DEPARTMENT OF THE INTERIOR

U.S. GEOLOGICAL SURVEY

United States Earthquakes, 1954

By

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and

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

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ILLUSTRATIONS

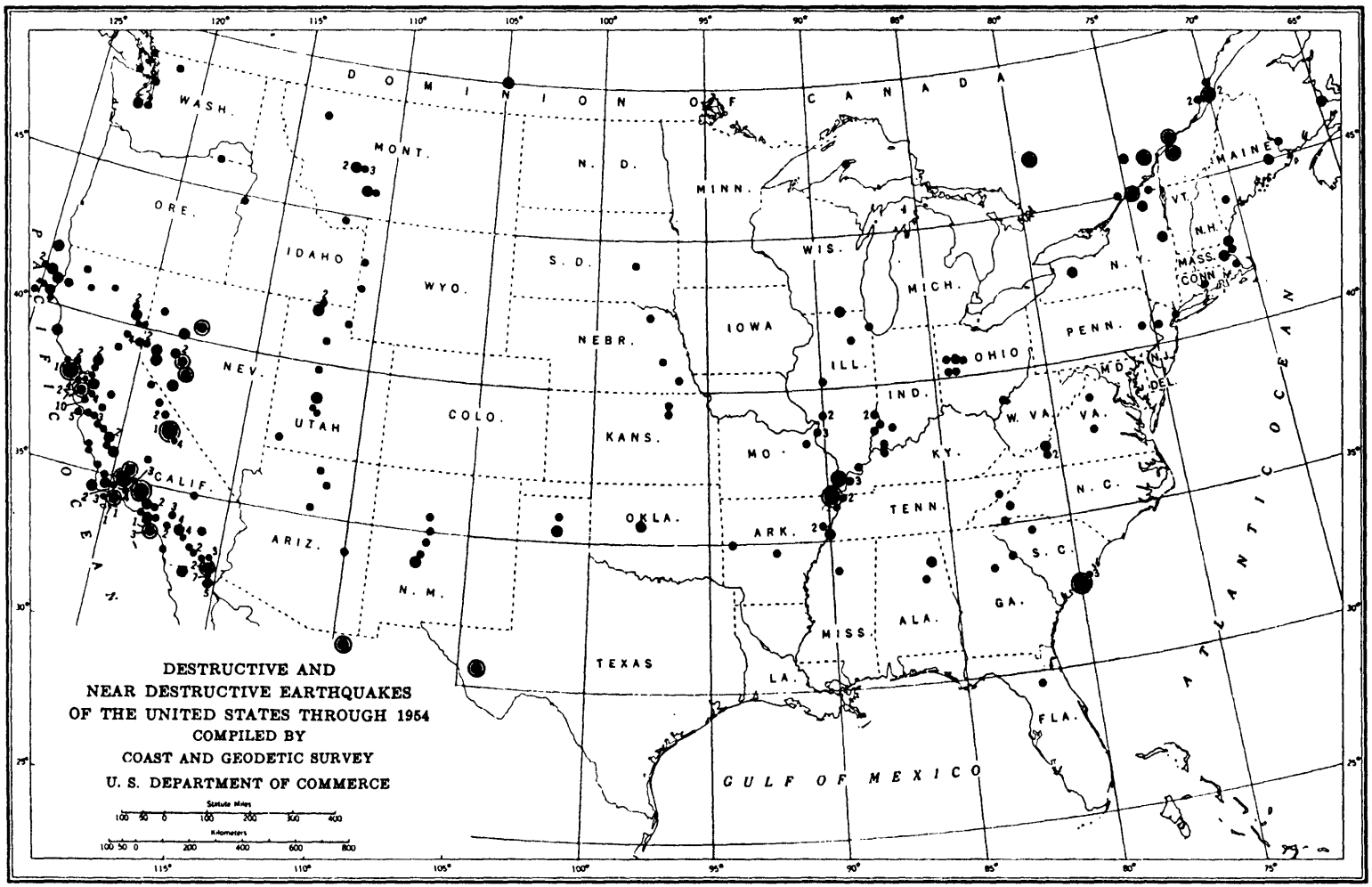

FIGURE 1.—Destructive and near destructive earthquakes in the United States through 1954.

UNITED STATES EARTHQUAKES, 1954

INTRODUCTION

This publication is a summary of earthquake activity in the United States and regions under its jurisdiction for the calendar year 1954. The sources of noninstrumental information used in the compilation include the United States Weather Bureau, whose observers prepare periodic reports on local seismic activity; telegraphic information collected by Science Service, Washington, D. C.; Bulletins of the Seismological Society of America; special reports of the Jesuit Seismological Association and the Northeastern Seismological Association; the *Hawaiian Volcano Letter;* newspaper clippings; and reports from interested individuals. Instrumental data used in locating earthquakes are obtained from the network of Coast and Geodetic Survey stations listed on page 72 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 1954:

Arizona.—Dr. Eldred D. Wilson, University of Arizona, Tucson.

Colorado.—Dr. C. A. Heiland, Heiland Division, Minneapolis-Honeywell, 130 East Fifth Avenue, 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. Everybody runs outdoors. Damage **negligible** in buildings of good design and construction; **slight** to moderate in well-built ordinary structures; **considerable** in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving motorcars. (VIII Rossi-Forel scale.)

VIII. Damage **slight** in specially designed structures; **considerable** in ordinary substantial buildings with partial collapse; **great** in poorly built structures. Panel walls thrown out of frame structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. Sand and mud ejected in small amounts. Changes in well water. Persons driving motorcars disturbed. (VIII+ to IX− Rossi-Forel scale.)

IX. Damage **considerable** in specially designed structures; well-designed frame structures thrown out of plumb; **great** in substantial buildings, with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Underground pipes broken. (IX+ Rossi-Forel scale.)

X. Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations; ground badly cracked. Rails bent. Landslides considerable from river-banks and steep slopes. Shifted sand and mud. Water splashed (slopped) over banks. (X Rossi-Forel scale.)

XI. Few, if any, (masonry) structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipelines completely out of service. Earth slumps and land slips in soft ground. Rails bent greatly.

XII. Damage total. Waves seen on ground surfaces. Lines of sight and level distorted. Objects thrown upward into air.

Epicenter maps.—Figure 1 is designed to show the existence of destructive and near destructive earthquakes in the United States through 1954. 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

[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.*

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 1954. In a few cases where instrumental control is not satisfactory or where results of investigations are inadequate, the plotted epicenters should be considered as showing the existence of the earthquake rather than the precise location.

In figures 1 and 2, those earthquakes occurring in the California area are plotted when felt reports are received from several places. Earthquakes reported as feeble are not plotted on the epicenter map of the United States, nor are minor aftershocks plotted for heavy earthquakes in California or any other region. The number after a dot indicates the number of shocks which have occurred at or near the location shown. Bulletins of the University of California Seismographic Station, Berkeley, and the Seismological Laboratory, Pasadena, should be consulted for further details regarding epicenters and often for data on additional shocks.

The selection of isoseismal or "felt area" maps (figs. 3–10) 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 72 is a list of Survey and cooperating teleseismic stations for which the Survey publishes results. During the year the locations of 213 epicenters were announced promptly on *Preliminary Determination of Epicenter* cards and an additional 795 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 monthly Seismological Bulletin, MSI series, available on mailing list CGS–7 from the Director, Coast and Geodetic Survey, Washington 25, D. C. During the year 1955, MSI–134 through 136 for the second through the fourth quarter 1948, MSI–145–a and 145–b for the monthly bulletins for January and February 1951, and MSI–169 through 180 for the monthly bulletins of 1955.

Magnitude and Intensity (Damage) Ratings.—Magnitude Rating, stated according to the Gutenberg-Richter scale, is a measure of the energy-release at the focus of the earthquake, having therefore a fundamental relation to the shock. It is estimated by the analysis of seismograph records, as explained in the *Bulletin of the Seismological Society of America*, Vol. 32, No. 3, 1942. Intensity (Damage) Rating, usually expressed on the Modified Mercalli scale of 1931, is a local measure of the effects on people and objects at any affected locality, being, therefore a result of many factors, including energy-release of the earthquake, distance, geological and topographic conditions, and structural properties of buildings. It varies from place to place. The two ratings are not simply comparable.

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

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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, 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.

(page 7 follows)

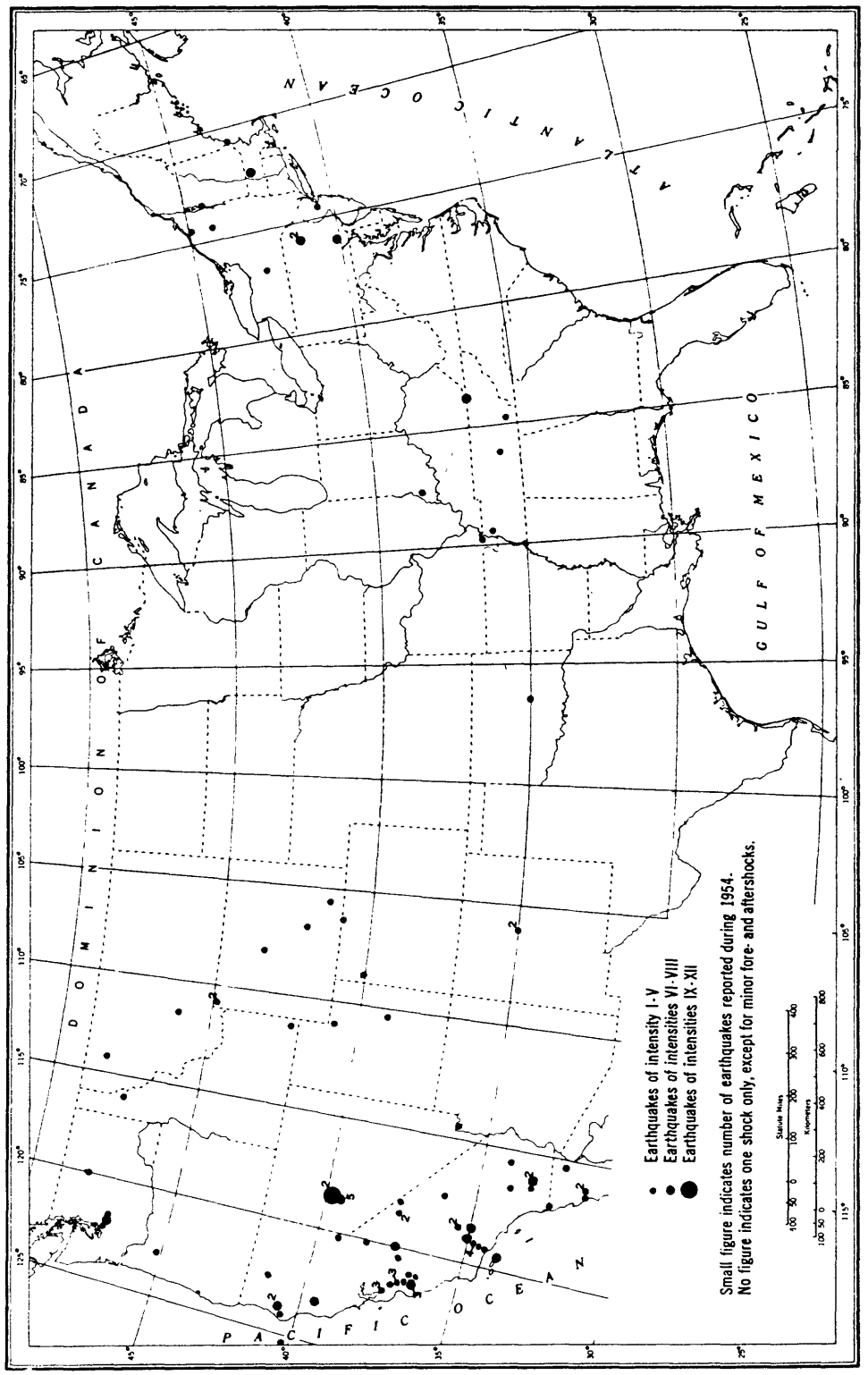

FIGURE 2.—United States earthquake epicenters, 1954.

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 Coast and Geodetic Survey; NESA, reported by the Northeastern Seismological Association, Weston, Mass.; JSA, reported by the Jesuit Seismological Association, St. Louis, Mo.; S, reported by the Seismograph Station, University of Washington, Seattle, Wash.; and W, reported by the Washington Office, 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-5 by the Coast and Geodetic Survey, Washington 25, D. C.

EARTHQUAKE ACTIVITY IN THE VARIOUS STATES

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

Arizona: March 19; April 29.

California: (Intensity VI and above) January 12, VII–VIII; 27, VI; March 19, VI (6); 22, VI; April 22, VI; 25, VIII; August 12, VI; 26, VI; September 15, VI; November 10, VI; December 21, VII; 30, VI.

Colorado: February 21, IV.

Idaho: June 7, V; October 30, IV.

Indiana: August 9, IV.

Kentucky: January 1, VI.

Missouri: February 2, VI.

Montana: January 28, IV; July 3, II; September 28; October 28, IV.

Nevada: February 20; March 18, III, IV; June 14, III; July 2, III; 6, IX, VII; (many aftershocks), 7, IV; 8, V (2); 9, IV; 12, IV; 28, III; 31 (2); August 2, V; 22; 23 (2), VIII; 28, 29 (2); no date given, V; 30, IV; 31, III, VII (many aftershocks); September 3 (3), 7; October 7; November 14, IV; December 16, IX; IV (many aftershocks); 17, V; 20, IV (3); 29.

New Hampshire: July 29, V; October 7.

New Jersey: March 31, IV.

New Mexico: November 2, IV; 3, V.

New York: January 31, IV; April 21, IV; May 20, IV; September 28; December 12, IV; 15.

Oklahoma: April 11, IV (2); 12 IV; 13 IV.

Oregon: February 1; April 23, IV.

Pennsylvania: January 7, VI; 23; February 21, VII; 23, VI; August 10; September 24.

Tennessee: January 17, IV; 22, V; April 26, V.

Utah: March 9, II; 31, IV; November 1, IV (2).

Washington: March 16, V; April 22–26; May 4, V; 15, VI; 23, V; June 18; November 11, III.

Wyoming: January 11; 20, V; 22, IV; 23, IV; 31, V; July 4, V; September 10, IV; October 3.

EARTHQUAKE ACTIVITY OUTSIDE THE UNITED STATES

Alaska: January 6, 13, 19, 20, 21; February 19; March 3 (5), 28, 31; April 5, 17, 23 (3), 28; May 10, 12, 16; June 24, 27; July 3, 30; August 17, 23; October 3, 4, 10, 22; November 3, 15, 16, 20, 26, 28; December 2, 10 (2), 13.

Hawaii: January 17, 20, 24, 31; February 6, 16, 22; March 30 (2); April 1 (2), 15 (3), 22; May 18, 31 (2); June 1, 18; July 1, 3, 25, 26; August 1, 2, 7, 30; September 1, 13; October 5, 7, 11; November 6, 19, 20, 26; December 4, 5, 6, 14, 23, 28.

Panama Canal Zone: March 15; April 10, 22; June 12; August 23 (3); December 8, 19.

Puerto Rico: None.

NORTHEASTERN REGION

(75TH MERIDIAN OR EASTERN STANDARD TIME)

January 31: 07:30. Canandaigua, N. Y. IV. Felt by many within a radius of 15 miles. In Canandaigua and Seneca Castle felt by several; buildings creaked and shook; dishes fell from pantry shelves in some houses; more than 200 calls to Canandaigua police headquarters. Many

feared an explosion in Aloquin. Shock threw a person to floor while leaning against kitchen stove. Also felt by many and sounded like an explosion in Clifton Springs, Seneca Castle, and Stanley.

April 21: 10:45. Plattsburgh, N. Y. IV. Number of phone calls described shock as rumblings that shook the whole house and a loud crash that awakened everyone. City Hall shook and windows rattled. Some reported a jet plane as the source of the disturbance. Doors rattled at Mallets Bay, Vt. Felt in Chazy, N. Y., and Burlington, Vt.

May 20: 18:00. Malone, N. Y. IV. Many flooded police station with calls about dishes rattling and houses shaking. Telephone building trembled. At police headquarters felt like an oil burner explosion. Also felt in Ellenburg Center and Twin Ponds.

July 29: 15:57:06*. Coastal areas of Maine, Massachusetts, New Hampshire. V. Tremor strongly felt and slight damage along coastal areas of the three States. According to the Weston and Harvard seismograph stations the epicenter was about 45 miles to the east. In Gloucester, Bayview section of Gloucester, Newburyport and Salisbury, Mass., small objects overturned and displaced; delicate clock stopped; glasses knocked from china closet; water pipe jangled. In Hampton Beach, N. H., and Kittery, Me., many frightened; dishes broke; bushes shaken slightly; windows and dishes rattled.

INTENSITY I TO IV IN MASSACHUSETTS: Amesbury, Andover, Cape Ann, Fair Haven, Greater Lawrence, Ipswich, New Bedford, North and South Dartmouth, Rockport, and Rowley.

INTENSITY I TO IV IN NEW HAMPSHIRE: Eppling, Exeter, Hampton, Portsmouth, Rye, Rye Beach, and Seabrook.

INTENSITY I TO IV IN MAINE: Eliot and York Village.

September 28: 22:50. Watertown, N. Y. Single report of a lamp and table shaking. Lasted ten seconds.

October 7: (no time given). Dracut, Mass. and Pelham, N. H. Three sharp tremors reported. One tremor broke dishes at Pelham.

December 12: 22:54:51*. Saranac Lake, N. Y. and vicinity. IV. Tremor felt and heard by many, and loose objects rattled in many northern New York communities—Bloomingdale, Lake Clear, Lake Placid Club, Paul Smiths, Ray Brook, Saranac Lake, Sunmount, and Vermontville.

December 15: 12:35. Lawrenceville, N. Y. Felt by several. Sounds heard before and during tremor.

EASTERN REGION

(75TH MERIDIAN OR EASTERN STANDARD TIME)

January 7: 02:25. Sinking Spring, Pa. VI. The tremor centered in the vicinity of Sinking Spring with the west section of the city experiencing minor damage. Plaster ripped from walls; dishes and liquor bottles tumbled from tables and shelves; furniture upset; house shook so that it was full of dust. Other slight damage reported to several brick and frame buildings. Off-duty police officers thrown out of beds. At Mohnton about four miles from Sinking Spring, half of the people felt the tremor, many believing their furnaces exploded. Dishes and lamps rattled. At Fritztown homes rocked and furniture toppled. Also felt at Denver, Kenhort, Lincoln Park, Temple, West Lawn, West Reading, Wyomissing, and Wyomissing Hills. The seismograph stations at Fordham, Palisades (Columbia University), and Washington (Coast and Geodetic Survey) recorded the main tremor. Additional tremors (all minor) occurred as follows: January 7—03:00, 03:30, 05:45, 20:25, 20:30; January 8—13:00, 16:45; January 9—02:00, 03:00, 09:00, 11:30, 13:25, 15:00, 16:30, 23:00; January 10—17:00; January 13—16:00, 22:30; January 15—14:40; January 16—21:54, 22:32.

January 23: 22:30. Sinking Spring, Pa. A tremor, the strongest since January 7, shook a 10-mile square area including Sinking Spring, Mohnton, Montrose, and Shillington.

February 21: 15:00. Wilkes-Barre, Pa. VII. The affected area was confined to the east bank of the Susquehanna River in a five block residential area of Wilkes-Barre. The Glen Alden Coal Company which operates coal mines that extend to a depth of 400 feet below the surface of the affected area denied any cave-in caused the tremor. The estimated property damage reached $1 million, a figure that may be considered high. Occupants fled to the streets. Sidewalks pushed sharply upward with a heaving motion and then collapsed. Hundreds of homes damaged; ceilings and cellar walls split; backyard fences pushed over. Gas and watermains snapped. Deadly methane gas rising from cracks in the earth presented a temporary emergency.

February 23: 22:55. Wilkes-Barre, Pa. VI. A second tremor with similar effects to the one of February 21 was reported from the same section of Wilkes-Barre. Hundreds fled to the streets. Cracks appeared in ceilings and walls of apartment buildings. Curbs pulled away from sidewalks; street pavements buckled from curb to curb. Additional water and gas mains were broken.

March 31: 16:25*. Monmouth County, N. J. shoreline. IV. Series of tremors from 16:25–23:30 startled residents of Red Bank, Plainfield and along Monmouth County shore line. Sounds

like explosions were heard in Freehold, Ocean Grove, Piscataway, and Shark River. At North Plainfield police headquarters windows rattled and buildings shook. Also felt at Asbury Park, Avon, Farmingdale, Neptune, and New Brunswick.

August 10: 22:40—22:50. Sinking Spring, Pa. About 12 rumblings, 4 of "good size", were felt within a ten-minute period. Also felt about one mile west of Sinking Spring at Green Valley Country Club.

September 24: 06:00 (about). Sinking Spring, Pa. In first tremor homes shook and doors rattled. Other tremors followed.

CENTRAL REGION

(90TH MERIDIAN OR CENTRAL STANDARD TIME)

January 1: 21:25*. Middlesboro, Ky. VI. Tremor centered near Middlesboro causing slight cracks to foundations and dislodging loose bricks and was felt in the bordering states of Kentucky, North Carolina, Tennessee, and Virginia. It was recorded by the Chapel Hill, N. C. seismograph. In Middlesboro, besides the slight damage, there was general alarm among the people, tables slid across the floors, and dishes, windows and small objects rattled. Intensity V was reported from Arjay, Capito, Harlan, Hazard, and Pikeville, Ky., where small objects fell off shelves and a flower vase was shaken off a television set. Also felt in Catrons Creek, Loyall, and Poor Fork. In Greenville, Harrogate, and Rutledge, Tenn., felt by all; awakened, and alarmed a few; rattled loose objects, some swinging from southwest to northeast; houses trembled.

INTENSITY I TO IV IN TENNESSEE: Bristol, Bullsgap, Greenville, Gatlinburg, Knoxville, Jacksboro, Johnson City, Kingston, Lafollette, Lee Valley, Luther, Luttrell, Maryville, Morristown, New Market, Newport, Sevierville, and Tazewell.

INTENSITY I TO IV IN NORTH CAROLINA: Asheville, Canton, Leicester, Marshall, Murphy, Montreat, Robinsville, Shelly, and Waynesville.

INTENSITY I TO IV IN VIRGINIA: Gate City, Ewing, and Jonesville.

January 17: 01:15. Dyersburg, Tenn. IV. Awakened some residents who heard tinkling of glassware on dressing tables. Felt in Finley.

January 22: (night). Athens and Etowah, Tenn. V. In Etowah tremor broke a window, and at the fire house the floor shook and windows rattled. In Athens houses shook violently and felt like a train in the distance.

February 2: 10:53*. Poplar Bluff, Mo. and Pocahontas, Ark. VI. Tremor centered in the New Madrid, Mo. area with slight damage in Poplar Bluff (plaster knocked from ceiling) and in Pocahontas (split wall of school building, damage less than $100). Numerous felt reports, some greater than intensity IV were received from the adjoining four state areas of Arkansas, Illinois, Missouri, and Tennessee.

INTENSITY I TO IV IN ARKANSAS: Biggers, Dalton, Datto, Engelberg, Maynard, Middlebrook, Pitman, and Success.

INTENSITY I TO IV IN ILLINOIS: Beaucoup, Brookport, Caseyville, Oraville, Radom, and Wolf Lake.

INTENSITY I TO IV IN MISSOURI: Annapolis, Bardley, Belleview, Birch Tree, Bismarck, Bloomsdale, Bonne Terre, Brazil, Briar, Cascade, Clayton, Coldwater, Couch, Crowder, Doniphan, Ellesville, Ellington, Elvin, Fairdealing, Flatwoods, Florissant, Frankclay, Franklin, Garwood, Gatewood, Glover, Graniteville, Handy, Harviell, Herculaneum, Hunter, Jacks Fork, Iron Mountain, Kinder, Knob Lick, LaDue, Luper, Marquand, Patterson, Perryville, Piedmont, Pine, Ponder, Poynor, Qulin, Rivermines, Thayer, University City, Van Buren, Wardell, Whitewater, and Zion.

INTENSITY I TO IV IN TENNESSEE: Dyersburg and Elbridge.

April 11: (no time given). 12:17:05; 13:12:48. Holdenville, Okla. IV. Four tremors were reported with about the same intensities on three successive days. Felt by several; felt like an explosion; windows rattled.

April 26: 20:09:27*. Memphis, Tenn. V. Felt along New Madrid Fault from Blytheville, Ark. and Jackson, Tenn. to Corinth, Miss. Felt strongest in Memphis where plaster cracked in ceiling, houses trembled, light boxes displaced, and dishes rattled; in Blytheville, Ark. a heavy linotype machine was jolted; in Poinsett, Ark. plaster cracked in a restaurant. In Covington and Millington, Tenn. dishes and windows rattled and felt like an atomic bomb exploded. In Lepanto, Ark. and Monette, Mo. buildings and houses shook; many ran out of houses and stores. Felt in Caraway and Crawfordsville, Ark.; Cairo, Ill.; Corinth, Miss.; and Collierville, Frayser and Raleigh, Tenn.

August 9: (no time given). Petersburg, Ind. IV. The tremor shook main street stores and rattled dishes. Whole town felt the vibrations which lasted only a short time. There was some speculation about a little mine subsidence.

WESTERN MOUNTAIN REGION

(105TH MERIDIAN OR MOUNTAIN STANDARD TIME)

January 11: 23:55. Lander, Wyo. (7 miles southwest of, in Sinks Canyon). Slight shock with trembling motion felt by two persons.

January 20: 13:50:01*. Epicenter 41½° north, 105½° west, southeastern Wyoming, W. Felt area approximately 2,000 square miles. V. Furnishings shifted and windows rattled at Albany. Motion rapid. At Centennial, motion was like a heavy dynamite blast and all were generally alarmed. Felt by all at Foxpark. Small objects shifted at Jelm. Motion rapid. Buildings shook, dishes "hopped" off tables at Laramie. Felt by most people (mainly indoors), frightened some. Roaring noise heard. Motion rapid. House swayed at the head of Lake Hattie. Plate fell from edge of cupboard at house on head of Little Laramie River. Felt by observer in home at Tie Siding. Motion slow. At Cowdrey, Colo. (4 miles north of), windows, doors, and dishes rattled and house creaked. Motion rapid. A lighter, shorter, shock at about 19:00 or 20:00 was felt at Foxpark and Jelm.

January 22: 22:00 (about). Jelm, Wyo. IV. Very strong but brief shock felt by observer and neighbors. "Shook things around here."

January 23: 18:58. Alcova, Wyo. (Alcova Government Community, southeast side of North Platte River). IV. Felt by all occupants of 12 houses. Loose objects rattled. Motion like near-by explosion, with slight trembling before and after shock. Slight aftershocks felt on January 24 and 25. Also felt in the Poison Spider area.

January 28: 23:20. Clarkston, Mont. IV. Felt by observer lying down in home. Walls creaked. Motion slow.

January 31: 20:30. Hot Springs State Park, Wyo. (Big Spring). V. Some large stones around Big Spring were dislodged and the stone platform at west edge was loosened. At Thermopolis many alarmed, buildings creaked, loose objects rattled.

February 21: 13:20:51*. Epicenter 40° north, 108¾° west, northwestern Colorado, W. IV. Dishes, venetian blinds, and door rattled at Grand Junction. Sensation of heater exploding. Between Fruita and Loma, ground shook noticeably and hanging plants swung. Also felt 2 miles north of Mack and at Redlands and Cameo. At the Dinosaur National Mounument in Utah (Castle Park area), windows and dishes rattled; house shook; chairs "danced."

March 9: 04:58. Salt Lake City, Utah. II. Light trembling with faint rumble. Felt by few sitting quietly in buildings, particularly tower operators at Airport No. 1.

March 18: 06:20:42*. Boulder City, Nev. IV. Felt by and awakened few.

March 19: 03:00. Yuma, Ariz. Slight tremor felt.

March 31: 07:00. Greenriver, Utah. IV. Felt by many. Windows, doors, and dishes rattled slightly. Motion slow.

April 29: 03:49:27*, 04:34:34*. Epicenter 29½° north, 112½° west, Gulf of California, W. Felt slightly by few in hotel at Douglas, Ariz. ". . . Felt in San Diego, Calif., and minor damage was reported in western Mexico, in the towns of Guaymas, Hermosillo, and Ciudad Obregon."—(*BSSA, July 1954.*)

June 7: 17:16:13*. Epicenter 47½° north, 116° west, northern Idaho, W. Coeur d'Alene and Kellogg. V. Felt by many in community. Windows, doors, and dishes rattled. Pendulum clock stopped. Felt by several and windows rattled at Chilco. Motion slow. Felt by several and frightened few at Harvard where windows, doors, and dishes rattled; house creaked, and house plants shook. Motion rapid.

June 14: 13:43:52*. Boulder City, Nev. III. Felt by several.

July 2: 03:43:13*. Epicenter 38°10′ north, 116°22′ west, east of Tonopah, Nev., B. III. Shocks accompanied by rumbling noises. Felt by several on July 1, 2, and 5 at Warm Springs and Twin Springs, 50 and 60 miles respectively, east of Tonopah.

July 3: 18:01. Helena, Mont. (west section). II. Slight quivering with loud rumble felt by one person outdoors.

July 4: 00:40, 09:32:50*. Epicenter 44.9° north, 110.8° west, Yellowstone National Park, Wyo., W. Yellowstone National Park (Mammoth). V. Shock at 00:40 awakened many and frightened few. Windows, doors, and dishes rattled loudly; pronounced creaking of houses. Small objects and furnishings shifted. Shock at 09:32:50 felt by many in community (some outdoors) and generally in park. Windows, doors, and dishes rattled; houses creaked. Small objects shifted. Frightened few at Old Faithful, where windows, doors, and dishes rattled; building creaked; trees, bushes shaken slightly. Motion rapid.

July 28: 11:40:02*, 11:43:13*. Boulder City, Nev. III. Felt by several.

September 10: 12:50:21*. Yellowstone National Park, Wyo. (Mammoth). IV. Felt by many. Windows, doors, and dishes rattled; walls creaked; hanging objects swung. Motion rapid. Recorded on Butte, Mont. seismograph.

September 28: 00:22:05*. Essex, Mont. Felt. Recorded by Butte and Hungry Horse seismographs.

October 3: 08:00. Douglas-Wheatland, Wyo. At Douglas Airport shock rattled windows, shook buildings and was recorded on the barograph. Also felt in Glendo and Wendover.

October 28: 06:09:18*. Kalispell, Mont. IV. Felt by many. House shaken strongly; buildings creaked; loose objects rattled. On Old No. 2 Highway, 11 miles from Kalispell, noise was likened to heavy truck passing on road. Also felt at Columbia Falls.

October 30: 19:50. Bennington and Georgetown, Idaho. IV. Felt by most people in Bennington and Georgetown where windows, doors, and dishes rattled. Thought to have been slightly stronger at Bennington (7 miles south of Georgetown). Felt slightly in Montpelier (12 miles south of Georgetown).

November 1: 00:45 (about). Logan, Utah, and vicinity. IV. Felt in eastern section of Logan and at Zanavoo Lodge, about 2.8 miles from the front of Bear River Range, and at a few intervening places. The known east-west extent of the area in which people were awakened was about 5 miles. Reports indicated a linear trend along the front of Bear River Range. Awakened many people in eastern section of Logan, with some reporting a second shock. One person reported a slow, vertical movement and that loose dresser knobs rattled. Near the mouth of Logan Canyon, dishes and windows rattled and bed shook. At Zanavoo Lodge the sudden shaking greatly disturbed a lady who was sleeping; rafters of the frame building squeaked. Eight-inch carving knife was thrown violently out of rack at edge of table. Noise sounded like basement furnace had exploded. A shock, reported as stronger than first, was felt about 3 minutes after the initial shock. Felt distinctly in Providence, 2 miles south of Logan, by one lady who reported two shocks of nearly equal intensity rattled dishes and made a rumbling sound. Second shock felt a minute or two after first. Also felt by others in Providence. In Millville, about 4 miles south of Logan, a lady reported the rocking chair in which she was sitting moved. Dishes rattled in at least one house in Hyrum, about 7 miles south of Logan.

November 2: 10:00 (about). Albuquerque, New Mexico region. Epicenter was probably between Albuquerque and Bernalillo, west of the Rio Grande. Reports indicated extent of the felt area was about 20 miles north-south and a few miles east-west. IV. At Bernalillo, a service station was shaken and doors rattled considerably. Employees on the third floor of a downtown office building in Albuquerque felt the building rock slightly north-south. Also felt 3 miles north of the center of town, at Sandia Pueblo (an Indian pueblo a few miles south of Bernalillo), and at Sandoval (a village about halfway between Albuquerque and Bernalillo).

November 3: 13:39. Albuquerque, New Mexico region. Epicenter in same area as shock of November 2. Stronger than previous shock, but felt area about the same. V. Felt by many in Albuquerque. Minor plaster cracks reported on third floor of the First National Bank Building. At the University of New Mexico, a drafting table shifted slightly; windows and doors rattled; lamps swung. Desk shook and television swayed at 4409 Ninth St. NW. Frightened many at Bernalillo, 18 miles north of Albuquerque, where windows, doors, and weighing scales rattled; small objects shifted. At Sandoval, furniture shook and filing cabinets "danced" in the 2-story courthouse. Kerosene swished in lamps standing on window ledge and perfume bottles rattled. Also felt 3 and 6 miles north of Albuquerque and at Sandia Pueblo.

CALIFORNIA AND WESTERN NEVADA

(120TH MERIDIAN OR PACIFIC STANDARD TIME)

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

January 1: 05:30:00*. Epicenter 39.0° north, 123.2° west, 8 miles south of Ukiah, B. Ukiah (about 4 miles south-southeast of). III. Two shocks close together felt by several.

January 4: 10:50:56*, 15:31:52*. Epicenter of first shock 33°16′ north, 116°03′ west, near Truckhaven; second shock, 33°16′ north, 116°06′ west, near Borego Valley, P. San Gorgonio Pass. "Residents of the Pass reported feeling two earthquakes on January 4 . . . a third tremor was reported as occurring about 8 P. M. on January 5."—(*BSSA, April 1954.*)

January 5: 19:48:44*. Epicenter 33°57′ north, 116°58′ west, near Beaumont, P. Hemet. IV. Felt by several in home. Windows and doors rattled.

January 11: 15:34. II. Felt by very few in southeast section of Palo Alto.

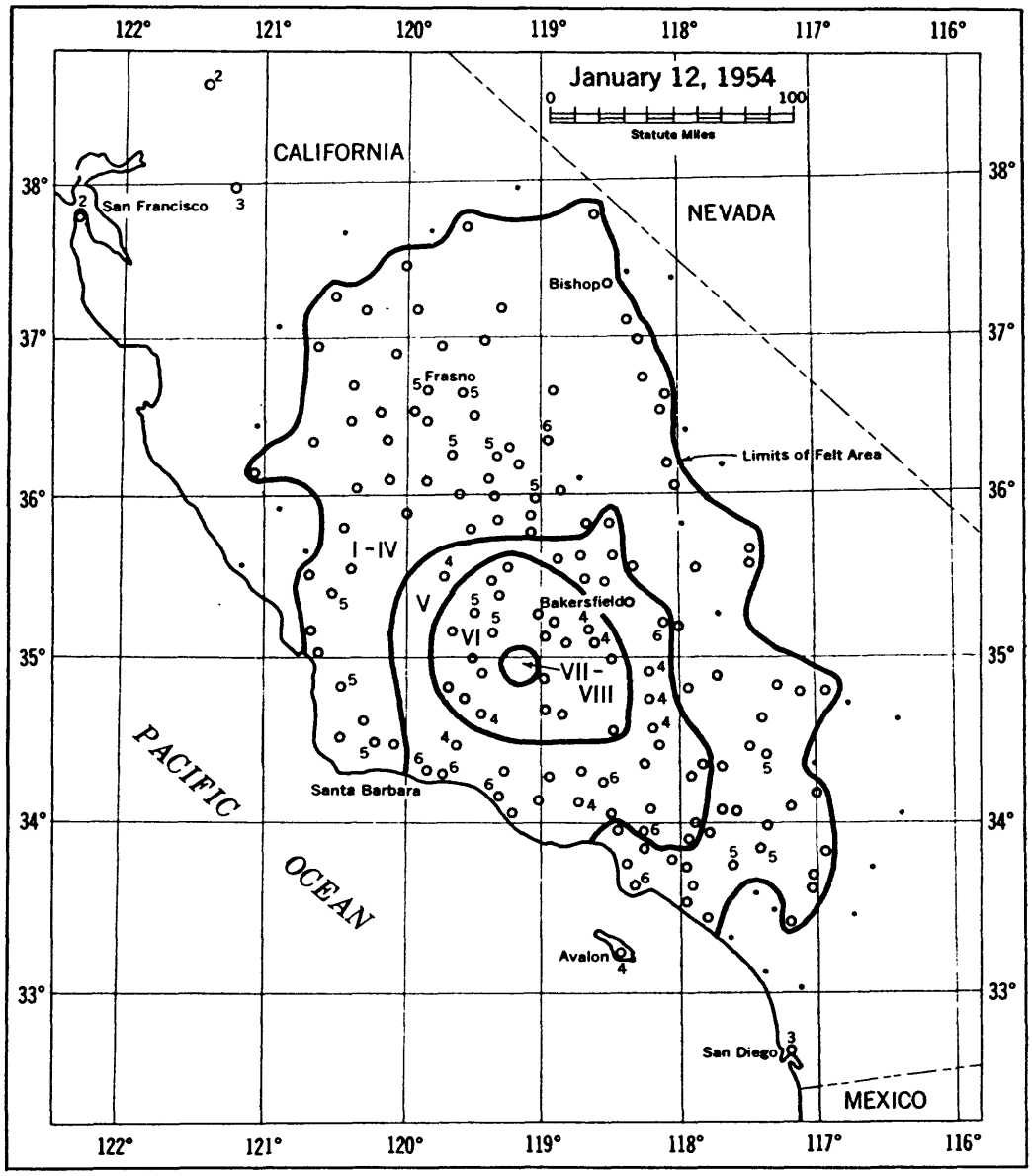

FIGURE 3.—Area affected by earthquake of January 12.

January 12: 03:02:00*. Epicenter 35°10′ north, 118°31′ west, northwest of Tehachapi, P. Tehachapi. IV. Heavy shaking with very loud humming sound. Felt by many. Buildings creaked; loose objects rattled.

January 12: 15:33:49*. Epicenter 35°00′ north, 119°01′ west, west of Wheeler Ridge Post Office; epicenter very close to major earthquake of July 21, 1952, P. Felt area about 35,000 square miles. (See map, page 12.) Maximum intensity of VII-VIII was assigned to the Maricopa Seed Farm (about 15 miles east of Maricopa) where bracing rods (poor details) broke in 3 steel-frame corrugated-iron buildings designed to resist lateral force of 5 percent gravity; anchor bolts stretched on 100-foot elevated water tank and one tank base shattered; asphalt paving cracked; some concrete-pipe and steel-line breakage; stacked seed boxes toppled; and unanchored platform pole transformers fell within a radius of about 2½ miles around the Farm. Press reported a 12-inch gas pipeline broke on the Ridge Route between Los Angeles and Taft; gas pipelines damaged in the Maricopa Flats area south of Taft; and pipeline cracked at the Paloma Oil Field. At Long Beach, an old 2-story frame house gradually slid off foundation, causing considerable damage to the structure.

INTENSITY VI:

Arvin.—Frightened many. Windows, doors, and dishes rattled; houses creaked. Trees, bushes shaken moderately. Small objects shifted and overturned. Plaster cracked. Damage slight.

Bakersfield.—Felt by all and frightened many. Press reported a sharp shock with rolling motion. Workmen hurried from scaffoldings; many people rushed from stores and office buildings. A 20-foot crack in an inside wall of the Bakersfield Savings and Loan Company was the only damage reported. Plaster cracked slightly. Switchboard in newspaper office temporarily out of commission. Lamps suspended 3 feet from ceiling swung in arc of about 2 feet. Trees, bushes shaken strongly. Small objects and furnishings shifted. Pendulum clocks stopped.

Cuyama.—Felt by all; many alarmed. Buildings creaked; loose objects rattled. Disturbed objects observed by all. Visible swaying of buildings and trees.

Di Giorgio.—Felt by all in community; frightened few. Trees, bushes shaken strongly. Small objects and furnishings shifted; few knickknacks, etc., fell. Motion slow, rolling.

Edison.—Frightened many in community. Trees, bushes shaken moderately. Small objects shifted and overturned. Motion slow.

Frazier Park.—Felt by all and frightened many in community. Small objects shifted; knickknacks fell. Press reported 3 shocks, one about 8 minutes after the first, and the third about 3 hours later. Motion rolling.

Goleta.—Felt by all in Post Office, outdoors by observer; frightened few in community. Windows rattled; house creaked. Hanging objects swung. Some plaster fell. Damage slight. Motion slow, rolling, gentle.

Gorman.—Felt by all in community. Windows, doors, and dishes rattled. Hanging objects swung. Small objects shifted. Motion slow.

Jawbone Aqueduct Station (35°18′ north, 118°02′ west).—Felt by many in community (some outdoors). Windows, doors, and dishes rattled; houses creaked. Trees, bushes shaken slightly. Plaster cracked. Motion rapid.

Lake Hughes.—Felt by all in community; frightened few. Windows, doors, and dishes rattled; walls creaked. Hanging objects swung. Small objects shifted. Motion slow, rolling.

Lamont.—Felt by all in community; frightened few. Hanging objects swung east-west. Pendulum clock facing south stopped. Trees, bushes shaken moderately. Motion rapid.

Lebec.—Felt by all; and frightened few in community. One bottle in store broke. Small objects shifted and overturned; knickknacks fell. Windows, doors, and dishes rattled; frame creaked. Hanging objects swung north. Trees, bushes shaken moderately. Motion rapid.

Long Beach.—Felt by many; frightened few. An old 2-story frame house shook and swayed for an hour after the shock, then finally slid off its 2-foot-high foundation, settling on the ground 18 inches toward the west. Walls cracked, gas pipes broke, and building warped. Pendulum clock facing north stopped. Small objects shifted. Motion slow, swaying.

Los Angeles.—Felt by many; some alarmed. Minor plaster cracks reported in walls of the City Hall above the 20th floor. Bottled water containers nearly toppled. Few windows cracked in southwestern part of the city. Rod hanger, one of many, supporting a commercial fluorescent light fixture on the fifth story of a reinforced-concrete building, broke at the connection. "The connection was poorly made, the threads being barely engaged." Old patched cracks reopened. All sheriff's substations in the county reported feeling the shock. Visible swaying of buildings and trees. Disturbed objects observed by many. Motion slow, swaying.

McFarland.—Felt by all in community. Pendulum clock stopped. Hanging objects swung north. Motion slow.

McKittrick.—Frightened many in community. Pendulum clock facing north stopped. Hanging objects swung. Motion rapid.

Maricopa.—Felt by all and frightened many in community. Damage slight. Plaster cracked. Small objects shifted and overturned; knickknacks fell; dishes broke. Pendulum clock facing north stopped. Motion rapid.

North Hollywood.—Felt by and frightened many in community (some outdoors). Damage slight to masonry and concrete. Plaster cracked. Light fixtures swayed. Rapid jerk, then rolling motion.

Santa Barbara.—Felt by all and frightened many in community. Knickknacks, books, and pictures fell; dishes broke. Visible swaying of buildings. Damage slight. Plaster cracked. Motion slow, swaying.

Sequoia National Park (Three Rivers).—Felt by all in office, some outdoors. Plaster cracked. Trees, bushes shaken moderately. Motion slow.

Shafter.—Felt by all in community. Trees, bushes shaken strongly. Small objects shifted. Motion slow.

Taft.—Felt by and frightened all in community. Plaster cracked. Small objects shifted and overturned; knickknacks, books, and pictures fell. Very severe, with low rumbling before and after shock. Trees, bushes shaken strongly. Pendulum clock stopped. Motion rapid.

Tehachapi.—Felt by most people. Press reported it as strongest since July 21, 1952. All buildings jolted. Some telephone lines out near Tehachapi. Disturbed objects observed by many. Small objects overturned. Roaring earth noises heard during shock. Pendulum clocks facing north stopped. Motion slow, swaying. Shock also felt at 03:02 on same day.

Ventucopa.—Felt by all in area; frightened few. Damage slight. Plaster cracked; one window broke; chimney shifted. Knickknacks, books, and pictures fell. Trees, bushes shaken moderately. Motion rapid.

Ventura and Newhall areas.—Felt by all in post office building, outdoors by some; frightened few. Broken telephone lines appeared to be the only damage in the Ventura-Newhall areas, with all telephone lines out at Newhall. Plaster cracked in the City Hall at Ventura. Hanging objects swung north-south. Trees, bushes shaken moderately. Motion slow.

Wasco.—Felt by all in community. Damage slight. Plaster cracked. Small objects and furnishings shifted. Trees, bushes shaken strongly. Motion slow.

Wheeler Ridge.—Felt by all in community (strongly in cars traveling east-west); frightened few. Plaster cracked. Small objects shifted and overturned; knickknacks fell. Hanging objects swung north. Trees, bushes shaken strongly. Felt strongly at Mettler Station (north of Wheeler Ridge).

INTENSITY V: Acton, Bodfish (Borel Powerhouse), Buellton, Buttonwillow, Corona, Creston, Fillmore, Fresno, Glenville, Grapevine, Hanford, Kernville, Llano (7½ miles southeast of), Miracle Hot Springs, Kern County Airport (about 2 miles west of Oildale), Oildale, Ojai, Oxnard, Palmdale, Pasadena, Piru, Porterville, Riverside, Roads End, San Dimas, Sanger, San Jacinto, Santa Maria, Somis, Three Rivers, Tupman, Valyermo, Van Nuys, Victorville, Visalia, Walnut, and Woody.

INTENSITY IV: Adelanto, Alpaugh, Alta Loma, Avalon (Santa Catalina Island), Barstow, Beverly Hills, Big Creek, Bigpine, Boron, Caliente, California Hot Springs, Camarillo, Cantil, Carpinteria, Caruthers, Coalinga, Corcoran, Culver City, Desert Springs, Ducor, El Monte, Etiwanda, Exeter, Falling Springs (San Gabriel Canyon), Fawnskin, Fullerton, Glendale, Haiwee Powerhouse (Coso Junction), Hawthorne, Helendale, Hinkley, Huntington Park, Independence, Ivanhoe, Keene, Kettleman City, Kings Canyon National Park (Grant Grove), Laguna Beach, La Habra, Lancaster, Lompoc, Lone Pine, Los Alamos, Los Prietos Ranger Station (22 miles northeast of Santa Barbara), Lost Hills, Manhattan Beach, Maywood, Mendota, Mojave, Monrovia, Moorpark, Newbury Park, Newport-Balboa, Olive View, Paso Robles, Pearblossom, Pine Flat Resort (2 miles north of California Hot Springs), Pismo Beach, Pixley. Pomona, Raisin, Reedley, Rosamond (Sec. 3, T9N, R15W), San Bernardino, San Fernando, San Gabriel, San Joaquin, San Pedro, Santa Ana, Santa Anita Race Track, Santa Paula, Santa Susana, Saugus (Power Plant Nos. 1 and 2), Saugus, Shandon, Springville, Stratford, Temecula, Terra Bella, Tipton, Tujunga, Tulare, Venice, Weldon, Wheatley Ranch (about 10 miles southeast of Ventucopa), Wheeler Springs and 2 miles southwest of, Whittier, Yermo, and Yosemite National Park (Yosemite Village).

INTENSITY I TO III: Banning, Benton, Bishop, Cantua Creek, Cedar Springs and Summit, Dos Palos, Edwards, Five Points, Friant, Hemet, Huron, Idria, Inyokern, King City, Le Grand, Mariposa, Olancha, Ontario, Owenyo, Parkfield, Sacramento, San Diego, San Francisco, San Luis Obispo, Santa Ynez, Seal Beach Steam Plant, Solromar, South Haiwee Reservoir (8 miles north of Coso Junction), Stockton, Tinemaha Reservoir (about 20 miles north of Independence), Topanga, Torrance, Trabuco Canyon, Trona, and Westend. Press reported the shock was felt (no details) at Buttonwillow (20 miles west of), Delano, Indio, Inglewood, and Merced.

January 12: 17:45:31*. Epicenter 35°02′ north, 119°06′ west, west of Wheeler Ridge, P. Press reported the shock was felt at Frazier Park and Ventucopa.

January 22: 21:09:14*. Epicenter 33°50′ north, 118°08′ west, north of Long Beach, P. Long Beach. "No damage was reported from a sharp earthquake that jolted the Long Beach area . . ."—(*BSSA, April 1954.*) Also reported felt at Lakewood and Los Altos, near Long Beach.

January 26: 01:43:22*. Epicenter 34°30′ north, 120°20′ west, west of Las Cruces, P. III. Felt be several in community at Santa Ynez. Motion rapid.

January 27: 06:19:48*. Epicenter 35°09′ north, 118°38′ west, west of Tehachapi (Cummings Valley), P. Sharp shock, with felt area of approximately 12,000 square miles. Damage slight.

INTENSITY VI:

Arvin.—Felt by, awakened, and frightened all. Damage slight. Small objects and furnishings shifted. Pendulum clock stopped. Trees, bushes shaken moderately. Motion rapid.

Frazier Park.—Felt by and awakened all in community. Motion slow.

Keene.—Felt by and awakened many in community; frightened few. Damage slight. Plaster cracked. Vases overturned. Trees, bushes shaken moderately. Motion rapid.

Lake Hughes.—Felt by and awakened all in community. Motion slow.

Tehachapi.—Felt by all and frightened many in community. Heavy jolt, followed by violent shaking. House shook violently. Small objects shifted and overturned; picture fell. Loud, thunderous, explosivelike earth noises heard at time of shock.

Wheeler Ridge.—Awakened all in community; frightened few; felt by some outdoors. Hanging objects swung northeast. Motion rapid.

INTENSITY V: Caliente, Di Giorgio, Glendale, Grapevine, Lebec, Miracle Hot Springs, Mojave, Monolith, and San Fernando.

INTENSITY IV: Acton, Agoura, Bakersfield, Buttonwillow, Cantil, Claraville, Edison, Fillmore, Gaviota, Gorman, Hanford, Hinkley, Jawbone Aqueduct Station (35°18′ north, 118°02′ west), Johnsondale, Kettleman City, Lost Hills, Maricopa, Pozo Guard Station (near Pozo), Rosamond (Sec. 3, T9N, R15W), Santa Susana, Sequoia National Park (Ash Mountain), Taft, Terra Bella, Valyermo, Ventura, Visalia, Walnut, and Wasco.

INTENSITY I TO III: Caruthers, Cholame, Kernville, Los Alamitos, Los Angeles, Manhattan Beach, Pasadena, Riverview, San Diego, Saugus, Tupman, and Wofford Heights (Isabella).

January 31: 20:23:57*, 20:32:02*, 21:10:07*. Epicenter 32.3° north, 115.3° west, P. V. These shocks and many smaller ones originated south of the international boundary. Felt by all and alarmed few at Imperial. Water in canals disturbed. Disturbed objects observed by many. Pictures, venetian blinds, and bridge lamps swayed. Grandfather clock stopped. Coffee in cups disturbed during second shock. Rumbling earth noises heard before shocks and during second shock. Four shocks felt. Motion swaying. At El Centro three distinct, sharp shocks were felt. People rushed from theaters. Motion rolling. Felt at all headings of the Imperial Irrigation District. Intensity III at Chula Vista (20:32:02) and San Diego (20:23:57, 20:32:02). Also felt at Blythe. Intensity IV at Somerton, Ariz., (20:23:57) where it was felt by many, some feeling 2 shocks. Also felt at Yuma (20:23:57, 21:10:07). In Mexico, near Black Butte, a remada was thrown down and a light brush shack leveled, also pumice blowholes opened in the earth.

February 1: 05:05:29*. Aftershock of January 31. El Centro. IV. Press reported people were awakened by the jolting motion. Also reported felt at Somerton, Ariz.

February 2: 14:58:29*. Epicenter 33°05′ north, 117°30′ west, off Oceanside, P. San Clemente. IV. Small and possibly artificial in origin. Felt by several in post office where windows rattled; walls creaked. Motion rapid.

February 4: 11:08:14*. Epicenter 37°45′ north, 122°07′ west, northeast of San Leandro, B. V. Felt over an area of approximately 500 square miles, principally in Contra Costa and Alameda counties. Felt by many in community at Hayward where windows, doors, and dishes rattled; small objects shifted. Motion rapid. Felt by and frightened many (some outdoors) at Walnut Creek where doors swung; small objects shifted. Felt with intensity IV at Alameda, Alamo, Moraga, Oakland, San Leandro, and San Ramon. Also felt at Lafayette, Mission San Jose, Mount Eden, Port Costa, and San Francisco.

February 4: 12:48:41*. Epicenter 35°21′ north, 118°58′ west, P. IV. Sharp, explosivelike jolt was felt at Bakersfield. Quite strong shock felt by many at Edison Oil Field (Edison); house creaked. "Apparently much stronger here than at Bakersfield." Motion fairly rapid.

February 6: 16:09:53*. Epicenter 35°02′ north, 119°06′ west, west of Wheeler Ridge, P. IV. Felt by many at Cuyama, by all in buildings. Buildings creaked; loose objects rattled. Motion swaying. Felt by many in community (some outdoors) at Lebec. Windows and doors rattled. Motion rapid. Felt by many at Tehachapi where buildings creaked and loose objects rattled. Fairly heavy jar. Felt by many and frightened few in community at Wheeler Ridge where windows rattled; walls creaked. Motion rapid. Felt slightly at Taft.

February 8: 07:23:45*. Epicenter 37°48′ north, 122°08′ west, northeast of San Leandro, B. San Francisco Bay area V. "A sharp earthquake rattled dishes and windows throughout the Bay area . . . The tremor was felt as far north as Martinez and south to Hayward. Broken crockery was the only damage reported."—(*BSSA, April 1954.*) Intensity IV at Alamo, Canyon, Oakland, and San Francisco, where windows, doors, and dishes rattled; houses creaked. Metal lockers rocked on the second floor of the Eastern Police Station in Oakland. In San Francisco, numerous calls came from the Geneva, Inglewood, Richmond, St. Francis Wood and Westlake, districts. Also felt at Berkeley, Hillsborough, Pescadero, Pleasanton, and Port Costa. Motion rapid.

February 10: 15:58:38*. Epicenter 34°56′ north, 119°04′ west, west of Grapevine Station, P. V. Two hard jolts with vertical motion felt by all at Grapevine. Felt by all and frightened many in community at Lebec; motion rapid. Two hard shocks felt by all and frightened many in

community at Wheeler Ridge where small objects shifted; motion rapid. Intensity IV at Cuyama, Edison Oil Field (Edison), Ojai, Santa Barbara, and Shafter where it was felt by many; buildings creaked and loose objects rattled. Reported as sharp at Bakersfield and strongly felt at Frazier Park. Also felt at Fillmore, Goleta, and Ventura.

February 12: 01:44:28*. Epicenter 33°20′ north, 116°26′ west, northwest of Borego Valley, P. V. Sharp motion preceded by rumbling noise awakened many and frightened few at Alpine; windows, doors, and dishes rattled; house creaked. Sharp jolt awakened many and frightened few at Julian; house creaked; motion rapid. Awakened all in home at Ranchita; windows rattled; motion rapid. Awakened many and frightened few at Thermal where windows, doors, and dishes rattled; motion rapid. Reported as sharp at Borego Valley. Sharp jolt followed by rapid motion felt at San Diego where it was felt by many, awakened few, frightened few; windows and dishes rattled; buildings creaked. Also felt at Calexico, Brawley, Escondido, Holtville, and Riverside.

February 14: 09:38:15*. Epicenter 37°48′ north, 122°04′ west, east of San Leandro Reservoir, B. Felt at El Cerrito.

February 18: 14:13. Benton (Quarantine Station). IV. Felt by many in community; awakened few in home; walls creaked. Motion rapid.

February 19: 13:06:28*. Epicenter 37°46′ north, 122°08′ west, northeast of San Leandro, B. V. Damage slight. Plaster cracked at Canyon. House swayed. Dizzy sensation felt. Motion slow. Water cooler and stand shifted at Moraga. Motion slow. "A small, sharp earthquake was felt in the Hayward area . . . A few windowpanes rattled, but no damage was reported."—(*BSSA, April 1954.*)

February 20: 14:07:13*. Epicenter 39.5° north, 120.0° west, west of Reno, Nev., B. "A very light earthquake was felt by a few residents of Reno . . ."—(*BSSA, April 1954.*)

February 24: 14:30:22*. Epicenter 35°04′ north, 119°04′ west, north of Wheeler Ridge, P. Wheeler Ridge. V. Two sharp shocks felt by all in community. Windows, doors, and dishes rattled; house creaked. Trees, bushes shaken slightly. Motion rapid. Felt by many in office and frightened few at Bakersfield. Windows and doors rattled; walls creaked. Awakened few in home and frightened few in community at Tupman. House creaked. Felt by all in office at Taft where windows. doors, and dishes rattled; house creaked. Motion slow. Also felt at Grapevine.

March 2: 13:18:00*. Epicenter 34°00′ north, 118°28′ west, near Culver City, P. Los Angeles area. Press reported a very slight shock was felt by residents of Leimert Park, Culver City, and Inglewood. Described as a short jolt by southwest Los Angeles residents. Short jolt felt by several and alarmed few at the Los Angeles Airport Weather Bureau station.

March 5: 20:49:53*. Epicenter 35°17′ north, 118°27′ west, north of Tehachapi, P. IV. Felt by most people at Tehachapi where buildings creaked and loose objects rattled. Motion bumping.

March 9: 11:55:30*. Epicenter 35.9° north, 120.5° west, west of Parkfield, B. IV. Slight earthquake rattled windows and dishes 26 miles northeast of Paso Robles.

March 12: 22:21:59. Epicenter 35°19′ north, 118°32′ west, east of Caliente, P. IV. Light jar felt at Tehachapi where buildings creaked and loose objects rattled.

