglewood. Felt by many in home and community. No damage other than shattered dishes or slight cracks in house walls. The shock was also felt at Beverly Hills, Compton, Culver City, El Segundo, and Manhattan Beach.

Negative reports were received from 22 places.

February 7: 02:11:47.* Epicenter 33°57′ north, 118°21′ west, P. Inglewood. Slight earth shocks along Inglewood Fault line. Felt in Southgate, Inglewood, Hawthorne, Palms, and Los Angeles areas.

February 17: 13:09:36.* Epicenter 33°41′ north, 117°56′ west, P. Near Costa Mesa. Felt slightly at Balboa.

February 19: 16:25. Meyers. Light shock, lasting 2 seconds. Felt by several. Walls creaked.

February 22: 11:58. Gabbs, Nev. Shock felt like truck running into brick wall. Felt all over mine area on rock and in town on alluvium.

February 23: 04:59:41.* Epicenter 33°45′ north, 116°49′ west, P. San Jacinto Fault, near Hemet. Sharp jolt preceded by noise. Houses creaked. Many awakened.

March 14: 16:30. Watsonville. "A sharp earthquake was felt at 4:30 p.m., P.W.T., on March 14, at Watsonville. It was felt by most residents of the area. No damage was reported." (SSA Bulletin, April 1945.)

March 20: 14:55:07.* Epicenter about 34°15′ north, 116°10′ west, P. Mojave Desert, northwest of Twentynine Palms. Felt slightly at Anza, Idyllwild, Ludlow, San Diego, and Twentynine Palms.

Negative reports were received from 29 places.

March 27: 11:41:52.* Epicenter 34°12′ north, 116°54′ west, P. Near Big Bear Lake. Felt by all at Fawnskin. Buildings creaked and rattled.

April 1: 16:43:42.* Epicenter about 34°00′ north, 120°01′ west, P. Santa Rosa Island. Felt over an area of approximately 1,000 square miles along coastal area of southern California, from Santa Maria south through Santa Barbara and Ventura, to Simi. Maximum intensity IV.

A strong motion record was obtained on the accelerograph in Santa Barbara.

INTENSITY IV:

Carpinteria, Gaviota, Los Alamos, Santa Barbara, Santa Maria, Santa Inez, Summerland, and Ventura.

INTENSITY I TO III:

Fillmore, Los Olivos, and Simi.

Negative reports were received from 15 places.

April 6: 08:46:45.* Epicenter about 34°00′ north, 116°46′ west, P. San Andreas Fault, near Cabazon. Felt by many in Idyllwild. Rattled windows and doors. Trees and bushes shaken slightly.

April 17: 21:58:02.* Epicenter 34°26′ north, 116°59′ west, P. Lucerne Valley. Intensity V at Fawnskin. Felt by all. Houses creaked. Felt slightly at San Bernardino.

April 19: 22:36:09.6.* Paradise, BC. Felt over an area of approximately 500 square miles in north-central California, from Hamilton City, northeast to Storrie, and thence southwest to Las Plumas. Maximum intensity VI.

INTENSITY VI:

Paradise.—Many awakened. Water pipes broken. No serious damage.

INTENSITY IV:

Las Plumas, Storrie, and northeast section of Butte county.

INTENSITY I TO III:

Northeast section of Glenn county.
Negative reports were received from 12 places.

April 24: 14:23:14.* Probable epicenter near Crumbaugh Lake, BC. Felt by many in Mineral.

May 1: 23:30. San Jose. "At 11:30 p.m., P.W.T., a shock was felt in some sections of San Jose and Santa Clara." (SSA Bulletin, July 1945.)

May 2: 12:47.9.* Epicenter 41.3° north, 122.5° west, P. Near Scott Mountain. Felt over an area of about 3,500 square miles in northwestern California. Maximum intensity VI.
Strong motion records were obtained on the accelerograph and displacement meter in Eureka.

INTENSITY VI:

Etna.—Felt by many. Cracked plaster.
Burnt Ranch.—First shock very slight, lasting 1 second; second shock quite heavy, lasting 2 seconds. Rattled windows and stopped clocks. Shook things out of cupboards and off dressers.

INTENSITY V:

Callahan, Clear Creek, Eureka, Hyampom, Salyer, Weaverville, and Weitchpec.

INTENSITY IV:

Bayles, Cecilville, Dunsmuir, Fort Jones, Gazelle, Hornbrook, Lewiston, McCloud, Miranda, Orleans, Redding, Somes Bar, Trinity Center, Weed, and Yreka.

INTENSITY I TO III:

Happy Camp and Round Mountain.
Negative reports were received from 14 places.

May 8: 11:08:46.* Epicenter about 37°30′ north, 118°34′ west, P. Northern Owens Valley. Intensity V in Owens River Gorge, about 20 miles from Bishop. Felt by all. Rattled windows and shifted small objects.

May 17: 02:45. Kern County. Felt by two. Damage slight.

May 17: 08:06.* Hollister, BC. Felt over an area of approximately 6,000 square miles. Maximum intensity VI. Considerable damage was done to glassware, drug supplies, liquors, and grocery store merchandise. Slight cracking and fall of plaster reported; several windows broken.
Strong motion records were obtained from the Weed instrument at Hollister; from two accelerographs and one displacement meter in the Southern Pacific Building in San Francisco; and from three Weed instruments in the Shell Building in San Francisco.

INTENSITY VI:

Hollister.—Disturbed objects observed by many. Visible swaying of buildings and trees. Slight damage to buildings. Cracked plaster and brick chimneys. Pictures and light fixtures swung. Moderately loud subterranean sounds heard during shock.

INTENSITY V:

Carmel, Gilroy, San Jose, and Tres Pinos.

INTENSITY IV:

Aromas, Big Sur, Chualar, Cupertino, Boulder Creek, Daly City, El Nido, Gonzales, Gustine, Hayward, Irvington, King City, La Honda, Lonoak. Los Banos, Los Gatos, Merced, Morgan Hill, Moss Landing, Mount Hermon, Pacific Grove, Redwood City, Robles del Rio, San Gregorio, San Juan Bautista, San Lucas, Soledad, Sunnyvale, and Watsonville.

INTENSITY I TO III:

Castroville, Davenport, Greenfield, Holy City, Newman, Salinas, San Ardo, San Francisco, Soquel, and Stockton.
Negative reports were received from 35 places.

May 18: 11:10. Friant. Shock felt by two. Buildings rattled and creaked.

May 19: 08:07.* Epicenter 40.6° north, 126.4° west, W. Off northern California coast. Felt over an area of approximately 1,500 square miles extending through most of the coastal towns from Crescent City south to Fort Bragg and Willits. A maximum intensity of V was reported from Upper Mattole, where small objects were reported to have shifted.

Strong motion records were obtained on the instruments located at Ferndale and Eureka.

INTENSITY IV:

Arcata, Blue Lake, Carlotta, Eureka, Ferndale, Fields Landing, Klamath, Orick, Piercy, and Scotia.

INTENSITY I TO III:

Briceland, Fort Bragg, Kneeland, Smith River, and Willits.

Negative reports were received from 17 places.

June 14: 15:57.9.* Epicenter about 36.9° north, 120.9° west, P. South of Los Banos. Felt by many in Hollister. Rattled loose objects. Hanging objects swung.

June 21: 14:58. Hollister. "An earthquake of moderate intensity was felt in Hollister at 2:58 p.m., P.W.T. No damage was reported." (SSA Bulletin, October 1945.)

July 7: 16.55.* Central section of El Dorado County. Four shocks felt at about 3-second intervals. Buildings creaked. Faint subterranean sounds heard by several before shocks.

July 9: 13:25. Watsonville. Slight shock.

July 11: 05:55. Watsonville. Sharp shock awakened hundreds of Pajaro Valley residents. Also felt slightly at Big Sur.

July 11: 09:13.* Epicenter 35°40′ north, 121°15′ west, P. Near San Simeon. Felt slightly at Cambria.

July 21: 12:19. Berkeley. "A slight earthquake was felt by residents of the Berkeley-Albany-Richmond area at 12:19 a.m., P.W.T. (SSA Bulletin, October 1945.)

July 24: 17:08:11.* Epicenter 34°54′ north, 118°57′ west, P. Near Tejon Pass. Felt slightly at Salt Creek Canyon.

July 27: 18:33.8.* Epicenter 34.7° north, 120.1° west, P. East of Santa Maria. Felt by many in Los Alamos. Houses creaked. Loud bumping sound heard.

August 1: 10:55. Banning. "An earthquake with a 'waving' motion was felt in Banning at 10:55 a.m., P.W.T. It was strong enough to swing hanging lamps, pictures, and other loose articles." (SSA Bulletin, October 1945.)

August 3: 01:41. Long Beach. Motion rapid. Felt by observer in home. Walls creaked.

August 4: 09:31. Near Bakersfield. Motion rapid, lasting 1 second. Windows rattled.

August 15: 10:56:24.* Epicenter 33°13′ north, 116°08′ west, P. San Jacinto Fault zone, near Borego Valley. Felt over an area of approximately 15,000 square miles. Maximum intensity VI. Reports from an intensive questionnaire coverage and field investigation indicate there was no structural damage.

Strong motion records were obtained from the instruments at El Centro and San Diego, from three accelerographs in the Hollywood Storage Company, and from two accelerographs and one displacement meter in the Subway Terminal Building in Los Angeles.

INTENSITY VI:

Borego Valley.—Felt by all; frightened few. Rattled windows, doors, and dishes. Hanging objects swung. Trees and bushes shaken strongly.

Fall Brook.—Felt by many; few alarmed. Cracked plaster slightly.

Mecca.—Felt by all in community; frightened few. Hanging objects swung. Trees and bushes shaken moderately. Overturned small objects.

Fullerton.—Felt by many. Disturbed objects observed by many. Some damage to cables and power lines.

San Jacinto.—Felt by all in community; frightened few. Rattled windows, doors, and dishes. Houses creaked. Trees and bushes shaken moderately. Cracked plaster.

INTENSITY V:

Brawley, Coachella, Dulzura, El Centro, Holtville, Imperial, Lake Arrowhead, Palm Springs, and San Diego.

INTENSITY IV:

Artesia, Baker, Calipatria, Campo, Del Mar, Descanso, Escondido, Fawnskin, Indio, Jacumba, Jamul, Lakeside, Pala, Palomar Mountain, Plaster City, Perris, San Juan Capistrano, Santa Ysabel, Thermal, Thousand Palms, Twentynine Palms, Victorville, Westminster, and Wildomar.

INTENSITY I TO III:

Adelanto, Anza, Beaumont, Cabazon, Corona, Covina, Desert Center, El Toro, Hynes, Laguna Beach, La Habra, Los Angeles, Mount Laguna, Newport Beach, Niland, Oceanside, Palmdale, Riverside, and Santa Ana.

Negative reports were received from 43 places.

August 24: 13:27. Lone Pine. "An earthquake 'distinctly rough' in character set windows rattling at 1:27 p.m., P.W.T. No damage was reported throughout Inyo and Mono counties, but mine officials in upper Pine Creek said that it was accompanied by a roar that 'drowned out' blasting going on in the canyon." (SSA Bulletin, October 1945).

August 27: 02:13.* San Jose. Felt over an area of approximately 13,000 square miles. Maximum intensity VI.

Strong motion records were obtained from the two accelerographs at the Bank of America Building in San Jose.

INTENSITY VI:

Mount Hamilton.—Awakened all. Walls creaked. Pendulum clocks stopped. Overturned small objects.

San Jose.—Awakened all. Cracked plaster. One chimney was reported shaken loose.

INTENSITY V:

Alma, Alviso, Boulder Creek, Hollister, San Francisco, and San Martin.

INTENSITY IV:

Albany, Agnew, Belmont, Ben Lomond, Berkeley, Big Sur, Burlingame, Carmel, Castroville, Crows Landing, Cupertino, Daly City, Danville, Davenport, Decoto, Felton, Gilroy, Gustine, Holy City, Huntington Lake, Irvington, Lafayette, Livingston, Los Altos, Los Gatos, Madrone, Millbrae, Mill Valley, Modesto, Montara, Monterey, Moss Landing, Mountain View, Mount Eden, Newark, Niles, Novato, Oakdale, Pacific Grove, Palo Alto, Patterson, Petaluma, Pinole, Pleasanton, Redwood City, Richmond, Rockaway Beach, Ross, San Bruno, San Carlos, San Gregorio, St. Helena, San Juan Bautista, San Leandro, San Rafael, Santa Cruz, Sharp Park, Soquel, South San Francisco, Stinson Beach, Sunol, Sunnyvale, Vallejo, and Waterford.

INTENSITY I TO III:

Bolinas, Hayward, Kentfield, Livermore, Lodi, Manteca, Moss Beach, Pinecrest, Salinas, South Dos Palos, Stockton, Walnut Creek, and Yosemite Valley.

Negative reports were received from 45 places.

August 28: 20:30 and 20:45. Mineral. Felt by several in home and community. Rattled dishes. Hanging objects swung.

August 29: 19:30. Grass Valley. "At 7:30 p.m., P.W.T., a light earthquake was felt in Grass Valley and Nevada City." (SSA Bulletin, October 1945.)

September 7: 04:34:20.* Epicenter 35°50′ north, 120°42′ west, P. Near Bradley. Felt sharply at Cambria, Parkfield, Paso Robles, and San Miguel. No damage.

September 7: 08:34:24.* Epicenter 33°58′ north, 116°48′ west, P. San Andreas Fault zone, north of Banning. Felt with intensity IV at Beaumont, Cabazon, Hemet, and Romoland. Slightly felt at Riverside.

A strong motion record was obtained from the Weed instrument in San Bernardino.

September 8: 03:20 and 03:30. Summit Lake Camp Ground (Lassen Volcanic National Park). Felt by several campers.

September 17: 16:22. Dunlap. Felt by two. Rattled windows and doors. Houses creaked.

September 26: 10:20. Near Hollister. Felt by observer in home. Rattled windows and doors. Houses creaked.

Sepetmber 28: 11:25. San Diego. Felt by many. Rattled windows and doors. Houses creaked.

September 29: 21:30. Guernsey Camp (Lassen Volcanic National Park). Felt in house tralier.

October 1: 09:30. Fairfield. Felt by several in community.

October 15: 21:11.* Mineral. Felt by several. Accompanied by rumbling noise.

October 18: 21:07.* Mineral. Felt by several. Rattled windows.

October 25: 08:45.* Mineral. Felt by several in community. Walls creaked. Recorded on seismograph at Boulder City along with several minor disturbances.

October 31: 12:41:52.* Epicenter 34°20′ north, 117°07′ west, P. Northeast of Lake Arrowhead. Felt by many in Fawnskin. Houses creaked.

November 3: 07:50:20.* Epicenter 36.7° north, 121.1° west, P. Southeast of Tres Pinos. Felt quite strongly near Hollister and near Soledad. Rattled windows and doors. Buildings creaked. Thunderous and prolonged subterranean sounds heard by many.

November 4: 18:42:27.* Epicenter 33°57′ north, 117°18′ west, P. Southeast of Riverside. Felt by observer. Rattled windows slightly.

November 8: 03:19:27.* Epicenter 33°57′ north, 117°18′ west, P. Southeast of Riverside. Two slight shocks felt by many. Rattled windows. Slight rumbling heard.

November 8: 12:07.* Madrone. Felt by many. Rattled windows and doors. Knickknacks fell. Damage slight. Recorded on seismograph at Boulder City.

INTENSITY IV:

Pescadero, San Martin, Soquel, and South San Francisco.

INTENSITY I TO III:

San Francisco and San Jose.

Negative reports were received from 9 places.

November 12: 17:13.* Pleasanton. Sharp shock rattled windows and buildings. Felt in Livermore and less perceptibly in Hayward.

November 14: 06:43:30.* Epicenter 35°24′ north, 118°55′ west, P. East of Bakersfield. Felt slightly at Bakersfield, and in Kern Canyon. Rattled windows and caused lighting fixtures to swing.

November 21: 15:00 (about). Santa Rosa. "An 'apparent light earthquake shock' was felt by local

residents a few minutes after 3 o'clock, P.S.T. Buildings quivered and chandeliers rocked, but there was no damage." (SSA Bulletin, January 1946.)

December 1: 19:36:12.* Epicenter 33°42′ north, 118°28′ west, P. Off Point Vicente. Felt slightly at Compton.

December 2: 20:29:22.* Near Orinda. Ten-second shock felt by several. Slight plaster cracks. Thunderous subterranean sounds heard. Also felt at Berkeley, Oakland, and San Francisco.

December 4: 13:07.* Near Mineral. Felt at Bucks Creek Powerhouse and Mineral. Rattled windows and doors. Recorded on seismograph at Boulder City, Nevada.

December 13: 19:17. Holy City. Felt by several in home. Houses creaked.

December 19: 08:10. Moss Beach. Two slight shocks, with interval of few seconds. Rattled doors slightly.

WASHINGTON AND OREGON

(105TH MERIDIAN OR PACIFIC WAR TIME)

January 3: 19:34:48.7.* Entiat, Wash. Felt by all. Rattled dishes and doors.

January 27: 22:06:08.1* Near Stanwood, Wash. Felt by many. Some plaster fell. Intensity IV at Granite Falls and Snohomish.

February 13: 20:02:9.1.* See Western Mountain Region.

February 27: 04:00 (about). Entiat and Winthrop, Wash. Felt slightly.

March 2: 00:54:59.3* Near Entiat, Wash. Motion rapid, lasting 4 seconds. Awakened many in community. Also felt at Chelan and Waterville.

April 29: 13:16:17.* Epicenter about 47.4° north, 121.7° west, BC. Ten miles southeast of North Bend, Wash. This earthquake was felt over the greater portion of Washington, a small section of western Idaho, and in the vicinity of Portland, Oreg. See map. Affected area covered approximately 50,000 square miles. Maximum intensity VII.

