DEPARTMENT OF THE INTERIOR

U.S. GEOLOGICAL SURVEY

United States Earthquakes, 1952

By

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and

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CONTENTS

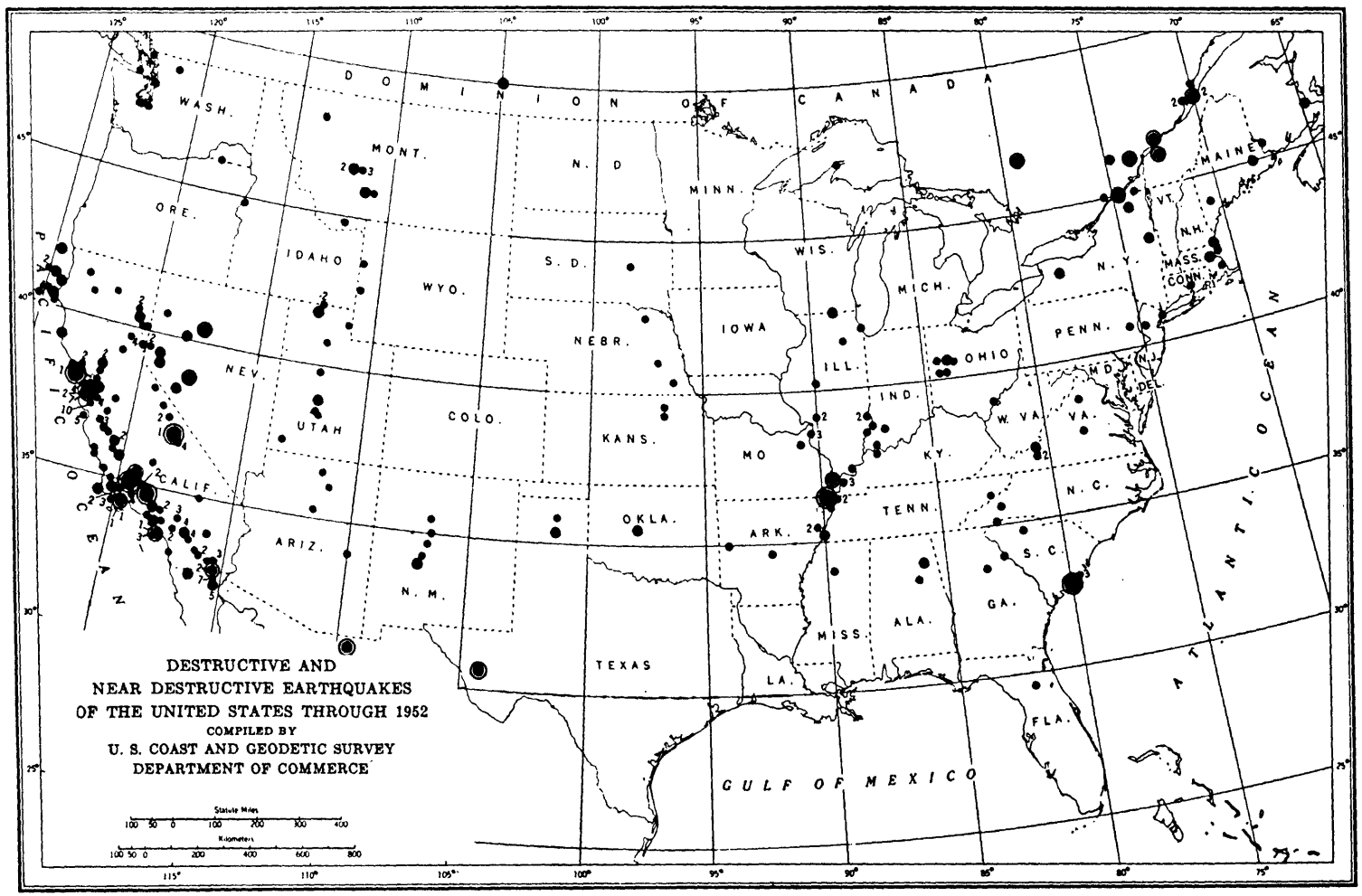

FIGURE 1.—Destructive and near destructive earthquakes in the United States through 1952.

ILLUSTRATIONS

UNITED STATES EARTHQUAKES, 1952

INTRODUCTION

This publication is a summary of earthquake activity in the United States and regions under its jurisdiction for the calendar year 1952. The sources of noninstrumental information used in the compilation include the United States Weather Bureau, whose observers prepare periodic reports on local seismic activity; telegraphic information collected by Science Service, Washington, D. C.; Bulletins of the Seismological Society of America; special reports of the Jesuit Seismological Assocation and the Northeastern Seismological Association; the *Hawaiian Volcano Letter*; newspaper clippings; and reports from interested individuals. Instrumental data used in locating earthquakes are obtained from the network of Coast and Geodetic Survey stations listed on page 66 and from other cooperating seismological stations in the United States and throughout the world.

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

Earthquake information services.—The Coast and Geodetic Survey maintains a Seismological Field Survey in San Francisco to collect earthquake information and make field investigations of strong shocks in the Pacific coast and western mountain States. Details concerning damage, destruction, and other effects are enumerated in the quarterly *Abstracts of Earthquake Reports for the Pacific Coast and the Western Mountain Region.* This report is available on request from the Director of the Coast and Geodetic Survey, Washington 25, D. C. Active cooperation in this work is received from the University of California Seismographic Station, Berkeley (Dr. Perry Byerly, in charge); and the Seismological Laboratory, Pasadena (Dr. Beno Gutenberg, Director); as well as State Collaborators in Seismology. The following Collaborators served as agents of the Coast and Geodetic Survey in their respective States in 1952:

Arizona.—Dr. Eldred D. Wilson, University of Arizona, Tucson.
Colorado.—Prof. C. A. Heiland, Heiland Research Corp., Denver.
Montana.—Prof. Stephen W. Nile, Montana School of Mines, Butte.
Nevada.—Dr. David B. Slemmons, University of Nevada, Reno.
New Mexico.—Prof. Stuart A. Northrop, University of New Mexico, Albuquerque.
Oregon.—Dr. Ira S. Allison, Oregon State College, Corvallis.
Utah.—Prof. J. Stewart Williams, Utah State Agricultural College, Logan.
Washington.—Prof. Howard A. Coombs, University of Washington, Seattle.
Wyoming.—Prof. Horace D. Thomas, University of Wyoming, Laramie.

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

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

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

MODIFIED MERCALLI INTENSITY SCALE OF 1931

(ABRIDGED)

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

Epicenter maps.—Figure 1 is designed to show the existence of destructive and near destructive earthquakes in the United States through 1952. The smallest dot indicates the shock was strong enough to overthrow chimneys or affect an area of more than 25,000 square miles (intensity VII to VIII); the largest solid dot may be associated with damage ranging from several thousand dollars to one hundred thousand dollars, or to shocks usually perceptible over more than 150,000 square miles (intensity VIII to IX); the smaller encircled dots represent damage ranging from approximately one hundred thousand to one million dollars, or an affected area greater than 500,000 square miles (intensity IX to X); the larger encircled dots represent damage of a million dollars or more, or an affected area usually greater than 1,000,000 square miles (intensity X to XII).

Figure 2 shows earthquake distribution in the United States during 1952. In a few cases where instrumental control is not satisfactory or where results of investigations are inadequate, the plotted epicenters should be considered as showing the existence of the earthquake rather than the precise location.

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

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

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

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

Teleseismic results.—On page 66 is a list of Survey and cooperating teleseismic stations for which the Survey publishes results. During the year the locations of 179 epicenters were announced promptly on *Preliminary Determination of Epicenter* cards and an additional 580 locations were reported weekly on *Supplement* cards. Those desiring to receive these cards should request addition of their name to the *PDE* mailing list. All seismogram interpretations are published in the quarterly *Seismological Bulletin*, MSI series, available on mailing list *CGS–7* from the Director, U. S. Coast and Geodetic Survey, Washington 25, D. C. During the year 1953, MSI–128 for the fourth quarter of 1946, and MSI–140, and MSI–142 and MSI–143 for the second and third quarter of 1950, were issued.

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

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

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

The preliminary analyses of strong-motion records are published in the *Quarterly Engineering Seismology Bulletin* which is available upon request from the Director of the Coast and Geodetic Survey, Washington 25, D. C. The revised analyses are given in table 1.

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

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

A summary of the earthquake program as carried out in the United States is briefly outlined in S. P. 282, *Earthquake Investigation in the United States*, revised 1953. The major organizations and stations are listed together with a list of the independent and/or privately operated stations. This publication is available from the Superintendent of Documents, Government Printing Office, Washington 25, D. C., for 20 cents.

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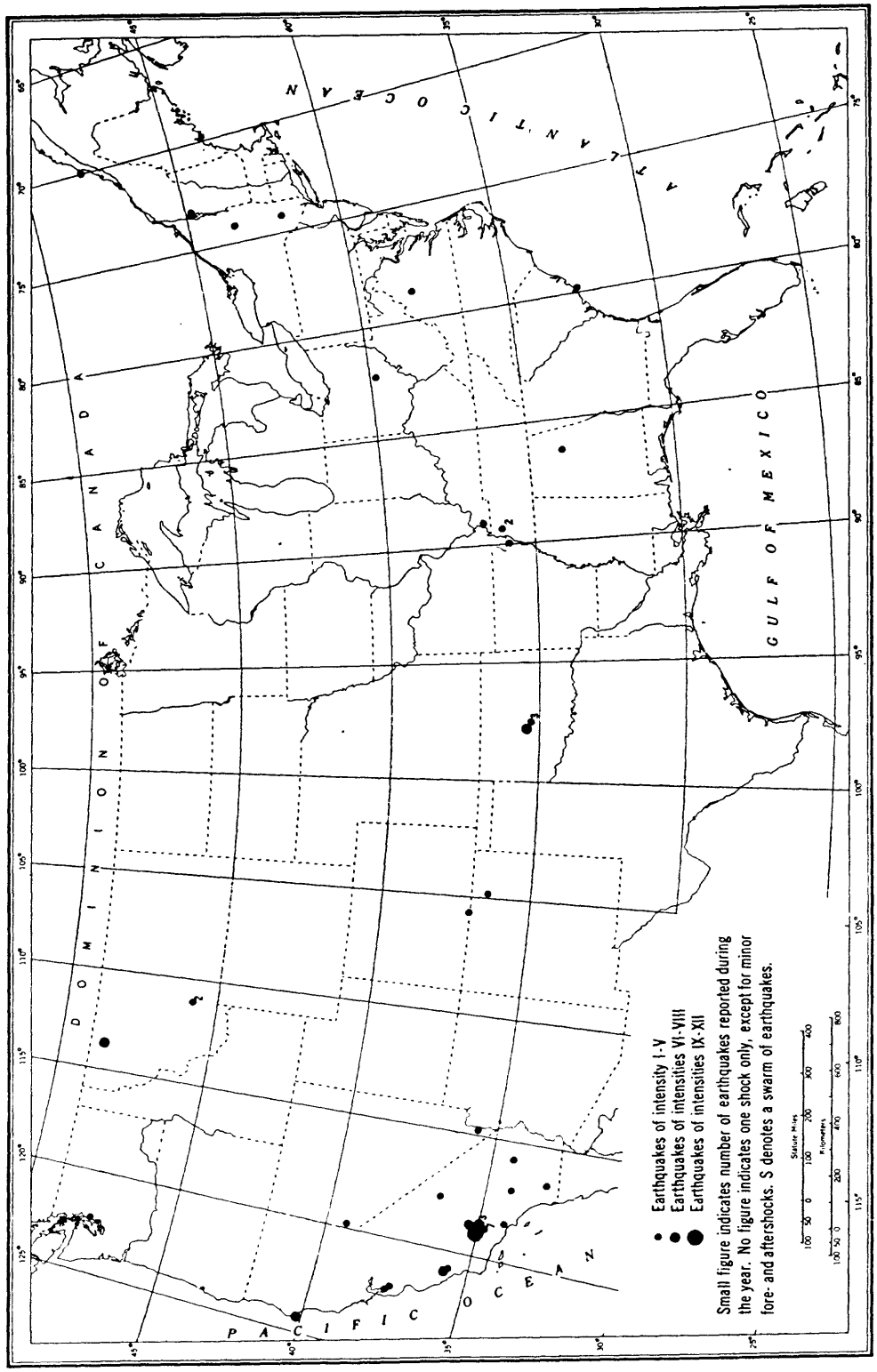

FIGURE 2.—United States earthquake epicenters, 1952.

NONINSTRUMENTAL RESULTS

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

An asterisk (*) indicates instrumental origin time of the earthquake when coordinates of the epicenter are given. Otherwise, instrumental times shown with asterisks are those of first motions.

When more than one degree of intensity is reported from a town, the town is listed under the highest intensity reported. More details will be found in the quarterly *Abstracts of Earthquake Reports for the Pacific Coast and the Western Mountain Region*, MSA series, issued on mailing list *CGS-3* by the United States Coast and Geodetic Survey, Washington 25, D. C.

EARTHQUAKE ACTIVITY IN THE VARIOUS STATES

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

Alabama: February 6, IV.

Arizona: October 22.

Arkansas: December 24, IV.

California: February 9, IV; May 9, VI; July 21, XI; 22, VII; 23, VII, VI; 25, VII; 28, VII; 31, VI; August 13, VI; 22, VIII; 23, VI; 29, VI; September 2, VI (2); 14, VI; 22, VII; October 16, VI; November 7, VI; 21, VII.

Colorado: October 7, V.

Florida: November 18, IV.

Idaho: September 9, IV.

Illinois: January 7.

Maine: October 14, V.

Missouri: May 28; December 28.

Montana: January 3, VI (2); February 12, II; 26, IV; March 31, VII; April 14, V; 15, IV; 22, VI, IV; 25, III; 26, III; 29, III; May 2, IV; 29, V; July 10, IV; 19, III; September 2, III; December 14, II.

Nevada: January 13; February 2, 3; 8, V; 9, 12, 13 (2), 14 (4), 15, 20 (3), 21 (3), 28; March 4, 12, 26; April 8; May 23, VI, IV, II; 24 (4), 25, 27, 30 (2); June 3, 12 (3), 15, 19; July 12; August 14, 23; September 13, 30 (3); October 2, 3, 16, 17 (2), 18, V, IV (6), II (2); 19 (4), 20, V, IV (2), II; 23, 25, 27, 31; November 1, 2, 4, 6, 24, 27, 28; December 6, 7.

New Mexico: May 21, IV; August 3, V; 17, V.

New York: August 24, V; October 8, V; November 20; December 21.

Ohio: June 20, VI.

Oklahoma: April 9, VII; 11, IV; 16, V; July 16; August 14, IV; October 7, IV.

South Carolina: September 27; November 19, V.

South Dakota: November 14.

Tennessee: February 20, V; June 11; July 16, VI; October 17, IV.

Texas: October 17, IV.

Utah: May 2, IV; July 21, IV; 23, IV; September 28, V.

Vermont: January 29, VI.

Virginia: September 10, IV.

Washington: February 20, IV, III; 22, V; 23; March 4, V; 14, IV; July 27, IV; August 6, V.

Wyoming: August 21, IV; 28, IV; September 2.

EARTHQUAKE ACTIVITY OUTSIDE THE UNITED STATES

Alaska: January 25; February 2, 22; March 9; May 8, 18, 21, 23; June 13, 15, 27 (2), 28; July 17, 24, 27, 29; August 6, 9; 13, 14, 16, 17, 27; September 26, 27; October 5 (2), 9, 10, 23; November 5, 15, 21, 29; December 4, 5 (2), 6 (2), 13, 14, 23, 26, 27 (3), 28, 29 (2).

Hawaii: January 23; February 1, 2 (2), 19, 21, 23; March 6, 13, 14, 16, 17, 18, 19, 20 (3), 21, 22 (2), 23 (2), 24 (2), 25 (2), 26, 27 (2), 28, 29, 31; April 6 (2), 7, 10, 12 (2); May 6, 23; June 3, 10, 13, 14, 26; July 6 (2), 7, 9 (2), 12; August 14; September 2, 14, 17, 19, 20, 24, 27, 30; October 3, 18, 25; November 10, 27 (2); December 3 (2), 10, 12, 25, 28.

Panama Canal Zone: March 27, IV; May 16, IV, 19; June 1; July 9; September 7, IV; November 27.

Puerto Rico: January 6; August 27.

NORTHEASTERN REGION

(75TH MERIDIAN OR EASTERN STANDARD TIME)

January 29: 23:00. Burlington, Vt. VI. Felt by many in Burlington. Affected area about 12 miles by 3½ miles. Ground cracks were about 2 miles long and 15 feet apart in the North End; cracked pavement found in airport parking lot. City gas main cracked. One or two cracked basement walls found. Also felt by several at Essex Junction, where several walls and few plaster walls cracked. Other tremors reported on the following day at 03:00 and 06:30.

October 14: 17:03:44*. Epicenter 47°58′ north, 69°49′ west, south-central Quebec, Ottawa. V. The tremor was felt on both sides of the St. Lawrence Valley but reported stronger on the Canadian. There was no damage in the United States. Questionnaire canvass was conducted by

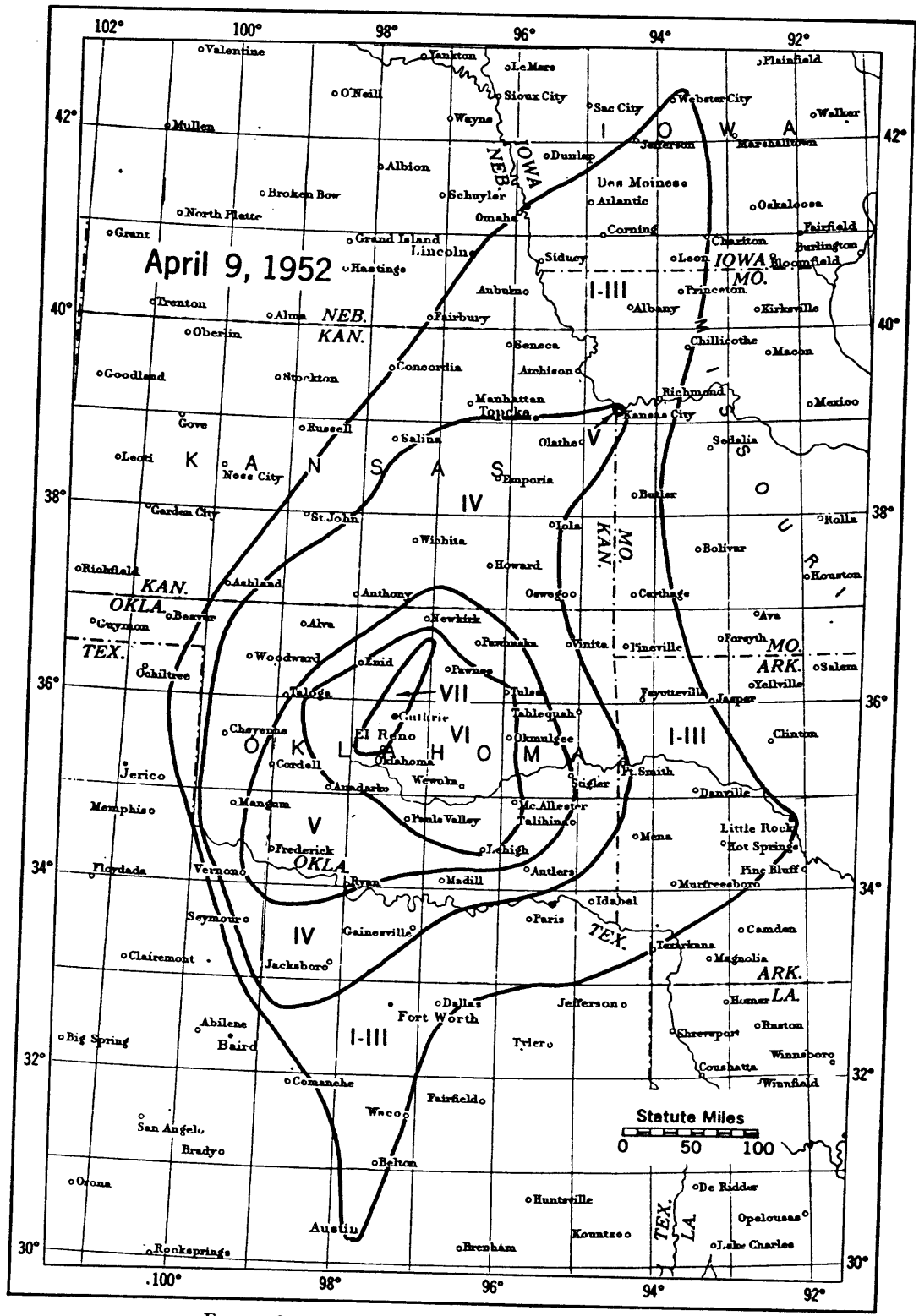

FIGURE 3.—Area affected by the earthquake of April 9.

the Dominion Observatory, Ottawa, and the following noninstrumental information furnished for publication.

Intensity V in Maine at Auburn where beds, chairs, and pictures moved; at Fort Kent dishes fell from cupboards and bottles tumbled off bar, smashing on floor; and at Presque Isle a cup was reported broken and a few people scared.

Intensity IV in Maine at Blaine, Fort Fairfield, Madawasha, Millinocket, Patten, St. Agatha, and Washburn.

Intensity I to III in Maine at Anson, Brewer, Caribou, Clayton Lake, Dexter, Frenchville, Hartland, Island Falls, Lincoln, Madison, Masardis, Milo, Orono, Perham, Portage Lake, Portland, Sheridan, Sinclair, and Van Buren.

Intensity I to III in Vermont at Beebe Plain, Canaan, Island Point, and St. Johnsbury.

EASTERN REGION

(75TH MERIDIAN OR EASTERN STANDARD TIME)

February 6: 10:12. Birmingham, Ala. IV. Felt by many and few alarmed. Affected area estimated 50 square miles. One slightly cracked wall reported.

August 24: 19:07. Mohawk Valley, N. Y. V. Klock's Ridge across the Mohawk Valley about 5 miles north of Fort Plain with northeast terminus in Ephratah was the probable source of the shock. Intensity V at Fort Plain where it was felt by many; bottles knocked off shelves, disturbed objects observed by several; dishes rattled. Felt by many at Gloversville. Furniture jarred, building trembled, and many objects disturbed. Dishes rattled and pictures swayed. Also felt at Canada Lake, Canajoharie, Ephratah, Fonda, Johnstown, Rockwood, and Sammonsville.

September 10: 22:15. Charlottesville, Va. IV. Shock centered between Shalwell and Free Bridge along route 250. Several people awakened. Woman thrown off balance while walking in home. Windows rattled, houses vibrated. Light swayed. Felt at Coply Hill, Eastham, Fry's Spring, Monticello Mountain, North Charlottesville, and Rio. Lesser shock felt at Charlottesville 22:35.

September 27: 07:32. Summerville, S. C. Very slight trembling motion felt by one observer.

October 8: 16:40. Poughkeepsie, N. Y. V. Many frightened and ran into streets. Few windows broke, buildings shook. Also felt in Clintondale, Hyde Park, and Milton. Several brief aftershocks noted by rumblings.

November 18: 15:12. Quincy, Fla. IV. Slight termor felt by many. Windows and dishes rattled. Shock interfered with writing of parking ticket. Felt in Lake City.

November 19: (no time given). Charleston, S. C. V. Frightened many. Houses shook, windows rattled, and hanging pictures swayed. Also felt at Folly Beach, Isle of Palma, Mt. Pleasant, Sullivan's Island, and on Charleston Peninsula.

November 20: (no time given). Auburn, N. Y. Slight tremors felt in some homes along Woodlawn Avenue. Lesser tremors felt on previous days.

December 21: 07:00. Massena, N. Y. Churchgoers felt rumble and then a bump.

CENTRAL REGION

(90TH MERIDIAN OR CENTRAL STANDARD TIME)

January 7: 16:21:05*. Epicenter in east-central Illinois near De Witt-McClean County line, JSA. Felt by a few at Monticello, Osman, and Rankin.

February 20: 16:34:39*. Epicenter 36.4° north, 89.5° west, Tennessee-Missouri border, JSA. V. Felt by many in four adjoining States of Arkansas, Kentucky, Missouri, and Tennessee. At Tiptonville, Tenn., some merchandise toppled from a store shelf and many rushed from buildings into streets. Dishes and windows rattled at Union City. Many high-school students alarmed. Displays toppled and bottles thrown from shelves at Hickman, Ky. Felt in Dyer, Henry, Houston, Lake, Obion, Tipton, and Weakley Counties, Tenn. Also felt in Ballard, Callaway, Carlisle, Fulton, Graves, Hickman, and McCracken Counties, Ky.; Mississippi, New Madrid, and Pemiscot Counties, Missouri; Clay County, Arkansas.

April 9: 10:29:15*. Epicenter 35.4° north, 97.8° west, about 5 miles southwest of Oklahoma City, Okla, W. Felt over a 140,000-square-mile area, including Oklahoma, except the panhandle section, eastern half of Kansas, southeastern tip of Nebraska, northern and central section of Texas, and throughout the western section of Iowa, Missouri, and Arkansas. Slippage along the Nemaha Fault was effected by slight displacement of the buried granitic ridge beneath. The felt data conforms to the known trace of the fault, i. e., the strike is northeasterly from Oklahoma City toward Kansas City and Des Moines, an echelon faulting at the hinge point in the Oklahoma City region, then a southerly strike toward Austin, Tex. See map page 6. Damage was not extensive. Portions of chimneys fell in El Reno and Ponca City. Bricks loosened from a building wall and tile facing of commercial buildings bulged at Oklahoma City. Maximum intensity VII. Magnitude 5.5.

INTENSITY VII:

El Reno.—Felt by all and many alarmed to near panic. Brick chimney fell into living room of house; portion of smokestack fell and ripped 2-foot hole in roof at water plant. Many cracks reported in municipal buildings. Plateglass windows shattered in business district; dishes broke; books and canned goods tumbled from shelves; furniture moved around. Damage amounted to several thousand dollars.

Oklahoma City.—Felt by major proportion of population, many alarmed. Bricks jarred from a wall at city pumping plant. Tile facing of commercial building bulged. Many cracks reported,

one 50 feet long at State capitol building. Tank of 114 foot diameter had center columns thrown out of the socket; moved in a westerly direction. Furnishings were displaced.

Ponca City.—Majority of populace was alarmed. Brick chimney partially toppled causing minor damage. Brick wall of a building cracked. Pictures and lighting fixtures swayed.

INTENSITY VI:

Ada.—Felt by majority and frightened many. Dishes knocked off shelves, windows rattled, trees and buildings swayed.

Ames.—Proportion of citizens felt rocking motion. Plaster walls cracked. Slight damage.

Anadarko.—Many felt violent tremors. Museum wall cracked. Small objects disturbed.

Atoka.—Populace aware of quake. Near panic at the school as walls cracked and plaster fell. Dishes rattled, windows broke.

Canton.—Few people observed small objects moving and buildings swaying. Concrete block-house had walls and foundation cracked.

Chickasha.—Everyone heard rumblings that created general alarm. Slight damage to tall buildings. Plaster walls cracked, some plaster fell.

Cleveland.—Many felt abrupt shock. Flagpole noticed swaying. Several plaster walls, ceilings, and cellar wall cracked. Some plaster removed. Small objects disturbed, electric lights and chairs swayed, dishes rattled.

Cushing.—Glass door cracked, as well as numerous cases of cracked plaster. Houses and well-constructed buildings shook as the quake was felt inside and out. Electric iron was thrown from the ironing board. Bottles "jigged," and dishes and windows rattled.

Enid.—Grain elevator cracked—"the place was really jumping. I thought someone was shaking the conveyor belt. Cellar concrete floor of a brick home had two long cracks with east-west strike."

Hanna.—School building cracked; largest crack on west wall. Plaster walls cracked. Seventh-grade student jumped out of a first-floor window. "Wall looked as if it was going to fall." Small objects disturbed appreciably.

Holdenville.—Felt by many inside and out. Walls cracked slightly and some plaster fell.

Kingfisher.—Felt by proportion of populace. Buildings seen to tremble; second floor of court-house cracked slightly. Cracked plaster fell down in many homes. Books and several other small items thrown to floor. Chandeliers, chairs, beds, dishes, and books displaced.

Langton.—Press reported that a radio was knocked off a table.

McAlester.—Felt by many. General alarm but no panic. Many plaster cracks; the cracks were vertical. Chairs with casters rolled across floor.

Minco.—Near panic in school quelled by fast-thinking faculty in ordering the children to proceed orderly from the building. Walls were displaced. Sizable plaster cracks occurred in the school building. Numerous dwellings shaken throughout Grady County as reported by the press.

Purcell.—Felt by several. East wall of building cracked, the north wall pushed out 5 inches. Fishbowl ornament overturned. Wall pictures swayed, furniture bounced, small objects moved.

Stillwater.—Many persons witnessed the tremor. General alarm. Plaster walls cracked. Concrete floor cellar of post office cracked slightly. Loose objects rattled, dishes bounced, and iceboxes moved a few inches.

Sulphur.—Felt by many. Stone administration building of Platt National Park had an open crack in one wall and a split beam over the fireplace, and three broken windowpanes. A few small objects disturbed.

Tulsa.—Officeworkers in the taller buildings were "terrified." Walls cracked; one woman was injured due to falling plaster. Instances of cracked plumbing were reported by the press. Food in refrigerators moved noticeably. Desks were noticed to vibrate. Dishes and windows rattled.

Union City.—Ninety percent of populace felt tremors. There was general alarm. Well-constructed brick homes had foundation cracks and many reports of wall plaster cracks. Grocery store reported shelves of both walls were emptied of contents. Some loose objects thrown to floor from shelves and walls. Trees and buildings swayed visibly.

Wewoka.—Felt by few persons; general alarm. Press reported bricks tumbled from a chimney.

INTENSITY V IN OKLAHOMA: Altus, Ardmore, Bartlesville, Beaver, Blackwell, Briston, Duncan, Eufaula, Frederick, Geary, Guthrie, Henryetta, Jefferson, Marlon, McCurtain, Medford, Muskogee, Norman, Paul's Valley, Pawhuska, Stigler, Tribbey, Village, and Wetumka.

INTENSITY V IN KANSAS: Kansas City and Medicine Lodge.

INTENSITY V IN TEXAS: Lake Pauline and Vernon.

INTENSITY IV IN OKLAHOMA: Antlers, Apache, Bengal, Buffalo, Cache, Calvin, Camargo, Carnegie, Chandler, Cherokee, Claremore, Clinton, Cordill, Crescent, Dacoma, Dewey, Durant, Elmore City, Fairview, Fort Supply, Gage, Garber, Guymon, Goodwell, Healdton, Helena, Hobart, Hollis, Hugo, Jet, Konawa, Lawton, Lindsay, Madill, Mangum, Mannford, Marshall, Meeker, Mustang, Newkirk, Okemah, Orlando, Paoli, Pawnee, Perry, Piedmont, Prague, Ralston, Redrock, Roff, Roosevelt, Sapulpa, Seiling, Shawnee, Skiatook, Snomac, Taloga, Tishomingo, Vinita, Vinson, Wagoner, Watonga, Waukomis, Waurika, Weatherford, Wirt, Woodward, and Yukon.

INTENSITY IV IN ARKANSAS: Fort Smith.

INTENSITY IV IN IOWA: Webster City.

INTENSITY IV IN KANSAS: Concordia, Hutchinson, Iola, Junction City, Lawrence, Lindsborg, McPherson, Topeka, Wichita, and Winfield.

INTENSITY IV IN MISSOURI: Kansas City.

INTENSITY IV IN TEXAS: Breckenridge, Denison, and Wichita Falls.

INTENSITY I TO III IN OKLAHOMA: Alex, Alva, Anadarko, Armstrong, Arnett, Barnsdall, Billings, Bluff City, Braggs, Caddo, Caney, Custer, Drumright, Edmond, Elk City, Faxon, Fort Cobb, Frederick, Freedom, Gore, Granite, Haskell, Hennepin, Hinton, Hominy, Idabel, Kingston, Langley,

Laverne, Maramec, Medford, Miami, Mutual, Nowata, Okeene, Okmulgee, Perkins, Pickens, Renfrow, Ripley, Rogers, Rush Springs, Sayre, Seminole, Shattuck, Snow, Stilwell, Thomas, Tonkawa, Tuttle, Verden, Wakita, Walters, Waynoka, Webbers Falls, and Yale.

INTENSITY I TO III IN ARKANSAS: Clarksdale, Clarksville, Dardanelle, Fayettsville, Harrison, Little Rock, Magnolia, and Texarkana.

INTENSITY I TO III IN IOWA: Clarinda, Des Moines, Missouri Valley, and Red Oak.

INTENSITY I TO III IN KANSAS: Abilene, Arkansas City, Atchison, Emporia, Fort Riley, Great Bend, Independence, Junction City, Leavenworth, Lindsborg, Parsons, and Wellington.

INTENSITY I TO III IN MISSOURI: Appleton City, Boonville, Fountain Grove, Independence, Joplin, Kansas City, Pleasant Hill, St. Joseph, and Sweet Springs.

INTENSITY I TO III IN NEBRASKA: Lincoln, Nebraska City, and Omaha.

INTENSITY I TO III IN TEXAS: Abilene, Albany, Amarillo, Austin, Canadian, Crowell, Dallas, Denton, Fort Worth, Graham, Jacksboro, Lipscomb, Paris, and Sherman.

Negative reports were received from 5 places in Arkansas, 12 places in Iowa, 5 places in Kansas, 10 places in Missouri, 10 places in Nebraska, 36 places in Oklahoma, and 35 places in Texas.

April 11: 14:30. El Reno, Okla. IV. Felt by many at El Reno, Kingfisher, and Union City. Other weak shocks felt at 12:30 at El Reno and Union City; at 23:58 on April 15 at Geary, Oklahoma City, Piedmont, and Union City.

April 16: 00:05. El Reno, Okla. V. Citizens awakened. Drop lines on switchboard at telephone central knocked out. Homes and buildings shook. Also felt at Kingfisher, Oklahoma City, Tulsa, and Union City. One of several April 9 aftershocks.

May 28: 03:54:14*. Epicenter 36.7° north, 89.2° west, New Madrid County, Mo., JSA. Felt in New Madrid County, especially at Catron where a jeweler reported one of his atmospheric pressure clocks was jarred 3 minutes off the correct time. Also felt in Dunklin and Pemiscot counties, Mo.; Phillippy and Miston, Tenn.; and Oakton, Ky.

June 11: 15:20. Johnson City, Tenn. Slight tremor felt by few.

June 20: 03:38:06*. Epicenter 39¾° north, 82¼° west, southeastern Ohio. VI. At Zanesville an old chimney reported toppled. Coal toppled from cars at Corning, intensity V. Intensity IV at Buchtel, Cumberland, Hemlock Junction, Lancaster, Moxahala, Nashport, Somerset, and above two cities the majority of the populace observed disturbed objects; windows and dishes rattled, pictures shook, and doors thrown open.

INTENSITY I TO III: Adams Mills, Amesville, Athens, Bexley, Blue Rock, Brownsville, Caldwell, Cambridge, Congo, Crooksville, Dexter City, Fultonham, Gibisonville, Hemlock Grove, Logan, McConnelsville, Millersburg, Millersport, Pennsville, Rockbridge, and South Bloomingville.

Negative reports received from 32 places.

July 16: 17:48:10*. Epicenter 36.2° north, 89.6° west, near Dyersburg, Tenn., JSA. VI. Felt by nearly all and frightened many. Press reported numerous cracks in a concrete-block structure. Dishes rattled and houses creaked. Also felt at Finley and Jenkinsville. Weak aftershock felt by few.

July 16: 18:30 and 20:00. El Reno and Union City, Okla. Felt. Slight, abrupt aftershock of the April 9 earthquake.

August 14: 15:40. El Reno, Okla. IV. Many at El Reno observed houses sway; objects disturbed; dishes rattled. At Union City, dishes bounced. Felt at Oklahoma City and Chickasha.

October 7: 22:15. Wewoka, Okla. IV. Felt by several. Pans rattled and windows creaked. Also felt at Holdenville.

October 17: 09:48. Orange, Texas. IV. Linesman atop a pole felt it quiver. Buildings swayed and windows rattled.

October 17: 22:16:18*. Dyersburg, Tenn. IV. Awakened several. Windows rattled and homes swayed gently. Felt at Finley and Lenox. Recorded on St. Louis University seismographs. Aftershocks reported at 22:30, 22:35, and 22:46:03*.

November 14: (no time given). Pactola, S. Dak. Residents generally startled. Initially sharp tremor but less severe in final 5 seconds.

December 24: 22:23:24*. Epicenter 36.1° north, 90° west, near Blytheville, Ark., JSA. IV. Felt in southeastern Missouri and northeastern Arkansas. At Blytheville sharp tremor of 5 seconds' duration, accompanied by a distant rumble; shook houses and swayed Christmas trees. Also felt at Jonesboro, Lepanto, Marked Tree, and Wilson, Ark., and Memphis, Tenn.

December 28: 10:59:27*. Epicenter probably in Mississippi County, Mo., JSA. Felt in southeastern Missouri, western Kentucky, and Tennessee.

WESTERN MOUNTAIN REGION

(105TH MERIDIAN OR MOUNTAIN STANDARD TIME)

January 3: 19:34. Helena, Mont. IV. Dishes rattled. Faint rumblings heard before and after shock.

January 3: 21:00. Niarada, Mont. IV. Felt by several. Windows, doors, and dishes rattled.

January 13: 17:07:30*. Boulder City, Nev. IV. Felt by many.

February 2: 19:25:16*. Boulder City and Hoover Dam, Nev. IV. Felt by many. Windows rattled, walls creaked.

February 3: 03:06:16*, 03:21:13*. Hoover Dam, Nev. Heard by many.

February 8: 01:59:12*. Boulder City and Hoover Dam, Nev. V. Felt by many. Windows rattled, walls creaked. Small objects overturned and shifted.

February 9: 12:50:16*. Boulder City and Hoover Dam, Nev. IV. Felt by many. Windows rattled, walls creaked.

February 12: 13:37:07*. Boulder City, Nev. II. Felt by few.
February 12: 14:50. Helena, Mont. II. Slight shock felt by observer.
February 13: 07:46:22*. Boulder City and Hoover Dam, Nev. IV. Felt by many. Windows rattled, walls creaked.
February 13: 14:00:11*. Boulder City, Nev. II. Felt by few.
February 14: 00:23:11*, 00:52:09*. Boulder City and Hoover Dam, Nev. IV. Felt by many. Windows rattled, walls creaked.
February 14: 01:14:30*. Boulder City and Hoover Dam, Nev. IV. Felt by several. Walls creaked.

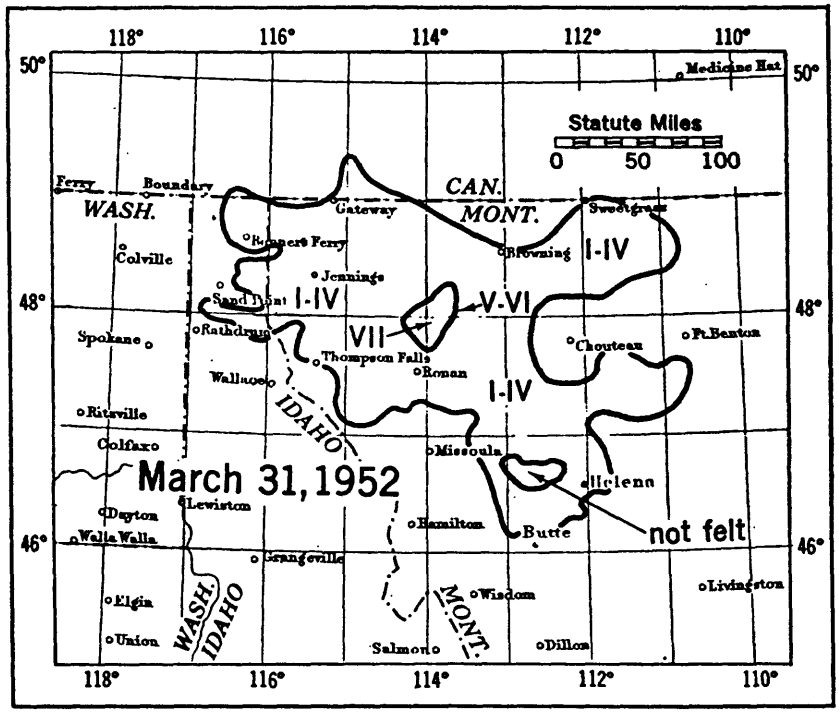

FIGURE 4—Area affected by the earthquake of March 31.

February 14: 15:19:11*. Boulder City, Nev. III. Felt by several.
February 14: 22:01:34*. Boulder City, Nev. Felt slightly.
February 15: 12:04:09*. Boulder City and Hoover Dam, Nev. IV. Felt by many.
February 20: 06:24:37*. Boulder City, Nev. III. Felt by several.
February 20: 06:41:18*. Boulder City and Hoover Dam, Nev. VI. Felt by all. Small objects shifted and overturned. Felt by several in Henderson and Las Vegas.
February 20: 07:36:41*. Boulder City and Hoover Dam, Nev. IV. Felt by many. Windows rattled, walls creaked.
February 21: 04:46:34*. Boulder City and Hoover Dam, Nev. IV. Felt by several. Windows rattled.
February 21: 07:20:10*. Boulder City and Hoover Dam, Nev. IV. Felt by several. Windows rattled.
February 21: 10:58:09*. Boulder City, Nev. II. Felt by few.
February 26: 21:28. Helena, Mont. IV. Felt by many. Frame creaked.
February 28: 12:25:17*. Boulder City, Nev. III. Felt by several.
March 4: 10:00:00*. Boulder City, Nev. II. Felt by few.
March 12: 07:14:59*. Boulder City and Hoover Dam, Nev. IV. Felt by many.
March 26: 08:31:34*. Boulder City, Nev. IV. Felt by many.
March 31: 17:37:41*. Epicenter 48.0° north, 113.8° west, northwestern Montana, W. Felt over an area of approximately 35,000 square miles of Montana, Idaho, and southern British Columbia, Canada. See map, page 10. Damage slight to brick, masonry, and concrete at Flathead Lake. Maximum intensity VII.

INTENSITY VII:

Flathead Lake (east shore, about 11 miles southeast of Bigfork). Frightened all. Damage slight to brick masonry and concrete. Walls, chimneys cracked and chimneys twisted and fell. Windows, dishes, and doors rattled.

INTENSITY VI:

Essex.—Felt by all, frightened few. Hanging objects swung. Windows, doors, and dishes rattled; walls and buildings creaked.

Essex (½ mile east of).—Felt by many, frightened few. Hanging objects swung. Windows, doors, and dishes rattled; houses creaked.

Eureka.—Felt by several in home, frightened few in community. Plaster and chimneys cracked. Small objects shifted. Hanging objects swung. Windows, doors, and dishes rattled.

Flathead Lake (east shore).—Felt by many. Cans fell off shelf in grocery store and knocked some merchandise off shelves in another store. Small objects and furnishings shifted and overturned. Windows and dishes rattled.

Heron.—Felt by several at post office. Canned goods fell from store shelves. Small objects shifted and vases overturned. Windows, doors, and dishes rattled.

Polson.—Felt by many, frightened few. Reported to have opened a new crack in the front boiler of the mill. Platform rockers in store rocked back and forth vigorously. Dishes and articles in hardware store rattled. Utensils hanging on wall swung and rattled.

Polson (East Shore Road).—Felt by and frightened all in home. Observer and wife ran outside, fearing chimney might fall. Trees and bushes shaken moderately. Windows rattled.

Rollins (near on Highway No. 93).—Two cars reported to have gone out of control (dense fog) at time of shock and ran into bank.

Swan Lake (southwest shore).—Felt by several; outdoors by observer. Several panes of glass fell from windows of greenhouse.

Swan Lake.—Felt by and frightened many in homes and some outdoors. Electric poles reportedly swayed about 8 inches. Small pond disturbed slightly. Stovepipe on a horizontal circular base, previously vertical, was tilted about 15°. Wallpaper cracked some. Box fell from shelf and house plants overturned.

Swan Lake (Larson's Lodge, near southeast shore).—Frightened all. Damage slight to brick. Chimneys cracked. Windows, doors, and dishes rattled; walls creaked.

Swan Lake (near southeast shore).—Felt by all, frightened many. Small objects shifted. Windows, doors, and dishes rattled; house creaked and swayed.

Swan Lake (near south end).—Felt by all in community, frightened all in home. Wires swayed, hanging objects swung. Windows, doors, and dishes rattled; house creaked.

INTENSITY V: Bigfork, Kalispell, Proctor, Stockett, and Superior.

INTENSITY IV: Basin, Belt, Big Arm, Canyon Ferry, Columbia Falls, Conrad, Coram, Creston (4 miles south of), Dayton, Deer Lodge, East Glacier Park, Eden (6 miles south of), Glacier Park, Great Falls, Haugan, Highwood, Hot Springs, Hungry Horse Dam, Kila, Lindbergh Lake, Lonepine, Niarada and vicinity, Olney, Pablo, Perma, Plains, Polebridge, Power, Rexford, Ronan, Stryker, Trailcreek, Ural, Warland, Whitefish, Whitepine, and Wolf Creek.

INTENSITY IV IN IDAHO: Careywood, Edgemere, and Elmira.

INTENSITY I TO III: Anaconda, Armington, Camas and vicinity, Cascade, Devan, Dupuyer, East Helena, Fortine, Greenough, Helena, Jefferson City, Joplin, Libby, Lincoln, Moiese, Noxon (6 miles northeast of), Ovando, Paradise, Shelby, Somers, Summit, Sunburst, Sweetgrass, Trego, Vaughn, and Whitlash.

INTENSITY I TO III IN IDAHO: Addie, Bonners Ferry, Copeland, Ponderay, and Porthill.

INTENSITY I TO III IN CANADA: Province of British Columbia: Fernie and Newgate.

Negative reports were received from 101 places in Montana, 69 places in Idaho, and 9 places in Canada.

April 8: 11:44:24*. Boulder City, Nev. II. Felt by few.

April 14: 13:37:20*. Moiese and St. Ignatius, Mont. V. Felt by many, frightened few at Moiese. Felt by several at St. Ignatius. At both places knickknacks fell and small objects and furnishings shifted. Trees, bushes shook slightly. Windows, stoves, and dishes rattled. Also felt at Lindbergh Lake.

April 15: 07:20. Whitepine, Mont. IV. Sharp shock felt by observer.

April 22: 09:54:42.5*. Epicenter 46.2° north, 111.4° west, western Montana, W. Felt over an area of approximately 1,500 square miles, centering in an area near Townsend and Toston. A field investigation, including personal interviews with nearly all of the inhabitants between Sixteen Mile Creek to north of Deep Creek, was conducted by Prof. Stephen W. Nile. Maximum intensity VI.

INTENSITY VI:

Daniels Ranch (about 8 miles northeast of Townsend).—People frightened and went outside. Plaster cracked. Dishes, utensils, etc., rattled.

Daniels Cow Camp (about 10 miles northeast of Toston).—Reported much plaster fell inside camphouse. Sheep shook so hard that they nearly toppled over when being loaded.

Dry Creek area (about 10 miles southeast of Townsend).—Felt very strongly by all (five). Almost knocked one man off feet. Cattle very frightened, nearly stampeded. Jeep parked with locked wheels moved 3 feet. Trees, bushes shook moderately.

Six Mile Creek (about 7 miles east of Toston).—Felt strongly by all in family, one frightened. Observer felt ground move up and down and saw vibrations travel along fence. Tops of powerline poles swayed and transformer on pole shook noticeably. Few bricks fell from chimney.

Townsend Valley at mouth of Dry Hollow (about 3 miles north of Toston).—Large tractor rocked so violently that operator jumped off in fear that it would roll over.

INTENSITY V: Greyson Creek (about 6 miles southeast of Townsend), Toston, Toston (about 1 mile north northwest of), Townsend, and White Sulphur Springs.

INTENSITY IV: Butte, Clarkston, Divide, Francis, Maudlaw, Radersburg, The Pavilion (about 14 miles east of), Townsend, Three Forks, Trident, and Wilsall.

Negative reports were received from 78 places.

April 22: 12:22. Basin, Mont. IV. Felt by two in home. Windows and doors rattled; walls creaked.

April 25: (no time given). Cooke, Mont. III. Felt by one person. Lasted a few seconds.

April 26: 11:20. Helena, Mont. III. Felt by five people in store.

April 29: 09:55. (about). Springdale, Mont. III. Felt by observer in home. Lasted about 2 seconds.

May 2: 03:15 and 09:15. Toquerville, Utah. IV. Press reported two distinct shocks felt here and at surrounding areas.

May 2: 03:30. Springdale, Mont. IV. Slight shock awakened few.

May 21: 21:20. Dog Canyon, N. Mex. (about 70 miles northwest of Carlsbad). IV. Felt by two in ranch house. Windows, doors, and dishes rattled; house creaked.

May 23: 21:15:15*. Epicenter 36.1° north, 114.7° west, Arizona-Nevada border, W. Felt over approximately 1,000 square miles. Slight damage to wood and plaster, and foundation cracks were reported. Maximum intensity VI.

INTENSITY VI:

Boulder City.—Felt by all. Several instances of slight damage, as plaster and foundation cracks, reported. Windows, doors, and dishes rattled; house creaked.

Whitney.—Frightened many in community. Walls cracked and knickknacks fell. Small objects fell. Windows, doors, and dishes rattled.

INTENSITY V: Las Vegas and Las Vegas (Weather Bureau Office).

INTENSITY IV: Overton.

INTENSITY I TO III: Henderson and Nelson.

May 23: 21:48:08*. Boulder City, Nev. IV. Felt by many.
May 23: 22:31:18*. Boulder City, Nev. II. Felt by few.
May 24: 02:52:54*. Boulder City, Nev. IV. Felt by many.
May 24: 08:35:13*. Boulder City, Nev. II. Felt by few.
May 24: 09:51:11*. Boulder City, Nev. II. Felt by few.
May 24: 14:55:09*. Boulder City, Nev. II. Felt by few.

May 25: 06:06:01*. Boulder City area, Nev. Intensity IV and felt by many at Boulder City where windows, doors, and dishes rattled, and house creaked, and at Whitney where dishes rattled. Intensity III at Searchlight where it was felt by several in home, outdoors by some, and windows, doors, and dishes rattled.

May 27: 02:01:02*. Boulder City, Nev. IV. Felt by many.

May 29: 20:15. Western Montana aftershock. V. Felt with maximum intensity at Greyson Creek and Townsend. At Shearer Ranch (Greyson Creek) table shook very strongly and "we thought chimney might fall." At Williams Ranch (Greyson Creek) shock strongly felt. Man sitting on sofa said he was rolled strongly back and forth. Objects rattled. Felt by many at Townsend where old cracked plaster fell and piano rattled vigorously against wall. Intensity IV at Cottonwood Creek (Daniels Ranch, about 8 miles northeast of Townsend) felt quite sharply; at Lombard, where railway station shook vigorously and vibrated desk. Felt only by those at station. At Six Mile Creek (Bartz Ranch, about 7 miles east of Toston) where one was frightened and dining table shook quite noticeably. Also felt at The Pavilion (14 miles east of Townsend on Deep Creek), Sixteen Mile Creek (Stockberger Ranch, about 4 miles southeast of Toston), Toston, and Toston (about 5 miles from).

May 30: 16:21:30*. Boulder City, Nev. II. Felt by few.
May 30: 20:18:55*. Boulder City, Nev. IV. Felt by many.
June 3: 22:25:16*. Boulder City, Nev. II. Felt by few.
June 12: 03:51:22*. Boulder City, Nev. II. Felt by few.
June 12: 18:48:05*. Boulder City, Nev. IV. Felt by many.
June 12: 22:02:23*. Boulder City, Nev. II. Felt by few.
June 15: 08:23:31*. Boulder City, Nev. IV. Felt by many.
June 19: 18:02:06*. Boulder City, Nev. II. Felt by few.
July 10: 17:29. Helena, Mont. IV. Felt by many.
July 12: 04:22:06*. Hoover Dam, Nev. III. Felt by few.

July 19: 06:38. Kenwood, Mont. III. Felt by observer. Light jolt with vibrations. Faint rumbling subterranean sounds heard during shock.

July 21: 18:00. Santoquin, Utah. IV. Short sharp earthquake shook kitchen walls and rattled windows.

July 23: 12:28. Salt Lake City, Utah. IV. Press reported Salt Lake City and vicinity rocked lightly. Light fixtures swayed and dishes rattled. At the Weather Bureau, airport station building shook and desk was felt to move.

August 3: 20:42. Cimarron area, New Mexico. V. Felt by most residents, awakened and frightened few. Small objects and furnishings shifted. Houses shook and hanging objects swung. Windows, doors, and dishes rattled. Also felt about 4 miles south of Cimarron.

August 14: 12:41:14*. Boulder City and Hoover Dam, Nev. IV. Felt by many. Windows rattled.

August 17: 03:45. Los Alamos area, New Mexico. V. Felt by all, awakened and frightened all in home. Some statements of slight damage to walls of homes. Bassinet shifted. Doors and dishes rattled. At Bandelier National Forest (Santa Fe), IV, felt by several in home and by some outdoors, awakened few. Also felt at Espanala where bed shook slightly.

August 21: 20:05. Esterbrook, Wyo. IV. Felt by several and all slightly alarmed. Creaking of building and rattling of loose objects heard by observer. Also felt 35 to 40 miles southwest of Esterbrook.

August 23: 20:02:05*. Boulder City, Nev. IV. Felt by many. Windows rattled.

August 28: 20:00. Medicine Bow, Wyo. IV. Felt by several. Buildings creaked, loose objects rattled.

September 2: 04:45. Helmville, Mont. III. Reported by one rancher. Lasted 2 seconds.

September 2: 14:00 (about). Esterbrook, Wyo. Faint subterranean sounds heard by observer in home and one person traveling toward Esterbrook from Glendo.

September 9: 02:30 and 02:45. Bonners Ferry, Idaho, and vicinity. IV. Press reported shock felt by at least 25 persons in Bonners Ferry and vicinity. Several awakened. Several heard rumbling and windows and dishes rattle.

September 13: 10:45. Boulder City, Nev. IV. Felt by all in office, frightened few in community and Boulder powerplant. Windows and door rattled.

September 28: 13:00 and 13:30. Lehi, Utah. V. Press reported rumblings heard during both shocks. Several telephone calls placed limits of tremor as far west as Saratoga and north to Point of the Mountain. Floorlamps swayed and dishes broke according to several residents. Another shock reported felt at 02:30 on the 29th.

September 30: 02:00. Boulder City, Nev. Reported as stronger than following shock at 22:24:27*.

September 30: 18:37:38* and 22:24:27*. Boulder City, Nev. Reported felt.

September 30: 23:25:32*. Boulder City, Nev. III. Felt by observer in home.

October 2: 21:12. Boulder powerplant control room, Boulder City, Nev. IV. Windows rattled. Lasted 1 second.

October 3: 01:08. Boulder powerplant control room, Boulder City, Nev. IV. Felt by several. Windows, doors, and furniture rattled.

October 7: 02:20. Reported felt over a small area of the border regions of southern Colorado and northern New Mexico. Maximum intensity V. Felt by, awakened, and frightened all in Antonito, Colo., home. Windows, doors, and dishes rattled. Rocks and boulders dislodged. Awakened all about 15 miles west of Antonito, where it was felt strongly at Osier. In Chama, N. Mex., many awakened. Small objects and chairs shifted, doors swung, and windows rattled. Felt by several, awakened, and frightened few in Tres Piedras, N. Mex. Small objects shifted. Windows, doors, and dishes rattled; house creaked. On No Aqua Peak, three cases of dynamite exploded on October 7.

October 16: 14:19:03*. Boulder City, Nev. IV. Felt by many. Windows rattled.

October 17: 17:44:54*. Boulder City, Nev. IV. Felt by many.

October 17: 23:45:43*. Boulder City, Nev. IV. Felt by many.

October 18: 10:29:36*. Boulder City, Nev. IV. Felt by many.

October 18: 12:55:10*. Boulder City and vicinity, Nev. V. Felt by all. Windows, doors, and dishes rattled. Lasted about 8 seconds.

October 18: 13:08:47*. Boulder City, Nev. II. Felt by few.

October 18: 13:40:53*. Boulder City, Nev. IV. Felt by many.

October 18: 13:42:44*. Boulder City, Nev. IV. Felt by many.

October 18: 13:56:51*. Boulder City, Nev. IV. Felt by many.

October 18: 13:58:45*. Boulder City, Nev. IV. Felt by many.

October 18: 18:52:28*. Boulder City, Nev. IV. Felt by many.

October 18: 23:45:22*. Boulder City, Nev. II. Felt by few.

October 19: 04:29:36*. Boulder City, Nev. IV. Felt by many.

October 19: 04:30:00*. Boulder City, Nev. IV. Felt by many.

October 19: 08:01:02*. Boulder City, Nev. II. Felt by few.

October 19: 17:56:07*. Boulder City, Nev. II. Felt by few.

October 20: 00:26:39*. Boulder City, Nev. V. Felt by all and awakened few in community. Windows, doors, and dishes rattled. Lasted 7 seconds.

October 20: 00:33:58*. Boulder City, Nev. IV. Felt by many.

October 20: 01:53:06*. Boulder City, Nev. IV. Felt by many.

October 20: 03:55:25*. Boulder City, Nev. II. Felt by few. Lasted 2 seconds.

October 22: 12:46:36*. Epicenter 32° north, 113½° west, Arizona-Mexico border region, W. Felt at Tucson, Ariz.

October 23: 21:19:48*. Boulder City, Nev. II. Felt by few.

October 25: 17:52:34*. Boulder City, Nev. IV. Felt by many.

October 27: 02:35:05*. Hoover Dam powerplant, Boulder City, Nev. IV. Felt by several in powerhouse. Windows rattled. Lasted 2 seconds.

October 31: 04:14:33* and 05:06:34*. Boulder City and Hoover Dam powerplant, Boulder City, Nev. IV. Felt by many at Boulder City. At powerplant windows rattled, first shock lasted 2 seconds. Second shock lasted about 1 second.

November 1: 16:35:48*. Boulder City, Nev. IV. Felt by many.

November 2: 05:18:02*. Boulder City and Hoover Dam, Nev. IV. Windows rattled, etc.

November 4: 23:18:38*. Boulder City, Nev. IV. Felt by many.

November 6: 13:05:10*. Boulder City, Nev. IV. Felt by many.

November 24: 02:01:23*. Boulder City, Nev. II. Felt by few.

November 27: 07:28:55*. Boulder City, Nev. III. Felt by several.

November 28: 18:34:15*. Boulder City and Hoover Dam, Nev. IV. Felt by many. Windows rattled, etc.

December 6: 19:49:38*. Boulder City, Nev. IV. Felt by many.
December 7: 01:20:13*. Boulder City, Nev. IV. Felt by many.
December 14: 00:58. Helena, Mont. II. Lasted 2 seconds.

CALIFORNIA AND WESTERN NEVADA

(120TH MERIDIAN OR PACIFIC STANDARD TIME)

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

January 7: 22:34:28*. Epicenter 34°00′ north, 116°21′ west, Little San Bernardino Mountains, P. V. Felt by all and awakened many in Hemet and Indio. Windows rattled. Trees, bushes shaken moderately. Felt with intensity IV in Mecca, Palm Springs, and Thermal. Windows and dishes rattled. Rocked buildings and startled sleepers in Palm Springs. Also felt at Mt. Helix and Lakeside.

January 9: 21:32:00*. Epicenter 36°08′ north, 117°57′ west, near Haiwee, P. IV. Felt by several at South Haiwee Reservoir (8 miles north of Coso Junction). Building creaked and loose objects rattled. Rumbling subterranean sounds accompanied shock. Also felt at Haiwee powerhouse (Coso Junction).

January 10: 03:30:19*. Epicenter 40°05′ north, 120°47′ west, northeast of Quincy, B. IV. Felt by several, awakened few at Quincy. Windows rattled. Lasted about 10 seconds.

January 12: 04:28:16*. Epicenter 34°25′ north, 119°25′ west, east of Santa Barbara, P. IV. Felt by several at Ojai. Buildings creaked and loose objects rattled.

January 27: 08:08:50*. Epicenter 33°37′ north, 117°05′ west, south of Winchester, P. III. Felt by few at Hemet. One slight jolt preceded by considerable noise.

February 4: 10:25:37*. Epicenter 37°34′ north, 118°35′ west, Owens River Gorge, P. III. Felt by observer in home at Long Valley Dam (Bishop).

February 8: 09:40:28*. Epicenter 33°06′ north, 116°38′ west, P. V. Felt by all, frightened few. At Alpine and Borrego Springs windows, doors, and dishes rattled. Few knicknacks and pictures fell. Trees and bushes shaken slightly. Felt with intensity IV at Julian, Mesa Grande, Ranchita, and Santa Ysabel. Also felt at Palomar Mountain and Warner Springs.

February 8: 12:50. San Francisco. "A slight earthquake was felt . . . in the Sunset District."—(*BSSA, April 1952.*)

February 9: 00:43:30* (main shock), 00:54:46*, and 11:44:25*. Epicenter 36°40′ north, 117°51′ west, northeast of Lone Pine, P. VI. Press reported main shock in Lone Pine cracked one building and caused plaster to fall in several homes. Sierra Cafe cracked halfway around and halfway between ground and roof. Several shocks were felt for 5 days. Intensity V at Owenyo. Felt by many, awakened all and frightened few in home. Windows, dishes, and doors rattled; walls creaked. Intensity I to IV at Darwin Wash (about 6 miles of), Independence, Keeler, and Whitney Portal.

February 10: 05:50:55*. Epicenter 33°35′ north, 119°11′ west, northwest of Santa Barbara Island, P. Press reported a slight shock felt at Altadena, Los Angeles, and Pasadena.

February 12: 17:52:58*. Epicenter 33°36′ north, 118°37′ west, northwest of Catalina, P. IV. Press reported a slight shock shook southwestern Los Angeles, and south bay areas, and Los Angeles International Airport. Felt in Palos Verdes, Redondo Beach, and Manhattan Beach, where windows and dishes rattled.

February 13: 06:05 and 08:35. Two slight shocks felt at Lone Pine.

February 13: 07:13:37*. Epicenter 32°52′ north, 118°15′ west, east of San Clemente Island, P. IV. Felt by many at Avalon, Balboa, Los Angeles, Los Angeles International Airport, and San Pedro, where windows and doors rattled and hanging objects swung. Buildings creaked, loose objects rattled.

February 13: 23:31:04*. Epicenter 32°55′ north, 118°18′ west, northeast of San Clemente Island, P. IV. Felt by observer in home and frightened few at Avalon where windows and doors rattled. At San Pedro felt as sharp shock.

February 17: 04:36:58*. Epicenter 34°01′ north, 117°14′ west, south of Loma Linda, P. V. Felt by and awakened many, frightened few. At Banning, Los Angeles, Perris, Redlands, and Riverside, houses creaked and loose objects, windows, and doors rattled. Recorded on instruments at Beaumont Weather Bureau Office. Also felt by several at San Diego.

February 19: 13:27:15*. Epicenter 36°34′ north, 118°14′ west, west of Lone Pine, P. Press reported felt at Lone Pine.

February 28: 08:05:04*. Epicenter 36°58′ north, 118°02′ west, southeast of Tinemaha, P. IV. Felt by several at Aberdeen and Fort Independence where windows, doors, and dishes rattled and house creaked. Hanging objects swung.

March 3: 08:14:16*. Epicenter 33°29′ north, 117°40′ west, P. III. Some at Inglewood and Laguna Beach felt slight shock according to press.

March 4: 23:19. Corte Madera. III. Felt by observer in home. Lasted about 10 seconds.

March 6: 16:00 (about). Redding, IV. "Redding and the surrounding area were shaken . . . by a sharp earthquake. Windows rattled, but there were no reports of damage."—(*BSSA, April 1952*).

March 7: 15:25.7*. Epicenter probably near Wheeler Ridge. IV. Felt by several at Wheeler Ridge. Lasted about 1 second.

March 7: (no time given). Reno, Nevada. "Residents of Reno felt a slight earthquake on March 7. The shock was estimated to be centered about 12 miles from Reno."—(*BSSA, July 1952.*)

March 11: 23:30. Corte Madera. III. Felt by observer in home. Lasted about 20 seconds.

March 16: 14:11:02*. Epicenter 32°07′ north, 115°17′ west, Colorado River Delta, P. III. Hanging objects swung at San Diego and reported felt at El Centro.

March 21: 23:45. Corte Madera. III. Felt by observer in home. Lasted about 10 seconds.

March 23: 05:36:13*. B. Manzanita Lake. V. Felt by all. Plaster slightly cracked. Buildings creaked, objects disturbed, hanging objects swung.

April 17: 13:56:33*. Epicenter 34°15′ north, 117°29′ west, near Cajon, P. Slight shock felt at Riverside and San Bernardino. Weed seismograph operated at San Bernardino.

April 18: 20:37:02*. Epicenter 37°46′ north, 122°10′ west, near southeast Oakland, B. "A brief but sharp earthquake struck east Oakland . . . shaking homes and startling residents of the Diamond district."—(*BSSA, July 1952.*)

April 24: 13:52:05*. Epicenter 35°38′ north, 118°18′ west, near Weldon, P. III. Felt in home at Jawbone Aqueduct Station. Lasted about 4 seconds.

April 29: 22:05. Hollister (7 miles south of). Weak shock.

April 30: 23:00:18*. Epicenter 33°41′ north, 118°02′ west, near Huntington Beach, P. Felt at Huntington Beach.

May 5: 06:10. Awakened all in home at Potter Valley and felt by, awakened many, frightened few at Willits where windows rattled and frame creaked. Intensity IV at Calpella and Redwood Valley where windows and dishes in drainer rattled.

May 6: 10:21:10*. Epicenter 41.0° north, 124.6° west, Crescent City, B. "An earthquake was felt in Crescent City and Ferndale. . . ."—(*BSSA, July 1952.*)

May 6: 21:45. Montecito and Summerland. IV. Felt by all in home. Windows and doors rattled.

May 9: 08:31:32*. Epicenter 39.4° north, 119.7° west, B. Moderate shock felt over approximately 3,000 square miles of northeastern California and western Nevada. Maximum intensity VI.