March 17: 13:40. IV. Rapid motion felt by few sitting in home at Chilcoot. Windows rattled.

March 18: 20:32:12*. Epicenter 39.1° north, 119.6° west, southeast of Carson City, Nev., B. III. Very mild trembling motion felt by several at Carson City.

March 19: 01:54:29* (principal shock). Epicenter 33°17′ north, 116°11′ west, Santa Rosa Mountains, P. Felt over an area of approximately 40,000 square miles of southern California and portions of southwestern Nevada and western Arizona. (See map, page 17.) Maximum intensity VI. Recorded aftershocks were numerous. The largest in the first few hours occurred at 02:15:22*, 02:19:57*, 02:21:17*, 05:08:04*, and 06:00:57*; all were reported felt. All epicenters are near that of the principal shock. The largest aftershock was at 02:21:17.

INTENSITY VI:

Alberhill.—Awakened all and frightened few in community. Windows rattled; tile creaked. Motion slow.

Borrego Springs.—Felt by and awakened all in community; frightened few. Trees, bushes shaken moderately. Vases and small objects overturned; knickknacks and books fell. Motion rapid. Shocks at 02:15:22, 02:19:57, and 02:21:17 also felt.

Boulevard.—Felt by, awakened, and frightened all in community. Vases, small objects, and groceries overturned; few glass objects broke. Motion slow.

Brawley.—Felt by and awakened all in community; frightened many. Windows, doors, and dishes rattled; house creaked. Motion slow, circular.

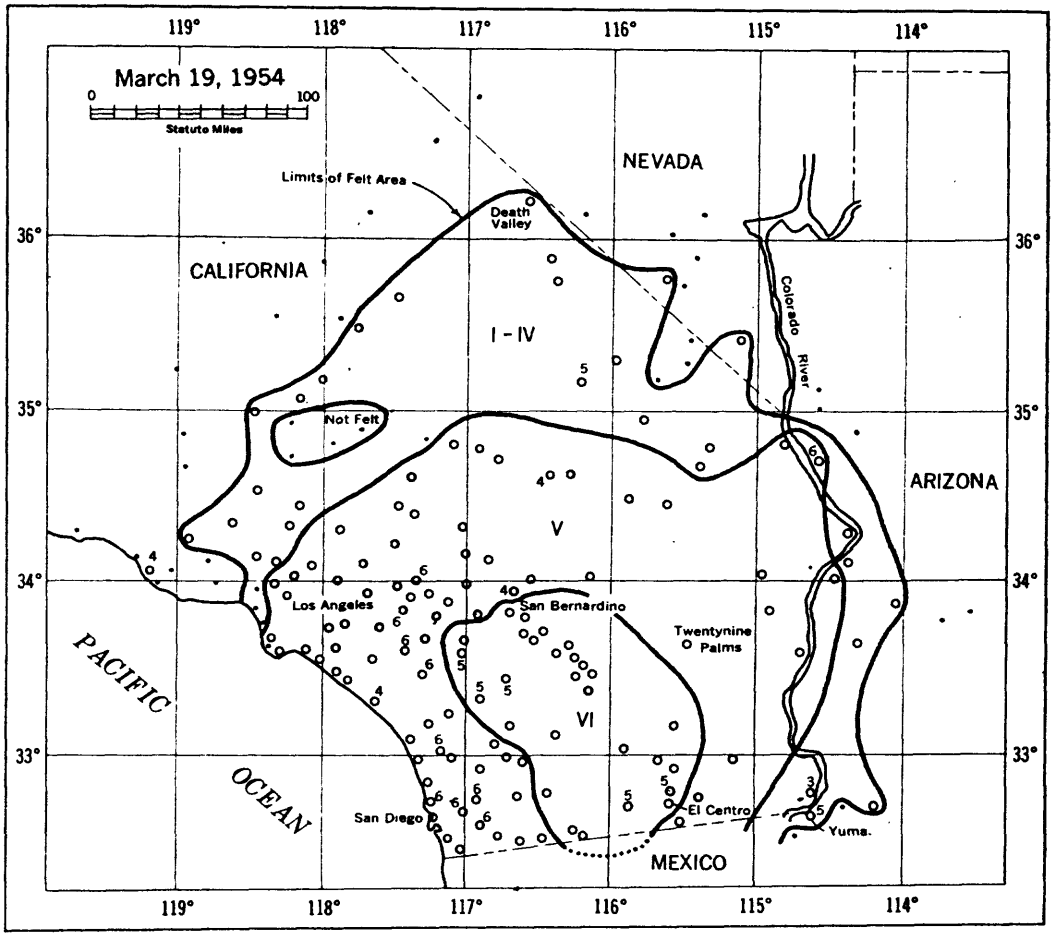

FIGURE 4.—Area affected by earthquake of March 19.

Cathedral City.—Felt by and awakened all in community; frightened few. Small objects, vases, etc., shifted and overturned; knickknacks fell. "Only known damage in stores was due to stock falling from shelves." Motion rapid.

Coachella.—Felt by, awakened, and frightened all in community. Pendulum clock stopped. Trees, bushes shaken strongly. Small objects and furnishings shifted; vases and small objects overturned; knickknacks, books, and pictures fell. Opened old crack in grocery store. Near panic reported among prisoners as the jail rocked and swayed. Windows and plaster reported cracked. Motion rapid.

El Centro.—Felt by, awakened, and frightened all. Trees, bushes shaken moderately. Small objects shifted; vases overturned; knickknacks fell. Plaster cracked. Dishes broke. Damage slight. Motion rapid and slow. Police in all Imperial Valley towns reported a strong, rolling shock, followed by a milder one at 02:21:17. Bedroom lights snapped on throughout the county. Bottles toppled from grocery shelves in the north end. Door chimes sounded.

Garnet.—Felt by and awakened all in community. Dishes shifted. Preceded by rumbling sound.

Indio.—Felt by and awakened all in community; frightened many. Trees, bushes shaken strongly. Damage slight. Small objects and furnishings shifted; vases overturned; knickknacks fell. Groceries fell from shelves in store. Windows broke and plaster cracked. Motion slow, rolling, and rapid. Light shock was felt at 02:21:17.

Jacumba.—Felt by all in area; awakened many. Damage slight. Plaster cracked and fell from walls of several structures. Motion rapid. "Light shock felt about 15 minutes later, with diminishing after tremors."

Jamul.—Awakened all in community; frightened few. Much vibration. Motion rapid and slow. "Severest shock in many years."

Kane Springs.—Knickknacks fell.

La Jolla.—Felt by and awakened many in community; frightened few. Cracked plaster and few walls. Pendulum clock stopped. Motion rapid.

Lakeside.—Felt by and awakened many in community; frightened few. Damage slight. Plaster cracked. Cans and jars rolled off shelves in stores. Small objects and furnishings shifted, vases, etc., and small objects overturned. Motion rapid and slow. About 5 small aftershocks felt, the strongest at 02:21:17. Last shock (very mild) felt at 06:00:57.

La Mesa.—Felt by, awakened, and frightened all in home; felt outdoors by others. Plaster cracked. Motion rapid.

Mecca.—Very strong, preceded by loud noise. Felt by and awakened all in community; frightened many. Plaster cracked. Pictures shifted and fell; vases overturned; knickknacks fell. Trees, bushes shaken strongly. Motion rapid. "Loosened heavy rocks on U. S. Highway 195, 5 miles east of Mecca."

Mecca (3 miles southeast of).—Felt by most people. Damage slight. Roaring earth noises heard at time of shock. Visible swaying of buildings and trees. Canned goods fell from shelves. Shocks at 02:19:57, 02:21:17, 02:32:19, 05:08:04, and 06:00:57 also felt.

Mount Laguna.—Felt by and awakened all in community; frightened many. Some jars on store shelves shifted; vases and small objects overturned; knickknacks fell. "Eased off with short tremors until 02:04." Motion rapid, vertical.

Niland.—Felt by and awakened all in community; frightened few. Windows rattled. Motion slow.

Oasis (16 miles southeast of Coachella).—Twelve-inch concrete surface irrigation pipe broke. (Field investigation revealed this break may not have been caused by the earthquake as both hot and cold water had been running in the pipe and could have caused the crack.)

Palm Springs.—Felt by all in community; frightened many. Damage slight. Water pipe broke in hotel, several swimming pools cracked, and parked truck rolled. Knickknacks, books, pictures fell; plaster cracked and fell. Pendulum clock stopped. Trees, bushes shaken strongly. Motion rapid.

Rancho Mirage.—Felt by and frightened all in area. Damage slight. Plaster cracked. Small objects overturned. Motion rapid.

Riverside.—Felt by all; awakened and frightened many in community. Damage slight. Plaster cracked. Trees, bushes shaken moderately. Motion rapid.

San Bernardino.—Felt by and awakened many; frightened few. Rumbling earth noises heard at beginning of shock. Press reported 2 high-voltage lines swung together and caused a minor power interruption in one section of the city. Cracks were reported in the City Hall. Snapped powerline leading to a house. Motion rapid, slow, rocking and swaying.

San Jacinto.—Awakened all and frightened many in community. Damage slight. Plaster fell. Furnishings shifted; vases and small objects overturned; knickknacks fell. Pendulum clock stopped. Motion slow.

San Marcos.—Felt by all and awakened many in community; frightened few. Damage slight. Walls cracked. Small objects shifted and overturned; knickknacks fell. Trees, bushes shaken moderately. Motion rapid.

Thermal.—Felt by and awakened all in community; frightened many. Small objects shifted and overturned. Motion rapid.

Thousand Palms.—Awakened all in community; frightened all in home. Small objects overturned; knickknacks fell. "Shock at 02:19:57 was not as strong as first one. Three small shocks felt between first and second one." Motion slow, rolling.

Valerie Jean.—Felt by and awakened all in home. Pendulum clock facing north stopped; jumped the pendulum into a metal frame in the back of the pendulum. Minor crack, running north-south, full length of 12-foot-long concrete floor. Motion slow.

Warner Springs.—Awakened all in community. Small objects and furnishings shifted. Motion rapid. Same report for shock at 02:15:22.

Westmorland (Squeaky Springs).—Trailer knocked off blocks. Knickknacks fell.

White Water.—Felt by and awakened all in community; frightened few. Motion slow. "Some reported feeling 3 shocks; I felt 2."

Wildomar.—Felt by, awakened, and frightened many in community. Damage slight. Some small objects and furnishings shifted; some small objects overturned. Pendulum clock facing southeast stopped. Shock felt at 02:25.

INTENSITY VI IN ARIZONA:

Topock (near).—Concrete reportedly cracked on two A. T. & S. F. bridges.

INTENSITY V: Adelanto, Aguanga, Amboy, Anza, Baker, Balboa, Banning, Barstow, Big Bear City, Blythe, Bonsall, Cadiz, Calexico, Calimesa, Campo (Morena Village), Chula Vista, Colton, Corona, Del Mar, Descanso, Desert Center and 5 miles northeast of, Dulzura, El Cajon, Escondido,

Fawnskin, Fontana, Forest Home, Fullerton, Glamis, Glendora, Helendale, Hemet, Holtville, Huntington Beach, Huntington Park, Imperial, Julian, Laguna Beach, Leucadia, Long Beach, Los Angeles, Ludlow, Mesa Grande, Midland, Moreno, Mount Baldy, Mount Helix (near San Diego), Mount Wilson, Needles, Newberry, North Hollywood, Oceanside, Ontario, Pala, Pasadena, Perris, Plaster City, Potrero, Ramona, Redlands, Rice, Rolling Hills, Seal Beach, San Diego, Santa Ana, Santa Ysabel, San Ysidro, Summit, Trabuco Canyon, Twentynine Palms, Valyermo, Victorville, Westmorland, Yermo, Yorba Linda, and Yucca Valley.

INTENSITY V IN ARIZONA: Poston and Yuma.

INTENSITY IV: Acton, Alhambra, Altadena, Burbank, Castaic, Death Valley Junction, Essex, Fenner, Hipass, Hollywood, Jawbone Aqueduct Station, Kelso, Lake Hughes, Lucerne Valley, Maywood, Mill Creek (34°05′ north, 117°05′ west), Morongo Valley, Mountain Center, Oxnard, Parker Dam, Pisgah Substation (near Ludlow), Pomona, Ridgecrest, San Clemente, San Gabriel, Shoshone, Sun Valley, Tecopa, Tujunga, Whittier, and Yucca Grove.

INTENSITY IV IN ARIZONA: Parker, Quartzsite, Topock, and Wellton.

INTENSITY I TO III: Bard, Cantil, Fillmore, Glendale, Palmdale, San Fernando Power Plant, and Tehachapi.

INTENSITY I TO III IN ARIZONA: Bouse.

INTENSITY I TO III IN NEVADA: Goodsprings and Searchlight.

March 22: 20:14:50*. Epicenter 33°17′ north, 116°11′ west, Santa Rosa Mountains, P. Aftershock of March 19. Palm Springs. VI. Felt by and frightened many in community. Damage slight. Plaster cracked. Small objects and furnishings shifted. Pendulum clock stopped. Motion slow. Felt by all in community and frightened few at Santa Ysabel (V). Intensity IV at Descanso, El Centro and the Imperial Valley, Fawnskin, Indio, Los Angeles, Pomona, San Diego, Thermal, and Thousand Palms. Also felt at Anza and Chino.

March 23: 21:17:32*. Epicenter 33°17′ north, 116°11′ west, Santa Rosa Mountains, P. Aftershock of March 19. IV. Windows, doors, and dishes rattled 2 miles east of Cathedral City. Felt by several in home at Palm Springs. Motion slow.

March 27: 07:43:31*. Epicenter 36°31′ north, 121°10′ west, northeast of Soledad, B. V. Felt by all and awakened all still sleeping at Pinnacles National Monument; awakened observer sleeping on ground. Motion rapid. Intensity IV at Greenfield, Hollister (7 miles south of), and San Benito. Also felt at King City.

March 31: 16:36:24*. Epicenter 36°44′ north, 121°18′ west, southeast of Tres Pinos, B. V. Felt by all in community and frightened few 7 miles south of Hollister. Windows, doors, and dishes rattled; house creaked. Motion rapid. Reported as sharper than shock on the 27th.

April 5: 21:29. II. Rapid motion felt by several in home at San Diego.

April 6: 05:06:45*. Epicenter 34°59′ north, 118°50′ west, Tejon Ranch, P. IV. Felt by many at Tehachapi where buildings creaked and loose objects rattled. Motion rocking.

April 6: 23:05:02*. Epicenter 39°22′ north, 120°09′ west, northeast of Truckee, B. IV. Felt by many in community at Reno, Nev., where windows and doors rattled. Motion rapid.

April 9: 04:01:22*. Epicenter 35°28′ north, 118°42′ west, Kern River Gorge, P. II. Tehachapi. Felt like a strong gust of wind from the northwest hitting the house.

April 9: 06:50, 15:40. IV. First shock awakened all in home at Pleyto School near Bryson. Windows, doors, and dishes rattled; house creaked. Both sharp, with rapid motion.

April 9: 21:18:58*. Epicenter 35°18′ north, 118°32′ west, east of Caliente, P. IV. Felt by many at Tehachapi. Heavy jolt, with explosivelike sounds heard before shock. Buildings creaked; loose objects rattled. Felt sharply at Bealville and Woodford.

April 10: 14:16:52*. Epicenter 37°15′ north, 121°46′ west, near Coyote, B. IV. Few alarmed at Morgan Hill where buildings creaked and loose objects rattled. Motion swaying. Police department received many calls from San Jose residents. Motion described as "straight up-and-down with sidewise rock." Felt by many and frightened few in community at San Martin where windows rattled and house creaked. Motion rapid. Also felt at Glenwood and Santa Cruz.

April 20: 01:11:30*, 01:18:35*. Epicenter 36°07′ north, 117°56′ west, near Haiwee, P. IV. Shock at 01:18:35 felt strongly in wooden buildings and awakened several families at Haiwee Power Plant camp, also felt by the operator at the plant. Windows, doors, and dishes rattled. Motion rapid. Both shocks reported felt at the Haiwee seismograph station.

April 22: 10:44:10*, 10:50:13* (main shock), 11:08:32*. Epicenter 36°54′ north, 121°41′ west, east of Watsonville, B. Main shock felt over an area of approximately 2500 square miles of the coastal region of west-central California. Maximum intensity VI. Damage slight.

INTENSITY VI:

Aptos.—Felt by all in post office, frightened few in community. Damage slight. Shifted small objects and furnishings; knickknacks fell; dishes broke. Motion rapid.

Gilroy.—Felt by and frightened many in community. People ran from cafe. Damage slight. Plaster fell; walls cracked. Small objects shifted. Trees, bushes shaken moderately to strongly. Motion rapid. Shock at 10:44:10 also felt.

INTENSITY V: Moss Landing.

INTENSITY IV: Bolinas, Chualar, Glenwood, Hollister and 7 miles south of, San Francisco, San Juan Bautista, San Martin, and Watsonville.

INTENSITY I TO III: Corralitos (Enos Ranch), Hayward, Los Gatos, Salinas, and Santa Cruz. Also reported felt by the press (no details) at San Jose, Soquel and at Monterey Bay Heights (near Soquel).

April 25: 12:33:28*. Epicenter 36°56′ north, 121°41′ west, east of Watsonville, B. Felt over an area of approximately 12,000 square miles. (See map, page 21.) Maximum intensity VIII.

INTENSITY VIII:

About 10 miles east of Watsonville.—Along the Chittenden Road on the south bank of the Pajaro River, several houses were seriously damaged, ground cracked, and loose earth slid onto the road. The houses, all poorly built, 1-story, frame structures on sleepers, moved toward the river several inches. Frames thrown out of plumb, furnishings wrecked, and ground cracks paralleled the river. Evidence pointed to slumping of the loose foundation material as a cause.

INTENSITY VII:

About 9 miles east of Watsonville.—At this point the Chittenden Road crosses the Pajaro River. Abutment wing walls of reinforced-concrete bridge cracked, abutments slumped several inches, expansion joints moved back and forth 1 inch. About 160 feet of railroad track moved about 3 inches toward the river and dropped about 2 inches, due to landslide settlement. Ground cracks paralleled the track on the river side along edge of ballast. Pile trestle bridge (structure 90.16) rocked back and forth, and ground distortions where piling entered the ground indicated half amplitude motion of about one-half inch. About 1 mile east of Chittenden (milepost 90.4) small slides occurred in a cut and larger slides threatened. Pavement cracked in the Chittenden Road almost directly across from the slides; caused by ground settlement and incipient sliding.

About 7 miles east of Watsonville (Pajaro Gap).—North wall of the Pajaro Gap is fairly sheer and is composed of very loose alluvium. Fairly large earth slide occurred. Pendulum scriber, located on bridge crossing the Pajaro River, moved about ¾ inch from its position at rest. Seven glass batteries, not braced to resist shock, banged together and broke.

About 5 miles east of Watsonville.—Most merchandise thrown off shelves of 1-story, frame, shed-like store. Difficult to maintain balance. Motion rolling, with upward and northward jolt.

Aromas.—Felt by all in community. Several chimneys fell, electric wires pulled loose from some houses, and three grocery stores suffered considerable loss when jars fell from shelves. Pendulum clock facing northeast stopped. Motion rapid.

Interlaken District (about 2 miles northeast of Watsonville).—Beds, desks, bureaus, refrigerator, and stove moved up to 2 feet in all directions. Much damage to furnishings. Water heater pulled 2 inches from plastered walls. The house, a fairly new, well-built, 1-story, frame stucco structure had many plaster cracks. Another house of same type construction, 1½ story, had full-height brick chimney pulled loose and cracked. Few chimneys fell; many damaged. Headstones twisted at St. Francis Church cemetery. Breakage of dishes, etc., was general in the area.

INTENSITY VI:

Aptos.—Felt by all in home and frightened many in community. Damage slight to merchandise in grocery and liquor stores. Dishes broke. Knickknacks, books, and pictures fell.

Boulder Creek.—Felt by all and frightened few in community. People ran from second floor of 2-story building. Small objects shifted; bottles fell from drugstore shelf. Hanging objects swung in all directions. Motion slow.

Capitola (near Santa Cruz).—Reported as considerably stronger here than at Santa Cruz. Groceries and other objects fell in stores.

Castroville.—Felt by all in area, also reported felt on the ocean. Farmers claimed ground moved with wavelike motion. Motion slow.

Corralitos (Enos Ranch).—Felt by all. Moderately loud earth noises heard before shock. Disturbed objects observed by many. Chairs, tables, and beds displaced. Water in open containers swayed. Plaster cracked. Motion swaying, ending with sudden jolt and twist.

Cupertino.—Felt by all in home. Damage slight. Plaster cracked. Small objects shifted. Grocery stocks fell from shelves. Motion rapid.

Freedom.—Felt by and frightened all in community. Plaster, walls, and chimneys cracked; some chimneys fell. Pictures and plaster fell. Furniture overturned. Dishes broke. Merchandise fell from store shelves and broke. Stores closed. (Field investigation revealed intensity did not exceed VI at Freedom.)

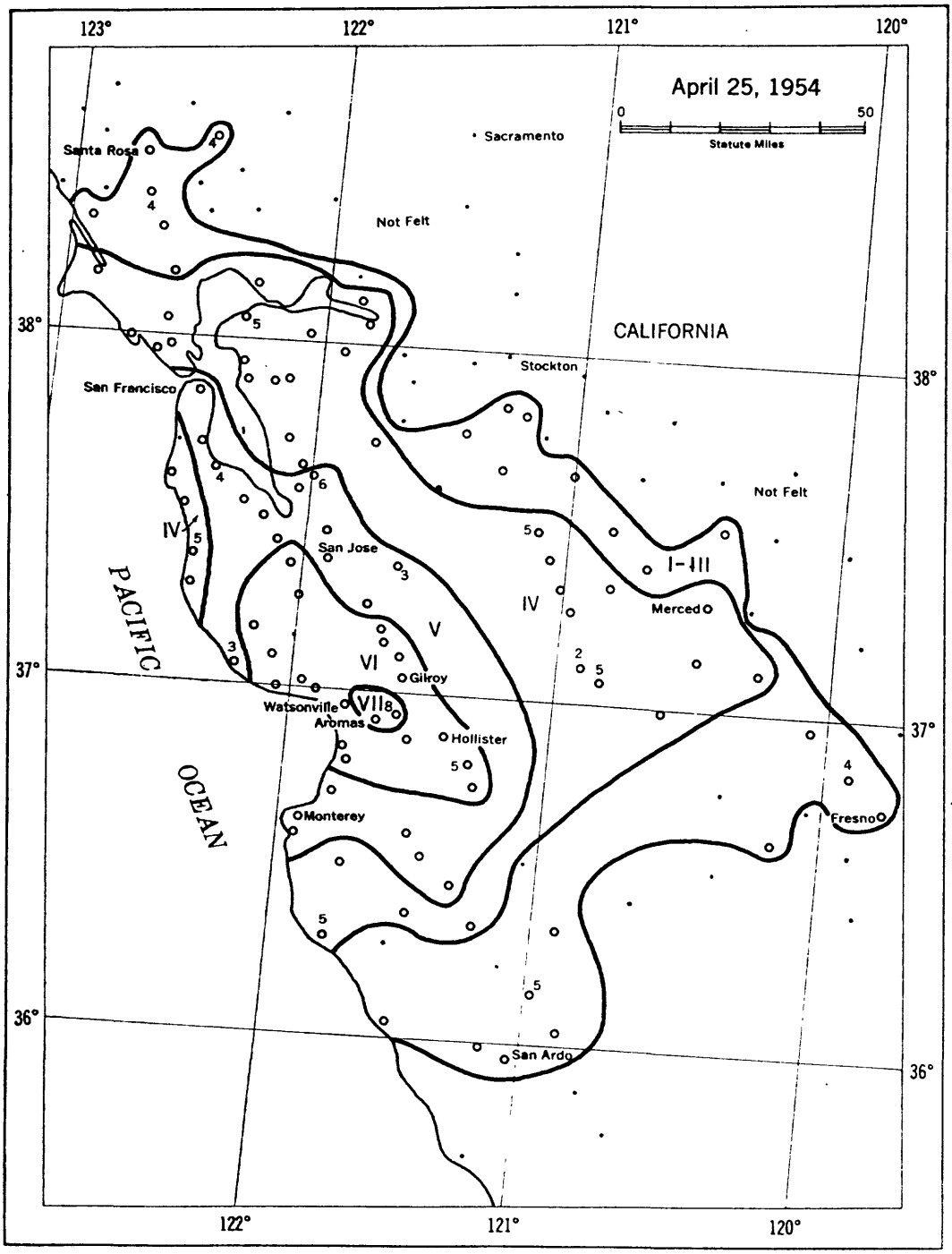

FIGURE 5.—Area affected by earthquake of April 25.

Gilroy.—Cracked and fallen plaster and broken dishes reported to be the main damage in homes and in some downtown stores; several windows broke and many cracked. Few chimneys in residential area damaged. Pump shaft broke, causing pump to stop. Considerable stock breakage in stores. Motion rapid.

Glenwood.—Felt by all and frightened few in community. Trees, bushes shaken strongly. Light fixtures swayed for 5 minutes or more. Rumbling sound heard. Strong rolling motion.

Hollister.—Felt by all and frightened few in community. Two plateglass windows broke; some walls cracked; some loss of merchandise in stores. Visible swaying of trees. Bumping earth noises heard at time of shock. Motion rapid, rocking.

Hollister (7 miles south of).—Felt by all and frightened many in community. Damage slight. Dishes broke. Small objects shifted and overturned; knickknacks fell. Pendulum clock stopped. Motion slow. Weak aftershock felt about 13:25.

Holy City.—Felt by all and frightened many in community. Pendulum clock stopped. Hanging objects swung. Motion rapid.

Los Gatos.—Felt by and frightened many in community. Hundreds rushed to the streets. Library building had several new plaster cracks and several old cracks reopened. Several in the foothills overlooking the Santa Clara Valley reported they saw the valley floor move. Small objects shifted. Several bottles fell from shelves in store. Motion trembling and rocking.

Los Gatos (5 miles southwest of).—Slight cracks in porch floor and chimney. Andirons clanked. Rattling and bumping earth noises heard during shock. Motion rolling.

Madrone.—Felt by many in community; frightened few. Damage slight. Few knickknacks fell. Trees, bushes shaken moderately. Motion rapid.

Morgan Hill.—Felt by all and frightened many in community. Small objects and furnishings shifted. Coffee spilled from cup to saucer. Faint rumbling earth noises heard by several at time of shock. Motion rapid, rocking.

Moss Landing.—Frightened many in community. Small objects shifted. Trees, bushes shaken strongly. Automobiles rocked violently. Motion rapid.

Mount Hermon.—Felt by and frightened all. Damage slight. Small objects shifted and overturned. Pendulum clocks stopped, one faced south. Spilled water to north from indoor containers. Hanging flower pot swung for 15 minutes. Trees, bushes shaken strongly. Motion rapid.

Niles.—Felt by all and frightened few in community. Plaster cracked. Small objects shifted. Knickknacks fell. Motion rapid.

Paicines.—Felt by all and frightened few in community. Trees, bushes shaken slightly. Small objects shifted. Motion slow.

San Juan Bautista.—Felt by and frightened many in community. Only negligible plaster damage at San Juan Bautista Mission. Hanging objects swung. Motion slow.

San Martin.—Felt by many and frightened few in community. Damage slight. Plaster and windows cracked. Small objects and furnishings shifted; knickknacks and pictures fell. Motion slow.

Santa Cruz.—Felt by many in community; frightened few. Small objects shifted and overturned. Plaster cracked. On Santa Cruz pier chandeliers swung in arc of about 1 foot. Rumbling earth noises heard before shock. Motion swaying, rolling.

Soquel (2 miles north of).—Felt by all in home; frightened few. Small objects shifted and overturned. Minor damage. Motion slow.

Watsonville.—Felt by all and frightened many in community. Plaster cracked and fell in some dwellings and downtown buildings. Few chimneys damaged. Forty-year-old building had some concrete knocked from front of building. Some breaks in water pipe connections leading from mains to houses. Some power interruptions caused by lines whipping together. Dishes and windows broke. Building inspectors reported damage was minor. Grocery and liquor stores suffered heavy loss from broken merchandise. Motion rapid.

INTENSITY V: Ben Lomond, Big Sur, Carmel, Chualar, Coyote, Gonzales, Los Banos and 6 miles south of, Marina, Milpitas, Monterey, Mountain View, Newark, Palo Alto, Patterson, Pinole, Redwood City, San Bruno, San Francisco, San Gregorio, San Jose, San Lucas, Soledad, and Tres Pinos.

INTENSITY IV: Alviso, Antioch, Berkeley, Bolinas, Canyon, Carmel Valley, Chowchilla, Chualar Canyon, Collinsville, Colma, Concord, Cotati, Crows Landing, Dos Palos, El Nido, Fairfax, Fort Ord, Greenfield, Gustine, Half Moon Bay, Hastings Reservation (15 miles from Carmel Valley Village), Hayward, Herndon, Inverness, Livermore, Merced, Mill Valley, Montara, Moraga, Newman, Oakland, Paloma Station (near Jamesburg), Pescadero, Pleasanton, Saint Helena, Saint Mary's College, San Leandro, San Mateo, San Quentin, San Rafael, San Ramon, Sausalito, Seaside, South San Francisco, Stevinson, Stinson Beach, Sunnyvale, and Vallejo.

INTENSITY I TO III: Alcatraz, Big Sur (25 miles south of), Davenport, Eureka Canyon (8 miles north-northwest of Freedom), Firebaugh, Fresno, Jolon, Kentfield, Lathrop, Livingston, Lockwood, Lonoak (Mee Ranch), Madera, Manteca, Modesto, Mount Hamilton, Novato, Pebble Beach, Petaluma, Point Reyes Station, Richmond, San Anselmo, San Ardo, San Joaquin, Santa Rosa, Snelling, Sunol, Tomales, Tracy, Turlock, Vernalis, and Volta.

April 27: 20:53:07*. Epicenter 36°55′ north, 121°41′ west, east of Watsonville, B. IV. Felt by many at Moss Landing Steam Plant. Also felt at Salinas Substation (PG&E). Motion slow.

April 29: 16:36:23*. Epicenter 34°02′ north, 116°46′ west, northwest of White Water, P. IV. Felt by many in home at Fawnskin, where windows rattled strongly and walls creaked. Motion rapid. Distinct jolt felt at Banning. "A slight earthquake was felt in the Palm Springs area."—(*BSSA, July 1954.*)

April 30: 04:47. Watsonville. IV. "A number of persons were awakened."—(*BSSA, July 1954.*)

May 1: 14:04:39*. Epicenter 35°26′ north, 118°42′ west, Kern River Gorge, P. IV. Felt by several at Kern River Powerhouse No. 1 (east of Bakersfield) where buildings creaked, loose objects rattled, and plant annunciator sounded. Rumbling earth noises heard at time of shock. Motion bumping. Felt sharply at Bealville. Felt by many at Tehachapi, where buildings creaked and loose objects rattled. Motion bumping. Felt by several at Bakersfield. Motion slow, rolling.

May 5: 03:01:14*, 05:09:46*. Epicenter 27½° north, 112½° west, west-central part of the Gulf of California, W. San Diego. "Press reported the shocks caused chandeliers to sway."—(*BSSA, July 1954*)

May 10: 06:24:23*. Epicenter 36°05′ north, 120°48′ west, northeast of San Ardo, B. Slight shock felt at King City.

May 10: 20:12:20*. Epicenter 35°18′ north, 118°32′ west, east of Caliente, P. IV. Felt by many at Tehachapi and surrounding area. Buildings creaked; windows, doors, and dishes, and loose objects rattled. Light trembling, followed by heavy jarring. Motion rapid.

May 12: 12:38:42*. Epicenter 35°26′ north, 118°42′ west, near Kern River Gorge, P. IV. Felt strongly at Bakersfield.

May 23: 15:52:43*. Epicenter 34°59′ north, 118°59′ west, near Wheeler Ridge, P. IV. Felt by several in community at Antelope Station where windows, doors, and dishes rattled; house creaked. Trees, bushes shaken slightly. Sharp jolt felt by many at Bakersfield. Motion fairly rapid. Felt by all and alarmed few at Cuyama Valley. Slight visible swaying of buildings and trees. One bump and sway. Felt by many at Fillmore. Dishes rattled at Glendale where it was felt quite strongly. Officeworkers in downtown Los Angeles became dizzy and then noticed structures swaying slightly and fixtures moving with a rocking motion. Motion sharp, rolling. Felt quite strongly in Montrose and Altadena; also felt in the foothill communities of Glendora and Monrovia. Felt by people indoors for several miles around North Hollywood. Floor lamps swayed. Motion rolling. Felt by several in community at Rolling Hills, where windows and doors rattled; house creaked. Motion slow. Felt by several at Saugus where loose objects rattled. Motion trembling, then two jerks close together. Felt by several 10 miles north of Saugus at Power Plant No. 2 where windows rattled. Motion rapid. Felt by most everyone at Tehachapi where buildings creaked; loose objects rattled. Sharp shock, motion trembling, then a jar. Felt by several at Tupman where windows, doors, and dishes rattled; house creaked. Motion rapid to slow. Felt by many (some outdoors) at Wasco. Motion rapid. Felt by many at Wheeler Springs where buildings creaked and loose objects rattled. Motion trembling, slight rocking. Also felt at Agoura, Bellflower, Hanford, Piedra, San Fernando Power Plant, Springville, Stratford, and Whittier.

May 25: 02:48:23*. Epicenter 35°39′ north, 118°31′ west, near Isabella, P. V. Awakened many in community and frightened few at Borel Powerhouse (Bodfish) where windows and doors rattled; house creaked. Started with explosivelike sound and shook violently for about 4 seconds. Motion rapid. Slight rumblings every few minutes for several hours after first shock.

May 28: 03:54:55*. Epicenter 36°50′ north, 121°42′ west, east of Moss Landing, B. Felt at Moss Landing Steam Plant (PG&E). Motion rapid.

May 28: 20:20:20*. Epicenter 39°28′ north, 120°20′ west, northwest of Truckee, B. IV. Felt by and several slightly alarmed at the Blue Canon Airport; buildings creaked and loose objects rattled. Disturbed objects observed by several. Fluorescent light swung north-south. Motion trembling. Felt by many (some outdoors) at Norden; frightened few. Windows, doors, and dishes rattled. Motion rapid.

June 22: 01:33:03*, 03:49:29*, 04:50:04*, 09:08:00*. Epicenter 36°34′ north, 121°25′ west, north of Gonzales, B. V. Very hard shocks (03:49:29, 04:50:04) at Chualar Canyon (9 miles east of Chualar). Felt by and awakened many in community. Windows, doors, and dishes rattled; house creaked. Motion rapid. Thirteen other slight shocks reported felt from about 02:00 to 07:00. Strong shock (03:49:29) at Gonzales. Felt by, awakened, and frightened many in community. Windows, doors, and dishes rattled; frame creaked. Motion rapid. Mild shocks felt at 01:33:03, 03:50, and 04:50:04. Shock at 03:49:29 felt by many and alarmed few at Hollister where buildings creaked, loose objects rattled, sash weights and chandeliers swung. Motion very rapid, rocking.

Shocks felt at 01:33:03, light rolling motion; 04:15, medium shock, tapering off; 04:50:04, light rolling motion. Shock at 03:49:29 awakened all in home at Soledad (Sec. 6, T19S, R5E); walls creaked. Motion slow.

July 4: 11:13:31*. Epicenter 35°19′ north, 118°55′ west, near Bakersfield, P. IV. Shock was felt sharply at Bakersfield and slightly at Greenfield (about 10 miles south of Bakersfield), and was preceded by a rumbling noise.

July 5: 11:18:52*. Epicenter 40°26′ north, 124°16′ west, south of Ferndale, B. Eureka. Slight rumbling earthquake was felt in the Eureka-Ferndale areas.

July 6: 03:13:20*. Epicenter 39°25′ north, 118°32′ west, east of Fallon, Nev., B. Felt over an area of approximately 130,000 square miles. (See map, page 24.) Magnitude 6.6. Maximum intensity IX and was assigned to the main fracture zone on the east edge of Rainbow Mountain in the Stillwater Range of mountains about 15 miles southeast of Fallon, Nev. In other areas the intensity did not exceed VIII, and was related to the movement of unstable ground. No deaths occurred and the only known injuries were to personnel at the Naval Auxiliary Air Station, about 5 miles southeast of Fallon, where heavy steel lockers fell on several men. Extensive damage occurred to canals and drainage systems of the Newlands Reclamation Project. Paved highways in the Fallon and Stillwater areas settled, cracked, and buckled in several places, one section south of Fallon settled 18 inches for a distance of 200 feet. A number of old and poorly built buildings in Fallon were considerably damaged, some walls were torn down and rebuilt.

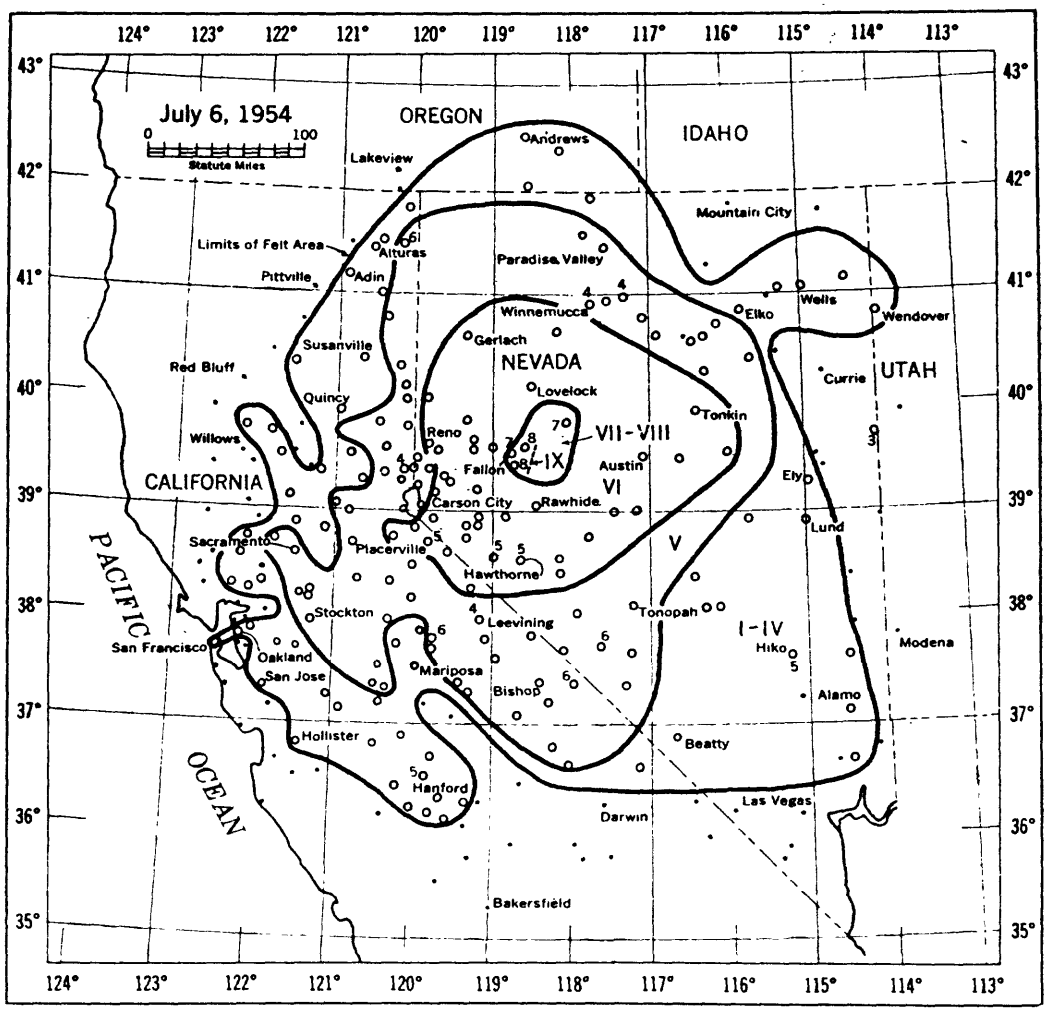

FIGURE 6.—Area affected by earthquake of July 6.

INTENSITY IX TO VIII IN NEVADA:

Rainbow Mountain Fault Zone.—There was a practically continuous line of cracks in the Lahontan Lake Bed material for about 6 miles along the eastern edge of Rainbow Mountain. North of Rainbow Mountain the cracking continued as an intermittent zone to beyond Stillwater Point Reservoir. Southeast of Rainbow Mountain there were many small northeast trending cracks on the surface of Eight and Four Mile flats and some craterlets were found. Strike of the cracks was north and slightly east. Relative movement was mountain side up, valley side down. Scarps from a fraction of an inch to a foot or more were observed and in places there were small grabens. Little or no horizontal movement was evident. Total linear extent of the fault zone was about 11 miles.

Fallon.—Stillwater-Salt Wells areas.—Extensive damage occurred to canal and drainage facilities of the Newlands Project, particularly in the Lone Tree and Stillwater areas, approximately 7 miles south and 15 miles east, respectively from Fallon. Project officials reported numerous redwood box-type culverts, partially or completely collapsed. Longitudinal cracking and sloughing occurred in many places along both drainage channels and irrigation canal banks. Coleman Diversion Dam, about 1 mile northwest of Fallon, failed. Irrigation water was cut off from approximately 80 percent of land under the Project. Estimated damage to Project facilities was nearly $200,000. In the Lone Tree and Stillwater areas canal banks settled from 1–3 feet and bottoms of canals were raised 1–2 feet. In one case the bottom of a drainage ditch was raised 5–6 feet.

In the Lone Tree district, near the Ralph Davis home, the canal banks, roadway and fields were cracked, sunk, and upheaved. Water from canal splashed and geysers spouted from fields. Many fences pushed out of line, some stretching very taut while others sagged. At the Dennis Sorenson ranch, ground ruptured and lurched toward canal, causing canal to partially close up, and alfalfa field subsided. Sand and silt volcanoes formed on the front lawn of the elder Sorenson Ranch and serious damage occurred to the wood-frame house. Wells and pressure systems at the Vernon Austins and the Dennis Sorensons were put out of commission. Well casing was heaved a foot above the surface at Austins and a 4-inch concrete floor bulged and cracked. Fields on the Dick Bass Ranch were covered with 6 inches of water sloshed from canals. Water and sand geysered from a large, jagged crack in the Taylor corral which sunk several inches. Several ditch banks and roadways on the ranch were cracked and broken. Cracks in fields and water spout evidence at the Warren and Frank Miller ranches. At the Frey Ranch, the east-west fence on the south side of drainage ditch shifted north.

At the Naval Auxiliary Air Station, about 5 miles southeast of Fallon, boiler house foundation cracked and subsided approximately 1 inch; pumphouse foundation subsided about 8 inches, causing cracks. Water main broke. Two flocculation tanks put out of commission due to separators being shaken out of place. Main reservoir roof damaged and required extensive repairs. Entire water system required extensive purging and removal of debris. Incinerator building collapsed and was a complete loss. Ordnance inert building cracked and settled, causing overlap of ½ inch to ¼ inch on doors. Numerous cracks in building located at Gas Farm No. 2. Damage estimated at approximately $6464. Several persons suffered minor injuries when heavy steel lockers fell.

In the Harmon district, about 6 miles east of Fallon, there were large cracks in State Highway 42, one place settling 12–18 inches. There were large cracks in the road leading to the Alex Baumann place. The adobe house of Charles Cress was badly damaged.

About 5 miles south of Fallon, U. S. Highway 50 settled 18 inches for a distance of 200 feet.

The Sagouspe Dam, about 5 miles northeast of Fallon, was reported to have settled about 1 foot but was not seriously damaged.

In the Stillwater area at the Charles Kent Ranch there was extensive ground breakage. Sand volcanoes formed and ground sloughed considerably. Large water troughs nearly emptied. Old 1-room wood and adobe schoolhouse wrecked and haystack overturned. Flow of hot water artesian wells decreased and new one formed. Bridge near the Osgood house badly damaged. On the Gilbert Testolin Ranch cracks allowed water to flood adjoining fields to a depth of several inches; road wrinkled and settled several inches. The 150-foot Stillwater flume collapsed. Old adobe-walled building collapsed.

On the steep western face of Stillwater Point a landslide covered many acres. Many small landslides occurred in the southern part of the Stillwater Range to the east and several small landslides occurred on the steep eastern slopes of Rainbow Mountain.

About 1½ miles west of Stillwater, near the Stillwater School, State Highway 42 was damaged. In this same locality mud boils formed in a field.

At the Indian Reservation, about 4 miles west of Stillwater, ditches were twisted and portions raised or sunken; structures pushed upward.

East of Stillwater at the Wildlife Management Area headquarters, there were cracks in the roadway near the shop 2–3 feet wide and the equipment yard had smaller cracks extending in all directions. The east canal was severely damaged for about 2 miles, with 200 yards almost completely

filled in and clogged. Pieces of equipment weighing thousands of pounds were knocked down and moved about.

At Salt Wells, about 15 miles southeast of Fallon, building was shaken loose from foundation, yard paving and ceiling of dancehall cracked, and an 800-gallon water tank and supporting tower moved several inches. A well, 58 feet deep, with water level originally at 33 feet, was lowered to 28 feet of water.

INTENSITY VII IN NEVADA:

Dixie Valley (about 25 miles northeast of Stillwater).—Felt by all in home and community; awakened all; frightened children. Trees, bushes shaken strongly. Plaster cracked; small ground cracks. Doors and all pictures swung. Horses stampeded. Motion "Like walking on the deck of a ship in very bad weather."

Fallon.—A number of old concrete block, clay and adobe brick buildings of poor construction in the business district were seriously damaged, necessitating extensive repairs to walls. Some walls were torn down and rebuilt. Two churches of concrete-block were seriously damaged, one condemned. School buildings suffered only slight damage, with the exception of the West End School where concrete floors buckled. Damage to the majority of dwellings in Fallon was slight and consisted mainly of fallen chimneys, cracked plaster, and broken windows. Some furniture overturned and broke. One observer reported earth noises sounded like a flight of jet bombers and another reported: "There was so much noise from falling books, breaking dishes, crashing lamps, etc., . . . Ground billowed and heaved like the ocean."

Fallon (about 2 miles west of).—Felt by and awakened all in community; frightened many. Trees, bushes shaken strongly. Damage considerable to wood, brick, masonry, and concrete. Balance could not be maintained during first part of shock. Plaster, windows, walls, chimneys, and ground cracked. Knickknacks, books, pictures and plaster fell. Dishes and windows broke. Very rapid motion, followed by north-south shifting movement that gradually diminished. All shocks had a north-south shifting movement.

Fallon (about 2½ miles west of).—Forty-foot break in canal bank. (probably delayed result of main shock.)

Fallon (about 3 miles south of, on west side of U. S. Highway 50).—Old weather-worn adobe building cracked.

INTENSITY VI IN NEVADA:

Austin.—Felt by and awakened all in community; frightened few. Trees, bushes shaken strongly. Small objects and furnishings shifted. Motion rapid. Several lighter aftershocks felt.

Austin (6 miles north of).—Felt by all; awakened and frightened many in community. Small objects and furnishings shifted; canned goods fell. Dresser facing south moved south about 1 inch. Two most severe shocks preceded by loud roar. Several slight aftershocks felt on same day.

Austin (18 miles east of, Givens Ranch).—Felt by and awakened all in home. Small objects and furnishings shifted; knickknacks fell. Motion slow.

Carson City.—Felt by and frightened all in community; awakened many. People ran from homes. Damage slight. Plaster cracked and fell. Capitol building had minor amount of plaster or loosened paint on floor. Small objects shifted. Pendulum clocks facing east stopped. Motion slow.

Dayton.—Felt by, awakened, and frightened all in community. Windows and doors rattled; frame creaked. Hanging objects swung. Motion slow.

East Walker River Ranch (via Yerington).—Awakened all and frightened few in home. Pendulum clock facing east stopped. Small objects and furnishings shifted and overturned. Motion rapid.

Eureka.—Felt by all in community; awakened and frightened many. Damage slight. Plaster and walls cracked. Furnishings shifted; small objects overturned; books fell. Pendulum clocks facing east stopped. Motion rolling. "Several weaker shocks since."

Fernley.—Felt by and awakened all in community; frightened many. Walls cracked. Small objects shifted and overturned; knickknacks and books fell. Pendulum clocks stopped. Motion rapid.

Gabbs.—Felt by and awakened all in community; frightened few. Damage slight. Walls cracked. Motion rapid.

Gabbs (13 miles northwest of, Kaiser Mine).—Felt by and awakened all in community; frightened few. Hanging objects swung. Motion rapid.

Gerlach.—Awakened all and frightened many in community. Water line broke. Railroad cars broke loose and ran through switch in yards. Much water splashed from city water tanks. Cans fell from shelves in store. Furnishings shifted; small objects overturned; knickknacks fell. Pendulum clock facing southwest stopped. Trees, bushes shaken moderately.

Hazen.—Felt by all. Stock fell from shelves in grocery store.

Imlay.—Felt by, awakened, and frightened all in community. Trees, bushes shaken moderately. Motion slow, rolling.

Lovelock.—Felt by and awakened all in community. Damage slight. Merchandise fell in stores, dishes fell, and some plaster fell. Motion rapid.

Lovelock (30 miles east of, on U. S. Highway 40).—A truck driver napping in truck was jerked awake so abrubtly he thought he had gone to sleep while driving.

Luning.—Felt by, awakened, and frightened all in community. Small objects shifted and overturned; knickknacks fell; dishes broke. Pendulum clock stopped. Trees, bushes shaken strongly. Motion slow.

Mason.—Felt by all; awakened and frightened many. Damage slight. Plaster cracked. Small objects shifted and overturned. Liquids spilled east-west from indoor and outdoor containers. Pendulum clocks facing east-west stopped. Motion rapid.

Mina.—Felt by and awakened all in community. Small objects and furnishings shifted. Hanging objects swung east-west. Motion rapid.

Minden.—Awakened all in community; frightened few. Pendulum clock stopped. Hanging objects swung north. Motion slow.

Nixon.—Felt by and awakened all in community; frightened few in home. Hanging objects swung. Motion rapid, rolling.

Pyramid.—Awakened all in community. Very loud roaring noise heard. Motion rapid, rotating.

Rawhide (Nevada Scheelite Mine).—Awakened all and frightened many in community. Damage slight. Dishes broke. Small objects and furnishings shifted and overturned; few knickknacks, books, and pictures fell. Motion rapid.

Reno.—Felt by and awakened many in community; frightened few. Damage slight. Small objects and furnishings shifted slightly; small objects overturned. Plaster cracked. Pendulum clock stopped. Trees, bushes shaken strongly. Motion rapid.

Reese River.—Awakened many and frightened few in community. Damage slight. Plaster and chimneys cracked. Motion rapid.

Schurz.—Felt by and awakened all in community; slight alarm. Small objects and furnishings shifted; dishes overturned. Liquid spilled east-west from indoor and outdoor containers. Knickknacks fell. Trees, bushes shaken moderately. Merchandise fell from shelves in store. Motion rapid.

Silverpeak.—Felt by, awakened, and frightened all. Trees, bushes shaken strongly. Motion rapid.

Smith.—Felt by many in valley; awakened and frightened many in community. Damage slight. Plaster cracked. Small objects shifted; few knickknacks fell. Old pendulum clock facing east started. Trees, bushes shaken moderately. Motion slow.

Sparks.—Felt by and awakened all or many in community. House creaked. Hanging objects swung. Motion slow.

Virginia City.—Felt by, awakened, and frightened many in community. Damage slight. Plaster and walls cracked. Knickknacks fell. Trees, bushes shaken strongly. Motion rapid.

Wabuska.—Awakened all in community; frightened few. Cans fell from store shelves. Motion rapid.

Wadsworth.—Felt by and awakened all in community; frightened many. Hanging objects swung. Motion rapid.

Wellington.—Felt by and awakened all in community; frightened many. Trees, bushes shaken strongly. Small objects overturned. Motion rapid.

Yerington.—Felt by and awakened all in community. Plaster cracked on third floor of Masonic building. House trailer bounced. Small objects and furnishings shifted slightly. Roaring earth noises heard before shock. Motion rolling.

INTENSITY VI:

Bridgeport.—Felt by, awakened, and frightened all in community. Trees, bushes shaken strongly. Motion rapid.

Cedarville.—Awakened all in community. Trees, bushes shaken strongly. Motion slow.

Coleville.—Felt by, awakened, and frightened all in community. Trees, bushes shaken strongly. Motion slow.

Deep Springs.—Awakened many; frightened few. Damage slight. Chimney cracked and twisted; plaster cracked. Small objects and furnishings shifted. Trees, bushes shaken moderately. Motion rapid.

Kyburz.—Felt by all; awakened and frightened many in community. Trees, bushes shaken moderately. Small objects and furnishings shifted; knickknacks fell. Motion rapid.

Meyers.—Awakened all in community. Hanging objects swung east-west. Motion rapid.

Yosemite National Park.—Felt by and awakened all in community; frightened many. Pendulum clocks stopped. Furnishings shifted; small objects overturned; knickknacks fell. Motion slow, rolling.

INTENSITY V IN NEVADA: Battle Mountain, Beowawe, Carlin, Coaldale, Crystal Bay, Dyer, Fish Lake Valley (Dyer), Glenbrook, Golconda, Goldfield, Goldpoint, Hawthorne, Hiko, J. D. Ranch (about 30 miles southwest of Palisade), Jiggs, Millett Ranch (about 36 miles south of Austin) Orovada, Palisade, Paradise Valley, Steamboat Springs, Tonkin Ranch (about 40 miles southwest of Palisade), Tonopah, Valmy, and Verdi.

INTENSITY V: Applegate, Benton, Bigpine Power Plant (Bigpine), Bishop, Camp Connell, Caruthers, Chilcoot, Colfax, Courtland, Doyle, Electra Powerhouse (via Jackson), El Portal, Floriston, Foresthill, Galt, Herlong, Huntington Lake, Jackson, June Lake, Kings Canyon National Park, Lake Alpine, La Porte, Laws, Le Grand, Lodi, Lone Pine, Long Valley Dam (about 20 miles northwesterly from Bishop), Mammoth Lakes, Markleeville, Meeks Bay, Merced, Modesto, Norden, Omo Ranch, Owens River Gorge Control Power Plant (Inyo County), Pinecrest, Placerville, Portola, Ravendale, Sacramento, Sierraville, Snelling, Soda Springs, Sonora, Stockton, Tahoe Valley, Thornton, Tiger Creek Powerhouse (via Jackson), Tinemaha Reservoir (Independence), Truckee, Wawona, Wendel, and Woodland.

INTENSITY IV IN NEVADA: Austin (25 miles south of), Beatty, Caliente, Carp, Deeth, Denio, Duckwater, Elko, Ely, Lund, McDermitt, Red House, Tungsten, Tybo, and Winnemucca.

INTENSITY IV: Ahwahnee, Alamo, Alturas, Auburn, Baxter, Boca, Brooks, Camp Nelson, Canyon, Chico, Corcoran, Coulterville, Bullards Bar Powerhouse (Dobbins), Downieville, El Nido, Fairfield, Firebaugh, Fort Bidwell, Fresno, Hanford, Hollister and 7 miles south of, Kettleman City, Knights Ferry, Leevining, Livermore, Madeline, Marysville, Mather, Milford, Monticello, Napa, Newman, Oakland, O'Neals, Orland, San Joaquin, San Jose, Sloughhouse, Stevinson, Stovepipe Wells Hotel (Death Valley), Stratford, Susanville and 12 miles north of, Tracy, Trowbridge, Vacaville, Westhaven, and Wishon.

INTENSITY IV IN UTAH: Wendover.

INTENSITY I TO III IN NEVADA: Cobre (3 miles from, at Valley Pass), Twin Springs (60 miles east of Tonopah), Uvada, Warm Springs (50 miles east of Tonopah), and Wells.

INTENSITY I TO III: Adin, Gridley, Lake Spaulding (Emigrant Gap), Madera, Mariposa, Mineral, Quincy, Richvale, San Francisco, Visalia, and Volta.

INTENSITY I TO III IN OREGON: Whitehorse Ranch (about 20 miles southeast of Andrews).

July 6: 03:18:04*, 03:26:55*, 03:41, 03:49:00*, 04:53:59*, 04:56:28*, 05:36:00*. Fallon, Nev. aftershocks, P.

Reported felt in Nevada.—Austin (6 miles north of), no times given; Carson City (03:49:00), Ely (03:18:04), Eureka (several weaker shocks felt; no times given), Fallon (03:41, 03:49:00, 04:53:59), Fernley (03:49:00), Fish Lake Valley (Dyer; 03:49:00), Gerlach (03:41), Mason (03:26:55, 03:49:00), Minden (03:49:00), Nixon (03:49:00), Schurz (03:18:04, 03:49:00, 05:36:00), Yerington (03:49:00). Intensity IV at Winnemucca where the shock at 03:26:55 awakened and frightened few in community, doors swung, motion slow; shock at 03:49:00 also felt. Hawthorne reported: "Main jolt followed by light tremors until 03:49:00 when another jolt shook buildings."

Baxter (03:49:00), Electra Powerhouse (via Jackson; five shocks felt), Meyers (04:53:59), Pescadero (04:53:59 or 04:56:28), Sacramento (03:18:04), Tiger Creek Powerhouse (via Jackson; 03:49:00). Intensity V at Tahoe City where the shock at 03:26:55 awakened many in home; pendulum clock stopped.

July 6: 08:30. IV. Felt by many in community (some outdoors) at Laws. Motion slow.

July 6: 11:00. Fallon aftershock. Wabuska, Nev. Felt.

July 6: 14:07:41*. Epicenter 39.3° north, 118.5° west, southeast of Fallon, Nev., B. Fallon aftershock.

INTENSITY VIII IN NEVADA:

Salt Wells (about 5 miles southeast of).—U. S. Highway 50 settled, necessitating filling and resurfacing the road. Many people observed a large cloud of dust in this area.