The shock was the most intense in this region since the quake of November 12, 1939. The 2-minute shaking was accompanied by a noise as of a muffled explosion. Although no damage was caused, the tre-

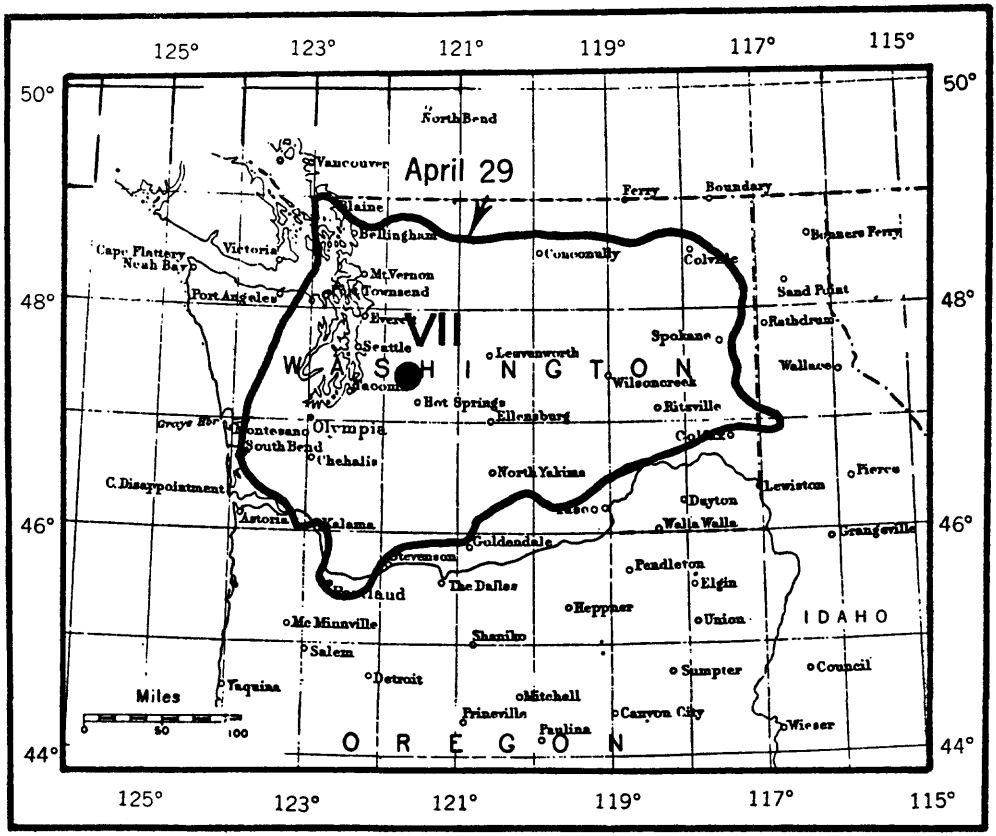


FIGURE 5.—Area affected by the earthquake of April 29, 1945.

mors were powerful enough to dislodge bricks from a dozen or more homes in the Cle Elum area. Only one minor casualty resulted; a boy at Roslyn was struck on the head by a falling brick.

Seismologists determined the shock originated in the Mount Si Fault, the old crack in the earth's crust that extends from North Bend almost due north along the west face of Mount Si to the town of Sultan. At the Mount Si Ranger Station, near North Bend, the earth buckled and heaved and tons of rock and earth cascaded down the 4,000 foot cliffs. Many local residents called the newspapers seeking information about the quake.

INTENSITY VII:

North Bend.—Felt by all in community. Trees and bushes shaken strongly. Cracked plaster and chimneys. Broke dishes, windows, and town water main. Damage was mostly to chimneys. Caused large rock slides on west face of Mount Si. Moderately loud to terrific muffled explosion-like sounds heard.

Palmer.—Felt by all. Trees and bushes shaken strongly. Cracked plaster and ground. Overturned vases and small objects. Damage slight.

Stampede Pass.—Buildings rocked back and forth. Slight damage as seams and joints spread in an east-west direction. Moderately loud, bumping and scraping subterranean sounds heard.

INTENSITY VI:

Baldi.—Felt by all. Rattled windows. Houses creaked. Spilled water from indoor containers in a northerly direction. Trees and bushes shaken moderately.

Cedar Falls.—Motion bumping, with abrupt onset. Felt by all. Small rock slides across Cedar River. Muffled subterranean sounds heard.

Cle Elum.—Felt by all in community. Frightened many. Cracked windows and chimneys. Hanging objects swung. Pendulum clocks stopped. Trees and bushes shaken moderately. Damage slight.

Ellensburg.—Felt by many in community. Rattled dishes and cracked plaster.

Elma.—Felt by several. Buildings creaked. Two north-south walls were cracked, cracks running south to north.

Greenwater.—Felt by several. Bumping subterranean sounds heard by several before shock. Damage to a few old brick chimneys. Pictures displaced on east-west walls. Pendulum clocks stopped.

Hyak.—Two shocks about 10 seconds apart. Felt by all in community. Slight visible swaying of buildings and trees. Articles fell from shelves.

Index.—Felt by many. Small landslides occurred. Bumping subterranean sounds heard by many before shock. Visible swaying of buildings and trees. Cracked plaster in a few instances.

Leavenworth.—Felt by all. Buildings creaked. Rumbling heard at time of shock. Visible swaying of buildings and trees. Slight damage to buildings. Some chimneys had top layers of bricks knocked to ground.

Preston.—Rapid undulating motion, abrupt onset, accompanied by loud rumbling noise. Felt by all. Overturned small objects. Spilled water from indoor containers. Trees and bushes shaken moderately.

Skykomish.—Felt by several. Buildings creaked. Moderately loud rumbling subterranean sounds heard before shock. Pictures displaced. Wires on electric light poles swayed vigorously up and down.

Snoqualmie.—Felt by many. Visible swaying of trees and light poles. Plastered ceilings cracked around edges; chimneys and crockery damaged. Display goods on shelves fell to floor. Roaring subterranean sounds heard by many before shock.

INTENSITY V:

Anacortes, Ardenvoir, Beverly, Coupeville, Chelan, Chewalah, Darrington, Entiat, Enumclaw, Everett, Gifford, Coulee Dam, Lakebay, Lake Cle Elum, Landsburg, Mount Vernon, Olga, Orondo, Orting, Packwood, Quilcene, Sultan, Scenic, Tacoma, Waterville, Winthrop, and Yakima.

INTENSITY IV:

Ariel, Bothell, Bremerton, Bumping Lake, Camano Island, Centralia, Cheney, Clear Lake, Concrete, Connell, Deer Park, Des Moines, Easton, Eastsound, Elbe, Ephrata, Gig Harbor, Hartline, Hoodsport, Holden, Issaquah, Kahlotus, Kelso, Kirkland, Klickitat, La Conner, Lake Wenatchee, Langley, Lopez Island, Lucerne, Mazama, Mineral, Monotor, Monroe, Mount Vernon, Naches, Nespelem, Odessa, Okanogan, Olympia, Omak, Paradise, Point Roberts, Port Gamble, Port Townsend, Poulsbo, Prosser, Puyallup, Rockport, Rosalia, Sedro-Wooley, Shelton, South Bend, Spanaway, Spokane, Stevens Pass, Tieton Ranger Station, Twisp, Wenatchee, Wellpinit, and Wilkeson.

INTENSITY IV IN OREGON:

Fossil and Portland.

INTENSITY I TO III:

Arlington, Bellingham, Camas, Conconully, Coulee City, Davenport, Evans, Glacier, Granite Falls, Lind (six miles north of), Newport, Othello, Roche Harbor, South Bend, Springdale, Wilson Creek, and Yacolt.

INTENSITY I TO III IN IDAHO:

Potlatch.

Negative reports were received from 59 places in Washington, and from 23 places in Oregon.

April 30: 00:45:45.* Aftershock of preceding earthquake. Intensity VI at North Bend, Wash. Many were awakened, houses creaked, and vases overturned. Damage slight. Felt also at Enumclaw, Longmire, and Orting.

May 1: 12:46:04.* Aftershock of April 29 earthquake. Felt over considerable area in west-central Washington. Maximum intensity V.

INTENSITY V:

Cle Elum, Stampede Pass, and Waterville.

INTENSITY IV:

Bumping Lake, Coulee Dam, Lake Wenatchee, Leavenworth, Longmire, Palmer, Sultan, and Wilkeson.

May 1: 21:01:43.* Aftershock of April 29 earthquake. Felt at North Bend, Wash.

May 3: 21:00 (about). North Bend, Wash. Felt by three people.

June 15: 15:25:02.* Epicenter probably in the Strait of Georgia near the international boundary. Intensity V at Point Roberts where trees and bushes were shaken strongly. Houses creaked and small objects were shifted. Intensity IV at Bellingham, Concrete, Friday Harbor, La Conner, Marietta, and Richardson.

Negative reports were received from 27 places.

September 22: 19:40. Walla Walla and College Place, Wash. Brief series of shocks with rapid onset. Felt strongly in Veterans Hospital section. Moderately loud rumbling similar to muffled explosion preceded shocks. Affected area extended as far as Blalock Lake.

September 23: 02:57.8.* See Western Mountain Region.

November 11: 21:05. Epicenter probably near San Juan Island, Wash. Felt generally without damage at Chimacum, Coupeville, Double Bluff, and Port Townsend. Slight plaster cracks reported at Port Townsend.

Negative reports were received from 10 places.

November 23: 16:30. Packwood, Wash. Slight shock awakened many. Rattled windows, doors, and dishes. Hanging objects swung.

Negative reports were received from 5 places.

ALASKA

(105TH MERIDIAN TIME)

January 16: 07:54. Anchorage. Light shock felt by several.

Jan ary 21: 04:04. Slaters Camp, near Fairbanks. Sharp shock felt by many. Awakened many. Buildings creaked.

February 8: 07:47. Anchorage. Slight shock felt by several.

February 10: 12:40. Anchorage. Slight shock felt by several.

March 5: 06:19. Nome. Two slight shocks.

April 11: 21:40. Anchorage. Light tremor felt by a few people.

June 3: 03:07. Slaters Camp, near Fairbanks. Light tremor awakened a few people.

September 17: 17:55. Adak Island. Light shock accompanied by rumbling. No damage.

October 10: 02:00. Anchorage. Very light shock.

October 15: 00:03 and 03:06. Juneau. Two sharp shocks generally observed. No damage.

November 16: 10:05. Juneau. Two sharp shocks felt by many. Felt slightly at Skagway.

November 17: 14:20. Juneau. Light shock felt by several.

December 1: 14:37. Anchorage. Sharp bump felt by several.

HAWAIIAN ISLANDS

(HAWAIIAN STANDARD TIME)

January 24: 10:38. Ten to fifteen miles below east rim of Kilauea. Moderate shock widely felt over southeast half of island of Hawaii.

March 4: 00:00. Southwest rift of Mauna Loa. Moderate shock widely felt on island of Hawaii. Stopped clocks in South Kona.

May 19: 01:48. East slope of Mauna Loa. Felt generally on Hawaii and slightly on Oahu.

July 13: 02:15. Along Puna coast southwest of Kalapana. Widely felt in eastern half of island of Hawaii.

August 9: 10:46. East slope of Mauna Loa above Kapapala. Felt generally in southwest part of island of Hawaii.

September 19: 05:33. Between Mauna Loa an Mauna Kea. Felt over entire island of Hawaii.

PUERTO RICO

(60TH MERIDIAN TIME)

No earthquakes were reported in Puerto Rico during the year 1945.

PANAMA CANAL ZONE

(60TH MERIDIAN TIME)

June 3: 09:05.6.* Epicenter near 8.3° north, 82.6° west, W. Generally felt in Chiriqui Province with minor damage at David and Puerto Armuelles. Felt by many in Canal Zone. Some were awakened.

July 5: 08:03. Santa Fe, Republic of Panama, about 105 miles west of Balboa Heights. Reports indicate the town was strongly shaken and that panic spread among the residents because of a tremendous roar that preceded the shock. No casualties. Also felt in Canal Zone.

September 17: 00:15. Pacific side of Canal Zone. Felt by many. No damage.

December 1: 17:33. Gatun. Slight shock felt by a few.

MISCELLANEOUS ACTIVITIES

GEODETIC WORK OF SEISMOLOGICAL INTEREST

In June 1945 the first-order network of leveling in and around Los Angeles, California, was releveled to detect possible earth movement, particularly in the vicinity of Terminal Island. The surveys extended from Santa Monica to San Juan Capistrano along the coast and inland from El Toro to Burbank through Alhambra, Brea, and Santa Ana. The total network comprised 476 miles of leveling, of which 256 miles were completed in 1945. This releveling has been adjusted and the results are available for distribution.

TIDAL DISTURBANCES OF SEISMIC ORIGIN

No seismic seawaves were recorded during the calendar year 1945.

SEISMOLOGICAL OBSERVATORY RESULTS

The Coast and Geodetic Survey publishes the results of its teleseismic stations and cooperating 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 and International Union Geodesy and Geophysics.)
Boulder City, Nev.
(Bureau of Reclamation, National Park Service)
Bozeman, Mont.
(Montana State College)
Burlington, Vt.
(University of Vermont)
Butte, Mont.
(Montana School of Mines)
Chicago, Ill.
(University of Chicago and U. S. Weather Bureau)
College, Alaska.
(University of Alaska)
Columbia, S. C.
(University of South Carolina)
Grand Coulee, Wash.
(Bureau of Reclamation, National Park Service)
Honolulu, T. H.
(University of Hawaii)
Huaucayo, Peru.
(Carnegie Institution of Washington)
Lincoln, Nebr.
(Nebraska Wesleyan University)
Logan, Utah.
(Utah State Agricultural College)
Montezuma, Chile.
(Smithsonian Institution)
New Kensingson, Pa.
(Private station)
Overton, Nev.
(Bureau of Reclamation, National Park Service)
Philadelphia, Pa.
(The Franklin Institute)
Pierce Ferry, Nev.
(Bureau of Reclamation, National Park Service)
Rapid City, S. D.
(South Dakota State School of Mines)
Salt Lake City, Utah.
(University of Utah)
San Juan, P. R.
Seattle, Wash.
(University of Washington)
Shasta, Calif.
(Bureau of Reclamation, National Park Service)
Sitka, Alaska.
Tucson, Ariz.
Ukiah, Calif.
(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, New Kensington, Philadelphia, and Seattle are independent stations.

Boulder City, Grand Coulee, Overton, Pierce Ferry, and Shasta are cooperative stations of the Lake Mead Seismological Survey.

All readings were made or revised at the Washington Office except those for Balboa Heights and Bureau of Reclamation stations.

The provisional epicenter results for 1945 were not ready when this publication went to press. Those for the year 1944 are listed in table 1. Those for the stronger shocks of 1945 are listed in table 2.

Table 1.—*Summary of instrumental epicenters for 1944.*

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.

1944	Origin time G. C. T.	Region and focal depth	Coordinates of provisional epicenter	
			Latitude	Longitude
	h. m.		° ′	° ′
Jan. 3	10 19.3	North of Gulf of Venezuela	13 N.	71 W.
Jan. 4	0 57.9	....do	13 N.	71 W.
Jan. 5	10 59.1	....do	13 N.	71 W.
Jan. 5	21 12.7	Sumatra, near southwest coast	3 S.	102 E.
Jan. 6	16 44.0	Peru, west coast	15 S.	76 W.
Jan. 7	2 49.3	Eastern New Guinea. Slightly deeper than 100 km	4.5 S.	143 E.
Jan. 10	20 09.9	Mexico, near southwest coast. Damage in State of Guerrero. Slight depth	17.4 N.	100.9 W.
Jan. 10	20 33.6	....do	17.5 N.	100.5 W.
Jan. 12	15 02.6	California, off coast of Cape Mendocino	40.6 N.	125.1 W.