INTENSITY VI IN NEVADA:

Carson City.—Press reported the 70-year-old Capitol Building rolled with shock and two big electric clocks stopped. New cracks appeared in four State buildings and chairs careened back and forth. Shifted small objects and furnishings.

Virginia City.—Felt by and frightened many in community. Damage slight. Overturned small objects. Knicknacks and plaster fell. Building creaked; windows, doors, and dishes rattled.

INTENSITY IV: Applegate, Castle Creek, Colfax, Downieville, Doyle, Floriston, Foresthill, Kyburz, Myers, Soda Springs, Tahoe City, Truckee, and Vinton.

INTENSITY IV IN NEVADA: Fernley, Minden, Reno, Steamboat, and Stewart.

INTENSITY I TO III: Bijou, Chico, Homewood, Loyalton, and Sacramento.

INTENSITY I TO III IN NEVADA: Wadsworth.

Negative reports were received from 23 places in California and from 11 places in Nevada.

May 18: 03:52:58*. Epicenter 37°53′ north, 122°12′ west, near Orinda, B. Slight shock felt according to press.

May 26: 23:27:04*. Epicenter 33°21′ north, 116°24′ west, north of Borego, P. III. Felt by several at Ensign Ranch. Moderately loud rumbling subterranean sounds heard for several seconds before shock.

June 1: 03:45. Warm Springs. IV. Felt by several. Buildings creaked; loose objects rattled. Wall pictures shook, disturbed objects observed.

June 5: 02:38:13*. Epicenter 33°17′ north, 116°42′ west, near Warner Springs, P. V. Felt by and awakened many, frightened few at San Diego. Venetian blinds and windows rattled. Very strong vertical movement. Intensity IV in Mt. Helix, Suncrest, and Valley Center (3 miles northeast of), where buildings creaked and loose objects rattled. At Suncrest vertical movement was reported. Also felt at El Cajon, Lakeside, La Jolla, and Ramona.

June 8: 20:15. Park Village. IV. Felt by three people. Building creaked, loose objects rattled.

June 12: 05:45:42*. Epicenter 32°34′ north, 117°16′ west, off San Diego, P. V. Felt by and awakened many at Del Mar. Felt by several and lasted about 15 seconds, III, at Coronado, East San Diego, Mission Hills, Pacific Beach, and San Diego.

June 17: 10:19:31*. Epicenter 37°37′ north, 118°40′ west, Owens River Gorge, P. IV. Felt by several in home at Long Valley Dam. Windows rattled; frame creaked.

June 17: 21:00 (about). Point Arguello Lifeboat Station. IV. Felt by several. Disturbed objects observed by several. Tables, chairs, beds, and dishes rattled.

July 10: 00:45:52*. Epicenter 33°55′ north, 118°11′ west, near Clearwater, P. V. Awakened and frightened many in southwest Los Angeles County communities. Tall buildings swayed noticeably and many burglar alarms were set off in Los Angeles. Intensity V reported from Bellflower, Compton, Inglewood, Long Beach, Maywood, and Norwalk; IV from Alhambra, Huntington Park, Montebello, and Seal Beach. Also felt in Bell, Culver City, East Los Angeles, Hidden Springs Camp (near Mount Wilson), La Habra, Lynwood, Pasadena, San Fernando, and South Gate.

Negative reports were received from 14 places.

July 14: 12:15.2*. Epicenter 32.6° north, 115.4° west, south of Imperial Valley, P. IV. Brawley. Felt by many. Windows and doors rattled.

July 21: 02:20. Oroville (about 1 mile north of). Disturbance recorded on rain-gage chart at the Division of Forestry Headquarters at Thermalito.

July 21: 01:43:03*. Epicenter 35.0° north, 119.1° west. Foreshock of the Kern County earthquakes, P. Reported felt at some places.

July 21: 03:52:14*. Epicenter 35°00′ north, 119°02′ west, about 26 miles south of Bakersfield, P. Main shock of the Kern County series, and largest earthquake in the United States since 1906.

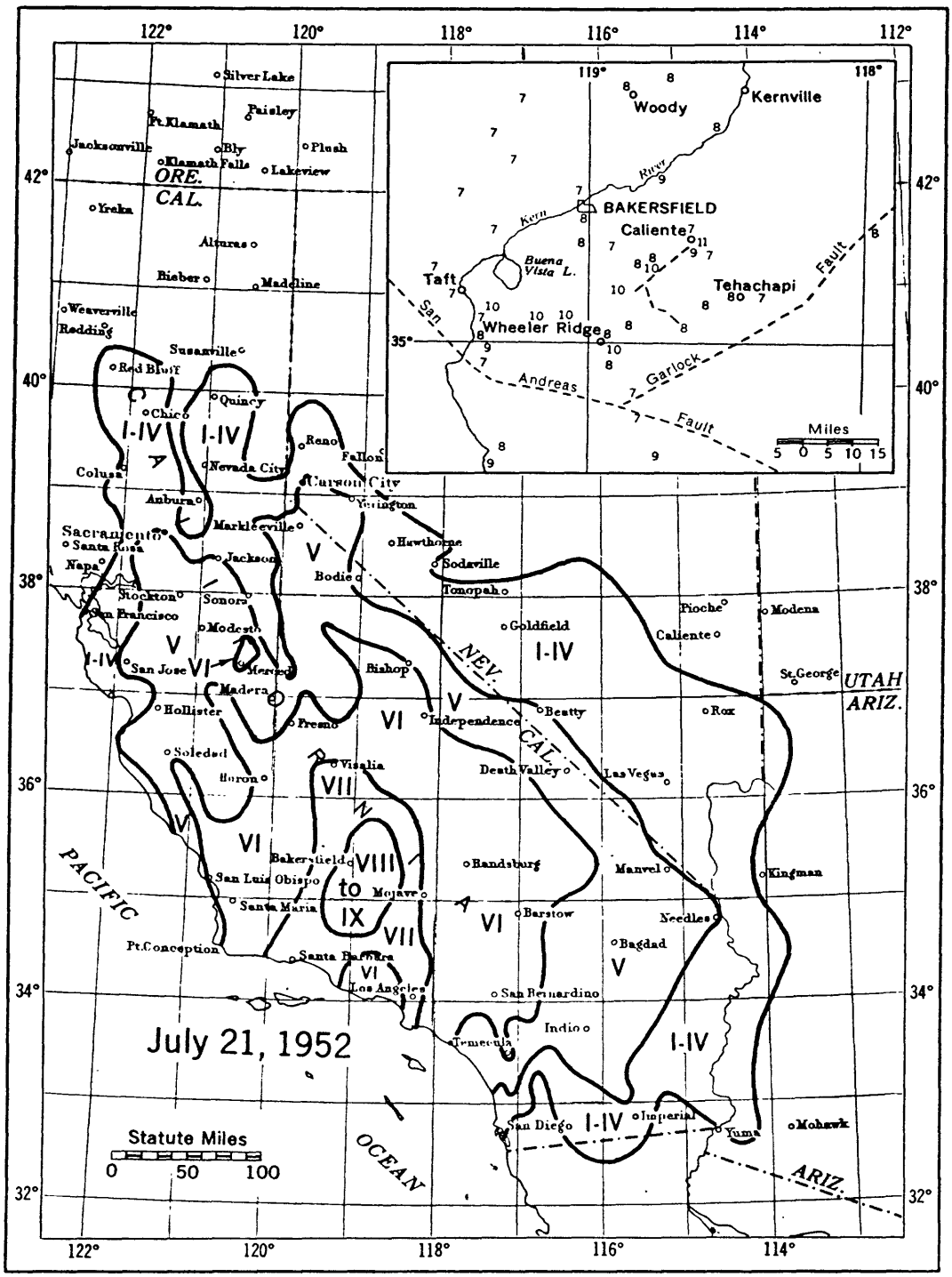

FIGURE 5.—Area affected by the earthquake of July 21.

Felt over a land area of approximately 160,000 square miles. See map, page 16. Magnitude was 7.7. Maximum intensity XI effects were observed in a very small area on the Southern Pacific Railroad near Bealville. Urban area intensities, however, did not exceed VIII. Twelve persons were killed, nine of the deaths occurring from the collapse of a brick wall in the town of Tehachapi; 18 persons were hospitalized and several hundred were given first-aid treatment. Damage estimates ranged upward of $50 million.

In the vicinity of the White Wolf Fault along the lower slopes of Bear Mountain there were many surface ruptures, and near Caliente reinforced-concrete railroad tunnels were demolished. South of Arvin concrete irrigation pipe systems were badly shattered, many fields required releveling, and hundreds of electric power transformers fell from elevated platforms. Near Wheeler Ridge 10-inch diameter steel lines were pulled apart and in one case telescoped 42 inches. At the Paloma Cycling Plant fire caused by a broken gas line did several million dollars' damage. At Arvin, Tehachapi, and Bakersfield damage to well-designed and constructed buildings was slight, but old and poorly built masonry and adobe buildings were cracked and many collapsed.

Reports of long-period wave effects were widespread. Water splashed from swimming pools in the Los Angeles area and the taller buildings suffered superficial but costly damage. At Owens Lake, 100 miles from the epicenter, salt beds shifted and brine lines bent into S shapes. At Gerlach, Nev., a pendulum clock stopped. At Phoenix, Ariz., the shock was felt in upper stories of buildings, and at Stirling City, Calif., a standing locomotive swayed.

One hundred eighty aftershocks of magnitude 4.0 and over were recorded by the Seismological Laboratory, California Institute of Technology, from July 21 to September 26. Hundreds of smaller shocks were recorded. Forty-seven aftershocks of magnitude 4.0 and over occurred on the 21st, of these 6 were of magnitude 5.0 and over.

July 21:

Origin time	*Epicenter*	*Magnitude P.*
04:02*----------	35.0° north, 119.0° west----------	5. 6
04:05:31*----------	35.0° north, 119.0° west----------	6. 4
04:19:36*----------	34°57′ north, 118°52′ west----------	5. 3
07:13:58*----------	35°11′ north, 118°39′ west----------	5. 1
09:42:44*----------	35°14′ north, 118°32′ west----------	5. 1
11:41:22*----------	35°08′ north, 118°46′ west----------	5. 5

NOTE—Strong-motion seismograph records are described in detail in section entitled "Strong-Motion Seismograph Results."

Schools noted as (Old) and (New) were constructed before April 10, 1933, and after April 10, 1933, respectively, in accordance with provisions of the Field Act to resist lateral forces.

INTENSITY XI:

Observed in a square mile or less area on the Southern Pacific Railroad ¾ mile southeast of Bealville in central Kern County. Reinforced-concrete tunnels with walls 18 inches thick were cracked, twisted, and caved in. The distance between portals of 2 tunnels was shortened about 8 feet in 300 feet. Rails were shifted and bent into S-shaped curves. Damage estimated at $2 million.

INTENSITY IX TO X:

Most of the intensities were observed at scattered locations within a sparsely populated belt several miles wide from the epicenter across San Joaquin Valley below Arvin, and northeastward along the lower slopes of Bear Mountain through the railroad damage area to above Tehachapi Creek. In the valley the relatively flat, poorly consolidated alluvium was erratically cracked and recontoured. At the Jones Ranch 3 miles southwest of Arvin ground cracks traversed and split the concrete foundation of a home, causing partial collapse. Slumping was noticeable, cotton rows were offset up to 12 inches, and pavement on Edison Road was crumpled for ⅛ mile. At the Frick Ranch southwest a mile, there was a similar zone of cracks through a yard, cottonfields, and a haystack. Still further southwest near State Highway 166 there was another fracture area. Here several 10- and 12-inch steel oil lines, 3 feet below surface, were pulled apart, and 1 telescoped 42 inches. Five miles north and 2 miles east of Wheeler Ridge on the Antelope Valley Potato Co. farm, water wells caved in, earthen reservoirs were flattened, and a concrete floor slab split. At Buena Vista Lake the resort operator reported 5-foot waves. Another report stated that portions of the east levee slumped 2 feet. Slumping and fissuring were prominent along certain parts of the Kern Island Canal. There was extensive damage throughout the valley area below Arvin to irrigation systems constructed of unreinforced concrete pipe. Many breaks occurred at mortar bands, line intersections, and standpipes. Along the lower slopes of Bear Mountain from a point 4 miles east of Arvin to the vicinity of the Old White Wolf headquarters, there was a series of northeastward-trending compression ridges like giant mole tracks. Near the ranch headquarters the compression features were subordinate to cracking that ran north crossing both the Bear Mountain Road and U. S. Highway 466. On line with the compression ridge series, severe cracking was evident from the Bealville turnoff at Highway 466 northeastward to above the railroad damage area. About 2.2 miles due east of Caliente there was a large crack, 59 inches at the widest point, with a vertical displacement of over 2 feet. At the Rogers Ranch headquarters on the south side of Highway 466 across from the Bealville turnoff, an east-west access road was vertically displaced several feet, cracks ran through an ancient wooden barn splitting the concrete floor, and a spring ceased to flow. Nearby framehouses and the owner's brick home were little damaged. Fill sections in the mountainous area long Highway 466 settled from a few inches to over a foot and at many places the pavement was cracked and wrinkled.

In the mountain areas surrounding the epicentral region, effects were similar. Landslides of loose material occurred in Caliente, Sand, Sycamore, Tejon, and other canyons. In Grapevine Canyon, large boulders, one the size of an automobile, were dislodged from steep hillsides. There were many rockfalls on the highway along the Ridge Route. A large landslide blocked U. S. Highway 99 temporarily at a point 8 miles south of Gorman. It was reported that in Sec. 34, T9N, R25W,

cracks 18 inches wide and 20 feet deep were found and that huge boulders were moved as much as 3 feet. At the Kern River powerhouse, about 10 miles northeast of Bakersfield, at the bottom of Kern Canyon, boulders fell from both sides of the steep canyon walls, breaking watergates, sections of the concrete dam, roofs, waterlines, and sewers. A power-transmission line was knocked down, and a walkway over the river destroyed. On State Highway 178 from 10 miles east of Bakersfield to Bodfish, there were many slide areas, with rocks from pebble size to truck size on the road. This road was closed for weeks due to continued sliding caused by heavy aftershocks.

Outside the central region there was one small area of intensity X. At the southern end of Owens Lake, over 100 miles from the epicenter, salt beds were piled in windrows running in an east-west direction, 18 inches high and 75 feet apart. Two-inch-diameter sample pipes driven into the salt beds 4 to 6 feet were badly bent. Six wells, consisting of outer caissons 20 feet in diameter and 8 feet high with 4 feet in the salt beds, were shaken down and in most cases submerged. Fifteen hundred feet of 12-inch brine line supported on piling 3 feet above surface was shaken off supports and several welds fractured.

INTENSITY VIII:

Arvin and vicinity.—One death from burns when stove blew up. Lime-mortared brick walls of old buildings in two-block business area extensively damaged and partially collapsed. Wood frame buildings and reinforced buildings of other materials appeared to have sustained slight to no damage. A second-story wall of the (New) Arvin High School administration building was fractured. An elevated steel water-storage tank at the school was strained but did not fall. Press reported three city water mains broke. Electric and gas service disrupted. Electric power transformers fell. In the railroad yards an empty railway boxcar was overturned by impact of another car which was moved on track by force of shock. Loose boxcars in yard rolled around. Upset stacks of shipping boxes in freight yards. Heavy objects, such as refrigerators, stoves, etc., were moved and much furniture overturned. Fluorescent lights and other ceiling light fixtures fell. People reported it was very difficult to maintain balance. Sharp aftershocks were reported felt at 04:10, 04:20, and 05:00. Strong after shock at 07:20 caused additional damage to buildings. About 4½ miles northeast of Arvin an 800-foot water well ceased to flow; pump appeared undamaged. Two miles south of Arvin a 60-horse-power motor and pumphead on water well was uplifted 18 inches without apparent settlement of ground; a week later the water flow failed. In the area 5 miles south of Arvin an old frame residence was off foundation and showed stucco cracks. Light fixtures were broken and heavy machinery overturned. About one-third of the transformers were down in this area. These elevated pole transformers were not anchored to the platforms. Collapse of wood-supported farm water tanks and overthrown baled hay frequent in this area. About a mile farther south, steel-supported farm water tanks suffered considerable damage. Some ground cracking, fallen chimneys and plaster, broken windows and dishes, fallen household objects, were generally reported from Arvin and vicinity.

Bakersfield.—Press reported several persons injured. One observer reported it was extremely difficult to walk as floor was weaving up and down. Three large water tanks collapsed. Walls of several downtown stores severely cracked, brick facades fell, and many plateglass windows broken. The city hall, courthouse, and the Kern County General Hospital were severely cracked. Several (Old) schools extensively damaged. Approximately 500 house connection lines (electric) broken. Much merchandise thrown to floor in stores. Household objects and furniture overturned in homes, cracked chimneys, broken windows, plaster cracked and fell. Many aftershocks felt.

Bakersfield (5 miles south of).—Man was thrown to floor upon attempting to walk. Refrigerator moved 4 inches. Large exterior cracks in garage and garage door jammed. House cracked severely both inside and outside, one exterior crack all the way across back of house. All concrete retaining walls around flowerbeds cracked. House across the street from this location had 4-inch crack in cement driveway and across lawn. Everyone on this block of 10 houses reported their houses had interior cracks. Observer counted 43 aftershocks on the 21st, with a hard one about 20 minutes after the main shock.

Bakersfield (north of, in Sec. 1, T28S, R27E).—Water tank (55,000 bbl.) bulged 2½ to 3 feet on north rim. Looked like it had been hit with large sledgehammer. Definite water slosh.

Caliente.—Felt by, awakened, and frightened all in community. Damage considerable. Water tank (about 20 by 20 feet and set about 5 feet off ground) collapsed. Water sloshed out of another tank and dented top of new automobile 6 inches. Outlet pipe on this tank broke and escaping water prevented people in trailer next to tank from opening the trailer door. The Caliente School (New) had minor amount of plaster damage. Suspended ceiling heaters swung enough to break vent connections. Ground surface around school cracked extensively. Locomotive swayed. Books, pictures, and plaster fell.

Caliente (3 miles east of).—Felt by, awakened, and frightened all in home. Knickknacks and books fell, dishes broken, ground cracked, piano moved 2 feet. Slight damage to wood.

California Institution for Women (about 10 miles west of Tehachapi).—Extensive damage, necessitating evacuation of inmates. One-story brick guardhouses at the main gate did not appear to be damaged. Furnishings and dishes within the buildings were widely scattered. Some furniture was overturned and broken. Near the prison, leaning telephone poles and ½-inch ground cracks were seen. A number of 20-foot-high, 15,000-gallon private water tanks in this area were destroyed. Inspection of the tanks showed considerable dry rot, inadequate bracing, and ineffective anchoring to the foundations.

Camp Scheideck (about 10 miles north of Wheeler Springs).—Cracked ground around trees. Reyes Creek, running through this property, appeared muddy all day and increased in flow about one-third. Damage slight to brick. Shifted small and large objects, including juke box.

Cantil.—Plaster, windows, walls, chimneys, and ground cracked. Knickknacks, books, pictures, plaster, and walls fell. Large pumping water wells pumped very muddy water for several hours

after shock. Well at the Cantil School pumped muddy water until July 26. Well at the Wagon Wheel Cafe (junction of Highway 6 and Randsburg County road) went completely dry. This well had about 70 feet of water in the casing before shock. Artesian wells on several ranches (next to Kane Dry Lake) report a great increase in water flow.

Comanche Point (west end).—Ground crack 3 or 4 inches wide, with the west or valley side dropped 6 to 8 inches relative to the east side. The length of the zone is about ¼-mile striking NE.–SW. About ½ mile south of Comanche Point Road at start of mountain foothills, adobe and concrete house and barn had many cracks; some adobe bricks fell. Pipes in field cracked in numerous places. Some canned food fell. Spring increased in flow from ¼ pipe to more than a full pipe. Several new springs formed south in foothills. On Comanche Point Road, about 1,000 feet of concrete pipe was cracked. Reservoir cracked and pump fell into reservoir. Water level lowered a few feet. Shifted barn a few inches and moved haystack piled in bales. Hot-water tank damaged, outside plaster damaged, and all dishes broken. In this area springs which had been dry or running only a trickle increased enough to cause a small runoff across road.

Cummings Valley area.—Motion so strong observer could not get out of bed. Damage great to masonry and adobe. North of the Women's Institution, about 1¼ miles, ground was cracked, chimneys and two adobe walls fell, furniture overturned. The Cummings Valley School, a small poorly constructed building, reportedly built in 1910, was a total loss. South of the school, in Sec. 36, T32S, R31E, house moved 4 inches off foundation and pipes broke under house. Banks of water reservoir sank 3 feet on northeast side and there were many cracks. Irrigation pipes in the Cummings Valley were split and cracked. Shifted everything in house, overturned and broke furniture, broke dishes and windows, cracked plaster, walls, and ground. Plaster, walls, and chimneys fell.

Cuyama area (south).—Many springs began flowing in T8N, R22W. At the Wegis Ranch, T7N, R22W, water started flowing more than double. Ground cracks in barnyard. South of this ranch, water flowed from a crack 12 inches wide, and a spring dry for 5 years became full of water.

Glenville and vicinity.—At the Austin Cafe a well with 14 feet of water went dry. Well 1 mile south went dry and another ½ mile north was cut down to about one-half its former flow. About 3 miles from Glenville (on way to Kernville), spring flow increased. About 3 miles from Glenville (toward Woody), spring increased from trickle to a stream.

Goleta (Lane's Ranch).—Press reported "The main deep water well on Lane's Ranch had gone dry and he was about to spend $5,000 digging a new one when the temblor shook the earth. The next day the old well gushed water as it did 20 years ago." In Goleta the shock awakened all. Some plaster, windows, and walls cracked. Some dishes, windows, and funiture broken. Damage slight.

Grapevine.—Four people seriously injured. People intensely frightened and all said it was impossible to stand. Extensive ground cracks seemed to follow the contours of the hills, many small slides and slumping on hillsides. Motel-style adobe brick dormitory collapsed completely, trapping the occupants. Oil storage tanks emptied when fittings broke off. One break in old 10-inch oil line. Oil sloshed from tanks ENE.–WSW. Along a fence line, running approximately N.–S., that followed the edge of a hillside, the 4 x 4 posts were atlernately driven into and lifted from the ground as much as 12 inches. Five miles south of Grapevine a 10-inch steel water-supply line broke and telescoped.

Kern County oil well damage.—Several hundred of the 13,000 producing wells in Kern County were affected:

Coalinga: Wells sanded, variation noted in daily production and in casing gas pressure.

Coles Levee: One well produced mud through corroded casing.

Edison: Increase of water in wells.

West Edison: Gas pressure increased in 25 wells. Production below normal.

Elk Hills: Thirty wells sanded.

Fruitvale: Wells on edge lost production; center wells gained in gas pressure. Returned to normal in a few days.

Kern River: Seventy-five wells sanded.

Lost Hills: Wells sanded, variation noted in daily production and in casing gas pressure.

Midway Sunset: Several wells went to water due to failure of water shutoff.

Mountain View: One well, tubing sprung couplings; a new 4,500-foot well reported to have collapsed liner. Also surface damage to line and tank connections.

South Belridge: Wells sanded.

Paloma Cycling Plant: Damage from fire, estimated at approximately $3 million, was caused when broken gas lines were ignited. Two tanks (2,500 bbl.) of butane knocked over. Two large pressure absorbers had stretched anchor bolts. Untied pipe support moved. Turnbuckles broke on a spherical tank, column failed, line broke, causing fire. Horizontal storage tanks (2,500 bbl.) well anchored at one end, had pin support sheared laterally. Buckled top row of plate on condensate tanks and sloshed oil. Cast-steel foot plates on cooling tower cracked through; tower moved west. Settlement of soil over buried conduits and lines. At the Paloma Substation damage was negligible. Minor shifting of transformers and scorching due to the fire in plant.

Kern County pole transformer damage.—About 700 electric power transformers at 269 locations thrown from elevated platforms. These transformers were not anchored to platforms and weighed about 1,000 pounds each. This type of damage was particularly noticeable in the Arvin-Wheeler Ridge area.

Lytle Creek (Fontana region).—Press reported Fontana's water supply was greatly increased when the shocks freed underground springs along the north fork of Lytle Creek. Water-company officials reported the flow was increased by 630 gallons per minute.

Maricopa Road (State Route 166).—Some well failures reported on this road. (Locations not given.)

Miracle Hot Springs.—Frightened all. Miracle Hot Springs went dry during the first shock, but resumed flow during the later shocks. Temperature of water seemed hotter. Many rockslides in canyon. Small objects and furniture overturned. Democrat Springs (about 10 miles southwest of Miracle Hot Springs) went completely dry.

Shafter School (about 5 miles south of Greenfield).—(Old) Concrete wall fractured; partitions, floors, and roof badly damaged. Must be abandoned. One corner and ground settled about 8 inches. School traversed by the rift.

Tehachapi.—Ten killed; 38 hospitalized; several hundred given first-aid treatment; nearly all panic stricken. Approximately 21 old buildings of brick, mortar and rubble masonry, in the business district, were completely destroyed, others extensively damaged and condemned. Three adobe dwellings and 2 frame dwellings (50 years old) totally destroyed. In general, wood frame dwellings and other business buildings of newer construction suffered only slight to moderate damage, consisting mostly of cracked plaster, walls, and fallen chimneys. A railroad water tank collapsed and an elevated steel water tank damaged. Numerous reports of overturned and broken furniture, broken windows and dishes. School damage consisted principally of plaster cracking and spalling, with some broken windows. Roofing in one unit cracked sufficiently to cause leaks. Shop equipment overturned. Numerous cracks in the surface of the Tehachapi Elementary School grounds. At other places in Tehachapi some small ground cracks were noted.

Tehachapi (west of, Culatrack Ranch). One spring dried up. One framehouse with wood interior and wood roof caved in. One framehouse had cracked plaster and fallen chimney.

Tehachapi (3 miles west of).—About 1 mile of telephone lines down or leaning along road.

Tehachapi (8 miles north of).—Crack in county road.

Tehachapi (in area few miles south and east of).—Front of adobe farmhouse partially collapsed; chimney down. Cement irrigation pipe snapped in several places. Only pipes full of water cracked. Knocked down transformers. Few brick chimneys fell from farmhouses. One farmhouse had chimney down, stone walls cracked, and dirt walls in basement down. An adobe hut had all walls partially or completely down.

Tehachapi to Arvin Road.—Practically all fills on highway embankments showed consolidation and slipping on the road between Tehachapi to Arvin. Some 20 fills had settled from 3 to 12 inches, and few were entirely displaced.

Tehachapi (5 miles north of, on U. S. Highway 466).—Rock slides at this locality and about 2 miles on farther north.

Tehachapi (2 miles north of, on U. S. Highway 466).—Highway overpass moderately damaged.

Tejon Ranch headquarters (11 miles east of Wheeler Ridge on El Paso Creek).—Buildings are almost entirely massive adobe brick and stone, some over 100 years old. Toppled chimneys, collapsed fireplaces, wholesale fall of plaster, destruction of some furniture (due to collapse of stone fireplaces), cracked walls, especially around doors and windows. Overturning of such heavy articles as bookcases and overstuffed chairs; shifting of refrigerators and beds. Rotated 1 automobile approximately 45°. El Paso Creek, dry in the vicinity of the ranch headquarters, flowed 2,000 gallons after the shock. One mile east of Tejon Ranch headquarters a 40-foot pole with 3 fixed transformers on the crossarm was pulled or thrown completely out of the ground without breaking the wires.

Tejon Indian Village (about 4 miles west of Cummings Mountain, and approximately 16 miles east of Wheeler Ridge, in Tejon Canyon).—Evidence of extensive sliding and many cracks; earthslumps noticed on the hillsides. Damage severe to adobe-brick houses. Several collapsed.

Wheeler Hot Springs.—Press reported Sulphur Springs increased in flow. Campers in the mountains reported small streams which were dry on previous Sunday were flowing within hours.

Wheeler Ridge.—Buildings were mainly cafes and cabins of stone and wood frame construction in generally poor repair. Main damage resulted from overturning of such heavy articles of furniture as a bar, storage cabinets, refrigerators, and emptying of shelves in homes, restaurants, and stores, with so much breakage as to cause temporary closing of business. One stone wall not firmly attached to building fell and adobe-brick building at north end of town badly cracked throughout. Parked automobiles, in gear, moved distances up to 6 feet. Railroad boxcar, used for storage and mounted on wooden blocks and tree stumps, moved. Hairline cracks were noticed in all of surrounding fields. People reported being literally thrown from beds and all unable to stand during the main shock.

Wheeler Ridge (1.5 miles south of, Rose pumping station).—Connecting pipes and fittings between boilers and pumps were torn loose. Pump bases slightly cracked; heater tanks shifted slightly; cracks appeared in ground where pipes entered. Two out of five small wood framehouses in a row shifted and toppled off blocks and were shambles. In one case porch separated from rest of house. Near the houses there were intermittent ground cracks, running the length of the 5 houses, the longest about 35 feet and ½ inch wide.

Wheeler Ridge (3 miles north of).—Three farm water tanks thrown down.

Wheeler Ridge (northwest of, about 4 miles west of U. S. Highway 99 and State Highway 166).—Oil storage tanks on steel supports thrown over.

Wheeler Ridge (½ mile south of).—Frame building shifted off foundation.

Wheeler Ridge PG&E Substation (few miles north of Wheeler Ridge on east side of U. S. Highway 99).—Transformers (70 kv.) moved south into legs of transformer structure and east in varying degrees. Cast-iron clip on footing of 70 kv. oil circuit breaker failed. Failure possible due to uplift. Storage battery rack in substation moved around but not damaged.

Wheeler Ridge Road (at point 5.4 miles south of Bear Mountain Road).—E–W cracks across road; little into field.

Woody (Sec. 34, T25S, R29E, and Sec. 3, T26S, R29E).—Tank walls on the spring badly cracked and broken, flow nearly shut off. Later shocks opened it again and flow is equal to if not greater than before shock.

Woody.—Felt by and awakened all in community; frightened many. Well in back of and at fire station lost, then came back after shock. Some springs flowing only a drip before shock began flowing as much as a 2-inch pipe after. Water supply and springs milky. Knickknacks, books, and pictures fell; dishes and vases broke. About 2 miles from Woody, septic tank pipe drainage damaged, few bottles fell, and small articles moved. About 1 mile south of Woody, observer ran outside with children. Animals disturbed and noisy before shock. Second shock seemed to move house, but no damage. Rumblings came from the direction of the mountains 10 to 12 seconds before shocks are felt.

INTENSITY VII:

Alpaugh.—Very severe shock. Awakened and frightened all. Trees, bushes shaken strongly. Plaster cracked; dishes broken. Water sloshed from irrigation ditches and canals.

Bealville.—Chimney broken at railway station.

Bena, near.—Horse and cattle knocked off feet.

Beverly Hills and Bel-Air.—Press reported huge cracks and buckled walls in swimming pools. Water from swimming pools sloshed over gardens and into homes.

Buttonwillow.—Felt by, awakened, and frightened all in community. The Buttonwillow School (Old) considerably damaged throughout. Unfit for use. Plaster, windows, walls, chimneys, and ground cracked. Small objects and furniture overturned. Dishes, windows, and furniture broken. Damage slight.

Castaic.—Felt by and awakened all; frightened many. Press reported large gas main broken. Trees, bushes shaken strongly. Dishes broken. Damage slight.

Cuyama.—Severe shock. Felt by and awakened all; frightened many. Severe damage to merchandise in stores. Power and telephone service disrupted. Furniture overturned and broken; dishes broken. Chimneys twisted and fell. Trucks and cars moved as much as 8 inches. Small fissures in ground. Distinct shocks of decreasing intensity felt at 04:02, 04:06, 04:12, 04:18, 04:25, 04:26, 04:40.

Corcoran.—Felt by and awakened all in community; frightened many. Water sloshed from swimming pools and canals of the Corcoran irrigation district over the banks. Water stage recorders on streams and canals in the Corcoran region showed fluctuations from 0.05 to 0.15 foot.

Compton.—Felt by and awakened all; frightened many. Trees, bushes shaken strongly. Small objects overturned. Furnishings shifted. Light fixtures shaken from ceiling of business office.

Di Giorgio School District (2 miles east and 1 mile north of Arvin).—The auditorium (Old) with offices, storage space, boys' and girls' lavatories in nonreinforced brick structure abandoned. Brick chimney collapsed and wall moved out.

Di Giorgio Road (about 2.5 miles south of U. S. Highway 99).—Slight sag in roadbed. No cracks along road.

Exeter.—Felt by and awakened all; frightened many. Trees, bushes shaken strongly. Windows, plaster, walls, and chimneys cracked. Damage slight to brick. Press reported post office showed minor damage; ceiling pulled away from north wall about 1 inch and cracks at new addition. Merchandise thrown. Trailer rolled back and forth. Minor leaks in pipelines.

Fairfax School (3 miles west of Edison) (Old).—Appeared to withstand first shock but started to fail during July 29 aftershock. Failure was progressive thereafter, with collapse at many places. Pottery turntable overturned.

Fellows.—Felt by, awakened, and freightened all in community. Upright piano moved about 1 inch. Frame walls "danced." Knickknacks, books, and pictures fell. Plaster and walls cracked; roof damaged. Windows and dishes broken. Damage considerable.

Fellows—(Sec. 6, T32S, R23E).—Felt by and awakened all; freightened many. Knickknacks fell and heavy light fixture fell at first part of shock. Dishes broken. House shifted northeast on foundation ⅜ inch and sewer connection broke at ground level on southwest side of house. Production tanks sloshed contents out on N–S sides.

Fillmore.—Felt by, awakened, and frightened all. Trees, bushes shaken strongly. Few dishes broken. Plaster and few walls fell. Transformer knocked down. Damage slight to brick and concrete. Press reported bricks fell from firewall and damage limited to powerlines, cracks in buildings, and broken merchandise. Intermittent shocks to 05:26; one at 06:00.

Fort Tejon (4 miles northwest of Lebec). Adobe brick buildings in various stages of collapse and restoration. Some walls and partially restored buildings (unreinforced) badly damaged. Chimneys damaged; adobe building collapsed. At the El Tejon School (New) some clay roof tiles loosened but attaching wires prevented any from falling; some acoustical ceiling tile fell. Some cracking at construction joint in one wall where addition was constructed.

Frazier Park.—Felt by, awakened, and frightened all. Trees, bushes shaken strongly. Furniture overturned and broken. Chimneys twisted and fell. Plaster, walls, and ground cracked. Windows and dishes broken. Damage considerable to brick and masonry. "Tremors continuing at intervals up to present time, 7–22–52."

Glendale.—Felt by, awakened, and frightened all in community. Trees, bushes shaken strongly. Furniture overturned. Windows and dishes broken. Plaster, fixtures, and walls fell. Press reported heaviest damage was to Presbyterian Church. Cornice fell from drugstore. Many burglar alarms set off. Wall bed collapsed on occupants. Damage considerable to brick and masonry. Faint shocks felt at 04:05 and 04:08, and for several days.

Gorman.—Felt by and awakened all; frightened many. Trees, bushes shaken strongly. Plaster, windows, walls, chimneys, and ground cracked. Knickknacks, books, pictures, plaster, and walls fell. Dishes, windows, and furniture broken. Chimneys twisted and fell. Damage considerable.

Hollywood.—Press reported a 2½-foot crack in pavement of street. Plateglass windows broken.

Johnsondale.—Felt by and awakened all; frightened many. Trees, bushes, shaken strongly. Knickknacks fell; chimneys twisted and fell. Dishes broken. Damage slight to brick. "Light shocks felt until this writing, 7–25–52."

Hanford.—Felt by, awakened, and frightened many. Some found it difficult to stand. Buildings and trees swayed visibly. Chimneys cracked, knickknacks and plaster fell. Press reported a stone chimney collapsed, few minor leaks in water mains, all swimming pools sloshed water, and bells rang.

Keene.—Awakened and frightened all in community. Trees, bushes shaken strongly. Plaster, windows, and walls cracked. Knickknacks, books, pictures, walls, and chimneys fell (about 20 per cent of chimneys damaged). Windows and dishes broken; reinforced concrete block house cracked. Glass block trim in cafe shifted. Water level in well changed. Damage moderate. At Stonybrook Retreat near Keene it was difficult to stand. All patients evacuated immediately. Strong shocks continued for several days.

Lake Hughes.—Felt by and awakened all; frightened many. Trees, bushes shaken strongly. Knickknacks fell; chimneys twisted and fell. Dishes broken. Damage slight.

Lakeside Union School (about 4 miles south of Old River, east of Buena Vista Lake) (New).—As a result of an 8-inch shift in tanks and piping, some of the short steel angle legs of the filter supports failed. Bookcases not attached to walls toppled and literally covered floor of entire room.

Lakeview P. G. & E. Substation (near Old River Road a few miles north of State Highway 166).—Damage negligible with slight movement of transformers and capacitor structure. Fence buckled due to ground crack. Foundation for substation building showed some movement. Ground around foundation cracked and disturbed.

Lamont.—Felt by and awakened all; frightened many. Trees, bushes shaken strongly. Knickknacks, books, pictures, and plaster fell. Dishes broken; furniture overturned and broken. All contents of refrigerator fell out on floor and was broken. Outer tier of brick fell from face of old stone building and some chimneys fell.

Lancaster.—Press reported damage to water towers and tanks. Windows broken in many downtown stores. Telephone lines and powerlines down at several outlying ranches. Water sloshed in elevated tank. Deep well pump out of commission. Street lamps swayed.

Lebec.—Felt by, awakened, and frightened all in community. Very difficult to move about. Trees, bushes shaken strongly. No damage to well-built structures such as new Kern County firehouse. Stoves, beds, and refrigerators shifted. Large-scale breakage of dishes, bric-a-brac, and other fallen objects. Windows broken. Some chimneys fell; much fallen plaster in hotel. Cracked columns and along the roof line of large stone garage.

Lorraine.—Felt by, awakened, and frightened all in community. Plaster, windows, walls, chimneys, and ground cracked. Knickknacks, books, and pictures fell. Dishes and windows broken. Twisted chimneys. Damage considerable to brick.

Los Angeles.—Moderate but costly damage of cracked partition walls, cracked and fallen plaster; broken plateglass windows occurred to some multistory buildings. Bricks fell from firewalls and parapets and some lighting fixtures fell, especially fluorescent light tubing in one building. Sixty-eight earthquake-operated gas shutoff valves in schools of the Los Angeles School District were operated. Hanging space heaters broke gas lines in industrial installation. Excess flow valves operated. Numerous power disruptions, scores of burglar alarms set off, and church bells rang. Press reported several were injured in Los Angeles County. Aftershocks felt 04:00, 04:07, and 04:08 mild, 04:20, 05:00, 06:00, 07:30.

McFarland.—Felt by and awakened all in community. Knickknacks and pictures fell. Plaster, windows, walls, and chimneys cracked slightly. At the McFarland Union School (Old) 10 regular classrooms, 1 kindergarten, and 1 musicroom may have to be abandoned. Old cracks opened up and wall failures resulted. Walls pulled away from roof framing but did not collapse.

Magunden Substation (5 miles east of Bakersfield.)—Twenty-five old-type insulators broken. Disconnected switches damaged—misalinement. Old circuit breakers leaked. Welds broke loose on anchor plates on transformer banks.

Maricopa.—Nearly all old masonry buildings seriously damaged, some condemned. A 100,000-gallon water tank suffered damage to tops of foundation piers and had stretched anchor bolts. Maricopa Unified (Elementary and High School) (Old) damaged. High-school units slightly damaged; elementary units considerably damaged.

Midway Steam Plant, P. G. & E. (near Buttonwillow).—Several windows broken. West partition wall in control room so badly cracked that it had to be replaced, one horizontal crack full length of wall (6 inches) about 4 feet above the floorline. The crack opened up and spalled so that one could see through the wall. Wall apparently nonreinforced. Ten-thousand-gallon elevated water tank collapsed and fell toward the east.

Monolith.—Felt by, awakened, and frightened all in community. Trees, bushes shaken strongly. Plaster, windows, walls, chimneys, and ground cracked. Knickknacks, books, pictures, and plaster fell. Dishes and windows broken; furniture in frame houses broken. Chimneys fell. At Monolith Portland Cement plant one 30-year-old chimney damaged at the 110-foot level, one reinforced concrete building cracked, several jack shafts on mills in misalinement. East of Monolith a cement blockhouse cracked and chimney fell. At the Monolith substation plaster cracked and two chimneys damaged.

Monrovia.—The 50-year-old city hall severely cracked. Part of the Masonic Temple's chimney fell. Parked car rolled into house. Flashes from electric transformers all over city.

Mount Pinos (in public park on top of mountain).—Awakened all and frightened many. Trees, bushes shaken strongly. Furniture overturned; knickknacks, books, pictures, and plaster fell; chimneys twisted and fell. Plaster, windows, walls, chimneys, and ground cracked. Dishes broken.

Newhall.—Press reported a 12-inch gas line broken near the city limits.

North Hollywood.—Felt by, awakened, and frightened all. Trees, bushes shaken strongly. Plaster, windows, walls, and chimneys cracked. Knickknacks, books, pictures, and plaster fell. Windows and dishes broken. Much water sloshed from swimming pools. Burglar alarms set off. Many transformers out, some sections without lights for several hours. File drawers in cabinet opened. One building had large exterior and interior cracks, some extending through the walls. Damage confined mostly to plateglass windows in stores. Minor shock at 04:03, and lesser shocks at 5-minute intervals until 04:30.

Norris School District (6 miles west and 3 miles north of Bakersfield) (Old).—Braces on roof and ceiling of auditorium shaken loose. Brick chimney sheared off.

Oak Creek Pass (5 miles south of Monolith and ½ mile past Pioneer Monument).—Indications of minor motion along a dropped fault bloc of the Garlock Fault, a secondary event along a sag pond.

Oildale.—Felt by, awakened, and frightened all. The Standard School (Old) had large cracks in three masonry arches; brick chimney sheared off. One wooden tank damaged and had to be replaced. Trees, bushes shaken strongly. Furniture overturned. Plaster, windows, walls, and chimneys cracked. Windows and dishes broken; glass goods in all stores toppled and broke.

Ojai.—Felt by and awakened all; frightened many. Slight sloughing along highway cuts. Damage slight to brick and masonry. Visible swaying of trees. Water in large outdoor tank sloshed over. Desk moved 5 inches northwest. Plaster and knickknacks fell. Dishes broken. All power off. Many aftershocks felt on 21st and for several days afterward.

Old River Road and Copus Road.—At corner of Old River Road and Copus Road there were cracks running perpendicuar to road *N*–S.

Old River Substation, PG&E (about 10 miles east of Buena Vista Lake).—Transformers (70 kv. to 12 kv.) shifted to edge of foundation and tipped but did not fall. Auto transformer structure bent at top of concrete and flat diagonals buckled.

Oxnard.—Felt by and awakened all; many alarmed and ran outdoors. Considerable damage to American Crystal Sugar factory; brick parapets at east and west sides of factory fell; large brick tunnel for carrying gases to smokestacks collapsed. Workman injured by falling brick. Masonic Temple lost ornamental plaster from top and corner tower cracked. Damage slight to chimneys, tile roofs, etc. Visible swaying of trees and poles. Plaster, windows, walls, and chimneys cracked. Dishes and windows broken. Transformers and circuit breakers out.

Pasadena.—Felt by and awakened all; frightened many. Press estimated damage in Pasadena was about $20,000. Thirty-foot section of brick parapet on 2-story building collapsed. Store windows cracked and other minor damage. Church bells rang.

Pattiway (Sec. 19, T10N, R23W).—Felt by all. Top row of chimney bricks and plaster on top of adobe and under rafter fell; book and alarm clock fell. Moved piano 2 inches northwest. Visible swaying of buildings and trees. Shock felt at 03:57 and several later.

Porterville.—Felt by and awakened all; frightened many. Press reported part of the auditorium of the Porterville Union High School condemned, portions of the parapet on the east and west sides damaged and old cracks widened. Foundation of shoestore and wall of laundry building cracked. Measurement of city bench marks after earthquake showed movement. Many older-type brick buildings had firewalls cracked and floors damaged. Dishes and windows broken. Chimneys twisted and fell; plaster fell.

Posey.—Felt by, awakened, and frightened all in community. Broke dishes; furniture overturned. Ground cracked.

Redondo Beach.—Awakened all in community. Press reported 4 large lighting fixtures, weighing 40 pounds each, fell from ceiling of city hall. Shocks felt at 03:58, 04:03, and 04:08.

San Bernard Substation, PG&E (few miles northeast of Wheeler Ridge).—Unanchored transformers shifted on foundation 3 feet south. Door forced open by air circuit breaker (on wheels) which landed on the ground.

San Dims.—Felt by and awakened all; frightened many. Chimney fell from old house. Trees, bushes shaken strongly. Furniture overturned; knickknacks, books, pictures, and plaster fell.

Santa Barbara.—Awakened all in community. A number of buildings were damaged, many located on State Street. Some suffered severe plaster and masonry cracks. Several firewalls fell on adjoining buildings, damaging the roofs. Some walls must be replaced. Many plateglass windows broken. Chimneys and ground cracked some. Snapped high-power wires at Montecito (near Olive Mill Road). Only very minor plaster cracking in Santa Barbara city schools. Trees, bushes shaken strongly. Heavy objects shifted; furniture overturned. Spilled oil from outdoor tanks in east direction.

Saticoy.—Felt by, awakened, and frightened all. Trees, bushes shaken strongly. Floor lamp, books, pictures, and chimneys fell; hundreds of boxes of lemons overturned. Dishes broken.

Saugus.—Felt by and awakened all; frightened many. Very severe shock. Trees, bushes shaken strongly. Knickknacks, books, and pictures fell; furniture overturned. Plaster cracked. Damage slight. Press reported Deer Creek Dam (earthfill) on the Los Angeles Aqueduct cracked.

Shafter.—Felt by, awakened, and frightened all in community. Damage slight to brick, masonry, and concrete. Dishes, windows, and furniture broken. Plaster, windows, and walls cracked. Trees and bushes shaken strongly. Furniture overturned; knickknacks, plaster, and walls fell.

South Haiwee Dam and Reservoir.—Awakened all in community. Stacks of canned oil and objects from shelves overturned. Four cracks in rockfill dam 150 feet each way from center of dam ½ to 1 inch wide. Aftershock felt at 04:39, slight; another at 09:23 with strong roaring noise and rolling motion.

Taft.—Felt by, awakened, and frightened all, everyone outside, some found it difficult to stand. Damage in general was moderate. Some walls badly cracked, some chimneys and parapets fell, brick and tile loosened, a long overhanging porch fell. Gas and water line damage negligible. Large tank

(55,000 bbl.) wrinkled at lower seams, minor leaks. Moved heavy objects, refrigerators, etc.; stove "jumped" out of glass cups under legs, jarred hot water heater and concrete tubs loose from walls. Sidewalk cracked and shifted. Some ground cracks reported. Merchandise thrown down in stores, many dishes broken. In the vicinity of Taft two nonproductive capped oil wells began producing oil, one well blew off cap. Four-inch waterline reported broken in SE¼, Sec. 36, T31S, R24E. Swimming pool lost 1 foot of water.

Tipton.—Felt by and awakened all; frightened many. Chimneys fell. Damage slight to brick and concrete. Plaster and walls cracked. Trees, bushes shaken strongly.

Tupman.—Felt by, awakened, and frightened all. Damage slight to wood. Tank (10,000 bbl.) collapsed inward at three places. Elk Hills School (Old) suffered serious wall damage but no collapse. Unsafe to use. Chimneys twisted. Knickknacks, books, and pictures fell; dishes broken.

Twin Oaks (vicinity of).—Crack in county road.

Van Nuys.—Press reported large cracks in the municipal building courtroom, rooms, and hallways. Huge fluorescent light on eighth floor fell, steel filing cabinets tipped over, and a piece of cornice in first-floor foyer fell. Brickwall in yard crumbled. Large chickenhouse collapsed, causing $6,000 damage.

Ventucopa.—Felt by, awakened, and frightened all in community. Dishes, windows, and furniture broken. Chimneys twisted. Trees, bushes shaken strongly. Plaster, windows, walls, chimneys, and ground cracked. Knickknacks, books, pictures, plaster, and walls fell. Moderate shock lasting 10 seconds felt at 04: 09.

Ventura.—Felt by, awakened, and frightened all. Several old two-story unreinforced buildings with poor mortar damaged. Damage was mainly on the second floors and consisted of front and rear walls loosened from sidewalls, severe cracks, loose and fallen bricks, and parapet wall damage. Plate-glass windows broken in several stores. One power pole knocked down. Chimneys fell. Furniture overturned, dishes broken. Plaster cracked and fell in courthouse, walkway bridge split, books hurled from shelves. Light shocks felt until 11: 55.

Vineland School District (4 miles west and 1 mile north of Arvin).—Vineland School (Old) severely damaged. Gable wall collapsed and brickwall pulled about ¾ inch from roof framing. At the Sunset School (New), a row of suspended light fixtures fell and shop equipment overturned.

Visalia.—Felt by and awakened all; general alarm. Press reported 76-year-old courthouse closed. All sections of the building, except the west annex built in 1936, condemned. Visible swaying of house. Bricks fell from few chimneys. North-south end of walls cracked, mostly plaster cracks; plaster fell. Fireplace on south wall had 5-foot pronged crack through bricks; mortar pulled from bricks. Many small ceiling cracks in north end of municipal auditorium; plaster dust on floors and desks. Light shocks at 04:05 and 04:20, strong bump at 04:40.

Visalia (3 miles west of).—Felt by and awakened all in region, frightened many. Chimneys, plaster, and knickknacks fell. Damage slight to brick, masonry, and concrete. Plaster, windows, walls, and chimneys cracked. Dishes and windows broken.

Weed Patch.—Felt by, awakened, and frightened all. At the Weed Patch PG&E Substation, four 70-kv. to 12-kv. transformers on tracks ran off foundation and tipped over. Track in N–S direction. Displaced saddle-type pier under transformer oil storage tank. Tank shifted 1½ inches and left the pier at its maximum displacement. Ground broken on right side of pier. Large, well-built incinerator at cotton gin had small vertical cracks. Small objects and vases overturned; dishes broken. Ground cracked.

Weed Patch (6 miles south of).—Felt by and awakened all; frightened few. Damage slight. Small objects and furnishings shifted E.–W.; small objects and vases overturned. Walls and ground cracked. Knickknacks and books fell.

White Oak Lodge (about 10 miles southwest of Tehachapi).—Some chimneys damaged. Some dry branches broken off trees a few miles away along the Garlock Fault.

Woodford.—Keene School (Old) suffered considerable damage.

INTENSITY VI:

Acton.—Felt by and awakened all in entire area; frightened many in community. Damage slight. Small objects and furnishings shifted; vases overturned; knickknacks and pictures fell.

Adelanto.—Felt by and awakened all in community; frightened many. Damage slight. Dishes broken in restaurant. Furniture moved. Plaster cracked. Pendulum clock stopped. Small objects and furnishings shifted; small objects overturned; knickknacks fell.

Agoura.—Felt by all and awakened many in community. Plaster cracked. Trees, bushes shaken strongly.

Alhambra.—Many windows cracked in downtown area. Power disrupted in residential districts.

Altadena.—Felt by and awakened all in community; frightened many. Damage very slight. Trees, bushes shaken moderately. Small objects overturned.

Anaheim.—Awakened all and frightened many in community. Damage slight. Some plaster and windows cracked, few dishes broken. Trees, bushes shaken strongly.

Arcadia. Several windows cracked; bottles on shelves broken; powerlines shortcircuited.

Arrowhead Springs (near San Bernardino).—Damage to gasline at hotel.

Avenal.—Felt by, awakened, and frightened all in community. Damage slight. Vases overturned; knickknacks fell; dishes broken. Plaster cracked. Pendulum clocks stopped. Trees, bushes shaken strongly.

Avery.—Felt by and awakened all in community.

Azusa.—Press reported five powerlines down. Burglar alarms set off.

Backus Ranch (8 miles south of Mojave).—Awakened and frightened all in community. Damage slight. Small objects shifted; vases overturned; jar fell from shelf. Water sloshed from swimming pool on east side and water emptied from observation pan 4 feet in diameter and 10 inches deep.

Baker.—Felt by and awakened all in community; frightened many.

Bakersfield (6 miles east and 1 mile north of).—Terrific roar and sound heard like falling rock right under house. Flashes of light seen a few seconds before shock was felt.

Baldwin Park.—Felt by, awakened, and frightened all in community. Pendulum clock facing northwest stopped. Small objects shifted. Trees, bushes shaken strongly.

Barstow.—Felt by and frightened all in community. Small boy thrown out of bed and bed rolled across room. Area filled in with trash settled. "Many small tremors felt since this one." Trees, bushes shaken strongly. Small objects shifted and overturned; knickknacks fell. Weakened cupboard. Split large tree.

Bartlett.—Awakened and frightened all in community. Damage slight.

Beardsley School (about 5 miles northwest of Bakersfield).—Assembly Hall (Old) had some damage to tower portion, apparently movement at old cracks.

Beaumont.—Awakened all in community. Pendulum clock started. Trees, bushes shaken strongly.

Bellflower.—Awakened all and frightened many in community. Press reported powerline severed. "Most severe since 1933." Small objects shifted; plaster cracked.

Beverly Hills (just north of). Felt by all. Water in swimming pool sloshed back and forth, about 12 inches between high- and low-water marks, for 20 minutes or more.

Big Bear City.—Felt by, awakened, and frightened all in community. Trees, bushes shaken strongly.

Bigpine.—Felt by and awakened all in community. Damage slight. Small objects shifted. Trees, bushes shaken moderately.

Bishop.—Felt by and awakened all; frightened many. Walls at post office cracked. Damage slight to pumice-brick, and mortar. Pendulum clock facing south stopped. Knickknacks fell.

Bodfish.—Felt by and awakened all in community; frightened many. Walls cracked. Broken water pipe was attributed to earthquake. "Many aftershocks for 2 hours."

Boron.—Felt by and frightened all in community; awakened many. Damage slight. Some plaster, windows, and walls cracked. Trees, bushes shaken strongly. Knickknacks fell.

Buellton.—Felt by, awakened, and frightened all. Few small objects and furnishings shifted. Slight damage to a few water pipes.

Burbank.—Felt by and awakened all in community; frightened many. Press reported people rushed into streets as windows shattered, lights swayed, dishes fell off shelves, and powerlines fell. Visible swaying of buildings. Pendulum clock stopped. Trees, bushes shaken strongly. Furnishings shifted.

Calabasas.—Awakened and frightened all in community. Vases overturned.

California Hot Springs.—Felt by and awakened all; frightened many. Trees, bushes shaken strongly. Many small shocks.

Camarillo.—Awakened and frightened many in community. Damage slight. Small objects and furnishings shifted; knickknacks fell.

Camp Nelson.—Felt by, awakened, and frightened all in community. Damage slight. Chimneys cracked. Small objects and furnishings shifted; knickknacks, books, and pictures fell. Trees, bushes shaken strongly.

Canoga Park.—Heavy shock. Slight damage to dishes, lamps, etc., in homes and stores.

Cantua Creek.—Felt by all; awakened many. Small objects shifted; knickknacks, books, pictures, and plaster fell.

Carpinteria.—Felt by, awakened, and frightened all in community. Pendulum clocks stopped, one faced west. Vases, small objects, and furniture overturned; knickknacks fell; dishes broken. Plaster, walls, and chimneys cracked; plaster fell. Much merchandise fell in stores.

Cartago.—Felt by and awakened all in community. Hanging objects swung N.–S. Very slight aftershocks.

Caruthers.—Felt by and awakened all; frightened many. Trees, bushes shaken strongly. Small objects shifted. Loosely strung electric wires crossed. Several wells reported pumping sand.

Chatsworth.—Felt by and awakened all in community; frightened many. Trees, bushes shaken strongly. Lamps overturned; knickknacks, books, and pictures fell. Plaster cracked. About $35 damage to water tank column.

Chino.—Felt by and awakened all in community. Press reported canned goods fell from shelves in some stores and other cases of minor damage, such as broken jars in markets and cracked plaster in some homes. Some electric power wires touched and short-circuited. Damage slight to brick and masonry. Trees, bushes shaken strongly. Furnishings shifted; small objects overturned. More shocks felt on July 22 and 23.

Cholame.—Awakened and frightened all in community. Pendulum clock stopped.

Claremont.—Press reported pump station slightly damaged and powerlines fell.

Clovis.—Awakened all in community; frightened few. "Strongest since 1906 in this vicinity."

Colton.—Felt by, awakened, and frightened all in community. House lurched so violently walking was difficult. High-tension wires swung together and shorted telephone line. Many plaster cracks inside and all around the outside of house at the junction of house and foundation. Small objects shifted; knickknacks fell. Oil spilled from outdoor containers. Trees, bushes shaken strongly.

Compton.—Press reported several powerlines cut, traffic lights disrupted, and windows broken.

Concepcion.—Felt by and awakened all. Trees, bushes shaken moderately.

Cornell.—Felt by and awakened all in community.

Corona.—Felt by, awakened, and frightened all. Damage slight. Trees, bushes shaken strongly. Small objects and furnishings shifted.

Covina.—Felt by and awakened many in community. Plaster cracked. Damage slight.

Creston.—Felt by all, awakened many, and frightened few in community. Damage slight. Trees, bushes shaken moderately. Small objects shifted. Plaster cracked.

Crucero.—Felt by and awakened all. Trees, bushes shaken moderately.

Culver City.—Felt by and awakened all in community. Plaster cracked. Press reported dishes fell in many homes and water tower at RKO studio spewed water.

Death Valley.—Felt by and awakened all in community. Small objects shifted.

Delano.—Felt by all and frightened many in community. Pendulum clock facing west stopped. "Shocks have continued."

Del Rosa.—Felt by, awakened, and frightened all. Window weights made loud noise knocking against casing. One pendulum clock facing east started; one facing north stopped. Small objects shifted; door chimes and birdcages rattled and swung. Damage slight to brick and concrete.

Downey.—Felt by and awakened all, frightened few. Press reported powerlines down and telephone service disrupted.

Ducor.—Awakened and frightened many in community. Damage slight. Small vase overturned. Brick chimney damaged.

Earlimart.—Felt by, awakened, and frightened all in community. Trees, bushes shaken strongly. Small objects and furnishings shifted. "Strongest shock ever felt here." Shocks felt at 04:15 and 04:40.

East Los Angeles.—Relative movement between office building and two adjoining finishing buildings. Flashing on roof of office building indicated a displacement of ⅛ inch N.–S. and 1/16 inch E.–W.

Edwards.—Very strong shock. Felt by and awakened many in community. Vases and small objects overturned. Plaster cracked and windows broken.

El Monte.—Felt by and awakened all; frightened many. Trees, bushes shaken strongly. Small objects shifted and overturned. Press reported large die blocks weighing several thousand pounds shifted 2 inches.

Encino.—Felt by, awakened, and frightened all in community. Power service disrupted. Small objects shifted; vases overturned; knickknacks fell. Trees, bushes shaken moderately. Pendulum clock stopped.

Essex.—Felt by and awakened all in community. Hanging objects swung. Light shock 2 or 3 minutes later.

Fawnskin.—Felt by and awakened all in community; frightened many. Trees, bushes shaken moderately. Small objects shifted; knickknacks, books, and pictures fell. Two light tremors later.

Firebaugh, near.—Press reported moss dislodged in canal and water sloshed over canal in spots.

Fontana.—Felt by and awakened all in community; frightened few. Trees, bushes shaken strongly. Small objects shifted; canned food in store fell; ceiling light bowl unhooked. Shock felt at 04:10 and 04:20.

Forest Home.—Awakened many and frightened few in community. Some plaster, windows, walls, and chimneys cracked. Damage slight to wood and concrete.

Fresno.—Felt by and frightened many; some panic. Minor plaster cracks in some downtown buildings, small pieces of ornamental facing fell from one building, some windows broken. Several power failures. Visible swaying of buildings and trees. Moderately heavy articles moved and tipped over. Clocks started and stopped.

Friant.—Felt by and frightened all in community; awakened all in home. Hanging objects swung.

Friant.—*(about 5 miles south of, in San Joaquin River bottoms).* Press reported walls of house badly cracked, and tankhouse moved about 1 inch on foundation.

Fullerton.—Awakened and frightened all in community; some people left homes for a short time. Press reported gas and city water main broken; power disrupted. Damage estimated at less than $1,000. Four-inch water main, running E.–W., on hill part of town broken. Trees, bushes shaken strongly: visible swaying of trees.

Gardena.—Felt by and awakened all; frightened many. Pendulum clock facing north stopped. Trees, bushes shaken strongly. Small objects shifted slightly. Plaster cracked. Damage slight to wood and brick.

Gaviota.—Felt by and awakened all; frightened many. Hanging objects swung. Trees, bushes shaken strongly.

Goshen.—Felt by, awakened, and frightened many, some outdoors. Damage slight. Plaster cracked and windows broken. Small objects shifted and overturned.

Guadalupe.—Felt by, awakened, and frightened all in community. Damage slight. Small objects shifted and overturned; books fell.

Haiwee powerhouse (Coso Junction.)—Awakened all in community. Hanging objects swung.

Huasna (about 10 miles southeast of Arroyo Grande).—Felt by and awakened all in community. Pendulum clock facing south stopped. Small objects fell and broke 2 or 3 miles north and south of Huasna.

Hawthorne.—Awakened all and frightened many in community. Damage slight. Trees, bushes shaken strongly. Small objects shifted; vases overturned.

Helendale.—Very violent rocking N.–S. Frightened all. Trees, bushes shaken strongly.

Highway Highlands.—Felt by, awakened, and frightened all in community. Trees, bushes shaken strongly. Shifted small objects and furnishings; overturned small objects; knickknacks fell.

Hidden Springs Camp (near Mount Wilson).—Felt by and awakened all; frightened many. Hanging objects swung. Lighter shock 10 minutes later, and slight shocks at 04:20, 04:21, 04:27, 04:38.

Hinkley.—Felt by and awakened all; frightened many. Trees, bushes shaken strongly. Small

objects shifted. Strong aftershock at 09:40. At the Hinkley compressor station, PG&E, there were minor cracks in floors, fine hair cracks in foundations of two compressors. Concrete supports in yard for piping spalled where steel saddles were embedded in concrete.

Huntington Park.—Felt by, awakened, and frightened all. Police officers reported houses along Miles Avenue moved "like they were on waves" and flagpole in front of police station "whipped about like a flyrod." Burglar alarms set off. Plaster cracked. Dishes and windows broken. Lights out. Pendulum clock stopped. Small objects and furnishings shifted; small objects and furniture overturned; knicknacks fell.

Huron.—Felt by all; awakened and frightened many in community. Hanging objects swung. Plaster cracked.

Independence.—Heavy motion. Felt by, awakened, and frightened all in community. Hanging objects swung. Trees, bushes shaken moderately.

Indio.—Awakened many in community; frightened few. Knickknacks, books, and pictures fell. Press reported telephone lines snapped.

Inglewood.—Felt by all; awakened and frightened many. Press reported windows cracked in several homes and buildings; cracks in buildings. Pendulum clocks stopped. Small objects and furnishings shifted; knickknacks fell.

Inyokern (Indian Wells Valley.)—Felt by all; few alarmed. Visible swaying of buildings and trees. Ice box and table moved. Few books fell from bookcase; lamp fell. Shocks felt at 06:42 and 09:30.

Inyokern.—Felt by and awakened all, frightened few. Trees, bushes shaken strongly. Merchandise fell in stores.

Isabella.—Felt by, awakened, and frightened all in community. Damage considerable. Cracked plaster and chimneys; plaster fell. Trees, bushes shaken strongly. Small objects shifted and overturned.

Ivanpah.—Felt by, awakened, and frightened all in community. Beds rocked violently; small objects shifted. Trees, bushes shaken moderately.

Jawbone Aqueduct Station (35°18′ N. 118°02′ W.)—Felt by and awakened many in community; frightened few. Trees, bushes shaken moderately. Small objects shifted and overturned. Shocks felt all day and night.

Johannesburg.—Felt by and awakened many in community; frightened few. Windows cracked.

Kaweah.—Felt by and awakened all; frightened few. Hanging objects swung. Trees, bushes shaken slightly.

Keeler.—Felt by, awakened, and frightened many in community. One pendulum clock facing east stopped; one facing north started. Water in swimming pool sloshed out 5 feet.

Kern River powerhouse No. 3 (*Kern River Valley, about 5 miles north of Kernville.*)—Felt by almost everyone in locality. Several slight plaster cracks. Cabinet doors with friction latches swung open; crane hooks swung in arc of about 18 inches. Disturbed objects observed by several.

Kern Steam Plant, PG&E (4 miles west of Bakersfield).—Damage to building negligible. All structures are designed for a lateral force of 20 percent of gravity. Oil storage tank about three-fourths full sloshed about 500 barrels out on NW.–SE. sides. Roof and tank rotated about 15° counterclockwise and broke ladder leading to roof loose from its connection; another tank had roof rotated about 15° clockwise. Main transformers on tracks in N.–S. direction had rail stops displaced up to 1½ inches. Boiler feed pump lost suction and froze.

Kernville.—Felt by and awakened all; frightened few. Small objects shifted and overturned; pictures and canned goods in stores fell from shelves. Small shocks felt every 4 or 5 minutes until 05:00.

Kettleman City.—Felt by all; awakened and frightened many in community. Pendulum clock stopped. Small objects and furnishings shifted; groceries fell from shelves. Several shocks felt.

King City.—Felt by all in home; awakened all. Hanging objects swung. Trees, bushes shaken strongly; one tree fell.

Kings Canyon National Park.—Awakened all in community; frightened few. Hanging objects swung. At Grant Grove it was felt by nearly all and awakened many. Shocks also felt at 04:12, 04:29, 04:43; shock at 04:43 rattled dishes.

La Canada.—Felt by and awakened all in area. Plaster cracked. Several shocks felt.

La Crescenta.—Felt by all and frightened many in community; awakened all in home. Plaster cracked. Small objects shifted and overturned; knickknacks and pictures fell. "Seemed to be heaver than 1933." Shocks felt for 45 minutes.

Laguna Beach.—Felt by many. Bells rang. Visible swaying of buildings and trees. Walls cracked slightly. Birdcages, window shades, etc. swung.

La Habra.—Felt by and awakened all; frightened many. Hanging objects swung.

Lake Arrowhead.—Felt by, awakened, and frightened all in community.

Lake Mary (formerly Wildyrie).—Felt by, awakened, and frightened all in community.