INTENSITY VI IN NEVADA:

Fallon.—Press reported the shock caused little additional damage to buildings. Clouds of dust arose in the Stillwater Range east of Stillwater. Motion described as violent, swaying.

INTENSITY V IN NEVADA: Fernley, Fish Lake Valley (Dyer), Lovelock, and Mason.

INTENSITY IV IN NEVADA: Hawthorne, Nixon, Pyramid.

INTENSITY IV: Baxter, Benton, Brockway, Laws, Long Valley Dam (about 20 miles northwesterly from Bishop), San Francisco, Tahoe City, Wawona, and Yosemite National Park.

INTENSITY I TO III IN NEVADA: Goldfield, Hiko, Jiggs, Schurz, Wabuska, and Yerington.

INTENSITY I TO III: Chilcoot, Doyle, Lake Spaulding (Emigrant Gap), Markleeville, Norden, Oakland, Sacramento, San Diego, and Tiger Creek Powerhouse (via Jackson).

July 6: 14:13:25*. Fallon aftershock, P. IV. Frame store creaked at Baxter.

July 6: 15:57:07*. Fallon aftershock, P. Felt at Wabuska, Nev.

July 7: 18:13:56*. Fallon aftershock, P. IV. Felt by many at Minden, Nev. Light fixtures swayed. Shocks reported felt on the 7th at Austin, Nev.

July 7: 18:40. IV. Felt by several and frightened few 7 miles south of Hollister. Windows, doors, and dishes rattled; house creaked. Motion slow.

July 8: 04:55:10*. Fallon aftershock, P. V. Stillwater, Nevada area. People held floor lamps to keep them from falling. Shock also felt at 06:00.

July 8: 11:31:57*. Fallon aftershock, P. V. Severe shock 6 miles north of Austin, Nev. Sharp, rapid shock at Dyer. House creaked and fixtures swayed at Minden. Also felt at Lovelock.

July 9: 00:50:03*. Fallon aftershock, P. IV. Awakened quite a number of people at Lovelock, Nev. Motion jerking.

July 10: 04:28:40*. Epicenter 33°02′ north, 116°29′ west, near Julian, P. IV. Awakened and frightened few at Descanso. Windows, doors, and dishes rattled. Motion rapid.

July 12: 08:05:25*. Fallon aftershock, P. IV. Felt in post office and by some outdoors (quiet) at Fernley, Nev. Windows and doors rattled; walls creaked. Hanging objects swung. Motion rapid.

July 17: 10:55:12*. Epicenter 41°18′ north, 123°34′ west, northeastern Humboldt County, B. V. Dirt floor of storeroom cracked at Sawyer's Blind Horse Ranch (Cecilville). Loose objects rattled; buildings creaked. Cup fell from cupboard. Motion bumping. Felt with minor intensity at Eureka and Sawyers Bar. A shock at 13:10 was reported felt at Blue Ridge Lookout.

July 18: 10:40. IV. Felt by many at Tehachapi. Loose objects rattled; buildings creaked. Motion trembling and rocking.

July 23: 16:00:41*. Epicenter 34°10′ north, 118°39′ west, near Calabasas, P. V. Granada Hills. Felt generally.

July 28: 23:09:42*. Epicenter 37°54′ north, 121°59′ west, about 15 miles east of Berkeley in the Walnut Creek region, B. Reported felt at Walnut Creek.

July 29: 00:51:36*. Epicenter 37°25′ north, 121°20′ west, about 15 miles northeast of Mount Hamilton, B. Press reported a small shock was felt at Gilroy, Hollister, Morgan Hill, and San Jose. Also reported felt on the San Francisco Peninsula.

July 31: 03:00, 07:15. Fallon aftershocks. Reported felt 2 miles west of Fallon, Nev.

August 2: 02:18:53*. Fallon aftershock, P. V. Press reported cracks in downtown Fallon, Nev., buildings appeared enlarged. Two or three shocks felt every day. "It was not felt in Reno or other surrounding cities."—(*BSSA, January 1955.*)

August 10: 05:24. "A light earthquake rattled dishes and windows in the Concord area. No damage was reported."—*BSSA, October 1954.*)

August 12: 04:50:06*. Epicenter 36°54′ north, 121°39′ west, east of Watsonville, B. VI. Rockslides reported on road near Logan. Felt by and awakened many in community 7 miles south of Hollister. Motion rapid. Awakened some people at Hollister. Awakened all in home at Moss Landing. Motion rapid. Awakened observer at Bakersfield. Motion rapid. Felt by observer at Pescadero where rumble was heard.

August 19: 13:46:32*. Epicenter 39°27′ north, 123°29′ west, northwest of Willits, B. Felt by several in community at Comptche. Motion rapid.

August 20: 00:01:45*. Epicenter 37°40′ north, 118°40′ west, northern Owens Valley, P. V. Awakened all in home at Long Valley Reservoir (about 20 miles northwesterly from Bishop). Hanging objects swung. Motion rapid. Felt by many and awakened few in community at Benton. House creaked. Motion slow.

August 20: 20:55:06*. Epicenter 37°57′ north, 122°19′ west, El Cerrito Hills, B. Slight shock. Reported felt at Berkeley, El Cerrito, Richmond, and Oakland.

August 22: 03:30, 05:37:22*. Epicenter 38.6° north, 119.4° west, east of Markleeville, B. Felt by several in home at Markleeville. Motion slow.

August 22: 05:51:06*. Epicenter 35°20′ north, 118°51′ west, near Edison, P. IV. Bakersfield (Sec. 32, T29S, R29E). Felt by several and awakened few in community. Quite strong; preceded by rumble. One person reported feeling a shock around 04:00.

August 22: (late afternoon). Fallon aftershock. Felt at Fallon, Nev.

August 23: 09:50. Fallon aftershock. Felt at Paradise Valley, Nev.

August 23: 20:45. Fallon aftershock. Felt at Mina, Nev. Motion north-south.

August 23: 21:51:32*. Epicenter 39°35′ north, 118°27′ west, east of Fallon, Nev., B. VIII. Felt over an area of approximately 150,000 square miles. (See map, page 30.) Magnitude 6.8.

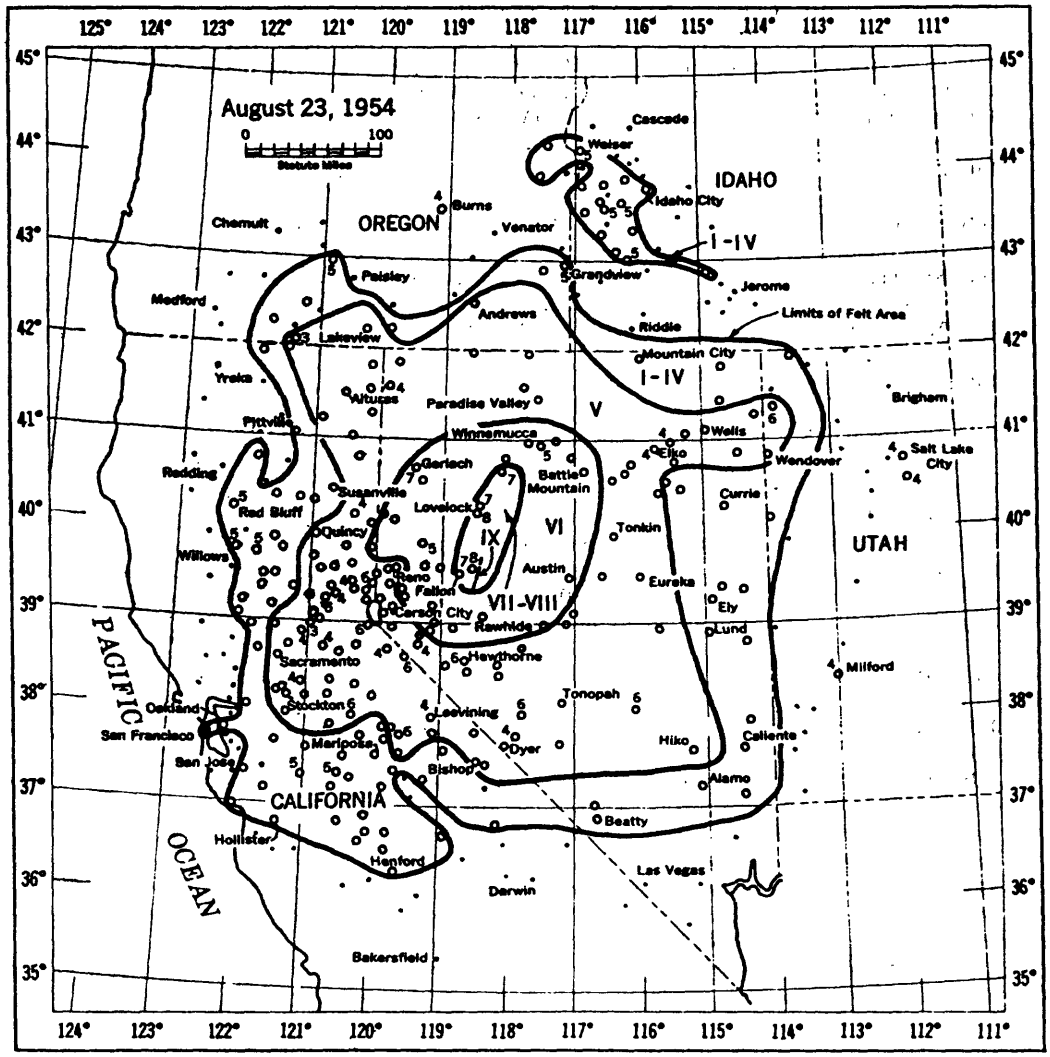

FIGURE 7.—Area affected by earthquake of August 23.

Maximum intensity IX was assigned to the July 6 main fault break along the eastern edge of Rainbow Mountain where movement was increased several inches. Additional surface movement occurred in the same rupture zones as those of the main shock, with the extension of ground breakage north for about 11 miles to the region southeast of Carson Sink. Vertical movement only was observed, with the west side uplifted relative to the east side. Damage to buildings, roads, and irrigation facilities occurred in the same general areas as the main shock, with the exception of the Lovelock area where the Rogers Dam was considerably damaged. Motion in the strongly shaken area was generally described as rapid, north-south.

INTENSITY VIII–VII IN NEVADA:

Type of damage to the Newlands Reclamation Project irrigation facilities was practically the same as occurred during the July 6 shock with reference to collapsed culverts, settlement and cracking of ditch and drain banks, canal and drain bottom upheavals and tilting and cracking of canal turnout and drop structures. In some instances the damage was more severe than that observed following the main shock. A large part of the emergency work was completely obliterated by this shock. Two concrete drop structures were seriously damaged, one requiring replacement. Damage to power distribution facilities was estimated at $5,000 and consisted of sagging and broken transmission lines, pole displacement, broken service connections, and short circuiting. Estimated damage to Project facilities was approximately $91,000.

In Fallon, subsidence seriously damaged the West End School buildings. There were sand boils around foundations, general cracking of sidewalks and horizontal movement of sidewalks in the area, and a 4-inch water main broke in two places. In the business district more cracks appeared in a number of buildings. The north wall (undergoing repairs) of the Kent store fell and crashed through the ceiling of an adjoining building. Many chimneys fell, heavy objects overturned, and furniture broke. People reported it was very difficult to maintain balance or walk.

In the Lone Tree District (south of Fallon) damage was similar to that occurring on July 6. Road west of the Lone Tree School shifted more toward north. At the Dennis Sorenson Ranch barn and garage cracks were enlarged. At the elder Sorenson Ranch a 15 x 18 foot concrete building tipped toward east and porch of house had dropped 3½ inches.

In the Stillwater area (west of Stillwater) State Highway 42 was extensively cracked. One crack was reported to be 300 feet long, a yard wide, and 3 to 6 feet deep. Just west of Stillwater highway bridge had 3-inch settlement of approaches, beams cracked, wingwall moved out, and there were signs of battering at one end. At the Kent Ranch an old channel was filled in and a new one formed. One well ceased to flow and another began flowing. Numerous cracks in yard and brick cellar badly cracked. Refrigerator overturned. At the Shoffner Ranch (about 3 miles west of Stillwater) fields and ditch banks sunk and drains filled in. Fields had big cracks and holes from which sand and water bubbled. All furniture in the south end of house moved to middle of room, range and water heater moved about 1 inch toward north, moved cement laundry tubs north about 2 feet, and washing machine with locked wheels skidded about four feet. Loosened foundation of house, cracked walls, and cement steps pulled loose from house. Chimneys fell and an old adobe house (badly damaged in the July 6 shock) collapsed completely. Haystacks overturned. There were cracks and silt boils in road near the cemetery on the Indian Reservation (west of Stillwater), ditches were broken, drainage canals caved in, and gates thrown out of line.

In the Sagouspe Diversion Dam area (about 4½ miles north of Fallon) ground was reported cracked and sunken, ditches filled, and many water spouts were observed with sand ejected. New cracks were reported in the Sagouspe Dam. In the Indian Lakes area ground was cracked and sunken and there were some water spouts.

In the Lovelock area the Rogers Dam (about 3 miles northeast of Lovelock) was seriously damaged. The southeast abutment was cracked and a reinforcing piece of concrete on the east side was snapped off and slapped around, causing damage to the stilling basin. Damage estimated at $10,000. The earth-fill crossing of the river east of the Tule Ranch (southeast of Lovelock) went out. In Lovelock a 10-foot strip of facade fell from the top of the brick Mercantile Building and a large crack between partitions in the upper part was enlarged. An adjacent hotel had cracks opened up. One brick chimney fell and bricks fell from another. Throughout Lovelock minor home damage occurred.

Ground displacement was observed east of Upsal Hogback located in Sec. 2, T20N, R28E and Sec. 35, T21N, R28E.

At Dixie Valley (about 25 miles northeast of Stillwater) it was reported to have caused much more damage than the July 6 shock, although damage was still reported as slight. Awakened all in community; walls cracked, plaster fell. Motion rapid.

At Gerlach (approximately 90 miles northwest of the epicenter) machines overturned in movie hall, furniture broke, water splashed from city water tank, and ground cracks were reported. Motion rolling.

At Imlay (approximately 80 miles northeasterly from the epicenter) twisting and fall of chimneys was reported, dishes and windows broke, and furniture shifted. Awakened and frightened many. Damage slight. Motion rapid.

INTENSITY VI IN NEVADA:

Austin.—Felt by all; awakened many and frightened few in community. Damage slight. One chimney cracked. Small objects shifted and overturned. Pendulum clock stopped. Trees, bushes shaken strongly. Motion rapid.

Battle Mountain.—Felt by, awakened, and frightened many in community. Pendulum clock stopped. Damage slight to masonry. Motion rapid.

Berlin.—Felt by all, awakened and frightened many in community. House shook violently. Motion rapid.

Dayton.—Felt by, awakened, and frightened all in community. Small objects shifted. Motion rolling.

Empire.—Felt by all; awakened and frightened many in community. Plaster cracked. Knick-knacks fell. Motion slow.

Fernley.—Felt by, awakened, and frightened all in community. Pendulum clock stopped. Trees, bushes shaken moderately. Small objects and furniture overturned. Plaster, windows, walls, and chimneys cracked; plaster fell. Motion rapid. Small tremor felt at 23:05.

Flanigan.—Felt by and awakened all in community; frightened all in home. Doors out of line. Concrete and plaster cracks. Damage slight. Motion rolling.

Goldfield.—Awakened and frightened few in community. Small objects and furnishings shifted; knickknacks, books, pictures, and plaster fell. Damage slight. Motion rapid.

Hawthorne.—Felt by all and frightened many in community. Trees, bushes shaken moderately. Small objects shifted. "Seemed to be stronger than one on July 6, with 2 or 3 peaks of intensity." Motion rapid; also reported as slow and rocking.

Hazen.—Felt by all; awakened all in home. Observer unable to walk without support. Hanging plant swung for about 15–20 minutes. Motion rapid.

Mason.—Felt by and awakened all in community; frightened many. Damage slight. Twisting of chimneys. Plaster, windows, walls, chimneys, and ground cracked. Pendulum clock stopped. Trees, bushes shaken strongly. Motion rapid.

Pyramid.—Felt by, awakened, and frightened all in community. Windows, doors, and dishes rattled; walls creaked. Motion rapid.

Rawhide.—Felt by and awakened all in community; frightened many. Small objects and furnishings shifted. Motion rapid.

Red House.—Felt by and awakened all in community. Motion slow.

Reese River (40 miles southwest of Austin).—Felt by and awakened many in community; frightened few. Damage slight. Plaster and chimneys cracked. Motion rapid.

Schurz.—Felt by and awakened all in community; frightened few. Pendulum clock stopped. Small objects shifted. Motion rapid.

Silverpeak.—Awakened all in community. Windows, doors, and dishes rattled; house creaked. Motion rapid.

Twin Springs (60 miles east of Tonopah).—Felt by and awakened all in community. Plaster cracked. Damage slight to concrete. Motion rapid. Several succeeding light shocks, some just a light rolling motion. Cattle disturbed and ran around the fields for a short time after the larger shock.

Valmy.—Felt by and awakened all in community; frightened many. Trees, bushes shaken moderately. Small objects and furnishings shifted; knickknacks, books, and pictures fell. Motion slow, then severe shake.

Virginia City.—Felt by and awakened all in community; frightened many. Pendulum clock stopped. Trees, bushes shaken slightly. Motion slow.

Wabuska.—Felt in home and community (some outdoors; active); frightened few. Some canned goods fell from store shelves. Motion rapid.

Wadsworth.—"Everyone in town said it was worse than the July 6 shock."

Winnemucca.—Felt by all; everyone went outdoors. Stocks toppled in stores and objects fell in homes. Drugstore wall reportedly cracked. Water splashed from containers. Pendulum clock stopped. Motion rolling, swaying. Pendulum clock stopped at the airport 5 miles southwest of Winnemucca and building shaken severely for 20 seconds with hard jolting motion.

Yerington.—Awakened all in community. Small objects and furniture overturned. Merchandise toppled from store shelves. Few minor cracks in business building and courthouse. Motion rapid.

INTENSITY VI:

Baxter.—Awakened all in community; frightened few. Hanging objects swung and towels swung in arc of 6–8 inches. Motion slow.

Chilcoot.—Hard shake. Felt by all in community. Some canned goods fell from shelf.

Coleville.—Felt strongly by all and awakened all in community; frightened many. Trees, bushes shaken strongly. Small objects shifted. Damage slight. Motion slow.

Floriston.—Felt by and frightened many in community. Plaster cracked. Damage slight.

Meeks Bay.—Felt by and awakened all in community; frightened many. Windows, doors, and dishes rattled; house creaked. Motion rolling.

Sonora.—Felt by most people; awakened few; frightened many. Plaster and foundations cracked. Damage slight to concrete. Motion rapid and slow.

Yosemite National Park.—Felt by and awakened all in community; frightened few. Pendulum clock stopped. Small objects shifted. Damage slight. Motion slow.

INTENSITY VI IN UTAH:

Lucin.—Felt by, awakened, and frightened all in community. All houses shook. Hanging objects swung. Motion slow.

INTENSITY V IN NEVADA: Beowawe, Carlin, Carson City, Crystal Bay, Deeth, Denio, Duckwater, Dyer, East Walker River Ranch, Eureka, Givens Ranch (18 miles east of Austin), Glenbrook, Golconda, Hiko, Jiggs, Kaiser Mine (about 70 miles southeast of Fallon), Lamoille, Luning, McDermitt,

Millett Ranch (about 36 miles south of Austin), Mina, Minden, Montello, Nixon, Orovada, Palisade, Paradise Valley, Reno, Shafter, Smith, Sparks, Steamboat, Tonkin Ranch (about 40 miles southwest of Palisade), Tonopah, Tungsten, Verdi, Visbah Ranch (25 miles south of Austin), and Wells.

INTENSITY V: Adin, Alturas, Benton, Bishop, Camp Connell, Cedarville, Chico, Clements, Colfax, Downieville, Doyle, Eagleville, Foresthill, Fort Bidwell, Galt, Jackson, June Lake, Knights Ferry, Kyburz, Lake Spaulding (Emigrant Gap), La Porte, Laws, Lodi, Madeline, Merced, Nevada City, Newman, Norden, Omo Ranch, Orland, Owens Valley (Independence), Pinecrest, Portola, Quincy, Ravendale, Red Bluff, Roseville, Sacramento, San Andreas, Sierra City, Sierraville, Stockton, Tahoe City, Thornton, Trowbridge, Truckee, Tulelake, Wawona, Wendel, and Yosemite National Park.

INTENSITY V IN IDAHO: Boise, Grand View, Nampa, and Weiser.

INTENSITY V IN OREGON: Jordan Valley, Lakeview, Merrill, Summer Lake, Valley Falls, and Whitehorse Ranch (about 20 miles southeast of Andrews).

INTENSITY V IN UTAH: Lynn and Wendover.

INTENSITY IV IN NEVADA: Alamo, Caliente, Contact, Currie, Elko, Ely, Fish Lake Valley (Dyer), Halleck, Lund, Mountain City, Pioche, Ruby Valley, Shoshone, Springdale (Beatty), Vya (Sheldon Refuge), Wellington, and Wilkins.

INTENSITY IV: Ahwahnee, Applegate, Arbuckle, Auburn, Blue Canon Airport (Emigrant Gap), Caruthers, Colusa, Coulterville, Courtland, Dorris, El Nido, El Portal, Firebaugh, Fresno, Hanford, Hollister (7 miles south of), Kerman, Kings Canyon National Park, Leevining, Mammoth Lakes, Markleeville, Marysville, Mather, Milford, Mineral, Modesto, Oregon House, Oroville, Pittville, Placerville, Pollock Pines, Pratville (west side of Lake Almanor), San Francisco, San Joaquin, San Jose, San Martin, Snelling, Soda Springs, Stevinson, Stirling City, Susanville, Westwood (3 miles south-southwest of), and Woodland.

INTENSITY IV IN IDAHO: Caldwell, Emmett, Hammett, Horse Shoe Bend, Maising, and Parma.

INTENSITY IV IN OREGON: Adel, Arock, Beatty, Burns, Harper, and Klamath Falls.

INTENSITY IV IN UTAH: Ibapah, Milford, Murray, Salt Lake City, and Yost.

INTENSITY I TO III IN NEVADA: Beatty, Carp, Lee, McGill, and Yelland Ranch (Ely).

INTENSITY I TO III: Chester, Dunnigan, Gridley, Huntington Lake, Jawbone Aqueduct Station (35°18′ north, 118°02′ west, north of Mojave), Knowles, Le Grand, Madera, Mariposa, Oakland, Pittsburg, Pulga, Richvale, Round Mountain, Santa Cruz, Tracy, and Volcanoville (near Georgetown).

INTENSITY I TO III IN IDAHO: Hagerman, Idaho City, Murphy, Orchard, and Oreana.

INTENSITY I TO III IN OREGON: Adrian, Brogan, and Malin.

August 26: 01:25:49*, 01:29:09*. Hollister area, B. IV. "Hollister and Pajaro Valley residents were shaken by two earthquakes . . . The first . . . was strong enough to awaken sleepers. The second was preceded by a rumbling sound. No damage was reported."—(*BSSA, January 1955.*) First shock felt by several and awakened few at Moss Landing. Both shocks reported as very slight at Moss Landing Steam Plant.

August 26: 05:48:03*. Epicenter 33°55′ north, 119°30′ west, near Anacapa Island, P. VI. "Plaster was shaken from the ceiling of the Ventura County Courthouse. No other damage was reported."—(*BSSA, January 1955.*) Press reported many people were jarred awake by a short, sharp shock at Santa Barbara. Disturbed objects observed by many, house swayed visibly, compass needle and compass turned around, and chandeliers swung. Motion bumping. Felt by, awakened many, and frightened few at Maywood. Windows, doors, and dishes rattled. Motion rapid. Intensity IV at Long Beach, Los Angeles, Oxnard, San Fernando, Santa Rosa Island, Summerland, and Torrance. Also felt at Glendale, Hollywood, Laguna Beach, Los Alamos, and Santa Ynez.

August 28: 21:13. Fallon aftershock. Dyer, Nev. Slight shock. Noticed by swinging of clock pendulum.

August 29: (around 02:00). Fallon aftershock. Tonkin Ranch, Nev. (about 40 miles southwest of Palisade). Two slight shocks felt.

August: 10:00. (no date given). Fallon aftershock. Wells, Nev. V. Felt by many in home; frightened few. Pendulum clock stopped. Small objects shifted; knickknacks fell. Motion rapid.

August 30: (night). Fallon aftershock. Fallon, Nev. IV. Two shocks about 30–45 seconds apart. One strong enough to creak building and immediately preceded by roaring like distant thunder. Hanging objects swung and water in containers moved north-south. Motion gentle, swaying.

August 31: 09:30 (about). Fallon aftershock. Markleeville. III. Felt by several in home and community (some outdoors). Motion slow.

August 31: 14:20:32*, 21:18:46*. Epicenter 39.6° north, 118.2° west, Dixie Valley, Nev., B. VII.

INTENSITY VII IN NEVADA:

Stillwater Range (near Job's Peak, about 17 miles east-northeast of Stillwater).—Series of three violent shocks, rapid, hard vibrations, each lasting for about 15–20 seconds and about 15 seconds apart. During all the series the sound of rocks pounding and sliding together was heard and sounded like it was directly below observer. The last vibrating of the third series was by far the hardest and loudest. Earth appeared to be vibrating 1–2 feet. Sage brush whipped very hard and fast and parked jeep rocked very hard. Observer remained seated as he was doubtful if balance could be maintained if standing. Minor local rockslides heard. Three or four tremors felt about 22:30. Did not compare with the first shock, but easily felt. From 22:30 until 07:00 ten very mild shocks felt.

Stillwater Range (West Lee Canyon, in area about 10 miles northeast of Stillwater).—(14:20:32). Everything in cabin overturned, including stove.

Stillwater Range (in area about 20 miles northeast of Stillwater). (14:20:32).—Dust arose in columns out of Job's Canyon and up past IXL Canyon to the north, and south to several other canyons below Job's. Dust continued coming out of Cox Canyon longer than any of the others.

Stillwater Range. (14:20:32).—Observer located at the south sentry gate of the Naval Auxiliary Air Station observed a large white cloud of dust on a low mountain top several miles to the east. Appeared as if a portion of the hill fell off.

INTENSITY VI IN NEVADA:

Fallon. (14:20:32).—Frightened all in community. Damage slight. Small objects shifted and overturned. Pendulum clock stopped. Motion rapid. Slight shock felt around 21:00; short time later a longer one which rattled shelf leaning against wall.

Fallon (1 mile south from center of town on U. S. Highway 95). (14:20:32).—Preceded by two slight shocks. Felt by all; general alarm. People felt dizzy. Buildings and trees rocked back and forth. Bricks fell and cracks widened in already damaged buildings. Pendulum clock stopped. Gentle rocking and swaying motion.

Fernley.—Felt by all and frightened few in community. Plaster cracked. Motion slow. Very light shock at 21:18:46.

Mason.—Felt by all in home and community; frightened few. Small objects shifted. Pendulum clock stopped. Trees, bushes shaken strongly. Slight shock at 21:18:46. Many slight trembles felt.

INTENSITY V IN NEVADA: Eureka (14:20:32, 21:18:46).

INTENSITY IV IN NEVADA: Carson City (14:20:32, 21:18:46), Fish Lake Valley (Dyer) (14:20:32), Flanigan (slight at 21:18:46), Hawthorne (slight at 21:18:46), Jiggs (14:20:32), Nixon (14:20:32), Paradise Valley (14:20:32), and Winnemucca (14:20:32).

INTENSITY IV: Baxter (14:20:32, 21:18:46), Chilcoot (14:20:32), and Yosemite National Park (Government Center) (21:18:46).

INTENSITY I TO III: Markleeville (14:20:32), San Diego (21:18:46), and Yosemite National Park (central Yosemite Valley) (14:20:32).

September 2: 23:12:10*. Epicenter 34°10′ north, 118°25′ west. Very small shock, P. Felt at Van Nuys.

September 3: 08:14:17*. Epicenter 33°58′ north, 118°18′ west, near Gardena, P. Felt at Southgate.

September 3: 20:30 (about). Fallon aftershock. Dixie Valley, Nev. Three sharp shocks close together. Several slight motions during the night.

September 4: 04:03. Tehachapi. IV. Buildings creaked; loose objects rattled. Motion jolting.

September 7: 23:17:30*. Fallon, Nev. aftershock. Strong shock felt at Fallon.

September 15: 20:51:04*. Epicenter 37°18′ north, 120°01′ west, east of Merced, B. VI. Coarsegold. An irregular ground crack about 10 feet long and ⅛″ to ¼″ wide was observed in compact soil adjacent to gasoline tanks at the Coarsegold Forestry Camp. People awakened over a large area. Residents in Knowles, Oakhurst, and Raymond reported hearing and feeling the shock. Also reported felt several miles down Highway 41 from Coarsegold, and along the River Road. Initial noise sounded like thunder and ended with an explosive burst. At the San Joaquin Experimental Range (2½ miles south of O'Neals) observer and wife were startled. Sounds like a muffled explosion heard an instant before and during shock. Venetian blinds rattled. A bump or jolt.

September 30: 15:33. Brawley. IV. "A light earthquake shook the Imperial Valley on September 30 at 3:33 P.M., P.S.T. Residents of Brawley reported their houses creaked and dishes rattled. Several other shocks were felt in the afternoon and throughout the evening."—(*BSSA, January 1955.*)

October 1: 12:12:30*. Epicenter 33°07′ north, 115°34′ west, near Calipatria, P. Brawley. Reported as sharper than tremors felt on September 30. (*BSSA, January 1955.*)

October 4: 18:38:08*. Epicenter 35°19′ north, 118°39′ west, near Caliente, P. Observer felt table shake in Bakersfield. Motion rapid, brief.

October 7: (night). Fallon aftershock. Felt at Stillwater, Nev.

October 16: 16:52:43*. Epicenter 37°50′ north, 122°08′ west, possibly an explosion, B. IV. Canyon. Felt by several in home. Windows rattled; floor trembled. Felt like concussion from explosion. Motion rapid.

October 17: 14:57:18*. Epicenter 31.5° north, 116.5° west, Baja California, W. IV. San Diego. Felt by many in community. Hanging objects swung. Motion rapid. Also felt in the Imperial Valley.

October 20: 18:45:52*. Epicenter 34°00′ north, 117°10′ west, near Redlands, P. Redlands. "A number of persons reported feeling an earthquake . . . It seemed to be localized in the south Redlands and Yucaipa area, without damage."—(*BSSA, January 1955.*)

October 24: 01:44:05*, 02:41, 03:21:18*, 06:00. Epicenter 31½° north, 116° west, Baja California, W. V. Several light shocks reported felt in San Diego. Police received many calls from people awakened by the shocks. Hanging objects swung. Residents of near-by Coronado said windows shook and dishes rattled. El Centro reported feeling two shocks, one at 01:44:05 and another shortly after 06:00. Calexico, 12 miles south of El Centro, also felt the shocks.

October 26: 00:28:28*. Epicenter 33°43′ north, 117°28′ west, near Santiago Peak, P. Felt sharply at Corona and Riverside.

October 26: 08:22:26*. Epicenter 33°44′ north, 117°28′ west, near Santiago Peak, P. Felt sharply at Riverside.

October 26: 18:25:42*. Epicenter 38°02′ north, 121°50′ west, near Antioch, B. Felt at the PG&E Contra Costa Substation (3 miles east of Antioch).

October 29: 18:02:43*. Epicenter 34°02′ north, 115°33′ west, east of Dale, Mojave Desert, P. IV. Felt by five families at the Hayfield Pumping Plant near Desert Center. Buildings creaked; loose objects rattled. Motion trembling. Felt by many in home, by some outdoors (active), and frightened few in community at Twentynine Palms. Windows and doors rattled; walls creaked. Motion rapid.

October 31: 22:42:40*. Epicenter 37°04′ north, 120°35′ west, south of Merced, B. V. Awakened many at El Nido where windows, doors, and dishes rattled; house creaked. Explosivelike motion. At Le Grand everyone contacted felt it. Two miles southwest of O'Neals observer thought cracks in adobe walls may have been lengthened. Felt by many and frightened few in community at El Portal. Windows rattled. Motion slow. Creaking of buildings and rattling of loose objects heard by many at Fresno. Motion trembling. Creaking of buildings heard by several at Yosemite National Park. Rockslide heard several miles up valley. Motion bumping. Houses shook at Modesto and drive-in audience felt the shock. Felt by some at Merced and Bakersfield.

November 7: 00:39:31*. Epicenter 33°52′ north, 118°20′ west, near Gardena, P. IV. Long Beach. "A slight earthquake jarred the Long Beach and Lakewood areas . . . It caused chandeliers to swing, but no damage was reported."—(*BSSA, January 1955.*)

November 8 through November 10: (no times given). IV. Whitmore (7 miles east of, at Huggards Mill). Several sharp, short shocks with intermittent slight tremors. Felt by observer in home. Windows rattled. Motion rapid.

November 10: 10:07:21*. Epicenter 39°04′ north, 123°02′ west, between Ukiah and Lakeport, B. Felt over an area of approximately 2500 square miles of Lake and Mendocino counties. Maximum intensity VI. Slight damage, consisting of cracked plaster and few broken windows, reported from several localities.

INTENSITY VI:

Hopland.—Felt by all and frightened many in community. Small objects shifted; desks and chairs moved. Felt like building was bumped by truck. Motion slow.

Nice.—Strong shock. Felt by all in community. Small objects shifted and fell; dishes fell. Window cracked. Motion rolling.

Potter Valley.—Felt by many in community (some outdoors). Plaster cracked. Trees, bushes shaken moderately. Motion rapid.

Talmadge.—Felt by many in community; frightened few. Damage slight. Plaster cracked. Small objects overturned; knickknacks fell. Trees, bushes shaken moderately. Motion slow. One spring in Mill Canyon was reported to have lost 90 percent flow and another spring some 1,500 feet west gained about the same amount. Inspection on December 16 revealed both springs were back to normal flow. Two concrete dams and pipelines in the canyon were not affected.

Willits.—Felt by many in community; frightened few. Damage slight. Crack reported in concrete floor of market. Plaster cracked. Motion rapid.

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Witter Springs.—Felt strongly by many in community. Loud earth noises heard. Trees, bushes shaken moderately. Windows cracked. Vases overturned. Motion slow.

INTENSITY V: Calpella, Kelseyville, Lakeport, Ukiah, Upper Lake, and Yorkville.

INTENSITY IV: Boonville (1 mile north of), Clearlake Oaks, Hobergs, Lucerne, Mendocino, Redwood Valley, and 4 miles northwest of Ukiah at Pine Ridge.

INTENSITY I TO III: Garberville.

November 12: 04:26:47* (main shock), 05:16.7*, 05:23, 08:49. Epicenter 31½° north, 116° west, Baja California, W. V. The main shock was felt strongly throughout San Diego and Imperial counties and as far north as Los Angeles and San Bernardino. Awakened many in San Diego, houses creaked, doors and windows rattled, objects swung; in some places an underground rumbling was heard. The sheriff's office at El Centro reported it gave them a "pretty good shaking." Reported as noticeably heavy in Brawley, Long Beach, Newhall, Palm Springs, San Bernardino, and San Pedro. Felt by all in community and awakened all in home at Grossmont. Windows, doors, and dishes rattled; house creaked. Motion rapid and slow. Awakened many in community at Ranchita. Windows, doors, and dishes rattled. Motion rapid. Awakened many in community at Walnut. Pendulum clock stopped. Motion slow. Awakened all in home at Trabuco Canyon. Motion rapid. Awakened many at Wildomar. Some small objects and furnishings shifted. Motion rapid. Felt by, awakened many, and frightened few in community at Somerton, Ariz. Intensity IV at Agua Caliente, Fallbrook (4½ miles south of), Indio, Moreno, San Clements; Wellton and Yuma, Ariz. It was barely felt at Los Angeles. Also felt at Colton. More than 100 persons were reported homeless in the Baja California mining village of El Alamo, 70 miles south of Ensenada, when boulders fell from a mountain onto the village. Two strong aftershocks were reported, one at 05:16.7 and another at 08:49.

November 14: 16:20. Dyer, Nev. (Fish Lake Valley). IV. Felt by several and awakened observer. Slight swaying of pendulum on Anniversary clock. Rumbling sound like distant explosion heard by several before shock. Motion rapid, jerking.

November 16: 23:23:57*. Epicenter 36°28′ north, 118°00′ west, south of Lone Pine, P. V. Awakened many in community at Keeler. Windows and doors rattled; walls creaked. Motion rapid, explosivelike, then rumble and roll. Felt by several in home at Coso Junction. House creaked and loose objects rattled. Motion sharp. Press reported it was short and sharp at Lone Pine.

November 17: 03:55:12*. Epicenter 31½° north, 116° west, Baja California aftershock, W. IV. People were awakened at El Centro and Calexico where windows rattled. Awakened few in San Diego. Motion rapid. Sharp jolt felt at Mount Helix and Spring Valley.

November 17: 15:03:51*. Epicenter 34°30′ north, 119°07′ west, P. IV. A rolling shock was felt from Santa Barbara to Santa Monica. Described as sharp in Oxnard, Santa Barbara, and Ventura. Felt by many indoors at Ojai where buildings creaked and loose objects rattled. Felt slightly by quite a number of people at Fillmore. Also felt in the Los Angeles region (especially toward the coast), Pasadena, and Santa Ynez.

November 18: 21:53:51*. Epicenter 40.5° north, 124.1° west, near Scotia, B. IV. Felt by many near bay shore at Eureka. Motion swaying.

November 25: 03:16:35*. Epicenter 40°16′ north, 125°38′ west, 65 miles off Cape Mendocino, B. Felt over a land area of approximately 9,000 square miles of Humboldt and Mendocino counties. Reported felt slightly at San Francisco. Maximum intensity V.

INTENSITY V:

Bridgeville.—Felt by and awakened many in community; frightened few. Windows, doors, and dishes rattled; house creaked. Motion slow.

Burnt Ranch.—Felt by several and awakened few in community. Trees, bushes shaken moderately. Slight damage to fireplace. Loud rumbling heard. Motion rapid.

Carlotta.—Felt by and awakened many in community; frightened few. Windows, doors, and dishes rattled; house creaked. Motion slow.

Eureka.—Felt by and awakened many in community. Buildings creaked; loose objects and windows rattled. Pendulum clock (24-inch pendulum) stopped. Motion bumping, rocking.

Ferndale.—Felt by and awakened all in home; frightened many in community. Pendulum clock stopped. Motion slow.

Fields Landing.—Felt by, awakened, and frightened all in home. Windows and doors rattled; house creaked.

Hoopa.—Felt by many in community; awakened all in home. Small objects and furnishings shifted; chairs rocked. Motion slow.

Hyampom.—Felt by and awakened many in community; frightened few. Windows, doors, and dishes rattled; house creaked. Motion slow.

Korbel.—Felt by and awakened all in home. House creaked strongly. Motion slow, steady.

Loleta.—Felt by and awakened many; frightened few. Motion slow.

Orick.—Felt by and awakened many in community. Windows, doors, and dishes rattled.

Pepperwood.—Felt by and awakened all in home. Doors rattled. Motion slow.

Scotia.—Felt by and awakened many in community. Windows, doors, and dishes rattled; house creaked. Motion rapid and slow.

South Fork.—Felt by and awakened many in community. Motion slow.

INTENSITY IV: Arcata, Bell Springs, Fortuna, Fort Bragg, Garberville, also 8 miles north and 8 miles south of, Holmes, Miranda, Orleans, Piercy, Point Arena, Rockport, Samoa, Weott, and Willow Creek.

INTENSITY I TO III: Junction City, San Francisco, Spyrock, Trinidad, and Willits.

November 26: 00:49:21*. Epicenter 36°09′ north, 117°45′ west, Coso Range, east of Haiwee, P. Haiwee Power Plant (Coso Junction). V. Awakened and frightened all in home. Windows, doors, and dishes rattled; house creaked. Motion rapid. Felt by many and awakened few in home at Haiwee Reservoir. Motion rapid.

November 26: 18:33:17*. Epicenter 36°09′ north, 117°45′ west, Coso Range, east of Haiwee, P. Haiwee Power Plant and Reservoir (Coso Junction). IV. Felt by all in home at Reservoir. Windows and dishes rattled; walls creaked. Motion rapid at both places. Reportedly felt in area of about 15 miles.

November 30: 22:30:41*. Epicenter 36°43′ north, 121°29′ west, near Hollister, B. Hollister. V. Felt by many. Buildings creaked; loose objects rattled. Glassware in antique shop displaced. Motion bumping.

December 2: 12:06:51*. Epicenter 34°00′ north, 118°26′ west, Culver City, P. Reported felt at Inglewood.

December 12: 22:25. Norden. II. Slight shock felt by few.

December 13: 02:49:26*. Epicenter 39°17′ north, 120°10′ west, near Truckee, B. Norden. V. Felt by and awakened many in community. House creaked. Motion rapid. Felt by several at Soda Springs (about 1½ miles west of Norden).

December 16: 03:07:13*, 03:11:29*. Epicenter 39°19′ north, 118°12′ west, near Frenchman's Station, Nev., B. X. Major Nevada earthquake. Felt over an area of approximately 200,000 square miles. (See map, page 38.) Magnitude 7.0. Maximum intensity X was assigned to the spectacular surface ruptures which occurred in an area roughly bounded by geographic coordinates of 39°01′ to 39°50′ north, 118°00′ to 118°15′ west. Within this area there were two major fault zones: In the north on the west side of Dixie Valley along the east base of the Stillwater Range of mountains; in the south on the east side of Fairview Valley in the Clan Alpine Range. Faulting extended north and south for a linear distance of approximately 55 miles. Due to the thinly settled region of the epicentral tract, this potentially destructive earthquake caused relatively little property damage. No deaths or injuries were reported.

INTENSITY X TO VIII:

Dixie Valley-Fairview Valley areas.—In the Dixie Valley fault zone there was 5–15 feet of vertical movement and some horizontal displacement. Water of about 60° temperature flowed from a fracture at Mud Springs and cut several trenches 2–3 feet deep down the slope toward the Dixie Valley Road. Where the fracture ran through more compact sediments the fissure was several to many feet deep. At IXL Canyon, about 2 miles north of Mud Springs, there were large vertical displacements and a 55-foot graben. In the settlement of Dixie Valley and vicinity it was reported all wells increased in flow, new wells formed, and water bubbled from the ground in spots. Adobe cellar, gasoline and water tank, and stone wall collapsed. Piano moved across room, buffet up-ended, stove moved several feet, dressers toppled, pictures turned at all angles, and automobile moved halfway out of garage. Locked windows opened. Woman reported she was abruptly ejected from bed and thrown three times before she finally got outside. Largest movements were observed at the eastern base of Chalk Mountain, Fairview Peak, and Slate Mountain. Where the fault zone crossed U. S. Highway 50, three miles south of Chalk Mountain, vertical movement varied between 3 and 6 feet. The highway was badly cracked. East of Fairview Peak there were vertical movements of 6–20 feet and horizontal displacements of 4-12 feet. About 2 miles west of Carroll Summit several rocks of automobile size fell on the highway. At Frenchman's Station damage to buildings was reported as negligible. Slot machines, refrigerators, and freezer "walked." Well decreased in flow and water cloudy. Ground crack ran under the store with southeast side up approximately 4 inches. An estimated $3,000 liquor stock loss.

INTENSITY VII IN NEVADA:

Austin.—Felt by and awakened all in area; frightened many. Everything shifted. Dishes, windows, and furniture broke. Knickknacks, books, pictures, plaster, and walls fell. Chimneys twisted and fell. Ground cracked. "We have had small shocks every day since the two big ones. On December 20 there were three small shocks felt by many in Austin." Motion rapid, rolling.

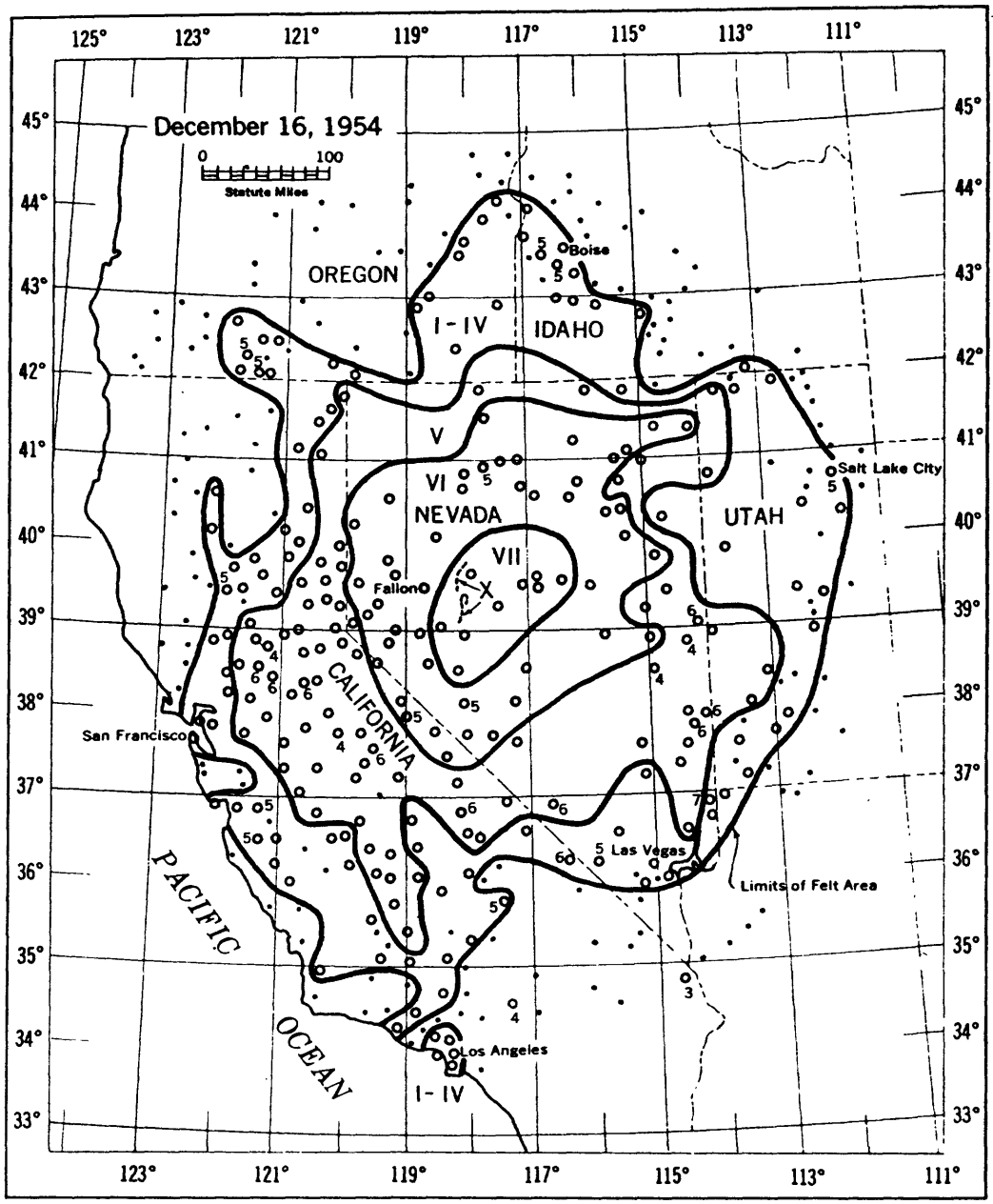

FIGURE 8.—Area affected by earthquake of December 16.

Austin (12 miles east of, on U. S. Highway 50 at the Frontier Tavern).—Stucco cracked. Large coke box on casters moved west 4 inches. Case of canned goods knocked to floor. First shock had shaking motion preceded by roaring earth noises; second shock had rolling motion.

Bartine Ranch (24 miles west of Eureka, on U. S. Highway 50).—Several east-west cracks in compact ground of driveway. Cracks were nearly parallel to the highway. Door swung back and forth. One object fell from shelf. Two shocks, first strongest. Roaring earth noises heard before second shock.

Carroll Station (east of Carroll Summit by 3 miles).—Difficult to walk. Parallel waves appeared in wooden floor. Two slot machines on a steel table nearly fell, finally slid a few feet. Cans migrated off shelves and table lamp fell from shelf. During second shock bottles were held on shelf to keep from falling.

Clan Alpine Valley (Byers Ranch).—Small objects and furniture overturned. Crumpled northwest corner of building. Damage slight. Two shocks. Motion rapid. Loud earth noises.

Givens Ranch (12 miles east of Austin, on U. S. Highway 50, thence 5 miles north).—Stucco on outside of stone house cracked and board ceiling pulled away from the stone walls as much as 1 inch.

Kaiser Mine (about 13 miles northwest of Gabbs).—Felt by, awakened, and frightened all in community. Piano, refrigerator, and other heavy objects moved. Dishes in all dwellings broke. Plaster, windows, walls, chimneys, and ground cracked. Plaster fell; walls reportedly fell. Furniture broke. Two and a half inch water line broke. Damage considerable. Reported break in the old Hot Springs Road about 2½ miles west of the mine and cracking in the alluvium at the west base of the mountain. Stalls were broken in a "knee shape" in the older section of the mine; in the new section stalls were shoved about 2-3 inches into the header squeeze blocks. At 05:00 observer was outside and saw building bounce on foundation. Shock heard and felt at 07:00. "There have been shocks of varying intensity continuously since December 16 (Jan. 31, 1955)."

Luning.—Felt by, awakened, and frightened all. Dishes and windows broke. Chimneys twisted. Damage considerable. Damage to telephone building estimated at $2,000. Motion rapid.

Mesquite.—Observer reported two walls collapsed. Motion rapid.

Mina.—Felt by and awakened all in community; frightened many. Dishes broke. Water thrown 25 feet from 50-foot railway water tank. Eight-inch water line broke. Vertical crack in concrete wall of 1-story hotel. Grocery stock fell. Motion slow. Second shock reported as more severe.

Nevada Scheelite Mine (Rawhide).—Felt by, awakened, and frightened all in community. Loud earth noises heard. Furnishings shifted; knickknacks and pictures fell. Dishes broke. About ½ gallon of water splashed out of fish tanks. House trailer mounted on blocks shook in all directions. Damage considerable to timbered stopes underground. One quarter mile above the mine observer reported ground cracked and "seemed to be a continuous wave below me." Rocks rattled down the canyon. Motion rapid. "We are still having shocks every day (Jan. 8, 1955)."

Rawhide.—Felt by and awakened all in community; frightened few. Loud roaring earth noises heard. Knickknacks and pictures fell; dishes fell and broke. All pictures tilted about 15°. Ground cracked. Damage slight. Motion slow. Tremors felt every 5–10 minutes until 07:00.

INTENSITY VI IN NEVADA:

Austin (20 miles east of).—Awakened all in home and community; frightened few. Damage slight. Plaster cracked. Faint earth noises heard. "I am not certain if any other shocks have been felt since this one."

Baker.—Felt by and awakened all in community. Faint earth noises heard. Pendulum clock stopped. Motion slow.

Battle Mountain.—Awakened and frightened all in community. Windows and doors rattled; house creaked. Motion rapid. Same report for shock at 03:11:29.

Battle Mountain (Copper Canyon).—Felt by and awakened all in community. Damage slight. Plaster cracked. Knickknacks fell; dishes broke. Motion slow.

Beatty.—Felt by all; people frightened. Pendulum clock stopped. Trees, bushes shaken strongly. Small objects shifted. Very strong rolling motion.

Carlin.—Awakened many in community; felt outdoors. Pendulum clock stopped. Small objects and furnishings shifted. Trees, trimmed so that wind could not blow them against house, beat against the roof top. Motion rapid.

Carson City.—Press reported big chunks of ornamental frieze fell from the ceiling of the Assembly Chamber in the 87-year-old State Capitol building. Dozens of small cracks in the walls. Door jammed tight for many years opened. A "good-sized hole" opened between two cell blocks in the State Prison. Felt by and frightened all in community. Chimneys cracked. Damage considerable to brick. Faint earth noises heard. Both shocks felt. Motion generally described as slow.

Cherry Creek.—Awakened many in community. Concrete cracked slightly.

Dayton.—Felt by and frightened all in community. Pendulum clock stopped. Walls cracked; plaster fell. Damage slight. Motion rapid.

Deeth.—Awakened all and frightened many in community. Plaster cracked.

Dyer.—Felt by and awakened all in community; frightened many. Widened cracks in a few poorly constructed buildings. Cupboard doors swung back and forth. Small ornaments on piano fell. Damage slight. Both shocks strong. Motion rolling. Some reported a shock at 06:00.

Duckwater.—Awakened all and frightened many in community. Small objects shifted. Loud earth noises heard. Both shocks felt. First shock had rapid motion; second, slow.

Elko.—Damage reported in several city owned structures was primarily due to building settlement. Paint was found in the worst "earthquake" crack. The reinforced concrete pretreatment tank at the sewage disposal plant lost its gas pressure through leakage. Many people quite excited.

Pendulum clocks stopped. Bookcase swayed. Visible swaying of buildings and trees. Both shocks felt. Motion rolling.

Elko (15 miles west of).—Rocks rolled onto highway.

Empire.—Felt by and awakened many in community; frightened few. Plaster, walls, chimneys, and ground cracked. Damage slight. Dishes broke. Knickknacks, books, pictures, and plaster fell. Motion slow. "No major shocks felt since the 16th."

Eureka.—Felt by all; awakened many in community; frightened few. Some bricks knocked off chimneys and edges of brick buildings. Plaster cracked and fell. Knickknacks fell. Some cans migrated off shelves in grocery stores. Rough finishing coat of plaster on wall of courthouse cracked. Damage slight. Light bulb on wire in home swung about 2 feet. Two distinct shocks, followed by three others in several hours. First shock had slow motion; second, rocking.

Fallon.—Felt by, awakened, and frightened all in community. Damage slight. Some ceilings were cracked, some bricks knocked loose, and few dishes and vases broken. Bags of seed overturned. Knickknacks, books, and pictures fell. Pendulum clocks stopped. Trees, bushes shaken strongly. It was believed a slight displacement occurred at the Carson Diversion Dam. Motion both rapid and slow. Three shocks felt, with smaller shocks until after 08:00.

Fernley.—Felt by and awakened all in community; frightened many. Damage slight. Plaster cracked and fell; windows, walls, and chimneys cracked. Knickknacks, books, and pictures fell. Both shocks felt. Motion rapid. Many small aftershocks felt during early morning. Last one felt at 06:20.

Flanigan.—Felt by, awakened, and frightened all in community; also felt at ranches in the region. Plaster and walls cracked. Pendulum clock stopped. Both shocks felt. Motion slow. "The duration was most frightening."

Golconda.—Felt by and awakened all in community; frightened many. Small objects and furnishings shifted. Motion slow. Same report for shock at 03:11:29.

Halleck.—Awakened all in community; frightened few. Small objects and furnishings shifted. Explosivelike shock reported felt a few seconds before the main shock. Motion rapid.

Hawthorne (U. S. Naval Ammunition Depot).—Felt by all and frightened many in community; awakened all in home. Small objects shifted. Trees, bushes shaken moderately. Moderate disturbance of ammunition. Moderate earth noises heard. Motion rapid.

Hazen.—Felt by and awakened all. Motion slow. Both shocks felt.

Imlay.—Awakened all and frightened many in community. Knickknacks and books fell. Motion slow.

Jiggs.—Felt by, awakened, and frightened all in community. Trees, bushes shaken moderately. Small objects shifted and overturned. Both shocks felt. Second shock much stronger than first, with rolling motion; noise with both shocks.

Lovelock.—Felt by and awakened all in community; frightened many. Plaster and chimneys cracked; chimneys twisted slightly. Dishes broke. One 12-inch cast iron pipe broke in sulfur joint and two 4-inch cast iron pipes broke in sulfur joints. Considerable amount of merchandise fell in stores. Old cracks widened and more cracks appeared inside and outside of business buildings and dwellings throughout the area. Electricity off briefly in some sections due to twisted wires. First shock heaviest of three. Faint earth noises heard. Motion rapid to rolling.

Lund.—Felt by all and awakened many in community. Chimneys cracked. Shifted small objects and furnishings. Moderate earth noises heard immediately before shock. Two shocks felt. Motion slow, rolling.

Manhattan.—Felt by and awakened all in community; frightened few. Hanging objects swung. Both shocks felt. Motion slow, rolling.

Mason.—Felt by and awakened all in community; frightened few. Trees, bushes shaken strongly. Ground cracked. Small objects shifted; knickknacks fell. Both shocks felt. Motion rapid. Many slight shocks felt until 12:00.

Minden.—Felt by and awakened all in community; frightened many. Motion slow, rolling. Several lighter shocks felt later in the morning.

Montello.—Felt by, awakened, and frightened many in community. Plaster and windows cracked. Knickknacks, books, pictures, and plaster fell. Damage slight. Both shocks felt. Motion slow.

Nixon.—Felt by and awakened all in community; frightened many. Hanging objects swung. Both shocks felt. Motion rapid.

Orovada.—Awakened all in community; frightened few. Damage slight. Plaster cracked. Small objects and furnishings shifted. Both shocks felt. Motion rapid.

Palisade.—Awakened all in community; frightened few. Both shocks felt. Motion slow.

Panaca.—Awakened and frightened all. Plaster and windows cracked. Both shocks felt. Motion rapid.

Red House.—Awakened all.

Ruby Valley.—Felt by and awakened many in community; frightened few. Vases, small objects, and furniture overturned. Knickknacks fell. Birdcages shaken off hooks and chickens fell from roosts. Both shocks felt. Motion slow. Moderate earth noises heard.

Ruby Valley (south end).—Felt by, awakened all, and frightened few in home. Damage slight. Dishes broke. Small objects and furnishings shifted. Vases, small objects, and furniture overturned. Knickknacks, books, and pictures fell. Motion slow. Loud earth noises heard 2–3 seconds before shock.

Schurz.—Felt by and awakened all in community; frightened few. Damage slight. Small objects and furnishings shifted. Both shocks felt.

Silverpeak.—Awakened all in community; frightened few. Damage slight. Plaster cracked. Dishes broke. Small objects shifted and overturned. Knickknacks fell. Both shocks felt. Motion rapid. Moderate earth noises heard.