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

1944	Origin time G. C. T.	Region and focal depth	Coordinates of provisional epicenter	
			Latitude	Longitude
	h. m.		° ′	° ′
Jan. 15	5 46.1	Mid-Atlantic Ocean	18 N.	47 W.
Jan. 15	23 49.5	Argentina, near San Juan. 8,000 killed and $100,000,000 property and industrial damage. Slight depth	31.5 S.	68.5 W.
Jan. 16	2 25.5	California, off coast of Cape Mendocino	40.6 N.	124.8 W.
Jan. 16	14 27.7	Nicaragua, off west coast	11 N.	89 W.
Jan. 20	2 59.2	Samoan Islands region	15 S.	174.5 W.
Jan. 29	2 25.0	Southwestern Alaska. Felt	63 N.	156.5 W.
Feb. 1	3 22.5	Turkey, near Gerede. Destructive. 1,000 killed	41.0 N.	33.0 E.
Feb. 1	5 16.2	Near Hokkaido, Japan	41.5 N.	143 E.
Feb. 3	11 25.3	Colombia. Felt	6 N.	72 W.
Feb. 3	12 15.2	Northwestern Canada. Felt	59.6 N.	135.9 W.
Feb. 3	14 10.2	Colombia. Felt	6.5 N.	72 W.
Feb. 4	15 41.4	California	33.0 N.	116.0 W.
Feb. 5	6 13.7	....do	33.0 N.	116.0 W.
Feb. 5	17 20.0	Near southern Formosa	23 N.	121 E.
Feb. 5	20 02.3	Loyalty Islands region	20.5 S.	168.5 E.
Feb. 6	3 50.5	Venezuela, near northeast coast	10 N.	62 W.
Feb. 6	18 40.8	British Guiana	6 N.	59 W.
Feb. 15	5 39.5	North Atlantic Ocean	51 N.	32 W.
Feb. 15	15 56.0	South of Puerto Rico	17 N.	67 W.
Feb. 18	15 32.0	Gulf of California	30.5 N.	114.2 W.
Feb. 19	11 35.9	West of Iceland	63 N.	25 W.
Feb. 21	11 28.7	Mexico, off Colima coast	18.3 N.	105.3 W.
Feb. 23	12 25.1	Lower Aleutian Islands region	52.5 N.	179 W.
Feb. 25	6 51.0	California	35.1 N.	116.6 W.
Feb. 25	7 32.6	Alaska, Katzebue Sound	67 N.	165 W.
Feb. 26	22 23.6	Alaska, Prince William Sound	61 N.	147 W.
Feb. 27	20 14.5	Lower California	29.2 N.	114.1 W.
Feb. 28	17 44.1	Alaska, near Fairbanks	63 N.	147 W.
Feb. 29	3 41.9	Southeastern Peru. Depth approximately 200 km	14.8 S.	70.7 W.
Feb. 29	16 28.1	Indian Ocean	1.5 N.	77 E.
Mar. 1	17 16.1	Mindanao, off east coast. Depth approximately 200 km	8 N.	127 E.
Mar. 6	14 03.4	Oregon, off coast	45 N.	129 W.
Mar. 6	20 09.1	....do	44.7 N.	129.0 W.
Mar. 6	21 05.9	....do	44.7 N.	129.0 W.
Mar. 6	22 51.2	....do	45 N.	129 W.
Mar. 6	23 16.5	....do	45 N.	129 W.
Mar. 7	6 09.3	....do	44.7 N.	129.0 W.
Mar. 7	6 45.1	....do	45 N.	129 W.
Mar. 7	8 21.5	....do	45 N.	129 W.
Mar. 8	7 54.8	Nevada	37.6 N.	114.1 W.
Mar. 9	8 41.9	California	33.9 N.	115.7 W.
Mar. 9	16 21.3	Oregon, off coast	45 N.	129 W.
Mar. 9	22 03.7	Eastern Turkistan	44 N.	83 E.
Mar. 9	22 13.0	....do	44 N.	83 E.
Mar. 10	1 38.8	Peru, off southwest coast	16.5 S.	76 W.
Mar. 10	6 40.0	Hokkaido, Japan, near south coast	42.5 N.	143.5 E.
Mar. 20	9 31.0	Southwestern Utah	37.2 N.	114.0 W.
Mar. 21	22 09.9	Hokkaido, Japan, near south coast	42 N.	143 E.
Mar. 22	0 43.2	Floris Sea. Depth approximatly 200 km	8 S.	124 E.
Mar. 22	8 09.7	California	34.0 N.	116.5 W.
Mar. 24	17 01.9	Costa Rica, near west coast	9 N.	83.5 W.
Mar. 31	22 51.9	West of New Guinea	5.5 S.	136.5 E.
Apr. 1	9 22.2	South Pacific Ocean	54.5 S.	129 W.
Apr. 2	4 40.0	Gulf of California	27 N.	111 W.
Apr. 3	17 50.8	Southwest of Tonga Islands	23 S.	179 W.
Apr. 5	4 40.6	Northwestern Turkey. Felt	40.5 N.	31 E.
Apr. 7	13 32.9	Nicaragua, north of Lake Nicaragua. Depth approximately 100 km	12.4 N.	85.7 W.
Apr. 12	15 32.2	California, off coast. Felt	34.3 N.	119.5 W.
Apr. 13	6 42.0	Gulf of California	29 N.	113 W.
Apr. 19	22 32.0	Pacific Ocean, west of Easter Island	29 S.	116 W.
Apr. 21	15 01.4	Colombia, off west coast	4 N.	84 W.
Apr. 23	10 57.7	Tonga Islands region. Depth approximately 375 km	22 S.	177.5 W.
Apr. 26	1 54.3	North of Netherlands New Guinea. Slight depth	1 S.	135 E.
Apr. 27	14 38.2	....do	0.5 S.	134.5 E.
Apr. 27	19 05.2	....do	0.5 S.	134.5 E.
Apr. 28	5 50.4	Panama, off south coast	8 N.	83 W.
May 5	13 45.6	California	34.0 N.	116.4 W.
May 5	13 47.2	....do	34.0 N.	116.4 W.
May 6	0 13.7	Mid-Atlantic Ocean	22.5 N.	45.0 W.
May 7	15 10.1	Northwest of Kodiak Island	58 N.	153.5 W.
May 9	14 29.9	Colombia. Felt. Depth approximately 100 km	3 N.	74.5 W.
May 14	8 51.6	South of Fiji Islands. Depth approximately 600 km	23 S.	179.5 E.
May 15	19 18.1	New Guinea, near north coast	4 S.	143.5 E.
May 18	19 54.9	South Pacific Ocean	48 S.	112 W.
May 19	0 19.3	East Indies, near New Ireland	2.7 S.	153.3 E.
May 21	4 41.9	South America, off northeast coast	9 N.	43 W.
May 21	17 07.1	Dominican Republic, near north coast	19.5 N.	71 W.
May 23	10 38.5	South of Aleutian Islands	51.2 N.	170.6 W.
May 24	1 30.4	Dominican Republic, near north coast	19.5 N.	71 W.
May 25	1 06.5	South of Fiji Islands. Slightly deeper than 600 km	22 S.	179 W.
May 25	12 58.1	East Indies, near New Ireland	2.5 S.	152.0 E.
May 29	2 43.3	South of Panama	5.2 N.	82.4 W.
June 3	7 12.2	West Indies, north of Leeward Islands	20 N.	63 W.
June 3	15 46.4	Peru, off northwest coast. Slight depth	8 S.	80 W.

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

1944	Origin time G. C. T.	Region and focal depth	Coordinates of provisional epicenter	
			Latitude	Longitude
	h. m.		° ′	° ′
June 6	3 44.2	Near New Britain	5 S.	152 E.
June 6	23 20.0	Peru, off southwest coast	15.5 S.	76.5 W.
June 7	6 28.9	South-central Haiti	18.5 N.	72 W.
June 7	21 10.9	California. Felt	34.2 N.	117.5 W.
June 8	2 38.3	Near border of Peru and Brazil. Slightly deeper than 600 km.	9.5 S.	73.5 W.
June 9	20 35.0	East of New Guinea	4 S.	150 E.
June 10	11 11.8	California. Felt	34.0 N.	116.8 W.
June 10	11 15.5	....do	34.0 N.	116.8 W.
June 11	19 18.9	Ecuador, off west coast	0.8 N.	85.8 W.
June 12	10 45.6	California. Felt	34.0 N.	116.7 W.
June 12	11 16.6	....do	34.0 N.	116.7 W.
June 12	11 39.1	California	34.0 N.	116.7 W.
June 12	11 48.8	....do	34.0 N.	116.7 W.
June 12	13 45.4	California. Felt	34.0 N.	116.7 W.
June 12	20 22.9	California	34.0 N.	116.7 W.
June 13	8 27.5	California. Felt	34.7 N.	120.5 W.
June 13	8 46.7	....do	34.7 N.	120.5 W.
June 13	9 55.1	Aleutian Islands region	51 N.	171 W.
June 13	11 07.4	California. Felt	34.7 N.	120.5 W.
June 13	17 30.2	California	34.0 N.	116.7 W.
June 14	0 04.6	....do	34.0 N.	116.7 W.
June 14	1 21.7	....do	34.0 N.	116.7 W.
June 14	9 46.5	....do	34.0 N.	116.7 W.
June 15	20 44.4	....do	34.0 N.	116.7 W.
June 16	21 51.6	Mexico, near Colima coast	19.0 N.	105.2 W.
June 17	23 41.0	California	34.0 N.	116.7 W.
June 18	22 12.3	Gulf of California	26 N.	110 W.
June 19	0 03.5	California. Felt	33.9 N.	118.2 W.
June 19	3 06.1	....do	33.9 N.	118.2 W.
June 21	10 58.3	Loyalty Islands region. Slight depth	21.5 S.	169.5 E.
June 23	21 28.7	California	34.0 N.	116.7 W.
June 25	1 08.3	Guatemala, off west coast	14.5 N.	93 W.
June 25	4 16.3	Western Turkey	39 N.	29 E.
June 25	8 06.9	East of Amelia Island	52 N.	173 W.
June 25	14 17.4	Loyalty Islands region	21.5 S.	170 E.
June 25	17 42.2	Mid-Atlantic Ocean	0.4 S.	24.1 W.
June 28	5 31.8	Guatemala, off west coast	14.5 N.	93 W.
June 28	6 55.3	California	34.0 N.	116.8 W.
June 28	7 58.9	Guatemala, off west coast	14.8 N.	92.7 W.
June 29	11 29.8	Peru, off west coast	11 S.	79 W.
July 1	10 54.0	California	34.0 N.	116.7 W.
July 2	22 12.4	Guatemala, near west coast	14.5 N.	93 W.
July 3	5 38.4	California. Felt	35.3 N.	117.9 W.
July 10	13 24.9	Samoan Islands region. Depth approximatly 150 km	14 S.	176 W.
July 10	15 47.8	Kermadec Islands region. Depth slightly less than 100 km	31 S.	178 W.
July 12	19 30.4	Idaho. Felt	44.7 N.	115.2 W.
July 13	0 14.3	South of Fiji Islands	22 S.	170 E.
July 13	19 50.8	Mexico, near south coast	16 N.	97 W.
July 16	10 19.1	South of Tonga Islands. Depth approximately 450 km	22 S.	175 W.
July 19	10 21.4	Honshu, Japan, off east coast	35 N.	143 E.
July 20	7 26.4	Alaska, Cook Inlet	59.5 N.	152.5 W.
July 21	12 25.0	Oregon, off coast	42.5 N.	127 W.
July 22	2 02.9	California	33.5 N.	116.8 W.
July 22	11 28.6	Southern Mexico. Felt	16.5 N.	95 W.
July 23	12 45.2	California	33.2 N.	116.1 W.
July 23	16 13.5	Northern Argentina. Depth approximately 250 km	24 S.	66 W.
July 26	9 11.9	California	34.0 N.	116.4 W.
July 26	22 59.9	California. Felt	33.8 N.	118.2 W.
July 27	0 04.4	Unimak Island, off southwest coast. Depth approximately 70 km	54 N.	165 W.
July 27	8 18.6	Bay of Bengal, near Andaman Islands	12 N.	93 E.
Aug. 2	12 29.2	Costa Rica, near west coast	9.5 N.	84 W.
Aug. 4	22 46.9	California. Felt	33.0 N.	116.0 W.
Aug. 5	1 24.1	Peru, off west coast	13.5 S.	93 W.
Aug. 5	13 06.9	Nicaragua, off west coast	12.5 N.	87.5 W.
Aug. 7	1 18.9	Nevada	39.5 N.	120.0 W.
Aug. 7	3 25.3	Peru, off south coast	17.5 S.	73.5 W.
Aug. 7	18 47.3	Mexico, off south coast	16 N.	97.5 W.
Aug. 7	23 38.2	Peru, off south coast	18 S.	74 W.
Aug. 9	4 15.4	Puerto Rico, off northwest coast. Felt	19.0 N.	67.2 W.
Aug. 9	14 01.1	California	35.9 N.	117.8 W.
Aug. 10	1 52.9	British Columbia, off southwest coast	51.0 N.	130.7 W.
Aug. 10	11 31.5	Southern Mexico	16.5 N.	96 W.
Aug. 10	15 27.2	Peru, near west coast	12 S.	77 W.
Aug. 12	21 21.3	California	35.9 N.	117.8 W.
Aug. 13	6 27.9	....do	35.9 N.	117.8 W.
Aug. 13	8 22.3	British Columbia, off southwest coast	50.5 N.	132 W.
Aug. 14	11 07.5	North of Kodiak Island. Depth approximately 100 km	58.5 N.	153 W.
Aug. 15	11 47.6	Mariana Islands region. Depth approximately 100 km	13 N.	143.5 E.
Aug. 17	2 52.7	California	34.3 N.	117.1 W.
Aug. 18	10 33.4	Northern Honshu, Japan. Depth approximately 200 km	38 N.	140 E.
Aug. 18	19 22.5	Chile, off north coast	21.5 S.	71 W.
Aug. 21	20 14.6	Mid-Atlantic Ocean	3 N.	31 W.
Aug. 22	18 22.5	California	34.0 N.	116.7 W.
Aug. 24	23 37.8	Mexico, off south coast. Dpeth approximately 100 km	15.5 N.	93 W.
Aug. 25	7 30.4	California. Felt	34.0 N.	116.7 W.

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

1944	Origin time G. C. T.	Region and focal depth	Coordinates of provisional epicenter	
			Latitude	Longitude
	h. m.		° ′	° ′
Aug. 25	12 27.1	Tonga Islands region. Depth approximately 250 km	18 S.	176 W.
Aug. 30	1 14.2	New Hebrides Islands region	17 S.	168.5 E.
Aug. 30	4 00.8	Peru, off west coast. Depth approximately 100 km	14.5 S.	78 W.
Sept. 3	1 36.7	California	34.2 N.	116.4 W.
Sept. 3	19 11.5	South Pacific Ocean, near Dougherty Island	56 S.	123 W.
Sept. 3	21 29.6	Colombia	3 N.	71.5 W.
Sept. 3	22 58.6	Northeastern Chile. Depth approximately 100 km	22.5 S.	68 W.
Sept. 4	12 55.5	California	33.3 N.	116.1 W.
Sept. 5	4 38.7	St. Lawrence Valley. Approximately $2,000,000 property damage at Cornwall, Ontario and Massena, New York	44.9 N.	74.3 W.
Sept. 5	8 51.2	Aftershock of preceding quake	44.9 N.	74.3 W.
Sept. 5	15 30.0	Tonga Islands region	18 S.	167 W.
Sept. 6	5 52.4	Loyalty Islands region	22 S.	172 E.
Sept. 9	4 12.3	Western Colorado. Felt	39 N.	107.5 W.
Sept. 9	17 32.7	Aleutian Islands region	51 N.	179 E.
Sept. 9	23 24.8	Aftershock of St. Lawrence Valley quake of Sept. 5	44.9 N.	74.3 W.
Sept. 11	9 45.4	Molucca Islands region. Slight depth	1 N.	127 E.
Sept. 14	2 02.3	California. Felt	37.5 N.	118.7 W.
Sept. 15	19 20.1	Ecuador	0.5 S.	79 W.
Sept. 16	22 44.7	California, off northwest coast	42.5 N.	127 W.
Sept. 18	19 45 2	California	34.0 N.	115.8 W.
Sept. 19	13 06.0	Foreshock of Kamchatka quake of Sept. 23	54 N.	161 E.
Sept. 20	14 12.3	California	34.0 N.	116.7 W.
Sept. 20	16 39.5	....do	33.8 N.	117.7 W.
Sept. 23	12 13.3	Kamchatka, off southeast coast. Slight depth	53.8 N.	161.2 E.
Sept. 23	16 01.3	Kermadec Islands region	30 S.	177 W.
Sept. 24	10 55.8	Aftershock of Kamchatka quake of Sept. 23	54 N.	161 E.
Sept. 24	15 13.7	California	33.4 N.	116.2 W.
Sept. 25	16 15.7	Aftershock of Kamchatka quake of Sept. 23	54 N.	161 E.
Sept. 27	16 25.1	U. S. S. R., 250 miles southeast of Tashkent	39 N.	73 E.
Sept. 29	19 08.2	Aleutian Islands region	52 N.	171 W.
Oct. 2	17 22.1	Guatemala. Depth slightly less than 200 km	14.5 N.	90.1 W.
Oct. 2	20 29.9	Hokkaido, Japan. Depth approximately 100 km	44 N.	143 E.
Oct. 3	2 27.7	Northwestern Wyoming. Felt	44.2 N.	109.2 W.
Oct. 5	15 21.4	Colombia, near west coast	4.5 N.	78 W.
Oct. 5	16 57.0	Solomon Islands region. Felt	5 S.	154 E.
Oct. 5	17 28.4	Southeast of Loyalty Islands. Depth approximately 100 km	22 S.	172 E.
Oct. 6	2 34.6	Western Turkey. Destructive in Ayvalik and Burhomze regions	39 N.	27 E.
Oct. 11	9 45.2	South of Samoa. Depth approximately 100 km	16 S.	172 W.
Oct. 12	15 27.2	California	34.0 N.	115.8 W.
Oct. 17	18 37.0	Western China, north of Trans-Himalaya Mountains	34 N.	84 E.
Oct. 20	1 13.1	Nevada	38.5 N.	118.3 W.
Oct. 23	23 40.1	Ecuador, near west coast	0.5 N.	80.0 W.
Oct. 24	0 27.7	Aftershock of preceding quake	0.5 N.	80 W.
Oct. 24	7 53.3	California	34.1 N.	116.4 W.
Oct. 26	22 54.2	....do	33.3 N.	116.2 W.
Oct. 27	6 25.4	Lower California	31.0 N.	116.0 W.
Oct. 27	6 32.8	....do	31.0 N.	116.0 W.
Oct. 27	12 27.0	....do	31.0 N.	116.0 W.
Oct. 28	4 01.5	....do	31.0 N.	116.0 W.
Oct. 28	18 30.3	California. Felt	34.0 N.	116.7 W.
Oct. 29	0 11.5	Aftershock of Western China quake of Oct. 17	34 N.	84 E.
Oct. 29	7 14.1	California	34.1 N.	116.5 W.
Oct. 30	5 34.1	Atlantic Ocean	11 N.	43.5 W.
Nov. 4	8 12.0	California	36.3 N.	120.1 W.
Nov. 4	15 19.1	....do	33.0 N.	116.0 W.
Nov. 8	20 30.1	Southwestern Utah	38.8 N.	112.9 W.
Nov. 10	13 16.7	South of Alaskan Peninsula	55.7 N.	156.4 W.
Nov. 13	19 23.5	South of Fiji Islands. Depth approximately 600 km	21 S.	177 E.
Nov. 14	0 30.4	South of Easter Islands	33 S.	115 W.
Nov. 14	20 47.0	Mindanao, off southeast coast	4.5 N.	128.2 E.
Nov. 16	12 10.9	Queen Charlotte Islands region	11.5 S.	165.5 E.
Nov. 17	22 10.3	Aftershock of preceding quake	11.5 S.	165.5 E.
Nov. 18	7 53.2	East of Easter Islands	28 S.	113.5 W.
Nov. 19	5 55.9	California	32.7 N.	115.8 W.
Nov. 21	10 02.3	Tierra del Friego, off southeast coast	56 S.	62 W.
Nov. 22	5 25.6	California	32.7 N.	115.8 W.
Nov. 24	4 49.1	New Hebrides Islands region. Depth approximately 200 km	19 S.	169 E.
Nov. 26	17 57.6	California	32.7 N.	115.8 W.
Nov. 27	23 35.7	Nevada	37.5 N.	117.1 W.
Nov. 28	16 10.6	Gulf of California	26 N.	111 W.
Nov. 29	18 51.4	Aftershock of New Hebrides Islands quake of Nov. 24	19 S.	169 E.
Nov. 30	1 45.8	Southwest of Tonga Islands. Depth approximately 200 km	25 S.	178 W.
Nov. 30	18 53.2	California	34.7 N.	120.4 W.
Dec. 1	4 00.4	West of Tonga Islands. Depth approximately 600 km	21 S.	178.5 W.
Dec. 1	14 31.8	California	32.6 N.	115.8 W.
Dec. 3	20 59.7	....do	32.7 N.	115.8 W.
Dec. 4	20 34.6	Mariana Islands region. Felt. Slight depth	15 N.	146 E.
Dec. 5	0 51.1	Chile. Depth approximately 100 km	32 S.	70.5 W.
Dec. 5	14 25.6	Kermadec Islands region	27.5 S.	177.5 W.
Dec. 5	14 41.4	Mexico, off west coast	25 N.	109 W.
Dec. 5	17 09.3	....do	25 N.	109 W.
Dec. 7	4 35.7	Honshu, Japan, off south coast. Destructive in Japan. Accompanied by seismic sea-waves	33 N.	137 E.
Dec. 8	1 10.7	Tonga Islands region	20.5 S.	174 W.
Dec. 8	7 17.1	Loyalty Islands region. Depth approximately 100 km	21.5 S.	169 E.