La Mirada.—Awakened all and frightened many in community. Pendulum clock facing south stopped. Small objects and furnishings shifted. Few tremors felt every day until July 24th.

Laton.—Felt by and awakened many; frightened few. Damage slight to masonry. Walls cracked. Small objects and furnishings shifted; small objects overturned; knickknacks fell. Pendulum clock stopped. Trees, bushes shaken strongly. Other tremors felt on the 21st and continued at intervals until July 22d.

La Verne.—Felt by and awakened all; frightened few. Small objects and furnishings shifted. some damage in grocery store. Press reported canned goods fell in stores.

Lemoore.—Safe in city hall jarred loose from its foundation. Pictures shaken from walls; dishes fell; bricks fell from few chimneys. Water in swimming pools sloshed. Damage slight. One mile northeast of Lemoore shock awakened few and frightened one in home. House creaked. Trees, bushes shaken slightly. Sharp shock felt at 05:15 and another about 15 minutes later.

Lennox.—Press reported powerlines down.

Lindsay.—Felt by and awakened all in community; general alarm. Strong, visible swaying of buildings and trees. Press reported walls and plaster cracked. Eight shocks felt in first 2 hours.

Little Lake.—Felt by and awakened all; frightened few. Plaster cracked. Small objects overturned; knickknacks fell.

Littlerock.—Felt by, awakened, and frightened all in community. Damage slight to concrete. Plaster cracked. Small objects shifted; knickknacks, books, and pictures fell.

Loma Linda.—Felt by and awakened all; frightened few. Hanging objects swung E–W. House creaked loudly.

Lomita.—Awakened and frightened all in community. Damage slight. Plaster cracked. Shifted small objects and furnishings. Pendulum clock facing northeast stopped. Trees, bushes shaken strongly.

Lompoc.—Felt by and awakened all; frightened many. Damage slight to wood and brick. Powerlines broken in several places; electricity off in city. Dishes broken. Small objects and furnishings shifted, small objects overturned; knickknacks and pictures fell; plaster cracked and fell. Visibile swaying of buildings in center section of town, and fire engines swayed.

Lone Pine.—Felt by and awakened all, frightened few. Small objects and furnishings shifted. Minor plaster cracks. Damage slight to concrete.

Long Beach.—Awakened and frightened all in community. Two very elderly persons thrown out of bed, one died later from shock. Press reported 2 water mains broken. Masonry fell and large plateglass window broke in bank building. Several powerlines down. Oil splashed over tanks in harbor district. Hanging light fixtures swayed in about 3-foot arc and some wall cracks in post office.

Long Valley Dam (north of Bishop.)—Awakened all and frightened many in community; felt outdoors by some.

Los Alamos.—Awakened and frightened all. Damage slight. Walls and chimneys cracked; windows and dishes broke. Small objects and furnishings shifted; small objects and furniture overturned; knickknacks, books, pictures, and plaster fell. Trees, bushes shaken strongly.

Los Alamitos.—Awakened and frightened all. Damage slight. Plaster cracked. Small objects and furniture shifted; overturned small objects; knickknacks and pictures fell.

Los Banos (about 10 miles east of, at headquarters of the San Luis Canal Co.).—Cracks in woodstucco house. Main canal washed over its banks.

Los Olivos.—Felt by and awakened all; frightened many. Damage considerable; one old porch roof fell and one chimney fell. Stucco cracked and house shifted on foundation about 1 inch. Plaster and chimneys cracked. Small objects and furnishings shifted; small objects overturned.

Los Priestos Ranger Station (about 22 miles east of Santa Barbara).—Felt by all at station; general alarm. Disturbed objects observed by all. Rocks on San Marcos Pass. All fire lookouts reported feeling the shock.

Lost Hills.—Felt by and awakened all; frightened many. Damage slight. Trees, bushes shaken strongly. Small objects overturned; dishes broken.

Lost Hills (SW¼, Sec. 10, T28S, R20E).—Felt by many; people nervous. Visible swaying of buildings and trees. Objects displaced on E.–W. shelves. Shocks also felt at 04:00 and 04:05.

Lucerne Valley.—Felt by, awakened, and frightened all in community. Small objects shifted and overturned; knickknacks fell.

Lynwood.—Felt by and awakened all; frightened many. Trees, bushes shaken moderately. Press reported lighting system out of commission, including Firestone Park.

Malibu.—Press reported some powerlines down. Windows rattled and light fixtures swayed.

Manhattan Beach.—Felt by and awakened all in community. Slight damage to buildings. Plaster cracked slightly. Small objects and bed shifted; few knickknacks fell. Burglar alarms set off.

Maricopa (northwest of, in NE. corner of Sec. 3, T11N, R24W).—Felt by and awakened observer. Trees, bushes shaken moderately to strongly. Small objects and furnishings shifted; small objects and furniture overturned.

Maywood.—Felt by all; awakened and frightened many in community. Damage slight to wood, brick, and masonry. Cracked plaster. Trees, bushes shaken moderately.

McKittrick.—Felt by all in community, frightened all in home. Damage slight. Dishes broke. Small objects and furnishings shifted; small objects overturned; knickknacks fell Trees, bushes shaken strongly. Many shocks followed.

Mendota—Awakened all in community; frightened few. Trees, bushes shaken moderately. Small objects and furnishings shifted; small objects overturned; knickknacks, books, pictures, and plaster fell.

Merced.—Felt by and awakened many (some outdoors); frightened few. Press reported a chickenhouse collapsed, killing 300 chickens. No other damage was reported by any of the emergency agencies in the county.

Merced Falls.—Felt by several (some outdoors); awakened and frightened few in community. Damage slight. Plaster cracked and fell. Trees, bushes shaken slightly.

Mile Post 357.45 (Southern Pacific Railway, Kern County).—Slight cracks in fill. Damage about $150.

Mineralking—Very hard shock. Awakened all and frightened many in community. Slight rock and dirt slides. Many tremors felt.

Miramonte.—Felt by and awakened all; frightened many. Damage slight. Small objects and furnishings shifted; knickknacks and pictures fell. Trees, bushes shaken strongly.

Modesto.—Felt by many; awakened all; frightened few. Pendulum clock facing southwest stopped.

Mojave.—Felt by, awakened, and frightened all in community. Damage slight. Dishes broke. Plaster cracked. Minor plaster cracks and some old cracks probably enlarged at the Mojave School (New). Small objects overturned; knickknacks and pictures fell. Trees, bushes shaken strongly.

Monache Meadows (15 miles by air northwest of Coso Junction).—Awakened all in community; frightened children. Pendulum clock facing west stopped. Trees, bushes shaken moderately. "Aftershocks not strong."

Montalvo.—Felt by and awakened all; frightened many. Pendulum clock facing south stopped. Small objects shifted and overturned.

Montebello.—Felt by, awakened, and frightened all in community. Pendulum clock stopped. Trees, bushes shaken moderately. Few small objects shifted and overturned.

Montecito (near Olive Mill Road).—Press reported high-power wires snapped.

Montrose.—Felt by and awakened all; frightened few. Damage slight. Few dishes and windows broke. Small objects shifted and overturned; some knickknacks, books, pictures, and plaster fell. Trees, bushes shaken strongly.

Moore Hill (about 20 miles above Le Grand).—Awakened all and frightened few in community. House creaked.

Moorepark.—Felt by, awakened, and frightened many in community. Damage slight. Chimneys cracked. Some dishes and windows broke. Furnishings shifted; small objects, some knickknacks, books, pictures, and plaster fell. Trees, bushes shaken strongly.

Morro Bay.—Felt by and awakaned all in community. Trees, bushes shaken slightly.

Mount Baldy.—Felt by, awakened, and frightened all in community. Pendulum clock stopped. Small objects and furnishings shifted.

Newbury Park.—Felt by and awakened many; frightened few. Pendulum clock stopped. Small objects overturned and picture fell.

Newhall.—Felt by, awakened, and frightened many. Small objects and furnishings shifted.

Newport Beach.—Felt by, awakened, and frightened all in community. Damage slight. Plaster cracked. Small objects and furnishings shifted.

Newport Beach-Balboa.—Felt by, awakened, and frightened many (some outdoors). Small objects moved. Trees, bushes shaken moderately. Aftershocks felt.

Nipomo.—Awakened all and frightened many in community. Plaster and walls cracked; chimneys cracked and twisted. Small objects shifted and overturned; knickknacks and pictures fell. Trees, bushes shaken moderately.

Northridge.—Felt by everyone in area; awakened and frightened all in home. Trees, bushes shaken strongly. Small objects shifted; vases, etc., overturned; knickknacks and books fell. Plaster cracked.

Norwalk.—Press reported telephone amd powerlines down in six different locations. Man suffered heart attack.

Oceano.—Felt by, awakened, and frightened all in community. Small objects and furnishings moved; small objects and furniture overturned.

Olancha.—Felt by and awakened all in community. Damage slight to masonry and concrete. Small objects and furnishings shifted slightly. Trees, bushes, shaken strongly.

Olive.—Awakened all and frightened many in community. Hanging objects swung. Trees, bushes shaken slightly.

Olive View.—Awakened and frightened many in community. Plaster cracked. Pendulum clock stopped. Trees, bushes shaken slightly.

Ontario.—Awakened and frightened all in community. Press reported several transformers on high-voltage lines blown out.

Onyx.—Felt by and awakened all; frightened few. Damage slight. Dishes broke. Small objects shifted and overturned; knickknacks and pictures fell.

Orcutt.—Felt by, awakened, and frightened many in community (some outdoors). Damage slight. Plaster cracked. Small objects overturned.

Oro Grande.—Shock quite severe. Felt by and awakened all; frightened many. Small objects shifted; vases overturned; knickknacks, books, and pictures fell. Other shocks felt on 21st at 23:15 and 23:30.

Owenyo.—Felt by all in community and in Owens Valley; awakened all in community. Sloshed water from 20,000-gallon water tank. "Light shocks continued for 24 hours after main shock."

Pacific Palisades.—Felt by and awakened all; frightened few. Plaster cracked. Damage slight.

Pacoima.—Awakened and frightened all in community. Walls cracked and dishes broke. Powerlines down. Water in swimming pools sloshed out in northerly direction. Small objects and furnishings shifted. Uprooted mailbox set in concrete. Trees, bushes shaken strongly.

Palmdale.—Felt by, awakened, and frightened all in community. Press reported damage in Palmdale and Antelope Valley (northwest of Palmdale) consisted mainly of fallen plaster and broken windows. Much merchandise destroyed in Palmdale drugstores. Grocery stores in Antelope Valley reported heavy losses. Plants overturned and lamp thrown from television.

Panamint Springs.—Felt by and awakened all.

Paso Robles.—Press reported cracks in tower of the Paso Robles Inn and slight damage to brick

and cement at some places. Miniature golf course had cracks in new cement work and brick wall of a storage building cracked.

Paso Robles (10 miles east of, on Highway 41).—Cement floor of ranchhouse kitchen cracked.

Pearblossom.—Felt by and awakened all in entire area; frightened few. Damage slight. Small objects and furnishings shifted; few small objects and furniture overturned. Trees, bushes shaken strongly. Seven or eight lesser shocks followed for a period of time every few minutes.

Phelan.—Felt by and awakened all; frightened few.

Piru.—Felt by and awakened all; frightened many. Trees, bushes, shaken slightly. Damage slight. Small objects and furnishings shifted; small objects and furniture overturned; some knick-knacks, books, and pictures fell. Three distinct shocks felt, including one at 04:05. Intermittent movements, light to moderate, felt until 04:45.

Pixley.—Felt by and awakened all; frightened many. Damage slight to brick, masonry, and concrete. Dishes broke. Small objects and furnishings shifted; small objects overturned; knick-knacks, books, pictures, and plaster fell. Trees, bushes shaken strongly.

Pomona.—Felt by, awakened, and frightened many in community. Press reported plateglass windows and plaster cracked, store displays scattered, and bookcases toppled. Definite visible swaying of buildings. Trees, bushes shaken slightly. Shocks felt at 03:55 and 04:00. In the northwest section shocks felt for one-half hour after main shock.

Port Hueneme.—Felt by and awakened all; frightened many. Small objects shifted. Large circular clarifier pool 50 feet in diameter and filled with water sloshed on the north and south sides. Press reported crates of lemons toppled at warehouse.

Poso, near (1 mile past Bucks Cafe).—Powerline broke, causing fire. At Poso Heights Cafe in Poso, few bottles shook from shelves.

Pozo Guard Station (Pozo).—Awakened all and frightened many in community. Damage slight to concrete. Cement cracked. Small objects and furnishings shifted; knickknacks, books, and pictures fell. Trees, bushes shaken strongly.

Puente.—Felt by all, awakened, and frightened many in community. Damage slight. Dishes broke. Minor plaster cracks. Small objects and furnishings shifted; small objects and furniture overturned; knickknacks, books, and pictures fell. Aftershocks felt for 30 minutes.

Raisin.—Felt by, awakened, and frightened all in community. Damage slight. Pendulum clock stopped. Plaster and windows cracked.

Randsburg.—Awakened all in community. Windows, doors, and dishes rattled.

Reedley.—Felt by and awakened all; frightened many. Damage slight. Trees, bushes shaken moderately. Plaster and windows cracked.

Reseda.—Felt by all in community; frightened many. Damage slight. Knickknacks fell; dishes broke.

Rialto.—Felt by, awakened, and frightened all in home. Trees, bushes shaken moderately. Small objects shifted and overturned. Water sloshed from swimming pool. About 2 miles south of the mouth of Lytle Creek Canyon doors swung about 3 to 5 inches and bric-a-brac on window ledge shifted. Small plaster and floor cracks widened slightly. Damage slight to wood.

Ridgecrest.—Felt by all; awakened many and frightened few. Small objects shifted. Chimneys and walls cracked. Damage slight.

Rio Bravo (Shafter).—Press stated that only damage reported was to the floating roofs of two large oil storage tanks.

Riverdale.—Felt by and awakened all; frightened few. Small objects shifted and overturned.

Riverside.—Felt by and awakened all; frightened many. Press reported one elderly man suffered heart attack 20 minutes after shock and died. Damage slight. Windows broke. Plaster and walls cracked; pictures and plaster fell. Furnishings shifted. Trees, bushes shaken strongly.

Roads End.—Felt by, awakened, and frightened all in home. Trees, bushes shaken strongly. Small objects shifted and overturned; knickknacks fell.

Rosamond.—Felt by and awakened all; frightened few. Damage slight. Plaster and walls cracked. Dishes broke. Small objects shifted and overturned; knickknacks, books, and pictures fell. Trees, bushes shaken strongly.

Rosamond (Sec. 22, T10N, R16W).—Very strong. Felt by all in mountain cabin. Trees, bushes shaken strongly. Small objects and furnishings shifted; small objects and furniture overturned; knickknacks, books, and picutres fell. Continued light shakes.

Rosedale Highway (about 10 miles west of Bakersfield).—Some oil sloshed out on east-west sides of tank.

Rosemead.—Press reported some buildings were cracked and many windows broke.

San Ardo.—Felt by and awakened all; frightened few. Hanging objects swung.

San Bernardino.—Generally felt over entire area; many frightened. Damage generally described as slight. Press reported it snapped powerlines in two locations, set off burglar alarms, merchandise thrown down, sloshed chemicals from tanks, fluorescent lighting tubes broken, and one man thrown out of bed. Plaster and walls cracked. Door chimes rang. Some small objects shifted and fell. Trees, bushes shaken moderately to strongly.

Sandberg.—Strong shock. Felt by and awakened all. Light shock preceded main shock. Several weak shocks felt during the following hours, some recorded at 04:02, 04:05, 04:19, 04:24, 04:45.

San Fernando, near.—Press reported large shelf supporting glass aquariums collapsed.

San Fernando.—Strong shock. Felt by and awakened all in community. Pendulum clock stopped. Trees, bushes shaken strongly. Several flashes from power transformers. Three or four minor shocks followed.

San Francisavito Canyon (Powerplant No. 1 of the Los Angeles Department of Water and Power).—Felt by all in home. Small objects shifted; vases overturned.

San Gabriel.—Press reported power failures.

Sanger.—Felt by, awakened, and frightened all in home. Plaster cracked. Small objects and furnishings shifted. Trees, bushes shaken slightly.

San Jacinto.—Felt by and awakened all; frightened many. Trees, bushes shaken strongly. Plaster cracked. Damage slight.

San Lucas.—Very hard shock. Felt by and awakened all; frightened many. Pendulum clock facing north stopped.

San Luis Obispo.—Felt by, awakened, and frightened many. Several water main leaks reported. Bells rang. Few reports of plaster cracks. Pendulum clocks stopped. Small objects and furnishings shifted. Beds on rollers moved. Press reported church bell, which had not rung in 3 weeks due to kink in bell clapper, was jarred loose and the swaying tower rang the bell 7 or 8 times. Knocked pictures off walls. Other shocks felt at 03:58, 04:05, 04:10, 04:13, 04:15.

San Marino.—Felt by all; many alarmed. Building shook strongly. Sloshed water from swimming pool; several inches of water sloshed out. Pictures displaced. Shocks at 04:06, and 04:20.

Santa Monica.—Press reported minor damage to the Franklin Street hill water tank. Streets blocked off because of fallen powerlines. Manikins toppled in stores. Several windows broke. Santa Monica pier swayed so violently fisherman hung desperately to railing to keep from falling.

San Miguel.—Awakened all; frightened few. Trees, bushes shaken moderately. "Considered most severe since 1906."

San Pedro.—Felt by and frightened all in community. Press reported cracks on almost every floor of the city hall. Five powerlines down. Traffic signals disrupted in the San Pedro-Wilmington districts. Large mirror fell and broke. Four lighter shocks felt within 20 minutes.

Santa Ana.—Felt by and awakened all; frightened many. Damage slight. Plaster cracked. Press reported a 90-foot crack in parking lot. Plaster fell at the Masonic Hall. Trees, bushes shaken strongly.

Santa Maria.—Felt by and awakened many or all in community; frightened many (some outdoors). Plaster and windows cracked; plaster fell. Visible swaying of buildings and power poles. Light globe hanging 6 feet from ceiling swayed W.–E. in arc of 10 inches and stopped swinging at 04:17. Main lines at PG&E plant swayed, touched, and burned off. Shock at 04:07; five small ones until 04:15, light one at 04:58.

Santa Paula.—Felt by all, awakened, and frightened many. Small objects and furniture overturned. Damage slight.

Santa Susana.—Felt by and awakened all in home; frightened many. Small objects shifted; vases overturned; knickknacks fell.

Santa Ynez.—Felt by, awakened, and frightened all in home. Small objects overturned. Damage slight. Second shock at 04:05.

Savanah.—Railroad tracks out of line on bridge. Damage about $50.

Sec. 18, T31S, R29E (farming section about 6 miles west and 1 mile north of Arvin).—Felt by, awakened, and frightened all in home. Small objects and furnishings shifted; vases, small objects, and furniture overturned; knickknacks, books, and pictures fell. Many dishes broke.

Seeley.—Awakened and frightened all. Trees, bushes shaken strongly. Plaster cracked.

Selma.—Felt by and awakened all in community; frightened many. Trees, bushes shaken strongly.

Sequoia and Kings Canyon National Parks.—Press reported most telephone service was disrupted within the parks, only one line was open to Giant Forest. Eighteen shocks felt in some places. Knocked oven doors open at Giant Forest and woman rushed out of building at Milk Ranch Lookout. Severe swaying at Ash Peak and in Kern Canyon cabin "jumped up and down."

Sequoia National Park (Ash Mountain Headquarters, 8 miles northeast of Three Rivers).—Felt by all. Disturbed objects observed by many. Table lamps fell to the southwest. Eighteen shocks were felt from 03:52 to 05:15. Series of lesser shocks felt for several days, usually 2 or 3 in a group with intervals of several minutes.

Sequoia National Park (near Giant Forest Village).—Felt by practically all. Disturbed objects observed by many. Visible swaying of tree tops. Needle on chart of precipitation gage made vertical line about 1 inch above and below base line. Several shocks felt after main shock until 7–23–52.

Sequoia National Park (Lodgepole area).—Felt by and alarmed many. Disturbed objects observed by several. Visible swaying of buildings. Telephone poles swayed and snapped wires. Two lighter shocks felt.

Seven Oaks.—Felt by and awakened all; frightened few. Pendulum clock stopped. Trees, bushes shaken slightly.

Shandon.—Felt by and awakened all; frightened few. Trees, bushes shaken moderately. Small objects shifted and overturned. Plaster and walls cracked. Damage slight.

Shell Beach.—Press reported large bone fell from museum shelf.

Sierra Madre.—Felt by and awakened all in community; frightened few. Pendulum clock stopped. Small objects overturned. Old sealed wall cracks opened.

Simi.—Felt by, awakened, and frightened all in community. Damage slight. Some plaster, windows, walls, and chimneys cracked; some knickknacks, books, pictures, and plaster fell. Trees, bushes shaken strongly. "Strongest shock ever felt in Simi."

Soledad.—Felt by, awakened, and frightened many in community (some outdoors). Walls cracked. Trees, bushes shaken moderately. "Strongest shock since 1906 in this community."

Solvang.—Felt by, awakened, and frightened all in entire valley. Damage slight. Plaster, windows, and walls cracked slightly. "Strongest remembered in this area and thoroughly frightened everyone." Small objects and furnishings shifted; small objects and furniture overturned. Trees, bushes shaken strongly.

Somis.—Awakened all and frightened many in community. Some damage. Walls and chimneys cracked; twisted chimneys. Knickknacks and books fell. Trees, bushes shaken strongly.

South Dos Palos.—Felt by all in area; awakened and frightened all.

South Gate.—Press reported powerlines down at South Gate and Lynwood. Numerous burglar alarms set off.

Springville.—Felt by and awakened all; frightened many (some outdoors). Trees, bushes shaken slightly. Damage slight.

Stanton.—Press reported high powerlines snapped.

Stratford.—Felt by and awakened all; frightened many; sickening effect. Damage slight. Walls cracked. Small objects and furnishings shifted; small objects overturned; knickknacks and plaster fell. Canned goods, etc., fell from store shelves. Trees, bushes shaken strongly.

Summerland.—Felt by, awakened, and frightened all in community. Windows, doors, and dishes rattled; house creaked.

Summit.—Felt by and awakened all; frightened few. Hanging objects swung E–W.

Sunland.—Felt by all; frightened many. Damage slight. Pendulum clock stopped. Trees, bushes shaken strongly.

Temecula.—Felt by and awakened all; frightened many. Plaster and windows cracked slightly. Damage very slight.

Temple City.—Press reported power disrupted generally in this area.

Terra Bella.—Felt by, awakened, and frightened many in community (some outdoors). Damage slight. Walls cracked and old cracks enlarged at post office; plaster fell. Knocked food, etc., from shelves, which was principal damage; small objects overturned. Light drop cords swayed 8 inches after motion stopped.

Topanga.—Felt by and awakened all; frightened many. Damage slight to plastered walls. Trees, bushes shaken strongly. Small objects shifted and overturned. Slight tremors about 10 minutes apart for 45 minutes. At the Topanga ranger station nearly everyone felt the shock and there was general alarm. Five or six shocks felt here from 03:52 to 04:45.

Torrance (3 miles east of).—Felt by and awakened all; frightened many. Newly constructed 5-foot concrete block wall was cracked from top to bottom, cracks about ¼ inch wide. About $300 damage to stucco. Tall power pole and trees swayed violently. "Similar damage to other homes in this vicinity." Walls cracked. Knickknacks, books, and pictures fell; bed moved about 6 inches from wall. Water and fish spilled from fish bowl.

Trona.—Felt by and awakened many; frightened all in home. Damage slight. Knocked dishes over and broke bottled goods in stores. Visible swaying of trees and poles. Two telephone poles almost down; only wires held them up. Small objects and furnishings shifted; small objects overturned; knickknacks and pictures fell. Minor sways felt at 04:07, 04:25, and 07:58.

Tujunga.—Felt by, awakened, and frightened all in community. Damage slight. Plaster cracked. Few knickknacks, books, pictures, and some plaster fell. Trees, bushes shaken strongly. "Many aftershocks felt."

Tulare.—Felt by, awakened, and frightened all in area. Press reported one brick wall cracked. Small objects shifted and overturned. Trees, bushes shaken strongly.

Twentynine Palms.—Felt by, awakened, and frightened many in community. Damage slight. Trees, bushes shaken slightly. Small objects shifted; pictures fell. Some people felt 3 shocks, 2 very weak and about 10 minutes apart.

Upland.—Felt by (some outdoors) and awakened many in community; frightened all in home. Hanging objects swung. Pendulum clock facing west stopped.

Van Nuys.—Awakened and frightened all in community. Eighteen-foot lengths of 8-inch pipe, laid in N.–S. and E.–W. directions, had top layer shifted over 1 foot SE. Plaster cracked. Vases overturned; knickknacks fell.

Van Nuys (5 miles west of).—Felt by many; general alarm. Disturbed objects observed by many. Visible swaying of buildings and trees. Numerous N.–S. plaster cracks. Cupboard doors opened. Several shocks from 03:52 to 04:30.

Verdugo.—Awakened all and frightened many in community. Small objects shifted and overturned; knickknacks fell.

Vernon.—Press reported heavy overhead cranes were shoved from 8 to 15 feet from access ladders, but none fell from tracks. Recording instruments jiggled all over charts.

Venice.—Felt by, awakened, and frightened all in community. Pendulum clock stopped. Trees, bushes shaken strongly.

Venice School (¼ mile north and ¼ mile east of, east of Visalia).—Felt by and awakened many in community, awakened all in home, frightened few. Trees, bushes shaken strongly. Small objects and furnishings shifted; small objects and furniture overturned; knickknacks, books, pictures, and plaster fell. "Many small shocks every day and night since the 21st."

Victorville.—Felt by, awakened, and frightened all in home. Plaster and windows cracked. Small objects and furnishings shifted; small objects overturned. Trees, bushes shaken strongly.

Walnut.—Awakened all and frightened many in community. Damage slight. Plaster cracked. Few E.–W. ground cracks where adobe joins shale foundation. Trees, bushes shaken strongly. Intermittent settling tremors felt.

Wasco.—Felt by and awakened all; frightened many. Damage slight. Very slight damage to masonry walls at Wasco Union School (Old). Plaster and walls cracked; plaster fell. Small objects and furnishings shifted; small objects overturned. Trees, bushes shaken strongly.

Wasioja Trailer Park (near Cuyama).—Felt by all in trailer park; awakened many; frightened few. Trailers swayed and creaked. Trees, bushes shaken strongly.

Weldon (South Fork Union School District (Old)).—Three-room building damaged by previous

earthquakes and only temporary repairs made. Little damage from recent earthquakes. Will probably be recommended for abandonment.

Westend.—Awakened all and frightened many in community. Damage slight. Pendulum clock facing west stopped. Small objects shifted and overturned; knickknacks and pictures fell.

Wheeler Springs.—Felt by, awakened, and frightened all in community. Damage slight. Trees, bushes shaken moderately. Small objects and furnishings shifted; small objects overturned; knick-knacks fell.

Whittier.—Press reported cracks in buildings.

Wildomar.—Felt by, awakened, and frightened many. Small objects and furnishings shifted; some small objects overturned. Plaster and windows cracked. Several beds turned from a one-half to one-quarter circle, in clockwise direction. Another jolt felt at 04:08.

Willow Springs (15 miles south and 7 miles west of Mojave).—Southern Kern Union School District (Old). Old obsolescent building suffered additional damage which may require its abandonment.

Woodlake.—Felt by all in county; awakened and frightened all. Damage slight. Bricks fell from top of fireplace. Plaster cracked. Small objects shifted and overturned. Trees, bushes shaken strongly.

Wrightwood.—Felt by, awakened, and frightened all in community. Damage slight to brick and masonry. Some chimneys lost some masonry. Plaster and windows cracked. Small objects and furnishings shifted; canned goods fell from store shelves. Trees, bushes shaken strongly. Short but sharp aftershocks felt.

Yermo.—Felt by, awakened, and frightened all in community. Small objects overturned. Plaster cracked slightly. Window weights banged violently.

Yorba Linda.—Awakened all and frightened many in community. Small objects shifted. Plaster cracked. Damage slight.

Yosemite National Park.—Felt by and awakened many; frightened few. Damage slight to masonry. Walls cracked. Small objects and furnishings shifted; small objects overturned. Trees, bushes shaken strongly. Several shocks felt.

Yucaipa.—Felt by and awakened all in community. Small objects and furnishings shifted; pictures fell. Deep crack in cement floor of small laundry building.

Zaca Lake (near Los Olivos).—Large openings along shore and out in the lake. Large settling of the shoreline into the lake which caused the lake to rise.

INTENSITY VI: NEVADA

Las Vegas.—Felt by all; awakened and frightened many; sickening effect on some people. At one building construction project structural steel had to be realined before concrete could be placed. Buildings and trees shaken strongly. Small objects and furnishings shifted; small objects overturned; knickknacks fell.

Whitney.—Felt by all; awakened many. Trees, bushes shaken moderately. Small objects shifted; knickknacks and pictures fell.

INTENSITY V: Aguanga, Ahwahnee, Alabama Gates (6 miles north of Lone Pine on Los Angeles Aqueduct), Alta Loma, Amboy, Angels Camp, Artesia, Avalon (Santa Catalina Island), Azusa, Balch Park (about 8 miles northeast of Springville), Banning, Benton, Bishop (25 miles north of), Bloomington, Borrego Springs, Bradley, Cabazon, Calimesa, Camanche, Cambria, Capistrano Beach, Carmel Valley, Casmalia, Cayucos (shock also felt at 04:10), Chowchilla, Chualar, Claraville (Sec. 32, T 28 S, R 34 E), Coalinga, Coleville, Costa Mesa (several shocks felt since 7–21), Daggett, Dardanelle (small shocks felt since 7–21), Darwin, Del Mar, Desert Center (5 miles northeast of), Desert Center, Dinuba, Dixon, East Highlands, Edison (Edison School (New)), El Centro, El Nido, El Portal, El Segundo, Elwood, Escalon, Escondido, Fall Brook, Farmington, Firebaugh, Firebaugh (near), Foresthill, Fresno (4 miles southeast of), Fresno (7 miles north of), Fulton Ranger Station (Glennville region; many shocks on 21st and numerous light trembles felt to time of writing, 4:50 p. m., July 23d), Georgetown, Gonzales, Greenfield, Hemet, Herndon, Highland, Hollister and 7 miles south of, Holt, Huntington Beach, Huntington Lake, Idria, Imperial, Irvine, Isleton, Ivanhoe, Jamesburg, Kelso, Kerman, Knightsen, Kyburz, Ladd Place (10 miles east of Newberry), La Grange, La Jolla, Lakeside, Laws (three small shocks felt after the main one to time of writing, 05:30), Leevining, Lindcove (½ mile west of Lindcove Store), Linden, Livermore, Llano, and 7 miles southeast of at Shawnee Hills Ranch), Lockwood, Lodi, Long Barn, Lonoak, Los Banos, Los Gatos, Ludlow, Lytle Creek (Glenn Ranch), Manteca, Marina, Mariposa, Mecca, Mendota Dam (near Mendota), Mendota (Firebaugh Canal Co.), Mentone, Meyers, Midway City, Mill Creek Ranger Station (Sec. 13, T 1 N, R 2 W), Milpitas, Monterey Park, National City, Needles, Nevada City, Niland, North Fork, Oakhurst, Oakland, Oceanside, Palm City, Palm Springs, Palos Verdes Estates, Parkfield, Patterson, Patton, Perris, Pescadero, Pinecrest, Pinedale, Pine Valley, Pisgah substation (15 miles west of Ludlow), Point Arguello lifeboat station (near Surf; shock also felt at 04:03), Redlands, Red Mountain, Rio Vista, Romoland, Sacramento, Salinas, San Clemente, San Diego, San Jose, San Juan Capistrano, Santa Cruz, Sante Fe Springs, Seal Beach, Shoshone, Silverado, Snelling, Stevinson, Stockton, Sun Valley, Surf, Tecopa, Thermal, Tinemaha Reservoir (about 10 miles south of Bigpine), Tollhouse, Topaz, Torrance (east section; shocks also felt at 04:05 and 04:25), Tranquillity (21 miles southwest of at Panoche Junction; shocks also felt at 04:02 and 04:05), Trimmer, Vernalis, Volta, Waterford, Wawona Station (Yosemite National Park), Westhaven, White Water, Wilton, and Wishon.

INTENSITY V IN NEVADA: Beatty, Bunkerville, Carson City, Dyer, Gerlach, Glenbrook, Hoover Dam, Minden, Pahrump, Smith, Wellington, Yerington, Zephyr Cove.

INTENSITY IV: Alameda, Alberhill, Alta Sierra and immediate vicinity, Antioch, Anza, Aptos, Aromas district, Beaumont (3 miles from, at Weather Bureau Office), Big Sur, Blythe, Boulder Creek.

Bridgeport and Bridgeport Dam, Calexico, Cathay, Cedar Crest Resort (Cedar Crest), Chinese Camp, Clio, Coalinga (14 miles northwest of), Coulterville, Crestline, Davenport, Davis, Dudley's (Dudley Ranch, about 5 miles southeast of Groveland), Dunnigan, Emerald Bay, Emigrant Gap, Encinitas, Gilroy, Greenville, Gridley (shock also felt at 04:10), Grizzly Flats, Hipass, Homewood, Jacumba, Julian (northeast of, at Ensign Ranch), June Lake, Knights Ferry, Knowles, La Honda, Lake Tahoe (Tahoe Valley at Skylake Camp), La Mesa, Los Altos, Markleeville, Marysville, Mission San Jose, Mono Lake, Mount Laguna, Newark, Newberry, Nipton, North Palm Springs, O'Neals and 3 miles southwest of, Orland, Pacific House, Palo Alto, Palomar Mountain, Piedra, Pittsburg, Plaster City, Pleasanton, Poway, Priest Valley (near Coalinga; other shocks also felt), Quincy, Red Bluff, Redwood City, Richvale, Rio Linda, Robbins, Rumsey, Saint Helena, San Francisco, San Simeon, Santa Rosa, Sheridan (2 miles southwest of), Sonora, Solona Beach, Sorrento, Strawberry Valley, Tahoe City, Tracy (northwest section), Vista, Warner Springs, Watsonville, West Los Angeles, Westmorland, Willows, and Woodland.

INTENSITY IV IN NEVADA: Boulder City, Goldfield, Goodsprings, Hawthorne, Jean, Logandale, Mina, Moapa, Reno, Silver Peak, Twin Springs, Virginia City, Davis Dam (Mojave), Parker, and Yucca.

INTENSITY I TO III: Barstow (5 miles north of), Chico, Holtville, Jackson, Lake Alpine, Madera, Niles, Pacific Grove, Palo Verde, Pinole, Pleasant Grove, Port Chicago, Roseville, San Benito, Stirling City, Sunol, Vidal, West Point, and Winterhaven.

INTENSITY I TO III IN NEVADA: Overton and Sparks.

INTENSITY I TO III IN ARIZONA: Bagdad, Phoenix, and Wellton.

Negative reports were received from 104 places in California; 31 places in Nevada; 25 places in Arizona; 3 places in Utah.

A questionnaire coverage was made in Mexico by Ing. Ricardo Monges Lopez, Director, Instituto de Geofisica, Servicio Sismologico de Mexico, Universada Nacional de Mexico. Several reports were received of earthquakes being felt, but none could definitely be identified as the shock of 21 July at 03:52:14*. Records from Pasadena indicate that several local shocks occurred in northern Mexico for a 2-week period following the 21st of July, and it is believed that the reports relate to these local shocks. Negative reports were received from 7 places in Baja California and from 10 places in the State of Sonora.

July 21: 04:05:31*. Epicenter 35.0° north, 119.0° west, near Fort Tejon, P. V. Felt by many and alarmed few at Huasna (about 10 miles southeast of Arroyo Grande). Disturbed objects observed, ornaments damaged, and pendulum clock stopped. "Slight tremors felt for 2 or 3 days, last one Friday noon, July 25. I did not feel the heavier one early Wednesday a. m. About 8 shocks felt on the 21st following the main shock until about 05:15."

July 21: 07:53*. V. Sharp shock felt by all at Haiwee powerplant and vicinity. Camp residents reported several sharp shocks felt during the morning.

July 21: 11:41:22*. Epicenter 35°08′ north, 118°46′ west, north of Tejon Creek, P. V. Frightened all and chips of plaster fell at Arvin. Buildings creaked, loose objects rattled, and venetian blinds swayed at Los Angeles.

July 21: 11:49. IV. Press reported a good solid jar was felt in downtown Fresno. Other sections of the city felt a slight jar.

July 21: 13:40. III. Slow rocking motion, lasting about 30 seconds, felt in Los Angeles. Direction W.

July 21: 23:00. Rather severe shock felt by observer in Cuyama.

July 22: 00:00. V. Three-inch waterline (probably weakened by previous shocks) reported broken in the Taft area (SE¼, Sec. 36, T31S, R24E). Also felt in Cuyama.

July 22: 00:47:34*. Epicenter 35°05′ north, 118°45′ west, P. IV. Disturbed objects observed, buildings creaked, loose objects rattled at Lost Hills (SW¼, Sec. 10, T28S, R20E). Few awakened at Trona. Press reported slight shock at Bakersfield.

July 22: 01:45. Press reported slight shock felt in the Los Angeles area.

July 22: 05:45. V. Felt by, awakened, and frightened all in home in Sec. 18, T31S, R29E (southeast of Bakersfield). Dishes shifted and overturned. Buildings creaked and loose objects rattled at Lost Hills (SW¼, Sec. 10, T28S, R20E). Also felt at Cuyama.

July 22: 11:00. Felt by observer at Cuyama.

July 22: (a. m.). Shocks felt by few in Mecca.

July 22: 12:14. IV. Felt by observer in home at Santa Ynez where windows, doors, and dishes rattled.

July 22: 14:00. Light shock reported felt at Black Mountain Fire Lookout (about 25 miles northeast of Fresno), Fresno, and Miami Lookout (east of Mariposa).

July 22: 16:38:32*. Epicenter 35°22′ north, 118°35′ west, west of Walker Basin, P. V. Additional damage to old brick building (already near collapse) in the Arvin business district. Felt strongly in Bakersfield. Five miles south of Bakersfield a corner of house (already damaged) fell, and at Edison and Weed Patch Highway all were frightened. More plaster and bricks fell from house on Comanche Point Road to such extent that owner will rebuild. Felt by many in Fresno where few paint chips and plaster cracks were reported. Heavy at Kern River powerhouse No. 1 in Kern Canyon. Felt by many in Los Angeles where light posts and buildings swayed visibly. Felt by many in Yosemite National Park, pendant lamps and stand lamps swayed 2 to 6 inches. Intensity IV at Black Mountain Fire Lookout (about 25 miles northeast of Fresno), Huntington Lake, Kernville, La Crescenta, Laws, O'Neals, Raisin, South Haiwee Reservoir (Coso Junction), Tinemaha Reservoir (Independence), and Trona. Also felt at Alpaugh, Blue Ridge (east of Exeter), Cuyama, and Sanger.

July 22: 19:19:23*. Epicenter 35°22′ north, 118°35′ west, west of Walker Basin, P. V. Felt

by and frightened many in Bakersfield. Felt moderately at Kern River powerhouse No. 1 and felt slightly at Black Mountain Lookout, Caruthers, and Fresno.

July 22: 23:28. Moderate shock at Kern River powerhouse No. 1.

July 22: 23:53:18*. Epicenter 35°00′ north, 118°50′ west, Tejon Ranch, P. VII. Arvin. Press reported weakened walls collapsed and fronts of buildings fell in. One house, which suffered only minor damage during the main shock on the 21st, was almost destroyed. Gas and water mains were broken and transformers ripped off. People very frightened. Press reported people were awakened in Los Angeles and nearby cities; disturbed objects observed by several. Three miles east of Torrance slight damage was reported, small objects overturned, and many awakened. Hard, jolting shock at Cuyama. Rattled windows and doors at Fresno. Rattled windows at San Marino. Buildings creaked, loose objects rattled, and venetian blinds and table lamps swayed at Temple City. Noticeable at Huntington Lake, moderate at Kern River powerhouse No. 1, slight at Newbury Park. Also felt at Alpaugh.

July 23: 00:05. IV. Sharp motion awakened and frightened few at Santa Ynez. "Have felt a number of lighter shocks."

July 23: 00:30. IV. Vibration like that made by a passing train felt by several in home at Laws. Windows and doors rattled; walls creaked.

July 23: 04:40. Very slight shock felt at Caruthers.

July 23: 05:17:05*. Epicenter 35°13′ north, 118°49′ west, Arvin, P. VII. Press reported several more weakened buildings fell in Arvin. Felt by, awakened, and frightened all. Furniture shifted and overturned; knickknacks, books, and pictures fell; dishes broke. Plaster and walls cracked. Felt by, awakened, and frightened all 1 mile northwest of Arvin, where furnishings shifted and small objects overturned; knickknacks, books, and pictures fell; dishes broke. Ground cracked. Slight damage. Observers reported jolt was worse than the main shock of July 21 and that damage would probably have been greater than that caused by the main shock had it lasted longer. Press reported weakened buildings fell and new cracks appeared in others at Tehachapi, two persons were treated for broken bones, and 25 others treated for minor cuts and bruises. Intensity IV at Fresno, Los Angeles (southwest section), South Haiwee Reservoir (Coso Junction), and Weed Patch Highway (south of Bakersfield). Felt slightly at Ventura and Yosemite National Park. Also felt at Cuyama and Terra Bella.

July 23: 05:30:03*. Epicenter 35°15′ north, 118°29′ west, P. Moderate shock felt at Kern River powerhouse No. 1.

July 23: 09:22:24*. Epicenter 35°19′ north, 118°30′ west, east of Caliente, P. III. Felt by several (some outdoors) at South Haiwee Reservoir (Coso Junction). Direction E–W, then circular; lasted about 30 seconds.

July 23: 10:13:50*. Epicenter 35°00′ north, 118°50′ west, Tejon Ranch, P. VI. Old brick building at Arvin, already very seriously damaged, collapsed almost completely. Felt by many at Los Angeles, where disturbed objects were observed by many and light fixtures swung. Intensity IV at Fresno and San Pedro. Felt at Bakersfield and at Newbury Park.

July 23: 10:30. IV. Short multiple vibrations felt by all in office in central section of Pasadena.

July 23: 10:45. Light shock felt at Santa Ynez.

July 24: 03:47:55*; 09:45, and 11:42. Epicenter 35°24′ north, 118°35′ west, P. II. Felt by few in southwest section of Los Angeles.

July 24: 15:41. IV. Building creaked; light fixtures and typewriter stand rattled at the San Joaquin Experimental Range about 3 miles west-southwest of O'Neals.

July 25: 04:45. IV. Felt by all at Kernville.

July 25: 05:13:08*. Epicenter 35°19′ north, 118°30′ west, east of Caliente, P. II. Felt by few in southwest section of Los Angeles.

July 25: 09:00. Felt sharply at Kernville.

July 25: 11:09:45* and 11:43:23*. Epicenter 35°19′ north, 118°30′ west, east of Caliente, P. Maximum intensity VII.

INTENSITY VII:

Caliente Creek Canyon (35 miles east of Bakersfield).—Press reported two landslides in this area.

Fairfax (5 miles south of Bakersfield).—Some pipeline damage and releveling. The area was unaffected by this type of damage during the main shock of July 21.

Oiler Canyon Grade (about 5 miles airline, northeast of Caliente).—Small slides. Large slides on hills several miles to the east.

State Highway 178 (between Bakersfield and Kernville).—Press reported landslide of such proportions that road repair crews were ordered to leave the area.

Tejon Canyon (about 10 miles southeast of Arvin).—Strong shake. Ground cracks enlarged some.

White Wolf Ranch (in hills southeast of).—Large slides in hills southeast of White Wolf Ranch. Trees shaken sharply, and twigs and branches rustled audibly.

INTENSITY VI:

Arvin.—Few bricks fell from already damaged buildings.

Bealville, near (at crossing of fault trace and U. S. Highway 466).—Sharp shock at 11:09:45*. Bushes shaken. Persons on hill examining earthquake cracks frightened and ran.

Lorraine (7 miles west of, and 3 miles east of Lorraine Fire Station).—Press reported additional damage to homes. People evacuated.

Los Angeles.—Press reported a subterranean oil pool under the driveway of a house was fractured and gas pressure drove the liquid to the surface. Officeworkers and lunchers rushed into the streets. First shock felt by and frightened many; second felt by many and few alarmed. Disturbed objects observed by many. Pendulum clock stopped by first shock.

Tehachapi.—Press reported a few bricks fell from already damaged buildings.

INTENSITY V: Backus Ranch about 8 miles south of Mojave (11:43:23*), Bakersfield, Burbank, George Air Force Base about 7 miles northwest of Victorville, Glendale, Haiwee powerplant (Coso Junction), Maywood, White Wolf Ranch on Bear Mountain Road a few miles southwest of Bealville, and Yosemite National Park.

INTENSITY IV: Adelanto, Barstow, Claraville (Sec. 32, T28S, R34E), Huntington Park, Kernville (11:43:23*), La Crescenta, Pasadena, South Haiwee Reservoir (Coso Junction), and Trona.

INTENSITY I TO III: Alpaugh (11:09:45*), East Highlands, Fillmore, Fresno, and Wildomar (11:09:45*).

July 25: 12:06:05*. Epicenter 35°19′ north, 118°30′ west, east of Caliente, P. IV. Rattled windows and doors at Kernville. "Have not reported all the shakes we have had because we have been having about 12 a day."

July 26: 01:22:06* and 07:08:30*. Epicenter of first shock 35°17′ north, 118°33′ west; second shock 35°05′ north, 118°45′ west, P. Press reported two aftershocks, described as "fair sized"; jolted Southern California.

July 27: 05:00. V. Awakened many and frightened few in Maywood. Hanging objects swung and house creaked.

July 28: 20:30. IV. Awakened and frightened few in home at Laws. Dishes rattled and walls creaked.

July 28: 23:03:46* (main shock). Epicenter 35°23′ north, 118°51′ west, north of Edison, P.

July 29: 00:01:46*. Epicenter 35°24′ north, 118°49′ west, north of Edison, P.

July 29: 07:49:50*. Epicenter 35°11′ north, 118°36′ west, near Bear Mountain, P.

Unless otherwise indicated, reports refer to the main at 23:03:46*.

INTENSITY VII:

Bakersfield.—Press reported a previously damaged department store received additional damage when a parapet 60 feet by 4 feet collapsed and a wall against a machine shop crumbled. Several large buildings had masonry cracks, and bricks tumbled from the tops of already damaged buildings. The rear wall of the city hall, already cracked, bulged. All four wings of the Kern County Hospital were ordered evacuated. Telephone wires swayed together and wiring ripped out of attic in home, causing fire. At least 10 fires broke out in the Bakersfield area. They included blazes in homes, one oil-derrick fire in Oildale, north of the city, and spot fires caused by toppling powerlines. One home was destroyed. Damage was confined almost entirely to Bakersfield. Tehachapi, Arvin, and other Kern County mountain communities, hard hit by the July 21st shock, escaped unscathed from this shock. Two Bakersfield residents suffered heart attacks and a woman was injured while running in panic from a downtown cafe. A bulldozer operator was hurt when thrown from machine while working on the Southern Pacific line. By 00:10, six aftershocks had struck Bakersfield and police called out reserves to help patrol the streets.

Bear Mountain area.—Columns of dust indicated new slides in this area. (Presumably the shock at 07:49:50*.)

Bena (near).—Landslide partially blocked U. S. Highway 466.

Edison.—Felt by, awakened, and frightened all in community. Plaster, walls, and chimneys cracked; chimneys twisted and fell; books, pictures, and plaster fell; dishes and furniture broke. Trees, bushes shaken strongly. Furnishings shifted and furniture overturned. "This shock caused more damage in this community, 8 miles east of Bakersfield, than any others to date."

Friant-Kern Canal (near Fresno).—Press reported a large mass of earth slid against the canal and caused the lining to bulge in some places. Engineers believe the shocks probably caused the slide.

Piedra (near).—Press reported additional movement of a huge rockslide.

INTENSITY VI:

Cuyama (central section).—Felt by all; many alarmed. Visible swaying of buildings and trees. Little damage to buildings. Few small ground cracks. Other shocks of lesser intensity felt at 00:01, 00:15, and 07:49 on the 29th.

INTENSITY V: Adelanto, El Portal (00:01:46* on 29th), Fresno and Bakersfield areas, Glendale, Hanford (another shock felt at 03:00 on 29th), Lompoc in south coast section (another shock felt at 23:25 on 28th), Los Alamos (west section), Los Angeles (southwest section), Maywood, Monrovia, Santa Maria (east section), Torrance (3 miles east of), and Walnut.

INTENSITY IV: Antioch, Burbank (southwest section), El Nido, Exeter, Laws (first and second shocks reported), Lost Hills (Sec. 10, T28S, R20E), Los Prietos Ranger Station (central section of Santa Barbara County), Mineralking, O'Neals (3 miles SSW. of), Saugus powerplant No. 2 (10 miles north of Saugus), Trona, Wildomar, and Yosemite Valley in central section (several shocks felt).

INTENSITY I TO III: Los Angeles (00:01:46* and 07:49:50*), San Diego, San Luis Obispo (northeast section), and Victorville (several shocks felt during past week).

July 30: 19:00. IV. Felt by an awakened few (some outdoors) in Wildomar. Windows, doors, and dishes rattled; house creaked.

July 30: 20:00 (about). Press reported a shock was felt by some residents of Monrovia.

July 31: 04:09:08*. Epicenter 35°19.5′ north, 118°36.5′ west, north of Caliente, P.

INTENSITY VI:

Arvin.—Press reported some windows were broken and some bricks jarred loose.

Bakersfield.—Press reported a hard jolt. Felt by many. Walls creaked and plaster cracked. Another shock reported at 11:53.

Taft area (SW¼, Sec. 27, T31S, R23E).—Six-inch gravity line, probably loosened by previous shocks, shaken off pipe trestle.

INTENSITY V: Cuyama (central section), East Pasadena, Los Angeles (southwest section), Maywood, and Tehachapi.

INTENSITY IV: El Nido, Glendale, Huasna (about 10 miles southeast of Arroyo Grande), Kettleman City, Long Beach, Lost Hills (Sec. 10, T28S, R20E), Ludlow, Trona, and Yosemite Valley (central section).

INTENSITY I TO III: Fresno, Hollywood, Milpitas, Monrovia, Oakland, San Diego, and San Francisco.

July 31: 09:19:08*. Epicenter 35°17′ north, 118°35′ west, P.

July 31: 11:53:14*. Epicenter 35°20′ north, 118°55′ west, P. Both shocks, described as moderate, reported felt in Long Beach and Los Angeles areas. Shock at 11:53:14* reported felt in Bakersfield.

August 1: 05:04:30*. Epicenter 34°54′ north, 118°57′ west, near Fort Tejon, P. V. Generally felt in the Cuyama area, where buildings creaked, loose objects rattled, and pendulum clock stopped. "Several reports of light tremors during the early morning." Awakened many at Glendale. Felt by many and frightened some in the west section of Los Alamos, where disturbed objects were observed by few and light globes swung. Press reported fire station No. 2 at Santa Monica was evacuated after this shock further weakened the building. Felt by many and alarmed few in the northeast section of Torrance, where buildings and trees swayed visibly, building creaked, and loose objects rattled. Intensity IV at Huasna (about 10 miles southeast of Arroyo Grande), Los Angeles (southwest section), and Lost Hills (Sec. 10, T28S, R20E). Intensity I to III at Bakersfield.

August 4: 02:10. IV. Felt by several at work in Kern Canyon powerhouse and awakened few in community. Windows, doors, and dishes rattled; house creaked.

August 4: 11:47:50*. III. Light shock felt by several at Bakersfield (PG&E); also felt at Corcoran and Kern Canyon (PG&E). Motion moderate at Pattiway with direction NE.–SW.

August 7: 08:31:51*. Epicenter 35°02′ north, 119°03′ west, Wheeler Ridge, P. V. Felt by all and general alarm in central section of Cuyama, where buildings creaked, loose objects rattled, and some objects displaced. Intensity IV at Hausna, Los Alamos (west section), Maricopa, and Taft.

August 7: 11:15:12*. Epicenter 34°20′ north, 120°41′ west, off Point Concepcion, P. IV. Felt by many in west section of Los Alamos.

August 8: 22:01. IV. Press reported the shock was strong enough to shake windows in Bakersfield. Felt by few in southwest section of Los Angeles.

August 10: 04:23:16*. Epicenter 35°19′ north, 118°30′ west, east of Caliente, P.

August 10: 11:44:23*. Epicenter 35°00′ north, 119°00′ west, Wheeler Ridge, P. IV. Press reported the shocks were strong enough to shake windows in Bakersfield. Felt by few in southwest section of Los Angeles.

August 10: 05:00. IV. Awakened all in home at Woody. Windows and doors rattled.

August 12: 20:29:39*. Epicenter 35°19′ north, 118°30′ west, P. Press reported the shock felt in Los Angeles and was slightly stronger than the following one on the 13th.

August 13: 09:39:25*. Epicenter 35°09′ north, 118°41′ west, northwest of Cummings Valley, P. VI. Felt by all; frightened few at Arvin where trees and bushes were shaken moderately, small objects overturned, knickknacks fell, and slight damage to brick reported. Press reported the shock felt in Los Angeles; felt by few in southwest section.

August 13: 22:47:07. Epicenter 39°18′ north, 122°53′ west, B. V. Awakened many at Potter Valley, Ukiah, and Upper Lake; frightened many at Ukiah. Windows rattled at the PG&E Mendocino substation near Hopland and felt by several at Hopland.

August 17: 20:40:10*. Epicenter 35°02′ north, 119°03′ west, Wheeler Ridge, P. IV. Felt by many in central section of Cuyama, where buildings creaked, loose objects rattled, buildings and trees swayed visibly. Hard jolt reported from the Magunden area near Bakersfield. Felt by several at Lost Hills, where buildings and trees swayed slightly. Press reported the shock was felt in Los Angeles.

August 19: 11:12:26*. Epicenter 35°03′ north, 119°14′ west, east of Maricopa, P. V. Felt by many in central district of Cuyama, where disturbed objects were observed by many, buildings and trees swayed visibly, and pictures swung N.–S. Felt strongly at Taft.

August 20: 00:47:47*. Epicenter 34°53′ north, 119°02′ west, vicinity of Fort Tejon, P. V. Generally felt in Cuyama, where buildings creaked, loose objects rattled, disturbed objects observed by many, and pictures swayed N.–S. Felt by few in Los Angeles.

August 22: 04:30. V. Awakened many and frightened few at Leevining, where small objects and furnishings shifted.

August 22: 14:41:24*. Epicenter 35°20′, north, 118°55′ west, east of Bakersfield, P. Felt over an area of approximately 40,000 square miles of south-central California. See map, page 38. Maximum intensity of VIII limited to the downtown area of Bakersfield, where damage ran into the millions of dollars. Two were killed and 35 injured.

INTENSITY VIII:

Bakersfield.—Severe damage in the downtown district, with heaviest damage along 17th, 18th, and 19th Streets. Many buildings of older brick construction, weakened by the July 21 earthquake, wrecked beyond repair and condemned. The city hall and Kern County Courthouse were abandoned after this earthquake. There was additional serious damage to the Kern County Hospital and County Jail. In East Bakersfield two blocks of old buildings were ordered razed. The Episcopal Church was ordered razed and several other churches badly damaged. State engineers reported that three schools (Old)—the Fremont, Emerson, and Lincoln—were totally unfit for use after the earthquake, and the Fairfax School (Old) collapsed at many places. Damage to underground utilities appeared to be minor. One 4-inch, cast-iron waterline, buried 3 feet, cracked in 18–19th Street alley and one 8-inch and one 12-inch line had small cracks. About 800 to 900 wiring connections to homes broken. Few sewer leaks reported. Damage occurred to the mechanism of the 100-foot-diameter tank at the

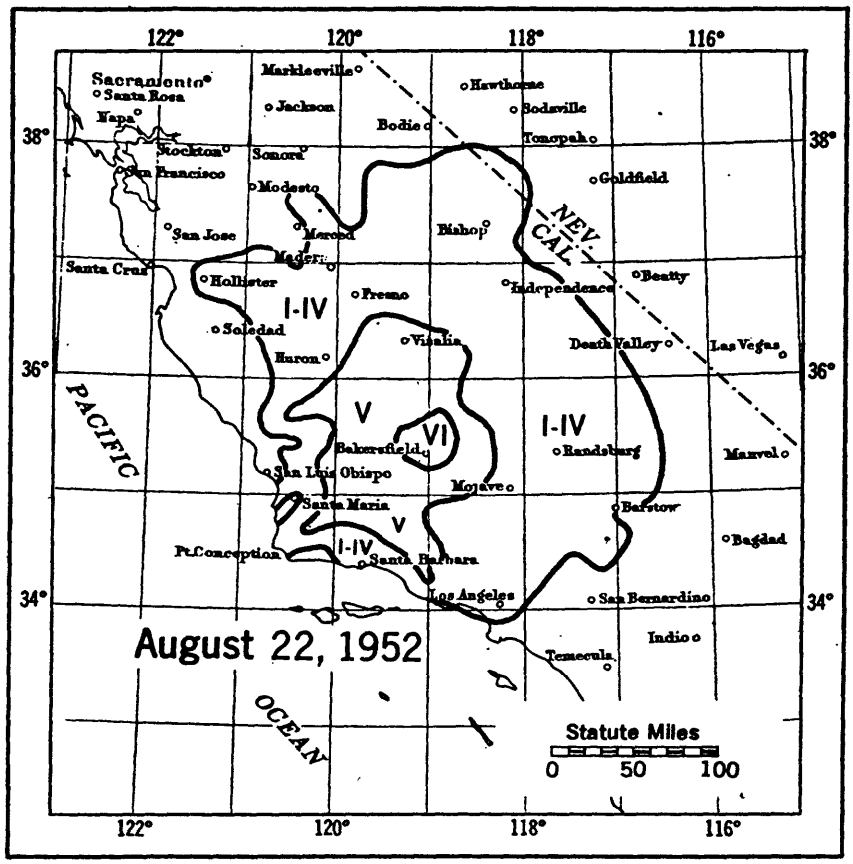

FIGURE 6.—Area affected by the earthquake of August 22.

old sewage treatment plant. From areas outside of the downtown district, people reported plaster and walls cracked, chimneys twisted and fell, dishes and windows broke, some furniture overturned and broke, and many objects fell.

INTENSITY VII:

Kern Front oilfield (next to Kern River oilfield, 5 miles north of Bakersfield).—Several wells sanded, and several blew gas through casingheads.

Kern River oilfield (5 miles north of Bakersfield).—Twenty to twenty-five wells sanded.

Racetrack oilfield (2 miles east of Edison).—Several wells increased output, with salt water. Surface cracks across field.

Tejon Hills oilfield (10 miles northeast of Grapevine).—One well sanded. Pump barrel damaged by dogleg. On Rocco lease, 4 producers ruined, 2 badly damaged, and 2 others damaged. One newly completed well went from 54 barrels a day to 6 barrels a day, with sand; another had crushed casing. Some wells increased production; some lost. The middle of three 1,500-barrel storage tanks was thrown off foundation. Outside tanks suffered only minor damage. No damage to well-built structures in the area.

INTENSITY VI:

Buttonwillow.—Felt by many; frightened few. Damage slight to brick. "Many shocks all night."

Cuyama (central section).—Felt by all and frightened many in community. Disturbed objects observed by many. Small objects and vases overturned; knickknacks fell.

Edison.—Felt by all and frightened many in community. Trees, bushes shaken moderately. Small objects overturned and knickknacks fell. Damage slight.

Greenfield Corners (south of Bakersfield).—Felt by all and frightened many. Small objects and furniture overturned; knickknacks, books, pictures, and plaster fell. Trees, bushes shaken strongly.

Ivanhoe.—Felt by many or all in community and frightened few. Small objects shifted, vases overturned, and knickknacks fell. Plaster cracks. Damage slight.

Oildale.—Frightened many in community. Small objects shifted, vases overturned, knickknacks fell.

Olancha.—Felt by many and frightened few in community. Damage slight. Trees, bushes shaken moderately.

Sanger.—Felt by all and frightened few in community. Damage slight. Plaster and walls cracked. Small objects shifted.

Saticoy.—Felt by all in community and frightened few. Trees, bushes shaken strongly. Small objects shifted and overturned.

Selma.—Felt by and frightened many in community (some outdoors). Small objects and furnishings shifted; small objects overturned; knickknacks, books, and pictures fell

Terra Bella.—Felt by many in home and at post office; frightened few in community. Small objects shifted. Plaster and walls in post office cracked; plaster fell. Already damaged Presbyterian Church declared unsafe.

Tipton.—Frightened many in community. Plaster cracked.

Wasco.—Felt by all and frightened many in community. Pendulum clock facing north stopped. Trees, bushes shaken strongly. Plaster cracked and fell. Damage slight.

Woodlake.—Felt by all; frightened few. Plaster cracked some. Few dishes and windows broke. Damage slight.

Woody (fire station).—Felt by and frightened all at station. Fire station shaken so severely firemen left building immediately. Trees, bushes shaken moderately.

INTENSITY V: Alpaugh, Arvin, Aztec School (New) (about 5 miles northeast of Bakersfield), Caliente, Camp Nelson (Tulare County), Cantua Creek, Chowchilla, Corcoran, Coso Junction, Cutler, Delano, Earlimart, Fellows, Fillmore, Fresno, Friant, Grapevine, Guadalupe, Hanford, Isabella, Kettleman City, Kingsburg, Lompoc, Los Alamos, Lost Hills, McKittrick, Maricopa, Mendota, Miracle Hot Springs, Monolith, Nipinnawasee, Paso Robles, Pozo Guard Station (about 16 miles southeast of Santa Margarita), Springville, Summit, Taft, Tupman, Visalia, and Wheeler Springs.

INTENSITY IV: Acton, Badger, Big Creek, Bigpine, Calwa City (near Fresno), Cantil, Caruthers, Clovis, Darwin, Dunlap, Frazier Park, Grover City (near Pismo Beach), Herndon, Hollister, Huntington Lake, Huron, Independence, Kerman, Lake Hughes, Lake Shore, Laws, Lemoore, Los Angeles, Mojave, O'Neals and 3 miles southwest of, Orange Cove, Oxnard, Pearblossom, Pixley, Pond, Posey, Raisin, Reedley, Sacramento, San Fernando, San Miguel, Santa Barbara, Santa Margarita, Santa Maria, Santa Paula, Saugus, Simi, Snelling, Soda Lake (near Grover City), Sonora, South Haiwee Reservoir (Coso Junction), Strathmore, Topanga, Tranquillity, Tujunga, Tulare, Ventura, Westend, Yosemite Valley (central section), and Yosemite National Park.

INTENSITY I TO III: Armona, Bagby, Barstow, Bishop, California Hot Springs, Casmalia, Clarksburg, Coalinga, Daggett, Edwards, Firebaugh, Fish Camp, Five Points, Goleta, Idria, Johannesburg, Keeler, Kings Canyon National Park, Lebec, Le Grand, Long Valley Dam (north of Bishop), Los Banos, Midpines, Modesto, Mono Hot Springs, Nipomo, Oakhurst, Pearblossom, San Francisco, Santa Ynez, Trona, Vernalis, and Victorville.

INTENSITY I TO III IN NEVADA: Dyer.

Negative reports were received from 84 places in California and 3 places in Nevada.

August 22: 21:10. Very hard jar felt at Lake Hughes.

August 22: 22:03:03*. Epicenter 35°00′ north, 118°44′ west, Tejon Ranch, P. Reported as rather strong at Grapevine.

August 23: 02:09:07*. Epicenter 34°30′ north 118°13′ west, near Acton, P. Felt area approximately 35,000 square miles. See map, p. 40. Maximum intensity VI. It is believed that the extension of higher intensities abnormally north into Kern County may be due to confusion with other shocks occurring on August 22d and 23d.

INTENSITY VI:

Amboy.—Felt by many. "Water tower damaged. Will have to be braced."

Camarillo.—Felt by and awakened many; frightened few. Damage slight. Plaster cracked. Small objects shifted and overturned.

Moorpark.—Felt by, awakened, and frightened many in community. Damage slight. Small objects shifted and overturned, dishes broke, chimneys cracked.

Oxnard.—Felt by and awakened many. Some furniture moved in poorly constructed houses, water splashed from open containers E–W, plaster cracked slightly in older houses.

Summerland.—Felt by and awakened all; frightened few. Walls creaked.

Tujunga.—Strong shock awakened all in community. Trees, bushes shaken moderately.

INTENSITY V: Arvin, Bakersfield, Bellflower, Caliente, Compton, Cuyama, Fawnskin, Fillmore, Glendora, Grapevine, La Crescenta, Los Angeles, Los Olivos, Miracle Hot Springs, Mount Baldy, North Hollywood, Ojai, Pearblossom, San Fernando, Santa Maria, Santa Monica, Saugus (powerplant No. 2), Sierra Madre, Topanga, Torrance, Venice, Ventura, and Walnut.

INTENSITY IV: Acton, Agoura, Anza, Cantil, Carpinteria, Glendale, Goleta, Helendale, Hidden Springs Camp (near Mount Wilson), Highland Park, Huntington Beach, Indio, Irvin, Lake Hughes, Lost Hills, Montebello, Nipomo, Norwalk, Pala, Phelan, Riverside, Santa Ynez, Shafter, Taft, Victorville, Westend, Wildomar, Woody, Wrightwood, and Yorba Linda.

INTENSITY I TO III: Alpaugh, Buellton, Concepcion, Culver City, Daggett, Downey, Edwards, Elsinore, Frazier Park, Guadalupe, Johannesburg, Keene, Los Alamos, San Bernardino, Santa Paula, Tupman, Wasco, and Wheeler Ridge.

Negative reports were received from 55 places.

August 23: (No specific times given). Grapevine. Observer reports: "From midnight on, four shocks were felt."

August 23: 12:10 and 13:20. IV. Felt by several in home and frightened few in community at Ventucopa. Windows, doors, and dishes rattled slightly; house creaked. Trees, bushes shaken slightly.