Smith.—Felt by and awakened many in community; frightened few. Damage slight. Plaster cracked. Small objects in stores shifted and overturned. Trees, bushes shaken moderately. Both shocks felt. Motion slow. Faint earth noises heard.

Sparks.—Felt by, awakened all, and frightened many in community. Damage slight. Small objects and furnishings shifted. Knickknacks fell. Trees, bushes shaken moderately. Both shocks felt. Loud earth noises heard 3 seconds before shock.

Stewart.—Awakened and frightened all in community. Damage slight. Both shocks felt. Motion slow.

Stillwater.—Felt by and awakened all in home. Damage slight. Few dishes and vases, etc., broke. At one home clay in the furnace broke and the bottom broke out of hot water heater. Both shocks felt. Motion slow, circular.

Tonopah.—All bottles off shelves in bar. Plaster fell from ceiling and few cracks appeared. Some people went outside and stood in the street. Both shocks felt. Motion slow. Eight miles east-southeast of Tonopah at the CAA station teletypes swayed and pendulum clock stopped. Both shocks felt. Motion swaying. Moderate roaring earth noises heard at peak of motion.

Tungsten.—Awakened all in community; frightened few. Small objects shifted. Both shocks felt. Motion rapid. Moderate earth noises heard.

Tuscarora.—Awakened many and frightened few in community. Small objects shifted; knickknacks fell. Plaster cracked. Both shocks felt. Motion slow. Faint earth noises heard 3 seconds before shock.

Ursine.—Felt by and awakened all in community. Both shocks felt. Motion rapid. Loud earth noises heard.

Valmy.—Felt by and awakened all in community; frightened few. Doors swung. Trees, bushes shaken moderately. Small objects and furnishings shifted. Plaster cracked. Books and pictures fell. Both shocks felt. First slow and rolling; second, rolling and severe.

Verdi.—Felt by, awakened all, and frightened many in community. Earth noises heard.

Wabuska.—Felt by and awakened all in community; frightened few. Cans fell from store shelves. Trees, bushes shaken strongly. Both shocks felt. Motion slow. Loud roaring earth noises heard.

Wadsworth.—Felt by, awakened, and frightened all in community. Doors swung. Moderate earth noises heard. Motion slow.

Wellington.—Felt by and awakened all; frightened few. Trees, bushes shaken slightly. Both shocks felt. Motion rolling. Faint earth noises heard.

Wilkins.—Awakened many in community. Small ground cracks. Both shocks felt. Motion slow.

INTENSITY VI:

Benton.—Felt by and awakened all in community; frightened many. Trees, bushes shaken moderately to strongly. Small objects shifted; knickknacks fell. Motion slow, circular. Loud earth noises heard.

Coleville.—Felt by, awakened, and frightened all in community. Small objects shifted and overturned. Jarred all doors open in some homes. Shook few objects from shelves. Damage negligible. Motion slow. Both shocks felt.

Death Valley Junction.—Awakened many in community; frightened few. Damage slight. Plaster and windows cracked. Motion slow.

Floriston.—Felt by and awakened many in home; frightened few. Small objects shifted. Plaster cracked. Motion slow.

Jackson.—Felt by and awakened many in community; frightened few. Pendulum clock stopped. Small objects and furnishings shifted; knickknacks, books, and pictures fell. Two shocks felt. Motion slow.

Long Valley Dam (about 20 miles northwesterly from Bishop).—Awakened all in community; frightened few. Hanging objects swung. Both shocks felt. Motion slow.

Mono Lake.—Felt by and awakened all in community. Pendulum clock stopped. Small objects and furnishings shifted; vases and small objects overturned.

Sacramento.—An estimated $20,000 damage to a 9,500,000-gallon underground water tank at the city's filtration plant when supporting column toppled and the roof settled to the water. Some damage was reported at the city's sewage disposal plant and damage was reported to have occurred at the Campbell Soup Company. Many awakened. Door chimes rang and a burglar alarm was set off in a downtown department store. Swimming pools sloshed over. Power interrupted by cable breaks. Plaster cracked. Pendulum clock stopped. Shocks were reported felt at 03:07:13, 03:11:29, 03:15, and 03:17. Motion slow, swaying.

Sloughhouse.—Felt by and awakened all in community; frightened many. Small objects shifted. Moderate earth noises heard. Motion rapid.

Tinemaha Reservoir (about 12 miles north of Independence).—Felt by and awakened all in community. Both shocks felt. Motion both rapid and slow.

Yosemite National Park (eastward end of Yosemite Valley).—Felt by and awakened many in community; frightened few. Slight cracks in walls and woodwork slightly separated from wallboard. Some bottles, jars, and cans toppled from shelves in store; some glassware broke. Both shocks felt, with others following at intervals for ½ hour. Roaring earth noises heard before shocks.

Yosemite National Park (Government Center).—Felt by, awakened and frightened many. Few bottles and jars fell to floor at store. Pictures, lamps, and window weights swung. Both shocks felt. Motion trembling, rocking, and rolling. Moderately loud rumbling earth noises heard during shocks. "Most severe and noticeable in many years."

INTENSITY V IN NEVADA: Basalt, Beowawe, Caliente, Candelaria, Crystal Bay, East Ely, Elgin, Ely, Eureka (14 miles east of, on U. S. Highway 50), Gardnerville, Glenbrook, Goldfield, Hiko, Lamoille, Logandale, McDermitt, McGill, Mountain City, Overton, Pahrump, Paradise Valley, Pioche and Caselton, Reno, Silver City, Spring Valley (Ely), Steamboat, Virginia City, Wells, Winnemucca, Yerington, and Zephyr Cove.

INTENSITY V: Ahwahnee, Amador City, Angels Camp, Applegate, Arvin, Bakersfield, Big Creek, Bigpine, Bijou, Bishop and 26 miles north of, Butte City, Camanche, Caruthers, Chilcoot, Copperpolis, Corcoran, Cortland, Delano, Dixon, Downieville, Doyle, Electra Powerhouse (via Jackson), El Nido, El Portal, Emigrant Gap, Escalon, Farmington, Firebaugh, Foresthill, Fort Bidwell, Fresno, Gonzales, Greenville, Hanford, Hollister, Independence, Isleton, Keeler, Knights Ferry, Laws, Leevining, Le Grand, Livermore, Locke, Lockeford, Lodi, Lone Pine, Los Banos, Madeline, Madison, Markleeville, Marysville, Merced, Modesto, Newman, Norden, Omo Ranch, Orland, Owenyo, Pacific House, Placerville, Porterville, Portola, Ravendale, Raymond, Santa Rosa, Scotty's Castle (Death Valley), Sierraville, Snelling, Sonora, Springville, Stevinson, Stockton, Tahoe City, Tahoe Pines, Thornton, Tiger Creek Powerhouse (via Jackson), Tipton, Tracy, Trona, Trowbridge, Tulelake, Vade, Vinton, Visalia, Volcanoville (near Georgetown), Waterford, and West Point.

INTENSITY V IN IDAHO: Boise, Caldwell, and Nampa.

INTENSITY V IN OREGON: Klamath Falls, Merrill, and Nyssa.

INTENSITY V IN UTAH: Garrison, Ibapah, Lynn, Milford, Salt Lake City.

INTENSITY IV IN NEVADA: Alamo, Bunkerville, Indian Springs, Jarbridge, Lages Station (near, at Junction of U. S. Highway 50 and 93), Las Vegas, Lee, Pyramid, Shoshone, Sloan, and Sunnyside.

INTENSITY IV: Aberdeen (35 miles south of Bishop), Adelanto, Adin, Alameda, Alturas, Beverly Hills, Brentwood, Bullards Bar Powerhouse (Dobbins), Burlingame, Cantil, Canyon, Canyondam (Lake Almanor), Chico, Colusa, Coulterville, Dunnigan, Fairfield, Haiwee Powerhouse (Coso Junction), Hollywood, Jawbone Aqueduct Station (35°18′50″ north, 118°02′40″ west), King City, Kings Canyon National Park (Grant Grove), Knowles, Lake City, Lake Hughes, Las Plumas, Los Angeles, Lost Hills, Maricopa, Mariposa, Northridge (1 mile north of), Oakland, Oregon House, Oroville, Park Village (about 25 miles northwest of Death Valley Junction), Piedra, Quincy, Raisin, Red Bluff, Redwood City, Richvale, Roads End, Roseville, Rumsey, San Ardo, San Benito, San Joaquin, Santa Maria, Solromar, Stirling City, Strawberry Valley, Susanville, Taylorsville and Genesee, Three Rivers, Ventura, Volta, Watsonville, Wawona, Westhaven, and Winters.

INTENSITY IV IN ARIZONA: Littlefield.

INTENSITY IV IN IDAHO: Bruneau, Fairfield, Fruitland, Grandview, Hagerman, Orchard, Oreana, Parma, Rupert, and Star.

INTENSITY IV IN OREGON: Adel, Adrian, Arock, Diamond, Frenchglen, Jordan Valley, Juntura, Malin, Sprague River, Whitehorse Ranch (about 20 miles southeast of Andrews), and Worden.

INTENSITY IV IN UTAH: Callao, Delta, Dugway, Gandy, Grantsville, Park Valley, Parowan, Provo, Saint George, Scipio, and Snowville.

INTENSITY I TO III IN NEVADA: Boulder, Currie.

INTENSITY I TO III: Fillmore, Manhattan Beach, Montara, Needles, Project City, San Francisco, Santa Cruz, Santa Monica, Stove Pipe Wells Hotel (Death Valley), Tehachapi, Vernon, Waterman, and Wheeler Ridge.

INTENSITY I TO III IN ARIZONA: Fredonia.

INTENSITY I TO III IN IDAHO: Midvale (23 miles south of), Payette, and Stowell.

INTENSITY I TO III IN OREGON: Beatty, Brogan, Fort Klamath, Ontario, Riverside, Westfall, and Williams.

INTENSITY I TO III IN UTAH: Cedar City (6 miles north of), Enterprise, Leamington, and Saint John.

December 16: 06:24.1*. Nevada aftershock. Laws. IV. Brief, rapid motion felt by many in community.

December 16: 23:08:58*. Epicenter 37°33′ north, 122°08′ west, east of San Leandro, B. Felt over approximately 4500 square miles. Maximum intensity VI. Minor damage reported from several localities.

INTENSITY IV:

Castro Valley.—Canned goods fell from shelves in store.

Hayward.—Felt by, awakened, and frightened all in home. Loud earth noises heard. Motion rapid. Plaster and walls reported cracked.

Oakland.—Generally felt. Motion rapid. Some chimneys and a water main reported broke. Woman's nose reportedly broken by falling plaster. Control tower at the Oakland Airport "seemed to bounce up and down."

San Leandro.—Plaster and walls reported cracked.

INTENSITY V: Alameda, Berkeley, Burlingame, Canyon, Daly City, Lafayette, Mission San Jose, Moraga, Mount Eden, Newark, Orinda, Pinole, Port Chicago, Redwood City, San Gregorio, Stinson Beach, Sunol, Vallejo, and Westlake District (northern San Mateo County boundary).

INTENSITY IV: Alamo, Alcatraz, Alvarado, Alviso, Aptos, Belmont, Bolinas, Concord, Coyote, Crows Landing, Diablo, Elmira, Felton, Gilroy, Half Moon Bay, Inverness, Knightsen, Millbrae, Palo Alto, Petaluma, Point Reyes Station, Rio Vista, Saint Mary's College, San Francisco, San Ramon, Santa Clara County, Santa Cruz, Sonoma, South San Francisco, Tiburon. Tomales, Vacaville, Vernalis, Walnut Creek, and Watsonville.

INTENSITY I TO III: Bel Aire (Marin County), Birds Landing, Cupertino, Danville, Livingston, Lodi, Marshall, Mill Valley, Milpitas, Montara, Mount Hamilton, Newman, Richmond, San Rafael, Sebastopol (1 mile east of), and Winters.

December 17: 07:22:31*. Epicenter 36°44′ north, 121°20′ west, near Tres Pinos, B. IV. Felt by many in Hollister.

December 17: 16:02. Nevada aftershock. V. Felt by all and frightened few at the Naval Ammunition Depot in Hawthorne, Nev. Motion rapid, sharp.

December 20: 03:00. Nevada aftershock. Felt strongly at Dixie Valley, Nev.

December 20: (around noon). Nevada aftershock. Battle Mountain, Nev. "We were down in 850-foot shaft. One man thought shaft was caving in. Not very severe."

December 20: (no times given). Nevada aftershocks. IV. Austin, Nev. Three small shocks felt by many.

December 20: 23:11:12*, 23:15. Epicenter 32°38′ north, 117°07′ west, near National City, P. V. Thousands were awakened in the El Cajon Valley by an explosivelike shock which rattled dishes, but caused no damage. At El Cajon it sounded like two big trucks had collided. Felt in San Diego, Coronado. and as far north as Escondido. Felt by many in post office at Jamul where windows rattled. Motion rapid, brief. Felt by several at work in San Diego where windows rattled. Motion slow.

December 21: 11:56:29*. Epicenter 40°49′ north, 124°05′ west, between Eureka and Arcata, B. Felt over an area of approximately 50,000 square miles. (See map, page 44.) Magnitude 6.6. Maximum intensity VII. Principal structural damage occurred in the Eureka-Arcata areas. The old City Hall and the old County Courthouse in Eureka were extensively cracked. Several old poorly constructed brick walls bulged and there was some parapet damage but damage was mainly to chimneys, plaster, plate-glass windows, and merchandise. In the poorly consolidated ground areas north and east of Eureka there were some pipeline failures and Eureka's main water reservoir was cracked.

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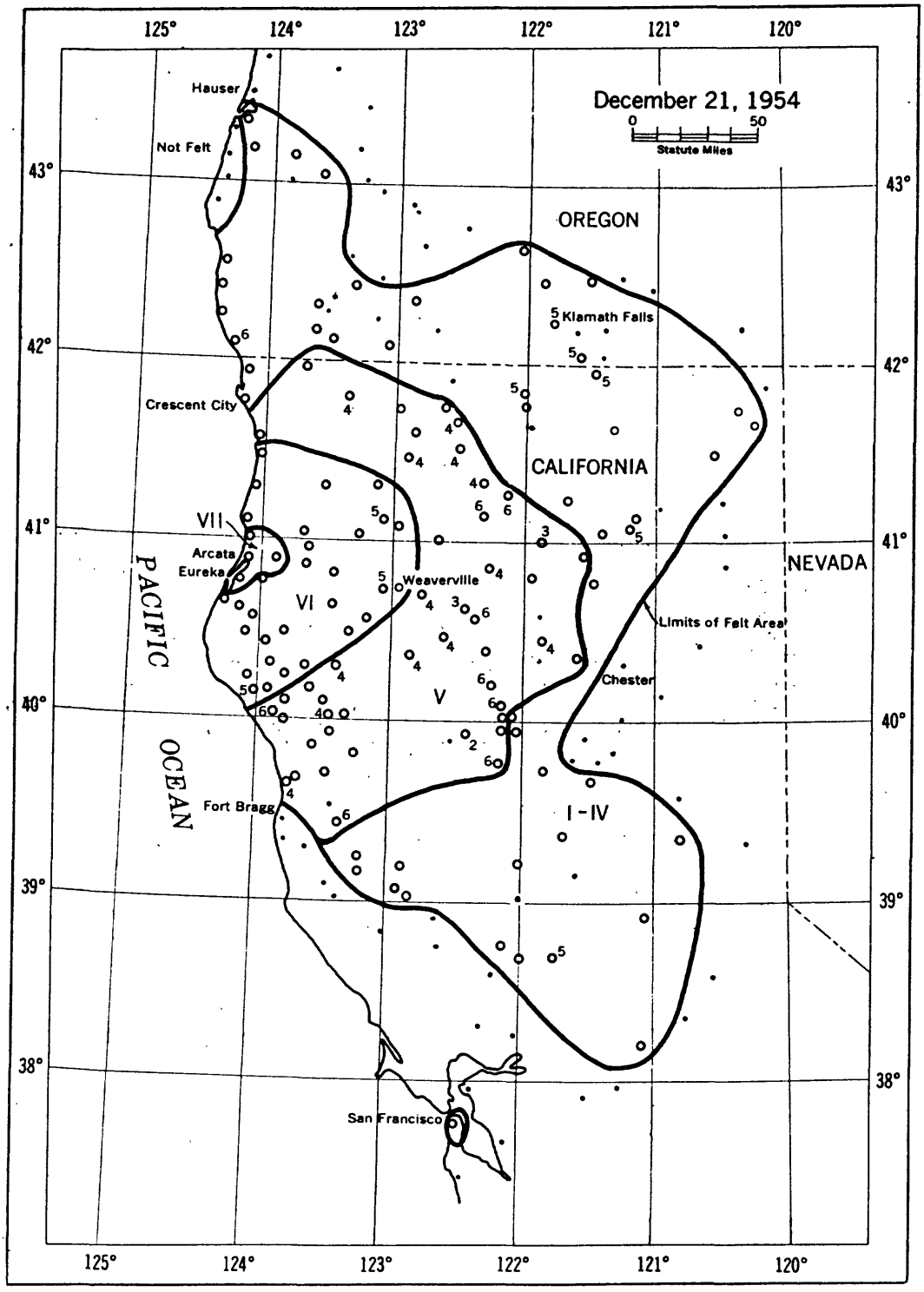

FIGURE 9.—Area affected by earthquake of December 21.

Numerous, but no serious breaks occurred in Eureka's water distribution system. Two tall brick industrial stacks were cracked. U. S. Highway 101 between Eureka and Arcata was cracked and bulged to some extent, but no serious damage occurred to roads or bridges. A check by the city of Eureka indicated a large section of the older downtown filled area had settled from 2 to 6 inches. Some water main breaks were reported in Arcata but damage there was also mainly to chimneys, plaster, plate-glass windows, merchandise, and household objects. A wooden water tank collapsed several miles west of Ferndale. Banks of the Davis Creek (about 15 miles east of Eureka) were reportedly caved in and boulders were heard falling in the hills. One death occurred when a man fell into Humboldt Bay and drowned; a number of persons were injured by falling objects.

INTENSITY VII:

Arcata and vicinity.—Felt by and frightened all in community. Several people were injured by falling objects. Ground settled approximately 1 inch at the Arcata Sewage Disposal Plant. Aside from broken windows and plaster damage, there was little damage to wooden buildings, which predominate, in Arcata. Damage was reported as much heavier west of Burns Freeway than to the east. Vertical movement appeared to be about 18 inches at the Van Fleet Lumber Mill (about ½ mile southwest of Humboldt State College). North-south lumber piles fell toward west; east-west piles shifted but did not fall. Heavy household objects overturned; electric stove shifted 16 inches. Some old brick walls and brick floors cracked; plaster cracked, windows broke, chimneys fell. Two miles northeast of Arcata (on Mad River) man sitting on heels was toppled over. Loud grinding earth noises seemed to come from directly beneath him. Swift current of Mad River suddenly stopped, water rushed across the river, then back, then upstream, and was immediately changed to a yellow muck. Swaying of trees sounded like a heavy windstorm. Difficult to maintain balance; some people reported they were knocked down. Many reported loud rumbling earth noises. Many aftershocks reported felt.

Bayside and vicinity.—Felt by and frightened all in community. Plaster and wallpaper cracked. Chimneys twisted, some fell. Heavy stoves moved. Dishes broke. Water pipeline broke at home on Jacoby Creek Road. One mile south of Horse Mountain pickup truck seemed to drop down then shake back and forth.

Beatrice and vicinity.—Felt by and frightened all. Plaster cracked; chimneys fell. Furniture overturned. Dishes and floors lamps broke. Damage considerable to brick. About 1 mile from Beatrice on Hookton Road house settled, causing windows and doors to drag. Wallpaper cracked all over house. Moved all beds and threw objects all over upstairs rooms, clothes fell in closets. Moved wood range and tipped water heater over. Milk thrown out of deep bowls. Side of well fell in and water pipes broke. Barn on marshy land broke in half and settled down in the mud. All of the neighbors had damage. Some trees fell 2 miles north by northeast of Beatrice. Moderate damage occurred to the Beatrice Bridge which had broken guard rail and broken pavement on approaches. Motion rapid.

Blue Lake.—Felt by and frightened all in community. Acetylene tanks, shafts of lumber, etc., shifted. Dishes, windows, furniture broke. Plaster cracked and fell; chimneys fell. Merchandise thrown to floors of stores, causing merchants to close. Cars shook violently. Piano shifted north 3 inches. "I was standing by a fence post when the shock started. I grabbed the post, then saw I couldn't let loose of it, and it kept hitting me on the side of the head." Motion rapid.

Brainard (U. S. Highway 101, halfway between Eureka and Arcata).—"The highway was pushed up on the road seams (horizontal across road) in the vicinity of Brainard cut."

Crannell.—Felt by and frightened all in community. Chimneys twisted and fell. Dishes, mirrors, and lamps broke. Electric power off. Damage slight. Motion rapid.

Cummins Road (about 3 miles northeasterly from Eureka, off old Arcata Road).—Felt by and frightened all in community. Chimney broke off at roof, fireplace pulled loose from house, living room floor cracked full length, ceiling cracked, and roof cracked in places. Deepfreeze, mangle, electric range, all shifted 2 feet. All dishes and lamps broke, also canned fruit. Plumbing broke in bath room. Ground cracks in yard up to 4 inches wide. Motion rapid.

Cutten (southeast suburb of Eureka).—Apartment-size gas range shifted north-northwest 1½ inches. Floor covered with groceries and broken dishes from cupboards of east and south walls. Bookcase fell. Small radio, table lamps, and reading table knocked over. Felt like house would collapse. At the old Cutten Elementary School a chimney was destroyed. Motion rocking and rolling.

Davis Creek (about 15 miles east of Eureka).—Two boys fishing in Davis Creek managed to run free of a "sudden crack" at about midstream which travelled rapidly from the east bank and dug a trench about a foot wide and three feet deep. Banks of the creek were reportedly caved in. Boulders were heard crashing down the hills.

Elk River (just off U. S. Highway 101).—Felt by and frightened all in home. Damage slight. Walls and chimneys cracked; plaster fell. Dishes broke. Furniture overturned. Trees, bushes shaken moderately. Motion rapid.

Eureka.—Some leaks in Eureka's water supply line from Sweesey Dam on the Mad River and concrete cracks in Eureka's main reservoir. About 30 breaks, but none serious, throughout the city's water distribution system. No serious damage to electric, gas, and telephone services. Several small fires caused by shorted electrical circuits. One elevated steel water tank (not earthquake resistant) at the Eureka Redwood Plant nearly failed due to broken rods. One brick stack, 150-foot high, at the Eureka Lumber Company, had 50 feet badly cracked, and a 175-foot brick stack at the Holmes-Eureka Lumber Company was also badly cracked. Both stacks were cracked in the 1932 earthquake. On Hawthorne Street, near U. S. Highway 101, there was a crack approximately 5 feet deep and 10 inches wide. The Eureka City Hall (built in 1904) and the Humboldt County Courthouse (built in 1885) were extensively damaged. The front walls of the City Hall were badly cracked and leaned outwardly. Interior plaster in all rooms of the County Courthouse was baldy cracked and wall leaned outwardly approximately 6 inches. Both buildings were evacuated. Kress and Daly's stores (both old buildings) appeared to be the most severely damaged. Building front of the Kress store was baldy cracked and leaned outwardly. The west wall of Daly's buckled outwardly at the center. Several other old buildings had damage in the form of broken parapets, cracks, extensive plaster damage, and broken plate-glass windows. Losses were heavy from fallen merchandise. Numerous chimneys were cracked and many fell in the residential areas; much plaster cracked. Heavy household objects such as stoves, refrigerators, etc., shifted, in some cases as much as 12 inches; much furniture overturned. Linotype machines in downtown newspaper office were torn loose and "walked." Shock was generally described as abrupt, accompanied by a loud roaring noise, with twisting, rapid motion, first north-south then east-west.

Ferndale and vicinity.—Felt by and frightened all in community. Damage occurred to a number of stores and consisted mainly of cracked plaster, broken plate-glass windows, and cracked or fallen chimneys. Merchandise fell and broke in some stores. In homes some furniture overturned and broke. A large wooden water storage tank at the Valley Flower Cooperative Creamery, several miles west of Ferndale, collapsed. Near-by power lines fell. Four and one half miles east of Ferndale observer reported "trees in orchard swayed and looked like rapidly bowing dancers." Wallpaper cracked. Knickknacks and pictures fell. Motion rapid.

Fieldbrook.—Felt by and frightened all. Chimney cracked and shifted slightly. Power poles shaken strongly and wires wrapped. Damage considerable to underpinnings of house. Ground cracked and some trees fell in the woods near Fieldbrook. On Fieldbrook Road furniture moved, many dishes broke, chimneys shifted. Damage considerable. Extremely loud earth noises heard. "Held onto fence in order to keep balance." Motion rapid.

Fields Landing.—Frightened all in community. Ground cracked, chimneys twisted and fell, windows and furniture broke, plaster fell. In the King Salmon area several septic tanks were raised 6 inches or more out of the ground. Ground cracked. Several wood "sea walls" failed and there was considerable cracking and caving adjacent, also several sand boils from which water spurted. One fence showed a curvature and sagging. Small section of shallow-buried water pipe forced out of ground. Difficult to maintain balance.

Fortuna and vicinity.—Felt by and frightened all in area. Overall damage in Fortuna was about $10,000. Department store had a couple of cracks, several broken windows, and stock damage. Furniture broke, plaster and several chimneys fell. Church organ shifted 3 inches and organ pipes knocked down. Parked car seemed to leap east-west then shake in all directions. Three miles south of Fortuna (on Drake's Hill) trees whipped. Several people reported they clung to door, cars, etc., in order to maintain balance. Motion rapid. Slight shock felt at 12:20.

Korbel.—Felt by and frightened all in community. Large plate-glass windows broke. Large lumber piles tumbled. Large fluorescent lights swung violently in post office. Numerous persons lost complete sets of dishes and all their canned fruit. All lamps tipped over. Large oil cook stove moved 12 inches and many refrigerators moved. Threw a large bookcase full of books and knickknacks across living room. Many terra cotta chimneys caved in. Ground cracked. Well water was like thin mud for almost two days. Five miles east of Korbel, chimney twisted and fell. Motion rapid.

Kneeland Road (Old Kneeland Road, about 4 airline miles east of Eureka in mountains).—Knocked heavy wood cook stove off base. Moved house 1 inch to the east on foundation and twisted it out of line. Knocked over all table lamps, all loose appliances fell to floor, dishes fell from cupboard. Telephone out of order. Observer could hardly stand and when trying to walk was knocked against door. Motion rapid.

McKinleyville.—Felt by and frightened all in community. Chimneys fell, walls cracked, furniture shifted and overturned. Dishes broke. Sixteen-foot rolling door on overhead track rolled back and forth several feet. Heavy tires leaning against wall moved 6 feet. Motion rapid.

Mitchell Heights (2 miles east of Eureka).—Felt by and frightened all in community. Damage considerable to brick. Furniture overturned. Chimneys cracked, twisted, and fell. Dishes broke. Trees, bushes shaken strongly. Motion rapid.

Mitchell Hill or Ryan Slough (about 2 miles east of Eureka).—Felt by all in community; frightened all in home. Chimneys twisted and cracked. Walls cracked. Furniture overturned. Dishes broke. Knickknacks, books, and pictures fell. Motion rapid, heavy.

Mitchell Heights (upper).—Frightened all in home. Damage considerable. Chimneys twisted. Plaster, windows, walls, chimneys, and ground cracked. Dishes broke. Furniture overturned. Motion rapid.

Mitchell Road (lower Mitchell Road).—Frightened all in community. Damage considerable to brick, masonry, concrete, and wood. Wrecked plumbing and septic tank. Plaster, windows, chimneys and ground cracked. Dishes and windows broke. Furniture overturned. Motion rapid.

Pigeon Point Road (halfway between Ryan Slough and Freshwater Corners on the south side of Lower Pigeon Point Road).—Frightened all in home. Walls cracked. Many dishes fell from cupboard on the west wall. Water heater shifted and connection loosened so that water ran out on floor. Fine cracks in ceiling beams. Trees, telephone poles and wires jumped and swung violently. Motion rapid.

Rio Dell.—Frightened all in community. Grocery stores with broken merchandise suffered the most damage. Large crack in furniture store, and some houses in the area were moved a couple of inches from foundations. Heavy shuffleboard shifted 5 inches south and heavy cash register shifted 4 inches north. Chimney twisted. Water shaken out of toilet tank and sugar shaken from sugar bowl. Kitchen stove and oil heater against the north wall twisted about 6 inches into room. Dining table bounced toward the west about 4 inches. Objects fell and broke in every room. Eight-foot shelf of books on east wall thrown to floor. Fireplace on west side had deep crack in the floor and up inside inner walls, also in the rock-faced front. Kitchen floor very wet from leaking hot water pipe. Motion described as both rapid and slow; direction both north-south and east-west.

Rohnerville.—Felt by and frightened all in community. Damage slight to wood. Lamps, dishes, canned fruit, etc., broke; chimney broke. Furnishings shifted. Outside electric wires whipped strongly. Ground crack in driveway less than half mile north. Chairs (stacked) knocked over. Door to deepfreeze opened. First shock south-north; hard shock east-west. Motion rapid.

Samoa.—Felt by and frightened all in community. Approximately 41 dwelling chimneys damaged. The Hammond Lumber Company reported: Some cracks (not serious) in smokestack; several floor beams in Fuel House split; leaks in three water tanks and some braces loosened; one post split at Sawmill; several breaks in fire protection mains; broken guy line on crane runway; several braces fell from Planing Mill monorail system; some knee braces fell in Planing Mill building; two trusses moved in warehouse; blowpipe from Dry Sorter to Factory buckled; floor in warehouse cracked; main office out of shape and some plaster fell; fresh water main from tanks to Power Plant broken; machinery out of alignment; some lumber piles fell with considerable loss of lumber; large crack in upper side wall of furnace and some brick lining fell in furnace. At Plant No. 2: One break in fire main; three posts in Sawmill damaged; floor in Carrier Shop buckled; some loss of lumber when piles fell.

Samoa (Fairhaven District, about 1½ miles south of Samoa).—Felt by and frightened all in community. Trees, bushes shaken strongly. Small objects shifted and overturned, floor lamp fell toward north and broke. Slight tremor, then violent, rapid upheaval. Ground seemed to rise up and down with twisting effect. Observer held on to fence to keep from falling.

Worthington District (about 3 miles east of downtown Eureka).—Frightened all in community. Trees, bushes shaken strongly. Small objects shifted and overturned, knickknacks fell. Fireplace chimney broke about a foot above roof and top part shifted two inches. Motion rapid.

INTENSITY VI:

Alton.—Felt by and frightened all in community. Damage slight. Small objects shifted and fell. Dishes broke. Ceiling popped. Trees, bushes shaken strongly. Motion rapid. Slight shock felt about half hour later.

Blocksburg.—Felt by all in community; frightened few. Trees, bushes shaken strongly. Small objects shifted.

Briceland.—Felt by all in community; frightened few. Trees, bushes shaken strongly. Dishes rattled; house creaked. Motion slow, rolling.

Bridgeville.—Frightened all in community. Trees, bushes shaken strongly. Knickknacks and pictures fell. Dishes broke. Knocked merchandise from shelves, breaking a few articles. Plastered ceiling cracked. Boulders rolled down onto highway. Motion slow.

Burnt Ranch.—Felt by all and frightened many in community. Damage slight. Walls and chimneys cracked. Water spilled east-west from indoor containers. Knickknacks and books fell. Motion rapid.

Carlotta.—Felt by all and frightened many in community. Damage slight. Chimneys twisted. Dishes broke. Knickknacks, books, and pictures fell. Trees, bushes shaken strongly. Motion slow.

Castella.—Felt in all houses. Damage slight. Plaster cracked and fell. Small objects and furnishings shifted; knickknacks fell. Trees, bushes shaken moderately. Motion rolling.

Cobb's (25 miles east of Bridgeville).—Frightened most of the men in the woods so badly that they stopped work and went home. Men working on tractors felt it. Knocked down an A-frame used in the woods.

Denny.—Felt by and frightened all. Damage slight. Knickknacks fell; jars of fruit, etc., broke. Pendulum clock stopped. Trees, bushes shaken strongly. Motion heavy, abrupt onset.

Dows Prairie (about 6 miles north of Arcata).—Frightened all. Damage slight. Three glass jars broke. Small objects shifted; vases overturned. Trees, bushes shaken strongly. Motion rapid.

Dows Prairie School and Grange (6/10 mile south of).—Trees, bushes shaken strongly and big building shaken strongly. Car rocked back and forth. Three bottles fell from shelf in bathroom. Motion rapid. Very loud rumble heard. Shock felt about 20:50. About 40 shocks reported felt since the main shock.

Dyerville.—Felt by and frightened all in community. Windows, doors, and dishes rattled; walls creaked. Trees, bushes shaken strongly.

Fernbridge.—Frightened all in community. Slight damage to bent of west approach of Fernbridge highway bridge. Soil displaced around base of pile supporting west approach due to rocking of bridge. Dishes broke. Ceiling cracked. Furnishings shifted; small objects overturned; knickknacks fell. Trees, bushes shaken strongly. Motion rapid.

Fort Seward.—Felt by all and frightened many in community. Trees, bushes shaken moderately. Small objects and furnishings shifted. House trailer facing north-south seemed to move up and down. Motion slow. Few mild shocks felt after main shock.

Freshwater (Freshwater Elementary School District).—Located at Three corners. In the old one-story frame building built in 1897, there were two or three plaster cracks; two concentric rings on lighting fixtures came down; steps to school slightly misplaced; a few books and supplies scattered. Water pipes had few leaks. Oil heaters moved (falling soot). In the new building (90 percent completed) there were slight cracks in concrete and a 6-inch square of plaster broke in janitor's room and was believed due to action of pipes going through wall.

Gerber.—Felt by many in home and frightened few in community. Trees, bushes shaken moderately. Plaster cracked. Pictures fell. Motion slow.

Hayfork.—Felt by all and frightened few. Damage slight. Plaster and windows cracked. Trees, bushes shaken moderately to strongly. Motion rapid.

Holmes.—Felt by all in home. Small objects shifted; pictures fell. Trees, bushes shaken strongly. Motion rapid.

Honeydew.—Felt by all and frightened many in community. Small objects shifted; knickknacks fell. Trees, bushes shaken moderately. Motion rapid.

Hoopa.—Felt by and frightened all. Split hot water tank. Dishes, windows, and furniture broke. Small objects and furnishings shifted. Trees, bushes shaken strongly. Motion rapid.

Hyampom.—Felt by all and frightened few. Damage slight. Chimneys cracked. Knickknacks, books, pictures, and plaster fell. Water and oil spilled from indoor and outdoor containers and tanks. Trees, bushes shaken strongly. Motion rapid.

Hydesville.—Felt by and frightened all or most in area. Small objects and furnishings shifted; small objects overturned; knickknacks fell. Pendulum clock stopped. Trees, bushes shaken strongly. Considerable noise. Motion rapid.

Kekawaka (84 miles south of Eureka).—Felt by all on job. Large oak tree seemed to sway about 6 feet. Observer leaning on 6 x 6 foot truck which seemed to move about a foot. Very strong shock.

Klamath.—Frightened many. Windows, doors, and dishes rattled. Hanging objects swung. Liquid in outdoor containers spilled. Motion rapid.

Kneeland Mountain (Hunt Ranch).—Felt by and frightened all; awakened baby. Trees, bushes shaken strongly. Knickknacks fell; lamps overturned. One dish broke. Separated rafters from walls on very old pole barn. Almost knocked observer down. Motion rapid.

Loleta.—Felt by and frightened all in community. Damage considerable. Dishes, windows, and furniture broke. Plaster, windows, walls, and chimneys cracked. Knickknacks, books, pictures, and plaster fell. Furniture overturned. Motion rapid.

Loleta (2 miles southeast of Old Table Bluff Lighthouse).—Frightened all in community. Trees, bushes shaken strongly. Small objects shifted; knickknacks fell. Motion rapid.

Loleta (2 miles north of, Table Bluff, off U. S. Highway 101).—Small objects overturned; knickknacks fell; lamps overturned and broke. Dishes and fruit jars fell from shelves and broke.

McCloud.—Felt by many. Ten-inch wooden water main broke. Buildings creaked; loose objects rattled; light fixtures swayed. Faint rumbling earth noises heard after shock. Motion trembling, circular.

Miranda.—Felt by all and frightened many in community. Trees, bushes shaken strongly. Furniture overturned; knickknacks, books, and pictures fell. Very slight plaster cracks (1/64 inch) at the new Miranda Elementary School. Motion rapid.

Orick.—Felt by all and frightened few in community. A store was badly cracked. Damage slight. Furniture overturned. Water and oil spilled from outdoor and indoor containers and tanks. Knickknacks, books, pictures, and plaster fell. Trees, bushes shaken strongly. Motion rapid.

Orick (about 3 miles north of, where Lost Man Creek joins Prairie Creek on U. S. Highway 101).—Articles on shelves running north-south fell. Heavy deer head on north wall twisted halfway around. Water tumbler thrown about 2 feet off stand. Lamps, large mirror, and dishes overturned and broke. At the Hammond Lumber Company leaves, twigs, and small branches fell. High chimney on Mill building swayed violently and guy wires whipped. Bottled goods in grocery store broke. Felt by all except one family riding on rough driveway. House moved rather gently with a shuddering motion, then shook violently.

Orland.—Felt by many and frightened few in community. Damage slight. Underground water pipe broke and flooded alley. Rack of brooms knocked over in store. Ceramic tile in home cracked. Bathroom pipe broke and water flooded adjoining room. Water sloshed in old swimming pool west of town. Motion slow.

Orleans.—Felt by all and frightened few. Damage slight. Small objects and furnishings shifted; knickknacks, books, pictures, and plaster fell. Pendulum clock stopped. Trees, bushes shaken moderately. Motion rapid.

Pepperwood.—Felt by and frightened many in community. Damage slight. Small objects shifted and overturned; knickknacks and books fell. Plaster cracked. Trees, bushes shaken strongly. Motion rapid.

Piercy.—Felt by many and frightened few in community. Windows and doors rattled; frame creaked. Water spilled from outdoor containers and tanks. Motion slow.

Proberta.—Trees swayed 2–3 feet and objects in store swung at least a foot. Felt by many in post office and frightened few. Nauseated sensation for at least 3 hours afterwards. Motion slow, swaying, north-south.

Red Bluff.—Felt by and frightened many in community. Brick chimney atop store twisted on base to almost 45°. Car bounced back and forth. Furniture moved; trees swayed. Pendulum clock stopped. Motion rocking, swaying, north-south.

Redding.—Two windows at the City Hall cracked. Wind indicator at airport jolted around in a complete circle. Motion slow.

Sawyers Bar.—Damage slight. Plaster cracked. Canned goods fell from shelves in store. Roaring earth noises heard by many at time of shock. Trees, bushes shaken slightly. Motion slow.

Scotia.—Felt by all and frightened many in community; observer ran outdoors. Damage slight to considerable. Chimneys cracked; windows broke. Trees, bushes shaken strongly. Small objects and furnishings shifted; knickknacks, books, and pictures fell. Pendulum clock stopped. Motion rapid. Shock felt by many about half hour later.

Showers Pass (about 43 miles east of Eureka).—Felt by several. House creaked. Hanging objects swung. Trees, bushes shaken strongly. Motion slow.

South Fork (South Fork High School).—Pronounced cracks in classroom built about 3 years ago.

Trinidad and vicinity.—Felt by all and frightened many in community. Damage slight. Plaster cracked. Small and large objects shifted; vases and small objects overturned; knickknacks fell; dishes broke. Pendulum clock stopped. Cabinet doors swung. State Highway Patrol officers reported a few minor slides about 1 mile south of Trinidad and south of Big Lagoon Bridge. Trees, bushes shaken strongly. Motion rapid.

Waddington.—Felt by all in community; frightened all in home. Damage slight. Small objects shifted; vases overturned. Trees, bushes shaken strongly. Motion rapid.

Weaverville.—Felt by all and frightened many. Courthouse swayed and "danced," and there were numerous cracks, but none serious. Most customers left stores. Old antique clock stopped for many years began ticking. Motion slow.

Weott.—Frightened all in community. Furnishings shifted. Pendulum clock stopped. Trees, bushes shaken strongly. Motion rapid.

Willits.—Felt by all and frightened many in community. Damage slight. Plaster cracked. Small objects shifted. Trees, bushes shaken moderately. Motion rapid, definite north-south movement.

Willow Creek (rocky bluff on bank of Trinity River).—Felt by all in home and yard; frightened all in home. Hanging objects swung. Station wagon moved. Man outside was concerned for safety when he noticed he was standing under electrical wires.

INTENSITY VI IN OREGON:

Brookings.—Felt by several, some outdoors (quiet). Damage slight. Plaster and concrete walls cracked. Trees, bushes shaken slightly. Motion slow.

INTENSITY V: Alderpoint, Bell Springs, Butte Valley (Siskiyou County), Cecilville, Corning, Cottonwood, Covelo, Crescent City, Cummings, Eel Rock, Elk Valley Weather Observation Station (½ mile south of Oregon-California border), Ettersburg, Fort Jones, Garberville, Hat Creek Powerhouse No. 1 (Cassel), Junction City, Lake Mountain, Laytonville, Macdoel, Mineral, Nubieber, Phillipsville, Requa, Richardson Grove (8 miles south of Garberville), Rockport, Round Mountain, Sawyers Mountain View Ranch (about 7 miles east of Cecilville), Scott Bar, Tehama, Trinity Center, Tulelake, Weed, Woodland, and Yreka.

INTENSITY V IN OREGON: Klamath Falls and Merrill.

INTENSITY IV: Auburn, Bieber, Brooks, Capay, Colusa, Davis Creek (Modoc County), Etna, Gazelle, Grenada, Happy Camp, Honeydew and Upper Mattole, Island Mountain, Las Plumas, Lewiston, Los Molinos, McArthur, Manton, Mount Hebron, Mount Shasta, O'Brien (3 or 4 miles north of in Salt Creek District), Ono, Platina, Ruth, Smith River (5 miles north of, on Old U. S. Highway 101), Vina, Washington, and Westport.

INTENSITY IV IN OREGON: Cave Junction, Coos Bay, Gold Beach, Harbor, Holland, Medford, Modoc Point, O'Brien, Pistol River, and Selma.

INTENSITY I TO III: Alturas, Big Bend, Calpella, Chico, Clements, Finley, Flournoy, Gridley, Hartsook, Hat Creek, Lake City, Lakeport, Pondosa, Project City, Richfield, San Francisco, South San Francisco, Tionesta, Ukiah and Upper Lake.

INTENSITY I TO III IN OREGON: Bonanza, Coquille, Denmark, Fort Klamath (3 miles south of), Ophir, Sitkum, Sprague River, and Takilma.

December 21: 12:30 and about 00:00. Eureka aftershocks. Arcata (817 Fickle Hill Road). Shock at 12:30 felt slightly by most people. Shock about 00:00 felt by some in Arcata.

December 22; 10:33. Arcata (817 Fickle Hill Road). III. Felt slightly. Dishes and doors rattled slightly.

December 22: 13:12:24*. Epicenter 36.0° north, 121.0° west, near San Ardo. III. Short jolt with rapid motion felt at Mee Ranch (intersection of Highway 198 and Lonoak-Hollister Road). Trembling motion felt by several at King City.

December 23: 11:04:59*. Epicenter 36°47′ north, 121°26′ west, south of Hollister, B. Hollister (7 miles south of). IV. Felt by many in community. Windows, doors, and dishes rattled; house creaked. Motion rapid and slow. Shook strongly at Hollister for 3–4 seconds, then tapered off.

December 24: 01:10:11*. Eureka aftershock. Epicenter 40°44′ north, 124°04′ west, B. Eureka. V. Felt by, awakened, and frightened all in home. Windows, doors, and dishes rattled. Rapid west-east motion, then slow, north-south motion. Hard shock with twisting motion felt on Pigeon Point Road about halfway between Ryan Slough and Freshwater Corners on south side of Lower Pigeon Point Road.

December 29: 02:49:32*. Epicenter 38°59′ north, 119°54′ west, northwest of Minden, Nev., B. Slight tremor felt by few at Markleeville.

December 30: 01:16:13*. Eureka aftershock. Epicenter 40°49′ north, 124°05′ west, between Eureka and Arcata, B. VI.

INTENSITY VI:

Arcata.—Felt by all and frightened many in community. Seven plate-glass windows broke and some merchandise fell from shelves in stores. "This shock finished my tall ceramic greenware." Motion rapid, jolting.

Arcata (about 2½ miles northeast of, Glendale District).—Felt by, awakened, and frightened many in community. Damage slight. Windows rattled; frame creaked. "Seemed as strong as the shock on December 21, but didn't last as long." Motion rapid.

Blue Lake.—Awakened and frightened many in community. Damage slight. Observer held floor lamp to keep it from falling. Windows, doors, and dishes rattled. Motion rapid.

Cutten (southeast suburb of Eureka).—Felt by, awakened, and frightened many in community. Overturned one table; small objects shifted; one small object fell. Several minor tremors felt since December 21, with wavelike rolling, rocking motion.

Eureka.—Felt by, awakened, and frightened many in community. Damage slight. New breaks in Eureka's main water transmission line. Largest of the breaks occurred near the Dolly Varden Lumber Company where the wooden line was pulled loose on December 21. Two other breaks occurred, one at the Ryan Slough crossing and one at Gannon Slough. Some windows in old buildings broke; plaster and chimney cracked. Pendulum clock stopped. Observer jumped out of bed and felt floor move back and forth. Motion rapid.

Ferndale.—Awakened all and frightened many in community. Pendulum clock stopped. Motion rapid.

Fields Landing.—Awakened all and frightened many in community. Windows, doors, and dishes rattled; house creaked. Hanging objects swung. Motion rapid.

Kneeland.—Felt by, awakened all, and frightened few in community. Walls creaked. Hanging objects swung. Motion rapid.

Korbel.—Heavy shock. Awakened all in home.

INTENSITY V: Alton, Bridgeville, Burnt Ranch, Fortuna, Hoopa, Loleta, Orick, Orleans, Pepperwood, Rio Dell, Scotia, South Fork, and Trinidad.

INTENSITY IV: Hayfork, Honeydew, Somesbar, and about 5 miles north of Arcata (1/10 mile east of U. S. Highway 101).

INTENSITY I TO III: Scott Valley, Smith River, and Weott.

December 31: 08:56:53*. Epicenter 37.6° north, 118.5° west, northern Owens Valley, P. Laws. V. Resembled a large blast. Loud earth noises heard. People, especially children, frightened. Everything rocked in all directions. Doors swung. Pendulum clock stopped. Motion rapid. Slight shock felt about 09:00. Felt by many (some outdoors) and frightened few at Bishop where building creaked slightly. Motion rapid. Also felt at Bigpine.

WASHINGTON AND OREGON

(120TH MERIDIAN OR PACIFIC STANDARD TIME)

February 1: 17:23. Reported felt at Canby, Oreg.

March 16: 07:56:09.* Epicenter 47.1° north, 121.8° west, S. The University of Washington reported the shock very likely originated in the Mud Mountain area of Mt. Rainier Felt over an area of approximately 3,000 square miles of western Washington, principally in King and Pierce counties. Maximum intensity V.

INTENSITY V:

Buckley.—Felt by and awakened many in community. Doors rattled; frame creaked. Motion rapid, one bump, like explosion.

Kapowsin.—Frightened few in community. Small objects shifted. Motion rapid.

Lester.—Felt by many in home and post office; awakened all in home. Rattled windows, doors, and dishes. Motion slow.

North Bend.—Awakened all in home. A rumble, then slight shaking of house. Motion rapid.

Palmer (Tacoma Headworks).—Felt by all and frightened few in community. Windows and dishes rattled; frame houses creaked. Trees, bushes shaken slightly. Quick, sharp shock.

Sumner.—Felt by many (some outdoors) and frightened few in community. Small objects shifted and knickknacks fell. Motion rapid.

INTENSITY IV: Carbonado, Carnation, Couger Mountain (east of Seattle, near Issaquah), Cumberland, Des Moines, Enumclaw, Fall City, Hobart, Kent, Orting, Parkland, Preston, and Snoqualmie.

INTENSITY I TO III: Kanaskat, Lake Burien, Lake City, Maple Valley, Maplewood, Mercer Island, Milton, Northgate, Olympia, Port Orchard, Puyallup, Ravensdale, Redmond (2 miles east of), Renton, Seahurst, Seattle, Tacoma, and East Tacoma.

April 22–26: Local tremors felt around Duwamish Valley in south end of Seattle at 15:00 on 22nd; 17:00 on 24th; 14:00 and 16:00 on 26th.

April 23: 11:19:26*. Epicenter 45.1° north, 122.9° west, northeast of Salem, Oreg., B. IV. Portland area. Slight shock was felt in scattered parts of the Portland area. Telephone calls came from the northeast, southeast, and northwest sections, and from Oregon City, West Linn, Clackamas Heights, and Gladstone. Some residents of the area said there was only one distinct jolt ac-

companied by a sound like two cars colliding. Wavelike motion felt by several at Salem. Water spilled from vase. Eight miles east of Salem a series of wavelike motions were felt.

May 4: 17:42:29*. Epicenter 47°19′ north, 122°25′ west, near Dash Point in Tacoma, S. V. Felt over approximately 1,500 square miles of northwestern Washington. A sharp, quick earthquake shook windows, dishes, and nerves in Tacoma, but did little other damage. Telephone operator at Tacoma said the shock seemed to lift her chair off the floor. Many calls received. Lakewood resident reported a china cabinet fell over, causing about $50 damage. Northend resident reported a cracked basement wall. College of Puget Sound at Tacoma reported 3 distinct shocks, with north-south motion. Felt with intensity IV at Dieringer, Dockton, Gig Harbor, Puyallup, Seattle, Sumner, and Sylvan. Also felt at Alderton, Burley, Dash Point, Des Moines, Fragaria, Milton, Palmer, Port Orchard, and Preston.

May 15: 05:02:13*. Epicenter 47°25′ north, 122°22′ west, Puget Sound, S. VI. Moderately strong shock felt over an area of approximately 17,000 square miles. (See map, page 52.) Damage negligible. Maximum intensity VI.

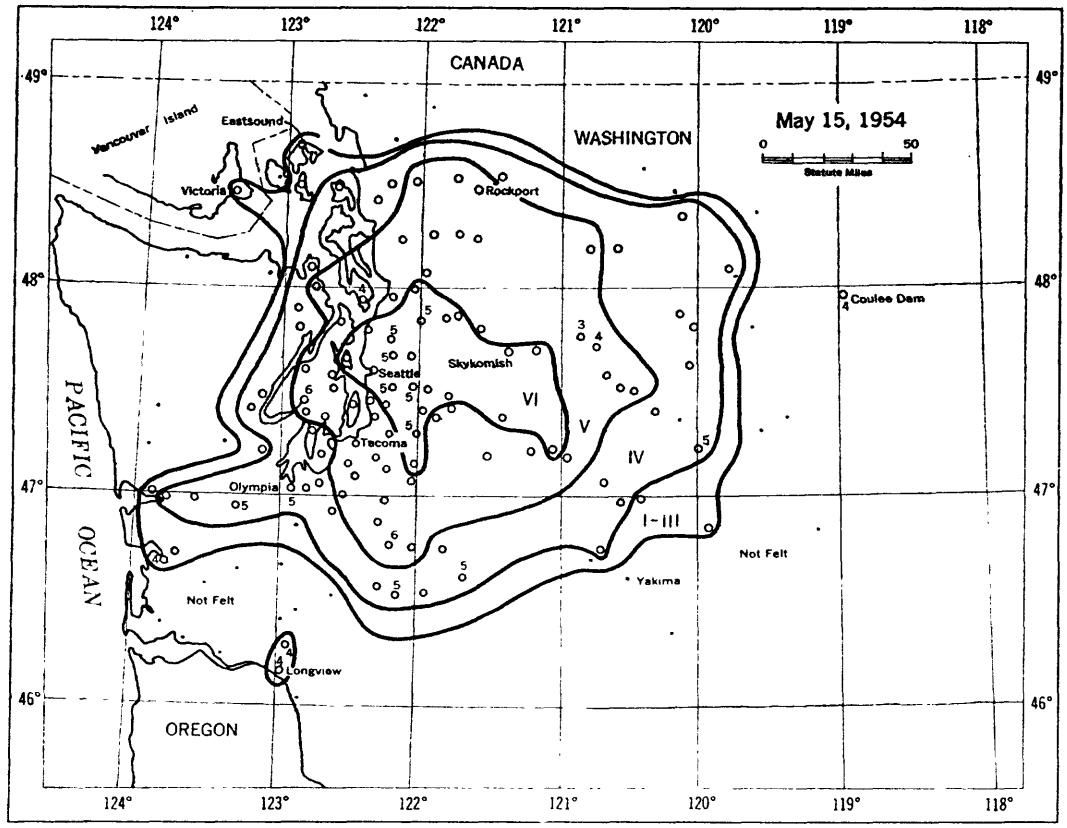

FIGURE 10.—Area affected by earthquake of May 15.

INTENSITY VI:

Belfair.—Felt by and awakened many in community. Trees, bushes shaken slightly. Small crack in concrete block building. Few felt a shock at 05:45. Motion slow.

Buckley.—Awakened all and frightened few in community. Windows and doors rattled. Motion slow.

Burton.—Felt by and awakened all in home. Windows, doors, and metal tables rattled. Small objects shifted and light, metal tables on casters rolled. Motion rapid.

Edmonds.—Awakened all in community. Dishes rattled. Vase overturned.

Elbe.—Felt by, awakened all, and frightened many in community. Small objects shifted; few small objects overturned. Motion rapid.

Hobart.—Felt by and awakened all in community; frightened few in home. Windows, doors, and dishes rattled; frame creaked. Motion slow.

Hyak.—Felt by all, awakened and frightened many in community. Small objects shifted and overturned. Motion rapid.

Lake Stevens.—Felt by, awakened many, and frightened few in community. Concrete retaining wall (built day before) cracked. Motion rapid.

Manchester.—Felt by many in home; awakened and frightened all. Windows, doors, and dishes rattled. Motion slow.

North Bend.—Awakened all and frightened few in community. Damage slight. Small objects shifted. Trees, bushes shaken slightly, Motion rapid.

Preston.—Felt by all, awakened most, and frightened many in community. Small objects shifted and overturned; knickknacks fell. Motion rapid.

Rollingbay.—Felt by and awakened all in community.

Ronald.—Awakened all in community. Frame creaked.

Scenic.—Awakened all and frightened few in community. Windows, doors, and dishes rattled. Motion slow.

Seattle.—Felt by and awakened many throughout Seattle, frightened some. Small plaster crack at 1419 E. 66th St. Windows, doors, and dishes rattled; buildings creaked. Hanging objects swung. Beds shook. Some thought motion rapid; others, slow.

Skykomish.—Awakened and frightened many in community. Damage slight. Small objects overturned; dishes broke. Motion rapid.

Startup.—Felt by, awakened all, and frightened many in community. Trees, bushes shaken strongly. Small objects and furnishings shifted. Observer ran outdoors and saw electric light pole swaying. Water in fish pool moved back and forth. Electric light wire between house and barn swayed as if shaken by strong wind. Change noticed in closing of door which was hard to close before shock. Sounded like rumbling freight train. Motion slow.

Sultan.—Felt by, awakened all, and frightened many in community. Windows, doors, and dishes rattled; house creaked. Trees, bushes shaken moderately. Motion slow.

Tukwila.—Awakened all and frightened many in community. Windows rattled; house creaked. Motion rapid, accompanied by loud noise.

Redmond (5 miles east of, Union Hill):—Felt by and awakened all in home. Trees, bushes shaken moderately. Books fell. Motion rapid.

INTENSITY V: Alderton, Algona, Allyn, Ashford, Auburn, Bellevue, Black Diamond, Bothell, Bremerton, Bryant, Burien, Carbonado, Cashmere, Cedar Falls, Cle Elum, Concrete, Cove, Darrington, Des Moines, Dieringer, Dockton, Dryden, Easton, Eatonville, Eglon, Everett, Fortson, Fort Steilacoom, Glenoma, Gold Bar, Granite Falls, Hadlock, Hansville, Harper, Holden, Houghton, Index, Issaquah, Kapowsin, Kennydale, Kenmore, Kent, Kirkland, Lakebay, Lakeview, Leavenworth, Lester, Lyman, Maple Valley, McMillin, Milton, Mirror Lake, Monroe, Olympia, Orillia, Orting, Oso, Packwood, Portage, Porter, Port Gamble, Port Ludlow, Port Orchard, Poulsbo, Puyallup, Restil, Richmond Beach, Rockport, Roslyn, Roy, Seabeck, Seabold, Seahurst, Selleck, Snoqualmie, Snoqualmie Falls, Southworth, Spanaway, Steilacoom, Sumner, Suquamish, Tacoma, Trinidad, Vashon, Wauna, Wilkeson, Woodinville, and Zenith.

INTENSITY IV: Aberdeen, Anacortes, Brewster, Burley, Carnation, Castle Rock, Chelan, Chimacum, Colby, Coulee Dam, Cumberland, Ellensburg, Enumclaw, Fragaria, Graham, Keyport, Kingston, Lacey, Lake Cushman (Hoodspor)t, Lakeside, Leland, Lilliwaup, Longmire, Longview, Lucerne, Maltby, Manson, Marblemount, Midway, Montesano, Morton, Mount Vernon, Nisqually, Olalla, Pacific, Port Blakely, Port Townsend, Possession Point (Whidbey Island), Quilcene, Randle, Ravensdale, Redondo, Sedro Woolley, Silverdale, Snohomish, South Bend, Sylvan, Thorp, Tracyton, Trout Lodge (Naches), Tumwater, Twisp, Vaughn, Vega (Anderson Island), Waterville, Wenatchee, Winslow, Winton, Yelm, and Yoman.

INTENSITY I TO III: Beverly, Dabob, Eastsound, Grapeview, Hoquiam, Kittitas, Lopez, Merritt (Leavenworth), Shelton, and South Prairie.