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

1944	Origin time G. C. T.	Region and focal depth	Coordinates of provisional epicenter	
			Latitude	Longitude
	h. m.		° ′	° ′
Dec. 8	9 20.8	Nevada	38.4 N.	117.4 W.
Dec. 8	12 59.5	Loyalty Islands region. Depth approximately 100 km	21.5 S.	169 E.
Dec. 10	5 11.5	Indian Ocean, 1,000 miles east of Madagascar	23 S.	65 E.
Dec. 10	16 25.1	New Hebrides Islands region. Depth slightly less than 100 km	18.5 S.	168 E.
Dec. 12	4 17.1	Aleutian Islands region	52 N.	179.5 W.
Dec. 20	20 45.1	Kermadec Islands region	27.5 S.	177.5 W.
Dec. 21	5 19.1	California, off north coast	42 N.	125 W.
Dec. 21	20 13.8	Kermadec Islands region	27.5 S.	177.5 W.
Dec. 21	22 27.7	....do	27.5 S.	177.5 W.
Dec. 22	5 35.4	....do	27.5 S.	177.5 W.
Dec. 22	22 32.1	Chile, near coast of Antofagasta Province. Depth approximately 200 km	24 S.	70 W.
Dec. 23	8 16.4	California	36.4 N.	117.9 W.
Dec. 27	15 25.7	New Britain. Depth approximately 100 km	6 S.	150 E.
Dec. 28	1 05.6	....do	6 S.	150 E.
Dec. 29	22 55.9	Mexico, off south coast	8 N.	104 W.
Dec. 29	23 45.3	....do	8 N.	104 W.
Dec. 30	22 03.1	Oregon, off coast	43.7 N.	127.0 W.

Table 2.—*Principal earthquakes of the world from January 1945 to December, 1945, 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, (3) earthquakes of unusual interest outside the two preceding categories, and (4) magnitudes as determined by Pasadena.

1945	Origin time G. C. T.	Region	Coordinates of provisional epicenter		Remarks, Depths, Principal Facts, Magnitudes
			Latitude	Longitude	
	h. m.		° ′	° ′	
Jan. 1	1 20.7	Baffin Bay	73 N.	69½ W.	7
Jan. 12	18 38.5	Honshu, Japan, off southcentral coast	34½ N.	138 E.	6.9
Feb. 10	4 57.9	Hokkaido, Japan, off south coast	41½ N.	142 E.	Depth slight. Felt in Honshu. Property damage. 7.3.
Feb. 14	3 01.3	Idaho	44.7 N.	115.4 W.	Felt in Idaho, Montana, Oregon, and Washington.
Mar. 17	23 57.9	Colombia, off west coast	6.7 N.	78.1 W.	Felt in Panama Canal Zone.
Mar. 20	.....	Turkey	.....	.....	One dispatch reports 14 killed, another 300 killed, near Adana.
Apr. 15	2 35.3	Kamchatka, off east coast	57½ N.	164 E.	7
May 19	15 07.0	California, off Cape Mendocino	40.6 N.	126.4 W.	Felt in California. 6
June 3	13 05.6	Panama, western Chiriqui Province	8.6 N.	82.6 W.	Felt in Panama. 7.
June 22	9 18.6	Hokkaido, Japan, off northeast coast	44 N.	146 E.	Depth about 100 km. 7.0
June 24	19 57.9	Chile, about 100 miles south of Santiago	35 S.	71 W.	....Do.
June 27	13 08.3	Gulf of California	26.7 N.	111.3 W.	Felt in Lower California. 7.0
July 15	5 35.1	Mariana Islands region	17½ N.	146 E.	Depth about 100 km. 7.1
July 26	10 32.3	South Carolina	34.3 N.	81.4 W.	
Aug. 21	16 29.6	Central Peru	10½ S.	75½ W.	Depth about 100 km.
Sept. 13	11 17.1	Chile, about 60 miles south of Santiago	34.2 S.	70.8 W.	.... Do. 7.1
Sept. 28	22 24.1	California, off north coast	41.7 N.	126.9 W.	6
Oct. 9	14 36.7	Hokkaido, Japan, off east coast	44 N.	147½ E.	Depth about 100 km. 7.0
Oct. 25	14 58.7	Kamchatka, off east coast	57 N.	165 E.	
Nov. 3	22 09.0	Alaska, off south coast	59 N.	151 W.	
Nov. 8	10 02.7	Greenland, near northeast coast	81 N.	18 W.	
Nov. 16	18 02.3	Alaska, about 100 miles west of Juneau	58 N.	137 W.	
Nov. 26	5 13.2	Southwest of Tonga Islands	21 S.	180 W.	Depth about 600 km. 7.0
Nov. 27	21 57.0	Iran, off southeast coast	25 N.	60½ E.	Strong seismic seawaves. Destructive along Arabian Sea coast, especially at Ormara, Baluchistan, and Karachi, India. 4,000 persons reported killed. Considerable property damage. 8¼
Dec. 8	1 04.1	South of New Britain	6½ S.	151 E.	7.1
Dec. 28	17 48.8	....Do	6½ S.	151 E.	7.8

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 twelve preceding issues of this series, Serials 579, 593, 600, 610, 619, 629, 637, 647, 655, 662, 672, and 682, 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. 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.

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 1945 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 centimeters per second per second for acceleration. It is sometimes desirable to express acceleration in terms of the acceleration of gravity, indicated by "g" which is equal to 980 cm/sec.^{2} For practical purposes it is only necessary to point off three decimal places to convert cm/sec.^{2} to "g."

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

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

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

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

Time used.—Times given in connection with the strong motion seismograph results for 1945 are war time or one hour more than standard.

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 1.80 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 4 in this issue. 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 4 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 have been reduced from 0.1 second to about 0.07 second. Also a number of the 6-inch and 12-inch recorders have been 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) conglomerate 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 12-inch drums as compared with the 6-inch.

In the notes following table 3 listing the strong-motion records obtained during 1945 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 4 maximum recorded acceleration is not necessarily associated with the same ground period as the maximum computed displacement.

Table 3.—*List of shocks recorded and records obtained on strong motion seismographs in 1945*

Date, epicenter, and recording station	Records		
	Accelerograph	Displacement meter	Weed strong motion seismograph
Jan. 7: Northern California:			
San Jose	2		
Hollister			1
Jan. 10: Northern California: Ferndale	1		
Mar. 17: Off Colombia, South America:			
Balboa Heights	1		
Apr. 1: Southern California: Santa Barbara	1		
May 2: Northern California: Eureka	1	1	
May 17: Northern California:			
Hollister			1
San Francisco Shell Building			3
San Francisco Southern Pacific Building	2	1	
May 19: Northern California:			
Ferndale	1		
Eureka	1	1	
June 1: Southwestern Montana: Helena	1		
June 8: Chile, Santiago region: Santiago	1		
June 24: Chile, Santiago region: Santiago	1		
August 15: Southern California:			
El Centro	1		
San Diego	1		
Los Angeles Subway Terminal	2	1	
Hollywood Storage Company	3		
Aug. 27: Northern California: San Jose	2		
Sept. 7: Southern California: San Bernardino			1
Sept 13: Chile, Santiago region: Santiago	1		
Total	23	4	

NORTHERN CALIFORNIA EARTHQUAKE OF JANUARY 7

Epicenter in the Hollister area. Maximum intensity VI at three places.

San Jose Bank of America.—Station about 48 miles NW 320° of epicenter. Intensity III in San Jose. Maximum acceleration 3 cm/sec.^{2} and computed maximum displacement .102 cm. on thirteenth floor. Maximum acceleration 1 cm/sec.^{2} and computed maximum displacement 0.002 cm. in basement.

Hollister.—Intensity VI in Hollister. Recorded maximum displacement 0.73 cm. and no available computed maximum acceleration.

NORTHERN CALIFORNIA EARTHQUAKE OF JANUARY 10

Epicenter in the Upper Mattole area. Maximum intensity V.

Ferndale.—Station about 20 miles NW 350° of epicenter. Intensity IV in Ferndale. Maximum acceleration 8 cm/sec.^{2} and computed maximum displacement 0.007 cm.

EARTHQUAKE OF MARCH 17 OFF COLOMBIA, SOUTH AMERICA

Provisional epicenter off the coast of Colombia at 6.7° north, 78.1° west. Maximum intensity about IX at the epicenter.

Balboa Heights.—Station about 170 miles NW 233° of epicenter. Felt in Balboa Heights. Maximum acceleration 14 cm/sec.^{2} and computed maximum displacement 0.050 cm.

SOUTHERN CALIFORNIA EARTHQUAKE OF APRIL 1

Epicenter from local instrumental data, 34°00′ north, 120°01′ west, Santa Rosa Island. Maximum intensity IV reported at several places.

Santa Barbara.—Station 36 miles NE 32° of epicenter. Intensity IV in Santa Barbara. Maximum acceleration 6 cm/sec.^{2} and computed maximum displacement 0.045 cm.

NORTHERN CALIFORNIA EARTHQUAKE OF MAY 2

Epicenter from local instrumental data, 41.3° north, 122.5° west, near Scott Mountain. Maximum intensity VI at two places.

Eureka.—Station 50 miles SW 256° of epicenter. Intensity V at Eureka. Maximum acceleration 4 cm/sec.^{2} and computed maximum displacement 0.003 cm. Maximum displacement 0.03 cm. recorded on displacement meter and computed maximum acceleration 0.7 cm/sec.^{2}

NORTHERN CALIFORNIA EARTHQUAKE OF MAY 17

Epicenter in the Hollister area. Maximum intensity VI at Hollister.

Hollister.—Maximum acceleration 55 cm/sec.^{2} and computed maximum displacement 0.068 cm.

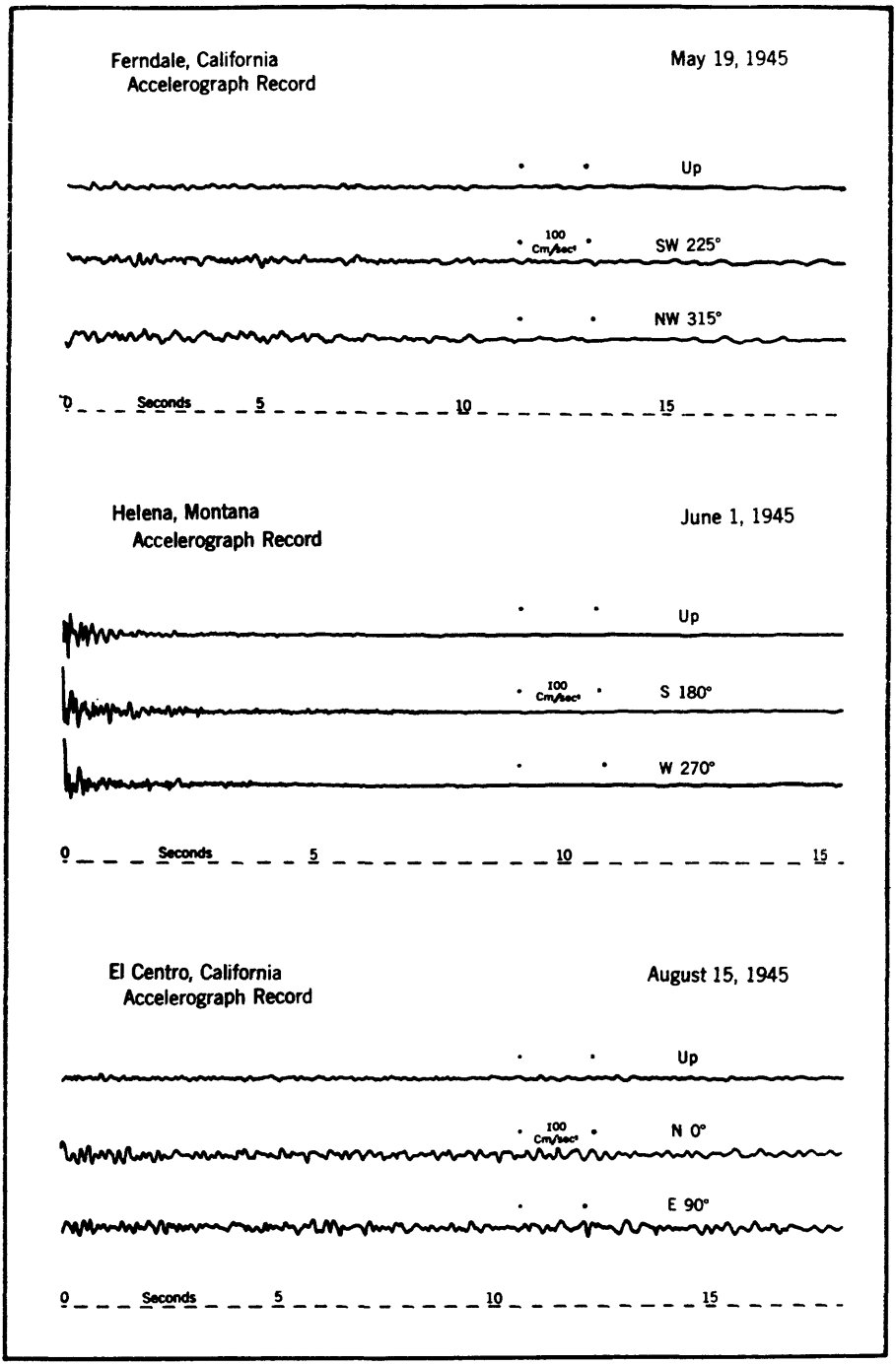


FIGURE 6.—Tracings of accelerograph records obtained at Ferndale on May 19, Helena, Montana, on June 1, and El Centro on August 15.

San Francisco Shell Building.—Station about 85 miles NW 210° of epicenter. Maximum acceleration 4 cm/sec.² and computed maximum displacement 0.072 cm. on twenty-ninth floor. Maximum trace amplitude 0.24 cm. on twenty-first floor, and 0.07 cm. in sub-basement.

San Francisco Southern Pacific Building.—Station about 85 miles NW 210° of epicenter. Maximum acceleration 13 cm/sec.² and computed maximum displacement 0.075 cm. on fourteenth floor. Maximum acceleration 2 cm/sec.² and computed maximum displacement 0.009 cm. in basement. Maximum displacement 0.01 cm. recorded on displacement meter and computed maximum acceleration 4 cm/sec.²

NORTHERN CALIFORNIA EARTHQUAKE OF MAY 19

Epicenter from local instrumental data, 40.6° north, 126.4° west, off northern California coast. Maximum intensity V at one place.

Ferndale.—Figure 6. Station 105 miles NE 70° of epicenter. Intensity IV at Ferndale. Maximum acceleration 10 cm/sec.² and computed maximum displacement 0.076 cm.

Eureka.—Station about 115 miles NE 60° of epicenter. Intensity IV at Eureka. Maximum acceleration 2 cm/sec.² and computed maximum displacement 0.002 cm. Maximum displacement 0.50 .cm. recorded on displacement meter and computed maximum acceleration 0.32 cm/sec.²

SOUTHWESTERN MONTANA EARTHQUAKE OF JUNE 1

Epicenter from local instrumental data, 46.6° north, 112.0° west, about 3 miles northwest of Helena. The location is the same as the destructive Helena earthquake of October 31, 1935. Maximum intensity V.

Helena.—Figure 6. Station about 3 miles SE 165° of epicenter. Intensity V at Helena. Maximum acceleration 35 cm/sec.² and computed maximum displacement 0.008 cm.