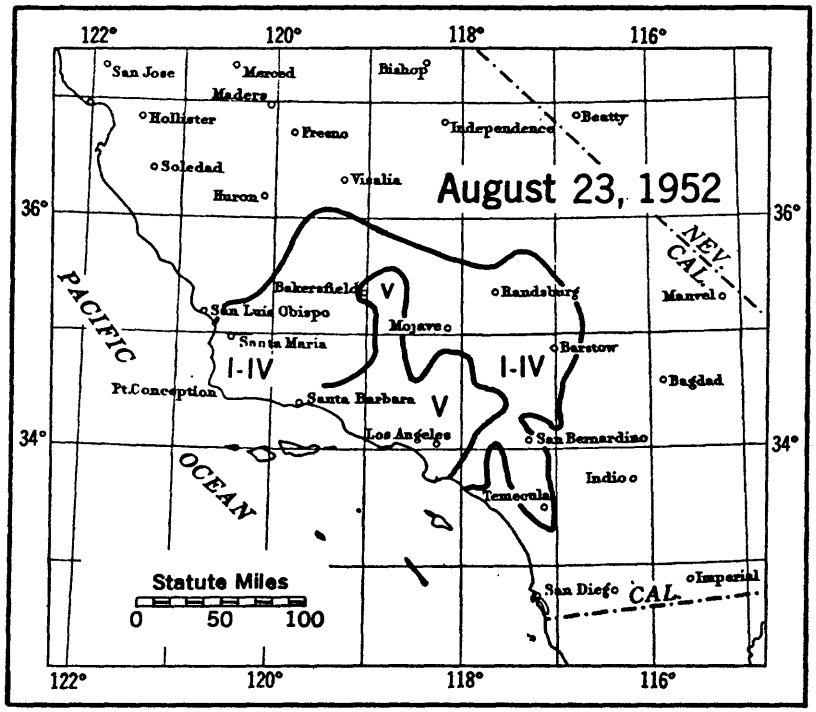

FIGURE 7.—Area affected by the earthquake of August 23.

August 23: 23:15. IV. Felt by many in home and awakened few at Caliente. Windows, doors, and dishes rattled; house creaked.

August 24: 19:30. IV. Felt by several in home and by some outdoors 17 miles southeast of Bakersfield. Windows rattled and walls creaked.

August 24: 22:20:26*. Epicenter 35°06′ north, 118°58′ west, near Grapevine Station, P. V. Felt by and awakened many in community 17 miles southeast of Bakersfield. Trees, bushes shaken slightly. Small objects shifted.

August 26: 12:56:40*. Epicenter 35°05′ north, 118°25′ west, near Tehachapi, P. V. Felt by all at Tehachapi where buildings creaked and loose objects rattled. Intensity IV at Arvin (5 miles northwest of) and Monolith. Weak shock at Wheeler Ridge.

August 26: 13:50. Weak shock at Wheeler Ridge.

August 26: 15:40. IV. House creaked at Wheeler Ridge.

August 26: 18:10 and 22:37. V. Press reported two sharp jolts were felt by most people in Bakersfield. Second shock stronger of the two, caused bricks to fall from already damaged buildings in Bakersfield. Intensity IV in Arvin where it was felt by all in home, frightened few, and house creaked.

August 27: 00:30. III. Awakened observer at Tehachapi.

August 27: 07:18. III. One jolt felt by several at Mount Hamilton. In San Jose (east side near foothills) chandelier swung.

August 28: 08:44. IV. One heavy jolt felt at Tehachapi. Bumping subterranean sounds heard by several just before shock.

August 29: 10:46. IV. One heavy jolt felt at Tehachapi. Bumping subterranean sounds heard by several just before shock.

August 29: 20:56:00*. Epicenter 35°19′ north, 118°30′ west, east of Caliente, P. VI. Felt by and awakened all in community at Arvin. Windows and dishes rattled; house creaked. Trees, bushes shaken slightly. Felt by all, awakened many, and frightened few at Miracle Hot Springs where windows, doors, and dishes rattled; house creaked. One very heavy jolt at Tehachapi, with other shocks felt at 21:02 and 21:04 which were not as strong as the first shock. Windows, doors, and dishes rattled at Terra Bella. Felt by several at Los Alamos and Tulare. Slight shock at Kettleman City. Press reported the shock was felt at Bakersfield; no damage. Reported not felt at Visalia.

August 30: 04:30. III. Light shock at Tehachapi. Bumping subterranean sounds heard by several just before shock.

September 2: 04:41:32*. Epicenter 35°08′ north, 118°42′ west, Tejon Ranch, P. VI. Felt by all and awakened many in home at Arvin; plaster cracked; damage slight. Very hard jerks awakened all in community at Lake Hughes. Felt by all in community at Grapevine. Press reported many light sleepers were awakened in Los Angeles. Awakened few at Glendale. Windows, doors, and dishes rattled at Tujunga. Slight shocks felt by some persons at Fillmore.

September 2: 08:38:08*. Epicenter 35°18′ north, 118°32′ west, P. VI. Felt by all in school and frightened few at Arvin. Plaster cracked; damage slight.

September 2: 12:45:56*. Epicenter 34° 58′ north, 119°00′ west, P. V. Felt by all at Grapevine.

September 4: 02:16. IV. One sharp jolt felt by several at Walnut.

September 4: 05:56. IV. Fairly light shake or jolt felt by many at Tehachapi.

September 4: 10:06:49*. Epicenter 35°19′ north, 118°30′ west, east of Caliente, P. IV. Sharp jar felt by many at Tehachapi. Building creaked and loose objects rattled. Felt by several at Los Angeles Municipal Airport. Also felt at Knox and Piute Ranches.

September 4: 10:30. IV. Felt by all in school at Arvin where walls creaked.

September 6: 07:40 and 19:00. Very light shocks felt at Grapevine.

September 10: 23:35. IV. Three or four definite rolling motions awakened few at the women's prison west of Tehachapi.

September 11: 20:20 (about). IV. Slight movement at Grapevine where houses creaked. Very light shock felt by several in community at Wheeler Ridge.

September 12: 02:10. IV. Slight movement at Grapevine where houses creaked.

September 12: 02:35:25*. Epicenter 35°00′ north, 119°03′ west, Wheeler Ridge, P. V. Felt by and awakened many in community, frightened few at Wheeler Ridge where small objects were shifted. Slight damage reported by PG&E at Bakersfield. Buildings creaked and loose objects rattled at Cuyama. Felt by all at the PG&E Kern steam plant.

September 13: 01:06:47*. Epicenter 36°37′ north, 121°25′ west, Gabilan Range, B. V. Awakened many in home 7 miles south of Hollister. Windows rattled and walls creaked.

September 14: 02:03 and 03:01. IV. Sharp, short shocks felt at the PG&E Kern Canyon powerhouse.

September 14: 02:45. VI. Felt by and awakened many at Miracle Hot Springs. Windows, doors, and dishes rattled; house creaked. Plaster cracked. Damage slight.

September 14: 12:43:23*. Epicenter 35°13′ north, 118°40′ west, near Bear Mountain, P. V. Dislodged loose material from steep walls of Sycamore Canyon. Felt by many at Tehachapi, where buildings creaked and loose objects rattled. Felt sharply outdoors at Arvin. Felt by one at Pasadena.

September 14: Between 22:00 and 23:00. Light shock reported felt at Tehachapi.

September 15: 12:07. IV. Felt by many at Tehachapi. Buildings creaked and loose objects rattled.

September 15: 17:37. IV. Felt by many; frightened few at Wheeler Ridge where windows rattled.

September 15: 23:20. IV. Felt by, awakened, and frightened few in community at Wheeler Ridge. Windows, doors, and dishes rattled and house creaked.

September 16: 06:24:53*. Epicenter 35°19.5′ north, 118°36.5′ west, near Caliente, P.

September 16: 07:21:07*. Epicenter 35°22′ north, 118°35′ west, Walker Basin, P. V. Both shocks felt by all, awakened many, and frightened few in community at Miracle Hot Springs. Plaster cracked and observer reported the shocks were stronger than any felt since August 23d. Another shock felt at 08:00. Both shocks felt sharply at Knox Ranch. The shock at 07:21:07 was reported from Wheeler Ridge, where it was felt by several and frightened few in community.

September 16: 17:21. V. Felt by all in community and frightened few at Wheeler Ridge. Windows rattled and walls creaked.

September 17: 23:10. V. Felt by and awakened many in community at Kernville, where windows, doors, and dishes rattled. "Rapid shake. Seemed to be stronger in Bodfish and Johnsondale."

September 18: 18:35. IV. Slight jar felt by many at Tehachapi. Buildings creaked and loose objects rattled.

September 19: 05:00 (about). Bumping motion with abrupt onset felt at Tehachapi.

September 19: 08:19. IV. Shock felt by observer at Tehachapi. Building creaked and loose objects rattled.

September 19: 12:23. IV. Felt by many at Tehachapi. Building creaked and loose objects rattled.

September 21: 22:12. III. Shock lasting 5 seconds felt at the PG&E Kern Canyon powerhouse.

September 22: 03:41:25*. Epicenter 40°12′ north, 124°25′ west, 12 miles southwest of Petrolia, B. Sharp shock felt over approximatley 4,000 square miles of northwestern California. Maximum intensity VII. Moderate damage.

INTENSITY VII:

Petrolia.—Felt by, awakened, and frightened all in community. Press reported several chimneys fell and many damaged, including some large fireplace chimneys. Bricks fell from houses. Plumbing in upper story of one house was twisted loose and water flooded home. Some houses moved 1 to 2 inches on foundations. Much merchandise fell in the general store and broke. Plants in greenhouse thrown to floor. Radio was reportedly thrown across room and stoves and other kitchen equipment ripped and thrown off balance. Refrigerator tipped over. Ground cracked around one home. Oilwell casing cracked at the Petrolia Oil Well Co. and bunkhouse off foundation. Dishes and windows broken.

INTENSITY VI:

Alton.—Felt by and awakened all in community. Windows rattled and walls creaked.

Briceland.—Felt by and awakened all in community. Small objects shifted and overturned.

Carlotta.—Felt by and awakened all in community. Small objects shifted.

Ettersburg.—Felt by and awakened all. Doors opened.

Ferndale.—Felt by and frightened many; awakened all. Pendulum clock facing N.-NE. stopped. Knickknacks fell.

Fields Landing.—Felt by, awakened, and frightened all in community. Windows rattled and house creaked.

Fortuna.—Felt all over this area; awakened many. Pendulum clock stopped. Small objects shifted; knickknacks and pictures fell. Damage slight.

Garberville.—Felt by and awakened all. Windows, doors, and dishes rattled and house creaked.

Harris.—Felt by and awakened all. House creaked.

Holmes.—Felt by and awakened all in community. Windows, doors, and dishes rattled and house creaked. Clock on dresser knocked over.

Honeydew.—Awakened and frightened all in community. Small objects and furnishings shifted; small objects overturned. Opened oven doors on stoves. Broke gas line in community. Damage slight.

Loleta.—Felt all over area; awakened all and frightened many or all. Small objects shifted.

Rio Dell.—Felt and awakened all in community. Small objects shifted; knickknacks fell. Damage slight.

INTENSITY V: Alderpoint, Arcata, Beatrice, Benbow Inn (Benbow), Blocksburg, Blue Lake, Bridgeville and 7 miles northeast of, Eureka, Fort Bragg, Fort Seward, Hartsook, Kneeland, Korbel, Laytonville, McCann, Miranda, Pepperwood, Piercy, Scotia, South Fork, Spyrock, Weott, Westport, and Zenia.

INTENSITY IV: Bell Springs, Burnt Ranch, Comptche, Covelo, Cummings, Eel Rock, Hyampom, Island Mountain, Lake Mountain, Rockport, Ruth, and Willits.

INTENSISY I TO III: Elk, Orleans, and Phillipsville (1 mile north of).

Negative reports were received from 60 places.

September 22: 22:59. IV. Two sharp tremors felt by many at Tehachapi.

September 24: 05:10. Slight shock felt at Ferndale.

September 24: 08:44. III. Shock lasting 1 second felt by observer in Tehachapi.

September 25: 08:02. IV. Felt by several in community and frightened few in Wheeler Ridge. Windows rattled and walls creaked.

September 25: 08:21:35*. Epicenter 35°03′ north, 118°54′ west, northeast of Wheeler Ridge, P. V. Felt by all and frightened few in community at Wheeler Ridge. Small objects overturned; and trees, bushes shaken moderately.

September 25: 08:45. IV. Felt by several and frightened few at the California Institution for Women west of Tehachapi. Roof framing rattled.

September 25: 19:51:50*. Epicenter 35°08′ north, 118°46′ west, north of Tejon Creek, P. IV. Loud rumble, followed by a sharp jolt, lasting 4 seconds.

September 25: 20:35:43*. Epicenter 38°25′ north, 122°35′ west, B. IV. Press reported an explosivelike motion was felt by many in Santa Rosa. Most calls to the police came from the area bordering Highway 12 between Santa Rosa and Kenwood, a small community 5 miles south of Santa Rosa. Felt by and alarmed many in Saint Helena, where buildings creaked, loose objects rattled, and light fixtures swayed. Press reported it was stronger on the Spring Mountain hillside than on the valley floor.

September 26: 12:21:20*. Epicenter 35°06′ north, 118°37′ west, Tejon Ranch, P. II. Two jarring shocks felt by observer at Tehachapi. Another shock felt at 13:04.

September 28: 07:50. V. One strong jerk felt by all in Kernville. Windows and dishes rattled.

October 2: 15:10:21*. Epicenter 35°24′ north, 118°38′ west, north of Caliente, P. V. Felt by all in community. Windows rattled and frame creaked. At Caliente felt by several in store.

October 4: 23:59. Tehachapi. IV. Felt by many. Buildings creaked.

October 4: (no time given). Scotia. III. Felt by several.

October 6: 15:20. Tehachapi. III. Fairly heavy bumping jar.

October 9: 08:21*. Tehachapi, Kern County, P. IV. Felt by many. Buildings creaked, loose objects rattled.

October 12: 05:13*. Kern County (near Chuchupate), P. V. Felt by all, awakened many; frightened few at Wheeler Ridge. Windows, doors, and dishes rattled; house creaked. Shifted small objects and furnishings.

October 12: 16:34:09*. Epicenter 37°45′ north, 122°11′ west, near Diamond District, Oakland, B. Felt over an area of approximately 3,500 square miles. Felt area extended from Jenner on the coast, easterly to Calistoga, southeasterly to Vacaville, southwesterly to Ben Lomond, and thence along the coastal areas to Jenner. Damage very slight; few plaster cracks reported. Maximum intensity V.

INTENSITY V: Alameda, Alviso, Berkeley, Brisbane, Canyon, Daly City, Dillon Beach, Inverness, Moraga, Oakland, Orinda, Pinole, Port Costa, Richmond, Saint Mary's College, and Vallejo.

INTENSITY IV: Alamo, Alvarado, Belmont, Ben Lomond, Bodega Bay, Bolinas, Calistoga, Clayton, Concord, Corte Madera, Crockett, El Cerrito, El Granada, Hayward, Jenner, Lafayette, Martinez, Mill Valley, Montara, Mount Eden, Petaluma, Redwood City, San Francisco, San Leandro, San Mateo, San Ramon, Sharp Park, South San Francisco, and Walnut Creek.

INTENSITY I TO III: Alcatraz, Boulder Creek, Decoto, Diablo, Half Moon Bay, Irvington, Lagunitas, Napa, Novato, Palo Alto, Pedro Valley, Pescadero, Pleasanton, Point Reyes Station, Saint Helena, San Bruno, San Gregorio, San Rafael, Santa Rosa, Sausalito, Stinson's Beach, and Vacaville.

Negative reports were received from 35 places.

October 14: 01:00. Boulder Creek. IV. Observer awakened by rattling of table. Windows rattled. Bed shook for 30 seconds.

October 14: 22:53*. Tehachapi, P. IV. Felt by many. Loose objects rattled and building creaked.

October 15: 16:10. Tehachapi, P. II. Felt by two people.

October 16: 04:22*. Epicenter 34°54′ north, 118°57′ west, near Fort Tejon, P. VI. Felt by and awakened all; frightened few at Wheeler Ridge. Windows rattled; walls creaked. Hanging objects swung N. Felt by many at Tehachapi. Buildings creaked and loose objects rattled.

October 17: 04:48:50* and 07:23:22*. Epicenter 34°06′ north, 117°18′ west, near San Bernardino, P. IV. "Numerous residents in the San Bernardino area reported being awakened by sharp local earthquakes on the morning of October 17."—(*BSSA, January 1953.*)

October 18: 23:30. Loomis Ranch, P. III. Felt by several.

October 19: 00:30. Loomis Ranch, P. III. Felt by several.

October 19: 06:04:42*. Epicenter 34°30′ north, 118°13′ west, near Acton, P. V. Felt by and awakened many in Acton and vicinity. Windows and doors rattled; house creaked. Felt by several at Loomis Ranch, where subterranean sounds heard by several before shock. Also felt at Arcadia, Flintridge, Pasadena, and South Pasadena.

October 19: 19:29*. Tehachapi, Kern County, P. IV. Felt by many. Buildings creaked; loose objects rattled.

October 20: 10:14:43*. Epicenter 35°19′ north, 118°30′ west, east of Calients, P. IV. At Tehachapi building creaked, loose objects rattled. Lasted about 3 seconds.

October 20: 20:01*. Magunden and Kern Canyon powerhouse, P. III. Motion up and down; brief.

October 21: 12:47. Tehachapi, P. IV. Felt by many. Building creaked; loose objects rattled.

October 21: 16:45:52*. Epicenter 37°53′ north, 122°22′ west, San Francisco Bay, B. Felt from Forest Knolls, southeasterly to Clayton, thence southwesterly through San Jose to Santa Cruz. Felt area of approximately 2,500 square miles. Maximum intensity V.

INTENSITY V:

Richmond.—Felt by all in community; frightened few. Damage slight. Overturned small objects. Trees and bushes shook moderately. Windows, doors, and dishes rattled strongly.

INTENSITY IV: Alameda, Aptos, Emeryville, Forest Knolls, Hayward, Montara, Mountain View, Niles, Oakland, Palo Alto, Redwood City, San Francisco, San Jose, San Leandro, South San Francisco, and Walnut Creek.

INTENSITY I TO III: Ben Lomond, Clayton, Lafayette, Pinole, Saint Mary's College, Santa Cruz, and Sharp Park.

Negative reports were received from 61 places.

October 22: 12:03:28*. Epicenter 35°20′ north, 118°55′ west, near Bakersfield, P. "A sharp, short earthquake jolted Bakersfield. . . . No damage was reported." (*BSSA, January 1953.*)

October 22: 21:33:34*. Epicenter 35°35′ north, 118°30′ west, near Bodfish, P. V. Felt by and awakened many at Bodfish. Windows, doors, and dishes rattled; walls creaked. Felt by many, awakened and frightened few in homes at Borel Powerhouse. Windows and doors rattled; house creaked. Hanging objects swung. Shock of lesser intensity but longer duration reported felt about 16:00.

October 25: 09:11*. Tehachapi, P. III. Motion bumping. Lasted about 1 second.

October 26: 00:30. Tehachapi, P. IV. Felt by many; awakened observer. Smaller shocks at 00:15* and 01:00*.

October 26: 03:36:40*. Epicenter 40°05′ north, 120°46′ west, near Genesee, B. III. Felt by observer in home at Quincy.

October 26: 21:27*. Tehachapi, P. IV. Felt by many. Building creaked; loose objects rattled.

October 28: 12:52:50*. Epicenter 35°22′ north, 118°30′ west, northeast of Caliente, P. IV. At Tehachapi building creaked and loose objects rattled.

November 2: 22:12*. Tehachapi, P. IV. Two shocks and second one stronger. Felt by many. Building creaked; loose objects rattled. Bumping subterranean sounds heard at time of shocks.

November 4: 11:07:31*. Epicenter 32.8° north, 116.9° west, near El Cajon, P. IV. "A sharp earthquake . . . was reported to have sent people running into the streets in El Cajon Valley, 20 miles east of San Diego. The earthquake was generally felt in downtown San Diego."—(*BSSA, January 1953.*) At La Mesa, building creaked and loose objects rattled. Followed at intervals of 1 to 2 minutes by 2 sharp but not loud cracks.

November 5 and 6: 23:32 and 10:00. Oxnard. "Minor earthquakes were reported felt at. . . ."—(*BSSA, January 1953.*)

November 6: 19:00, 19:15, and 22:20. Tehachapi. IV. Felt by many. Building creaked; loose objects rattled.

November 7: 00:55:35*. Epicenter 35°00′ north, 119°05′ west, west of Wheeler Ridge, P. VI. Felt by and awakened all; frightened few at Lebec and Wheeler Ridge. Dishes, windows, and doors rattled at both places. At the last-named place, house creaked and hanging objects swung. Small objects shifted. Another slight shock at about 05:00 was felt by several. Awakened and frightened many in Taft, V, where windows, doors, and dishes rattled and house creaked. Intensity IV at Laton, Los Angeles, Ojai, Santa Barbara, and Tehachapi. Intensity I to III at Bakersfield, Kern River powerhouses (PG&E), and Santa Ynez.

November 7: 01:37. Midway (PG&E). III. Two distinct mild shocks of brief duration.

November 7: 03:22*. Tehachapi, P. IV. Two shocks, second one stronger, felt by many. Building creaked; loose objects rattled. At 04:00 and 05:05 there were trembling motions.

November 7: 19:47*. Tehachapi, P. IV. Building creaked; loose objects rattled. "Other light tremors were reported which I did not feel due to being asleep or driving car." Another shock was reported at 20:45.

November 8: 11:37:54*. Epicenter 37°39′ north, 122°28′ west, south of Daly City, B. IV. Press reported windows in city hall rattled loudly at Daly City; felt by several in office at San Anselmo: press reported doors and dishes rattled in Marina, Parkside, Sunset, and Merced Heights areas of San Francisco. Some excited housewives reportedly rushed outside; felt by several; dishes rattled at Mill Valley. Also felt at Kentfield, Oakland, and San Rafael.

November 9: 10:41:02*. Epicenter 35°34′ north, 118°25′ west, east of Bodfish, P. IV. Felt by many in home and community; frightened few. Windows and doors rattled; walls creaked.

November 9: 06:30. Borel powerhouse (Bodfish). III. Shock awakened few.

November 11: 09:43. Borel powerhouse, P. V. Felt by several and frightened few in community. Damage slight to cement. Windows and doors rattled; walls creaked. About six shocks felt.

November 12: 07:06*. Tehachapi, P. IV. Felt by many. Building creaked; loose objects rattled.

November 12: 09:04. Borel Powerhouse. V. Felt by many in home, some outdoors; frightened few. Damage slight to concrete; opened few cracks. Windows and doors rattled; walls creaked.

November 12: 22:54* and 23:01* (stronger). Tehachapi, P. IV. First shock felt light, second heavy jarring and bumping. Building creaked; loose objects rattled. Moderately loud rumbling heard before.

November 16: 05:48:24*. Epicenter 33°57′ north, 117°10′ west, P. IV. Felt by many in home; frightened few at Hemet. Windows rattled. "Residents of Riverside and San Bernardino Valley felt a light earthquake at. . . ."—(*BSSA, January 1953.*)

November 21: 23:46:38*. Epicenter 35°50′ north, 121°10′ west, near Bryson, P. Felt over an area of 20,000 square miles. Some damage reported such as twisting and fall of chimneys and broken dishes. School near Bryson was a shambles inside from broken objects. Cracks appeared in building walls and ground. See map, page 44. Maximum intensity VII.

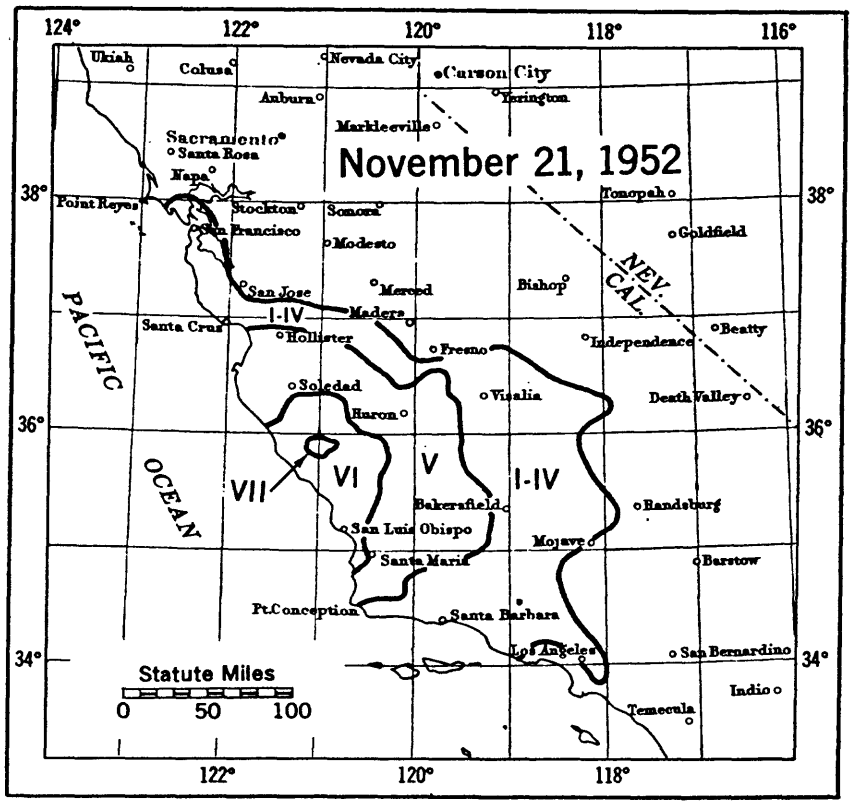

FIGURE 8.—*Area affected by the earthquake of November 21.*

INTENSITY VII:

Bradley.—Felt by, awakened, and frightened all in community. Damage considerable. Twisting and fall of chimneys; and knickknacks, books, pictures, and plaster fell. Dishes, windows, and furniture broke. Shifted and overturned small objects and furniture.

Bradley (10 miles northwest of).—Felt by, awakened, and frightened all at Elmo Buttle Ranch. Damage considerable. Twisting and fall of chimneys. Ground cracks appeared bordering San Antonio River and showed splashes of silt and water. Walls and chimneys cracked; windows opened. Dishes broke; books and pictures fell. Shifted and overturned small objects and furniture.

Bryson.—Large cracks through walls found in poured adobe storehouse (30 years old). A threaded waterpipe joint in the ground pulled apart. Wells cased with 3-foot concrete pipe filled with quicksand. Most old chimneys (5 or 6) knocked down. Pleyto School was a shambles inside from dishes, mirrors, clocks, etc., being thrown to the floor and broken. "Earthquakes are still being felt here (Pleyto School) every few hours. . . ."

INTENSITY VI:

Arroyo Grande.—Felt by and awakened all; frightened many. Small objects shifted; vases overturned. Windows, doors, and dishes rattled; house creaked.

Atascadero.—Awakened all in community; frightened few. Damage slight. One chimney, knickknacks, books, and pictures fell. Small objects and furnishings shifted; vases overturned. Windows, doors, and dishes rattled.

Cambria.—Awakened all in home and community; frightened few. Small objects and vases shifted and overturned. Knickknacks and pictures fell. Windows, doors, and dishes rattled; house creaked.

Camp Cooke.—Awakened all in community; frightened few. Windows, doors, and dishes rattled. Hanging objects swung.

Carmel Valley.—Felt by and awakened all; frightened few. Small objects and furnishings shifted and knickknacks fell. Windows, doors, and dishes rattled.

Cayucos.—Felt by and awakened many; frightened few. Cracked plaster, and bottles in drugstore broke. Windows, doors, and dishes rattled; house creaked.

Chualar.—Awakened all in community.

Creston.—Felt by and awakened all; frightened many. Damage slight to brick; walls and chimneys cracked. "This is hardest shock felt in this area. Two slight shocks followed about 5 minutes later." Small objects shifted. Windows, doors, and dishes rattled; house creaked.

Gorda Station (about 20 miles north of San Simeon).—Felt by, awakened, and frightened all in community. Knickknacks and books fell. Hanging objects swung. Windows, doors, and dishes rattled; house creaked.

Guadalupe.—Awakened all and frightened many in community. Windows, doors, and dishes rattled. Hanging objects swung.

Harmony.—Felt by and awakened all in the area; frightened few in community. Knickknacks, books, and pictures fell. Small objects and furnishings shifted.

Hearst Ranch.—Awakened and frightened all in community. Some chimneys down and cracked plaster at stables on Pico Creek. Buried 5-inch water main broken at old leak. Telephone lines and trees down. Small objects shifted and overturned.

King City.—Felt by, awakened, and frightened all in community. Cracked walls and small objects overturned. Windows, doors, and dishes rattled.

Lockwood.—Felt by all in community; awakened and frightened all in home. Few chimneys fell and small objects shifted.

Lonoak.—Felt by all, awakened many, and frightened few. Plaster and outside stucco cracked. Small objects shifted.

Morro Bay.—Felt by and awakened all in community and frightened many. Damage slight, mostly glass. Vases and small objects overturned. Windows, doors, and dishes rattled; house creaked.

Oceano.—Felt by, awakened, and frightened all. Windows rattled. Plaster shaken off ceiling of old building.

Parkfield.—Felt by and awakened all in community; frightened few. Mirror shook from wall.

Paso Robles.—Felt by and awakened all. Press reported it shook arm off record player turntable in radio station. Few bottles broke in store. House trailers shook off blocks. Small objects and furnishings shifted.

Pismo Beach.—Felt by and awakened all; frightened many in community. Plaster, windows, walls, and chimneys cracked, and dishes broke. Knickknacks, books, and pictures fell. Small objects and some furnishings shifted; vases and small objects overturned.

Salinas.—Awakened all in community; frightened few. Windows rattled. Hanging objects swung.

San Ardo.—Felt by all in region; awakened and frightened many. Damage slight in case of two fallen chimneys. Vases overturned, and knickknacks and pictures fell.

San Luis Obispo.—Felt by, awakened, and frightened many in community. Mirror fell, paint cans off shelves, bottles and several plateglass windows broke. Bricks loosened from chimney. Freight cars being made up for train started down the tracks. Few chimneys fell.

San Simeon.—Felt by and awakened all in community. Small objects overturned, and groceries and bottles fell. Windows, doors, and dishes rattled; house creaked. Many aftershocks felt.

Santa Margarita.—Felt by all; awakened, and frightened many. Dishes and windows broke. Knickknacks, books, pictures, and plaster fell. Vases, small objects, and furniture overturned.

Templeton.—Felt by all in home; awakened many and frightened few in community. Knickknacks, books, pictures, and plaster fell. Windows, doors, and dishes rattled.

INTENSITY V: Avenal, Ben Lomond, Big Sur, Buellton, Buttonwillow, Caruthers, Casmalia, Cholame, Coalinga, Corcoran, Dos Palos, Hollister, Hollister (7 miles south of), Huasna, Kettleman City, Lompoc, Lost Hills, Lost Hills (SW¼, Sec. 10, T28S, R20E), Lucia, Maricopa, Monterey, Moss Landing, Nipomo, Orcutt, Paicines, Paso Robles (13 miles west of), Riverdale, San Miguel, Santa Cruz, Santa Maria, Shafter, Stratford, Sudden, and Surf.

INTENSITY IV: Aptos, Arvin, Caliente, Cantil, Cantua Creek, Carmel, Castroville, Coalinga (14 miles northwest of), Concepcion, Cutter, Cuyama, Cuyama Valley, Earlimart, Fowler, Goleta, Hanford, Huron, Idria, Lemoore, Lindsay, Los Alamos, Los Banos, Los Gatos, Los Olivos, McFarland, McKittrick, Miracle Hot Springs, Miramonte, Mojave, Morgan Hill, North Hollywood, Oakland, Olancha, Oxnard, Paloma, Pinehurst, Porterville, Priest Valley, Raisin, San Benito, San Francisco, Santa Barbara, Santa Ynez, Somis, Tehachapi, Three Rivers, Tranquillity, Ventura, Visalia, Wasco, Watsonville, and Wheeler Ridge.

INTENSITY I TO III: Carpinteria, Fillmore, Firebaugh, Gaviota, Keene, Lake Hughes, Los Angeles, San Gregorio, San Mateo County, San Rafael, Santa Susana, Saugus, Sharp Park, Tulare, and Whittier.

Negative reports were received from 56 places.

November 22: 00:53*. Bryson aftershock. IV.

INTENSITY IV: Arvin, Caliente, Jolon, Lost Hills, McFarland, Malibu, Maricopa, Miracle Hot Springs, Morgan Hill, Nipomo, Pismo Beach, and Shafter.

INTENSITY I TO III: Carmel, Cayucos, Cholame, Fillmore, Firebaugh, Keene, Los Olivos, Oxnard, Raisin, San Simeon, Saugus, Sharp Park, and Tehachapi.

Negative reports were received from 85 places.

November 22: 05:37:22*. Bryson aftershock. V.

INTENSITY V: Caliente, Miracle Hot Springs, and Wheeler Springs.

INTENSITY IV: Arvin, Earlimart, Lindsay, Maricopa, Morgan Hill, Pismo Beach, San Ardo, Shafter, and Solromar.

INTENSITY I TO III. Cayucos, Cholame, Jolon, McFarland, Oxnard, Raisin, San Simeon, and Visalia.

Negative reports were received from 88 places.

November 22: 10:45*. Tehachapi, P. IV. Felt by many. Building creaked; loose objects rattled.

November 22: 11:00. Covina, P. IV. Felt by few. Buildings creaked; loose objects rattled.

November 26: 04:13*. Tehachapi, P. IV. Building creaked; loose objects rattled.

November 26: 10:06*. Tehachapi. IV. Building creaked and loose objects rattled.

November 26: 18:38. Tehachapi. IV. Building creaked; loose objects rattled.

November 27: 07:36*. Epicenter 34°58′ north, 118°56′ west, near Wheeler Ridge, P. V. Felt by all and frightened few in community. Windows, doors, and dishes rattled; house creaked.

November 28: 08:22*. Epicenter 35°03′ north, 118°58′ west, near Wheeler Ridge, P. V. Felt by all and frightened few in community. Windows, doors, and dishes rattled; house creaked. Hanging objects swung. Intensity IV at Miracle Hot Springs. Three shocks felt. Very sharp.

November 29: 08:00 (a. m. or p. m. not given). Jolon. IV. Windows rattled. Lasted 3 seconds.

November 29: 08:19*. Tehachapi, P. IV. Felt by many. Building creaked; loose objects rattled.

November 29: 17:40. Tehachapi. IV. Felt by many. Buildings creaked; loose objects rattled.

November 29: 18:39. Tehachapi. IV. Felt by many. Building creaked; loose objects rattled.

November 30: 05:05*. Tehachapi, P. IV. Felt by many. Building creaked; loose objects rattled. Subterranean sounds heard by several.

November 30: 21:26:10*. Epicenter 35°00′ north, 118°50′ west, Tejon Ranch, P. "Residents of the Echo Park area of Los Angeles reported a slight earthquake. . . ."—(*BSSA, January 1953.*)

December 6: 15:50. Paso Robles, IV. Press reported shock was felt by two residents of Peachey Canyon area. Dishes rattled. Also felt by at least two residents of Adelaida.

December 11: 16:27.2*. Lonoak, P. III. Two explosivelike rapid motions felt in home and community.

December 12: 23:34:34*. Epicenter 37°52′ north, 122°13′ west, northeast of Berkeley, B. "A small earthquake shook the San Francisco Bay area. . . ."—(*BSSA, January 1953.*)

December 18: 12:40*. Epicenter 35°21′ north, 118°50′ west, east of Bakersfield, P. III. At Bakersfield (PG & E) very slight shock felt by several.

December 29: 23:25:58*. Epicenter 34°56′ north, 116°47′ west, near Yermo, P. V. Felt by and awakened many in community; frightened few. Windows rattled; house creaked.

WASHINGTON AND OREGON

(120TH MERIDIAN OR PACIFIC STANDARD TIME)

February 20: 11:07:09.5*. Epicenter 48.7° north, 123.4° west, San Juan Islands, W. IV. On Orcas Island different people reported in the press that shocks were similar to dropping something heavy in the house or to the house settling a little. Felt by many at Olga. Disturbed objects observed by several. Slight visible swaying of buildings and trees reported. Buildings creaked; loose objects rattled. Also felt by few at Seattle.

February 20: 16:00. Lopez, Wash. III. Felt by several. Thunderous subterranean sounds accompanied shock.

February 22: 01:39:53*. San Juan Islands. V. At Olga felt by and awakened many. Rattling of loose objects heard by many. Disturbed objects observed by several. Felt by few who were awake at Seattle.

February 23: 01:07:50*. Duval, Wash. Reported felt.

March 4: 11:42. Spokane, Washington. V. Homes shook and chairs moved in a limited area.

March 14: 06:59:37*. Epicenter 48.7° north, 123.1° west, off northwest coast of Washington, W. Intensity IV at Coupeville, where it was felt by several. Houses creaked, loose objects rattled, and pictures moved on walls.

July 27: 11:52 and 12:14. Seattle, Wash. IV. Felt by few. Stovepipe shook and small objects on sewing machine moved during both shocks. Some thought the second shock was the stronger.

August 6: 09:31. Seattle, Wash. V. Felt by many in central section of Seattle. Few old plaster cracks opened and some plaster fell. Small objects swayed. Buildings creaked and loose objects rattled. Residents in South and West Seattle reported doors, lamps, and windows rattled. Awakened one person in West Seattle.

ALASKA

(150TH MERIDIAN OR ALASKA STANDARD TIME)

January 25: 18:50:50*. Epicenter near Adak. Felt at Mitchell Field and Adak.

February 2: 00:20:06*. Epicenter 51½° north, 179° west, Andreanof Islands. Felt at Adak.

February 22: 01:40. Anchorage. Felt by several. Several observed swaying of light fixtures.

March 9: 10:00:17*. Epicenter 59½° north, 136° west, Alaska-Canada border. In Juneau felt by nearly all. Light fixtures swayed, doors rattled, and few windows and dishes cracked. Several shocks reported in rapid succession. In Sitka and Angoon felt by several. Chandeliers swayed slightly from northeast to southwest.

May 8: 20:20. Palmer. Felt.

May 18: 05:45. Manly. Felt.

May 21: 23:06. Caswell. Felt.

May 23: 06:30. Caswell. Felt.

June 13: 16:10. Shearwater. Felt.

June 15: 21:15. Wiseman. Intensity III.

June 27: 16:35. Valdez. Felt.

June 27: 20:49:06*. Adak. Felt by many.

June 28: 17:25. Caswell. Felt.

July 17: 14:18. Anchorage. Felt by several. Trembling motion in north-south direction.

July 24: 22:45. Palmer. Felt.

July 27: 21:20. McKinley. Felt.

July 29: 09:54:27*. Epicenter 53½° north, 175° west, Andreanof Islands. Felt at Mitchell Field.

August 6: 20:58:22*. College. Felt.

August 9: 14:22. Adak and Great Sitkin. Felt.

August 13: 12:30, 21:30. Lost River (80 miles northwest of Nome). Felt.

August 14: 06:00, 18:17. Lost River. Felt.

August 16: 10:35, 19:44. Lost River. Felt.

August 17: 11:36, 15:22, 15:24. Lost River. Felt.

August 27: 14:22:39*. Epicenter near Andreanof Islands. Felt at Mitchell Field.

September 26: 20:33:45*. Mitchell Field. Felt strongly.

September 27: 16:21:48*. Epicenter 58½° north, 137° west, near coast of southeastern Alaska. Felt at Sitka.

October 5: 15:35:53*. Epicenter near Kenai Peninsula. Anchorage and Spenard. Felt by several. Light fixtures swayed and car rocked slightly.

October 5: 19:15. Anchorage. Felt by several. Floorlamp swayed east-west.

October 9: 10:31. Anchorage. Felt by several.

October 10: 11:53:46*. Epicenter in northern Alaska. Depth about 100 km. Felt by several in Anchorage.

October 23: 07:51:20*. College. Felt.

November 5: 06:46:20*. Anchorage. Felt by several. Disturbed objects observed by several. Also felt at Eklutna Lake, Kasilof, Naptowne, Seward, Valdez, and Whittier.

November 15: 05:50. Three shocks within 30 minutes. Lost River. Awakened few and felt by several. Dishes rattled, hanging objects swung, and small objects moved.

November 21: 07:26:50*. Epicenter in western Alaska. At Lost River all awakened. Small objects overturned; knickknacks fell; windows, doors, and dishes rattled. Felt at Teller.

November 29: 13:45. Shearwater. Felt.

December 4: 16:24. Lost River. Felt by several.

December 5: 02:30. Teller. Felt.

December 5: 16:54. Lost River. Felt by several. Moved small objects. Windows, doors and dishes rattled.

December 6: 14:58. Shemya Air Force Base. Alarmed few. Felt by all. Disconnected water main and electrical cables, cracked cement floor, many objects disturbed.

December 6: 19:05. Whittier. Felt.

December 13: 09:56, 21:16. Lost River. Felt by several. Windows, doors, and dishes rattled. Felt at Caswell.

December 14: 20:06. Lost River. Felt.
December 23: 16:30, 16:34. Felt by several. Hanging objects swung north-south.
December 26: 09:20. Lost River and Teller. Felt.
December 27: 16:55. Lost River. Felt by several. Windows, doors, and dishes rattled. Felt at Teller and Wales.
December 27: 18:57:07*. Lost River and Teller. Felt by several. Windows, doors, and dishes rattled. Walls creaked. Hanging objects swung.
December 27: 19:28:09*. Lost River. Felt by many. Windows, doors, and dishes rattled.
December 28: 15:25, 20:00. Lost River. Felt by several. Windows, doors, and dishes rattled. First shock felt at Teller.
December 29: 05:31. Kasilof. Felt.
December 29: 20:40. Anchorage. Felt by few. Cups on hooks swayed. Felt at Caswell.

HAWAIIAN ISLANDS

(HAWAIIAN STANDARD TIME)

NOTE.—Data on the following local disturbances were determined from seismograph stations operated on the island of Hawaii by the Hawaiian Volcano Observatory of the U. S. Geological Survey. "Felt locally" appearing in the summary means in the vicinity of the observatory. For additional information, see the Volcano Letter, Nos. 515–518.

January 23: 06:27. Very feeble. Felt at Kukuihaele. Origin at Waimea Plain, about 5 miles east-southeast of Kamuela.
February 1: 20:30. Very feeble. Felt at Captain Cook. Origin Central Kona.
February 2: 01:16. Moderate. Felt strongly at Hilo and throughout the island. Origin nearly under Kaumana, about 30 miles deep.
February 2: 05:58. Felt at Kukuihaele.
February 19: 11:20. Very feeble. Felt at Kapapala. Origin southeast slope of Mauna Loa near Kapapala.
February 21: 06:15. Slight. Felt from Volcano district to Pepeekeo. Origin east rift of Kilauea about 2 miles east of Napau crater.
February 23: 22:41. Very feeble. Felt at Kapapala. Origin southwest rift of Mauna Loa at about 8,500 feet altitude.
March 6: 20:44. Feeble. Felt at Hilo and in Volcano district. Origin Hilina fault system, about 2 miles northwest of Ka Laea Puki.
March 13: 11:38. Epicenter 19°02.′4 north, 155°06.′2 west, off south shore. Strong. Felt from Volcano district to Naalehu.
March 14: 18:21. Epicenter 19°02.′8 north, 155°04.′8 west, off south shore. Strong. Felt from Hilo to Kapapala.
March 16: 15:53. Feeble. Felt in Volcano district. Origin Kilauea Caldera.
March 17: 17:58. Epicenter 19°07.′5 north, 155°02.′0 west, off south shore. Felt at Naalehu, caused small tsunami at Kalapana.
March 18: 10:53. Epicenter 19°00.′1 north, 155°19.′8 west, off south shore. Moderate. Felt at Naalehu.
March 19: 02:55. Epicenter 19°06.′5 north, 155°01.′8 west, off south shore. Strong. Felt at Naalehu.
March 20: 09:51. Epicenter 19°03.′2 north, 155°14.′7 west, off south shore. Moderate. Felt at Naalehu.
March 20: 20:16. Epicenter 19°03.′5 north, 155°23.′7 west, off south shore. Moderate. Felt at Naalehu.
March 20: 23:48. Epicenter 19°02.′2 north, 155°23.′6 west, off south shore. Moderate. Felt at Naalehu.
March 21: 04:35. Epicenter 19°02.′7 north, 155°13.′9 west, off south shore. Strong. Felt at Naalehu.
March 22: 02:05. Epicenter 19°02.′5 north, 155°12.′1 west, off south shore. Strong. Felt at Naalehu.
March 22: 19:20. Epicenter 19°06.′4 north, 155°03.′9 west, off south shore. Moderate. Felt at Naalehu.
March 23: 06:52. Epicenter 19°11.′7 north, 154°55.′0 west, off south shore. Moderate. Felt at Naalehu and Pahala.
March 23: 15:05. Epicenter 19°02.′8 north, 155°14.′4 west, off south shore. Moderate. Felt at Naalehu and Kapapala.
March 24: 02:02. Epicenter 19°08.′0 north, 155°01.′7 west, off south shore. Moderate Felt at Naalehu.
March 24: 13:29. Epicenter 19°06.′3 north, 155°02.′4 west, off south shore. Strong. Felt at Naalehu.
March 25: 07:04. Epicenter 19°04.′3 north, 155°05.′8 west, off south shore. Strong. Felt at Naalehu.
March 25: 09:17. Epicenter 19°05.′2 north, 155°05.′1 west, off south shore. Strong. Felt at Naalehu.
March 26: 04:40. Epicenter 19°03.′3 north, 155°13.′8 west, off south shore. Moderate. Felt at Naalehu.
March 27: 04:31. Epicenter 19°03.′1 north, 155°12.′6 west, off south shore. Moderate. Felt at Naalehu.
March 27: 22:44. Epicenter 19°02.′2 north, 155°13.′9 west, off south shore. Moderate. Felt at Naalehu and Pahala.

March 28: 11:57. Epicenter 19°03.'3 north, 155°11.'5 west, off south shore. Moderate. Felt at Naalehu.
March 29: 02:42. Off south shore. Moderate. Felt at Naalehu.
March 31: 22:00. Epicenter 19°02.'2 north, 155°13.'4 west, off south shore. Strong. Felt at Naalehu.
April 6: 21:09:51. Epicenter 21° north, 157° west, Hawaiian Islands, W. Felt on islands of Oahu, Maui, Kawai, Molokai, and Hawaii.
April 6: 22:58. Strong. Felt generally in Volcano district. Origin Kilauea Caldera, shallow.
April 7: 12:53. Strong. Felt from Naalehu to Volcano. Origin Kilauea, east rift near Makaopuhi crater, about 12 miles deep.
April 10: 22:52. Slight. Felt strongly from Naalehu to Volcano, moderately at Hilo, and slightly as far as Paauhau and Kukuihaele. Origin beneath the SW. rift of Mauna Loa near the 9,200-foot contour.
April 12: 05:53. Strong. Felt at Naalehu and Kapapala. Origin Kilauea, east rift, 1 mile NW. of Heake crater, about 13 miles deep.
April 12: 19:40. Slight. Felt in Volcano district. Origin Kilauea, east rift near Puu Huluhulu.
May 6: 06:35. Epicenter 19°09.'2 north, 155°19.'3 west, off south shore. Felt at Kapapala.
May 23: 12:12:26*. Epicenter 19°29′ north, 155°29′ west, Kealakekua fault, about 3.3 miles west of Napoopoo, central Kona, about 6 miles deep. Magnitude 6. Felt throughout the island of Hawaii and on the island of Maui. Minor damage in central Kona.
June 3: 21:12. Slight. Felt in Volcano district. Origin about 4 miles north-northeast of Whitney Laboratory.
June 10: 16:25. Slight. Felt at Kapapala. Origin summit of Mauna Loa, shallow.
June 13: 06:57. Slight. Felt in Volcano district. Origin about 4 miles northeast of Whitney Laboratory.
June 14: 10:44. Slight. Felt in Volcano district. Origin east slope of Mauna Loa.
June 26: 17:23. Very feeble. Felt strongly at Kapapala. Origin near Kapala, shallow, probably on Kaoiki fault.
July 6: 15:38. Very feeble. Felt at Kukuihaele.
July 6: 22:56. Feeble. Felt at Kukuihaele.
July 7: 04:43. Slight. Felt at Hilo and Kukuihaele.
July 9: 06:54. Slight. Felt in Volcano district.
July 9: 08:10. Slight. Twin earthquake. Felt at Hilo, Volcano, and Naalehu. Origin probably Hilina fault system.
July 12: 13:53. Moderate. Felt from Kona to Hilo. Origin in central Kona.
August 14: 14:08. Slight. Felt at Volcano, Kapapala, and Naalehu. Origin of south shore.
September 2: 04:45. Feeble. Felt at Glenwood, Volcano, Naalehu, and Kona. Origin Kilauea Caldera.
September 14: 08:11. Very feeble. Felt at Kukuihaele.
September 17: 12:41. Tremor. Felt in Kona.
September 19: 20:58. Felt in Kona.
September 20: 06:53. Felt in Kona.
September 24: 11:45. Felt in Kona. Origin in central Kona.
September 27: 07:22. Tremor. Felt in Kona. Origin central Kona, probably Kealakekua fault.
September 30: 04:10. Felt in Kona.
October 3: 12:12. Feeble. Felt at Naalehu and Kapapala.
October 18: 17:02. Very feeble. Felt at Kapapala. Origin Kaoiki fault near Wood Valley.
October 25: 09:25. Very feeble. Felt in Kona. Origin central Kona.
November 10: 21:42. Very feeble. Felt in Kona. Origin central Kona.
November 27: 16:35. Very feeble. Felt in Kona. Origin central Kona.
November 27: 22:14. Epicenter 19°29′ north, 155°38′ west, near summit of Mauna Loa, 4 miles west of North Bay. Slight. Felt in Kona.
December 3: 01:12. Tremor. Felt in Kona. Origin west slope off Mauna Loa.
December 3: 20:03. Felt in Central Kona.
December 10: 18:01. Very feeble. Felt at Naalehu. Origin near summit of Mauna Loa.
December 12: 09:09. Feeble. Felt at Naalehu and Volcano district. Origin Kaoiki fault, south of Ainapo.
December 25: 00:10. Very feeble. Felt in central Kona.
December 28: 01:22. Very feeble. Felt in Kona. Origin beneath summit of Hualalai.

PANAMA CANAL ZONE

(60TH MERIDIAN TIME)

March 27: 18:03:19*. Balboa Heights. IV. Felt indoors by many. Windows rattled and walls creaked.
May 16: 16:45:40*. Epicenter 6½° north, 79° west, off coast of Panama, W. IV. Felt by many in Canal Zone. The Irish SS. *Irish Rose*, in latitude 6°30′ north and 78°41′ west, reported heavy tremors, and vibrations were suddenly felt throughout the ship lasting for about a minute. It caused the magnetic compass to swing in large arcs. Three additional heavy tremors were felt at 17:15, 17:58, and 18:09. Other light tremors were felt until 19:00.
May 19: 03:12:53*. Felt by a few in Canal Zone.

June 1: 19:48:34*. Felt by several in Canal Zone.
July 9: 14:15:18*. Epicenter 7½° north, 82° west, off coast of Panama, W. Felt by a few in Canal Zone. The British MS. *Agamemnon* in 7°20′ north, 82°20′ west, reported, "The vessel shuddered considerably for a total of 3 seconds."
September 7: 08:55:17*. Felt in Canal Zone with intensity IV.
November 27: 21:12:56*. Epicenter 7° north, 79° west, off south coast of Panama, W. Felt in Canal Zone.

PUERTO RICO

(60TH MERIDIAN TIME)

January 6: 15:05:25*. Epicenter near west coast of Puerto Rico, W. Felt at San Juan.
August 27: 13:01:00*. Epicenter 18½° north, 66½° west, Puerto Rico, W. Felt at Caguas and San Juan.

MISCELLANEOUS ACTIVITIES

GEODETIC WORK OF SEISMOLOGICAL INTEREST

The program of repeating geodetic control surveys for the purpose of detecting horizontal and vertical movement in the earth's crust was continued in 1952.

Early in the year, the arc of triangulation extending from Bakersfield to San Fernando, Calif., was reobserved with the exception of a small area on the southern end. This arc had been originally surveyed in 1932. However, because of the earthquakes in the Tehachapi and Bakersfield areas in the summer, it was felt that reobservation of the entire arc would be justified from a scientific standpoint and that level lines in the area should be rerun. Accordingly, field operations for this work were begun in the fall of 1952 and completed early in 1953. Results of these surveys show horizontal displacements up to 2 feet and vertical movements up to 4 feet.

Adjustments were completed for the three arcs—Avenal to San Luis Obispo, vicinity of Monterey Bay, and vicinity of Hayward, Calif.—reobserved in 1951. The results, when compared with earlier surveys, further confirmed the previously determined systematic creep of one side of the San Andreas Fault relative to the other side. There was no evidence, however, of any sharp displacement along the fault line within the areas resurveyed.

Area triangulation was established in two areas—between Medford, Oreg., and Redding, Calif., and in the Bakersfield-Kernville, Calif., area—which, while affording no basis for determination of earth movement at the present time, will serve as the basis for such activities in the future.

TIDAL DISTURBANCES OF SEISMIC ORIGIN

During the year 1952, tide records on file in the United States Coast and Geodetic Survey showed seismic sea waves from four earthquakes, all in the Pacific.

The quake off Hokkaido on March 4 created sea waves that were recorded by 23 gages in the Aleutians, Hawaii, and other Pacific Islands as well as on the coasts of North and South America. The range of the largest oscillation was 1.7 feet at Kahului, Maui, T. H.; 1.3 feet at Callao, Peru; 1.2 feet at Crescent City, Calif.; and 1.1 feet at Attu, Aleutian Islands. Elsewhere it was less than 1 foot.

The earthquake of March 19 east of Mindanao created sea waves that were recorded as waves of only one-fourth foot at Yap Island and at Apra Harbor and Tarague, Guam. A gage on Angaur Island, Palau Islands, showed a maximum oscillation of 2.2 feet.

A ripple on the tide record for Canton Island apparently resulted from the earthquake of July 13 near the New Hebrides.

The tsunami of November 4 from the earthquake off Kamchatka was recorded on gages throughout the Pacific. While not as destructive as that of April 1, 1946, at many places it was larger. It was recorded by 71 gages, including a number in foreign countries whose records were made available to the United States Coast and Geodetic Survey. The largest oscillation occurred in Chile, being over 12 feet at Talcahuano and 9.3 feet at Caldera. There were 7 to 9.5 foot waves on the California coast, and 7 to 8 foot oscillations in the Aleutian and Hawaiian Islands. The record of this tsunami is given in USC&GS Special Publication No. 300, "The Tsunami of November 4, 1952, as recorded at Tide Stations."

FLUCTUATIONS IN WELL WATER LEVELS

INTRODUCTION

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

Similar data for 1943 were published by the United States Coast and Geodetic Survey in Serial 672, United States Earthquakes, 1943, and those for subsequent years through 1949 appeared in Serial 748, United States Earthquakes, 1949, and Serial 755 and 762, United States Earthquakes 1950 and 1951, respectively. Descriptions of wells given here include only those that have not appeared in previous editions.

WELL DESCRIPTIONS

ALABAMA

Well No. Mad–1–Ct, nonartesian, SE¼ Sec. 36, T. 3 S., R. 1 W. Owner, city of Huntsville. Depth, 140 feet; diameter, 8 inches; finish, open. Aquifer, Fort Payne chert.

Well No. Mad–10–Ct, nonartesian, SW¼NW¼ Sec. 2, T. 4 S., R. 1 W. Owner, city of Huntsville. Depth, 149 feet; diameter, 6 inches; finish, open. Aquifer, Fort Payne chert.

Well No. Mad–18–Ct, nonartesian, NW¼NE¼ Sec. 23, T. 3 S., R. 1 W. Owner, city of Huntsville. Depth, 133 feet; diameter, 6 inches; finish, open. Aquifer, Fort Payne chert.

Well No. Mad–19–Ct, nonartesian, SE¼NW¼ Sec. 14, T. 3 S., R. 1 W. Owner, city of Huntsville. Depth, 95 feet; diameter, 6 inches; finish, open. Aquifer, Fort Payne chert.

Well No. Mar–1, artesian, NW¼SE¼ Sec. 32, T. 12 S., R. 13 W. Owner, M. M. Burleson. Depth, 520 feet; diameter, 6 inches; finish, open. Aquifer, sandstone.

ARIZONA

Well No. (D–17–20)10cc, subartesian, 31°58′ N., 110°18′ W., SW¼SW¼ Sec. 10, T. 17 S., R. 20 E. Owner, city of Benson. Depth, 700 feet; diameter, 4 inches; finish, unknown. Aquifer, Tertiary-Quaternary alluvium.

Well No. (D–8–6)17ddd, nonartesian, 32°45′ N., 111°47′ W., SE¼SES¼SE¼ Sec. 17, T. 8 S., R. 6 E. Owner, Bureau of Indian Affairs. Depth, 610 feet; diameter, 20 inches; finish, perforated 90 feet to 429 feet, open hole 460 feet to 610 feet. Aquifer, Tertiary-Quaternary alluvium.

Well No. (D–24–15)18ab, nonartesian, 31°20′45″ N., 110°50′30″ W., NW¼NE¼ Sec. 18, T. 24 S., R. 15 E. Owner, Neilson Brown. Depth, 47 feet; diameter, 12 inches; finish, perforated 5 feet to 45 feet. Aquifer, Quaternary alluvium.

Well No. (D–21–26)2ba, nonartesian, 31°38′ N., 109°40′ W., NE¼NW¼ Sec. 2, T. 21 S., R. 26 E. Owner, F. O. Mackey. Depth, 110 feet; diameter, 10 inches; finish, perforated 50 feet to 100 feet. Aquifer, Tertiary-Quaternary alluvium.

Well No. 8K–416, subartesian, 36°44′ N., 110°15′ W. Owner, Bureau of Indian Affairs. Depth, 807 feet; diameter, 10 inches; finish, perforated 87 feet to 562 feet. Aquifer, Navajo sandstone.

CALIFORNIA

Well No. 7/34–21E1, artesian, Sec.21, T. 7 N., R. 34 W. Owner, U. S. Government. Depth, 145 feet; diameter, 8 inches; finish, perforated 73 feet to 93 feet. Aquifer, Orcutt formation.

WellNo. 4/27–21B1, artesian, Sec. 21, T. 4 N., R. 27 W. Owner, city of Santa Barbara. Depth, 454 feet; diameter, 16 inches; finish, perforated 145 feet to 350 feet. Aquifer, older alluvium and Santa Barbara formation.

Well No. 6/30–29E1, water table, Sec. 29, T. 6 N., R. 30 W. Owner, Rancho Juan and Lolita. Depth, 52 feet; diameter, 10 inches; finish, unknown. Aquifer, alluvium.

Well No. 6/30–20F4, water table, Sec. 20, T. 6 N., R. 30 W. Owner, U. S. Government. Depth, 65 feet; diameter, 16 inches; finish, unknown. Aquifer, alluvium.

Well No. 15/16–20R1, nonartesian, Sec. 20, T. 158, R. 16 E., MDB & M. Owner, Tranquillity Irrigation District, Well No. 11. Depth, less than 500 feet; diameter, 16 inches; finish, unknown. Aquifer, upper water-bearing zone of alluvium.

Well No. 15/16–34E1, artesian, Sec. 34, T. 15 S., R. 16 E., MDB & M. Owner, James Irrigation District. Depth, deeper than 500 feet; diameter, 12 inches; finish, unknown. Aquifer, lower water-bearing zone of alluvium.

Well No. 19/18–27N1, nonartesian, Sec. 27, T. 19 S., R. 18 E., MDB & M. Owner, Boston Land Co., well No. 20. Depth, 151 feet; diameter, 16 inches; finish, unknown. Aquifer, upper water-bearing zone of alluvium.

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Well No. 3N/1W–34J1, artesian, Sec. 34, T. 3 N., R. 1 W., HB & M. Owner, city of Fortuna. Depth, 496 feet; diameter, 12 inches; finish, perforated from 182 feet to 226 feet and from 285 feet to 365 feet. Aquifer, unknown.

Well No. 6N/1E–18H1, nonartesian, Sec. 18, T. 6 N., R. 1 E., HB & M. Owner, Chester Hunt. Depth, 22.8 feet; diameter, 14 inches; finish, unknown. Aquifer, unknown.

Well No. 7/34–9H3, water table, Sec. 29, T. 7 N., R. 34 W. Owner, U. S. Government. Depth, 103 feet; diameter, 8 inches; finish, unknown. Aquifer, Orcutt formation.

NORTHERN FLORIDA

Well No. E74, artesian, Sec. 30, T. 1 N., R. 30 W. Owner, Chemstrand Corp. Depth, 352 feet; diameter 4 inches to 2½ inches; finish, screened 260 feet to 270 feet, 340 feet to 350 feet below surface. Aquifer, Citronelle formation (sand).

Well No. M450 (formerly M162A), artesian, SE¼NW¼ Sec. 8, T. 35 S., R. 17 E. Owner, Z. H. Patterson. Depth, 520 feet; diameter, 6 inches; finish, open hole. Aquifers, Hawthorn, Tampa, and Suwanee formations.

SOUTHERN FLORIDA

Well No. L246, nonartesian, SE¼NE¼ Sec. 20, T. 44 S., R. 25 E. Owner, U. S. Geological Survey. Depth, 27.7 feet; diameter, 8 inches; casing, 19 feet deep; finish, open hole. Aquifer, Hawthorn formation, Middle Miocene.

Well No. C130, artesian, NW¼NW¼ Sec. 4, T. 50 S., R. 25 E. Owner, U. S. Geological Survey. Depth, 71.5 feet; diameter, 6 inches; casing 69 feet deep; finish, open hole. Aquifer, Tamiami formation, upper Miocene.

IDAHO

Well No. 4N30E–7ad1, nonartesian, 43°40′ N., 112°55′ W. Owner, U. S. Geological Survey. Depth, 692 feet; diameter, 12 inches to 335 feet, and 10 inches to 587 feet; finish, open bottom. Aquifer, basalt.

Well No. 3N29E–14adl, nonartesian, 43°35′ N., 113°00′ W. Owner, U. S. Geological Survey. Depth, 588 feet; diameter, 8 inches; finish, perforated open bottom. Aquifer, basalt.

Well No. 8S26E–33bcl, artesian, 42°40′ N., 113°25′ W. Owner, U. S. Bureau of Reclamation. Depth, 242 feet; diameter 8 inches to 147 feet and 6 inches to 242 feet; finish, perforated open bottom. Aquifer, sand, gravel, and basalt.

Well No. 8S27E–3ldd1, temporary artesian, 42°40′ N., 113°20′ W. Owner, U. S. Bureau of Reclamation. Depth, 140 feet; diameter, 8¼ inches to 86 feet; finish, open bottom. Aquifer, cinders, sand, and basalt.

Well No. 53N2W–5adl, nonartesian, 48°00′ N., 116°35′ W. Owner, War Assets Administration, U. S. Government. Depth, 362 feet; diameter, 16 inches; finish, perforated 265 feet to 355 feet, open bottom. Aquifer, gravel.

Well No. 9S26E–10aal, nonartesian, 42°40′ N., 113°30′ N. Owner, U. S. Bureau of Reclamation. Depth, 96 feet; diameter, 8 inches to 46 feet, 5 inches to 96 feet; finish, perforated 66 feet to 96 feet, open bottom. Aquifer, basalt.

Well No. 3N33E–3abl, nonartesian, 43°15′ N., 112°30′ W. Owner, U. S. Geological Survey. Depth, 733 feet; diameter, 6¼ inches; finish, perforated 688 feet to 728 feet, open bottom. Aquifer, basalt.

Well No. 1S30E–15bcl, nonartesian, 43°20′ N., 112°50′ W. Owner, U. S. Geological Survey. Depth, 752 feet; diameter, 6¼ inches to 570 feet, 5 inches to 752 feet; finish, perforated open bottom. Aquifer, basalt.

Well No. 5S31E–27abl, nonartesian, 43°00′ N., 112°50′ W. Owner, H. L. Lowe. Depth, 46 feet; diameter, 16 inches to 2 feet, 12 inches to 20 feet; finish, open bottom. Aquifer, basalt.

Well No. 3N32E–29ddl, nonartesian, 43°30′ N., 112°45′ W. Owner, U. S. Geological Survey. Depth, 704 feet; diameter, 6 inches to 434 feet, 5 inches to 704 feet; finish, perforated 678 feet to 699 feet, open bottom. Aquifer, basalt.

Well No. 9S26E–7bcl, nonartesian, 42°40′ N., 113°30′ W. Owner, U. S. Bureau of Reclamation. Depth, 88 feet; diameter, 8 inches to 7 feet, 5 inches to 88 feet; finish, perforated 58 feet to 88 feet, open bottom. Aquifer, basalt.

Well No. 9S26E–10ddl, nonartesian, 42°40′ N., 113°30′ W. Owner, U. S. Bureau of Reclamation. Depth, 128 feet; diameter, 8 inches to 16 feet, 6 inches to 118 feet; finish, open bottom. Aquifer, basalt and cinders.

Well No. 5N34E–9bdl, nonartesian, 43°50′ N., 112°30′ W. Owner, U. S. Geological Survey. Depth, 552 feet; diameter, 6 inches; finish, perforated 287 feet to 317 feet, open bottom. Aquifer, basalt.

Well No. 9S20E–1dal, nonartesian, 42°40′ N., 114°00′ W. Owner, U. S. Bureau of Reclamation. Depth, 400 feet; diameter, 8 inches to 12 feet, 6 inches from 340 feet to 400 feet; finish, perforated open bottom. Aquifer, basalt.

Well No. 53N2W–4aal, nonartesian, 48°00′ N., 116°35′ W. Owner, War Assets Administration, U. S. Government. Depth, 328 feet; diameter, 16 inches; finish, perforated 240 feet to 320 feet, open bottom. Aquifer, gravel.

Well No. 53N2W–9aal, nonartesian, 48°00′ N., 116°35′ W. Owner, War Assets Administration, U. S. Government. Depth, 351 feet; diameter, 16 inches; finish, perforated 280 feet to 345 feet, open bottom. Aquifer, gravel.

Well No. 6S18E–22aal, nonartesian, 42°50′ N., 114°20′ W. Owner, D. C. Casper. Depth, 232 feet; diameter, 6 inches; finish, open bottom. Aquifer, basalt.