INTENSITY I TO III IN CANADA: Victoria, B. C.

May 23: 05:41:42*. Methow Valley, Wash. V. Felt by many at Twisp where terriffic roar was heard and house shook from roof down. Felt by and awakened many at Winthrop where house creaked and hanging objects swung. Sharp and brief, like heavy blast. Recorded by University of Washington seismograph.

June 18: 07:09:48*. Seattle, Wash. Feeble local shock felt by few in northend of Seattle. Recorded by University of Washington seismograph.

November 11: 14:15:12*. Epicenter approximately 125 miles distant. III. Felt by several in home at Raymond. It was also felt about halfway between Raymond and Aberdeen. Recorded weakly at Seattle.

ALASKA

(150TH MERIDIAN OR ALASKA STANDARD TIME)

January 6: 19:30. Valdez. Slight shock. Duration 1 second.

January 13: 18:04:07*. Valdez. Slight shock. Duration 2 seconds.

January 19: 18:43:41*. Kasilof. Slight shock.

January 20: 12:19:46*. Kasilof. Slight shock.

January 21: 08:56:47* and 08:58:43*. Circle Hot Springs. Slight shocks.

February 19: (no time given). Homer (5 miles northwest of). Slight shock.

March 3: 09:50. Cordova. Felt by several. Two shocks about 30 seconds apart. Onset abrupt. Horizontal swaying motion.

March 3: 10:46:07*. Epicenter 61½° north, 146½° west. Southern Alaska, W. Valdez. V. Felt by many in Valdez and Anchorage. In Valdez the press reported the earthquake tumbled stock from grocery shelves. The Weather Bureau Office in Anchorage reported movement of bookcases against the wall, and at the peak of the quake there seemed to be a rotating or a wobbling of the building which was enough to cause persons in the next room to take a precautionary step of standing in the doorway. Also felt by several at the Weather Bureau Airport Station five miles southwest of Anchorage.

March 3: (no time given). Moose Pass. Felt.

March 3: 11:05. Seward. Slight shock.

March 3: 22:57. Valdez. Slight shock. Duration 2 seconds.

March 28: 08:30. Shemya Air Force Base. Felt by many. Onset gradual. Motion trembling. Overhead lights swung; disturbed objects observed by many.

March 31: 02:13:56*. McKinley Park. Slight shock.

April 5: 18:56:45*, 20:32:48*, 20:38:52*. Anchorage (5 miles southwest of). Felt by several at the Weather Bureau Airport Station. Swaying motion in north-south direction. Buildings creaked; loose objects rattled.

April 17: 10:10:37*. Epicenter 51½° north, 179° west, Andreanof Islands, Aleutian Islands, W. Felt on Adak. Duration 30 seconds.

April 23: 16:40:36*. Fairbanks. Felt by several. Abrupt onset. Swinging objects observed. Felt at College.

April 23: 22:33:04*. Epicenter 63° north, 148° west. Southern Alaska. Felt at College. Depth about 100 km.

April 23: 22:45. Valdez. Duration 2 seconds.

April 28: 19:15 and 19:45. Teller. Slight shocks.

May 10: 14:25:11*. Caswell. Slight shock.

May 12: 07:46:45*. Homer (5 miles northwest of). Felt.

May 16: 02:00. St. George Island. Awakened many in community. Windows, doors and dishes rattled. Trees and bushes shaken moderately.

June 24: 04:19. (a. m. or p. m.). Manley Hot Springs. Slight shock.

June 27: 09:00. Teller. Slight shock.

July 3: 03:24:03*. Anchorage (5 miles southwest of). Felt by several. Onset gradual, then abrupt. Trembling motion. Buildings creaked; loose objects rattled.

July 30: 12:05. Valdez. Slight shock. Duration 2 seconds.

August 17: 07:28:51*. Homer (5 miles northwest of). Slight shock.

August 23: 04:57:34*. Epicenter 61° north, 148½° west, Kenai Peninsula, W. Felt by and awakened many in Anchorage. Few alarmed. Motion first trembling, then rocking and swaying. (A few long power lines broken). Felt at Homer (5 miles northwest of), Kasilof, Naptowne, Seward, Valdez, and Whittier.

October 3: 01:18:46*. Epicenter 60½° north, 151° west, Kenai Peninsula, W. VIII. A sharp earthquake rocked a 1,000 square mile area of the lower Alaska mainland. Concrete walls cracked; plaster showered down; plate glass windows shattered; merchandise toppled from shelves at Anchorage, Homer, Kenai, Seward, Sterling, and Valdez. Minor landslides spilled down on the Seward-Anchorage highway. More than 140 feet of railroad tracks were knocked out of commission just north of Potter. Residents of top floors in Anchorage's two 14-story apartment "skyscrapers" fled into the streets when the violent rocking broke water connections. At the Denali Theater, where a midnight show was in progress, some 850 patrons rushed toward the exists, climbing over seats in a frenzy to escape. Three persons were reported injured slightly in the rush. Motorists driving cars at the time of the quake said it felt "like moving along on a flat tire." It was also felt at Cordova, Eklutna, Fairbanks, Kasilof, Kodiak, Latouche, Mantanuska Agricultural Experiment Station, Moose

Pass (severe enough to shake things from the shelves), Palmer, Puntilla, and Yakutat. Five aftershocks of a few seconds duration followed the main quake at 02:43, 05:21, 05:34, 06:18, and 07:26.

October 4: 10:12:36*. Kenai. Slight shock.

October 10: 01:59:59*, 09:55, 10:31. Kenai. Slight shocks.

October 22: 02:54:22*. Kenai. Slight shock.

November 3: 02:30. Palmer. Felt by several and frightened few. Hanging objects swung. Duration 15 seconds.

November 15: (no time given). Unalaska. Felt by several. Hanging objects swung.

November 16: (no time given). Unalaska. Felt by few and awakened one.

November 20: 17:37:15*. Circle Hot Springs. Felt. Duration 15 seconds.

November 26: 14:04:14*. Valdez. Felt. Duration 5 seconds.

November 28: 04:52. Valdez. Felt. Duration 1 minute.

December 2: 09:02. Valdez. Slight shock. Duration 2 seconds.

December 10: 06:31:46*. Whittier and Eklutna Lake. Slight shock. Felt at the Weather Bureau Airport station five miles southwest of Anchorage. Duration 10 seconds.

December 10: 7:13. Teller. Felt.

December 13: 13:09:42. Whittier. Felt.

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 Geological Survey. "Felt locally" appearing in the summary means in the vicinity of the observatory. For additional information see the Volcano Letter, Nos. 523–526.

January 17: 02:27. Tremor. Felt in Kalihiki, Kona. Origin Kona.

January 20: 21:39. Feeble. Felt in Papaloa, Kona; Hawaii National Park; and Kukuihaele, North Hamakua. Origin under Red Hill on the northeast rift of Mauna Loa.

January 24: 04:36. Slight. Felt in Hilo. Origin under Alae crater on the east rift of Kilauea.

January 31: 11:48. Slight. Felt in Hilo. Origin east rift of Kilauea, about 6 miles from the Observatory.

February 6: 15:59. Tremor. Felt in Kalihiki, Kona. Origin Kona.

February 16: 03:15. Felt in Captain Cook. Origin Kona.

February 22: 17:32. Felt in Kalihiki, Kona. Origin Kona.

March 30: 06:40:03* and 08:41:54*. Epicenter 20° north, 155° west, between the east rift of Kilauea and the sea near Kalapana, W. Strong. Magnitudes 6 and 6½. Both earthquakes were felt over the entire island of Hawaii, and at least the second, which was the larger of the two, was felt on parts of Maui. Extensive, but mostly moderate, damage was caused in the Hilo and Puna districts. In the Puna district, where the shaking was more intense, water tanks were thrown down and stone fences damaged. In the Hilo district the schools were evacuated. At one school 54 windows were smashed. Walls cracked, floors buckled, pillars were knocked askew. Short circuits cut off power to some residential areas. In a rickety county building books tumbled from shelves and plaster rained from the ceiling. Huge dust clouds rose from inside Kilauea Volcano as landslides poured down the almost perpendicular cone. A long crack opened up under the lookout position at Halemaumau, Hawaii's "drive-in volcano", where cars normally park on the rim to watch the fiery display. Several smaller aftershocks were felt in Puna and Hilo on March 30 and 31.

March 30: 11:19. Strong. Felt in Hawaii National Park. Origin Kilauea caldera.

April 1: 06:34:49. Strong. Felt in Hawaii National Park. Origin Kilauea caldera.

April 1: 15:56:42. Slight. Felt in Puna. Origin East Puna.

April 15: 06:27:50. Slight. Felt in Hawaii National Park. Origin Kilauea caldera.

April 15: 07:01:11. Slight. Felt in Hawaii National Park. Origin Kilauea caldera.

April 15: 07:15:00. Strong. Felt in Hawaii National Park. Origin Kilauea caldera.

April 22: 14:31:54. Slight. Felt in Hawaii National Park. Origin Kilauea caldera.

May 18: 16:56:48. Very feeble. Felt strongly in Kealakekua and Captain Cook, Kona. Origin Kona.

May 31: 03:50:44. Moderate. Felt in Hawaii National Park. Origin Kilauea caldera.

May 31: 03:54:05. Strong. Felt in Hawaii National Park. Origin Kilauea caldera just east of Halemaumau.

June 1: 20:42:53. Very feeble. Felt strongly in Kona. Origin Kona.

June 18: 03:00:03. Very feeble. Approximately under the Mauna Loa seismograph station. This is one of the largest of a series of more than 100 quakes on June 18, 19, 20, and 21. Many of these quakes were felt at Umikoa on the northeast flank of Mauna Kea, and several were felt at Kamuela and Hilo.

July 1: 09:06. Feeble. Felt in Hawaii National Park. Origin Kilauea caldera.

July 3: 11:52:33*. Epicenter 20½° north, 155½° west, east rift of Kilauea under the Alae Crater, W. Strong. Felt quite generally over the southern half of the island of Hawaii. Minor damage at Hilo.

July 25: 18:17:55. Slight. Felt in Hawaii National Park. Origin near Mauna Loa seismograph station.

July 26: 00:51:44. Slight. Felt in Hawaii National Park and central Kona. Origin Kaoiki fault west of the Observatory.

August 1: 23:27:48. Felt in central Kona. Origin central Kona.

August 2: 13:40:33. Strong. Felt in Volcano area. Origin under Alae Crater on the east rift of Kilauea.

August 7: 14:26:17. Strong. Felt generally over central Hawaii. Origin under Kilauea caldera.

August 30: 23:17:04. Moderate. Felt in Volcano area. Origin under Makaopuhi Crater.

September 1: 15:17:49. Felt in central Kona. Origin central Kona.

September 13: 02:42:53. Feeble. Felt in Hilo. Origin 5 km. east of Puu Kapukapu along south coast of Kilauea.

October 5: 12:23:54. Very feeble. Felt in Hawaii National Park. Origin northeast rift of Mauna Loa near Puu Ulaula.

October 7: 20:56:25. Moderate. Felt in Kalahiki, Captain Cook, and Hawaii National Park. Origin southeast flank of Mauna Loa about 20 km. north of Naalehu.

October 11: 06:26:33. Strong. Felt in Kalahiki, Captain Cook, Kamuela, Hawaii National Park, Hilo, and Honokokau. Origin west shore of Mauna Loa near Hookena.

November 6: 16:04:36. Moderate. Felt in Hawaii National Park. Origin near Kilauea caldera.

November 19: 10:55:34. Feeble. Felt strongly in Kamuela. Origin 15 km. southeast of Kamuela.

November 20: 15:02:51. Very feeble. Felt in Kamuela. Ten km. west of Pohakuloa.

November 26: 11:34:05. Feeble. Felt in Hawaii National Park. Origin east rift of Kilauea near Kilauea caldera.

December 4: 14:29:36. Slight. Felt in Hilo and Pahala. Origin Hilina Pali.

December 5: 20:59:15. Tremor. Felt in Captain Cook and Pahala. Origin in the vicinity of Kilauea caldera. This is the largest of a swarm of more than 200 small earthquakes originating at about the same place on December 4 and 5.

December 6: 19:15. Felt in Captain Cook.

December 14: 22:25:52. Moderate. Felt in the Volcano area. Origin Kilauea caldera.

December 23: 12:45:54. Moderate. Felt at Kamuela and Hawi. Origin near Kamuela.

December 28: 08:49:17. Feeble. Felt in the Volcano area. Origin Kaoiki fault near Halfway House.

PANAMA CANAL ZONE

(60TH MERIDIAN TIME)

March 15: 22:28:57. Intensity III at Balboa Heights.

April 10: 06:15:46*. Epicenter 10½° north, 78° west, off north coast of Panama, W. Intensity IV at Balboa Heights.

April 22: 21:20. The SS Horace Irving in latitude 8°12.5′ north, and 83°29′ west, reported violent tremors for about 5 seconds.

June 12: 13:40:54. Intensity II at Balboa Heights.

August 23: 07:24:53. Felt strong by at Puerto Armuelles.

August 23: 08:04:30*. Epicenter 8° north, 83° west, near coast of Panama, W. Felt strongly at Puerto Armuelles.

August 23: 10:35:31. Near coast of Panama. Felt strongly at Puerto Armuelles.

December 8: 10:06:32. Intensity III at Balboa Heights.

December 19: 05:56:50. El Volcan and Chiriqui, Panama. Felt.

PUERTO RICO

(60TH MERIDIAN TIME)

No earthquakes were reported in Puerto Rico during the year 1954.

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 1954.

The adjustment of the triangulation network extending from Newport Beach to Riverside, California, was completed. This project included networks observed in 1929, 1934, and 1953. A study of the shifts in position indicated by the results of these three surveys did not indicate any major systematic movement in the area. There are indications of minor displacements which may have resulted from seismic activity, or could have been the result of local disturbances due to construction, settling, etc.

Considerable progress was made in the reobservation of the network of triangulation over Imperial Valley. This project was completed in 1955. A preliminary review of the results of this resurvey shows the systematic creeping movement and displacement between the two sides of the San Andreas Fault.

After the earthquake of December 16, 1954, centered in the area east of Fallon, Nevada, plans were made to reobserve the triangulation and relevel the existing level lines in that area. An arc of triangulation, extending from Fallon to Ely, Nevada, and across the fault lines, had been completed just a few months before the earthquake. This coincidence offers the opportunity for accurate measurements of the horizontal and vertical displacement which occurred at the time of the earthquake.

TIDAL DISTURBANCES OF SEISMIC ORIGIN

No seismic seawaves were recorded during the calendar year 1954.

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 Coast and Geodetic Survey or from registers of seismographic stations nearest the locality.

Similar data for 1943 were published by the 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, 762, 773, and 785, United States Earthquakes, 1950, 1951, 1952, and 1953, respectively. Descriptions of wells given here include only those that have not appeared in previous editions.

WELL DESCRIPTIONS

ALABAMA

Well No. Col—1, semiartesian, Muscle Shoals, NE¼NW¼NW¼ Sec. 30, T. 3 S., R. 10 W. Owner, U. S. Army, Corps of Engineers. Depth, 265 feet; diameter, 8 inches; finish unknown. Aquifer, Tuscumbia limestone of Mississippian age.

ARIZONA

Well No. (D—23—22)33dcb, nonartesian, Cochise County, 31°23′ N., 110°07′ W., SE¼SW¼-SE¼ Sec. 33, T. 23 S., R. 22 E. Owner, United States Government. Depth, 91 feet; diameter, 10 and 8 inches; finish, 30–90 feet perforated casing. Aquifer, Quaternary alluvium.

CALIFORNIA

Well No. 3/8—29C1, semi-confined, San Bernardino County, Sec. 29, T. 3 N., R. 8 E. Owner, U. S. Navy. Depth, 800 feet; diameter, 10 inches; finish, perforated with Mills knife at intervals from 500 to 684 feet. Aquifer, late Tertiary to Quaternary alluvial deposits.

Well No. 2/7—4H1, semi-confined, San Bernardino County, Sec. 4, T. 2 N., R. 7 E., SBB and M. Owner, U. S. Navy. Depth, 500 feet; diameter, 10 inches; finish, perforated with Mills knife at intervals from 300 to 420 feet. Aquifer, late Tertiary to Quaternary alluvial deposits.

Well No. 2/7—2C1, semi-confined, San Bernardino County, Sec. 2, T. 2 N., R. 7 E., SBB and M. Owner, U. S. Navy. Depth, 400 feet; diameter, 10 inches; finish, perforated with Mills knife at intervals from 149 to 377 feet. Aquifer, late Tertiary to Quaternary alluvial deposits.

Well No. 26/40—22N1, semi-confined, Kern County, T. 26 S., R. 40 E., MDB and M. Owner, U. S. Navy. Depth, 203 feet; diameter, 12 inches; finish, unknown. Aquifer, Quaternary lacustrine deposits.

Well No. 13/13—15R1, artesian, Fresno County, Sec. 15, T. 13 S., R. 13 E., MDB and M. Owner, Hotchkiss well No. 32. Depth, deeper than 500 feet; diameter, 16 inches; finish, unknown. Aquifer, lower water-bearing zone; Recent Pleistocene and alluvium.

Well No. 6/33—8H4, nonartesian, near Lompoc, Sec. 8, T. 6 N., R. 33 W. Owner, U. S. Geological Survey. Depth, 43 feet; diameter, 4 inches; finish, open end. Aquifer, Quaternary alluvium.

Well No. 26/40—22P1, confined, Kern County, SE¼SW¼, Sec. 22, T. 27 S., R. 40 E., MDB. Owner, Inyokern Naval Ordnance. Depth, 850 feet; diameter, 8 inches; finish, perforated. Aquifer, Pleistocene alluvium under thick clay bed.

Well No. 27/40—10B1, nonartesian, Kern County, NW¼NE¼, Sec. 10, T. 27 S., R. 40 E., MDB. Owner, C. H. Bradley. Depth, 171 feet; diameter, 20 inches; finish, unknown. Aquifer, Quaternary alluvium.

Well No. 4/25—27Q2, artesian, near Carpinteria, Sec. 27, T. 4 N., R. 25 W. Owner, Mr. Free. Depth, 198 feet; diameter, 10 inches; finish, open end. Aquifer, probably Casitas formation of Pleistocene age.

Well No. 7/34—12E1, nonartesian, near Lompoc, Sec. 12, T. 7 N., R. 34 W. Owner, U. S. Geological Survey. Depth, 385 feet; diameter, 8 and 6 inches; finish, gravel bottom. Aquifer, Careaga-sand, upper Pliocene.

Well No. 18/18—31P1, nonartesian, Fresno County, SESW, Sec. 31, T. 18 S., R. 18 E., MDB and M. Owner, Calflax. Depth, 1,977 feet; diameter, 16 inches; finish, 380 to 1,977 perforated casing. Aquifer, upper water-bearing zone; Recent Pleistocene and alluvium.

IDAHO

Well No. 6N—33E—26dd1, nonartesian, Jefferson County, 43°10′ N., 112°30′ W. Owner, U. S. Geological Survey. Depth, 312 feet; diameter, 6¼ inches; finish, perforated 20 feet. Aquifer, Snake River basalt of Pliocene to Recent age.

Well No. 4S—32E—12dd1, nonartesian, Bingham County, 43°05′ N., 112°40′ W. Owner, Robert Hoglan. Depth, 39 feet; diameter, 4 inches; finish, unknown. Aquifer, Snake River basalt.

Well No. 6S—33E—20ab1, artesian (?), Power County, 42°53′ N., 112°41′ W. Owner, Edna LaVatta Kutch. Depth, 151 feet; diameter, 4¾ inches; finish, unknown. Aquifer, gravel and sand of unknown age.

Well No. 2S—20E—1db1, artesian, Blaine County, 43°17′ N., 114°01′ W. Owner, R. N. Leazonby. Depth, 194 feet; diameter, 8 inches; finish, open end. Aquifer, Quaternary alluvium.

Well No. 1S—20E—27bd1, artesian, Blaine County, 43°23′ N., 114°04′ W. Owner, Blaine County. Depth, 140 feet; diameter, 6 inches; finish, open end. Aquifer, Snake River basalt.

Well No. 2N—18E—9ab1, nonartesian, Blaine County, 43°31′ N., 114°19′ W. Owner, City of Hailey. Depth, 90 feet; diameter, 18 inches; finish, unknown. Aquifer, fluvioglacial material, Quaternary.

Well No. 6N—31E—13db1, nonartesian, Butte County, 43°51′ N., 112°44′ W. Owner, U. S. Geological Survey. Depth, 326 feet; diameter, 8¼ inches; finish, perforated casing 55 feet. Aquifer, Snake River basalt.

Well No. 1N—18E—1da1, artesian, Blaine County, near Bellevue, 43°26′ N., 114°16′ W. Owner, U. S. Bureau of Reclamation. Depth, 84 feet; diameter, 6 inches; finish, perforated casing 6 feet. Aquifer, Quaternary sand and gravel.

Well No. 1N—19E—31ca2, artesian, Blaine County, near Gannett, 43°20′ N., 115°15′ W. Owner, U. S. Bureau of Reclamation. Depth 75 feet; diameter, 6 inches; finish, perforated casing 25 feet. Aquifer, Quaternary sand and gravel.

Well No. 1S—19E—3cc2, artesian, Blaine County, near Gannett, 43°19′ N., 114°11′ W. Owner, U. S. Bureau of Reclamation. Depth, 51 feet; diameter, 6 inches; finish, perforated casing. Aquifer, Quaternary sand and gravel.

Well No. 1S—19E—11bb1, artesian, Blaine County, near Gannett, 43°19′ N., 114°10′ W. Owner, U. S. Bureau of Reclamation. Depth, 87 feet; diameter, 16 inches; finish, perforated casing 40 feet. Aquifer, Quaternary sand and gravel.

Well No. 3N—1E—8ca1, nonartesian, Ada County, near Boise, 43°36′ N., 116°21′ W. Owner, Nampa Meridian Irrigation District. Depth, reported 72 feet and measured 43 feet; diameter, 18 inches; finish, unknown. Aquifer, late terrace gravel of Pleistocene age.

Well No. 7N—31E—34bd1, nonartesian, Butte County, near Howe, 43°55′ N., 112°43′ W. Owner, U. S. Geological Survey. Depth, 320 feet; diameter, 6¼ inches; finish, perforated casing from 285 feet. Aquifer, Snake River basalt.

NEW JERSEY

Well No. 31.34.2.4.5, artesian, Ancora, 39°41′03″ N., 74°51′32″ W. Owner, State of New Jersey. Depth, 450 feet; diameter 10 and 8 inches; finish, unknown. Aquifer, Kirkwood formation of Miocene age.

Well No. 31.1.3.9.9, artesian, Pettys Island, Camden, 39°58′03″ N., 75°06′05″ W. Owner, Cities Service Oil Co. Depth, 143 feet, diameter, 8 inches; finish, unknown. Aquifer, Brunswick shale of late Triassic age.

Well No. 26.22.4.5.8, semiartesian, North Elizabeth, 40°41′48″ N., 74°13′02″ W. Owner, Elizabethtown Water Co. Depth, about 200 feet; diameter, 6 inches; finish, unknown. Aquifer, Brunswick shale.

Well No. 30.14.8.3.1, artesian, Gibbstown, 39°49′48″ N., 75°16′42″ W. Owner, Hercules Powder Co. Depth, about 100 feet; diameter, 6 inches; finish, unknown. Aquifer, Raritan formation of late Cretaceous age.

Well No. 30.22.9.7.3, nonartesian, Penns Grove, 39°42′32″ N., 75°27′20″ W. Owner, State of New Jersey. Depth, 51 feet; diameter, 6 inches; finish, 5½-inch screen 46 to 51 feet. Aquifer, Magothy and Raritan formations of late Cretaceous age.

Well No. 31.11.5.2.1, artesian, Westville, 39°51′52″ N., 75°09′10″ W. Owner, Texas Co. Depth, 327 feet; diameter, 8 inches to 150 feet, and 4 inches to 327 feet; finish, 4-inch screen 288 to 298 feet, #5 opening. Aquifer, Magothy and Raritan formations.

Well No. 31.11.5.1.1, artesian, Westville, 39°51′52″ N., 75°09′50″ W. Owner, Texas Co. Depth, about 300 feet; diameter, 6 inches; finish, 3-inch Cook screen, #040. Aquifer, Magothy and Raritan formations.

Well No. 26.21.5.4.5, artesian, Michigan Avenue, Kenilworth, 40°41′02″ N., 74°17′45″ W. Owner, Plainfield-Union Water Co. Depth, 190 feet; diameter, 6 inches; finish, steel casing. Aquifer, Brunswick shale.

OKLAHOMA

Well No. Seminole No. 1, artesian, SW¼NW¼NW¼, Sec. 17, T. 9 N., R. 6 E. Owner, Skelley Gas Corp. Depth, 496 feet; diameter, 8 inches; finish, open hole. Aquifer, Vamoosa formation of Pennsylvanian age.

UTAH

Well No. (B–5–1)27dc–1, artesian, near Ogden, SW¼SE¼, Sec. 27, T. 5 N., R. 1 W. Owner, U. S. Bureau of Reclamation. Depth, 350 feet; diameter, 8 inches; finish, perforated 315 to 335 feet. Aquifer, gravel.

Well No. (B–5–1)27dc–2, artesian, near Ogden, SW¼SE¼, Sec. 27, T. 5 N., R. 1 W. Owner, U. S. Bureau of Reclamation. Depth, 115 feet; diameter, 8 inches; finish, perforated 75 to 90 feet. Aquifer, sand.

Well No. (B–6–1)29ccc–1, artesian, Ogden, SW¼SW¼SW¼, Sec. 29, T. 6 N., R. 1 W. Owner, Ogden and Utah Railway and Depot Co. Depth, 755 feet; diameter, 12 inches; finish, 12-inch casing to 755 feet, perforated 572–606, 649–666, and 674–687 feet. Aquifer, Pleistocene sand and gravel.

Well No. (B–6–2)35bcc–1, artesian, near west Ogden, SW¼SW¼SW¼, Sec. 35, T. 6 N., R. 2 W., SLBM. Owner, George Lowe. Depth, 283 feet; diameter, 1½ inches; finish 1½-inch casing to 283 feet. Aquifer, Pleistocene sand and gravel.

TABLE 1.—*Fluctuations in well-water levels, January 1 through December 31, 1954*

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 Coast and Geodetic Survey, or from registers of seismographic stations nearest the locality.

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.*
ALABAMA							
Col-1	4-29-54	03:00	9.14	9.14	9.15	9.13	0.02
ARIZONA							
(D-13-24)16bbb	12-16-54	11:07	63.35	63.28	63.28	63.38	0.10
(D-13-29)18bac	12-16-54	11:07	88.22	88.22	88.18	88.26	.08
(D-24-15)18ab	12-16-54	11:07	6.73	6.73	6.70	6.76	.06
(D-23-22)33dcb	12-16-54	11:07	13.48	13.48	13.44	13.54	.10
CALIFORNIA							
3/8-29C1	2-1-54	04:00	87.81	87.80	+87.81	−87.81	0.01
2/7-2C1	2-1-54	04:30	28.14	28.15	28.14	28.15	.01
2/7-2C1	3-19-54	02:00	28.50	28.49	28.45	28.54	.10
2/7-4H1	3-19-54	10:00	188.76	188.76	188.73	188.78	.05
3/8-29C1	3-19-54	10:00	87.81	87.80	87.79	87.82	.03
26/40-22N1	3-19-54	09:00	73.37	73.37	73.37	73.38	.01
20/15-32A1	4-15-54	13:00	179.03	179.01	178.97	179.04	.07
19/18-27N1	4-15-54	16:00	82.93	82.93	82.93	82.94	.01
20/15-32A1	4-16-54	20:00	179.01	179.02	179.00	179.08	.08
20/15-32A1	4-20-54	14:00	179.14	179.14	179.14	179.15	.01
20/15-32A1	4-25-54	16:00	179.21	179.21	179.20	179.21	.01
13/13-15R1	4-26-54	07:00	281.45	281.16	280.85	281.45	.60
15/16-20R1	4-26-54	19:00	70.15	70.15	70.10	70.15	.05
15/16-34E1	4-29-54	10:00	152.55	152.55	152.52	152.60	.08
15/16-20R1	4-29-54	10:30	69.50	69.50	69.41	69.58	.17
13/13-5R1	5-2-54	15:00	278.15	278.15	278.15	278.45	.30
13/13-5R1	5-9-54	11:00	264.05	263.85	263.75	264.05	.30
15/16-34E1	6-17-54	23:00	148.80	148.86	148.80	148.88	.08
2/7-2C1	7-6-54	11:00	26.97	26.97	26.94	27.00	.06
2/7-4H1	7-6-54	11:00	188.85	188.85	188.84	188.85	.01
26/40-22N1	7-6-54	11:00	76.37	76.37	76.36	76.38	.02
26/40-22P1	7-6-54	11:00	64.40	64.40	64.38	64.42	.04
27/40-10B1	7-6-54	11:00	104.15	104.15	104.12	104.17	.05
6/30-29E1	8-10-54	00:45	20.22	20.23	20.12	20.38	.26
27/40-10B1	8-10-54	22:00	104.94	104.93	104.91	105.00	.09
6/33-8H4	8-18-54	16:30	25.43	25.46	25.42	25.54	.12
2/7-2C1	8-24-54	06:00	28.31	28.31	28.26	28.37	.11
2/7-4H1	8-24-54	06:00	188.91	188.92	188.90	188.93	.03
18/18-31P1	10-1-54	11:00	191.85	191.85	191.83	191.87	.04
18/18-31P1	10-6-54	13:00	192.21	192.21	192.18	192.23	.05
18/18-31P1	10-9-54	05:00	192.44	192.44	192.40	192.50	.10
18/18-31P1	10-16-54	02:00	192.41	192.41	192.37	192.45	.08
2/7-2C1	10-17-54	----------	29.82	29.82	29.81	29.84	.03
26/40-22P1	10-17-54	----------	64.73	64.73	64.72	64.73	.01
27/40-10B1	10-17-54	----------	105.86	105.88	105.80	106.11	.31
18/18-31P1	10-17-54	21:00	192.47	192.47	192.46	192.47	.01
20/15-32A1	11-8-54	00:00	182.50	182.50	182.46	182.56	.10
2/7-2C1	11-12-54	----------	29.48	29.48	29.47	29.50	.03
27/40-10B1	11-12-54	----------	106.05	106.04	105.95	106.36	.41
20/15-32A1	11-16-54	08:00	182.88	182.89	182.77	183.01	.24
2/7-2C1	11-25-54	----------	29.36	29.35	29.34	29.36	.02
2/7-4H1	11-25-54	----------	188.95	188.95	188.95	188.95	.00
3/8-29C1	11-25-54	----------	88.01	88.01	88.01	88.01	.00
26/40-22P1	11-25-54	----------	64.77	64.76	64.76	64.78	.02
18/18-31P1	11-25-54	08:00	185.15	185.15	185.13	185.16	.03
18/18-31P1	12-16-54	07:00	181.77	181.74	181.62	182.10	.48
7/34-12E1	12-16-54	03:00	302.25	302.26	302.21	302.30	.09
4/25-27Q2	12-16-54	03:00	147.43	147.50	147.43	147.56	.13

Footnotes at end of table.

TABLE 1.—*Fluctuations in well-water levels, January 1 through December 31, 1954*—Con.

CALIFORNIA—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.*
15/16-34E1	12-16-54	10:00	149.60	149.60	149.22	149.94	0.72
2/7-2C1	12-16-54		30.08	30.07	29.80	30.29	.49
2/7-4H1	12-16-54		189.01	189.02	188.95	189.09	.14
3/8-29C1	12-16-54		87.92	87.92	87.84	88.00	.16
26/40-22N1	12-16-54		74.26	74.24	74.23	74.28	.05
26/40-22P1	12-16-54		64.84	64.84	64.70	64.85	.15
13/13-15R1	12-18-54	19:00	250.78	250.74	250.73	251.33	.60
18/18-31P1	12-21-54	17:00	180.60	180.60	180.58	180.64	.06
15/16-34E1	12-21-54	19:00	148.96	148.96	148.92	149.01	.09
2/7-2C1	12-21-54		30.08	30.07	30.03	30.09	.06
26/40-22P1	12-21-54		64.89	64.89	64.88	64.90	.02
18/18-31P1	12-23-54	01:00	180.25	180.25	180.20	180.31	.11
NORTHERN FLORIDA							
L7	2-5-54	16:00	164.45	164.45	164.43	164.47	0.04
D206	2-19-54	20:30	6.71	6.69	6.68	6.72	.04
H500	2-19-54	20:30	50.60	50.58	50.57	50.61	.04
M92	2-19-54	21:00	40.44	40.43	40.42	40.44	.02
P45	2-19-54	21:10	66.25	66.28	66.23	66.28	.05
J23	2-19-54	22:00	36.47	36.47	36.46	36.48	.02
D206	8-24-54	06:00	11.60	11.58	11.55	11.63	.08
H30	8-24-54	06:00	+7.79	+7.76	+7.80	+7.75	.05
P45	8-24-54	06:00	67.43	67.41	67.39	67.44	.05
T35	8-24-54	06:00	14.10	14.12	14.03	14.23	.20
J23	8-24-54	06:10	38.98	38.95	38.92	38.98	.06
M92	8-24-54	06:10	39.76	39.73	39.71	39.78	.07
M450	8-24-54	06:20	1.99	1.98	1.94	2.01	.07
O47	8-24-54	06:40	3.08	3.07	3.06	3.09	.03
O47	10-3-54	11:20	3.85	3.85	3.85	3.86	.01
M92	10-3-54	11:45	39.28	39.30	39.28	39.30	.02
H500	10-3-54	12:00	49.23	49.25	49.23	49.25	.02
D206	10-3-54	12:00	10.60	10.62	10.60	10.63	.03
T35	10-17-54	23:30	20.90	20.91	20.84	20.96	.12
H500	11-25-54	10:30	50.10	50.07	50.07	50.10	.03
M46	11-25-54	10:50	+17.43	+17.43	+17.44	+17.42	.02
H30	11-25-54	10:55	+9.00	+9.00	+9.01	+8.99	.02
L7	11-25-54	11:00	168.41	168.41	168.38	168.44	.06
P246	11-25-54	11:05	26.23	26.25	26.23	26.25	.02
O47	11-25-54	11:05	4.34	4.35	4.34	4.36	.02
M92	11-25-54	11:20	40.60	40.60	40.58	40.62	.04
D206	11-25-54	11:20	10.07	10.07	10.06	10.08	.02
T35	11-25-54	11:30	22.77	22.76	22.68	22.79	.11
H30	12-16-54	09:50	+8.59	+8.57	+8.71	+8.44	.27
H500	12-16-54	09:50	50.42	50.44	50.22	50.62	.40
M450	12-16-54	10:00	2.30	2.34	2.15	2.57	.42
P13	12-16-54	10:30	9.41	9.49	9.40	9.53	.13
S9	12-16-54	10:30	1.54	1.55	1.48	1.61	.13
J23	12-16-54	10:50	42.63	42.62	42.54	42.70	.16
D206	2-20-54	00:50	6.68	6.69	6.67	6.70	.03
P45	2-20-54	00:50	66.15	66.17	66.14	66.19	.05
M92	2-20-54	01:00	40.37	40.38	40.36	40.39	.03
T35	4-5-54	18:20	5.11	5.10	5.07	5.12	.05
T35	4-7-54	04:00	5.05	5.03	5.00	5.07	.07
T35	4-25-54	01:30	3.58	3.57	3.54	3.59	.05
H500	4-29-54	11:00	51.76	51.77	51.75	51.79	.04
O47	4-29-54	11:00	4.08	4.09	4.07	4.11	.04
P45	4-29 54	11:20	69.22	69.23	69.18	69.28	.10
T35	4 29-54	11:20	3.93	3.95	3.86	4.04	.18
D206	4-29-54	11:30	8.50	8.52	8.47	8.55	.08
P16	4-29-54	11:50	64.89	64.90	64.88	64.90	.02
O47	4-29-54	12:00	4.10	4.11	4.09	4.12	.03

Footnotes at end of table.

TABLE 1.—*Fluctuations in well-water levels, January 1 through December 31, 1954*—Con.

NORTHERN FLORIDA—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.*
T35	4-29-54	12:00	3.95	3.95	3.74	4.16	0.42
H500	4-29-54	12:10	51.77	51.79	51.76	51.81	.05
J23	4-29-54	12:15	37.10	37.13	37.07	37.17	.10
D206	4-29-54	12:15	8.53	8.55	8.50	8.58	.08
P45	4-29-54	12:20	69.23	69.25	69.20	69.28	.08
J23	4-29-54	12:50	37.12	37.12	37.05	37.18	.13
P16	4-29-54	12:50	64.90	64.91	64.89	64.92	.03
T35	5-5-54	13:30	10.50	10.49	10.46	10.53	.07
J23	5-5-54	13:45	37.27	37.27	37.24	37.29	.05
H500	5-11-54	05:30	51.54	51.53	51.52	51.55	.03
D206	5-13-54	16:00	9.30	9.29	9.25	9.31	.06
T35	7-6-54	11:30	18.10	18.10	18.06	18.12	.06
O47	12-16-54	10:55	5.04	5.05	4.95	5.13	.18
P16	12-16-54	11:00	67.48	67.49	67.45	67.53	.08
G30	12-16-54	11:00	7.98	7.97	7.95	8.00	.05
E74	12-16-54	11:20	84.28	84.29	84.27	84.30	.03
D206	12-16-54	11:30	10.33	10.36	10.25	10.46	.21
T35	12-16-54	11:45	18.85	18.91	18.50	19.30	.80
L7	12-16-54	12:10	168.58	168.62	168.35	168.84	.49
P246	12-16-54	12:15	26.39	26.42	26.30	26.50	.20
M92	12-16-54	12:20	41.00	41.02	40.87	41.16	.29
H30	12-21-54	19:00	+7.00	+7.03	+7.04	+7.00	.04
M450	12-21-54	19:00	2.44	2.42	2.41	2.44	.03
H500	12-21-54	19:50	50.38	50.36	50.34	50.38	.04
J23	12-21-54	20:00	42.60	42.59	42.58	42.60	.02
M92	12-21-54	20:00	40.88	40.87	40.86	40.88	.02
L7	12-21-54	20:50	168.62	168.63	168.57	168.67	.10
P246	12-21-54	21:20	26.68	26.68	26.67	26.69	.02
SOUTHERN FLORIDA							
S68	1-11-54	17:50	0.41	0.41	0.42	0.40	0.02
S19	1-11-54	17:55	1.30	1.30	1.31	1.27	.04
S19	2-5-54	15:05	.99	.99	1.04	.96	.08
S68	2-5-54	15:05	−.05	−.05	.04	−.16	.20
S19	2-19-54	00:10	.50	.50	.53	.47	.06
S68	2-19-54	00:10	−.61	−.61	−.59	−.64	.05
G553	2-19-54	00:20	3.68	3.68	3.70	3.66	.04
F210	2-19-54	00:25	.85	.85	.86	.85	.01
F210	2-19-54	21:30	.84	.84	.84	.85	.01
S19	2-19-54	21:30	.46	.46	.49	.43	.06
S68	2-19-54	21:30	−.48	−.48	−.46	−.50	.04
G553	2-19-54	21:40	3.65	3.65	3.67	3.63	.04
S68	4-29-54	10:55	.03	.03	.07	−.01	.08
F210	4-29-54	11:00	1.27	1.27	1.25	1.28	.03
F291	4-29-54	11:00	2.16	2.16	2.20	2.12	.08
G518	4-29-54	11:00	1.70	1.70	1.74	1.68	.06
G553	4-29-54	11:00	4.38	4.38	4.40	4.36	.04
G580	4-29-54	11:00	2.32	2.32	2.34	2.30	.04
S19	4-29-54	11:00	.79	.79	.85	.75	.10
S68	4-29-54	11:35	.04	.04	.07	.00	.07
F210	4-29-54	11:40	1.27	1.27	1.28	1.26	.02
F291	4-29-54	11:40	2.15	2.15	2.20	2.11	.09
G553	4-29-54	11:40	4.37	4.36	4.37	4.35	.02
G580	4-29-54	11:40	2.32	2.33	2.33	2.31	.02
S19	4-29-54	11:40	.79	.79	.84	.75	.09
S68	7-6-54	11:40	.66	.66	.68	.63	.05
G553	7-6-54	12:00	7.57	7.57	7.58	7.56	.02
S19	7-6-54	12:00	2.52	2.52	2.54	2.50	.04
F210	8-24-54	06:00	1.37	1.37	1.39	1.35	.04
S68	8-24-54	17:00	−.04	−.04	−.01	−.06	.05
F291	8-24-54	17:30	3.93	3.93	3.97	3.88	.09
G553	8-24-54	17:30	6.34	6.34	6.35	6.33	.02

Footnotes at end of table.

TABLE 1.—*Fluctuations in well-water levels, January 1 through December 31, 1954*—Con.

SOUTHERN FLORIDA—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.*
S329	8-24-54	17:30	2.27	2.27	2.81	2.74	0.07
S19	8-24-54	17:35	.69	.69	.73	.64	.09
C130	12-16-54	11:10	2.53	2.53	2.55	2.50	.05
F210	12-16-54	11:10	1.21	1.21	1.33	1.09	.24
F291	12-16-54	11:10	1.76	1.76	1.88	1.65	.23
G553	12-16-54	11:10	4.38	4.38	4.45	4.32	.13
G580	12-16-54	11:10	2.15	2.15	2.30	2.01	.29
L414	12-16-54	11:10	17.60	17.61	17.61	17.58	.03
S19	12-16-54	11:10	1.44	1.44	1.58	1.31	.27
S68	12-16-54	11:10	.39	.39	.47	.32	.15
F210	12-21-54	20:10	1.03	1.03	1.03	1.02	.01
F291	12-21-54	20:10	1.55	1.55	1.56	1.54	.02
S19	12-21-54	20:10	1.49	1.49	1.50	1.48	.02
S68	12-21-54	20:10	.36	.36	.37	.35	.02

IDAHO

3N-1E-8ca1	1-2-54	20:00 24:00	11.29	11.29	11.29	11.32	0.03
6S-25E-36da1	1-3-54	17:00 19:00	98.89	98.89	98.87	98.92	.05
6N-31E-27ba1	1-7-54	04:00 07:00	210.59	210.60	210.57	210.61	.04
4N-30E-7ad1	1-7-54	04:00 07:00	321.18	321.18	321.15	321.19	.04
8S-27E-31dd1	1-12-54	21:00 24:00	18.95	18.96	18.75	19.15	.40
8S-26E-33bc1	1-12-54	23:00 24:00	98.95	98.96	98.93	98.98	.05
8S-27E-31dd1	2-1-54	03:00 04:00	21.30	21.31	21.29	21.32	.03
8S-27E-31dd1	2-5-54	13:00 15:00	21.17	21.17	21.16	21.19	.03
3N-30E-31aa1	2-7-54	04:00 06:00	454.21	454.21	454.19	454.27	.08
8S-27E-31dd1	2-10-54	22:00 24:00	21.12	21.13	21.11	21.14	.03
7N-31E-34bd1	2-12-54	14:00 16:00	267.27	267.32	267.32	267.41	.09
6N-31E-27ba1	2-12-54	14:00 16:00	210.45	210.44	210.43	210.47	.04
4N-30E-7ad1	2-12-54	14:00 16:00	321.35	321.35	321.33	321.37	.04
3N-1E-8ca1	2-13-54	13:00 15:00	11.76	11.76	11.75	11.79	.04
9S-26E-10dd1	2-23-54	08:00 12:00	73.42	73.43	73.40	73.44	.04
9S-26E-10dd1	3-1-54	07:00 09:00	73.41	73.42	73.38	73.44	.06
3N-1E-8ca1	3-10-54	10:00 12:00	12.00	12.00	11.98	12.01	.03
8S-27E-31dd1	3-19-54	08:00	21.08	21.08	20.98	21.19	.21
4N-30E-7ad1	3-19-54	11:00	321.41	321.41	321.37	321.44	.07
9S-26E-10dd1	4-8-54	22:00	74.67	74.66	74.65	74.68	.03
8S-26E-27ab1	4-9-54	00:00	127.51	127.51	127.49	127.54	.05
8S-26E-27ab1	4-10-54	20:00	127.85	127.58	127.80	127.92	.12
9S-22E-33ab1	4-15-54	23:00	223.26	223.26	223.32	223.28	.05
7N-31E-34bd1	4-20-54	23:00	267.30	267.29	267.25	267.32	.07
8S-26E-27ab1	4-24-54	04:00	127.60	127.60	127.59	127.61	.02
8S-27E-31dd1	4-24-54	08:00	20.22	20.21	20.19	20.24	.05
6N-32E-11ab1	4-26-54	17:00	207.56	207.56	207.49	207.60	.11
6N-33E-26dd1	4-29-54	06:00	222.77	222.77	222.74	222.81	.07
5N-32E-36ad1	4-29-54	06:00	326.59	326.60	326.55	326.65	.10

Footnotes at end of table.

TABLE 1.—*Fluctuations in well-water levels, January 1 through December 31, 1954*—Con.

IDAHO—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.*
6N-31E-27ba1	4-29-54	09:00	210.42	210.42	210.38	210.50	0.12
6S-33E-20ab1	4-29-54	09:00	34.02	34.02	33.97	34.07	.10
3N-29E-14ad1	4-29-54	10:00	450.41	450.42	450.34	450.50	.16
4S-32E-12dd1	4-29-54	10:00	20.32	20.31	20.28	20.35	.07
8S-26E-33bc1	4-29-54	10:00	100.26	100.26	100.21	100.31	.10
8S-27E-31dd1	4-29-54	10:00	20.14	20.15	19.73	20.54	.81
4N-30E-7ad1	4-29-54	11:00	320.76	320.76	320.56	320.95	.39
8S-26E-33bc1	4-29-54	11:00	100.26	100.27	100.17	100.36	.19
7S-25E-19ba1	4-29-54	12:00	232.61	232.62	232.58	232.65	.07
9S-25E-23ca1	4-29-54	12:00	124.36	124.36	124.31	124.41	.10
8S-26E-27ab1	4-29-54	15:00	127.97	127.97	127.92	128.06	.14
9S-22E-33ab1	5-2-54	22:00	223.35	223.34	223.29	223.43	.14
8S-27E-31dd1	5-5-54	10:00	20.09	20.11	20.04	20.17	.13
8S-26E-27ab1	5-8-54	16:00	127.83	127.83	127.81	127.85	.04
8S-26E-27ab1	5-10-54	17:00	128.13	128.16	128.08	128.25	.17
8S-26E-27ab1	5-11-54	18:00	128.15	128.14	128.12	128.20	.08
9S-20E-1da1	5-11-54	19:00	347.46	347.46	347.42	347.50	.08
8S-24E-31dc1	5-12-54	21:00	143.47	143.49	143.44	143.47	.05
8S-24E-31dc1	5-14-54	00:00	143.48	143.48	143.45	143.51	.06
8S-26E-27ab1	5-14-54	12:00	128.14	128.14	128.09	128.22	.13
8S-27E-31dd1	5-14-54	16:00	20.15	20.15	20.14	20.28	.14
8S-24E-31dc1	5-15-54	22:00	143.45	143.44	143.42	143.46	.04
8S-26E-27ab1	5-16-54	23:00	128.19	128.17	128.15	128.24	.09
8S-26E-27ab1	5-17-54	22:00	128.17	128.16	128.14	128.21	.07
8S-24E-31dc1	5-17-54	23:00	143.44	143.44	143.43	143.45	.02
8S-26E-27ab1	5-19-54	00:00	128.13	128.12	128.08	128.29	.21
8S-26E-27ab1	5-22-54	18:00	128.24	128.24	128.23	128.29	.06
8S-24E-31dc1	5-25-54	02:00	143.33	143.34	143.31	143.37	.06
8S-26E-27ab1	6-2-54	18:00	128.23	128.22	128.18	128.29	.11
9S-25E-23ca1	6-12-54	21:00	122.80	122.80	122.77	122.82	.05
9S-25E-23ca1	6-17-54	20:00	122.81	122.81	122.78	122.82	.04
8S-26E-27ab1	6-17-54	22:00	128.07	128.07	128.03	128.15	.12
8S-26E-27ab1	6-20-54	11:00	127.96	127.96	127.93	128.02	.09
8S-24E-31dc1	6-20-54	20:00	143.07	143.06	143.05	143.07	.02
9S-25E-23ca1	6-21-54	19:00	122.79	122.79	122.76	122.81	.05
8S-26E-27ab1	6-23-54	01:00	127.94	127.94	127.92	127.96	.04
6N-33E-26dd1	7-6-54	08:00	223.16	223.17	223.14	223.22	.08
6N-31E-27ba1	7-6-54	08:00	210.56	210.56	210.55	210.63	.08
5N-32E-36ad1	7-6-54	09:00	327.95	327.97	327.91	328.01	.10
5N-34E-9bd1	7-6-54	10:00	256.86	256.86	256.83	256.90	.07
4N-30E-7ad1	7-6-54	10:00	321.77	321.78	321.55	321.95	.40
3N-29E-14ad1	7-6-54	10:00	451.69	451.70	451.32	452.10	.78
3N-30E-31aa1	7-6-54	10:00	455.21	455.25	455.20	455.26	.06
7S-24E-2ad1	7-6-54	10:00	202.91	202.92	202.81	203.02	.21
9S-26E-10dd1	7-6-54	10:00	73.07	73.07	73.03	73.11	.08
4N-3W-25da5	7-6-54	11:00	9.26	9.26	9.24	9.28	.04
3N-1E-8ca1	7-6-54	11:00	9.62	9.62	9.57	9.68	.11
2N-31E-35dc1	7-6-54	11:00	583.92	583.93	583.86	583.98	.12
6S-31E-16ba1	7-6-54	11:00	12.95	12.95	12.90	13.00	.10
8S-25E-24bd1	7-6-54	11:00	134.75	134.76	134.70	134.81	.11
8S-26E-33bc1	7-6-54	11:00	99.42	99.42	99.21	99.64	.43
8S-27E-31dd1	7-6-54	11:00	19.95	----------	----------	----------	(1)
9S-25E-23ca1	7-6-54	11:00	122.19	122.19	122.08	122.28	.20
7S-25E-19ba1	7-6-54	12:00	233.63	233.63	233.48	233.78	.30
6N-31E-27ba1	7-6-54	19:00	210.48	210.48	210.46	210.50	.04
4N-30E-7ad1	7-6-54	19:00	321.69	321.68	321.61	321.79	.18
7S-24E-2ad1	7-6-54	21:00	202.87	202.86	202.81	202.91	.10
4N-3W-25da5	7-6-54	22:00	9.35	9.35	9.35	9.36	.01
3N-1E-8ca1	7-6-54	22:00	9.58	9.58	9.55	9.60	.05
3N-29E-14ad1	7-6-54	22:00	451.62	451.61	451.48	451.76	.28
6S-31E-16ba1	7-6-54	22:00	12.88	12.88	12.87	12.89	.02
7S-25E-19ba1	7-6-54	22:00	233.60	233.59	233.55	233.63	.08
8S-25E-24bd1	7-6-54	22:00	134.80	134.79	134.77	134.81	.04
9S-25E-23ca1	7-6-54	22:00	122.15	122.14	122.10	122.18	.08

Footnotes at end of table.

TABLE 1.—*Fluctuations in well-water levels, January 1 through December 31, 1954*—Con.

IDAHO—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.*
8S-26E-33bc1	7-6-54	23:00	99.34	99.33	99.26	99.43	0.17
4N-30E-22bd1	7-7-54	02:00	346.82	346.81	346.78	346.85	.07
8S-26E-27ab1	7-12-54	22:00	128.00	128.00	127.94	128.21	.27
9S-25E-23ca1	7-24-54	20:00	121.06	121.06	121.04	121.08	.04
5N-29E-23cd1	7-30-54	17:00	272.16	272.14	272.06	272.21	.15
8S-27E-31dd1	8-2-54	07:00	20.22	20.22	20.20	20.25	.05
6N-32E-11ab1	8-9-54	02:00	207.51	207.51	207.44	207.56	.12
6N-32E-11ab1	8-10-54	01:00	207.50	207.49	207.42	207.56	.14
1N-19E-31ca2	8-11-54	22:00	25.88	25.89	25.82	25.94	.12
2N-31E-35dc1	8-15-54	20:00	583.65	583.65	583.62	583.69	.07
6N-32E-11ab1	8-16-54	23:00	207.54	207.54	207.49	207.56	.07
8S-27E-31dd1	8-23-54	23:00	20.13	----------	----------	----------	(1)
9S-26E-10dd1	8-24-54	02:00	70.57	70.56	70.46	70.66	.20
9S-20E-1da1	8-24-54	03:00	343.74	343.73	343.70	343.74	.04
6S-31E-16ba1	8-24-54	03:00	11.70	11.69	11.62	11.74	.12
7S-24E-2ad1	8-24-54	04:00	203.08	203.08	202.90	203.25	.35
7S-25E-19ba1	8-24-54	05:00	233.75	233.75	233.45	233.99	.54
8S-23E-2ba1	8-24-54	05:00	200.70	200.66	200.64	200.73	.09
7N-31E-34bd1	8-24-54	05:00	267.15	267.15	267.10	267.20	.10
6N-31E-27ba1	8-24-54	05:00	210.44	210.42	210.32	210.59	.27
6N-33E-26dd1	8-24-54	05:00	223.08	223.06	222.98	223.17	.19
5N-29E-23cd1	8-24-54	05:00	272.11	272.11	272.06	272.17	.11
5N-32E-36ad1	8-24-54	05:00	328.24	328.22	328.13	328.33	.20
5N-34E-9bd1	8-24-54	05:00	256.98	256.97	256.88	257.08	.20
2N-31E-35dc1	8-24-54	05:00	583.49	583.49	583.38	583.64	.26
1S-19E-3cc2	8-24-54	05:00	9.04	9.04	8.79	9.28	.49
3N-32E-29dd1	8-24-54	05:30	654.24	654.24	654.23	654.25	.02
8S-24E-31dc1	8-24-54	06:00	141.92	141.92	141.87	141.96	.09
8S-25E-24bd1	8-24-54	06:00	134.60	134.62	134.53	134.69	.16
8S-26E-33bc1	8-24-54	06:00	98.25	98.25	98.00	98.63	.63
53N-2W-9aa1	8-24-54	06:00	231.63	231.63	231.58	231.68	.10
4N-3W-25da5	8-24-54	06:00	9.85	9.85	9.81	9.89	.08
4N-1W-35aa1	8-24-54	06:00	5.97	5.97	5.96	5.98	.02
4N-30E-7ad1	8-24-54	06:00	322.30	322.29	321.94	322.80	.86
3N-1E-8ca1	8-24-54	06:00	8.85	8.85	8.73	8.96	.23
3N-29E-14ad1	8-24-54	06:00	451.98	451.98	----------	----------	(1)
1N-18E-1da1	8-24-54	06:00	42.56	42.56	42.36	42.84	.48
1N-19E-31ca2	8-24-54	06:00	26.92	26.93	26.58	27.30	.72
1S-19E-11bb1	8-24-54	06:00	3.08	3.08	3.07	3.09	.02
4S-32E-12dd1	8-24-54	06:00	15.57	15.53	15.30	15.75	.45
6S-33E-20ab1	8-24-54	06:00	33.48	33.47	33.34	33.60	.26
8S-25E-36da1	8-24-54	07:00	97.99	97.99	97.79	98.22	.43
9S-25E-23ca1	8-24-54	07:00	119.42	119.42	119.27	119.58	.31
9S-22E-33ab1	8-24-54	08:00	224.61	224.61	224.60	224.63	.03
2N-28E-35ad1	8-24-54	09:30	602.72	602.70	602.62	602.75	.13
4N-30E-22bd1	8-24-54	10:00	347.28	347.27	347.10	347.44	.34
3N-1E-8ca1	8-31-54	22:00	8.59	8.59	8.58	8.60	.02
6S-33E-20ab1	8-31-54	22:00	33.64	33.64	33.63	33.66	.03
4N-29E-9dc1	9-4-54	00:45	393.03	393.04	393.01	393.06	.05
5N-34E-9bd1	9-11-54	12:00	256.88	256.87	256.81	256.94	.13
1N-18E-1da1	9-22-54	23:00	44.21	44.21	44.18	44.22	.04
6N-31E-13db1	9-22-54	23:45	214.23	214.22	214.19	214.25	.06
8S-27E-31dd1	10-17-54	20:00 21:00	22.19	22.19	22.07	22.31	.24
4N-30E-7ad1	10-17-54	23:00	322.89	322.90	322.85	322.95	.10
1N-18E-1da1	10-17-54	23:00	42.86	42.85	42.84	42.86	.02
1N-19E-31ca2	10-17-54	23:00	33.53	33.53	33.52	33.54	.02
8S-26E-33bc1	10-18-54	01:00	98.59	98.58	98.56	98.61	.05
1S-19E-11bb1	10-31-54	08:00	5.55	5.55	5.51	5.59	.08
8S-27E-31dd1	11-12-54	09:00 10:00	21.80	21.80	21.70	21.86	.16
4N-30E-7ad1	11-12-54	10:00	323.13	323.14	323.09	323.15	.06
1S-20E-27bd1	11-12-54	10:00	63.93	63.93	63.92	63.93	.01
1N-18E-1da1	11-12-54	12:00	44.06	44.06	44.04	44.09	.05

Footnotes at end of table.

TABLE 1.—*Fluctuations in well-water levels, January 1 through December 31, 1954*—Con.