EARTHQUAKE OF JUNE 8 NEAR SANTIAGO, CHILE

Epicenter near Santiago, Chile. Maximum intensity unknown.

Santiago.—Weak record obtained. Maximum acceleration 16 cm/sec.² and computed maximum displacement 0.004 cm.

EARTHQUAKE OF JUNE 24 NEAR SANTIAGO, CHILE

Epicenter from instrumental data, 35° south, 71° west, about 105 miles south of Santiago. Maximum intensity unknown.

Santiago.—Maximum acceleration 6 cm/sec.² and computed maximum displacement 0.003 cm.

SOUTHERN CALIFORNIA EARTHQUAKE OF AUGUST 15

Epicenter from local instrumental data, 33°13′ north, 116°08′ west, in San Jacinto Fault near Borego Valley. Maximum intensity VI at a few places.

El Centro.—Figure 6. Station 42 miles SE 127° of epicenter. Intensity V at El Centro. Maximum acceleration 13 cm/sec.² and computed maximum displacement 0.013 cm.

San Diego.—Station 78 miles SW 217° of epicenter. Intensity V at San Diego. Maximum acceleration 5 cm/sec.² and computed maximum displacement 0.013 cm.

Los Angeles Subway Terminal.—Station 160 miles NW 297° of epicenter. Intensity III at Los Angeles. Maximum acceleration 3 cm/sec.² and computed maximum displacement 0.015 cm. on thirteenth floor. Maximum acceleration 1 cm/sec.² and computed maximum displacement 0.562 cm. in sub-basement. Maximum displacement 0.1 cm. recorded on displacement meter and computed maximum acceleration 1 cm/sec.²

Hollywood Storage Company.—Station 164 miles NW 298° of epicenter. Maximum acceleration 9 cm/sec.² and computed maximum displacement 0.062 cm. in penthouse. Maximum acceleration 1 cm/sec.² and computed maximum displacement 0.004 cm. in basement. Maximum acceleration 1 cm/sec.² and computed maximum displacement 0.005 cm. in P. E. lot.

NORTHERN CALIFORNIA EARTHQUAKE OF AUGUST 27

Epicenter in the San Jose area. Maximum intensity VI at one place.

San Jose.—Figure 7. Intensity IV at San Jose. Maximum acceleration 15 cm/sec.² and computed maximum displacement 0.55 cm. on thirteenth floor. Maximum acceleration 16 cm/sec.² and computed maximum displacement 0.019 cm. in basement.

SOUTHERN CALIFORNIA EARTHQUAKE OF SEPTEMBER 7

Epicenter from local instrumental data, 33°58′ north, 116°48′ west, in San Andreas Fault north of Cabazon. Maximum intensity IV at a few places.

San Bernardino.—Station 36 miles NW 285° of epicenter. The surface waves are scarcely perceptible.

EARTHQUAKE OF SEPTEMBER 13 NEAR SANTIAGO, CHILE

Epicenter from instrumental data, 34.2° south, 70.8° west, about 60 miles south of Santiago. Destructive. Maximum intensity unknown.

Santiago.—Figure 7. Maximum acceleration 131 cm/sec.² and computed maximum displacement 0.275 cm.

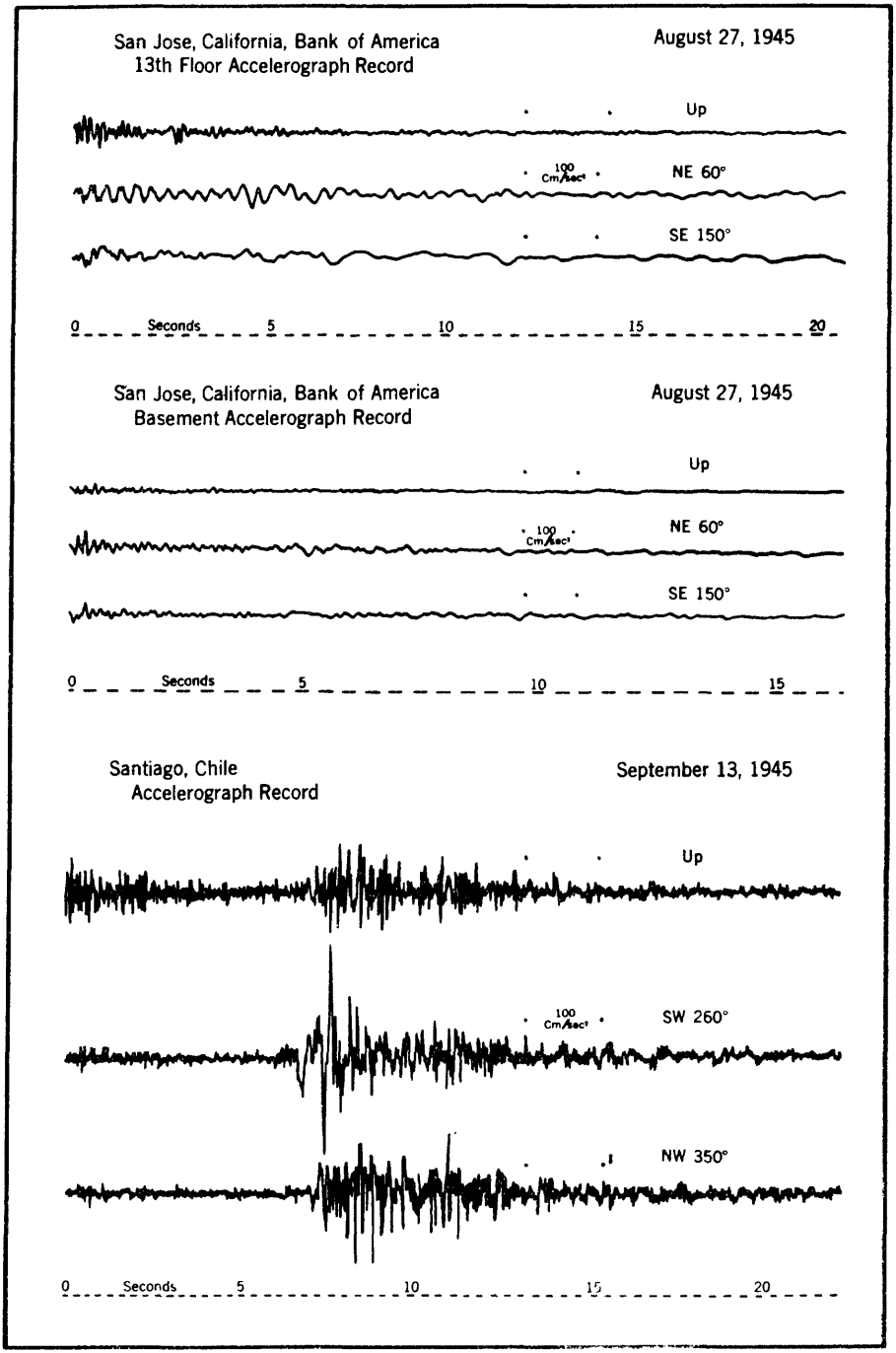


FIGURE 7.—Tracings of accelerograph records obtained at San Jose Bank of America, 13th floor and basement, on August 27, and Santiago, Chile, on September 13.

Table 4.—*Summary of strong motion seismograph data for the year 1945*

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

Station and component	Earthwave period	Maximum acceleration	Maximum displacement	Remarks
	Seconds	*Cm/sec.²*	*Cm.*	
NORTHERN CALIFORNIA EARTHQUAKE OF JANUARY 7				
San Jose Bank of America, 13th floor accelerograph:				
Vertical, up	0.19	3	0.003	Very weak.
	.28	1	.002	
NE: 60°	.87	3	.057	Weak long-period waves.
	1.18	3	.102	Short periods superposed.
SE: 150°	.52	2	.012	Weak irregular long periods.
	.51	3	.020	
basement accelerograph:				
Vertical, up				Too weak.
NE: 60°	.28	1	.002	Very weak.
SE: 150°	.36			Do.
Hollister Weed seismograph:				
NE: 45°			.69	Trace amplitude only.
NW: 315°			.73	Do.
NORTHERN CALIFORNIA EARTHQUAKE OF JANUARY 10				
Ferndale accelerograph:				
Vertical, up	0.31	3	0.007	Short periods superposed.
	.22	2	.002	
SW: 225°	.12	4	.001	Irregular periods.
	.18	5	.004	Do.
	.32	1	.003	
NW: 315°	.09	8	.002	Possibly preceded by stronger motion.
	.08	4	.001	
	.27	2	.004	Weak.
EARTHQUAKE OF MARCH 17 OFF COLOMBIA, SOUTH AMERICA				
Balboa Heights accelerograph:				
Vertical, up	0.18	1	0.001	Weak irregular motion.
	.18	1	.001	Do.
SE: 100°	.25	7	.001	Regular sinusoidal motion.
	.27	7	.013	Short periods superposed.
	.44	6	.030	Do.
	.27	6	.011	Sinusoidal wave.
SW: 190°	.38	14	.052	Irregular motion.
	.20	7	.007	Do.
	.46	3	.016	Short periods superposed. Weak motion.
SOUTHERN CALIFORNIA EARTHQUAKE OF APRIL 1				
Santa Barbara accelerograph:				
Vertical, up	0.52	3	0.021	Weak short-period waves superposed.
	.41	3	.013	Weak.
	.50	3	.019	Do.
NE: 45°	.32	6	.016	Possibly preceded by stronger motion.
	.57	3	.025	Short-period waves superposed.
	.47	4	.022	Regular waves.
	.43	3	.014	
SE: 135°	.18	3	.002	Weak irregular waves.
	.60	5	.045	
	.60	4	.036	
NORTHERN CALIFORNIA EARTHQUAKE OF MAY 2				
Eureka accelerograph:				
Vertical, up	0.17	2	0.001	Very weak record.
	.14	2	.001	
NE: 79°	.16	2	.001	Possibly preceded by stronger motion.
	.19	3	.002	
SE: 169°	.19	2	.002	Weak irregular motion.
	.15	2	.001	
	.17	4	.003	
Eureka, right displacement meter:				
SE: 169°	1.09	0.7	.02	Very weak motion.
	1.12	.3	.01	
Eureka, left displacement meter				
SW: 259°	1.63	.5	.03	Weak motion.
	1.34	.5	.02	
	1.17	.6	.02	

Table 4.—Summary of strong-motion seismograph data for the year 1945—Continued

NORTHERN CALIFORNIA EARTHQUAKE OF MAY 17

Hollister Weed seismograph:				
NE: 45°	0.09	55	0.001	Strong sharp phases.
	.16	37	.024	Do.
	.18	28	.023	
	.18	7	.006	
NW: 315°	.21	38	.042	Strong sharp phases.
	.21	48	.023	Do.
	.23	51	.068	
	.30	26	.061	Sinusoidal waves.
San Francisco Shell Building, sub-basement Weed seismograph:				
N: 0°	.....	.....	.....	Double trace amplitude 0.07 cm. Brief duration. Lost motion evident.
E: 90°	.....	.....	.....	Double trace amplitude 0.03 cm.
21st floor Weed seismograph:				
E: 90°	.....	.....	.....	Initial and maximum trace amplitude 0.23 cm. with reversal 0.11 cm. to new zero position. Brief and jerky.
N: 0°	.....	.....	.....	Initial and maximum trace amplitude 0.24 cm. with reversal 0.07 cm. to new zero position.
29th floor Weed seismograph:				
E: 90°	.84	4	.072	Regular sinusoidal waves.
	.72	4	.054	
N: 0°	.76	2	.036	Regular sinusoidal waves.
	.76	2	.036	These periods are greater than all of the natural periods of the building except the fundamental which is 1.90 sec.
San Francisco Southern Pacific Building, basement accelerograph:				
Vertical, up	.41	2	.009	Very weak.
NW: 319°	.48	1	.006	Do.
NE: 49°	.46	1	.005	Do.
Right displacement meter:				
NW: 319°	.48	1.60	.01	
Left displacement meter:				
NE: 49°	.30	4.44	.01	
14th floor accelerograph:				
Vertical, up	.32	1	.003	Irregular motion.
	.42	2	.009	
	.37	1	.003	Weak waves.
SW: 229°	.42	7	.031	Possibly preceded by stronger motion.
	.46	4	.022	
	.81	2	.033	Weak short-period waves superposed.
NW: 319°	.48	13	.075	Possibly preceded by stronger motion.
	.51	10	.066	
	.52	6	.041	
	1.01	2	.051	Regular waves.

NORTHERN CALIFORNIA EARTHQUAKE OF MAY 19

Ferndale accelerograph:				
Vertical, up	0.25	5	0.008	Irregular motion.
	.33	3	.008	Do.
	.20	3	.003	
	.32	1	.003	
SW: 225°	.43	6	.028	Short-period waves superposed.
	.15	6	.003	
	.25	9	.015	Regular waves.
	.32	3	.008	Do.
NW: 315°	.32	10	.026	Possibly preceded by stronger motion.
	.52	9	.062	Short-period waves superposed.
	.43	4	.019	Irregular waves.
	.61	8	.076	
Eureka accelerograph:				
Vertical, up	.....	.....	.....	Extremely weak.
NE: 79°	.06	2	.001	Very weak.
	.24	1	.001	
SE: 169°	.29	1	.002	Weak irregular motion.
	.17	2	.001	
Eureka, right displacement meter:				
SE: 169°	1.94	0.11	.11	Regular motion.
	8.70	.32	.50	
Eureka, left displacement meter:				
SW: 259°	1.70	.20	.09	Regular motion.
	7.90	.24	.28	

Table 4.—Summary of strong-motion seismograph data for the year 1945—Continued

SOUTHWESTERN MONTANA EARTHQUAKE OF JUNE 1				
Helena accelerograph:				
Vertical, up	0.11	28	0.008	Strong phase.
	.13	11	.005	Regular waves.
	.11	4	.001	
S: 180°	.08	35	.006	Strong phase at beginning.
	.09	20	.004	
	.11	11	.003	Strong phase.
	.14	4	.002	Sinusoidal waves.
W: 270°	.06	29	.003	Possibly preceded by stronger motion.
	.14	16	.008	
	.10	3	.001	Irregular waves.
	.11	1	.001	
EARTHQUAKE OF JUNE 8 NEAR SANTIAGO, CHILE				
Santiago accelerograph:				
Vertical, up	0.13	10	0.004	Possibly preceded by stronger motion.
	.11	5	.002	Regular waves.
SW: 260°	.07	11	.001	
	.09	6	.001	
	.07	5	.001	Weak motion.
NW: 350°	.09	16	.003	Possibly preceded by stronger motion.
	.15	4	.002	
	.24	1	.001	Irregular motion.
EARTHQUAKE OF JUNE 24 NEAR SANTIAGO, CHILE				
Santiago accelerograph:				
Vertical, up	0.11	3	0.001	Weak irregular motion.
	.05	2	.001	Very weak.
SW: 260°	.10	6	.002	Weak irregular motion.
	.11	3	.001	Short periods superposed on longer periods.
NW: 350°	.20	3	.003	Weak.
	.11	2	.001	
SOUTHERN CALIFORNIA EARTHQUAKE OF AUGUST 15				
El Centro accelerograph:				
Vertical, up	0.14	4	0.002	Very irregular motion.
	.15	2	.001	
	.23	3	.004	Short periods superposed.
N: 0°	.15	13	.007	Possibly preceded by stronger motion.
	.17	12	.009	Regular waves.
	.27	7	.013	
	.23	7	.009	
E: 90°	.16	10	.007	Possibly preceded by stronger motion.
	.10	11	.003	
	.17	11	.008	Regular waves.
	.20	12	.012	
	.34	4	.012	
San Diego accelerograph:				
Vertical, up	.19	1	.001	Very weak.
	.29	1	.002	
E: 90°	.32	5	.013	Possibly preceded by stronger motion.
	.33	4	.011	Short periods superposed.
	.36	2	.007	
S: 180°	.13	3	.001	
	.32	2	.005	Sinusoidal waves.
	.36	1	.003	
Los Angeles Subway Terminal 13th floor accelerograph:				
Vertical, up	.40	1	.004	Very weak.
SW: 219°	.60	1	.009	
	.67	1	.011	Sinusoidal waves.
NW: 309°	.22	1	.001	Weak irregular motion.
	.22	3	.004	
	.56	2	.015	Weak motion.
Sub-basement accelerograph:				
Vertical, up	.....	.....	.....	Too weak.
SE: 129°	.....	.....	.....	Do.
SW: 219°	4.9	1	.562	Very weak.
Right displacement meter:				
NE: 39°	.....	.....	.....	Very long periodic and weak waves.
Left displacement meter:				
SE: 129°	5.6	1	.1	Very weak.
Hollywood Storage Company Penthouse accelerograph:				
Vertical, up	.40	2	.008	
	.52	2	.013	Sinusoidal weak motion.
S: 180°	.34	3	.009	Irregular waves.
	.65	3	.032	
W: 270°	.52	9	.062	Very irregular motion
	.45	5	.026	
	.50	2	.013	

Table 4.—Summary of strong-motion seismograph data for the year 1945—Continued

SOUTHERN CALIFORNIA EARTHQUAKE OF AUGUST 15.—Continued

Basement accelerograph:				
Vertical, up	.41	1	004	Very weak.
E: 90°	.42	1	.004	Do.
S: 180°	.41	1	004	Do.
P. E. lot accelerograph:				
Vertical, up				Too weak.
E: 90°	.44	1	.005	Very weak.
S: 180°	.39	1	.004	Do.