Well No. 8S24E–31dcl, nonartesian, 42°40′ N., 113°40′ W. Owner, U. S. Bureau of Reclamation. Depth, 194 feet; diameter 8 inches to 85 feet, 6 inches to 188 feet; finish perforated 158 feet to 188 feet, open bottom. Aquifer, basalt.

Well No. 11S19E–31cd2, nonartesian, 42°25′ N., 114°15′ W. Owner, Mark Gray. Depth, 650 feet; diameter, 12 inches; finish, perforated open bottom. Aquifer, gravel.

Well No. 4N30E–22bdl, nonartesian, 43°50′ N., 112°50′ W. Owner, U. S. Geological Survey. Depth, 498 feet; diameter, 6 inches to 406 feet, 5 inches to 496 feet; finish, perforated 435 feet to 445 feet, open bottom. Aquifer, basalt.

Well No. 53N2W–5adl, nonartesian, 48°00′ N., 116°35′ W. Owner, U. S. Government, War Assets Administration. Depth, 362 feet; diameter, 16 inches; finish, perforated 265 feet to 355 feet, open bottom. Aquifer, gravel.

Well No. 5N31E–14bcl, nonartesian, 43°45′ N., 112°48′ W. Owner, U. S. Geological Survey. Depth, 329 feet; diameter, 6 inches to 255 feet, 4 inches to 329 feet; finish, perforated 299 feet to 324 feet, open bottom. Aquifer, basalt.

Well No. 3N30E–31aal, nonartesian, 43°31′ N., 113° 00′ W. Owner, U. S. Geological Survey. Depth, 676 feet; diameter, 8 inches to 406 feet, 6 inches to 676 feet; finish, perforated 512 feet to 553 feet, open bottom. Aquifer, basalt.

Well No. 3N30E–14adl, nonartesian, 43°35′ N., 113°00′ W. Owner, U. S. Geological Survey. Depth, 588 feet; diameter, 8 inches; finish, perforated, open bottom. Aquifer, basalt.

Well No. 2N27E–2ddl, nonartesian, 43°31′ N., 113°10′ W. Owner, U. S. Geological Survey. Depth, 812 feet; diameter, 6 inches; finish, perforated, open bottom. Aquifer, basalt.

Well No. 8S25E–36dal, nonartesian, 42°45′ N., 113°30′ W. Owner, U. S. Bureau of Reclamation. Depth, 207 feet; diameter, 12 inches to 56 feet, 10 inches to 111 feet: finish, perforated, open bottom. Aquifer, cinders and basalt.

INDIANA

Well No. Ba2, water table, NE¼SW¼ Sec. 18, T. 9 N., R. 6 E. Owner, V. E. Sprouse & Co., 1804 22d Street, Columbus, Ind. Depth, 52 feet; diameter, 6 inches. Aquifer, Pleistocene gravel.

Well No. Be3, artesian, SW¼NW¼ Sec. 25, T. 25 N., R. 8 E. Owner, Northern Indiana Public Service Co., Van Buren at 8th, Fowler, Ind. Depth, 233 feet; diameter, 10 inches; casing depth, 120 feet. Aquifer, Devonian limestone.

Well No. Ma4, artesian, NE¼NE¼ Sec. 35, T. 15 N., R. 3 E. Owner, Layne-Northern Co. Edward Ave., Indianapolis, Ind. Depth, 304 feet; diameter, 8 inches; Aquifer, Devonian-Silurian limestone.

Well No. Ma21, artesian, SE¼SW¼ Sec. 1, T. 15 N., R. 3 E. Owner, Continental Baking Co., 339 East Market St., Indianapolis, Ind. Depth, 316 feet; diameter, 8 inches. Aquifer, Devonian-Silurian limestone.

Well No. Ma22, artesian, NW¼NE¼ Sec. 1, T. 15 N., R. 3 E. Owner, Arthur Baxter, 139 South East St., Indianapolis, Ind. Depth, 310 feet; diameter, 10 inches. Aquifer, Devonian-Silurian limestone.

IOWA

Well No. 82–7–21K1, artesian, NW¼SE¼ Sec. 21, T. 83 N., R. 7 W. Owner, Wapsi Valley Creamery. Depth, 156 feet; diameter, 8 inches to 6⅝ inches; finish, open hole from 105 feet to 156 feet. Aquifer, dolomite of Silurian age.

Well No. 80–17–17K2, artesian, NW¼SE¼ Sec. 17, T. 80 N., R. 17 W. Owner, State Conservation Commission. Depth, 122 feet; diameter 7 inches; finish, cased to 27 feet, open hole 27 feet to 122 feet. Aquifer, sandstone of Pennsylvania age.

Well No. 80–17–17M2, artesian, NW¼SW¼ Sec. 17, T. 80 N., R. 17 W. Owner, State Conservation Commission. Depth, 189 feet; diameter 7 inches; finish, cased to 108 feet, open hole 108 feet to 189 feet. Aquifer, sandstone of Pennsylvania age.

Well No. 80–17–17L1, artesian, NE¼SW¼ Sec. 17, T. 80 N., R. 17 W. Owner, State Conservation Commission. Depth, 94 feet; diameter, 7 inches; finish, cased to 41 feet, open hole 41 feet to 94 feet. Aquifer, sandstone.

Well No. 89–47–22B2, artesian, NW¼NE¼ Sec. 22, 89 N., R. 47 W. Owner, Sioux City. Depth, 343 feet; diameter 26 inches to 16 inches; finish, cased to 343 feet, perforated 147 feet 11 inches to 343 feet. Aquifer, Dakota sandstone.

Well No. 96–20–3P1, artesian, NE¼SE¼SW¼ Sec. 3, T. 96 N., R. 20 W. Owner, M. & St. L. Railroad. Depth, 805 feet; diameter, 12 inches to 10 inches; finish, cased from 0 to 30 feet and 614 feet to 730 feet, 10 inch open hole below 730 feet. Aquifer, St. Peter sandstone.

KANSAS

Well No. 14–22–26ad, nonartesian, SE¼NE¼ Sec. 7, 14 S., R. 22 W. Owner, U. S. Bureau of Reclamation. Depth, 98 feet; diameter, 6 inches; finish, unknown. Aquifer, terrace sand and gravel.

KENTUCKY

Well No. 8845–3700–10. Owner, E. L. Davis, Paducah. Depth, 65.5 feet; diameter, 4 inches; finish, 61 feet of 4 inch casing. Aquifer, Holly Spring sand.

Well No. 8835–3650–17. Owner, J. Whittemore, Paducah. Depth, 106 feet; diameter, 10 inches; finish, screen at 83 feet to 105 feet. Aquifer, Holly Spring sand.

Well No. 8715–3710–1, artesian, 37°14½′ N., 87°17½′ W. Owner, W. G. Duncan Co., Greenville. Depth, 120 feet; diameter, 6 inches; finish, open. Aquifer, sandstone.

Well No. 8245–3745–404, artesian, 37°46′ N., 82°45½′ W. Owner, Kentucky Water Co. at Van Lear, Ky. Depth, 115 feet; diameter, 6 inches; finish, open. Aquifer, Breathitt formation.

Well No. 8250–3750–24, water table, 37°52′ N., 82°52′ W. Owner, Pluney Blevins, 1 mile south of Volga. Depth, 51.4 feet; diameter, 6 inches; finish, open. Aquifer, sandstone.

Well No. 8245–3735–2, artesian, 37°39′31″ N., 82°49′42″ W. Owner, Paul Dotson, 3 miles southwest of Prestonsburg. Depth, 52 feet; diameter, 6 inches; finish, open. Aquifer, Breathitt formation.

Well No. 8545–3705–2, nonartesian, 37°09′ N., 85°49′ W. Owner, Gaston Jewell, 4 miles southwest of Horse Cave. Depth, unknown; diameter, 8 inches. Aquifer, limestone of Meramec group.

Well No. 8720–3650–98, artesian, 36°50′ N., 87°20′ W. Owner, Mr. W. A. Cowherd, 6 miles east of Hopkinsville. Depth, 1,660 feet; diameter, 8 inches; finish, open. Aquifer, Ste. Genevieve limestone.

Well No. 8700–3710–3, artesian, 37°12½′ N., 87°04′ W. Owner, city of Drakesboro. Depth, 150 feet; diameter, 8 inches; finish, open. Aquifer, sandstone.

LOUISIANA

Well No. Be–2, artesian, NE¼SE¼ Sec. 29, T. 6 S., R. 8 W. Owner, Southern Pacific Railroad. Depth, 276 feet; diameter, 6 inches; finish, screened. Aquifer, Pleistocene sand and gravel.

Well No. Lf–437, artesian, Irregular Sec. 40, T. 11 S., R. 4 E. Owner, Southern Pacific Railroad. Depth, 150 feet; diameter, 4 inches; finish, screened. Aquifer, Pleistocene sand and gravel.

MARYLAND

Well No. Dor–Ce–22, artesian, about 1 mile east of Cambridge between Shoal Creek and Choptank River. Owner, State of Maryland. Depth, 406 feet; 10-inch casing; open hole. Aquifer, sand.

Well No. Wi–Cf–3, semiartesian, 3.7 miles east of Salisbury and 0.7 mile south of Maryland Highway 50. Owner, city of Salisbury. Depth, 109 feet; 16-inch casing; 18-foot screen. Aquifer, sand.

Well No. Wi–Ce–13, nonartesian, south bank of South Prong above the first dam on the Wicomico River. Owner, city of Salisbury. Depth, 65 feet; 16-inch casing; 20-foot screen. Aquifer, sand.

Well No. Cal–Gd–5, artesian, 38°19′58″ N., 76°27′26″ W. Owner, U. S. Navy. Depth, 248 feet; diameter, 8 inches; cased, screen. Aquifer, Eocene, Manjemoy.

Well No. Cal–Gd–6, artesian, 38°19′58″ N., 76°27′08″ W. Owner, U. S. Navy. Depth, 493 feet; diameter, 8 inches to 6 inches; screen. Aquifer, Eocene, Aquia.

Well No. Care–Dc–56, artesian, near conjunction of Maryland Highways 328 and 404 and the Choptank River. Owner, Denton Cemetery. Depth, 137 feet; 6-inch casing; open hole. Aquifer, sand.

MICHIGAN

Well No. 47.26.8.dd820, nonartesian, 920′ E., 535′ S. of NW. corner Sec. 8. Owner, Jones & Laughlin Ore Co. Depth, 1,381 feet; diameter, 3 inches; 20-foot casing; open hole. Aquifer, Negaunee iron formation.

Well No. 47.26.8.dd821, nonartesian, 935′ E., 830′ S. of NW. corner Sec. 8. Owner, Jones & Laughlin Ore Co. Depth, 1,385 feet; diameter, 3 inches; 20-foot casing, open hole. Aquifer, Negaunee iron formation.

Well No. 47.26.8.dd824, nonartesian, 330′ E., 645′ S. of NW. corner Sec. 8. Owner, Jones & Laughlin Ore Co. Depth, 1,251 feet; diameter, 3 inches; 20-foot casing; open hole. Aquifer, Negaunee iron formation.

Well No. 47.26.8dd825, nonartesian, 335′ E., 345′ S. of NW. corner Sec. 8. Owner, Jones & Laughlin Ore Co. Depth, 1,031 feet; diameter, 3 inches; 20-foot casing; open hole. Aquifer, Negaunee iron formation.

MONTANA

Well No. A1–4–25dc, artesian, 1½ miles north of Belgrade. Owner, U. S. Geological Survey. Depth, 400 feet; diameter, 6 inches; Aquifer, sand and gravel.

Well No. D2–4–9bc, artesian, 9½ miles west of Bozeman. Owner, U. S. Geological Survey. Depth, 600 feet. Aquifer, semiconsolidated sandstone (Tertiary lake beds) in contact with pre-Cambrian gneiss.

NEVADA

Well No. S22/61-4bccl, artesian, 36°3′48″ N., 115°10′20″ W. Owner, Fitzpatrick. State Engineer No. 41. Depth, 355 feet; diameter, 8 inches. Aquifer, Quarternary alluvium.

Well No. S20/53–24caal, artesian, 36°11′45″ N., 115°58′00″ W. Owner, Ray Thomas. State Engineer No. 40. Depth, 570′; diameter, 10″. Aquifer, Quarternary alluvium.

Well No. S19/60–33baal, artesian, 36°15′44″ N., 115°16′21″ W. Owner, U. S. Geological Survey. State Engineer No. 555. Depth, 1,008 feet; diameter, 8 inches; finish, cased to 92.5 feet. Lsd is 2,407.2 feet above M. S. L. Aquifer, sand and gravel.

Well No. S21/54–10aacl, artesian, 36°8′54″ N., 115°53′25″ W. Owner, Bowman, formerly H. D. Cornell. State Engineer No. 22. Depth, 800 feet; diameter, 14 inches; finish, cased, 472 feet, perforated 100 feet to 450 feet. Aquifer, Quarternary sand and gravel.

Well No. S19/60–9bccl, artesian, 36°18′53″ N., 115°16′43″ W. Owner, P. J. Goumond. State Engineer No. 427. Depth, 830 feet; diameter, 10 inches; finish, cased to 140 feet. Aquifer, Quaternary sand and gravel.

Well No. S20/60–36ddbl, artesian, 36°9′55″ N., 115°12′52″ W. Owner, M. D. Kidder. State Engineer No. 18. Depth. 385 feet; diameter 4 inches: finish, cased to 381 feet. Aquifer, Quaternary gravel.

Well No. S20/61–19bccl, artesian, 36°11′40″ N., 115°12′20″ W. Owner, R. S. Hicks. State Engineer No. 4. Depth, 244 feet; diameter, 12 inches. Aquifer, Quarternary alluvium.

Well No. 11/24–22dcl, artesian, 38°48′43″ N., 119°16′40″ W. Owner, Fred Fulstone. Depth, 94.5 feet; diameter, 18 inches; finish, concrete-cribbed. Aquifer, Quarternary alluvium.

Well No. S19/60–27bdcl, artesian, SW¼SE¼NW¼ Sec. 27, T. 19 S., R. 60 E. Owner, U. S. Geological Survey. Depth, 905 feet; diameter, 5 inches; casing 84 feet deep; finish, open hole. Aquifer, Quaternary alluvium.

NEW JERSEY

Well No. 28.4.9.35, nonartesian, near Old Bridge. Owner, Duhernal Water System. Depth, 75 feet; diameter, 6 inches; casing, 75 feet; finish, steel casing. Aquifer, Old Bridge sand, member of Raritan formation.

Well No. 26.21.6.6.3, artesian, Hillside township, northeast side of Morris Avenue, about 500 feet northeast of Elizabeth River. Owner, Elizabethtown Water Co. Depth, 400 feet; diameter, 12 inches; finish, rock, open hole. Aquifer, Brunswick shale.

Well No. 28.5.4.8.1, nonartesian, Old Bridge. Owner, Duhernal Water System. Depth, 67 feet; diameter, 6 inches; finish, screen. Aquifer, Raritan formation.

Well No. 26.22.4.4.4, artesian, Hillside township, Union County. Owner, Elizabethtown Water Co. Depth, 400 feet; diameter, 12 inches; finish, rock, open hole. Aquifer, Brunswick shale.

Well No. 26.21.5.6.8, artesian, near junction of Galloping Hill Road and Chestnut Street, Kenilworth. Owner, White Laboratories, Inc. Depth, 350 feet; diameter, 6 inches; finish, open hole. Aquifer, Brunswick shale.

Well No. 30.14.8.1.2, artesian, Gibbstown. Owner, E. I. du Pont de Nemours & Co. Depth, 127.5 feet; diameter, 8 inches; finish, steel casing with screen. Aquifer, Magothy and Raritan formations.

Well No. 30.14.8.2.4, artesian, Gibbstown. Owner, F. I. du Pont de Nemours & Co. Depth, 98 feet; diameter, 6 inches; finish, steel casing. Aquifer, Magothy and Raritan formations.

Well No. 26.21.5.9.2, artesian, Galloping Hill Road, Kenilworth. Owner, White Laboratories, Inc. Depth, 250 feet: diameter, 8 inches; finish, open hole. Aquifer, Brunswick shale.

NEW MEXICO

Well No. 10.24.9.330, artesian, 4 miles north of Main Street and Second Street, Roswell. State Engineer well. Depth, 258 feet; diameter, 10 inches. Aquifer, San Andres formation.

Well No. 10.24.21.212, artesian, 3 miles north of Main Street and Second Street, Roswell. State Engineer well. Depth, 324 feet; diameter, 10 inches. Aquifer, San Andres formation.

Well No. 11.24.29.242, artesian, 5¼ miles south of Main Street and Second Street, Roswell. State Engineer well. Depth, 553 feet; diameter, 10¾ inches. Aquifer, San Andres formation.

Well No. 13.25.27.211, artesian, 4½ miles west of Greenfield. State Engineer well. Depth, 880 feet; diameter, 10 inches. Aquifer, San Andres formation.

Well No. 18.26.5.330, artesian. Depth, 1,056 feet; diameter, 8 inches. Aquifer, San Andres formation.

Well No. 24.29.8.111, artesian. Depth, 405 feet; diameter, 6⅝ inches. Aquifer, base of Rustler formation.

Well No. 6, artesian thermal, Sec. 4, T. 14 S., R. 4 W. Owner, C. E. James. Depth 105 feet; diameter, 6⅝ inches. Aquifer, Magdalena group.

Well No. 11.23.3.342, artesian, 4 miles west of Main Street and Second Street, Roswell. Owner, J. L. Mask. Depth 595 feet; diameter, 15 inches. Aquifer, San Andres formation.

NEW YORK

Well No. N1212, artesian, 40°48′25″ N., 73°31′20″ W., 1.3 miles east of Broadway and Jericho Turnpike junction. Owner, Nassau County. Depth, 185 feet; diameter 4 inches; casing, 3½ inches. Aquifer, Magothy formation.

Well No. N2790, artesian, 40°38′05″ N., 73°39′50″ W. Second Avenue near Williamson Avenue, Bay Park. Owner, U. S. Geological Survey and Nassau County. Depth, 560 feet; diameter, 6 inches to 4 inches; casing, 4 inches. Aquifer, Magothy formation.

Well No. N3355, artesian, 40°46′25″ N., 73°27′10″ W. Nassau County Sanatorium. Owner U. S. Geological Survey. Depth, 1,090 feet; diameter, 6 inches; cased, screened. Aquifer, Lloyd sand member of Raritan formation.

Well No. N1379, artesian, 40°38′30″ N., 73°42′40″ W. Owner, Long Island Water Corp. Depth, 190 feet; diameter, 6 inches; cased, screened. Aquifer, Jameco gravel.

Well No. N3862, artesian, 40°36′20″ N., 73°44′15″ W. Lawrence Sewage Plant, Lawrence. Owner, U. S. Geological Survey. Depth, 300 feet; diameter, 6 inches; cased, screened. Aquifer, Magothy formation.

Well No. N3864, artesian, 40°38′30″ N., 73°42′40″ W. Owner, Long Island Water Corp. Depth, 470 feet; diameter, 6 inches; cased, screened. Aquifer, Magothy formation.

Well No. N3866, artesian, 40°38′15″ N., 73°41′40″ W. Lawrence School, Hewlett. Owner, U. S. Geological Survey. Depth, 400 feet; diameter, 6 inches; cased, screened. Aquifer, Magothy formation.

OKLAHOMA

Well No. Caddo–11, nonartesian, NE¼NE¼ Sec. 11, T. 8 N., R. 12 W. Owner, Indian Land—Prather. Depth, 201 feet; diameter, 9 inches; cased to 4 feet; finish, open hole. Aquifer, Rush Springs sandstone.

Well No. Caddo–14, nonartesian, SE. cor. Sec. 28, T. 9 N., R. 13 W. Owner, U. S. Geological Survey. Depth, 335 feet; diameter, 8 inches; cased. Aquifer, Rush Springs sandstone.

Well No. Grady–66, nonartesian, NW. cor. Sec. 33, T. 4 N., R. 8 W. Owner, U. S. Geological Survey. Depth, 254 feet; diameter, 7 inches; cased. Aquifer, Rush Springs sandstone.

Well No. Major–3, nonartesian, NE. cor. Sec. 4, T. 20 N., R. 9 W. Owner, George Suit. Depth 60 feet; diameter, 24 inches; cased, screen and gravel wall finish. Aquifer, terrace deposit.

TENNESSEE

Well No. 79:9–110, artesian, 35°04′34″ N., 90°01′34″ W. Memphis. Owner, Memphis Light, Gas, and Water Division. Depth, 330 feet; diameter, 4 inches; finish, screened. Aquifer, sand of the Claiborne group.

Well No. 79:65–1, artesian, 35°08′20″ N., 90°02′05″ W. Memphis. Owner, Clover Farm Dairy. Depth, 501 feet; diameter, 6 inches; finish, screened. Aquifer, sand of the Claiborne group.

Well No. 79:9–107, artesian, 35°05′49″ N., 90°01′55″ W. Memphis. Owner, Memphis Light Gas, and Water Division. Depth, 338 feet; diameter, 4 inches, screened. Aquifer, sand of the Claiborne group.

Well No. 79:9–135, artesian, 35°04′32″ W., 90°01′47″ W. Memphis. Owner, Memphis Light, Gas, and Water Division. Depth, 265 feet; diameter, 4 inches; screened. Aquifer, sand of the Claiborne group.

TEXAS

Well No. 341, artesian, 30°19′ N., 97°45′ W., Travis County. Owner, Austin Memorial Park. Depth, 330 feet; diameter, 6 inches; cased, open hole finish. Aquifer, Edwards limestone.

UTAH

Well No. (B–6–1)30cca–1, artesian, NE¼SW¼SW¼ Sec. 30, T. 6 N., R. 1 W., near Ogden. Owner, California Packing Corp. Depth, 756 feet; diameter, 10 inches; finish, perforated 224 feet to 250 feet and 526 feet to 535 feet. Aquifer, large gravel.

Well No. (C–2–6)36cdd–1, artesian, SE¼SE¼SW¼ Sec. 36, T. 2 S., R. 6 W. Owner, E. C. Walk. Depth, 176 feet; diameter, 6 inches; finish, open end. Aquifer, gravel.

Well No. (D–5–1)14adb–1, artesian, NW¼SE¼NE¼ Sec. 14, T. 5 S., R. 1 E. Owner, Dought Relief Administration. Depth, 350 feet; diameter, 10 inches; finish, unknown. Aquifer, gravel and sand.

Well No. (A–2–1)18abd, artesian, SE¼NW¼NE¼ Sec. 18, T. 2 N., R 1 E., Centerville. Owner, T. Q. Williams. Depth, 90 feet; diameter, 2 inches; finish, open end. Aquifer, alluvium.

Well No. (C–2–4)33add–1, artesian, SE¼SE¼NE¼ Sec. 33, T. 2 S., R. 4 W., near Tooele. Owner, Ida L. Clegg. Depth, 165 feet; diameter, 6 inches; finish, perforated 60 feet to 165 feet. Aquifer, sand and gravel.

Well No. (C–7–8)10cbd–1, artesian, SE¼NW¼SW¼ Sec. 10, T. 7 S., R. 8 W. Owner, U. S. Army Dugway Proving Grounds. Depth, 175 feet; diameter, 8 inches; finish, perforated 155 feet to 175 feet. Aquifer, gravel.

Well No. (C–23–2)19dab–1, artesian, NW¼NE¼SE¼ Sec. 19, T. 23 S., R. 2 W., near Richfield. Owner, William Hallows. Depth, 310 feet; diameter, 2 inches; finish, open end. Aquifer, base of clay on rock.

Well No. (D–4–4)12aaa–1, artesian, NE¼NE¼NE¼ Sec. 12, T. 4 S., R. 4 E., near Heber. Owner, Hartly Carlisle. Depth, 65 feet; diameter, 48 inches; finish, cement tile to bottom. Aquifer, gravel.

Well No. (C–21–5)21aba–1, artesian, NE¼NW¼NE¼ Sec. 21, T. 21 S., R. 5 W., near Fillmore. Owner, State of Utah. Depth, 246 feet; diameter, 6¼ inches; finish unknown. Aquifer, gravel.

Well No. (C–35–11)33dbc–1, artesian, SW¼NW¼SE¼ Sec. 33, T. 35 S., R. 11 W., near Cedar City. Owner, W. H. Wood. Depth, 140 feet; diameter, 12 inches; finish perforated 50 feet to 140 feet. Aquifer, gravel.

Well No. (D–6–2)8bdb–2, artesian, NW¼SE¼NW¼ Sec. 8, T. 6 S., R. 2 E., near Pleasant Grove. Owner, Columbia-Geneva Steel Division of U. S. Steel. Depth, 120 feet; diameter, 5 inches; finish, unknown. Aquifer, sand and gravel.

WASHINGTON

Well No. 20/3–18C1, semiartesian, 47°15′ N., 122°30′ W. NE¼NW¼ Sec. 18, T. 20 N., R. 3 E., Tacoma. Owner, city of Tacoma. Depth, 185 feet; diameter, 12 inches; cased, perforated. Aquifer, sand and gravel, Pleistocene.

WISCONSIN

Well No. Dg–4, artesian, NW¼SW¼ Sec. 5, T. 11 N., R. 16 E. Owner, city of Horicon, Dodge County. Depth, 650 feet; diameter, 8 inches; finish, open. Aquifer, sandstone of Cambrian age.

Well No. Lf–56, artesian, SE¼NE¼ Sec. 32, T. 1 N., R. 2 E. Owner, Coulthard Estate, Lafayette County. Depth, 265 feet; diameter, 6 inches; finish, open. Aquifer, limestone of Ordovician age.

Well No. M1–36, artesian, NE¼SE¼ Sec. 12, T. 7 N., R. 21 E. Owner, A. D. Smith Corp. Milwaukee County. Depth, 1,091 feet; diameter, 13⅜ inches; cased to 774 feet; finish, open. Aquifer, sandstone of Cambrian age.

Well No. M–148, nonartesian, NE¼SE¼ Sec. 32, T. 6 N., R. 21 E. Owner, Milwaukee Co., Milwaukee County. Depth, 179 feet; diameter, 5 inches; finish, open. Aquifer, Niagara limestone of Silurian age.

Well No. WK–31, artesian, NE¼NE¼ Sec. 2, T. 5 N., R 19 E., Fulton Farms. Owner, Wisconsin-Waukesha Co. Depth, 600 feet; diameter, 6 inches; cased to 429 feet, finish, open. Aquifer, Niagara limestone of Silurian age.

OAHU, HAWAII

Well No. 132, artesian, 21°20′05″ N., 157°52′25″ W, Oahu, Kamechameha School. Owner, B. P. Bishop Estate. Depth, 346 feet; diameter, 10 inches; cased to 265 feet; finish, open. Aquifer, Koolau volcanic series, Tertiary and early Pleistocene, basaltic lava flows, aa and pahoehoe types.

Well No. 36A, artesian, 21°18′10″ N., 157°49′45″ W, Oahu, Wilder and Clement Streets, Honolulu. Owner, Honolulu Board of Water Supply. Depth, 395 feet; diameter, 12 inches; finish, open hole. Aquifer, Basalt of the Koolau volcanic series (Tert. and Pleist.), basaltic lava flows of aa and pahoehoe types.

Well No. 2, artesian, 21°17′50″ N., 157°48′55″ W. Owner, B. P. Bishop Estate. Depth, unknown; diameter, 8 inches; casing depth, unknown; finish, open hole. Aquifer, Basalt of the Koolau volcanic series.

Well No. 83, artesian, 21°18′20″ N., 157°51′05″ W. Owner, city and County of Honolulu. Depth, 509 feet; diameter, 8 inches to 6 inches; casing depth, 460 feet; finish, open hole. Aquifer, Basalt of the Koolau volcanic series.

Well No. Oahu T–24, artesian, 21°21′27″ N., 157°53′10″ W. Owner, Honolulu Board of Water Supply. Depth, 115 feet; diameter, 12 inches; casing depth, 66 feet; finish, open hole. Aquifer, Basalt of the Koolau volcanic series.

Well No. T–41, artesian, 21°22′45″ N., 158°01′50″ W. Owner, Honolulu Board of Water Supply. Depth, 113 feet; diameter 12 inches; casing depth, 92 feet; finish, open hole. Aquifer, Basalt of the Koolau volcanic series.

Well No. 1A, artesian, 21°16′45″ N., 157°46′45″ W. Owner, B. P. Bishop Estate. Depth, 131 feet; diameter, 4 inches; casing depth, 100 feet; finish, open hole. Aquifer, Basalt of the Koolau volcanic series.

TABLE 1.—*Fluctuations in well-water levels, Jan. 1 through Dec. 31, 1952*

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

ALABAMA

Well No.	Date	Time G. C. T.	Depth to water				Amplitude of fluctuation
			Before disturbance	After disturbance	At highest point	At lowest point	
			ft.	*ft.*	*ft.*	*ft.*	*ft.*
Mad-1-Ct	11-4-52	17:30	57.55	57.57	57.57	57.51	0.06
Mad-10-Ct	11-4-52	17:30	57.39	57.39	57.45	57.31	.14
Mad-18-Ct	11-4-52	17:30	66.52	66.52	66.76	66.32	.44
Mad-19-Ct	11-4-52	17:30	37.23	37.23	37.35	37.13	.22
Mar-1	11-4-52	17:30	10.25	10.25	10.30	10.22	.08

ARIZONA

477	7-21-52	12:00	20.20	20.23	19.76	20.23	0.47
(D-8-6)17ddd	7-21-52	12:40	42.42	42.45	42.25	42.58	.33
(D-24-15)18ab	7-21-52	11:50	.....	.....	9.29	9.18	.11
(D-21-26)2ba	7-21-52	.....	.....	.....	47.67	47.73	.06
8K-416	7-21-52	12:00	54.80	54.84	54.79	54.87	.08
8K-416	11- 4-52	18:00	.....	54.39	54.40	54.37	.03
8K-416	11- 8-52	19:00	.....	54.16	54.15	54.17	.02
8K-416	11-13-52	12:00	.....	54.05	54.04	54.07	.03
8K-416	11-15-52	8:00	.....	53.90	53.89	53.91	.02

TABLE 1.—*Fluctuations in well-water levels, Jan. 1 through Dec. 31, 1952*—Continued

CALIFORNIA

Well No.	Date	Time G. C. T.	Depth to water				Amplitude of fluctuation
			Before disturbance	After disturbance	At highest point	At lowest point	
			ft.	*ft.*	*ft.*	*ft.*	*ft.*
7/34-21E1	7-21-52	12:00	21.24	21.16	21.12	21.36	0.24
4/27-21B1	7-21-52	12:00	73.87	73.45	73.45	74.02	.57
7/34-12E1	7-21-52	12:00	303.53	303.52	----------	----------	1+
7/34-9H3	7-21-52	----------	11.21	11.21	11.20	11.24	.04
6/30-29E1	7-21-52	12:50	12.55	12.57	12.50	12.71	.21
6/30-20F4	7-21-52	----------	14.82	14.82	14.52	15.25	.73
15/16-20R1	7-21-52	12:45	52.61	52.33	51.70	53.42	1.72
15/16-34E1	7-21-52	12:00	133.40	133.35	132.74	133.72	.98
19/18-27N1	7-21-52	12:00	81.12	81.00	80.90	81.16	.26
15/16-34E1	7-21-52	20:00	133.60	133.62	133.60	133.63	.03
15/16-20R1	7-22-52	12:45	52.52	52.52	52.49	52.53	.04
15/16-20R1	7-23-52	13:15	52.59	52.59	52.18	52.21	.03
15/16-20R1	7-25-52	20:00	52.90	52.90	52.89	52.91	.02
3N-1W-34J1	9-22-52	11:30	36.97	36.93	37.00	36.91	.09
6N-1E-18H1	9-22-52	11:30	6.92	6.92	6.02	6.91	.11
3N/1W-34J1	11- 4-52	16:45	37.40	37.41	38.35	38.45	.10
15/16-34E1	11-22-52	07:45	137.88	137.88	137.79	138.00	.21
15/16-20R1	11-22-52	07:45	51.72	51.66	51.61	51.89	.28

NORTHERN FLORIDA

D206	2-14-52	04:30	6.68	6.69	6.67	6.72	0.05
L7	3- 4-52	00:10	162.07	162.04	161.92	162.33	.41
D206	3- 4-52	01:15	6.27	6.29	6.09	6.43	.34
H30	3- 4-52	02:10	+8.25	+8.29	+8.34	+8.18	.16
H500	3- 4-52	00:50	50.65	50.63	50.48	50.77	.29
J23	3- 4-52	02:10	34.03	34.03	----------	34.05	----------
P16	3- 4-52	02:35	66.88	66.88	66.86	66.89	.03
P13	3- 4-52	02:30	9.28	9.30	9.26	9.31	.05
P246	3- 4-52	02:30	25.83	25.86	25.79	25.88	.09
P44	3- 4-52	02:10	2.88	2.89	2.84	2.93	.09
S5	3- 4-52	02:20	7.00	6.99	6.97	7.02	.05
S9	3- 4-52	01:45	2.07	2.08	2.04	2.12	.08
T36	3- 4-52	01:45	5.76	5.77	5.73	5.82	.09
V24	3- 4-52	01:50	7.87	7.93	7.84	7.97	.13
V31	3- 4-52	01:50	4.91	4.90	4.87	4.92	.05
D206	3- 9-52	17:20	6.47	6.45	6.43	6.47	.04
D206	3-19-52	11:00	6.23	6.25	6.22	6.27	.05
P16	4- 9-52	19:55	66.11	66.08	66.06	66.11	.05
L7	4-19-52	10:10	160.64	160.64	160.63	160.65	.02
D206	5- 6-52	19:50	7.39	7.38	7.35	7.40	.05
H500	5-13-52	19:35	53.14	53.15	53.13	53.17	.04
D206	5-16-52	20:35	7.81	7.82	7.80	7.82	.02
T35	6-19-52	15:05	2.79	2.78	2.77	2.81	.04
C9	7-21-52	12:05	91.41	91.42	91.39	91.42	.03
D206	7-21-52	12:05	8.68	8.71	8.60	8.82	.22
E74	7-21-52	12:15	78.59	78.60	78.45	78.74	.29
H13	7-21-52	12:10	7.78	7.79	7.72	7.84	.12
H30	7-21-52	12:10	+6.25	+6.24	+6.46	+6.00	.46
H500	7-21-52	12:55	51.02	51.06	50.57	51.42	.85
J23	7-21-52	12:10	39.12	39.13	38.58	39.63	1.05
M92	7-21-52	12:10	40.92	40.94	40.67	41.15	.48
M162A	7-21-52	12:05	+2.63	+2.63	+2.90	+2.36	.54
O47	7-21-52	12:40	6.46	6.47	6.39	6.56	.17
P13	7-21-52	12:10	7.83	7.83	7.77	7.85	.08
P16	7-21-52	12:15	67.68	67.70	67.54	67.83	.29
P13	7-21-52	12:25	9.72	9.69	9.50	9.91	.41
P246	7-21-52	12:05	26.08	26.05	25.86	26.27	.41
P269	7-21-52	12:00	9.70	9.80	9.43	10.10	.67
P561	7-21-52	12:00	2.57	2.56	2.39	2.52	.13
P45	7-21-52	12:00	67.10	67.08	66.93	67.24	.31
P51	7-21-52	12:00	6.38	6.36	6.25	6.52	.27
S5	7-21-52	11:50	7.11	7.12	7.02	7.17	.15
S9	7-21-52	11:50	1.72	1.72	1.57	1.87	.30
T35	7-21-52	11:50	3.31	3.35	2.39	4.26	1.87
T36	7-21-52	11:50	10.07	10.08	9.93	10.27	.34
V31	7-21-52	11:50	6.65	6.68	6.57	6.76	.19
D206	8-17-52	17:00	8.59	8.57	8.56	8.60	.04
T35	8-17-52	17:50	1.50	1.50	1.48	1.51	.03
T35	8-20-52	16:10	1.20	1.22	1.19	1.25	.06
D206	9- 9-52	13:05	8.26	8.26	8.24	8.27	.03
H30	9- 9-52	13:00	+5.18	+5.20	+5.21	+5.18	.03
H500	9- 9-52	13:10	50.48	50.47	50.46	50.49	.03
M92	9- 9-52	13:00	40.17	40.18	40.16	40.19	.03
O47	9- 9-52	13:20	6.63	6.63	6.63	6.64	.01
P246	9- 9-52	13:40	26.23	26.25	26.23	26.26	.03
P44	9- 9-52	13:15	1.22	1.21	1.20	1.22	.02

See footnotes at end of table.

TABLE 1.—*Fluctuations in well-water levels, Jan. 1 through Dec. 31, 1952*—Continued

SOUTHERN FLORIDA

Well No.	Date	Time G. C. T.	Depth to water				Amplitude of fluctuation
			Before disturbance	After disturbance	At highest point	At lowest point	
			ft.	*ft.*	*ft.*	*ft.*	*ft.*
G580	2-17-52	15:15	1.82	1.82	1.88	1.77	0.11
G595	2-17-52	14:15	2.61	2.61	2.63	2.58	.05
F210	3- 3-52	14:35	1.12	1.12	1.20	1.04	.16
F291	3- 4-52	2:45	1.09	1.09	1.15	1.03	.12
G72	3- 4-52	2:30	5.39	5.39	5.40	5.39	.01
G221	3- 4-52	2:45	.69	.69	.80	.59	.21
G519	3- 4-52	1:30	1.10	1.10	1.14	1.06	.08
G594	3- 4-52	2:00	6.18	6.18	6.19	6.16	.03
G612	3- 4-52	2:00	.80	.80	.82	.77	.05
S18	3- 4-52	2:30	1.48	1.48	1.50	1.45	.05
S19	3- 4-52	2:00	.94	.94	1.01	.87	.14
S68	3- 4-52	1:45	1.05	1.05	.20	.10	.10
S329	3- 4-52	2:15	1.69	1.69	1.73	1.62	.11
F291	4-19-52	10:00	.70	.70	.72	.69	.03
G221	4-19-52	9:55	.11	.11	.13	.09	.04
F210	5-13-52	19:45	1.04	1.04	1.04	1.03	.01
F291	5-13-52	19:30	.60	.60	.63	.58	.05
G221	5-13-52	18:35	.58	.58	.61	.56	.05
G580	5-13-52	18:20	1.34	1.34	1.35	1.34	.01
S19	5-13-52	19:10	1.14	1.14	1.16	1.12	.04
S68	5-13-52	19:15	.16	.16	.17	.15	.02
S329	5-13-52	19:35	2.09	2.09	2.10	2.08	.02
F210	7-21-52	12:15	1.03	1.03	1.47	.60	.87
F291	7-21-52	12:10	.83	.83	1.22	.46	.76
F358	7-21-52	11:55	3.55	3.55	3.58	3.52	.06
G218	7-21-52	12:10	4.56	4.56	4.74	4.43	.31
G476	7-21-52	12:10	1.10	1.10	1.17	1.02	.15
G518	7-21-52	12:20	1.86	1.86	2.00	1.68	.32
G551	7-21-52	12:30	4.36	4.36	4.37	4.35	.02
G553	7-21-52	12:30	2.90	2.90	3.50	2.70	.80
G580	7-21-52	12:00	1.89	1.89	2.47	1.37	1.10
G594	7-21-52	12:00	5.46	5.46	5.53	5.42	.11
G595	7-21-52	12:05	3.30	3.30	3.31	3.29	.02
G612	7-21-52	12:25	1.60	1.60	1.70	1.47	.23
G613	7-21-52	12:05	2.93	2.93	2.96	2.92	.04
L246	7-21-52	11:55	16.09	16.09	16.11	16.08	.03
L414	7-21-52	12:10	17.93	17.93	17.97	17.87	.10
M125	7-21-52	12:10	1.60	1.60	1.63	1.56	.07
S18	7-21-52	12:25	1.42	1.42	1.45	1.37	.08
S19	7-21-52	12:20	1.24	1.24	1.81	.79	1.02
S68	7-21-52	12:12	.24	.24	.58	.05	.53
S329	7-21-52	12:30	1.36	1.36	1.59	1.12	.47
S539	7-21-52	12:25	.37	.37	.41	.34	.07
C130	7-21-52	12:25	2.38	2.38	2.55	2.23	.32
F210	8-20-52	15:50	1.25	1.25	1.26	1.24	.02
F291	8-20-52	16:00	1.42	1.42	1.43	1.41	.02
F210	9- 9-52	12:55	1.37	1.37	1.38	1.36	.02
G553	9- 9-52	12:00	3.43	3.43	3.44	3.42	.02
G580	9- 9-52	11:50	2.31	2.31	2.32	2.30	.02
S19	9- 9-52	12:00	1.20	1.20	1.21	1.19	.02
S68	9- 9-52	12:15	.85	.85	.86	.84	.02
F179	9- 9-52	12:15	1.79	1.79	1.80	1.70	.10
F291	9-21-52	2:50	2.01	2.01	2.02	2.00	.02
G553	9-21-52	2:45	5.69	5.69	5.70	5.68	.02
S19	9-21-52	3:15	1.99	1.99	2.00	1.99	.01
S68	9-21-52	2:30	1.23	1.23	1.24	1.22	.02
S329	9-21-52	2:20	2.81	2.81	2.82	2.80	.02
F179	9-21-52	2:30	2.86	2.86	2.86	2.85	.01
F291	10-28-52	4:15	5.87	5.87	5.90	5.84	.06
G518	10-28-52	4:10	4.08	4.08	4.09	4.07	.02
G580	10-28-52	3:50	5.60	5.60	5.61	5.59	.02
S19	10-28-52	4:00	5.59	5.59	5.60	5.58	.02
S68	10-28-52	4:00	2.00	2.00	2.06	1.93	.13
S329	10-28-52	3:15	6.31	6.31	6.34	6.28	.06
F210	11- 4-52	17:25	4.28	4.28	4.52	4.17	.35
F291	11- 4-52	17:30	4.52	4.52	4.73	4.36	.37
G72	11- 4-52	17:05	6.87	6.87	6.91	6.84	.07
G218	11- 4-52	17:50	6.37	6.37	6.42	6.29	.13
G476	11- 4-52	17:40	2.82	2.82	2.88	2.76	.12
G518	11- 4-52	17:45	3.00	3.00	3.16	2.88	.28
G553	11- 4-52	18:00	4.52	4.52	4.53	4.51	.02
G580	11- 4-52	17:40	4.95	4.95	5.15	4.74	.41
G594	11- 4-52	17:05	7.43	7.43	7.48	7.38	.10
G595	11- 4-52	17:00	6.10	6.10	6.01	5.99	.02
G618	11- 4-52	17:45	7.70	7.70	7.73	7.67	.06
L414	11- 4-52	17:45	18.32	18.32	18.38	18.26	.12
M125	11- 4-52	17:05	6.67	6.67	6.70	6.64	.06
S18	11- 4-52	17:05	3.85	3.85	3.92	3.78	.14
S19	11- 4-52	17:15	3.69	3.69	3.89	3.51	.38
S68	11- 4-52	17:05	2.93	2.93	3.06	2.78	.28
S329	11- 4-52	17:05	5.36	5.36	5.54	5.19	.35
S539	11- 4-52	17:45	1.69	1.69	1.71	1.66	.05
G130	11- 4-52	17:05	3.01	3.01	3.15	2.88	.27

See footnotes at end of table.

TABLE 1.—*Fluctuations in well-water levels, Jan. 1 through Dec. 31, 1952*—Continued

IDAHO

Well No.	Date	Time G. C. T.	Depth to water				Amplitude of fluctuation
			Before disturbance	After disturbance	At highest point	At lowest point	
			ft.	*ft.*	*ft.*	*ft.*	*ft.*
4N-30E-7ad1	3- 4-52	00:00 01:00	324.34	324.36	324.21	324.50	0.29
3N-29E-14ad1	3- 4-52	02:00	452.70	452.70	452.68	452.72	.04
8S-26E-33bc1	3- 4-52	01:30	99.98	99.98	99.94	100.0	.06
8S-27E-31dd1	3- 4-52	00:00	20.91	20.91	20.82	20.99	.17
53N-2W-5ad1	3- 4-52	01:00	242.82	242.82	----------	----------	−.02
3N-29E-14ad1	3- 4-52	02:00	452.70	452.70	452.68	452.72	.04
4N-30E-7ad1	3- 5-52	17:00	324.34	324.34	324.30	324.36	.06
3N-29E-14ad1	3- 5-52	16:00 17:00	452.59	452.59	452.56	452.61	.05
9S-26E-10aa1	6- 5-52	10:30	75.52	75.52	75.49	75.57	.08
3N-33E-3ab1	7-21-52	11:50	673.3	----------	671.6	674.8	3.2
1S-30E-15bc1	7-21-52	12:10	710.65	710.67	710.58	710.76	.18
5S-31E-27ab1	7-21-52	12:00	14.65	14.65	14.54	14.80	.26
8S-26E-33bc1	7-21-52	12:00	98.42	----------	98.07	99.01	.94
3N-32E-29dd1	7-21-52	12:00	654.32	654.32	654.04	654.58	.54
9S-26E-7bc1	7-21-52	12:00	60.74	60.74	61.64	60.83	.19
9S-26E-10aa1	7-21-52	11:45	73.32	73.34	73.21	73.48	.27
9S-26E-10dd1	7-21-52	12:00	70.11	70.11	69.87	70.42	.55
5N-34E-9bd1	7-21-52	11:00	257.77	257.77	257.34	258.25	.91
9S-20E-1da1	7-21-52	12:00	344.96	345.00	344.85	345.10	.25
53N-2W-4aa1	7-21-52	12:00	209.47	209.47	209.43	209.50	.07
53N-2W-9aa1	7-21-52	12:30	231.20	231.20	231.14	231.27	.13
6S-18E-22aa1	7-21-52	11:00	179.12	179.12	178.77	179.48	.71
8S-24E-31dc1	7-21-52	11:45	142.56	142.56	142.24	142.85	.61
11S-19E-31cd2	7-21-52	12:00	137.96	137.96	137.82	138.20	.38
8S-27E-31dd1	7-25-52	17:00	20.10	20.10	20.03	20.19	.16
4N-30E-7ad1	7-29-52	05:00 06:00	323.75	323.75	323.67	323.82	.15
8S-26E-33bc1	7-29-52	07:25	98.20	98.20	98.16	98.23	.07
8S-27E-31dd1	7-29-52	07:30	20.02	20.02	19.83	20.23	.40
8S-26E-33bc1	8-20-52	15:30	97.74	97.74	97.71	97.77	.06
8S-27E-31dd1	8-20-52	14:00	20.09	20.09	19.79	21.38	.59
4N-30E-7ad1	8-20-52	15:00	323.33	323.33	323.14	323.49	.35
4N-30E-22bd1	8-20-52	15:00	348.21	348.21	348.12	348.31	.19
3N-29E-14ad1	8-20-52	15:00 16:00	450.21	450.21	450.16	450.26	.10
53N-2W-5ad1	8-21-52	01:30	231.78	231.78	----------	----------	−.02
8S-26E-33bc1	11- 4-52	17:30	97.95	97.95	97.84	99.09	.25
5N-31E-14bc1	11- 4-52	17:00	264.30	264.30	264.28	264.32	.04
4N-30E-7ad1	11- 4-52	17:00	323.86	323.86	322.41	323.30	.89
3N-30E-31aa1	11- 4-52	17:00	454.95	454.95	454.82	455.09	.27
3N-30E-14ad1	11- 4-52	17:30	450.87	450.87	450.78	450.96	.18
2N-27E-2dd1	11- 4-52	18:00 19:00	760.62	760.62	760.54	760.71	.17
53N-2W-9aa1	11- 4-52	15:30	233.43	233.43	233.41	233.45	.04
8S-25E-36da1	11- 4-52	17:30	98.16	98.16	98.15	98.17	.02

ILLINOIS

ANL-13	2-20-51	08:35	103.28	103.29	103.28	103.31	0.03
ANL-9	3- 9-52	20:00	91.41	91.39	91.37	91.42	.05
ANL-10	3- 9-52	20:00	638.14	638.15	638.21	638.09	.12
ANL-13	3-18-52	08:50	102.95	102.94	102.92	102.95	.03
ANL-13	5- 4-52	15:50	102.70	102.70	102.69	102.72	.03
ANL-9	7-21-52	11:15	90.97	90.99	+90.5	+91.3	1+
ANL-10	7-21-52	12:20	72.06	71.95	70.82	73.02	2.20
ANL-11	7-21-52	12:00	640.67	640.64	640.83	640.43	.40
ANL-9	8-20-52	15:30	91.24	91.25	91.25	91.25	.01
ANL-11	8-20-52	15:00	640.45	640.44	640.45	640.44	.01
ANL-13	10-12-52	08:55	103.67	103.67	103.66	103.70	.04
ANL-11	10-15-52	18:50	75.70	75.69	75.67	75.70	.03
ANL-9	10-26-52	17:10	91.69	91.68	91.67	91.69	.02
ANL-11	10-26-52	20:10	75.72	75.71	75.72	75.70	.02
ANL-9	10-29-52	17:20	91.93	91.92	91.92	91.94	.02
ANL-11	10-29-52	17:15	76.40	76.40	76.39	76.40	.01
ANL-9	11- 4-52	16:55	91.76	91.72	91.51	91.93	.42
ANL-10	11- 4-52	17:20	72.05	72.03	71.87	72.32	.45
ANL-11	11- 4-52	17:30	76.32	76.31	76.18	76.46	.28
ANL-9	11- 7-52	20:50	91.91	91.90	91.89	91.91	.02
ANL-13	11-13-52	07:15	104.46	104.45	104.44	104.46	.02
ANL-9	11-18-52	09:00	641.35	641.36	641.35	641.37	.02
ANL-9	12- 7-52	01:55	91.82	91.82	91.80	91.83	.03

See footnotes at end of table.

TABLE 1.—*Fluctuations in well-water levels, Jan. 1 through Dec. 31, 1952*—Continued

Well No.	Date	Time G. C. T.	Depth to water				Amplitude of fluctuation
			Before disturbance	After disturbance	At highest point	At lowest point	
			ft.	*ft.*	*ft.*	*ft.*	*ft.*
INDIANA							
Ba-2	11- 4-52	17:00	17.09	17.10	17.09	17.10	0.01
Be-3	11- 4-52	17:00	41.10	41.09	40.96	41.19	.23
Ma-4	11- 4-52	17:15	2.61	2.61	2.59	2.62	.03
Ma-21	11- 4-52	17:00	41.60	41.60	41.59	42.00	.41
Ma-22	11- 4-52	17:00	67.95	67.97	67.89	68.03	.14
IOWA							
83-7-21K1	3- 4-52	01:30	66.75	66.89	66.68	67.00	0.32
83-7-21K1	8-20-52	15:30	68.46	68.46	68.35	68.55	.20
83-7-21K1	11- 4-52	----	67.74	67.78	----	----	+1.0
80-17-17K2	11- 4-52	17:30	50.77	50.77	50.73	50.81	.08
80-17-17M2	11- 4-52	17:30	106.27	106.27	106.25	106.29	.04
80-17-17L1	11- 4-52	17:30	9.51	9.51	9.46	9.55	.09
89-47-22B2	11- 4-52	17:25	17.28	17.21	17.14	17.53	.39
96-20-3P1	11- 4-52	17:30	55.43	55.43	55.23	55.72	.49
KANSAS							
14-22-26ad	7-21-52	11:00	27.96	27.98	27.91	28.05	0.14
KENTUCKY							
8715-3710-1	7-15-52	19:00	27.08	27.08	27.08	27.08	−0.01
8245-3745-404	7-21-52	12:00	31.73	31.74	31.52	31.93	.41
8250-3750-24	7-21-52	11:30 12:00	31.43	31.44	31.42	31.43	.01
8245-3735-2	7-21-52	12:00	12.44	12.46	12.43	12.48	.05
8715-3710-1	7-21-52	11:30 12:00	34.77	34.77	34.72	34.82	.10
8545-3705-2	7-21-52	11:00 12:00	121.92	121.92	121.90	121.94	.04
8545-3705-2	7-24-52	12:00	122.04	122.05	122.02	122.21	.19
8720-3650-98	8-19-52	13:30 14:00	45.28	45.28	45.12	45.49	.37
8245-3745-404	8-20-52	15:00 15:30	32.00	32.01	32.00	32.04	.04
8715-3710-1	9- 6-52	17:00 17:30	41.10	41.11	41.09	41.12	.03
8245-3745-404	9- 9-52	12:45	32.32	32.32	32.32	32.33	.01
8715-3710-1	9-27-52	19:00	29.90	29.93	29.86	30.00	.14
8245-3745-404	11- 4-52	18:00	32.47	32.43	32.29	----	+.23
8715-3710-1	11- 4-52	16:00 18:00	----	----	29.65	29.69	.04
8700-3710-3	11- 4-52	----	----	----	6.40	6.45	.04
LOUISIANA							
Cu-445	3- 4-52	02:15	70.42	70.43	70.39	70.45	0.06
Ac-40	3- 4-52	02:30	43.45	43.46	43.43	43.48	.05
Ve-460	3- 4-52	02:00	11.70	11.71	11.68	11.72	.04
B-2	7-21-52	12:00	51.98	51.98	51.97	52.00	.03
Cn-28	7-21-52	13:00	12.96	12.97	12.88	13.07	.19
Cn-445	7-21-52	12:00	73.49	73.48	73.45	73.52	.07
Cu-446	7-21-52	11:30	66.58	66.59	66.52	66.66	.14
JD-43	7-21-52	12:30	52.07	52.05	51.32	52.83	1.51
JD-224	7-21-52	12:10	68.09	68.08	68.03	68.08	.05
La-437	7-21-52	----	18.22	18.23	17.94	18.54	.58
Ou-100	7-21-52	12:00	109.72	109.75	109.63	109.83	.20
Cu-445	11- 4-52	----	80.45	80.47	80.40	80.53	.13
Cu-446	11- 4-52	----	64.53	64.56	64.40	64.68	.28
Ou-100	11- 4-52	17:30	14.13	14.14	14.04	14.23	.19
EB-4	11- 4-52	18:00	182.40	182.38	182.35	182.44	.09
Ve-460	11- 4-52	17:00	16.44	16.45	16.30	16.59	.29
Wa-7	11- 4-52	17:15	21.43	21.43	21.40	21.45	.05

See footnotes at end of table.

TABLE 1.—*Fluctuations in well-water levels, Jan. 1 through Dec. 31, 1952*—Continued

Well No.	Date	Time G. C. T.	Depth to water				Amplitude of fluctuation
			Before disturbance	After disturbance	At highest point	At lowest point	
			ft.	*ft.*	*ft.*	*ft.*	*ft.*
MARYLAND							
Dor-Ce-22	7-21-52	13:00	81.50	81.50	81.42	81.57	0.15
Wi-Cf-3	7-21-52	12:30	36.98	36.98	36.94	37.04	.10
Wi-Ce-13	7-21-52	12:15	4.23	4.23	4.21	4.25	.04
Cal-Gd-5	7-21-52	13:15	----	----	----	----	.02
Cal-Gd-6	7-21-52	13:05	----	----	----	----	.10
Dor-Ce-22	11- 4-52	18:30	95.85	95.85	95.80	95.92	.12
Wi-Cf-3	11- 4-52	17:30	36.80	36.80	36.41	36.35	.06
Wi-Ce-13	11- 4-52	17:45	3.25	3.25	3.24	3.26	.02
Care-De-56	11- 4-52	17:45	30.52	30.52	30.42	30.63	.21
MICHIGAN							
WaYp22	3- 3-52	03:30	72.66	72.65	72.62	72.70	0.08
GeFL491	3- 3-52	03:30	26.36	36.32	26.11	26.57	.46
GeFL491	3-19-52	12:45	25.81	25.81	24.77	24.83	.08
GeFL491	5- 9-52	17:45	26.29	26.29	26.27	26.31	.04
IgLS265	7-21-52	12:45	52.77	52.76	52.59	52.90	.31
WaYk22	7-21-52	13:00	71.98	71.99	71.83	72.12	.29
GeFL491	7-21-52	13:45	33.39	33.39	33.35	33.43	.08
IgLS	7-21-52	13:45	52.77	52.76	52.59	52.90	.31
WaYk22	7-21-52	13:00	71.98	71.99	71.83	72.12	.29
GeFL491	7-21-52	13:45	33.39	33.39	33.35	33.43	.08
47.26.8.dd820	7-21-52	11:57	29.65	29.64	29.59	29.68	.09
47.26.8.dd821	7-21-52	12:00	38.65	38.65	38.58	38.76	.18
47.26.8.dd824	7-21-52	11:55	46.66	46.65	46.42	46.83	.41
47.26.8.dd825	7-21-52	12:00	41.63	41.63	41.59	41.66	.07
MONTANA							
A1-4-25cc	7-21-52	12:00	----	----	----	----	0.50
D2-4-9bc	7-21-52	12:00	----	----	----	----	.17
A1-4-25cc	8-20-52	15:00	----	----	----	----	.04
D2-4-9bc	8-20-52	15:00	----	----	----	----	+.01
A1-4-25cc	11- 4-52	17:30	----	----	----	----	.22
D2-4-9bc	11- 4-52	17:30	----	----	----	----	.03
NEVADA							
S22/61-4bccl	1-17-52	20:00	85.66	85.60	85.54	86.24	0.70
S20/53-24caal	1-31-52	01:20	31.59	31.58	31.57	31.63	.06
S20/53-24caal	1-31-52	21:30 23:30	31.58	31.59	31.58	31.65	.07
S19/60-33baal	2-17-52	23:30	3.83	3.86	3.81	3.89	.08
S20/53-24caal	3- 4-52	02:00	32.78	32.77	32.79	32.74	.05
S21/54-10aacl	3- 4-52	02:45	30.48	30.48	30.40	30.55	.15
S22/61-4bccl	3- 9-52	20:30	86.87	86.87	86.77	87.15	.38
S19/60-9bccl	3-19-52	11:00	74.10	74.10	74.06	74.12	.06
S21/54-10aacl	3-19-52	11:30	30.32	30.31	30.30	30.33	.03
S19/60-9bccl	6-10-52	07:00	79.18	79.20	79.16	79.25	.09
S19/60-9bccl	6-10-52	07:30	79.20	79.11	78.98	79.38	.40
S19/60-9bccl	6-11-52	06:30	79.14	79.16	79.08	79.30	.22
S19/60-9bccl	6-16-52	11:00	78.63	78.64	78.60	78.72	.12
S19/60-9bccl	6-17-52	10:15	79.46	79.48	79.40	79.63	.23
S20/60-36ddbl	7- 9-52	19:45	62.45	62.24	62.18	62.28	.10
S19/60-9bccl	7-16-52	03:45	----	79.54	79.35	80.08	.73
S19/60-9bccl	7-16-52	20:00	79.80	79.61	79.54	79.93	.39
S19/60-9bccl	7-21-52	----	79.88	79.79	----	----	2.0
S22/61-4bccl	7-21-52	----	90.40	----	89.91	----	1.09
S20/60-36ddbl	7-21-52	----	62.91	----	----	----	2.0
S20/61-19bccl	7-21-52	----	28.23	----	27.22	28.50	1.28
11/24-22dcl	7-21-52	----	55.67	55.68	55.66	55.69	.03
S19/60-27bdcl	7-21-52	----	15.50	13.60	17.10	9.40	7.70
S21/54-10aacl	7-21-52	----	37.85	----	----	----	1.00
S21/54-10aacl	7-23-52	00:45	37.86	37.85	37.83	37.88	.05
S19/60-9bccl	7-23-52	00:45	79.71	79.70	79.64	79.75	.11
S21/54-10aacl	7-25-52	18:15	37.62	37.62	37.60	37.63	.03
S19/60-9bccl	7-25-52	18:15	79.98	79.97	79.92	80.02	.10
S19/60-9bccl	7-29-52	06:15	80.12	80.12	80.04	80.21	.17
S22/61-4bccl	8-30-52	00:00	90.57	90.56	90.45	91.13	.68

See footnotes at end of table.

TABLE 1.—*Fluctuations in well-water levels, Jan. 1 through Dec. 31, 1952*—Continued

Well No.	Date	Time G. C. T.	Depth to water				Amplitude of fluctuation
			Before disturbance	After disturbance	At highest point	At lowest point	
			ft.	*ft.*	*ft.*	*ft.*	*ft.*
NEW JERSEY[1]							
26.21.5.4.6	3- 4-52	03:15	+63.99	+63.99	+64.00	+63.98	0.02
26.22.4.4.4	3- 4-52	03:15	+29.8	+29.8	+30.1	+29.55	.55
28.4.9.3.5	4- 9-52	16:40	+0.63	+0.63	----------	----------	−.01
31.1.6.4.8	6-19-52	20:00	8.47	8.47	8.39	8.50	.11
28.5.4.8.1	6-29-52	16:45	+6.36	+6.37	+6.37	+6.36	.01
26.21.6.6.3	7-21-52	12:30	+24.76	+24.76	+24.89	+24.59	.30
28.5.4.8.1	7-21-52	12:30	+5.71	+5.71	+5.71	+5.70	.01
26.22.4.4.4	7-21-52	12:30	+31.10	+31.10	+31.50	+30.75	.75
26.21.5.6.8	7-21-52	12:45	+51.19	+51.20	+51.25	+51.18	.07
30.14.8.1.2	8-29-52	16:30	+4.24	+4.24	+4.24	+4.25	.01
31.1.6.4.8	11- 4-52	17:40	7.56	7.56	7.48	7.64	.16
30.14.8.2.4	11- 4-52	17:30	1.68	1.68	1.65	1.70	.05
26.21.5.4.6	11- 4-52	17:30	+62.55	+62.55	+62.57	+62.53	.04
26.21.5.9.2	11- 4-52	17:40	+53.59	+53.69	+53.92	+53.43	.49
26.21.5.6.8	11- 4-52	17:40	+43.94	+43.94	+43.97	+43.91	.06
NEW MEXICO							
10.24.9.330	3- 4-52	01:23	24.20	24.13	24.13	24.21	0.08
10.24.21.212	3- 4-52	01:23	20.50	20.40	20.37	20.52	.15
11.24.29.242	3- 4-52	01:23	69.86	69.83	69.83	69.86	.03
13.25.27.211	3- 4-52	01:23	20.20	20.25	19.72	20.58	.86
18.26.5.330	3- 4-52	01:23	46.60	46.55	46.44	46.63	.19
24.29.8.111	3- 4-52	01:23	37.69	37.74	37.53	37.89	.36
6	3- 4-52	01:23	.09	.07	.03	.12	.09
24.29.8.111	3- 6-52	----------	37.74	37.75	37.73	37.77	.04
24.29.8.111	3- 9-52	20:00	37.36	37.35	37.34	37.37	.03
13.25.27.211	3- 9-52	20:00	25.64	25.63	25.62	25.67	.05
13.25.27.211	3-19-52	22:58	47.89	47.91	47.88	47.96	.08
24.29.8.111	3-19-52	10:58	37.61	37.62	37.60	37.63	.03
24.29.8.111	4-19-52	09:59	37.13	37.13	37.12	37.12	.01
10.24.9.330	7-21-52	11:52	30.33	30.32	30.04	30.64	.60
10.24.21.212	7-21-52	12:00	26.97	26.98	26.67	27.35	.68
11.24.29.242	7-21-52	12:00	80.23	80.31	80.11	80.33	.22
13.28.27.211	7-21-52	11:53	63.12	63.13	62.44	63.62	1.18
18.26.5.330	7-21-52	12:00	73.13	73.12	72.95	73.27	.32
24.29.8.111	7-21-52	12:00	36.28	36.31	35.66	36.94	1.28
6	7-21-52	11:53	+.41	+.38	+1.17	.39	1.56
11.23.3.342	7-21-52	12:00	162.37	162.38	162.31	162.48	.17
24.29.8.111	8-17-52	16:02	36.19	36.18	36.17	36.19	.02
13.28.27.211	8-20-52	15:25	86.61	86.62	86.59	86.62	.03
24.29.8.111	8-20-52	15:25	36.10	36.11	36.09	36.13	.04
13.28.27.211	9- 9-52	13:00	78.90	78.92	78.85	78.95	.10
24.29.8.111	9- 9-52	12:55	35.82	35.83	35.80	35.84	.04
10.24.9.330	11- 4-52	16:58	28.12	28.13	27.88	28.35	.47
10.24.21.212	11- 4-52	16:58	24.37	24.43	24.02	24.75	.73
11.24.29.242	11- 4-52	16:58	74.92	74.94	74.81	75.03	.22
18.26.5.330	11- 4-52	16:58	52.12	52.16	51.94	52.38	.44
6	11- 4-52	16:58	.64	.62	.43	.83	.42
11.23.3.342	11- 4-52	16:58	161.93	161.90	161.89	161.97	.08
24.29.8.111	11- 7-52	21:00	35.66	35.65	35.61	35.69	.08
6	11- 7-52	21:00	.60	.57	.40	.78	.38
24.29.8.111	11-30-52	----------	35.72	35.71	35.70	35.73	.03
13.28.27.211	12- 6-52	----------	4.73	4.72	4.67	4.77	.10
24.29.8.111	12- 6-52	----------	35.57	35.58	35.52	35.60	.08
13.28.27.211	12-24-52	----------	2.47	2.48	2.45	2.51	.06
24.29.8.111	12-24-52	----------	35.95	35.95	35.94	35.95	.01
NEW YORK							
Sn-128	1-14-52	00:45	29.06	28.95	28.73	29.33	0.60
Q-64	2-14-52	02:20	−1.57	−1.57	−1.51	−1.61	.10
S-6455	3- 4-52	----------	37.83	37.83	37.87	38.81	.06
Q-64	3- 4-52	02:15	−1.45	−1.45	−1.09	−1.83	.74
N-180	3- 4-52	02:00	19.84	19.84	19.88	19.81	.07
Sa-529	7-21-52	12:20	52.73	52.75	52.62	52.86	.24
K-519	7-21-52	12:15	.82	.82	.81	.84	.03
Q-64	7-21-52	12:15	−0.76	−0.82	−0.52	−1.19	.67
N-180	7-21-52	11:50	19.77	19.77	19.59	19.77	.18
N-1212	7-21-52	12:15	85.66	85.65	85.66	85.64	.02
N-2790	7-21-52	11:50	4.71	4.72	4.70	4.74	.04
N-3355	7-21-52	12:00	32.16	32.16	32.15	32.17	.02
K-519	11- 4-52	17:30	1.23	1.23	1.22	1.24	.02
Q-64	11- 4-52	15:45 17:00	−1.69	----------	−1.20	−2.26	1.06
N-180	11- 4-52	16:30	19.22	19.23	19.19	19.27	.08
Sa-529	11- 4-52	17:30	49.83	49.82	49.6	50.13	.53
N-2790	11- 4-52	17:35 18:00	4.43	4.40	4.43	4.40	.03

See footnotes at end of table.