IDAHO—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.*
1S-19E-3cc2	11-12-54	12:00	13.18	13.18	13.18	13.20	0.04
8S-26E-33bc1	11-12-54	12:00	99.07	99.08	99.05	99.10	.05
2S-20E-1db1	11-12-54	13:00	147.22	147.22	147.19	147.25	.06
3N-29E-14ad1	11-25-54	10:00	452.44	452.43	452.38	452.49	.11
6N-31E-27ba1	11-25-54	11:00	210.59	210.58	210.50	210.69	.19
4N-30E-7ad1	11-25-54	11:00	323.34	323.34	323.19	323.48	.29
1S-20E-27bd1	11-25-54	11:00	64.77	64.77	64.75	64.79	.04
8S-26E-33bc1	11-25-54	11:00	99.36	99.36	99.33	99.38	.05
6N-31E-27ba1	12-15-54	12:00	210.63	210.62	209.45	210.87	.42
5N-34E-9bd1	12-15-54	12:00	254.77	254.78	254.45	255.02	.57
4S-32E-12dd1	12-16-54	07:00	19.96	19.99	19.70	20.29	.59
4N-30E-7ad1	12-16-54	08:00 09:00	323.57	323.56			(1)
4S-32E-12dd1	12-16-54	07:00	19.96	19.99	19.70	20.29	.59
2S-20E-1db1	12-16-54	08:00 09:00	149.23	149.23	148.90	149.57	.67
8S-27E-31dd1	12-16-54	08:00 09:00	21.57				(1)
8S-23E-2ba1	12-16-54	09:00 10:00	198.80	198.81	198.68	198.92	.24
1S-20E-27bd1	12-16-54	09:00 10:00	65.99	65.82	65.82	66.04	.22
53N-2W-9aa1	12-16-54	10:30	233.28	233.28	233.24	233.32	.08
3N-29E-14ad1	12-16-54	10:00 11:00	452.34	452.35			(2)
7S-24E-2ad1	12-16-54	10:00 11:00	202.41	202.44			(1)
7S-25E-19ba1	12-16-54	10:00 11:00	233.25	233.27			(1)
9S-20E-1da1	12-16-54	10:00 11:00	345.53	345.58	345.50	345.64	.14
6S-31E-16ba1	12-16-54	11:00	15.29	15.29	15.15	15.44	.29
1N-18E-1da1	12-16-54	11:00	46.27	46.28	45.94	46.62	.68
8S-24E-31dc1	12-16-54	11:00	142.72	142.75	142.60	142.83	.14
8S-25E-24bd1	12-16-54	11:00	134.95	134.97	134.60	135.26	.57
8S-25E-36da1	12-16-54	11:00	99.92	99.92			(1)
8S-26E-33bc1	12-16-54	11:00	100.00	99.99			(1)
9S-25E-23ca1	12-16-54	11:00	121.98	122.00	121.55	122.43	.88
2N-31E-35dc1	12-16-54	11:00 12:00	583.42	583.45	583.08	583.55	.47
9S-26E-10dd1	12-16-54	11:00 12:00	72.51	72.53	72.41	72.63	.22
9S-22E-33ab1	12-16-54	12:00	224.15	224.15	224.11	224.19	.08
5S-31E-27ab1	12-16-54	12:00	19.54	19.54	19.51	19.57	.06
6S-33E-20ab1	12-16-54	12:00	33.56	33.57	33.49	33.80	.31
2N-18E-9ab1	12-16-54	15:00	25.14	25.15	25.13	25.17	.04
1S-19E-3cc2	12-16-54	17:00	14.86	14.88	14.62	15.11	.49
6N-33E-26dd1	12-21-54	15:00 16:00	222.91	222.89	222.84	222.96	.12
6N-31E-27ba1	12-21-54	17:00 18:00	210.60	210.59	210.50	210.72	.22
5N-34E-9bd1	12-21-54	17:00 18:00	254.68	254.68	254.65	254.71	.06
4N-30E-7ad1	12-21-54	17:00 18:00	323.57	323.55	323.27	323.82	.55
1S-20E-27bd1	12-21-54	17:00 18:00	66.03	66.03	65.99	66.08	.09
2S-20E-1db1	12-21-54	17:00 18:00	149.68	149.67	149.57	149.74	.17
7S-25E-19ba1	12-21-54	18:00 19:00	233.27	233.25	233.14	233.26	.12

Footnotes at end of table.

TABLE 1.—*Fluctuations in well-water levels, January 1 through December 31, 1954*—Con.

IDAHO—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.*
53N-2W-9aa1	12-21-54	18:30	233.36	233.36	233.35	233.37	0.02
6N-31E-13db1	12-21-54	18:00 19:00	214.4	214.4	----------	----------	(1)
6S-33E-20ab1	12-21-54	20:00	33.52	33.52	33.48	33.57	.09
3N-29E-14ad1	12-21-54	21:00 22:00	452.35	452.34	452.21	452.50	.29
ILLINOIS							
ANL-10	4-29-54	10:45	71.64	71.64	71.53	71.76	0.23
ANL-9	4-29-54	11:15	91.44	91.45	91.34	91.57	.23
ANL-10	4-29-54	11:30	71.64	71.65	71.50	71.78	.28
ANL-9	4-29-54	11:45	91.45	91.46	91.31	91.59	.28
ANL-11	5-5-54	11:00	75.99	75.99	75.98	76.00	.02
ANL-9	5-5-54	13:45	91.35	91.35	91.31	91.39	.08
ANL-10	5-5-54	14:00	71.99	71.97	71.93	72.03	.10
ANL-10	5-5-54	17:45	71.96	71.94	71.89	72.09	.20
ANL-10	7-6-54	11:30	72.81	72.80	72.69	72.93	.24
ANL-9	7-6-54	11:45	92.20	92.20	92.19	92.23	.04
ANL-20	8-24-54	06:15	39.46	39.46	39.42	39.50	.08
ANL-10	8-24-54	06:15	74.89	74.88	74.73	75.12	.39
ANL-9	8-24-54	06:30	92.60	92.60	92.39	92.79	.40
ANL-11	8-24-54	07:00	78.62	78.61	78.58	78.64	.06
ANL-20	10-11-54	16:30	38.68	38.68	38.53	38.73	.20
ANL-11	12-16-54	10:30	78.34	78.38	78.34	78.42	.08
ANL-9	12-16-54	11:00	91.95	91.98	91.53	92.40	.87
ANL-10	12-16-54	11:00	75.17	75.14	74.76	75.53	.77
ANL-11	12-21-54	19:30	78.09	78.11	78.09	78.12	.03
ANL-10	12-21-54	19:45	74.78	74.83	74.68	74.86	.18
ANL-9	12-21-54	20:00	92.15	92.14	92.07	92.20	.13
KENTUCKY							
8245-3745-404	8-24-54	04:00	28.29	28.30	28.26	28.33	0.07
MICHIGAN							
GeFL491	1-13-54	00:13	29.92	29.92	29.89	29.95	0.06
GeFL491	3-19-54	10:15	29.16	29.16	29.14	29.17	.03
GeFL491	5-5-54	12:50	28.90	28.90	28.88	28.92	.04
GeFL491	7-6-54	11:20	34.47	34.47	34.46	34.49	.03
GeFL491	7-24-54	05:00	35.90	35.89	35.83	35.98	.15
GeFL491	12-16-54	11:30	30.30	30.31	30.19	30.41	.22
GeFL491	12-21-54	20:30	30.27	30.27	30.22	30.31	.09
NEVADA							
S22/61-4bcc1	1-3-54	02:40	85.36	85.36	85.31	85.42	0.11
S19/60-9bcc1	1-12-54	19:30	80.50	80.50	80.48	80.51	.03
S19/60-9bcc1	1-12-54	23:50	80.50	80.50	80.45	80.55	.10
11/24-22dc1	1-15-54	00:30	56.94	56.94	56.92	56.98	.06
S19/60-9bcc1	2-1-54	06:50	79.41	79.41	79.39	79.43	.04
S19/60-9bcc1	2-25-54	07:45	81.10	81.10	81.08	81.12	.04
S22/61-4bcc1	3-16-54	12:15	86.70	86.70	86.68	86.74	.06
S19/60-9bcc1	3-19-54	10:50	83.56	83.56	83.49	83.62	.13
S21/61-15bca1	3-27-54	15:10	15.08	15.08	14.85	15.53	.68
S20/60-25adb1	4-29-54	10:15	43.92	43.92	43.87	43.97	.10
S19/60-33baa1	4-29-54	10:45	13.09	13.09	13.06	13.10	.04

Footnotes at end of table.

TABLE 1.—*Fluctuations in well-water levels, January 1 through December 31, 1954*—Con.

NEVADA—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.*
S19/60-9bcc1	4-29-54	10:50	85.03	85.03	84.88	85.17	0.29
S20/60-25adb1	4-29-54	11:05	43.89	43.89	43.75	43.97	.22
S19/60-33baa1	4-29-54	11:35	13.08	13.08	13.03	13.12	.09
S19/60-9bcc1	4-29-54	11:40	85.03	85.03	84.84	85.21	.37
S20/60-25adb1	4-29-54	22:45	45.23	45.23	----------	45.34	----------
S19/60-9bcc1	5-5-54	13:45	85.44	85.44	85.39	85.49	.10
S19/60-9bcc1	6-6-54	07:10	86.39	86.39	86.34	86.47	.13
S20/60-36dbb1	6-30-54	16:40	69.74	69.74	69.67	69.84	.17
S20/60-36dbb1	7-3-54	18:00	70.27	70.27	70.20	70.41	.21
11/24-22dc1	7-3-54	19:00	57.55	57.55	57.49	57.57	.08
S19/60-33baa1	7-6-54	10:30	13.63	13.63	13.58	13.68	.10
S20/60-25adb1	7-6-54	10:40	49.64	49.64	49.58	49.68	.10
11/24-22dc1	7-6-54	11:15	57.59	57.59	57.48	57.75	.27
S19/60-9bcc1	7-6-54	11:40	86.61	86.61	86.39	86.75	.36
S19/60-33baa1	7-6-54	21:45	13.60	13.60	13.60	13.63	.03
11/24-22dc1	7-6-54	22:10	57.55	57.55	57.44	57.81	.37
S19/60-9bcc1	7-6-54	22:15	87.30	87.30	87.24	87.37	.13
S19/60-9bcc1	7-7-54	17:10	87.34	87.34	87.32	87.54	.22
S19/60-9bcc1	7-8-54	09:20	87.53	87.53	87.47	87.64	.17
S19/60-33baa1	7-12-54	21:45	13.97	13.97	13.88	14.05	.17
S19/60-33baa1	7-13-54	22:45	13.94	13.94	13.89	13.49	.40
11/24-22dc1	7-21-54	08:00	57.67	57.67	57.64	57.69	.05
11/24-22dc1	7-21-54	09:30	57.68	57.68	57.65	57.72	.07
S19/60-9bcc1	7-26-54	08:10	88.07	88.07	88.05	88.09	.04
S19/60-9bcc1	7-26-54	09:00	88.07	88.07	88.05	88.13	.08
S20/60-25adb1	8-24-54	07:00	52.22	52.22	52.02	52.38	.36
S19/60-9bcc1	10-26-54	17:00	84.64	84.66	84.63	84.71	.08
S20/60-25adb1	11-12-54	06:45	47.62	47.62	47.60	47.64	.04
S19/60-9bcc1	11-12-54	11:40	85.18	85.18	85.10	85.26	.16
S19/60-9bcc1	11-22-54	07:45	84.95	84.95	84.90	85.12	.22
S20/60-25ladb1	11-25-54	01:45	47.40	47.40	47.37	47.44	.07
S19/60-9bcc1	11-25-54	11:15	84.19	84.19	83.97	84.39	.42
S20/53-24caa1	11-25-54	11:15	37.99	37.99	37.90	38.08	.18
S19/60-27bdc1	12-16-54	+11:00	+8.3	+8.2	+10.1	+5.5	4.60
11/24-22dc1	12-16-54	+11:00	58.02	58.02	57.93	58.25	.32
S19/60-33baa1	12-16-54	11:00	12.78	12.71	11.87	13.62	1.75
S22/61-4bcc1	12-16-54	11:15	87.68	87.97	87.66	88.00	.34
S20/60-25adb1	----------	11:15	46.12	46.23	----------	----------	(3)
S19/60-33baa1	12-25-54	10:50	13.83	13.83	13.79	13.85	.06

NEW JERSEY

31.1.6.4.8	2-8-54	14:30	−9.59	−9.59	−9.57	−9.60	0.03
28.5.4.8.1	2-21-54	19:10	+3.72	+3.72	+3.72	+3.72	.01
28.5.4.8.1	2-21-54	20:50 21:10	+3.71	+3.71	+3.71	+3.71	.01
28.5.4.8.1	3-1-54	19:20	+3.77	+3.77	+3.77	+3.76	.01
26.22.4.4.4	4-29-54	11:20	+28.70	+28.71	+28.72	+28.68	.04
31.1.6.4.8	4-29-54	12:00	−11.05	−11.05	−11.04	−11.06	.02
26.21.5.4.6	4-29-54	12:00	+61.87	+61.87	+61.88	+61.87	.01
26.22.4.4.4	4-29-54	12:00	+28.73	+28.74	+28.88	+28.62	.26
31.1.6.4.8	5-10-54	15:00	−9.01	−9.01	−9.00	−9.03	.03
31.11.5.1.1	7-2-54	13:00	−0.83	−0.88	−.79	%.92	.13
26.21.5.4.5	7-5-54	15:45	+62.54	62.55	62.55	62.28	.27
26.22.4.4.4	7-6-54	11:45	+29.70	29.69	29.71	29.68	.03
26.21.5.4.5	7-6-54	13:00	+62.56	62.57	63.84	61.18	2.66
28.5.4.8.1	7-15-54	02:00	+4.18	+4.18	4.18	4.17	.01
30.14.8.3.1	7-15-54	03:15	16.34	16.34	16.34	16.37	.03
31.34.2.4.5	7-15-54	03:30	41.32	41.32	41.30	41.33	.03
30.22.9.7.3	7-15-54	03:30	−3.41	−3.42	−3.42	3.46	.04
31.1.3.9.9	7-15-54	03:30	+2.0	2.0	2.1	1.7	.04
31.11.5.2.1	8-2-54	10:30	−25.80	−25.80	−25.71	−25.98	.27
31.1.6.4.8	8-2-54	10:30	−10.63	−10.63	−10.60	−10.68	.08

Footnotes at end of table.

TABLE 1.—*Fluctuations in well-water levels, January 1 through December 31, 1954*—Con.

NEW JERSEY—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.*
31.1.6.4.8	8-21-54	13:30	−11.02	−11.02	−11.01	−11.05	0.04
26.22.4.5.8	8-24-54	06:00	+20.76	20.76	20.77	20.75	.02
26.22.4.4.4	8-24-54	06:30	+28.85	28.86	28.90	28.82	.08
26.21.5.4.5	8-26-54	01:45	+62.06	62.06	62.14	62.06	.08
30.14.8.2.4	12-16-54	11:07	−1.37	−1.37	−1.35	−1.37	.02
26.22.4.4.4	12-16-54	11:12	+28.78	+28.79	+28.92	+28.62	.30
31.1.6.4.8	12-16-54	11:15	−11.42	−11.42	−11.39	−11.46	.07
26.21.5.9.2	12-16-54	11:20	+53.12	+53.11	+53.14	+53.03	.11
NEW YORK							
Sa-529	4-17-54	20:30	47.40	47.42	47.39	47.41	0.02
Sa-529	4-29-54	10:10	48.47	48.48	48.45	48.50	.05
Sa-529	4-29-54	11:00	48.48	48.49	48.40	48.55	.15
Q-64	4-29-54	11:15	−.18	−.18	−.13	−2.33	2.20
N-1212	4-29-54	11:15	18.37	18.37	18.37	18.36	.01
Q-64	4-29-54	12:00	−.20	−.20	−.09	−.33	.24
N-1212	4-29-54	12:00	18.36	18.36	18.38	18.34	.04
Sa-529	5-5-54	12:45	48.18	48.19	48.17	48.19	.02
Q-64	7-6-54	08:45	.03	.03	.04	.02	.02
Sa-529	7-6-54	11:15	51.00	50.99	50.97	51.02	.05
W-529	7-6-54	12:00	33.37	33.37	33.36	33.38	.02
Q-64	7-6-54	12:00	.03	.03	.05	.09	.04
W-529	8-24-54	06:15	37.36	37.36	37.34	37.40	.06
Sa-529	8-24-54	06:45	54.86	54.86	54.80	54.91	.11
Q-64	9-24-54	06:30	−.74	−.74	−.71	−.78	.06
Sa-529	10-3-54	11:40	50.58	50.57	50.57	50.59	.02
Sa-529	10-17-54	11:00	49.71	49.71	49.71	49.72	.01
Sa-529	11-25-54	11:45	48.14	48.14	48.11	48.15	.04
Q-64	11-25-54	12:00	.41	.41	.46	.36	.10
Q-64	12-4-54	19:00	.64	.64	.72	.66	.06
Sa-529	12-16-54	11:45	47.37	47.39	47.32	47.44	.12
Q-64	12-16-54	12:00	1.17	1.17	1.22	1.07	.15
N-180	12-16-54	12:00	19.71	19.71	19.73	19.69	.04
Q-64	12-21-54	20:00	1.28	1.28	1.34	1.24	.10
Sa-529	12-21-54	20:30	47.61	47.61	47.59	47.63	.04
OKLAHOMA							
Seminole 1	12-21-54	10:00	96.84	96.84	96.82	96.86	0.04
Seminole 1	12-21-24	10:40	96.84	96.83	96.82	96.85	.03
Seminole 1	12-21-54	11:20	96.83	96.83	96.81	96:83	.02
Seminole 1	12-21-54	12:00	96.82	96.82	96.80	96.82	.02
Seminole 1	12-21-54	12:40	96.82	96.81	96.79	96.83	.04
Seminole 1	12-21-54	13:50	96.81	96.81	96.80	96.83	.03
Seminole 1	12-21-54	18:50	96.84	96.84	96.82	96.85	.03
Seminole 1	12-21-54	21:50	96.81	96.81	96.81	96.82	.01
Seminole 1	12-22-54	00:40	96.80	96.80	96.79	96.80	.01
Seminole 1	12-22-54	02:30	96.80	96.80	96.80	96.81	.01
Seminole 1	12-22-54	03:30	96.81	96.81	96.81	96.82	.01
Seminole 1	12-22-54	04:30	96.82	96.82	96.79	96.82	.03
Seminole 1	12-22-54	06:00	96.83	96.83	96.82	96.84	.02
Seminole 1	12-22-54	06:40	96.83	96.83	96.83	96.84	.01
Seminole 1	12-22-54	09:00	96.82	96.82	96.81	96.83	.02
Seminole 1	12-22-54	10:30	96.80	96.79	96.78	96.81	.03
Seminole 1	12-25-54	13:30	97.18	97.18	97.16	97.18	.02
Seminole 1	12-25-54	15:00	97.19	97.19	97.19	97.21	.02

Footnotes at end of table.

TABLE 1—*Fluctuations in well-water levels, January 1 through December 31, 1954*—Con.

TENNESSEE

Well No.	Date	Time G. C. T.	Depth to water				Amplitude of fluctuation
			Before disturbance	After disturbance	At highest point	At lowest point	
			ft.	*ftl.*	*ft.*	*ft.*	*ft.*
79:1-2	2-19-54	23:36	84.14	84.14	84.13	84.16	0.03
148-1S	4-29-54	11:34	42.18	43.17	43.16	43.19	.03
9-115	5-21-54	16:13	83.27	83.27	83.25	83.29	.04
3A	6-17-54	01:42	71.39	71.42	71.37	71.44	.07
7:1-6	7-6-54	12:10	79.04	79.05	79.03	79.06	.03
7-17	7-23-54	15:30	111.72	111.72	111.69	111.74	.05
5-193	7-23-54	21:30	119.67	119.68	119.66	119.73	.07
1-4	7-23-54	21:35	86.49	86.50	86.49	86.51	.02
9-107	8-22-54	14:09	118.12	118.10	118.06	118.17	.11
7:1-6	8-24-54	06:30	79.82	79.82	79.77	79.87	.10
7:1-6	9-21-54	08:00	80.15	80.15	80.14	80.17	.03
3-A	9-21-54	08:45	71.75	71.80	71.71	71.82	.11
3-A	10-3-54	02:00	72.17	72.17	72.15	72.16	.01
7:1-6	10-17-54	23:30	79.28	79.28	79.27	79.29	.02
1-6	11-25-54	11:30	79.60	79.60	79.59	79.61	.02
79:1-2	11-27-54	08:00	85.53	85.53	85.53	85.55	.02
1-6	12-16-54	11:30	79.02	79.03	78.95	79.12	.17
1-2	12-16-54	11:30	85.38	85.38	85.37	85.38	.01
148-1D	12-16-54	11:30	48.92	48.92	48.91	48.93	.02
148-1S	12-16-54	11:30	46.41	46.41	46.40	46.43	.03
1-6	12-21-54	19:30	78.61	78.60	78.59	78.62	.03
1-2	12-29-54	04:45	85.11	85.11	85.10	85.13	.03

UTAH

(C-35-11)33dbc-1	3-4-54	13:15	−80.15	−80.18	−80.17	−80.20	0.03
(C-2-6)36cdd-1	3-10-54	09:15	−80.47	−80.47	−80.45	−80.48	.03
(B-6-1)30cca-1	3-19-54	09:30	−28.66	−28.65	−28.64	−28.67	.03
(B-5-1)27dc-1	3-19-54	09:45	−185.07	−186.06	−185.05	−185.08	.03
(B-5-1)27dc-2	3-19-54	10:00	−66.65	−66.64	−66.64	−66.65	.01
(B-5-1)27dc-2	4-29-54	10:30	−66.98	−66.98	−66.96	−66.99	.03
(B-5-1)27dc-1	4-29-54	10:45	−186.23	−186.23	−186.20	−186.26	.06
(B-5-1)27dc-2	4-29-54	11:15	−66.96	−66.98	−66.94	−67.01	.07
(C-2-6)36cdd-1	4-29-54	11:15	−80.73	−80.73	−80.69	−80.75	.06
(C-2-4)33add-1	4-29-54	11:15	−78.84	−78.84	−78.84	−78.85	.01
(B-5-1)27dc-1	4-29-54	11:30	186.24	−186.24	−186.13	−186.32	.19
(C-35-11)33dbc-1	4-29-54	11:30	−79.68	−79.69	−79.68	−79.70	.02
(B-6-1)30cca-1	4-29-54	11:45	−28.84	−28.84	−28.80	−28.88	.08
(B-6-1)29ccc-1	4-29-54	12:00	+18.7	+18.6	+18.8	+18.4	+.40
(C-2-6)36cdd-1	4-29-54	12:00	−80.73	−80.73	−80.65	−80.76	.11
(C-2-4)33add-1	4-29-54	12:00	−78.84	−78.84	−78.89	−78.89	.00
(B-6-1)30cca-1	4-29-54	12:30	−28.84	−28.84	−28.74	−28.94	.20
(C-2-6)36cdd-1	5-5-54	12:45	−80.66	−80.66	−80.65	−80.67	.02
(B-5-1)27dc-1	5-5-54	13:10	−186.47	−186.47	−186.45	−186.49	.04
(B-6-1)30cca-1	5-5-54	13:30	−28.86	−28.86	−28.84	−28.88	.04
(C-35-11)33dbc-1	7-6-54	10:30	−86.44	−86.45	−86.42	−86.48	.06
(B-6-2)35bcc-1	7-6-54	11:00	−10.52	−10.54	−10.44	−10.62	.18
(C-7-8)10cbd-1	7-6-54	11:00	−80.54	−80.58	−80.54	−80.60	.06
(B-5-1)21dc-1	7-6-54	11:15	−189.48	−189.48	−189.32	−189.61	.29
(B-6-1)29ccc-1	7-6-54	11:15	+15.2	+15.2	+16.7	+13.8	2.90
(B-6-1)29abb-1	7-6-54	11:20	+18.3	+18.3	+18.9	+18.0	.90
(C-2-6)36cdd-1	7-6-54	11:30	−81.27	−81.33	−81.18	−81.45	.27
(B-6-1)30cca-1	7-6-54	11:45	−31.05	−31.06	−30.94	−31.14	.20
(C-35-11)33dbc-1	7-6-54	21:00	−86.47	−86.48	−86.47	−86.49	.02
(B-6-2)35bcc-1	7-6-54	21:45	−10.54	−10.54	−10.52	−10.58	.06
(C-7-8)10cbd-1	7-6-54	21:45	−80.57	−80.55	−80.55	−80.57	.02
(C-2-6)36cdd-1	7-6-54	22:00	−81.32	−81.32	−81.27	−81.37	.10
(B-6-1)29ccc-1	7-6-54	22:15	+15.2	+15.2	+15.8	+14.8	1.00
(B-6-1)29abb-1	7-6-54	22:20	+18.2	+18.2	+18.3	+18.0	.30
(B-5-1)21dc-1	7-6-54	22:30	−189.40	−189.38	−189.34	−189.43	.09
(B-6-1)30cca-1	7-6-54	23:00	−31.03	−31.03	−31.00	−31.07	.07
(B-6-1)29abb-1	8-24-54	06:00	+15.1	+15.1	+15.2	+14.6	.40

Footnotes at end of table.

TABLE 1—*Fluctuations in well-water levels, January 1 through December 31, 1954*—Con.

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.*
UTAH—Continued							
(B-6-1)29ccc-1	8-24-54	06:00	+11.5	+11.5	+14.7	+9.0	5.70
(B-6-1)30cca-1	8-24-54	06:00	−33.09	−33.09	−31.85	−32.23	.38
(C-35-11)33dbc-1	8-24-54	06:00	−89.65	−89.66	−89.63	−89.67	.04
(B-5-1)27dc-1	8-24-54	08:45	−191.88	−191.88	−191.56	−192.10	.54
WASHINGTON							
20/3-18C1	8-24-54	05:30	94.19	94.18	93.87	94.52	0.65
20/3-18C1	11-25-54	10:45	04.08	04.06	93.95	94.27	.32
20/3-18C1	12-21-54	18:00	93.85	93.84	93.67	94.02	.35
WISCONSIN							
Lf-57	1-13-54	00:45	85.84	85.84	85.82	85.86	0.04
Lf-57	2-11-54	00:30	86.30	86.32	86.28	86.34	.06
Lf-57	3-3-54	07:45	86.60	86.60	86.59	86.61	.02
Lf-57	3-19-54	10:00	86.58	86.58	86.49	86.66	.17
Lf-57	4-17-54	20:15	87.04	87.04	87.01	87.07	.06
Lf-57	4-29-54	11:00	87.31	87.33	87.20	87.48	.28
Lf-57	4-29-54	11:45	87.33	87.35	87.09	87.63	.54
Lf-57	5-5-54	14:15	87.39	87.40	87.24	87.53	.29
Lf-57	7-6-54	11:00	87.61	87.59	87.52	87.70	.18
Lf-57	8-24-54	05:45	87.14	87.13	87.89	87.37	.48
Lf-57	8-31-54	22:15	87.20	87.20	87.17	87.21	.04
Lf-57	10-3-54	11:30	87.41	87.48	87.40	87.53	.13
Lf-57	10-17-54	23:15	87.59	87.61	87.58	87.64	.06
Lf-57	10-24-54	11:15	87.58	87.59	87.58	87.60	.02
Lf-57	11-12-54	12:30	87.72	87.72	87.67	87.76	.09
Lf-57	11-25-54	11:45	87.77	87.82	87.65	87.90	.25
Lf-57	12-16-54	11:00	87.88	87.88	87.44	88.24	.80
Lf-57	12-21-54	19:45	87.90	87.90	87.60	88.20	.60
HAWAIIAN ISLANDS							
132	2-1-54	00:30	17.49	17.49	17.48	17.50	0.02
132	2-5-54	08:40	17.72	17.71	17.70	17.72	.02
132	3-3-54	06:30	17.50	17.49	17.49	17.51	.02
132	3-30-54	16:45	17.05	17.06	17.04	17.08	.04
1A	3-30-54	17:10	9.96	9.99	9.96	10.01	.05
36A	3-30-54	18:10	15.51	15.51	15.50	15.52	.02
83	3-30-54	18:40	+.22	+.22	+.23	+.21	.02
132	3-30-54	18:45	17.09	17.09	17.04	17.16	.12
1A	3-30-54	19:10	10.02	10.00	9.87	10.10	.23
T-41	3-30-54	20:00	65.75	65.75	65.75	65.80	.05
36A	3-30-54	20:10	15.54	15.54	15.50	15.57	.07
36A	4-29-54	11:50	15.93	15.93	15.93	15.95	.02
132	4-29-54	11:50	17.48	17.47	17.44	18.52	.08
132	6-6-54	17:45	18.09	18.09	18.08	18.10	.02
132	10-3-54	02:20	18.94	18.94	18.93	18.95	.02
132	11-25-54	11:00	18.22	18.21	18.09	18.33	.24
83	11-25-54	11:40	.86	.86	.84	.87	.03
1A	11-25-54	11:45	10.03	10.02	9.94	10.06	.12
36A	11-25-54	12:00	16.64	16.63	16.55	16.71	.16
132	12-16-54	10:00	17.03	17.02	16.96	17.13	.17
1A	12-16-54	11:20	9.89	9.88	9.83	9.93	.10
36A	12-16-54	11:20	15.42	15.41	15.40	15.54	.14
83	12-16-54	12:00	+.28	+.28	+.29	+.27	.02
132	12-21-54	19:20	16.82	16.82	16.81	16.84	.03

[1] Greater than 1 foot.
[2] Probably greater than 2 feet.
[3] Greater than 2 feet.
+ Water surface above mean sea level or land surface datum.
− Water surface below mean sea level.

SEISMOLOGICAL OBSERVATORY RESULTS

The Coast and Geodetic Survey publishes the results of its teleseismic stations and cooperating stations in the monthly *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
(The Panama Canal Co.)
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.)
Montezuma, Chile
(Smithsonian Institution.)
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Boulder City and Hungry Horse are cooperating stations of the Bureau of Reclamation. Montezuma is operated by Smithsonian personnel.

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 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–157, January 1954. 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, Coast and Geodetic Survey, Washington 25, D. C.

SUMMARY OF INSTRUMENTAL EPICENTERS FOR 1951

The summary of instrumental epicenters for 1951 is not available for publication at this time. However, the summary will be published as soon as the data become available. The last Seismological Bulletin to be issued covers March 1951.

TABLE 2.—*Summary of instrumental epicenters for 1954*

1954	Origin Time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter	
			Latitude	Longitude
	h m s		° ′	° ′
Jan. 1	13 04 17*	Sawoe Sea. Depth about 100 km. Mag. 6½	8½ S.	124 E.
2	13 52 27*	Off east coast of Hokkaido, Japan	43 N.	147 E.
2	20 17 25*	Fox Islands, Aleutian Islands	54 N.	165 W.
3	09 48 33*	Off coast of Oregon	43 N.	125 W.
3	11 14 52*	do	43 N.	125 W.
3	17 30 31*	Near east coast of Hokkaido, Japan	43½ N.	145 E.
4	11 16 29*	Near coast of Costa Rica	9 N.	85 W.
4	12 08 49**	Bouvet Island region. South Atlantic Ocean		
5	03 18 00*	Off east coast of Hokkaido, Japan	43 N.	147 E.
5	07 18 10*	Spitzbergen foreshock	76 N.	6 E.
6	15 53 59*	Southwest of Spitzbergen	76 N.	7 E.
7	04 08 24*	South of Fiji Islands	25 S.	179½ E.
7	06 48 50**	About 500 miles south of Fiji Islands		
8	04 13 45**	Near north coast of Honshu, Japan		
9	01 43 15*	South of Panama	5½ N.	83 W.
9	08 06 30*	Off coast of Honshu, Japan	34½ N.	141 E.
10	08 59 58*	Yukon, Canada	65½ N.	136½ W.
11	17 09 02*	Ryuku Islands region	23 N.	126 E.
12	14 16 22*	New Zealand foreshock	49 S.	165 E.
12	14 20 26*	New Zealand foreshock. Mag. 6.9	48½ S.	165 E.
12	23 33 46.5	Near Wheeler Ridge, Calif. Minor property damage. Mag. 5.9.	35 N.	119.1 W.
13	00 13 12*	Off coast of South Island, New Zealand. Felt. Mag. 6.9	48½ S.	165 E.
14	02 11 25**	Celebes Sea		
14	19 37 38**	Fox Islands, Aleutian Islands. Depth slightly greater than normal.		
15	03 24 03**	Kermadec Islands		
15	23 30 32*	Tonga Islands. Depth slightly greater than normal	19½ S.	174 W.
16	22 45 27*	Off coast of Vancouver Island, British Columbia	49 N.	129½ W.
17	03 03 20**	Tonga Islands		
17	03 03 57*	Off coast of Honshu, Japan	34 N.	141 E.
17	11 46 10*	Central Honshu, Japan. Felt at Tokyo. Depth about 60 km	36 N.	139½ E.
17	17 39 33*	Mozambique	16½ S.	36 E.
17	20 43 43*	Rat Islands, Aleutian Islands. Depth about 150 km	52 N.	178½ E.
18	09 39 58**	New Hebrides Islands		
18	10 47 07**	Banda Sea		
18	14 16 05**	Near west coast of Greece. Felt		
18	14 45 10*	Near east coast of Kamchatka	52½ N.	159 E.
19	21 16 40*	Samoa Islands region	14 S.	175½ W.
20	04 16 25*	Pacific Ocean, south of Mexico. Mag. 6	8½ N.	103½ W.
20	13 50 14*	Tonga Islands. Depth about 200 km	21 S.	176½ W.
20	20 50 01*	Southeastern Wyoming. Felt in Laramie	41½ N.	105½ W.
21	23 24 26**	Fiji Islands. Depth about 600 km		
22	11 16 07*	Near Unimak Island, Alaska	54 N.	163 W.
22	11 39 09*	New Britain	6 S.	151½ E.
22	21 23 04*	Loyalty Islands. Depth about 100 km	20 S.	169 E.
23	16 06 30*	Tadzhik S. S. R.	37½ N.	72½ E.
23	17 11 54*	do	37½ N.	72½ E.
24	13 32 47**	Near west coast of Greece		
25	03 29 28**	Near Negros, Philippine Islands		
25	16 03 45*	North Atlantic Ocean	33 N.	40 W.
26	08 58 59*	Near coast of New Britain	6½ S.	152 E.
27	10 30 00*	Near coast of Alaska Peninsula. Depth slightly greater than normal.	56½ N.	157 W.
27	14 19 47*	Southern California. Felt at Tehachapi. Mag. 5.0	35½ N.	118½ W.
27	18 16 07**	Near coast of Guerrero, Mexico. Felt at Chilapa. Depth about 60 km.		
28	22 14 54**	Near coast of Guerrero, Mexico. Felt at Acapulco. Depth about 60 km.		
29	08 00 14*	Solomon Islands. Depth about 100 km	8½ S.	159 E.
30	18 27 44*	Near Unimak Island, Alaska	54 N.	163 W.
31	11 43 27*	Off east coast of Kamchatka	52 N.	160 E.
31	14 03 10*	Fiji Islands region. Depth about 600 km	21 S.	179½ E.
Feb. 1	00 32 00**	Fiji Islands region. Depth about 300 km		
1	01 06 48*	Volcano Islands. Mag. 7.1	24 N.	143 E.

Footnotes at end of table.

TABLE 2.—*Summary of instrumental epicenters for 1954*—Continued

1954	Origin Time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter	
			Latitude	Longitude
			° ′	° ′
Feb. 1	01 20 07*	Volcano Islands aftershock	24 N.	143 E.
1	02 23 13*	....do	24 N.	143 E.
1	03 33 19*	Southern Idaho	43 N.	114 W.
1	04 03 11*	Volcano Islands aftershock	24 N.	143 E.
1	04 23 54	Lower California. Felt. Mag. 5.2	32¼ N.	115¼ W.
1	04 31 59.5	Lower California. Felt. Mag. 5.6	32¼ N.	115¼ W.
1	05 46 41*	Volcano Islands aftershock	24 N.	143 E.
1	06 20 57**	....do		
1	08 15 40**	Kermadec Islands region		
1	13 05 27.5	Lower California aftershock. Felt. Mag. 5.1	32¼ N.	115¼ W.
1	14 00 44**	Greenland foreshock		
1	15 46 00**	....do		
2	04 42 12*	Near coast of Peru	6½ S.	81 W.
2	17 45 45*	Off northeast coast of Greenland	83 N.	7 W.
3	08 04 06**	Off east coast of Honshu, Japan		
3	15 56 51*	Hindu Kush	36½ N.	70 E.
3	18 23 53*	Kurile Islands. Depth about 100 km	45½ N.	148½ E.
4	03 43 21**	Off east coast of Honshu, Japan		
5	09 19 42*	Off coast of New Britain. Mag. 6¾	4½ S.	153 E.
5	13 08 53*	Colombia-Venezuela border. Depth about 100 km	7½ N.	71½ W.
5	15 17 59*	Chiapas, Mexico. Extensive property damage at Chilon, Petalcingo, Tila, and Wajalon. Depth about 100 km. Mag. 6¼.	17½ N.	92½ W.
7	06 15 21*	New Hebrides Islands. Depth about 100 km. Mag. about 6	15 S.	167½ E.
7	21 38 10**	About 300 miles south of Kermadec Islands		
8	00 28 20**	Central Chile-Argentina border region		
8	14 19 09*	Northern Chile-Bolivia border. Minor damage at Calama, Chile. Depth about 150 km.	22½ S.	68 W.
8	18 43 10*	Off southeast coast of Honshu, Japan	29½ N.	141 E.
9	04 03 58*	Near east coast of Hokkaido, Japan	43 N.	144 E.
9	08 56 25*	Leeward Islands. Depth about 60 km	19 N.	64 W.
9	17 39 40*	Fox Islands, Aleutian Islands. Depth about 100 km	53 N.	166½ W.
9	23 27 36**	North Atlantic Ocean about 400 miles southwest of Azores		
10	11 33 43*	Marianas Islands	14 N.	143 E.
10	23 58 38*	Near Wheeler Ridge, Calif. Felt at Bakersfield and Santa Barbara. Mag. 4.5.	35 N.	119 W.
11	00 30 16*	Kansu Province, China. Felt in Lanchow district. Mag. 7.2	39½ N.	101 E.
11	14 33 50**	Leeward Islands		
11	21 04 50*	Marianas Islands	14½ N.	144 E.
12	01 47 41*	Kansu, China aftershock	40 N.	100½ E.
12	03 13 49**	Near east coast of Dominican Republic. Depth about 150 km		
12	10 08 46*	Southern Peru. Depth about 150 km	17½ S.	70 W.
12	21 22 30**	Near north coast of Java		
14	06 41 44*	Near coast of northern Peru	6½ S.	81 W.
14	10 43 21*	Fiji Islands. Depth about 600 km	17 S.	179½ W.
14	14 42 02*	Off coast of Honshu, Japan	33½ N.	141 E.
15	03 22 45*	South of Panama. Mag. 6¼–6½	5½ N.	82½ W.
15	12 03 06*	Near coast of Mexico. Minor damage at Acapulco. Depth slightly greater than normal.	16½ N.	100 W.
15	15 40 37*	Northern Peru foreshock	6½ S.	81 W.
15	19 50 52*	Near coast of northern Peru	6½ S.	81 W.
17	01 38 50*	Off southeast coast of Kamchatka	51½ N.	160 E.
17	08 57 54*	....do	51½ N.	160 E.
17	11 36 18*	Kurile Islands. Depth about 100 km	46½ N.	151 E.
19	00 40 25*	Off coast of Nicaragua. Felt at Managua. Mag. 6½–6¾	11½ N.	87½ W.
19	13 28 26*	Sinkiang, China	45 N.	91½ E.
19	19 07 51*	Kermadec Islands. Felt on Raoul Island. Depth about 60 km. Mag. 7.0.	30½ S.	177½ W.
19	21 34 41*	Near coast of Nicaragua. Felt at Mangua and San Salvador. Mag. 6½–6¾.	12½ N.	87½ W.
19	23 36 13*	Michoacan, Mexico. Felt at Uruapan. Depth about 100 km	19 N.	101 W.
20	02 00 43*	Nicaragua aftershock. Felt at Managua. Mag. 5¾–6	11½ N.	87½ W.
20	04 27 47**	Near coast of Nicaragua		
20	18 35 05*	Flores Sea. Depth about 580 km. Mag. 7.0	7 S.	124½ E.
20	19 53 00**	Windward Islands region. Depth about 100 km		
20	21 28 28*	Kermadec Islands. Felt on Raoul Island	28 S.	177½ W.
21	01 29 06**	Near coast of Nicaragua. Depth about 60 km		

Footnotes at end of table.

TABLE 2.—*Summary of instrumental epicenters for 1954*—Continued

1954	Origin Time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter	
			Latitude	Longitude
			° ′	° ′
Feb. 21	04 21 55**	Northern Kurile Islands		
21	04 50 30**	Kermadec Islands		
21	15 54 42*	Fiji Islands	15½ S.	178 W.
21	16 09 11*	Andreanof Islands, Aleutian Islands	52 N.	175½ W.
21	18 43 35**	Off south coast of Kamchatka		
21	20 20 46*	Colorado-Utah border	40 N.	109 W.
21	22 49 04*	New Hebrides Islands	17½ S.	169½ E.
21	23 39 25*	Near coast of Nicaragua. Depth about 60 km	12½ N.	87 W.
22	06 11 26*	Off coast of Honshu, Japan. Felt	34½ N.	141 E.
22	10 03 40*	Solomon Islands	9½ S.	161 E.
22	10 26 39*	Honshu aftershock	34 N.	141 E.
22	12 03 36*	Sandwich Islands. Depth about 140 km. Mag. 7.0	57 S.	27 W.
23	06 40 30*	Bhutan. Felt at Shillong, India	27½ N.	91 E.
24	17 27 52*	Near coast of Honshu, Japan. Felt at Tokyo and Yokohama	35½ N.	139½ E.
24	19 36 15*	Marianas Islands	13 N.	144 E.
24	20 45 19*	Bonin Islands region. Depth about 500 km	27½ N.	140 E.
24	22 30 20.5	Near Wheeler Ridge, Calif. Felt at Bakersfield. Mag. 4.5	35.1 N.	119.1 W.
25	11 09 44*	South Pacific Ocean	39 S.	91 W.
25	11 50 42*	North Atlantic Ocean	52½ N.	34 W.
25	22 15 15*	South of Panama	5½ N.	83 W.
25	23 51 40*	Honshu aftershock	34 N.	141 E.
26	03 21 12*	Kurile Islands. Depth about 100 km	45 N.	148 E.
26	18 46 19*	Hindu Kush. Depth about 220 km	36 N.	71 E.
27	23 34 32*	New Hebrides Islands	13 S.	166½ E.
28	00 55 22*	Ryukyu Islands region. Felt on southern Kyushu, Japan. Mag. 6.	27 N.	131 E.
Mar. 3	06 02 55*	Central New Guinea. Mag. 7.0	5½ S.	142½ E.
3	07 44 36*	Near east coast of Kamchatka	53 N.	160 E.
3	10 37 10**	Central New Guinea. Depth about 60 km		
3	15 21 27*	New Guinea aftershock	5½ S.	142½ E.
3	18 35 53**	Mona Passage, West Indies. Depth about 100 km		
3	19 47 54*	Near west coast of Greece	38 N.	21 E.
3	20 46 07*	Southern Alaska. Felt at Valdez. Depth about 60 km	61½ N.	146½ W.
4	10 46 05**	Kermadec Islands region		
5	04 13 27*	Near north coast of Honshu, Japan	40½ N.	143 E.
5	11 17 43*	Ceram Island, East Indies	3 S.	130 E.
6	00 29 27*	Fiji Islands region. Depth about 550 km. Mag. 6½	24 S.	180
7	01 44 30**	Ascension Island region		
7	23 35 00*	Off east coast of Honshu, Japan	38 N.	144 E.
8	08 17 19*	Near west coast of Greece. Minor damage on Cephalonia	38 N.	20½ E.
8	13 37 35*	Off east coast of Honshu, Japan	37½ N.	143 E.
8	18 00 45*	Samoa Islands region	15 S.	175 W.
8	18 05 55*	Near coast of El Salvador. Felt in El Salvador. Depth about 60 km.	13 N.	89 W.
8	20 26 24**	New Hebrides Islands region		
9	02 21 43*	Atlantic Ocean, northeast of Brazil. Mag. 6	1½ N.	30½ W.
9	05 30 48**	Chinghai Province, China		
9	05 39 20*	Off south coast of Kamchatka. Mag. 6¼–6½	50 N.	157 E.
9	10 25 02*	Fiji Islands. Depth about 350 km	19½ S.	178 W.
9	11 07 03*	Samoa Islands region. Felt at Apia	16 S.	173 W.
9	19 38 55**	Northern Colombia. Felt at Santa Rosa de Viterbo-Boyaca		
9	21 36 05*	Dominican Republic	19 N.	71 W.
10	07 22 55*	Fiji Islands region	13½ S.	178½ W.
10	14 09 07*	Ecuador. Depth about 100km	2 S.	78 W.
11	10 30 10*	Guatemala. Depth about 100 km. Mag. 5¾	14½ N.	90½ W.
12	11 12 10**	Sandwich Islands region		
12	11 23 47*	Tonga Islands. Felt at Apia	17 S.	174 W.
13	00 58 53**	Southern Pakistan		
14	08 52 36*	Fiji Islands	16 S.	179 W.
14	12 54 32**	Kermadec Islands. Depth slightly greater than normal		
14	17 44 28**	Off southeast coast of Kamchatka	51½ N.	160 E.
16	01 02 57*	Off coast of Panama	7½ N.	82 W.
16	05 27 04**	Northern Kurile Islands. Depth about 60 km		
16	09 54 18*	Off coast of Crete	34 N.	27 E.
16	15 56 18**	Northwest Washington. Felt in Seattle and Tacoma		
17	13 00 50**	Off coast of Guerrero, Mexico		

Footnotes at end of table.

TABLE 2.—*Summary of instrumental epicenters for 1954*—Continued

1954	Origin Time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter	
			Latitude	Longitude
			° ′	° ′
Mar. 19	08 11 02*	Fiji Islands region	25 S.	178 W.
19	09 54 27	Santa Rosa Mountains, Calif. Slight property damage. Mag. 6.2.	33.3 N.	116.1 W.
19	10 21 17*	Santa Rosa Mountains aftershock. Mag. 5.5	33½ N.	116 W.
20	14 04 07*	Kurile Islands. Depth about 100 km	47 N.	154 E.
21	06 09 23*	Near southeast coast of Kamchatka. Depth about 60 km	52 N.	158½ E.
21	12 03 40**	About 400 miles south of Kermadec Islands		
21	20 43 10**	Off coast of Guatemala		
21	23 42 00*	Northwestern Burma. Minor damage at Shillong. Also felt in East Pakistan; Assam, Bengal, Bihar and Orissa Provinces, India. Depth about 180 km. Mag. 7.4.	24½ N.	95 E.
22	06 00 34**	Tonga Islands region		
22	06 49 05*	Kermadec Islands region foreshock	27 S.	176½ W.
22	09 38 43*	Kermadec Islands region	27 S.	176½ W.
22	10 23 39*	Central New Guinea	5 S.	140 E.
22	16 31 33**	Kansu Province, China		
22	17 10 50*	Southern Mexico. Depth about 60 km	17 N.	95½ W.
22	18 58 02*	Near east coast of Kamchatka	55½ N.	157 E.
23	04 14 47*	Santa Rosa Mountains aftershock. Felt. Mag. 5.1	33½ N.	116 W.
24	01 31 39**	Marianas Islands. Depth about 100 km		
25	03 33 40*	Samoa Islands region	15 S.	176½ W.
25	09 30 58*	Kermadec Islands	28½ S.	178 W.
26	04 35 25*	Off south coast of Hokkaido, Japan. Depth about 60 km	42 N.	142 E.
26	09 39 06*	Near coast of Ecuador	2 S.	79½ W.
26	10 47 17*	Southern Kurile Islands. Depth about 60 km	44 N.	147 E.
27	11 34 00*	Near west coast of Hokkaido, Japan. Depth about 250 km	44½ N.	142 E.
27	18 21 05*	Central Peru. Depth about 150 km	8 S.	75½ W.
27	18 40 55*	Near coast of Costa Rica. Felt San Jose. Depth about 100 km.	9 N.	84 W.
28	01 23 33**	Samoa Islands		
28	06 04 08*	....do	12½ S.	171 W.
28	12 58 35*	About 500 miles northwest of Easter Island		
28	17 10 40*	Fox Islands, Aleutian Islands	53 N.	168 W.
28	19 20 58*	Peru-Brazil border. Depth about 100 km	7½ S.	73½ W.
28	20 36 22*	Rat Islands, Aleutian Islands. Mag. 6-6¼	52 N.	176 E.
28	20 58 09*	Near Islands, Aleutian Islands. Depth about 60 km	52 N.	175½ E.
29	00 34 48*	North Atlantic Ocean	50 N.	16 W.
29	04 01 10*	Near north coast of Luzon Island, Philippine Islands	19½ N.	121 E.
29	06 17 05*	Near south coast of Spain. Extensive property damage at Malaga. Felt at Cadiz, Granada, and Madrid, Spain; Tangier, Spanish Morocco, and Casablanca, French Morocco. Depth about 640 km. Mag. 7.0.	37 N	3½ W.
29	13 58 30*	Ecuador. Felt in Guayaquil. Depth about 100 km	2½ S.	78½ W.
30	10 46 48*	Kurile Islands	46½ N.	153½ E.
30	13 57 02*	Samoa Islands	13 S.	171 W.
30	16 19 57*	Rat Islands, Aleutian Islands	52 N.	175½ E.
30	16 32 03*	....do	52 N.	175½ E.
30	16 40 03*	Hawaii foreshock. Felt at Hilo. Mag. 6	20 N.	155 W.
30	18 41 54*	Near northwest coast of Hawaii, T. H. Minor damage at Hilo. Mag. 6½.	20 N.	155 W.
31	08 30 04*	Samoa Islands	12 S.	171½ W.
31	18 25 48*	Arabian Sea. Mag. 7.2	13¼ N.	58 E.
April 1	02 22 16*	Off coast of Puerto Rico	19½ N.	65½ W.
1	14 08 59*	North of Puerto Rico. Depth about 60 km	19½ N.	67 W.
1	18 18 47*	Kurile Islands. Depth about 60 km. Mag. 6¼	46½ N.	153½ E.
1	23 11 22*	Southern Mexico. Felt at Tichucalco and Chiapas. Depth about 150 km.	17½ N.	92 W.
2	10 23 25*	Fiji Islands region	17 S.	178 W.
2	14 58 26*	Kermadec Islands. Depth about 60 km	28½ S.	177 W.
2	20 25 45*	Near south coast of Kamchatka	50½ N.	156 E.
3	00 04 40*	Off east coast of Kamchatka	52½ N.	159½ E.
3	01 20 58*	....do	53½ N.	163½ E.
3	07 59 44*	Off coast of Colombia	3 N	80 W.
4	13 20 04*	Tonga Islands region. Depth about 200 km	16½ S.	175 W.
4	23 13 55*	Near south coast of Hokkaido, Japan. Felt	42 N.	142½ E.
5	17 52 22*	Argentina-Bolivia-Chile border. Felt in Calama, Chile. Depth about 150 km.	23 S.	67½ W.

Footnotes at end of table.

TABLE 2.—*Summary of instrumental epicenters for 1954*—Continued

1954	Origin Time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter	
			Latitude	Longitude
			° ′	° ′
April 5	19 26 00*	Off Vancouver Island, British Columbia	48 N.	129 W.
5	19 34 57*	----do----	48 N.	128 W.
6	14 35 10**	Southern Iran		
6	20 24 08**	New Hebrides Islands		
7	16 34 25**	Rat Islands region. Aleutian Islands		
8	16 39 52*	Easter Island region	23½ S.	116 W.
9	06 17 30**	Southern Peru-Bolivia border region. Depth about 200 km		
9	07 15 03*	Off north coast of Luzon, Philippine Islands. Felt at Calayan and Aparri.	19½ N.	121½ E.
9	13 56 20*	Bonin Islands region. Depth about 400 km	27 N.	140 E.
10	03 07 47**	Off east coast of Kamchatka		
10	08 05 06**	New Hebrides Islands. Depth about 60 km		
10	10 15 46*	Off north coast of Panama. Felt at Balboa Heights, Canal Zone.	10½ N.	78 W.
10	13 14 17**	New Hebrides Islands. Depth about 200 km		
11	03 03 03*	Solomon Islands	7 S.	155 E.
11	03 15 51**	Solomon Islands aftershock		
11	04 38 30**	Samoa Islands		
11	05 40 03*	Northern Chile-Argentina border. Depth about 150 km	26½ S.	68½ W.
11	10 25 21*	Arabian Sea	11 N.	57 E.
11	10 53 20*	Hindu Kush. Depth about 60 km	37 N.	70½ E.
11	18 36 33**	Solomon Islands		
12	19 36 15**	Samoa Islands		
13	07 36 23*	Catamarca Province, Argentina. Depth about 200 km	27½ S.	66 W.
13	07 54 51**	Northern Colombia-Venezuela border		
13	15 25 48*	Near south coast of Honshu, Japan	34½ N.	133½ E.
14	07 45 27*	Near east coast of Kamchatka	52½ N.	158½ E.
14	07 54 24*	Northern Chile. Felt at Antofagasta. Depth about 100 km	22½ S.	70 W.
14	13 24 47*	Andaman Islands region	10 N.	93 E.
15	04 02 30*	Near south coast of Panama	7½ N.	81 W.
15	04 40 05**	Panama aftershock		
15	05 05 58**	----do----		
15	07 48 46**	----do----		
15	08 39 00**	----do----		
16	10 30 25*	Hokkaido, Japan. Depth about 60 km	43 N.	142½ E.
17	12 09 59*	Near west coast of Hokkaido, Japan. Depth about 60 km	43 N.	141 E.
17	20 10 37*	Andreanof Islands, Aleutian Islands. Felt on Adak. Mag. 6¾.	51½ N.	179 W.
17	22 54 58*	Andreanof Islands, Aleutian Islands	51½ N.	180
18	01 11 01**	----do----		
18	03 03 26*	Kermadec Islands	31 S.	178 W.
19	16 13 43**	Loyalty Islands region. Depth about 60 km		
19	16 53 20**	Western Sinkiang Province, China		
21	09 57 40*	Dagestan A. S. S. R	43 N.	46 E.
21	18 40 45**	Windward Islands		
21	20 23 05*	Near coast of Peru. Felt at Lima. Depth about 100 km	13 S.	77 W.
22	14 53 22*	Marianas Islands region	22 N.	142½ E.
23	01 21 20**	Near south coast of Costa Rica. Depth about 100 km		
24	08 33 04*	Southern Alaska. Felt at College. Depth about 100 km	63 N.	148 W.
24	17 33 50*	Near east coast of Honshu, Japan	34 N.	140½ E.
24	18 32 52*	Central Hokkaido, Japan	43 N.	141½ E.
25	00 27 54*	Atlantic Ocean, about 500 miles southwest of Liberia	0	15½ W.
25	03 42 25**	Northern Burma-China border region		
25	09 56 30**	Off northeast coast of Dominican Republic		
25	20 33 26.5	Near coast of central California. Minor damage at Watsonville and Gilroy. Mag. 5.2.	36.8 N.	121.8 W.
26	02 11 04*	Near south coast of Hokkaido, Japan	42 N.	143 E.
26	09 17 20*	Galapagos Islands	½ S.	91½ W.
26	20 24 44*	Off southeast coast of Kamchatka. Depth about 60 km. Mag. 6½.	51 N.	158½ E.
27	10 06 24*	South of Panama. Mag. 6½	6 N.	82½ W.
27	21 21 35*	South of Tasmania	56 S.	147 E.
28	04 50 51*	Near Islands, Aleutian Islands	51½ N.	175 E.
29	10 49 27*	Gulf of California foreshock. Minor damage in Western Mexico. Mag. 6½.	29½ N.	112½ W.

Footnotes at end of table.