NORTHERN CALIFORNIA EARTHQUAKE OF AUGUST 27

San Jose Bank of America 13th floor accelerograph:				
Vertical, up	0.17	15	0.001	Strong motion at beginning.
	.18	10	.008	Regular motion.
	.19	9	.008	
NE: 60°	.33	9	.025	Short-period waves superposed.
	.44	13	.064	
	1.89	6	.55	Very long waves.
SE: 150°	.29	7	.015	Very irregular motion.
	1.94	5	.048	Part of record lost.
Basement accelerograph:				
Vertical, up	.11	8	.002	Irregular waves.
	13	4	.002	
	13	1	.001	Weak irregular waves.
NE: 60°	15	12	.007	Possibly preceded by stronger motion.
	.10	16	.004	
	.02	5	.001	Short-period waves superposed.
SE: 150°	13	8	.003	Possibly preceded by stronger motion.
	.10	4	.001	Very irregular.
	.43	4	.019	

SOUTHERN CALIFORNIA EARTHQUAKE OF SEPTEMBER 7

San Bernardino strong motion seismograph:				Surface waves are scarcely perceptible.

EARTHQUAKE OF SEPTEMBER 13 NEAR SANTIAGO, CHILE

Santiago accelerograph:				
Vertical, up	0.14	40	0.020	Strong phase. Possibly preceded by stronger motion.
	.10	28	.007	Strong irregular motion.
	.14	14	.007	
	.09	50	.010	Strong motion corresponding to S phase on a teleseismic record.
	.08	53	.008	Sharp phases.
	.09	7	.001	Short periods superposed on 0.43 sec. waves.
SW: 260°	.14	15	.008	Weak irregular motion at beginning.
	.12	7	.003	
	.29	131	.275	Maximum acceleration for quake.
	.08	42	.007	Regular motion.
	.13	18	.007	Do.
	.05	13	.001	Short periods superposed on 0.75 sec. waves.
NW: 350°	.12	10	.004	Weak irregular motion.
	.25	37	059	Strong irregular waves.
	.17	67	.049	Strong motion.
	.14	23	.011	
	.11	13	.004	Irregular motion.
	.07	8	.001	Short periods superposed on longer waves.

Table 5.—*Instrumental constants of strong motion seismographs in 1945*

Station and instrument	Orientation of instrument[1]	Pendulum period	Static magnification	Sensitivity[2]	Damping ratio	Instrument number
		Sec.		*Cm.*		
NORTHERN CALIFORNIA EARTHQUAKE OF JANUARY 7						
San Jose Bank of America						
13th floor accelerograph No. 35	Up	0.100	77	1.96	10	V–107
	NE. 60°	.097	76	1.81	12	L–87
	SE. 150°	.097	76	1.81	9	T–97
Basement accelerograph No. 8	Up	.069	111	1.34	13	V–49
	NE. 60°	.068	113	1.32	9	L–50
	SE. 150°	.067	115	1.31	8	T–51
Hollister Weed seismograph No. 8	NE. 45°	.18	10.1	0.93	3.6	.....
	NW. 315°	.18	10.1	0.86	5.1	.....
NORTHERN CALIFORNIA EARTHQUAKE OF JANUARY 10						
Ferndale accelerograph No. 28	Up	0.097	71	1.70	10	V–126
	SW. 225°	.098	71	1.73	12	L–124
	NW. 315°	.100	74	1.88	10	T–125
EARTHQUAKE OF MARCH 17 OFF COLOMBIA, SOUTH AMERICA						
Balboa Heights accelerograph No. 31	Up	0.098	.....	2.82	8	V–73
	SE. 100°	.100	.....	2.88	8	L–74
	SW. 190°	.100	.....	2.96	10	T–75
SOUTHERN CALIFORNIA EARTHQUAKE OF APRIL 1						
Santa Barbara accelerograph No. 26	Up	0.101	78	2.02	8	V–55
	NE. 45°	.097	78	1.87	9	L–56
	SE. 135°	.099	77	1.91	11	T–57
NORTHERN CALIFORNIA EARTHQUAKE OF MAY 2						
Eureka accelerograph No. 30	Up	0.070	101	1.25	10	V–29
	NE. 79°	.069	107	1.29	9	L–13
	SE. 169°	.069	108	1.30	8	T–8
Eureka displacement meter No. 13	SE. 169°	10.0	1	.....	8	.....
	SW. 259°	9.9	1	.....	10	.....
NORTHERN CALIFORNIA EARTHQUAKE OF MAY 17						
Hollister Weed seismograph No. 8	NE. 45°	0.19	10.1	0.93	3.1	.....
	NW. 315°	.18	10.1	0.86	5.0	.....
San Francisco Shell Building[3]						
Sub-basement Weed seismograph No. 2	N. 0°	.184	7.3	0.63	5.1	.....
	E. 90°	.188	7.3	0.65	5.4	.....
21st floor Weed seismograph No. 6	E. 90°	.18	6.4	0.52	3.6	.....
	N. 0°	.18	6.4	0.52	2.9	.....
29th floor Weed seismograph No. 4	E. 90°	.18	7.6	0.62	4.1	.....
	N. 0°	.18	7.6	0.69	4.8	.....
San Francisco Southern Pacific Building[3]						
Basement accelerograph No. 27	Up	.068	115	1.35	13	V–110
	NW. 319°	.069	118	1.42	10	L–90
	NE. 49°	.069	111	1.34	9	T–100
Basement displacement meter No. 18	NW. 319°	9.9	1.0	.....	9.0	.....
	NE. 49°	9.9	1.0	.....	9.6	.....
14th floor accelerograph No. 34	Up	.101	83	2.13	9	V–108
	SW. 229°	.101	80	2.07	12	L–88
	NW. 319°	.101	78	2.01	10	T–98
NORTHERN CALIFORNIA EARTHQUAKE OF MAY 19						
Ferndale accelerograph No. 28	Up	0.097	72	1.71	9	V–126
	SW. 225°	.099	71	1.76	11	L–124
	NW. 315°	.100	74	1.89	9	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°	.069	108	1.30	8	T–8
Eureka displacement meter No. 13	SE. 169°	10.0	1	.....	8	.....
	SW. 259°	9.9	1	.....	10	.....

Table 5.—Instrumental constants of strong-motion seismographs in 1945—Continued

SOUTHWESTERN MONTANA EARTHQUAKE OF JUNE 1						
Helena accelerograph No. 48	Up	0.100	76	1.93	9	V–135
	S. 180°	.100	81	2.04	10	L–133
	W. 270°	.102	83	2.18	9	T–134
EARTHQUAKE OF JUNE 8 NEAR SANTIAGO, CHILE						
Santiago accelerograph No. 50	Up	0.097	80	1.90	10	V–151
	SW. 260°	.098	82	1.98	8	L–141
	NW. 350°	.100	81	2.04	9	T–150
EARTHQUAKE OF JUNE 24 NEAR SANTIAGO, CHILE						
Santiago accelerograph No. 50	Up	0.097	80	1.90	10	V–151
	SW. 260°	.098	82	1.98	8	L–141
	NW. 350°	.100	81	2.04	9	T–150
SOUTHERN CALIFORNIA EARTHQUAKE OF AUGUST 15						
El Centro accelerograph No. 4	Up	0.098	78	1.88	10	V–10
	N. 0°	.099	77	1.90	8	L–4
	E. 90°	.100	77	1.63	8	T–15
San Diego accelerograph No. 5	Up	.096	106	2.46	10	V–70
	E. 90°	.100	107	2.72	9	L–71
	S. 180°	.099	111	2.76	8	T–72
Los Angeles Subway Terminal[3]						
13th floor accelerograph No. 39	Up	.101	83	2.14	10	V–112
	SW. 219°	.100	81	2.05	8.5	L–92
	NW. 309°	.100	79	2.01	10	T–102
Sub-basement accelerograph No. 3	Up	.69	116	1.40	8	V–58
	SE. 129°	.69	118	1.43	9	L–59
	SW. 219°	.70	120	1.48	10	T–60
Sub-basement displacement meter No 13	NE. 39°	9.9	1.0	.....	9	.....
	SE. 129°	10.3	1.0	.....	10	.....
Hollywood Storage Company[3]						
Penthouse accelerograph No. 40	Up	.099	81	2.00	8	V–113
	S. 180°	.099	84	2.09	7	L–93
	W. 270°	.100	79	2.00	8	T–103
Basement accelerograph No. 22	Up	.068	105	1.22	8	V–25
	E. 90°	.069	111	1.33	8	L–3
	S. 180°	.070	110	1.37	6	T–18
P. E. lot accelerograph No. 1	Up	.070	108	1.34	8	V–66
	E. 90°	.070	108	1.34	6	L–64
	S. 180°	.070	111	1.38	8	T–65
NORTHERN CALIFORNIA EARTHQUAKE OF AUGUST 27						
San Jose Bank of America						
13th floor accelerograph No. 35	Up	0.101	82	2.10	10	V–107
	NE. 60°	.098	76	1.86	11	L–87
	SE. 150°	.098	76	1.85	9	T–97
Basement accelerograph No. 8	Up	.070	111	1.36	10.6	V–49
	NE. 60°	.067	113	1.30	8.1	L–50
	SE. 150°	.067	115	1.31	4.7	T–51
SOUTHERN CALIFORNIA EARTHQUAKE OF SEPTEMBER 7						
San Bernardino Weed seismograph No. 10	SE. 135°	0.19	10	.....	1.9	.....
	NE. 45°	.19	10	.....	1.6	.....
EARTHQUAKE OF SEPTEMBER 13 NEAR SANTIAGO, CHILE						
Santiago accelerograph No. 50	Up	0.097	80	1.90	.....	V–151
	SW. 260°	.097	82	1.98	9	L–141
	NW. 350°	.102	81	2.04	8	T–150

[1] The directions given indicate the direction of pendulum displacement relative to instrument pier, which will displace the trace upward on the original seismogram.

Directions for the horizontal components are given first by quadrant followed by specific directions expressed in degrees measured from north around by east.

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

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

TILT OBSERVATIONS

With the cooperation of the University of California, two tilt-meters were operated at Berkeley. The tilt-graph data obtained from these instruments during 1945 are shown in figure 8, inside back cover.

A third tilt-meter was operated at Long Beach, California, in cooperation with the Long Beach Harbor Department. The 1945 tilt-graph results from this station are shown in figure 9, inside back cover.

CORRECTION TO PREVIOUS PUBLICATION

1944, September 5: Origin time of the destructive Cornwall, Ontario-Massena, New York earthquake should be 4h 38.7 m., G. C. T.

U. S. Earthquakes 1944, page 30, table 4; the date November 15 should read November 14.

PUBLICATION NOTICES

To make immediately available the results of its various activities to those interested, the Coast and Geodetic Survey maintains mailing lists of persons and firms desiring to receive notice of the issuance of charts, Coast Pilots, maps, and other publications.

Should you desire to receive such notices, you may use the form given below, checking the list covering the subjects in which you are interested.

(Date).....

DIRECTOR U. S. COAST AND GEODETIC SURVEY,

Washington 25, *D. C.*

Dear Sir: I desire that my name be placed on the mailing lists indicated by check below, to receive notification of the issuance of publications referring to the subjects indicated:

☐	109.	Astronomic Work	☐	109–I.	Oceanography
☐	109–A.	Base Lines.	☐	109–J.	Traverse
☐	109–B.	Coast Pilots.	☐	109–K.	Seismology
☐	109–C.	Currents	☐	109–L.	Geomagnetism
☐	109–D.	Geodesy	☐	109–M.	Tides
☐	109–E.	Gravity	☐	109–N.	Topography
☐	109–F.	Hydrography	☐	109–O.	Triangulation
☐	109–G.	Leveling	☐	109–P.	Cartography
☐	109–H	Nautical charts	☐	109–R.	Aeronautical charts.

(Name).....

(Address).....

84-941

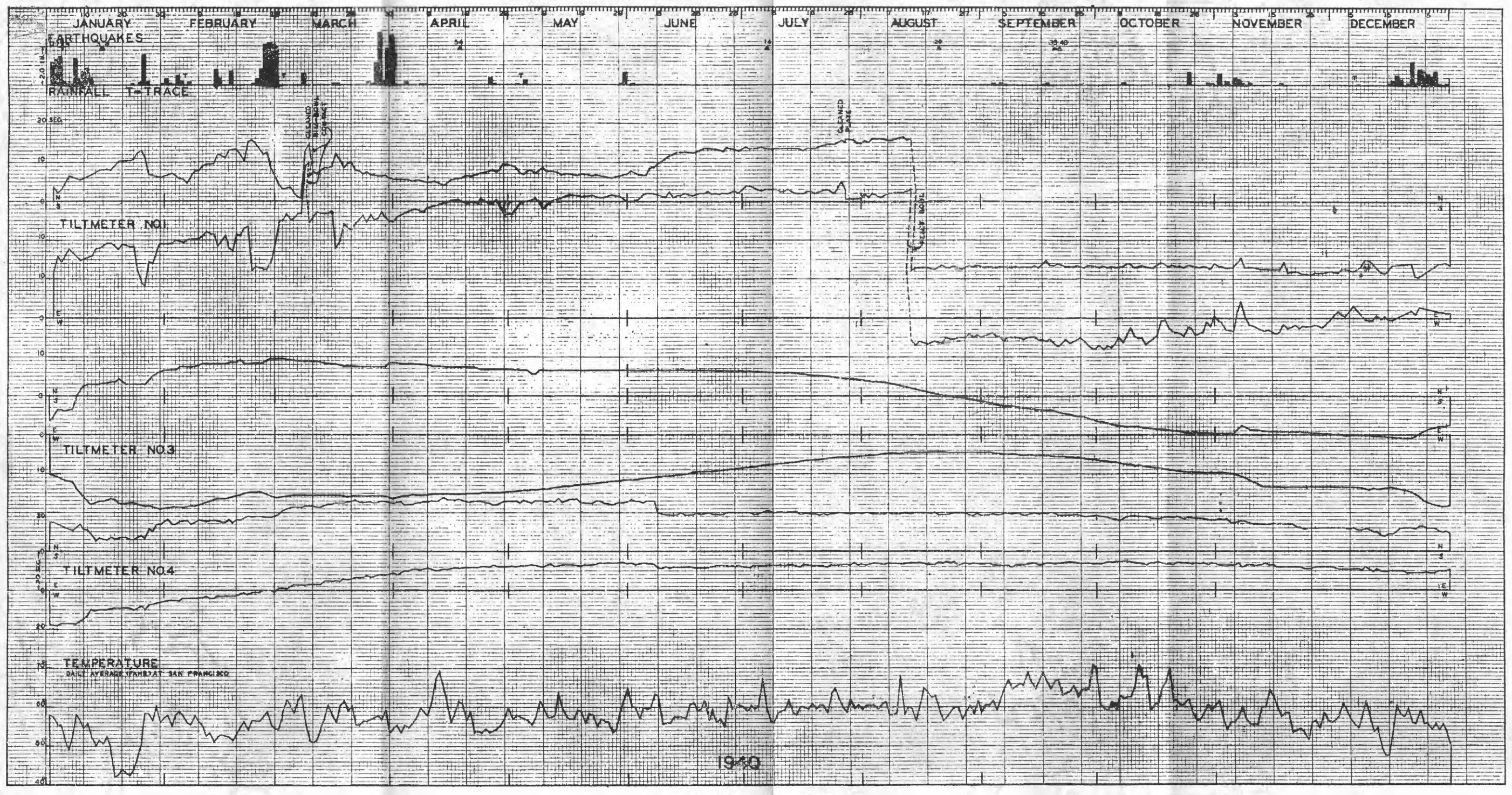
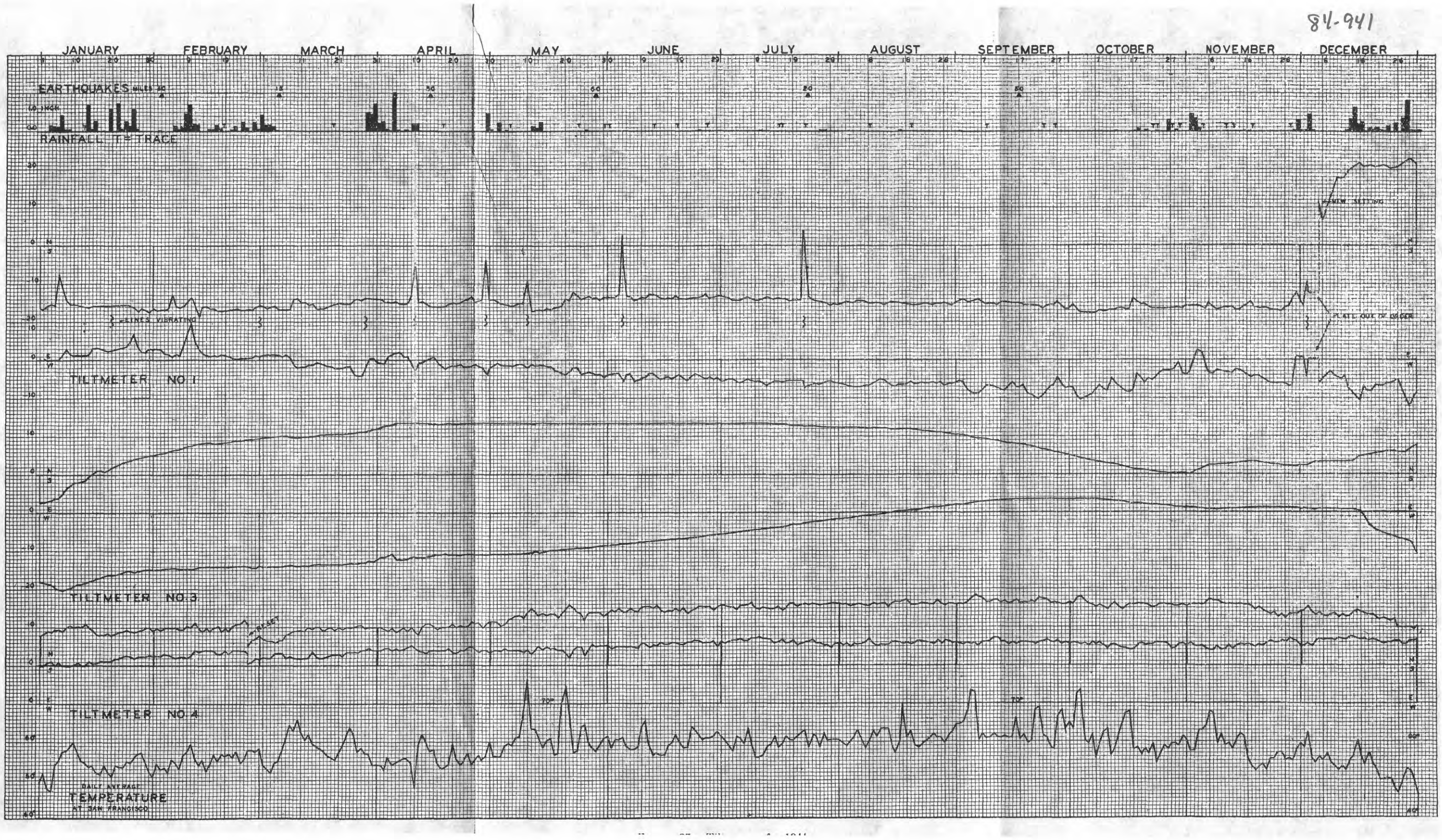


FIGURE 13.—Berkeley tilt-graph for 1940.