TABLE 1.—*Fluctuations in well-water levels, Jan. 1 through Dec. 31, 1952*—Continued

NEW YORK—continued

Well No.	Date	Time G. C. T.	Depth to water				Amplitude of fluctuation
			Before disturbance	After disturbance	At highest point	At lowest point	
			ft.	*ft.*	*ft.*	*ft.*	*ft.*
N-1379	11- 4-52	17:30	0.38	0.37	0.36	0.40	0.04
N-3355	11- 4-52	17:45	32.73	32.74	32.72	32.75	.03
N-3862	11- 4-52	17:15	2.92	2.89	2.92	2.89	.03
N-3864	11- 4-52	17:15	1.64	1.64	1.64	1.65	.01
N-3866	11- 4-52	17:45	3.95	3.95	3.97	3.93	.04
Q-64	12- 6-52	21:00	−1.42	−1.42	1.39	−1.46	.07
Q-64	12-23-52	19:10	−1.38	−1.39	−1.30	−1.48	.18
OKLAHOMA							
Caddo-11	7-21-52	12:00	55.69	55.69	55.53	55.81	0.28
Caddo-14	7-21-52	12:00	37.46	37.53	37.45	37.53	.08
Grady-66	7-21-52	12:00	80.67	80.67	80.34	81.00	.66
Major-3	7-21-52	12:00	22.78	22.80	22.78	22.81	.03
RHODE ISLAND							
P-48	11- 4-52	18:00	7.06	7.06	7.04	7.07	0.03
TENNESSEE							
79:1-2	7-21-52	12:00	77.98	77.98	77.94	78.04	0.10
79:5-193	7-21-52	12:30	106.38	106.38	106.35	106.43	.08
79:7-26	7-21-52	11:30	93.16	93.15	93.10	93.21	.11
79:8-73	7-21-52	12:00	128.27	128.28	128.23	128.32	.09
79:9-110	7-21-52	12:00	61.05	61.03	60.98	61.07	.09
79:65-1	7-21-52	12:00	128.05	128.04	128.02	128.10	.08
79:148-10	7-21-52	12:00	47.58	47.59	47.55	47.62	.07
79:1-2	11- 4-52	17:30	80.51	80.50	80.47	80.55	.08
79:5-193	11- 4-52	17:30	103.56	103.56	103.53	103.60	.07
79:9-107	11- 4-52	17:30	72.09	72.09	72.07	72.11	.04
79:9-110	11- 4-52	17:30	57.18	57.20	57.16	57.23	.07
79:9-131	11- 4-52	17:30	85.01	85.03	84.93	85.13	.20
79:9-135	11- 4-52	17:00	44.36	44.36	44.34	44.38	.04
79:148-10	11- 4-52	17:10	47.60	47.59	47.55	47.65	.10
TEXAS							
224	3- 4-52	03:25	77.51	77.50	77.36	77.67	0.31
436	3- 4-52	02:00	78.15	78.15	77.76	78.50	.74
790	3- 4-52	02:00	111.28	111.25	111.29	111.24	.05
J1-6	3- 4-52	02:50	96.15	96.15	96.10	96.19	.09
341	3- 4-52	02:20	214.43	214.42	214.35	214.48	.13
341	3- 5-52	15:50	228.28	228.32	228.18	228.45	.27
J1-6	3- 9-52	05:45	96.71	97.18	96.58	98.30	1.72
436	7-21-52	12:10	81.80	81.80	81.69	81.97	.28
224	7-21-52	12:00	81.66	81.66	81.56	81.76	.20
J1-6	7-21-52	11:50	100.76	100.76	100.59	100.92	.33
341	7-21-52	11:45	214.26	214.38	209.43	218.45	9.02
341	7-22-52	00:30	214.38	214.40	214.36	214.46	.10
341	7-25-52	19:00	214.45	214.41	214.36	214.47	.11
341	7-29-52	18:55	214.25	214.23	214.14	214.30	.16
341	7-31-52	11:55	214.39	214.38	214.36	214.40	.04
UTAH							
(B-6-1)30cca-1	3- 3-52	02:00	30.28	30.28	30.26	30.30	0.04
(C-2-6)36cdd-1	3- 3-52	02:00	78.53	78.53	78.50	78.56	.06
(D-5-1)14adb-1	3- 3-52	02:30	57.00	56.98	56.94	57.07	.13
(A-2-1)18abd	7-21-52	12:00	+22.4	+22.4	+23.1	+21.8	1.3
(B-6-1)30cca-1	7-21-52	12:30	30.49	30.49	1+	1+	1+
(C-2-4)33add-1	7-21-52	13:00	33.70	33.71	33.54	----------	----------
(C-7-8)10cbd-1	7-21-52	12:00	76.21	76.22	76.10	76.40	.3
(C-23-2)19dab-1	7-21-52	11:45	+25.7	+25.7	+26.7	+24.1	2.6
(D-4-4)12aaa-1	7-21-52	12:45	12.08	12.08	12.06	12.11	.05
(D-5-1)14adb-1	7-21-52	----------	46.04	46.10	----------	----------	1+
(D-5-1)14adb-1	7-23-52	----------	46.35	46.35	46.33	46.37	.04
(B-6-1)30cca-1	7-29-52	08:00	30.42	30.42	30.40	30.44	.04
(B-6-1)30cca-1	8-23-52	00:00	30.34	30.34	30.31	30.36	.05
(C-21-5)21aba-1	11- 4-52	16:00	13.35	13.35	13.32	13.36	.04
(C-35-11)33dbc-1	11- 4-52	16:00	79.21	79.18	79.16	79.26	.10

See footnotes at end of table.

TABLE 1.—*Fluctuations in well-water levels, Jan. 1 through Dec. 31, 1952*—Continued

UTAH—continued

Well No.	Date	Time G. C. T.	Depth to water				Amplitude of fluctuation
			Before disturbance	After disturbance	At highest point	At lowest point	
			ft.	*ft.*	*ft.*	*ft.*	*ft.*
(D-5-1)14adb-1	11- 4-52	16:30	47.50	47.50	47.16	47.82	0.66
(B-6-1)30cca-1	11- 4-52	18:00	30.03	30.04	29.93	30.14	.21
(C-21-5)21aba-1	11- 4-52	18:00	13.35	13.35	13.35	13.36	.01
(C-35-11)33dbc-1	11- 4-52	18:00	79.18	79.18	79.17	79.20	.03
(D-6-2)8bdb-2	11- 4-52	18:00	12.03	12.03	11.84	12.20	.36
(B-6-1)30cca-1	11- 4-52	----------	30.04	30.04	30.03	30.05	.02
(B-6-1)30cca-1	11-22-52	08:00	29.11	29.12	29.09	29.13	.04
(C-2-6)36cdd-1	11-22-52	08:00	78.29	78.29	78.28	78.30	.02
(D-5-1)14adb-1	11-22-52	08:00	47.57	47.57	47.56	47.59	.03
(A-2-1)18abd-1	11-29-52	23:45	+22.6	+22.6	+22.8	+22.5	.3
(C-2-6)36cdd-1	11-29-52	22:00	78.50	78.50	78.49	78.51	.02
(D-5-1)14adb-1	11-30-52	00:00	47.90	47.90	47.89	47.91	.02
(B-6-1)30cca-1	12-23-52	08:00	28.46	28.46	----------	28.55	.09
WASHINGTON							
20/3-18c1	7-21-52	11:50	92.48	92.51	92.13	92.90	0.77
20/3-18c1	8-20-52	15:35	94.02	94.01	93.87	94.16	.29
20/3-18c1	11- 4-52	----------	94.19	----------	93.95	94.45	.50
WISCONSIN							
ML-36	3- 4-52	01:00	181.03	181.01	181.00	181.04	0.04
ML-148	3- 4-52	01:20	30.04	30.08	30.03	30.11	.08
WK-31	3- 4-52	02:10	131.60	131.59	131.58	131.60	.02
Dg-4	7-21-52	10:00	112.91	112.89	112.88	112.95	.07
Lf-56	7-21-52	11:00	62.20	62.13	61.91	62.43	.52
ML-36	7-21-52	11:00	192.48	192.49	192.34	192.60	.26
ML-148	7-21-52	11:00	30.10	30.46	30.26	30.57	.31
WK-31	7-21-52	10:00	130.50	130.58	130.45	130.58	.13
ML-45	7-21-52	11:00	41.75	41.75	41.72	41.79	.07
ML-148	8-20-52	18:50	29.62	29.62	29.61	29.64	.03
Lf-56	9- 9-52	12:00	64.17	64.14	64.16	64.18	.02
Lf-56	11- 4-52	17:50	66.04	66.00	65.64	66.40	.76
ML-36	11- 4-52	17:50	192.19	192.18	192.10	192.27	.17
ML-148	11- 4-52	17:50	31.55	31.52	31.39	31.66	.27
WK-31	11- 4-52	17:50	130.09	131.10	130.04	131.13	1.09
Lf-56	11- 4-52	19:00	----------	----------	65.94	66.03	.09
OAHU, HAWAII							
132	2-14-52	04:05	29.34	29.33	29.37	29.31	0.06
Oahu-T-24	3- 4-52	01 25	25.51	25.50	25.55	25.45	.10
Oahu-T-41	3- 4-52	01:40	22.25	22.25	22.25	22.20	.05
1A	3- 4-52	01:30	8.42	8.43	8.58	8.22	.36
36A	3- 4-52	02:00	30.75	30.74	----------	----------	1.0+
132	3- 4-52	02:00	29.07	29.07	29.65	----------	1.0+
132	3- 9-52	17:20	29.13	29.11	29.16	29.07	.09
132	3-19-52	12:00	29.11	29.18	29.25	29.08	.17
36A	3-19-52	13:00	30.87	30.88	30.93	30.82	.11
132	3-19-52	12:00	29.11	29.18	29.25	29.08	.17
132	6-22-62	22:30	26.97	26.96	26.99	26.96	.03
1A	7-21-52	12:00	8.14	8.17	8.19	8.12	.07
36A	7-21-52	12:30	27.73	27.75	27.71	27.77	.06
132	7-21-52	12:15	26.42	26.46	26.52	26.37	.15
Oahu-T-41	7-21-52	12:00	19.35	19.35	19.35	19.35	----------
1A	11- 4-52	17:00	8.36	8.34	8.62	8.01	.61
2	11- 4-52	----------	----------	----------	26.90	26.61	.29
83	11- 4-52	17:00	----------	----------	28.77	28.41	.36
36A	11- 4-52	17:00	----------	----------	----------	----------	1.0+
132	11- 4-52	17:20	27.33	27.32	----------	----------	1.0+
Oahu-T-24	11- 4-52	17:00	24.51	24.50	24.55	24.46	.09
Oahu-T-28	11- 4-52	17:00	12.19	12.19	12.22	12.16	.06
Oahu-T-41	11- 4-52	17:10	20.56	20.56	20.57	20.54	.03
132	11- 6-52	21:10	27.34	27.33	27.35	27.31	.04
36A	12- 6-52	11:10	29.45	29.48	29.49	29.44	.05
132	12- 6-52	11:10	27.82	27.84	27.89	27.78	.11
36A	12- 6-52	18:40	29.64	29.62	29.66	29.59	.07
132	12- 6-52	19:10	27.94	27.98	27.99	27.87	.12

+Water surface above mean sea level or land surface datum.
−Water surface below mean sea level.
[1] Values refer to mean sea level datum.

SEISMOLOGICAL OBSERVATORY RESULTS

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

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

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

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

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

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

All readings were made or revised at the Washington Office except those for Balboa Heights. All seismograms are on file in the United States Coast and Geodetic Survey, except those for Balboa Heights, Burlington, Logan, and New Kensington, which may be obtained on loan by addressing the Seismograph Station Director: Meteorological and Hydrographic Office, Panama Canal Company, Balboa Heights, C. Z.; University of Vermont, Burlington, Vt.; Utah State Agricultural College, Logan, Utah; 508 Pershing Drive, New Kensington, Pa.

For detailed instrumental data regarding these stations, including instrumentation, constants, and other information, see *Seismological Bulletin*, MSI–141, for the first quarter of 1950. Those desiring to receive this publication as issued should request addition of their name to the *CGS–7* mailing list. All requests should be made to the Director, United States Coast and Geodetic Survey, Washington 25, D. C.

TABLE 2.—*Summary of instrumental epicenters for 1950*

1950	Origin Time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter	
			Latitude	Longitude
	h m s		° ′	° ′
July 2	22 49 24*	Central Colombia. Felt at Bogota	4 N.	73½ W.
3	10 03 36*	Caroline Islands	8½ N.	141 E.
3	12 29 13*	Tonga Islands region	24 S.	176 W.
5	03 34 59*	New Hebrides Islands	19 S.	168 E.
5	18 30 13*	Southern Alaska	62 N.	154 W.
7	11 35 36	North of Indio, Calif. Mag. 3.2	33 50 N.	116 16 W.
7	16 46 54*	Solomon Islands	11 S.	164 E.
7	16 54 10*	Solomon Islands aftershock	11 S.	163 E.
8	03 31 41*	Kermadec Islands region. Mag. 5½-6	33½ S.	179½ W.
9	00 03 02*	Solomon Islands	10 S.	161 E.
9	00 28 24*	Pakistan	25½ N.	63 E.
9	01 39 29*	About 500 miles southwest of Easter Island. Mag. 6¾	33 S.	112 W.
9	02 35 30*	Northern Colombia. Destructive in Arboleta, Cucutilla, Salazar de las Palmas, Cucuta and Mutizca, Colombia; and in San Cristobal, Venezuela. 211 killed and 500 injured. Damage estimated at $5 million	8 N.	73 W.
9	03 28 59**	Northern Colombia aftershock		
9	03 34 27**	Azores Islands region		
9	03 38 33**	Azores Islands aftershock		
9	04 40 03*	Western Brazil. Depth about 650 km. Mag. 7	8 S.	71 W.
9	04 50 05*	Western Brazil aftershock. Depth about 650 km. Mag. 6¾-7	8 S.	71 W.
9	09 45 01*	Western Brazil aftershock. Depth about 650 km. Mag. 6¼-6½	8 S.	71 W.
9	12 34 13*	Northern Colombia aftershock	8 N.	73 W.
9	16 10 20*	Hindu Kush. Depth about 220 km	36½ N.	71 E.
9	19 17 12*	Pacific Ocean, about 600 miles south of Easter Island	36½ S.	103 W.
10	05 33 32**	Indian Ocean, about 400 miles north of Rodriquez Island		
10	13 51 20*	Fiji Islands. Depth about 600 km	21 S.	178½ W.
11	09 19 42	West of Bakersfield, Calif. Mag. 3.6	35 23 N.	119 15 W.
12	01 36 19*	Pacific Ocean, 700 miles west of Gallapagos Islands	1 S.	102 W.
12	11 09 12*	Fox Islands, Aleutian Islands. Mag. 6¼	53 N.	167 W.
12	11 48 01*	Tonga Islands. Depth about 100 km	20 S.	175 W.
12	15 46 51**	Off east coast of Kamchatka. Depth about 100 km		
12	20 57 10**	South of Alaska Peninsula		
12	21 26 25**	Near south coast of Karafuto. Depth about 500 km		
13	04 03 50*	Bonin Islands region. Depth about 500 km. Mag. 6¾-7	27½ N.	139½ E.
14	12 06 57*	Fox Islands, Aleutian Islands	52½ N.	168½ W.
15	10 28 47**	Tonga Islands aftershock. Depth about 100 km		
15	11 42 02**	Off coast of Peru		
15	13 29 21**	Tonga Islands. Depth about 60 km		
16	11 58 48*	Galapagos Islands region	2 S.	86 W.
17	08 56 26**	Central Peru		
17	20 17 55*	Loyalty Islands. Depth about 100 km	21½ S.	171 E.
17	21 09 28**	Near coast of northern Chile		
18	01 33 12*	Southern Honshu, Japan	35 N.	136 E.
19	10 52 09**	Andreanof Islands, Aleutian Islands. Depth about 150 km		
20	03 03 45**	Northern Chile. Felt. Depth about 100 km		
20	09 30 45*	Fiji Islands region	16½ S.	173 E.
20	13 14 24**	Fiji Islands aftershock		
21	07 18 55*	Kermadec Islands	29½ S.	178 W.
21	08 16 28*	Western Brazil. Depth about 650 km	7½ S.	71 W.
21	20 31 59*	New Hebrides Islands. Mag. 6¾-7	15½ S.	168½ E.
22	12 33 47**	Northern Catamarca province, Argentina. Depth about 100 km		
22	23 07 58**	New Hebrides Islands region		
23	15 50 06*	New Hebrides Islands	16 S.	165 E.
23	23 32 08*	Leeward Islands region	19 N.	61½ W.
25	18 15 00*	Mid-Atlantic ocean	31 N.	42 W.
26	08 31 29*	Off east coast of Dominican Republic	19 N.	67½ W.
27	09 39 52	Calipatria, Calif. Mag. 3.4	33 07 N.	115 34 W.
27	09 54	Calipatria, Calif. Mag. 4.1	33 07 N.	115 34 W.
27	11 29 26	Near Calipatria, Calif. Minor damage at Brawley and Niland. Mag. 4.8	33 07 N.	115 34 W.
27	17 30 29*	Fiji Islands region. Depth about 600 km	17 S.	179 W.
27	22 50 49	Calipatria, Calif. Mag. 4.5	33 07 N.	115 34 W.
28	03 25 30	Calipatria, Calif. Mag. 4.7	33 07 N.	115 34 W.
28	04 55 13*	New Hebrides Islands	13 S.	167 E.
28	05 28 21*	New Hebrides Islands aftershock	13 S.	167 E.
28	17 26 48	Calipatria, Calif. Mag. 4.7	33 07 N.	115 34 W.
28	17 50 48	Near Calipatria, Calif. Felt at Brawley, Niland, Westmoreland, and San Diego. Mag. 5.4	33 07 N.	115 34 W.
28	17 58 12	Calipatria, Calif. Mag. 4.8	33 07 N.	115 34 W.
29	00 17 10	Calipatria, Calif. Mag. 4.5	33 07 N.	115 34 W.
29	14 36 32	Near Calipatria, Calif. Estimated $50,000 property damage at Calipatria, Brawley, Niland, and Westmoreland. Mag. 5.5.	33 07 N.	115 34 W.
29	16 45 56*	Molucca Passage. Mag. about 7	2½ N.	127½ E.
29	18 42 48	Calipatria, Calif. Mag. 4.7	33 07 N.	115 34 W.
29	23 48 58*	Solomon Islands. Mag. 7.1	6 S.	155 E.
Aug. 1	02 04 43**	Near east coast of Hokkaido, Japan		
1	08 37 20	Calipatria, Calif. Felt. Mag. 4.8	33 07 N.	115 34 W.
1	09 11 39*	Off south coast of Hokkaido, Japan	42½ N.	145 E.
1	10 42 50**	Hokkaido aftershock		
2	06 50 48	West of Lompoc, Calif. Mag. 3.3	34 40 N.	120 48 W.
2	10 50 15*	Marianas Islands. Depth about 100 km. Mag. 6½-6¾	12 N.	142½ E.
2	13 49 55*	Near coast of Eritrea, Africa	15 N.	39½ E.
3	06 14 56*	Guerrero, Mexico. Felt. Mag. 6-6¼	18½ N.	100 W.

See footnotes at end of table.

TABLE 2.—*Summary of instrumental epicenters for 1950*—Continued

1950	Origin Time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter	
			Latitude	Longitude
	h m s		° ′	° ′
Aug. 3	09 28 04*	Near northern Colombia-Venezuela border. Felt	8 N.	72½ W.
3	15 26 38**	Marianas Islands region. Mag. 6½		
3	15 44 49**	Off east coast of Honshu, Japan		
3	22 18 18*	Northwestern Venezuela. Destructive at Tocoyo. 100 killed. Mag. 6¾.	10 N.	69½ W.
4	01 46 56	Southeast of Borrego Valley, Calif. Mag. 3.7	33 00 N.	116 05 W.
5	09 16 48*	Auckland Island region. Mag. 6¾	50 S.	164 E.
5	10 45 10**	Northwestern Venezuela aftershock		
6	12 45 25**	Samoa Islands region		
7	02 44 44*	Near south coast of Mindanao, Philippine Islands. Mag. 6¾	6 N.	126 E.
7	04 51 41**	Kurile Islands		
7	15 47 23*	Molucca Passage	1 N.	126½ E.
8	02 59 18**	Fiji Islands region. Depth about 600 km		
8	05 12 00*	Near coast of southeastern Alaska	55 N.	134½ W.
9	18 45 06**	Santa Cruz Islands		
10	09 55 26	North of Weldon, Calif. Mag. 3.6	35 43 N.	118 15 W.
10	17 55 08**	New Hebrides Islands region		
10	19 19 30*	Solomon Islands. Depth slightly greater than normal	7 S.	155½ E.
11	03 01 10**	Kurile Islands. Depth about 100 km		
11	10 23 11*	New Hebrides Islands region	17 S.	169 E.
11	20 20 52**	Tonga Islands		
12	02 17 17	Near Baldwin Lake, Calif. Felt at Big Bear, Highland, Riverside. Mag. 4.3.	39 19 N.	116 48 W.
12	10 44 07**	Kermadec Islands region		
12	16 10 16**	New Hebrides Islands		
13	16 43 20*	Near north coast of Dominican Republic	19½ N.	70½ W.
13	18 39 16*	Andreanof Islands, Aleutian Islands. Felt at Adak. Depth about 100 km.	51½ N.	177 W.
14	06 31 35**	Near coast of southern Peru. Felt		
14	19 16	Calipatria, Calif. Mag. 4.7	33 07 N.	115 34 W.
14	22 51 26*	Santiago del Estero province, Argentina. Depth about 650 km. Mag. 7¼.	27 S.	62½ W.
15	04 47 35**	Kurile Islands. Depth about 150 km		
15	14 09 30*	Assam. 574 killed. Damage estimated at $20 million. Mag. 8.6.	28½ N.	97 E.
15	18 38 40*	Assam	28½ N.	94½ E.
15	21 01 33*	----do	28 N.	96 E.
15	21 42 19*	Assam. Felt	26 N.	92½ E.
16	06 41 56*	Assam-Burma border	27 N.	96 E.
16	09 13 50*	Marianas Islands	14 N.	146 E.
16	17 51 27*	Assam-Bhutan border. Felt	27½ N.	92 E.
17	01 54 13*	Sikang province, China. Felt	29½ N.	94½ E.
17	05 29 14*	Sikang province, China	30 N.	94 E.
17	14 23 16*	Samoa Islands. Depth about 150 km	12½ S.	172 W.
17	16 15 22*	Fiji Islands region. Depth about 600 km. Mag. 6¾–7	21 S.	180
18	01 07 34*	Northern Burma. Felt	25½ N.	96 E.
18	16 58 47*	Sikang province, China	30 N.	96 E.
20	01 44 55*	Western Montana. Felt	47¼ N.	113¼ E.
20	09 03 35*	Assam-China border	29 N.	94 E.
20	23 34 19*	New Hebrides Islands	15 S.	167 E.
21	05 51 35*	Assam	28½ N.	96 E.
21	15 40 59*	Off north coast of Dominican Republic	20 N.	70 W.
22	06 43 16*	Sikang province, China	30½ N.	94 E.
22	07 40 15*	Near east coast of Kamchatka. Depth about 60 km	53 N.	159½ E.
22	13 22 17*	Northern Burma	27½ N.	97½ E.
22	22 47 58	Near Ventura, Calif. Felt. Mag. 4.2	34 09 N.	119 21 W.
23	03 09 21*	Sikang province, China	29½ N.	95 E.
23	18 47 02*	China-Assam border	29 N.	95½ E.
24	01 27 43*	Assam	28 N.	96½ E.
24	17 45 34*	Off coast of Oregon	42½ N.	126 W.
25	02 15 10*	Off coast of Vancouver Island	49½ N.	129 W.
26	04 39 27*	Seward Peninsula, Alaska. Felt at Nome. Mag. 6½	65 N.	162 W
26	07 12 29*	New Hebrides Islands. Depth about 100 km	19 S.	170 E.
26	10 41 33**	Fiji Island region. Depth about 300 km		
27	00 34 12*	Seward Peninsula aftershock. Felt at Nome	65 N.	162 W.
27	00 37 31*	----do	65 N.	162 W.
27	11 00 04*	Sikang province, China	30 N.	94 E.
27	14 26 12*	East central Peru. Depth about 150 km	8 S.	74½ W.
27	15 33 32**	Southwestern Alaska		
27	22 03 04*	Eastern Turkey	39 N.	41 E.
28	12 52 48**	Marianas Islands region		
28	19 45 26	North Big Bear Lake, Calif. Felt at Big Bear and Fawnskin	34 18 N.	116 47 W.
29	20 23 34**	Marianas Islands region		
30	04 47 44**	Fox Islands, Aleutian Islands. Depth about 100 km		
30	06 49 11**	Fox Islands, Aleutian Islands		
30	06 50 59*	Off south coast of Ceram Island. Mag. about 6½	4 S.	129½ E.
30	09 13 49*	New Hebrides Islands	19 S.	168 E.
30	09 24 35**	----do		
30	23 13 53**	----do		
31	07 05 36*	Near south coast of Mindanao, Philippine Islands. Mag. about 7.	6 N.	126 E.
31	17 22 12*	Northern Yugoslavia, 70 buildings destroyed at Dubrovici	45 N.	17½ E.
31	18 47 43*	Off coast of Oregon	42 N.	125 W.
31	19 52 33*	Assam-China border	29 N.	95½ E.

See footnotes at end of table.

TABLE 2.—*Summary of instrumental epicenters for 1950*—Continued

1950	Origin Time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter	
			Latitude	Longitude
	h m s		° ′	° ′
Sept. 1	02 46 55*	Indian Ocean	3½ S.	89½ E.
1	07 00 50**	Kurile Islands		
2	02 47 22*	Fox Islands, Aleutian Islands. Depth about 100 km. Mag. 6¼-6½.	52½ N.	169 W.
2	13 18 38**	Northeast of Balleny Islands, Antarctic Ocean		
2	16 14 40*	Sikang province, China	30 N.	96½ E.
2	23 59 39**	Mid-Atlantic Ocean, about 1,000 miles southwest of Cape Verde Islands		
3	00 33 50**	Fiji Islands region. Depth about 600 km		
3	02 53 03*	Sikang province, China	29 N.	93½ E.
3	04 05 15*	Solomon Islands	11 S.	162½ E.
3	19 18 55**	Off coast of El Salvador		
3	23 30 43*	Assam	29 N.	95 E.
4	06 19 02*	Assam-China border	29 N.	95½ E.
4	12 17 17*	Northern Turkey	41 N.	34½ E.
4	14 01 05**	Near south coast of Hokkaido, Japan		
5	04 04 36**	Central Italy foreshock		
5	04 09 00*	Central Italy. 2 killed, 35 injured, 21 villages damaged	42 N.	13½ E.
5	19 19 56	Northwest of Anza, Calif. Felt. Mag. 4.8	33 39 N.	116 45 W.
7	01 54 55**	About 300 miles south of Fiji Islands		
7	14 58 52**	Kermadec Islands. Depth about 500 km		
8	06 58 21*	Fiji Islands region. Depth about 500 km	22 S.	178 W.
8	07 14 53**	Near coast of Oaxaca, Mexico		
8	10 31 46	East of El Centro, Calif. Mag. 3.6	32 59 N.	115 45 W.
8	19 15 32	East of Paradise Valley, Nev. Mag. 3.7	41.5 N.	117.3 W.
9	05 37 38**	Northern Chile. Felt		
9	10 21 40*	New Britain region. Mag. 6¼	4 S.	153 E.
9	12 42 06**	Tonga Islands		
9	14 27 44*	New Hebrides Islands region	20 S.	170 E.
10	03 21 25*	Near east coast of Honshu, Japan. Felt at Tokyo. Depth about 60 km. Mag. 6¾.	35 N.	140 E.
10	15 16 04*	New Hebrides Islands. Depth about 100 km. Mag. 7.1	15½ S.	168½ E.
11	00 18 34*	Assam-China border	29 N.	94 E.
11	01 14 50**	Samoa Islands		
12	03 53 10**	Near north coast of Luzon, Philippine Islands. Felt at Laoag		
13	06 06 02**	Hokkaido, Japan. Depth slightly greater than normal		
13	11 07 41*	Assam-China border. Felt	29 N.	94 E.
13	11 59 40*	Off east coast of Greenland	76 N.	3 E.
13	20 43 10**	New Hebrides Islands region		
14	07 31 20**	Andreanof Islands, Aleutian Islands. Felt on Adak and Great Sitkin.		
14	07 52 27*	Central Bolivia. Depth about 600 km	19 S.	63 W.
14	09 05 57**	Molucca Passage. Depth about 200 km		
14	21 45 00**	Off south coast of Mozambique		
15	14 14 30*	Tonga Islands. Depth about 100 km	23 S.	176 W.
15	19 05 08*	Tonga Islands. Depth about 250 km	16 S.	175 W.
16	00 55 36*	About 1,000 miles west of Galapagos Islands. Mag. 6½	4 S.	104½ W.
16	12 30 50**	Kurile Islands		
16	12 39 13*	do	48 N.	156 E.
16	12 48 39*	Kyushu, Japan. Depth about 150 km. Felt at Fukuoka and Hiroshima.	32½ N.	131 E.
16	21 58 15*	Rat Islands, Aleutian Islands. Depth about 100 km. Mag. 6½-6¾.	52 N.	177 E.
17	19 43 30	Lower California. Felt from San Diego to Jacumba. Mag. 4.5	32 10 N.	116 25 W.
18	19 36 43*	Western Brazil. Depth about 650 km. Mag. about 6	8 S.	71 W.
19	02 34 58**	About 300 miles south of Fiji Islands		
19	20 29 48*	Near north coast of New Guinea. Mag. 6.9	2 S.	138½ E.
20	00 34 46*	New Britain region. Depth about 500 km	4 S.	154 E.
20	03 04 16*	Chiapas, Mexico. Depth about 100 km	17 N.	93 W.
21	22 02 13	East of Fallon, Nev. Mag. 3.7	39.4 N.	118.0 W.
21	22 51 01*	Indian Ocean. Mag. 5¾	9½ S.	66 E.
22	01 36 36*	Kurile Islands. Depth about 150 km	47½ N.	153 E.
22	07 52 07*	Easter Island region. Mag. 6¾	25 S.	114 W.
22	08 05 35**	Kurile Islands region		
22	23 53 29*	Fiji Islands region. Depth about 450 km. Mag. 7	18 S.	177 W.
23	06 23 40*	Southeastern Crete. 4 injured and 400 buildings damaged	35 N.	25½ E.
23	17 26 15**	South of Fox Islands, Aleutian Islands		
23	18 38 40*	Near north coast of Mindanoa, Philippine Islands. Felt at Surigao and Hinatuan.	9½ N.	126½ E.
23	20 21 55**	Fiji Islands region		
24	07 27 18	Off Cape Mendocino, Calif. Mag. 3.8	40 15 N.	124 24 W.
24	22 13 28*	East central Alaska. Felt at College	64 N.	146 W.
24	22 56 39*	Northeastern Iran	34½ N.	60 E.
25	02 49 57**	Off east coast of Mindanao, Philippine Islands. Felt at Surigao and Hinatuan.		
25	18 09 27*	Central Chile. Felt	32½ S.	71 W.
25	23 15 58*	Off east coast of Mindanao, Philippine Islands. Felt at Surigao and Hinatuan.	9½ N.	126 E.
26	06 45 48**	Southeastern Peru		
27	03 36 55*	Off coast of Mexico. Mag. 5¼-5½	20 N.	108½ W.
27	03 43 32**	Mexico aftershock		
27	08 23 58*	Fiji Islands region	18½ S.	175 E.
28	03 29 36*	Near east coast of Formosa	23 N.	121 E.

See footnotes at end of table.

TABLE 2.—*Summary of instrumental epicenters for 1950*—Continued

1950	Origin Time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter	
			Latitude	Longitude
	h m s		° ′	° ′
Sept. 28	11 03 22	Northwest of Bishop, Calif. Felt at Bishop, Laws, and Owens Gorge. Mag. 4.1.	37 29 N.	118 35 W.
28	13 25 11*	New Britain	5 S.	151 E.
28	21 47 01*	Northwest of Queen Charlotte Islands. Felt on Annette Island	54½ N.	134½ W.
29	00 43 15**	Marianas Islands region		
29	06 32 16*	Off coast of Colima, Mexico. Depth about 60 km. Mag. 7	19 N.	107 W.
29	07 54 24**	Colima aftershock. Mag. 6–6¼. Depth about 60 km		
30	07 28 54*	Assam. Felt	28½ N.	94 E.
Oct. 1	01 35 30**	Samoa Islands region. Felt at Apia		
1	09 28 45**	Samoa Islands. Felt at Apia		
1	13 06 14**	Queen Charlotte Islands region		
2	11 43 30*	Off west coast of Mexico	21 N.	108½ W.
3	09 03 58**	Western Alaska		
3	11 38 00	South of Noyo, Calif. Felt at Fort Bragg. Mag. 2.7	39 24 N.	123 51 W.
3	11 56 22**	Tonga Islands region		
3	12 40 08*	Western Yukon, Canada	65½ N.	128 W.
3	23 01 57*	Assam	28 N.	96½ E.
4	17 10 53**	New Hebrides Islands. Depth about 100 km		
4	18 03 23*	New Hebrides Islands	19 S.	169 E.
5	00 41 07*	New Hebrides Islands region. Mag. about 6¼	18½ S.	170 E.
5	16 09 25*	Near coast of Costa Rica. Moderate property damage and several injured at Puntarenas and San Jose. Mag. 7.7.	10½ N.	85½ W.
5	16 48 17*	Near coast of Costa Rica	10 N.	85 W.
5	20 09 13*	Costa Rica aftershock	10½ N.	85½ W.
5	20 52 30*	----do----	10½ N.	85½ W.
5	23 07 49*	Near coast of Ecuador. Felt	3½ S.	80½ W.
6	01 39 00	Pinto Mountains, Calif. Mag. 3.4	33 57 N.	115 50 W.
6	08 16 02*	Off northeast coast of Puerto Rico. Depth about 100 km	19½ N.	65 W.
6	11 20 05*	Mona Passage	17 N.	68 W.
6	12 43 03*	Off northeast coast of Puerto Rico	19½ N.	64½ W.
6	14 31 47**	Lower California		
6	15 39 44	Off Cape Mendocino, Calif. Mag. 4.1	40 23 N.	124 45 W.
7	19 58 10*	About 50 miles west of Vancouver Island, British Columbia	50 N.	129½ W.
8	03 23 07*	Banda Sea. Felt at Amboina. Mag. 7.6	4 S.	128 E.
8	04 50 08**	Northern Assam. Felt		
8	06 40 18	•Near San Nicolas Island, Calif. Mag. 3.5	33 09 N.	119 53 W.
8	07 24 02*	North Atlantic Ocean	32½ N.	40½ W.
8	07 29 39*	----do----	31 N.	41 W.
8	09 01 29**	Santa Cruz Islands region		
8	11 09 36*	North Atlantic Ocean	32 N.	40½ W.
8	11 30 51**	----do----		
8	11 35 06**	About 400 miles south of Fiji Islands		
8	12 24 19	Off Cape Mendocino, Calif. Mag. 4.6	40 17 N.	124 48 W.
8	14 49 37**	New Britain Island region		
8	16 37 23*	----do----	32 N.	41 W.
8	16 40 34*	----do----	31 N.	40½ W.
8	16 49 11*	North Atlantic Ocean	32 N.	41 W.
9	17 31 55**	Marianas Islands, about 300 miles north of Guam		
10	16 20 14*	Costa Rica aftershock	10½ N.	85½ W.
10	18 42 20*	Near southwest coast of South Island, New Zealand. Felt	45 S.	167 E.
10	23 15 21*	Fiji Islands. Depth about 600 km	17 S.	179 W.
11	02 54 18*	Off coast of Panama	5½ N.	83 W.
11	04 01 00**	Off west coast of Costa Rica		
11	08 09 17**	Southern Alaska. Depth about 60 km		
11	08 35 11**	Southern Alaska. Depth about 60 km. Felt at Anchorage		
12	23 49 28*	Ceram Island region	4 S.	128 E.
13	14 32 48*	Santa Cruz Islands region	10 S.	166 E.
14	00 22 00**	Mid-Atlantic Ocean		
14	04 59 26*	New Britain Island	5 S.	150½ E.
14	13 27 07**	Costa Rica aftershock		
14	17 41 36**	----do----		
14	17 59 31	Near Hemet Reservoir, Calif. Mag. 3.1	33 41 N.	116 47 W.
14	20 25 38	Lower California. Mag. 3.8	32 10 N.	116 34 W.
15	15 59 53*	Solomon Islands. Mag. about 6½	10 S.	160 E.
15	20 40 11	Near Brawley, Calif. Felt. Mag. 3.8	33.0 N.	115.4 W.
15	23 42 50**	Tonga Islands		
16	00 48 45	New Brawley, Calif. Felt. Mag. 3.9	33.0 N.	115.4 W.
16	05 25 22*	Near coast of northern Peru. Depth about 60 km. Felt	5 S.	80 W.
16	07 57 03**	North Atlantic Ocean		
16	15 42 36*	Sikang province, China	29 N.	95 E.
17	03 54 25*	Central Nevada. Mag. 4.3	39½ N.	117½ W.
17	10 31 46**	Costa Rica aftershock		
17	14 56 10**	----do----		
17	15 06 46*	Off west coast of Costa Rica. Depth about 150 km	11 N.	88 W.
17	16 35 17*	Santa Cruz Islands region	13 S.	165 E.
17	22 07 20*	Near coast of Costa Rica	10 N.	85½ W.
19	03 48 25*	Off northeast coast of Puerto Rico	19½ N.	64 W.
19	09 51 11*	Kermadec Islauds region	34 S.	178 W.
19	23 13 07	Near Brown, Calif. Mag. 3.2	35 43 N.	117 55 W.
20	07 44 39*	Puerto Rico aftershock	19½ N.	65 W.
21	04 12 56*	Tonga Islands. Depth about 60 km. Mag. about 6½	18½ S.	173½ W.
21	08 27 13**	Colima, Mexico, foreshock		
21	08 57 10**	Colima, Mexico, foreshock. Mag. about 5¾		
21	09 42 58*	Off coast of Colima, Mexico. Mag. about 6¼	17½ N.	106 W.

See footnotes at end of table.

TABLE 2.—*Summary of instrumental epicenters for 1950*—Continued

1950	Origin Time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter	
			Latitude	Longitude
	h m s		° ′	° ′
Oct. 21	13 33 51**	Galapagos Islands region		
21	16 01 12*	Santa Cruz Islands. Depth about 200 km	11½ S.	166½ E.
22	05 52 03*	Near coast of eastern Crete. Felt at Sitia and Hierpetra	35 N.	26 E.
22	15 10 47*	Kurile Islands region. Depth about 100 km	48½ N.	153 E.
22	18 54 46**	New Hebrides Islands. Depth slightly greater than normal		
23	08 12 50*	Central Nevada. Mag. 4.6	39½ N.	117 W.
23	14 55 30**	Guatemala foreshock		
23	15 03 34**	do		
23	16 13 18*	Near coast of Guatemala. Felt in Chiapas, Mexico. Mag. 7.3	14½ N.	92 W.
23	17 05 25*	Guatemala aftershock	15 N.	91½ W.
23	17 47 51*	Guatemala aftershock. Mag. about 6½	14½ N.	92 W.
23	17 59 36*	Guatemala aftershock	14½ N.	92 W.
23	19 50 50*	do	15 N.	91½ W.
23	21 32 00*	do	14½ N.	91½ W.
23	23 38 44*	Guatemala aftershock. Mag. 6.1	14½ N.	92 W.
23	23 49 04**	Guatemala aftershock		
24	00 23 22**	do		
24	00 52 03*	Guatemala aftershock. Mag. 6.2	15 N.	92 W.
24	01 45 25**	Kermadec Islands region		
24	01 52 02**	Guatemala aftershock		
24	05 50 15*	do	14½ N.	92 W.
24	06 16 40**	do		
24	09 28 49**	do		
24	15 55 04*	do	14½ N.	92 W.
24	22 18 42*	Off east coast of Hokkaido, Japan	43½ N.	148 E.
25	05 05 02**	Guatemala aftershock		
25	07 03 18*	Ryukyu Islands. Felt at Ishigaki Island. Depth about 100 km	26 N.	125½ E.
25	08 44 07*	Solomon Islands	6½ S.	155 E.
26	02 44 50**	Guatemala aftershock		
26	03 49 55*	Kermadec Islands foreshock. Mag. about 6¼	32 S.	178 W.
26	07 10 44*	Loyalty Islands region. Depth about 60 km	21½ S.	170½ E.
26	11 46 16*	Off northeast coast of Honshu, Japan. Felt	38 N.	143 E.
26	15 38 43*	Kermadec Islands. Mag. 6½–6¾	31½ S.	178 W.
27	05 59 10*	Pacific Ocean, about 400 miles southwest of Guam	11½ N.	139 E.
27	21 28 41*	New Hebrides Islands	15 S.	167 E.
27	22 24 53*	Tonga Islands region	23 S.	177 W.
28	09 05 38*	Kermadec Islands	32 S.	177½ W.
28	22 15 45*	Near coast of Guatemala. Felt. Depth about 100 km	14½ N.	92 W.
30	02 26 10*	Somoa Islands region. Felt at Apia. Depth about 60 km	14 S.	173½ W.
30	10 22 57*	Southeastern Peru. Depth abont 150 km	13½ S.	69½ W.
30	13 50 22*	Solomon Islands region	11 S.	163 E.
31	04 49 15*	Andreanof Islands, Aleutian Islands	52 N.	174 W.
31	19 15 16*	Mid-Atlantic Ocean	½ N.	25½ W.
31	19 35 14**	Gulf of California foreshock		
31	20 22 30*	Gulf of California. Mag. about 5½	23½ N.	108 W.
Nov. 1	01 22 57**	Guatemala foreshock		
1	12 45 30*	Near west coast of Costa Rica. Depth about 60 km	10½ N.	85 W.
1	20 21 22	Baja, California. Felt at Campo. Mag. 3.9	32 07 N.	116 28 W.
2	05 06 22	Western Nevada. Felt at Reno. Mag. 3.9	39 37 N.	119 55 W.
2	07 07 38*	Off northwest coast of Formosa	26½ N.	121 E.
2	07 30 56**	Fiji Islands region. Depth about 600 km		
2	15 27 53*	Banda Sea. Felt at Darwin. Depth about 60 km. Mag. 7.5	6½ S.	129 E.
2	18 14 07*	Banda Sea aftershock. Depth about 60 km	6½ S.	129 E.
2	20 17 27*	Sikang province, China	30 N.	97½ E.
3	06 29 42*	About 150 miles southwest of Puerto Rico	16 N.	67 W.
4	07 22 45*	New Hebrides Islands. Depth about 150 km	15 S.	168 E.
4	08 56 10**	About 300 miles south of Fiji Islands		
4	13 20 35*	Sonora, Mexico	31½ N.	113½ W.
5	11 35 40	Southeast of Brawley, Calif. Mag. 3.4	32 55 N.	115 27 W.
5	16 35 20*	Near coast of Guatemala. Mag. 6¼	14½ N.	92 W.
5	17 37 25*	Off coast of Shikoku, Japan. Felt. Mag. 6.9	33 N.	134½ E
6	18 26 58	Near Indian Springs, Nev. Mag. 3.8	36 35 N.	115 40 W.
6	20 55 46	Northwest of Los Coronados, Calif. Felt at San Diego. Mag. 4.4	32 43 N.	117 50 W.
6	22 22 05*	Solomon Islands region. Depth slightly greater than normal. Mag. 6½–6¾	7½ S.	155½ E.
7	01 27 37**	Off west coast of Puerto Rico		
7	06 24 40**	Solomon Islands aftershock		
7	15 02 35	Off Huntington Beach, Calif. Felt. Mag. 2.9	33 38 N.	118 01 W.
7	15 44 37	Near Santa Susana, Calif. Mag. 2.8	34 13 N.	118 43 W.
7	16 40 55**	Kurile Islands region		
8	01 59 06*	New Hebrides Islands	18 S.	168 E.
8	02 18 10*	Solomon Islands region. Mag. 7¼	9½ S.	159 E.
8	02 36 00*	Solomon Islands aftershock	9½ S.	159 E.
8	06 41 08*	do	9½ S.	159 E.
8	08 54 43	Near Calabasas, Calif. Mag. 3.1	34 04 N.	118 41 W.
8	10 07 54**	East-central Turkey		
8	11 49 22*	Solomon Islands aftershock	9½ S.	159 E.
8	11 53 30*	do	9½ S.	159 E.
9	11 00 22**	Andreanof Islands, Aleutian Islands		
9	11 54 53*	Kurile Islands. Depth about 200 km	46½ N.	150 E.
9	12 07 46*	Solomon Islands aftershock	9½ S.	159 E.
9	12 27 00	Kurile Islands. Depth about 200 km	48 N.	152 E.
10	00 35 42	Northeast of Morongo Valley, Calif. Mag. 3.5	34 08 N.	116 31 W.
10	02 14 17*	Revilla Gigedo Islands region. Mag. 5½–5¾	20 N.	109½ W.

See footnotes at end of table.

TABLE 2.—*Summary of instrumental epicenters for 1950*—Continued

1950	Origin Time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter	
			Latitude	Longitude
	h m s		° ′	° ′
Nov. 10	05 02 05*	Samoa Islands region. Depth about 350 km	16 S.	176 W.
10	17 28 15	Western Nevada. Felt at Reno. Mag. 4.0	39 38 N.	119 41 W.
11	03 38 07*	Off east coast of New Guinea	6 S.	148 E.
11	09 28 23*	Revilla Gigedo Islands. Mag. about 5½	19½ N.	109 W.
11	13 51 08*	Costa Rica aftershock	10½ N.	85 W.
11	14 19 45*	Off east coast of Kamchatka	53 N.	161 E.
11	19 14 39	South of Gorman, Calif. Mag. 3.3	34 40 N.	118 50 W.
11	19 32 28	South of Gorman, Calif. Mag. 3.1	34 40 N.	118 50 W.
12	08 26 26	Off Cape Mendocino, Calif. Felt at Ferndale. Mag. 3.7	40.7 N.	124.9 W.
12	23 32 28	Little San Bernardino Mts., Calif. Mag. 3.8	34 01 N.	116 00 W.
14	02 04 40	Mt. Lassen, Calif. Felt at Mineral. Mag. 4.1	40 29 N.	121 30 W.
14	02 35 50	Mt. Lassen, Calif. Felt at Mineral, Chester, Lake Alamnor, and Butte Valley. Mag. 4.6.	40 29 N.	121 30 W.
14	04 15	Mt. Lassen aftershock. Mag. 3.2		
14	04 23 46*	Solomon Islands	11 S.	161 E.
14	04 32 00**	Solomon Islands afterchock		
14	05 35	Mt. Lassen aftershock. Mag. 3.6		
14	06 34 32	Mt. Lassen aftershock. Mag. 4.5	40 29 N.	121 30 W.
14	08 32 34**	Solomon Islands aftershock		
14	21 55 53	Mt. Lassen aftershock. Felt at Caribou Powerhouse. Mag. 4.0	40 29 N.	121 30 W.
15	03 22 42	Mt. Lassen aftershock. Mag. 4.1	40 29 N.	121 30 W.
16	00 57 15**	Marianas Islands region. Depth about 100 km		
16	05 26 49*	Off coast of Hokkaido, Japan. Depth about 60 km	41½ N.	145 E.
16	07 08 29**	Solomon Islands		
16	13 12 11*	Kermadec Islands region	32 S.	180
17	03 46 51	Near Hawthorne, Calif. Felt in Los Angeles. Mag. 3.8	33 55 N.	118 19 W.
17	11 57 23	Pinto Mts., Calif. Mag. 3.3	34 08 N.	115 50 W.
17	15 57 40*	Mid-Atlantic Ocean	6 N.	36 W.
17	19 28 23*	Near coast of Mexico. Depth about 60 km. Mag. 6¾. Felt on board SS. *Corrientes* at 17°00′ N., 100°35′ W.	17½ N.	100½ W.
17	22 01 04*	Tadzhik, S. S. R.	39 N.	70 E.
18	04 57 52	West of Shoshone, Calif. Mag. 3.5	36 00 N.	116 25 W.
19	21 34 56**	Tadshik, S. S. R., aftershock		
19	23 43 31	Off Cape Mendocino, Calif. Mag. 4.2	39 43 N.	125 31 W.
21	07 10 03*	China-India border	29 N.	96 E.
21	13 55 58*	Southern Bolivia. Depth about 300 km	20½ S.	65 W.
21	22 21 18*	Off northeast coast of New Guinea	3½ S.	147 E.
22	10 16 28*	Andreanof Islands, Aleutian Islands. Felt on Adak. Depth about 60 km. Mag. 6¾.	51½ N.	176½ W.
23	13 58 24	Southwest of Hollister, Calif. Felt at Hollister and Watsonville. Mag. 4.1.	36 49 N.	121 31 W.
24	13 03 42*	Samoa Islands. Mag. 6¼–6½	15 S.	173 W.
24	20 18 48*	....do	15 S.	173 W.
25	05 21 30**	Samoa Islands region. Felt at Apia		
25	17 18 48**	Eastern Turkey		
26	03 02 04**	Tonga Islands region		
26	06 09 05**	Kermadec Islands region. Depth about 60 km		
27	02 01 28**	Samoa Islands region		
27	03 28 24**	....do		
27	17 10 03**	Samoa Islands region. Felt at Apia		
27	18 08 19**	Andreanof Islands, Aleutian Islands. Felt on Adak		
28	12 18 45**	Samoa Islands region		
28	17 53 15*	Western Turkey. Felt	39 N.	28 E.
29	01 37 52*	Marianas Islands region	22 N.	143 E.
29	18 35 47*	Banda Sea	4 S.	128½ E.
Dec. 1	14 50 58*	Atlantic Ocean. Depth about 60 km. Mag. 7	14½ N.	47 W.
1	17 31 13*	Fox Islands, Aleutian Islands	52 N.	172 W.
1	19 01 10**	Near west coast of Guatemala. Depth about 100 km		
2	08 30 27*	Near coast of central Chile. Felt. Depth about 100 km	26 S.	71 W.
2	15 19 20*	Western Brazil. Depth about 650 km. Mag. 6¾	7½ S.	71 W.
2	16 17 10*	New Hebrides Islands	17 S.	168 E.
2	18 40 38*	Western Brazil aftershock. Depth about 650 km	7½ S.	71 W.
2	19 51 50*	New Hebrides Islands. Depth about 60 km. Mag. 7¾	18 S.	167½ E.
2	19 55 28**	New Hebrides Islands aftershock. Depth about 60 km. Mag 7¼		
2	21 15 13**	New Hebrides Islands aftershock. Depth about 60 km		
2	21 46 45**	New Hebrides Islands aftershock. Depth about 60 km		
2	22 09 13**	....do		
2	22 18 12*	....do	18 S.	167½ E.
2	22 56 08**	....do		
3	03 07 47**	....do		
3	06 26 52*	Northern Assam	29 N.	95½ E.
3	07 47 36**	New Hebrides Islands aftershock. Depth about 60 km		
3	08 22 12**	....do		
3	09 40 13**	....do		
3	11 55 18**	....do		
3	13 26 59**	....do		
3	13 31 47**	....do		
3	16 01 31**	....do		
3	20 04 40**	Santa Cruz Islands region		
3	20 25 24**	New Herbides Islands aftershock. Depth about 60 km		
4	01 44 06**	....do		
4	03 55 48**	....do		
4	06 47 00**	Northern Alaska Peninsula. Depth about 100 km		
4	07 38 02*	New Hebrides Islands aftershock. Depth about 60 km	18 S.	167½ E.

See footnotes at end of table.

TABLE 2.—*Summary of instrumental epicenters for 1950*—Continued

1950	Origin Time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter	
			Latitude	Longitude
	h m s		° ′	° ′
Dec. 4	10 18 05*	New Hebrides Islands. Depth about 60 km	17 S.	166 E.
4	11 07 48*	New Hebrides Islands aftershock. Depth about 60 km	18 S.	167½ E.
4	13 51 50**	Fiji Islands region		
4	16 21 35*	Leeward Islands	18½ N.	63 W.
4	16 28 01*	New Britain Island region. Depth about 100 km. Mag. 7.2	5 S.	553½ E.
4	20 12 16*	New Hebrides Islands. Depth about 60 km	17 S.	166½ E.
4	20 38 16**	New Hebrides Islands aftershock. Depth about 60 km		
4	21 35 12**	Northern Chile-Bolivia border region. Depth about 150 km		
5	01 34 20**	New Hebrides Islands aftershock. Depth about 60 km		
5	05 47 04**	Samoa Islands. Depth about 60 km		
5	08 43 07**	New Hebrides Islands aftershock. Depth about 60 km		
5	11 55 46**	New Hebrides Islands region		
5	12 06 11**	New Hebrides Islands aftershock. Depth about 60 km		
5	16 52 18*	....do	18 S.	167½ E.
5	21 41 30**	Kyushu foreshock		
5	21 53 38*	Near south coast of Kyushu, Japan	31 N.	130 E.
6	04 00 41**	Solomon Islands region		
6	07 18 41**	New Hebrides Islands aftershock. Depth about 60 km		
6	16 54 10**	....do		
6	17 44 30**	Off south coast of Honshu, Japan		
6	21 06 07**	New Hebrides Islands aftershock. Depth about 60 km		
7	04 54.8	Near Volcano Lake, Calif. Mag. 3.9	32.4 N.	115.1 W.
7	05 04.9	Near Volcano Lake, Calif. Mag. 4.1	32.4 N.	115.1 W.
8	00 58 40**	New Hebrides Islands aftershock. Depth about 60 km		
8	04 53 37**	Southern Idaho-Oregon border region		
8	07 09 12*	Tonga Islands region	23 S.	178 W.
8	08 58 56**	New Hebrides Islands aftershock. Depth about 60 km		
8	12 49 55*	Samoa Islands	15 S.	173 W.
8	15 31 39**	New Hebrides Islands aftershock. Depth about 60 km		
9	05 45 09**	Tonga Islands		
9	17 46 18**	New Hebrides Islands aftershock. Depth about 60 km		
9	21 38 44*	Northern Argentina-Chile border. 1 killed and several injured at Calama, Chile. Also felt at Arica, Chile, and on board SS. *Santa Margarita* at 22°42′ S., 71°10′ W. Depth about 100 km. Mag. 8.0.	24 S.	67 W.
10	02 50 40*	Near coast of southern Peru. 4 killed, 12 injured, and moderate property damage at Ica. Depth about 60 km.	14 S.	76 W.
10	05 09 02**	Solomon Islands region. Depth about 60 km		
10	06 45 11*	Hawaiian Islands. Felt	19½ N.	155½ W.
10	08 31 10	West of Clark Lake, Calif. Mag. 3.4	33 21 N.	116 25 W.
10	08 41 40*	Near east coast of Kamchatka	54½ N.	161½ E.
10	09 08 45*	Near coast of southern Peru	15 S.	77 W.
10	09 45 44**	New Hebrides Islands aftershock. Depth about 60 km		
10	11 16 44**	New Hebrides Islands. Depth about 60 km		
10	13 23 10*	Kermadec Islands region. Depth about 300 km. Mag. 7¼	28½ S.	179 W.
10	21 04 53**	Salta province, Argentina		
11	03 32 55*	Northern Argentina-Chile border. Depth about 200 km	23 S.	68 W.
11	07 25 06*	Hawaiian Islands. Felt	19½ N.	155½ W.
11	14 46 41*	Western Brazil. Depth about 650 km. Mag. 6¼	8 S.	71 W.
11	22 29 01	Herlong, Calif. foreshock. Felt at Doyle. Mag. 4.1	40 05 N.	120 04 W.
14	00 31 53*	New Hebrides Islands region	19 S.	171 E.
14	01 52 46*	Tonga Islands region. Felt at Nukualofa and Apia. Depth about 200 km. Mag. 7.7.	19½ S.	176 W.
14	03 00 26**	Tonga Islands aftershock. Depth about 200 km		
14	08 59 34	Herlong, Calif., foreshock. Felt at Wendel. Mag. 4.5	40 05 N.	120 04 W.
14	09 19 59	Herlong, Calif., foreshock. Mag. 4.0	40 05 N.	120 04 W.
14	09 29 51	Herlong, Calif., foreshock. Felt at Vinton. Mag. 4.0	40 05 N.	120 04 W.
14	13 10 38	Herlong, Calif., foreshock. Mag. 4.0	40 05 N.	120 04 W.
14	13 24 19	Near Herlong, Calif. Felt in northeastern California and western Nevada. Slight damage at Herlong Mag. 5.6	40 05 N. 40 05 N.	120 04 W. 120 04 W.
14	13 56 23	Near Wheeler Ridge, Calif. Mag. 4.4	35 03 N.	119 10 W.
14	14 15 48*	Oaxaca, Mexico. Felt in central and southeastern Mexico. Slight damage in the Federal District. Mag. 7.3.	17 N.	98½ W.
14	16 41 11	Herlong, Calif., aftershock. Mag. 4.1	40 05 N.	120 04 W.
15	01 38 01**	Bonin Islands region. Depth about 100 km		
15	09 34 32**	Herlong, Calif., aftershock		
15	09 49 40**	Southern Mexico aftershock		
15	18 01 15	Herlong, Calif., aftershock. Felt at Herlong and Wendel. Mag. 4.4.	40 05 N.	120 04 W.
15	23 51 52**	Argentina-Bolivia border. Depth about 200 km		
16	07 17 00**	Southern Mexico aftershock		
16	10 49 01*	Off coast of Oregon	43½ N.	127 W.
17	01 08 01*	Southern Mexico aftershock. Mag. about 6¼	17 N.	98½ W.
18	02 29 53**	Kermadec Islands		
18	08 04 46*	Guatemala. Depth about 200 km	15 N.	90 W.
18	15 25 15**	About 600 miles off coast of southern Chile		
18	15 44 39*	Near south coast of Ceram Island	4 S.	128½ E.
19	09 18 25**	Samoa Island. Felt at Apia		
19	19 43 53*	Off coast of Vancouver Island, British Columbia	49 N.	129 W.
19	21 27 19*	North Atlantic Ocean	54 N.	35 W.
20	02 13 06**	Southern Mexico aftershock		
20	18 17 52**	....do		
21	11 36 48*	Central Chile. Felt. Depth about 100 km	29½ S.	71 W.
21	23 57 06**	Off south coast of Mexico		

See footnotes at end of table.

TABLE 2.—*Summary of instrumental epicenters for 1950*—Continued

1950	Origin Time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter	
			Latitude	Longitude
	h m s		° ′	° ′
Dec. 22	02 05 36	Southwest of Santa Rosa Mountain, Calif. Felt in Santa Rosa Mountains, and at Campo and Hemet. Mag. 4.0.	33 25 N.	116 34 W.
22	07 56 05*	Galapagos Islands region	3 N.	95 W.
22	09 10 37*	Nicobar Islands	8 N.	91½ E.
22	12 27 04	Near Haiwee, Calif. Mag. 3.2	36 04 N.	118 01 W.
22	17 33 48**	Kermadec Islands		
23	08 53 00*	Northern Honshu, Japan	38 N.	140½ E.
23	17 46 10*	Fiji Islands region. Depth about 600 km	21 S.	179½ W.
24	05 10 03**	Off south coast of Kyushu, Japan		
24	09 16 20**	Kyushu, Japan		
24	16 33 48**	Ascension Island		
24	20 36 44*	New Hebrides Islands	18½ S.	168½ E.
25	00 16 09	Near Deep Springs, Calif. Mag. 3.5	37 20 N.	118 04 W.
26	06 18 35**	Southeastern Peru		
26	12 05 49	North of Arlington, Calif. Felt at Riverside. Mag. 3.1	33 57 N.	117 35 W.
26	12 26 14	Southwest of Bishop, Calif. Mag. 3.0	37 16 N.	118 33 W.
26	13 51 43*	Southern Mexico aftershock. Felt. Mag. 6½	17 N.	98 W.
27	04 34 07*	Northern Chile. Depth about 100 km	20 S.	70 W.
27	23 10 02**	Leeward Islands foreshock. Depth about 100 km		
27	23 19 24**	....do		
28	02 31 22**	Off southeast coast of Kamchatka		
28	14 17 26*	Western Brazil. Depth about 650 km. Mag. 6¼	7½ S.	71 W.
28	21 06 16*	Near coast of southern Peru. Depth about 60 km	15 S.	76 W.
28	22 41 11*	Volcano Islands region. Depth about 100 km	23 N.	142½ E.
29	11 15 10**	Tonga Islands		
29	11 56 03*	Tibet	32½ N.	87½ E.
29	20 16 30*	Leeward Islands. Depth about 100 km	17 N.	62½ W.
30	03 48 09	Near Desert Hot Springs, Calif. Felt at Whitewater. Mag. 3.7	33 57 N.	116 30 W.
30	06 42 51*	Kermadec Islands region. Depth about 60 km	31 S.	176½ W.
30	13 02 19*	Central Ecuador. Depth about 200 km	1 S.	77 W.
30	16 08 52	Near Cottonwood Lakes, Calif. Felt at Cottonwood. Mag. 3.2	36 26 N.	118 13 W.
30	21 14 44*	Tonga Islands region. Depth about 250 km	18½ S.	175½ W.
31	09 46 29**	Leeward Islands aftershock. Depth about 100 km		

*Indicates probable error of ⅒ minute. ** Indicates probable error of ¼ minute.

TABLE 3.—*Principal earthquakes of the world from January through December 1952*

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

1952	Origin time G. C. T.			Region	Coordinates of provisional epicenter				Remarks
					Latitude		Longitude		
	h	m	s		°		°		
Jan. 3	06	03	48*	Erzurum Province, Turkey	39½	N.	41½	E.	Severe damage to 17 villages, 94 killed and 262 injured; 157 houses destroyed or damaged in the Hasankale region.
13	04	03	41*	Ryukyu Islands region	23	N.	124½	E.	Felt in Ryukyus. Mag. 6.9.
31	20	55	11*	Ruanda-Urundi, Tanganyika	4	S.	30½	E.	Mag. 6¼.
Feb. 11	07	01	01*	Java Sea	5½	S.	110	E.	Depth about 650 km. Mag. 6.9.
14	03	38	10*	Flores Sea, north of Timor Island.	7	S.	126½	E.	Mag. 7¼.
26	11	31	03*	Peru-Bolivia	14	S.	69½	E.	Depth about 250 km. Mag. about 7.
Mar. 4	01	22	41*	Near east coast of Hokkaido, Japan.	42½	N.	143½	E.	31 killed, 572 injured; 713 houses destroyed, 5,980 damaged. 28 killed and warehouses destroyed at Kushiro. 3 killed and 309 houses destroyed at Kiratapu. 1,000 houses destroyed or damaged at Shiranuka and 400 houses destroyed at Hamanka. 4 schools collapsed at Sapporo. 10-foot seismic sea wave. Mag. 8.3.
9	17	03	43*	Near south coast of Hokkaido, Japan.	42	N.	143½	E.	17 injured, 113 houses destroyed. Mag. 7.1.
19	10	57	07*	Off east coast of Mindanao, Philippine Islands.	9½	N.	126½	E.	Felt throughout Mindanao and Visayas Islands. Slight damage at Butuan. Mag. 7¾.
May 9	17	47	40*	Solomon Islands	6½	S.	155	E.	Depth about 60 km. Mag. 7.
June 11	00	31	32*	San Juan Province, Argentina	32	S.	67½	W.	Felt in San Juan, Santa Lucia, Desamparados, and Concepcion Provinces. 1 killed and 15 injured at San Juan, and 4 killed, 20 injured at Maradona. Mag. about 7.
July 17	16	09	57*	Southern Honshu, Japan	34½	N.	136	E.	9 killed and 134 injured. 350 houses damaged or destroyed in Osaka-Kyoto region. Depth about 150 km. Mag. 6¾.
21	11	52	14.3	Kern County, Calif	35°00′	N.	119°02′	W.	13 killed and many injured. $20 million property damage by main shock and total of $60 million for series of shocks. Severe structural damage in Tehachapi and Arvin. Many tunnels severely damaged. Agricultural section of Kern County suffered heavy crop losses due to irrigation system failures. Mag. 7.7.
Aug. 17	16	02	06*	Eastern Tibet	30½	N.	91½	E.	55 killed, 157 injured. 850 buildings destroyed in Pongdo and Tanpu. Mag. about 7½.
Sept. 21	02	30	40*	Argentina-Bolivia	22	S.	65½	W.	Felt. Depth about 300 km. Mag. 7.2.
Oct. 22	17	00	38*	Southern Turkey	36½	N.	35½	E.	20 killed, 44 injured, and extensive property damage in Adana.
28	04	29	51*	Haiti	18½	N.	73½	W.	6 killed, 50 injured, and 1,000 homeless at Anse-a-Veau. Damage estimated at $50,000.
Nov. 4	16	58	23.0	Near east coast of Kamchatka	52.7	N.	159.9	E.	Depth slightly greater than normal. Seismic sea wave caused damage in Midway, Hawaiian Islands, Peru, and Chile. 13-foot seismic seawave. Mag. 8¼.
29	08	22	34*	do	53	N.	160	E.	Mag. 6.9.
Dec. 6	10	41	14*	Solomon Islands	8	S.	157	E.	Mag. 7.1.
24	18	39	33*	New Britain Island	5½	S.	151½	E.	Mag. 7.
30	12	07	08*	Costa Rica	10½	N.	84	W.	29 killed in Limon Province.

*Indicates probable error of ⅒ minute.

STRONG-MOTION SEISMOGRAPH RESULTS

INTRODUCTION

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

Interpretation of records.—The analyses appearing in tables 5 and 6 are based on the assumption of simple harmonic motion. This refers especially to the computation of displacement from accelerograph records. As most accelerograph records are of irregular character, and the character of the longer period waves is often obscured by the superposition of shorter period waves of relatively large amplitude, the estimates of displacement must be considered only rough approximations. These analyses are essentially condensations of material appearing in the *Quarterly Engineering Seismology Bulletin* available through mailing list *CGS–5* from the Director, United States Coast and Geodetic Survey, Washington 25, D. C.