TABLE 2.—*Summary of instrumental epicenters for 1954*—Continued

1954	Origin Time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter	
			Latitude	Longitude
April 1			° ′	° ′
29	11 34 34*	Gulf of California. Minor damage at Sonora, Mexico. Mag. 6.9.	29 N.	112½ W.
29	13 12 32**	Gulf of California aftershock		
30	00 03 10*	Off east coast of Kamchatka	53 N.	162 E.
30	06 25 32**	Kermadec Islands		
30	12 01 10*	Andreanof Islands, Aleutian Islands	51½ N.	179 W.
30	13 02 36*	Central Greece. 26 killed, 157 injured. $10 million dollar damage. Mag. 7.0.	39½ N.	22 E.
30	19 33 30*	Central Greece aftershock	39½ N.	22 E.
30	23 04 30*	Mid-Atlantic Ocean	½ N.	19 W.
May 1	00 20 03*	Fiji Islands region	17 S.	174 E.
1	00 56 32*	do	17 S.	174 E.
1	20 53 16*	Aegean Sea	36½ N.	26 E.
2	03 13 50*	Marianas Islands region	14 N.	141½ E.
2	17 48 02*	Off northwest coast of Sumatra	4 N.	94½ E.
2	18 27 20*	Near east coast of Kamchatka	53½ N.	160½ E.
3	03 58 24*	Mid-Atlantic Ocean	6 N.	35½ W.
3	05 24 55*	Near south coast of Greece	36 N.	21½ E.
3	08 51 17*	do	36 N.	21½ E.
3	11 03 50**	Near east coast of Kamchatka		
3	13 29 42*	Dodecanese Islands. Felt	36 N.	27 E.
3	15 29 40*	Off southeast coast of Kamchatka. Mag. 6.6	51½ N.	159½ E.
3	17 13 32*	Near coast of Nicaragua. Depth about 150 km. Mag. 6	12 N.	86 W.
3	18 20 26*	Sikang Province, China	31 N.	98½ E.
4	06 24 47*	Near east coast of Honshu, Japan. Felt at Tokyo	36 N.	141 E.
4	08 33 44**	West central Greece. Felt at Tropes and Patras		
4	16 43 22*	Central Greece	39½ N.	22 E.
4	16 45 33*	do	40 N.	21 E.
4	17 35 05*	Off southeast coast of Kamchatka	52 N.	159½ E.
4	17 51 22*	Devon Island region, Canada	74 N.	81 W.
4	23 44 55**	Central Greece		
5	11 01 14*	Gulf of California foreshock. Mag. 5¼	27½ N.	112½ W.
5	11 35 13*	Marianas Islands	15 N.	147½ E.
5	13 09 46*	Gulf of California. Mag. 6½-6¾	27½ N.	112½ W.
5	17 13 12*	Off south coast of Kamchatka. Mag. 6½	50 N.	156½ E.
6	09 02 14*	Off south coast of Kamchatka. Depth about 100 km	50 N.	155½ E.
7	00 23 00**	Central Peru-Brazil border region. Depth about 150 km		
7	02 19 37*	Off east coast of Hokkaido, Japan. Depth about 60 km	43 N.	146 E
7	20 55 30**	Marianas Islands, about 250 miles northeast of Guam		
8	20 15 32**	Banda Sea		
9	01 39 20**	Volcano Islands region		
9	14 14 32*	Near Jan Mayen Island	71 N.	12 W.
9	20 44 15*	Ryukyu Islands	24½ N.	125 E.
10	07 58 48*	do	26 N.	125 E.
10	14 30 38*	Fiji Islands. Depth about 600 km	17½ S.	179 W.
11	04 26 45**	Arctic Ocean, northwest of Spitsbergen		
11	22 50 02*	Off north coast of Honshu, Japan	41 N.	141 E.
12	06 22 14**	Near east coast of Mindanao, Philippine Islands		
13	14 46 38*	Oaxaca, Mexico. Minor damage. Depth about 100 km. Mag. 6½.	17 N.	95½ W.
14	22 39 25*	Near coast of Honshu, Japan. Felt in eastern Honshu. Depth about 240 km. Mag. 6.8.	36 N.	137 E.
15	13 02 14*	Northwest Washington. Felt	48 N.	122 W.
16	12 59 51**	Pribilof Islands		
16	20 10 42*	Hindu Kush. Depth about 200 km	36½ N.	70½ E.
18	05 11 05*	Central Peru. Felt	10½ S.	75½ W.
18	10 13 55*	Ryukyu Islands. Depth slightly greater than normal	25 N.	125 E.
19	06 31 05*	Molucca Passage. Depth about 100 km	3½ N.	126 E.
19	09 34 56*	Southern Switzerland. Felt in France, Italy, and Switzerland.	46½ N.	7½ E.
19	23 07 12*	New Britain. Mag. 6¼-6½	5 S.	151 E.
21	16 13 15*	Off east coast of Alaska Peninsula	56 N.	157 W.
23	04 10 27*	Kurile Islands. Depth about 150 km	46 N.	149½ E.
23	06 56 42*	Celebes Sea	3 N.	124 E.
23	23 52 42.5	Southwestern California. Felt in Los Angeles. Mag. 5.1	35 N.	118¾ W.
24	07 28 59*	Kurile Islands. Depth slightly greater than normal	48½ N.	156 E.

Footnotes at end of table.

TABLE 2.—*Summary of instrumental epicenters for 1954*—Continued

1954	Origin Time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter	
			Latitude	Longitude
			° ′	° ′
May 24	08 14 40*	Marianas Islands. Depth about 60 km	15 N.	145 E.
25	22 03 34*	Central Greece. Several injured and moderate property damage.	39½ N.	22 E.
26	01 43 03*	Off southeast coast of Kamchatka	51½ N.	159½ E.
26	09 57 55**	Kermadec Islands		
26	18 57 30*	Kurile Islands. Depth slightly greater than normal	48½ N.	156 E.
27	06 50 09*	Near east coast of Kyushu, Japan	32 N.	131½ E.
28	06 52 38**	About 400 miles off coast of Liberia		
28	07 43 00**	Central Greece		
28	08 01 00**	Off coast of Guerrero, Mexico		
29	05 37 21*	Fiji Islands. Depth about 550 km	18 S.	178 W.
29	12 11 37*	Northern Bolivia	12 S.	68 W.
29	14 57 36**	Central Chile-Argentina border. Felt in Chile. Depth about 150 km.		
29	22 21 00**	Kermadec Islands region		
30	04 41 00*	Near coast of Peru	11½ S.	78 W.
30	19 46 56**	Celebes Sea		
31	15 48 48*	Flores Sea. Depth about 150 km. Mag. 6½	8 S.	118½ E.
June 1	20 32 38*	Central Peru	12 S.	74 W.
4	00 45 18*	Kurile Islands	45 N.	148 E.
4	06 50 42*	Galapagos Islands. Mag. 6¾	½ S.	91½ W.
4	10 41 37**	Java Sea		
4	16 01 45**	Central Gulf of California. Mag. 6		
4	16 56 46**	Kermadec Islands		
4	20 42 25**	Gulf of California. Mag. 5½		
5	01 48 20*	Near coast of Guerrero, Mexico. Felt	18 N.	102½ W.
5	04 31 26*	Northern Chile. Depth about 200 km	22 S.	69 W.
5	13 14 24*	Central Honshu, Japan. Felt. Depth about 60 km	36 N.	139½ E.
5	14 05 32*	Central Greece	39½ N.	21½ E.
6	16 50 33*	Western New Guinea. Mag. 6¾	3½ S.	136½ E.
6	21 58 37*	Off south coast of Honshu, Japan	32 N.	140 E.
7	10 15 33*	New Britain region. Depth about 450 km. Mag. 6¾	3½ S.	152½ E.
8	00 16 13*	Northern Idaho. Felt	47½ N.	116 W.
9	10 02 50*	Near north coast of Luzon, Philippine Islands. Felt at Tuguegarao, Aparri, Laoag, and Baguio.	18 N.	121½ E.
9	10 54 03*	Fiji Islands. Depth about 600 km	20½ S.	178½ W.
10	02 59 08**	New Hebrides Islands		
10	04 39 38*	North Atlantic Ocean	33½ N.	38 W.
10	18 36 49*	Fiji Islands. Depth about 750 km	19 S.	179 W.
10	22 37 56*	South of Honshu, Japan. Depth about 400 km	29½ N.	139½ E.
10	23 34 00*	Jan Mayen Island. Felt	71½ N.	8 W.
11	16 55 45*	Near Islands, Aleutian Islands. Depth about 60 km	52 N.	172½ E.
12	05 35 13*	Fiji Islands. Depth about 550 km. Mag. 6½	18 S.	179 W.
13	16 57 14*	Loyalty Islands. Depth about 100 km	22 S.	171 E.
14	06 45 50*	Tonga Islands	17 S.	174 W.
14	13 27 58**	Near south coast of Mindanao, Philippine Islands. Felt at Davao and Dadiangas.		
14	14 06 08*	Marianas Islands	19 N.	145 E.
14	16 18 45**	Sandwich Islands		
15	13 29 59*	Northern Peru. Depth about 100 km. Mag. 6½–6¾	5 S.	77 W.
17	01 42 22*	Off south coast of Kodiak Island. Mag. 6½	56 N.	154½ W.
17	18 39 03*	Kodiak Island aftershock		
18	02 01 46*	----do	56 N.	154 W.
18	17 54 40**	Sunda Strait. Felt in Djakarta		
19	01 56 30*	Off south coast of Kyushu, Japan	30½ N.	130 E.
19	03 15 40*	Mozambique Channel	15½ S.	42 E.
19	22 09 15*	Gulf of California	27½ N.	112 W.
20	20 45 57*	Near north coast of New Guinea. Depth about 60 km	5 S.	146 E.
20	22 07 54*	Mid-Atlantic Ocean	½ N.	18 W.
21	01 48 44*	Northern Chile. Depth about 150 km. Felt strongly at Montezuma. Mag. 6.6.	23 S.	68½ W.
21	02 06 53*	Banda Sea	6 S.	129 E.
21	08 59 20*	Pacific Ocean, west of Ecuador	1½ N.	84 W.
21	14 24 46*	Near east coast of Kamchatka. Depth about 60 km	55 N.	162½ E.
22	09 18 32**	Kermadec Islands region. Depth about 60 km		
24	07 58 12*	Marianas Islands. Depth about 200 km	18½ N.	145½ E.

Footnotes at end of table.

TABLE 2.—*Summary of instrumental epicenters for 1954*—Continued

1954	Origin Time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter	
			Latitude	Longitude
			° ′	° ′
June 25	05 20 11*	Arctic Ocean	73½ N.	8 E.
28	04 57 48**	Antarctic Ocean, near 59° S., 142° W		
28	21 31 45**	South central Tibet		
28	23 24 34*	Galapagos Islands	0	91½ W.
29	01 10 50*	West central Bolivia	17 S.	67½ W.
30	13 26 50*	Southwestern Ethiopia	7 N.	37 E.
30	15 05 26*	Near southeast coast of Kamchatka	51½ N.	158 E.
30	15 18 20*	Gulf of California	24 N.	109 W.
July 1	03 15 16*	Off east coast of Kamchatka	52 N.	159½ E.
1	05 23 57*	Off east coast of Formosa	23½ N.	122 E.
2	02 45 12*	Southeastern Luzon, Philippine Islands. 13 killed, many injured, and extensive property damage at Sorsogon, Bacon, Dalt, and Legaspi City. Depth about 60 km. Mag. 6¾.	13 N.	124 E.
2	09 06 19*	Northern Peru	5 S.	77 W.
2	10 43 13	South central Nevada. Mag. 5.2	38.2 N.	116.4 W.
3	00 32 53*	Near Lake Tanganyika, Belgian Congo. Damage at Uvira	3½ S.	29 E.
3	21 15 00*	Off north coast of Luzon, Philippine Islands. Felt at Calayan and Aparri.	19½ N.	121½ E.
3	21 52 33*	Near northeast coast of Hawaii, T. H. Felt in Hilo	20½ N.	155½ W.
3	22 31 25*	Near southwest coast of Java. Felt in western Java and Sumatra. Depth about 100 km. Mag. 6.9.	6½ S.	105½ E.
4	16 32 50	Yellowstone National Park. Felt	44.9 N.	110.8 W.
5	13 52 18*	Near south coast of Kamchatka. Depth about 60 km	50½ N.	156½ E.
6	04 00 13*	Bismarck Sea	3 S.	148 E.
6	08 04 42*	Kurile Islands. Depth about 100 km. Mag. 6¾	46½ N.	153½ E.
6	08 21 23*	Kurile Islands	46 N.	153 E.
6	08 54 32**	----do		
6	10 14 00*	----do	46 N.	153 E.
6	10 46 46*	----do	46 N.	153 E.
6	11 13 19	Near Fallon, Nevada. Several injured and moderate property damage. Mag. 6.6.	39.5 N.	118.4 W.
6	11 49 00*	Fallon aftershock. Mag. 5.5	39 N.	118½ W.
6	13 15 11*	Fallon aftershock. Mag. 5.2	39½ N.	119 W.
6	15 47 02**	Arctic Ocean, 200 miles west of Spitzbergen		
6	15 56 25**	Near coast of Guatemala. Depth about 150 km		
6	22 07 41	Fallon aftershock. Mag. 6.4	39½ N.	118½ W.
7	01 21 24**	Northern Kurile Islands		
8	02 13 56*	Fallon aftershock. Mag. 5.0	39½ N.	118½ W.
8	12 55 10**	Fallon aftershock. Mag. 4.8		
8	19 31 57*	Fallon aftershock. Mag. 5.4	39 N.	118½ W.
9	08 50 03**	Fallon aftershock. Mag. 4.7		
9	12 20 38*	Tonga Islands region. Depth about 100 km	16 S.	174½ W.
9	15 38 18*	Off east coast of Hokkaido, Japan	43½ N.	147 E.
9	18 28 49*	Off northwest coast of Honshu, Japan. Depth about 250 km	41 N.	138½ E.
10	16 00 40*	Near coast of central Chile	38 S.	73½ W.
10	22 56 53*	Hindu Kush. Depth about 200 km	37 N.	70½ E.
12	17 32 10*	Kurile Islands	46 N.	153 E.
12	17 44 56*	----do	46 N.	153 E.
12	18 51 43**	Kurile Islands region		
12	21 55 02*	Kurile Islands	46 N.	153 E.
13	08 04 44*	New Britain region	3 S.	151 E.
13	22 07 40**	Northern Kurile Islands		
14	23 43 48**	Kurile Islands region		
15	00 03 44*	Wallis Islands region	13 S.	177 W.
15	00 34 32**	Samoa Islands region		
15	13 24 35*	Queen Charlotte Islands region	54 N.	138 W.
16	12 41 38*	Off east coast of Honshu, Japan	40 N.	144½ E.
18	00 56 50**	Revilla Gigedo Islands region		
18	06 34 35*	Near east coast of Kamchatka	55 N.	161½ E.
18	09 07 44*	Near east coast of Honshu, Japan. Felt. Mag. 6½	35½ N.	140½ E.
18	13 18 55*	Near south coast of Greece	37½ N.	23 E.
18	14 42 38*	Near west coast of Greece	38½ N.	20½ E.
18	19 53 22*	Kermadec Islands. Felt on Raoul. Depth about 400 km	30 S.	180
19	02 15 16**	Near coast of northern Chile. Felt at Antofagasta. Depth about 60 km.		
21	04 38 51*	Szechwan Province, China	27½ N.	101 E

Footnotes at end of table.

TABLE 2.—*Summary of instrumental epicenters for 1954* —Continued

1954	Origin Time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter	
			Latitude	Longitude
			° ′	° ′
July 21	13 50 11**	Off southeast coast of Honshu, Japan		
23	04 33 30*	Central Chile. 3 injured and minor property damage in Coquimbo. Depth about 60 km. Mag. 6¾.	30½ S.	71½ W.
23	14 45 16*	Eastern Afghanistan	34½ N.	69½ E.
23	15 03 48*	Wallis Islands	14 S.	178 W.
23	20 52 20**	New Hebrides Islands		
24	09 41 16**	do		
24	21 43 49**	do		
25	11 00 15*	Northwestern Venezuela	10 N.	72½ W.
26	19 09 00*	Central Ecuador	1½ S.	79 W.
26	20 15 45*	Central Chile. 1 killed and moderate property damage in Osorno. Mag. 6½.	41 S.	73 W.
26	22 09 57*	Mid-Atlantic Ocean. Mag. 6¼	12½ N.	44 W.
27	06 46 44*	Mid-Atlantic Ocean aftershock	12½ N.	44 W.
27	20 57 45**	do		
29	03 23 46*	Southern Peru. Depth about 100 km	16½ S.	70½ W.
29	03 34 20*	Off south coast of Kamchatka. Mag. 6¼	49½ N.	158 E.
29	04 06 20**	Kurile Islands region		
29	04 42 27**	Western Switzerland. Felt		
29	06 27 59*	Kermadec Islands region	28 S.	179 W.
29	13 53 42**	Kurile Islands region		
29	22 23 54*	Tabasco, Mexico	17½ N.	92½ W.
30	02 00 10*	Near Fallon, Nevada. Felt. Mag. 5.2	39½ N.	118½ W.
30	08 46 11*	Pacific Ocean, southeast of Easter Island. Depth about 100 km. Mag. 6½.	35½ S.	97½ W.
31	00 59 57*	Ningsia Province, China. Mag. 6¾	39 N.	104 E.
31	01 15 04**	Ningsia aftershock		
31	01 22 22**	do		
31	23 22 27**	Bolivia-Chile border. Depth about 100 km		
Aug. 1	03 22 38*	Northern New Guinea	3 S.	140 E.
1	06 00 48*	Northern Chile. Depth about 100 km	20 S.	69½ W.
1	09 15 40*	Indian Ocean	12½ S.	66 E.
1	21 32 11**	Loyalty Islands		
2	10 18 53*	Near Fallon, Nevada. Minor property damage. Mag. 5.3	39½ N.	118½ W.
2	23 28 33*	Southeast of Easter Island	37 S.	99½ W.
3	18 18 11*	Northern Greece	40 N.	25 E.
4	13 52 25*	Fox Islands, Aleutian Islands. Depth about 200 km	54 N.	169 W.
4	21 35 18**	Kurile Islands		
5	03 48 27**	North central Greece		
5	04 12 54**	Northern Greece aftershock		
5	04 37 34**	do		
5	05 03 08*	Fallon aftershock. Mag. 4.7	39½ N.	118½ W.
5	08 49 52*	Rat Islands, Aleutian Islands. Depth about 60 km. Mag. 6..	52 N.	176 E.
5	09 17 41*	Northern India	36 N.	77½ E.
5	20 39 05**	Dodecanese Islands		
5	23 44 28**	Near northeast coast of New Guinea		
6	11 33 41*	Near south coast of Greece	36½ N.	23 E.
6	16 19 45*	Mid-Atlantic Ocean	1 S.	23½ W.
6	19 21 14*	Southern Italy	41 N.	16 E.
7	09 37 24*	Bolivia-Chile border. Depth about 100 km	18½ S.	69 W.
7	15 13 40**	Hindu Kush region. Depth about 220 km	36½ N.	71 E.
7	17 57 00**	East central Kamchatka		
8	06 39 24**	Near coast of Costa Rica		
8	16 30 12*	Fiji Islands region. Depth about 550 km	23½ S.	179 E.
9	19 16 48*	Off east coast of Kamchatka. Depth about 60 km. Mag. 6½	53 N.	161 E.
9	21 24 13**	Southern Kurile Islands. Depth about 150 km		
10	01 00 38**	Oaxaca, Mexico		
10	05 34 21*	South of Honshu, Japan. Depth about 400 km	30 N.	139 E.
10	13 44 52*	Kermadec Islands	32½ S.	178 W.
11	07 27 04**	Near south coast of Hokkaido, Japan		
11	08 30 16*	Crete	35 N.	24½ E.
11	11 12 36*	Near north coast of Dominican Republic. Depth about 100 km.	19½ N.	69½ W.
12	10 48 03*	New Hebrides Islands	16½ S.	169½ E.
12	11 35 23**	Central Peru		

Footnotes at end of table.

TABLE 2.—*Summary of instrumental epicenters for 1954*—Continued

1954	Origin Time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter	
			Latitude	Lo gitude
			° ′	° ′
Aug. 12	11 53 20*	Near south coast of Mindanao, Philippine Islands. Felt at Hinatuan, Zamboanga and Odiongan.	6 N.	126 E.
12	23 18 14*	Near east coast of Kamchatka	53 N.	159 E.
12	23 42 32*	Near east coast of Borneo	2 N.	118 E.
14	01 36 43*	Off southeast coast of Kamchatka	51 N.	160½ E.
14	14 01 01*	Fiji Islands. Depth about 550 km	18 S.	179 W.
14	22 56 08**	Ceram Sea		
15	05 38 35**	Salta Province, Argentina		
15	05 40 10**	Near east coast of Kamchatka		
15	23 56 56*	Near north coast of Formosa. Felt	25 N.	122½ E.
16	09 02 32**	Sinkiang Province, China		
16	14 26 44*	Fiji Islands. Depth about 550 km	21 S.	178½ W.
16	23 35 10**	Tonga Islands		
17	05 36 44**	Tonga Islands region		
18	04 42 20*	Tonga Islands. Felt at Apia and Nukualofa. Depth about 150 km. Mag. 6.8.	21½ S.	176 W.
18	15 04 48**	About 350 miles northwest of Galapagos Islands		
18	17 58 06**	Off southeast coast of Kamchatka		
19	21 03 23**	Near north coast of Turkey		
20	15 29 30**	Southeastern Arabia		
20	19 21 33*	Jan Mayen foreshock	70½ N.	15 W.
20	20 24 15**	----do		
20	22 59 16*	----do	71 N.	14 W.
21	00 25 35*	----do	71 N.	13½ W.
21	04 13 14*	----do	71 N.	14½ W.
21	06 38 33*	Near east coast of Mindanao, Philippine Islands. Felt at Dadiangas, Davao, and Hinatuan.	7 N.	126½ E.
21	07 19 46*	Jan Mayen foreshock	70½ N.	14 W.
21	13 05 05*	----do	70½ N.	14 W.
21	17 40 05*	----do	71 N.	14 W.
21	22 51 00*	Jan Mayen Island region	72 N.	13 W.
22	02 51 42*	Jan Mayen aftershock	71½ N.	13½ W.
22	10 08 02*	----do	71 N.	14½ W.
22	12 39 38*	----do	71 N.	14 W.
22	14 09 05**	Samoa Islands region		
22	18 13 43*	Marianas Islands	21 N.	145 E.
22	18 21 12*	Jan Mayen aftershock	70½ N.	14 W.
23	09 32 37*	----do	70½ N.	14 W.
23	11 39 18*	----do	71 N.	15 W.
23	12 04 30*	Near coast of Panama. Felt at Puerto Armuelles	8 N.	83 W.
23	14 35 31**	Panama aftershock. Felt at Puerto Armuelles		
23	14 57 34*	Kenai Peninsula. Felt at Anchorage	61 N.	148½ W.
24	05 51 31.5	Near Fallon, Nevada. Minor property damage at Fallon and Lovelock. Mag. 6.8.	39.5 N.	118.4 W.
25	02 17 13*	Fallon aftershock. Mag. 5.0	39½ N.	118½ W.
26	12 56 15	Fallon aftershock	39½ N.	118½ W.
26	18 40 20*	Off east coast of New Britain	5 S.	153 E.
26	19 17 22*	New Britain aftershock	5 S.	153 E.
27	10 55 00*	Volcano Islands. Depth about 100 km. Mag. 6.7	24 N.	143 E.
27	12 21 27*	Jan Mayen aftershock	70½ N.	14½ W.
28	02 41 52*	Arctic Ocean	86 N.	85 E.
28	03 47 58*	Volcano Islands. Depth about 60 km	24 N.	142 E.
28	10 01 20*	Near east coast of Honshu, Japan. Felt at Tokyo	37 N.	141 E.
28	23 04 25**	About 300 miles off south coast of Tierra del Fuego, Argentina		
29	03 41 06*	Fallon aftershock	39½ N.	118½ W.
29	03 58 05*	Fallon aftershock. Mag. 5.1	39½ N.	118½ W.
30	07 57 23*	Kurile Islands. Depth about 60 km. Mag. 6¼	44 N.	147½ E.
30	21 15 52*	Kurile Islands	49½ N.	155½ E.
31	22 20 32	Near Fallon, Nevada. Felt. Mag. 6.3	39½ N.	118½ W.
Sept. 1	05 18 46.5	Near Fallon, Nevada. Felt. Mag. 5.7	39½ N.	118½ W.
1	11 29 25**	Fallon aftershock		
1	12 25 40**	Northern Kurile Islands		
2	01 54 32*	Albania-Yugoslavia border region	42 N.	20 E.
2	18 51 29*	Santa Cruz Islands. Depth about 100 km. Mag. 6¼–6¾	10 S.	166 E.
4	03 28 32*	Northern New Guinea. Depth about 60 km. Mag. 6¼–6½	3 S.	139½ E.
4	06 43 46*	Nepal foreshock	28 N.	83½ E.

Footnotes at end of table.

TABLE 2.—*Summary of instrumental epicenters for 1954*—Continued

1954	Origin Time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter	
			Latitude	Longitude
			° ′	° ′
Sept. 4	06 45 14*	Nepal	28 N.	83½ E.
4	08 53 20*	Southeast of Formosa	21½ N.	122½ E.
4	13 11 49*	Santa Cruz Islands	11½ S.	166 E.
5	07 45 31*	Fiji Islands region. Mag. 6½	19 S.	176 E.
5	17 15 20*	Molucca Passage	2½ N.	127 E.
5	18 55 00**	Off south coast of Kamchatka		
6	00 48 23**	Wallis Islands, 400 miles west of Samoa		
6	11 25 23**	Luzon foreshock		
6	14 06 31*	do	20½ N.	122 E.
6	16 46 58*	Off north coast of Luzon, Philippine Islands	21 N.	121 E.
6	18 30 48*	Near southeast coast of Kamchatka. Depth about 60 km. Mag. 6½.	51 N.	158 E.
6	20 11 40**	Luzon aftershock		
7	00 08 23*	do	21 N.	121 E.
7	00 11 46**	do		
7	00 35 13*	Luzon aftershock. Felt at Basao	21 N.	121½ E.
7	07 14 59*	Fiji Islands. Depth about 600 km	17 S.	179 E.
8	02 39 49*	Assam-China border	29 N.	95½ E.
8	17 31 03**	Southern Peru. Depth about 100 km		
9	01 02 16*	Tonga Islands. Depth about 200 km	20½ S.	177 W.
9	01 04 37*	Northern Algeria. 1400 killed, 3000 injured, and major property damage in the region of Orleansville. Mag. 6¾.	36 N.	1½ E.
9	01 49 48**	Algeria aftershock		
9	02 52 22*	do	36 N.	1½ E.
9	03 43 55**	Central Nicaragua		
9	04 50 10**	Near coast of Colombia		
9	09 21 05**	Fallon, Nevada. Mag. 4.9		
9	09 28 41*	Algeria aftershock	36 N.	1½ E.
9	17 57 03**	Near coast of Venezuela		
9	18 54 33**	Northern Afghanistan		
10	05 44 04*	Algeria aftershock	36 N.	2 E.
11	23 57 54**	Bonin Islands region. Depth about 60 km		
12	07 43 50*	Off south coast of Hokkaido, Japan. Mag. 6¼	41 N.	143 E.
13	02 00 26*	Tonga Islands region. Depth about 150 km	23½ S.	178 W.
13	02 09 55*	Tonga Islands. Depth about 150 km. Mag. 6¾	21 S.	175½ W.
13	07 57 25**	Southern Gulf of California		
13	18 12 37*	Luzon aftershock	21 N.	121½ E.
13	18 19 16*	do	21 N.	121½ E.
14	00 48 18*	do	21 N.	121½ E.
14	07 20 07**	Ryukyu Islands region		
14	16 21 59**	Oaxaca, Mexico		
15	06 38 04*	Near coast of Peru. Depth about 60 km	4½ S.	82 W.
15	13 20 15*	Gulf of California	26 N.	110 W.
15	17 56 08*	Fiji Islands. Depth about 600 km. Mag. 6.6	18 S.	178½ W.
16	22 18 15**	Algeria aftershock		
17	01 13 08*	New Ireland region	4½ S.	153½ E.
17	07 33 21*	Near Northeast coast of Formosa. Felt	24½ N.	122 E.
17	11 03 14*	Tonga Islands region. Depth about 250 km. Mag. 6.9	21½ S.	176½ W.
17	14 45 00**	Bonin Islands		
17	19 01 52**	Colombia-Venezuela border		
18	04 55 20*	Leeward Islands region. Felt at Martinique	16 N.	60 W.
18	15 31 06*	Marianas Islands	14 N.	145 E.
18	18 24 50**	Kurile Islands		
20	00 10 09*	North Atlantic Ocean	53 N.	35½ W.
20	00 39 28*	Celebes. Mag. 5¾-6	1½ S.	120½ E.
20	08 06 00*	Fiji Islands. Depth about 600 km	20½ S.	179½ W.
20	17 05 40*	Tonga Islands. Depth about 550 km	21 S.	178 W.
21	03 40 22**	Sumbawa Island. Depth about 150 km		
21	09 41 50**	Marianas Islands		
23	21 43 36*	Kurile Islands region. Mag. 6¼	49 N.	156 E.
25	07 05 48*	Near coast of Mexico	17 N.	100 W.
25	19 22 17*	Dominican Republic	19 N.	70 W.
27	04 07 40**	Fiji Islands region		
27	16 38 20*	Southern Hokkaido, Japan. Depth about 60 km	42½ N.	142 E.
27	17 18 23**	Hokkaido, Japan		
28	00 25 00*	Off southeast coast of Kamchatka	52 N.	160 E.

Footnotes at end of table.

TABLE 2.—*Summary of instrumental epicenters for 1954*—Continued

1954	Origin Time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter	
			Latitude	Longitude
			° ′	° ′
Sept. 28	12 53 06*	Samoa Islands region	15½ S.	173 W.
28	21 43 10**	Off coast of Oaxaca, Mexico		
28	23 25 10**	Pacific Ocean, about 500 miles southeast of Easter Island		
29	08 23 49**	Tonga Islands		
29	14 34 44**	Off southeast coast of Kamchatka		
29	21 44 46**	Near east coast of Dominican Republic		
Oct. 1	02 55 31*	Santa Cruz Islands. Mag. 6¾	11 S.	166 E.
1	03 41 34**	Solomon Islands region		
1	06 50 24*	Samoa Islands. Felt at Apia. Depth about 60 km	14½ S.	173 W.
1	12 20 39**	Near coast of Chiapas, Mexico		
2	10 00 52*	Bonin Islands region. Depth about 450 km	29 N.	140 E.
2	19 48 50*	Central Peru	10½ S.	75 W.
3	02 47 17*	Santa Cruz Islands. Mag. 6¾	10 S.	165½ E.
3	08 50 45*	Komandorski Islands	54 N.	168½ E.
3	08 51 23**	Eastern Wyoming. Felt		
3	11 18 46*	Kenai Peninsula, Alaska. Minor damage at Anchorage, Seward, Valdez, and Homer. Depth about 100 km. Mag. 6¾.	60½ N.	151 W.
3	13 34 14*	Marianas Islands. Depth about 200 km	17½ N.	145 E.
3	23 21 36*	Molucca Islands	1 S.	127½ E.
4	01 33 21*	Formosa. Felt	25 N.	122 E.
4	08 12 18*	Ryukyu Islands region. Depth about 100 km	27½ N.	125½ E.
4	09 32 56*	Santa Cruz Islands	11 S.	166 E.
4	22 39 20**	New Hebrides Islands region		
5	04 18 13*	Off south coast of Honshu, Japan. Felt at Tokyo	33 N.	141 E.
5	11 28 17*	Lake Baikal, U. S. S. R.	55 N.	109 E.
6	08 20 09*	Off southeast coast of Kamchatka	52 N.	160½ E.
6	08 27 48*	----do	52 N.	160 E.
7	07 57 23**	Chagos Archipelago region, Indian Ocean		
7	19 18 08**	Off east coast of New Guinea		
8	09 14 53*	Central Chile. Depth about 100 km	31½ S.	71½ W.
8	10 46 04*	Kurile Islands	44½ N.	148 E.
9	01 47 13**	Tonga Islands region. Depth about 150 km		
9	19 12 53*	Tonga Islands region	15½ S.	173½ W.
10	23 21 40*	Near coast of Colombia	7 N.	78 W.
11	16 11 45*	Off southeast coast of Kamchatka	52 N.	162 E.
11	17 11 17**	New Hebrides Islands. Depth about 150 km		
12	19 23 30**	Northern Algeria. Property damage at Carnot, Attafs, and Dupleix.		
13	06 02 10*	South of Panama	4 N.	83 W.
14	01 35 00*	Banda Sea. Mag. 6¼–6½	7 S.	128 E.
16	00 28 11*	Jan Mayen Island region	71 N.	14 W.
16	01 02 19*	Jan Mayen aftershock	71 N.	14 W.
16	16 18 40**	Tonga Islands region. Depth about 250 km		
16	20 15 32**	Jan Mayen aftershock		
17	15 02 28**	Northern Chile		
17	22 57 18*	Lower California. Felt in San Diego and Imperial Counties, California. Mag. 5.7.	31½ N.	116½ W.
18	10 55 10**	Andreanof Islands, Aleutian Islands		
19	17 48 14*	North Atlantic Ocean	57½ N.	32½ W.
20	13 54 51**	Central Formosa		
20	19 54 05*	Fallon, Nevada. Mag. 4.4	39 N.	119 W.
20	23 41 43*	South of Honshu, Japan	31 N.	141 E.
21	00 10 07*	Southern Indian Ocean. Mag. 6½–6¾	41 S.	80½ E.
21	03 28 25*	Near east coast of Kamchatka	54½ N.	162 E.
21	06 51 48*	Guatemala. Felt in El Salvador. Depth about 60 km. Mag. 6½.	14 N.	90½ W.
21	18 01 53*	Near coast of Algeria	36½ N.	2 E.
21	20 03 00*	Central Peru. Depth about 100 km	10 S.	75 W.
22	16 29 47*	Off south coast of Honshu, Japan. Depth about 350 km	32 N.	138 E.
22	17 13 46**	----do	32 N.	138½ E.
23	00 45 08*	Kurile Islands. Depth about 100 km	45 N.	148 E.
23	18 08 14*	Fiji Islands. Depth about 100 km	16 S.	179 W.
24	09 44 05*	Lower California. Felt in San Diego and Imperial Counties, California. Mag. 6.0.	31½ N.	116 W.
24	11 21 18**	Lower California aftershock. Mag. 5.4		

Footnotes at end of table.

TABLE 2.—*Summary of instrumental epicenters for 1954*—Continued

1954	Origin Time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter	
			Latitude	Longitude
			° ′	° ′
Oct. 24	23 37 10*	Western Turkey	39½ N.	27 E.
25	19 03 50**	Fiji Islands region. Depth about 200 km		
26	19 16 42**	Andreanof Islands, Aleutian Islands		
26	20 28 13*	do	51½ N.	176 W.
26	22 22 14*	South of Panama	6 N.	82½ W.
27	03 22 54*	Andreanof Islands, Aleutian Islands	51 N.	176½ W.
27	09 54 30*	Pacific Ocean, southwest of Galapagos Islands	4 S.	105 W.
27	10 30 19*	Near Islands, Aleutian Islands	52 N.	174 E.
27	21 48 41*	Sinkiang Province, China	40 N.	77 E.
27	23 52 06**	Kodiak Island region, Alaska		
28	01 07 27*	Northern Chile. Felt at Montezuma. Depth about 100 km	22 S.	69½ W.
29	11 09 10**	Loyalty Islands region		
29	20 00 17**	New Hebrides Islands		
30	16 05 02*	Northern Kurile Islands	50 N.	157 E.
30	18 26 56**	New Hebrides Islands region		
30	21 56 50*	Ningsia Province, China	38 N.	104 E.
30	23 43 27*	Azerbaijan S. S. R.	40 N.	46 E.
30	23 58 13**	Near northeast coast of New Guinea		
31	08 01 39*	Andreanof Islands, Aleutian Islands	51 N.	176½ W.
31	23 12 52*	New Hebrides Islands. Mag. 6¼–6½ (Berk)	18½ S.	170 E.
31	23 33 52*	New Hebrides Islands	18½ S.	170 E.
Nov. 1	05 59 54**	Marianas Islands region. Depth about 300 km		
1	20 56 22*	Off coast of Guatemala. Depth about 60 km	14 N.	92 W.
1	21 09 58*	Northern Iran	37 N.	57 E.
1	23 40 55**	Peru-Chile border region. Felt at Arica, Chile		
2	08 24 08*	Sumbawa Island region. Extensive damage at Bima. Mag. 6½–6¾.	7½ S.	119 E.
2	08 25 46**	Andreanof Islands, Aleutian Islands		
2	10 05 26*	Ningsia Province, China	38 N.	104 E.
2	10 26 47**	Sumbawa aftershock		
2	10 39 47**	do		
3	03 14 20*	Andreanof Islands, Aleutian Islands. Depth about 100 km	52 N.	176 W.
3	18 07 25*	Volcano Islands	24½ N.	142½ E.
3	22 16 13**	Central Peru		
5	09 10 24*	Near coast of northern Honshu, Japan	39½ N.	142 E.
5	13 07 05**	Northern Kurile Islands		
5	18 24 04*	Off coast of Colima, Mexico	18 N.	105½ W.
5	22 46 44*	Off east coast of Kamchatka	52½ N.	160½ E.
6	13 07 14*	Southern Ryukyu Islands	23½ N.	124 E.
7	05 18 57*	Tonga Islands region	24½ S.	176 W.
7	07 06 00*	Near coast of Kamchatka	52½ N.	160½ E.
7	08 39 26*	do	52½ N.	160½ E.
7	19 50 14**	Kurile Islands		
7	22 52 47*	Eastern Turkey	40 N.	40 E.
8	02 15 28*	Haiti-Dominican Republic border. Depth about 60 km	20 N.	71 W.
9	11 35 22*	Hokkaido, Japan	43 N.	142 E.
10	07 24 52*	Kamchatka. Depth about 100 km	56½ N.	160 E.
10	18 07 22**	Northern California. Felt in Mendocino and Lake counties. Mag. 4.4 (Berk).		
11	05 14 10**	Persian Gulf		
12	12 26 47*	Lower California. Extensive damage at El Alamo. Felt in southern California. Mag. 6.3.	31½ N.	116 W.
12	21 48 34*	Samoa Islands. Felt at Apia	15 S.	173½ W.
13	14 46 31*	Northern Ryukyu Islands	30 N.	131½ E.
13	18 23 22*	Off coast of Chile	45 S.	79 W.
14	05 36 19*	Lower California aftershock. Mag. 5.4	31½ N.	116 W.
14	18 25 50**	Fiji Islands. Depth about 550 km		
15	01 38 12**	Guerrero, Mexico		
15	04 53 39*	Chile-Bolivia border	20 S.	68½ W.
15	11 30 23*	Off south coast of Honshu, Japan	34 N.	141 E.
15	16 26 40*	Marianas Islands. Depth about 200 km. Mag. 6½–6¾	19 N.	145½ E.
16	12 03 58*	Off south coast of Panama	7 N.	83 W.
17	03 59 14**	Western Bolivia		
17	11 55 12*	Lower California aftershock. Mag. 4.9	31½ N.	116 W.
17	17 18 15*	Marianas Islands. Depth about 600 km	19 N.	145 E.
18	05 20 04*	Kurile Islands. Depth about 100 km	49 N.	155 E.

Footnotes at end of table.

TABLE 2.—*Summary of instrumental epicenters for 1954*—Continued

1954	Origin Time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter	
			Latitude	Longitude
			° ′	° ′
Nov. 18	20 44 55*	Honshu, Japan	39 N.	142 E.
19	05 56 03*	Sea of Japan. Depth about 600 km. Mag. 6½	41 N.	131½ E.
20	07 01 52*	Northern Chile. Depth about 150 km	22 S.	69 W.
21	04 48 32*	Ceram Sea	2 S.	126 E.
21	07 37 27*	Kermadec Islands	29 S.	178 W.
21	16 15 26*	Near south coast of Kamchatka	51 N.	159½ E.
22	18 40 25**	Fiji Islands. Depth about 650 km		
23	02 30 48*	Assam-China border	29 N.	95½ E.
23	04 25 33*	Jan Mayen Island region	72 N.	1½ W.
23	06 24 10**	Northern Kurile Islands		
23	06 30 35**	Samoa Islands		
23	09 59 45*	Off coast of Kamchatka. Depth about 60 km. Mag. 5½	53 N.	159½ E.
23	10 17 35*	Off coast of Kamchatka. Depth about 60 km. Mag. 5¾	52½ N.	160 E.
23	13 00 05*	Near north coast of Sicily. Depth about 300 km	38½ N.	15 E.
23	15 52 29*	Chile-Bolivia border	19½ S.	69 W.
23	21 12 55*	Off southeast coast of Kamchatka. Depth about 60 kms Mag. 6–6¼.	52 N.	160½ E.
24	00 33 42*	Loyalty Islands	20 S.	169 E.
24	09 45 11**	Fiji Islands		
25	11 16 36*	Off Cape Mendocino, California. Felt in northern California. Mag. 6.8.	40½ N.	126 W.
25	12 05 00**	Off coast of Hokkaido, Japan		
25	20 48 50*	Off coast of Chiapas, Mexico	15 N.	94½ W.
25	21 33 38*	Fiji Islands region. Depth about 650 km. Mag. 6½	21½ S.	179 E.
26	08 11 22**	Fiji Islands. Depth about 200 km		
27	05 07 40*	Off east coast of Kamchatka	53 N.	161½ E.
27	08 03 09*	Chile-Bolivia border	21 S.	68 W.
27	16 02 22*	Near coast of Nicaragua	12 N.	87 W.
28	09 20 14**	El Salvador. Depth about 150 km		
29	01 39 02*	Near east coast of Kamchatka	53½ N.	160 E.
29	21 39 50**	Sinkiang Province, China		
30	20 25 54**	About 300 miles off south coast of Honshu, Japan		
Dec. 1	05 08 26**	Near coast of central Peru		
2	08 06 00**	Near coast of Chiapas, Mexico		
2	09 05 00*	Off coast of Oregon	43½ N.	125 W.
2	17 15 01**	Off east coast of Kamchatka		
2	23 13 29*	Near coast of Nicaragua. Depth about 100 km	12 N	86½ W.
3	02 10 45**	Off coast of Nicaragua		
3	08 46 02*	Off coast of Oregon	44 N.	127 W.
3	19 09 02*	Yukon, Canada	67½ N.	136 W.
3	21 38 12*	Kirgiz S. S. R.	41½ N.	74½ E.
3	22 06 20*	Near south coast of Mindanao, Philippine Islands. Depth about 250 km.	5 N.	125½ E.
3	22 27 38*	Bismarck Sea	3½ S.	148 E.
4	07 00 29*	New Britain region. Mag. 6½	5 S.	152½ E.
4	18 10 23*	Near north coast of Dominican Republic	20 N.	69 W.
4	18 31 07*	Near Trinidad. One killed, several injured and extensive property damage. Depth about 60 km. Mag. 6½.	11 N.	61 W.
6	02 51 40*	New Ireland region	3½ S.	151 E.
6	04 13 40**	New Hebrides Islands		
6	11 22 00**	Kermadec Islands		
6	11 56 24*	Near east coast of Kamchatka	54½ N.	161 E.
6	15 44 49*	Off south coast of Mindanao, Philippine Islands	4½ N.	125½ E.
6	23 45 51*	Santa Cruz Islands	11 S.	166 E.
7	06 21 33*	Near Unimak Island, Alaska	54 N.	164½ W.
7	14 48 30*	Celebes Sea region. Depth about 100 km	3½ N.	125½ E.
9	14 13 27*	Off coast of Peru	15½ S.	76 W.
9	14 30 26*	Marianas Islands	12 N.	144 E.
10	00 31 40*	Samoa Islands	12 S.	172½ W.
10	09 53 43*	....do	13 S.	171 W.
10	13 00 27*	West of Jamaica. Mag. 6¼	18½ N.	81½ W.
11	03 32 15*	Off coast of Liberia	1½ S.	13½ W.
11	12 17 52**	Tonga Islands region		
11	12 57 07*	North Atlantic Ocean. Mag. 6½	52½ N.	32 W.
12	10 39 32**	Kermadec Islands		

Footnotes at end of table.

TABLE 2.—*Summary of instrumental epicenters for 1954*—Continued

1954	Origin Time G. C. T.	Region, focal depth, and remarks	Coordinates of provisional epicenter	
			Latitude	Longitude
			° ′	° ′
Dec. 12	17 09 38*	Santa Cruz Islands	10 S.	166 E.
13	01 29 50**	Southern Kurile Islands		
13	04 06 46**	Off south coast of Kodiak Island		
13	09 20 09*	Near east coast of Mindanao, Philippine Islands. Felt at Davao and Hinatuan.	7 N.	126½ E.
13	12 45 02*	Samoa Islands	13½ S.	173½ W.
13	16 10 10*	Guerrero, Mexico	19 N.	101 W.
13	20 38 50*	Assam	27 N.	93 E.
13	22 38 43*	Molucca Passage	2 N.	126 E.
14	01 51 55**	Tonga Islands		
15	23 35 59**	Near west coast of Greece		
16	06 57 57*	Tonga Islands region	24 S.	175 W.
16	11 07 12	Near Fallon, Nevada. Moderate property damage. Mag. 7.0.	39.3 N.	118.0 W.
16	11 11 29	Fallon aftershock. Felt. Mag. 6.8	39.3 N.	118.0 W.
16	12 56 55**	Near east coast of Crete		
16	13 15 03*	Fallon aftershock. Mag. 5.0	39½ N.	118 W.
16	14 16 57*	Fallon aftershock. Mag. 5.8	39½ N.	118 W.
16	15 09 42*	Fallon aftershock. Mag. 5.1	39½ N.	118 W.
18	01 45 36**	Fallon aftershock. Mag. 4.7		
18	14 47 49**	Northern Burma		
19	10 23 40*	Jujuy Province, Argentina. Felt in northern Chile. Depth about 250 km. Mag. 6½–6¾.	23 S.	66½ W.
20	01 38 01**	Central Argentina-Chile border. Depth about 100 km		
20	12 31 58*	Fiji Islands. Depth about 600 km	17 S.	178½ W.
20	17 35 54*	Tonga Islands region	24 S.	175 W.
20	17 36 47*	Fallon aftershock. Mag. 5.0	40 N.	118 W.
21	01 22 17*	Off north coast of Luzon, Philippine Islands	20 N.	121½ E.
21	10 06 10**	Near coast of Guatemala. Depth about 150 km		
21	11 57 19*	Bismarck Sea	3½ S.	145½ E.
21	19 56 27.5	Humboldt County, California. Several injured and extensive property damage. Mag. 6.6.	40.49 N.	123.05 W.
21	22 04 05*	Marianas Islands region	22½ N.	146 E.
22	04 18 16*	Solomon Islands	5½ S.	154½ E.
23	16 27 16*	Near west coast of Greece. Minor property damage	38 N.	21 E.
24	00 56 17**	Santa Cruz Islands. Depth about 150 km		
24	02 34 53**	Bonin Islands		
24	12 26 11*	Oaxaca, Mexico	16½ N.	96 W.
26	03 40 41*	South of Honshu, Japan	30 N.	141½ E.
26	03 41 36*	....do	30 N.	142 E.
26	09 55 15**	Southern Gulf of California		
26	18 10 35**	El Salvador. Depth about 200 km		
27	05 32 45*	Fiji Islands. Depth about 500 km	19 S.	178 W.
27	06 47 41*	Banda Sea. Depth about 200 km	6 S.	130 E.
27	07 19 16*	Off south coast of Honshu, Japan	30½ N.	141 E.
27	14 18 27**	Solomon Islands		
27	19 03 06*	Marianas Islands region	12 N.	146½ E.
28	01 00 37*	New Britain region	5 S.	152½ E.
28	01 09 20*	New Britain aftershock	4½ S.	153 E.
28	02 14 13*	....do	5 S.	152½ E.
28	02 47 20**	300 miles off south coast of Honshu, Japan		
28	22 18 20**	100 miles off coast of Chiapas, Mexico		
29	09 39 59*	Kamchatka	56 N.	160½ E.
30	09 16 08*	Humboldt County, California. Mag. 5.3	41 N.	124 W.
30	10 37 13*	Tonga Islands	15 S.	174 W.
30	11 05 58*	Near south coast of Greece	37 N.	22 E.
30	11 32 28*	Fox Islands, Aleutian Islands. Felt at Unalaska. Depth about 60 km. Mag. 6½–6¾.	53 N.	168 W.
31	14 27 21*	Near east coast of Kamchatka	52 N.	159 E.

*Indicates probable error of 1/10 minute.
**Indicates probable error of ¼ minute.

TABLE 3.—*Principal earthquakes of the world from January through December 1954*

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.

1954	Origin Time G. C. T.	Region	Coordinates of provisional epicenter		Remarks
			Latitude	Longitude	
	h m s		°	°	
Jan. 12	14 20 26*	New Zealand foreshock	48½ S.	165 E.	Mag. 6.9.
13	00 13 12*	New Zealand	48½ S.	165 E.	Felt on Campbell Island and in southern New Zealand. Mag. 6.9.
Feb. 1	01 06 48*	Volcano Islands	24 N.	143 E.	Mag. 7.1.
19	19 07 51*	Kermadec Islands	30½ S.	177½ W.	Felt on Raoul Island. Depth about 60 km. Mag. 7.0.
20	18 35 05*	Flores Sea	7 S.	124½ E.	Depth about 580 km. Mag. 7.0.
22	12 03 36*	Sandwich Islands	57 S.	27 W.	Depth about 140 km. Mag. 7.0.
Mar. 3	06 02 55*	Central New Guinea	5½ S.	142½ E.	Mag. 7.0.
21	23 42 09*	Northwestern Burma	24½ N.	95 E.	Minor damage at Shillong. Also felt in Assam, Bengal, Bihar and Orissa, Provinces India. Depth about 180 km. Mag. 7.4.
29	06 17 05*	Near south coast of Spain	37 N.	3½ W.	Extensive property damage at Malaga. Felt at Madrid, Granada and Cadiz, Spain; Tangier, Spanish Morocco, and Casablanca, French Morocco. Depth about 640 km. Mag. 7.0.
Apr. 29	11 34 34*	Gulf of California	29 N.	112½ W.	Minor damage at Sonora, Mexico. Mag. 6.9.
May 14	22 39 25*	Near coast of Honshu, Japan	36 N.	137 E.	Felt in Eastern Honshu. Depth about 240 km. Mag. 6.8.
Jul. 2	02 45 12*	Southeastern Luzon, Philippine Islands.	13 N.	124 E.	13 killed, many injured, and extensive property damage at Bacon, Daet, Legaspi City, and Sorsogon. Depth about 60 km. Mag. 6¾
3	22 31 25*	Near southwest coast of Java	6½ S.	105½ E.	Felt in western Java and Sumatra. Depth about 100 km. Mag. 6.9.
6	11 13 19*	Near Fallon, Nevada	39.5 N.	118.4 W.	9 injured, moderate property damage. Felt over an area of 130,000 square miles. Mag. 6.8.
Aug. 24	05 51 31.5	....do	39.5 N.	118.4 W.	Minor property damage at Fallon and Lovelock. Felt area 150,000 square miles. Mag. 6.6.
Sept. 9	01 04 37*	Northern Algeria	36 N.	1½ E.	1,400 killed, 3,000 injured. Major damage in the region of Orleansville. Felt area extended from Tizi-Ouzou in the east to Mostagnem in the west and south to Tiaret. Mag. 6¾.
17	11 03 14*	Tonga Islands region	21½ S.	176½ W.	Depth about 250 km. Mag. 6.9.
Oct. 3	11 18 46*	Kenai Peninsula, Alaska	60½ N.	151 W.	Minor damage at Anchorage, Seward, Valdez, and Homer. Depth about 100 km. Mag. 6¾.
21	00 10 07*	Southern Indian Ocean	41 S.	80½ E.	Mag. 6½–6¾.
Dec. 16	11 07 12	Near Fallon, Nevada	39.3 N.	118.0 W.	Moderate property damage. Felt throughout Oregon, Idaho, Utah, and California, from San Francisco to Los Angeles. Mag. 7.0.
16	11 11 29*	Fallon aftershock	39.3 N.	118.0 W.	Felt Mag. 6.8.

*Indicates probable error of 1/10 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.

Interpretation of records.—The analyses appearing in tables 6 and 7 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, 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) residual clay and shale, 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 0.1 g.

Damping ratio of the pendulum is the ratio between successive amplitudes when the pendulum oscillates.

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 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, Coast and Geodetic Survey, Washington 25, D. C.

Acceleration and displacement scales representing the equivalent of 0.1 g. and 1 inch are indicated on the tracings of the acceleration and displacement curves. The scales provide the investigator with a quick means for making 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.—*Coast and Geodetic Survey strong-motion stations in operation as of December 31, 1954*

NORTHERN CALIFORNIA

Station	Accelero-graph	Displace-ment meter	Weed
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	1	
San Jose, Bank of America, 13th floor	1		
Suisun Bay Bridge	1		

SOUTHERN CALIFORNIA

Arvin	1	1	
Bakersfield	1		
Bishop	1		
Cachuma Dam, Crest	1	1	
Cachuma Dam, Valve House	1	1	
Colton	1	1	
El Centro	1	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		
Log 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, Los Angeles	1		

TABLE 4.—*Coast and Geodetic Survey strong-motion stations in operation as of December 31, 1954*—Continued

OUTSIDE CALIFORNIA

Station	Accelero-graph	Displace-ment meter	Weed
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		
Portland, Oreg., State Office Bldg	1		
Ross Dam, Wash., Block 16	1		
Ross Dam, Wash., Right Bank	1		
Seattle, Wash., Army Base	1		
Tacoma, Wash., College of Puget Sound	1		
OUTSIDE UNITED STATES			
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	61	12	11

TABLE 5.—*List of shocks recorded and records obtained on strong-motion seismographs in 1954*

Date	Region and recording station	Records			
		Accelero-graph	Survey displace-ment meter	Carder displace-ment meter	Weed
Jan. 12	Southern California, Arvin	1		1	
	Bishop	1			
	Colton	1	1		
	Hollywood	2			
	Los Angeles, Occidental Life Building	2			
	Los Angeles, Subway Terminal Building	2	1		
	Pasadena	1	1		
	San Francisco, Southern Pacific Building	2	1		
	Santa Barbara	1			
	Taft	1			
	Vernon	1			
	Westwood	1			
Jan. 27	Southern California, Arvin	1		1	
Jan. 31	Imperial Valley, California, El Centro	1		1	
	Imperial Valley, California, El Centro	1		1	
Unknown date	Southern California, Los Angeles, Edison Building	1			
	Pasadena	1	1		
	Westwood	1			
Mar. 9	Southern California, Santa Barbara	1			
Mar. 19	Southern California, Colton	1	1		
	El Centro	1		1	
	Hollywood	3			
	Hoover Dam	3			
	Long Beach	1		1	
	Los Angeles, Occidental Life Building	2			
	Los Angeles, Subway Terminal Building	2	1		
	Pasadena	1	1		1
	San Bernardino				1
	San Diego	1			
	Vernon	1			
	Westwood	1			
Apr. 21	Peru, South America, Lima	1			
Apr. 22	San Francisco, Southern Pacific Building	2	1		
Apr. 25	Central California, Hollister	1		1	
	Oakland, Chabot Observatory				1
	Oakland, City Hall	2			
	San Francisco, Alexander Building	3			
	San Francisco, 450 Sutter Building				2
	San Francisco, Shell Building				3
	San Francisco, Southern Pacific Building	2	1		
	San Jose, Bank of America Building	2		1	
	Suisun Bay Bridge	1			
May 4	Puget Sound Area, Tacoma, Washington	1			
May 15	Puget Sound Area, Seattle, Washington	1		1	
May 23	Southern California, Bakersfield	1			
	Taft	1			
	Westwood	1			
June 22	Central California, Hollister	1		1	
	Central California, Hollister	1		1	
July 6	Western Nevada, Bishop	1			
	Hollister	1		1	
	Hoover Dam	2			
	Oakland, City Hall	1			
	Sacramento				1
	San Francisco, Alexander Building	3			
	San Francisco, 450 Sutter Building				2
	San Francisco, Shell Building				3
	San Francisco, Southern Pacific Building	2	1		
	San Jose, Bank of America Building	2		1	
July 6	Western Nevada, Bishop	1			
	San Francisco, Alexander Building	3			
	San Francisco, Southern Pacific Building	2	1		
Unknown date	Unknown location, San Francisco, Southern Pacific Building	2	1		
Aug. 23	Western Nevada, Bishop	1			
	Hawthorne	1			
	Hollister	1		1	
	Oakland, City Hall	2			
	San Francisco, Alexander Building	3			
	San Francisco, Southern Pacific Building	2	1		
	San Jose, Bank of America Building	2		1	

TABLE 5.—*List of shocks recorded and records obtained on strong-motion seismographs in 1954*—Continued

Date	Region and recording station	Records			
		Accelero-graph	Survey displace-ment meter	Carder displace-ment meter	Weed
Aug. 26	Southern California, Santa Barbara	1			
Aug. 29	Peru, South America, Lima	1			
Aug. 31	Western Nevada, Bishop	1			
	Fallon	1			
	Hawthorne	1			
	Sacramento				1
	San Francisco, 450 Sutter Building				1
	San Francisco, Shell Building				3
	San Francisco, Southern Pacific Building	2	1		
Aug. 31	Western Nevada, Fallon	1			
	Hawthorne	1			
Sept. 4	Western Nevada, Fallon	1			
Sept. 5	Western Nevada, Fallon	1			
Sept. 7	Western Nevada, Fallon	1			
Sept. 9	Western Nevada, Fallon	1			
Sept. 11	Western Nevada, Fallon	1			
Sept. 13	Western Nevada, Fallon	1			
Sept. 14	Western Nevada, Fallon	1			
Sept. 20	Peru, South America, Lima	1			
Oct. 17	Imperial Valley, California, El Centro	1		1	
Oct. 24	Southern California, El Centro	1		1	
	San Diego	1			
Oct. 24	Imperial Valley, California, El Centro	1		1	
Nov. 12	Southern California, El Centro	1		1	
	Los Angeles, Occidental Life Building	2			
	Pasadena	1	1		
	San Diego	1			
	Vernon	1			
	Westwood	1			
Nov. 25	Northern California, Eureka	1			
	Ferndale	1	1		
	San Francisco, Southern Pacific Building	2	1		
Dec. 16	Western Nevada, Bakersfield	1			
	Bishop	1			
	El Centro	1		1	
	Hollister	1		1	
	Hollywood	3			
	Hoover Dam	3			
	Long Beach	1		1	
	Los Angeles, Edison Building	1			
	Los Angeles, Occidental Life Building	2			
	Los Angeles, Subway Terminal Building	2	1		
	Oakland, City Hall	2			
	Sacramento				1
	San Bernardino				1
	San Francisco, Alexander Building	3			
	San Francisco, 450 Sutter Building				2
	San Francisco, Shell Building				3
	San Francisco, Southern Pacific Building	2	1		
	San Jose	2		1	
	Santa Ana				1
	Taft	1			
	Vernon	1			
	Westwood	1			
Dec. 16	Western Nevada, Bishop	1			
	Hoover Dam	3			
	San Francisco, Southern Pacific Building	2	1		
	San Jose, Bank of America Building	2		1	
	Taft	1			
Dec. 16	Central California, Hollister	1		1	
	Oakland, City Hall	2			
	San Francisco, Southern Pacific Building	2	1		
Dec. 21	Northern California, Eureka	1			
	Ferndale	1	1		
	San Francisco, Southern Pacific Building	2	1		
Dec. 30	Northern California, Eureka	1			
	Ferndale	1	1		
Unknown date	Northern California, Eureka	1			
	Total	174	25	25	27

TABLE 6.—*Summary of outstanding instrumental and noninstrumental data for 1954*

Epicenter	Recording station and distance	Location of instrument	Intensity [1]	Acceleration	Displacement [2]
				cm./sec.²	*cm.*
SOUTHERN CALIFORNIA EARTHQUAKE OF JANUARY 12					
35°00′ N., 119°01′ W., west of Wheeler Ridge, VII to VIII.* Mag. 5.9.	Taft, 27 miles	Underground tunnel.	VI	70	0.16
SOUTHERN CALIFORNIA EARTHQUAKE OF JANUARY 27					
35°09′ N., 118°38′ W., west of Tehachapi, VI.* Mag. 5.0.	Arvin, 12 miles		VI	44	0.3
SOUTHERN CALIFORNIA EARTHQUAKE OF JANUARY 31					
32.3° N., 115.3° W., Baja California, V.* Mag. 5.6.	El Centro, 40 miles	Subbasement	V	15	0.3
SOUTHERN CALIFORNIA EARTHQUAKE OF MARCH 19					
33°17′ N., 116°11′ W., Santa Rosa Mountains, VI.* Mag. 6.2.	El Centro, 50 miles	Subbasement	VI	21	0.8
PERU EARTHQUAKE OF APRIL 21					
13° S., 77° W., near coast of Peru	Lima, 75 miles	1st floor		27	0.007
CENTRAL CALIFORNIA EARTHQUAKE OF APRIL 25					
36°56′ N., 121°41′ W., east of Watsonville, VII.* Mag. 5.3.	Hollister, 17 miles	Basement	VI	58	0.51
WESTERN NEVADA EARTHQUAKE OF JULY 6, 03:14					
39°25′ N., 118°32′ W., east of Fallon, IX.* Mag. 6.6.	San Francisco, Southern Pacific Building, 235 miles.	14th floor		26	0.9
WESTERN NEVADA EARTHQUAKE OF JULY 6, 14:08					
39.3° N., 118.5° W., southeast of Fallon, IX.* Mag. 6.4.	San Francisco, Southern Pacific Building, 235 miles.	14th floor		19	0.7
WESTERN NEVADA EARTHQUAKE OF AUGUST 23					
39°35′ N., 118°27′ W., east of Fallon, VII.* Mag. 6.8.	Hawthorne, 72 miles	Basement	VI	28	0.1
PERU EARTHQUAKE OF AUGUST 29					
Peru	Lima	1st floor		27	0.002

Footnotes at end of table.