84-941


JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER
EARTHQUAKES
RAINFALL T = TRACE
NEW SETTING
PLATE OUT OF ORDER
WIRES VIBRATING
TILTMETER NO. 1
TILTMETER NO. 3
TILTMETER NO. 4
DAILY AVERAGE
TEMPERATURE
AT SAN FRANCISCO

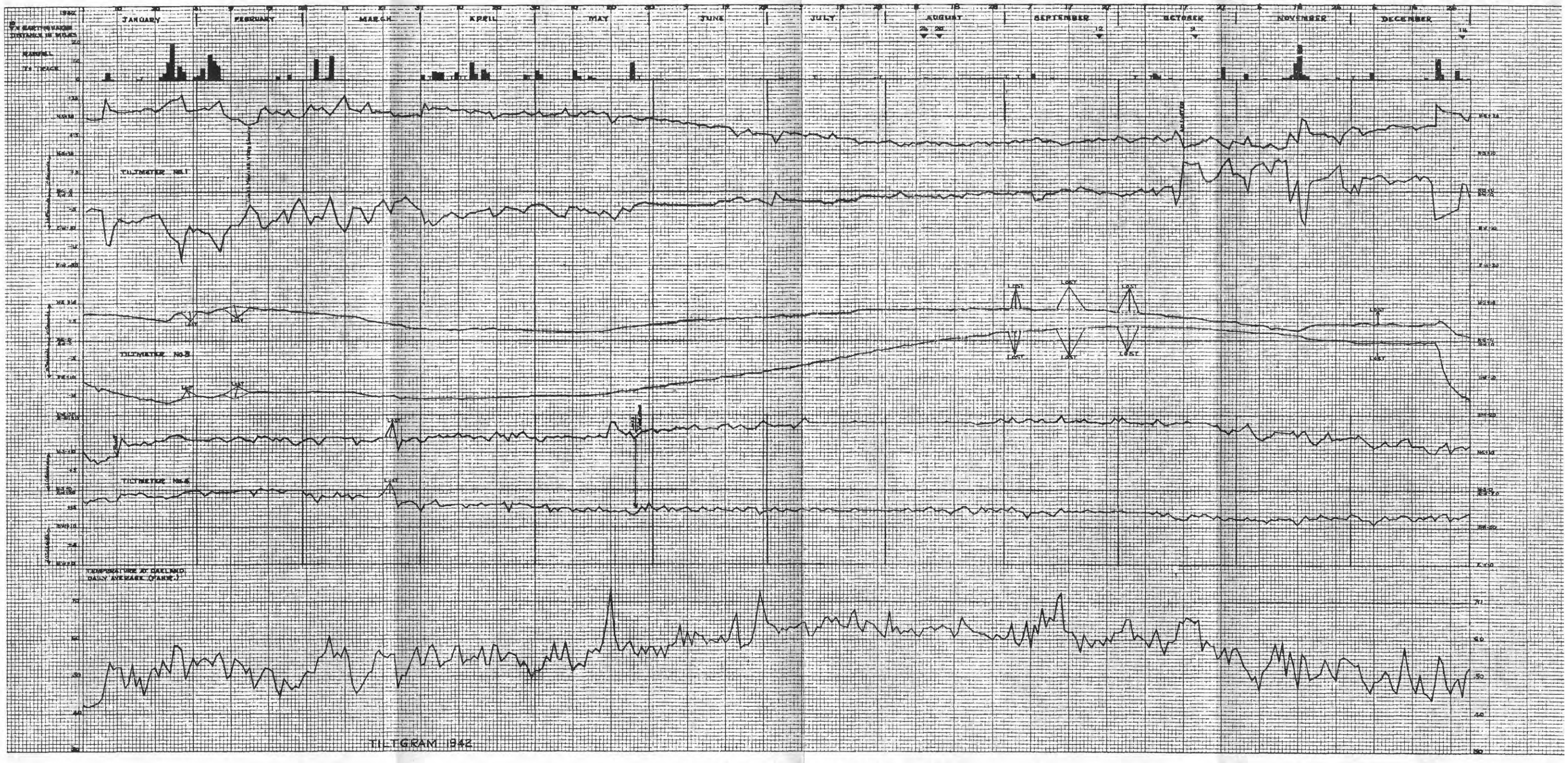


FIGURE 11.—Berkeley tilt-graph for 1942.

84-941

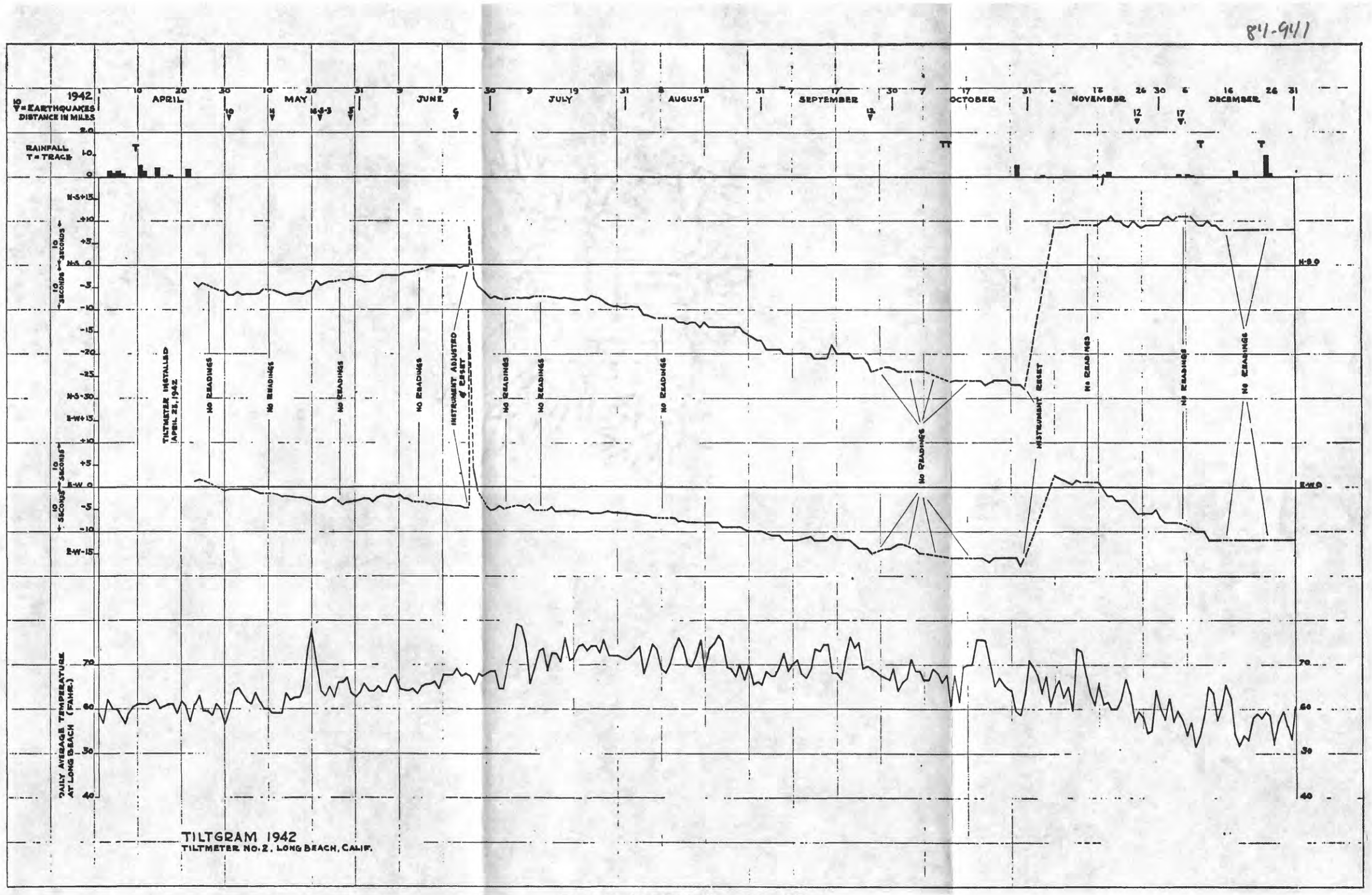


FIGURE 12.—Long Beach tilt-graph for 1942.

84-941

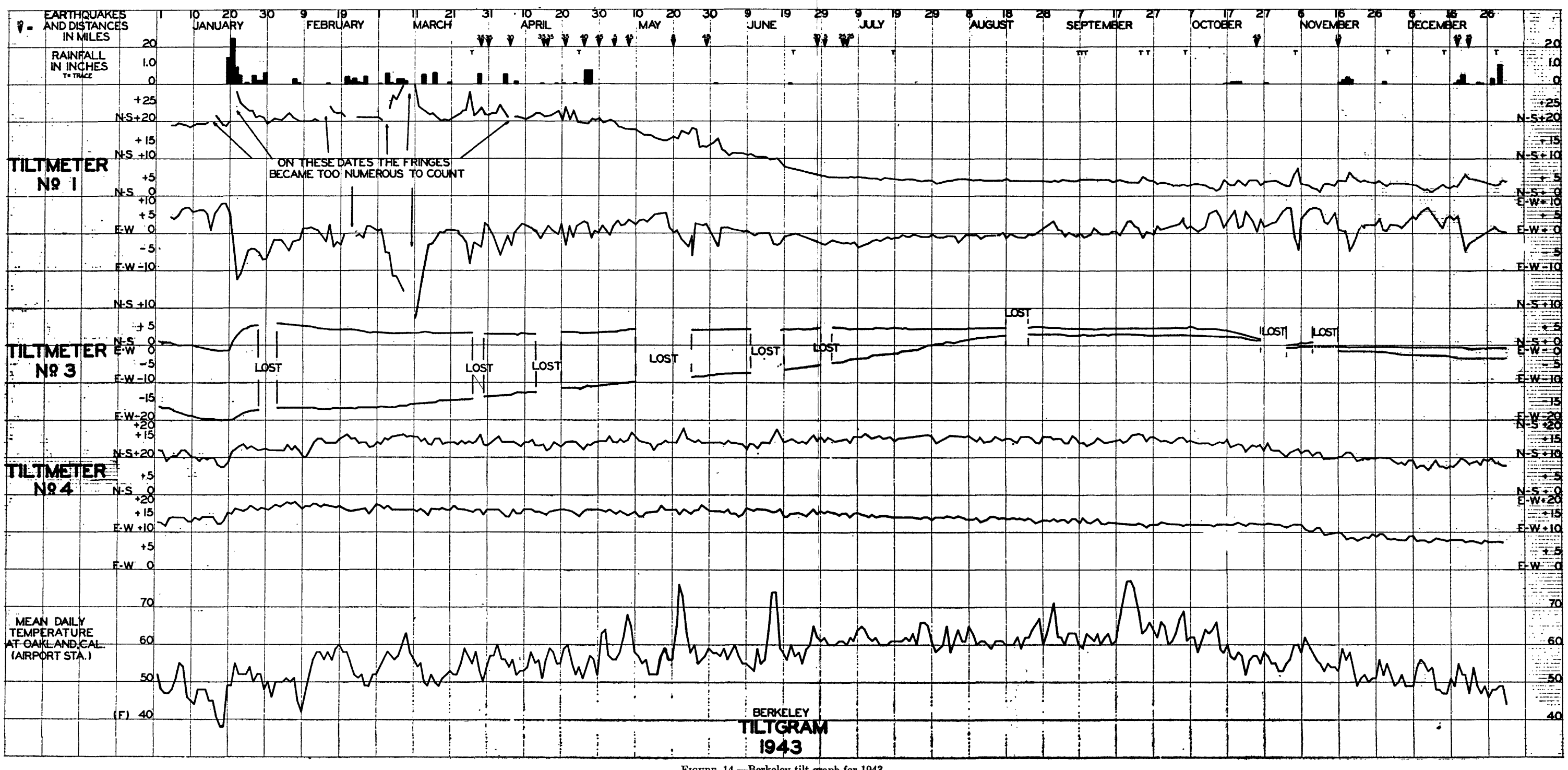


FIGURE 14.—Berkeley tilt-graph for 1943.

84-941

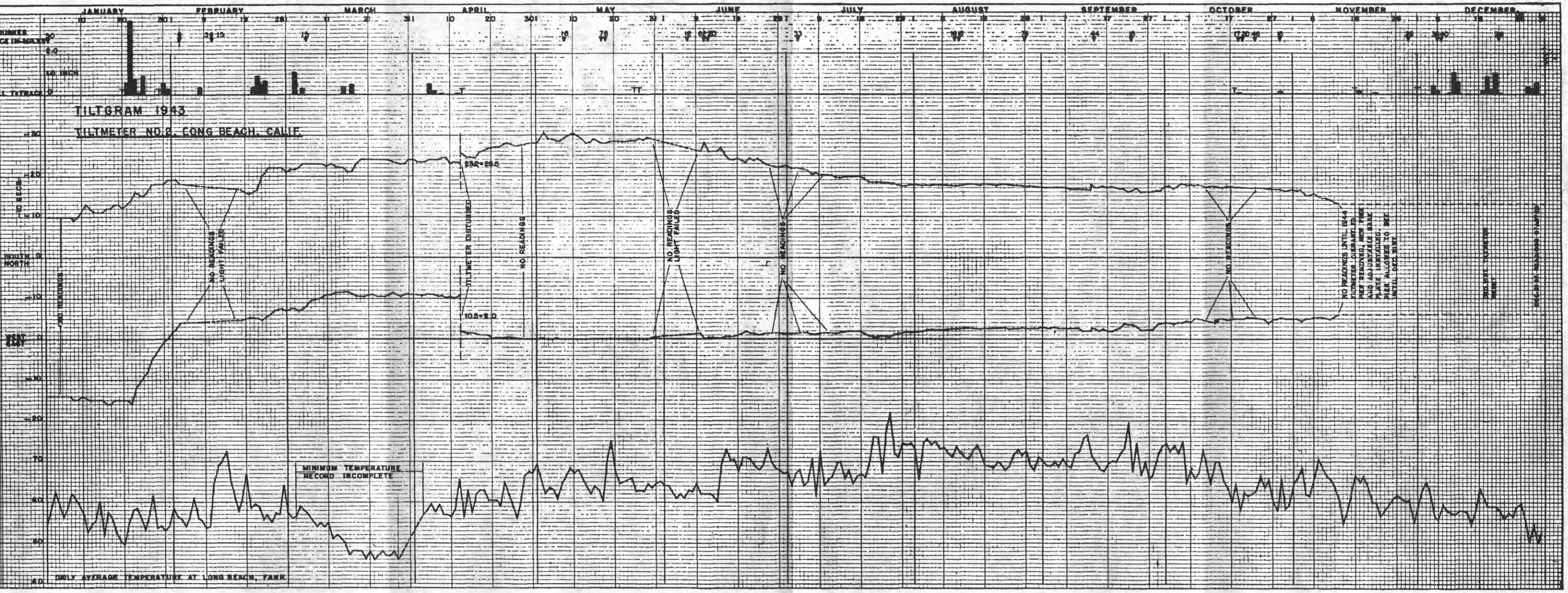


FIGURE 15.—Long Beach tilt-graph for 1943.