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

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

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

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

Seismogram illustrations.—Reproductions of records in this publication are tracings of the original records and must not be accepted as genuine copies. The tabulated instrumental constants refer to the original records. The tracings are reduced approximately in the ratio of 1.6:1 and 2:2 for crosswise and lengthwise figures, respectively, with the following exceptions: Westwood on July 21, 2:1; Taft on November 22 and San Jose, Costa Rica, on December 30, 1.6:1. They are intended to show the nature of the data rather than furnish a means through which the reader can make his own measurements. Those who desire true copies for critical study should make request to the Director of the Coast and Geodetic Survey, Washington 25, D. C.

Acceleration scales are indicated on the tracings of acceleration curves by two dots, the distance between them representing the equivalent of 100 cm/sec.^{2} when applied to the curves over which they appear. These dots provide a quick means for making auxiliary scales in cases where an investigator desires to make rough measurements on the published curves. The measurements of periods on records of this nature are

dependent largely on the judgment of the person reading them and considerable latitude must be allowed in appraising their accuracy. The aim of such analyses is primarily to give a fair picture of the magnitudes of the various elements involved, and the figures tabulated should therefore not be used for important studies without first referring to the illustrations for some idea of the nature of the original records.

TABLE 4.—*U. S. Coast and Geodetic Survey strong-motion stations in operation as of Dec. 31, 1952*

Station	Accelerograph	Displacement meter	Weed
NORTHERN CALIFORNIA			
Berkeley, University of California	1		
Eureka	1		
Ferndale	1	1	
Hollister, Library	1	†1	
Monterey, City Hall			1
Oakland, City Hall, basement	1		
Oakland, City Hall, 16th floor	1		
Oakland, Chabot Observatory			1
Sacramento, Federal Building			1
San Francisco, Alexander Bldg., basement	1		
San Francisco, Alexander Bldg., 11th floor	1		
San Francisco, Alexander Bldg., 16th floor	1		
San Francisco, 450 Sutter St., basement			1
San Francisco, 450 Sutter St., 29th floor			1
San Francisco, Golden Gate Park	1		
San Francisco, Shell Bldg., subbasement			1
San Francisco, Shell Bldg., 21st floor			1
San Francisco, Shell Bldg., 29th floor			1
San Francisco, Southern Pacific Bldg., basement	1	1	
San Francisco, Southern Pacific Bldg., 14th floor	1		
San Francisco, State Bldg., basement	1	1	
San Jose, Bank of America, basement	1		
San Jose, Bank of America, 13th floor	1		
Suisun Bay Bridge	1		
SOUTHERN CALIFORNIA			
Arvin	1	†1	
Bishop	1		
Colton	1	1	
El Centro	1		
Hollywood Storage Co., basement	1		
Hollywood Storage Co., penthouse	1		
Hollywood Storage Co., adjoining P. E. Lot	1		
Long Beach	1		
Los Angeles, Edison Bldg., basement	1		
Los Angeles, Occidental Life Bldg., basement	1		
Los Angeles, Occidental Life Bldg., 11th floor	1		
Los Angeles, Subway Terminal, subbasement	1	1	
Los Angeles, Subway Terminal, 13th floor	1		
Los Angeles, Vernon, C. M. D.	1		
Pasadena, California Institute of Technology	1	1	1
San Bernardino			1
San Diego	1		
San Luis Obispo	1		
Santa Ana			1
Santa Barbara	1		
Taft	1		
Westwood, University of California, Las Angeles	1		
OUTSIDE CALIFORNIA			
Bozeman, Mont., Montana State College	1		
Butte, Mont., Montana School of Mines	1		
Columbia Falls, Mont., Hungry Horse Dam, Bureau of Reclamation	1		
Hawthorne, Nev., U. S. Naval Ammunition Depot	1		
Helena, Mont., Carroll College	1		
Hoover Dam, Nev., 1215 Gallery	1		
Hoover Dam, Nev., intake tower	1		
Hoover Dam, Nev., oilhouse	1		
Logan, Utah, Utah State Agricultural College	1		
Olympia, Wash., Highway Test Laboratory	1		
Ross Dam, Wash	1		
Seattle, Wash., Army Base	1		

†Carder displacement meter.

TABLE 4.—*U. S. Coast and Geodetic Survey strong-motion stations in operation as of Dec. 31, 1952*—Continued

OUTSIDE UNITED STATES

Station	Accelero-graph	Displace-ment meter	Weed
Balboa Heights, C. Z.	1		
Bogota, Colombia, South America	1		
Guatemala City, Guatemala, Central America	1		
Lima, Peru, South America	1		
Quito, Ecuador, South America	1		
San Jose, Costa Rica, Central America	1		
Santiago, Chile, South America	1		
Total	55	8	11

TABLE 5.—*List of shocks recorded and records obtained on strong-motion seismographs in 1952*

Date	Region and recording station	Records			
		Accelero-graph	Survey displace-ment meter	Carder displace-ment meter	Weed
Feb. 17	Colton	1	1		
Apr. 17	San Bernardino				1
Apr. 29	Santiago	1			
May 23	Hoover Dam	3			
May 25	do	3			
July 19	Lima	1			
July 21	Bishop	1			
	Colton	1	3		
	El Centro	1			
	Hawthorne	1			
	Hollister	1		1	
	Hollywood	3			
	Hoover Dam	3			
	Long Beach	1			
	Los Angeles Edison Bldg	1			
	Los Angeles Occidental Life Bldg	2			
	Los Angeles Subway Terminal	2	1		
	Oakland City Hall	2			
	Pasadena	1	1		1
	Sacramento				1
	San Bernardino				1
	San Diego	1			
	San Francisco, Alexander Bldg	3			
	San Francisco Shell Bldg				3
	San Francisco Southern Pacific Bldg	2	1		
	San Jose, Calif	2			
	San Luis Obispo	1			
	Santa Ana				1
	Santa Barbara	1			
	Taft	3			
	Vernon	1			
	Westwood	1			
July 22	Colton		1		
	Guatemala City	1			
	Hollywood	5			
	Long Beach	1			
	Los Angeles Subway Terminal	2	2		
	Pasadena	2	2		
	Taft	2			
	Westwood	2			
	Tehachapi	3			
July 22–23	do	3			
July 23	Taft	1			
July 25	Colton		1		
	Hollister	1		1	
	Hollywood	1		1	
	Los Angeles Occidental Life Bldg	4			
	Los Angeles Subway Terminal	3	2		
	Pasadena		2		
	Santa Barbara	1			
	Taft	1			
	Westwood	2			
	Vernon	1			
July 28	Bishop	1			
	Hollister	1		1	
	Los Angeles Occidental Life Bldg	2			
	Los Angeles Subway Terminal	1	1		
	Pasadena	1	1		
	San Jose, Calif	2			
	Santa Barbara	1			

TABLE 5.—*List of shocks recorded and records obtained on strong-motion seismographs in 1952*—Continued

Date	Region and recording station	Records			
		Accelerograph	Survey displacement meter	Carder displacement meter	Weed
July 28	Taft	1			
	Vernon	1			
	Westwood	1			
July 29	Taft	1			
July 31	Hollywood	3			
	Los Angeles Occidental Life Bldg	2			
	Los Angeles Subway Terminal	2	1		
	Pasadena	1			
	Taft	1			
	Vernon	1			
	Westwood	1			
July 24–31	Tehachapi	5			
Aug. 1	Hollywood	3			
Aug. 3	Lima	1			
Aug. 7	Taft	1			
	Wheeler Ridge	1		1	
Aug. 8–10	Wheeler Ridge	2		2	
Aug. 10–12	do	1		1	
Aug. 12	Caliente			1	
	Tehachapi	1		1	
Aug. 13	Wheeler Ridge	1		1	
Aug. 13–14	Taft	1			
Aug. 14	Wheeler Ridge	1		1	
Aug. 16	do	1		1	
Aug. 17	do	2		1	
	Tehachapi	1		1	
Aug. 17–18	Wheeler Ridge	2			
Aug. 18–22	do	2			
Aug. 22	Arvin	1		1	
	Hollister	1		1	
	Hollywood	2			
	Pasadena	1	1		
	San Francisco Southern Pacific Bldg	2	1		
	Taft	1			
	Tehachapi	1		1	
	Wheeler Ridge	2		2	
	Tehachapi	1		1	
Aug. 23	Hollywood	2			
	Pasadena	1	1		
	San Francisco Southern Pacific Bldg	2	1		
	Tehachapi	1		1	
	Westwood	1			
	Wheeler Ridge	1		1	
Aug. 26	do	1			
Aug. 29	Caliente			1	
	Tehachapi	1		1	
	Wheeler Ridge	1			
Sept. 2	Tehachapi	1		1	
Sept. 12	Taft	1			
Sept. 13	Hollister	1		1	
Sept. 16	Caliente			2	
Sept. 22	Eureka	1			
	Ferndale	1	1		
	San Francisco Southern Pacific Bldg	2	1		
Sept. 25	Wheeler Ridge	1		1	
Oct. 12	Berkeley	1			
	Chabot Observatory				1
	Oakland City Hall	2			
	San Francisco Southern Pacific Bldg	2	1		
Oct. 16	Wheeler Ridge	1		1	
Oct. 21	San Francisco Shell Bldg				2
	San Francisco Southern Pacific Bldg	2	1		
Nov. 8	do	2	1		
Nov. 12	Hawthorne	1			
Nov. 16	Bishop	1			
Nov. 21	Hollister	1		1	
	Los Angeles Occidental Life Bldg	2			
	Pasadena	1	1		
	San Francisco, 450 Sutter St				2
	San Francisco Shell Bldg				1
	San Francisco Southern Pacific Bldg	2	1		
	San Jose, Calif	2			
	San Luis Obispo	1			
	Santa Barbara	1			
	Taft	1			
	Westwood	1			
Dec. 30	Costa Rica	1			
Unknown dates	Bishop	1			
	San Francisco, 450 Sutter St				2
	Total	187	31	31	16

TABLE 6.—*Summary of outstanding instrumental and noninstrumental data for 1952*

Epicenter	Recording station and position [1]	Location of instrument	Intensity [2]	Maximum acceleration	Computed maximum displacement
				cm/sec.^{2}	*cm.*
SOUTHERN CALIFORNIA EARTHQUAKE OF FEB. 17					
34°01′ N., 117°14′ W., south of Loma Linda, V.*	Colton, 10 miles NW. 290°	1st floor	V	12	0.015
		DM [3]		11	.04
CHILE EARTHQUAKE OF APR. 29					
35° S., 72° W., central Chile	Santiago, 100 miles NE. 10°	Basement		8	0.006
NEVADA EARTHQUAKE OF MAY 23					
36.1° N., 114.7° W., Arizona-Nevada border, VI.*	Hoover Dam, 10 miles SW. 210°	1215 Gallery	VI	46	0.014
		Intake tower		146	.133
		Oilhouse		21	.009
NEVADA EARTHQUAKE OF MAY 25					
Boulder City area, IV*	Hoover Dam	1215 Gallery	IV	9	0.006
		Intake tower		14	.032
PERU EARTHQUAKE OF JULY 19					
	Lima	1st floor		21	0.004
SOUTHERN CALIFORNIA EARTHQUAKE OF JULY 21					
35°00′ N., 119°02′ W., Kern County, XI.*	Hollywood, 74 miles SE. 147°	Penthouse	VII	131	1.428
		Basement		36	.330
		P. E. Lot		42	.409
	Los Angeles, Occidental Life Bldg., 77 miles SE. 148°.	11th floor	VII	115	7.268
		Basement		25	1.037
GUATEMALA EARTHQUAKE OF JULY 22					
	Guatemala City	Basement		4	0.097
PERU EARTHQUAKE OF AUG. 3					
12½° S., 78° W., near coast of Peru	Lima, 70 miles SW. 240°	1st floor		21	.0031
NORTHERN CALIFORNIA EARTHQUAKE OF SEPT. 22					
40°12′ N., 124°25′ W., 12 miles SW. of Petrolia, VII.*	Ferndale, 27 miles SW. 194°	1st floor	VI	71	0.332
		DM [3]		19	1.9
SAN FRANCISCO BAY AREA EARTHQUAKE OF OCT. 12					
37°45′ N., 122°11′ W., near Diamond District, Oakland, V.*	Oakland City Hall, 8 miles SE. 134°	16th floor	V	93	0.102
		Basement		25	.017
SAN FRANCISCO BAY EARTHQUAKE OF OCT. 21					
37°53′ N., 122°22′ W., San Francisco Bay, V.*	San Francisco, Southern Pacific Bldg., 6 miles SW. 193°.	14th floor	V	20	0.117
		Basement		4	.007
		DM [3]		6	.03

See footnotes at end of table.

TABLE 6.—*Summary of outstanding instrumental and noninstrumental data for 1952*—Continued

NEVADA EARTHQUAKE OF NOV. 12

Epicenter	Recording station and position [1]	Location of instrument	Intensity [2]	Maximum acceleration	Computed maximum displacement
				cm/sec.[2]	*cm.*
38½° N., 118½° W., western Nevada.	Hawthorne, 5 miles NW. 280°	Basement		13	0.005

SOUTHWESTERN CALIFORNIA EARTHQUAKE OF NOV. 21

35°50′ N., 121°10′ W., near Bryson, VII.*	San Luis Obispo, 48 miles SE. 142°	Basement	VI	58	0.08

COSTA RICA EARTHQUAKE OF DEC. 30

10½ N., 84° W., Cartago Province, Costa Rica.	San Jose, 30 miles N. 0°	1st floor		98	0.099

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

TABLE 7.—*Composite of strong-motion instrumental date for 1952*

SOUTHERN CALIFORNIA EARTHQUAKE OF FEB. 17

Station and component [1]	Instrument number	T_0	V	Sensitivity [2]	ϵ	Earth wave period	Maximum acceleration	Maximum displacement	Remarks
Colton accelerograph: [3]		*sec.*		*cm.*		*sec.*	*cm/sec.*[2]	*cm.*	
Vertical-up	V-253	0.064	120	1.26	12	0.18	6	0.005	Weak record.
E. 90°	L-254	.066	124	1.36	9	.22	12	.015	
S. 180°	T 255	.065	125	1 35	8	.25	6	.009	
Displacement meter:									
W. 270°	16 R	9.63			10	.38	11	.04	
N. 0°	16 L	9.53			10	.38	8	.03	
CHILE EARTHQUAKE OF APRIL 29									
Santiago accelerograph:									
Vertical-up	V-151	0.098	80	1.93	11	0.12	8	0.003	
SW. 260°	L-149	.097	82	1.96	9	.19	7	.006	
NW. 350°	T-150	.099	81	2.02	10	.14	6	.003	
NEVADA EARTHQUAKE OF MAY 23									
Hoover Dam: [3]									
1215 Gallery accelerograph:									
Vertical-up	V-331	0.082	129	2.16	11	0.10	21	0.005	
SE 135°	L-332	.080	125	2.00	10	.10	41	.010	
SW 225°	T-333	.079	120	1.90	10	.11	46	.014	
Intake tower accelerograph:									
Vertical-up	V-328	.080	127	2.04	20	.09	83	.017	
NW. 315°	L-329	.079	126	1.99	5	.08	116	.019	
						.23	30	.040	
NE1 45°	T-330	.079	126	1.99	9	.19	146	.133	
Oilhouse accelerograph:									
Vertical-up	V-334	.080	123	1.98	11	.08	20	.003	
NW. 315°	L-335	.080	123	2 00	8	.13	21	.009	
NE. 45°	T-336	.081	122	2.01	8	.10	17	.004	

See footnotes at end of table.

TABLE 7.—*Composite of strong-motion instrumental data for 1952*—Continued

NEVADA EARTHQUAKE OF MAY 25

Station and component [1]	Instrument number	T_0	V	Sensitivity [2]	ϵ	Earth wave period	Maximum acceleration	Maximum displacement	Remarks
Hoover Dam: [3]									
1215 Gallery accelerograph:		*sec.*		*cm.*		*sec.*	*cm/sec.²*	*cm.*	
Vertical-up	V-331	0.082	129	2.16	11	0.21	5	0.006	
SE. 135°	L-332	.080	125	2.00	10	.14	7	.003	
SW. 225°	T-333	.079	120	1.90	10	.16	9	.006	
Intake tower accelerograph:									
Vertical-up	V-328	.080	127	2.04	20	.10	12	.003	
NW. 315°	L-329	.079	126	1.99	5	.30	14	.032	
NE. 45°	T-330	.079	126	1.99	9	.20	14	.014	

PERU EARTHQUAKE OF JULY 19

Lima accelerograph:									
Vertical-up	V-286	0.065	123	1.30	9	0.08	13	0.002	
NW. 278°	L-287	.063	124	1.26	8	.08	21	.003	
NE. 8°	T-288	.064	122	1.24	10	.10	17	.004	

SOUTHERN CALIFORNIA EARTHQUAKE OF JULY 21

Bishop accelerograph:									
Vertical-up	V-241	0.067	118	1.33	9	1.08	6	0.177	
E. 90°	L-242	.066	117	1.30	11	.30	11	.025	
						.88	18	.353	
S. 180°	T-243	.065	119	1.28	12	.34	11	.032	
						1.11	14	.437	
Colton accelerograph: [3]									
Vertical-up	V-253	.064	120	1.25	11	.17	9	.007	
						.56	12	.095	
E. 90°	L-254	.066	125	1.36	6	.63	14	.141	
						.40	10	.041	
S. 180°	T-255	.064	125	1.31	7	.66	11	.121	
						.17	11	.008	
Displacement meter:									
W. 270°	16R	9.79	------	------	9	1.57	5	.32	Total range of motion: 3.27 cm.
						3.68	2	.73	
N. 0°	16L	9.42	------	------	9	1.65	5	.33	Total range of motion: 4.92.
						4.82	3	1.85	
El Centro accelerograph:									
Vertical-up	V-208	.065	121	1.30	9	1.83	3	.254	
N. 0°	L-206	.065	122	1.29	9	------	------	------	Trace defective.
E. 90°	T-207	.065	121	1.30	4	1.71	4	.296	
Hawthorne accelerograph:									
Vertical-up	V-244	.066	125	1.38	9	------	------	------	Motion very small.
S. 180°	L-245	.068	124	1.45	9	1.08	2	.059	
W. 270°	T-246	.068	126	1.47	8	1.32	4	.176	
Hollister accelerograph: [4]									
Vertical-up	V-238	.068	123	1.5	8	.98	5	.122	
SW. 181°	L-239	.066	124	1.4	7	.58	6	.051	
						.84	7	.125	
NW. 271°	T-240	.066	124	1.4	12	1.07	10	.290	
						.53	7	.050	
Carder displacement meter:									
NW. 271°	5	2.53	0.9	------	11	.59	30	.26	Shaking continued with moderate amplitudes for more than 5 minutes.
						1.95	9	.85	
NE. 1°	6	2.26	1.1	------	9	1.56	7	.42	
						1.99	5	.47	
Hollywood Storage Co.: [3]									
Penthouse accelerograph:									
Vertical-up	V-193	.045	121	.62	7	.15	26	.015	
						.34	56	.164	
S. 180°	L-192	.046	122	.64	9	.74	103	1.428	
						.86	74	1.386	
						1.01	14	.362	
W. 270°	T-191	.044	123	.61	28	.12	8	.003	
						.58	131	1.116	
						.61	82	.772	
Basement accelerograph:									
Vertical-up	V-217	.065	125	1.33	12	.10	9	.002	
						.55	14	.107	
E. 90°	L-216	.066	123	1.37	8	.35	28	.087	
						.67	29	.330	
						.25	13	.021	
S. 180°	T-215	.064	123	1.27	9	.42	36	.161	
						.25	25	.040	
						.57	30	.247	

See footnotes at end of table.

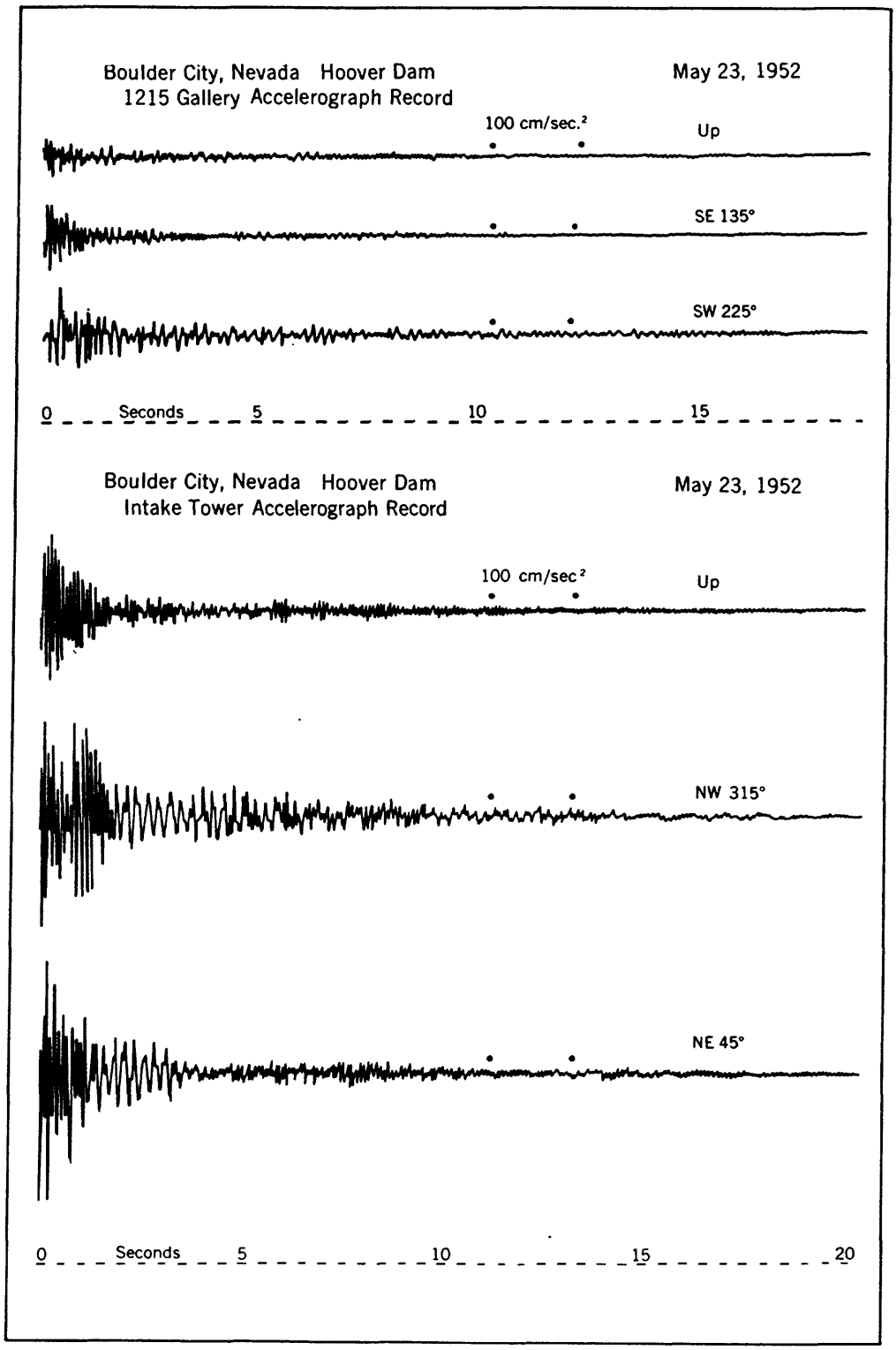

FIGURE 9.—Tracings of accelerograph records obtained at Boulder City, Nev. Hoover Dam 1215 Gallery and intake tower on May 23.

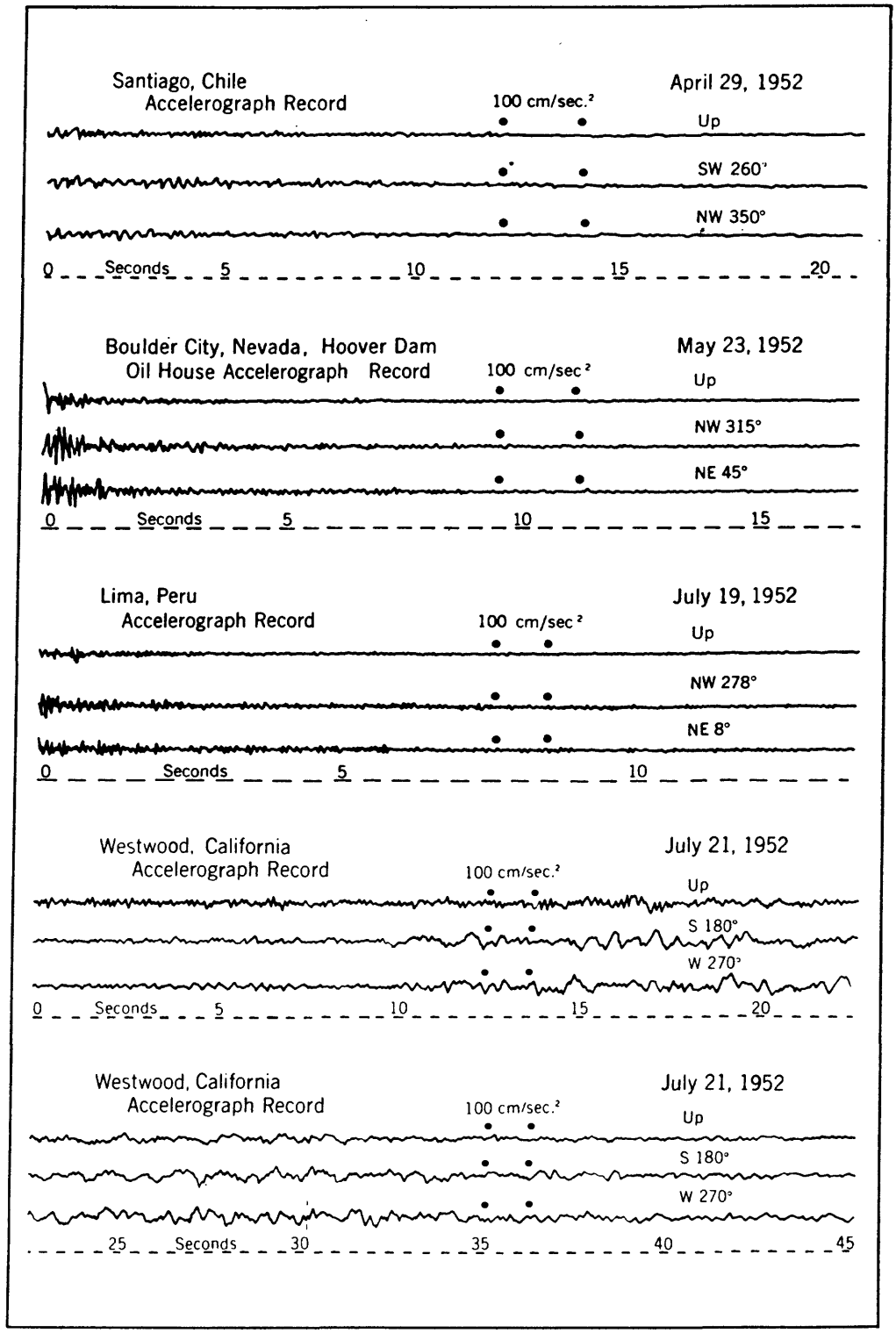

FIGURE 10.—Tracings of accelerograph records obtained at Santiago, Chile, on April 29; at Boulder City, Nev., Hoover Dam oilhouse on May 23; at Lima, Peru, on July 19; at Westwood on July 21.

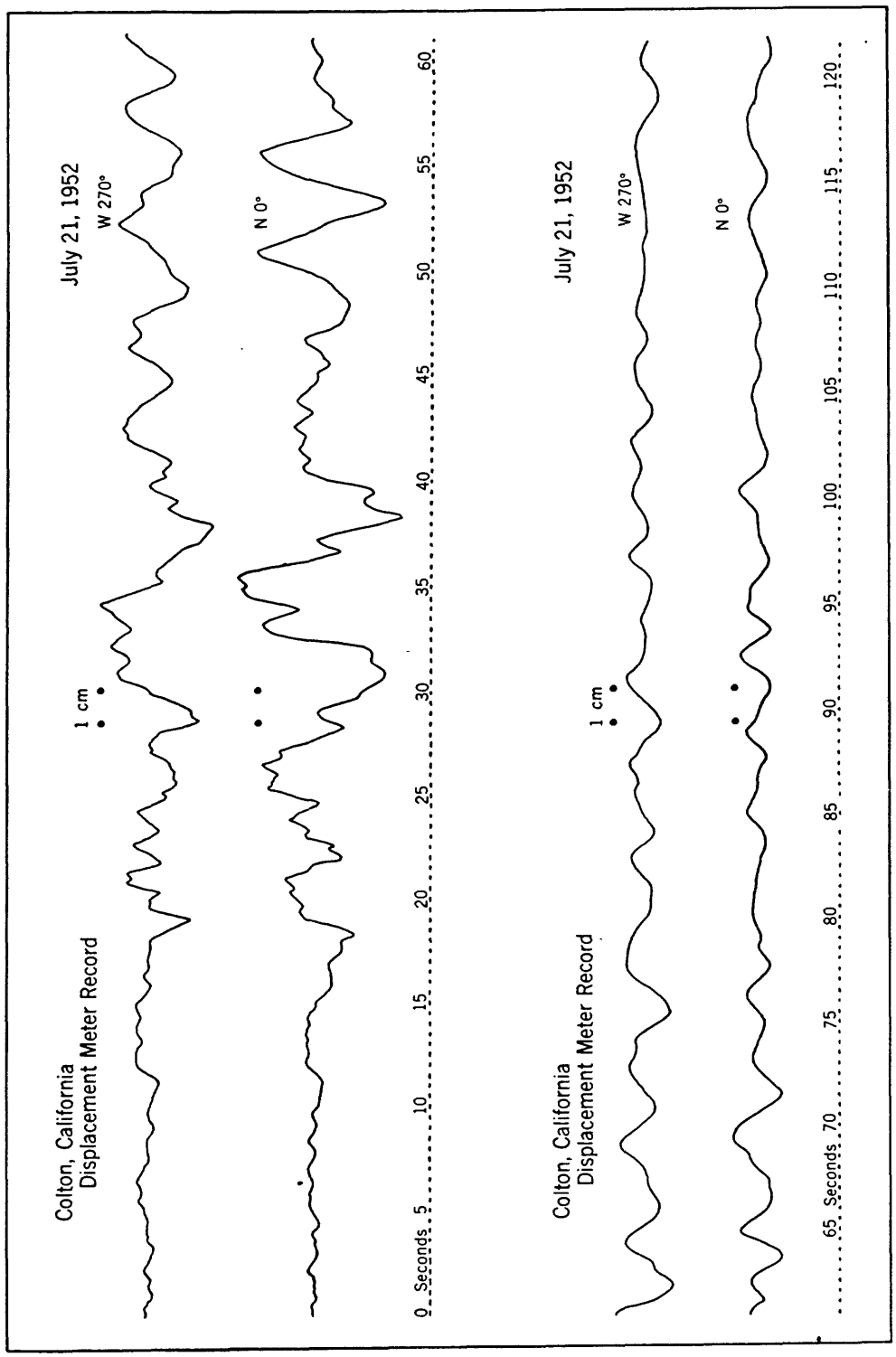

FIGURE 11.—Tracings of displacement meter record obtained at Colton on July 21.

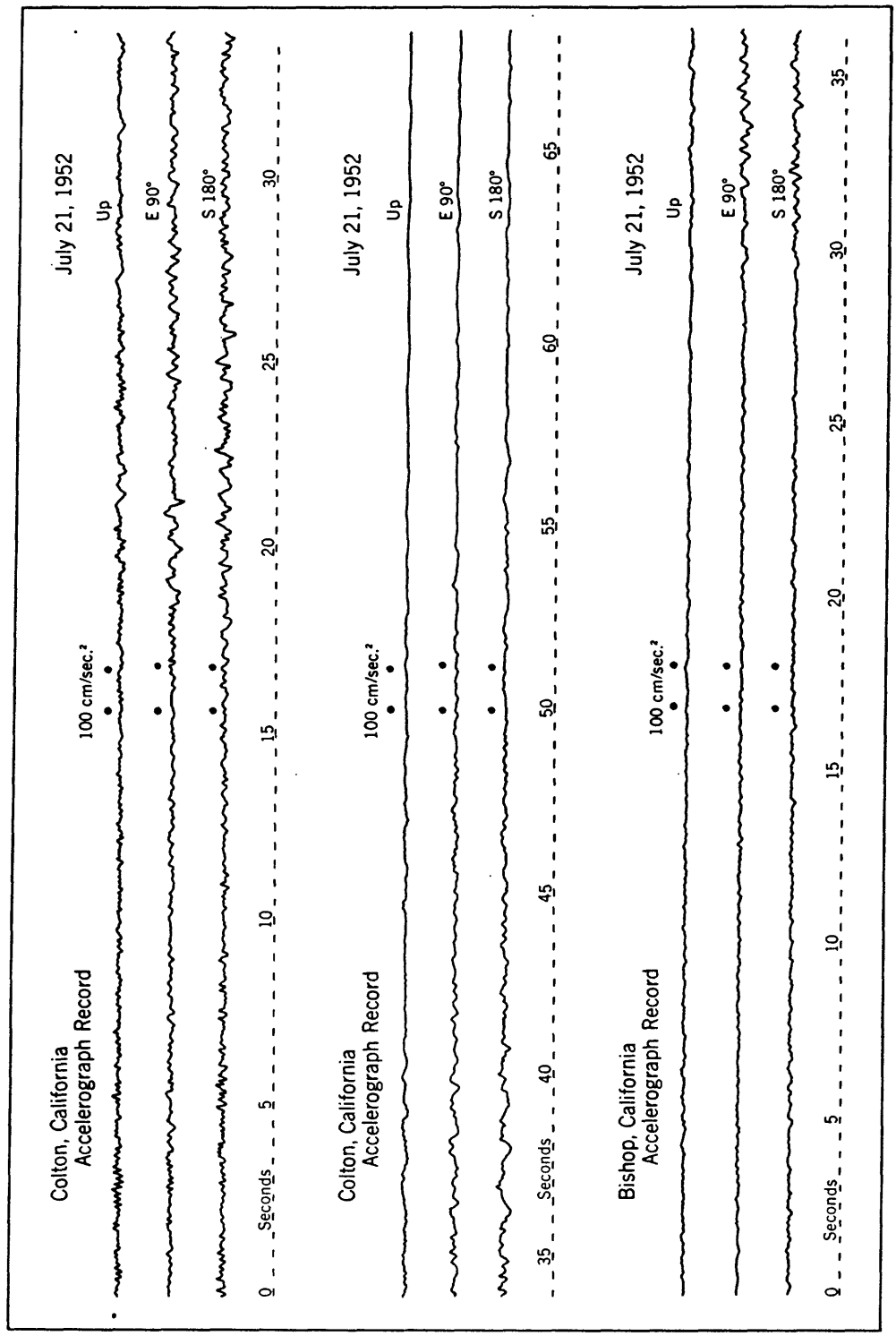

FIGURE 12.—Tracings of accelerograph records obtained at Colton and Bishop on July 21.

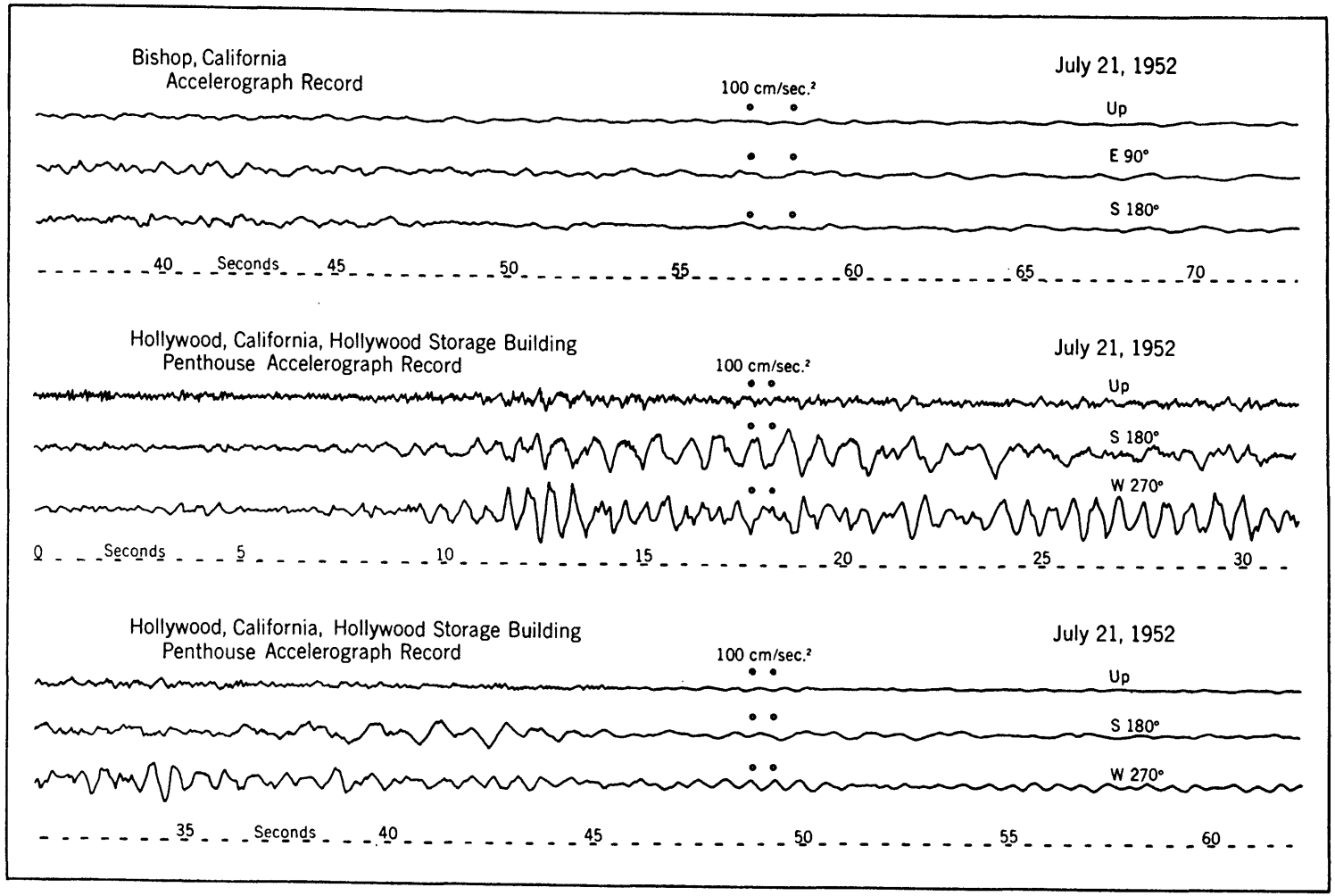

FIGURE 13.—Tracings of accelerograph records obtained at Bishop and Hollywood Storage Building penthouse on July 21.

TABLE 7.—*Composite of strong-motion instrumental data for 1952*—Continued

SOUTHERN CALIFORNIA EARTHQUAKE OF JULY 21—continued

Station and component [1]	Instrument number	T_0	V	Sensitivity [2]	ϵ	Earth wave period	Maximum acceleration	Maximum displacement	Remarks
Hollywood Storage Co.[3]—Con.									
P. E. Lot accelerograph:		sec.		cm.		sec.	cm/sec.^{2}	cm.	
Vertical-up	V-214	0.065	123	1.32	8	0.09	13	0.003	Shaking continued with moderate amplitudes for more than 5 minutes.
						.49	12	.073	
E. 90°	L-213	.066	121	1.32	9	.30	41	.093	
						.21	24	.027	
						.64	32	.332	
S. 180°	T-212	.066	120	1.33	9	.62	42	.409	
						.26	29	.043	
						.19	25	.023	
Hoover Dam:[3]									
1215 Gallery accelerograph:									
Vertical-up	V-331	.081	129	2.13	10	1.75	2	.155	
SE. 135°	L-332	.079	125	1.98	10	3.08	2	.481	
SW. 225°	T-333	.079	120	1.89	10	2.50	4	.633	
Intake tower accelerograph:									
Vertical-up	V-328	.080	127	2.05	16	2.76	2	.386	
NW. 315°	L-329	.079	126	2.00	5	1.02	5	.132	Sinusoidal waves.
NE. 45°	T-330	.079	126	2.00	9	1.03	5	.134	Do.
Oilhouse accelerograph:									
Vertical-up	V-334	.078	123	1.89	8	2.03	2	.209	
NW. 315°	L-335	.079	123	1.94	8	2.75	1	.191	
NE. 45°	T-336	.079	124	1.97	7	1.99	1	.100	
Long Beach accelerograph:									
Vertical-up	V-265	.065	125	1.34	10	.11	3	.001	
						1.47	6	.328	
N. 0°	L-266	.064	125	1.28	8	1.22	14	.528	
						.76	16	.234	
E. 90°	T-267	.065	124	1.33	10	.27	6	.011	
						.89	15	.301	
Los Angeles Occidental Life Bldg.[3] (formerly Chamber of Commerce Bldg.):									
11th-floor accelerograph:									
Vertical-up	V-187	.046	121	.65	10	.18	19	.016	
						.74	6	.083	
SW. 218°	L-186	.045	122	.64	11	1.58	115	7.268	
						1.88	18	1.611	
NW. 308°	T-185	.045	122	.62	8	1.70	92	6.731	
						.13	20	.009	
Basement accelerograph:									
Vertical-up	V-205	.064	123	1.30	12	.99	9	.223	
						.17	6	.004	
NE. 36°	L-204	.065	123	1.33	13	.91	16	.335	
						.24	8	.012	
						.48	17	.099	
SE 126°	T-203	.066	123	1.36	13	.38	19	.069	
						1.28	25	1.037	
						.62	19	.185	
Los Angeles Subway Terminal:									
13th-floor accelerograph:									
Vertical-up	V-190	.046	125	.68	8	.19	27	.025	
						.14	30	.015	
SW. 218°	L-189	.046	124	.68	6	.20	18	.018	
						.92	60	1.286	
NW. 308°	T-188	.046	125	.68	3	1.16	74	2.521	
						.48	22	.128	
Basement accelerograph:									
Vertical-up	V-211	.065	119	1.28	8	.56	8	.064	
						.22	6	.007	
SE. 128°	L-210	.065	120	1.29	7	.63	17	.171	
						1.13	31	1.002	
						3.60	5	1.641	
SW. 218°	T-209	.065	121	1.28	7	.96	19	.443	
						.50	15	.095	
						2.92	3	.648	
Basement displacement meter:									
NE. 38°	15R	10.17	------	------	14	4.01	9	3.62	Total range of motion, 9.29 cm.
						3.70	9	3.20	
						2.85	5	.96	
						4.17	3	1.36	
						3.81	4	1.49	
SE. 128°	15L	10.56	------	------	10	4.39	4	2.05	Total range of motion, 10.82 cm.
						4.55	8	4.17	
						1.72	9	.64	
						4.75	5	3.04	
						4.49	3	1.70	

See footnotes at end of table.

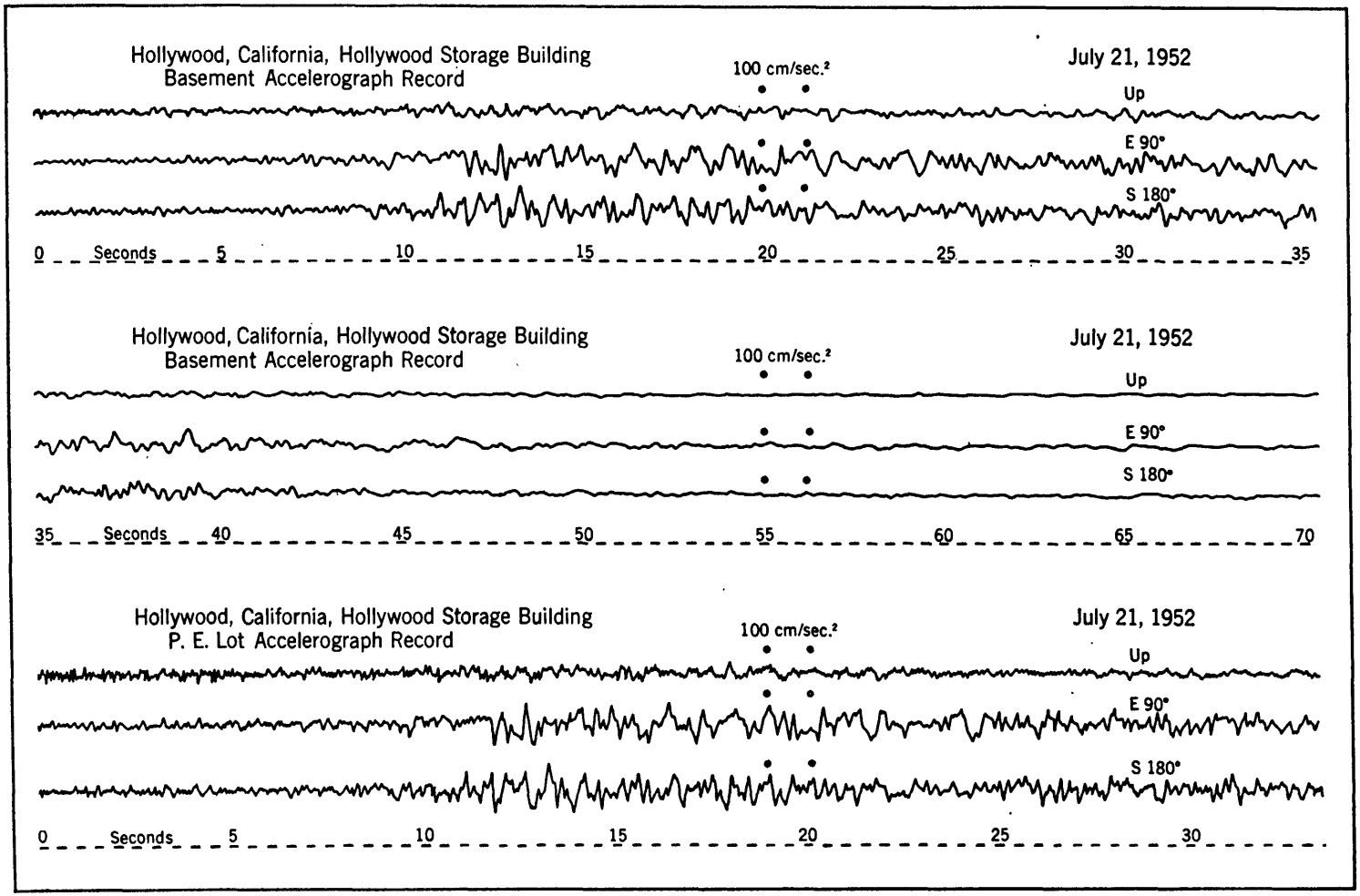

FIGURE 14.—Tracings of accelerograph records obtained at Hollywood Storage Building, basement, and P. E. Lot on July 21.

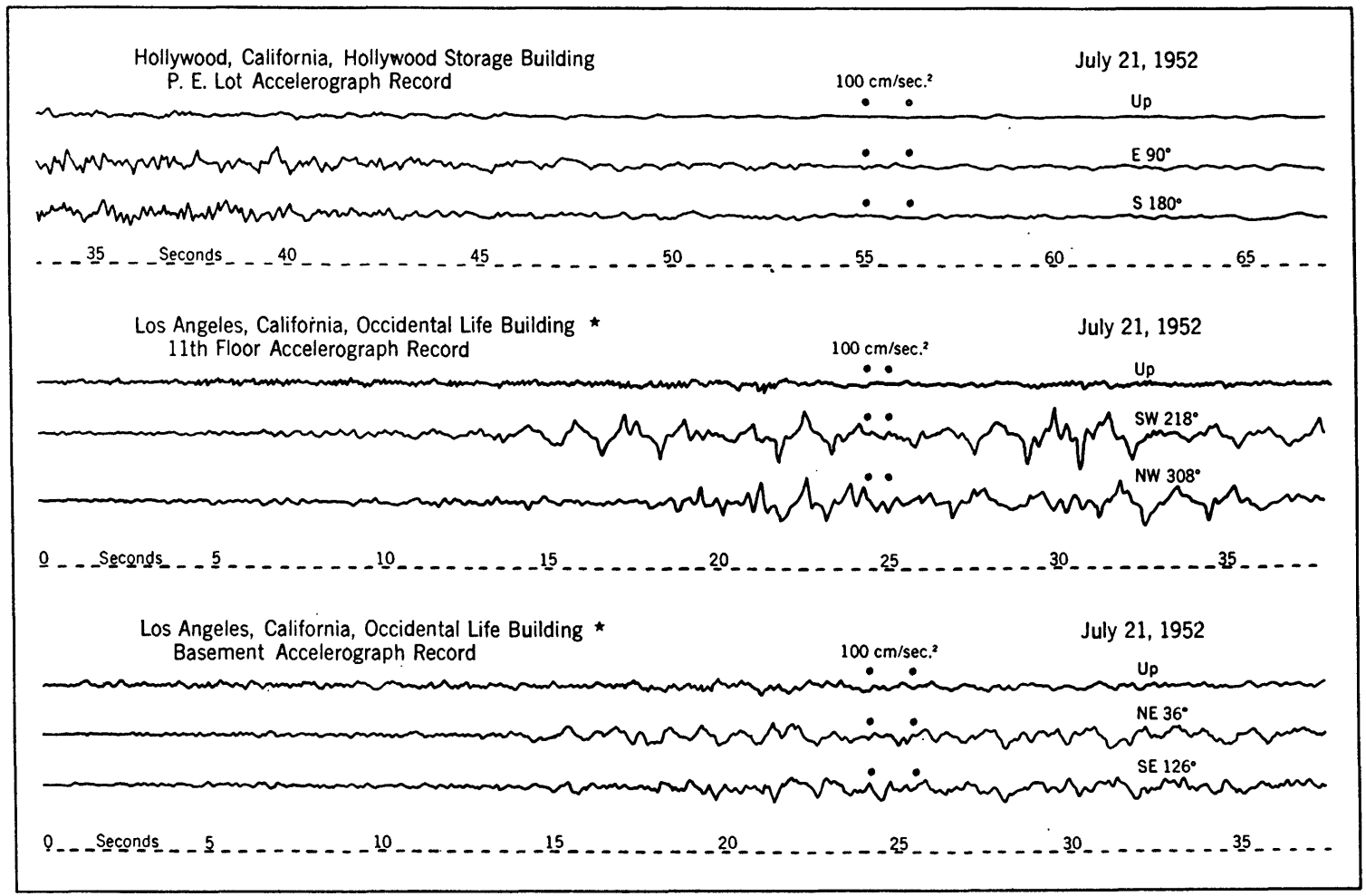

FIGURE 15.—Tracings of accelerograph records obtained at Hollywood Storage Building, P. E. Lot, and Los Angeles Occidental Life Building, basement and 11th floor on July 21.

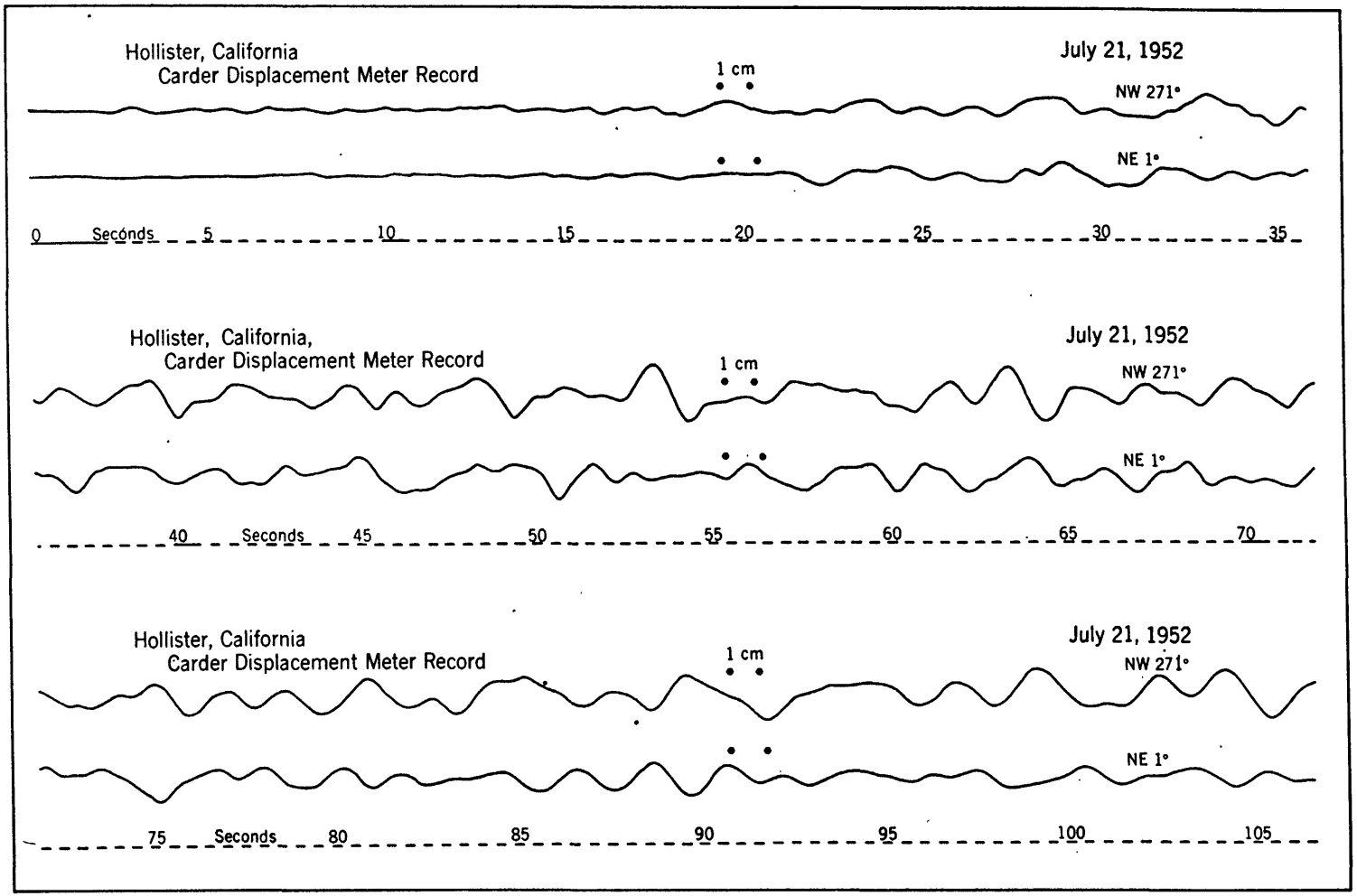

FIGURE 16.—Tracings of displacement meter record obtained at Hollister on July 21.

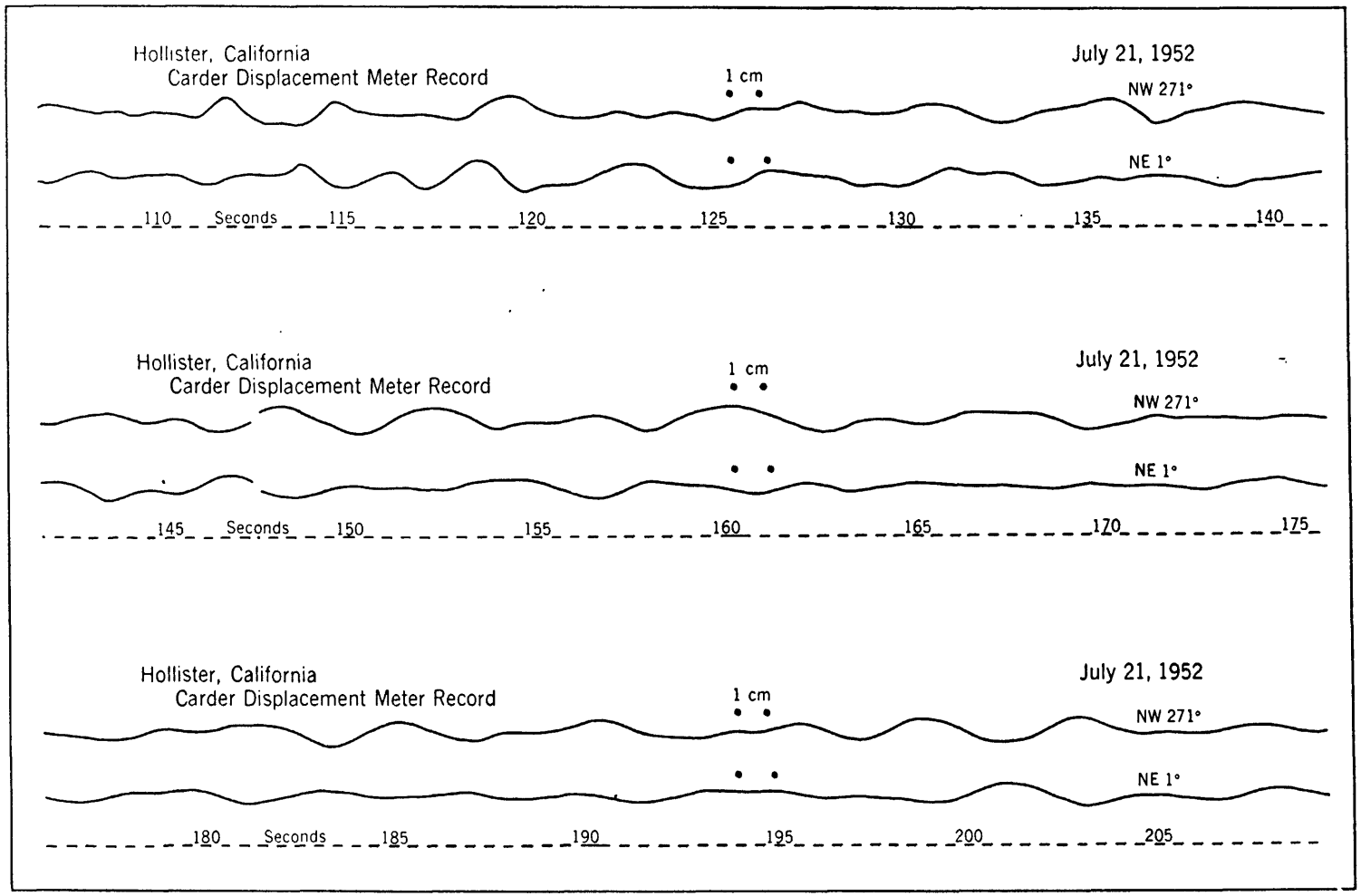

FIGURE 17.—Tracings of displacement meter record obtained at Hollister on July 21.

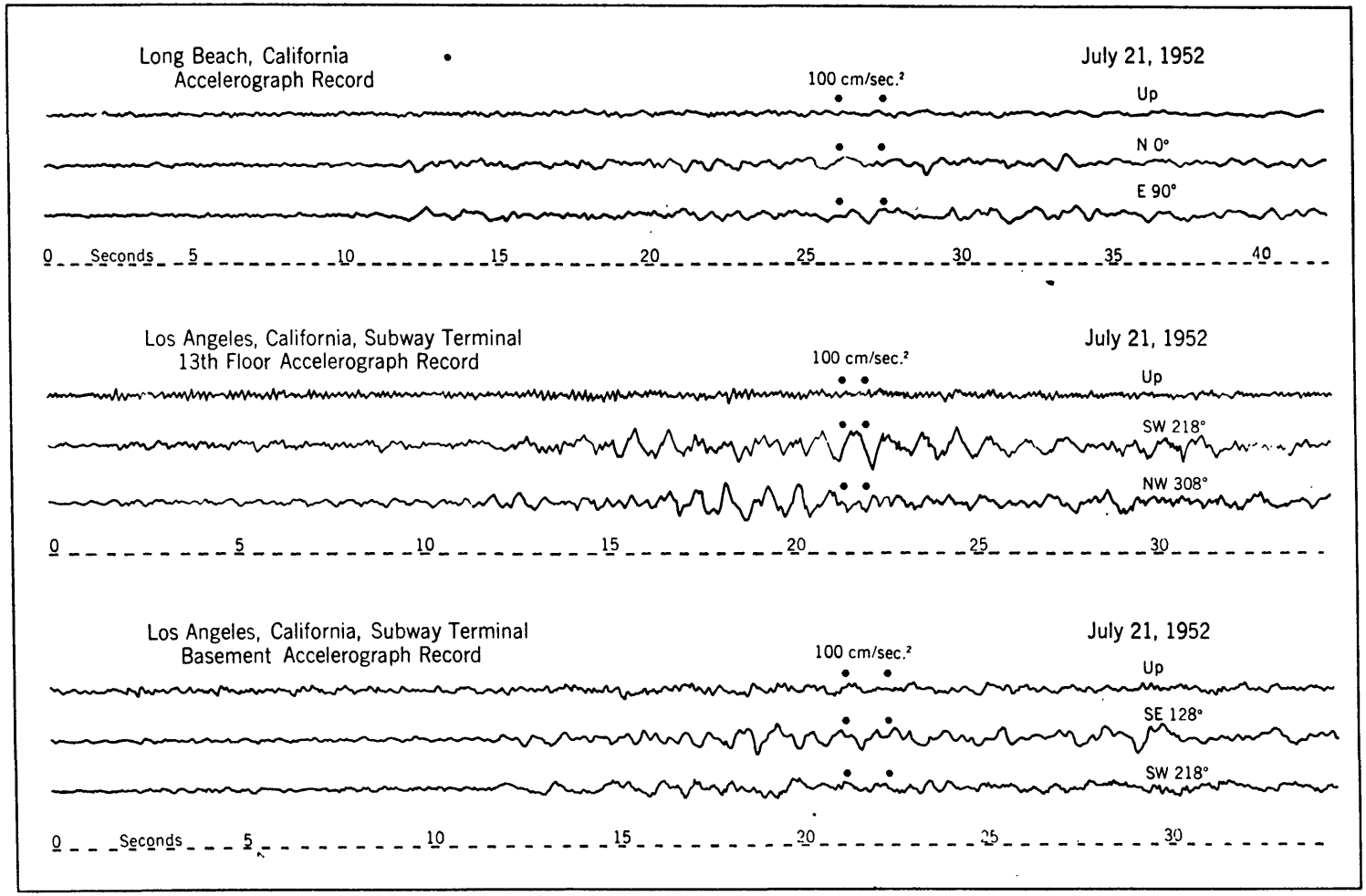

FIGURE 18.—Tracings of accelerograph records obtained at Long Beach and Los Angeles Subway Terminal basement and 13th floor on July 21.

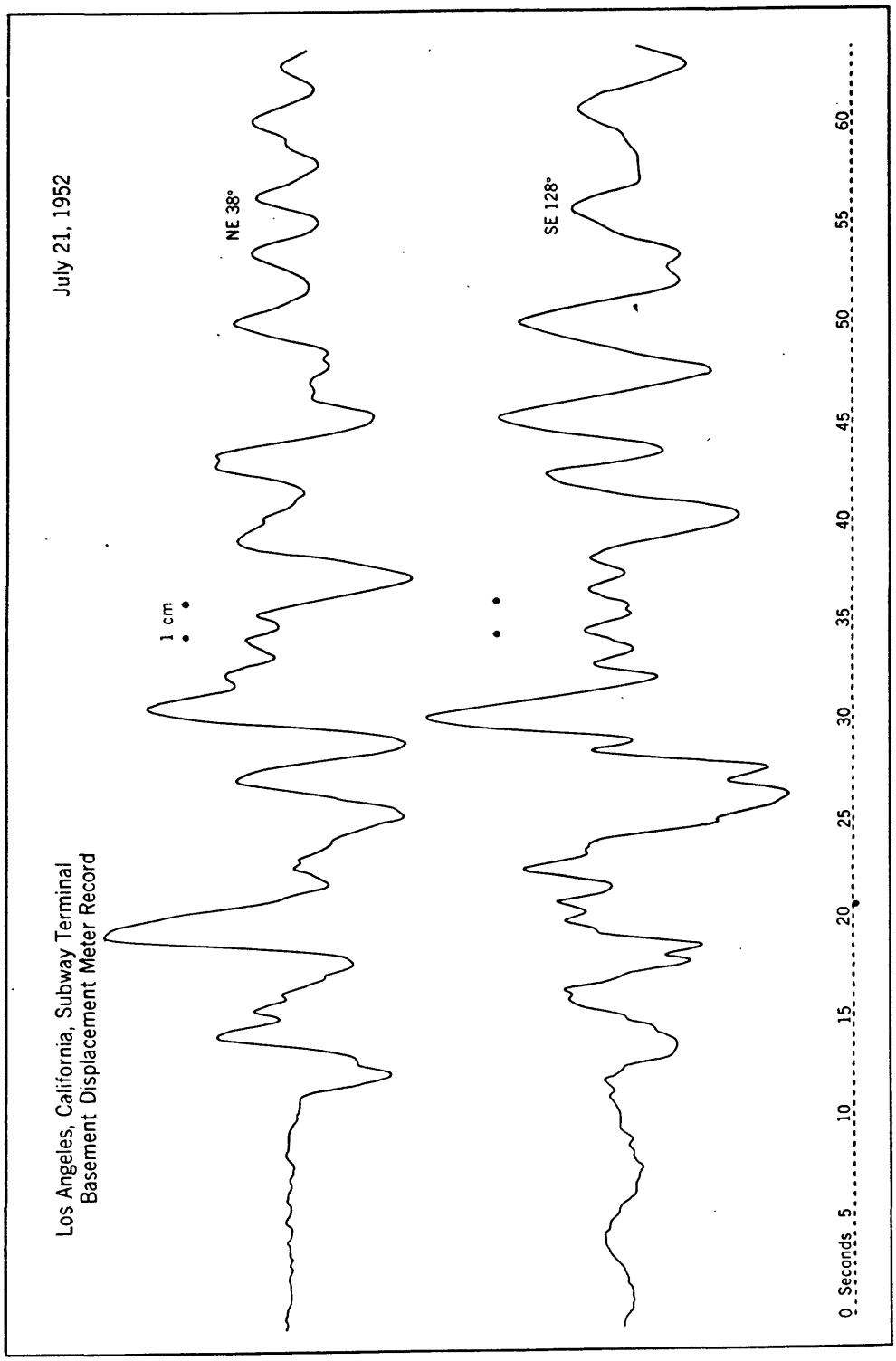

FIGURE 19.—Tracings of displacement meter record obtained at Los Angeles Subway Terminal basement on July 21.