TABLE 6.—*Summary of outstanding instrumental and noninstrumental data for 1954*—Con.

Epicenter	Recording station and distance	Location of instrument	Intensity [1]	Acceleration	Displacement [2]
				cm./sec.²	*cm.*
WESTERN NEVADA EARTHQUAKE OF AUGUST 31, 14:22					
39.6° N., 118.2° W., Dixie Valley, VII.* Mag. 6.3.	Fallon, 32 miles	Basement	VI	21	0.13
WESTERN NEVADA EARTHQUAKE OF AUGUST 31, 21:19					
39.6° N., 118.2° W., Dixie Valley, Mag. 5.7.	Fallon, 32 miles	Basement		18	0.16
WESTERN NEVADA EARTHQUAKE OF SEPTEMBER 7					
Fallon aftershock	Fallon, 32 miles	Basement		18	0.018
SOUTHERN CALIFORNIA EARTHQUAKE OF NOVEMBER 12					
31½° N., 116° W., Baja California, V.* Mag. 6.3.	El Centro, 94 miles	Subbasement	IV	21	0.6
NORTHWESTERN CALIFORNIA EARTHQUAKE OF NOVEMBER 25					
40°16′ N., 125°38′ W., Off Cape Mendocino, V.* Mag. 6.8.	Ferndale, 91 miles	1st floor	V	17	0.7
WESTERN NEVADA EARTHQUAKE OF DECEMBER 16, 03:07					
39°19′ N., 118°12′ W., near Frenchman's Station, X.* Mag. 7.0.	Bishop, 135 miles	1st floor	V	29	1.1
NORTHWESTERN CALIFORNIA EARTHQUAKE OF DECEMBER 21					
40°47′ N., 123°52′ W., 12 miles east of Eureka, VII.* Mag. 6.6.	Eureka, 15 miles	Basement	VII	228	1.5
	Ferndale, 25 miles	1st floor	VII	163	6.4
NORTHWESTERN CALIFORNIA EARTHQUAKE OF DECEMBER 30					
40°49′ N., 124°05′ W., between Eureka and Arcata, VII.* Mag. 4.7	Eureka, 15 miles	Basement	VI	49	0.17

[1] Reported intensity of earthquake at recording station.

[2] Displacement is the maximum recorded at the station reporting the maximum acceleration of the earthquake. If displacement is much greater at another location it is given along with the maximum acceleration at the same location.

*Following intensity designation in epicenter column, indicates maximum reported intensity of earthquake.

TABLE 7.—*Composite of strong-motion instrumental data for 1954*

SOUTHERN CALIFORNIA EARTHQUAKE OF JANUARY 12

Station and component	Instrument No.	T_s	V	Sensitivity	ϵ	Acceleration		Displacement		Remarks
						Period	Amplitude	Period	Amplitude*	
Arvin:		*sec.*		*cm./0.1 g*		*sec.*	*cm./sec.²*	*sec.*	*cm.*	
Vertical	V-354	0.065	117	1.27	12	0.3	8		0.02	
N.-S	L-356	.066	120	1.37	11	.4	22	1.4	.3	
E.-W	T-355	.064	122	1.27	12	.3	15	1.6	.3	
N.-S	CDM-1	2.14	1		17					
E.-W	CDM-2	2.06	1		19					
Hollywood Storage Co.: Penthouse:										
Vertical	V-193	.046	121	.64	9	.4	9		.04	
N.-S	L-192	.046	123	.66	16	.4	8		.03	
E.-W	T-191	.046	124	.66	5	.5	44		.3	
Taft:										
Vertical	V-298	.08	115	1.76	12	.2	24		.02	
N. 21° E	L-299	.08	122	1.96	10	.3	70		.16	
N. 69° W	T-300	.081	121	1.96	12	.2	67		.07	

SOUTHERN CALIFONIA EARTHQUAKE OF JANUARY 27

Arvin:										
Vertical	V-354	0.066	117	1.25	10	0.3	39		0.09	
N.-S	L-356	.068	120	1.36	10	.2	23	1.1	.3	
E.-W	T-355	.065	122	1.29	6	.1	44	.9	.3	
N.-S	CDM-1	2.14	1		16					
E.-W	CDM-2	2.10	1		16					

SOUTHERN CALIFORNIA EARTHQUAKE OF JANUARY 31

El Centro:										
Vertical	V-208	0.065	122	1.29	10	0.1	6			
N.-S	L-206	.068	122	1.38	9	.2	15	1.6	0.2	
E.-W	T-207	.066	121	1.30	12	.1	11	2.6	.3	
N.-S	CDM-3	2.31	1		10					
E.-W	CDM-4	2.32	1		10					

SOUTHERN CALIFORNIA EARTHQUAKE OF MARCH 19

El Centro:										
Vertical	V-208	0.064	121	1.24	8	0.1	7			
N.-S	L-206	.066	125	1.36	7	.6	19	1.4	0.6	
E.-W	T-207	.065	120	1.26	12	.6	21	1.4	.8	
N.-S	CDM-3	2.35	1		10					
E.-W	CDM-4	2.37	1		11					
Los Angeles, Occidental Life Building, 11th floor:										
Vertical	V-187	.046	121	.64	10	1.0	3		.08	
N. 38° E	L-186	.046	123	.63	10	1.9	8		.7	
N. 52° W	T-185	.044	122	.59	7	1.7	15		1.1	
San Diego:										
Vertical	V-322	.08	125	1.96	7	.8	3		.05	
N.-S	T-324	.08	121	1.91	9	.9	16		.3	
E.-W	L-323	.08	123	1.93	7	.4	9		.04	

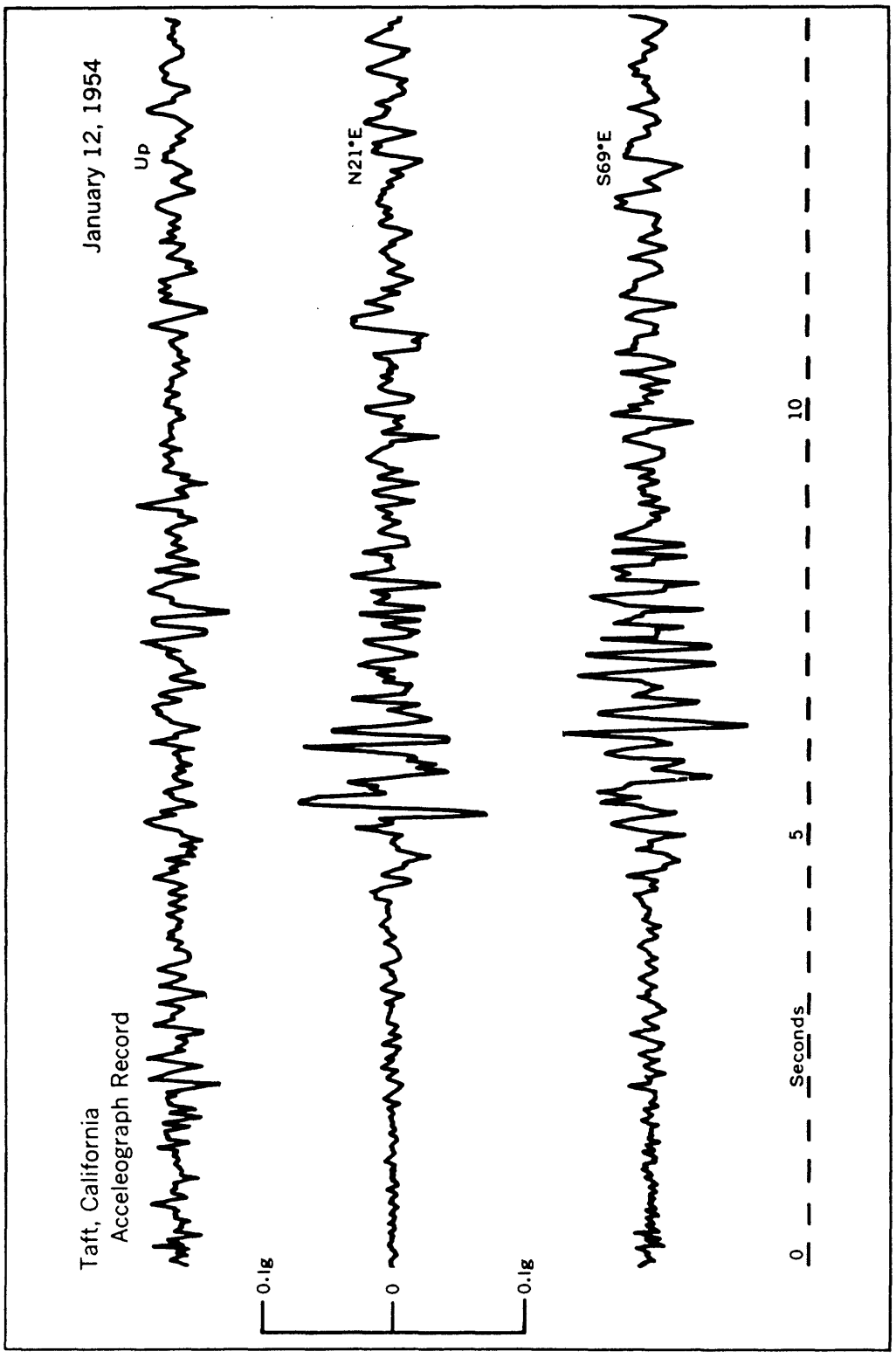

FIGURE 11.—Tracings of accelerograph records obtained at Taft, on January 12.

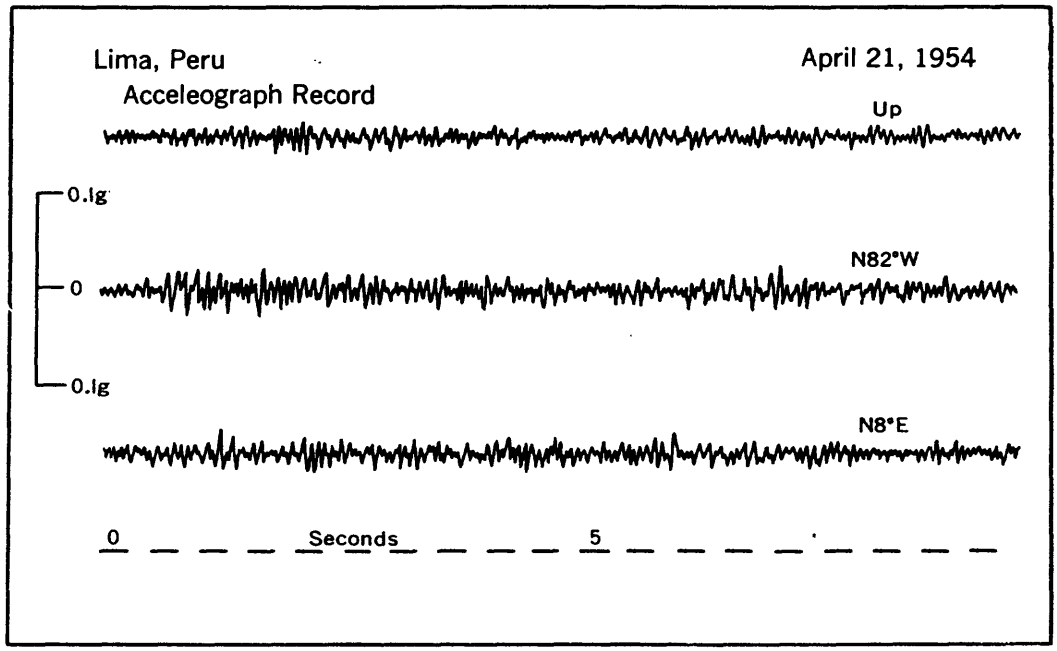

FIGURE 12.—Tracings of accelerograph records obtained at Lima, Peru, on April 21.

TABLE 7.—*Composite of strong-motion instrumental data for 1954*—Continued

PERU EARTHQUAKE OF APRIL 21

Station and component	Instrument No.	T_s	V	Sensitivity	ϵ	Acceleration		Displacement		Remarks
						Period	Amplitude	Period	Amplitude[a]	
Lima:		*sec.*		*cm./0.1 g*		*sec.*	*cm./sec.²*	*sec.*	*cm.*	
Vertical	V-286	0.065	123	1.28	7	0.1	15		0.004	Waves approximately sinusoidal.
N. 8° E	T-288	.064	122	1.24	8	.1	24		.006	Do.
N. 82° W	L-287	.064	125	1.27	7	.1	27		.007	Do.
CENTRAL CALIFORNIA EARTHQUAKE OF APRIL 25										
Hollister:										
Vertical	V-238	0.067	122	1.37	9	0.1	24		0.01	
N. 1° E	L-239	.065	124	1.31	7	.7	54	0.8	.51	
N. 89° W	T-240	.065	122	1.29	13	.6	58	.6	.44	
N. 1° E	CDM-5	2.08			8					
N. 89° W	CDM-6	2.27			7					
Oakland, City Hall, 16th floor:										
Vertical	V-226	.047	117	.63	9	.2	11		.01	
N. 26° E	L-227	.046	115	.61	7	1.2	14		.5	Sinusoidal waves.
N. 64° W	T-228	.049	118	.69	8	1.3	43		1.8	Do.
San Francisco, Southern Pacific Building, 14th floor:										
Vertical	V-184	.047	120	.65	14	.2	14		.01	
N. 45° E	L-183	.047	120	.66	8	1.4	36		1.8	
N. 45° W	T-182	.046	122	.64	13	1.3	47		2	
San Jose, Bank of America Building, 13th floor:										
Vertical	V-175	.048	120	.67	10	.2	7		.01	
N. 31° W	T-173	.047	120	.65	10	1.6	12		.8	
N. 59° E	L-174	.046	121	.64	9	1.8	28		2.3	Do.

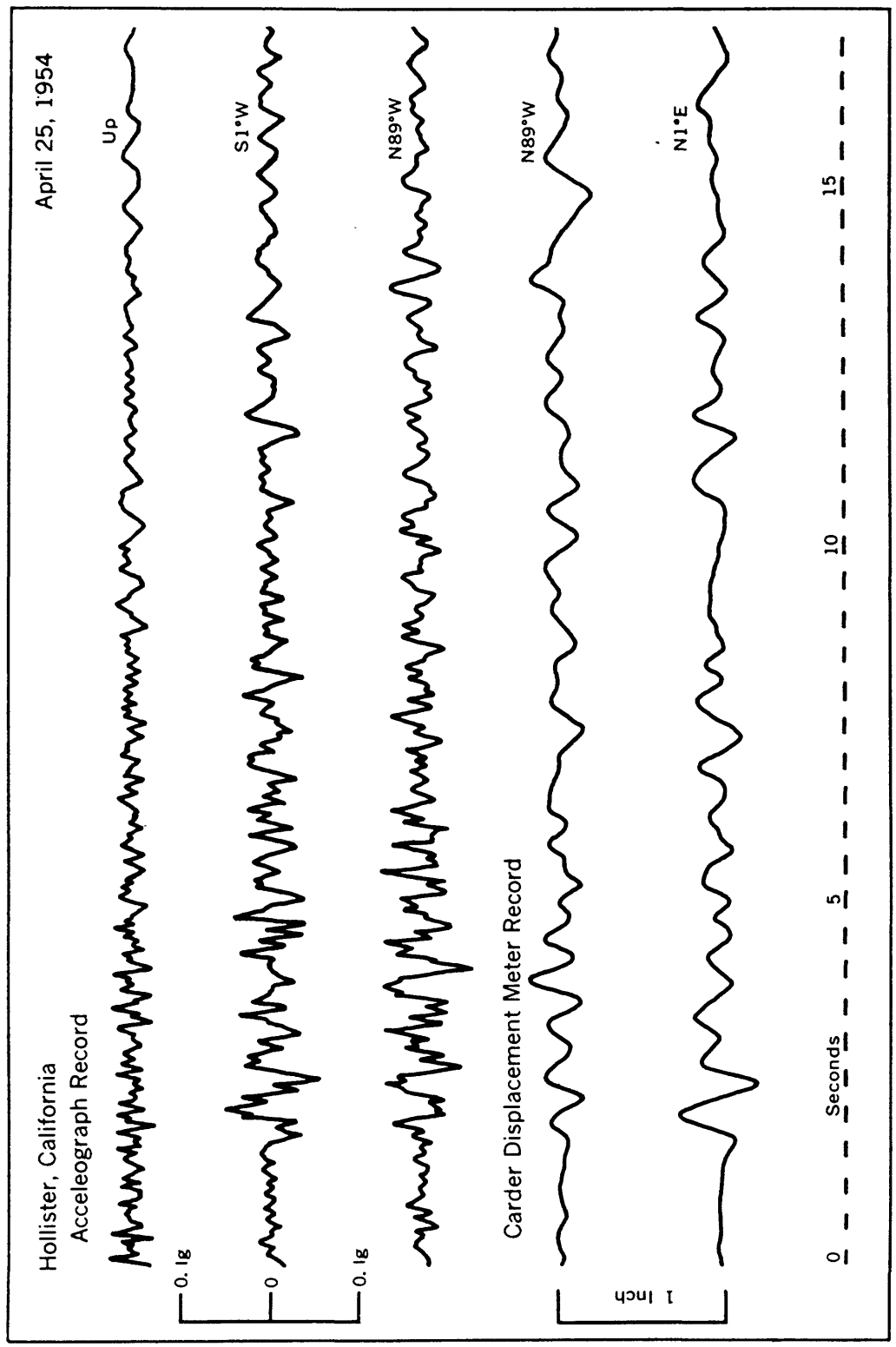

FIGURE 13.—Tracings of accelerograph and displacement meter records obtained at Hollister, on April 25.

TABLE 7.—*Composite of strong-motion instrumental data for 1954*—Continued

WESTERN NEVADA EARTHQUAKE OF JULY 6, 03:14

Station and component	Instrument No.	T_s	V	Sensitivity	ϵ	Acceleration		Displacement		Remarks
						Period	Amplitude	Period	Amplitude*	
		sec.		*cm./0.1 g*		*sec.*	*cm./sec.²*	*sec.*	*cm.*	
San Francisco, Southern Pacific Building, 14th floor:										
Vertical	V-184	0.046	119	0.64	14	1.2	3		0.1	
N. 45° E	L-183	.046	120	.63	9	1.3	16		.7	Waves nearly sinusoidal.
N. 45° W	T-182	.045	122	.61	9	1.2	26		.9	Do.

WESTERN NEVADA EARTHQUAKE OF JULY 6, 14:08

San Francisco, Southern Pacific Building, 14th floor:										
Vertical	V-184	0.046	119	0.64	14	1.6	2		0.13	
N-45° E	L-183	.046	120	.63	9	1.3	14		.6	Waves nearly sinusoidal.
N. 45° W	T-182	.045	122	.61	9	1.2	19		.7	Do.

WESTERN NEVADA EARTHQUAKE OF AUGUST 23

Hawthorne:										
Vertical	V-244	0.065	124	1.30	11	0.2	10		0.01	
N.-S.	L-245	.068	125	1.41	8	.2	28		.03	
E.-W.	T-246	.066	126	1.35	9	.5	18		.1	
San Jose, Bank of America Building, 13th floor:										
Vertical	V-175	.046	120	.62	11					Trace motion barely discernible.
N. 31° W	T-173	.047	118	.64	7	1.8	11		.9	Sinusoidal waves.
N. 59° E	L-174	.046	118	.61	8	1.8	18		1.4	Do.

PERU EARTHQUAKE OF AUGUST 29

Lima:										
Vertical	V-286	0.064	123	1.26	7	0.06	13		0.001	
N. 8° E	T-288	.063	122	1.22	9	.05	19		.002	
N. 82° W	L-287	.064	125	1.25	7	.06	27		.002	

WESTERN NEVADA EARTHQUAKE OF AUGUST 31, 14:22

Fallon:										
Vertical	V-289	0.078	123	1.87	9	0.7	5		0.06	
N.-S.	T-291	.079	120	1.86	7	.5	21		.13	
E.-W.	L-290	.079	120	1.88	10	.3	12		.03	

WESTERN NEVADA EARTHQUAKE OF AUGUST 31, 21:19

Fallon:										
Vertical	V-289	0.078	123	1.87	9	0.5	5		0.03	
N.-S.	T-291	.079	120	1.86	7	.6	17		.16	
E.-W.	L-290	.079	120	1.88	10	.4	18		.07	

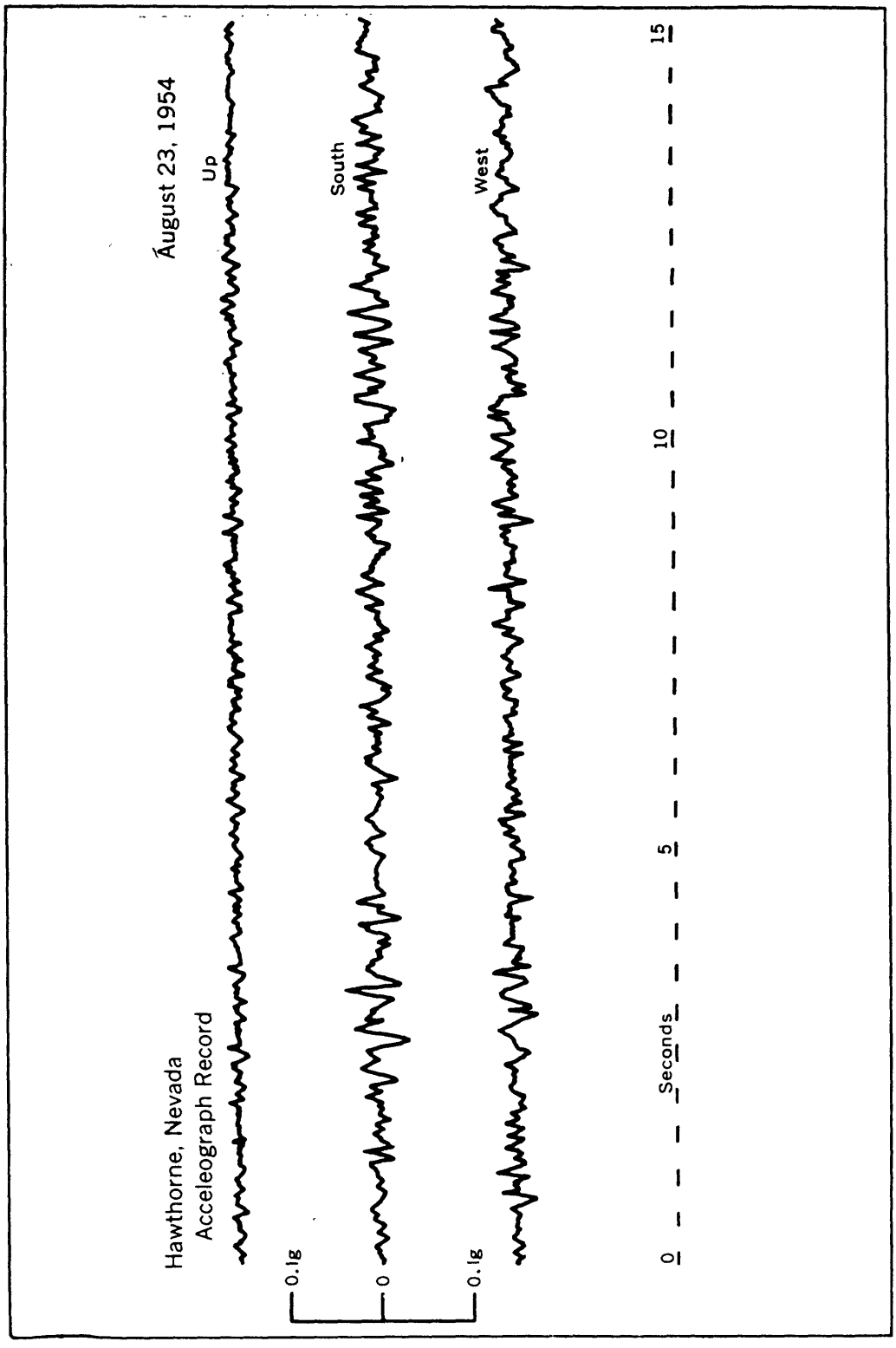

FIGURE 14.—Tracings of accelerograph records obtained at Hawthorne, on August 23.

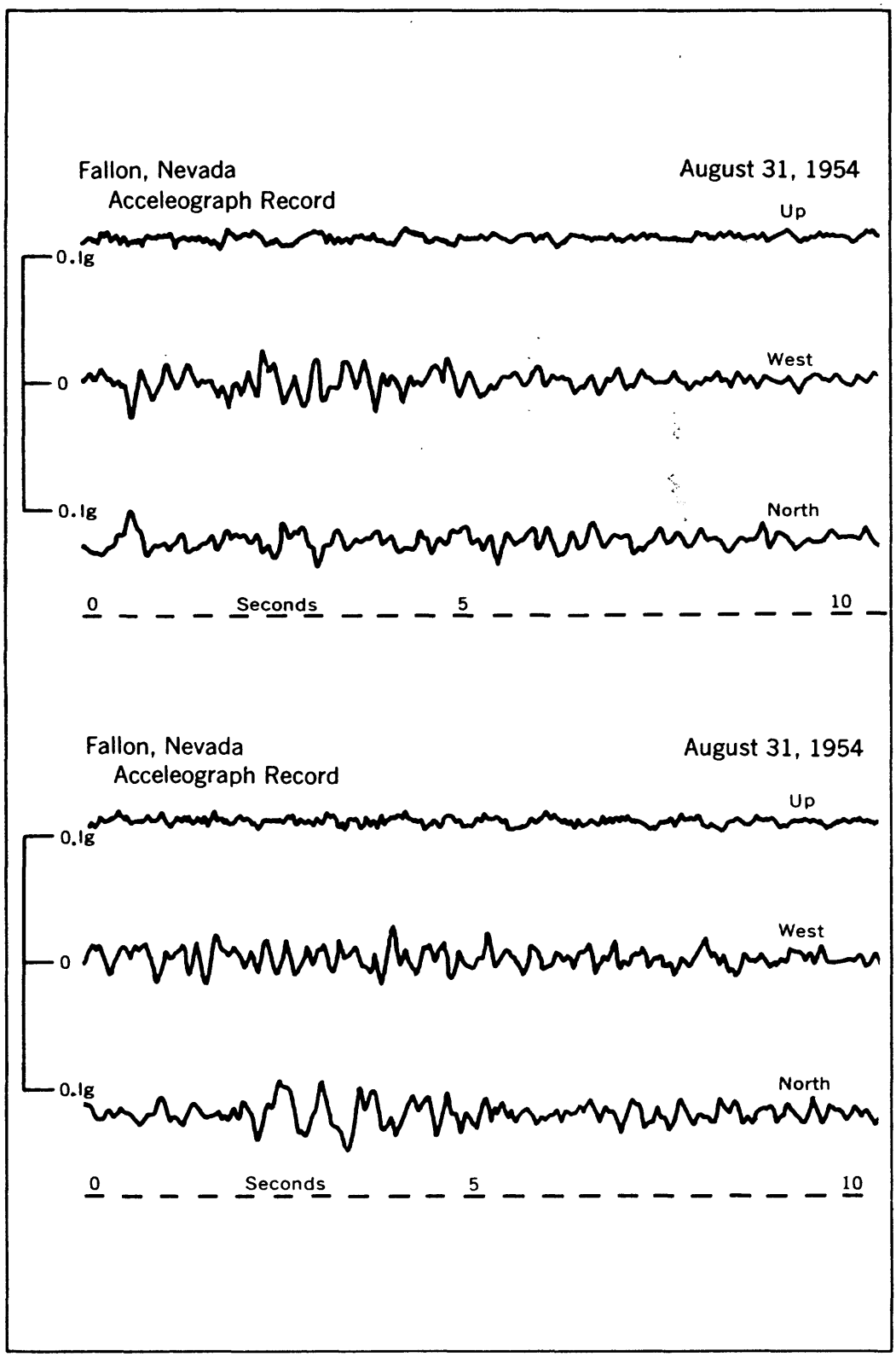

FIGURE 15.—Tracings of accelerograph records obtained at Fallon, on August 31.

TABLE 7—*Composite of strong-motion instrumental data for 1954*—Continued

WESTERN NEVADA EARTHQUAKE OF SEPTEMBER 7

Station and component direction	Instrument No.	T_o	V	Sensitivity	ϵ	Acceleration		Displacement		Remarks
						Period	Amplitude	Period	Amplitude*	
Fallon:		*sec.*		*cm./0.1 g*		*sec.*	*cm./sec.²*	*sec.*	*cm.*	
Vertical	V-289	0.078	123	1.86	10	0.2	2		0.002	
N.-S.	T-291	.079	119	1.85	4	.2	5		.005	
E.-W.	L-290	.079	120	1.87	10	.2	18		.018	
SOUTHERN CALIFORNIA EARTHQUAKE OF NOVEMBER 12										
El Centro:										
Vertical	V-208	0.065	121	1.26	8	0.4	4		0.02	
N.-S.	L-206	.066	125	1.36	9	.6	21	0.9	.6	
E.-W.	T-207	.066	120	1.29	10	.8	16	.9	.5	
N.-S.	CDM-3	2.29			10					
E.-W.	CDM-4	2.33			11					
NORTHWESTERN CALIFORNIA EARTHQUAKE OF NOVEMBER 25										
Ferndale:										
Vertical	V-247	0.066	124	1.32	13	0.4	8		0.03	
N. 44° E.	L-248	.066	125	1.35	9	.3	16	16	.55	
N. 46° W.	T-249	.064	123	1.26	12	.3	17	9	.7	
N. 44° E.	SDM-13	10.38	1		14					
N. 46° W.	SDM-13	9.66	1		11					
WESTERN NEVADA EARTHQUAKE OF DECEMBER 16, 03:07										
Bishop:										
Vertical	V-241	0.066	118	1.28	13	0.5	5		0.03	
N.-S.	T-243	.064	119	1.23	7	.4	14		.06	
						2	10		1	
E.-W.	L-242	.066	116	1.25	12	.4	29		.12	
						3	5		1.1	
San Francisco, Southern Pacific Building, 14th floor:										
Vertical	V-184	.046	119	.64	12					Trace motion barely discernible.
N. 45° E.	L-183	.047	120	.67	9	1.3	25		1.1	
N. 45° W.	T-182	.046	122	.63	10	1	25		.6	
San Jose, Bank of America Building, 13th floor:										
Vertical	V-175	.046	120	.64	11	1.6	3		.2	
N. 31° W.	T-173	.047	119	.65	9	1.8	17		1.4	Nearly sinusoidal waves.
N. 59° E.	L-174	.046	120	.62	9	1.9	21		1.9	Do.

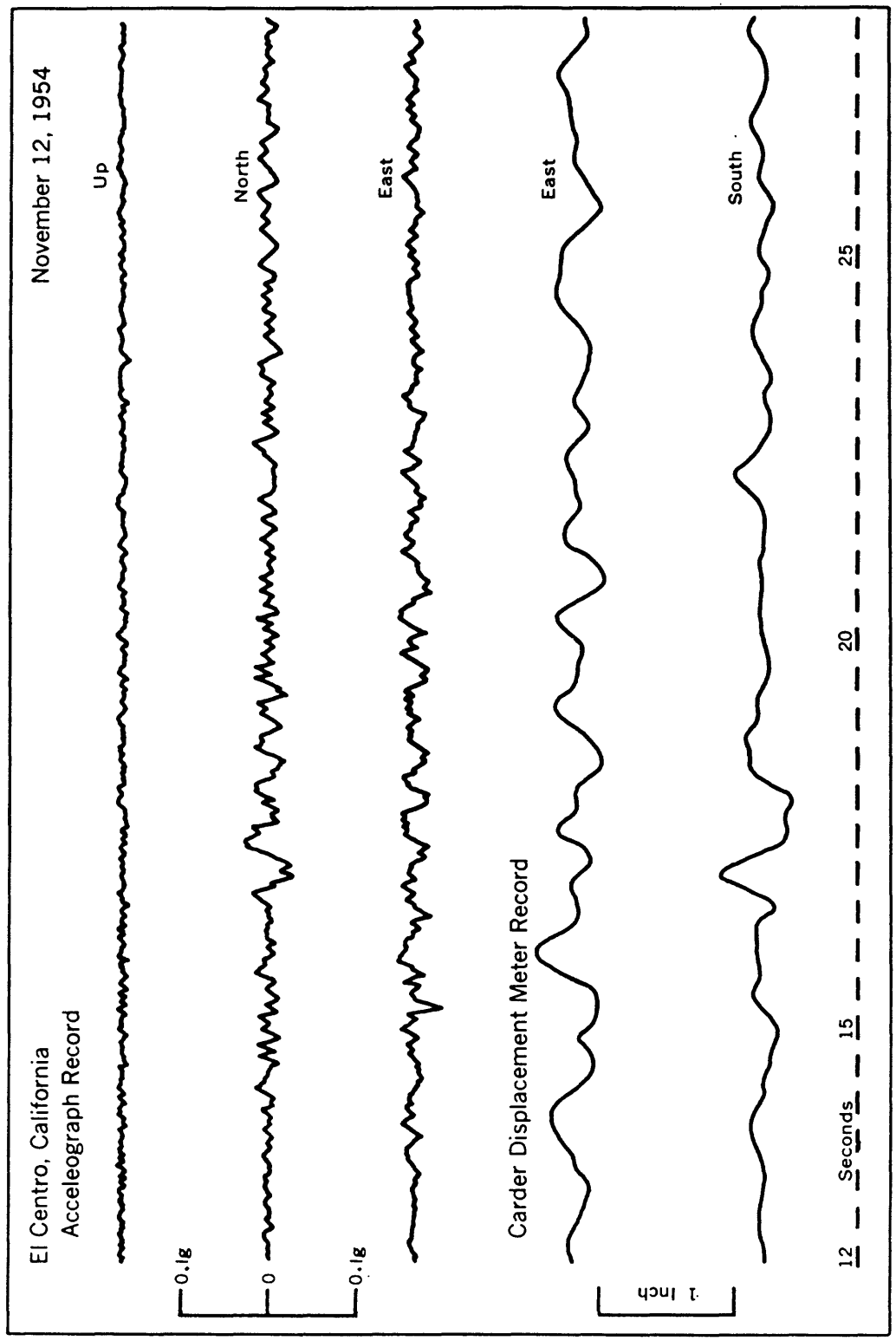

FIGURE 10.—Tracings of accelerograph and displacement meter records obtained at El Centro, on November 12.

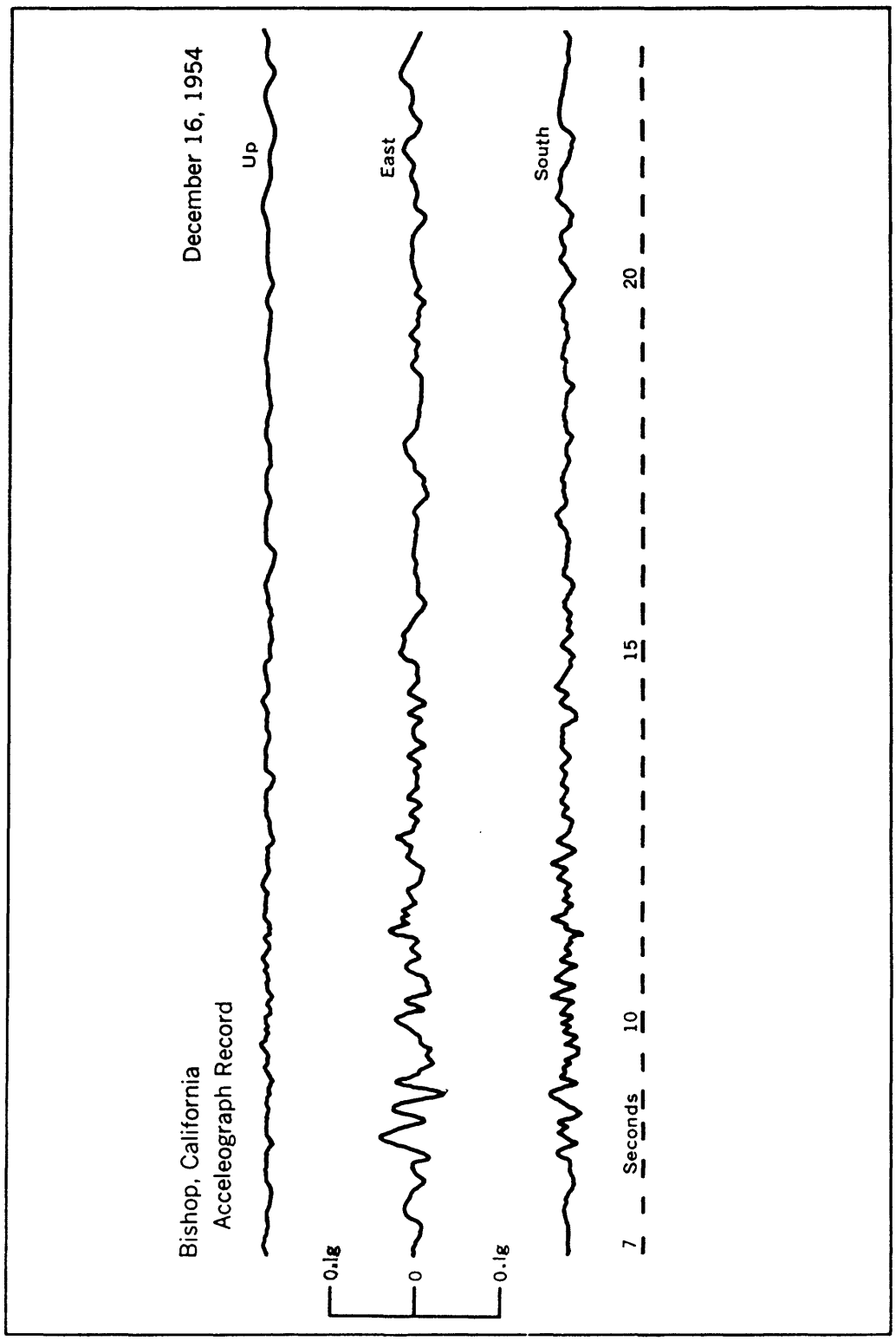

FIGURE 17.—Tracings of accelerograph records obtained at Bishop, on December 16.

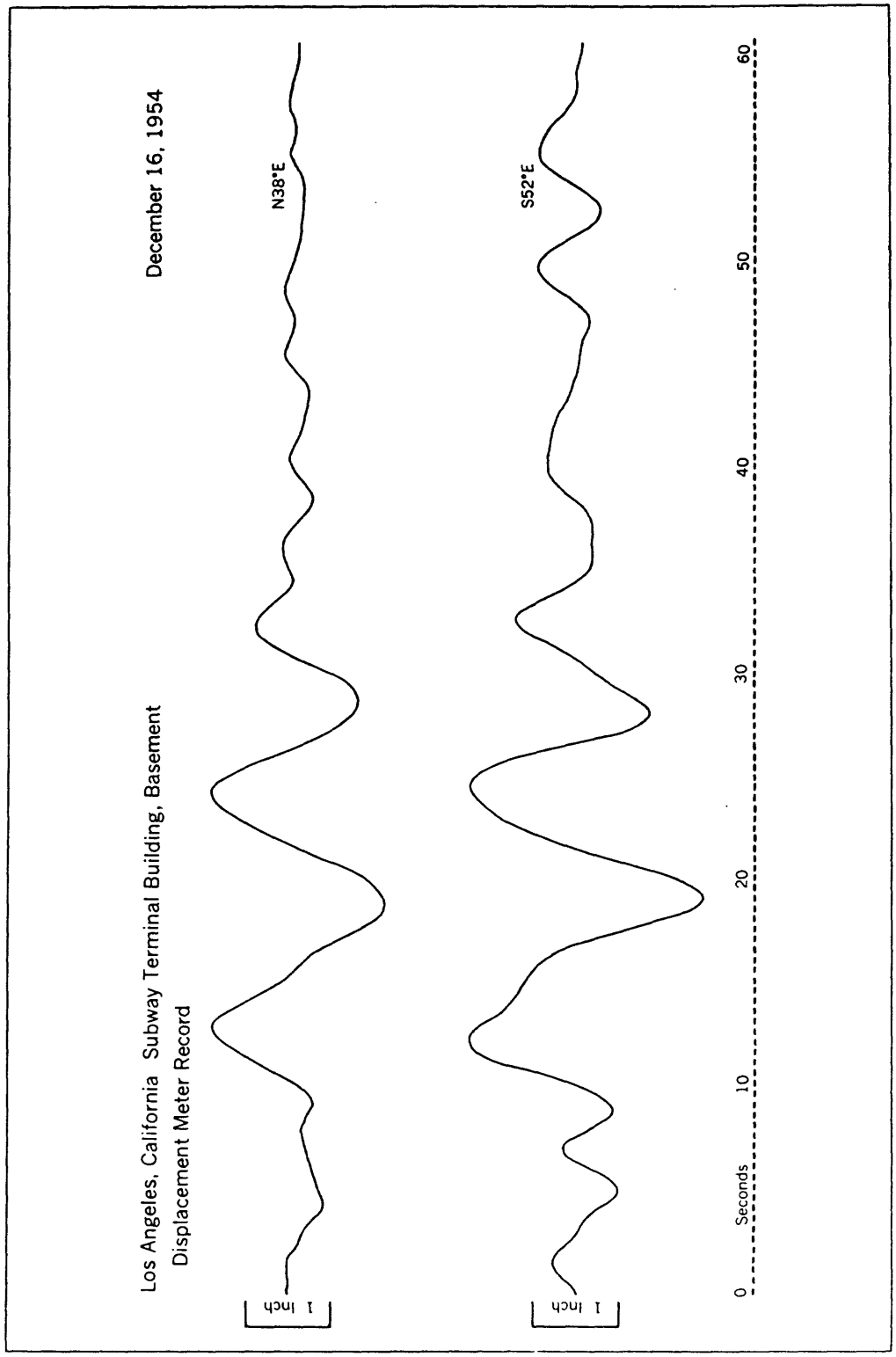

FIGURE 18.—Tracings of displacement meter records obtained at Los Angeles Subway Terminal basement on December 16.

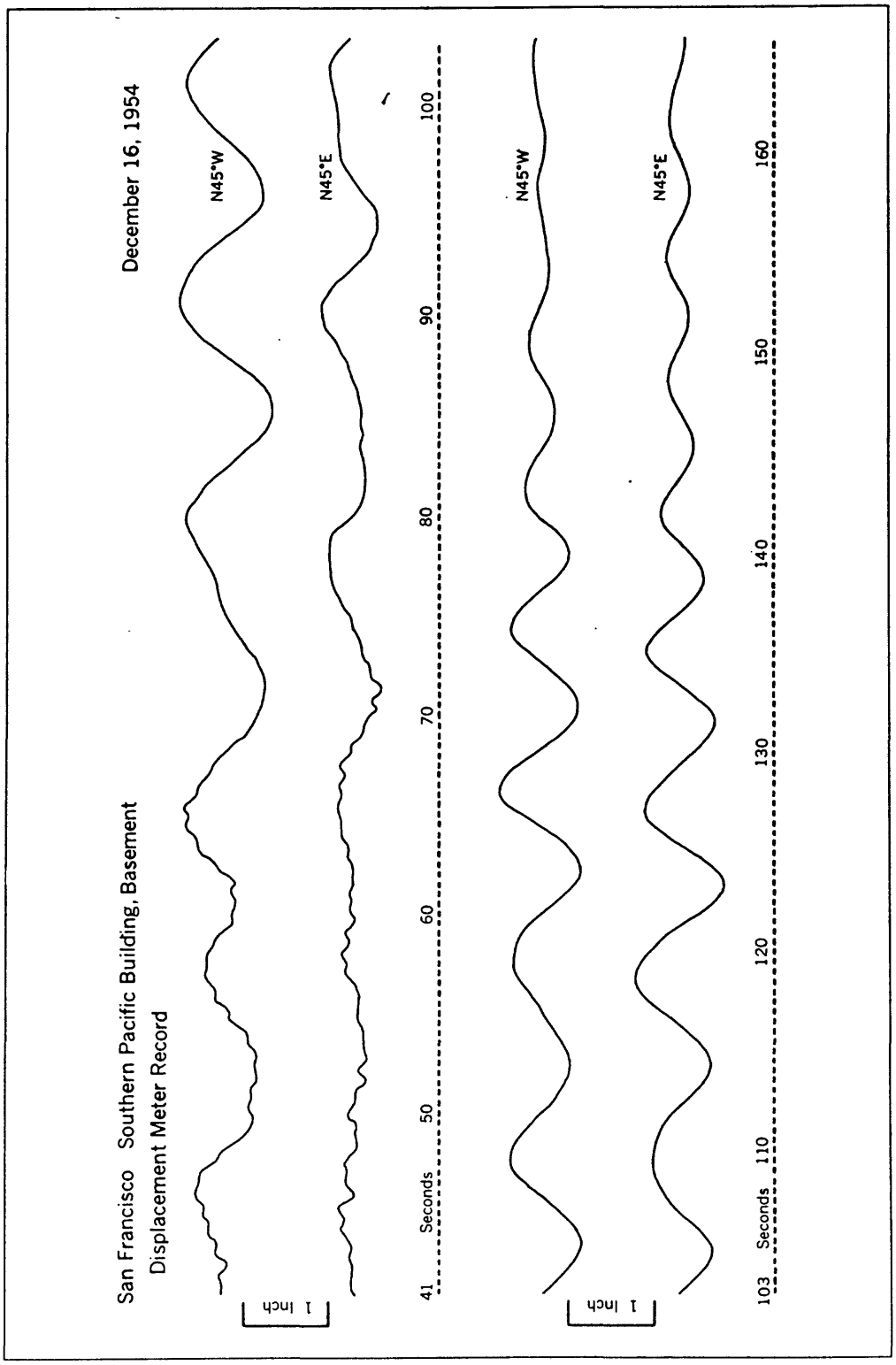

FIGURE 19.—Tracings of displacement meter records obtained at San Francisco Southern Pacific Building, on December 16.

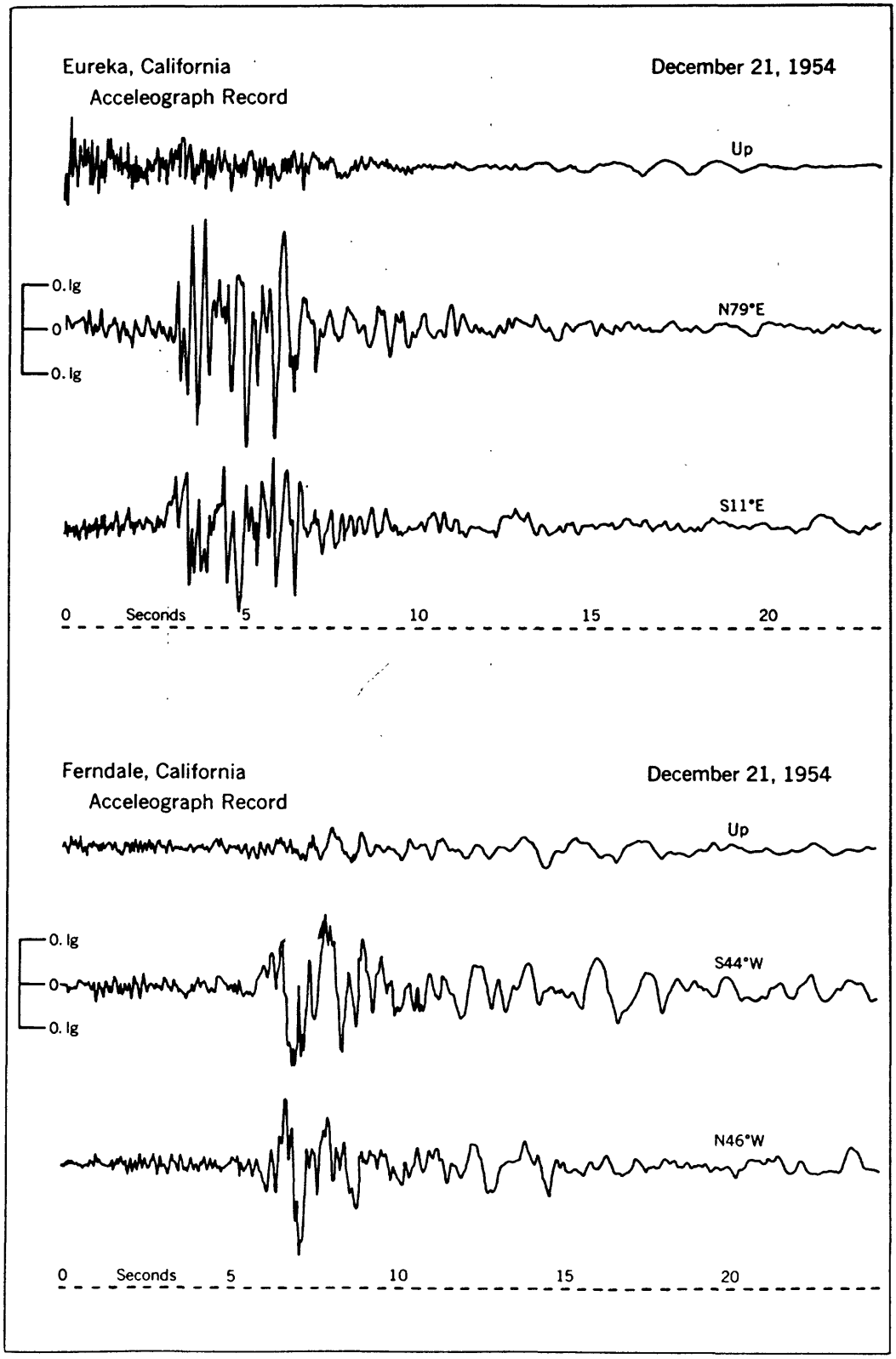

FIGURE 20.—Tracings of accelerograph records obtained at Eureka and Ferndale, on December 21.

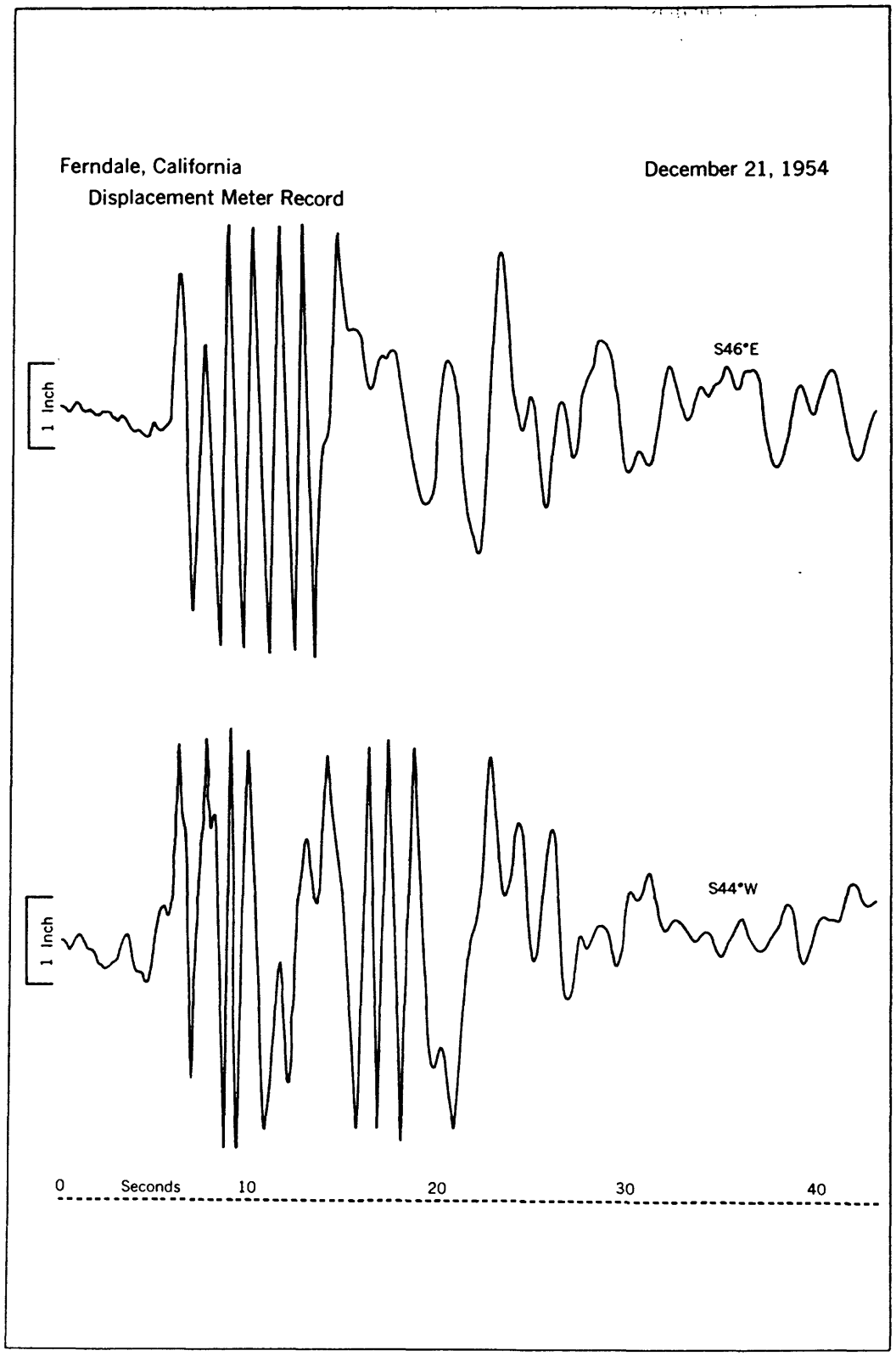

FIGURE 21.—Tracings of displacement meter records obtained at Ferndale, on December 21.

TABLE 7.—*Composite of strong-motion instrumental data for 1954*—**Continued**

NORTHWESTERN CALIFORNIA EARTHQUAKE OF DECEMBER 21

Station and component direction	Instrument No.	*Ts*	*V*	Sensitivity	*r*	Acceleration		Displacement		Remarks
						Period	Amplitude	Period	Amplitude*	
Eureka:		*sec.*		*cm./0.1 g*		*sec.*	*cm./sec.²*	*sec.*	*cm.*	
Vertical	V-250	0.066	116	1.27	7	0.14	79		0.04	
						.19	42		.04	
						1.4	19		.9	
N. 11° W.	T-252	.067	121	1.35	12	.4	129		.5	
						.4	31		.13	
						1.7	20		1.5	
N. 79° E.	L-251	.066	122	1.33	10	.4	225		.9	
						.5	228		1.4	
						1.9	23		2	
Ferndale:										
Vertical	V-247	.066	124	1.32	13	.9	35		.7	
						2	30		3	
N. 44° E.	L-248	.066	125	1.35	9	1.3	152	0.9	6.4	
						1.5	64	8	.8	
N. 46° W.	T-249	.064	123	1.26	12	1.3	163	1	6.4	
						1.8	59	2.8	3.6	
N. 44° E.	SDM-13	10.38	1		14					
N. 46° W.	SDM-13	9.66	1		11					

NORTHWESTERN CALIFORNIA EARTHQUAKE OF DECEMBER 30

Eureka:										
Vertical	V-250	0.066	116	1.27	7	0.2	16		0.02	
N. 11° W.	T-252	.067	121	1.35	12	.4	42		.17	
N. 79° E.	L-251	.066	122	1.33	10	.2	49		.05	
Ferndale:										
Vertical	V-247	.066	124	1.32	13	.4	7		.03	
N. 44° E.	L-248	.066	125	1.35	9	.4	24	1.2	.2	
N. 46° W.	T-249	.064	123	1.26	12	.4	10	1.2	.1	
N. 44° E.	SDM-13	10.38	1		14					
N. 46° W.	SDM-13	9.66	1		11					

*Estimated from acceleration if no entry in displacement period column.

TILT OBSERVATIONS

Through the cooperation of the Smithsonian Institution and the National Forest Service, tiltmeter stations equipped with Merritt Interferometer-type tiltmeters, were established at Table Mountain and Santiago Peak, California. A research grant from the Geological Society of America provided funds for the construction of the station. The two tiltmeters at the University of California, Berkeley, were continued in operation.

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