84-941

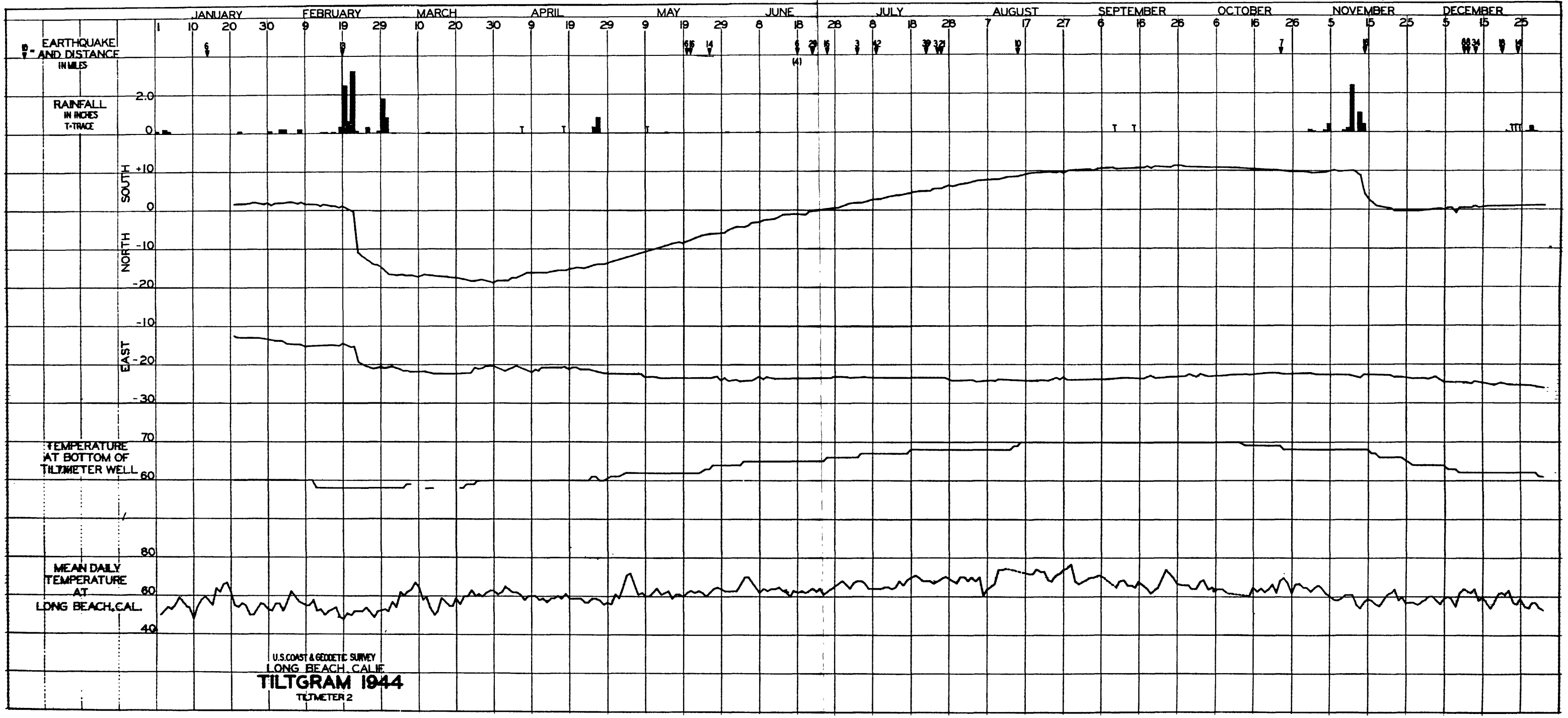


FIGURE 12.—Long Beach tilt-graph for 1944.

84-911

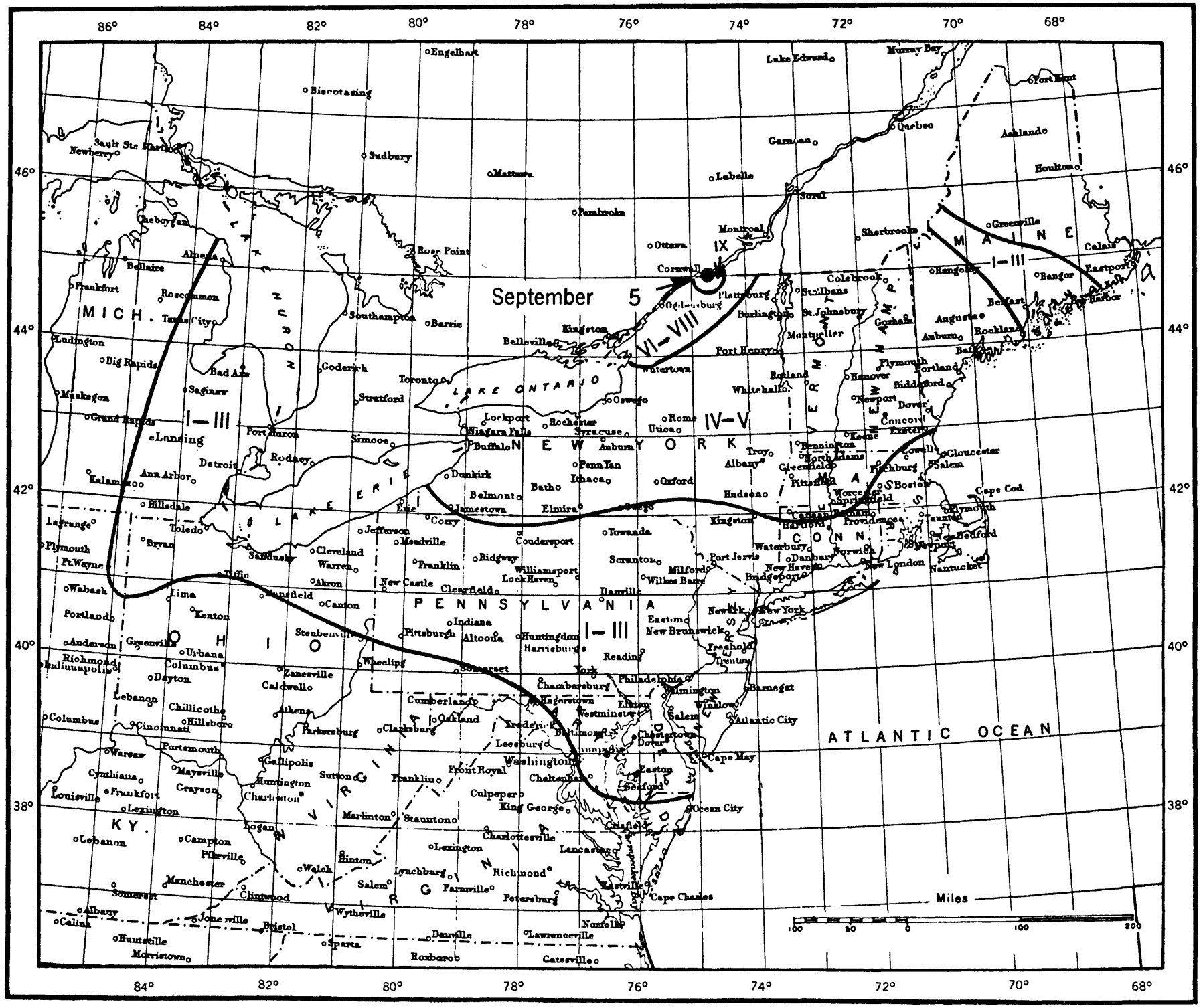


FIGURE 3.—Area affected by the Massena, New York-Cornwall, Ontario, earthquake of September 5, 1944.

84-941

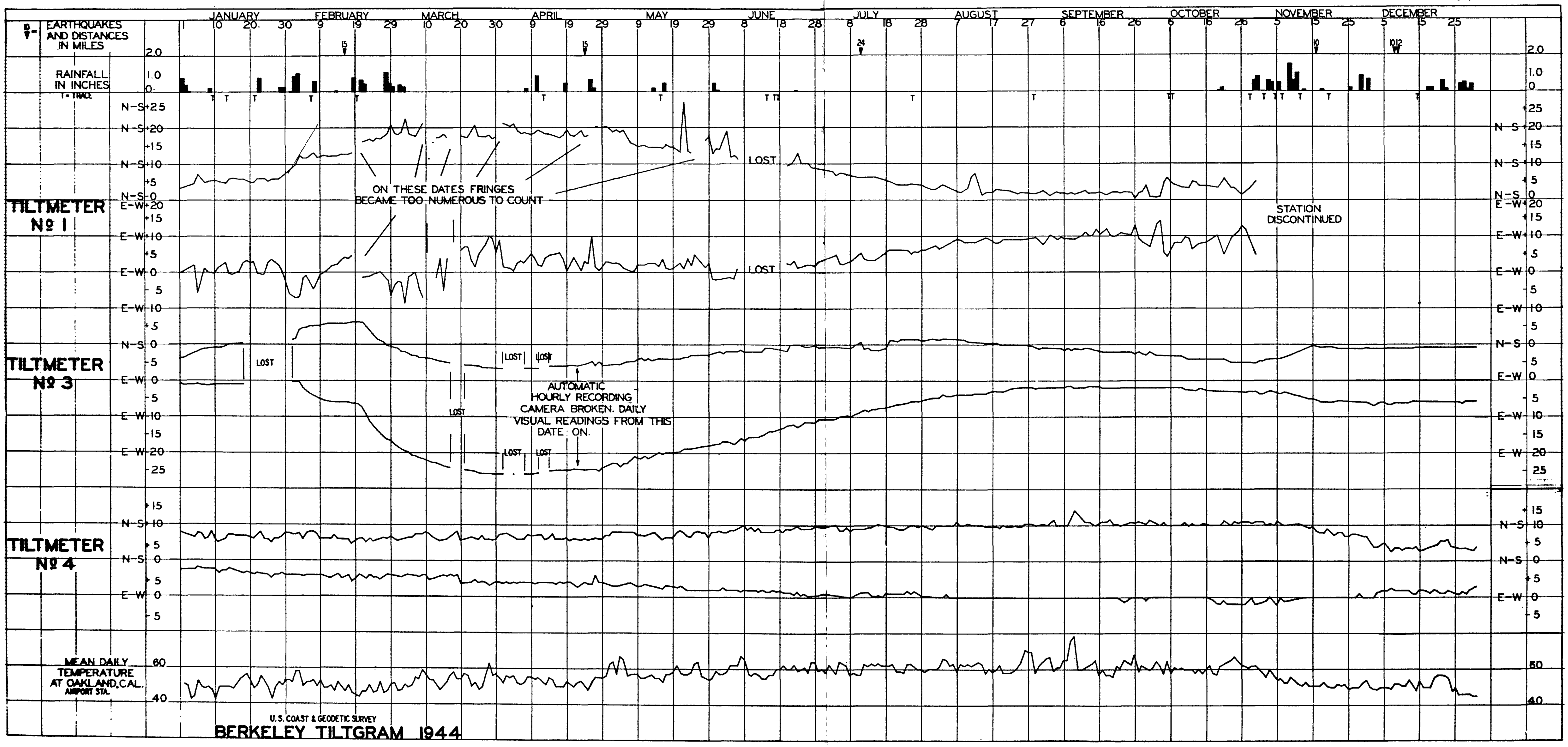


FIGURE 11.—Berkeley tilt-graph for 1944.

81-941

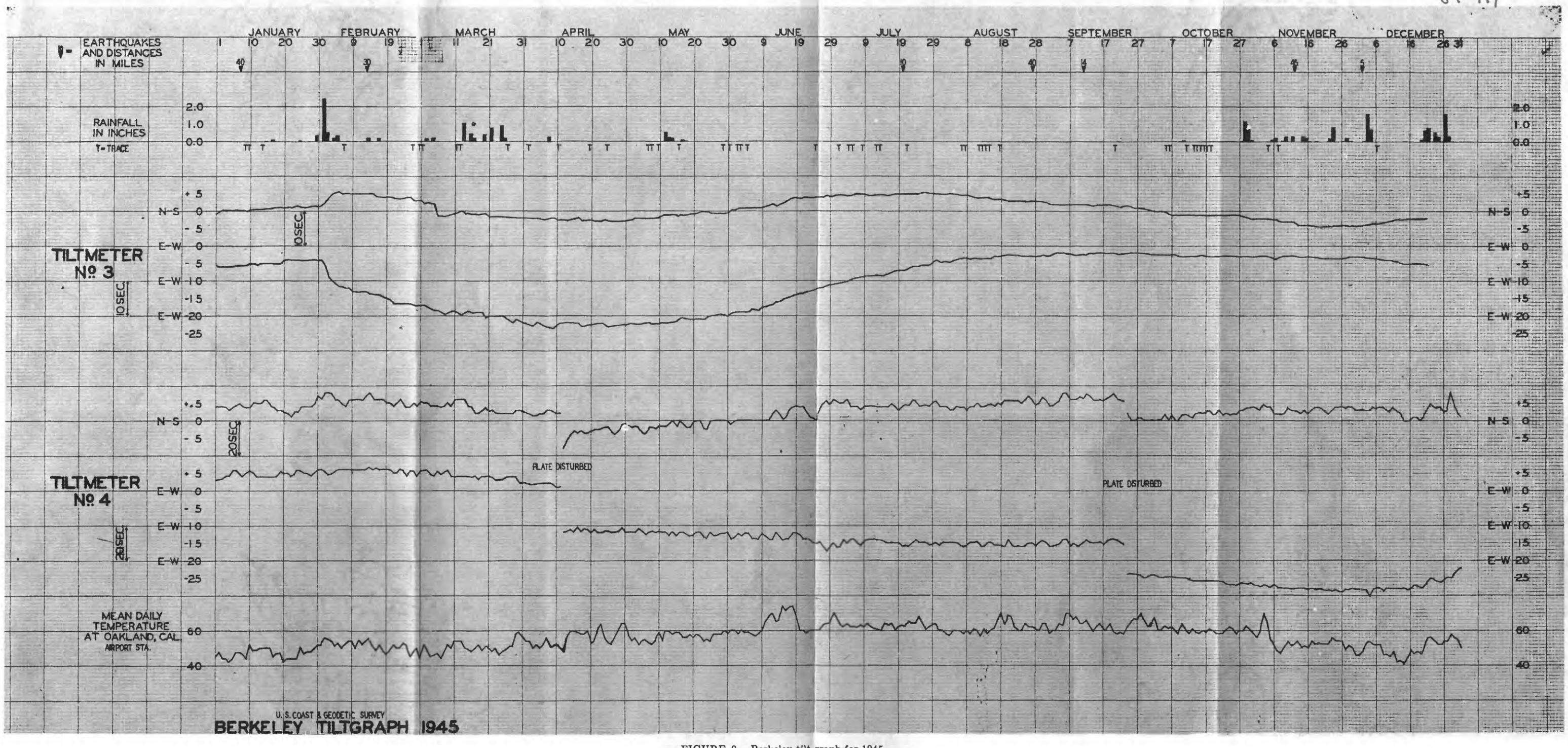


FIGURE 8.—Berkeley tilt-graph for 1945.

84-941

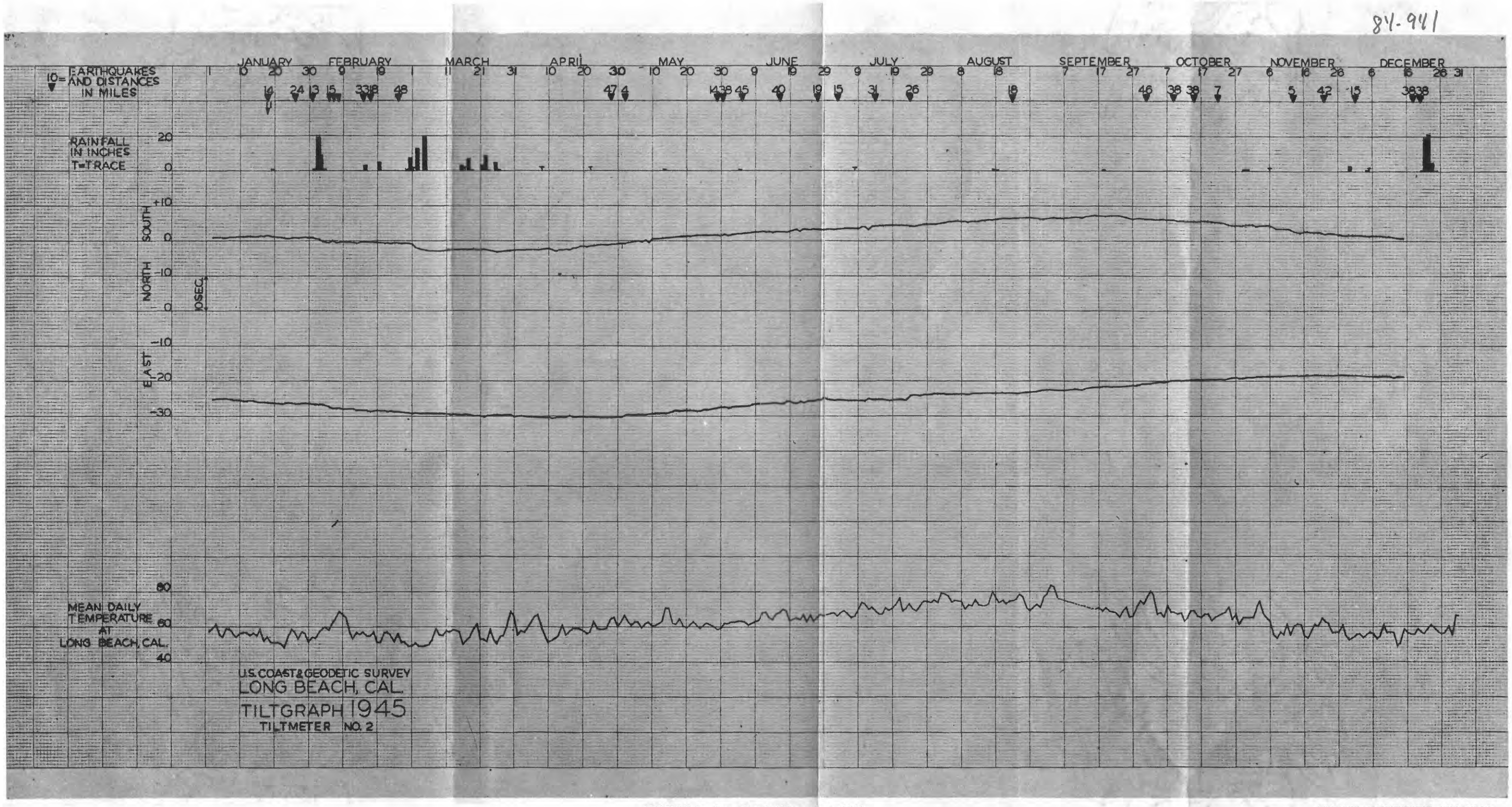


FIGURE 9.—Long Beach tilt-graph for 1945.

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