TABLE 7.—*Composite of strong-motion instrumental data for 1952*—Continued

SOUTHERN CALIFORNIA EARTHQUAKE OF JULY 21—continued

Station and component [1]	Instrument number	T_0	V	Sensitivity [2]	ϵ	Earth wave period	Maximum acceleration	Maximum displacement	Remarks
Oakland City Hall: [3]									
16th-floor accelerograph:		*sec.*		*cm.*		*sec.*	*cm/sec.²*	*cm.*	
Vertical-up	V-226	0.044	117	0.58	9	0.48	2	0.012	Sinusoidal waves.
NE. 26°	L-227	.046	116	.64	10	1.16	12	.409	Do.
SE. 116°	T-228	.047	118	.66	9	1.27	14	.572	Do.
Basement accelerograph:									
Vertical-down	V-235	.067	124	1.12	8				No discernible motion.
SW. 206°	L-236	.066	126	1.18	7	1.14	1	.033	
NW. 296°	T-237	.068	121	1.37	10	1.41	1	.050	
Pasadena accelerograph: [3]									
Vertical-up	V-325	.082	121	2.06	9	.12	7	.003	
						.26	14	.024	
						.73	18	.243	
S. 180°	L-326	.080	120	1.92	8	.63	40	.402	
						.22	7	.009	
						.96	17	.397	
W. 270°	T-327	.081	121	1.98	8	.68	49	.574	
						.91	32	.671	
						.23	9	.012	
Pasadena displacement meter:									
N. 0°	17R	9.8			10	.55	35	.27	
						.89	17	.34	
						2.97	6	1.41	
						1.85	14	1.24	
						1.75	12	.95	
E. 90°	17L	9.7			9	2.74	13	2.41	
						1.89	20	1.84	
						2.58	9	1.58	
						1.77	16	1.26	
						2.81	6	1.21	
Pasadena, Weed:									
E. 90°	7R	.20	70	.7	2	.73	63	.85	
N. 0°	7L	.21	68	.8	2	.50	34	.22	
San Bernardino, Weed:									
NW. 315°	10R	.19	6.4	.6	2	.80	28	.45	
SW. 225°	10L	.19	6.4	.6	2	1.11	25	.78	
San Diego accelerograph:									
Vertical-up	V-322	.080	124	2.02	8	1.16	1	.034	
E. 90°	L-323	.079	123	1.96	8	.43	5	.023	
						3.17	2	.509	Sinusoidal waves.
S. 180°	T-324	.080	122	1.96	9	.38	4	.015	
San Francisco Alexander Bldg: [3]									
16th-floor accelerograph:									
Vertical-up	V-181	.046	120	.66	14				Motion barely discernible.
SE. 171°	L-180	.056	120	.64	8	1.24	5	.195	
SW. 261°	T-179	.046	121	.64	6	1.28	5	.207	
11th-floor accelerograph:									
Vertical-up	V-178	.046	121	.65	9				No discernible motion.
NE. 81°	L-177	.046	122	.65	8	1.06	2	.057	
SE. 171°	T-176	.046	119	.65	9	1.18	3	.106	
San Francisco Southern Pacific Bldg: [3]									
14th-floor accelerograph:									
Vertical-up	V-184	.047	119	.65	12	.51	3	.020	
SW. 225°	L-183	.046	120	.65	5	1.35	19	.877	
						1.15	6	.201	
NW. 315°	T-182	.045	122	.63	6	.49	9	.055	
						1.17	17	.589	
Basement accelerograph:									
Vertical-up	V-196	.068	122	1.45	10				Motion barely discernible.
NW. 315°	L-195	.068	123	1.46	6	1.00	3	.076	
NE. 45°	T-194	.068	123	1.45	8	1.11	4	.125	
Basement displacement meter:									
NW. 315°	18R	9.88			13	10.5	.2	.50	
NE. 45°	18L	9.78			11	10.2	.2	.50	
San Jose Bank of America: [3]									
13th-floor accelerograph:									
Vertical-up	V-175	.046	120	.64	9				Motion barely discernible.
NE. 59°	L-174	.046	121	.65	8	1.90	23	2.102	Sinusoidal waves.
SE. 149°	T-173	.047	120	.68	7	1.63	9	.605	Do.
Basement accelerograph:									
Vertical-up	V-202	.068	122	1.42	9				Motion barely discernible.
NE. 59°	L-201	.067	123	1.38	6	2.57	4	.669	
SE. 149°	T-200	.067	122	1.40	13	2.37	4	.569	

See footnotes at end of table.

TABLE 7.—*Composite of strong-motion instrumental data for 1952*—Continued

SOUTHERN CALIFORNIA EARTHQUAKE OF JULY 21—continued

Station and component [1]	Instrument number	T_0	V	Sensitivity [2]	ϵ	Earth wave period	Maximum acceleration	Maximum displacement	Remarks
		sec.		*cm.*		*sec.*	*cm/sec.²*	*cm.*	
San Luis Obispo accelerograph:									
Vertical-up	V-295	0.080	115	1.85	10	0.34	4	0.012	Motion barely discernible.
						.75	9	.128	
SW. 234°	L-296	.080	120	1.92	9	.31	9	.022	
						.51	10	.066	
NW. 324°	T-297	.080	116	1.87	11	.80	14	.227	
						.44	8	.039	
Santa Ana, Weed:									
SE. 135°	9R	.22	6.8	.8	2	.75	18	.26	
NE. 45°	9L	.20	7.0	.7	2	.75	24	.34	
Santa Barbara accelerograph:									
Vertical-up	V-259	.066	126	1.37	7	.15	29	.017	
						.18	41	.034	
						.74	25	.347	
NE. 42°	L-260	.064	127	1.32	6	.25	30	.047	
						.47	55	.308	
						.93	32	.701	
SE. 132°	T-261	.066	125	1.36	7	.50	76	.481	
						1.05	71	1.982	
						.31	21	.051	
Taft accelerograph:									
Vertical-up	V-298	.080	113	1.82	8	.17	39	.029	
						.47	87	.487	
						.10	47	.012	
						.54	99	.731	
						2.67	6	1.083	
NE. 21°	L-299	.081	120	1.98	9	.84	116	2.072	
						.54	118	.871	
						.24	128	.187	
						.63	101	1.015	
						.87	86	1.648	
SE 111°	T-300	.082	119	2.02	8	.39	99	.381	
						.41	126	.536	
						.42	104	.464	
						.28	126	.250	
						.50	68	.430	
Vernon accelerograph:									
Vertical-up	V-256	.064	126	1.31	7	.24	12	.017	
SW. 187°	L-257	.065	128	1.37	10	.73	32	.432	
						.41	27	.115	
NW. 277°	T-258	.065	129	1.36	7	.24	18	.026	
						.96	36	.840	
Westwood accelerograph:									
Vertical-up	V-262	.065	123	1.33	6	.17	14	.010	
S. 180°	L-263	.066	123	1.35	8	.69	15	.181	
						.37	10	.347	
W. 270°	T-264	.066	125	1.36	9	.70	22	.273	
						.32	13	.034	

GUATEMALA EARTHQUAKE OF JULY 22

Guatemala City accelerograph:									
Vertical-up	V-277	0.066	118	1.29	18	0.56	2	0.016	
SW. 194°	L-278	.066	117	1.28	31	.98	4	.097	
NW. 284°	T-279	.065	112	1.19	12	.60	4	.036	

PERU EARTHQUAKE OF AUG. 3

Lima accelerograph:									
Vertical-up	V-286	0.065	123	1.30	9	0.10	9	0.002	
						.18	14	.011	
NW. 278°	L-287	.063	124	1.26	8	.24	9	.013	
						.09	12	.002	
						.17	21	.015	
NE. 8°	T-288	.064	122	1.24	10	.28	6	.012	
						.11	10	.003	
						.24	21	.031	

See footnotes at end of table.

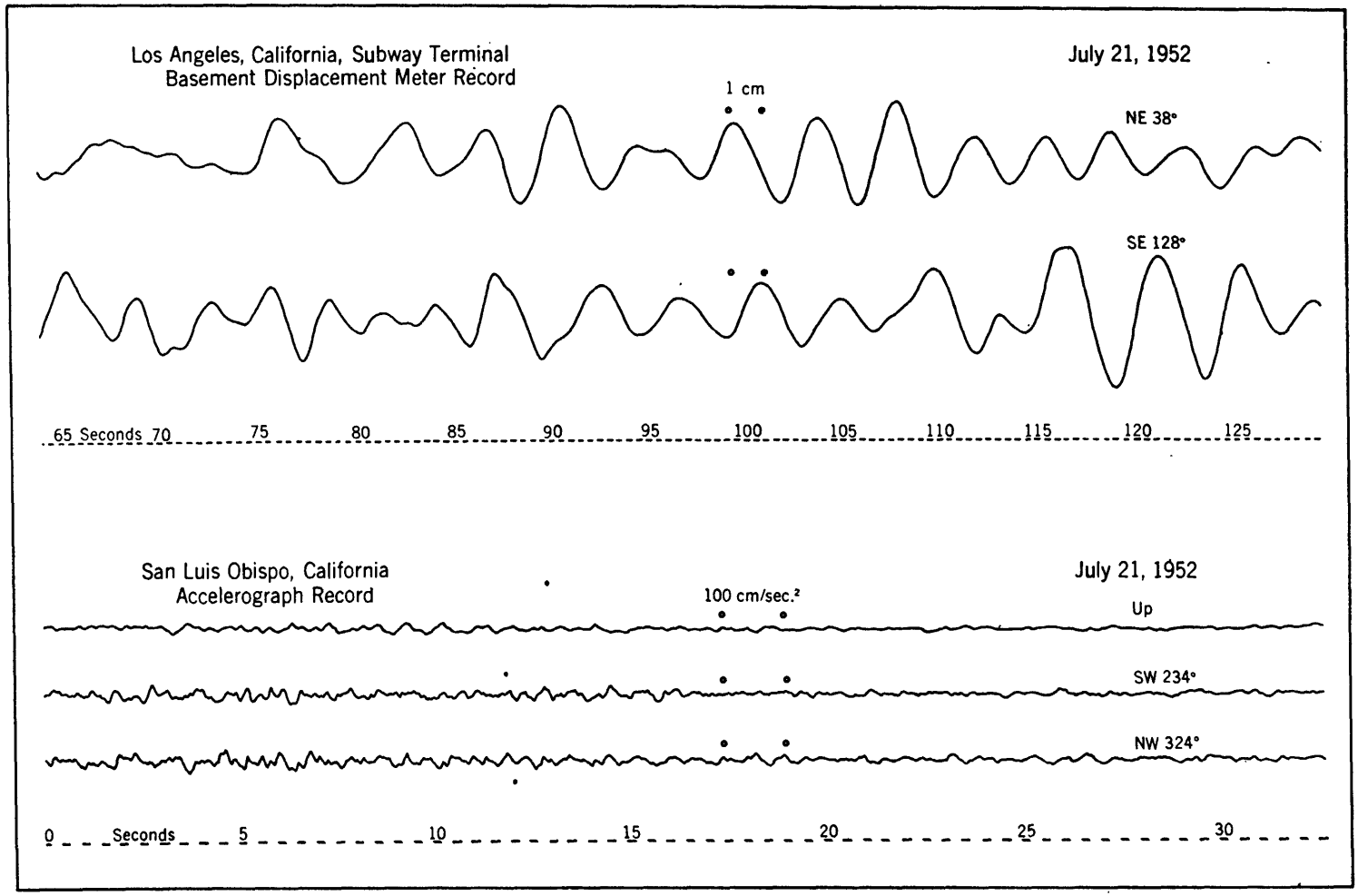

FIGURE 20.—Tracings of displacement meter record obtained at Los Angeles Subway Terminal basement and accelerograph record at San Luis Obispo on July 21.

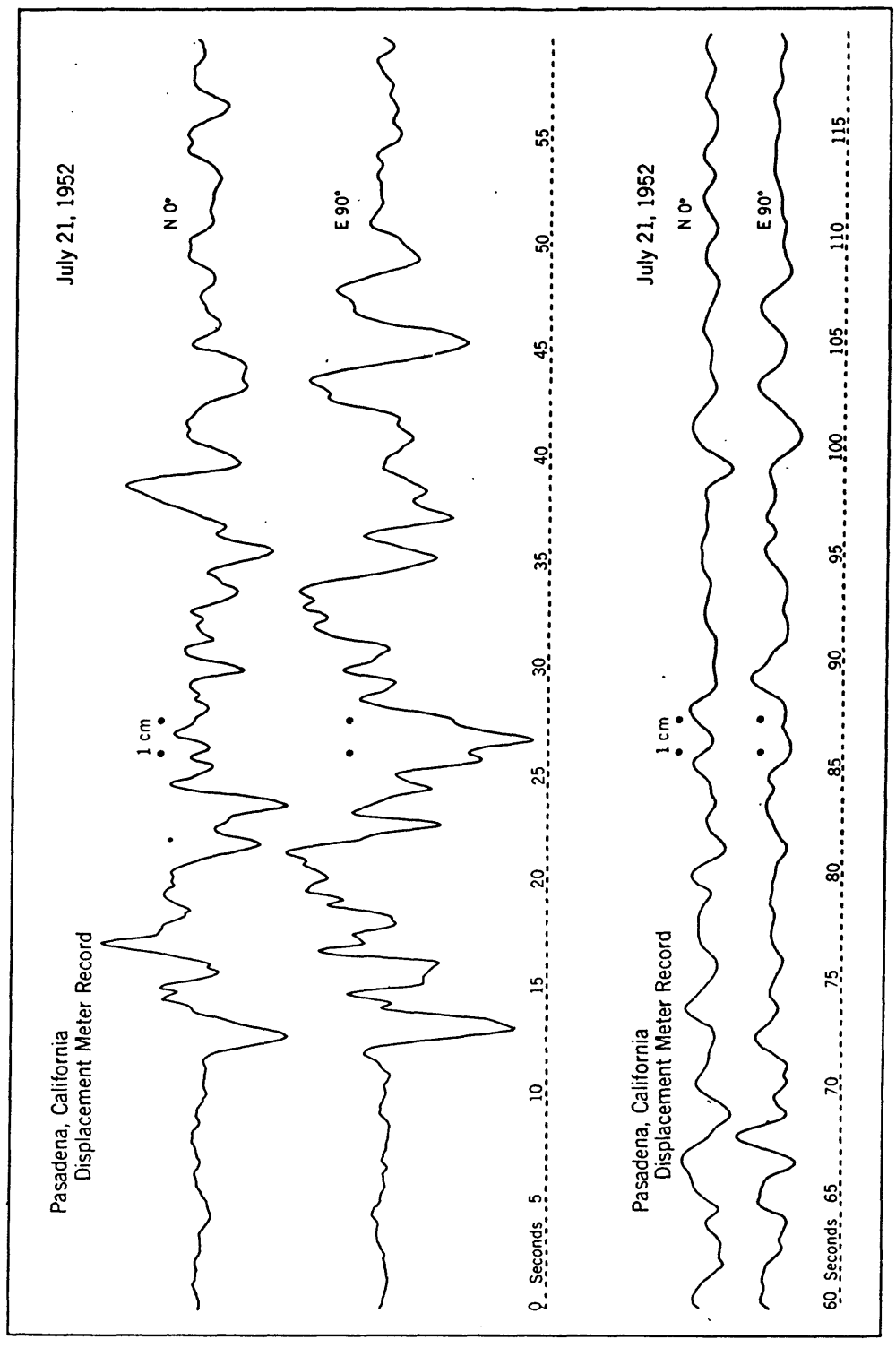

FIGURE 21.—Tracings of displacement meter record obtained at Pasedena on July 21.

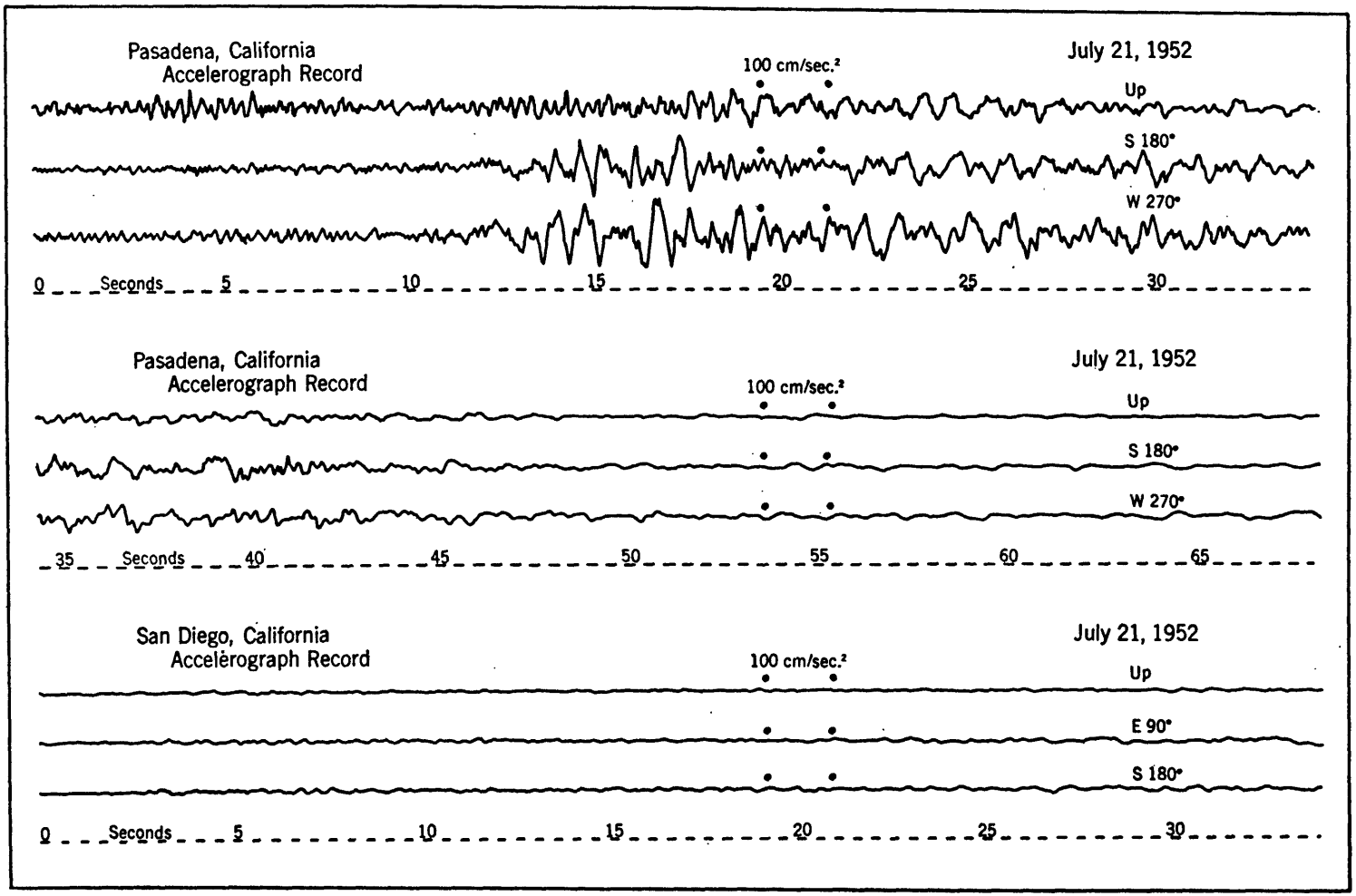

FIGURE 22.—Tracings of accelerograph records obtained at Pasadena and San Diego on July 21.

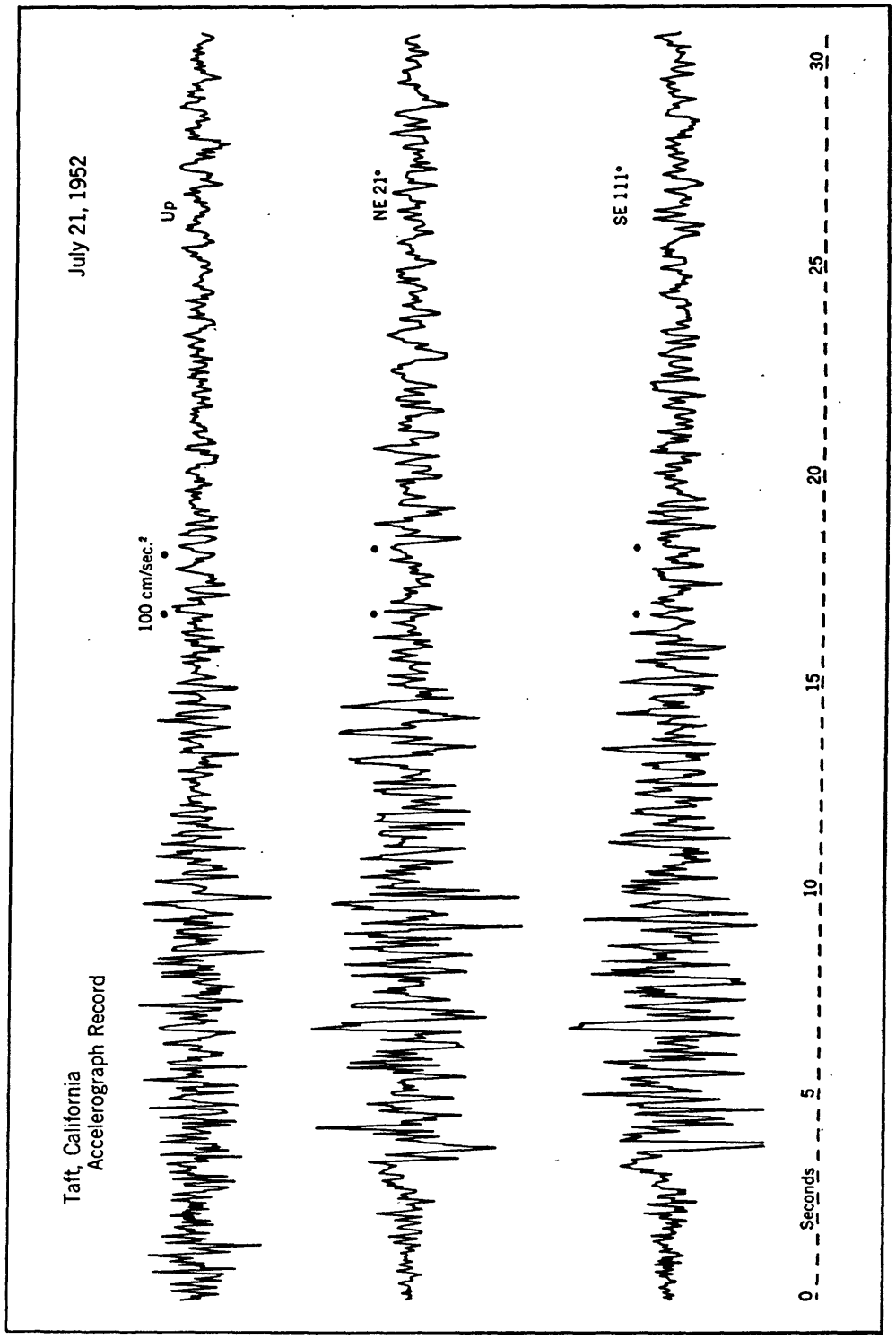

FIGURE 23.—Tracings of accelerograph records obtained at Taft on July 21.

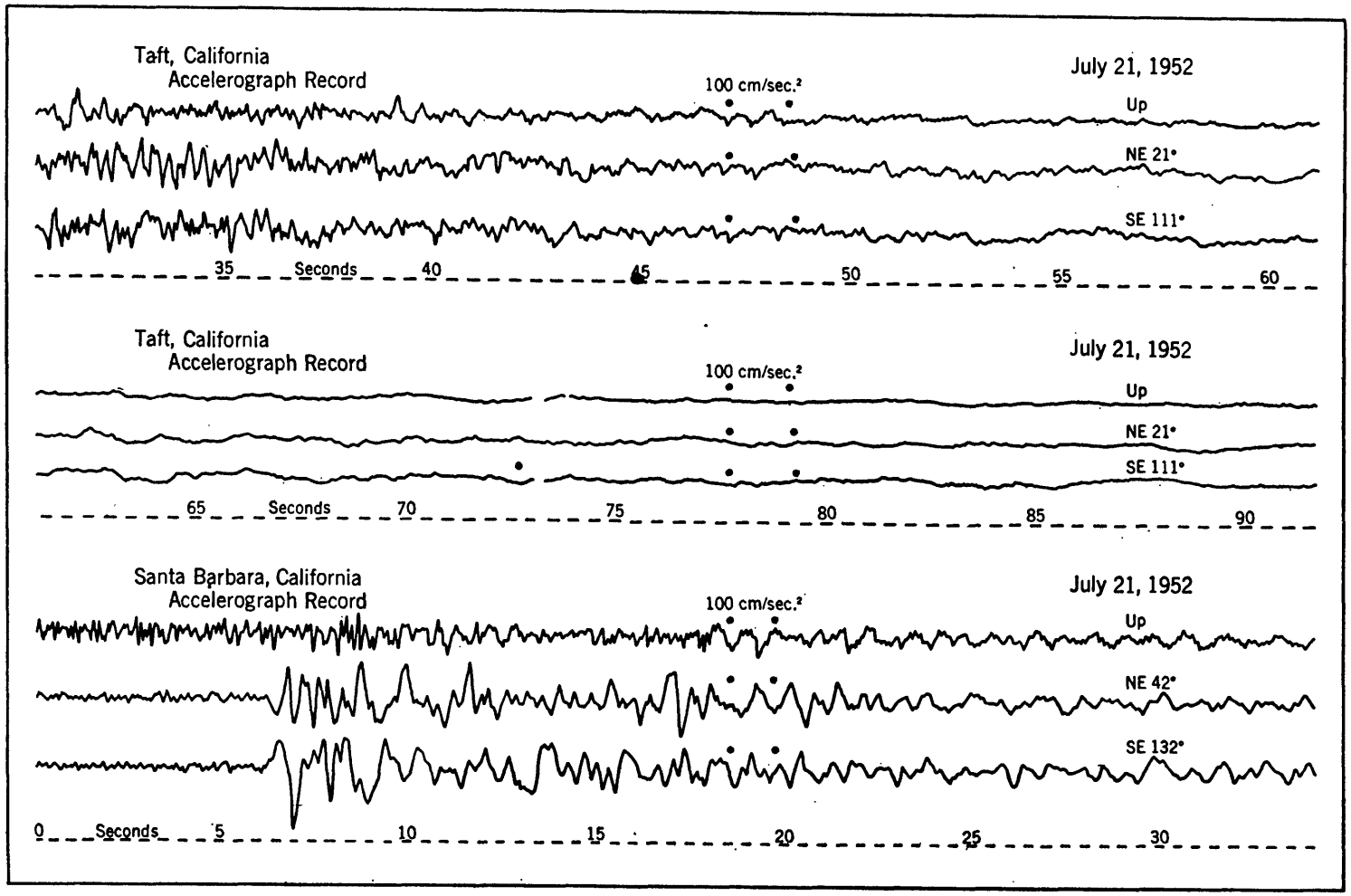

FIGURE 24.—Tracings of accelerograph records obtained at Taft and Santa Barbara on July 21.

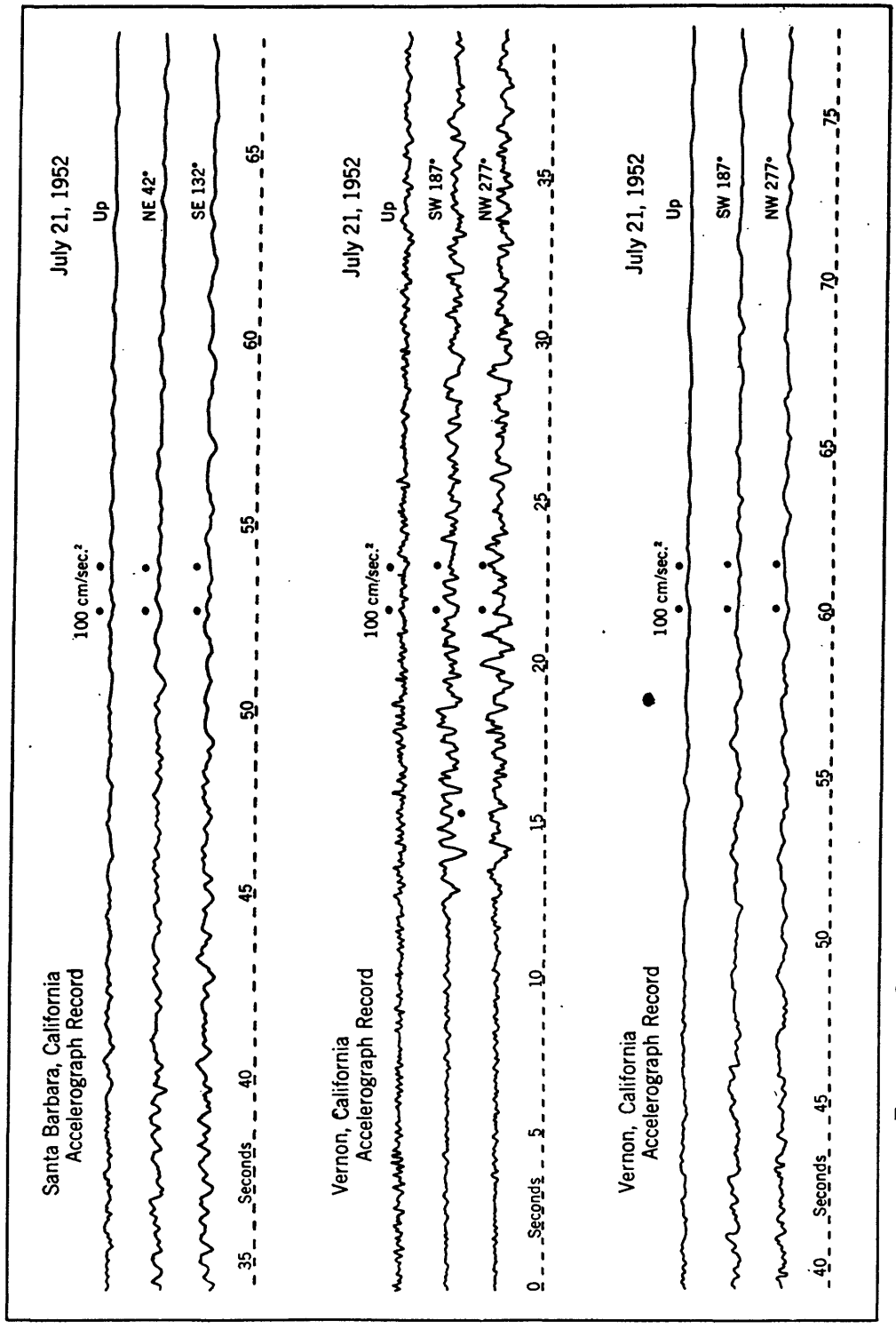

FIGURE 25.—Tracings of accelerograph records obtained at Santa Barbara and Vernon on July 21.

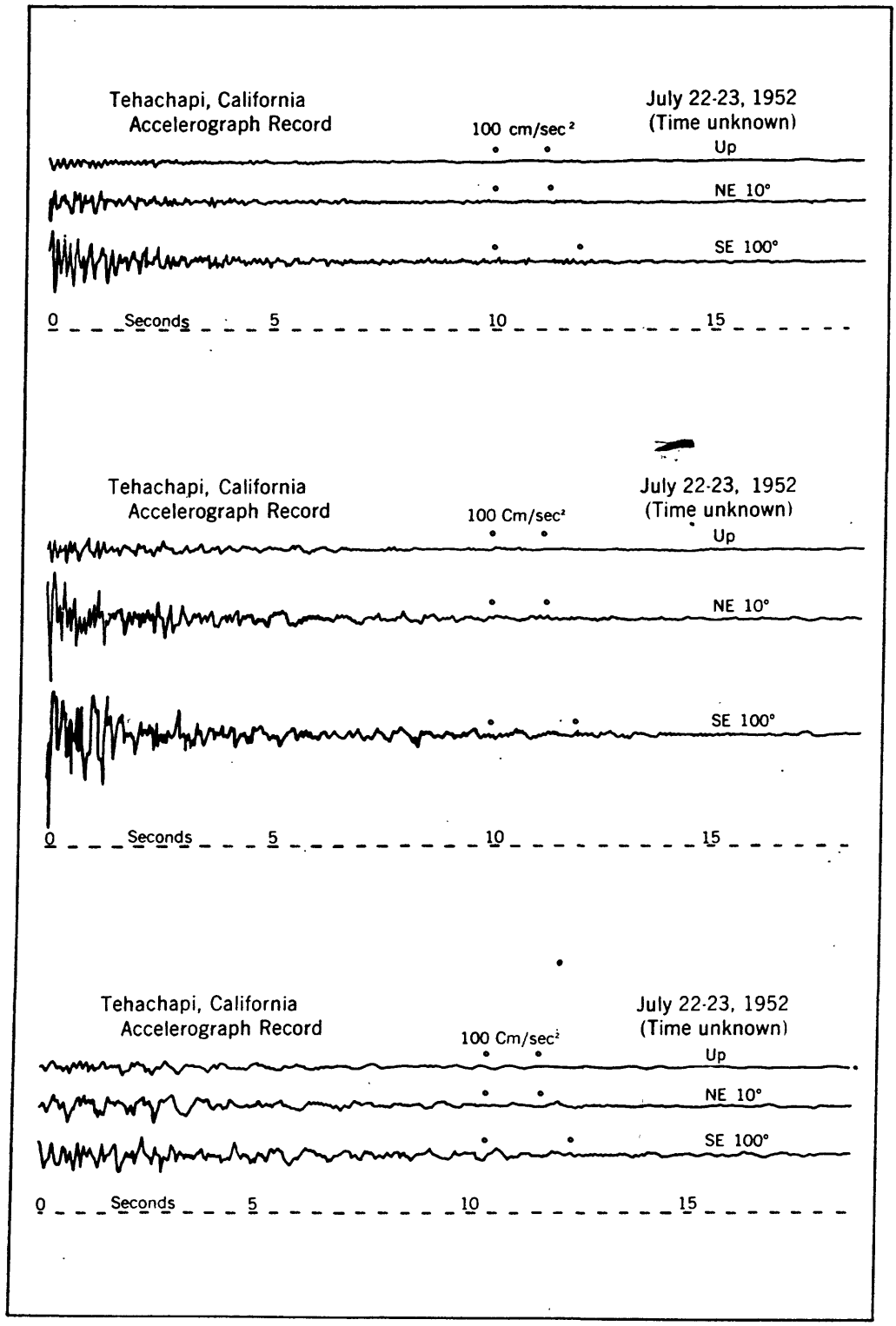

FIGURE 26.—Tracings of accelerograph records obtained at Tehachapi on July 22 and 23.

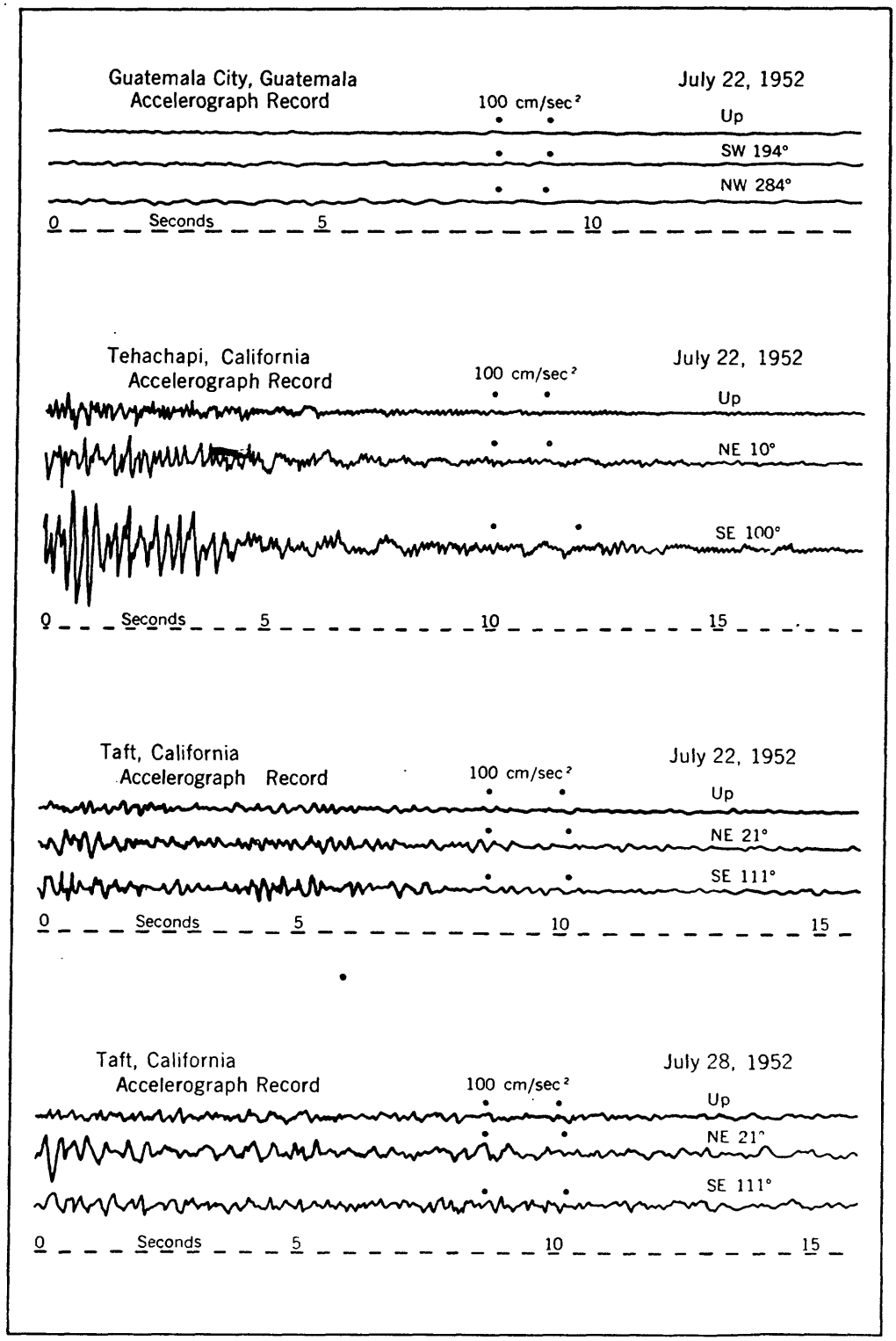

FIGURE 27.—Tracings of accelerograph records obtained at Guatemala City, Guatemala, and Tehachapi on July 22, and at Taft on July 22 and 28.

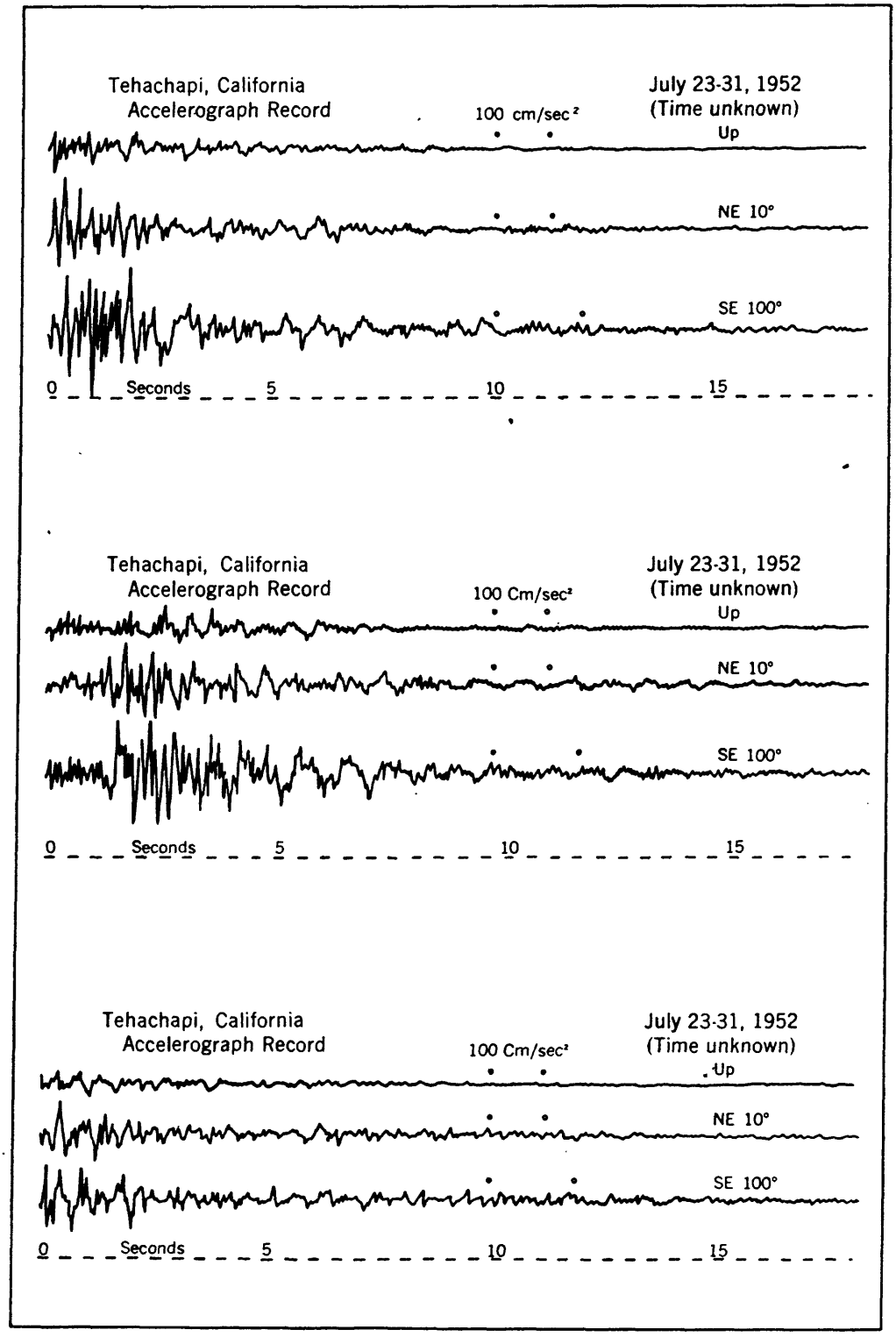

FIGURE 28.—Tracings of accelerograph records obtained at Tehachapi on July 23–31.

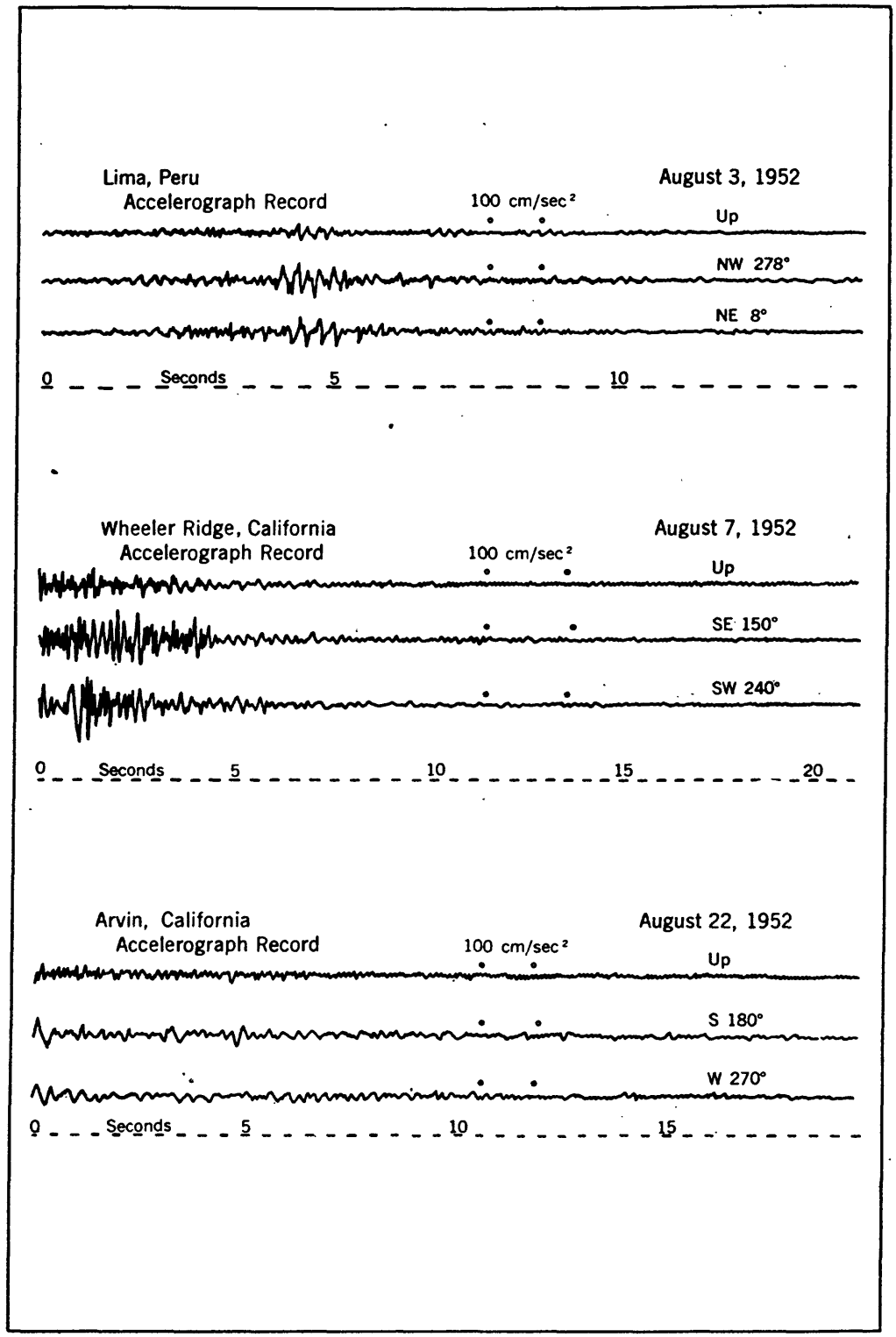

FIGURE 29.—Tracings of accelerograph records obtained at Lima, Peru, on August 3; at Wheeler Ridge on August 7; at Arvin on August 22.

TABLE 7.—*Composite of strong-motion instrumental data for 1952*—Continued

NORTHERN CALIFORNIA EARTHQUAKE OF SEPT. 22

Station and component [1]	Instrument number	T_0	V	Sensitivity [2]	ϵ	Earth wave period	Maximum acceleration	Maximum displacement	Remarks
		sec.		*cm.*		*sec.*	*cm/sec.²*	*cm.*	
Eureka accelerograph:									
Vertical-up	V-250	0.066	114	1.27	8	0.53	3	0.021	
NE. 79°	L-251	.066	119	1.31	10	.26	9	.015	
SE. 169°	T-252	.067	119	1.35	10	.34	8	.023	
Ferndale accelerograph: [3]									
Vertical-up	V-247	.066	121	1.33	14	.32	25	.065	
SW. 224°	L-248	.066	130	1.43	10	.46	52	.278	
						.84	7	.125	
NW. 314°	T-249	.064	119	1.25	11	.43	71	.332	
						.72	19	.249	
Ferndale displacement meter:									
SE. 134°	13R	9.60	------	------	10	1.8	16	1.3	
SW. 224°	13L	9.92	------	------	11	2.0	19	1.9	
SAN FRANCISCO BAY AREA EARTHQUAKE OF OCT. 12									
Berkeley accelerograph:									
Vertical-up	V-292	0.080	115	1.87	8	0.11	13	0.004	First recorded motion.
NE. 73°	L-293	.079	115	1.83	10	.14	26	.013	Do.
SE. 163°	T-294	.080	115	1.84	11	------	10	------	Period not defined.
Oakland, Chabot Observatory, Weed:									
SW. 236°	8R	.19	7.3	.73	2	------	60	------	Periods not defined; accelerometer readings in doubt.
SE. 146°	8L	.18	7.2	.70	2	------	43	------	Do.
Oakland City Hall: [3]									
16th-floor accelerograph:									
Vertical-up	V-226	.044	117	.58	10	.14	75	.037	
NE. 26°	L-227	.046	116	.64	8	.24	70	.102	
SE. 116°	T-228	.047	118	.66	9	.20	93	.094	
Basement accelerograph:									
Vertical-down	V-235	.066	124	1.36	12	.11	25	.008	
SW. 206°	L-236	.066	126	1.38	8	------	24	------	First recorded motion period not defined.
NW. 296°	T-237	.067	121	1.38	8	.18	21	.017	
San Francisco Southern Pacific Bldg.: [3]									
14th-floor accelerograph:									
Vertical-up	V-184	.047	120	.67	10	.17	10	.007	
SW. 225°	L-183	.046	120	.64	8	.45	12	.062	
NW. 315°	T-182	.045	122	.63	3	.46	11	.059	
Basement accelerograph:									
Vertical-up	V-196	.068	122	1.41	10	.11	5	.002	
NW. 315°	L-195	.067	123	1.41	6	.16	5	.003	
NE. 45°	T-194	.068	122	1.41	10	.14	9	.004	
Basement displacement meter:									
NW. 315°	18R	10.0	------	------	9	.55	2.6	.02	
NE. 45°	18L	10.1	------	------	10	1.1	.7	.02	
WHEELER RIDGE EARTHQUAKE OF OCT. 16									
Wheeler Ridge accelerograph:									
Vertical-up	V-229	0.080	118	1.92	8	0.12	12	0.004	
SE. 150°	L-230	.081	123	2.05	11	.14	18	.009	
SW. 240°	T-231	.077	122	1.84	8	.15	19	.011	
SAN FRANCISCO BAY EARTHQUAKE OF OCT. 21									
San Francisco Southern Pacific Bldg.:									
14th-floor accelerograph:									
Vertical-up	V-184	0.047	119	0.66	9	0.19	6	0.005	
SW. 225°	L-183	.046	120	.64	5	.46	11	.059	
NW. 315°	T-182	.046	122	.65	4	.48	20	.117	

See footnotes at end of table.

TABLE 7.—*Composite of strong-motion instrumental data for 1952*—Continued

Station and component [1]	Instrument number	T_0	V	Sensitivity [2]	c	Earth wave period	Maximum acceleration	Maximum displacement	Remarks
NEVADA EARTHQUAKE OF NOV. 12									
Hawthorne accelerograph:									
Vertical-up	V-244	0.065	125	1.35	10	0.07	3	0.001	
S. 180°	L-245	.068	124	1.47	10	.16	10	.006	
W. 270°	T-246	.067	125	1.41	9	.12	13	.005	
SOUTHWESTERN CALIFORNIA EARTHQUAKE OF NOV. 21									
Hollister accelerograph: [4]									
Vertical-up	V-238	0.068	126	1.47	8	0.7	5	0.06	
SW. 181°	L-239	.066	124	1.36	7	.4	11	.04	
NW. 271°	T-240	.066	122	1.35	13	.4	12	.05	
Carder displacement meter:									
NW. 271°	5	2.52	.9	-------	10	1.4	6	.29	
NE. 1°	6	2.27	1.1	-------	10	1.8	2.8	.23	
Los Angeles Occidental Life Bldg. [3] (formerly Chamber of Commerce Bldg.):									
11th-floor accelerograph:									
Vertical-up	V-187	.046	120	.64	9	-------	-------	-------	Trace motion barely discernible.
SW. 218°	L-186	.045	122	.65	11	1.5	5	.28	
NW. 308°	T-185	.045	122	.65	9	1.6	5	.32	
Pasadena accelerograph: [3]									
Vertical-up	V-325	.082	122	2.06	9	-------	-------	-------	Maximum acceleration less than 1 cm/sec.[2]
S. 180°	L-326	.080	120	1.93	7	1.0	1	.03	
W. 270°	T-327	.081	120	1.99	8	.5	2	.01	
Displacement meter:									
N. 0°	17R	9.87	-------	-------	11	1.7	1.1	.08	
E. 90°	17L	9.70	-------	-------	10	1.8	1.2	.10	
San Francisco Shell Bldg.:									
21st-floor weed:									
NE. 81°	3R	.21	6.2	.7	2	1.0	1	.03	
NW. 351°	3L	.21	6.1	.7	2	1.0	4	.10	
San Francisco Southern Pacific Bldg.: [3]									
14th-floor accelerograph:									
Vertical-up	V-184	.047	119	.66	10	-------	-------	-------	Trace motion barely discernible.
SW. 225°	L-183	.046	120	.64	6	1.2	12	.44	
NW. 315°	T-182	.046	122	.65	4	1.1	15	.46	
Basement accelerograph:									
Vertical-up	V-196	.068	121	1.42	9	-------	-------	-------	Do.
NW. 315°	L-195	.068	123	1.44	6	.7	2	.02	
NE. 45°	T-194	.068	122	1.43	9	.8	2	.03	
Basement displacement meter:									
NW. 315°	18R	9.97	-------	-------	10	1.0	2.4	.06	
NE. 45°	18L	10.08	-------	-------	11	8	.09	.15	
San Jose Bank of America:									
13th-floor accelerograph:									
Vertical-up	V-175	.046	120	.64	9	-------	-------	-------	Do.
NE. 59°	L-174	.047	121	.67	10	1.6	4	.26	
SE. 149°	T-173	.047	121	.68	8	1.7	4	.29	
San Luis Obispo accelerograph:									
Vertical-up	V-295	.081	115	1.90	10	.36	29	.10	
SW. 234°	L-296	.079	120	1.91	10	.17	41	.03	
NW. 324°	T-297	.080	116	1.88	11	.24	58	.08	
Santa Barbara accelerograph:									
Vertical-up	V-259	.066	127	1.39	9	.8	2	.03	
NE. 42°	L-260	.064	127	1.34	8	1.1	4	.12	
SE. 132°	T-261	.065	126	1.36	8	1.1	4	.12	
Taft accelerograph:									
Vertical-up	V-298	.080	116	1.87	12	.5	3	.02	
NE. 21°	L-299	.081	122	2.01	10	.6	5	.05	
SE. 111°	T-300	.082	121	2.05	11	.7	4	.05	
COSTA RICA EARTHQUAKE OF DEC. 30									
San Jose accelerograph:									
Vertical-up	V-280	0.064	125	1.30	7	0.28	36	0.071	
SE. 171°	L-281	.064	125	1.30	8	.20	69	.070	
SW. 261°	T-282	.064	123	1.27	8	.20	98	.099	

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

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

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

[4] Single recorder for both the accelerometer and displacement meter.

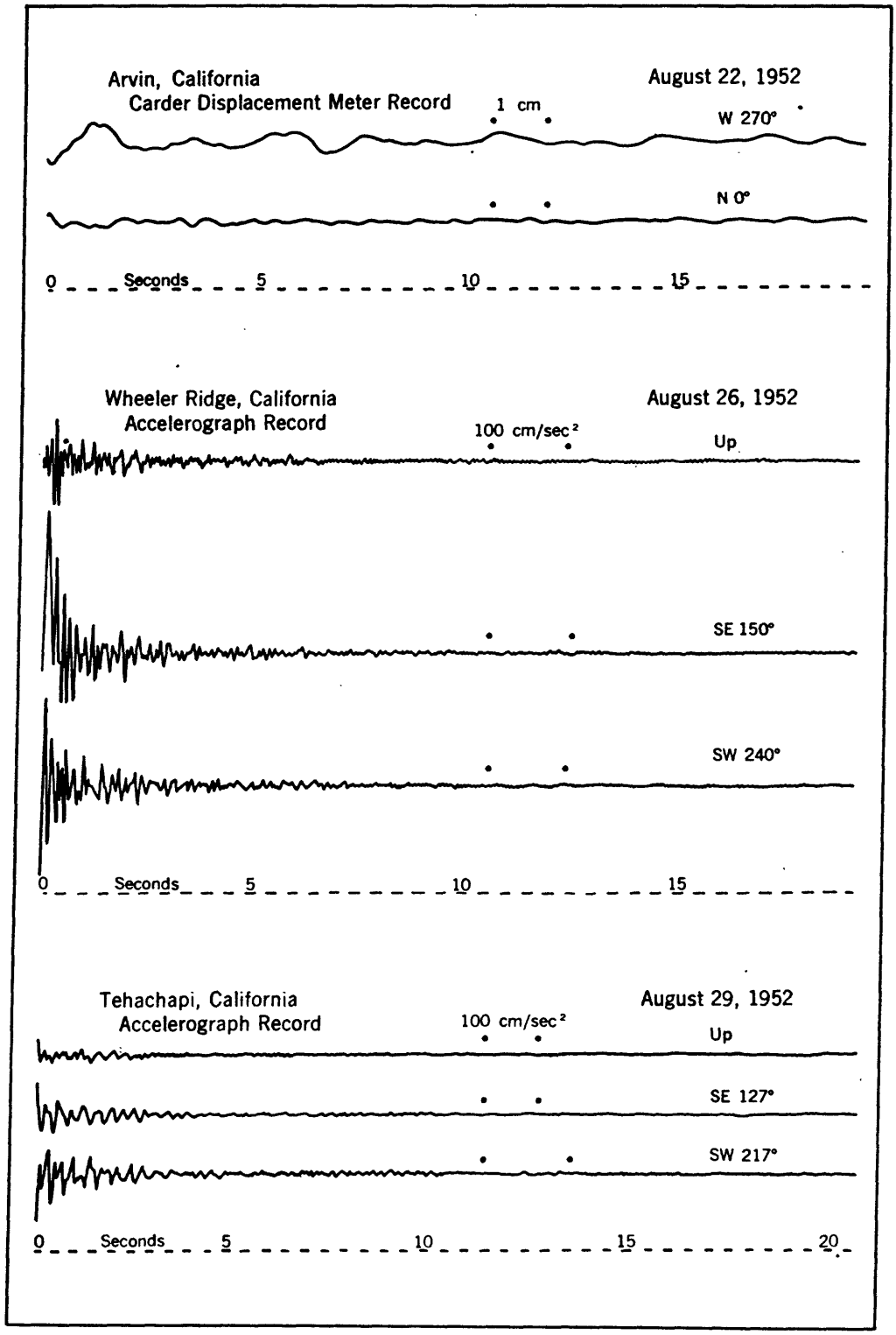

FIGURE 30.—Tracings of displacement meter record obtained at Arvin on August 22, and accelerograph records at Wheeler Ridge on August 26 and at Tehachapi on August 29.

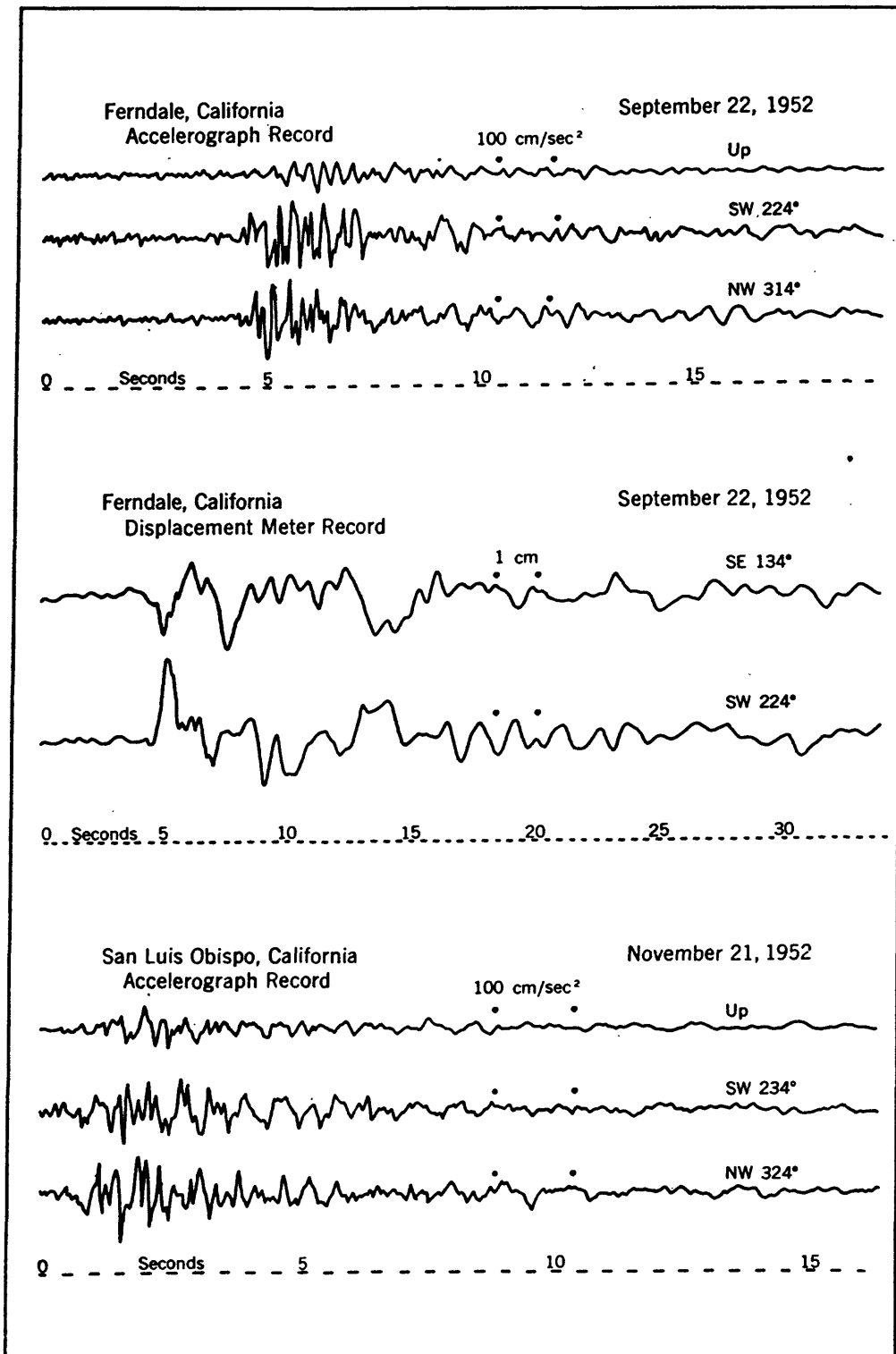

FIGURE 31.—Tracings of accelerograph and displacement meter records at Ferndale on September 22, and accelerograph records at San Luis Obispo on November 21.

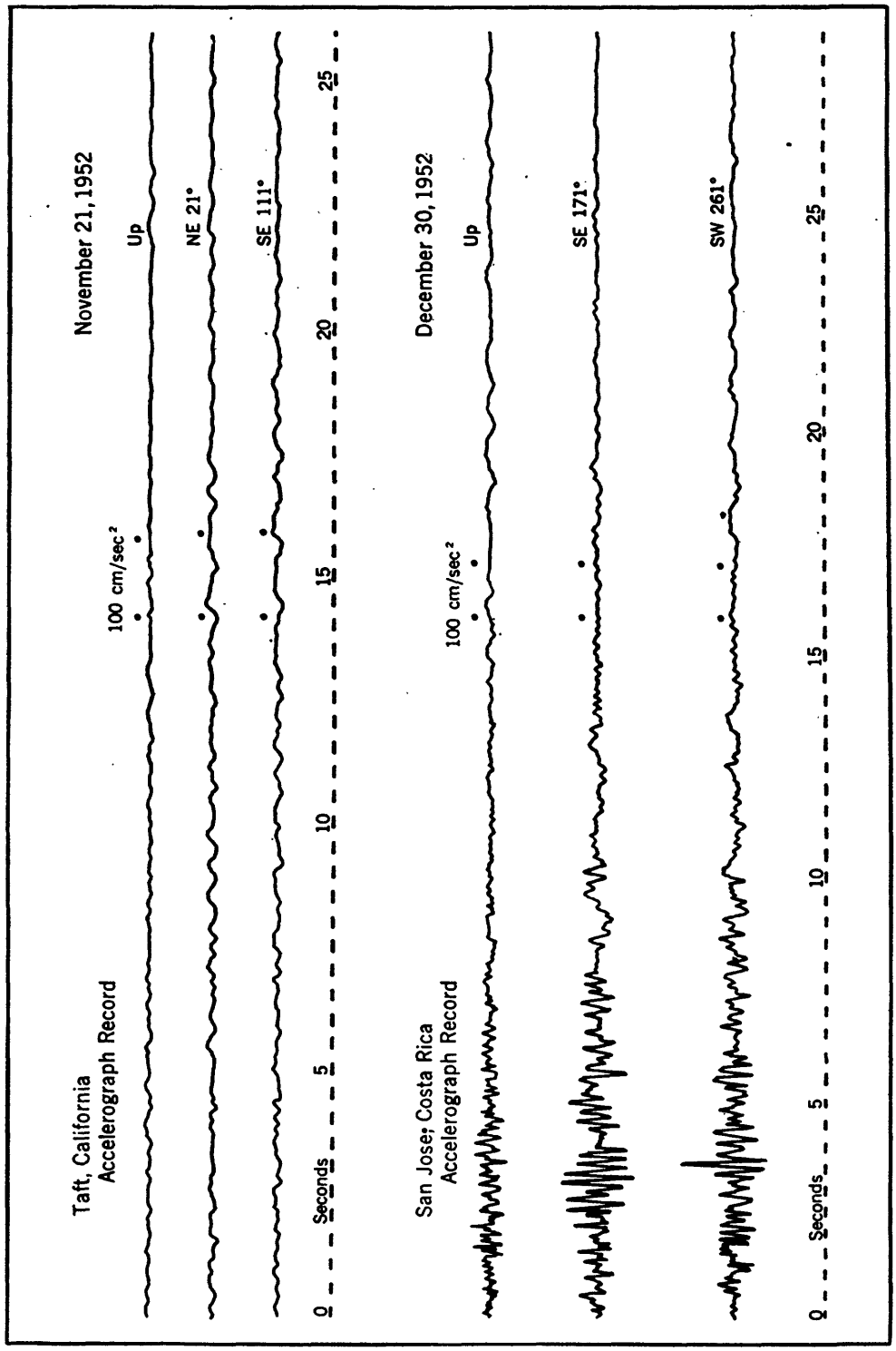

FIGURE 32.—Tracings of accelerograph records obtained at Taft on November 21, and at San Jose, Costa Rica, on December 30.

TILT OBSERVATIONS

Two tiltmeters at the University of California, Berkeley, were continued in operation. The one at the Long Beach City Recreation Park, Long Beach, was permanently discontinued during 1952.

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